



HT510a – MACHINE LEARNING + HUMAN LEARNING
Harvard Graduate School of Education
Spring 1 Module, 2 credits

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CLASS The class will meet on six evenings: January 25 – March 1
Attendance in class is required.

OVERVIEW *How can Machine Learning (ML) foster and shoulder Human Learning?* A fascinating development unfolding in front of our eyes is the rapid progress of machine learning algorithms and devices. This development portends the embryonic state of truly individualized education, where human learning is guided/assisted/mentored by algorithms, aiding skilled teachers. But a lot needs to be understood and developed; fundamental questions need to be discussed in depth, with an accent towards *unearthing the next levels of questions* to ask and research:

Studying via meta-analysis the state-of-the-art in machine learning (limitations, potential); Synthesizing via meta-analysis what is known about the impact of technology on the human brain (attention, motivation, expertise, etc.); Better understanding the space and types of tasks where machines are better suited, and that progression; *Eventually, through research and testing, describing learning pathways (scope, sequence) that melds TIE's expertise in education technology with MBE's expertise in understanding human learning, while incorporating formative assessments frameworks.*

Students will be involved in hands-on research projects synthesizing the field and creating the appropriate pathways for future evolution.

READINGS: Readings are available through links in this syllabus. Readings are required. Please be sure to:

- complete the readings before the class for which they are assigned;
- have a hard copy or electronic version of each reading available to you during the class at which it will be discussed;

Other resources may be distributed during class meetings and posted on the course website.

REQUIREMENTS: This class will be interactive, using a modified Socratic approach. Preparation, regular and punctual attendance, and active participation during class and section meetings are expected and are important for student learning and the overall success of the course. Students should inform the instructor or TF, as far in advance as possible, about any events that may prevent attendance or any request for accommodation based on disability.

To prepare for each class, students should complete all of the required readings. Students will be asked to speak knowledgeably about the readings throughout the course and to apply the legal principles to case studies in class and in section meetings.

Students will, as teams, explore and prepare for the class a presentation on one of four topics (see below).

All written work must follow HGSE academic policies and be clear and well organized, with proper citations, carefully edited, and proofread. Written work will be evaluated based on its thoroughness, accuracy, use of material from the course readings, following the instructions for the assignment, and clarity.

GRADING: The course is offered on a grade or sat/unsat basis. It can also be audited via special permission.

Sign-ons: Project Teams Spreadsheet: <http://bit.ly/HLMLPROJECTS18>
Facebook group: <http://bit.ly/HLMLFB>

COURSE OUTLINE, REQUIRED OR RECOMMENDED READINGS, AND ASSIGNMENTS

Optional readings/videos prior or after session 1:

- Pedro Domingos: (video) [The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World](#)
- WaitButWhy (Tim Urban): [The AI Revolution: The Road to Superintelligence](#)
- McKinsey paper: [Artificial Intelligence: the next digital frontier](#)
- Wired: The Limits of Machine Learning: <https://www.wired.com/story/greedy-brittle-opaque-and-shallow-the-downsides-to-deep-learning/>

Movies/TV Series:

- “2001 a Space Odyssey” (Stanley Kubrick)
- “Her” (Spike Jonze)
- “HumAns” (British or Swedish TV versions)

Class 1: Thursday January 25:
Overview, Why, Primers:

Charles: 40 mins presentation + 20 mins Q&A: Deep Learning + Deeper Learning:

- Why all the fuss about Machine Learning?
- Focus on Learning ABOUT & WITH Technology
- Establish clarity in the ontology and taxonomy for the class.

Break – 10 mins

Maya: 40 mins presentation + 20 mins Q&A: Learning sciences primer.

Break – 10 mins

Eron: 20 mins: Machine Learning teaser

Assignments by groups to research questions – 20 minutes.

- Session #3: Exploration of Pedagogical model: how can ML help produce assessments for learning? Using feedback mechanisms (questions, hints, haptics, etc.); using “productive failure” to explore questions and make mistakes.
- Session #4: Exploration of Knowledge Domain model – what is the interconnectedness between disciplines? What is the appropriate tiering of Knowledge? What are major pathways for learning progressions? (intra- and inter-discipline).
- Session #5: Exploration of Learner model: personalization possibilities such as emotional states; learner engagement; learner progressions; meta-learning loops.
- Session #6: EdTech companies in ML: survey, and devise ontology of the space.

Students choose one of the proposed specific research topics to present during next classes – sign-up form online at <http://bit.ly/HLMLPROJECTS18> to work as **teams**. Other topics per Instructor approval as solo projects. Optional Facebook group: <http://bit.ly/HLMLFB>

Class 2: Thursday, February 1

What tasks are Humans particularly suited for, vs Artificial Intelligence? What does this mean for what should Humans focus on? (knowledge, skills, character, meta-learning)

Guest speaker Robert Plotkin: 30 mins presentation + 10 mins Q&A: “Automating invention” <https://www.technologyreview.com/s/413113/instant-genius/>

Guest speaker Jamey Heit: 30 mins presentation + 10 mins Q&A: “Automated essay judging” <https://www.ecree.com/>

Break – 20 mins

Eron: 40 mins presentation + 20 mins Q&A: Machine Learning deeper dive.

ALL: guided conversations about similarities vs differences between ML and HL.

ALL: Q&A re research assignments for next 4 sessions

Class 3: Thursday February 8
Exploration of Pedagogical model:

Required readings/viewings:

- Center for Curriculum Redesign paper on [Evolving Assessments for the 21st Century \(summary/intro only\)](#)
- Christensen Institute: (Thomas Arnett)
<https://www.christenseninstitute.org/wp-content/uploads/2017/03/Teaching-in-the-machine-age.pdf>
- Imagine (a world of assessment without tests):
<https://www.youtube.com/watch?v=l5Z6gxpDOfl>

Guest speaker Doug Stein over webex: 30 mins presentation + 10 mins Q&A: “sensor fusion technology for generating, storing, analyzing, scoring and visualizing human process data.” <https://www.metacog.com/>

Team presentation and design review

Guides conversations based on presentations:

- Appropriate level of abstraction: “Clear the brush not mow the grass”
- Which are your favorites and why? (teams and class)
- What percentage of the work in the space do you think you got to?

Class 4: Thursday February 15
Exploration of Knowledge Domain model

Required readings:

- CCR Knowledge paper: http://curriculumredesign.org/wp-content/uploads/CCR_Knowledge_FINAL_January_2018.pdf and <http://www.curriculumredesign.org/our-work/papers/knowledgesuppmat>

Maya: presentation on CCR’s Knowledge domain exploration: 40 minutes + 20 minutes Q&A

Break – 10 minutes

Nate Shaffer – invited educator: Application to music curriculum: 30 minutes + 10 minutes Q&A

Team presentation and design review

Guides conversations based on presentations:

- Appropriate level of abstraction: “Clear the brush not mow the grass”
- Which are your favorites and why? (teams and class)
- What percentage of the work in the space do you think you got to?

Class 5: Thursday February 22

Exploration of Learner model

Required readings:

- iNACOL: [Student-Centered Learning: Functional Requirements for Integrated Systems to Optimize Learning](#) (Focus on essential diagram)

Team presentation and design review

Guides conversations based on presentations:

- Appropriate level of abstraction: “Clear the brush not mow the grass”
- Which are your favorites and why? (teams and class)
- What percentage of the work in the space do you think you got to?

Class 6: Thursday March 1 (last class)

EdTech space; Reflection and suggestion; Meta-analysis

Required readings:

- CCR Personalized Learning [report](#)

Team presentation and design review

Guides conversations based on presentations:

- Appropriate level of abstraction: “Clear the brush not mow the grass”
- Which are your favorites and why? (teams and class)
- What percentage of the work in the space do you think you got to?

2nd half of session:

Meta reflection: what parts of the project process could have been done by a computer vs. not? Where/how did you learn the skills to do that? What are the parallels and differences?

Suggestions for next year and satisfaction survey: (Link TBA)

- How to take the module forward
 - How to take the research forward
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