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A Framework for a Master's in Applied Artificial Intelligence Program in Computer and Information Systems Discipline

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ABSTRACT

Due to the increasing demand for efficient, effective, and profitable applications of Artificial Intelligence (AI) in various industries, there is an immense need for professionals with the right skills to meet this demand. As a result, several institutions have started to offer AI programs. Yet, there is a notable gap in academia: the absence of a comprehensive, technically focused framework for developing a master's program in Applied AI specifically tailored to meet the demands of the Computer and Information Systems (CIS) discipline. This paper addresses this gap by proposing a graduate-level Applied AI program framework for CIS students. This framework comprises an example graduate-level curriculum that focuses on critical competencies in the application of AI, including data analytics, machine learning, natural language processing, computer vision, AI ethics and governance, AI project management, IT infrastructure for AI systems, and AI-driven innovation. By following this framework, institutions can develop customized master's programs that align with the evolving field of AI and prepare CIS graduates to excel in diverse industries.

Keywords: Artificial intelligence, Applied learning, Graduate education, CIS curriculum, Competency

1. INTRODUCTION

Artificial Intelligence (AI) represents a paradigm shift that extends the capabilities of traditional software beyond symbolic programming to create systems with advanced, intelligent behavior. Unlike conventional software based on predefined rules and logic, AI systems are designed to learn from data, adapt to new scenarios, and make decisions with a degree of autonomy that mimics human cognition. This ability to learn and adapt is crucial in tasks involving pattern recognition, natural language processing, and complex problem-solving, where conventional software falls short. For example, while AI and traditional software can automate tasks, AI excels in scenarios requiring adaptability and continuous learning, such as dynamic fraud-detection systems or personalized medicine, where it continually improves accuracy and effectiveness based on new data.

The rapid evolution of AI as a transformative technology has profound implications for how we live, work, and interact with the world. It offers businesses unparalleled insights by analyzing vast amounts of data, thereby enabling them to optimize operations, identify risks, seize new opportunities (Raisch & Krakowski, 2021) and improve customer experience (Çipi et al., 2023), making it an indispensable tool for modern businesses. Innovative AI tools like ChatGPT have been deployed to enhance education services (Gupta & Chen, 2022), as seen in Khan Academy's personalized learning tool, "Khanmigo" (Koraishi, 2023).

The rise of AI also necessitates a shift in the roles and skills required in the workforce. While it is true that Computer and Information Systems (CIS) graduates with training in data analytics and AI can take up technical roles such as data architects, data scientists, analysts, and engineers, their potential contributions are not limited to these areas. Organizations increasingly recognize the importance of CIS professionals with AI expertise in leadership and governance roles, such as directors, vice presidents, Chief Information Officers (CIOs), and Chief Technology Officers (CTOs). These roles are crucial for understanding and overseeing AI implementations and aligning AI strategies with overall business objectives, ensuring ethical use of AI, and fostering an organizational culture that embraces technological innovation. As the most rapidly expanding area in technology, AI continues to profoundly influence business, resulting in a growing need

for AI expertise across different levels and functions within industries. The role of CIS education is thus crucial in preparing graduates for technical roles and strategic positions where they can lead AI initiatives while also integrating technical expertise with business acumen. However, current CIS curricula need to catch up in adopting AI compared to other computing disciplines. The education of AI, mainly confined within computing and engineering, focuses predominantly on technological innovation, with less emphasis on training the workforce to integrate AI into businesses for operational improvement and decision-making.

CIS education has traditionally been essential in merging theoretical knowledge with the practical aspects of computing in business contexts. This contrasts with Management Information Systems (MIS), which primarily focuses on managing information systems to meet business needs. While CIS delves deeper into the technicalities of computing and system development, MIS emphasizes the application of these systems to solve business problems and improve management processes. Therefore, CIS programs must evolve and incorporate AI, balancing technical mastery with its practical business applications. This will enable future professionals to develop and manage AI solutions and effectively implement them to revolutionize business processes and strategies.

To address the evolving challenges in business and technology, a concerted effort is underway involving IT professionals and CIS educators. Numerous studies have underscored AI's potential to transform business landscapes by enhancing decision-making and problem-solving capabilities (Taherdoost, 2023), improving operational processes and organizational performance (Mikalef et al., 2023), elucidating value-generation mechanisms (Enholm et al., 2022), and boosting trust in technological applications (Nasarian et al., 2024). Additionally, research highlights AI's role in increasing efficiency, effectiveness, and employee satisfaction within HR practices (Okatta et al., 2024) and reducing costs across business operations (Du et al., 2024).

Research at the intersection of CIS and AI spans a broad range of domains (Alam, 2021; Lin et al., 2021; Salastekar et al., 2023; Weisberg & Fishman, 2020). Innovative approaches, such as no-code AI, are being integrated into less technical and non-technical courses (Lin et al., 2021; Sundberg & Holmström, 2024; Wang & Wang, 2022), alongside the efforts to define specific AI skills and knowledge areas for IS students and professionals (Taherdoost, 2023). The classroom benefits and challenges of using generative AI tools like ChatGPT are also being examined (Al-Hafdi & AlNajdi, 2024; Bansal et al., 2024; Niloy et al., 2024; Van Slyke et al., 2023). Furthermore, adopting these approaches in business schools such as MIT Sloan, Tepper School of Business at Carnegie Mellon University, and others typically targets non-technical individuals, focusing more on managerial insights into AI rather than deep technical skills. This reveals a potential gap CIS programs could fill by offering more technically oriented, hands-on learning experiences to develop strong AI competencies. Current competency models often show limitations in integrating AI-specific technical skills, maintaining a narrow AI focus, addressing the ethical impacts of AI, covering interdisciplinary applications, and developing advanced AI management and strategic skills (Anton et al., 2020; Topi et al., 2017). This situation underscores the need to develop robust competencies for CIS graduates, preparing them for the demanding AI skills required in business.

1.1 Our Contribution

In this paper, we explore the role of CIS graduate-level education in preparing students to excel in AI-integrated business environments. We examine the current state of AI education in CIS programs, identify critical areas for improvement, and propose a framework for teaching AI in a business context. By doing so, we contribute to developing a standardized pedagogical approach to AI education that will better prepare graduate students to meet the demands of AI-driven businesses. Crucially, while our analysis primarily revolves around AI education in CIS programs, the proposed framework is applicable across a spectrum of disciplines, including MIS, Computer Science, Statistics, Mathematics, and Engineering. We recognize the diversity in educational backgrounds of potential candidates for our envisaged master's program. To this end, we suggest integrating tailored bridge courses to harmonize the varying academic foundations of students from these disciplines, ensuring a uniform baseline of AI-related knowledge and skills essential for success in the business domain.

Through this paper, we address the following important research questions that probe into the current state and future trajectory of CIS education in the context of AI adoption. Our investigation focuses on developing strategies to equip CIS graduates with the skills necessary to succeed in the quickly changing AI-driven business environment.

RQ1. What is the status of AI education in Computer and Information Systems (CIS) and business programs?

RQ2. To what extent do these programs align with the evolving needs of the business sector?

RQ3. What are the advantages and unique characteristics of CIS programs that enable graduates to effectively bridge the gap between technical expertise in AI and the practical application of AI in a business context?

RQ4. How do we create a curriculum for an Applied AI graduate program suitable for CIS graduates, considering the intersection of computer science and business and the practical application of AI in business settings?

By examining these research questions, we provide a comprehensive framework to develop a graduate program in Applied AI under the CIS discipline. In summary, our contribution is as follows:

- We thoroughly review the state-of-the-art works and initiatives undertaken by prominent business schools to create graduate programs in Applied AI.
- We systematically analyze two significant competency models: MSIS2016 (Topi et al., 2017) and AI competency (Anton et al., 2020), to gain insights into the essential skills and knowledge required for Applied AI.
- Using the insights gained from our analysis, we develop a competency model tailored explicitly to the Computer and Information Systems (CIS) discipline. This model forms the basis for a graduate program in Applied AI. This proposed model extends the MSIS2016 model in the context of the practical use of AI in businesses and organizations.

- In addition to the competency model, we also devise a comprehensive curriculum framework that CIS disciplines can use as a guide when creating their Applied AI programs, aligning with the competencies outlined in our proposed model.

1.2 Outline of the Paper

The rest of the paper is organized as follows. Section 2 reviews existing literature on integration of AI in IS education and initiatives from example business schools that have established graduate programs in Applied AI. This section also covers our analysis of the two significant competency models, MSIS2016 (Topi et al., 2017) and AI competency (Anton et al., 2020), addressing the first two research questions outlined above. Section 3 discusses the unique positioning of CIS in bridging Computer Science (CS), AI, and business, responding to the third research question and introducing our proposed AI Competency Model. Following this, Section 4 outlines a comprehensive curriculum framework based on this model, tackling the fourth research question by detailing how the curriculum meets current and prospective AI competency demands. The paper concludes in Section 5, summarizing our findings and reflecting on the broader implications for overall IS education.

2. LITERATURE REVIEW

It is no surprise that AI education is primarily found in computer science and engineering disciplines, which have been vital in developing the skilled workforce and driving recent AI advancements. We are observing a growing interest in AI literacy (Long & Magerko, 2020), which studies how people understand AI and how to design better technologies to diminish misconceptions about AI. AI has been identified as one of the key knowledge areas of computer science programs (Clear et al., 2019). Computer science and related engineering disciplines are adopting AI differently in their curriculum, including offering specialized AI courses, establishing AI research centers (Donlon & Goel, 2023), and incorporating AI concepts and applications across a wide range of disciplines. Non-technical disciplines are also actively researching effective ways of adopting AI in their curriculum (Alam, 2021; Lin et al., 2021; Salastekar et al., 2023; Weisberg & Fishman, 2020). Despite all the efforts, there is a gap in teaching AI in the business context, as its integration into business practices and decision-making processes remains challenging. Many business professionals and executives are aware of the potential of AI but lack the necessary understanding to leverage its capabilities in their organizations effectively.

On the other hand, there needs to be more business skills among technically skilled professionals in AI. While computer science and engineering programs equip students with the technical know-how to develop AI systems, they often do not emphasize the business acumen necessary to understand AI's strategic implications and potential applications within organizations. This disconnect hinders the effective integration of AI into business processes, as technically skilled professionals may need help communicating the value of AI solutions, aligning them with business objectives, or addressing the ethical and societal implications associated with AI implementation. Bridging this gap requires a multidisciplinary approach that combines technical education with business-oriented training, enabling AI professionals to build robust AI models and effectively collaborate with stakeholders, make data-driven decisions, and understand the broader organizational context in which AI operates.

To this end, our literature review examines recent research on integrating AI into information systems education. In this section, we focus on how AI concepts are incorporated into courses and curricula for both technical and non-technical audiences and connect the educational aspects to broader IT industry advancements, which helps contextualize the importance of AI in IS education. We then explore how various business schools have incorporated AI into their curricula, focusing on specific implementations and the scope of AI-focused courses or concentrations within these programs. Our analysis includes a detailed review of program descriptions and academic resources to identify the subjects and topics covered, with particular attention to areas such as machine learning, natural language processing, data analytics, and the application of AI in business contexts. We assess the in-demand skills and knowledge featured in these programs and critically evaluate the learning outcomes they aim to achieve. Finally, we thoroughly examine two fundamental competencies: the MSIS2016 (Topi et al., 2017) and the AI Competency Model (Anton et al., 2020) to understand their relevance and implementation in current educational frameworks. Overall, this literature review effectively demonstrates a progression from theoretical research to practical program-level implementation and then to the operationalization of competencies, providing a thorough exploration of AI in IS education. This sets the necessary groundwork for our proposed competency model.

2.1 AI in Information Systems Education

Integrating AI into information systems (IS) education has been a subject of ongoing research and development. This research ranges from integrating AI concepts in individual courses to embedding AI competencies into the curricula of less-technical audiences. To understand the broader implications of AI on education, it is critical to examine how emerging technologies are transforming the IT industry at large, serving as a backdrop for educational integration. A recent, in-depth survey explores the influence of emerging technologies on the IT industry. This analysis delves into advancements like cloud computing, IoT, AI, blockchain, big data, and virtual/augmented reality (Taherdoost, 2023). The analysis of 98 research papers discusses integrating AI technologies within IS and their transformative impact across diverse sectors. The study thoroughly evaluates the advantages and risks associated with AI deployment, exploring everything from basic algorithms and machine learning techniques to more sophisticated deep learning applications. It highlights how these technologies enhance decision-making and problem-solving—skills crucial within educational frameworks.

A systemic review of the role of AI in improving business values provides a detailed analysis of how AI technologies are integrated within organizations (Mikalef et al., 2023). It explores the mechanisms through which AI contributes to business processes and the broader types of business values it creates. The review identifies critical enablers such as data accessibility, sophisticated AI algorithms, organizational readiness, and challenges including data security issues, ethical dilemmas, and the complexity of technological integration.

Importantly, it categorizes the impact of AI into direct effects on operational processes and broader effects on organizational performance.

Grounding the discussion in educational settings, recent research further identifies the specific AI competencies that professionals and educators consider crucial in the current dynamic environment. In a recent study, semi-structured interviews were conducted with professionals predominantly from Europe, with educational backgrounds ranging from bachelor's to doctoral degrees and expertise in AI and various other domains (Tenório & Romeike, 2023). This approach provides rich qualitative insights into the competencies considered essential in the field. The authors categorize these into several domains: computing basics, AI fundamentals, AI capabilities, multidisciplinary AI, data management, machine learning, advanced machine learning, human-AI interaction, and responsible AI. Each category includes specific skills and knowledge areas, from understanding basic computing concepts and the historical context of AI to more advanced topics like machine learning algorithms, ethical considerations in AI, and the practical application of AI across diverse fields.

One study explores using a no-code approach to teach AI within a non-technical educational setting, focusing on individual course integration (Sundberg & Holmström, 2024). The authors perform the case study based on a master's-level AI for a business course at Umeå University, Sweden, in which qualitative data were collected through interactions with and observations of the students. The course's participating nineteen students, with an educational background in bachelor's degrees in business administration, computer science, and behavioral science, were presented with a case describing a fictional welding organization. The empirical materials used in the study include students' feedback and course evaluations (generated through emails, notes taken during the course, written evaluations and feedback from students), students' written assignments and presentations, datasets, models, and deployments created by the students (through the Pletarion no-code platform; NoCode Founders, 2024), and observations (teachers' experience and reflections during and after the course).

The authors identify several benefits of using no-code AI in education, including the visualization of data and provision of a graphical interface for uploading data, access to a portfolio of pre-trained models, tutorials, and datasets, as well as the automatic section of fine-tuning of algorithms for training, visual interface for evaluating and comparing the performance of models (e.g., through roc curve- and confusion matrix-based analyses). The authors also identify several changes while implementing the course.

First, crafting real-world scenarios for which students could gather data proved time-consuming, although resources like Kaggle (Kaggle, 2024) helped. Second, user management within the chosen platform caused difficulties for teachers. This highlights the need for upfront planning regarding user management and platform selection. While the original platform is no longer available, numerous alternatives exist, with free and paid tiers (Amazon Web Services, 2024; Google Cloud, 2024; Hugging Face, 2024). Paid versions often offer collaborative features that are valuable for long-term learning. Finally, student feedback suggests reducing group sizes due to collaboration challenges.

In alignment with the recent surge in efforts to develop intelligent tutors to support personalized student learning while addressing the low teacher-to-student ratio, a triangulation approach, blending exploratory, qualitative, and quantitative analyses has been performed to identify the factors affecting student use of ChatGPT (Niloy et al., 2024). The authors aim to address critical questions regarding the factors influencing student engagement with ChatGPT, including: What factors, drawn from prior literature, contribute to a positive intention among students to use ChatGPT? Are there additional factors not previously identified in the literature that could positively influence student intention to engage with ChatGPT? Lastly, they explore the significance of the identified factors in shaping students' intentions to use ChatGPT, thereby providing insights into the determinants of student adoption of this intelligent tutoring system.

A comparable study was conducted to explore students' perspectives on a chatbot-driven learning setting within the Internet Research and E-Commerce Unit of a Computer Skills course (Al-Hafdi & AlNajdi, 2024). Employing a mixed-methods approach, the study found students valued the chatbot's ability to provide flexible learning (pace and location), enhance understanding through repetition, and improve overall well-being. Additionally, students appreciated the chatbot's clear communication and reported increased motivation. These findings suggest a positive student reception towards chatbots in education, potentially empowering learners by providing control over their learning experience and access to preferred content formats.

A recent study explores the impact of AI tools like ChatGPT on information systems (IS) education (Van Slyke et al., 2023). Introduced in late 2022, ChatGPT rapidly gained attention for its potential to alter various societal sectors, including education significantly. The study aims to understand how these generative AI tools might affect IS education and suggests how educators could adapt. It outlines possible scenarios ranging from AI having minimal impact on IS education to becoming a competitor for IS educators. The challenges discussed include cheating, the impact on career readiness, changes in faculty roles, and strategies for responsibly integrating AI tools into educational settings. The authors recommend embracing these tools to enhance learning while preparing educators and students to use them effectively and ethically.

An examination of an education technology startup (Issa et al., 2024) using a qualitative case study approach sheds light on the potential downsides of implementing generative AI like ChatGPT. The study identifies three key concerns: hampered digital agility, increased technostress, and the need for process overhauls. While these technologies can streamline operations and offer innovative services, the research reveals challenges like higher workloads, stifled employee creativity, and a reliance on AI that could erode human expertise. This case highlights the broader organizational impact, suggesting a complex interplay between AI integration and its social, technical, and cognitive consequences.

A report on an academic panel discussion comprising university chancellors and presidents highlights the critical need for universities to develop human qualities such as critical thinking, empathy, and adaptability to harness the potential of AI effectively (Bansal et al., 2024). The report emphasizes the need for educational institutions to revamp curricula to prepare

students for a future heavily reliant on AI. This focus should prioritize human-AI collaboration and ethical considerations in technology use. The panelists call for an adaptable educational approach that can respond quickly to advancements in AI. This ensures higher education remains relevant and impactful in the face of rapid technological change.

A design science-based approach has been adopted to address how AI literature could be taught in IS education (Sengewald & Tremmel, 2024). Their study investigates effective methods to equip students with AI literacy that enhances their innovative capabilities. Utilizing this approach, the research outlines the development and evaluation of various learning archetypes essential for crafting an AI-centric curriculum. In a practical application, students were encouraged to use AI tools without restrictions in their projects. The findings indicate that those deeply engaged with AI tools substantially outperformed their peers, highlighting the importance of integrating critical engagement and understanding of AI technologies into the curriculum.

To summarize, we identify several challenges to the successful implementation of AI in IS education, including the following:

- Complexity of Real-World Applications. Implementing AI through practical, real-world scenarios proves to be a significant challenge. It is time-consuming to craft scenarios where students can effectively gather data. Resources like Kaggle can help, but the process demands substantial time and effort, which could be a barrier in educational settings.
- Platform and User Management Issues. The management of user roles and access within AI platforms presents operational difficulties, especially for educators. These challenges highlight the need for careful planning regarding user management and platform selection to ensure a smooth integration of AI tools in educational programs.
- Adaptation to New Teaching Methods. The integration of AI tools such as ChatGPT in IS education raises concerns about the adaptation required from both students and faculty. Issues such as potential cheating, impact on career readiness, and the need for significant changes in faculty roles necessitate strategies for responsibly integrating these tools into educational settings.

2.2 AI in Business Curricula

We are seeing a growing, inspiring interest among business schools in integrating AI into their curricula. Research shows that most of these programs revolve around machine learning and analytics (Chen, 2022). However, several pressing questions are yet to be addressed in developing a rigorous AI curriculum in business education. Lack of resources, such as AI faculty, a lack of consensus on the content of AI education, bridging the gap between the requirement of technical rigor of AI and business skills, and so on, blocking the business schools from establishing their own AI programs (Abdelwahab et al., 2023; Stine et al., 2019). A systematic collaboration is needed with different computing disciplines to develop an AI curriculum in a business context. A framework for evaluating, developing, and growing analytics and AI education for business schools to bridge the gap between supply and demand for analytics talent was proposed (Govindarajan & Sikka, 2020). The framework includes five major components: programs, curriculum, delivery models, collaborations, and career services. It emphasizes the need to accommodate different audiences, such as practitioners, orchestrators, and change agents, and suggests specialized programs for each group. It identifies the foundational technical skills that are essential for all students and the skills required to contribute to the successful implementation of AI to solve business problems. The article also explores different delivery models, highlighting the effectiveness of hybrid teaching with a combination of asynchronous and synchronous sessions.

2.2.1 Analysis of Example Business School's AI/ML Graduate Education. To identify leading business schools offering graduate programs in AI and ML, we utilized a comprehensive methodology that incorporates rankings from multiple prestigious sources. Specifically, we analyzed the 2024 rankings from U.S. News for the best business schools (U.S. News & World Report, 2024), Forbes' list of top business schools (Forbes, 2024), and the QS World University Rankings by Subject 2024 for Business & Management Studies (QS Top Universities, 2024). Based on these rankings, we selected the following illustrative examples of institutions that align with our program criteria. Our analysis includes the Massachusetts Institute of Technology (MIT) Sloan Business School (U.S. News, 5th; QS, 5th; Forbes, 7th), the Tepper School of Business at Carnegie Mellon University (U.S. News, 10th; QS, 63rd; Forbes, 17th), Georgia Tech (U.S. News, 25th; QS, 75th; Forbes, 28th), Wharton School of the University of Pennsylvania (U.S. News, 1st; QS, 7th; Forbes, 5th), University of California Berkeley (U.S. News, 7th, QS, 13th; Forbes, 11th), and London Business School (QS, 3rd) as an example from outside the U.S. that meets our program's standards.

Our analysis is intended to provide insights into some of the programs offered by well-regarded institutions, offering a snapshot of the diverse educational landscapes in AI/ML. The MIT Sloan Business School offers a master's in Business Analytics program (MIT Sloan School of Management, 2024), which strongly emphasizes analytics, encompassing AI and ML. The school also offers a course on "Artificial Intelligence: Implication for Business Strategy" for graduates with business backgrounds covering essential AI concepts, such as ML, NLP, and robotics in business, and the impact of AI in business and society (MIT, 2024).

The Tepper School of Business at Carnegie Mellon University (CMU) offers an online Master of Science in Business Analytics (MSBA) to prepare business and analytics professionals to thrive in the data-driven future with coverage of ML fundamentals and applications of ML in businesses (Tepper School of Business at Carnegie Mellon University, 2024). Georgia Tech's Master of Science in Analytics is a hybrid data science and analytics degree offered interdisciplinarity through Georgia Tech's Colleges of Computing, Business, and Engineering. Georgia Tech offers three tracks for students seeking a Master's in Analytics, which covers back ML and statistical modeling concepts (Georgia Institute of Technology, 2024). Wharton School of the University of Pennsylvania offers an "Artificial Intelligence for Business" course to provide learners with insights into the established and emerging developments in AI, Big Data, Machine Learning in finance, and the operational changes AI will bring (Wharton School of the University of Pennsylvania,

2024). The course starts with data management fundamentals, then moves to a module on introduction to AI and ML, followed by a module covering applications of ML in marketing, finance, and personalized business. Its final module discusses strategies for implementing AI within an organization and managing AI governance.

The University of California Berkeley offers a two-month-long program, "Artificial Intelligence: Business Strategies and Applications" (Berkeley Executive Education, 2024), which introduces basic applications of AI to those in business. While participants learn about AI's current capabilities and potential, they also gain more depth in automation, machine learning, robotics, and AI strategy. Throughout the course, participants develop and refine AI-related projects for their organizations. London Business School offers a "The Business of AI" program designed for executives and mid-to-senior-level managers with eight or more years of experience in management and leadership, which provides a solid understanding of AI, its advantages and limitations in business, the scope of AI and ML to create value for an organization and develop AI expertise (London Business School, 2024). In a nutshell, these programs introduce the concepts of foundations of analytics methods (Hartzel & Ozturk, 2022), data management techniques (Wang & Wang, 2023), introduction to AI/ML and some coverage of their advanced topics (Radovilsky & Hegde, 2022), some additional coverage of AI governance (Mäntymäki et al., 2022), and some level of hands-on experience on the application of AI/ML in business domain (Laato et al., 2020).

However, the intended audience of these programs is typically non-technical individuals who seek to understand the applications and implications of AI in a business context. As a result, the courses and modules offered in these programs provide a broad overview of AI concepts rather than in-depth technical training. To further illustrate the current landscape of AI education in business schools, a study analyzed AI courses from 46 business schools (Chen, 2022). This study reveals that ML is the most prevalent topic in these programs, accounting for 29% of the curriculum, followed by deep learning at 8%, and programming languages like Python and R at 17%. Interestingly, only 4% of the programs delve into industry-standard AI frameworks. The study also highlights the disparity in technical competencies, with "AI Producer" competencies forming 31% of the technical content, whereas "AI Consumer" aspects make up only 4%. We can summarize our observations of current trend in Applied AI education in the lens of CIS program's requirements as follows:

- Focus on Managerial Over Technical Skills. The programs are typically designed for non-technical individuals focusing more on a managerial understanding of AI rather than deep, technical expertise. This indicates a gap that CIS programs, with their technical orientation, could fill by providing more in-depth, hands-on learning experiences.
- Need for Strong Technical Competencies. There is an implied need for strong technical competencies in AI education. CIS programs should ensure robust programming modules are included, providing students with the necessary skills to implement and manage AI solutions effectively.
- Bridging the Producer-Consumer Gap. The disparity in technical competencies, with a higher focus on "AI Producer" skills in current programs, suggests a market need for graduates who are not just consumers but also creators of AI technology, addressing the critical problems of ethical building, deploying, and managing AI systems.

2.3 Information Systems (IS) and Artificial Intelligence (AI) Competency Models

Computer and Information Systems (CIS) is the discipline capable of bridging the gap between CS-focused AI and its application in the business domain. In the upcoming section, we will present our reasoning behind this claim. But first, let us review the two important competency models critical to this work.

2.3.1 MSIS 2016 - Global Competency Model for Graduate Degree Programs in Information Systems. We start the discussion with the review of MSIS 2016: Global Competency Model for Graduate Degree Programs in Information Systems developed by the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS) that guides degree programs in the Information Systems (IS) academic discipline (Topi et al., 2017). This model identifies three categories of core competencies: areas of IS competencies, individual foundational competencies, and domain competencies. The areas of IS competencies includes nine IS competency areas including Business Continuity and Information Assurance; Data, Information, and Content Management; Enterprise Architecture; Ethics, Impacts, and Sustainability; Innovation, Organizational Change, and Entrepreneurship; IS Management and Operations; IS Strategy and Governance; IT Infrastructure; and Systems Development and Deployment. It also emphasizes the development of individual foundational competencies, including Critical Thinking, Creativity, Collaboration and Teamwork, Ethical Analysis, Intercultural Competency, Leadership, Mathematical and Statistical Competencies, Negotiation, Oral Communication, Problem Solving, and Written Communication. This model can be tailored to develop a more domain-specific MSIS program.

2.3.2 AI Competency Model. The AI Competency Model (Anton et al., 2020) proposes a detailed categorization of the skills needed to effectively leverage AI in organizations. The authors use a rigorous mixed-methods approach, combining qualitative content analysis of the literature with quantitative analysis of over 9,000 job advertisements related to AI. Their key insight is to divide AI competencies into two broad categories: technical competencies and managerial competencies. Within technical competencies, the authors further distinguish between AI Producers, who invent, design and develop new AI algorithms, and AI Consumers, who apply AI to solve business problems. AI Producers need deep technical skills like programming, knowledge of AI frameworks, and STEM expertise. AI Consumers, on the other hand, require more domain knowledge and data management skills to properly frame business challenges and apply AI solutions. The identification of managerial competencies as equally important is another key contribution. This model emphasizes that technical wizardry alone is not sufficient - AI teams need communication, collaboration and business acumen to create value. The model also highlights the demand for these

competencies in major occupational categories like data science, software engineering, and business development.

2.3.3 Limitations of Both Models in the Lens of CIS Tailored AI Education. While both models are valuable for guiding education and competencies in their respective fields, the AI Competency Model (Anton et al., 2020) is specifically tailored for AI-related skills and roles, whereas the MSIS 2016 model provides a broader framework for general IS education. Each of the models has its limitations when it comes to the point of AI education tailored for CIS field, including:

- Lack of Integration of AI-Specific Technical Skills in MSIS 2016. The MSIS 2016 framework does not inherently focus on AI-specific technical skills like machine learning algorithms, AI programming, and data analytics at the depth required in the CIS field.
- Narrow AI Focus in the AI Competency Model. The AI Competency Model (Anton et al., 2020) overlooks broader IS competencies that are critical for a well-rounded CIS professional. It emphasizes AI production and consumption but lacks elements of wider system-integration and management.
- Insufficient Emphasis on Ethical Impacts of AI. While both models touch upon ethics and societal impacts, the rapidly evolving landscape of AI necessitates a more profound and dedicated focus on these aspects, particularly in AI-driven technologies where ethical considerations are increasingly complex and crucial.
- Limited Coverage of Interdisciplinary Applications. AI in the CIS field often requires an interdisciplinary approach, blending insights from fields like psychology, sociology, and business. Neither model sufficiently encapsulates the breadth of interdisciplinary knowledge and skills necessary for developing AI solutions that are effective, user-friendly, and socially responsible.
- Need for Advanced AI Management and Strategy Skills. As AI becomes more ingrained in organizational strategies, there is an increasing demand for skills in AI governance, strategic planning, and risk management. These are areas where both models could benefit from further development to fully prepare graduates for high-level decision-making roles involving AI.

3. PROPOSED COMPETENCY MODEL

As the intersection of Computer Science (CS) and Business, Computer and Information Systems (CIS) combines the technical foundations of CS with practical applications of Information Systems in a business context. Hence, compared to Computer Science (CS) and business disciplines, CIS has several advantages in adopting Applied AI for businesses, as outlined below:

- Holistic Understanding of Technical and Business Fundamentals. A CIS program curriculum covers technical aspects and business fundamentals, bridging the gap between CS and Business. With coverage of AI and ML, this comprehensive knowledge can equip CIS graduates with a deeper understanding of how AI can be integrated into business processes, strategies, and decision-making.
- Business Context-Oriented Practical Applications. CIS programs often emphasize hands-on experiences, providing students with practical skills in implementing and deploying technical solutions in real-world scenarios. This practical training, combined with their knowledge of business processes, organizational dynamics, and industry-specific requirements, enables CIS graduates to contribute immediately to developing, implementing, and managing AI projects within businesses. They can identify AI opportunities and tailor solutions that align with business goals, industry regulations, and customer needs, ensuring the successful integration of AI technology in a business context.
- Interdisciplinary Collaboration. CIS graduates are accustomed to collaborating with professionals from diverse backgrounds. This interdisciplinary collaboration is crucial in implementing AI projects effectively, as they require a multidisciplinary approach to leverage the strengths of different team members.
- System Analysis and Design. CIS professionals are trained to analyze and design complex systems, which aligns well with integrating AI technologies into existing business infrastructures. They can evaluate the impact of AI on various organizational components, such as business requirement analysis, system design, project management, modeling techniques, data management, security, privacy, and ethical considerations.

Next, we introduce an innovative Applied AI Competency Framework for CIS graduate programs, which merges the strengths of both the MSIS 2016 and AI Competency (Anton et al., 2020) models. This integration is tailored to effectively address the limitations of each model. In doing so, we have re-envisioned the MSIS 2016 framework, enriching it with the insights derived from the AI Competency Model (Anton et al., 2020). This strategic fusion facilitates a roadmap for adapting the core areas of the MSIS 2016 framework to meet the specific demands of Applied AI. Our detailed roadmap guides the adaptation of various MSIS 2016 focus areas to the realm of Applied AI. In Table 1, we map these redefined competencies to the AI Competency Model (Anton et al., 2020). This mapping not only underscores the compatibility between the two models, it also highlights the critical adaptations needed to meet the continuously changing requirements of AI in CIS education.

3.1 Adapting MSIS2016 Competencies to Applied AI

3.1.1 Business Continuity and Information Assurance (BCIA). The BCIA area focuses on information systems' continuity, auditing, and assurance. It involves planning and implementing procedures, operations, and technologies for managing risk, trust, security, safety, business continuity, and disaster recovery. Our recommendations for integrating AI into the BCIA domain are as follows:

- Develop policies and standards for ensuring the security and continuity of AI systems which involves creating guidelines and best practices to protect AI models, data, and infrastructure from unauthorized access, breaches, and disruptions.

- Plan and implement procedures, operations, and technologies for managing the risks associated with AI systems, such as adversarial attacks, data poisoning, and model theft. This includes identifying potential security threats, establishing risk management strategies, implementing security controls, and ensuring business continuity and disaster recovery plans tailored to AI applications, like model retraining requirements and data versioning.
- This task involves protecting the AI infrastructure and carrying out frequent checks and analyses to pinpoint any weaknesses within AI algorithms and data flows. Furthermore, establishing protocols for ongoing improvements, such as ensuring model clarity and maintaining detailed audit trails, is essential for the continuous enhancement and security of AI resources.

3.1.1.1 Proposed Applied AI Competency Area. AI Security and Risk Management (AISRM). This proposed competency covers various aspects of AI Competency Model (Anton et al., 2020). It primarily requires technical competencies for AI Producers in creating secure AI algorithms and for AI Consumers in applying AI for risk management. Additionally, it encompasses managerial competencies in policy development and strategic risk management for AI systems.

3.1.2 Data, Information, and Content Management (DATA). DATA competency provides a foundation for effectively managing structured and unstructured data and information. While this is relevant to the broader field of information management, including traditional data management practices, it may only partially encompass the specific needs and challenges of the AI field; therefore, it would be beneficial to expand this competency area to include AI-specific components. Our recommendations for integrating AI into the DATA domain are as follows:

- Equip students with the skills to perform statistical analysis and other data processing techniques essential for preparing data for AI models, including understanding and applying statistical methods to derive meaningful insights from large datasets.
- Identify and select AI-specific data management technologies and explore and evaluate AI- specific data management technologies and frameworks.
- Identify, create, and manage organizational policies and processes that govern AI data and information management's ethical, legal, and regulatory aspects, including the implications of AI technology decisions on data privacy, security, and data quality.
- Analyze the domain or AI project's specific data and information needs and identify the most effective ways to address those needs using data and information management solutions.
- Equip students with the skills to implement and manage large-scale datasets effectively, understanding the challenges and techniques specific to AI applications, such as handling high-volume and high-variety data sets comprising video, image, sensor reading, and language data, and ensuring the relevance and reliability of datasets for AI models.

3.1.2.1 Proposed Applied AI Competency Area. AI Data and Information Management (AIDM). This revised competency aligns with several of the technical competencies proposed in the AI Competency Model (Anton et al., 2020), including big data analytics framework, data management, and problem solving. Moreover, it incorporates essential managerial competencies, including strategic decision-making in business, promoting trust, and leadership skills, all within the context of AI data management.

3.1.3 Enterprise Architecture (EARC). EARC focuses on managing the complexity of information systems and aligning them with the organization's strategy, which provides a valuable foundation for the Applied AI framework. However, there are additional considerations specific to Applied AI that may need to be incorporated, as outlined in our proposal below:

- Integrate AI technologies and models into the existing enterprise architecture while considering scalability, reliability, and performance factors, as well as thoughtful selection and assessment of the impact and interoperability of AI solutions. Beyond mere integration, there is a need for the deployment and maintenance of an AI-specific architecture.
- Deploy and maintain an AI architecture which involves communicating and conveying the AI architecture to relevant stakeholders, considering the ongoing status of AI projects, and gathering input and feedback from the organization and the AI technology experts. It also involves performing regular maintenance and updates to the AI architecture to accommodate new developments in AI technology and changing organizational needs (e.g., upgrading an existing generic AI Chatbot with a robust, more business focused and efficient Large Language Model chatbot).

3.1.3.1 Proposed Applied AI Competency Area. AI-Driven Enterprise Architecture (AIEA). The proposed competency effectively integrates with a range of technical skills from the AI Competency Model (Anton et al., 2020), particularly those related to development methodologies and problem-solving strategies in the AI context. It also aligns with key managerial competencies, emphasizing the importance of effective communication strategies and astute business management.

3.1.4 Ethics, Impacts, and Sustainability (ETIS). The ETIS domain traditionally encompasses the development of environmentally and socially responsible IT solutions, aligned with legislative, regulatory, and industry standards. In the realm of Applied AI, this area assumes an even greater significance due to the unique ethical challenges and societal implications posed by AI technologies. Our proposal to adapt this domain to Applied AI is as follows:

- Understand and apply ethical frameworks specific to AI, considering issues such as fairness, transparency, accountability, and biases.
- Evaluate and mitigate the potential impacts of AI on employment and environmental sustainability, ensuring that AI deployments contribute positively to societal welfare (Hasan et al., 2024).
- Ensure privacy-by-design principles in AI development. This refers to implementing robust safeguards for sensitive data, adhering to stringent legal

and privacy regulations, and aligning with industry best practices.

3.1.4.1 Proposed Applied AI Competency Area. AI Ethics, Sustainability, and Impact (AIESI). The AI Competency Model (Anton et al., 2020) lacks explicit coverage of competencies related to ethics, sustainability, and impact in the AI domain. This omission is noteworthy given the growing importance of these areas in responsible AI development and deployment. By integrating a dedicated AI Ethics, Sustainability, and Impact (AIESI) competency, the model would be significantly enriched.

3.1.5 Innovation, Organizational Change, and Entrepreneurship (IOCE). The IOCE competency focuses on the ability to recognize and leverage the potential of current and upcoming technologies to address business opportunities. This area encompasses competencies needed to understand and intervene in various domain activities, utilizing information technologies to enhance the structure and performance of those activities. In Applied AI, IOCE involves recognizing and harnessing the potential offered by AI technologies to address existing and emerging business opportunities. Our proposal to adapt this domain to Applied AI is as follows:

- Monitor the AI landscape to identify and evaluate new methods, including advancements in machine learning algorithms, deep learning, and AI-driven analytics, to identify technologies that align with and advance an organization's strategic goals.
- Assess the benefits and potential risks of AI integrations, such as the implications of machine learning models on operational efficiency, customer experience, and market dynamics.
- Create strategic plans to capitalize on the potential of new and emerging AI methods and technologies for novel purposes within an organization.
- Design and implement business strategies that incorporate AI technologies, such as robotic process automation, AI-based customer service tools, and data-driven decision-making systems, to transform business operations across various levels—individual, team, and organizational.

3.1.5.1 Proposed Applied AI Competency Area. AI Innovation, Organizational Change, and Entrepreneurship (AIOCE). Much like the omission of competencies focused on the ethical and sustainability aspects of AI, the AI Competency Model (Anton et al., 2020) also falls short in widely addressing the utilization of AI techniques for driving innovation within business domains. It lacks in-depth exploration of integrating AI strategies for transformative innovation and organizational change.

3.1.6 IS Management and Operations (ISMO). The ISMO area covers the capability to develop, maintain, and consistently improve domain performance while providing appropriate information systems, services, and infrastructure. ISMO can be adapted to address the specific needs and challenges related to AI implementation and management, including the following:

- Apply professional management skills, such as resource allocation, talent management, and governance structures to design and manage an effective AI-driven organization.
- Ensure operational efficiency and effectiveness in the delivery of AI solutions. Focus on machine learning performance optimization, seamless AI Integration, and process automation.
- Govern AI project management principles and support their application within the organization, ensuring successful planning, execution, and delivery of AI projects. Govern AI projects by adhering to AI project lifecycle principles and agile methodology tailored for AI. Manage risks in AI Projects, strategize AI deployment, coordinate cross-functional AI teams, and develop comprehensive AI project roadmaps for effective AI innovation management.
- Manage AI systems and technologies, including data collection, preprocessing, model training, evaluation, and deployment, while considering ethical and legal implications.
- Manage information resources specific to AI in collaboration with line management and domain experts, including AI developing knowledge graphs, algorithm management, and AI-driven content curation.

3.1.6.1 Proposed Applied AI Competency Area. AI System Management and Operation (AISMO). This competency aligns closely with multiple aspects of the AI Competency Model (Anton et al., 2020), particularly in technical areas such as in-depth knowledge of AI technologies, understanding of various AI frameworks, and familiarity with AI development methodologies. Moreover, it resonates with key managerial competencies highlighted in their model, including advanced people and social skills essential for team management and effective communication strategies critical for successful AI project execution and stakeholder engagement.

3.1.7 IS Strategy and Governance (ISSG). The ISSG competency area focuses on creating and implementing long-term plans for organizational information systems, monitoring and controlling IS resources, and establishing oversight mechanisms. We can focus on incorporating the strategic and governance aspects specific to AI technologies to adapt the MSIS2016 Competencies in IS Strategy and Governance (ISSG) to the Applied AI field. The adapted competencies may include the following:

- Analyze the effect and impact of AI on industries, firms, and institutions. Utilize AI cost-benefit analysis, resource optimization, and AI budgeting techniques. Assess the AI readiness of organizations and conduct AI Market Trend Analysis.
- Develop and implement long-term plans for designing, deploying, delivering, and utilizing AI systems to achieve organizational objectives. Utilize predictive modeling and business intelligence to align AI systems with organizational objectives.
- Establish governance frameworks specific to AI technologies. It involves understanding the process of applying and analyzing governance frameworks tailored for AI, ensuring ethical and responsible AI practices.

3.1.7.1 Proposed Applied AI Competency Area. AI Governance (AIG). The model proposed by the AI Competency Model (Anton et al., 2020) falls short in adequately addressing the crucial aspect of long-term strategic planning and governance for AI projects, particularly in terms of aligning them with overarching organizational objectives.

3.1.8 IT Infrastructure (INFR). The INFR area covers competencies that allow graduates to contribute to needs analysis for and design and implementation of effective, technically correct IT infrastructure solutions. Besides the fundamental competencies specified in INFR, additional competencies are required for an AI environment, including:

- Define requirements for data ingestion, real-time analytics, and supporting intelligent applications in a particular domain. This includes focusing on AI data pipeline design, real-time data streaming requirements, and intelligent application support structures.
- Design and implementation architecture tailored for organizational data processing and system solutions suited to AI-based applications. Key considerations should include bandwidth optimization for AI data flow, latency reduction in AI processing, scalability for AI model growth, and robust security measures for AI systems.
- Negotiate and manage contracts with providers of AI infrastructure services, ensuring compliance with data privacy regulations and security considerations specific to AI workloads.

3.1.8.1 Proposed Applied AI Competency Area. AI Infrastructure (AIF). This competency aligns with and amplifies the competencies highlighted in the AI Competency Model (Anton et al., 2020), particularly emphasizing the integration of managerial skills in communication and business strategy. Specifically, it underscores the importance of aligning AI infrastructure with organizational goals, ensuring effective data handling, and fostering clear communication channels within the AI context.

3.1.9 Systems Development and Deployment (SDAD). The SDAD area covers the design of information systems and services, including how humans interact and experience IT artifacts. It also includes competencies related to implementing and deploying systems for organizational use. We propose the following recommendations to adapt this competency to the AI domain:

- Understand the limitations of existing methods (e.g., conventional programming) and define requirements for AI artifacts that can enhance existing business and create new scope of expansion.
- Design architectures that integrate AI with traditional systems for efficient, synergistic solutions. This includes leveraging the strengths of both AI and legacy systems to optimize overall system performance. Such integrations should also focus on scalability, to adapt to evolving business needs, and interoperability.
- Apply and specify requirements for AI artifacts by studying and documenting the whole or part of some domain activities. This process involves conducting a detailed analysis of the operational and strategic activities within a specific domain to identify where AI can add value.
- Perform system analysis and design on AI artifacts by considering functional and non-functional requirements. This involves evaluation of functional requirements, as well as non-functional requirements like usability, and efficiency.
- Implement the AI system, which involves coding, testing, and deploying the system to production. Incorporate feedback from users and other entities into the system throughout the process in an iterative manner.
- Develop skills for rigorous testing and evaluation of AI models, focusing on performance metrics and reliability.

3.1.9.1 Proposed Applied AI Competency Area. AI System Development and Deployment (AISDAD). Although the AI Competency Model (Anton et al., 2020) encompasses a range of technical and managerial competencies, these are dispersed throughout the model, resulting in a somewhat fragmented presentation. Crucially, this model lacks a cohesive and explicit focus on the iterative feedback loop, an essential aspect in the design, development, deployment, and maintenance of AI systems. This oversight leaves a gap in the model's ability to fully encapsulate the dynamic and evolving nature of AI system development. In contrast, the proposed competency emphasizes a more integrated approach, where continuous feedback and adaptation play a central role in ensuring the effectiveness and relevance of AI systems within organizational contexts. These proposed competencies are mapped to the MSIS2016 and AI competency (Anton et al., 2020) models in Table 1, showing how they build upon and enhance both models.

4. PROPOSED CURRICULUM MODEL

In the previous section, we define the competencies that graduates need to attain to satisfy the requirements of an MS in Applied AI under the CIS discipline. Going forward, we use the term MSAIS to distinguish this specific program from a traditional CIS program. It is important to recognize that the choice of a program name is at the discretion of individual institutions. This section aims to present a model curriculum for the MSAIS program, designed to be adaptable and customizable in alignment with the distinct needs and specifications of different departments or universities.

Proposed Applied AI for CIS Competency	Base Competency (MSIS2016, Topi et al., 2017)	AI Competency Model (Anton et al., 2020)	Enhancement and Additions for AI
AI Security and Risk Management (AISRM)	Business Continuity and Information Assurance (BCIA)	Technical Competencies (e.g., knowledge AI algorithm, problem solving); Managerial Competencies (e.g., decision making, communication)	Builds on the BCIA with AI-specific security policies and standards. Implements risk management strategies and continuous improvement policies for AI systems.
AI Data and Information Management (AIDM)	Data, Information, and Content Management (DATA)	Technical Competencies (e.g., big data analytics framework, data management, and problem solving); Managerial Competencies (e.g., decision making, people and social skills)	Maintains essential data management principles while expanding to include AI-specific technologies, frameworks, and ethical and legal considerations.
AI-Driven Enterprise Architecture (AIER)	Enterprise Architecture (EARC)	Technical Competencies (e.g., problem solving, programming, frameworks, STEM knowledge); Managerial Competencies (e.g., communication)	Enhances EARC by integrating and maintaining AI technologies, focusing on AI-specific scalability, reliability, and performance. Communicates changes effectively.
AI Ethics, Sustainability, and Impact (AIESI)	Ethics, Impacts, and Sustainability (ETIS)	Lacks an explicit coverage of several key areas related to this competency	Builds on ETIS principles by incorporating AI-specific ethical frameworks, addressing the impacts of AI on employment and sustainability, and implementing privacy-by-design.
AI Innovation, Organizational Change, and Entrepreneurship (AIOCE)	Innovation, Organizational Change, and Entrepreneurship (IOCE)	Lacks an explicit coverage of several key areas related to this competency	Extends IOCE by harnessing AI for new business opportunities and integrating AI strategies for innovation and organizational change.
AI System Management and Operation (AISMO)	IS Management and Operations (ISMO)	Technical Competencies (e.g., knowledge in AI technologies, frameworks, development methodologies); Managerial Competencies (e.g., people and social skills, communications)	Applies ISMO principles to AI project management. Optimizes AI integration and machine learning performance. Addresses AI technology applications and ethical considerations.
AI Governance (AIG)	IS Strategy and Governance (ISSG)	Lacks an explicit coverage of several key areas related to this competency	Develops AI-focused strategic planning and governance frameworks based on ISSG principles. Conducts AI readiness assessments and aligns AI initiatives with organizational goals.
AI Infrastructure (AII)	IT Infrastructure (INFR)	Technical Competencies (e.g., data management, development methodologies, problem solving); Managerial Competencies (e.g., communication, business acumen)	Defines AI-specific requirements for data ingestion and analytics based on INFR principles. Designs AI-optimized infrastructure architectures. Ensures compliance with AI-specific security standards.
AI System Development and Deployment (AISDAD)	Systems Development and Deployment (SDAD)	While covers several key areas related this competency are addressed, the model lacks a cohesive and explicit focus on the iterative feedback loop	Focuses on AI-driven system design and iterative development based on SDAD. Implements AI enhancements to business processes. Develops rigorous AI testing practices.

Table 1. Mapping of Proposed Applied AI Competency Model to MSIS2016 and AI Competency Model

4.1 Sample Curriculum

We adopted the U.S. Model presented in MSIS 2016 to develop our sample curriculum for MSAIS. Typically, a master's program in this field includes 10-12 courses, each carrying three semester credits, summing up to 30-36 semester credits in total. Our curriculum framework is primarily based on this U.S. Model, as our development process did not extend to a comprehensive analysis of international Computer Information Systems (CIS) graduate programs. The curriculum architecture we propose comprising eleven courses, each worth three semester credits. These courses are organized as follows:

- Essential for program entry, this includes a foundational understanding of application development, data and information management, IT infrastructure, systems analysis, design, acquisition, project management, and the role of information systems in organizations. This knowledge base is typically acquired in ABET-accredited various computing-related (e.g., IS, CS, Software Engineering) undergraduate programs. Candidates lacking in these areas would be required to complete bridge courses prior to admission. These bridge courses provide a complete overview and solid grounding in essential computing concepts and practices. They typically cover topics such as basic programming principles, understanding of databases, fundamentals of network and hardware infrastructure, introduction to software development life cycles, and an overview of key concepts in systems analysis and design. Furthermore, these courses often include modules on project management techniques specific to IT projects and an exploration of the strategic role of information systems in organizational contexts. The bridge courses not only ensure that all incoming students possess a uniform level of competence in core computing areas but also prepare them for the advanced and specialized curriculum of the program.
- Several courses that cover fundamental concepts of Applied AI and IT, including machine learning, deep learning, natural language processing, computer vision, programming foundation, applied statistics, advanced data management, and analytics.
- A blend of courses covering fundamental managerial competencies, including business management, business development, collaboration, leadership, and communication in an AI-driven business and organization.
- An extensive project that integrates multiple competencies, as outlined in Table 1, allowing students to apply their learning in a practical context.

Based on this outline, next, we present eleven sample courses for an MSAIS program. We present the mapping of this curriculum with our proposed Applied AI competencies in Table 2.

4.1.1 Introduction to Applied Artificial Intelligence. This introductory course provides a broad overview of AI, covering essential concepts, machine learning algorithms, and models. Emphasizing on key competencies like ethics, AI-driven business innovation, and governance, it offers hands-on experience with AI/ML tools (including non-coding tools, Wang and Wang, 2022) and programming languages for large datasets. This course serves as a gateway to the Applied AI Competency Model. The course includes case studies and scenarios demonstrating how AI is applied in various business sectors. It includes discussions on how AI-driven solutions can address real-world business challenges and opportunities.

	Proposed Applied AI Competencies								
Module/Course	AISRM	AIDM	AIEA	AIESI	AIOCE	AISMO	AIG	AII	AISDAD
Introduction to Applied Artificial Intelligence	×	×	×	×	×	×	×	×	×
Applied Statistics		×							
Applied AI Programming and Lifecycle		×							×
Advanced Machine Learning and Deep Learning									×
AI Technologies for Business Enhancement		×			×				
Advanced-Data Management and Analytics		×							
Information Assurance and Risk Management	×	×							
Advanced Enterprise Architecture and Infrastructure			×					×	
AI Governance and Ethics				×					×
AI-Enabled Organizational Innovation and Change					×				
AI Capstone Project	×	×	×	×	×	×	×	×	×

AISRM: AI Security and Risk Management
AIDM: AI Data and Information Management
AIEA: AI Enterprise Architecture
AIESI: AI Ethics, Sustainability, and Impact
AIOCE: AI Innovation, Organizational Change, and Entrepreneurship
AISMO: AI System Management and Operation
AIG: AI Governance
AII: AI Infrastructure
AISDAD: AI System Development and Deployment

Table 2. Mapping of the Proposed Sample Curriculum to the Proposed Applied AI Competencies

4.1.2 Applied Statistics. This foundational course focuses on the practical application of statistical concepts and techniques in the field of AI and business. The course emphasizes the use of statistics to analyze and interpret data, enabling students to make decisions and draw meaningful insights. Through hands-on exercises and programming projects, students will develop proficiency in using statistical methods to solve business problems, such as market analysis, customer segmentation, and sales forecasting.

4.1.3 Applied AI Programming and Lifecycle. Students utilize programming skills to explore essential AI and ML concepts using frameworks (e.g., scikit-learn). Through practical exercises and projects, students will gain hands-on experience in implementing AI algorithms and building ML models. The course provides a solid foundation for further studies and application of AI techniques in business domains. The course introduces the lifecycle of an AI project–from data collection, preprocessing, model selection, training, validation, and deployment to post-deployment monitoring–which is important for everyone involved in an AI project. Furthermore, the course explores into methodologies for evaluating a model, including accuracy, precision, recall, and the trade-offs involved helps in making informed decisions about the project's direction.

4.1.4 Advanced Machine Learning and Deep Learning. This course is designed as an advanced course building upon the foundations of AI Programming. It covers advanced ML techniques and introduces deep learning. Students will broadly understand various machine learning algorithms, including unsupervised learning, reinforcement learning, and neural networks, and utilize popular frameworks to gain hands-on experience on implementing their understanding to solve real-world business problems.

4.1.5 AI Technologies for Business Enhancement. This course offers an in-depth exploration of essential AI technologies critical for modern business applications. It begins with foundational AI technologies such as Natural Language Processing (NLP) and Computer Vision, which are pivotal for the digital transformation across various sectors. NLP is crucial for processing and analyzing textual data prevalent in business functions including customer service, marketing, compliance, and human resources. Similarly, Computer Vision is instrumental in interpreting and analyzing visual data, supporting industries from retail to healthcare. To address a broader spectrum of AI applications in business, the course will introduce modular sections on various sub-areas. This includes robotics, which focuses on automation and efficiency in manufacturing, logistics, and operations, and FinTech, which explores AI applications in algorithmic trading, credit scoring, and personalized financial services. Each module is designed to equip students with practical knowledge and skills to leverage AI in driving business innovation and efficiency.

4.1.6 Advanced Data Management and Analytics. This course focuses on the principles and techniques of managing and analyzing large-scale databases and performing analysis of the data to support AI applications. Students will gain a deep understanding of database management systems, data modeling, and query optimization to efficiently handle vast amounts of data. The course covers various advanced analytics techniques, including data warehousing, data lakes, and data visualization to extract valuable insights from complex datasets. The students will learn how to develop and implement data strategies that align with organizational goals. This includes understanding how to assess data needs, identify valuable data sources, and ensure that data management practices support strategic objectives. They will also learn about the life cycle of data from collection to disposal, ensuring they can oversee processes that maintain the quality and integrity of data throughout.

4.1.7 Advanced Enterprise Architecture and Infrastructure. The course explores advanced concepts and techniques for designing and managing scalable, reliable infrastructures to support AI applications. Students will gain hands-on experience leveraging cloud computing platforms to effectively deploy and scale AI solutions. The course also delves into big data frameworks and technologies, equipping students with the skills to efficiently handle and analyze massive datasets. By integrating cloud computing and big data frameworks within the broader context of enterprise architecture, students will develop the expertise to architect and optimize infrastructure solutions that enable the successful implementation of AI initiatives. Throughout this course, students will learn to align IT infrastructure planning with broader business strategies. This includes understanding how to assess current and future technology needs, plan for scalability, and ensure that infrastructure investments support organizational growth and transformation. It will allow them to explore leadership strategies for guiding teams through the implementation of new technologies. This includes communicating the business value of infrastructure investments and leading change management efforts.

4.1.8 Information Assurance and Risk Management. The course equips students with the knowledge and skills to ensure the security, integrity, and privacy of AI systems and data. The course covers essential concepts and methodologies related to information assurance and risk management in the context of AI applications. Students will explore various strategies for identifying, assessing, and mitigating risks associated with AI technologies, data handling, and system vulnerabilities. Topics covered include data protection, encryption, access control, threat modeling, and incident response. Students will understand how to identify and prioritize risks based on their potential impact on the organization and develop strategies that balance risk mitigation with operational efficiency and innovation. It will involve students exploring how to lead the development of a security-minded culture within their organization. This includes strategies for raising awareness, changing behaviors, and ensuring that all employees understand their roles in maintaining the security and integrity of AI systems and data.

4.1.9 AI Governance and Ethics. This course explores the critical aspects of responsible and ethical AI practices in organizations. It delves into the ethical implications, societal impacts, and legal considerations of AI technologies and applications. Students will examine real-world case studies and discuss privacy, bias, transparency, accountability, and fairness in AI systems. The course also covers the governance

mechanisms and regulatory frameworks that govern AI adoption, including data protection, compliance, and risk management. Students will explore strategies for developing AI governance frameworks, policies, and practices that align with organizational values and societal expectations.

4.1.10 AI-Enabled Innovation and Change. This course explores the transformative impact of AI technologies on businesses and organizations. It focuses on how AI can drive innovation, catalyze change, and create new industry opportunities. Students will study real-world examples and case studies to understand how AI reshapes business models, processes, and customer experiences. They will examine the role of AI in fostering creativity, enhancing decision-making, and enabling disruptive innovations. The course also covers strategies for effectively integrating AI into organizational culture and driving change. Students will learn to identify AI-enabled innovation opportunities, assess their potential value, and develop implementation strategies. Additionally, the course addresses the challenges and considerations associated with AI adoption, such as ethical implications, organizational readiness, and stakeholder engagement.

4.1.11 AI Capstone Project. This project-based course integrates and applies the core competencies in Applied AI. Students will work on a real-world AI challenge or opportunity, applying their knowledge and skills to develop and deploy an AI solution. This course provides students with a comprehensive learning experience, allowing them to showcase their expertise in various Applied AI competencies while solving complex real-world problems. The course covers the entire AI software lifecycle, starting with problem identification and requirements analysis, followed by data collection and preprocessing to ensure high-quality datasets for model training. Students will then develop AI models using machine learning and deep learning techniques, integrating these models into broader systems. The course emphasizes rigorous testing and validation to ensure model performance and reliability. Students will also learn to deploy AI systems in real-world environments, addressing scalability and real-time data processing challenges. Post-deployment, the course covers continuous monitoring, updating, and maintaining AI systems to ensure their effectiveness over time. Additionally, students will address ethical considerations and governance standards, ensuring their projects adhere to data privacy, security, and ethical guidelines throughout the lifecycle.

5. CONCLUSION

AI has the power to transform many industries, making it crucial to educate professionals who can harness their potential for driving ethical and sustainable business innovation. Numerous studies have underscored AI's potential to transform business landscapes by enhancing decision-making and problem-solving capabilities, improving operational processes and organizational performance, elucidating value-generation mechanisms, and boosting trust in technological applications. Additionally, research highlights AI's role in boosting HR efficiency and reducing operational costs. Despite these advantages, the Computer and Information Systems (CIS) discipline must adopt a structured approach to address the challenges posed by AI in business contexts.

This paper reviews existing research at the intersection of AI and IS education, including efforts by prominent business schools and analyses of the MSIS2016 and AI Competency Models. Our findings indicate that while current programs offer managerial insights into AI, they often lack in-depth technical training, revealing a significant gap that CIS programs can fill by providing more technically oriented, hands-on learning experiences. Current competency models also demonstrate shortcomings in integrating specific AI skills, maintaining an AI focus, addressing ethical concerns, covering interdisciplinary applications, and promoting advanced AI management and strategic skills. To overcome these limitations, we propose a competency model for a master's program in Applied AI within the CIS discipline, blending technical AI knowledge with practical applications from two different competency models. This model includes a flexible curriculum that can be customized by institutions to meet diverse needs. By implementing this framework, we aim to equip future AI professionals with the necessary skills and expertise to drive substantial organizational change while ensuring ethical and socially responsible outcomes. Institutions should leverage their unique strengths, such as expertise in AI and specific business domains, to effectively tailor AI-focus CIS program. A strategic hiring plan is crucial to recruit faculty and staff with specialized AI knowledge, including industry professionals as adjunct faculty to infuse real-world experience into the curriculum, or young researchers who bring innovative AI research ideas. Additionally, forming collaborative partnerships with businesses and other organizations can enrich the program by providing practical insights, keeping the curriculum current, and offering students hands-on experiences through internships, co-op placements, and project-based learning initiatives. We propose several directions of future work to further enhance and evaluate the curriculum and competency model.

- Our study primarily focuses on the MSIS2016 model as it is applied in the United States. This geographic limitation means that the findings might not fully reflect the diversity of educational practices and needs at a global level. Future research could expand the scope to include a more diverse set of geographic locations to provide a broader perspective on AI in CIS education.
- The research predominantly examines prominent universities, potentially overlooking the variations in how AI is integrated into IS education across different types of institutions, such as R1 (major research universities), R2 (doctoral), and institutions that focus primarily on teaching. A more granular analysis, considering the specific needs and constraints of different types of universities, could yield insights that are more universally applicable and inclusive of various educational contexts.
- There is also a need for a region-wide and university grade-wide evaluation to understand the current landscape of AI in IS education more thoroughly. This would allow for a more detailed assessment of how different institutions are adapting to the challenges and opportunities presented by AI technologies.
- Future research should involve empirical studies to assess the effectiveness of the proposed curriculum. This could include longitudinal studies tracking the

career progress of graduates to determine how well the skills acquired align with industry demands.

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Several AI-based tools, such as ChatGPT, Google Gemini, and Grammarly, were utilized to improve the writing of this paper.

7. REFERENCES

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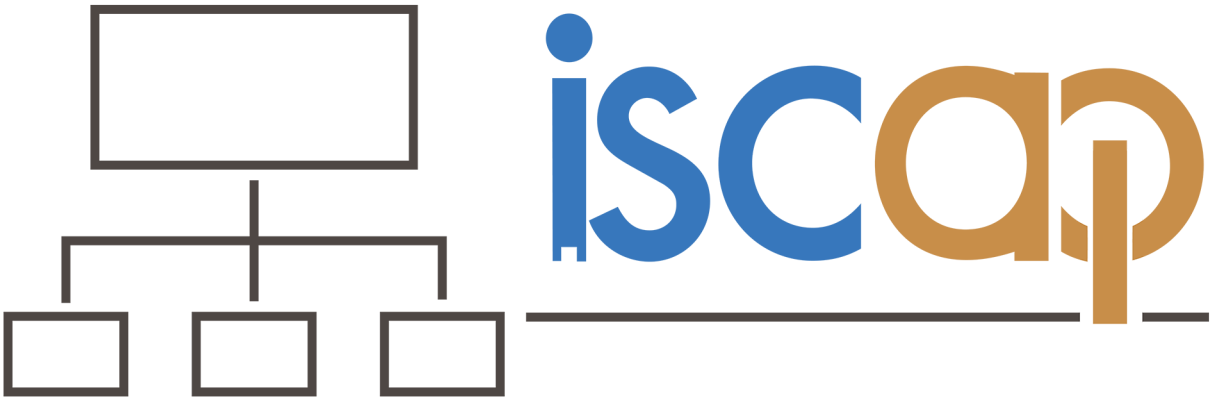

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