# MASSACHUSETTS INSTITUTE OF TECHNOLOGY

## 2023 BEAVER WORKS SUMMER INSTITUTE

### July 10, 2023

Welcome to the 2023 MIT Beaver Works Summer Institute!!

This summer you will be part of a class of almost 400 talented young people from across the United States. We hope that you are ready for a transformational learning experience over the next four weeks! Our program is quite rigorous and will provide you with a good understanding of what it means to be an engineer and scientist, as well as introduce you to career opportunities and current research in the engineering and science professions.

In addition to the technical work you will be performing as part of your classes, you will also attend daily guest lectures and seminars, and have assignments to work on at night. Your teacher assistants (TA's) and instructor's will be available to assist you in the classroom.

Please listen carefully during the First Day Orientation. Do not be shy about raising your hand and asking questions. Please read over all program materials provided, paying particular attention to your class schedule and syllabus. You will be responsible for being where you need to be, on-time, and ready to participate. Listen to your instructor's and program staff. Be respectful of them and your fellow students. Everyone comes from different backgrounds and have different levels of experience, so please practice tolerance and patience with your fellow students.

Thank you!

Sincerely,

The 2023 MIT BWSI Staff

# Code of Conduct for Beaver Works Summer Institute

Each participant in the MIT BWSI Program has a responsibility to add positively to the high standards of the academic, social, and scholarly environment. Participants in the program shall strive to ensure that all actions are consistent with their fundamental responsibility to contribute freely to the intellectual core of the program. Students who violate the rules and/or code of conduct are subject to punishment up to and including immediate dismissal from the program. Your acceptance into the program shows our confidence that you will conduct yourself with the highest regard for moral, legal, ethical, and academic standards. This program is one of excellence. In continuing that MIT tradition, we require the following.

1. Students shall maintain clarity of mind, body, and spirit. Consuming, inhaling, transporting, or selling of alcoholic beverages or illegal drugs by students is prohibited and will lead to immediate dismissal from the program. Students are not permitted to be in any room or setting where alcohol is served. Students shall not engage in inappropriate activities with other program participants.

2. Students are required to maintain peaceful, encouraging, and socially and academically constructive relationships with other participants. Any activities or interactions that compromise any student's personal or social well-being are grounds for dismissal from the program.

3. Students will add constructively to the academic environment and their surroundings. Defacement or destruction of the classroom, dormitory, or other MIT property will seriously jeopardize the future of this program and are grounds for immediate dismissal. Students whose behavior is judged by administration to be disruptive to the program may be sent home.

4. Students will actively engage in their environment and diligently complete their assigned tasks. All activities both academic and non-academic, including class attendance and completion of homework assignments, are required in this program (unless otherwise indicated on the schedule). The administrative staff may, at its discretion, elect to send a student home if his or her academic responsibilities are judged to have been neglected.

5. Students will show a commitment and focus to uninterrupted participation in the program. Students will not be permitted to visit home during the weekend except in exceptional cases and only with written permission from a parent or guardian and approval by administration prior to the student's absence. Students will have many commitments during the week and on the weekend. Parents are requested not to visit their son or daughter, since this would interfere with the student's performance in the program.

6. Students will behave appropriately in online activities, you are a representation of MIT. No inappropriate backgrounds or names can be used in any online activities that are BWSI related.

**RULES FOR ONLINE CONDUCT FOR BWSI**

The listing below provides only summaries of the rules for Online conduct for BWSI students; staff, parents and/or visitors.

Don't violate the privacy of other users.

Don't misuse the intellectual property of others.

Don't use BWSI platform(s) to harass anyone in any way.

Don't misuse electronic communications and collaboration services (including, without limitation, age appropriate virtual backgrounds).

This program is for students to learn, parents are not allowed into any virtual portions of the program unless specifically invited by the BWSI staff.

**Rules of Use**

All BWSI students; staff and/or visitors are expected to follow these rules. ***Violations of the rules can subject the offender to Institute disciplinary proceedings, dismissal from the program, and, in some cases, civil or criminal prosecution.***

**Note:** Laws that apply in "the real world" also apply in the "virtual" computer world (including MITnet). Laws about libel, harassment, privacy, copyright, stealing, threats, etc. are *not* suspended for computer users, but apply to all members of society whatever medium they happen to be using: face-to-face, phone, *or* computer. Furthermore, law-enforcement officials are more computer-savvy than ever, and violations of the law in "Cyberspace" are vigorously prosecuted.

Similarly, Institute policies (as described in MIT's Policies and Procedures, for example) also apply to online postings.

**Assuring Ethical Use of the System**

Along with the many opportunities that BWSI provides the community to share information comes the responsibility to use the system in accordance with MIT standards of honesty and personal conduct. Those standards, outlined in Section 13.2 of MIT's Policies and Procedures, call for all members of the community to act in a responsible, professional way.

**Don't violate the privacy of other users.**

The Electronic Communications Privacy Act (18 USC 2510 *et seq.*, as amended) and other federal laws protect the privacy of users of wire and electronic communications.

As Section 11.1 of MIT's *Policies and Procedures* notes, "Invasions of privacy can take many forms, often inadvertent or well-intended." All staff, students and/or visitors should make sure that their actions don't violate the privacy of other users, if even unintentionally.

Some specific areas to watch for include the following:

*Don't make any personal information about individuals publicly available without their permission.* This includes both text and number data about the person (biographical information, phone numbers, etc.), as well as representations of the person (graphical images, video segments, sound bites, etc.) For instance, it is *not* appropriate to include a picture of someone on a World Wide Web page without that person's permission. (Depending on the source of the information or image, there may also be copyright issues involved; cf. Rule 4).

*Don't create any shared programs that secretly collect information about their users.* (This means, for example, that you may not collect information about individual users without their consent.)

**Don't misuse the intellectual property of others.**

MIT faculty, students, and staff produce and consume a vast amount of intellectual property, much of it in digital form, as part of our education and research missions. This includes materials covered by the patent, copyright, and trademark laws, as well as license or other contractual terms.

Members of the MIT community also avail themselves of a wide variety of entertainment content that is available on the Internet, most of which is protected by copyright or subject to other legal restrictions on use.

All users need to ensure that their use of all these protected digital materials respects the rights of the owners.

Digital materials that may be covered by this rule, without limitation, are:

- Data
- E-books
- Games
- Journals and periodicals
- Logos
- Movies
- Music
- Photographs and other graphics
- Software
- Textbooks
- Television programs
- Other forms of video content

You should assume that all materials are subject to these legal protections, and may have some restrictions on use. Ease of access, downloading, sharing, etc., should not be interpreted as a license for use and redistribution.

**Don't harass anyone in any way.**

"Harassment," according to MIT's Policies and Procedures (Section 9.5), is defined as:

"...any conduct, verbal or physical, on or off campus, which has the intent or effect of unreasonably interfering with an individual or group's educational or work performance at MIT or that creates an intimidating, hostile or offensive educational, work or living environment... Harassment on the basis of race, color, gender, disability, religion, national origin, sexual orientation or age includes harassment of an individual in terms of a stereotyped group characteristic, or because of that person's identification with a particular group."

The Institute's harassment policy extends to the networked world. For example, sending email or other electronic messages which unreasonably interfere with anyone's education or work at MIT may constitute harassment and is in violation of the rules of BWSI.

Any member of the MIT community who feels harassed is encouraged to seek assistance and resolution of the complaint. Contact BWSI staff for help with the situation.

**Don't misuse electronic communications and collaboration services.**

Some members of the BWSI community access similar, or additional, 3rd party services on the Internet.

Users of all such services have a responsibility to use these services properly and to respect the rights of others in their use of these services, and in accordance with published terms of service.

Users may not use these services in violation of any applicable law.

All relevant MIT policies apply to the use of these services, but in particular:

- Any use that might contribute to the creation of a hostile academic or work environment is prohibited, (including, without limitation, age appropriate virtual backgrounds)
- Any commercial use not required for coursework, research or the conduct of MIT business is prohibited,
- Any non-incidental personal use such as advertisements, solicitations or promotions is prohibited [Note: some services exist on campus that have been designed for buying, selling and exchanging items within the MIT community, and those are allowed].

Any content posted to a service that is inconsistent with these rules, as well as unsolicited mail from outside of MIT (e.g., spam), may be subject to automated interception, quarantine and disposal.

*This policy was last updated in April 2023.*

# Beaver Works Summer Institute (BWSI)

July 10, 2023

bwsi-admin@mit.edu

# Student Program Details

This document provides information for participants of the MIT Beaver Works Summer Institute (BWSI) Program. Please use this document as a reference.

Any questions should be directed to program staff in person or via email at bwsi-admin@mit.edu.

In the case of an urgent matter, call program staff at 617-444-9381. This number will not be monitored until July 10, 2023.

## Virtual Program Expectations:

All students are required to be in the virtual program with video and sound daily by 5 minutes before their class starts. If a student does not show up with their video enabled and does not enable it upon request from instructors they will be asked to leave the program. Parents will be notified if a student is not following the rules of the program. Students must relay to any instructors immediately if there are issues.

## In-Person Program Expectations:

All students are required to arrive at the program 5 minutes before their class starts. Students need to come prepared with their laptop ready to use. If you do not have a working laptop let the staff know prior to the start of the program. If a student is habitually late will be asked to leave the program. Parents will be notified if a student is not following the rules of the program. Students must relay to any instructors immediately if there are issues.

## Tardy/Absence Policy

If you will be late, you must contact the MIT BWSI Program Manager at bwsi-admin@mit.edu and your course instructors via slack, discord or whatever course communication has been set up for your course as soon as you course instructors to avoid possible termination from the program. When emailing please title the message with your full name, course name and cc your parent(s) or guardian(s).

Unexcused tardiness or absence from class will result in immediate termination, we will notify parents immediately if a child is asked to leave the program.

If a student is sick, or for some reason feels like they cannot make it to class or a scheduled event, they will be required to contact the MIT BWSI Program Manager at bwsi-admin@mit.edu

and you course instructors via slack, discord or whatever course communication has been setup for your course as soon as possible to avoid possible termination from the program.

## Schedule

Students may find this program to be more challenging than high school. Students spend about many hours per day in classes and other mandatory activities. Students may expect to spend an average of two to three hours after class working on their projects.

The first day is Monday July 10th, 2023. This is orientation and a welcome day. All students are required to attend July 10th! This is mandatory.

Virtual courses are scheduled Monday through Friday, 10AM – 6PM EST. All students are expected to be in their virtual classroom by 9:55 AM EST each day ready to work.

In-Person courses are scheduled Monday through Friday 9AM – 5PM EST. All students are expected to be in their classrooms on MIT campus by 8:55 AM each day ready to work.

Unless otherwise indicated on the schedule, this program requires attendance at all program activities, both academic and non-academic.

## Lunch

Virtual lunchtimes will be dependent on your course schedules and will be explained to you by your instructors. During lunch time you can break from the virtual session but are required to be back in the session 5 minutes before the end of the break.

Lunch will be served before the seminars, students must arrive at 34-101 at Noon. Each class should schedule a break later in the day for the students.

## Attire

All classes and other program events are casual attire and we are asking that students be respectful of other students in this virtual and in-person environment and dress appropriately.

## Laptop Computer and Class Supplies

Like the online course, students must provide their own laptop computer for use in the program, and for homework. Some courses will be sending hardware kits to students as part of the curriculum. Due to the accelerated nature of BWSI, it is very important that care is taken with the materials sent, as there may not be time to replace broken or lost parts before the end of the course. If you have requested equipment from us we will be in touch soon for the loan of this equipment.

As a participant in BWSI, you will be provided an MIT email (aka Kerberos ID), this is so that you can authenticate for mit.zoom.us meetings.

Please do not hesitate to ask program staff if you have any questions. Your safety is paramount, so please ask first! Thank you, The BWSI 2023 Program Staff

# Beaver Works Summer Institute

# First Day Program Agenda

| Monday, July 10, 2023 |
|---|

| Zoom Meeting (All times are EST) |
|---|
| Meeting Link and Information: https://mit.zoom.us/s/98186189311 |
| Passcode: 432255 |

| | |
|---|---|
| 10:00 am to 10:30 am | Welcome Address - Sertac Karaman, Associate Professor, MIT |
| 10:30 am to 10:45 am | Welcome Address - Robert Shin, Director of Beaver Works and Principle Staff, ISR and Tactical Systems Division, MIT Lincoln Laboratory |
| 10:45 am to 11:00 am | Program Overview of - Lisa Kelley and Joel Grimm |
| 11:00 am to 12:15 pm | Presentation: Resource and Techniques for Managing Mental Health <br> Charmain Jackman |
| 12:15 pm to 1:15 pm | Lunch |
| 1:15 pm to 5:00 pm | Students head to class: https://mit.zoom.us/j/97730308072 |

# Beaver Works Summer Institute

# Daily Schedule

| | |
|---|---|
| 9:55 am | Students Arrive in their Classroom Meeting<br>https://mit.zoom.us/j/97730308072 |
| 10:00 am | Class Start – Lectures and coursework |
| 12:30 pm | Daily Technical Seminar – see dashboard for schedule (this is the same link every day)<br>Meeting Link and Information (EST):  https://mit.zoom.us/s/98186189311<br>**Passcode: 432255** |
| 1:30 pm | Classes Resume – Lectures and Coursework |
| 6:00 pm | Class Ends |

# Autonomous Cognitive Assistant

## General Information

Beaver Works Summer Institute offers students a chance to learn and use state-of-the-art machine learning tools in a program called Cog*Works: Build your own Cognitive Assistant. The program will guide students in learning and applying the foundational technologies of artificial intelligence for building cognitive assistants. Teams of students will leverage professional cognition services and open-source tools in conjunction with their own machine learning tools to develop cognitive systems.

### Lead Instructors

Hosea Chit Siu
Jeff Arena

### Assistant Instructors

Jacob Nelson
Bhargav Panguluru
Elaine Jiang
Pyae Sone Nyo Hmine
Adrianna Peng
Caden Juang

## Weekly Goals

Week 1: Audio Data

Week 2: Visual Data

Week 3: Linguistic Data

Week 4: Final Projects

## Class Email:

bwsi2023-cogworks@mit.edu

# Course Schedule

| Week | Day | Topic |
|---|---|---|
| Week 1 | | Introductions and Course Overview, Python and Math Review |
| | | The Physics of Sound, Recording and Storing Audio, Audio Processing |
| | | Visualizing Audio Data, Anomaly Detection and Feature Extraction |
| | | Capstone Project |
| Week 2 | | Review of Gradient Descent and Minimizing Loss Functions, Introduction to Neural Networks, Tensor Calculus and Back-Propagation |
| | | Dense Neural Networks, Activation Functions, and Hyper Parameters – Training a Convolutional Neural Network |
| | | Convolutions, Training and Convolutional Neural Network |
| | | Capstone Project |
| Week 3 | | Introduction to Language and Text, Quantifying Language Documents |
| | | Quantifying Meaning in Language, Generating and Classifying Language |
| | | Introduction to Recurrent Neural Networks, Text Classification with Deep Learning |
| | | Capstone Project |
| Week 4 | | Create your own cognitive assistant, Final Projects |
| | | Final Projects |
| Final Event | | Final Event Prep |