

# **Master of Science in Artificial Intelligence**

**Dec. 6, 2023**

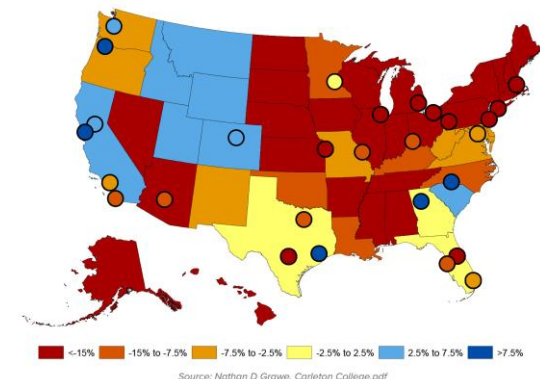


# Why and Why Now?

- Although “Artificial Intelligence” has a long history dating back to 1956, it has recently been **democratized and broadly adopted**.
- **AI is pivotable** in transforming existing disciplines, empowering new industries, and reimagining jobs:
  - Breakthroughs in science and engineering, augmenting human capabilities from medicine to learning, automation for increased efficiency and productivity, new innovations & markets
- **Job Market Opportunities:**
  - 2 million unfilled AI jobs (*Bureau of Labor Statistics*)
  - \$111,118 average base pay for AI job (*Glassdoor Economic*)
  - 83% of businesses say AI is their strategic priority (*Forbes*)
  - \$15.7 trillion contribution to global economy by 2030 (PWC)
- With looming “Enrollment Cliff”, degree offerings that could attract new students are important for WPI.



Forecasted growth and decline in college-going students, 2012-2029



# Why WPI?

- With WPI being a technological institution, “preparing young people for **emerging careers**” is central to our mission and future [John Boynton].
- WPI is **uniquely poised** to contribute due to our tremendous investments and successes in AI faculty, curriculum, research and disciplines.
- WPI leadership selected AI as **strategic direction**.





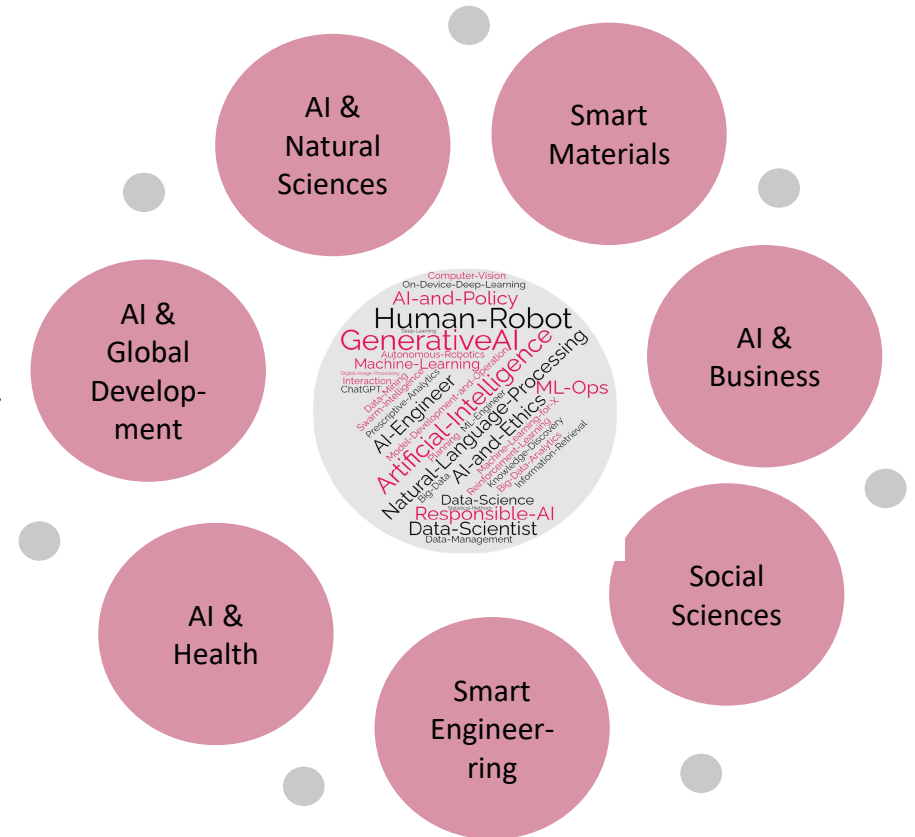






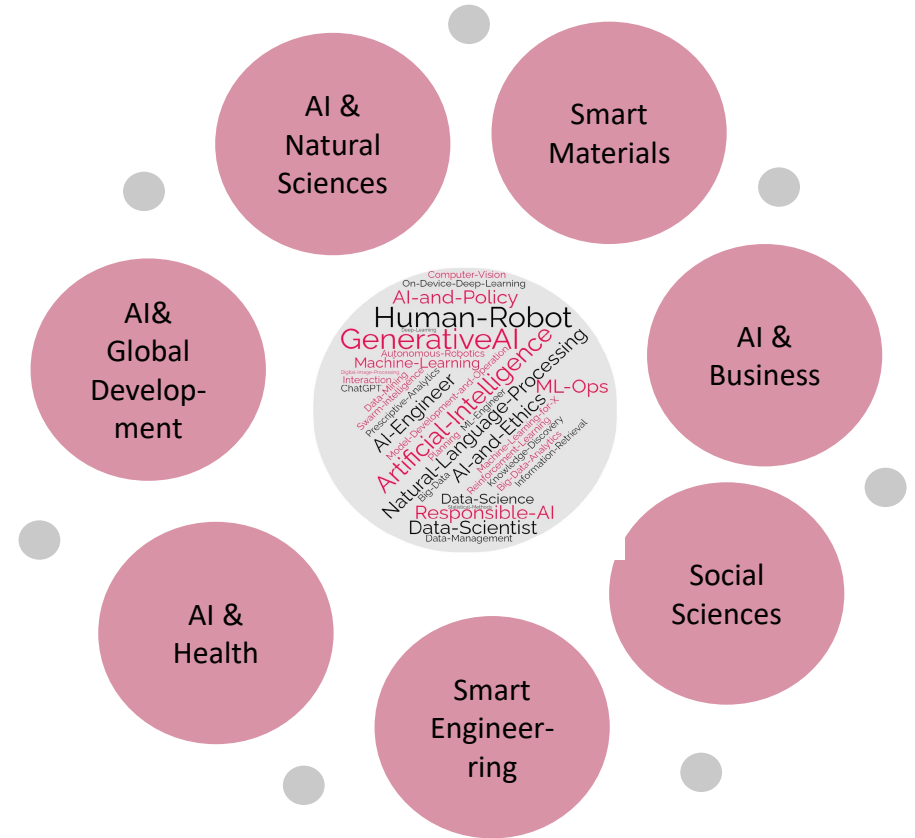
# What?

- Train students in the understanding, development, deployment and innovation of **AI techniques and systems** in a **responsible fashion** for economic growth & betterment of society
- This degree proposal is a **nimble start** for WPI to quickly offer a **(technical) AI degree**, but it is the **very beginning only . . .**



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- This degree proposal is a **nimble start** for WPI to quickly offer a **(technical) AI degree**, but it is the **very beginning only** as we move towards “**AI-for-all**”.





## CIP Code 11.0102

**Title:** Artificial Intelligence.

**Definition:** 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. It includes instruction in computing theory, cybernetics, human factors, natural language processing, and applicable aspects of engineering, technology, and specific end-use applications.

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Computer Science,  
Data Science  
Robotics Engineering  
Electrical Engineering  
Mathematical Sciences  
School of Business  
Social Sciences & Policies  
Humanities & Arts

# Structure of Proposed MS in Artificial Intelligence

Total: 30 credits

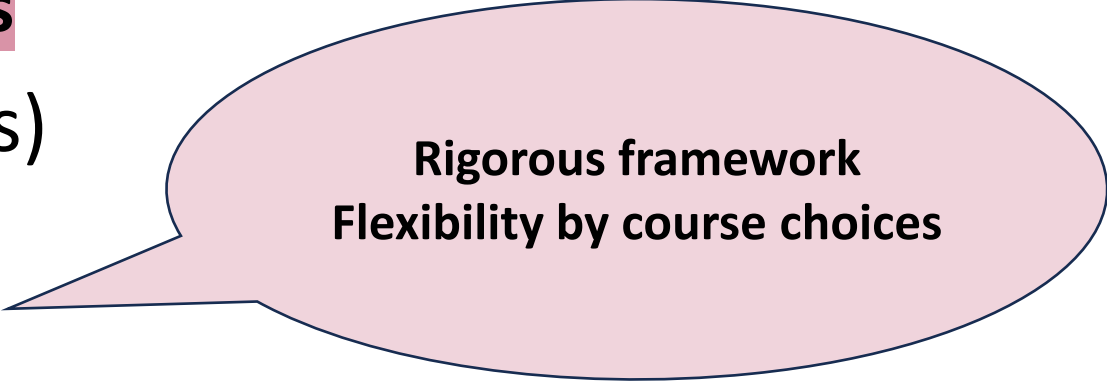
- Five core AI bins required (15 credits)
  - Artificial Intelligence Bin (at least 3 credits)
  - Ethics & AI Bin (at least 3 credits)
  - Machine Learning Bin (at least 3 credits)
  - Knowledge & Reasoning Bin (at least 3 credits)
  - Interaction & Action Bin (at least 3 credits)
- Capstone experience required (3 or 9 credits)
  - Graduate Qualifying Project in AI (3 credits), or
  - Master's Thesis in AI (9 credits)
- Remaining credits:
  - Additional core AI bin courses (any # of credits),
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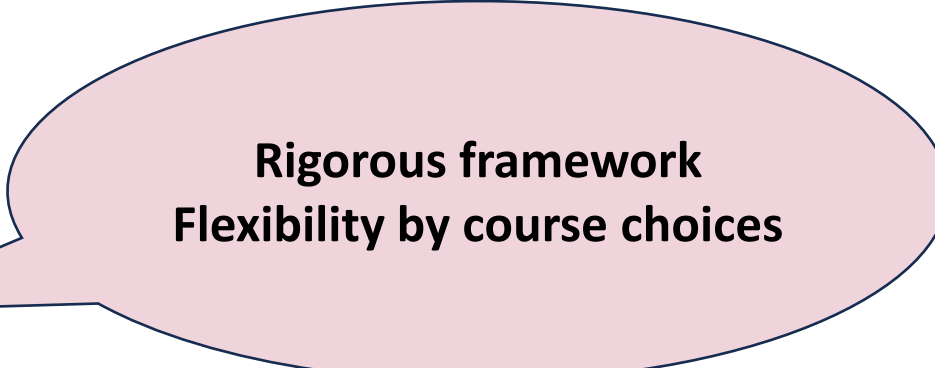
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**Fill gaps with  
Preparatory courses**

**Follow their  
interest & passion**

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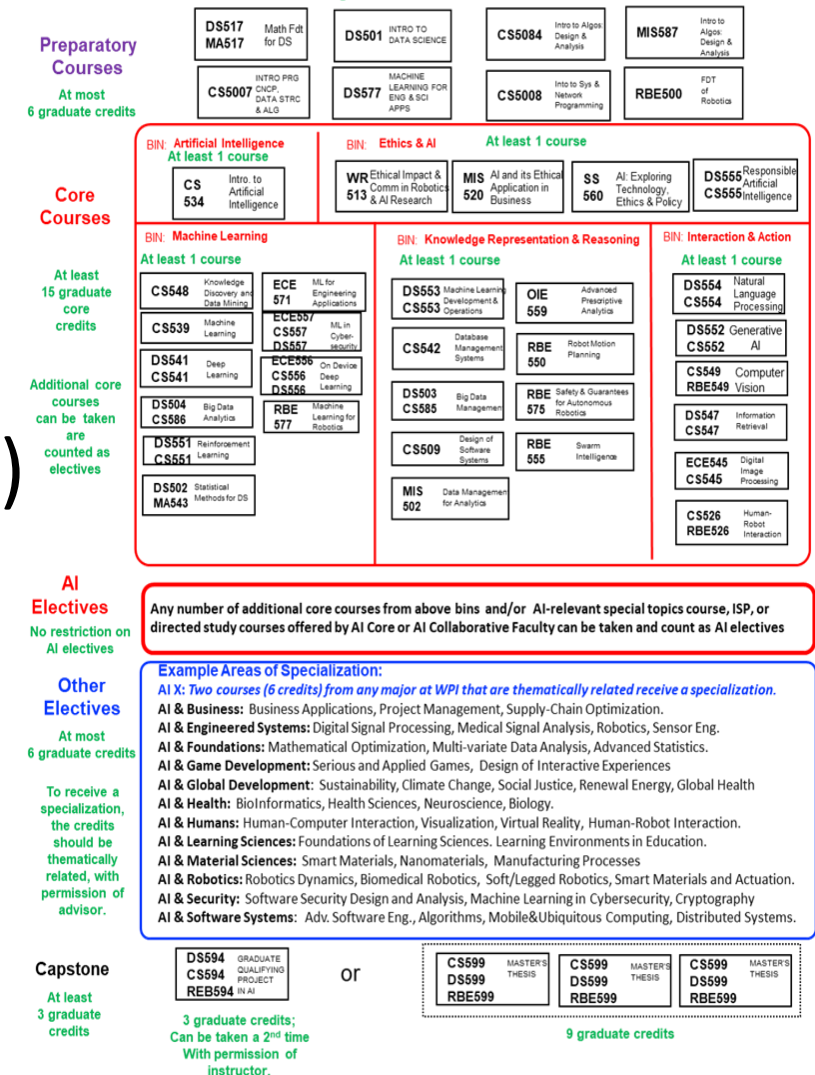
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## MS in Artificial Intelligence Degree Chart 30 graduate credits in total



# Five AI Core Bins

## BIN: Artificial Intelligence At least 1 course

<b>CS 534</b>	Intro. to Artificial Intelligence
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## BIN: Ethics & AI

At least 1 course

<b>WR 513</b>	Ethical Impact & Comm in Robotics & AI Research	<b>MIS 520</b>	AI and its Ethical Application in Business	<b>SS 560</b>	AI: Exploring Technology, Ethics & Policy	<b>DS555</b> <b>CS555</b>	Responsible Artificial Intelligence
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## BIN: Machine Learning

At least 1 course

<b>CS548</b>	Knowledge Discovery and Data Mining	<b>ECE 571</b>	ML for Engineering Applications
<b>CS539</b>	Machine Learning	<b>ECE557</b> <b>CS557</b> <b>DS557</b>	ML in Cyber-security
<b>DS541</b> <b>CS541</b>	Deep Learning	<b>ECE556</b> <b>CS556</b> <b>DS556</b>	On Device Deep Learning
<b>DS504</b> <b>CS586</b>	Big Data Analytics	<b>RBE 577</b>	Machine Learning for Robotics
<b>DS551</b> <b>CS551</b>	Reinforcement Learning		
<b>DS502</b> <b>MA543</b>	Statistical Methods for DS		

## BIN: Knowledge & Reasoning

At least 1 course

<b>DS553</b> <b>CS553</b>	Machine Learning Development & Operations	<b>OIE 559</b>	Advanced Prescriptive Analytics
<b>CS542</b>	Database Management Systems	<b>RBE 550</b>	Robot Motion Planning
<b>DS503</b> <b>CS585</b>	Big Data Management	<b>RBE 575</b>	Safety & Guarantees for Autonomous Robotics
<b>CS509</b>	Design of Software Systems	<b>RBE 555</b>	Swarm Intelligence
<b>MIS 502</b>	Data Management for Analytics		

## BIN: Interaction & Action

At least 1 course

<b>DS554</b> <b>CS554</b>	Natural Language Processing
<b>DS552</b> <b>CS552</b>	Generative AI
<b>CS549</b> <b>RBE549</b>	Computer Vision
<b>DS547</b> <b>CS547</b>	Information Retrieval
<b>ECE545</b> <b>CS545</b>	Digital Image Processing
<b>CS526</b> <b>RBE526</b>	Human-Robot Interaction



# AI+X Specialization in Thematically-related Courses in Any Discipline

6 credits | approved by AI advisor | meeting rules & approved by discipline

**Some examples are listed here:**

**AI & Business:** ML for Business, Project Management, Supply-Chain Optimization.

**AI & Engineered Systems:** Digital Signal Processing, Medical Signal Analysis, Sensor Eng.

**AI & Foundations:** Mathematical Optimization, Multi-variate Data Analysis, Advanced Statistics.

**AI & Game Development:** Serious & Applied Games, Design of Interactive Experiences, Virtual Worlds.

**AI & Global Development:** Sustainability, Climate Change, Social Justice, Global Health

**AI & Health:** BioInformatics, Health Sciences, Neuroscience, Biology.

**AI & Humans:** Human-Computer Interaction, Visualization, Virtual Reality, Human-Robot Interaction.

**AI & Learning Sciences:** Foundations of Learning Sciences. Learning Environments in Education.

**AI & Material Sciences:** Smart Materials, Nanomaterials, Manufacturing Processes

**AI & Neuroscience:** Computational Neuroscience, Brain-Computer Interaction, Advanced Psychophysiology.

**AI & Robotics:** Robotics Dynamics, Biomed. Robotics, Legged Robotics, Smart Materials & Actuation.

**AI & Security:** Software Security Design and Analysis, Machine Learning in Cybersecurity, Cryptography.

**AI & Software Systems:** Adv. Software Eng., Algorithms, Ubiquitous Computing, Distributed Systems.

# AI BS/MS Path & AI Graduate Certificate

## **AI BS/MS Path**

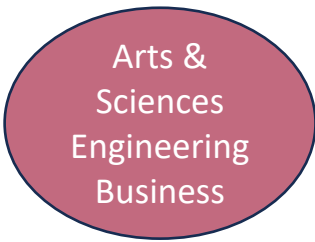
- Double-count up to 12 graduate credits in BS/MS.
- Included are all approved MS-AI core graduate courses and 4000-level undergraduate courses if the latter is acceptable in place of a graduate course by the unit offering the course and that graduate course is an MS-AI approved course.

## **AI Graduate Certificate (12 credits)**

- Introduction to AI Course (core bin)
- Two courses from 2 distinct core bins of MS-AI, besides Intro-to-AI bin
- Any fourth MS-AI approved course

# Comparison to Existing MS Degrees at WPI

Programs Compared: Computer Science, Data Science, Electrical Eng. and Robotics Engineering



## Similarities:

30 credits; Core Bin Requirements; Capstone Experience and/or MS thesis; **plus 3 to 9 credits of flexibility.**

## Differences:

**MS in CS:** 12 CS credits in CS Theory, Algos, Systems, Networks, & Compiler, Graphics, etc, -- *one Bin is AI.*  
**Allows 6 credits outside CS.** Courses or MS thesis. (**M of CS** – no MS thesis)

**MS in DS:** 15 credits in 5 Bins: Intro DS, Math Analytics, Data Access, Data Mining, Bus Intelligence.  
**Preapproved electives in DS, CS, Math and Business courses.** GQP or MS thesis.

**MS in ECE:** 21 credits in ECE courses; Smart Connected Sys, Integrated Sys, Cybersecurity, Power Systems  
**Allows 9 credits in CS, math, physics or eng.** Capstone or MS thesis. (**M Eng in ECE**, add Bus, no MS thesis)

**MS in RBE:** 15 RBE credits must include Fct Robotics, Robot Dynamics, Robot Control; Bus. Entrepreneur;  
**Allows 3-9 credits in any Science, Engineering or Business.**

**MS in AI:** 15 credits in core AI bins: Intro to AI, Ethics AI, Machine Learning, Knowledge+, Interactions+.  
**Allows 6 credits in disciplines outside AI as target applications.**



# Comparison to AI MS Degrees Elsewhere

	Northeastern Univ.	Boston Univ.	CMU	CMU
<b>Degree</b>	MS in AI	MS in AI	MS AI & Innovation	MS AI-Engineering
<b>Originating Unit</b>	Computing	CS department	School of Computer Science	College of Eng.; within eng. dept.
<b>Required credits</b>	Data science, machine learning, human-computer interaction	AI, algos, programming, machine learning,	Knowledge in AI: Coding Bootcamp; ML; Machine Learning., NLP, DL, ML on Large Datasets;. ML+.	AI+Eng: fundamentals of AI/ML + domain knowledge in eng
<b>Ethics</b>	required	optional	No mention	Required
<b>Bins /Concentrations</b>	<p><b>Select 2 out of 5 Specializations:</b></p> <ul style="list-style-type: none"> <li>Machine learning</li> <li>Knowledge man. &amp; reasoning</li> <li>Vision</li> <li>Intelligent interaction</li> <li>Robotics and agent systems</li> </ul>	<p><b>Concentration Areas:</b></p> <ul style="list-style-type: none"> <li>Machine Learning</li> <li>Knowledge &amp; Reasoning</li> <li>Vision</li> <li>Robotics</li> </ul>	<p><b>3 Electives in CS/DS:</b></p> <ul style="list-style-type: none"> <li>Search Engines, ML for text, ML+, vision, web, DB, software, cloud computing</li> </ul> <p><b>Plus,</b></p> <ul style="list-style-type: none"> <li>Future markets, Law &amp; tech, business model.</li> </ul>	<p><b>AI Core:</b></p> <ul style="list-style-type: none"> <li>AI Sys, ML for Eng, DL, AI Ethics</li> </ul> <p><b>Enabler Domains:</b> Computer Systems, Hardware for ML, etc.</p> <p><b>Producer Domains:</b> Distributed ML, Eng apps in AI, Stoch proc.</p> <p><b>Consumer Domains:</b> Speech/Image/Video Analytics for Semiconductor, Signal proc.,</p>
<b>Target careers</b>	ML engineer, AI/Data Scientist, Robotic engineer	ML engineer, AI scientist, Data Scientist	Entrepreneurs, ML engineer, Innovators.	Battery/Process engineer, quality engineer, DL engineer
<b>Other notes</b>	Other: Prof studies applied ML for finance, healthcare, etc.	<b>Starts in 2023-24.</b> MS in health info, AI +healthcare	Costs >= 100k	



# Endorsements by participating departments & schools for MS-AI programs and their courses

*School of Arts and Sciences*

*School of Engineering*

*School of Business*

Computer Science Department\*

Data Science Program\*

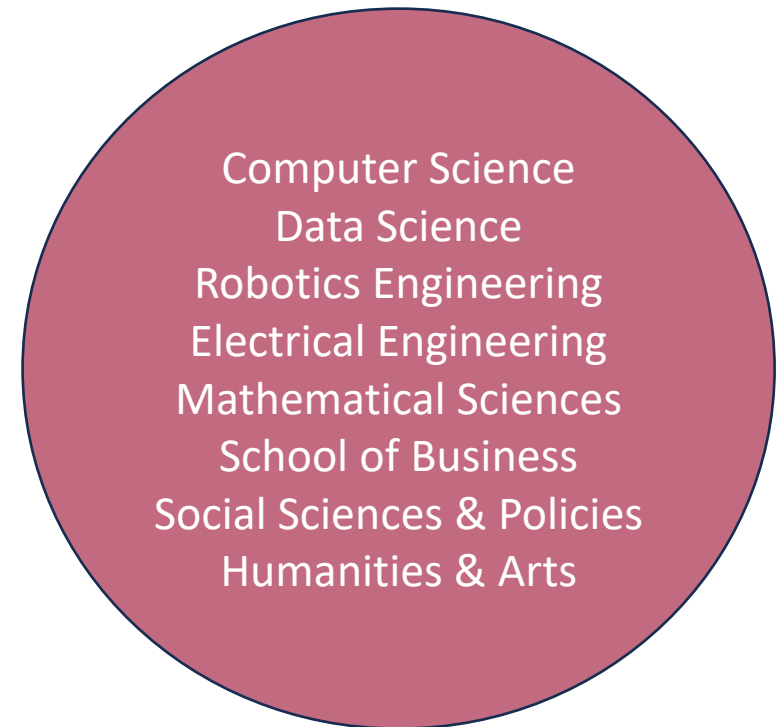
Robotics Engineering Department\*

Electrical and Computer Engineering Department

Mathematical Sciences Department

Social Science and Policy Studies Department

Humanities & Arts



# Management & Support

## MANAGEMENT:

- Program Head for MS-AI
- MS-AI Graduate Committee: One faculty from RBE & One from CS & One from DS.
- Faculty Advisory Committee for MS-AI
  - Advisory capacity for above leadership and commit to periodic meetings and to serve on subcommittees as needed based on size of student cohort and growth of program.
- Collaborative Faculty for MS-AI
  - Supervise MS thesis, ISP, and DR to students in this MS-AI degree.



## RESOURCES:

- Faculty positions in AI authorized in affiliated & other departments across WPI (Fall 2024)
- Advisor staff position approved for MS-AI program
- Funding for marketing for initial launch approved
- Funding for actual operation to be established (soon) based on cohort size & operation needs

School of Arts & Sciences\*  
School of Engineering  
School of Business