Integrating AI into Higher Education: Enhancing Graduate and Undergraduate Programs for the Future Workforce.

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ABSTRACT

As AI increasingly influences various aspects of society, there is a growing urgency to equip students with the knowledge and skills needed to navigate this rapidly evolving field. Universities are responding by developing AI-focused courses and degree programs, while global technology companies and online platforms provide complementary training and certification opportunities.

At the undergraduate level, integrating AI into curricula offers students a foundational understanding of AI concepts and hands-on experience with technologies like natural language processing, computer vision, robotics, and intelligent systems. This exposure enhances technical proficiency, problem-solving, and critical thinking skills, preparing students for current job market demands. Graduate programs take a more advanced, research-oriented approach, focusing on cutting-edge areas like machine learning, deep learning, and predictive modeling. These programs encourage students to tackle complex projects, often involving interdisciplinary applications in fields such as medicine, finance, and environmental science. Graduate students also explore innovation and entrepreneurship, examining how AI can disrupt industries and create new business models.

Integrating AI into Computer Science (CS) and Information Systems (IS) programs enhances student engagement, proficiency learning outcomes, and career readiness and prepares students to leverage AI responsibly and effectively in the global job market. This paper identifies key AI topics and proposes how they can be seamlessly integrated into undergraduate and graduate curricula to optimize learning and achieve critical educational outcomes.

Keywords: Artificial Intelligence, Computer Science Education, Machine Learning, Personalized Learning, Ethical AI, Research, Graduate Programs, Undergraduate Programs.

INTRODUCTION

The technological innovations of the 21st century have fundamentally transformed how the world operates [1], creating entirely new areas of expertise and workforce demands [2,3,4,5]. The interdisciplinary interest from scholars in linguistics, psychology, education, and neuroscience as well as other disciplines, who examine AI through the lens of their respective fields, such as its nomenclature, perceptions, and knowledge poses challenges in defining AI [6]. This has necessitated the development of AI categories within specific disciplinary contexts.

There is a pressing need for widespread education across all sectors to prepare society to thrive in an increasingly AI-driven world [3, 7]. While some AI specialists argue that a fundamental understanding of AI may not be necessary [8], we contend that equipping individuals with foundational knowledge of AI and its diverse, ever-expanding applications is essential [9,10,11,12]. This includes fostering opportunities for scientists, engineers, medical professionals, and anyone working with data to grasp the basics of machine learning, deep learning, and other AI techniques shaping our world. We do not suggest that every student needs a Ph.D. in AI or machine

learning; rather, we emphasize the importance of broader education to meet society's diverse needs [12]. Educators, as reflective practitioners, have a unique responsibility to understand the implications of integrating AI into educational systems and to actively prepare students for their roles as informed stakeholders and citizens in a technology-driven society.

Higher education institutions must acknowledge that technological advancements, particularly in artificial intelligence (AI), are transforming the job landscape. Both workers and students will need to adapt, and higher education must be ready to equip students with the skills necessary to thrive in the evolving workforce. The rapid advancements in Artificial Intelligence (AI) have revolutionized a wide range of industries, including healthcare, finance, transportation, and manufacturing. These innovations are not only enhancing efficiency and innovation in these sectors but are also reshaping the way we think about the future of work, problem-solving, and decision-making. AI's transformative impact presents an exceptional opportunity to revolutionize education, particularly in Computer Science (CS) and Information Systems (IS) programs, where students are trained to lead in technology-driven fields. Governments are increasingly pressuring universities to enhance graduate employability [13,14,15]. Consequently, graduate employability has garnered significant academic attention, often highlighting discrepancies between employers' and graduates' perceptions of its defining factors [16].

The 2021 National Security Commission on Artificial Intelligence (NSCAI) Final Report emphasized the urgency of accelerating AI innovation to benefit the United States while countering its malign uses. It identified the lack of human talent in AI-enabled technologies as the greatest barrier to U.S. national security and stressed the need to cultivate a digitally literate, AI-ready workforce by 2025 [17], all of which advocate for significant modifications to university curricula to address emerging workforce knowledge and skill needs. Furthermore, technological, socio-economic, geopolitical, and demographic changes will significantly influence industry needs, the job market, and the structure of academic degrees [18]. To prepare society with a future-ready workforce, students, faculty, and higher education leadership must embrace transformative changes. It is crucial to integrate the skills and abilities essential for the future into educational curricula [19]. The graduates of today will not only fill new job roles but also play a vital role in creating them. This paper focuses on the application of AI in higher education. As the field of Artificial Intelligence in Education (AIEd) evolves rapidly, there is a growing need to enhance academic understanding of its implications. Scholars such as [20,21] have highlighted the importance of exploring AIEd's transformative potential in educational contexts.

AI CONCENTRATION FOR BS IN COMPUTER SCIENCE PROGRAM

The field of AI is vast and rapidly evolving, making it essential to carefully define the objectives of a proposed 4-course concentration in AI within the CS program. Before finalizing the curriculum, we should thoroughly examine the field to determine the desired outcomes for students and the core areas to emphasize.

One foundational aspect of AI is classical AI, which focuses on search techniques. The primary goal here is to find optimal solutions within a large search domain. An intelligent agent is designed to perform this search, identifying the "best" solution while optimizing a specific objective function. These agents are programmed to emulate aspects of human intelligence. Examples

include navigating a maze efficiently, or a computer playing chess against a human with the objective of winning. Key topics in this area include search algorithms, knowledge representation using logic and inference, and the application of Bayes' rule and Bayesian statistics to address problems involving uncertain knowledge.

To ensure students gain a comprehensive understanding of AI, the concentration should include partial coverage of classical AI, exposing students to its foundational concepts and showcasing the breadth of the field. This approach will help them appreciate the diverse methodologies and applications within AI.

Beyond traditional AI, which involves programming agents to perform search-based tasks, there is the domain of machine learning and deep learning, which rely on neural networks. In these approaches, a model is trained on an existing dataset and subsequently used for tasks such as predictions, classifications, and identifications. Unlike traditional AI, there is no predefined code to execute specific tasks; instead, the model learns patterns from the data. The quality and performance of the model are highly dependent on the quality and relevance of the training data.

Machine learning is typically divided into three main categories:

1. **Supervised Learning**: In this approach, the training data is labeled, allowing the model to learn from known input-output relationships.
2. **Unsupervised Learning**: Here, the training data is unlabeled, and the model identifies patterns or structures within the data.
3. **Reinforcement Learning**: The model learns by interacting with an environment and receiving rewards or penalties based on its actions.

While there are variations and overlaps in these categories, these three areas provide a foundational framework. Each category encompasses its own set of theories, tools, applications, and training algorithms. Most of these algorithms are already implemented and are available as add-on packages in widely used programming languages such as Java, C#, and Python. Among these, Python is the preferred choice for most AI developers due to its simplicity and extensive library support for AI-related tasks.

The proposed concentration will cover all three learning methods—supervised, unsupervised, and reinforcement learning—using Python as the primary programming language. This focus will equip students with both theoretical knowledge and practical skills in leveraging these methods for diverse AI applications.

Deep learning, a subset of machine learning, is widely used for prediction and classification problems. Unlike traditional machine learning methods, deep learning employs neural networks to train models, often involving multiple layers to improve accuracy and cope with complexity. Applications such as image recognition and Large Language Models (LLMs) leverage deep learning with multilayer neural networks to achieve impressive results.

The application of AI in image, text, and audio processing, recognition, and generation is one of the fastest-growing areas of AI today. These domains encompass a range of specialized concepts,

mathematical formulations, algorithms, and tools that are critical for effective study, implementation, and evaluation of such systems.

When discussing AI applications in image and text recognition, it's essential to consider tools like **OpenCV** and **Scikit-image** for image processing, which provide a foundation for understanding and manipulating visual data. For natural language processing (NLP), tools like Python's **NLTK** and **Gensim** are pivotal. NLP focuses on enabling machines to comprehend and interact with human language, playing a vital role in applications such as speech recognition, language translation, and sentiment analysis.

Large Language Models (LLMs), a key advancement in NLP, are trained to generate and comprehend natural language text, offering capabilities that range from drafting coherent responses to performing complex textual analyses. These technologies form the backbone of many AI-driven solutions in text-based processing and understanding.

AI technologies in vision, text, and audio processing have paved the way for the emergence of **generative AI**, which is revolutionizing the field. Generative AI, a sophisticated application of deep learning, uses neural networks to process various inputs—including text, images, and audio—and generates new, original content based on the user's request. This transformative capability is underpinned by the concept of **prompt engineering**, which involves carefully crafting input requests to guide the system toward producing the most desirable outcomes.

Among the various implementations of generative AI, **transformer-based models** have emerged as the most prominent. Transformers provide a robust framework for handling diverse data types and tasks, making them a cornerstone of modern generative AI systems. This concentration will delve into the principles and techniques behind these transformative AI methods.

The AI concentration should ideally emphasize hands-on, project-based learning to ensure students gain practical experience. Incorporating elements of cloud computing and cloud services would add significant value by exposing students to industry-relevant technologies. Additionally, the program should prioritize the use of open-source tools, fostering accessibility and alignment with current industry practices. To enhance its credibility and appeal, the concentration should align with a recognized industry certification, or a program offered by a reputable university. In summary, the 4-course AI concentration emphasizes a comprehensive understanding of both classical and modern AI techniques. The curriculum will cover foundational concepts, such as classical AI with search algorithms and optimization, as well as Bayesian statistics for uncertain knowledge.

The concentration will also explore machine learning, divided into three categories: supervised learning (using labeled data), unsupervised learning (identifying patterns in unlabeled data), and reinforcement learning (learning through interaction with an environment). Python will be the primary language for practical applications, with an emphasis on deep learning and neural networks for tasks like prediction and classification.

Key AI applications, such as image, text, and audio processing, will also be covered, using tools like OpenCV, Scikit-image, and Python's NLTK and Gensim. The curriculum will delve into

natural language processing (NLP), including advancements like Large Language Models (LLMs), which enable machines to understand and generate human language.

A significant portion of the concentration will focus on generative AI, powered by deep learning and transformer-based models, which generate original content across different data types. The goal is to provide students with both theoretical insights and practical skills in AI, equipping them to navigate the evolving field.

IMPLEMENTATION:

The four-course Artificial Intelligence (AI) concentration within the undergraduate Computer Science (CS) program is currently under development and is expected to launch in early 2026. This concentration aims to provide students with a solid foundation in core AI concepts, methods, and applications, preparing them for careers in industry or further academic study. While there is an abundance of books, online courses, and reference materials covering various aspects of AI, it has proven challenging to identify textbooks that offer an ideal balance of depth, breadth, and accessibility suitable for undergraduate students. Consequently, no single required textbook has been assigned for these courses. Instead, the concentration will leverage a diverse range of resources, primarily utilizing the O'Reilly digital library of books and videos available through the institution's subscription. Additionally, carefully selected lessons, scholarly articles, and reputable online content will supplement the learning experience, ensuring students receive a comprehensive and up-to-date education in this rapidly evolving field.

To promote hands-on learning and practical skill development, a limited annual budget has been approved to fund cloud computing resources specifically for the AI concentration. These cloud services will enable students to engage in real-world projects involving the deployment and management of AI solutions in a cloud environment. Initially, cloud accounts will be provided to students, with the program director responsible for monitoring and managing usage to ensure that expenditure remains within approved budgetary limits. The goal is to gradually and thoughtfully integrate cloud computing into the curriculum, enhancing students' technical competencies and industry readiness.

To continuously improve the program, an exit survey will be administered to students upon completion of concentration. The survey will seek feedback on the curriculum, instructional resources, learning experiences, and overall satisfaction. Insights gathered from the survey will be analyzed to inform future refinements and enhancements, ensuring the concentration remains responsive to both student needs and the evolving demands of the AI field.

INTEGRATION OF AI SPECIALIZATION INTO THE MS IN COMPUTER SCIENCE PROGRAM

We propose introducing an AI and Machine Learning specialization within the existing MS in Computer Science (MSCS) program. The proposed specialization aims to achieve the following:

- Equip students with advanced knowledge and practical skills in AI technologies and methodologies.
- Foster innovative thinking and interdisciplinary collaboration to address real-world challenges using AI.

- Enhance students' career readiness by aligning the curriculum with industry needs and emerging trends.
- Strengthen the university's reputation as a leader in cutting-edge computer science education.

This specialization aligns seamlessly with the MSCS program's mission of preparing students for leadership roles in technology and innovation. By integrating advanced AI coursework, the specialization enhances the program's ability to provide a comprehensive education that bridges theory with practical application. It positions the university as a forward-thinking institution that stays at the forefront of technological trends. The following are some of the stakeholders' benefits

- **Students:** Gain advanced expertise and skills to excel in high-demand AI-related careers.
- **Industry:** Benefit from a pipeline of well-trained AI professionals capable of driving innovation.
- **University:** Strengthen its reputation and competitiveness in graduate education, attracting high-quality applicants and fostering academic excellence.

Reports from leading organizations such as the World Economic Forum and McKinsey emphasize the increasing demand for AI professionals across industries. According to LinkedIn's Emerging Jobs Report, AI specialists rank among the most sought-after roles, highlighting the critical need for skilled individuals in this field. The proposed AI specialization will equip graduates with the knowledge and skills necessary to fill these roles and drive advancements in AI-driven innovations. By integrating this specialization into the MSCS program, the university will not only address a critical industry need but also reinforce its commitment to delivering a future-ready education. This initiative will empower students, support industry growth, and enhance the university's position as a leader in computer science education. To align with student interests and market needs, a survey was conducted among current and graduated MSCS students to gather feedback on the existing curriculum. An overwhelming majority expressed a strong interest in incorporating AI-focused coursework into the program. Based on this feedback and the undeniable relevance of AI and Machine Learning in today's job market, the decision was made to introduce an AI specialization. This addition not only reflects the program's commitment to staying ahead of industry trends but also promises to attract high-caliber applicants and retain students seeking advanced expertise in this area. The proposed AI specialization positions the MSCS program as a leader in technological education, addressing the evolving needs of students, industry, and society. By integrating advanced AI coursework with experiential learning opportunities, the specialization ensures that graduates are well-prepared to excel in the rapidly evolving AI landscape. The curriculum will include four carefully selected courses designed to provide a comprehensive foundation in AI, Machine Learning, and their applications. This strategic addition will enhance the program's appeal, align with industry demands, and empower students to pursue successful and impactful careers in AI.

Course #1: Programming in Python

The proposed course, Programming in Python, is designed to provide students with a comprehensive foundation in Python, one of the most versatile and widely adopted programming languages in both academia and industry. Python's simplicity, readability, and robust ecosystem

of libraries make it an ideal language for students pursuing careers in fields such as software development, data analysis, artificial intelligence (AI), machine learning, and web development. This course will play a pivotal role in the curriculum, equipping students with the technical skills and problem-solving abilities required to succeed in today's technology-driven landscape. Python is not only user-friendly but also powerful enough for advanced programming tasks, making it a language that caters to a broad range of expertise levels. By including this course, students will gain the knowledge and skills needed to:

- **Understand Python Fundamentals**: Master the syntax, data structures, and core programming constructs of Python.
- **Solve Real-World Problems**: Apply Python to automate tasks, analyze data, and develop software solutions efficiently.
- **Leverage Advanced Libraries**: Use Python libraries and frameworks for data processing, visualization, web development, and machine learning.
- **Develop Scalable Applications**: Write clean, efficient, and maintainable code using Python's best practices and design principles.

This course aligns closely with industry and academic trends, reflecting Python's widespread use in cutting-edge applications across sectors. It also prepares students to:

- Participate effectively in interdisciplinary projects where Python is a common tool.
- Transition seamlessly into specialized courses or career roles requiring Python expertise.
- Gain a competitive edge in the job market, where Python skills are highly valued.

Incorporating Programming in Python into the curriculum ensures that students are equipped to meet the demands of modern computing environments. It not only fosters a strong programming foundation but also empowers students to innovate, solve complex problems, and excel in their academic and professional pursuits.

Course #2: Applied Optimization Methods

The proposed course, Applied Optimization Methods, is designed to equip students with the theoretical knowledge and practical skills required to address complex decision-making challenges across diverse disciplines, including computer science, engineering, operations research, data science, and artificial intelligence. Optimization is essential for solving problems that involve efficient resource allocation, cost minimization, or performance maximization under constraints. These techniques are critical in fields like data analytics, robotics, financial modeling, and algorithm design. This course will provide students with a strong foundation in optimization techniques, enabling them to apply these methods effectively in both academic research and industry contexts. The course ensures that students develop the skills needed to solve real-world challenges, enhancing their employability and preparing them for roles in cutting-edge industries where optimization is integral.

By bridging the gap between mathematical theory and practical implementation, this course empowers students to apply optimization techniques to solve multi-variable, real-world problems. The key learning outcomes include:

- **Understanding Core Principles**: Master foundational concepts in linear, nonlinear, and combinatorial optimization.
- **Problem Formulation and Modeling**: Learn to define and model optimization problems mathematically in various domains.
- **Algorithmic Applications**: Implement and analyze algorithms such as linear programming, gradient descent, and evolutionary algorithms.
- **Tool Utilization**: Gain hands-on experience with optimization tools and libraries in programming environments like Python or MATLAB.
- **Real-World Problem Solving**: Apply optimization techniques to scenarios in diverse fields and interpret results to make data-driven decisions.

This course will also prepare students for advanced topics in computational sciences, such as machine learning, operations research, and algorithm development, providing a pathway for deeper exploration in these areas. By integrating optimization methods into the curriculum, students will gain a competitive advantage in tackling complex, high-impact problems, ensuring they are well-positioned to meet the demands of today's technology-driven industries.

Course #3: Neural Network & Deep Learning

The proposed course, Neural Networks and Deep Learning, is designed to equip students with a robust understanding of advanced machine learning techniques that form the foundation of many transformative applications in artificial intelligence (AI). This course is essential for providing students with both the theoretical framework and hands-on experience needed to design, implement, and optimize neural network-based solutions for complex, real-world challenges.

Deep learning has revolutionized AI, driving advancements in fields such as natural language processing, computer vision, robotics, autonomous systems, and generative AI. Industries worldwide are increasingly leveraging neural networks to innovate, enhance operations, and create value in areas like healthcare, finance, retail, and entertainment. As a result, expertise in deep learning is now a key competency for professionals in computer science and AI. By offering this course, the MS in Computer Science program will stay aligned with industry demands and cutting-edge trends in AI research and development.

Upon successful completion of this course, students will be able to:

- Grasp the mathematical foundations of neural networks, including concepts like backpropagation, gradient-based optimization, and activation functions.
- Design, implement, and train neural network models using leading frameworks such as TensorFlow or PyTorch.
- Apply deep learning techniques to solve domain-specific problems, such as image classification, natural language processing, time-series prediction, and generative modeling.
- Evaluate and improve model performance using techniques like hyperparameter tuning, regularization, and advanced optimization strategies.
- Understand and address ethical considerations in neural network applications, including issues of bias, fairness, and the societal impact of AI systems.

The demand for professionals skilled in deep learning is growing exponentially. Reports by LinkedIn and Gartner list roles such as AI Engineer, Machine Learning Scientist, and Data Scientist among the fastest-growing job titles globally. Breakthroughs in generative AI, such as models like GPT and DALL·E, further highlight the transformative potential of deep learning technologies and the need for professionals with deep expertise in this domain.

This course will solidify the MS in Computer Science program's reputation as a leader in preparing students for emerging AI-driven careers. By integrating theoretical concepts with practical applications, it will prepare graduates to excel in high-demand roles and contribute meaningfully to the evolution of AI technologies. Neural Networks and Deep Learning is a vital addition to the MS in Computer Science curriculum, addressing the pressing need for advanced expertise in AI. By empowering students with cutting-edge skills, this course will enhance their career prospects and contribute to advancing technology and innovation across industries.

Course #4: Machine Learning Deployment

The proposed course, Machine Learning Development, is designed to equip students with the theoretical foundation and practical skills necessary to design, build, and deploy machine learning (ML) models. As machine learning becomes increasingly pervasive across diverse industries, this course plays a critical role in preparing students for careers in artificial intelligence, data science, and other technology-driven fields. Machine learning is among the most transformative technologies in computer science, enabling advancements in automation, predictive analytics, and intelligent decision-making systems. By offering this course, the MS in Computer Science program ensures that students are prepared to meet industry demands and excel in the rapidly evolving field of AI.

Machine learning has become a cornerstone of innovation across sectors, including healthcare, finance, retail, and manufacturing. The ability to develop and deploy ML models is a key competency for professionals in these industries. This course aligns the MS in Computer Science curriculum with current job market trends, addressing the increasing demand for skilled ML practitioners. By mastering these skills, students will be positioned to secure high-demand roles and drive impactful technological advancements. Upon completing this course, students will be able to:

- **Understand Core ML Concepts:** Grasp the principles of supervised, unsupervised, and reinforcement learning and their practical applications.
- **Build ML Models:** Develop proficiency in implementing machine learning models using popular libraries and frameworks such as Scikit-learn, TensorFlow, and PyTorch.
- **Prepare and Pre-process Data:** Learn best practices for cleaning, transforming, and preparing data for training robust and reliable ML models.
- **Optimize ML Models:** Acquire skills to evaluate, tune, and enhance models for improved accuracy, efficiency, and scalability.
- **Deploy and Monitor Models:** Understand the end-to-end ML lifecycle, including deployment to production environments and ongoing model performance monitoring.
- **Address Ethical Challenges:** Gain awareness of ethical considerations in ML, such as ensuring fairness, transparency, and accountability in real-world applications.

The inclusion of Machine Learning Development in the MS in Computer Science curriculum is crucial to maintaining the program's competitiveness and relevance in the field. By providing students with a robust foundation in machine learning, the course will not only enhance their technical capabilities but also prepare them to innovate and lead in a data-driven world. This course will ensure that graduates are poised to meet the challenges and seize the opportunities presented by the increasing integration of machine learning into various domains.

CONCENTRATIONS FOR BS IN INFORMATION SYSTEMS PROGRAM

The Bachelor of Science in Information Systems (BSIS) program at XXX University is designed for students seeking to apply computing technologies to solve complex business challenges. By bridging the gap between business and technology, the program emphasizes the practical and organizational applications of computers and related technologies, focusing on a non-technical approach to problem-solving. BSIS students acquire the skills to leverage technology in addressing operational, tactical, and strategic issues faced by organizations. This unique blend of business and technology expertise prepares graduates to meet the growing demand for professionals who can effectively connect these domains. Career opportunities for BSIS graduates include roles such as Business and Systems Analyst, Information Technology Manager/Director, IT Project Manager, and IT Consultant. The curriculum integrates foundational subjects, such as project management and systems analysis, with advanced courses in business process integration and computing technologies. This combination equips students with the knowledge and practical skills needed to navigate the dynamic intersection of technology and business management successfully.

A proposal for two concentrations in a BSIS program:

1. **Information Management Concentration**: This concentration emphasizes the strategic use of data and technology to enhance organizational decision-making and operational efficiency. Students develop skills in technology integration and process optimization to address real-world business challenges.
2. **Business Management Concentration**: This concentration requires students to complete three courses from the business school, offering a comprehensive understanding of core business principles. Key topics include management theory, organizational structure and behavior, effective communication, team management, human resource management, and strategies for managing change and fostering innovation.

We are exploring the integration of AI into the BSIS program, aligning seamlessly with the program's mission to bridge the gap between business and technology. As the corporate landscape continues to evolve, the demand for professionals capable of effectively connecting these two domains has never been greater especially in the realm of AI. Roles involving intelligent systems, automation, and data-driven decision-making increasingly call for expertise in AI applications. Incorporating AI into the curriculum will equip students with the knowledge and skills necessary to remain competitive in today's rapidly changing job market. This enhancement will empower graduates to address operational, tactical, and strategic challenges using cutting-edge technologies. Additionally, it will directly support long-term career paths for BSIS graduates, such as Business Analyst, IT Manager, and IT Consultant, by enabling them to implement and manage innovative,

technology-driven solutions effectively. By integrating AI, the program will ensure students are well-prepared to meet industry demands and excel in roles that require a seamless combination of business acumen and technological proficiency. This strategic addition reflects our commitment to preparing graduates who are not only ready to adapt to emerging trends but also to lead in an increasingly AI-driven world.

We propose incorporating the following four courses into the BSIS program to enhance its curriculum with foundational and applied knowledge in Artificial Intelligence (AI):

1. **Introduction to AI**:
   This course offers students a comprehensive introduction to the field of Artificial Intelligence, focusing on its core technologies and real-world applications. Students will explore the foundational stages of an AI project, gaining a solid understanding of key concepts such as machine learning models, neural networks, deep learning algorithms, and data mining techniques. Designed as a gateway to the world of AI, this course equips students with the essential knowledge and skills needed to comprehend and engage with AI systems effectively.

2. **Machine Learning: Supervised and Unsupervised Learning and Applications**:
   This course builds on the foundational knowledge introduced in "Introduction to AI," providing an in-depth exploration of machine learning techniques. Students will study both supervised and unsupervised learning methods, gaining hands-on experience with practical applications such as autonomous navigation, biomedical informatics, biometrics, and text and web mining. The course is designed to equip students with the skills and knowledge needed to leverage machine learning to solve real-world challenges effectively.

3. **Deep Learning: Neural Networks and Applications**:
   This course provides a comprehensive introduction to the fundamental principles of neural networks and deep learning. Students will explore advanced applications of deep learning, including computer vision, natural language processing, autonomous vehicles, and drone technologies. Emphasizing the transformative impact of deep learning across industries, the course equips students with the skills and knowledge required to contribute to cutting-edge AI projects and innovations.

4. **Ethics in AI**:
   This course delves into the ethical considerations surrounding the growing integration of AI into society. Students will explore key issues such as privacy, bias, accountability, and the broader societal impacts of AI technologies. Through case studies and discussions, the course fosters critical thinking and responsible decision-making, preparing students to navigate and address ethical challenges posed by AI in real-world contexts.

The proposed AI courses offer structured progression from foundational concepts to specialized techniques like machine learning and deep learning, with a focus on business applications and organizational impact. A dedicated ethics course ensures students understand the societal implications of AI. Topics such as supervised/unsupervised learning, neural networks, and autonomous systems prepare students for AI-driven decision-making and business optimization.

The proposal aligns with the BSIS program's mission to bridge business and technology by equipping students to address real-world challenges while maintaining a non-technical approach. These courses complement existing offerings in project management and systems analysis, enhancing students' interdisciplinary skills and market relevance. The inclusion of AI topics ensures the program remains competitive, preparing students for roles in data-driven decision-making, automation, and advanced analytics, while promoting responsible AI integration.

The technical complexity of AI may challenge the BSIS program's non-technical mission. To address this, AI courses should focus on practical applications for business decision-making and operational efficiency, aligning with the program's goals. Implementing these courses may require hiring AI experts and developing new materials, increasing resource demands. To mitigate this, industry resources like Intel's AI for the Workforce and AWS AI for Educators can be leveraged, offering tools and materials at minimal additional cost. AWS AI, with its focus on cloud-based AI and business applications, is especially suited for cloud-enabled businesses, though it may require extra preparation for non-technical students and is tied to the AWS ecosystem.

Intel's AI for the Workforce offers a comprehensive, workforce-oriented curriculum covering both technical and non-technical AI applications, with a focus on workforce readiness and ethical considerations. It provides a broader foundation, emphasizing practical applications across industries, which aligns with global trends in responsible technology use and the BSIS program's mission to equip students with employable skills. Unlike AWS AI, which requires familiarity with AWS tools, Intel's program is more flexible and accessible to both technical and non-technical learners. For the BSIS program, Intel's AI for Workforce is the ideal choice, as it aligns with the goal of integrating business and technology. It offers a comprehensive introduction to AI, illustrating its application in business contexts such as healthcare, retail, and finance, making it highly relevant for BSIS graduates pursuing roles in business analysis, IT management, or consulting.

IMPLEMENTATION AND EVALUATION OF AI-FOCUSED COURSES

To ensure success and long-term effectiveness of the proposed AI-focused curricula, it is critical to establish a comprehensive framework for both implementation and evaluation. As part of this process, pilot versions of the new AI concentration courses should be launched with an initial cohort of students. The effectiveness of these courses can be evaluated using a combination of direct and indirect measures. Direct measures might include assessments of student performance on capstone projects, course-specific evaluations, and skill-based assessments. Indirect measures could involve student self-assessments, alumni surveys, employer feedback, internship placements, and post-graduation employment outcomes.

In addition, key metrics such as course completion rates, student retention, GPA trends, and job placement rates can be tracked to assess the broader impact of the AI curriculum on academic achievement and career readiness. Collecting and analyzing longitudinal data will provide valuable insights into the curriculum's effectiveness over time and support evidence-driven decision-making for continuous refinement. Close collaboration with the institution's Office of Institutional Research and Centers for Teaching and Learning can further strengthen the evaluation process by applying best practices in educational assessment. Regular analysis of both qualitative and

quantitative data will enable institutions to identify areas for improvement, adjust course content, and evolve teaching strategies to better meet student needs and industry demands.

Ultimately, assessment findings will be integrated into an ongoing cycle of continuous improvement, ensuring that the AI curriculum remains current, market-relevant, and aligned with both academic standards and workforce expectations.

SCALABILITY AND INSTITUTIONAL READINESS

While the development of a high-quality curriculum is essential, the successful implementation of an AI concentration also hinges on the institution's overall readiness. Effective integration of AI programs at scale requires careful and strategic planning across multiple dimensions, including faculty development, infrastructure support, and administrative coordination. Faculty training is a foundational element of this readiness. Institutions must initiate targeted faculty development programs to equip instructors with both the technical expertise and the modern pedagogical strategies necessary for delivering AI-focused content. This may include workshops, certifications, and continuing education opportunities in collaboration with industry leaders. Strategic partnerships with organizations such as Intel's AI for Workforce Program and AWS's AI and Machine Learning Educator initiatives can significantly enhance faculty upskilling efforts, providing access to cutting-edge resources, professional development courses, cloud computing platforms, and real-world tools used by AI professionals.

In parallel, institutions must assess and upgrade their technological infrastructure to support the demands of AI education. This could involve investments in specialized hardware, such as high-performance computing systems, GPUs, and dedicated AI labs, as well as procurement of software licenses for essential tools like machine learning libraries, data analytics platforms, and cloud services. Universities should carefully evaluate current budget allocations and seek external funding opportunities, including industry sponsorships, federal grants, and research partnerships, to offset the cost of these investments. Administrative alignment is equally critical to ensure a smooth rollout. Clear policies regarding course scheduling, workload adjustments for faculty, resource management, and support services must be established to accommodate the evolving needs of an AI-focused program. Early identification and proactive management of these operational and resource-related factors will facilitate a seamless and scalable integration of AI curricula across multiple departments and campuses, positioning the institution for long-term success in preparing students for AI-driven careers.

ENHANCING REAL-WORLD EXPERIENCE THROUGH HANDS-ON LEARNING

While the paper commendably emphasizes the importance of project-based learning and industry-aligned content, it is equally critical to provide a more comprehensive roadmap for how students will gain meaningful real-world experience throughout their academic journey. Merely designing projects within courses is not sufficient; robust, structured experiential learning opportunities must be intentionally embedded into the curriculum. For example, capstone projects incorporated into senior-level AI courses should engage students with real-world data sets, encourage the development of deployable solutions, and promote collaboration with external stakeholders. Whenever possible, projects should be designed in partnership with industry professionals who

can serve as mentors, offering students valuable insights into practical challenges, professional expectations, and current technological trends. Beyond capstones, formalizing partnerships with local, regional, and national companies can create a pipeline of internship and cooperative education (co-op) opportunities in AI-focused roles. Such partnerships not only enhance students' professional readiness but also help universities build relationships that can support curriculum relevancy, job placement rates, and long-term program sustainability.

Furthermore, establishing advisory boards that include active industry practitioners and thought leaders can provide ongoing feedback to ensure that course content remains aligned with rapidly evolving workforce demands. These boards can also assist in identifying emerging skill gaps, recommending new tools and technologies, and fostering greater integration between academic learning and industry practice. To broaden experiential learning further, integrating service-learning projects, where students use AI to address real-world societal challenges, and encouraging participation in faculty-led research assistantships will create additional pathways for hands-on engagement. These experiences will empower students to apply classroom knowledge to authentic, interdisciplinary problems, fostering both technical competence and a deeper understanding of the broader impact of AI solutions. By deliberately incorporating these strategies, the curriculum can better prepare students not just to understand AI theories and tools, but to thrive as adaptable, innovative professionals in a dynamic, real-world environment.

CONCLUSION

In conclusion, AI is currently viewed as an enhancement to the broader fields of Computer Science (CS) and Information Systems (IS), rather than a complete overhaul of existing curricula and pedagogy. An academic degree in CS or IS with AI components is not expected to radically transform these fields but rather to incorporate AI through specific learning objectives. The proposal does not advocate for curricular changes that would lead to longer graduation times or increased cognitive load. Based on demand, we can consider several complementary approaches:

1. **Minimal Change**: Offer AI courses as electives, without altering the core curriculum, as a starting point.
2. **Integration of AI Content**: Introduce AI-related modules into existing technology-focused courses or integrate them into an introductory course on AI, machine learning, and deep learning, while keeping the core structure intact.
3. **Introduction of AI Courses**: Add one or more dedicated AI courses to the curriculum, without significantly altering the current structure.
4. **Significant Program Modification**: Develop a specialized concentration in AI.

The selection of AI topics and the corresponding courses within each program was carefully guided by multiple factors, including academic relevance, current and projected industry demand, and alignment with the evolving needs of the job market. In addition to traditional academic curriculum development practices, we systematically analyzed certification frameworks—such as Intel's AI for Workforce and AWS's AI Educator programs, to ensure that our course content aligns with industry-recognized competencies and standards. This dual focus on academic rigor and market-driven relevance forms the cornerstone of our AI concentration. Our AI concentration differentiates itself from similar offerings at other institutions in several meaningful ways. First, the curriculum

is intentionally structured to offer a balanced blend of theoretical foundations and hands-on practice. Beyond technical skills, we emphasize critical topics such as ethical considerations, responsible AI deployment, real-world business applications, and the creation of deployable AI solutions. While many AI programs tend to prioritize deep technical specialization, our approach is notably interdisciplinary. By doing so, we make the concentration accessible not only to students from traditional Computer Science backgrounds but also to those from Information Systems and other technically adjacent fields.

Another distinguishing feature is the curriculum's modular design, which allows institutions flexibility in adopting the concentration either in full or in phases, based on their resources and readiness. The use of open-source platforms, O'Reilly's digital library, and cloud-based tools further enhances the adaptability of the program, making it scalable and cost-effective across diverse institutional contexts. However, designing and proposing this curriculum was not without challenges. One of the major hurdles was ensuring accessibility and inclusivity for students with varying levels of technical expertise, particularly within the BSIS (Bachelor of Science in Information Systems) program. To overcome this, we adopted a scaffolded instructional approach, beginning with introductory courses that establish core concepts before gradually progressing to more complex and specialized topics. This structured progression allows students to build confidence and competence incrementally, ensuring a more equitable learning experience.

Overall, the deliberate combination of academic rigor, industry alignment, interdisciplinary accessibility, modular adaptability, and a scaffolded learning path ensures that the AI concentration is both forward-looking and inclusive, preparing a broad range of students to succeed in a rapidly evolving field.

As academicians, it is essential to consider internal and external factors that ensure the feasibility, sustainability, and relevance of any program change. Therefore, we recommend a gradual approach to integrating AI into the CS and IS programs. The first step would be introducing AI-related topics into core courses, followed by adding more AI-focused modules and courses in the second phase. Ultimately, we can consider a specialized program emphasis or concentration in AI as the final step.

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