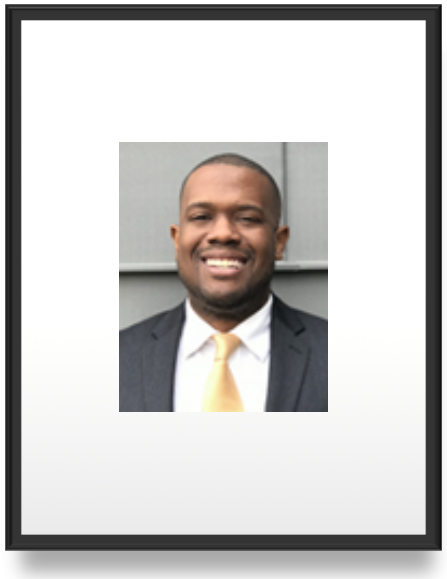
Introduction to Machine Learning and Artificial Intelligence: How it Can Shape Education

Jerome McClendon PhD

About Me

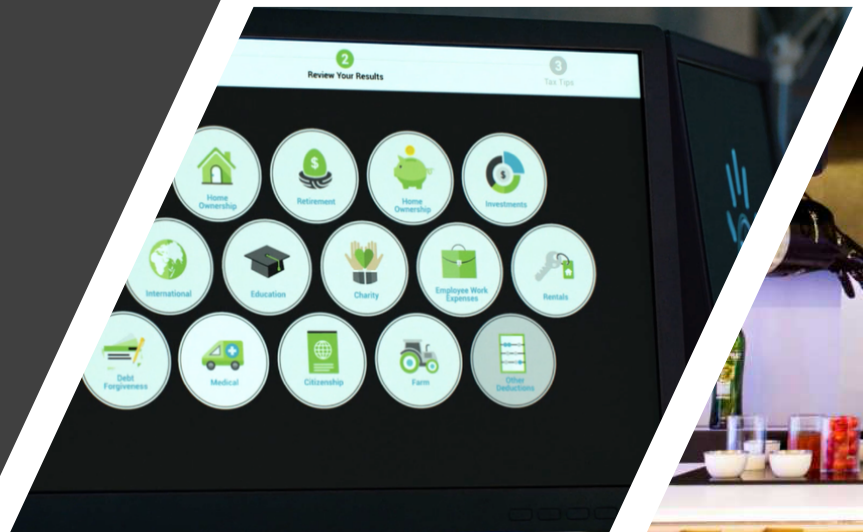
- Assistant Research Professor, Clemson University
- Automotive Engineering
- PhD in Computer Science focused on Machine Learning



Background

The Artificial Intelligence Explosion

- Now living in the Artificial Intelligence (AI) era
- You might have the following questions:
  - What is AI/ Machine Learning ?
  - Is it here to stay or is it just a buzz word ?
  - How can I use it ?
- AI and Machine Learning can be used in the following areas of Education:
  - Admissions
  - In the classroom
  - Advising
  - Performance evaluation and assessment



Artificial Intelligence

- What is AI?
  - The machine capability to **imitate intelligent behavior**.
  - Intelligent Behavior:

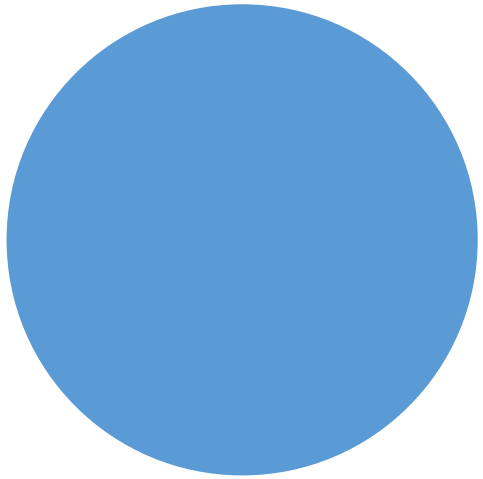
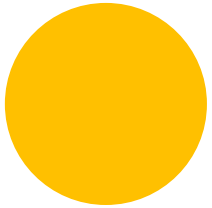
Approaches to AI

Ruled based

Example: If a student took class X and Y in high school then place them in class Z when entering college

Machine Learning

A set of statistical techniques for learning from observations (training set).

Types of Machine Learning Problems

Classification

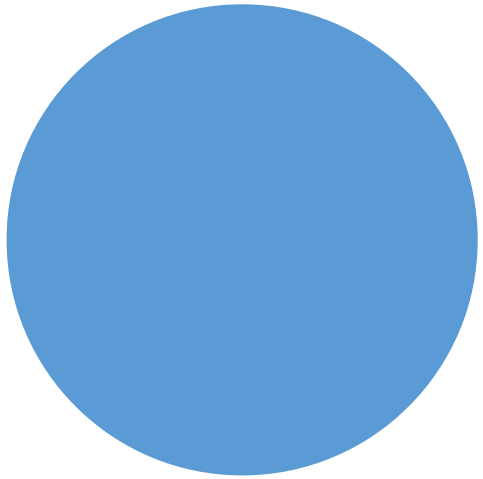
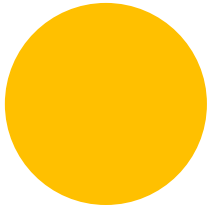
- Classification is the problem of determining which class or category an unknown observation belongs to, based on a training set consisting of observations whose category membership is known.
- **Example**: Determine if you place John Doe in math course Z will he pass or fail
- A training set of past students who have taken class Z. This training set consist of four independent variables indicating the past student's average math grade for each year in high school and a dependent variable which indicates whether he/she failed or passed course Z.

Regression

- A regression problem is when the output variable is a real or continuous value.
- **Example**: Predict John Doe's GPA if placed in the courses X,Y and Z in the same semester.
- A training set of past students who have taken courses X,Y and Z. This training set consist of the past student's grades for related courses taken in high school and a dependent variable which indicates their GPA in college when they took courses X,Y and Z.

Unsupervised Learning: Clustering

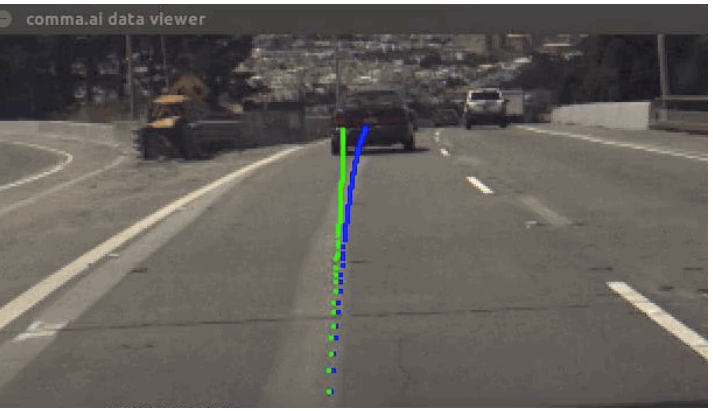
- Clustering is the process of grouping a set of objects based on their statistical similarity. Objects that are similar are placed closer to each other than to those in other groups .
- **Example:** After the fall semester administration wants to analyze the performance of the freshman class but they are not searching for a specific answer only looking for patterns in the data.
- Cluster by high school GPA, residence, semester credit hours and program . From that clustering we might discover patterns in their GPA

The Resurgence of AI

Deep Neural Networks

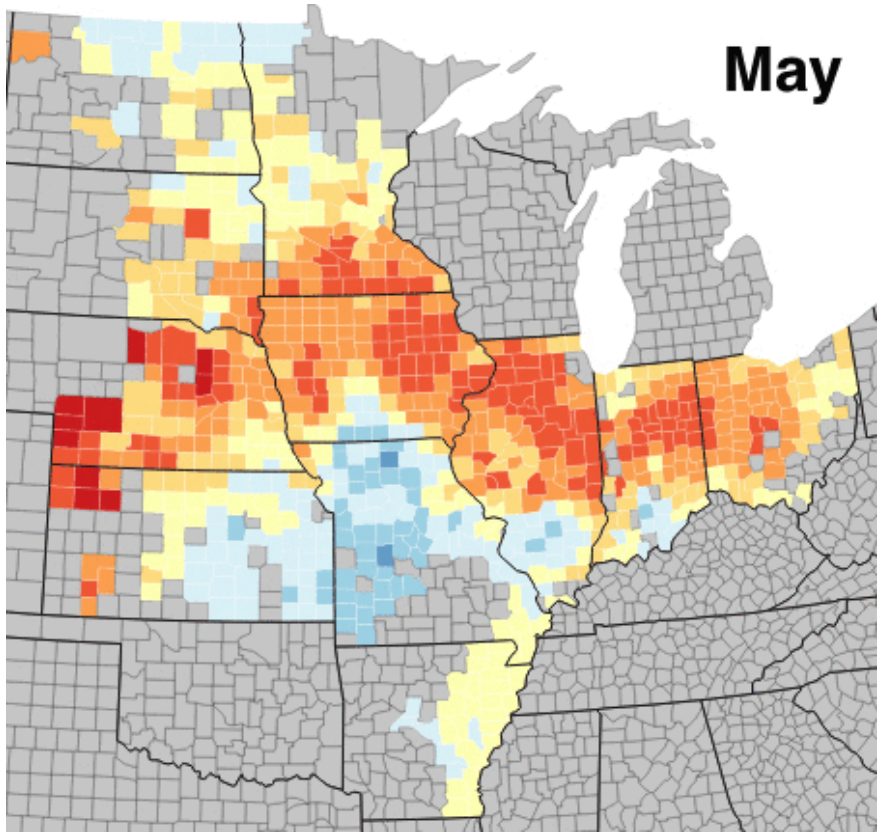
- A Neural Network is a machine learning technique inspired by our biological nervous systems.
- Deep Learning is set of techniques based on Neural Networks consisting of multiple neural network layers which allows the algorithm to learn complicated patterns.



Vision

Natural Language

Analytics and Decision Making



AI in Education

Admissions

- Automate the review of college applications:
  - In industry:
    - A 2017 Deloitte report found that 33 percent of the companies that responded to the survey already used some form of A.I. in their hiring process.
    - Evaluate the candidate through interview questions, games and video analysis including audio, tonality and speech patterns, the importance of which can be set
    - Bring in the best candidates faster and more efficiently
    - No bias*

Admissions

- Applications Quest is an analysis tool used for review in admission, school placement and academic support programs [2].
- The underlying concept behind Applications Quest is holistic comparisons of applications.
  - Uses clustering to measure the similarity and dissimilarity between applicants.
  - Diversity can be achieved by selecting an applicant from each cluster.

2. Gilbert, Juan. "Applications Quest: A Case Study on Holistic Diversity in Admission." *Journal of College Admission* 199 (2008): 12-18.

Admissions

- Concerns: Garbage in and garbage out

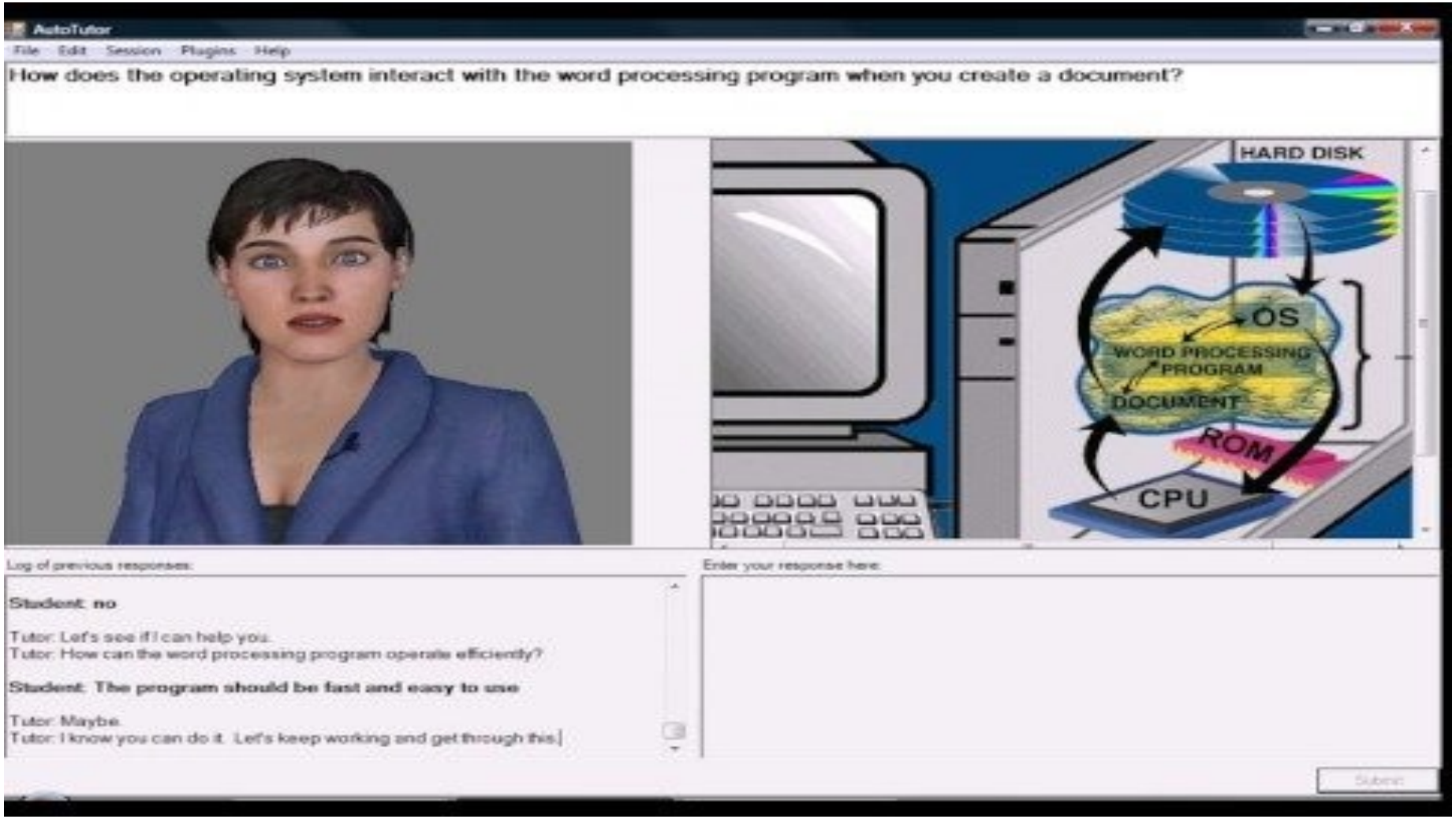
Admissions

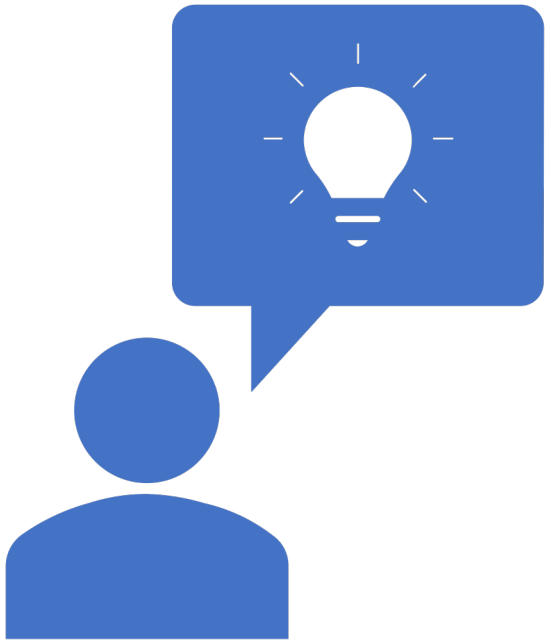
- Assist students in completing the application and applying for financial aid
  - Intelligent assistant like Siri

Classroom

- Intelligent Tutoring System
  - An agent that provides pedagogical functions such as problem generation, selection, and feedback generation which allows for customized instruction and feedback.
  - Georgia Tech virtual teaching assistant

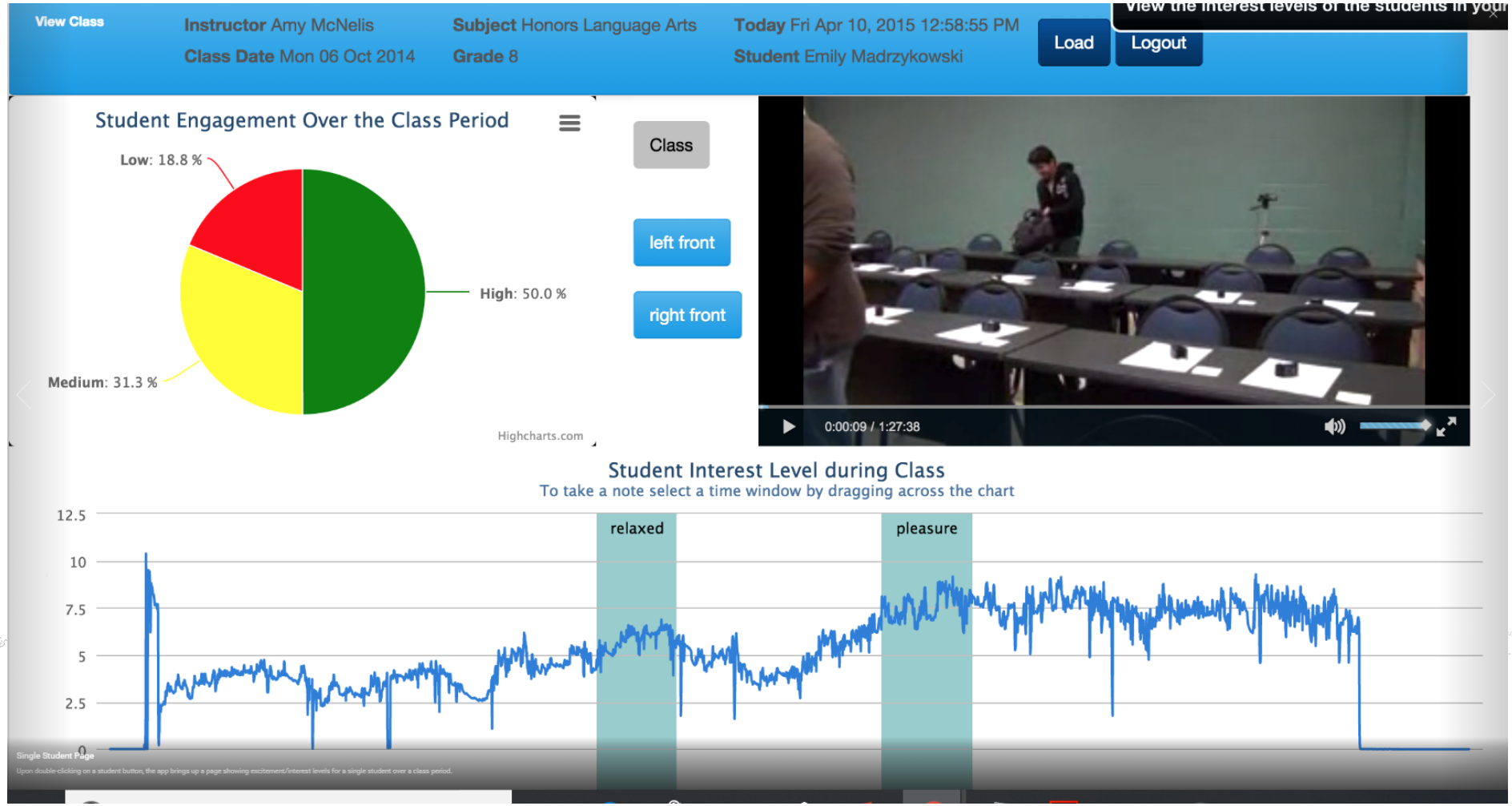
Classroom


AutoTutor
File Edit Session Plugins Help
How does the operating system interact with the word processing program when you create a document?
HARD DISK
OS
WORD PROCESSING PROGRAM
DOCUMENT
ROM
CPU
Log of previous responses:
Student: no
Tutor: Let's see if I can help you.
Tutor: How can the word processing program operate efficiently?
Student: The program should be fast and easy to use
Tutor: Maybe.
Tutor: I know you can do it. Let's keep working and get through this.
Enter your response here:
Submit



Classroom

- Adaptive Learning Systems = Personalization
  - Similar to Intelligent Tutoring Systems but can determine and adapt to the needs, styles, and competence level of the students.



- Engage Me[1]

Classroom

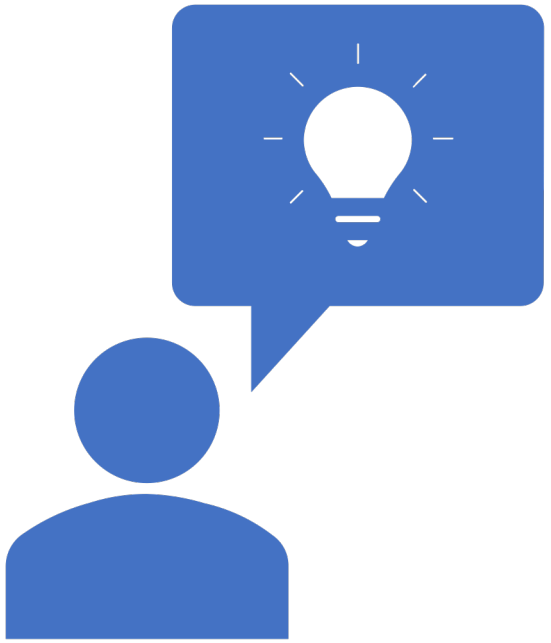
1..DAILY, SHAUNDRA B., et al. "EngageMe: Designing a Visualization Tool Utilizing Physiological Feedback to Support Instruction." *Technology, Instruction, Cognition & Learning* 10.2 (2015).

Classroom

- Adaptive Learning Systems + Engage Me (eye tracking, body pose and voice features)

Classroom

- Training Systems
  - Students can learn a skill through interaction with question and answering agents in a virtual simulation.
  - Clemson's Virtual Patient Project
    - https://www.youtube.com/embed/jwMCHCzsetc



Classroom

- Training Systems
  - Limitations:
    - only focused on speech
    - can not interact with the environment such as tools
    - no measure for engagement
    - static as it relates to learning
  - Suggestion:
    - Training System + Gestures + Augmented Reality + Engage Me + Adaptive Learning

Advising

- Intelligent Assistant similar to Siri
  - reduce the amount of time the student spends with their advisor
- Course recommendation system
  - similar to an Internet AD recommendation system which presents an AD based on browsing history

Performance Assessment and Evaluation

- Industry uses big data to automate the process of:
  - identifying problems (programs in which students are failing and how are the students within the programs similar)
  - forecast future performance (average GPA of the student body for next semester)
  - find new opportunities (which new course or program should be added)

AI Next Industrial Revolution

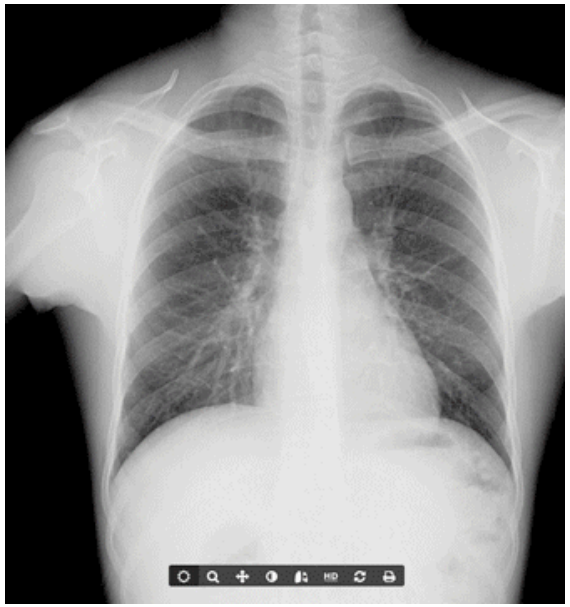
> *"The last 10 years have been about building a world that is mobile-first. In the next 10 years, we will shift to a world that is AI-first." — Sundar Pichai, CEO of Google, October 2016*

> *"It's hard to overstate," Amazon CEO Jeff Bezos wrote, "how big of an impact AI is going to have on society over the next 20 years."*

Manufacturing

- Automation

Medical



- Diagnosis

Automotive

- Self Driving Vehicles

Next Generation of Skilled AI Workers

- In a survey done by Ernst and Young:
  - 52 percent of executives, believe AI will have a "positive impact" on job creation
  - About one-third of respondents (32 percent) say that, with the implementation of AI, more jobs will be created than lost,
  - 20 percent anticipate that AI will even create a surge in new jobs.
  - **80 percent say there is a lack of talent to fill positions**
  - **48 percent a lack of managerial understanding and sponsorship is an issue standing in the way of successful AI implementation**

Preparing Students for the AI Future

- What skills do the students need:
  - Programming
  - Math (Calculus 1 and 2, Linear Algebra , Statistics)
- What tools do the students need:

Digital Divide

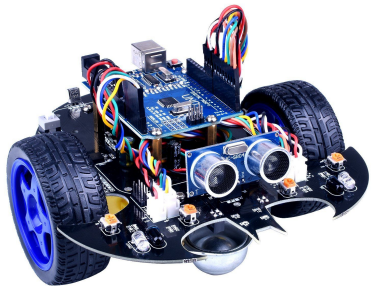
- Nanodegree in machine learning cost $999 flat fee.
- Prerequisites

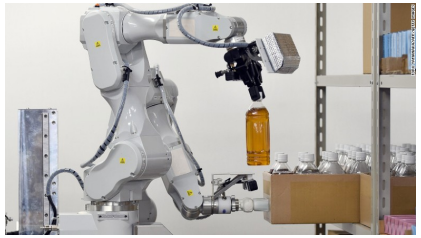
Big Idea: AI Maker Spaces for Teaching AI in Under-resourced Communities

Students

Build/Code

Build/Code





Robotic Platforms

Output:
Did the system perform as intended

Intelligent Tutor

Coursework/Feedback/Suggestions/Hints

Questions