Sponsorship Opportunity:

# Capstone Projects

## Introduction

Capstone projects offer companies direct access to highly trained, intensely motivated students applying their advanced skills and expertise to a wide range of challenges and opportunities.

Working with faculty supervision, teams focus on sponsor-defined projects that result in the exploration of solutions and potentially a proof-of-concept or prototype. Capstones are the culmination of the graduate or undergraduate program experience.

### Sponsors Can Expect

- A team of two to five students focused on a sponsor defined project over one or two semesters.
- Faculty supervision, a mid-term, and final presentations.
- Capstones often deliver a publication-quality report and a conference-style presentation. Many of the teams publish their results in top-tier conferences and workshops.

### Benefits

- Exposure to innovative, insightful ideas.
- Access to highly trained students for problem-solving and recruitment purposes.
- Developing relationships with world-renowned faculty.
- Building brand awareness within the campus community.
- Input on the problem statement from Carnegie Mellon professor(s).
- Licensing options to student work product(s) developed during the course.

### Requirements

- A problem to solve and/or data to analyze.
- A company mentor who is available for a specified number of contacts and meetings with the student team.
- A signed Educational Project Agreement.
- Payment of the capstone fee.

### Sample Project Themes

- Develop a new technology product offering (from ideation to commercialization).
- Optimize a delivery distribution network.
- Complete customer discovery.
- Develop autonomous robots.
- Perform market analysis.
- Implement AI systems responsive to market needs.
- Conduct technical research and feasibility evaluation.
- Evaluate privacy enhancing technologies for organizations.

Carnegie Mellon University
School of Computer Science

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# At-a-Glance

| PAGE | Capstone Programs | Date | Sponsorship Fee |
|---|---|---|---|
| 4 | **Artificial Intelligence and Innovation** | January – May *(spring semester)* | $50,000 per team,<br>6-7 students |
| 5 | **Automated Science** | ○ September – December *(fall semester)*<br>January – May *(spring semester)* | $5,000 – $15,000 per team,<br>3-5 teams |
| 3 | **Computational Data Science** | January – December | $40,000 *(using public data)*<br>$80,000 *(using private data)* |
| 5 | **Computer Vision** | Mid-January to early December<br>or Mid-August to early May<br>*(with a summer/winter break)* | $15,000 per student<br>*(2-student minimum)* |
| 3 | **Educational Technology and Applied Learning Science** | January – August | $80,000<br>teams of 4-6 students |
| 7 | **Human-Computer Interaction** | January-August | $85,000<br>*(for-profit company fee)* |
| 7 | **Human-Computer Interaction Undergraduate Project** | January – May *(spring semester)* | No fee |
| 6 | **Information Technology – Privacy Engineering** | ○ September – December<br>*(sometimes spring or summer)* | $25,000 per team<br>*($15,000 per team for start-ups and free for non-profits)* |
| 4 | **Information Technology Strategy Program – Project I, Project II** | January – August<br>*(two semesters)* | $15,000,<br>4-6 students per team |
| 3 | **Intelligent Information Systems** | January – December | $40,000 per team,<br>teams of 2-4 students |
| 5 | **Product Management** | April-December | $10,000 – $25,000 |
| 4 | **Robotic Systems Development** | Mid-Jan to early December<br>*(with a summer break)* | $15,000 per student,<br>3-5 students per team,<br>with a $60,000 maximum |
| 6 | **Robotics Systems Engineering and Robotics Capstone** | ○ September – December *(fall semester)*<br>January – May *(spring semester)* | $2,500 per team, 4-7 teams;<br>$10,000 for all projects |
| 6 | **Software Engineering – Scalable Systems and Embedded Systems Programs** | ○ September – December *(fall semester)* | $20,000 per team,<br>8-12 teams |
| 5 | **Software Engineering: Studio Project** | January – December *(three semesters)* | $40,000 per project<br>3-5 teams |

***Master's Degree*** ***Undergraduate Degree*** ○ ***Starts Fall 2021***

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## Master of Computational Data Science (MCDS)

**January – December**

**Sponsorship Fee: $40,000** *(using public data)* **/ $80,000** *(using private data)*

The MCDS program trains professional master's students in all aspects of design, engineering, and deployment of very large information systems. In the program, students delve deeply into topics like databases, distributed algorithms and storage, machine learning, language technologies, software engineering, human-computer interaction, and design. Housed in the Language Technologies Institute, MCDS draws from faculty members throughout Carnegie Mellon's top-ranked School of Computer Science, including the Computer Science Department, Machine Learning Department and the Human-Computer Interaction Institute.

PROGRAM LEAD Eric Nyberg
Professor and Director
Master of Computational Data Science Program

## Master of Educational Technology and Applied Learning Science (METALS)

**January – August**

**Sponsorship Fee: $80,000**

METALS graduates apply science of learning principles, evidence-based research, qualitative and quantitative cognitive task analysis, and data-driven methods to design, create, and improve educational resources and technologies that enable students and instructors to succeed.

The professional program culminates with a seven-month capstone project for an external client. Guided by industry, faculty and alumni mentors, capstone project teams of 4 to 6 students experience the end-to-end process of a product cycle from ideation, research, and design through high fidelity prototyping.

***Previous projects include:***

- an immersive second language learning system that incorporates AI, ML and speech recognition,
- an award-winning job shadowing application which was showcased at the White House,
- a tool for incorporating SEL in K3 students' instructional activities, and
- an app store for professional development with a recommendation engine for what to do next.

PROGRAM LEAD Michael Bett
Managing Director, METALS Program

## Master of Science in Intelligent Information Systems (MIIS)

**January – December**

**Sponsorship Fee: $40,000 per team, teams of 2-4 students**

MIIS is a practice-oriented, professional degree program that offers both advanced study and practical experience in the processing and analysis of unstructured and semi-structured information (such as text, image, video, speech, and audio), mining, and intelligent information technologies.

***Recent MIIS capstone projects include:***

- Abstractive Summarization of Medical Conversations
- Avoiding Derailment in Online Conversations
- Code-Mixed (Multi-language) Language Understanding
- Conversational Assisted Search
- Customer Service Call Analysis
- Describing Similarities and Differences Between Video Segments
- Intelligent Code Completion
- Predicting Patients' Conversation Transitions in Online Health Support Groups
- Recipe Generation from Ingredients
- Smart Reply for Text Messages
- Visual Question Generation from Video Clips

PROGRAM LEADS Teruko Mitamura
Research Professor

Ralf Brown
Principal Systems Scientist

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## Master of Information Technology Strategy Program (MITS): Project I, Project II

**January – August (two semesters)**

**Sponsorship Fee: $15,000, 4-6 students per team**

*(discounts available for start-ups and non-profits)*

The Master of Information Technology Strategy (MITS) is a uniquely cross-disciplinary, cooperative endeavor of the College of Engineering (CIT), School of Computer Science (SCS) and the Institute for Politics and Strategy (IPS) teaching students how to manage the rapidly evolving landscape of technology and related cyber challenges. Students gain an understanding of network and cyber operations, data analytics and forensics, cyber security, decision science, politics and strategy, international security, and the ability to apply best practices to solutions.

The MITS program provides a multidisciplinary education that prepares students to define and conceptualize:

- the emerging environment of threats caused by cyber operations;
- opportunities for enhanced information analysis and exploitation;
- development and management of innovative information technology systems; and
- decision-making challenges associated with the above.

The MITS capstone project students are put on concentration-focused teams and guided by a faculty mentor to put their studies to practical use in tackling a real-life problem or project presented by a sponsoring organization, producing tangible results for the sponsor.

MITS concentration areas include: Politics and Strategy, Data Analytics, Information Security, and Software and Networked Systems.

Guidance on capstone projects for each concentration can be found here.

PROGRAM LEAD Kelly Wadsworth
Graduate Program Manager
Institute for Politics and Strategy

## Master of Science Robotic Systems Development (MRSD)

**Mid-January to early December (with a summer break)**

**Sponsorship Fee: $15,000 per student, 3-5 students per team, with a $60,000 maximum**

MRSD is an advanced robotics graduate degree with a focus on technical and business skills. The curriculum provides a broad education in the sciences and technologies of robotics, reinforces theory through hands-on laboratory projects, and exposes students to practical business principles and skills. Students work as a team towards practical system-level robotics development and integration projects. Key business concepts and practices in the curriculum include technology planning, product conceptualization and development, team management, project management, prototyping, production, marketing, and sales.

Past projects can be found here.

PROGRAM LEAD John M. Dolan
Principal Systems Scientist

## Master of Science in Artificial Intelligence and Innovation (MSAII)

**January – May (spring semester)**

**Sponsorship Fee: $50,000 per team, 6-7 students**

The MSAII program equips students to identify potential artificial intelligence applications and develop and deploy AI solutions to large practical problems. Students work in teams to implement AI systems responsive to market needs. The curriculum provides a thorough grounding in machine learning, neural networks, natural language processing and deep learning, in addition to critical business skills such as market intelligence, intrapreneurship and entrepreneurship.

PROGRAM LEAD Michael I. Shamos
Distinguished Career Professor, Director,
Institute for eCommerce,
Institute for Software Research

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## Master of Science in Automated Science (MSAS)

**September – December (fall semester)**
**January – May (spring semester)**
**Sponsorship Fee: $5,000 – $15,000 per team, 3-5 teams**

The MSAS program trains practitioners in the design, implementation, and application of laboratory automation and artificial intelligence in biological research. Students train with world-class faculty, including those from the top-ranked School of Computer Science. Graduates become leaders in the emerging paradigm of Automated Science — the combination of robotic scientific instruments, Machine Learning, and Artificial Intelligence for iteratively building predictive models from experimental data and selecting new experiments to improve them.

PROGRAM LEAD Josh Kangas
Assistant Teaching Professor

## Master of Science in Computer Vision (MSCV)

**Mid-January to early December or Mid-August to early May (with a summer/winter break)**
**Sponsorship Fee: $15,000 per student** *(2 student minimum)*

The MSCV is a professional degree that prepares students for industry work in careers related to computer vision. Students gain proficiency at implementing computer vision applications based on state of the art algorithms; presenting the background and implementation details of a state of the art computer vision technique; conducting experimental analysis and testing consistent with current practice in computer vision, including standard metrics and benchmark datasets; and applying mathematical and machine learning tools, such as geometry, optimization, and statistics to computer vision applications.

PROGRAM LEAD Kris M. Kitani
Associate Research Professor
Director of the MSCV Program

## Master of Software Engineering Degree Program (MSE): "Studio Project"

**January – December (three semesters)**
**Sponsorship Fee: $40,000 per project, 3-5 teams**

The MSE program for professionals includes a Studio Project that occupies one-third of the program's curriculum. Recognized by the IEEE CSEE&T Hall of Fame for its trailblazing development, the Studio Project attracts real-world problems from industry, government, and academic research.

Each sponsored studio project is a team-oriented, real world capstone effort that provides a sandbox in which students demonstrate their grasp of core software engineering concepts. Students design and develop a product, interact with customers, and manage team tasks and processes in a full life-cycle environment. This experience affords students the opportunity to apply theoretical learning to practice in a realistic setting — to implement the ideas they have learned in the classroom to meet realistic challenges.

***Past projects include:***

- working on ground communication software for a moon rover,
- creating an interactive app for the Andy Warhol Museum,
- developing an integrated simulation environment for autonomous driving vehicles, and
- developing an app for retail shoppers to view available parking spots.

PROGRAM LEAD Matt Bass
Assistant Teaching Professor
Institute for Software Research

## Master of Science in Product Management (MSPM)

**April – December**
**Sponsorship Fee: $10,000 – $25,000**

The first-of-its-kind, this program focuses exclusively on building the next generation of product managers. The 12-month curriculum provides a thorough, challenging and balanced experience that includes the technical skills, business acumen and leadership development students will need to be successful in the role of a product manager.

PROGRAM LEAD Brad Eiben
Executive Director, MSPM

***Starts Fall 2021***

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## MSE–Scalable Systems (SS) and MSE–Embedded Systems (ES) Programs: Software Engineering Practicum

**September – December (fall semester)**

**Sponsorship Fee: $20,000 per team, 8-12 teams**

For the Scalable Systems program, students study scalable systems, including large-scale, intelligent systems.

For the Embedded Systems program, students study embedded systems, including Internet-of-Things (IoT) and cyber-physical systems.

Both programs are 16 months in duration. Students learn best practices for managing, predicting, and delivering quality software. The practicum project provides a sandbox in which students demonstrate their grasp of core software engineering concepts in the last semester of their degree.

***Past projects include:***

- developing a modular and portable Electronic Health Record (EHR API),
- building a dashboard to aggregate data from consumer robots, and
- developing a user-friendly cloud based platform to move business cases through a workflow.

PROGRAM LEAD Matt Bass
Assistant Teaching Professor
Institute for Software Research

## Robotics Systems Engineering and Robotics Capstone (additional Undergraduate major in Robotics)

**September – December (fall semester)**

**January – May (spring semester)**

**Sponsorship Fee: $2,500 per team, 4-7 teams; $10,000 for all projects**

Systems engineering examines methods of specifying, designing, analyzing and testing complex systems. In this course, principles and processes of systems engineering are introduced and applied to the development of robotic devices. The focus is on robotic systems engineered to perform complex behavior. Such systems embed computing elements, integrate sensors and actuators, operate in a reliable and robust fashion, and demand rigorous engineering from conception through production. The course is organized as a progression through the systems engineering process of conceptualization, specification, design, and prototyping with consideration of verification and validation. Students completing this course will engineer a robotic system through its complete design and initial prototype.

**Note:** Unlike the graduate courses, this undergraduate course is entirely student-driven. Companies are encouraged to sponsor the course as a whole (all projects) rather than individual teams.

PROGRAM LEADS David Wettergreen
Research Professor; Associate Director for Education and Director of the Ph.D. Program

Cameron Riviere
Research Professor

## Master of Science in Information Technology — Privacy Engineering (MSIT-PE)

**Primarily September – December (sometimes in the spring or summer)**

**Sponsorship Fee: $25,000 per team**

*(discounts available for start-ups and non-profits)*

Carnegie Mellon's Privacy Engineering Master's program is the first and only program dedicated to training computer scientists and engineers to develop products and services that respect user privacy. Classroom instruction, student research projects, internships, and capstone projects done in partnership with industry give students the skill set needed to identify and resolve privacy challenges in modern software systems.

***Past projects include:***

- privacy-related prototype systems development,
- user interface design and evaluation,
- consumer surveys, and
- analysis of privacy-related technical and regulatory issues.

PROGRAM LEADS Lorrie Cranor
Co-director, MSIT-PE Master's program

Norman Sadeh, Professor
Co-director, MSIT-PE Master's program

***Starts Fall 2021***

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## Master of Human-Computer Interaction (MHCI)

**January – August**

**Sponsorship Fee: $85,000** *(for-profit company fee)*

The MHCI program is the longest-running and most impactful Master of Human-Computer Interaction in the world. It is a three-semester program completed over the course of a full calendar year (August-August) and offers a professional degree that includes user-centered research, iterative designs and product development experience. Students are prepared for industry and careers related to user experience, human-computer interaction, and beyond.

Explore past projects here.

PROGRAM LEAD Skip Shelly
Associate Teaching Professor and
MHCI Program Director,
Human-Computer Interaction Institute

## Human-Computer Interaction Undergraduate Project

**January – May (spring semester)**

**Sponsorship fee: No fee**

The field of Human-Computer Interaction (HCI) is devoted to the design, implementation, and evaluation of interactive digital services and applications. The students come from a variety of backgrounds including Computer Science, Information Systems, Psychology, Cognitive Science, Design, Business, Stats/ML, and related programs.

The HCI Undergraduate Project is a semester-long capstone project course, required for all students who do the HCI primary major or the HCI additional major, in their last semester before graduation. The course integrates everything the students have learned in their coursework into one end-to-end experience. Students work in interdisciplinary teams of four to five students for a client, for a total of close to 1,000 hours of work. Guided by a faculty advisor, and starting with a problem statement provided by the client, students conduct user research and brainstorm design ideas that meet identified needs, go through a design ideation phase to produce and vet design ideas, with client input, and produce prototypes with increasing fidelity and iteratively test them with users to improve the design, ending with a working prototype that serves as a proof of concept of a novel service or product idea for the client.

Program website and project examples can be found here.

***Examples of previous projects:***

- A mobile app that helps dermatologists stage melanoma and decide on treatment,
- An intervention-based app that supports adolescents who are being cyberbullied,
- A web app for community auditing of machine learning services for inherent bias,
- An app to engage solar owners and provide an avenue for non-solar owners to learn about the benefits of solar energy in Western PA,
- Easy-to-use authoring tools that allow teachers to create personalized learning experiences.

PROGRAM LEAD: Vincent Aleven
Professor of Human-Computer Interaction
Director of Undergraduate Programs
Human-Computer Interaction Institute