Engineering Concentration in Machine Learning (ML)

Requirements and Instructions

bu.edu/eng/programs/machine-learning/

25 March 2022
Goals

Equip students with skills in:

1. **ML algorithms:**
   - select
   - adapt or optimize
   - design
   - assess performance
   - explore various application contexts

2. **ML software or hardware tools:** utilize, gain experience

3. **Data:** curate, visualize, or analyze data of various types

4. **Communication:** read and explain methods from ML literature

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Overview

- **Concentration Declaration**
- **Coursework** (elective courses on website + slides 11, 12)
  - 1 Required overview course (2 choices):
    - ENG EC 414: Introduction to Machine Learning
    - ENG EC 503: Learning from Data
  - 2 Elective depth courses (20+ choices across 3 pillars):
    - **Pillar I:** Models, Learning, and Inference (4 choices)
    - **Pillar II:** Optimization, Algorithms, and Programming (6 choices)
    - **Pillar III:** Applications (12 choices)
- **Experiential component**
  - Proposal + Report + Self-Recorded Presentation
  - Options: laboratory research, directed study, internships, senior design project, experiential course project, and others.
Concentration Declaration

- **Check**: You must have a **declared major** on record
- **Declare concentration** as early as possible, but not later than May 1 of junior year
- **Download and complete** ML concentration declaration form from website
- **Propose** 3 courses:
  - 1 required
  - 2 electives
  - **no proposed course must be required for the major**
  - If a course project is proposed to satisfy the experiential component, then it must be from a course that is different from the above 3 proposed courses
- **Sign, date and submit** ML concentration declaration form to: engrec@bu.edu
Experiential Component

- **Options:** laboratory research, directed study, internships, senior design project, experiential course project, and others.

- If a course project is proposed for the experiential component, then it must be from a course that is different from the 3 courses used to satisfy the course-requirements of the concentration.

- **Required course:** must be completed **before** experience

- **Supervisor:** needed, e.g., faculty member at a university or a researcher in industry

- **Group projects:** individuals must contribute **substantial effort** in lead roles for ML tasks
Experiential Component: Proposal

- Must be submitted and approved prior to experience (form on website)
- Not later than last day of fall semester classes, senior year
- Required course must be completed before experience
- Must include name and contact information of experience supervisor
- If a course project is proposed, then it cannot be from the 3 courses used to satisfy the course-requirements of the concentration
- Proposed experience must:
  - Be relevant to ML: must connect to some goals of concentration (slide 2)
  - Have substantial ML content
- Group projects:
  - substantial individual contribution to ML tasks required
  - individual proposal required
  - discussion of ML tasks and individual roles (lead vs support) required
- Submit proposal-form (completed, signed & dated) + PDF document of proposal (see slide 7) to engrec@bu.edu

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Experiential Component: Proposal

- **PDF document** (up to 2 pages) describing proposed experience in **sufficient detail**. Include the following information:

1. **Heading:** “Machine Learning Concentration Experiential Component Proposal” + Title + Your name & major + Name(s), affiliation(s) and email(s) of supervisor(s) + Name(s), major(s) and email(s) of team member(s) (for a group project) + Date

2. **What & Why:** context + motivation + goals

3. **How & When:** methods + proposed work + plan (timeline)

4. **Relevance to ML:** (connect to some **goals of ML concentration** on slide 2)
   - Data
   - ML algorithms or models
   - ML software or hardware tools

5. **Evaluation** basis for proposed work

6. Suitable figures, tables, and references

7. **Group projects:** discuss ML tasks and individual roles (lead vs support)
Experiential Component: Report & Presentation

- Must be submitted and approved after completion of experience (form on website)
- Not later than April 22 of senior year
- Must include supervisor’s approval via signature on report

Submit the following to engrec@bu.edu
- Copy of Experiential Component Proposal
- Summary Approval Form (completed, signed & dated)
- PDF document of report with supervisor’s signature (see slide 9)
- PDF document of presentation slides (see slide 10)
- Link to a self-recoded video of your presentation placed on your BU Google Drive (include link in PDF document of presentation slides)
Experiential Component: Report

- PDF document (up to 4 pages) summarizing experience in sufficient detail. Include the following information:
  1. **Heading**: “Machine Learning Concentration Experiential Component Report” + Title + Your name & major + Name(s), affiliation(s) and email(s) of supervisor(s) + Name(s), major(s) and email(s) of team member(s) (for a group project) + Date
  2. **Overview**: context + motivation + goals
  3. **Contributions**: work accomplished + comparison with goals & plan in proposal
  4. **Methods of study relevant to ML**: (connect to some goals of ML concentration on slide 2)
     - Data
     - ML algorithms or models
     - ML software or hardware tools
  5. **Evaluation** of contributions
  6. Suitable figures, tables, and references
  7. **Group projects**: discuss individual contributions (identify lead and supporting roles) related to ML tasks
Experiential Component: Presentation

- **Slides:**
  - Create slides (limit 10) summarizing your experience
  - Structure the slides similarly to the report
  - Submit a PDF version of your slides together with your report

- **Video recording:**
  - Create a video recording of your slide presentation by yourself
  - The video must not be more than 5 minutes in duration
  - You must be clearly visible at the beginning of the video
  - Place the video file in your BU Google Drive and include a link to it in the PDF document of your presentation slides (on slide 1)
Elective Courses

- **Pillar I: Models, Learning, and Inference**
  - ENG EC 500 (Orabona) Online Learning
  - ENG EC 505 – Stochastic Processes and Inference
  - ENG EC 517 – Introduction to Information Theory
  - ENG EC 523 / CAS CS 523 – Deep Learning

- **Pillar II: Optimization, Algorithms, and Programming**
  - ENG EC 500/525 – (Cutkosky) Optimization for Machine Learning
  - ENG EC 504 – Advanced Data Structures and Algorithms
  - ENG EC 524 – Optimization Theory and Methods
  - ENG EC 526 – Parallel Algorithms for High Performance Computing
  - ENG EC 527 – High Performance Programming with Multicore and GPUs
  - ENG EC 528 – Cloud Computing
Elective Courses

- **Pillar III: Applications**
  - ENG BE 403 – Biomedical Signals and Controls
  - ENG BE 500 – AI and Systems Biology
  - ENG BE/EC 519 Speech Processing by Humans and Machines
  - ENG BE 562 – Computational Biology: Genomes, Networks, Evolution
  - ENG BE 570 – Introduction to Computational Vision
  - ENG ME 416 – Introduction to Robotics
  - ENG ME 570 – Robot Motion Planning
  - ENG EC 401 – Signals and Systems
  - ENG EC 415 – Software Radios
  - ENG EC 500 – (Ohn-Bar) Robotic Learning and Vision for Navigation
  - ENG EC 516 – Digital Signal Processing
  - ENG EC 520 – Digital Image Processing and Communication
Questions?

- Administrative:
  Undergraduate Programs & Records Office
  engrec@bu.edu

- Other:
  ML Concentration Coordinator
  Prof. Prakash Ishwar pi@bu.edu