SPRING 2019

MAS.SXX **Democratizing AI through K-12 AI Education for All.**
Day Mondays 3—5pm
Units (2-0-7)
Instructor: Cynthia Breazeal (co-list with Hal Abelson)
Limit: 12 (for-credit participants)

Overview:

How can we prepare non-university students with knowledge, skills, and attitudes for future careers that increasingly rely on AI technologies? Otherwise, we risk leaving far too many people behind in the emerging AI-economy -- causing significant societal stress and divisiveness rather than enabling transformative opportunity where everyone can participate in, benefit from, influence our future with AI. Inequity of education remains a key barrier to future opportunities and jobs where success depends increasingly on intellect, creativity, and the right skills. While AI is already entering the education system to support students, teachers, or school administration -- it is not currently offered as a topic to be learned until the university level. Just as learning to code has become recognized as a new literacy for the 21st century, students need to also learn about AI given its growing prevalence across industries, institutions, and society on a global scale.

This weekly project-based class explores the question of "how do we empower children, from preschool to high school, to learn about AI in a collaborative, hands-on way?" Students taking this course will collaborate in teams to develop constructionist tools and activities to introduce preK-12 learners to important concepts, practices and design principles of artificial intelligence – i.e., how machines think and learn and how to design them in an ethical way. An important objective of class projects is to effectively integrate ethical design concepts and practices into their proposed activities and curriculum so that preK-12 students appreciate issues in bias, fairness, transparency, etc. in the AI-enabled projects they create in an age appropriate way. Example projects can take the form of developing an AI curriculum module that covers a core AI concept and associated practices through hands-on projects based on scratch, app inventor, Jupytr notebooks, etc. with integrated cognitive services or open source libraries (machine learning, computer vision, NLU, etc.). Existing research projects could be translated into compelling hands-on projects that introduce younger students to exciting AI methods and abilities. Other projects can explore how to effectively prepare and train mentors to support students as they learn about AI, including the development of personalized AI mentoring agents to help scale this knowledge and training.

Grading

40% design reviews and critiques
20% class attendance and participation
40% final project (no exam)

Website Coming soon

Draft syllabus/meeting schedule: Will be supplemented with guest lectures.

Feb 11	preK-12 AI Goals, Background, Prior work
Feb 18	Group brainstorm: What might an K-12 AI curriculum look like? Big Ideas Framing CITI certification done
Feb 25*	Ethical AI Design Practices. Team brainstorm 1: Hands-on projects to learn AI concepts & practices
March 4	Team brainstorm 2: Hands-on projects to learn AI concepts & practices
Mar 11	Students present "final" project plans
Mar 18	Design Critique: existing examples (cozmo, popbots, etc) Finalize COUHES submissions (final submission date = Mar 21 for Apr 11 meeting)
Mar 25	No class (spring break)
Apr 1	Team Project Progress Report
Apr 8	Design Critique: existing examples (calypso, MLforKids, etc.) Working session
Apr 15	Team Project Progress Report
Apr 22	No class (MLS members meetings)
Apr 29	Submit draft write-up without results individual meetings with group feedback
May 6	Final Project Presentations & Discussion
May 13	Final Project Presentations & Discussion

Draft Reading List
(subject to change, and also students will be asked to find additional readings related to their chosen projects):

Brennan, K., Monroy-Hernandez, A., & Resnick, M. (2010). Making projects, making friends: Online community as catalyst for interactive media creation. *New Directions for Youth Development*.

Brennan, K., & Resnick, M. (2012). New Frameworks for Studying and Assessing the Development of Computational Thinking. Proceedings of the 2012 annual meeting of the American Educational Research Association.

Brennan, K. (2013). Learning computing through creating and connecting. IEEE Computer, 46 (9): 52-59.

Brennan, K. (2014). Beyond right or wrong: Challenges of including creative design activities in the classroom. *Journal of Technology and Teacher Education*.

C.H. Tseng, M. Tissenbaum, W.H. Kuan, F.C. Hsu, C.C. Wong. A design-based approach to implementing a computational thinking curriculum with App Inventor and the Internet of Things, CTE 2018, July 2018

Bob Coulter (2017). Democratic Engagement: A Progressive Approach to CSCL. Proceedings of the Computer Supported Collaborative Learning conference.

Cunningham, C., & Lachapelle, C. (2010). The impact of Engineering is Elementary (EiE) on students' attitudes toward engineering and science. ASEE Annual Conference and Exposition.

Druga, S., (2018) *Growing up with AI – Cognimates: from coding to teaching machines*. S. M. Media Arts and Sciences, Massachusetts Institute of Technology.

Dasgupta, S., Hale, W., Monroy-Hernández, A., & Hill, B. (2016). Remixing As a Pathway to Computational Thinking. *19th ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW 2016).*

Dasgupta, S. & Resnick, M. (2014). Engaging Novices in Programming, Experimenting, and Learning with Data. *ACM Inroads*. 5 (4), pp. 72-75.

Flannery, L., Kazakoff, E., Bonta, P., Silverman, B., Bers, M., & Resnick, M. (2013). *Designing ScratchJr: Support for Early Childhood Learning Through Computer Programming*. Interaction Design and Children.

Keyre, J (2017) *Effectiveness of Hands-on Pedagogy in STEM Education.* Walden Dissertations and Doctoral Studies Collection. Ed.D. Walden University, College of Education.

S.C. Kong, D. Andone, G. Biswas, G., T. Crick, T., H.U. Hoppe, T. C. Hsu, R.H. Huang, K.Y. Li, C.K. Looi, M. Milrad, J. Sheldon, J.L. Shih, K.F. Sin, M. Tissenbaum, & J. Vahrenhold (Eds.), On Tools that Support the Development of Computational Thinking Skills: Some Thoughts and Future Vision, CTE 2018, July 2018.

Lee, C., & Soep, E. (2018). Beyond coding: Using critical computational literacy to transform tech. Texas Education Review, 6(1), 10-16. doi:10.15781/T24J0BF37

Manyika, J.,, Lund, S., Chui, M., Bughin, M., Woetzel, J., Batra, P., Ko, R. & Sanghui, S., (2017) “Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation,” McKinsey Global Institute, December, 2017.

Monroy-Hernandez, A., & Resnick, M. (2008). Empowering Kids to Create and Share Programmable Media. *Interactions*, vol. 15, no. 2, pp. 50-53.

Papert, S. (1980) *Mindstorms: Children, Computers, and Powerful Ideas*. Basic Books.

Resnick, M., Maloney, J., Monroy-Hernandez, A., Rusk, N., Eastmond, E., Brennan, K., Millner, A., Rosenbaum, E., Silver, J., Silverman, B., & Kafai, Y. (2009). Scratch: Programming for All. *Communications of the ACM*, vol. 52, no. 11, pp. 60-67 (Nov. 2009).

Resnick, M., & Rosenbaum, E. (2013). Designing for TInkerability. *Design, Make, Play: Growing the Next Generation of STEM Innovators* Honey, M., & Kanter, D. Routledge.

Resnick, M., Silverman, B., Kafai, Y., Maloney, J., Monroy-Hernández, A., Rusk, N., Silver, J. (2009, 11). Scratch. Communications of the ACM, 52(11), 60. doi:10.1145/1592761.1592779

Resnick, M., & Robinson, K. (2017). Lifelong Kindergarten: Cultivating creativity through projects, passion, peers, and play. The MIT Press.

Roque, R., Rusk, N., & Blanton, A. (2013). *Youth roles and leadership in an online creative community*. Computer Supported Collaborative Learning Conference Proceedings, vol. 1, International Society of the Learning Sciences.

Rusk, N. (2016). Motivation for Making. *Makeology: Makers as Learners* (eds: Peppler, K., Halverson, E., & Kafai, Y. Routledge.

Smith, A. & Anderson, J. (2014) “AI, Robotics, and the Future of Jobs,” Pew Research Center, August 6, 2014.

Soep, E., Lee, C., Van Wart, S., and Parikh, T. (forthcoming). Code for What? Programming Civic Imagination. To appear in: Popular Culture and the Civic Imagination: A Casebook, edited by Henry Jenkins, Gabriel Peters-Lazaro, and Sangita Shresthova, NYU Press.

Williams, R. (2018) *PopBots: Leveraging Social Robots to Aid Preschool Children’s Artificial Intelligence Education*. S. M. Media Arts and Sciences, Massachusetts Institute of Technology.

Williams R. & Breazeal C. (2019) *PopBots: Designing an Artificial Intelligence Curriculum for Early Childhood Education*. Manuscript submitted for publication.

Williams, R., Park, H.W. & Breazeal, C. (2019) A is for Artificial Intelligence: The Impact of an Artificial Intelligence Curriculum on Young Children’s Perceptions of Robots. Manuscript submitted for publication.

Wolber, D., Abelson, H., Spertus, E. & Looney, L. (2011) App Inventor 1: Create your own Android Apps. O'Reilly.

Yoon S., Klopfer, E., Anderson, E, Koehler-Yom, J. Sheldon, J. Shcoenfeld, I., Wendel, D., Scheintaub, H., Oztok, M., Evants, C., Goh, S. (2016) Designing Computer-Supported Complex Systems Curricula for the Next Generation Science Standards in High School Science Classrooms. Systems **2016**, 4(4), 38

Yoon, S.A., Anderson, E., Koehler-Yom, J., Klopfer, E., Sheldon, J., Wendel, D., Schoenfeld, I., Scheintaub, H., Oztok, M. and Evans, C., 2015. Designing curriculum and instruction for computer-supported complex systems teaching and learning in high school science classrooms. J-STEM: Journal of Research in STEM Education, 1(1), pp.4-14.

Yoon, S., Anderson, E., Wang, J. & Klopfer, E. (2015) Using an Adaptive Expertise Lens to Understand the Quality of Teachers' Classroom Implementation of Computer-Supported Complex Systems Curricula in High School Science. Research in Science and Technology Education 33(2), pp.237-251.

Yoon, S., Anderson, E., Wang, J. & Klopfer, E. (2015) Designing Computer-Supported Complex Systems Curricula for the Next Generation Science Standards in High School Science Classrooms. *International Journal of Science Education (in review)*

Yoon, S.A., Anderson, E., Koehler-Yom, J., Evans, C., Park, M., Sheldon, J., Schoenfeld, I., Wendel, D., Scheintaub, H. and Klopfer, E., *(2017)* Teaching about complex systems is no simple matter: building effective professional development for computer-supported complex systems instruction. Instructional Science, 45(1), pp.99-121.

Coding Platforms for Kids:

- Scratch: https://Scratch.mit.edu
- Snap: https://snap.berkeley.edu/
- App Inventor: https://Appinventor.mit.edu
- Cozmo CodeLab: https://www.anki.com/en-us/cozmo/code-lab/constructor-mode
- BeAMaker for Jibo: https://www.jibo.com/be-a-maker/
- Blockly: https://blockly-games.appspot.com/
- Lego Mindstorms: https://www.lego.com/en-us/mindstorms
- Scratch Jr: https://www.scratchjr.org/

Coding Platforms to Create Projects with AI Capabilities:

- Cognimates Studio: https://mitmedialab.github.io/cognimates-website/about/
- PopBots: https://www.media.mit.edu/projects/pop-kit/overview/
- Machine Learning for Kids: https://machinelearningforkids.co.uk/
- ECraft: https://ecraft2learn.github.io/ai/
- Tensorflow Playground: https://playground.tensorflow.org/
- Calypso for Cozmo: https://calypso.software/

AI Curriculum for Kids:

- AI Family Challenge: http://iridescentlearning.org/artificial-intelligence/the-curiosity-machine-ai-family-challenge/
- NVIDIA Digits: http://aiinschools.com/resources/
- Apps for Good Machine Learning Course: https://www.appsforgood.org/courses/machine-learning

Machine Learning for Middle School: http://blog.stephenwolfram.com/2017/05/machine-learning-for-middle-schoolers/