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This form is to be used with all new degree/certificate proposals as outlined in the process on the Academic Affairs website at https://www.uwyo.edu/acadaffairs/degrees. Departments shall use this form to provide documentation of collaboration and support for any courses and/or resources that will be contributing to the new degree/certificate that are not within the home department.

Date: 10/20/2023

Name of Proposal: MS in Artificial Intelligence

Department: EECS, SoC

College: CEPS

The above-named degree/certificate proposal has been reviewed by the following departments/colleges and all appropriate courses and resources have been discussed prior to proposal submission:

Bryan Shader, EECS	Bryan L Shader
Department Head	Signature
Gabrielle Allen, SoC	Gallen
Director	Signature
Cam Wright	
Dean	Signature
Cam Wright, CEPS	Cam Wright
Dean	Signature

Submitted on: 10/20/2 (date)

By: Bryan Shac

Feasibility Study for Artificial Intelligence (AI) Master's degree program

Executive Summary

Degree Title: Artificial Intelligence (AI) Master's degree program
Level of Degree or Certificate: Masters
Delivery Mode(s): Hybrid
Estimated Startup Cost of Degree: None; existing resources will be utilized to start the program
Anticipated Launch Date: Fall 2024
Description: The Artificial Intelligence (AI) Master's degree program is a postgraduate program that focuses on advanced study and research in AI. It is designed to equip students with the necessary knowledge, skills, and expertise to understand, develop, and apply AI technologies in various domains.

Table of Contents

1 A. Overview and Description of Degree

The Master of Science in Artificial Intelligence program comprises two years of coursework, thesis research, research projects, and practical applications of Artificial Intelligence (AI). The program will offer both Plan A and Plan B degrees, comprising 30 required credits. The Plan A degree program will comprise 24 required coursework credits, two seminar credits, and four thesis research credits (XX5960). Students must complete an accepted research thesis for the Plan A degree program approved by the student's graduate committee. The Plan B degree program, a non-thesis option, will comprise 28 required coursework credits and two seminar credits. A student pursuing the Plan B degree program as part of the 28 required coursework credits can do an independent study project at the graduate level of a maximum of three credits. In the future, based on the enrollment demand, both Plan A and Plan B degree programs could be delivered online. It is important to note that the specific structure and curriculum of this AI Master's program may vary among students based on discipline-specific AI and broader AI advancements. Coursework includes

- **Core Courses (12 credits).** The program begins with foundational courses covering essential AI topics, such as machine learning, computer vision, and data mining. These courses provide a solid understanding of AI's fundamental principles and algorithms. UW already offers several courses that will be used here, including

  COSC 4550/5550 Introduction to Artificial Intelligence;
  COSC 4555/5555 Machine Learning;
  COSC 4557/5557 Practical Machine Learning, and
  COSC 4570/STAT 4240/5240 Data Mining.
- **Elective Courses (12 credits for Plan A and 16 credits for Plan B).** Students can choose from various elective courses based on their interests and career goals. These courses may include specialized topics like deep learning, natural language processing, reinforcement learning, neural networks, robotics, AI ethics, AI in healthcare, AI for business, and intelligent agents. Electives allow students to deepen their knowledge in specific areas of AI that align with their research or professional interests. UW already offers several courses that will be used here, including

  PHIL 5440 Topics in the Philosophy of Mind; and
  COSC 5560 Modern Robots and Softbots.

  The goal of this program will be to allow for discipline-specific specialization through course offerings and other program requirements. Specific specialization tracks or concentrations may be established, such as AI for healthcare, AI for robotics, AI for cybersecurity, or AI for natural language processing. These 'tracks' would be noted on the final degree.
- **Research Projects for Plan B Students:** Throughout the Plan B degree program, students are involved in research projects supervised by faculty members or industry experts. These projects provide hands-on experience designing and implementing AI systems, conducting experiments, analyzing data, and addressing real-world AI challenges. Research projects often culminate in a final research paper.
- **Seminars (2 credits).** Regular seminars and workshops will be organized to expose students to the latest research advancements, emerging trends, and challenges in AI. Experts from academia, industry, and government will deliver talks and engage in discussions, allowing students to broaden their perspectives and stay updated with the evolving AI landscape. The SoC and EECS will host, co-host, or support tech talks, colloquia, or speaker series with discipline-specific and broad AI foci.

B. Program Purpose

The Artificial Intelligence (AI) Master's degree program is a postgraduate program that focuses on advanced study and research in AI. It is designed to equip students with the necessary knowledge, skills, and expertise to understand, develop, and apply AI technologies in various domains.

The demand for AI professionals has been steadily increasing in recent years. AI technologies are being adopted by various industries, including healthcare, finance, retail, manufacturing, and transportation, requiring skilled AI practitioners. The growth of AI is expected to continue in the coming years, leading to an increasing number of job openings. AI technologies such as deep learning, natural language processing, and computer vision continually advance, creating new possibilities for AI applications and driving the need for skilled professionals. The program is designed to help meet workforce demands as well as position graduates into promising careers in important, evolving areas of the future economy, including

- Academic and Research Opportunities. Universities and research institutions are actively involved in AI research and development. Other academic institutions offer AI-related courses, programs, and research opportunities to train the next generation of AI professionals and advance the field through cutting-edge research. AI professionals must have a strong foundation in mathematics, statistics, programming, and machine learning. Proficiency in programming languages such as Python and R, knowledge of machine learning algorithms, and experience with AI frameworks and tools (e.g., TensorFlow, PyTorch) are highly valued.
- Industry Opportunities. AI is being applied across various industries and sectors. For example, AI is used in healthcare for medical imaging analysis, drug discovery, personalized medicine, and healthcare chatbots. In finance, AI is employed for fraud detection, algorithmic trading, and risk assessment. In e-commerce, AI is used for personalized recommendations and customer service chatbots.

C. Program Strategic Overlay

The MS in AI supports UW's Strategic Plan by

- Enhancing student success and preparing students for life and adaptation to a changing and increasingly digital world.
- Providing a highly sought-after degree in a fast-growing workforce sector that will help grow both domestic and international enrollments.
- Raise UW's Scholarly capacity and profile nationally and internationally in Artificial Intelligence and its applications; and strengthen UW's relationships with external partners and stakeholders in the technological and computational sectors.
- Serve the State of Wyoming by providing AI-savvy graduates for our businesses, agencies, and educational institutes.
- Grow educational opportunities for Wyoming around the transformational area of Artificial Intelligence.

The MS in AI is a critical component of the EECS department's goal of developing research program that is nationally and internationally competitive and relevant to the Wyoming by focusing on a few specific areas that have significant anticipated funding growth and economically disruptive technologies. Those areas are (a) modern power grid data analysis and modeling, (b) artificial intelligence/machine learning/QISE, (c) visual and interactive computing and (d) cybersecurity and the internet-of-things.

Similarly, the MS in AI is central to the School of Computing's aims to provide University of Wyoming students, faculty and staff, and Wyoming businesses and citizens with the computational tools, skills and approaches to drive transformation and innovation in the state. The School of Computing will champion broader efforts to make the University of Wyoming more digital, inclusive, interdisciplinary, and entrepreneurial through computing partnerships across Wyoming.

2. Learning Outcomes

These learning outcomes aim to prepare graduates for various AI-related career paths, including research, development, implementation, and strategic decision-making in organizations leveraging AI technologies. The specific learning outcomes of the program may be altered based on the student's goals, faculty expertise, and the evolving needs of the AI industry.

- **Understanding of AI Fundamentals.** Graduates should have a solid understanding of AI's foundational concepts, principles, and algorithms. This includes knowledge of machine learning, deep learning, natural language processing, computer vision, robotics, and statistical methods.
- **Proficiency in AI Techniques and Tools**. Students should gain hands-on experience with various AI techniques and tools. This includes practical knowledge of programming languages commonly used in AI, such as Python or R, and experience with AI frameworks and libraries like TensorFlow, PyTorch, or scikit-learn.
- **Ability to Design and Implement AI Systems.** Graduates should be capable of designing and implementing AI systems to solve real-world problems. This includes analyzing data, selecting appropriate AI algorithms, training and evaluating AI models, and optimizing AI solutions for performance and accuracy.
- **Research and Critical Thinking Skills. S**tudents should develop research skills and a critical mindset necessary for conducting independent research in AI. This includes identifying research problems, reviewing relevant literature, designing experiments, analyzing data, and drawing conclusions based on evidence.
- **Ethical and Responsible AI Practices**. Graduates should know ethical considerations in AI development, deployment, and usage. They should be able to identify potential biases, privacy concerns, and social implications associated with AI systems and make informed decisions to ensure responsible AI practices. In addition to elective courses on ethics, topics addressing ethics and responsible AI practices will be embedded in several relevant core and elective courses.
- **Communication and Collaboration**. Graduates should be able to effectively communicate AI concepts and results to both technical and non-technical stakeholders. They should also be able to collaborate with professionals from diverse backgrounds to solve complex AI problems.
- **Discipline-Specific Applications.** Depending on the student's focus or specialization, graduates may gain expertise in applying AI techniques to specific disciplines. For example, healthcare, finance, cybersecurity, or natural language processing. They should be able to understand domain-specific challenges and develop AI solutions tailored to those domains.
- **Lifelong Learning.** As AI is a rapidly evolving field, graduates should have a mindset of continuous learning. They should be equipped with the skills and knowledge to stay updated with AI advancements, adapt to new technologies and techniques, and continue their professional growth beyond the program.

3. Curriculum Map and Program Structure

This curriculum map provides a general overview of courses to include in the AI Master's program. The sequencing and specific courses may differ based on specialization tracks or allowing for flexibility in content specific course selection/substitution. Additionally, practical projects, internships, or industry collaborations may be integrated into courses to provide hands-on experience and real-world applications of AI concepts. UW already offers a substantial number of courses this program would require, but this collaborative feature would distinguish students and opportunities in this program.

Year 1, Fall

i) **COSC 4550/5550 Introduction to Artificial Intelligence.** Credits: 3; A computational study of intelligent behavior. The focus is on intelligent agents, such as software agents or robots. Covers how agents' sense, reason, and act within their environment. Includes problem-solving, search, knowledge representation, planning, game playing, learning, and neural and belief networks.

OR

COMP 5300 Basic Computing II. Credits: 3; The overarching goal is that students understand how to use basic computational and digital tools and approaches to solve problems across scientific, social, and human domains. This course will allow students to explore or embed their desired contextual disciplines into the foundational concepts of the School of Computing. (This is not an established UW course yet; it is proposed for development in the SoC post-baccalaureate graduate certificate program).

- **COSC 4555/5555 Machine Learning**. Credits: 3; To program machines to learn and improve their performance on their own, based on experience and/or data. The first part covers machine learning techniques. The second part covers applications.

  OR

  COSC 4557/5557 Practical Machine Learning. Credits: 3; The class addresses the challenge of designing well-performing Machine Learning (ML) pipelines, including their hyperparameters, architectures of deep Neural Networks, and pre-processing. Future ML developers will learn how to use and design automated approaches for determining such ML pipelines efficiently.
- **STAT 4270/5270 Applied Bayesian Statistics.** Credits: 3; This course introduces Bayesian data analysis in an applied context. We will learn about Bayesian statistics primarily in a regression model context, taken broadly. A conceptual understanding of popular Markov Chain Monte Carlo algorithms will be provided.

  OR

  STAT 5380 Bayesian Data Analysis. Credits: 3; Bayesian statistical methods for analyzing various kinds of data. Topics include basic Bayesian ideas and model formulation (priors, posteriors, likelihoods), single- and multiple-parameter models, hierarchical models, generalized linear models, multivariate models, survival models and an introduction to computation methods.

Year 1, Spring

- **STAT 4240/5240 Data Mining.** Credits: 3; An introduction to statistical learning and data mining using techniques that have proven useful in recognizing patterns and making predictions. These techniques include both parametric and nonparametric models. Tools for computing and evaluating these techniques will also be studied.
- **Natural Language Processing (NLP).** Credits: 3; Text preprocessing and tokenization, language modeling and syntactic analysis, named entity recognition and sentiment analysis, machine translation and question answering.

  OR

COSC 5220 Languages and Automata. Credits: 3; The study of regular, context-free, and context-sensitive languages and their relations to finite-state, pushdown and linear-bounded automata. Context-free language recognition. The halting problem and decidability results.

- **COSC 5540 Computer Vision**. Credits: 3; Provides students with an understanding of applying computer methodologies to process two-dimensional and three-dimensional images. Primary areas of investigation are image preprocessing, knowledge representation, pattern recognition and motion understanding.

Year 2, Fall

- **Deep Learning.** 3 credits. Topics include neural networks and their architectures, convolutional neural networks (CNNs) for computer vision, recurrent neural networks (RNNs) for sequential data, and deep reinforcement learning
  OR
  EE 5410 Neural and Fuzzy Systems. Credits: 3; Theory of feed forward and recurrent neural networks. Supervised and unsupervised learning theories. Fuzzy logic and systems. Associative memories. Matching and self-organizing networks. Application of neural and fuzzy systems.
  OR
  EE 5440 Geometric/Deep Computer Vision. Credits: 3; Geometric methods including exponential coordinates for describing rigid motion, quaternions, pinhole models of cameras, and models of stereo cameras. Reconstruction of a 3D scene. Deep learning methods using convolutional and other neural networks will be used for computer vision. CNN architectures, classification, optimization, detection, identification, segmentation, GANs, and transformers are covered.
- **COSC 5552 Advanced Topics in AI.** Credits: 3; Advanced topics in AI are presented and discussed via research paper review.
  OR
  COMP 5350 Advanced Computing II. Credits: 3; Students will learn how to use the digital tools available in their fields of study as well as understand the theory of how digital approaches and computational methods will change their fields in the future. This course allows for the depth of knowledge within any discipline to be computationally driven towards competency and fluency. (This is not an established UW course yet; it is proposed for development in the SoC post baccalaureate graduate certificate program)
- **Other graduate electives with focus on AI or application of AI**
  OR
  COSC. Seminars and Workshops. 2 Credits.

Year 2, Spring

- **COSC/EE 5960 Thesis Research:** Credits: 4; Designed for students involved in research for their thesis. Also used for students whose coursework is complete and are writing their thesis.
- **Other graduate electives with a focus on AI or the application of AI**
  OR
  COSC. Seminars and Workshops. 2 Credits.

4. Course Descriptions

See above.

5. Assessment Plan

The MS in AI degree aims to prepare graduates for various roles in AI research, development, implementation, and strategic decision-making. The program focuses on eight key learning outcomes: foundational knowledge, technical skills, research capabilities, ethical considerations, communication, domain-specific applications, and a commitment to lifelong learning. Below, we detail assessment strategies for each of these learning outcomes.

- **Understanding of AI Fundamentals:**
  Assessment Methods: Written examinations, assignments, and projects.
  Evaluation Criteria: Demonstration of knowledge in machine learning, deep learning, natural language processing, computer vision, robotics, and statistical methods through accurate application and explanation.
- **Proficiency in AI Techniques and Tools:**
  Assessment Methods: Practical coding assessments, project submissions, and hack-a-thons.
  Evaluation Criteria: Proficiency in programming languages (Python or R), usage of AI frameworks (TensorFlow, PyTorch, or scikit-learn), and successful implementation of AI techniques.
- **Ability to Design and Implement AI Systems:**
  Assessment Methods: Project-based assessments, case studies, and presentations.
  Evaluation Criteria: Capability to analyze real-world problems, select appropriate AI algorithms, train and evaluate models, and optimize solutions for performance and accuracy.
- **Research and Critical Thinking Skills:**
  Assessment Methods: Research proposals, literature reviews, and experimental design projects.
  Evaluation Criteria: Demonstrated ability to identify research problems, review relevant literature, design experiments, analyze data, and draw evidence-based conclusions.
- **Ethical and Responsible AI Practices:**
  Assessment Methods: Ethical case studies, project evaluations, and reflective essays.
  Evaluation Criteria: Understanding and application of ethical considerations in AI, ability to identify biases, privacy concerns, and social implications, and making informed decisions for responsible AI practices.
- **Communication and Collaboration:**
  Assessment Methods: Presentations, reports, and group projects.
  Evaluation Criteria: Effectiveness in communicating AI concepts to both technical and non-technical stakeholders, and ability to collaborate with professionals from diverse backgrounds.
- **Discipline-Specific Applications:**
  Assessment Methods: Domain-specific projects, case studies, and industry collaborations.
  Evaluation Criteria: Ability to understand domain-specific challenges, apply AI techniques appropriately, and develop solutions tailored to specific disciplines such as healthcare, finance, cybersecurity, or natural language processing.
- **Lifelong Learning:**
  Assessment Methods: Continuous professional development plans, self-assessment, and reflective journals.
  Evaluation Criteria: Demonstrated commitment to staying updated with the latest advancements in AI, adaptability to new technologies and techniques, and a proactive approach to professional growth beyond the program.

Successful completion of the program requires satisfactory performance across all learning outcomes, demonstrating a well-rounded preparation for diverse AI-related career paths

Regular feedback will be provided to students through assessments, and faculty will use this feedback to improve the program continuously. Additionally, periodic program reviews will be conducted to ensure alignment with industry needs and the evolving landscape of AI.

6. Degree Program Evaluation

We will employ several methods to evaluate the program's formative stages. We will create a comprehensive data set to help evaluate the degree program at the end of five years. The evaluation will value well-rounded assessment from different perspectives, hopefully leading to informed decisions for program enhancement and development.

Program evaluation will be informed by the following.

- **Exit Surveys of Graduates:**
  This will include questions about the quality of instruction, curriculum relevance, resources provided, and their preparedness for real-world applications.
- **Employer Surveys:**
  Questions will focus on the graduates' performance, their ability to apply knowledge in practical scenarios, and the program's relevance to industry needs.
- **Annual Feedback through Focus Groups of our students**
  These discussions will identify areas for enhancement, address challenges, and gauge the ongoing effectiveness of the curriculum.
- **Alumni Tracking:**
  An alumni network will be established to track the career paths and achievements of graduates over the years to provide insights into the long-term impact of the program.
- **Assessment of Learning Outcomes:**
  This data will be used to gauge the program's academic rigor and effectiveness.
- **Industry Partnerships and Advisory Boards:**
  Regular feedback from these external stakeholders will guide adjustments to the program to keep it aligned with industry trends.
- **Review of Research Output:**
  The quality and impact of research output, publications, and contributions will be used to measure the program's academic strength.

7. New Resources Required

The need for new resources for this program's initialization is minimal. Sustainability and growth costs will need to be determined during program review periods. Self-sustaining funding will be encouraged. Strategic funding for other AI initiatives that would work in conjunction with this program may be addressed in different venues.

- Faculty and instructional staffing
  EECS and Math programs have faculty already teaching the core and suggested elective courses. **Currently, EECS has eight faculty members who offer courses in Artificial Intelligence.** SoC has their five new faculty hires to teach the COMP courses and help develop/teach other suggested elective course offerings.
- Program administration and staff support
  The SoC director and EECS department head have been working closely on related initiatives as well as this program development and will continue to do so to ensure program success. The SoC

has a program coordinator and adequate staff support to ensure the appropriate scheduling of courses.

- Technology

  UW is currently equipped with the technology needed to successfully implement this program. Future technological needs will be determined along with content developments. Program administration will encourage using research funding sources to maintain program technology that supports success.

Library and digital resources

See the above technology considerations that will be applied equally to needed resources here.

Marketing

The SoC has a marketing coordinator to advocate for adequate resource use to promote, recruit, and maintain program enrollment. The SoC and EECS leads will work with Institutional Marketing to develop an appropriate and affordable marketing plan for all external resource needs.

Support

Total projected additional revenues due to added course requirements, assuming a minimum of 10 students per year, is calculated below. We are not including indirect costs due to the wide variability in graduate student needs.

- Per resident student in the program at $311/graduate credit X 30 credits = $9,330
- Per non-resident students in the program at $930/graduate credit * 30 credits = $27,900
- Estimate: 5 resident students and 5 non-residents each year = $186,150 additional tuition

8. Substantive Change Determination

Higher Learning Commission (HLC), UW's regional accrediting agency, must approve all substantive changes to UW's offering. HLC considers substantive change as the addition of a program (degree or certificate/credential level) not previously included in the institution's accreditation, usually judged to be a program that is a significant departure from normal offerings, the addition of a program with 50%+ new coursework required, or the addition or change to an existing program which will be delivered 50%+ through alternative (hybrid, online) delivery. Substantive change may also be defined as a new program that does not meet the above guidelines but requires a significant amount of financial investment. Please contact the HLC Accreditation Liaison Officer (currently Steve Barrett, steveb@uwyo.edu) to make this determination.

9. Executive Summary of Demand Statistics*

The Office of Online & Continuing Education generated a market analysis from Gray Associates' data (see the attached appendix) in August 2023. Below, we briefly summarize the demand, projected enrollment, equality evaluation, and graduate employability presented in the report.

- The report concludes that an MS program focusing on AI will provide students with a new pathway into computing careers and will be attractive both for graduates from regional schools and international students.
- Nationwide graduate level completion numbers in AI from 2019 to 2021 increased by 54.107% from 2019 to 2021. This is significant.
- Student demand for this program is strong nationally. Completions in this region are strictly (100%) at the master level, while in the national market, 6% of the completions are at the bachelor level, 10% at the post-baccalaureate certificate, 78% at the master, and 6% at the PhD award level.
- There is strong 1-year and 3-year historic employment growth. Bureau of Labor Statistics is also suggesting strong 10-year future employment growth in this area.

Below is Bureau of Labor Statistics mean annual wage nationwide for AI laborers.

Artificial Intelligence	$83,266.00
Computer Science	$75,230.00
Computer Engineering	$92,460.00
Electrical Engineering	$95,660.00
Average	$86,654.00

Pro forma budget

	Fiscal Year			
	1	**2**	**3**	**4**
Revenue				
Enrollment in program in given Fiscal Year	10	20	20	20
NEW Resident enrollment (# of new students entering the program each year)	5	5	5	5
NEW Non Resident Enrollment (# of new students entering the program each year)	5	5	5	5
Total Resident credit hours generated	**75**	**150**	**150**	**150**
Total Non Resident credit hours generated	**75**	**150**	**150**	**150**
Per Credit Tuition (with 4% annual growth)				
Resident (Posted Tuition Rate)	$358	$372	$387	$403
Nonresident (Posted Tuition Rate)	$1,074	$1,117	$1,162	$1,208
Prior Year's Non Resident Discount Rate (updated annually by the budget office)	30%	30%	30%	30%
Estimated Actual Non Resident Per Credit Tuition	$752	$782	$813	$846
Total Resident Tuition in NEW Program	$26,850	$55,848	$58,082	$60,405
Total Non Resident Tuition in NEW Program	$56,385	$117,281	$121,972	$126,851
Total Tuition from NEW Enrollment	**$83,235**	**$173,129**	**$180,054**	**$187,256**
Fees				
Mandatory Fee (Per Full Time Student)	$827.96	$827.96	$827.96	$827.96
Mandatory Fee Revenue	$6,900	$13,800	$13,800	$13,800
Total New Revenue Generated	**$90,135**	**$186,929**	**$193,854**	**$201,056**
New Program Expense Assumptions				
Compensation and benefits				
Faculty	**$0**	**$0**	**$0**	**$0**
Other administrative staff				
Graduate Assistants				

Supplies				
Travel				
Marketing	$0	$0	$0	$0
Capital expense	0	0	0	0
Projected Financial Results for New Program	**FY1**	**FY2**	**FY3**	**FY4**
Total Expenses	$0	$0	$0	$0
Total New Revenues Remaining with Program	$90,135	$186,929	$193,854	$201,056
New Program's Total Surplus or Deficit	**$90,135**	**$186,929**	**$193,854**	**$201,056**
Operating margin (surplus or deficit / revenues)	**1.00**	**1.00**	**1.00**	**1.00**

TO	School of Computing, Judy Ann Yates
FROM	Jayne Pearce
DATE	25 August 2023
SUBJECT	Master of Science, Artificial Intelligence

Request from School of Computing:

*Executive Summary of Demand Statistics**

Describe and outline:

1. *Market area and primary target markets.*
2. *Educational market and student demand statistics, including peer comparisons of the size of enrollment, completions, and size trajectory (growth, decline) of comparator programs.*
3. *Employment trends and projections given core competencies of the degree or certificate.*
4. *Graduate salary trends and other post-completion trends.*

**available from Gray Associates data subscription*

Caveats:

- Gray Associates database uses approximately twelve different data sources to determine results. Slightly lagging data from the United States Department of Education, United States Department of Labor, and United States Federal Statistical System as well as current data from Google, job/employment market (Indeed, Monster, public state job postings, etc…), and various web pages and proprietary partnership resources to determine higher education institutional marketing costs, international student interest, completions etc… There are approximately 14,000 different CIP (Classification of Instructional Programs) Codes and Gray will determine results for each code, within different markets, and at the various award levels (undergraduate certificate, bachelor, post-baccalaureate certificate, master, post-master certificate, and doctoral). To my knowledge it is still a one of a kind (sole source) product that Online & Continuing Education subscribes to and if you would like access and training just let me know. All data in this report is from Gray Associates unless otherwise noted.
- The pandemic likely influenced program completion numbers. This analysis focuses on 3 years 2019, 2020 and 2021 program completions, 2022 program completions will be ready in the fall of 2023. A five percent decrease in completion numbers from previous years is reasonable (my assumption-some may disagree), notable would be completion increases or completions remaining constant. International student enrollment & completions numbers are influenced by political factors, plus the pandemic.
- Programs reported as Online should be adhering to the below definition. According to the United States Department of Education, IPEDS (Integrated Postsecondary Education System):
    - Distance education (DE) is education that uses one or more types of technology to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students and the instructor synchronously or asynchronously. The following types of technology may be used for distance instruction: a) Internet; b) Satellite or wireless communication; and c) Audio and video conferencing. A Distance Education program for which all the required

coursework for program completion can be completed entirely via Distance Education courses. https://nces.ed.gov/ipeds/use-the-data/distance-education-in-ipeds

- Higher education institutions do make mistakes when reporting to the United States Department of Education just as people falsely alter their income, occupation, and other data collection attributes when answering the American Community Survey or US Census.
- Currently Online & Continuing Education is advocating for:
    - Changes to the program approval process. Such as: An Accelerated New Program Proposal-a new program that does not require new resources and 50% (*or some percentage*) of the courses are already offered at the University for academic credit.
    - Promotion and increases in Dual Enrollment courses and or programs. Dual enrollment are college courses taught by college instructors; these courses are taught on campus, at statewide locations or through distance learning technology (*web-conferencing-e.g. Zoom*). The University of Wyoming can offer dual enrollment courses only, per state statute.
    - Adjusting the current tuition and fee structure and split to advocate for more dollars flowing to departments that offer online programs
    - Transitioning degree completion bachelor programs to complete bachelor programs
    - Hiring professional staff members to guide and increase instructional design capacity and marketing for online programs.
- FYI Best practice for online programs with strong enrollments to attract adult learners.
    - 100% asynchronously delivered
    - 7-8 week courses
    - Carousel course rotation (courses offered to meet student demand as they step in and out or attempt to move quickly)
    - Interactive and engaging courses (note: instructional design professionals coming soon)
    - Targeted marketing (Office of Online & Continuing currently developing marketing strategy, currently has one professional marketing staff member and will be hiring a second soon)
    - Market tuition rates per program
    - Program accreditation noted on webpage
    - If face to face meetings/activities are a desire of faculty, consider optional opportunities in various locations (with convenient transportation) for student engagement. The most important factor will be educational and dynamic speakers with a programmatic theme.
- Nationwide online student demographics/market
    - They are adult learner or not 18-25 years of age
    - They are working and typically have a full plate of additional responsibilities
    - In most cases they ask themselves: Will this degree allow me to earn more money? Increase my employment opportunities? Get a promotion with my current employer? etc..
    - They willingly pay more in tuition for convenience (100% asynchronously delivered-anytime anywhere education).

Definitions:

National Center for Education Statistics (NCES), Classification of Instructional Programs (CIP) Code Definitions, https://nces.ed.gov/ipeds/cipcode/browse.aspx?y=55

Artificial Intelligence and Robotics 11.0102

- A program that focuses on the symbolic inference, representation, and simulation by computers and software of human learning and reasoning processes and capabilities, and the computer modeling of human motor control and motion. Includes instruction in computing theory, cybernetics, human factors, natural language processing, and applicable aspects of engineering, technology, and specific end-use applications.

Interdisciplinary Opportunities:

Human Computer Interaction 30.3101

- An interdisciplinary program that focuses on the study of the interaction between people and technology and how that technology impacts society, and combines disciplines within the fields of computing and information science (information systems, software engineering, **artificial intelligence** and design) and the behavior sciences (cognitive science, cognitive psychology, sociology, organizational psychology, and social psychology). Includes instruction in information technology, cognitive and behavioral sciences, and systems design.

Linguistics 16.0102

- A program that focuses on language, language development, and relationships among languages and language groups from a humanistic and/or scientific perspective. Includes instruction in subjects such as psycholinguistics, behavioral linguistics, language acquisition, sociolinguistics, mathematical and computational linguistics, grammatical theory and theoretical linguistics, philosophical linguistics, philology and historical linguistics, comparative linguistics, phonetics, phonemics, dialectology, semantics, functional grammar and linguistics, language typology, lexicography, morphology and syntax, orthography, stylistics, structuralism, rhetoric, and applications to **artificial intelligence**.

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1) Market area and primary target market.

a) Admissions to the Carnegie Mellon University (https://www.ece.cmu.edu/academics/ms-ai.html) and Boston University (https://www.bu.edu/academics/grs/programs/computer-science/ms-in-artificial-intelligence/) master in Artificial Intelligence program requires a bachelor in computer science, computer engineering, electrical engineering or a related discipline. Bachelor award level market analysis for this report will focus on completion numbers in computer science 11.0701, computer engineering 14.0901, electrical engineering 14.1001, broadly on all Computer and Information Sciences and Support Services programs 11, and Artificial Intelligence 11.0102.

b) Wyoming residents:

i) In 2018 26 Wyoming residents attained a bachelor's degree in a computer related field online from an institution other than UW.

ii) In 2019 34 Wyoming residents attained a bachelor's degree in a computer related field online from an institution other than UW.

iii) In 2020 42 Wyoming residents attained a bachelor's degree in a computer related field online from an institution other than UW.

c) Below are 3-years of completions by UW undergraduates-perhaps a few might be interested in a Master of Science in Artificial Intelligence

Bachelor Completions	2019 Online	2019 Onground	2019 Total	2020 Online	2020 Onground	2020 Total	2021 Online	2021 Onground	2021 Total
Computer Science 11.0701 at UW	0	0	41	0	0	44	0	0	46
Computer Engineering 14.0901 at UW	0	0	12	0	0	11	0	0	8
Electrical Engineering 14.1001 at UW	0	0	23	0	0	24	0	0	37
Total UW Bachelor Completions	**0**	**0**	**76**	**0**	**0**	**79**	**0**	**0**	**91**

d) Regional bachelor award market (4-year + universities in Colorado, Nebraska, South Dakota, North Dakota, Montana, Idaho, and Utah)
   i) In 2021 there were regionally 4,766 graduates in computer science, computer engineering and electrical engineering and therefore potential enrollments in a master of Artificial Intelligence program based on the entry requirements of Carnegie Mellon University and Boston University.
   ii) From 2019-2021 there was a 27.888% increase in Computer Science graduates regionally
   iii) From 2019-2021 there was a 135.326% increase in online Computer Science graduates regionally
   iv) From 2019-2021 there was a 198.113% increase in Computer Engineering graduates regionally
   v) From 2019-2021 there was a 50% decrease in online Computer Engineering graduates regionally
   vi) From 2019-2021 there was an 8.785% decrease in Electrical Engineering graduates regionally
   vii) From 2019-2021 there was a 7.407% decrease in online Electrical Engineering graduates regionally
   viii) Below are 3-years of completions by regional higher education institution undergraduates in computer science, computer engineering, and electrical engineering-perhaps a few might be interested in a Master of Science in Artificial Intelligence

Bachelor Completions	2019 Online	2019 Onground	2019 Total	2020 Online	2020 Onground	2020 Total	2021 Online	2021 Onground	2021 Total
11.0701 Computer Science									
Colorado	156	802	958	185	967	1,152	227	1,023	1,250
Nebraska	41	252	293	42	268	310	56	269	325
South Dakota	19	122	141	22	122	144	27	147	174

North Dakota	15	153	168	2	168	170	12	153	165
Montana	0	0	145	1	134	135	0	0	122
Idaho	121	208	329	114	281	395	85	265	350
Utah	16	772	788	135	784	919	459	764	1,223
Regional Total	**368**	**2,309**	**2,822**	**501**	**2,724**	**3,225**	**866**	**2,621**	**3,609**
Utah's Western Governors University	*16*	*0*	*16*	*135*	*0*	*135*	*459*	*0*	*459*
14.0901 Computer Engineering									
Colorado	4	106	110	4	59	63	2	50	52
Nebraska	0	0	43	0	0	40	0	0	43
South Dakota	0	0	15	0	0	15	0	0	8
North Dakota	0	0	25	0	0	33	0	0	35
Montana	0	0	20	0	0	24	0	0	21
Idaho	0	0	19	0	0	29	0	0	44
Utah	0	0	108	0	0	131	0	0	113
Regional Total	**4**	**106**	**340**	**4**	**59**	**335**	**2**	**50**	**316**
14.1001 Electrical Engineering									
Colorado	10	273	283	5	283	288	3	286	289
Nebraska	0	0	61	0	0	75	0	0	57
South Dakota	0	0	42	0	0	49	0	0	46
North Dakota	17	82	99	21	101	122	9	86	95
Montana	0	0	75	0	0	62	0	0	61
Idaho	0	0	188	0	0	164	13	110	123
Utah	0	0	174	0	0	173	0	0	170
Regional Total	**27**	**355**	**922**	**26**	**384**	**933**	**25**	**482**	**841**

e) National bachelor award market for all programs within the 2-digit CIP Code 11 Computer and Information Sciences and Support Services:

Bachelor Completions	2019 Online	2019 Onground	2019 Total	2020 Online	2020 Onground	2020 Total	2021 Online	2021 Onground	2021 Total
All 2-digit CIP Codes 11 Computer and Information Sciences and Support Services	**14,646**	**78,038**	**92,684**	**15,895**	**85,856**	**101,751**	**18,556**	**91,280**	**109,836**

f) Bachelor of Artificial Intelligence programs. This is a very small program nationally, potentially an emerging program. In 2021 a bachelor in Artificial Intelligence was only offered at five higher education institutions. Even though the program size is small the data is suggesting very strong employment demand and growth potential. Strong 1-year and 3-year historic employment growth. BLS is also suggesting strong 10-year future employment growth. BLS mean wage is $83,286 annually.

Bachelor Completions	2019 Online	2019 Onground	2019 Total	2020 Online	2020 Onground	2020 Total	2021 Online	2021 Onground	2021 Total
11.0102 Artificial Intelligence	**16**	**2**	**18**	**0**	**0**	**39**	**0**	**0**	**31**
Carnegie Mellon University, PA	0	0	0	0	0	2	0	0	16
Full Sail University, FL	16	2	18	0	0	34	0	0	11
Illinois Institute of Technology, IL	0	0	0	0	0	0	0	0	1
Indiana University, Bloomington, IN	0	0	0	0	0	2	0	0	1
SUNY College of Plattsburg, NY	0	0	0	0	0	1	0	0	2

g) Artificial Intelligence and Robotics 11.0102 is on the Department of Homeland Security STEM Designated Degree List https://www.ice.gov/sites/default/files/documents/stem-list.pdf. International student recruitment possibilities.

h) The Office of Online & Continuing Education and the School of Computing could establish a marketing and recruitment plan in a 'geo' specific areas. We would be happy to discuss

i) Tuition discussion:

(1) With the assistance of the School of Computing a market tuition analysis could be performed. Best practice for online tuition setting is to evaluate the market and determine a flat or the same rate for residents and non-residents. This program may also require specific technology or material costs that may need to accompany the required budget of a new program proposal.

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2) **Educational market and student demand statistics, including peer comparisons of the size of enrollment, completions, and size trajectory (growth, decline) of comparator programs.**

All national master award level Artificial Intelligence completion numbers below:

Master Completions	2019 Online	2019 Onground	2019 Total	2020 Online	2020 Onground	2020 Total	2021 Online	2021 Onground	2021 Total
Artificial Intelligence 11.0102	**0**	**261**	**261**	**1**	**296**	**297**	**20**	**377**	**397**
Carnegie Mellon University, PA	0	103	103	0	115	115	0	126	126
University of Pennsylvania	0	83	83	0	78	78	0	87	87
University of Washington, Seattle Campus	0	28	28	0	27	27	0	51	51
Boston University, MA	0	0	0	0	2	2	0	25	25
Northwestern University, IL	0	0	0	0	13	13	0	22	22
Brandeis University, MA	0	17	17	0	24	24	7	10	17
University of Georgia	0	11	11	0	9	9	0	15	15
Gannon University, PA	0	0	0	0	0	0	10	0	10
University of Southern California	0	9	9	0	11	11	0	7	7
University of Arizona	0	0	0	1	1	2	3	3	6
Illinois Institute of Technology	0	0	0	0	1	1	0	5	5
Syracuse University, NY	0	1	1	0	2	2	0	5	5
Florida Atlantic University	0	0	0	0	0	0	0	4	4

Indiana University, Bloomington	0	1	1	0	2	2	0	4	4
University of Cincinnati	0	0	0	0	2	2	0	3	3
University of Boulder, CO	0	3	3	0	5	5	0	2	2
Oklahoma Christian University	0	1	1	0	2	2	0	2	2
South Dakota School of Mines and Technology	0	0	0	0	0	0	0	2	2
Northeastern, MA	0	0	0	0	0	0	0	1	1
Saint Louis University	0	0	0	0	0	0	0	1	1
Long Island University	0	0	0	0	0	0	0	1	1
University of Rochester, NW	0	4	4	0	0	0	0	1	1
University of Pittsburgh, Pittsburgh Campus, PA	0	0	0	0	2	2	0	0	0

a) Findings:
   i) Nationally, a rather small program overall, with increasing student enrollments.
   ii) Even though the national completion numbers are small many graduate level computer science, computer engineering, electrical engineering, machine learning, robotics, and the many other computer related departments are sharing with their students the teachings, concepts, learning outcomes, and opportunities associated with and related to artificial intelligence. This number is impossible to quantify. Additionally, based on the number of higher education institutions noted above entering the market (including Gannon University and below) with a program suggests this is an emerging program. Completion numbers for 2022 and beyond will confirm if emerging.
   iii) Graduate level completion numbers from 2019 to 2021 increased by 54.107%. This is significant
   iv) Student demand for this program is strong nationally. Completions in this region are strictly (100%) at the master level, while in the national market 6% of the completions are at the

bachelor level, 10% at the post-baccalaureate certificate, 78% at the master, and 6% at the PhD award level.

v) As noted above, the University of Colorado in Boulder and the South Dakota School of Mines and Technology are showing two completions in 2021. Webpage research (https://www.sdsmt.edu/Academics/Departments/Electrical-Engineering-and-Computer-Science/Graduate-Education/Computer-Science-and-Engineering-MS/ and https://www.colorado.edu/cs/research/artificial-intelligence) suggests that the institutions have a strong interest in integrating artificial intelligence into curriculum but I was not able to locate the plan of study for a master in artificial intelligence. Perhaps because of the emerging nature of this program and the small number of completions it has yet to appear on the webpage as an academic program.

vi) This is a US Department of Homeland Security STEM approve program and the international page views are very strong. Working with UW international student recruitment is strongly suggested.

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3) Employment trends and projections given core competencies of the degree or certificate.

a) BLS One-year historic employment growth in artificial intelligence is strong, increasing.

b) BLS Three-year historic employment growth in artificial intelligence is strong, increasing.

c) BLS Future job growth projections is very strong.

d) The employment market is not saturated. There are many opportunities for employment in the artificial intelligence field.

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4) Graduate salary trends and other post-completion trends.

a) Below is BLS mean annual wage nation wide

Artificial Intelligence	$83,266.00
Computer Science	$75,230.00
Computer Engineering	$92,460.00
Electrical Engineering	$95,660.00
Average	$86,654.00