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AI-Enhanced Strategies for Information Security: Safeguarding PHI in Government and Healthcare Sectors

Abstract: - As data becomes increasingly important in fields like healthcare and governmental uses, avoiding the adverse selection of valid data becomes increasingly important. Data offers the best potential value when it is fully drafted. The draft data or more incomplete data disallows the negative use of such information when this is used. Effectively, the government and healthcare entities have the challenge of storing important information in such a manner that unwanted authenticated uses cannot occur. We proposed an information security strategy (or application specification) for digital storage methods that provide useful activities authorizing near-complete important information to be stored while the removal of wanted data is discouraged. Specifically, the method comes with a crypto notary public key protocol that enables transactions to be publicly verified in the producer and the distributor accepts liability for misinformation. The system is intended to work at all confidentiality levels, thereby effectively reducing an entity's potential liability for data breaches. A prototype proof of concept demonstrated compliance with performance targets.

Keywords: Advanced-Data Storage and Management Strategies, Industry 4.0, Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), Smart Manufacturing (SM), Computer Science, Data Science, Vehicle, Vehicle Reliability.

I. INTRODUCTION

Organizations worldwide are facing unprecedented challenges in protecting the confidentiality, integrity, and availability of an ever-increasing volume of sensitive information, such as protected health information (PHI). For some of these organizations, including the government and HIPAA-affected entities in the healthcare sector, the highest standard of safeguarding that data (and much of the other data they possess, maintain, transmit, and use) is legally required, or they are subject to substantial consequences. The recent introduction of AI-enhanced strategies for information security, including PHI, offers the potential for these organizations to advance their data-safeguarding capabilities in an ever more digital and automated world. AI-enhanced strategies may also provide organizations a technical avenue to address the operational challenges necessary to more fully operationalize their safeguarding efforts, including the increased demand for expertise in helping advance both the organizations' technical capabilities and their governance, risk, and compliance (GRC) programs.

The case studies are an extension of our earlier research, which focused on the development of AI-enhanced vulnerability risk management strategies, where the technologies' outputs were considered in the durable medium and data mapping elements of the "keep: don't keep: keep" (KDK) model pipeline of health data governance in support of HIPAA compliance strategies. That work introduced a preliminary pipeline of information characteristics that HIPAA-affected entities might consider in categorizing their health data in the "obtain: don't keep: keep" (ODK) pipeline of health data governance in support of HIPAA compliance strategies. It combined a simplified and restricted AI practical application that demonstrated basic AI-based risk forecasting for two Office of National Coordinator for Health Information Technology (ONC) Core Data Elements of over four hundred fifty self-reported health and well-being care data with information (in the form of a machine-readable

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health domain model concept graph linked to ontologies) that enabled descriptive and comparative analyses of health data.

1.1. Background and Significance

The combination of artificial intelligence and public policies brings about a new approach to information security. This technique is applied to protect Protected Health Information (PHI) in the government and healthcare sectors, which is a challenging task given the volume and diversity of potential threats. Its newness and importance justify much of the international interest in better understanding the current scenarios, most relevant issues, more frequent measures, and future trends. Many of the most relevant contributions were embedded in large research engagements, classified as concept papers, literature reviews, and panels. The originality and the urgent demand to increase its practical usefulness justify the performance of new large-scale studies. The exploratory nature of its research problem also justifies high practical and scientific impacts.

Artificial intelligence was initially introduced and quickly updated via machine learning to monitor and prevent information security breaches. Although its use has made it possible to prevent a generation of attempts and measures, many of its users still do not have previous experience or lack more robust models. Pauses and performances become obvious beyond the initial excitement with mitigating news for cases of false positive, false negative, and adversary-controlled data. Its combination with algorithms disrupts and generates the generation of hard-to-prevent occurrences and impacts. Bad information and prediction models are also specific challenges and generate malicious data at high costs applied in artificial intelligence systems. Finally, AI techniques can be used to protect AI models, specifically against attacks that use malicious examples.

1.2. Research Aim and Objectives

The research aims to develop a novel AI-enhanced solution for protecting government and healthcare sector information. This will be achieved using a two-stage research methodology. First, the development of a novel AI-enhanced Information Security Strategy Assessment Method (AI-enhanced ISSAM) for governmental and healthcare organizations will be completed. Second, the evaluation of a functional prototype of the proposed methodology through a series of real-life case studies will be conducted. The objectives of the research aim, which will further identify the novelty and practicality of the AI-enhanced solution, are detailed below.

AI-Enhanced ISSAM has the following: - AI-Enhanced ISSAM will be the first known methodology that will identify the Key Information Assets (KIAs) influencing the organization's strategy regarding illicit intelligence (i.e. loss) interest. - Several heuristic rules for decision aids, for the assessment of the relative importance of the identified KIAs, that can be applied in terms of several stakeholder groups. - Adoption of a new data representation structure for risk assessment models to facilitate the application of different methods for analyzing uncertainty and inconsistency. - The development of an intelligent multi-criterion decision model for evaluating the IS status of organizational business strategies.

In addition to the practical guidelines and recommendations that will be developed for governmental and healthcare organizations, the organizations can indirectly benefit from the implementation of the prototype. The fact that this solution improves the accuracy and efficiency of human decision aids while freeing up valuable expert employees, allowing them to focus their energies on a more efficient enterprise toward achieving the organizational strategy and the relevant security goals.

Fig 1: Impact of AI in Healthcare

II. Information Security in Government and Healthcare Sectors

Information security is a growing concern in both the government and healthcare sectors. High-profile leaks of sensitive, personally identifying information (PII, e.g., social security numbers, health records) have federal government agencies working on implementing a single electronic medical record for each American, strengthening Health Insurance Portability and Accountability Act (HIPAA) - mandated security measures, and re-examining existing laws and regulations that impose steep fines on entities that lose such data. Within organizations in the private sector, the challenges are even more daunting. Processing massive anticipated enrollments into health insurance programs necessitates efficient management of information on individuals, families, and small businesses.

The deluge of personal data is a source of anxiety for which there is no perfect solution. Every entity with which PII is shared poses a risk. Well-intentioned employees can inadvertently expose PII to others, each of whom might expose it further. Within and between organizations, secure media handling, secure mail environments, and their electronic equivalents involve physical procedures, security procedures, and staff who must be trained in how to handle these data. Safe destruction of electronic storage media is difficult to achieve, with techniques available to thwart only a portion of possible threat agents. Absent robust, end-to-end security, government initiatives to impose new mandates, standards, and penalties upon the commercial and non-profit sectors seem equally untenable. Therefore, techniques to secure the voice and internet field platforms and services employed by organizations are needed.

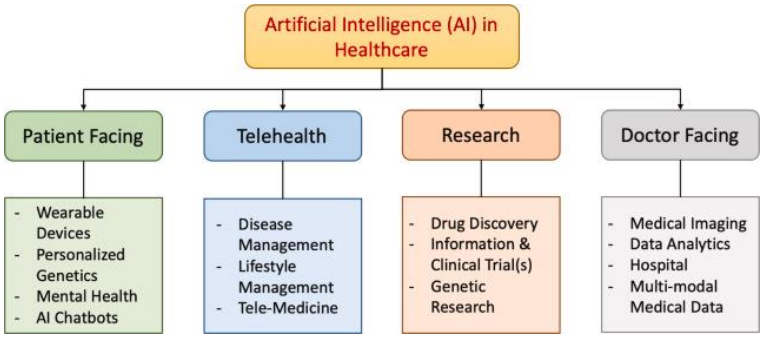

Fig 2: Illustration of artificial intelligence technology landscape in healthcare.

2.1. Challenges and Threats

To enforce the confidentiality, integrity, and availability property of personal healthcare information (PHI), requires multiple security measures such as administrative, physical protection, technical, and management policies. From a technology perspective, several interesting techniques bear the potential to assist the enforcement of the aforementioned multitude of security protocols. Among these are firewalls, intrusion detection systems, antivirus software, information rights management (IRM) tools, encryption, and digital rights management (DRM) tools. Encryption effectively shrinks the domain of users. Similarly, DRM provides a higher layer of security by enforcing usage controls at the right to decrypt the PHI layer after top control has been enforced and the policy boundary has been granulated to contain policy enforcement mismatches at the lower strata.

Large organizations are attractive targets to attackers due to the large amount of secrets these organizations are protecting. Despite the advances in technologies that make detection and prevention of electronic security problems relatively inexpensive, computer systems are rapidly evolving, and reducing the computer security risk is still a greater challenge due to the defense and construction of such systems. In 2000, the Department of Health and Human Services (DHHS) reported that 2,844 incidents had occurred in organizations that were affected by computing and network security breaches. In 2001, U.S. law enforcement reported that cyber security cost U.S. companies over six billion dollars.

III. Role of AI in Information Security

AI security software adds a layer of defense to traditional security software. It enhances information security either as a reactive measure or as a prophylactic measure. As a reactive measure, AI detects, classifies, and retaliates against sophisticated and stealthy threats with high precision. Whereas signature-based antivirus software works by searching through a database of malware signatures, TMTLS AI security observes all activities on a host system to identify malicious software. If a program tries to operate outside of its normal behavior, the

TMTLS AI response will prevent the program from executing its malicious actions. Only businesses that utilize security tools designed and maintained by a fully dedicated prevention and response team can be confident that their internal and external digital activities will remain free from vulnerabilities 24/7/365. AI provides network operators with an early warning system that is essential both for initial attack detection and rapid response because it can fire in seconds instead of hours, days, or weeks. It also scours networks to provide detailed forensic insights, so security teams can view recorded results and forensics before they make rapid, high-pressure decisions about how to proceed.

These behaviors underscore the essential role of AI in performing functions that involve establishing and maintaining the confidentiality, integrity, and accessibility of data. These functions represent the fundamental goals of information security—safeguarding vital information from theft, corruption, or lack of access. AI is essential in the design and implementation efforts to protect—both automatically and continuously—the information that government and healthcare practitioners must keep secure—both cultural (CI) and personal health information (PHI). Since the world is highly digitized, entities ranging from individual businesses to entire industries require information security to protect their data. As a result, good security testing is increasingly important to all areas of commerce and society, from information ethics (e.g., data privacy) to information sharing.

3.1. Overview of AI Technologies in Information Security

In this section, a brief overview of AI technologies and applications relevant to information security is provided. The possible use of AI in applying principles of information security to safeguarding PHI is explored in greater detail in Section 3.2 below. Artificial intelligence is the part of computer-based information systems that allows systems to learn from experience, adapt to new inputs, get better over time, and accomplish specific tasks much like a human. Machine learning, natural language processing, expert systems, virtual agents, and decision management all enable systems to make evidence-based decisions, thus enabling secure and efficient management of such systems. Philosophically, AI is based on the principles of logical reasoning for decision-making. It augments human intelligence by connecting reasoning to actions. Whether simple or complex, security decisions can be partially or fully automated using AI and rule-based systems.

AI technologies are now rapidly expanding to enable security solutions with superior capabilities. Secure AI can be applied across several use cases, from intelligent investigation and response automation for optimizing response times to catch up with malicious cyber-attackers, to leveraging intelligent voice recognition to build more secure security systems and biometric solutions. When it comes to information security, AI can be applied to resolve security teams' significant problems using data-driven security, directly supporting their organization's security goals and objectives. AI in information security solutions is capable of learning from cyber-attacks to offer seamless and proactive protection. AI tools analyze behavior to help awareness grow about an existing risk, allowing for reinforcement of protections and proactive threat management for possible vulnerabilities.

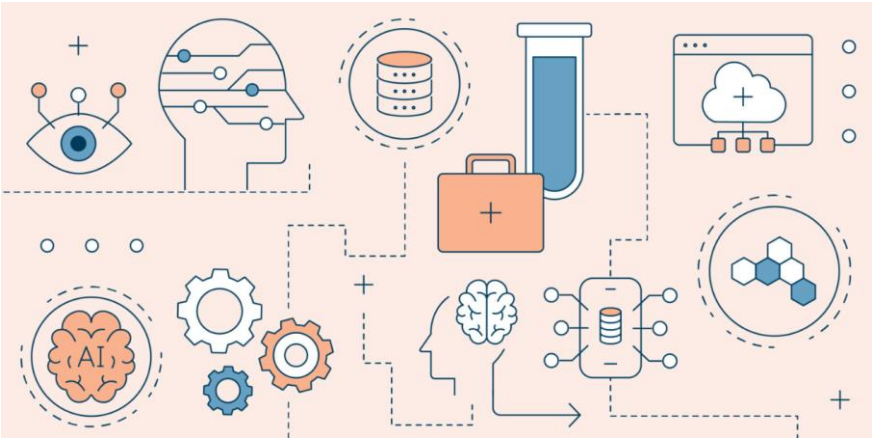

Fig 3: The creation and evolution of artificial intelligence (AI) is transforming the healthcare industry. The technology has created a new world of possibilities in medical diagnosis, treatment, and patient care.

IV. AI-ENHANCED STRATEGIES FOR SAFEGUARDING PHI

AI-enabled advancements are increasing productivity in healthcare settings, improving patient outcomes and experiences, enhancing decision-making, increasing system efficiency, and reducing costs. However, AI also

introduces unique vulnerabilities and risks to sensitive PHI. This chapter highlights the benefits and risks of AI on PHI for the government and healthcare sectors and introduces several technology and management strategies for safely harnessing AI by effectively controlling these risks. These strategies were gleaned from a review of contemporary research and were evaluated by a panel of seven industry leaders and academic experts. These strategies could serve the important function of protecting the privacy and confidentiality of PHI in healthcare and government settings as AI continues to rapidly evolve.

Since the HIPAA was enacted, significant technological advancements have been made in the realms of machine learning, artificial intelligence, cognitive computing, and the Internet of Things, even as the Obama and Trump Administrations have prioritized the lure of big data analysis to improve patient health outcomes, support scientific inquiry, advance technology, and provide value to Americans. These advancements are not only increasing productivity in healthcare settings, but are also improving patient outcomes and experiences, enhancing decision-making, increasing system efficiency, and reducing costs. With the significant benefits come equally significant privacy and security risks that threaten the confidentiality, integrity, and availability of this sensitive information.

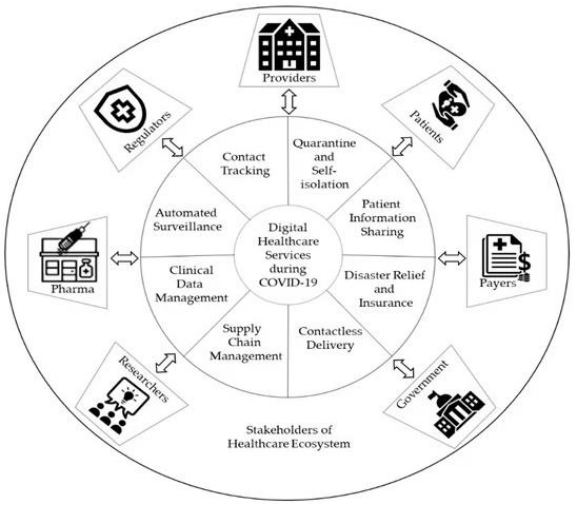

Fig 4: Healthcare Ecosystem and Digital Services for Pandemic Preparedness and Response During COVID-19.

4.1. Anomaly Detection and Intrusion Prevention

To detect and protect information assets from potential threats or attacks, organizations most often apply security strategies that typically involve intrusion detection methodologies. An intrusion into a system is defined as an unauthorized event within the information system, which has been created by an entity. It may compromise any of the available assurances such as confidentiality, integrity, or availability, and violates or circumvents the system security policy. An attack is defined as an attempt to exploit or compromise the integrity, confidentiality, or availability of the target system to a lesser extent. Therefore, a successful intrusion would indeed be called an attack and a failed intrusion attempt would be called merely an attempt. Analysis of system event data is the basis of timely and accurate detection and prevention of corruptive behavior of authorized users as well as the use of usernames by "wicked" users.

Anomaly detection is a process used to identify or isolate items, events, or observations that are not consistent with a "pattern" of items. The patterns that are not anomalous are often referred to as "normal." Anomaly detection is often used in preprocessing steps to identify the set of candidate sources in the event or network traffic data. These events may then be tested to identify data that deviates or is anomalous concerning a model built using the candidate sources. The nature of the test used to determine deviations is highly dependent on the model used and the requirements of the domain for which anomaly detection is performed. Anomaly detection is the process of identifying events that do not conform to an expected pattern or are considered unusual. Anomaly detection is generally used in pre-processing steps to identify a candidate set of sources that deviate from data before new pattern detection and analysis techniques. By identifying data deviations, intrusion detection can improve the performance of event processing by reducing the amount of data that must be examined.

4.2. Behavioral Biometrics

Behavioral biometrics, or the entity's typical patterns of action, are based on the passively or semi-passively collected data from the individual such as the way they answer questions, interface with applications, or use other systems. One way to partially leverage behavioral patterns that are already used in digital environments is to look at metrics from user behavior experiences developed for other purposes. One example is Continuous Evaluation programs (CEP) for insider threat protection. The National Insider Threat Task Force is expanding the use of controlled access and security defensive measures and new people-centric technology capabilities in response to increasing gaps in insider threat risk assessments, and gaps in insider threat risk reduction practices, procedures, and processes. Task force approaches to address issues include mapping and adjudicating CEP data to ensure employee privacy rights, as employees may be influenced by the fact that mitigations are not tailored to actual risk levels.

To leverage more passive methods of detecting deception, it is imperative to first define deception with the correct perspective. Due to the disparate nature of being, deception, and the actions that create the illusion of new perception, any definition of deception must be context-specific. A lack of correct perspective and conflation of malfeasance and non-malfeasance can lead to misplaced privacy concerns. However, defining deception in one application or context globally may limit mitigations available to other contexts. Any definition that depends on a static environment, action, or intent does not encapsulate the concept. This conversation is laced with difficulty because deceit can be intentional or unintentional, a reasoned action or a responsible action. How can we know when public misconceptions are involuntary? Intentional deception is readily understood and can specifically include the distortion of truth in communication, actions leading to false inferences, and actions aimed at creating a false belief or knowledge.

Fig 5: Behavioral Biometrics

V. Case Studies and Applications

Healthcare is an industry where it is difficult to control privacy and integrity with information security solutions that cause no problems to users. Machine learning classification algorithms were applied to collect and mine empirical data values of random samples of records of healthcare inner oracles at a regional hospital. A non-derogating result was achieved. Efficient privacy protection of individual patients whose data were mined was concluded within the bounds of a risk model. Had a fire occurred at the healthcare inner oracle, data records of healthcare domain patients from over 20 years might have been destroyed. Mini-database healthcare mechanisms of protection were computationally inefficient and were likely to cause inconvenience to healthcare workers. Definitive results of other investigators were employed in direct and indirect comparisons.

This paper discusses the risks and benefits of performing deep learning on healthcare data that is personally identifiable. In particular, we consider the values of healthcare patient blood tests that had not been ordered from any patient test set: we removed patient identifiers. Measured values of patient blood tests for real-world observations were used. If we succeed in protecting the healthcare patient test values, then we believe definitive conclusions can be drawn. Not protecting healthcare data that are far more richly detailed from the general public is viewed as likely to lead to Myskja-scale computer security problems. Generalizing machine learning-based methods of minimizing risks to a case that lacks an exact, predefined solution has the potential for learning far wider applications.

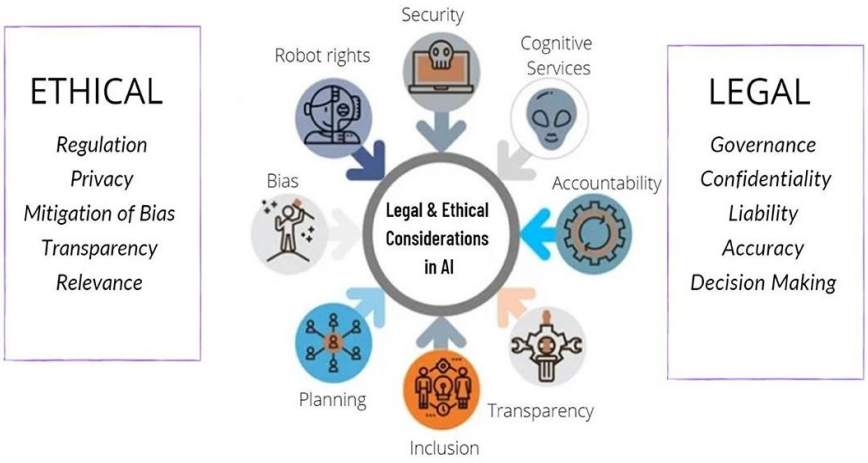

Fig 6: AI Regulation in Healthcare

5.1. Real-world Implementation in Government and Healthcare

In this section, we describe practical applications of the AI-Shield solution in making data shared among various systems interoperable and secure and realizing their benefits to users and stakeholders. It should be noted that although our descriptions used big data and healthcare application terms, this approach is general and could be used for any domain. Furthermore, oligotrophic authorizations by having the user or any attribute not contained within the private data record itself but determined at access time by the communication authorities take complete advantage of attribute-based access control using existing architectures and services, fully protecting privacy. The latency incurred by access checks is minimized as much as possible by architecture design and a priori access permissions are exploited.

VI. Challenges and Future Directions

The proposed model is an initial attempt, and we recognize that there are several assumptions and ideal conditions that need to be relaxed. The classification and regression tasks are far from perfect, and small angle transformations and subspace-based strategies are prone to small distortions. A major challenge is to identify a measure that can provide a high confidence level of a safe region for SOD. It is also worthwhile to address generatable input images for future attacks and establish some existential properties concerning the description proximity and the efficiency of the convex optimization. For applications in PHI protection in government and healthcare sectors, risks and benefits, ethical issues, and healthcare policies are also significant concerns. Finally, user-friendly interfaces for model customization and deployment will help improve the widespread adoption of the model by other organizations.

6.1. Ethical and Legal Concerns

In The core consideration of this chapter is imbued with multifaceted challenges converging at the confluence of AI and HI. The focus of the study is a paradigm shift challenging the conventional roles, notably the behavioral paradigm callously placing little interest in the sanctity of data privacy, human rights, and values determination. A conundrum driven by unbridled profit motives taking leaps and bounds over the public good occasioned by profit maximization to the exclusion of societal well-being. This concern is intentionally guided in the following pertinent structures. The first section of the research paper explores ethical and legal concerns impacting AI-driven systems embedded in human confidential information. The second section examines protection prospects, legal requirements, and rights of the stakeholder naive to self-decision and consent administration on their information. The chapter retakes pertinent courses to wrap up with a final viable analysis and finding.

In understanding the moral and ethical concerns impacting the development and use of AI as a result of several attributes associated with the tool that may cause desired and undesired consequences. At the heart is the ability of automated AI systems to assume an integrated role in decision-making on behalf of an end user or lie if it were impersonating a human counterpart via deployed conversational agents, facial recognition systems, and the power to profile persons, and by so doing, inadvertently expose inherent bias to data it processes. With commercially available conversational agents including Siri, Cortana, Echo, Viv, and multiple others, we have become accustomed to technical systems. It is key to understand that without taking regular Artificial Intelligence, these

conversational systems are prime examples of behavioral design paradigms—the conversation agents were modeled around the user's behavioral pattern so that the agents lie at man's dictatorial feet. No longer is the user in need of an assistant; he is now stepping down the power relationships wanting to control even the calculated visible agent. In the healthcare and government sectors where highly confidential data are encrypted as Protected Health Information or PII, the influence of such technology on decision-making in some AI-driven systems can be critical and have fatal consequences with implanted biased decisions. Human decision anchors are meant to grapple with the gains and losses before appropriate considerations, and ethics testing is applied to the rules and boundaries within reach of the person's power to make a decision, and unwarranted unfairness caused by decisions made influenced by such AI-driven systems and inherently biased reasons. AI is made up of the general level of classification, data, diagnosis, or any decision-influencing method decisions that must be evaluated and held at accountability, in pursuit of expressing the reasons underlying their decisions, not only for legal accountability but for social consent as well. AI systems are all biased, and human decision-making is centered on multiple possibilities, and uncertainties, and can be differentiated, biased, or both.

VII. Conclusion

Information security continues to be a major and complex challenge in the world today. In particular, due to an increasingly hostile cyber environment, posing serious hijacking threats to virtual systems, communications, and data. While a basic foundation for secure communications and data storage has been developed, the secure preservation of horizontally and vertically scalable in-stream data and relevant global models has not been fully addressed. The horizontal requirement applies where significant degradations in decision-making ability or a serious risk to the mission or health of fielded information agents must be tolerated. The vertical scalability requirement applies when such significant degradations are suffered by many such agents.

The main contribution of our paper is to present three complementary measures for safeguarding genomic and health data that arise in practice: non-local data fusion, distributed batching, and privacy-preserving analysis. These methods support secure mission- and safety-critical large-scale pattern analysis, inference, and synthesis for both private and collective use. Significant advantages of our methods stem from the local character of our primal detection, estimation, and other global pattern solutions for anomaly and deviation in image, text, sound, and other signals in witnessed dynamic processes. Each solution sub-diffuses for a highly compact description with a very small overhead. With sufficient proficiency and contextual decision capability in such primal data analysis, ciphertext and user-embedding ciphertext are significantly smaller than our solutions. Our joint primal-dual solutions exhibit a space-time self-cleaning property concerning evolved hijackings.

7.1. Future Trends

Artificial intelligence (AI) is poised for growth in expanding its role in the provision of information technology security solutions. Healthcare information technology continuously demands the rapid growth of AI security solution options as healthcare becomes a sector increasingly targeted by cybercriminals. The coordination of joint military and healthcare information security initiatives encourages growth in the sector by assisting both sectors with well-developed general security policy recommendations through recognition of the special needs of military strategies for the continuous chase for strategic security dominance. Marketed external backup plus business continuity strategies leverage some highly tested strategies. Nonetheless, it is important also to recognize cyberspace is expanding at a rapid rate with new patterns of computing resources deployment; potential virtual battlefield threats that move beyond the provision of actual physical damage to threats of coercion complementing physical harm strategies abound.

The implementation of artificial intelligence (AI) in information technology (IT) decision-making and risk management strategies continues to grow. Currently, less than half of healthcare organizations employ AI, but those using it consider it a valuable solution in improving healthcare outcomes. Sources also indicate that by 2022, the deployment of AI may potentially increase the size of the healthcare and life sciences global cybersecurity market with a compounded annual growth rate of 17.1 percent. Such growth follows from recognizing that AI enhances solution training to manage and solve complex healthcare problems using decision tree protocols that manage risk assessment warnings to improve cybersecurity processes. Healthcare is understood as a growing target of cybercriminals due in part to its wealth of patient data. This chapter examines data risk management. It reviews the protection standards and latest AI security strategies used to ensure the protection of a sector most able to verify health. It is in this application, after all, that healthcare most benefits from data examination as a

means of personalization of individual care. AI is used to protect different types of security challenges with similar benefits. Military secrets remain a valuable currency; however, country borders and disputed international relations drive strategic security concerns to favor different policies and data security protection strategies for the nation-state.

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