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Artificial Intelligence in the Governance Sector in India

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Executive Summary

The use of Artificial Intelligence has the potential to ameliorate several existing structural inefficiencies in the discharge of governmental functions. Our research indicates that the deployment of this technology across sub-sectors is still on the horizons. Much of the technological capacity and funding for AI in governance in India is coming from the private sector - a trend we expect will continue as the government engages in an increasing number of partnerships with both start-ups and large corporations alike. While there is considerable enthusiasm and desire by the government to develop AI-driven solutions in governance, including the release of two reports identifying the broad contours of India's AI strategy, this enthusiasm is yet to be underscored by adequate financial, infrastructural, and technological capacity. This gap provides India with a unique opportunity to understand some the of the ethical, legal and technological hurdles faced by the West both during and after the implementation of similar technology and avoid these challenges when devising its own AI strategy and regulatory policy.

The case study identified five sub-sectors including law enforcement, education, defense, discharge of governmental functions and also considered the implications of AI in judicial decision-making processes that have been used in the United States. After mapping the uses of AI in various sub-sectors, this report identifies several challenges to the deployment of this technology. This includes factors such as infrastructural and technological capacity, particularly among key actors at the grassroots level, lack of trust in AI driven solutions and adequate funding. We also identified several ethical and legal concerns that policy-makers must grapple with. These include over-dependence on AI systems, privacy and security, assignment of liability, bias and discrimination both in process and outcome, transparency and due process.

Subsequently, this report can be considered as a roadmap for the future of AI in India by tracking corresponding and emerging developments in other parts of the world. In the final section of the report, we propose several recommendations for policy-makers and developers that might address some of the challenges and ethical concerns identified. Some of these include benchmarks for the use of AI in the public sector, development of standards of explanation, a standard framework for engagement with the private sector, leveraging AI as a field to further India's international strategy, developing adequate standards of data curation, ensuring that the benefits of the technology reaches the lowest common denominator, adopting interdisciplinary approaches to the study of Artificial Intelligence and developing fairness,transparency and due process through the contextual application of a rules-based system.

It is crucial that policy-makers do not adopt a 'one-size-fits-all' approach to AI regulation but consider all options within a regulatory spectrum that considers the specific impacts of the deployment of this technology for each sub-sector within governance - with the distinction of public sector use. Given that the governance sector has potential implications for the fundamental rights of all citizens, it is also imperative that the government does not shy away from its obligation to ensure the fair and ethical deployment of this technology while also ensuring the existence of robust redress mechanisms. To do so, it must chart out a standard rules-based system that creates guidelines and standards for private sector development of AI solutions for the public sector. As with other emerging technology, the success of Artificial intelligence depends on whether it is deployed with the intention of placing greater regulatory scrutiny on the daily lives of individuals or for harnessing individual potential that augment rather than counter the core tenets of constitutionalism and human dignity.

Methodology

CIS recognizes that the term Artificial Intelligence (AI) is multiple in its uses and meanings--and at times contested.[1] For the purposes of this report, CIS's understanding of AI is that of a dynamic learning system that can be used in decision making, as opposed to a system that performs automated tasks. Our test to resolve the ambiguity between AI and automation is to think of it in the following way - the AI system replaces the brain whereas automation replaces the muscles. To explain further, if a tool was being used to do a repetitive task, or a repetitive decision, it would be automation, while tasks requiring intelligent decision making would be done by AI.

The aim of this report is to identify the ways in which AI is being implemented and utilized in various sub sectors in governance. Furthermore, this report aims to identify the key policy, ethical, and legal concerns in the development and use of AI in this sector and develop recommendations towards addressing the same while enabling AI innovation. As part of this, challenges in the development and use of AI in governance are also identified.

Recognizing that governance is a broad term that encompasses many functions and sectors, in our research we have considered five sub-sectors-1) Law Enforcement, 2) Education, 3)Discharge of government functions, 4) Judicial decision-making and 5) Defense. We have chosen these for the following reasons. First, each of these sectors have inherent institutional or procedural barriers to efficiency, which has lead to the use of algorithms in other parts of the world and spurred nascent developments in India. Second, the five sub-sectors encompass a broad range of governmental functions and also capture various stages of the use of AI. Third, the sub sectors pose diverse ethical concerns and therefore occupy a broad range of positions on the spectrum of regulatory options available when addressing the use and development of governance solutions driven by AI.

Our sources for mapping the use of Artificial intelligence in India included secondary sources such as press releases, media briefings and newspaper articles. We hope to supplement this research with more primary information from various crucial stakeholders in the governance sector.

Introduction

Governance, broadly understood as the "action or manner of governing a state" [2]thrives on the ability of the government to ensure efficient, effective, transparent and responsive administration. India is a large and diverse country making the task of governance that much more challenging. Slow and outdated processes and bureaucratic hurdles have traditionally fettered governance in India, but the recent pivot towards the adoption of emerging technologies is re-invigorating the system. Towards this, there has been sustained discourse in the recent past to optimize the use of AI in fostering efficient governance.[3] As the National Strategy for AI by NITI AAYOG has validly identified, the development of AI within each sector must consider the incremental value that the deployment of technology can provide to improve existing processes within each sector rather than aspiring to be a tool that can replace human decision-making in its entirety.[4]

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1 Artificial Intelligence: Literature Review (2017, December 16). Retrieved January 5, 2018, from https://cis-india.org/internet-governance/blog/artificial-intelligence-literature-review.

2 Oxford Dictionaries, s.v. "governance," accessed July 2, 2018, https://en.oxforddictionaries.com/definition/governance.

3 Goudarzi, S. and Khaniejo, N., The Centre for Internet and Society (2018, March 18). AI and Governance. Retrieved from https://cis-india.org/internet-governance/files/ai-in-governance.

4 Discussion Paper on National Strategy for Artificial Intelligence | NITI Aayog | National Institution for Transforming India. (n.d.). Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

However, this enthusiasm is yet to be realized by large-scale technological capability and deployment of AI driven solutions in the five sub-sectors of governance that we considered. We can say, broadly that in most cases, the use of AI in governance in India is 'on the horizon,' as the institutional and technological framework for its deployment is underway as is the infrastructure, capacity and trust needed to successfully adopt these frameworks.

In our research, we noticed three key trends. First, even though there has been enthusiasm at the prospect of using algorithms across all states, technological capability and implementation is far from uniform. Andhra Pradesh and Karnataka appear to be more vigorous than other states in implementing the use of algorithms in sectors such as education and agriculture. Second, most of the AI technology being used is developed by the private sector, which is working in partnership with or contractually with the government. Finally, much of the technology which is at the center of conversations in India around AI and governance has already been implemented in other countries, more specifically the United States, United Kingdom and China. While India could look to emulate some of this technology, it would do well to assess some of the technological, legal and ethical concerns that have arisen in these countries and leapfrog these challenges before the technology is implemented in Indian governance. Therefore, unlike the other case studies,[5] this report devotes a fair amount of attention to uses of AI in other jurisdictions to map the trajectory that technology development in India may take in the near future so that a regulatory model is readily available once the technology comes into force.

Artificial Intelligence in Indian Governance: Uses and Trends

This section explores the state of AI in Indian Governance by identifying key uses and trends, mapping key stakeholders in the ecosystem, identifying challenges, and reflecting on contextual legal and ethical concerns.

Law Enforcement

Globally, key AI technologies being explored, and in some cases used by law enforcement, include facial recognition, speech recognition, drones, robo cops, autonomous patrol cars, and predictive analytics.[6]

Our research found that India is still in nascent stages in developing the technological proficiency to fully implement AI solutions for law enforcement purposes and many projects are still at the stage of conceptualization. At the same time, India is developing projects that will enable the infrastructure and data necessary to fuel AI solutions in the law enforcement sector. Key uses of AI in law enforcement in India include:

Predictive Analytics

India has made some strides towards the use of big data analytics and algorithms for the purpose of processing vast tracts of data to generate predictive policing models[7]. It is forecasted that by March 2018, predictive policing technologies will be available in five

5 Artificial Intelligence in India: A Compendium. (n.d.). Retrieved from https://cis-india.org/internet-governance/blog/artificial-intelligence-in-india-a-compendium.

6 Malek, C. (2018, January 24). Robocops and predicting crime: Dubai Police plan an artificial intelligence future. Retrieved from https://www.thenational.ae/uae/robocops-and-predicting-crime-dubai-police-plan-an-artificial-intelligence-future-1.698034.

7 Das, S. (2017, March 21) How predictive analytics helps Indian police fight crime. Retrieved from http://www.computerworld.in/feature/how-predictive-analytics-helps-indian-police-fight-crime.

states-Kerala, Odisha, Maharashtra, Haryana and Tripura.[8] It is expected that this technology will be extended to all states by the end of 2018.[9] Improved and sophisticated data collection techniques are a mandatory prerequisite for running predictive policing programmes. It has also been reported that the National Crime Records Bureau is working with the Hyderabad based Advanced Data Research Institute (ADRIN) to develop the technology to carry out predictive policing processes.[10] There has been strong posturing towards the use of predictive policing strategies by Police Officials with concrete steps being taken across all states to set up robust data collection processes. In May, 2017, the National Crime Records Bureau organised a workshop on data analytics, dashboarding and the use of Artificial Intelligence in Policing.[11] N. Ramachandran, President of the Indian Police Foundation stressed on the importance of evidence-based predictive policing strategies and emphasized that India should seek to become a world leader in predictive policing.[12] During the event, the Special Commissioner of Delhi Police also spoke about the need to integrate CCTV footage with social media applications and data collected in the control room.

State efforts have seen a trend towards greater and more granular data collection that could support AI solutions. For example, the Telangana Police has reportedly set up 30,000 CCTV cameras with community support.[13] The Crime and Criminal Tracking Network and Systems was introduced in India in 2013 , with funding under the National e-Governance plan.[14] The objective of the endeavor was to create a nationwide criminal tracking database by integrating approximately 15,000 police stations, district and state police headquarters and automated services.[15] While it was originally scheduled to be completed by 2012, it was finally set up in August 2017[16] and has the potential to facilitate the quantity, quality, and type of data collection needed for predictive policing. In 2017 law enforcement in Rajasthan commissioned a pilot project with Staqu, an AI startup to develop the application ABHED (artificial intelligence based human efface detection) for facilitating criminal identity registration, tracking, and missing persons search. The app leverages machine learning and is designed to enable integration with the CCTNS.[17] As per Etihsam Zaidi, senior analyst at Gartner, the shift towards predictive policing may be driven by the fact that the police force in India has increasing access to mature data storage platforms including Hadoop and NoSQL that enable the storage and subsequent processing of vast tracts of incoming data

8 Sharma, V., (2017, September 23) Indian police to be armed with big data software to predict crime. Retrieved from http://www.newindianexpress.com/nation/2017/sep/23/indian-police-to-be-armed-with-big-data-software-to-predict-crime-1661708.html.

9 Ibid.

10 Ibid.

11 Press Information Bureau, Ministry of Home Affairs. (2017, May 13). NCRB organised a National Workshop on “Crime Data Analytics” [Press release]. Retrieved from http://pib.nic.in/newsite/PrintRelease.aspx?relid=161769.

12 Ibid.

13 Ibid.

14 (2017, December 17) Govt Launches Crime Tracking Pilot Project. Retrieved from http://www.thehindu.com/news/national/Govt-launches-crime-tracking-pilot-project/article12289850.ece.

15 NCRB CCTNS Branch. (n.d.). Retrieved from http://ncrb.gov.in/BureauDivisions/cctnsnew/index.html.

16 Press Information Bureau, Special Service and Features. (2017, October 6). CCTNS Digital Police Portal launched to fast-track Criminal Justice System in the Country [Press release]. Retrieved from http://pib.nic.in/newsite/printrelease.aspx?relid=171422.

17 Indo-Asian News Service, (2017, May 30) Alwar Police Is Using An AI Programme To Register Criminal Offences. Retrieved from https://www.firstpost.com/tech/news-analysis/alwar-police-is-using-an-ai-programme-to-register-criminal-offences-3703601.html.

in real time.[18] Superintendent of police (SP) cyber, Maharashtra, Balsingh Rajput has stated to Hindustan Times that Maharashtra Police are developing predictive techniques.[19] They are working to anticipate criminal intent through the use of sophisticated technologies and data-mining.[20] He also stated to Hindustan Times that "Predictive Policing will transform the way policing is done in the future. We are in the process of building solutions for predicting law and order problems, crime mapping and also will be able to generate strong leads on the intent of the criminals before the crime takes place." [21]As per Rajput, 47 police cyber crime labs have been set up in the state for the purpose of enabling speedy registration and enabling forensic investigation.[22] New Delhi Police has also concretised a strategy to make better use of technology in law enforcement. Scenario 2020 envisages the development of smart policing through use of among other tools, AI.[23] Lieutenant Governor Anil Bajpai has been reported as asking the Delhi Police to make the phased inclusion of 'smart policing' a priority area-although it remains to be seen what aspects of Artificial Intelligence 'smart policing' incorporates in the coming years and whether this is similar to predictive policing.[24]

The Delhi Police has started using predictive policing methods in conjunction with Indian Space Research Organisation (ISRO).[25]The system that is being designed called the Crime Mapping, Analytics and Predictive System provides police officials with Personal Digital Assistants for current access to information at crime scenes to reduce the burden of going back to police stations to file reports.[26] The web-based software is able to access data from Delhi Police's Dial 100 helpline and uses ISRO's satellite imagery to spatially locate 'hot-spots' using clustering algorithms.[27] Therefore, much like PredPol, this software enables Delhi Police to predict when and where crime might occur and thereby deploy police forces to make targeted interventions. Crime mapping is presently done at an interval of 15 days.[28] The reports are prepared by Joint Commissioners who forward it to the Special Commissioners,

18 Press Information Bureau, Special Service and Features. (2017, October 6). CCTNS Digital Police Portal launched to fast-track Criminal Justice System in the Country [Press release]. Retrieved from http://pib.nic.in/newsite/printrelease.aspx?relid=171422; Das, S. (2017, March 21) How predictive analytics helps Indian police fight crime. Retrieved from http://www.computerworld.in/feature/how-predictive-analytics-helps-indian-police-fight-crime.

19 Inamdar, N. (2017, November 13) Data mining to drive predictive policing in the future of Maharashtra police. Retrieved from https://www.hindustantimes.com/pune-news/data-mining-to-drive-predictive-policing-in-the-future-of-maharashtra-police/story-GIl9jy7W0AJYBAPzhy9dSO.html.

20 Ibid.

21 Ibid.

22 Ibid.

23 (2017, October 18) Prioritise Action Plan For Smart Policing, Says Baijal. Retrieved from https://www.thehindu.com/news/cities/Delhi/prioritise-action-plan-for-smart-policing-says-baijal/article19935328.ece.

24 Ibid.

25 Das, S. (2017, March 21) How predictive analytics helps Indian police fight crime. Retrieved from http://www.computerworld.in/feature/how-predictive-analytics-helps-indian-police-fight-crime.

26 (2016, July 15) Delhi Police Will Use Space Technology To Control Crime In The State. Retrieved from https://www.huffingtonpost.in/2016/02/07/delhi-police-space-techno_n_9179852.html; Pai, V. (2016, February 9) Delhi Police To Use Predictive Policing In Partnership With ISRO. Retrieved from https://www.medianama.com/2016/02/223-delhi-police-predictive-policing/.

27 Singh, K. P. (2017, February 27) Preventing crime before it happens: How data is helping Delhi Police. Retrieved from https://www.hindustantimes.com/delhi-news/delhi-police-is-using-precrime-data-analysis-to-send-its-men-to-likely-trouble-spots/story-hZcCRyWMVoNSsRhnBNgOHI.html.

28 Shekhar, R. (2016, June 19) Predictive policing to nail criminal minds. Retrieved from https://timesofindia.indiatimes.com/city/delhi/Predictive-policing-to-nail-criminal-minds/articleshow/52824404.cms.

after which they are forwarded to the police chiefs. They then use three strategies to process the available data and conduct surveillance operations The first strategy is a 'crime forecast' which would enable the police to identify gangs in certain areas in real-time. As part of a project called the Enterprise Information Integration Solution (EI2S),[29] this systems processes and analyzes petabytes of information from a dozen crime databases. The second strategy is 'neighbourhood analysis', which is essentially the clustering of hot-spots through algorithmic evaluation of geo-spatial data.[30] A third technique called proximity analysis would enable the evaluation of data about criminals, victims, witnesses and data who were located within a certain distance of the crime location and use this to analyse the changes that had taken place just before or after the crime.[31]The Jharkhand police force is also trying to implement a data analytics system with the aid of IIM Ranchi.[32] The system is predicated on the use of sophisticated algorithms and behavioural science which will aid in predicting crime, particularly in Naxal-prone areas.[33] To date, there has been no assessment of criminal response to predictive policing mechanisms in India.

Speech and Facial Recognition

There was a recent partnership forged between Best Group and Israeli security and AI research company Cortica to analyze the terabytes of data streamed from CCTV cameras deployed in public areas.[34] A key objective of this project is to improve safety in public places including streets, bus stops and train stations.

Punjab Police, in association with Staqu has commissioned the Punjab Artificial Intelligence System (PAIS), which digitizes criminal records and automates research through features like facial recognition.[35] Facial recognition enables police to retrieve information on the criminal. If a police officer locates a suspect, he clicks the picture.[36] The photograph is then entered on the application in his phone which compares the digital image with the stored photo.[37] The app will also send the criminal background of the individual within minutes to the mobile phone of the officer in question.[38]

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29 Halevy, A. Y., Ashish, N., Bitton, D., Carey, M., Draper, D., Pollock, J., & Sikka, V. (2005, June). Enterprise information integration: successes, challenges and controversies. In Proceedings of the 2005 ACM SIGMOD international conference on Management of data (pp. 778-787). ACM.

30 Shekhar, R. (2016, June 19) Predictive policing to nail criminal minds. Retrieved from https://timesofindia.indiatimes.com/city/delhi/Predictive-policing-to-nail-criminal-minds/articleshow/52824404.cms.

31 Ibid.

32 Edmond, D. S. (2013, September 15). Jhakhand's Digital Leap Retrieved from https://indianexpress.com/article/news-archive/web/jhakhands-digital-leap/.

33 Ibid.

34 Quain, J. R. (2018, April 11) Crime-predicting A.I. isn't science fiction. It's about to roll out in India. Retrieved from https://www.digitaltrends.com/cool-tech/could-ai-based-surveillance-predict-crime-before-it-happens/.

35 Punjab Police receive FICCI Smart Policing Award for 2018, Retreived from https://www.adgully.com/punjab-police-receive-ficci-smart-policing-award-2018-for-pais-78405.html

36 Sood A. Cops develop facial recognition to nab gangsters, Retreived from https://www.tribuneindia.com/news/punjab/cops-develop-face-recognition-app-to-nab-gangsters/471032.html

37 Ibid.

38 Ibid.

Robo-Cops

A Hyderabad based technology start-up, H-Bots Robotics has developed a smart policing robot that has yet to be deployed in the field.[39] The 'robocop' can play a role in handling law and order, and enhancing traffic management. If it were to be deployed autonomously, it can engage in a variety of important security related functions such as maintaining security at key choke points in places like malls and airports.

Education

In education, our research found that AI is predominately being used in decision making, student services, student progress monitoring, and personalized learning. Despite the diversity of languages in India, it does not appear that many solutions developed in this space are focusing on language. Machine learning appears to be the most commonly applied technique in the solutions.

Decision Making

US-based service provider HTC Global Services is focusing on the launching of products in the education space in India. This is a web-based application that will enable students to make more well thought out decisions when choosing courses and electives at universities. This program will essentially use the same algorithms that enable people to make choices on e-commerce platforms by analysing past data with AI and machine learning.[40]

Student Services

This would include solutions to hassles such as admission queries which are largely manual and take a considerable amount of time-both of the students and lecturers. Vishal Sethi-Global Practice Head-AI & Data Science has also mentioned that they are planning to launch an algorithm that can gauge the level of understanding by reading student expressions effectively.[41]

Student Progress Monitoring

The Chandrababu Naidu-led government in Andhra Pradesh is looking to collect information from a variety of databases and process the data through Microsoft's Machine Learning Platform to enable personalised monitoring of children and devote individualised attention to their progress, curbing school dropouts.[42]

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39 Janyala, S. (2017, December 30) Hyderabad-based startup launches smart 'robocop', named after 26/11 martyr Hemant Karkare. Retrieved from https://indianexpress.com/article/technology/tech-news-technology/hyderabad-based-startup-launches-smart-robocop-named-after-26-11-martyr-hemant-karkare-5004011/.

40 Moorthy, S. (2017, December 11) HTC Global sets sights on education space. Retrieved from https://www.thehindubusinessline.com/info-tech/htc-global-sets-sights-on-education-space/article9989540.ece.

41 Ibid.

42 Srivas, A. (2016, May 10) Aadhaar in Andhra: Chandrababu Naidu, Microsoft Have a Plan For Curbing School Dropouts. Retrieved from https://thewire.in/politics/aadhaar-in-andhra-chandrababu-naidu-microsoft-have-a-plan-for-curbing-school-dropouts.

Personalized Learning

Ek-step is an open-learning platform that uses Application Programming Interfaces (API)[43]The platform uses gamified apps available at Google Play Store.[44] It has reportedly been utilised in over 10,000 government schools across Karnataka as of 2016. [45]Further, the platform is available in 5 languages and across 18 states.

Recently, Co-Impact, which is a consortium of the world's leading philanthropists including the Bill and Melinda Gates Foundation and the Rockefeller Foundation announced that it will be working with EkStep Foundation in the near future. The government also plans to work with EkStep to launch the platform across the country.[46] CEO Shankar Maruwada stated that while thus far only teachers would require a mobile phone (or IoT device) to access the content, this initiative can be scaled up later.[47]Such an initiative would certainly benefit from using Artificial Intelligence for the organisation and filtering of relevant content for each individual learner. It could turn into either a smart content platform that acts as a teaching aid or be used to develop an ITS model using the available platform.

Defense

In defense, our research found that AI is predominantly used for intelligence, surveillance and reconnaissance, robot soldiers, cyber defense, risk terrain analysis, and intelligent weapons systems. Out of the sectors we looked at, defense is the one sector where clear use of autonomous systems is being contemplated. Yet, many of these projects are in nascent and pilot stages and the exact level of trust and support from different arms of the government is unclear.

Intelligence, Surveillance and Reconnaissance

The Indian army has started to use unmanned autonomous vehicles for reconnaissance purposes which include detecting naval mines in littoral waters and conducting surveillance on territorial waters to detect adversaries. A range of Unmanned Aerial vehicles such as the recently tested Rustom-2[48], which can operate both in manual and autonomous mode,[49] have also been developed to conduct aerial reconnaissance and surveillance. The DRDO has also engineered a robot called Daksh which can be operated using a remote within a range of 500

43 EkStep Foundation. https://ekstep.org/.

44 Lakshmi, S. (2016, December 26) EkStep takes a giant step to empower government school children through technology. Retrieved from https://timesofindia.indiatimes.com/city/bengaluru/EkStep-takes-a-giant-step-to-empower-govt-schoolchildren-through-technology/articleshow/56173272.cms.

45 Ibid.

46 Nanda, P. K. (2017, August 11) Govt plans to build content depository for improving teaching standards. Retrieved from https://www.livemint.com/Education/azxYcQZa3xQ7osUYebYeeI/Govt-plans-to-build-content-depository-for-improving-teachin.html.

47 Lakshmi, S. (2016, December 26) EkStep takes a giant step to empower government school children through technology. Retrieved from https://timesofindia.indiatimes.com/city/bengaluru/EkStep-takes-a-giant-step-to-empower-govt-schoolchildren-through-technology/articleshow/56173272.cms.

48 (2018, February 25) What is Rustom 2 drone? Retrieved from https://indianexpress.com/article/what-is/what-is-rustom-ii-drone-5077614/.

49 Chowdhury, A. P. (2017, April 17) AI and robotics is revolutionizing Defence sector, Indian Army takes credence. Retrieved from https://analyticsindiamag.com/ai-robotics-revolutionizing-defence-sector-indian-army-takes-credence/.

metres.[50] Its primary use, much like PackBot used by the US army, is to diffuse explosives. Partnerships with the private sector have also facilitated the development of this technology. [51]For example, Crone Systems[52], a New Delhi-based AI startup has mined and evaluated seasonal data for border infiltration patterns and can algorithmically ascertain the possibility of border infiltrations at certain times.[53]Innefu Labs[54] is working with Border Security Force and Central Reserve Police Force to track social media posts to forecast the location and time of agitations so that appropriate personnel may be deployed.

Robot soldiers

The Centre for Artificial Intelligence and Robotics (CAIR), a laboratory linked with DRDO has been working on a project to develop a Multi Agent Robotics Framework (MARF).[55] This seeks to galvanize multi-layered AI-powered architecture to develop an array of robots that can collaborate and function as a team, like human soldiers.[56] Robots already built [57]include a Wheeled Robot with Passive Suspension, a Snake Robot and a Robot Sentry.[58]

Indicating where the technology is headed, the US plans to develop unmanned and manned intelligent teaming in combat roles and autonomous convoy operations by 2025, such that there may be more 'robot soldiers' than human ones.[59]

Cyber Defense

The government is leveraging AI to strengthen and build cybersecurity capabilities. For example, CDAC in collaboration with IIT Patna is undertaking a project that seeks to develop cyber forensic tools driven by AI that can be leveraged by law enforcement, the government, and intelligence agencies.[60] In India, the government has entered into a contract with Innefu to analyze data they have obtained from intelligence agencies to evaluate threat patterns and predict future outcomes in their latest offering known as Prophecy.[61]

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50 Deoras, S. (2018, February 15) For US & China's Military The Future Is Robots, How Is India Competing. Retrieved from https://analyticsindiamag.com/us-chinas-military-future-robots-india-competing/.

51 Bansal, G. (2018, January 15) Data And Guns: How Ai Is Changing The Defence Sector. Retrieved from https://www.analyticsinsight.net/data-and-guns-how-ai-is-changing-the-defense-sector/.

52 CRON Systems, http://cronsystems.com/.

53 Bansal, G. (2018, January 15) Data And Guns: How Ai Is Changing The Defence Sector. Retrieved from https://www.analyticsinsight.net/data-and-guns-how-ai-is-changing-the-defense-sector/.

54 Innefu, http://www.innefu.com/.

55 Chowdhury, A. P. (2017, April 17) AI and robotics is revolutionizing Defence sector, Indian Army takes credence. Retrieved from https://analyticsindiamag.com/ai-robotics-revolutionizing-defence-sector-indian-army-takes-credence/.

56 Ibid.

57 Centre for Artificial Intelligence and Robotics (CAIR), DRDO, https://www.drdo.gov.in/drdo/labs1/CAIR/English/indexnew.jsp?pg=products.jsp.

58 (2006 October) Terrain Technologies, Retrieved from https://www.drdo.gov.in/drdo/pub/techfocus/oct06/oct06.pdf.

59 Lockett, J. (2017, June 15) US military will have more combat robots than human soldiers by 2025. Retrieved from https://nypost.com/2017/06/15/us-military-will-have-more-combat-robots-than-human-soldiers-by-2025/.

60 Ohri, R. (2018, February 15) Government readies AI-muscled cyber security plan. Retrieved from https://economictimes.indiatimes.com/news/politics-and-nation/government-readies-ai-muscled-cyber-security-plan/articleshow/62922403.cms.

61 Chowdhury, A. P. (2017, January 30) Cyber Warfare at large in Southeast Asia, India leverages AI for the same cause. Retrieved from https://analyticsindiamag.com/cyber-warfare-large-southeast-asia-india-leverages-ai-cause/.

Risk Terrain Analysis/GIS

As per a report released by the Defense Research and Development Organisation (DRDO),the applications of AI in risk-terrain analysis include[62]: (1) Military Geospatial information System: This helps in generating terrain trafficability maps (known as Going Maps-GMs) vis-a-vis five thematic layers namely soil, slope,moisture, land use and landform. They are then integrated to produce the maps in a three level hierarchical manner.(2) Terrain Feature Extraction System: This enables determination of land use classification using a multilayer perceptron for training and subsequent generation of multiple themes, (3) Terrain Reasoner System: Allows decision-makers to develop alternative routes for the accomplishment of a pre-specified mission, (4)Terrain-Matching Systems: These are intelligent support systems that integrates complex case-based reasoning into a cohesive whole.[63]

Intelligent Weapons Systems

DRDO has confirmed in February 2018 that a modified Pilotless Target Aircraft (PTA) Lakshya-II has been successfully tested for several rounds, therefore becoming India's first 'armed drone.'[64] As per the DRDO, it has achieved a precision of 20 metres and completed 9 successful flights.[65]

Discharge of Government Functions

The government of India has started to leverage AI to help deliver government services to the citizenry. In our previous case studies, we have found examples of the government pursuing projects with the private sector to enhance agriculture[66], finance[67], and health[68]. Other examples include:

Citizen/government interface/e-governance

The Andhra Pradesh government has reportedly been spearheading the use of Artificial Intelligence for the enhancement of the citizen-government interface in India by partnering with Microsoft to develop the Kaizala app.[69] Kaizala has been used to crowdsource citizen feedback from various social media accounts and verify where the feedback is coming from by linking this to the mobile number of a citizen. The information coming in, not just through Kaizala but also the government's prior web-portals is then processed using an automated Application Programming Interface (API) and routed to the appropriate department for

62 (2006 October) Terrain Technologies, Retrieved from https://www.drdo.gov.in/drdo/pub/techfocus/oct06/oct06.pdf.

63 Ibid.

64 (2018, February 24) India gets Locally developed Armed Drone: A Report http://idrw.org/india-gets-locally-developed-armed-drone-a-report/.

65 Ibid.

66 Jujjavarapu, G., Hickok, E., Sinha A., AI and the Manufacturing and Services Industry in India, Retrieved from https://cis-india.org/internet-governance/files/AIManufacturingandServices_Report_02.pdf.

67 Goudarzi S., Hickok E., Sinha A., AI in Banking and Finance, Retrieved from https://cis-india.org/internet-governance/files/ai-in-banking-and-finance.

68 Paul, Y. Hickok, E. Sinha, A. & Tiwari, U. (2018, January 26). Artificial Intelligence in the Healthcare Industry in India. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/ai-and-healthcare-report.

69 (2017, July 25) Andhra Pradesh explores new frontiers in e-Governance with Microsoft Kaizala. Retrieved from https://customers.microsoft.com/en-us/story/andhra-pradesh-government-powerbi-india-kaizala.

consideration. It has also been used to send automated notices to citizens. For example, Microsoft has reported that ration-shop owners have been forewarned if they have not distributed adequate ration portions by the set time and the weather department has used the automated messaging system to send trigger warnings for foreseeable tumultuous weather. AI is also being used for monitoring the implementation of governance projects. For example, the National Informatics Centre is piloting a project that will monitor toilet construction programme under the Swachh Bharat Abhiya. The project leverages AI to assess the condition of toilets.[70]

Agriculture

The main application of AI in the agricultural sector in India has been in the domain of predictive analytics. Microsoft has collaborated with ICRISAT to develop an AI Sowing App powered by Microsoft Cortana Intelligence Suite including Machine Learning and Power BI. It sends advisories to farmers providing them with information on the optimal date to sow by sending them text messages on their phones.[71] The government of Karnataka has signed a Memorandum of Understanding with Microsoft to use predictive analytics for the forecasting of commodity pricing.[72]

Categorisation and arrangement of documents

AI may be also used to efficiently categorise and efficiently arrange a wide range of government documents, including government notifications, freedom of information requests, land records and court orders quickly, thereby freeing up human resources.[73] Prime Minister Modi has expressed his views on the possibility of using AI to bolster the integrated court management system that seeks to digitise Supreme Court records. This categorisation not only helps the government to respond to citizens more efficiently but also enables citizens to access government notifications far more easily.[74]

Ecosystem Mapping

There are a number of stakeholders that make up the governance ecosystem and that need to work together for the successful adoption and implementation of AI. In order to map the stakeholder ecosystem, we began by identifying the key stakeholders that have an impact on use of AI in governance. The stakeholders were divided into five categories: developers, government,funders/investors, users, research and industry bodies. The developer mapping was further categorized on the basis of the type of company, sector, focus area and AI solution offered. The mapping also covered the various conferences that were held in India on topics relating to AI and governance. The data about the stakeholders was derived from

70 Prasad, R. S., (2018, May 04) Applying AI in governance will let India leapfrog many developmental, infrastructural constraints. Retrieved from https://economictimes.indiatimes.com/tech/software/applying-ai-in-governance-will-let-india-leapfrog-many-developmental-infrastructural-constraints/articleshow/64020506.cms.

71 Digital Agriculture: Farmers in India are using AI to increase crop yields. Retrieved from https://news.microsoft.com/en-in/features/ai-agriculture-icrisat-upl-india/.

72 Nagpal, J. (2017, October 27) Government of Karnataka inks MoU with Microsoft to use AI for digital agriculture. Retrieved from https://news.microsoft.com/en-in/government-karnataka-inks-mou-microsoft-use-ai-digital-agriculture/.

73 Mehr, H. (2017, August) Artificial Intelligence for Citizen Services

and Government. Retrieved from https://ash.harvard.edu/files/ash/files/artificial_intelligence_for_citizen_services.pdf.

74 Ibid.

publicly available information on websites, newspaper reports and conferences. Google Scholar was used to identify the key academic works being published in India in the sector. The data was then further categorized based on parameters relating to actor, sector, and use. As a note, the intention of this mapping is to provide a snapshot of the AI in the governance ecosystem in India and does not attempt to be exhaustive. The list of stakeholders identified as well as a brief summary of our findings is as presented below. The complete mapping can be found at the end of this Report in Annex 1.

Government: Government of India has begun initiatives to leverage AI for performing various activities for policing, to street safety to energy saving. Our study identified twenty-five such government initiatives out of which six are being undertaken by State Government departments. The twety national initiatives included not only reports such as the Report of the AI Task Force[75] and the Niti Aayog Discussion paper on AI[76] (released earlier this year) but also funding initiatives such as the National Artificial Intelligence Mission (N-AIM).[77] N-AIM is set to be the nodal agency for AI funding in research and development at a national level. The Niti Aayog's discussion paper on AI in India[78] released on the 5th of June 2018 also examines the key sectors where AI can be leveraged for socio economic good. The paper also discusses how the government can help in enabling AI inclusion and deployment through funding, research, and initiatives such as data marketplaces and AI test beds.[79]The other major initiatives by the government such as Digital India and Make in India also aims at making technologies AI, citizen centric.[80] The government bodies that have planned to use AI in their functioning include police departments of Delhi, and Mumbai and Telangana that are in the process of deploying AI for crime prevention and smart policing. The use of AI in energy saving is also being tested in Pune.[81] With respect to the use of AI in critical sectors like security and defence, a Task Force[82] including officials from the government, Defense Research and Development Organisation (DRDO) has been set up in february this year to discuss ways to deploy AI in defence.[83]

Developers: In our attempt to map significant developers of AI solutions in various aspects of governance, we were able to identify thirty eight companies that had developed AI enabled products and services in order to improve governance. Out of the thirty five developers identified, ten are international and twenty five are domestic developers.These developers were further examined on the basis of sectors and focus areas. The sectors identified for this study were defence, education, law enforcement, judicial decision making and the discharge

75 Task Force on Artificial Intelligence. (2018). Report of Task Force on Artificial Intelligence. Retrieved from http://dipp.nic.in/whats-new/report-task-force-artificial-intelligence.

76 NITI Aayog. (2018). Discussion Paper on National Strategy for Artificial Intelligence. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

77 Press Trust of India (2018, March 28) Central task force on AI recommends setting up of N-AIM, The Indian Express. Retrieved from https://indianexpress.com/article/india/central-task-force-on-ai-recommends-setting-up-of-n-aim-5114130/.

78 NITI Aayog. (2018). Discussion Paper on National Strategy for Artificial Intelligence. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

79 Ibid.

80 Gupta, K(2018, February 10) Digital India: IT ministry set up four committees to encourage AI research, Livemint. Retrieved from https://www.livemint.com/Politics/h2NthxiA7u5VhiDJqfTjcM/Digital-India-IT-ministry-set-up-four-committees-to-encoura.html.

81 NITI Aayog. (2018). Discussion Paper on National Strategy for Artificial Intelligence. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

82 Mukul, P. (2018, February 3) Task force set up to study AI application in military, The Indian Express. Retrieved from https://indianexpress.com/article/technology/tech-news-technology/task-force-set-up-to-study-ai-application-in-military-5049568/.

83 Ministry of Defence (2018). Draft Defence Production Policy 2018-Invite for Comments.

of government functions. The focus areas range from student services, cyber defense, Intelligent Weapons Systems to Judicial decision making.

In the law enforcement sector our study identified eleven developers, out of which nine were domestic and two were international. These developers we spread across focus areas ranging from biometrics and authentication (Staqu),[84] Predictive Analytics (Cortica)[85] to speech and face recognition (NEC Technologies India Private Limited)[86]. Developers such as Uncanny Vision[87] and H-Bots Robotics have developed AI for predictive analytics.[88] H-Bot are also developing AI in the form of Robo Cops.[89] In the field of defence our study identified five developers, comprising of one international company and four domestic companies. Our study also identified that companies such as Omnipresent RobotTech[90] and Tonbo[91] have developed AI for Intelligence, Surveillance and Reconaissance, and CRON Systems[92] have developed AI for Risk Terrain Analysis. The only international company identified, Innefu Labs have developed AI for cyber defence.[93] In the field of education our study identified six developers that are working on focus areas such as student services and personalised learning. Startups such as OpenEd.ai[94], and Embibe[95] are developing AI for Student Services whereas PrazAs[96] and Vedantu[97] have developed AI for Personalized Learning. With respect to Judicial Decision Making our study identified two developers CaseMine[98] and LegitQuest[99] that had developed AI for helping lawyers by providing analytics and linkages to cases. In the broad sector of discharge of government functions our study identified nine developers who were developing AI for various focus areas including Agriculture, healthcare and citizen/government interface/e-governance.Out of these developers six were international and two

84 ETtech (2017, May 29) AI startup Staqu to help Police forces find criminals with its app ABHED, ETtech. Retrieved from https://tech.economictimes.indiatimes.com/news/mobile/ai-startup-staqu-to-help-police-forces-find-criminals-with-its-app-abhed/58893019.

85 Cortica. Retrieved from https://www.cortica.com/.

86 NEC Technologies. Retrieved from https://in.nec.com/.

87 Uncanny Vision. Retrieved from http://www.uncannyvision.com.

88 H-BOTS. Retrieved from http://h-bots.com/.

89 The Bureau(2017, December 29) Hyderabad-based ventures H-Bots showcases 'robo cop', The Hindu Business Line. Retrieved from https://www.thehindubusinessline.com/info-tech/hyderabadbased-venture-hbots-showcases-robo-cop/article10005878.ece.

90 OmniPresent Robot Tech. Retrieved from http://www.omnipresenttech.com/.

91 Tonbo Imaging. Retrieved from https://tonboimaging.com/tonbo/.

92 Cron Systems. Retrieved from http://cronsystems.com/.

93 Thimmaya, P. (2016, July 4). Cyber security: Start-up Innefu Labs finds desi success, eyes foreign foray. Retrieved from https://www.financialexpress.com/industry/cyber-security-start-up-innefu-labs-finds-desi-success-eyes-foreign-foray/305475/.

94 AI for Education Global HackWeek, July 28 - Aug 11. (n.d.). Retrieved from http://opened.ai/index.html.

95 What would you like to STUDY today? (n.d.). Retrieved from https://www.embibe.com/.

96 Our Elite Math Tutors Can Visualize Student Thinking. (n.d.). Retrieved from https://hellothinkster.com/.

97 Kar, S. (2017, August 17). Edtech startup Vedantu goes AI way to beat the cluttered market - ETtech. Retrieved from https://tech.economictimes.indiatimes.com/news/startups/edtech-startup-vedantu-goes-ai-way-to-beat-the-cluttered-market/60097007.

98 The Most Granular Mapping Of Us Case Law. (n.d.). Retrieved from https://www.casemine.com/home.

99 Re-Defining Legal Research TM. (n.d.). Retrieved from https://www.legitquest.com/.

were domestic. The international companies included Microsoft[100] which has been developing AI for a number of functions, Accenture[101] which has developed AI for bird conservation and Google which has in collaboration with Meity has announced a set of digital initiatives aimed at empowering Indians.[102]

Users: In our study, we identified fifteen users of AI which include departments of the Central and state governments, PSUs, Government aided research Centres and Private foundations using AI.The list of Government agencies include DRDO[103], Ministry of Coal[104], National Crime Records Bureau[105], The Punjab Police[106], Power Grid Corporation of India[107] and the Department of Urban Planning of Arunachal Pradesh[108]. Additionally the Ministry of Women and Child Development has also proposed to use AI under the Suraksha Mitra which uses AI powered CCTV systems to detect anomalies in movement of people. This initiative is proposed to be launched in various cities.[109] Out of the two private companies identified EkStep, an education initiative has partnered with a startup that helps them make education more interactive[110] whereas Best Group, a private company which takes up contracts with the Indian Government partnered with Cortica AI to improve public safety on roads.[111] The city of Pune is using AI for energy saving of street lights.[112]

Academic, Consultancy and Industry Agencies: Our study identified twenty-one academic, Consultancy and Industry agencies that have published research on AI in sectors of

100 Nagpal J., (2017, April 14) Andhra Pradesh Government announces Microsoft Kaizala as the platform for Citizen Connect. Retrieved from https://news.microsoft.com/en-in/andhra-pradesh-government-announces-microsoft-kaizala-platform-citizen-connect/.

101 Gorey, C. (2017, January 03). In India, the Internet of Birds is starting to take off. Retrieved from https://www.siliconrepublic.com/machines/india-internet-of-birds-accenture.

102 Mathur, N. (2017, March 23). Google India joins hands with IT ministry for digital payments security. Retrieved from https://www.livemint.com/Industry/aBnCywhyc9WwLvl0L1wzPL/Google-India-joins-hands-with-IT-ministry-for-digital-paymen.html.

103 The research lab of DRDO is currently developing robots for the Indian army that can aid in surveillance and rescue. Bhatia, R. (2018, March 27). If The Future Of Warfare Is With Automated Weapons – Where Does India Stand In The Race? Retrieved from https://analyticsindiamag.com/if-the-future-of-warfare-is-with-automated-weapons-where-does-india-stand-in-the-race/.

104 Thomas, A. (2017, December 20). Taking flight: From Tata Power to Ministry of Coal, WeDoSky is taking drone business to new heights. Retrieved July 6, 2018, from https://economictimes.indiatimes.com/small-biz/startups/features/taking-flight-from-tata-power-to-ministry-of-coal-wedosky-is-taking-drone-business-to-new-heights/articleshow/62129616.cms.

105 Hebbar P., (2017, October 3) Indian Cops Have Big Plans On Using Big Data To Prevent And Solve Crimes. Retrieved from https://analyticsindiamag.com/indian-cops-big-plans-using-big-data-prevent-solve-crimes/.

106 Sood, A. (2017, September 21). Cops develop face recognition app to nab gangsters. Retrieved from http://www.tribuneindia.com/news/punjab/cops-develop-face-recognition-app-to-nab-gangsters/471032.html.

107 Rajput, R. (2018, May 25). Panic buttons, AI and drones: Police plan for women's safety in Mumbai. Retrieved from https://indianexpress.com/article/india/panic-buttons-ai-and-drones-police-plan-for-womens-safety-in-mumbai-5190225/.

108 Khandu, P. (2016, September 21). Go Live-e-governance project of Itnagar Municipal Council Launched. Retrieved from http://arunachal24.in/go-live-e-governance-project-of-itanagar-municipal-council-launched/.

109 Patel, T. (2018, March 13). Bengaluru to Get 10000 'Smart Eyes' to Ensure Women's Safety on Streets. Retrieved from https://www.thebetterindia.com/134240/bengaluru-smart-eyes-women-safety/.

110 EkStep.org. (n.d.). Retrieved from https://ekstep.org.

111 BestGroupIndia.co.in. (n.d.). Retrieved from http://bestgroupindia.co.in/home.

112 Deoras, S., Biswas, J., & Chowdhury, A. P. (2018, June 25). Smart Cities: Optimize Street Lighting in India. Retrieved from https://analyticsindiamag.com/smart-cities-optimize-street-lighting-india/.

governance. Out of the Academic Institutions, VIT[113] and M. J. College[114] have published papers on how AI can be of help in the sphere of cybersecurity. Our Study has also identified Carnegie India[115] to be instrumental in drawing up the literature of AI in the country. Our study has also noted that out of the twenty-one research papers, ten of them were written by Non-governmental organisations, while the rest eleven were written by public funded colleges or research centres. Out of the Industry bodies, PwC[116] and Nishith Desai Associates[117] have published academic papers addressing the need of developing AI in fields of agriculture, education, and other areas of societal importance.

Funders/Investors: The startups working on AI in the field of Governance have been funded by various investors that encourage development of AI in this sector. Our study has listed twenty funders/investor who have funded various AI startups. It was also noted that three of the identified startups were funded by more than one investor. The key investors identified were Reliance[118], Artiman Ventures[119], Qualcomm Ventures[120] and Edelweiss Private Equity[121].

Conferences: In order map out the ecosystem of AI in Indian Governance, we looked at thirteen conferences that were held or slated to be held in the country. Although, not all conferences were specific to AI, they did have sessions discussing how AI can help the Indian government in area of education, defense, smart cities and agriculture. These conferences centered around topics of digital innovation and the skill development required to deal with such innovation. The organisers of these conferences included industry bodies such as FICCI[122] and private sector such as IBM[123], stakeholders in media such as IndiaToday[124]. With regard to the venue of these conferences, it was noted that Delhi was the venue for six conferences out of the total of thirteen. The other venues were Chennai, Mumbai, Goa, Vellore, Hyderabad and Roorkee.

113 Anitha, A., Paul, G. and Kumari, S. (2016). Cyber Defense Using Artificial Intelligence. Retrieved from http://www.ijptonline.com/wp-content/uploads/2017/01/25352-25357.pdf.

114 Patil, P. (2016). Artificial intelligence in cybersecurity. International Journal of Research in Computer Applications and Robotics, 4(5), 1-5.

115 Vempati, S. (2016). India and the Artificial Intelligence Revolution. Retrieved from http://carnegieendowment.org/files/CP283_Vempati_final.pdf.

116 (2018, April 27) Advance artificial intelligence for growth: Leveraging AI and robotics for India's economic transformation. Retrieved from https://www.pwc.in/publications/2018/advance-artificial-intelligence-for-growth-leveraging-ai-and-robotics-for-india-s-economic-transformation.html.

117 (2018) EdTech: From IT to AI - A legal perspective. Retrieved from http://www.nishithdesai.com/fileadmin/user_upload/pdfs/Research_Papers/EdTech_From_IT_to_AI.pdf.

118 Kashyap, S. (2018, April 13). Reliance announces strategic investment of $180M in Embibe, the largest AI platform for education. Retrieved from https://yourstory.com/2018/04/reliance-announces-strategic-investment-180m-embibe-largest-ai-platform-education/.

119 Press Trust of India. (2017, September 12). Tonbo Imaging raises USD 17 mn in Series B funding. Retrieved from http://www.business-standard.com/article/pti-stories/tonbo-imaging-raises-usd-17-mn-in-series-b-funding-117091200353_1.html.

120 Ibid.

121 Ibid.

122 13th FICCI Higher Education Summit 2017. Federation of Indian Chambers of Commerce & Industry. Retrieved from http://www.ficci-hes.com/pdf/2017/Thematic%20program.pdf.

123 Agarwal, M. (2016, November 22). Meet The Top 10 Winners Of IBM SmartCamp for Smart City 2016 Challenge. Retrieved from https://inc42.com/buzz/smartcity-2016-challenge/.

124 Khosla, A. (2017, February 11). India Today School Summit 2017: Accelerating innovation, technology and education. Retrieved from https://www.indiatoday.in/education-summit/story/india-today-school-summit-2017-accelerating-innovation-technology-education-960233-2017-02-11.

Challenges

While there is great potential for the advancement of Artificial Intelligence in the governance space in India, socio-economic, technological and regulatory realities in India pose unique challenges which need to be recognized and addressed when framing policy and implementing the technology.

Improved capacity and enhanced understanding of emerging technologies

Across sectors, there is a need to grow capacity within the government for effective implementation of AI driven solutions.[125] This would also require greater **receptiveness, understanding and competence** with using information technologies, which the individuals responsible for implementing the solution -including teachers, policemen or government officials may not possess.[126] Much of this capacity building may have to come from the private sector given that the development of AI driven solutions in governance is largely being pursued through partnerships with the private sector. Yet, it is a challenge to ensure that channels of communication necessary for building capacity remain open between the developer working with the private sector and the government body adopting the technology and the government official or individual implementing the solution at the grassroots level.

Infrastructure

Our research indicates that the infrastructural pre-requisites for the successful and cohesive implementation of AI driven solutions have not yet been developed.

In the law enforcement sector, inputs that may be used as training data are not cohesive or diverse enough to develop algorithmic models that accurately capture the vast array of socio-economic realities in India that would need to be used in predictive policing models.[127] In education - the lack of internet penetration and access to IoT devices serve as infrastructure barriers. The overall internet penetration in India is around 31% as of 2016.[128] Urban India has 269 million internet users[129] out of a population of 444 million (coverage of 60%) while rural India has only 163 million out of 906 million people (2011 census) covered, which means that coverage is only 17%. In defence, the lack of adequate technological infrastructure has been recognized by Defence Minister Nirmala Sitharaman as a key challenge to adoption of AI in the sector.[130]

125 (2013, November 29) Skills gap, a serious problem in IT sector. Retrieved from http://www.cxotoday.com/story/lack-of-skills-a-serious-problem-in-it-sector/.

126 Philomina, M. J., & Amutha, S. (2016). Information and communication technology awareness among teacher educators. International Journal of Information and Education Technology, 6(8), 603.

127 Tiwary D (Dec 6 2017), “Why crime data do not always add up to the complete picture” Retreived fromhttps://indianexpress.com/article/explained/ncrb-crime-records-why-crime-data-do-not-always-add-up-to-the-complete-picture-4969741/; Mukundan A, (Sep 09,2016) “NCRB Data: Handle with care,” Retrieved from https://www.thehindu.com/opinion/op-ed/NCRB-data-handle-with-care/article14628673.ece

128 IAMAI & KANTAR IMRB, Internet IAMAI in India -IMRB Report – 2016, Retrieved from http://bestmediainfo.com/wp-content/uploads/2017/03/Internet-in-India-2016.pdf.

129 Ibid.

130 (2018, May 21) Govt working on applications of Artificial Intelligence for military use: Nirmala Sitharaman. Retrieved from http://www.dnaindia.com/india/report-govt-working-on-applications-of-artificial-intelligence-for-military-use-nirmala-sitharaman-2617429.

Trust

Across sectors, a genuine concern stems from the potential **cultural uncertainty** from each community that has been comfortable with using traditional tools rather than algorithmic models, particularly intelligent models. Policemen and teachers operating at the grassroots level have received training and gained hands on-experience using techniques that do not involve the use of AI or insights derived from the same. In fact in many cases, their experience and training does not involve the use of ICTs.[131] The operational units of the defense forces do not fully trust the solutions being developed by CAIR even though they are enthusiastic about the strategic benefits of developing autonomous solutions.[132]

Funding

Obtaining funding for developing AI driven solutions is a challenge that any emerging economy faces in the present day. The government has reiterated its enthusiasm for the development of AI-based solutions by allocating Rs.3,037 crores to the 'Digital India Programme' in the 2018 budget in a bid to improve funding and skilling in the area of robotics, Artificial Intelligence and the Internet of Things (IoT).[133]There has been some stress on developing a National Programme on Artificial Intelligence under the stewardship of NITI Aayog.[134] A report released by the NITI AAYOG recommends that International Centres for the Transformation of Artificial intelligence should be set up. As per the report,seed funding (in the range of INR 200 crore – INR 500 crore per ICTAI) with grants from both government and the private sector should cover the operational expenses of the ICTAI for the first five years apart from the physical infrastructure and technology/ computing infrastructure.[135] ***While these are positive signs, it remains to be seen how funding will be distributed across sub-sectors. Due to the lack of clarity on this issue, it is possible that a lion's share of funding is invested in certain sub-sectors that the government deems to be crucial at the expense of others.***

An allied concern with respect to funding is the legal and regulatory uncertainty that prevails in India on the regulation of AI-driven solutions. ***While the government has postured that they are keen on attracting investment in this sector, the two reports that have emerged from the government have not taken a clear position on regulation of AI and sectoral regulators are yet to indicate anything concrete, which may act as a disincentive to domestic and foreign investors or potential indigenous start-ups from engaging with the sector.***

Ethical and Legal Considerations

Much like the potential applications of AI across sub-sectors, the nature of regulatory issues are diverse. We cannot regulate AI in a 'one-size-fits-all' manner and need to consider contextual challenges unique to each sub-sector and the specific uses of the technology when doing so.

131 Sane R., (2017, April 11) Budgeting for the police. Retrieved from https://www.livemint.com/Opinion/DR8kPY8VKUDyMlkR2OHUfM/Budgeting-for-the-police.html.

132 Goudarzi, S. and Khaniejo, N., The Centre for Internet and Society (2018, March 18). AI and Governance. Retrieved from https://cis-india.org/internet-governance/files/ai-in-governance.

133 Thomas A., (2018, February 1) Budget 2018: Niti Aayog to establish National Programme on Artificial Intelligence. Retrieved from https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/budget-2018-niti-aayog-to-establish-national-programme-on-artificial-intelligence/articleshow/62738713.cms.

134 Ibid.

135 Discussion Paper on National Strategy for Artificial Intelligence | NITI Aayog | National Institution for Transforming India. (n.d.) p. 57. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

Seeing this, while we have bracketed ethical and legal challenges under the broad categories the application of each concern differs from sub-sector to sub-sector. For example, due process in the context of predictive policing might refer to concerns around 'reasonable suspicion,' whereas in the context of autonomous weapons systems, it refers to a lack of adherence to the standards of International Humanitarian Law (IHL) that applies during armed conflict. Therefore, we attempt to address the diverse concerns pertaining to a sub-sector separately within each highlighted concern.

The final point we must consider in the governance sector is that of accountability. Whenever a government body performs a 'public function,' they are subject to the entire gamut of fundamental rights, which include the substantive and procedural due process requirements in Article 21, the Right to Equality in Article 14 and the Freedom of Speech and Expression in Article 19, apart from statutory rights such as the right to information. Judicial discourse on the horizontal application of fundamental rights against private actors is fractured at best.[136] Therefore, the threshold of responsibility, accountability, oversight, and liability incurred by private actors using AI in the manufacturing or healthcare sector may be lower than the constitutional due process or transparency requirements the government must be subjected to.

Privacy and Security

Privacy and security of data collected and used is a concern that cuts across all uses of artificial intelligence. AI could also have grave impacts on the freedom of expression as it is applicable in a vast number of situations that impact how individuals access information online. The all-pervasive nature of AI systems, in conjunction with their ability to to track behaviour could have a 'chilling effect' on the freedom of expression. This could take place through self-censorship and altered behaviour in public spaces. Techniques such as video surveillance, facial recognition and sentiment analysis hinder freedom of expression while also infringing upon the right to privacy.[137]

In **law enforcement and defense**, in addition to the concretisation of records, use of algorithms is driven by the collecting and storage vast tracts of data on the victim, suspect, criminal and other circumstances surrounding the commission of each crime. The collection of this data may be through traditional means through the aggregation of crime records or through more overt surveillance techniques such as the use of body cameras. It has been well-recognized that continued mass surveillance and aggregation of public behaviour can result in changing behavioral patterns and could be used for the suppression of dissent or an alteration of power dynamics between the state and the individual.[138] It is crucial, therefore that the collection of data is done through the least intrusive means possible and complies with the Indian legal regime on privacy including surveillance. That said, the privacy regime in India is fairly nascent and the surveillance regime needs to be strengthened.[139] With the judicial recognition of privacy as a fundamental right in K. Puttuswamy v Union of India, the nature of data collection and storage can dilute the essence of privacy only if it serves

136 Bhatia, G. (2015, May 24). Horizontality under the Indian Constitution: A Schema. Retrieved from https://indconlawphil.wordpress.com/2015/05/24/horizontality-under-the-indian-constitution-a-schema/.

137 Article 19 (2018),Privacy and Freedom of Expression in the Age of Artificial Intelligence,Retrieved fromhttps://www.article19.org/wp-content/uploads/2018/04/Privacy-and-Freedom-of-Expression-In-the-Age-of-Artificial-Intelligence-1.pdf

138 See also Greenwald, G. (2014). No place to hide: Edward Snowden, the NSA, and the US surveillance state. Macmillan.

139 Hickok, E. (2013, January 31). A Comparison of Indian Legislation to Draft International Principles on Surveillance of Communications. Retrieved from https://cis-india.org/internet-governance/blog/comparison-of-indian-legislation-and-draft-principles-on-surveillance-of-communications.

as a legitimate restriction. Citing Neil Richards, the White paper on Data Protection in India released by the Sri krishna Commission has stated that unwarranted surveillance can have a chilling effect on democratic values.[140] This means that it would need to satisfy through an existing law; necessity, in terms of a legitimate state objective and proportionality, that ensures a rational nexus between the object of the invasion and the means adopted to achieve that object. The draft privacy bill released by the SriKrishna Commission[141] attempts to address certain issues plaguing the data ecosystem and could evolve to serve the role of such as law. Broadly, it appears to follow General Data Protection Regulation (GDPR) model and takes on robust privacy protection stances in several places.It contains some broad privacy principles on the procedure for sending notice to individuals before data is collected. However, it also gives the government carte blanche authority to process personal data without obtaining consent as long as it is done for any "function of state."[142] As discourse on this draft bill continues, it would be imperative to ensure that its implications for the development of a human rights-compliant AI strategy is considered.

Furthermore, the regime on privacy and surveillance must be relevant and inline with international human rights standards. Article 17 of the International Covenant on Civil and Political Rights (ICCPR), which India has signed and ratified provides that privacy is protected against interferences that are 'unlawful' and 'arbitrary'. In General Comment No. 31, the UNHRC has specified that it can take place only on the basis of a law that is well-defined and specifies the precise circumstances under which surveillance may be permitted. [143]The notion of arbitrary interference essentially refers to the principle of proportionality and states that any intrusion must be proportionate to the end sought.[144]. The UN High Commissioner's Report stated that the law enabling a surveillance measure must be (a) Accessible to the public; (b) Pursues legitimate aims, (c) Precise enough in terms of detailing the limits of this interference and (d) Provides for effective remedies against abuse of that right.[145] Any policy that impinges on the Right to Privacy must never be applied in a manner that impairs the 'essence of that right."[146]

The US Supreme Court has emphasized in a number of judgments that public activities, movements and literal physical characteristics in public are not protected by the Fourth Amendment. In United States v Knotts, the Supreme Court concluded that the use of an electronic beeper to follow a suspect did not amount to a search under the Fourth Amendment.[147] However, technology aided surveillance capabilities today exceed what a large number of police officers working together could accomplish in the past. In United States v Jones, (which concerned the tracking of a single-suspect for twenty-eight days) five judges stated that long-term surveillance of an individuals public movements may

140 Richards, N. M. (2012). The dangers of surveillance. Harv. L. Rev., 126, 1934 (as cited in the White Paper Of The Committee Of Experts On A Data Protection Framework For India).

141 Sinha A, (2018), Draft Privacy Bill and its Loopholes,Retreived from https://www.livemint.com/Opinion/zY8NPWoWWZw8AfI5JQhjmL/Draft-privacy-bill-and-its-loopholes.html

142 Ibid

143 Human Rights Comm., General Comment no. 31, Nature of the General Legal Obligation on State Parties to the Covenant, para 6, U.N. Doc. CCPR/C/21/Rev.1/Add.13 (May 26, 2004).

144 Joseph, S., & Castan, M. (2013). The international covenant on civil and political rights: cases, materials, and commentary. Oxford University Press.

145 High Commissioner for Human Rights, Rep. on the Right to Privacy in the Digital Age, para 34-35, U.N. Doc. A/HRC/27/37 (June 30, 2014).

146 Human Rights Comm., General Comment no. 31, Nature of the General Legal Obligation on State Parties to the Covenant, para 6, U.N. Doc. CCPR/C/21/Rev.1/Add.13 (May 26, 2004).

147 United States v. Knotts, 460 U.S. 276, 285 (1983).

be considered a Fourth Amendment search.[148] The premise here is a 'mosaic theory' of privacy which states that the danger to privacy enshrined in the Fourth Amendment lies in the aggregation of seperate sets of data even if each piece may not individually receive constitutional protection.[149] Just like other contexts, as India begins to explore considerations on surveillance vis-a-vis data collection processes that serve as the bedrock for the use of Artificial intelligence, it needs to consider the extent to which the aggregation of disparate sets of data, new forms of collection, and new forms of data may have implications for the right to privacy.[150]

In **education**, privacy and security concerns center around collection and use of data and consent, particularly when the data collected pertains to a minor. **Indian law is still uncertain on the age of consent**- an issue that has been recognised by the medical community when assessing the validity of consent derived for the purposes of conducting vaccinations.[151] As per section 88 of the Indian penal code, a person above the age of 18 years can give valid consent to suffer any harm from an act, not intended or known not to cause death and done in good faith and for his benefit. Similarly a child below the age of 12 cannot give valid consent. For individuals falling in the age group of 12–18 years, nothing specific has been described in Indian law. This is a legal concern that requires clarity before AI is rolled out in the educational sector as the extent to which each student feels comfortable with and consents to his/her data being algorithmically processed and acted upon may be different and could change over time. It is unclear whether parents can give consent on behalf of the child 's data being processed and the extent to which the child needs to be involved in the AI-driven learning path that is forged for him.

In **delivery of government services** privacy and security concerns are coupled with concerns of denial of services and profiling. Presently, India's quasi data protection regime found under section 43A of the IT Act does not bring the public sector under its scope. The Report of the AI Task Force appears confident about the positive implications of the Aadhaar Act, along with the privacy judgment and the SriKrishna Committee Report in protecting what it terms 'consumer data' [152]However, much like the NITI AAYOG Report, it does not endeavour to understand the implications of Aadhaar holistically and it does not articulate the dangers of rolling out AI prior to a comprehensive data protection framework being in place or consider how this framework would apply to automated or intelligent data processing.[153]

Liability

The state has a responsibility to guarantee fundamental rights to all the citizens of India and whenever a state authorises an act that is 'financially, functionally or administratively' under

148 United States v. Jones, 132 S. Ct. 945 (2012).

149 Joh, Policing by Numbers;David Gray & Danielle Keats Citron, A Shattered Looking Glass: The Pitfalls and Potential of the Mosaic Theory of Fourth Amendment, 14 N.C. J.L. & Tech. 381 (2013), available at http://ncjolt.org/wp-content/uploads/2013/06/10_GrayCitron_Final_14.2.pdf.

150 Matthan R., (2018, June 27) India should make clear laws on data collection. Retrieved from https://www.livemint.com/Opinion/hj1TG16CU4fk13jIwviv3O/India-should-make-clear-laws-on-data-collection.html.

151 Rajput, M., & Sharma, L. (2011). Informed consent in vaccination in India: medicolegal aspects. Human vaccines, 7(7), 723-727.

152 Hickok E., Mohandas S., and Barooah S. P., The AI Task Force Report - The first steps towards India's AI framework. Retrieved from https://cis-india.org/internet-governance/files/ai-task-force-report.pdf; (2018, March 20) Report of The Artificial Intelligence Task Force - The first steps towards India's AI framework. Retrieved from http://dipp.nic.in/sites/default/files/Report_of_Task_Force_on_ArtificialIntelligence_20March2018_2.pdf.

153 Ibid.

the control of the government, it can be held responsible for the act.[154] Therefore, regardless of whether the developer or implementor of the solution is a government employee, as long as the government has played a role in the development of implementation of the solution, it must be subject to scrutiny as per the entire gamut of fundamental rights contained in Part III of the Indian Constitution.

The key challenge for the government lies in ensuring that the software developer in the private sector abides by the constitutional standards of due process. A thorny issue may be the proprietary nature of the source code, which is owned by the developer rather than the user. Towards addressing this, a regime that develops standards for developers working with the government on 'public functions' should be developed.

Accountability, Oversight and Evaluation

A defining feature of Artificial Intelligence is the algorithmic 'black box' that processes inputs and generates usable outputs. In many ways, the potential multifarious uses of algorithms in governance could lead to what Frank Pasquale terms a 'Black Box Society' where opaque ('black-boxed') algorithms define the trajectory of daily existence .[155] Ensuring accountability is an imperative that is challenging when the "values and prerogatives that the encoded rules enact are hidden within black boxes"[156] However, given the metaphorical 'black box' that converts inputs into examinable outputs, implementing workable accountability and evaluation standards remain a challenge. Often evaluation is done by ex post facto assessing the impact of the algorithmic assessment. This may not be suitable testament to the efficacy of the algorithm. For example, the success of PredPol is often derived from the fact that the police have detected more crimes in the areas the algorithm brands as 'high risk.' However, this assessment does not account for the fact that more crime is detected in these areas because more policemen are deployed here.

Further, there needs to exist continuous channels of communication whenever there is governance by AI such that the individual being impacted by the use of the technology is made constantly aware about the manner in which the technology is being used to take decisions that may impact their daily lives.

Transparency

On the question of transparency, lessons can be learned from the Loomis case in the US, where the Court noted four crucial transparency requirements[157]: (1) The inputs themselves, (2) How the algorithm weighs these inputs, (3) whether combinations of certain factors such as race, gender or economic status may end up being used as variables and (4) The underlying assumptions made by the computer scientists who designed the algorithms.

This problem is compounded in India as the judiciary is yet to state a clear set of sentencing guidelines, thereby giving the judge wide discretion in the matter.[158] If algorithms were to be used, this leaves the door ajar for the use of a diverse set of irrelevant variables which

154 Pradeep Kumar Biswas v Indian Institute of Chemical Biology & Ors (2002) 5 SCC 111.

155 Pasquale, F. (2015). The black box society: The secret algorithms that control money and information. Harvard University Press.

156 Ibid.

157 State v. Loomis, 881 N.W.2d 749, 774 (Wisc. 2016).

158 In, the case of State of Punjab v. Prem Sagar & Ors., it was noted that "[i]n our judicial system, we have not been able to develop legal principles as regards sentencing. The superior courts[,] except [for] making observations with regard to the purport and object for which punishment is imposed upon an offender, had not issued any guidelines."; For insight into the lacunae in the existing system, See R. Niruphama, Need for Sentencing Policy in India: Second Critical Studies Conference – "Spheres of Justice" Paper Presentation (Sept. 20–22, 2007), http://www.mcrg.ac.in/Spheres/Niruphama.doc.

may prejudice the defendant unduly. Therefore, before using algorithms in the sentencing process, the Indian judiciary must take note of the various calls[159] to set up a uniform sentencing policy to ensure that the decision-making input into the algorithms are as consistent as possible. As these algorithms have been designed by private corporations, the explanation and verification of how the algorithm makes decisions is often 'black-boxed,'which means that there is limited information on how the algorithm makes its decisions.[160] It is important to note here that, unlike the GDPR,the draft privacy bill does not contain a Right to Explanation for meaningful information about the logic involved in automated decisions.[161]

Transparency is an issue that needs to be grappled with in all five sub-sectors.[162] However, the impacts of a lack of transparency may differ based on the sub-sector in question. Lack of transparency in a predictive policing algorithm may be a violation of constitutional due process standards as it directly impacts the life and liberty of an individual whereas a lack of transparency in an algorithm developing a learning path for a student or predicting weather patterns may be challenged through civil remedies or Right to Information claims.

Redress

As per constitutional standards, every individual affected by an action taken by or on behalf of the state machinery should be able to challenge this decision in a court. Using AI to take a variety of decisions could potentially pose problems in two ways. First, the conversion of inputs to output is often 'black-boxed' which means that even the developer may not be able to understand how the algorithm arrived at a certain decision. Second, even though the government is responsible in all cases, it remains unclear what the obligations of a developer in the private sector would be. Given the potentially complicated nature of public - private partnerships and that most amount of information regarding the operation of the technology could lie with the private sector and the lack of judicial precedent on the regulation of AI, it remains to be seen how a legal regime and judicial precedent will navigate questions of accountability liability and redress so that state action does not become a reason for dismissing or ignoring harm.

Bias and Discrimination

International human rights and Indian constitutional standards recognize two potential ways in which discrimination may take place. Indian legal tradition has recognized that every state has a constitutional obligation and duty to protect the life and liberty of its citizens,which is a fundamental requirement for the observance of the rule of law.[163] There should not be any discrimination on the basis of caste,creed,religion,political belief and ideology.[164] Direct discrimination occurs when an individual is treated less favourably than someone

159 Ahmad T., (2014, April) Sentencing Guidelines: India. Retrieved from https://www.loc.gov/law/help/sentencing-guidelines/india.php Retrieved from (2015, September 2) Different strokes for different folks. Retrieved from https://www.telegraphindia.com/1150902/jsp/opinion/story_40175.jsp

160 Tashea J., (2017, April 17) Courts Are Using AI To Sentence Criminals. That Must Stop Now. Retrieved from https://www.wired.com/2017/04/courts-using-ai-sentence-criminals-must-stop-now/.

161 Selbs A and Powles J, Meaningful Information and the Right to Explanation, Retrieved from https://academic.oup.com/idpl/article/7/4/233/4762325

162 Discussion Paper on National Strategy for Artificial Intelligence | NITI Aayog | National Institution for Transforming India. (n.d.) p. 85. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

163 Dalmia Cement (Bharat)Ltd v UOI (1996) 10 SCC 104 (Para 18) cited in Basu, DD (2011), Shorter Constitution of India, Lexis Nexis Butterworths Wadhwa

164 Zahira Habibullah Sheikh (5) v State of Gujarat (2006) 3 SCC 374

else similarly situated on one of the prohibited criterion engraved into the Convention in question.[165] Indirect discrimination occurs when a policy, rule or requirement is 'outwardly neutral' but has a disproportionate impact on certain groups that are meant to be protected by one of the prohibited grounds of discrimination.[166]

While this concept has been endorsed enthusiastically by constitutional courts all over the world, it was explicitly read into the indian Constitution by the Delhi High Court in the case of Madhu Kanwar v Northern Railway.[167] Given the manner in which algorithms cluster or classify individuals based on characteristics that may not be reflective of a group in question, any use of AI in governance must be wary of developing ostensibly neutral algorithms that result in indirect discrimination against a certain category of individuals.This is particularly crucial in a diverse country like India where differences in identity often causes discrimination and victimization.

Algorithmic discrimination may occur at three stages (1) Incomplete or inaccurate training data, (2) Algorithmic Processing and Profile Development and (3) Interpretation of Outputs.[168]

1. Incomplete or inaccurate training data

The data utilised may be incomplete or not reflective of how the statistics came into being, which has implications for the manner in which the algorithm may process its inputs.One specific problem in this case is that of 'overfitting.' [169] This issue is most acute in the case of supervised learning systems that require labelled data sets. As the labelling of datasets is expensive, the functioning of the model is based on the availability of suitable datasets.[170] For example, many natural language processing systems use readily available training datasets from leading western newspapers.This may not be reflective of speech patterns in different parts of the world[171]

This argument is furthered by Cathy O'Neil in Weapons of Math Destruction. She explains that there are two types of crimes. The first type of crimes such as murder, rape or assault are usually reported whereas Type 2 crimes, such as vandalism or possession of a small quantity of illicit drugs are usually 'found' only if a policeman is patrolling that area. [172]As there is usually increased police surveillance in poorer neighbourhoods inhabited by a largely Black or Hispanic population, the training data is likely to suggest that coloured individuals commit a higher proportion of crimes than they actually do.[173]

2. Algorithmic Processing

An AI driven solution is usually an amorphous problem[174]- such as the 'risk profile' of an individual While humans may not be able to assess vast tracts of data, expressing that

165 Moeckli, D. (2010). Equality and non-discrimination. International Human Rights Law, 189-208.

166 Ibid.

167 Madhu & Anr. vs Northern Railway & Ors. on 17 January, 2018.

168 Danks, D., & London, A. J. (2017, August). Algorithmic bias in autonomous systems. In Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (pp. 4691-4697); Discussion Paper on National Strategy for Artificial Intelligence | NITI Aayog | National Institution for Transforming India. (n.d.) p. 85. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

169 Ibid.

170 Ibid.

171 Ibid.

172 O'Neil, C. (2016). Weapons of math destruction: How big data increases inequality and threatens democracy. Broadway Books.

173 Ibid.

174 Danks, D., & London, A. J. (2017, August). Algorithmic bias in autonomous systems. In Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (pp. 4691-4697).

amorphous question in source code enables a machine to do so.Therefore, the process commences by assigning a value to the question that the machine can comprehend. Through its hidden layers, the machine then generates an output, which is also a value and is used to assign the desired 'risk profile.' to an individual.Citron and Pasquale termed this assignment of value to individuals as the 'scored society.'[175] The scored society refers to a paradigm where individuals are assigned quantitative values that modulate access to opportunities such as credit cards or insurance.[176] This assessment does not consider the multiple layers at which qualitative heuristics or traits are converted into rigid, quantitative values and the obfuscation of outputs that could occur as a result. In terms of human rights and constitutional law, this would qualify as unintentional indirect discrimination as certain classes of people are treated disparately by an apparently neutral algorithm.

3. Interpretation of algorithmic output

Finally, linked to the first two sources of algorithmic bias is the possibility of misinterpretation of the algorithm's outputs.[177] Given that autonomous systems function through hidden layers, there could be a mismatch between the information the algorithm produces and the output which the user requires. [178]This is fairly possible as developers are rarely able to specify exactly the nature of output they desire. Due to this mismatch, it is possible that the user interprets a quantitative result and applies it in a qualitative manner that is completely disaggregated from the hidden layers that arrived at the quantitative output.[179]

In law enforcement, the crime data that is used as the input into any predicting policing software may not necessarily be an accurate representation of criminal activity in a certain area.[180] It is naturally limited by what individuals choose to report and what law enforcement officers may observe and record.[181]There is a precarious under-counting of crime in India. The National Crime Records Bureau only records the 'principal offence' whenever a First Information Report is filed, which could mean that in a scenario where there is both rape and murder, murder could remain uncounted.[182] The use of the CCTNS system may improve the reliability of data. The extent to which it does so is crucial for the future of predictive policing programs. Further, there may be excessive 'finding' of crime in areas perceived to be high risk, further skewing the training data that is processed by the algorithm through its multiple hidden layers.

Similarly, inaccurate training data compounded by unknown bias in algorithmic processing might lead to the labelling of certain students and bracketing them into learning paths that may be difficult to challenge. In the case of autonomous weapons bias may lead to inaccurate targeting leading to the death of civilians which would be in violation of the principle of distinction enmeshed in customary International Humanitarian Law. (IHL)

175 Citron, D. K., & Pasquale, F. (2014). The scored society: due process for automated predictions. Wash. L. Rev., 89, 1.

176 Ibid.

177 Danks, D., & London, A. J. (2017, August). Algorithmic bias in autonomous systems. In Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (pp. 4691-4697).

178 Ibid.

179 Ibid.

180 Bennett Moses, L., & Chan, J. (2016). Algorithmic prediction in policing: assumptions, evaluation, and accountability. Policing and Society, 1-17.

181 Harcourt, B. E. (2008). Against prediction: Profiling, policing, and punishing in an actuarial age. University of Chicago Press.

182 Rukmini S., (2016, August 2) India officially undercounts all crimes including rape. Retrieved from http://www.thehindu.com/news/national/india-officially-undercounts-all-crimes-including-rape/article5121114.ece.

A key issue across sub-sectors is the relative lack of skill of the individual responsible for interpreting algorithmic output, which could lead to skewed policy implementation or decision-making even if the quantitative output generated by algorithmic processing is neutral and accurate.

Due Process

In 2016, the Wisconsin Supreme Court considered the legality of using risk assessment software such as COMPAS in criminal sentencing.[183] Eric Loomis, the defendant was arrested for being the driver of a car in a drive-by shooting and was designated as high risk by the COMPAS algorithm on all counts of recidivism, a score that was probably worsened by his registration as a sex-offendor.[184] Even though the Court pointed out certain limitations to the use of COMPAS as a sentencing tool, it did not invalidate its use as a violation of constitutional due process standards.

In specific terms, Loomis claimed that the software violated constitutional standards of due process for three reasons[185]

(1) Accuracy: It violated the right to be sentenced based on accurate information as the proprietary nature of the software prevented him from accessing his scores. The Court responded by stating that the algorithm compiled information from a questionnaire he completed and from public records, which meant that he had an opportunity to ascertain the accuracy of the algorithm.[186]

(2) Individualized Sentencing: It violated his right to individualized sentencing because it inferred characteristics from larger groups. The Court concluded that this due process challenge would be valid if these inferred characteristics was the only factor being used in the sentencing process.[187]

(3) Gendered assessments:The software used improperly constructed gendered assessments in determining the length of the sentences. The Court rejected the argument stating that if the use of gender promoted accuracy it served both the institutions and the defendant rather than a discriminatory agenda.[188]

While they were evolved in the specific context of use of Artificial Intelligence in sentencing, the principles highlighted in the case cull out certain ethical concerns with the use of algorithms in the risk determination process.

Indian legal tradition has an inherent presumption in preserving the principles of natural justice in a bid to secure the fairest possible outcome. The expression ‘due process of law’ is not used explicitly in any provisions of the Indian Constitution. However, it can be inferred through creative reading of Article 21-something the judiciary has sought to do. It is now widely accepted that Maneka Gandhi v UOI[189] brought due process into the Constitution by incorporating the concept of non-arbitrariness articulated in E.P. Royappa v UOI under Article 21.[190] The Court held that that a law prescribing a procedure for deprivation of life and personal liberty under Article 21 could not be any sort of procedure but it has to be one that is neither arbitrary nor unfair or unreasonable.

183 State v. Loomis, 881 N.W.2d 749 (Wisc. 2016).

184 Ibid.

185 State v. Loomis, 881 N.W.2d 749 (Wisc. 2016).

186 Ibid.

187 Ibid.

188 Ibid.

189 Maneka Gandhi vs Union Of India 1978 AIR 597.

190 E. P. Royappa vs State Of Tamil Nadu & Anr 1974 AIR 555.

In law enforcement, the notion of 'innocent before proven guilty' may result in certain guilty individuals going free. Yet, it reflects the inherent judgment of the framers of our Constitution that freeing someone who may have committed a crime for lack of evidence poses less of a danger to our society and constitutional foundation than allowing an innocent individual to be convicted or spend excessive amounts of time in jail. This determination of fairness has been in many ways left to the human discretion of a judge. Yet programming Indian notions of fairness into algorithms and adapting these to different contexts is not a simple task. Especially as algorithms are designed to favour supposed efficiency, often at the cost of fairness.[191] The challenge ahead lies in ensuring that the prospective efficiency that the use of Machine Learning may hold in the criminal justice framework does not come at the cost of human decision-making in ensuring procedural due process.

Due process in the context of predictive policing might refer to concerns around 'reasonable suspicion,' whereas in the context of autonomous weapons systems, it refers to a lack of adherence to the standards of International Humanitarian Law (IHL).

The obligation to exercise discretion compels the administrative decision-making body to test each decision on a case to case basis vis-a-vis the norms that the office is bound by and the norms it has been tasked to uphold. This duty also includes an obligation to not invalidly reduce the scope of one's discretionary power.[192] The decision-maker must be willing to listen to a variety of stakeholders who may have something to say and incorporate that those suggestions.[193] Similar concerns may be posed with regard to the use of AI in education. It is imperative that the teacher continues to exercise discretion at every stage of the process when engaging with the individual child and does not replace the emotional connect between a student and teacher.The fundamental requirement in domestic administrative frameworks has translated into the construct of International Law through the notion of reasonableness[194] or 'feasibility' in IHL.[195]The possibility of leaving a window of opportunity for amending one's policies is also a core component of the obligation to exercise discretion. Therefore, in the case of entirely autonomous weapons systems,a state's attempt to predetermine what would be 'reasonable' use in all circumstances and to model behaviour on this rigid set of parameters would be a potential violation of the obligation to use discretion on a case-by-case basis. There are two core reasons that explain why it is just and equitable to not violate the obligation to not fetter one's discretion.The first stems from the rights of the affected individual in each specific case. It forms the edifice of the trust relationship in any administrative relationship and the bedrock of the relationship of reciprocity between the parties engaging in acts of warfare.[196] The second justification lies in the fact that sound executive decisions cannot be rigid in an ever-changing world These adjustments, which require the continuing and constant exercise of discretion is simply due to heuristics that are inevitable in human judgement-something jurist H. L. A. Hart identified as 'relative ignorance of fact' and 'relative indeterminancy of aim'.[197] These limit the efficacy of any decision-making making done in advance or embedded into an autonomous system.

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191 O'Neil, C. (2016). Weapons of math destruction: How big data increases inequality and threatens democracy. Broadway Books.

192 Lieblich, E., & Benvenisti, E. (2014). The Obligation to Exercise Discretion in Warfare: Why Autonomous Weapon Systems are Unlawful.

193 Barth, T. J., & Arnold, E. (1999). Artificial Intelligence and Administrative Discretion: Implications for Public Administration. The American Review of Public Administration, 29(4), 332-351.

194 Corten, O. (1999). The notion of "reasonable" in international law: legal discourse, reason and contradictions. International & Comparative Law Quarterly, 48(3), 613-625.

195 Lieblich, E., & Benvenisti, E. (2014). The Obligation to Exercise Discretion in Warfare: Why Autonomous Weapon Systems are Unlawful.

196 Benvenisti, E., & Cohen, A. (2013). War is governance: explaining the logic of the laws of war from a principal-agent perspective. Mich. L. Rev., 112, 1363.

197 Hart, H. L. (2013). Discretion. Harv. L. Rev., 127, 652.

The duty to exercise discretion is an ongoing obligation during the conduct of hostilities.[198] It requires the military commander exercise discretion both when planning the attack during the attack, up to the last moment before pulling the trigger. In the context of autonomous weapons systems, in an out-of-the-loop scenario, the duty to exercise discretion 'in the last moment' would have to be performed by the AWS, which could potentially be excessive delegation of this duty. Effectively, the human only exercises discretion when programming the system but fails to exercise holistic discretion at [199]every step of the battlefield.

AI in Governance: Future Trends and International Developments

The use of AI in governance is growing across contexts. India is still nascent in its deployment of AI in governance when compared to other countries. This section will highlight how AI is being deployed for governance purposes in other countries and call out directions the technology is going. In doing so, it will reflect on potential future uses that India can explore.

Law Enforcement

Facial Recognition Technologies: A feature of the recent pivot towards technology by police forces across the globe is the use of facial-recognition technology through the use of body-cams on policemen to help conduct surveillance. The Russian company Netchlab claims that its high-performing facial recognition algorithm can to detect "abnormal and suspicious behavior of people in certain areas" to help conduct surveillance and data gathering.200 Though some police forces in India are starting to use body cams, it does not appear that these are products driven by AI.201 Facial recognition companies have also been developing patterns to identify potentially problematic behaviour in large crowds.202 For example, IBM recently advertised a Deep Learning Engine which could identify and pinpoint suspects in limited time.203 Further, researchers in the US funded by the Defense Advanced Research Projects Agency have been working on "automated suspicion algorithms " for the purpose of analyzing images and videos.204 Shenzhen in China is expanding a network of facial recognition surveillance cameras to catch violators of traffic rules,jaywalkers and drunk drivers.205 Chinese tech start-ups are also attempting to expand their AI driven facial recognition technologies across other parts of South East Asia.206

198 Lieblich, E., & Benvenisti, E. (2014). The Obligation to Exercise Discretion in Warfare: Why Autonomous Weapon Systems are Unlawful.

199 Ibid.

200 Kofman A., (2017, April 30) Taser Will Use Police Body Camera Videos "To Anticipate Criminal Activity". Retrieved from https://theintercept.com/2017/04/30/taser-will-use-police-body-camera-videos-to-anticipate-criminal-activity/.

201 Reveal Media https://www.revealmedia.in/.

202 Ibid.

203 Ibid.

204 Rich, M. L. (2015). Machine Learning, Automated Suspicion Algorithms, and the Fourth Amendment. U. Pa. L. Rev., 164, 871.

205 Tao L., (2018, April 25) Shenzhen police can now identify drivers using facial recognition surveillance cameras. Retrieved from https://www.scmp.com/tech/china-tech/article/2143137/shenzhen-police-can-now-identify-drivers-using-facial-recognition.

206 Dai S., (2018, July 3) Tech start-ups push to make China's facial recognition systems part of daily life across Asia. Retrieved from https://www.scmp.com/tech/start-ups/article/2153471/tech-start-ups-push-make-chinas-facial-recognition-systems-part-daily.

Predictive Policing: Although India has taken initial steps to implement predictive policing initiatives, many projects in other contexts are much more advanced. Among the tools used to predict crime, PredPol has received the most media attention[207] and commercial success worldwide.[208] It claims that it can do more than spatial analysis and 'hot spot identification' and can identify with great precision the territories that must be patrolled.[209] While the company does not provide the public access to the algorithm , it is known that the PredPol algorithm has its origins in an algorithm that was designed for the purpose of predicting earthquake aftershocks[210].It uses the geo-physical theory of 'loading' into crime analysis through the theory of contagion which effectively implies that a geo-spatial area that has seen a crime is likely to see more crime, much like an area that has been impacted by an earthquake is likely to feel aftershocks[211] The occurrence of criminal activity can be predicted by calculating hotspots and the potential of contagion from one crime to another. [212]The uniqueness of this method lies in the fact that it is a relatively 'lean' model as there are relatively few parameters in this equation that relies only on data on geo-spatial location.[213]

The United Kingdom is following suit and incorporating big data driven predictive policing into its law enforcement strategy.[214] Kent Police has been using PredPol since December 2012.[215] The Durham Constabulary is working to develop an AI-based system to calculate the risk of individuals re-offending.[216] The Harm Assessment Risk Tool (HART) uses variables such as past offending history, age, postcode and other background characteristics which are then analysed using classifying algorithms to predict the odds of them re-offending.[217]

Predictive Policing has also taken off in many parts of Europe.[218] Danish Police have purchased an intelligence-based policing platform from the private company Palantir in order to analyse data collected through the surveillance of social media posts through the

207 (2013, July 20) Predictive Policing: Don't even think about it. Retrieved from https://www.economist.com/briefing/2013/07/20/dont-even-think-about-it.

208 Demortain D., and Benbouzid B. (2017). Evaluating Predictive Algorithms in Centre for Analysis of Risk and Regulation at the London School of Economics and Political Science, Algorithmic Regulation at 14.

209 Mohler, G. O., Short, M. B., Malinowski, S., Johnson, M., Tita, G. E., Bertozzi, A. L., & Brantingham, P. J. (2015). Randomized controlled field trials of predictive policing. Journal of the American Statistical Association, 110(512), 1399-1411.

210 Predictive Policing: George Mohler Interview. Retrieved from https://www.datascienceweekly.org/data-scientist-interviews/predictive-policing-george-mohler-interview.

211 Demortain D., and Benbouzid B. (2017). Evaluating Predictive Algorithms in Centre for Analysis of Risk and Regulation at the London School of Economics and Political Science, Algorithmic Regulation at 14.

212 Predpol, How Predictive Policing Works Retrieved from http://www.predpol.com/how-predictive-policing-works/.

213 Demortain D., and Benbouzid B. (2017). Evaluating Predictive Algorithms in Centre for Analysis of Risk and Regulation at the London School of Economics and Political Science, Algorithmic Regulation at 14.

214 Burgess M., (2017, March 8) This map claims it can predict crimes across London before they happen. Retrieved from http://www.wired.co.uk/article/london-crime-predict-police-2017.

215 Bell G (2018,Feb 13),Predictive Policing statistics from Kent Police, Retrieved from http://www.kentonline.co.uk/maidstone/news/predictive-policing-statistics-from-kent-police-159920/

216 Baranuik C., (2017, May 10) Durham Police AI to Help with Custody Decisions. Retrieved from https://www.bbc.com/news/technology-39857645.

217 Ibid.

218 Dahllof S., Hirschauge O., Shezaf H., Baker J., And Nielsen N. C., (2017, October 6) EU states copy Israel's 'predictive policing'. Retrieved from https://euobserver.com/justice/139277.

use of algorithms for the generation of hot-spots.[219] It is likely that other European states will soon follow suit.

Among the Asian states, China has been the major user of predictive policing strategies. Authorities in China have considered using facial recognition technologies and predictive analytics through algorithms in law enforcement.[220] Cloud Walk, which is a company headquartered in Guangzhou has been developing its systems to track movements of individuals based on risk levels. Frequent visitors to weapons shops or transportation hubs are more likely to be flagged as high risk targets.[221] With few limitations on data collection through a privacy regime, China has an extensive archive on citizens from government records and over 170 million surveillance cameras.[222]

Robo-cops: Thames Valley Police have stated that very soon AI systems may be used to answer calls, detect crime and patrol busy areas in the United Kingdom possibly replacing human discretion.[223] Dubai has also introduced its first robot cop and plans to automate 25% of its police force by 2030.[224]

Comparison and learnings for India: While there has been much talk about deploying 'smart-policing' methods along with the development of a prototype for a 'robo-cop', the extent to which these prototypes depend on AI and the timeline for deployment in the field is unclear.

Education

Smart Content Platforms: Third Space Learning in the United Kingdom has created an AI driven project to find correlations between positive teaching and learning patterns.[225] Other examples of smart content platforms include Content Technologies Inc[226], which is an artificial intelligence development company based in USA that has expertise in the field of business processes and the designing of intelligent instruction. It has created a variety of smart content services for secondary education. Cram101, an online platform for instance uses Artificial Intelligence to break down and summarise chapters and multiple choice tests[227]. Other companies, such as Netex [228]offer smart digital content platforms which enable automated real-time feedback and assessment that serve a wide range of customers across

219 (2017, February 22) New legal framework for predictive policing in Denmark. Retrieved from https://edri.org/new-legal-framework-for-predictive-policing-in-denmark/.

220 Lant K., (2017, July 25) China's "Minority Report" Style Plans Will Use AI to Predict Who Will Commit Crimes. Retrieved from https://futurism.com/chinas-minority-report-style-plans-will-use-ai-to-predict-who-will-commit-crimes/.

221 Yang Y. and ors., (2017, July 23) China seeks glimpse of citizens' future with crime-predicting AI. Retrieved from https://www.ft.com/content/5ec7093c-6e06-11e7-b9c7-15af748b60d0.

222 Ng S. Y., (2017, July 23) China is using AI to predict who will commit crime next. Retrieved from https://mashable.com/2017/07/24/china-ai-crime-minority-report/#fCkZmcYs8qqc.

223 Hope C., (2017, October 13) Robocops to replace British bobbies on the streets, police force reveals. Retrieved from https://www.telegraph.co.uk/news/2017/10/13/robocops-replace-british-bobbies-streets-police-force-reveals/.

224 (2017, June 1) Robocop joins Dubai police to fight real life crime. Retrieved from https://uk.reuters.com/article/uk-emirates-robocop/robocop-joins-dubai-police-to-fight-real-life-crime-idUKKBN18S4LF.

225 Dickson B., (2017, March 13) How Artificial Intelligence enhances education. Retrieved from https://thenextweb.com/artificial-intelligence/2017/03/13/how-artificial-intelligence-enhances-education/.

226 Content Technologies Inc., http://contenttechnologiesinc.com/.

227 Faggella D., (2017, September 1) Examples of Artificial Intelligence in Education. Retrieved from https://www.techemergence.com/examples-of-artificial-intelligence-in-education/.

228 Offices in Coruna, Madrid, London, Mexico, India.

the globe including Telefonica-a Spanish multinational broadband company,Mondelez-an American-based confectionary and the University of Cambridge.[229]

Intelligent Tutoring System: Another useful manifestation of AI is the Intelligent Tutoring System.[230] An ITS system will introduce a theory, ask student questions related to the theory and then monitor responses, which would be utilised to generate the next cycle of theoretical prompts.[231] Examples of Intelligent Tutoring Systems include Thinkster Math[232], Carnegie Learning.[233] and Amy which was developed in New Zealand and now is being used in Dubai.[234] Stanford University and the University of Washington have also begun to develop a modified algorithm driven tutorial system which analyzes whether the existing curriculum is not working and then modifies the content accordingly.[235]

A major driver of the burgeoning Artificial Intelligence sector in the developed world may be the increasing use of IoT devices by pupils of all ages.[236] Products such as Century Intelligent Learning enables students to access smart content at any time and presents the quizzes generated on children's mobile phones after data analytics syncing the relevancy of the content with the child's pedagogical level.[237]

Among other Asian countries, China seems to have taken great strides towards the use of AI in education.[238] The education sector has become the third most commonly used vertical for the application of Artificial Intelligence after medicine and automobiles. China has made AI-enabled education a part of the national strategy road-map.[239] By collaborating with online education startup Master Learner, teachers in China can hand a time consuming review process 'diagnosing' students strengths and weaknesses to the machine. The advent of this technology is particularly useful in China as it has 188 million pupils in school and most of the good schools are concentrated in metropolitan areas.[240] To ensure that pupils in all parts

229 Netex http://www.netex.com/.

230 Nye, B. D. (2015). Intelligent tutoring systems by and for the developing world: A review of trends and approaches for educational technology in a global context. International Journal of Artificial Intelligence in Education, 25(2), 177-203.

231 Dickson B., (2017, March 13) How Artificial Intelligence enhances education. Retrieved from https://thenextweb.com/artificial-intelligence/2017/03/13/how-artificial-intelligence-enhances-education/.

232 Thinkster Math http://hellothinkster.com/.

233 Carnegie Learning, https://www.carnegielearning.com/.

234 Nasir S., (2017, November 5) Dubai teachers pitch for artificial intelligence in curriculum. Retrieved from https://www.khaleejtimes.com/news/education/dubai-teachers-pitch-for-artificial-intelligence-in-curriculum.

235 Dickson B., (2017, March 13) How Artificial Intelligence enhances education. Retrieved from https://thenextweb.com/artificial-intelligence/2017/03/13/how-artificial-intelligence-enhances-education/.

236 Vector Security Team, (2017, February 21) The Impact Of IOT Devices On Kids. Retrieved from https://www.vectorsecurity.com/blog/the-impact-of-iot-devices-on-kids.

237 Century-Tech Limited http://www.century.tech/.

238 Jing M., (2017, October 14) China wants to bring artificial intelligence to its classrooms to boost its education system. Retrieved from https://www.scmp.com/tech/science-research/article/2115271/china-wants-bring-artificial-intelligence-its-classrooms-boost.

239 Ibid.

240 Swank G., (2017, September 29) How Artificial Intelligence Is Disrupting the Education Industry. Retrieved from https://www.huffingtonpost.com/entry/how-artificial-intelligence-is-disrupting-the-education_us_59c50cbae4b0b7022a6469ba; Gao H., (2014, September 4) China's Education Gap. Retrieved from https://https://www.nytimes.com/2014/09/05/opinion/sunday/chinas-education-gap.html.

of the country can benefit from the use of Artificial Intelligence, China's Education Ministry has mandated that governments at all administrative levels spend at least 8 per cent of their annual funding on the digitisation of education.[241]

Comparison with and learnings for India: It appears that india lags behind other countries-both in Asia and the West on the application of AI in education-in terms of the number of private sector developers entering the space and establishing themselves, the scale at which the technology is being deployed and due to the absence of a clear national strategy that charts out how AI would be used in this sector and how pupils from diverse backgrounds could benefit from this technology. China has been particularly instrumental in using AI to review student performance through the adoption of a robust national strategy which ensures adequate funding in this space. The recently released National Strategy on Artificial Intelligence by NITI-AAYOG identifies the possible scope of AI in the education space but unlike China is yet to devise a clear implementation framework. A cohesive implementation framework will probably reduce the burden on teachers working in schools in far-flung areas and is something that India should develop as it could potentially ameliorate the state of education in rural India

Discharge of Government Functions

Agriculture

The main uses of Artificial Intelligence in agriculture globally fall into the three following categories[242]:

1) **Agricultural Robots**: These are being developed by companies to handle basic agricultural jobs such as harvesting crops[243] and estimating more precise treatment for each crop. Blue River Technology, now acquired by major agricultural manufacturer John Deere, for example has developed a Robot called See & Spray which uses computer vision and precision technology to improve the accuracy of weed sprayed on cotton plants.[244] Blue River Technologies claims that this technology can reduce the amount of chemicals sprayed by 80% and consequently reduce expenditure on herbicides by Robots at 90%. [245]The company has also developed smart tractors-which contains a smart attachment to each tractor being used by the farmer.[246] This enables farmers to develop customised treatment for each crop based on the algorithmic analysis of data

2) **Crop and Soil Monitoring**: Drones, satellites and other software-based applications are being used to evaluate crop and soil health.[247] For example, Berlin-based agricultural start up PEAT[248] has developed a deep learning application called Plantix[249] that can identify potential defects or nutrient deficiencies in soil quality. An image recognition application captures

241 Notice of the New Generation Artificial Intelligence Development Plan, Chinese State Council. Retrieved from http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm.

242 Sennaar K., (2017, November 16) AI in Agriculture – Present Applications and Impact. Retrieved from https://www.techemergence.com/ai-agriculture-present-applications-impact/.

243 Agricultural Robotics http://harvestcroorobotics.com/.

244 Blueriver Techonology http://www.bluerivertechnology.com/.

245 Blueriver Techonology http://smartmachines.bluerivertechnology.com/.

246 (2017, November 23) How AI In Agriculture Is Being Used. Retrieved from https://gamaya.com/blog-post/how-ai-in-agriculture-is-being-used/.

247 Ibid.

248 Plantix: Image recognition for plant diseases https://plantix.net/.

249 Ibid.

images through a smartphone camera. These images are then evaluated by algorithms which correlate foliage patterns with soil defects, pests and diseases.[250]

3) **Predictive Analytics**: Deep learning models are being used to evaluate the impact of environmental factors such as weather patterns, thereby enabling farmers to make smarter farming choices.[251]

Miscellaneous Administrative Functions

Traffic Lights: Cities in the United Kingdom[252] and the United States[253] have announced that they plan to use artificial intelligence in traffic lights to detect areas where there is a heavy concentration of vehicles and alter their patterns accordingly. If accurate data can be obtained for traffic patterns in India, this could mark a major step towards reducing congestion and consequently, vehicular pollution as there will be less cars gridlocked on the streets.

National Power Grids: The United Kingdom's National Grid has announced that it is planning to integrate Artificial Intelligence into Britain's electricity system- a bid that could improve power network efficiency by as much as 10%.[254] By processing vast amounts of data from various data points that may include weather forecasts to internet searches, AI can create predictive models that pre-empt surges or reductions in usage of electricity. This determination is crucial as one of the National Grid's major tasks is to maintain a consistent frequency that can only be done if supply and demand of electricity is closely monitored.[255]

Disaster Relief Management: Algorithms could be used to accurately model the onset and impact of natural disasters such as hurricanes by analyzing available data. Engineers at the University of Oxford worked with disaster relief team Rescue Global last year to model such projections for Hurricane Irma, that battered the Caribbean Islands.[256] Algorithmically determined projections were used to identify the areas worst affected and to organise relief efforts accordingly.

Citizen Services and E-governance: Artificial Intelligence could be used in a wide range of ways to improve the interface between the citizens and the government and thereby foster much-needed bureaucratic efficiency in India. The functions of Artificial Intelligence in enabling the discharge of bureaucratic citizen services may be categorised in 4 broad ways:[257]

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250 Sennaar K., (2017, November 16) AI in Agriculture – Present Applications and Impact. Retrieved from https://www.techemergence.com/ai-agriculture-present-applications-impact/.

251 FarmShots http://farmshots.com/.

252 McGoogan C., (2017, May 16) AI traffic lights to end rush hour jams in Milton Keynes. Retrieved from https://www.telegraph.co.uk/technology/2017/05/15/ai-traffic-lights-end-rush-hour-jams-milton-keynes/.

253 Patel P., (2016, October 17) Pittsburgh's AI Traffic Signals Will Make Driving Less Boring. Retrieved from https://spectrum.ieee.org/cars-that-think/robotics/artificial-intelligence/pittsburgh-smart-traffic-signals-will-make-driving-less-boring.

254 Drax, (2017, September 20) How artificial intelligence will change energy. Retrieved from https://www.drax.com/technology/artificial-intelligence-will-change-energy/.

255 Drax, (2017, June 23) Why we need the whole country on the same frequency. Retrieved from https://www.drax.com/energy-policy/need-whole-country-frequency/.

256 (2017, September 20) Using AI, citizen science and disaster response to help victims of Hurricane Irma. Retrieved from https://phys.org/news/2017-09-ai-citizen-science-disaster-response.html.

257 Mehr, H. (2017, August) Artificial Intelligence for Citizen Services and Government. Retrieved from https://ash.harvard.edu/files/ash/files/artificial_intelligence_for_citizen_services.pdf.

Citizen Inquiries and Information: Robots may be used to replace workers that answer routine requests for information from the government.[258]Chatbots have been used in government office in the US state of North Carolina to generate auditory or textual computerized conversational systems to free up the help centre operators line.[259] New York City has also entered into a partnership with IBM's AI platform to speed up their customer-management system that may be used to address citizen queries.[260] The government of Singapore has also partnered with Microsoft to develop chatbots that may act as digital representatives of the government and accordingly engage with the public. [261]

Categorisation and arrangement of documents: AI may be also used to efficiently categorise and efficiently arrange a wide range of government documents, including government notifications, freedom of information requests, land records and court orders quickly, thereby freeing up human resources.[262]

Routing of Requests and assistance with filing documents: Artificial Intelligence could also be used to help citizens file petitions and route these petitions to the appropriate authority. This function has been developed in Mexico City to streamline bureaucratic hurdles.[263] A free chatbot legal app called DoNotPay has been used in the US and Canada to help asylum-seekers navigate through the vast realm of paperwork, assess whether they qualify for refugee status and ensure that the correct documentation has been addressed.[264]

Translation: Translation using AI has already been used by various businesses. For example, Unbabel crowdsources data and uses machine learning to translate texts into as many as 14 languages.[265] AI was also used to translate government information at the recent Pyeongchang Winter Olympics in South Korea.[266]

Comparison with and learnings for India

Apart from the agricultural sector, where the government in conjunction with the private sector has made some inroads, India is yet to use AI widely in the discharge of government functions. Use in other countries indicates that the application of AI in this sector could be critical in weeding out administrative malaise-something that India's governance machinery could benefit from.

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258 Ibid.

259 Goldsmith S., (2017), Artificial intelligence will help create a more responsive government. Retrieved from http://www.govtech.com/opinion/Artificial-Intelligence-Will-Help-Create-a-More-Responsive-Government.html.

260 IBM Cognitive Business, (2017, January 31) Watson helps cities help citizens. Retrieved from https://medium.com/cognitivebusiness/watson-assists-cities-with-311-3d7d6898d132.

261 (2016, July 12) Singapore to explore next-generation digital government services with Conversations as a Platform proof-of-concept. Retrieved from https://news.microsoft.com/en-sg/2016/07/12/singapore-to-explore-next-generation-digital-government-services-with-conversations-as-a-platform-proof-of-concept/.

262 Mehr, H. (2017, August) Artificial Intelligence for Citizen Services and Government. Retrieved from https://ash.harvard.edu/files/ash/files/artificial_intelligence_for_citizen_services.pdf.

263 Mehr H., (2017, August 21) AI: Coming to a government office near you. Retrieved from https://becominghuman.ai/ai-coming-to-a-government-office-near-you-1cbb8eae1d7e.

264 Mohan M., (2017, March 9) The 'robot lawyer' giving free legal advice to refugees. Retrieved from https://www.bbc.com/news/blogs-trending-39205935.

265 Castro D. and New J,, (2016, October) The Promise of Artificial Intelligence. Retrieved from http://www2.datainnovation.org/2016-promise-of-ai.pdf.

266 Kim Y., (2018, February 23) What it felt like to visit the most tech-centric Olympics ever. Retrieved from https://www.technologyreview.com/s/610181/what-it-felt-like-to-visit-the-most-tech-centric-olympics-ever/.

Judicial Decision Making

The Use Of Risk Assessment Tools

There has been academic research on the possibility of incorporating statistical risk assessment into the judicial decision-making process in US[267]. A variety of modern risk assessment tools utilise machine learning algorithms which create risk models utilising vast tracts of data. As time elapses, they adjust to new data that is gathered[268].Risk assessment tools are being used in a variety of contexts including prison rehabilitation programs, pretrial risk determination and most recently, in the sentencing process.[269] Broadly speaking risk assessment may be done at three stages[270]: (1) Purpose of determining rehabilitation measures given the unique background circumstances of the accused; (2) Pre-Trial Stage for determination of bail and (3) At the sentencing stage.

(1) Most rehabilitative **risks/needs assessment** (RNA) is the risk-needs-responsivity (RNR) model which is attempts to respond to recidivism through appropriate treatment. They are based on three fundamental principles[271]: (1) The risk principle which stipulates that risk is predictable and high risk offenders should get differential treatment from low risk offenders; (2) The needs principle which considers rehabilitative treatment as a response to criminogenic needs and (3) The responsivity principle which outlines how treatment should be tailored for the specific individual.

RNA instruments have been used in Canada and California, where algorithms are used to target dynamic risk factors to design the treatment and static risk factors are used to measure risk posed by each individual.[272]

The main tool for determination of the risk posed to decide on **pre-trial detention/release** is the Public Safety Assessment (PSA)which is used in 29 American jurisdictions and three entire states for the purpose of risk assessment. The mechanism makes a risk assessment based on risk factors and are used to determine whether an individual is high risk or low-risk.

The final and most widespread possible use for algorithms in judicial decision-making process is at the **sentencing stage**.[273]At this stage in the judicial process, most facts have already been established along with the relevant sentencing parameters. The opacity in the sentencing process lies in the fact that the relative weight assigned to each variable remains unknown, which adds an instinctive element to the judges' reasoning,that may be influenced by subconscious bias.[274] Use of algorithms could aid the sentencing process in two ways. [275]First, it could be used to analyse and filter the vast tracts of data on existing sentencing jurisprudence to evaluate and identify trends in the criteria used by judges to discharge sentences. In doing so, the algorithm could then be used to hand out sentences without compromising on human reasoning. Second, it could be used to analyse data on the accused and factor in the likelihood that the individual concerned would re-offend This data-driven

267 ANN, I. L., & ANN, S. Selective Incapacitation: Reducing Crime Through Predictions of Recidivism.

268 Kehl, D. L., & Kessler, S. A. (2017). Algorithms in the Criminal Justice System: Assessing the Use of Risk Assessments in Sentencing.

269 Ibid.

270 Ibid.

271 James, N. (2015). Risk and needs assessment in the criminal justice system.

272 James, N. (2015). Risk and needs assessment in the criminal justice system.

273 Stobbs, N., Bagaric, M., & Hunter, D. (2017). Can sentencing be enhanced by the use of artificial intelligence?. Criminal Law Journal, 41(5), 261-277.

274 Ibid.

275 Ibid.

approach to decision-making could remove the influence of subconscious human bias which may creep into the sentencing process..Arguably, the use of algorithms would not alter the existing sentencing rules or procedure but merely make the existing framework more efficient.

Currently, courts and correctional facilities in the United States[276] are focusing on the second function by using AI as a 'risk assessment tool' which evaluates the likelihood that the defendant would re-offend, or appear for the next court date which influences decisions on length of sentencing, bail and parole. One of the earliest and most widely used risk-assessment tools for the purposes of sentencing is the Level of Service Inventory – Revised (LSI-R).[277] LSI-R, developed by the Canadian company Multi-Health Systems, extracts information from a wide range of both static and dynamic factors, which include criminal history to personality patterns and are used to determine a person's risk of recidivism.[278] Another widely used tool named COMPAS looks at five main static and dynamic variables under five main fields namely: criminal involvement, relationships/lifestyles, personality/attitudes, family, and social exclusion.[279]COMPAS can be used for purposes beyond sentencing but is being used now in a number of states including Florida, Wisconsin and Michigan for sentencing determinations.[280]

There has been no indication that AI may be used for judicial decision-making in India in any form.

Defense

Intelligence, Reconnaissance and Surveillance (ISR) and Detection: In addition to combat functions, Artificial Intelligence can be used for the purpose of conducting surveillance and detecting imminent threats or predicting future threats.[281] This may take two forms. First,unmanned vehicles could be used to replace human patrols harsh terrains or during severe weather conditions. For example, the U.S. army has used the PackBot to defuse roadside bombs, thus reducing the troop casualty figure.[282] The second feature is the analysis of big data for the purpose of detecting threats.[283] The US Department of Defense has developed Project Maven which uses AI technologies using deep learning networks to algorithmically analyse video footage collected from altitudinal platforms.[284] Before AI was

276 Barnoski, R. P. (2006). Sex Offender Sentencing in Washington State: Predicting Recidivism Based on Demographics and Criminal History. Washington State Institute for Public Policy.

277 Ibid.

278 Ibid.

279 Northpointe (Mar. 19, 2015). Practitioner's Guide to COMPAS Core. Retrieved from https://assets.documentcloud.org/documents/2840784/Practitioner-s-Guide-to-COMPAS-Core.pdf.

280 Kehl, D. L., & Kessler, S. A. (2017). Algorithms in the Criminal Justice System: Assessing the Use of Risk Assessments in Sentencing.

281 Reddy R.S., (2018, March 5) How AI can help the Indian Armed Forces. Retrieved from https://www.livemint.com/Opinion/EzKziDVFvruJ0KLJF7ySQM/How-AI-can-help-the-Indian-Armed-Forces.html.

282 Melendez S., (2017, June 12) The Rise Of The Robots: What The Future Holds For The World's Armies. Retrieved from https://www.fastcompany.com/3069048/where-are-military-robots-headed.

283 Allen C.G., (2017, December 12) Project Maven brings AI to the fight against ISIS. Retrieved from https://thebulletin.org/project-maven-brings-ai-fight-against-isis11374.

284 This project was being developed in partnership with Google, which sparked headlines when they chose to not renew the contract after employees wrote a letter in April to Sundar Pichai raising ethical concerns with the project. However, the Defense Department will continue the project and devote $7.4 billion on AI, Big Data and the cloud in fiscal 2017. See Seligman L., (2018, June 29) Pentagon's AI Surge On Track, Despite Google Protest. Retrieved from https://foreignpolicy.com/2018/06/29/google-protest-wont-stop-pentagons-a-i-revolution/.

incorporated into the working of the platform, a large number of analysts had to work round the clock to analyse only a fraction of the sensor data.[285]

Cyber Defense: The volume and velocity of data that needs to be processed in defending cyberspace cannot be handled by human being without aid from automation.[286] Artificial Intelligence can be used to identify and predict threat patterns. For example, AI-Squared is a collaboration between the Computer Science and AI Laboratory (CSAIL) at the Massachusetts Institute of Technology and a machine learning startup called PatternEx which uses a recurrent neural network to identify cyber attacks.[287]

'Intelligent' Weapon Systems: With rising security threats in the global commons, there has been a vigorous worldwide interest in 'intelligent weapons systems'[288] that can operate with an increased surrendering of human control.China has developed armies of miniature drones that can operate as a team and engage in precision targeting. [289] The US has developed an autonomous submarine called 'Sea Hunter'[290] capable of operating at sea for months. Both US and China have developed Long Range Anti-Ship Missile, which is 'intelligent' enough to bypass the engagement range of ships that are not on the target lists[291] although they cannot yet select its target in flight but are constantly fed data by a stream of human operators.[292]

Defense logistics: AI may be used to help manage the defense supply chain. Real time dashboards can track the locations of tanks and munitions. Further, AI can handle day-to day logistics which will enable humans to perform higher value tasks. AI could potentially be used to coordinate multilateral military engagements.

Comparison with and learnings for India: As noted before, India is enthusiastic about the prospects of AI in defense and has occupied a key role in the strategic debate around autonomous weapons system. However, unlike western countries and other Asian powers like China, the Indian Army is yet to deploy technology that significantly improves the capacity of the army. However, much like the west, it is fast entering into partnerships with private sector developers in an attempt to incorporate AI as an integral tool into the functioning of the army.

Recommendations

This section endeavours to frame a set of high level recommendations that policy-makers in India should consider when developing and implementing India's strategy for use of AI in governance. Each of the recommendations require further empirical, theoretical and methods driven research in order to cement a robust and workable AI strategy going forward.

285 Ibid.

286 Tyugu, E. (2011, June). Artificial intelligence in cyber defense. In Cyber Conflict (ICCC), 2011 3rd International Conference on (pp. 1-11). IEEE.

287 Jones E., (2016, September 9) The Rise of Artificial Intelligence in Cyber Defense. Retrieved from https://www.entrepreneur.com/article/281040.

288 Singh A., (2016, September 22) Is China really building missiles with artificial intelligence?. Retrieved from https://www.orfonline.org/research/china-artificial-intelligence/.

289 Bhatia R., (2018, March 27) If The Future Of Warfare Is With Automated Weapons – Where Does India Stand In The Race?. Retrieved from https://analyticsindiamag.com/if-the-future-of-warfare-is-with-automated-weapons-where-does-india-stand-in-the-race/.

290 Austin M., (2018, February 3) 'Sea Hunter,' a drone ship with no crew, just joined the U.S. Navy fleet. Retrieved from https://www.digitaltrends.com/cool-tech/darpa-sea-hunter-joins-navy-fleet/.

291 Ibid.

292 Leopold G., (2017, February 9) Artificial Intelligence giving weapons greater autonomy. Retrieved from https://defensesystems.com/articles/2017/02/09/chinait.aspx.

Designing ethics, due process, fairness and transparency through a rules-based system applied contextually

- **Fairness and Bias in Governance**

Making AI fair, accountable and transparent is one of the most crucial areas in AI research.[293] While there can be no bright-line rules that will necessarily enable the operator or designer of a Machine Learning System to arrive at an ex ante determination of fairness, from a public policy perspective, there must be a set of contextualized rules or best practices that explain how notions of fairness should be utilised in the real world applications of AI-driven solutions.[294] While broad parameters should be encoded by the developer to ensure compliance with constitutional standards, it is also crucial that the functioning of the algorithm allows for an ex-post determination of fairness by an independent oversight body if the impact of the AI driven solution is challenged.

Further, while there is no precedent on this anywhere in the world, India could consider establishing a Committee entrusted with the specific task of continuously evaluating the operation of the development and use of AI-driven algorithms and solutions in the public sector. Such a committee could also be responsible for researching future technological trends. Questions that the government would need to answer with regard to this body include:

- What should the composition of the body be?
- What should be the procedural mechanisms that govern the operation of the body?
- When should the review committee step in? This is crucial because excessive review may re-entrench the bureaucracy that the AI driven solution was looking to eliminate.
- What information will be necessary for the review committee to carry out its determination? Will there be conflicts with IP, and if so how will these be resolved?
- To what degree will the findings of the committee be made public?
- What powers will the committee have? Beyond making determinations, how will these be enforced?

- **Transparency**

Transparency is a crucial requirement of natural justice.[295] Transparency should be incorporated not only into the design of the algorithm itself but also into the social situations that surround it. Algorithms should be devised and evaluated consistently within and across sectors to ensure that a common understanding of transparency permeates throughout.

Oswald et al have suggested two proposals that might combat algorithmic opacity through the design of a rules based system that can apply in a context-specific manner.[296]

Experimental proportionality was a proposal designed to enable the courts to make

293 Sample I., (2017, November 5) Computer says no: why making AIs fair, accountable and transparent is crucial. Retrieved from https://www.theguardian.com/science/2017/nov/05/computer-says-no-why-making-ais-fair-accountable-and-transparent-is-crucial

294 Kroll, J. A., Barocas, S., Felten, E. W., Reidenberg, J. R., Robinson, D. G., & Yu, H. (2016). Accountable algorithms. U. Pa. L. Rev., 165, 633.

295 Carothers, T., & Brechenmacher, S. (2014). Accountability, Transparency, Participation, and Inclusion: A New Development Consensus?. Carnegie Endowment for International Peace.

296 Oswald, M., Grace, J., Urwin, S., & Barnes, G. C. (2018). Algorithmic risk assessment policing models: lessons from the Durham HART model and 'Experimental' proportionality. Information & Communications Technology Law, 27(2), 223-250.

proportionality determinations of an algorithm at the experimental stage even before the impacts are fully realised. In such cases they recommend that the courts give the benefit of the doubt to the public sector body subject to another hearing within a stipulated period of time once data on the impacts of the algorithm become more readily available. However, even at the experimental stage, the public sector body must be able to showcase a baseline connection with a legitimate aim and a theoretical connection of the outcomes to the means being deployed. Therefore, at the experimental stage, proportionality would be looked at as a theoretical device subject to the collection of more data on real-life impact, which would enable the courts to adopt an empirical approach to proportionality determination.

The second framework dubbed by acronym 'ALGO-CARE' calls for the design of a rules-based system which ensures that the algorithms[297] are:

(1) Advisory: Algorithms must not replace human discretion;

(2) Lawful: Algorithm's proposed function, application, individual effect and use of datasets should be considered in conjunction with necessity, proportionality and data minimisation principles;

(3) Granularity: Consideration should be given to data analysis issues such as meaning of data, challenges stemming from disparate tracts of data, omitted data and inferences;

(4) Ownership: Due regard should be given to intellectual property ownership but in the case of algorithms used for governance, it may be better to have open source algorithms at the default. At any rate, the developer must ensure that the algorithm works in a manner that enables a third party to investigate the workings of the algorithm in an adversarial judicial context.

(5) Challengeable: The results of algorithmic analysis should be applied with regard to professional codes and regulations and be challengeable. In a report evaluating the NITI AAYOG Discussion Paper, CIS has argued that AI that is used for governance, must be made auditable in the public domain, if not under Free and Open Source Software (FOSS)- particularly in the case of AI that has implications for fundamental rights.[298]

(6) Accuracy: The design of the algorithm should check for accuracy;

(7) Responsible: Should consider a wider set of ethical and moral principles and the foundations of human rights as a guarantor of human dignity at all levels and

(8) Explainable: Machine Learning should be interpretable and accountable.

A rules based system like ALGO-CARE can enable predictability in use frameworks for AI. Predictability compliments and strengthens transparency.

Algorithmic Impact Assessment

There is an obligation on the government to develop guidelines and procedures for the assessment of the impact of each AI-driven solution.

A 2018 Report by the AI Now Institute lists methods that should be adopted by the government for conducting his holistic assessment[299]: These should include: (1) Self-assessment by the government department in charge of implementing the technology, (2)

297 Ibid.

298 Abraham S., Hickok E., Sinha A., Barooah S., Mohandas S., Bidare P. M., Dasgupta S., Ramachandran V., and Kumar S., NITI Aayog Discussion Paper: An aspirational step towards India's AI policy. Retrieved from https://cis-india.org/internet-governance/files/niti-aayog-discussion-paper.

299 Reisman D., Schultz J., Crawford K., Whittaker M., (2018, April) Algorithmic Impact Assessments: A Practical Framework For Public Agency Accountability. Retrieved from https://ainowinstitute.org/aiareport2018.pdf.

Development of meaningful inter-disciplinary external researcher review mechanisms, (3) Notice to the public regarding self-assessment and external review, (4)Soliciting of public comments for clarification or concerns, (5) Special regard to vulnerable communities who may not be able to exercise their voice in public proceedings. An adequate review mechanism which holistically evaluates the impact of AI would ideally include all five of these components in conjunction with each other.

Using constitutional principles to assess the use of AI in governance

As the government is discharging a 'public function' whenever AI is used in governance, policy-makers need to ensure that all use-cases in the government sector are compliant with fundamental rights enshrined in Part III of the constitution. In particular, it may be useful to consider the legal principles evolved when analyzing these corpus of rights. This analysis will be particularly useful as it would mean tat we are looking to the existing edifice of the Indian constitutional and legal standards, rather than attempting to import principles that may have been evolved elsewhere:

Fair, just and reasonable AI: The majority on the seven-judge bench of Maneka Gandhi v UOI[300] stated that any procedure established by law under Article 21 (right to life and personal liberty) would have to be "fair, just and reasonable" and could not be "fanciful, oppressive or arbitrary". Any impact of Artificial Intelligence must also be held to the same standard.

Classification Test compliant AI: Whenever a government functioning using AI is classifying groups into clusters or categories, the classification should be based on (1) An intelligible differential which distinguishes persons or things that are grouped together from those left outside the group and (2) The differential must have a rationale nexus to the object sought to be attained by the action.[301]

Reasonably Restrictive AI: Multiple tests have been evolved by the Supreme Court in its interpretation of 'reasonableness' under Article 19(2) These standards include proximiy, arbitrariness and proportionality.[302]

The first test is that of **proximity**. The court emphasized that for a restriction to be reasonable it must have a relation to the object with which the measure was imposed and not go beyond it.[303] When AI is used in governance, if it does have adverse impacts on free speech, it must be ensured that the use of AI remains within the boundaries for the object with which the technology and the consequent restriction was deployed. The second test-**proportionality** looks a little beyond proximity and tests whether a legal restriction is excessive in nature.[304] The doctrine of arbitrariness has also found favour with the recent decisions of the Supreme Court with Justice Nariman embarking on a detailed articulation of judicial precedent where he clarified that **arbitrariness** essentially meant disproportionality.[305] Any use of AI in governance, which restricts the guarantee of a fundamental right in a manner that is disproportionate to the object sought with the specific use-case.

300 1978 AIR 597

301 Cases cited in Basu, DD (2011), Shorter Constitution of India, Lexis Nexis Butterworths Wadhwa

302 Choudhry S., Khosla M., Bhanu Mehta P. (2016), The Oxford Handbook of the Indian Constitution, Oxford University Press

303 1966 AIR 740

304 Choudhry S., Khosla M., Bhanu Mehta P. (2016), The Oxford Handbook of the Indian Constitution, Oxford University Press

305 C Bhatia G (2017),With triple talaq order, Supreme Court revives 'arbitrariness' as grounds to challenge unequal laws, Retrieved from https://scroll.in/article/849670/with-triple-talaq-order-supreme-court-revives-arbitrariness-as-grounds-to-challenge-unequal-laws

Delegating appropriate amounts of discretion to autonomous systems

As the government begins to adopt AI into governance - the extent to which and the circumstances in which AI should take autonomous decisions needs to be determined. Questions on whether AI should be autonomous, should always have a human in the loop, and should have a 'kill-switch' when used in such contexts also need to be answered. A framework or high level principles can help to guide these determinations. For example:

- **Modeling Human Behaviour**: An AI solution trying to model human behaviour, as in the case of judicial decision-making or predictive policing may need to be more regulated, adhere to stricter standards, and need more oversight than an algorithm that is trying to predict 'non-human' phenomenon such as traffic congestion or weather patterns.
- **Human Impact**: an AI solution which could cause greater harm if applied erroneously- such as a robot soldier that mistakenly targets a civilian requires a different level and framework of regulation than an AI solution designed to create a learning path for a student in the education sector and errs in making an appropriate assessment. Furthermore, situations where human impact is involved can take more complex strategic decision making that an AI may not necessarily be able to carry out. For example, in a war scenario, though all indicators may point to 'pushing the red button' a human may not take this decision.
- **Public Interest**: AI solutions whose primary users are state agents attempting to discharge duties in the public interest such as policemen, should be approached with more caution than those used by individuals such as farmers getting weather alerts.

The extent of delegation could be guided by the three criteria listed above. For example, in the case of predictive policing and autonomous weapons systems, there should always be human discretion continuously monitoring and evaluating the actions taken by the software and taking the final decision. In the case of weather updates for farmers or other actions that do not attempt to regulate or predict human behaviour, a greater portion of the task can be delegated to autonomous systems.

Development of Processes of Explanation

The government needs to develop appropriate and contextualized processes of explanation when decision making is being augmented or carried out by AI.

An explanation is not equivalent to complete transparency. The obligation of providing an explanation does not mandate that the developer should know the flow of bits through the AI system. Instead, the legal requirement of providing an explanation requires an ability to explain how certain factors may be utilised to arrive at an outcome in a certain situation. Doshi-Velez and Kortz have highlighted two technical ideas that may enhance a developer's ability to explain the functioning of AI systems.[306]AI systems are designed to have the inputs differentiated and processed through various forms of computation-in a reproducible and robust manner. Therefore, developers can explain a particular decision by examining the inputs in an attempt to determine which of them have the greatest impact on the outcome. The second property of counterfactual faithfulness enables the developer to consider which factors caused a difference in the outcomes. Both these solutions can be deployed without necessarily knowing the contents of black boxes. As per Pasquale, 'Explainability matters because the process of reason-giving is intrinsic to juridical determinations – not simply one

306 Doshi-Velez, F., Kortz, M., Budish, R., Bavitz, C., Gershman, S., O'Brien, D., ... & Wood, A. (2017). Accountability of AI under the law: The role of explanation. arXiv preprint arXiv:1711.01134.

modular characteristic jettisoned as anachronistic once automated prediction is sufficiently advanced."[307]

Articles 13–15 of the General Data Protection in the EU provide rights to 'meaningful information about the logic involved' in automated decisions.[308] While there has been some debate on whether this grants data subjects, a 'right to explanation,' the terminology is less important than the substance of the right. The role of explanation of decisions taken by automated systems lies in ensuring that the subject has the ability to challenge potential constitutional violations and the developer has the ability to live up to prevailing standards on accountability in administrative law and not use the 'black box' as a shield from engaging with problematic impacts of the technology.

Use AI systems to augment capabilities

As capacity is built amongst stakeholders and AI solutions implemented, it is important that government officials are trained to use the solutions in an augmenting capacity to supplement their own decisions and judgement.

This is particularly true in law enforcement, education, service delivery, defense, and judicial systems where the decision taken by the AI will directly impact an individual(s) and potentially inform human to human interaction. Instead, the technology should be used in avenues where overburdening of human resources are preventing quality human to human interaction so as not to reduce the scale and effects of the interaction but to supplement and enhance it.

Establish a framework for working with the private sector

Primary accountability for any use of AI sanctioned by the State should lie with the government itself. There must be a cohesive and uniform framework that regulates the partnerships which the government enters into with the private sector.

As mentioned previously, constitutional standards demand that the government be held responsible for the adverse impacts of a technological solution whenever it has sanctioned the use of Artificial intelligence in any field. However, given that most projects will likely be developed in conjunction with the private sector, a regime that imposes obligations on the private sector needs to be established to ensure consistency, quality, and the integration of core principles of due process. Towards this, there must be:

- Uniformity in the wording and nature of contracts that the government signs for the development of AI driven solutions within each sub-sector. This would make it easier to develop a uniform code of standards for private sector developers.
- The contracts must impose on the developer basic transparency and accountability obligations and ensure that the solutions they develop are in conjunction with constitutional standards.
- Private sector developers must be willing to be continuously evaluated by expert committees to ensure that they are complying with their obligations.

307 Frank A. Pasquale 'Toward a Fourth Law of Robotics: Preserving Attribution, Responsibility, and Explainability in an Algorithmic Society' (July 14, 2017). Ohio State Law Journal, Vol. 78, 2017; U of Maryland Legal Studies Research Paper No. 2017-21, 7.

308 Andrew D Selbst, Julia Powles; Meaningful information and the right to explanation, International Data Privacy Law, Volume 7, Issue 4, 1 November 2017, Pages 233–24.

Developing effective standards for data curation

In order to ensure that the training data being used by the algorithm is holistic, the prevailing data curation practices need to ensure that it adequately represents the heterogenous socio-economic realities in India.[309]

Therefore, the databases being maintained by the government need to more effectively curate data by adopting a symbiosis of the following methods[310]:

Development of uniform conceptual model standards

Standards based data representation that applies to the curation of all databases would reduce syntactic heterogeneity, which would improve interoperability and enable more efficient processing of data coming in from different sources. The NITI AAYOG Report on the implementation of Artificial Intelligence in India suggests the adoption of a decentralised data marketplace based on blockchain technology that would guarantee both privacy and security through the four tenets of traceability,access controls, compliance with local and international regulations and compliance with price delivery mechanisms in India.[311]

Improved theoretical models and methodologies

Theoretical models driven by statisticians enable the evaluation of data under different contexts, thus facilitating the detection of potential issues with data quality.

Improving data level trust and 'last mile' data curation infrastructure

It is essential that the algorithm developer trusts the data curation efforts that have resulted in the databases. Further, the data curator processing the training data into source code must equally trust data coming in from all sources and geographic areas. Therefore, there needs to be an improvement in the quality of 'last-mile' data inputs i.e. the individuals responsible at the grassroots level need to be trained in operational standards and quantitative collection methodologies.

Crowdsourcing data from a variety of sources to ensure inclusion and the representative nature of the dataset

Though inclusive and representative data sets are important across industries, as the public sector is responsible to society at large, the government has a heightened obligation to ensure that the data sets it adopts for the use of AI in governance are holistic. If individuals at the last mile are reskilled and adequate models are developed, then the next step would be to ensure that all individuals likely to be impacted by algorithmic governance are represented in the data set. Adequate implementation models that enable representative collection and subsequent curation of data, including the hitherto 'disregarded' or 'unconnected' is something the government should consider. [312]This is particularly important as the government

309 Abraham S., Hickok E., Sinha A., Barooah S., Mohandas S., Bidare P. M., Dasgupta S., Ramachandran V., and Kumar S., NITI Aayog Discussion Paper: An aspirational step towards India's AI policy. Retrieved from https://cis-india.org/internet-governance/files/niti-aayog-discussion-paper.

310 Freitas, A., & Curry, E. (2016). Big data curation. In New Horizons for a Data-Driven Economy (pp. 87-118). Springer, Cham.

311 Discussion Paper on National Strategy for Artificial Intelligence | NITI Aayog | National Institution for Transforming India. (n.d.) p. 79. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

312 Stewart, R. B. (2014). Remedying Disregard in Global Regulatory Governance: Accountability, Participation, and Responsiveness+. American Journal of International Law, 108(2), 211-270.

envisions digital infrastructure like Aadhaar as being key in enabling the comprehensive data sets needed to fuel AI in India.[313]

Developing an enabling framework for use of AI driven solutions

Digital Infrastructure

Building a robust national Artificial Intelligence driven framework requires establishing adequate indigenous infrastructural capacity for data storage and processing.[314] This is particularly true for AI solutions used in governance as they will be handling the data of citizens and sensitive information related to the functioning of the Indian government.

AI Data Storage

India needs to develop capacity to scale data storage as the volume of data being processed increases. This includes ensuring effective storage capacity, IOPS (Input/Output per second)[315] and ability to process massive amounts of data.

AI Networking Infrastructure

In order to provide the high levels of efficiencies of scale needed to support AI, organizations working with the government and the government itself will need to upgrade their networks.[316] Scalability must be undertaken on a high priority which will require a high-bandwidth, low latency and creative architecture, which again needs funding for the purpose of reskilling.[317]

Improved access to and awareness of ICT's

The government, in conjunction with private sector entities that are working towards launching Artificial Intelligence across sectors must first seek to ensure that all stakeholders have access to and are able to use ICT devices.

The development of smart content or Intelligent Tutoring Systems in the education can only be done on a large scale if both the teacher and the student has access to and feel comfortable with using basic ICT tools. A U.K. government report has suggested that any skilled workforce using AI should be a mix of those with a basic understanding responsible for implementation at the grassroots level , more informed users and specialists with advanced development and implementation skills.[318] The same logic applies to the agriculture sector, where the government is looking to develop smart weather-pattern tracking applications. A potential short-term solution may lie in ensuring that key actors have access to an IoT device so that he/she may access digital and then impart the benefits of access to proximate individuals. In the education sector, this would involve ensuring that all

313 "Qualifying Aadhaar/Big Data as an enabler for AI the Task Force in its report states that Aadhaar can "Come up with Indian data formats for all the sectors/sub-sectors for Al applications, by drawing upon the available relevant International standards." Task Force on Artificial Intelligence. (2018). Report of Task Force on Artificial Intelligence. Retrieved from http://dipp.nic.in/whats-new/report-task-force-artificial-intelligence. 37

314 Ibid

315 IOPS is the standard unit of measurement for the maximum number of reads and writes to non-contiguous storage locations. Retrieved from https://searchstorage.techtarget.com/definition/IOPS-input-output-operations-per-second.

316 Violino B, (April 2018)" Designing and building artificial intelligence infrastructure" (Search Enterprise AI), retreived from https://searchenterpriseai.techtarget.com/feature/Designing-and-building-artificial-intelligence-infrastructure.

317 Ibid.

318 Points, L., & Potton, E. (2017). Artificial intelligence and automation in the UK.

teachers have access to and are competent in using an IoT device. In the agricultural sector, this may involve equipping each village with a set of IoT devices so that the information can be shared among concerned individuals.

Re-skilling using AI with a focus on communities under-represented in the technology sector

Widespread use of AI will undoubtedly require re-skilling various stakeholders to make them aware of the technology and processes involved in the use of AI. Artificial Intelligence can be used as a resource in the re-skilling process itself-as it would be used in the education sector to gauge people's level of comfort with the technology. Further, there should be a focus on communities that are under-represented in the tech sector-such as women and sexual minorities-to ensure that the algorithms themselves and the community working on AI driven solutions are holistic and cohesive.

Using Artificial Intelligence To Further India's Strategic Agenda

Leading the evolution of AI-driven solutions in emerging economies

While India should use the emergence of Artificial Intelligence in the economy as a means of spearheading the global debate on AI and attempt to drive itself to a leadership position among emerging economies, it should be cautious about using Indian territory as a 'garage' for potentially harmful solutions.

The NITI AAYOG Report mentions that India should leverage AI as a 'garage' for emerging economies.[319] While there are certain positive connotations of this suggestion in so far as India seeks to occupy a leadership position on these issues regionally and along with other emerging economies shape the global rights based discourse to seek equitable solutions for the application of AI.

However, using India as a 'garage' could simultaneously imply that Indian citizens are used as guinea pigs for solutions that could violate human rights. This should be safeguarded against. Enacting a privacy legislation and having adequate frameworks for discrimination and bias are important steps to towards this. Other guiding principles could be developed such as requiring that projects have clear benefits for India. This could prevent against companies coming into India to develop or test a solution and then exiting. As noted earlier, it will also be important to ensure that the processing of the AI driven solution happens in India itself so that the developer remains accountable to the government and the relevant constitutional constraints.

Re-negotiating India's trade commitments to bolster the development of an indigenous AI industry

India should negotiate it's trade commitments at the WTO in a manner than enables its nascent AI industry to grow without being branded as being excessively 'protectionist'

Corporations located in the West are attempting to rewrite the rules of a digital economy in a bid to stymie public interest through means including lobbying for 'e-commerce' rules at the WTO in order to maintain their privileged position in the market.[320] India should look to robustly negotiate these rules in a manner that enables them to develop an indigenous AI industry that caters to the needs of and remains accountable to the people who these solutions impact most gravely.

319 NITI Aayog. (2018). Discussion Paper on National Strategy for Artificial Intelligence. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper. 18

320 James D (2017, 11) Nov "E-commerce and the World Trade Organization" Retrieved from https://www.alainet.org/en/articulo/189305.

India should position itself strategically in the global security discourse on Artificial Intelligence and cement a role as a crucial actor in the emerging international norms formulation space on the weaponization of AI.

India has chaired the United Nations Group of Governmental Experts on Lethal Autonomous Weapons Systems. (LAWS)[321] Amidst polar opposition among governments and advocacy groups, India has maintained its leadership position in the debate without cementing themselves firmly either with the states that call for a pre-emptive ban or for the states that strongly oppose such a ban. Continuing this neutral approach and closely observing developments in the technology both internationally and domestically would enable India to retain its strategic vantage point and be a key driver in the international norms formulation space on LAWS[322]

Development of adequate redressal mechanisms

The legal regime on the use of AI that fosters accountability and enables redressal mechanisms must be accessible to all stakeholders.

As seen with case studies involving predictive policing and judicial decision-making using AI in the United States, often the groups impacted would be those 'disregarded' by existing administrative and judicial mechanisms. Therefore, challenges to algorithmic governance can only be treated fairly by existing judicial mechanisms if judges develop a working knowledge of how the technology functions and also consults experts to augment their understanding. In addition to the court-based system, alternative dispute resolution mechanisms are an imperative in this field due to the vast backlog of cases in india. By the time the court arrives at a decision, the technology may have evolved in a manner that causes harm not envisaged in the judgement.

Interdisciplinary approach to the study of AI

As seen with the development of AI in the west, mere technological progress without an evaluation of the economic, demographic, political, legal and anthropological impacts of this technology would lead to outcomes that are not in compliance with constitutional standards of fairness and due process.

Therefore,as suggested by the NITI AAYOG Report, the government needs to set up 'centres of excellence'. Building upon the stakeholders identified in the NITI AAYOG Report, the centers of excellence should involve a wide range of experts including lawyers, political philosophers, software developers, sociologists and gender studies from diverse organizations including government, civil society,the private sector and research institutions to ensure the fair and efficient roll out of the technology.[323] An example is the Leverhulme Centre for the Future of Intelligence set up by the Leverhulme Foundation at the University of Cambridge[324] and the AI Now Institute at New York University (NYU)[325] These research centres bring together a wide range of experts from all over the globe.

321 Mohanty B., (2017, November 24) Amidst Calls for a Ban, India Leads the Debate on Lethal Autonomous Weapons. Retrieved from https://thewire.in/external-affairs/amidst-calls-ban-india-leads-debate-lethal-autonomous-weapons.

322 On the geo-politics of Artificial Intelligence see Rosso C., (2018, May 4) The Geopolitics of AI. https://www.psychologytoday.com/us/blog/the-future-brain/201805/the-geopolitics-ai; Meserole C., (2018, July 1) Wars of None: AI, Big Data, and the Future of Insurgency.

323 Discussion Paper on National Strategy for Artificial Intelligence | NITI Aayog | National Institution for Transforming India. (n.d.) p. 54. Retrieved from http://niti.gov.in/content/national-strategy-ai-discussion-paper.

324 Leverhulme Centre for the Future of Intelligence, http://lcfi.ac.uk/.

325 AI Now, https://ainowinstitute.org/.

Ensure benefits of technology reaches the lowest common denominator, achieves SDGs, other international obligations, and guarantees socio-economic rights

Prevailing domestic and international human right standards place an obligation on the state to do everything within their capacity to ensure that basic human rights are guaranteed to all its citizens.[326] AI could also enable developing countries like india to accomplish their Sustainable Development Goals (SDGs) and other international commitments in the field of environmental law.[327]

Therefore, if Artificial intelligence is being developed for the purpose of governance, the government must ensure that the benefits of the technology trickle down to all levels of society. Funding of AI projects must therefore not be inordinately diverted solely to the policing or defense sector that arguably protect national security at a macro-level but also address core individual and socio-economic rights in sectors such as education, service delivery, agriculture and health care. Furthermore, given that the use of AI for the guaranteeing of socio-economic rights has potentially fewer irreversible ethical and legal concerns, it may be prudent for the government to consider funding the development of technology in these sectors before it moves on to sectors such as predictive policing and defense.

Conclusion

This report sought to highlight key uses of Artificial Intelligence under the broad sector of governance. The research concluded that despite enthusiasm from the government, both in the form of public statements and key reports such as the recently published report of the AI Task Force and NITI Aayog, the technology is not yet developed enough to be utilised on a large scale. This affords policy-makers the unique opportunity to take a step back and evaluate the impact of similar AI-driven solutions that have been implemented in the west and leapfrog the various capacity-driven challenges and ethical concerns within each sub-sector. It also calls for a pre-emptive evaluation and prevention of the development of technology that may harm individuals through a violation of basic constitutional tenets.

We argued therefore, that regulatory approaches to AI must not be undertaken in a 'one-size-fits-all' manner. Instead, all options on a regulatory spectrum must be considered. Learnings from developments in the West indicate that technology that attempt to replace human discretion such as autonomous weapon systems or 'robo-cops' or predict human behaviour such as predictive policing algorithms or risk-assessment softwares must be looked at with great caution. However, descriptive technology that seeks to determine weather patterns or aid defense logistics should be encouraged with the caveat that the technology developed reaches the lowest common denominator and helps alleviate socio-economic distress.

This remains a challenge given that development capacity rests mainly with the private sector, which will attempt to key in on lucrative projects that would give them commercial returns. The involvement of the private sector also poses challenges for algorithmic impact assessment, which means that the government must develop a liability regime that holds these developers to account.

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326 De Schutter, O., Ramasastry, A., Taylor, M. B., & Thompson, R. C. (2012). Human Rights Due Diligence: The Role of States. Human Rights in Business. http://humanrightsinbusiness. eu/wp-content/uploads/2015/05/De-Schutter-et-al.-Human-Rights-Due-Diligence-The-Role-of-States. pdf.

327 AI For Global Good — Accelerating The Sdgs. Retrieved from https://ai.xprize.org/AI-For-Good/sustainable-development-goals.

Broadly speaking, the success of the utilisation of AI in governance depends largely on the attitude and motivation of the government. The technology could be weaponized to tilt the balance of power between the citizens and the state in favour of the state in a bid to erode fundamental civil liberties such as the Right to Privacy or the Freedom of Speech and Expression or be harnessed as a tool that corrects entrenched systemic inequality and empowers the disregarded. The approach the government adopts is crucial for the future of AI in today's complex and ever-changing socio-economic state of affairs.

Annex 1 - Deep Dives into the Technology

Systems Theory

This section explores some of the theoretical underpinnings of the technology being used in the various sub-sectors. Policy-makers can use this theory to ensure cohesive implementation of AI-driven solutions.

Law Enforcement

There is some evidence to support the notion that crime may be predicted as criminals tend to operate in their comfort zone, which means that they would commit the same kinds of crimes they have committed successfully in the past at similar times and locations.[328] Block and Knight caution after empirical analysis in Is Crime Predictable? that the odds of success in predicting crime depends on the reliability and comprehensiveness of data available.[329] According to the RAND Corporation Report[330],criminals make 'rational' choices when committing crimes-weighing factors such as pay-offs, suitability of targets and location and the odds of getting caught. If predictive policing can enable policemen to patrol locations conducive for crime, then it could become a deterring factor in the criminal's calculus.[331]

As stated by Perry et al in the RAND Corporation report[332], the core of predictive policing lies in generating a prediction led-policing business process, which comprises of a flow of activities and data points. At each stage of this cycle decisions are made on matters such as (1) Nature of data to be collected, (2) Duration and frequency of the collection, (3)The type of analytical tools that may need to be used.[333] The RAND Corporation report also contains an illustration of the various kinds of predictive techniques that may be used for policing.[334]

The four stages in the predictive policing cycle are:

1. **Data collection**: This is the first stage of the process where a large amount of data on past crimes is collected. Data may be collected by considering factors such as records on crimes committed, their location, witness statements and profiles of accused. Additionally, data may also be collected by analysing social media traffic through algorithms to investigate the role an individual plays within a social network.[335]

328 For summaries of criminal behavior theories, see Lambert, R. D. (2017). Routine Activity and Rational Choice: Volume 5. Routledge.; Neill, D. B., & Gorr, W. L. (2007). Detecting and preventing emerging epidemics of crime. Advances in Disease Surveillance, 4(13).

329 Block, C. R., Knight, S. L., Gould, W. G., & Coldren, J. D. (1987). Is Crime Predictable?: A Test of Methodology for Forecasting Criminal Offenses. Illinois Criminal Justice Information Authority.

330 Perry, Walter L., Brian McInnis, Carter C. Price, Susan Smith and John S. Hollywood. Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. Santa Monica, CA: RAND Corporation, 2013. http://www.rand.org/pubs/research_reports/RR233. Also available in print form. at 3 (calling it a blended theory of crime prediction)

331 Ibid; Clark T. B., (2015, March 9) How Predictive Policing Is Using Algorithms to Deliver Crime-Reduction Results for Cities. Retrieved from http://www.govexec.com/state-local/2015/03/predictive-policing-santa-cruz-predpol/107013/.

332 Perry, Walter L., Brian McInnis, Carter C. Price, Susan Smith and John S. Hollywood. Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. Santa Monica, CA: RAND Corporation, 2013. http://www.rand.org/pubs/research_reports/RR233. Also available in print form.2

333 Bennett Moses, L., & Chan, J. (2016). Algorithmic prediction in policing: assumptions, evaluation, and accountability. Policing and Society, 1-17.

334 Perry, Walter L., Brian McInnis, Carter C. Price, Susan Smith and John S. Hollywood. Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. Santa Monica, CA: RAND Corporation, 2013. http://www.rand.org/pubs/research_reports/RR233. Also available in print form.18.

335 Sengupta, S. (2013). Privacy fears grow as cities increase surveillance. New York Times.

2. **Data analysis**: Software driven by an algorithm looks for trends and patterns in the available data on past crimes.The analysed data is then used by the algorithm to engage in decision-making, generating predictive maps on areas where crime could occur.

The RAND Corporation report mentions three kinds of algorithms that may be used.[336] **Regression algorithms** model relationships between variables and are iteratively refined using a measure of error.[337] This method would use more variables than just crime history. **Clustering algorithms** use an approach to data mining that seeks to cluster data into various groups.[338] The objective is to create clusters in a way that sets of data that are more similar to each other than sets outside the cluster.[339] An example of this is spatial clustering algorithms that use geospatial data on crime incidence to generate hot spots for future crime occurrence. [340] The final kind of algorithms are **classification algorithms** that attempt to create rules that assign a class or label to certain events.[341] They are generally supervised learning algorithms[342] that use training data sets to learn patterns that determine category or class of an outcome[343] A classification algorithm would attempt to predict, for example, that there is a 75% chance of a burglary in a certain region or classify regions into 'high-crime','medium-crime' or 'low-crime' . The classification algorithm is different from regression methods as they do not provide a continuing number (such as an average of 3.4 robberies over the next 2 weeks) but a category or probability.

A variety of predictive policing strategies have been used in various cities across the globe. [344] It has been most widely in the United States. Sacramento Police has begun to use hot spot analysis along with analysis of optimal patrol time in order to ensure they patrol high-risk areas efficiently enough to act as a deterrent.[345] The Safer Derbyshire Partnership has begun

336 Perry, Walter L., Brian McInnis, Carter C. Price, Susan Smith and John S. Hollywood. Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. Santa Monica, CA: RAND Corporation, 2013. http://www.rand.org/pubs/research_reports/RR233. Also available in print form. 35.

337 Brownlee J., (2013, November 25) A Tour of Machine Learning Algorithms. Retrieved from https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms/.

338 George R., (2015, November 24) Predictive Policing: What is it, How it works, and its Legal Implications. Retrieved from https://cis-india.org/internet-governance/blog/predictive-policing-what-is-it-how-it-works-and-it-legal-implications; Bachner, J. (2013). Predictive policing: Preventing crime with data and analytics. IBM Center for the Business of Government.

339 Perry, Walter L., Brian McInnis, Carter C. Price, Susan Smith and John S. Hollywood. Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. Santa Monica, CA: RAND Corporation, 2013. http://www.rand.org/pubs/research_reports/RR233. Also available in print form.38

340 Ibid; Kennedy, L. W., Caplan, J. M., & Piza, E. (2011). Risk clusters, hotspots, and spatial intelligence: risk terrain modeling as an algorithm for police resource allocation strategies. Journal of Quantitative Criminology, 27(3), 339-362.

341 Ibid.

342 Brownlee J., (2013, November 25) A Tour of Machine Learning Algorithms. Retrieved from https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms/; See Caruana, R., & Niculescu-Mizil, A. (2006, June). An empirical comparison of supervised learning algorithms. In Proceedings of the 23rd international conference on Machine learning (pp. 161-168). ACM.

343 Perry, Walter L., Brian McInnis, Carter C. Price, Susan Smith and John S. Hollywood. Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. Santa Monica, CA: RAND Corporation, 2013. http://www.rand.org/pubs/research_reports/RR233. Also available in print form.,at 39

344 George R., (2015, November 24) Predictive Policing: What is it, How it works, and its Legal Implications. Retrieved from https://cis-india.org/internet-governance/blog/predictive-policing-what-is-it-how-it-works-and-it-legal-implications.

345 Ouellette, Danielle. "Dispatch - A Hot Spots Experiment: Sacramento Police Department," June 2012. http://cops.usdoj.gov/html/dispatch/06-2012/hot-spots-and-sacramento-pd.asp.

to identity juvenile crime hotspots. They used the MapInfo software to create "multiple discrete data sets to create detailed maps and visualisations of criminal activity, including temporal and spatial hotspots."[346] Researchers working with Pittsburgh Bureau of Police have used regression models to analyse whether there were 'leading indicators' of violent crime in high risk areas.[347]Police in Morris County have used risk-terrain analysis to identify violent crimes and burglaries using five inputs:" past burglaries, addresses of individuals arrested for property crimes, proximity to major highways, geographic concentration of young men and the location of apartment complexes and hotels." [348] Apart from Los Angeles[349],The Santa Cruz Police Department has used the PredPol software by applying algorithmic modelling to databases containing five years worth of crime data.[350] Chicago Police have used data mining and spatio-temporal analysis to conduct surveillance using an algorithm-generated 'heat-list'[351]. In addition, analysts assessed the BPI through a comparison of predicted crime in the treatment areas to observed crime.

In an effort to target commercial robberies and maximize apprehension rates, Baltimore County Police Department launched a Business Patrol Initiative with grants from the Department of Justice.[352] Using an iterative algorithm[353] after plotting robberies on a map, analysts identified a Centre of Minimum Distance.[354] This is the point on the map which has the least distance from all other points on the map. Using the assumption that the CMD was where the offender originated on the map, analysts were able to calculate all possible routes emanating from each crime location and back.[355] Using this data they were able to generate a surface map which incorporated the apprehension locations of all previous robbers and contour lines which denoted the probabilities of apprehension.[356]

3. **Surveillance**: The data is then used to deploy police forces in areas mapped as being prone to crime by algorithms and enables them to make targeted interventions through increased situational awareness.[357]

4. **Criminal Response**: Short term assessments would include rapid analysis to ensure that

346 Pitney Bowes Business Insight. "The Safer Derbyshire Partnership." Derbyshire, 2013. Retrieved from http://www.mapinfo.com/wp-content/uploads/2013/05/safer-derbyshire-casestudy.pdf

347 Hvistendahl, M. (2016). Can 'predictive policing'prevent crime before it happens. Science Magazine, 28.

348 Goode, E. (2011). Sending the police before there's a crime. New York Times.

349 Berg, N. (2014). Predicting crime, lapd-style. The Guardian, 25.

350 City of Santacruz Newsletter, (2012). Predictive Policing. Retrieved from http://www.cityofsantacruz.com/government/city-departments/city-manager/community-relations/city-annual-report/march-2012-newsletter/predictive-policing.

351 Gorner, J. (2013). Chicago police use heat list as strategy to prevent violence. Chicago Tribune, 21, 2013.

352 Bachner, J. (2013). Predictive policing: Preventing crime with data and analytics. IBM Center for the Business of Government.

353 Ned Levine & Associates and the National Institute of Justice, CrimeStat III: A Spatial Statistics Program cited in Bachner, J. (2013). Predictive policing: Preventing crime with data and analytics. IBM Center for the Business of Government.

354 Ibid.

355 Ibid.

356 Ibid.

357 Perry, Walter L., Brian McInnis, Carter C. Price, Susan Smith and John S. Hollywood. Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. Santa Monica, CA: RAND Corporation, 2013. http://www.rand.org/pubs/research_reports/RR233. Also available in print form. at xviii.

interventions are working and there are no immediate problems with the targeting.[358]. The longer-term criminal response should be measured by devising a statistical method to collect and analyse the data to evaluate whether use of such mechanisms are actually leading to a reduction in crime rates.[359]

Artificial Intelligence in Education

The Indian education sector has made rapid progress in recent decades by greatly increasing access to schooling. Primary school enrollment in India rose as high as 96% in 2009 and girls made up 56% of the school-going population between 2007 and 2013.[360] However, a high drop-out rate, poor quality in teaching and assessment standards, an onerous student-teacher ratio and inadequate infrastructure continue to remain fundamental challenges[361], along with issues of gender-related violence, which remains a major impediment for girls' education.[362] Similarly, in the higher education sector, a lack of capacity to absorb students into the university system, a lack of quality teachers, accountability for teachers[363], identity/ socio-economic impediments and the absence of relevant and comprehensive curricula prevent the development of equitable and effective universities.[364] Harnessing the potential of technology and AI in particular might solve some of these challenges, if deployed with the core ethical and strategic concerns in mind. The use of Artificial Intelligence in education - also known as AIED - has been highlighted as a priority area for the government or the recently established AI-Task-Force[365]

In AIEd - the knowledge about the world is presented in three core models, which serve as the edifice of AIEd[366]:

The pedagogical model which represents the ethical approaches, knowledge and expertise related to teaching. Examples of specific knowledge would include allowing students to make mistakes while exploring a concept before being given the right answer.

The domain model which represents the subject being learned which might include substantive content such as how to add or subtract fractions or even process-oriented learning such as the structuring of an essay or how to evaluate the validity of a historical source.

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358 Ibid.

359 See, for example, (2015, November 11) UCLA Study Proves Predictive Policing Successful in Reducing Crime Over Several Months of Deployment with The LAPD. Retrieved from http://www.predpol.com/ucla-predictive-policing-study/.

360 Sahni, U (2015). Primary education in India: Progress and challenges. The Brookings Institute. Retrieved from https://www.brookings.edu/opinions/primary-education-in-india-progress-and-challenges.

361 Ibid.

362 Sahni, U(2015). Primary education in India: Progress and challenges. The Brookings Institute. Retrieved from https://www.brookings.edu/opinions/primary-education-in-india-progress-and-challenges.

363 Abrar P., (2015, February 16) Nandan Nilekani plans tech project 'Ek Step' to hone children's basic skills. Retrieved from https://economictimes.indiatimes.com/small-biz/startups/nandan-nilekani-plans-tech-project-ek-step-to-hone-childrens-basic-skills/articleshow/46257341.cms.

364 Thorat S., (2015, August 11) A blueprint for higher education. Retrieved from http://www.thehindu.com/opinion/lead/a-blueprint-for-higher-education/article7522994.ece.

365 Nagpal J., (2017, April 3) Microsoft advances efforts to transform learning in Indian schools for a digital future. Retrieved from https://news.microsoft.com/en-in/microsoft-advances-efforts-transform-learning-indian-schools-digital-future/.

366 Ibid; Wood A., (2016, September 28) Artificial intelligence is the next giant leap in education. Retrieved from https://www.raconteur.net/technology/artificial-intelligence-is-the-next-giant-leap-in-education.

The learner model which represents the student's background, difficulties and emotional state and how that is impacting their engagement with the subject matter at hand.

Autonomy In Weapons Systems

There has been a significant increase in the level of autonomy of weapons systems by military forces-including various unmanned systems that operate across all domains of warfare. The gradual increase in autonomy has lead to these unmanned systems being adapted, designed and used to deliver weapons, thereby being termed weapons systems.[367] To date, when unmanned systems are used to deliver weapons, the final decision to fire a weapon and the target is still being taken by a human being and not a machine.[368] While developers envisage greater autonomy for weapons systems, autonomy becomes a challenging concept in cluttered.complex environments.[369]

The discourse around autonomous weapons systems today revolves mainly around robotics. Patrick lin et al have arrived at a useful summary of what may be considered robotic military systems.[370]

"Most robots are and will be mobile, such as vehicles, but this is not an essential feature; however, some degree of mobility is required, e.g., a fixed sentry robot with swivelling turrets or a stationary industrial robot with movable arms. Most do not and will not carry human operators, but this too is not an essential feature; the distinction becomes even more blurred as robotic features are integrated with the body. Robots can be operated semi- or fully-autonomously but cannot depend entirely on human control: for instance, tele-operated drones such as the Air Force's Predator unmanned aerial vehicle would qualify as robots to the extent that they make some decisions on their own, such as navigation, but a child's toy car tethered to a remote control is not a robot since its control depends entirely on the operator."

Therefore autonomy in weapons systems is a function of the post-activation capacity of a robot to operate without any external control in various operational areas for substantial periods of time. There are three main categories on the spectrum of control and automation[371] :

(1) Remote controlled or tele-operated systems which are controlled by a remote operator directly,

(2) Automated systems (sometimes called semi-autonomous systems) which are able to act independently of external control and

(3) Autonomous systems which act entirely without external control within the constraints of the software that programed them.

While this spectrum is useful, many weapons systems often include all three rungs of the continuum when discharging various functions.[372] Therefore, it may be useful to discuss autonomy in the context of critical functions such as target acquisition, tracking and selection rather than autonomy of the entire weapons systems Looking at weapons systems on a function-by-function basis also enables clearer application of prescribed standards of International Humanitarian Law when judging the moral acceptability of the use of force against targets.[373]

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367 US Department of Defense, Unmanned Systems Integrated Roadmap FY2013-2038 (2013), p. 19, http://www.defense.gov/pubs/DOD-USRM-2013.pdf 73.

368 Ibid.

369 P. W. Singer, Wired for War (New York: Penguin, 2009,)126-128.

370 P. Lin, P. G. Bekey and K. Abney, Autonomous Military Robotics: Risk, Ethics, and Design, Ethics + Emerging Sciences Group at California Polytechnic State University (2008), p. 4.

371 ICRC, " Autonomous weapons systems: Technical, Military, Legal and Humanitarian Aspects " (Report of Expert Meeting,Geneva, 26 to 28 March 2014) 42.

372 Ibid.

373 Ibid.

Annex 2: AI in Governance - Stakeholder Mapping

AI in Governance: Stakeholder Mapping

Government Authorities

National Informatics Centre
Using AI to capture photos with GPS Coordinates and Current Status of ongoing Rural Road Works Projects implemented by Rural Development & Panchayat Raj Department.

Further Reading

National Supercomputing Mission
To make India one of the world leaders in supercomputing and to enhance India's capability in solving grand challenge problems of national and global relevance.

Further Reading

Centre for Development of Advanced Computing (C-DAC)
R&D in IT, Electronics and associated areas

Further Reading

Ministry of Electronics and Information Technology (MeitY)
To promote e-Governance for empowering citizens, inclusive and sustainable growth of the Electronics, IT & ITeS industries, R&D and innovation, enhancing efficiency through digital services and ensuring a secure cyberspace.

Further Reading

Rural Electrification Corporation
Tracking rural electrification in India in real time

Further Reading

AI Task Force
To chalk out the strategic roadmap for Defence in the area of Artificial Intelligence and Robotics

Further Reading

CAIR
Equipping Indian armed forces with self-reliant, adaptable, and fault-tolerant systems

Further Reading

Delhi Police
Aspires to adopt ""technology based policing"" by using smart policing, artificial intelligence, and self-learning systems among other advanced technologies.

Further Reading

Used facial recognition to identify 3000 missing children

Further Reading

Dima Hasao district, Assam
e-checking at checkpoints, CCTVs using facial recognition software

Further Reading

National Crime Records Bureau
To use crime data analytics software to enable predictive policing

Further Reading

Karnataka Government
Launched Centre of Excellence for data science and Artificial Intelligence (CoE-DS&AI) in collaboration with NASSCOM

Further Reading

Indian Ministry of Civil Aviation
To install facial-recognition systems at airports

Further Reading

Niti Aayog
Published the Discussion Paper on National Stratergy for AI, in June

Further Reading

National AI strategy

Digital India
Research and work on development of citizen-centric use cases

Further Reading

National Institution for Transforming India
To open Atal Tinkering Labs to promote new tech including AI

Further Reading

Ministry of Information and Broadcasting
Agency for SITC of Software and Service and Support for function, operation and maintenance of Social Media Communication Hub

Further Reading

Mumbai Police
Installation of panic buttons, automatic number plate identification system and facial recognition system

Further Reading

The Centre for Development of Advanced Computing
Using artificial intelligence-based tools to tackle cyber security threats

Further Reading

Ministry of Women and Child Development
AI powered 'Smart Eyes' cameras under the "Suraksha Mitra" proposal

Further Reading

National Artificial Intelligence Mission (N-AIM)
Nodal agencey to co-ordinate AI activities

Further Reading

Government of Maharashtra Pune
The Pune Street Light Project - Street lights that can be remote controlled through Supervisory Control and Data Acquisition (SCADA) systems

Further Reading

Government of Gujarat, Surat
Network of more than 600 surveillance cameras

Further Reading

Telangana Police
Smart Robo Cop equipped with cameras, and an array of sensors connected to GPS

Further Reading

Google
Discharge of Government functions
Across focus areas

OpenEd.ai
Education
Student Services

Innefu Labs
Defence
Cyber Defense

CRON Systems
Defence
Risk Terrain Analysis /GIS

Embibe
Education
Student Services

Omnipresent RobotTech
Defence
Intelligent Weapons Systems

Tonbo
Defence
Intelligence, Surveillance and Reconnaissance

eDreams
Education
Personalized Learning

PrazAs
Education
Personalized Learning and Student Progress Monitoring

Vedantu
Education
Personalized Learning

Staqu
Law Enforcement
Biometrics and Authentication

H-bots Robotics
Law Enforcement
Robo-Cops and predictive analytics

LegitQuest
Judicial Decision Making
Judicial Decision Making

Grameener
Discharge of Government Functions

Tessact
Law Enforcement
Speech and Facial Recognition

Eye-D
Discharge of Government Functions
Aid for the differently abled

Intello Labs
Law Enforcement
Speech and Facial Recognition

Netradyne
Discharge of Government Functions
Citizen/government interface/e-governance

CaseMine
Judicial Decision Making
Judicial Decision Making

Microsoft
Discharge of Government Functions
Citizen/government interface/e-governance

Developers

Cortica
Law Enforcement
Predictive Analytics

IBM
Discharge of Government Functions
Across focus areas

Brainasoft
Discharge of Government Functions
Citizen/government interface/e-governance

Uncanny Vision
Law Enforcement
Predictive Analytics

Advanced Data Research Institute (ADRIN)
Law Enforcement
Predictive Analytics

NEC Technologies India Private Limited (NECTI)
Law Enforcement
Speech and Face recognition and Biometric Authentication

Biomatiques
Law Enforcement
Speech and Face recognition and Biometric Authentication

Indianeye Security Pvt. Ltd. (ISL)
Law Enforcement
Speech and Face recognition and Biometric Authentication

Accenture
Discharge of Government Functions
Citizen/government interface/e-governance

POLSEC Law Enforcement
Law Enforcement
Speech and Face recognition and Biometric Authentication

TYPE OF COMPANY
International
Domestic

Company
Sector
Focus Area

Continental AG
Discharge of Government Functions
Citizen/government interface/e-governance

Tata Group
Discharge of Government Functions
Citizen/government interface/e-governance

Visual AI
Defence
Intelligence, Surveillance and Reconnaissance

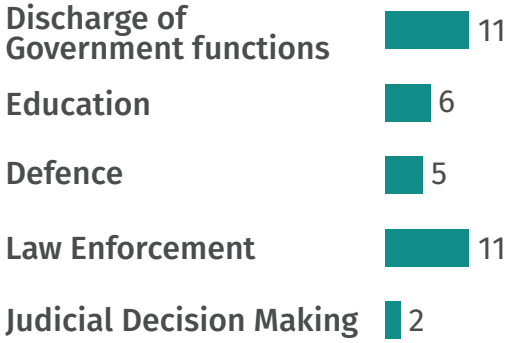
Esyasoft Technologies Private Limited
Discharge of Government Functions
Citizen/government interface/e-governance

IBM
Education
Student Services

Distribution of Developers Based on Type and Focus Area

TYPE OF COMPANY

SECTOR



FOCUS AREA

The Centre for Artificial Intelligence and Robotics
Development of **Multi Agent Robotics Framework (MARF)**

EkStep
Partnered with Sahaj to use **machine learning tools**

Best Group
Will use Cortica's Autonomous AI India

Punjab Police
Will use **Punjab Artificial Intelligence System (PAIB)**

Department of Urban Development, Arunachal Pradesh
Launched **IMC**

National Crime Records Bureau
To use **crime data analytics software**

Government of India - Ministry of coal
Uses **WeDosky's drones and AI software**

Power grid corporation of India
Uses **Esyasoft's smart grid technology management software**

Mumbai Police
Installation of **panic buttons, automatic number plate identification system and facial recognition system**

Users

Government of Gujarat, Surat
Has built a network of more than 600 surveillance cameras, teamed up with Microsoft to develop solutions

Government of Maharashtra Pune
Launched The Pune Street Light Project

Ministry of Women and Child Development
AI powered 'Smart Eyes' cameras

Delhi Police
To adopt **"technology based policing"**

Dima Hasao district, Assam
Plans to use facial recognition

Indian Ministry of Civil Aviation
Planning to install **facial-recognition systems** at airports

Telangana Police
Plans to deploy **Smart Robo Cop**

Research and Academia

Carnegie India
India and the Artificial Intelligence Revolution
India and the Challenge of Autonomous Weapons

International Crop Research Institute for Semi Arid Tropics
Using scientific information for better agriculture

Nishith Desai Associates
EdTech: From IT to AI

Wadhwani Foundation

Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI)

Department of Agriculture Bangalore
Enable Smart Farm in Digital India with Artificial Intelligence and IoT

VIT University, Vellore
Cyber Defense using Artificial Intelligence

IIT Delhi
Artificial intelligence based approach to forecast PM2.5 during haze episodes: A case study of Delhi, India

Mewar University, Chittorgarh
The Future Potential Trends, Issues and Suggestions of Artificial Intelligence in Indian Education System

IIIT Allahabad
Saxena, Aditya K., Shweta Sharma, and Vijay K. Chaurasiya. "Neural network based human age-group estimation in curvelet domain." Procedia Computer Science 54 (2015): 781-789.

M. J. College, Maharashtra
Patil, P. (2016). Artificial intelligence in cybersecurity. International Journal of Research in Computer Applications and Robotics, 4(5), 1-5.

PwC along with ASSOCHAM
Advance artificial intelligence for growth: Leveraging AI and robotics for India's economic transformation

Conference on Artificial Intelligence, Ethics and Society
Opportunities and Challenges for AI in India - aies-conference.com

Indian Federation of United Nations Associations
Agriculture Advancement using Artificial Intelligence

International Organization of Scientific Research
ICT Innovation in Indian Banking Sector: Trends and Challenges

Indira Gandhi Institute of Development Research
Technological Change, Automation and Employment: A Short Review of Theory and Evidence

Advanced Data Research Institute (ADRIN)
Research on developing analytics software for crime prevention

AI Task Force
Report on AI Task Force

Daksh

Institute of Technology and Management Nanden
Thorat, S. B., Nayak, S. K., & Dandale, J. P. (2010). Facial recognition technology: An analysis with scope in India. arXiv preprint arXiv:1005.4263

Institute of Technology-Patna

Centre for Development of Advanced Computing

Jigsaw Academy

TYPE OF COMPANY

Investors/ Funders

Karnataka IT and Biotechnology Department
Esyasoft

Qualcomm Ventures
Tonbo

Amazon Web Services
OpenAI

Anand Chandrasekaran
Uncanny Vision

Artiman Ventures
Tonbo

Edelweiss Private Equity
Tonbo

Indian Angel Network
Staqu

IndiaNivesh
Innefu Labs

Infosys
OpenAI

InsuResilience Investment Fund
Sky met

Investus
eDreams

Microsoft
OpenAI

Omidyar Network
Vedantu

Ram Jethmalani
LegitQuest

Reliance
Embibe

Reliance
OpenAI

Reliance
Netradyne

Tiger Global
Vedantu

WRV Capital
Tonbo

Your Nest
Cron Systems

Conferences and Exhibitions

National Cyber Defence Summit
15th -16th December, 2017
Goa

DEFEXPO
11th April, 2018
Chennai

India Today School Summit
Organiser: **VIT University**
February, 2017
Vellore

Artificial Intelligence in Education - Applications and Implications
3rd - 4th February, 2017
Delhi

13thFICCI Higher Education SUMMIT 2017
1st November, 2017
Delhi

Stem Summit & Awards 2018
Organiser: **AICRA**
11th April, 2018
Delhi

Softomotive Invests in AI Conversation in India: How can AI enhance humanities' ability to work
11th -12th October, 2017
Hyderabad

DEFENCE & PUBLIC SECURITY
Organiser: **Geospatial World Forum**
18th January, 2018
Hyderabad

Agriculture Grand Challenge for agri-start-ups
15th -16th December, 2017
Delhi

Secutech India Safety and Security Conclave (SISSC)
5th -7th April, 2018
Mumbai

International Conference on Computer Vision and Image Processing
Organiser: **IIT Roorkee**
26th - 28th February, 2018
Roorkee

CRIS on AI for Innovations in Consumer Experience & Service Delivery
24th March, 2018
New Delhi

IBM Smartcamp for Smart Cities
Organiser: **IBM**
18th November, 2016
New Delhi