Machine Intelligence

MACHINE INTELLIGENCE COMMUNITY

Rachel Manzelli, Tyrone Hou, Justin Chen
September 12, 2018

Welcome to BUMIC!

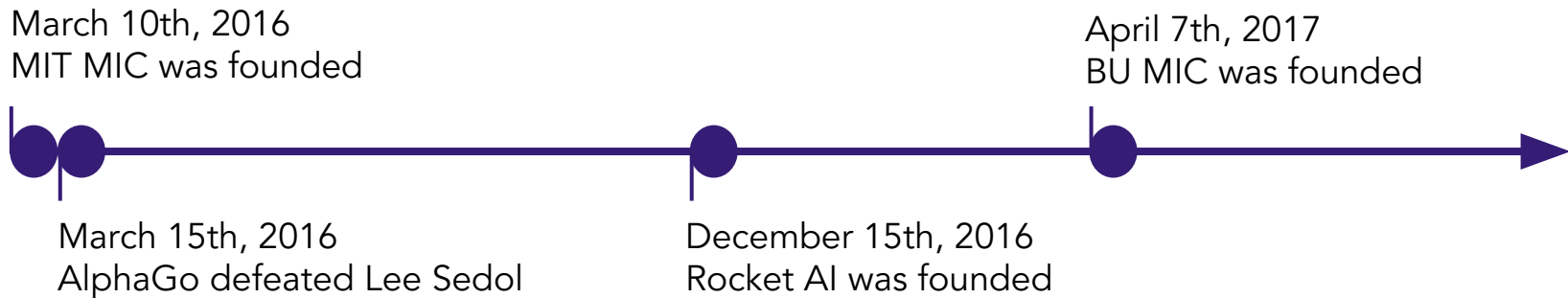We're excited to start a great year with you

Sign in

https://goo.gl/72uwxS

Who are we?

March 10th, 2016
MIT MIC was founded

April 7th, 2017
BU MIC was founded

March 15th, 2016
AlphaGo defeated Lee Sedol

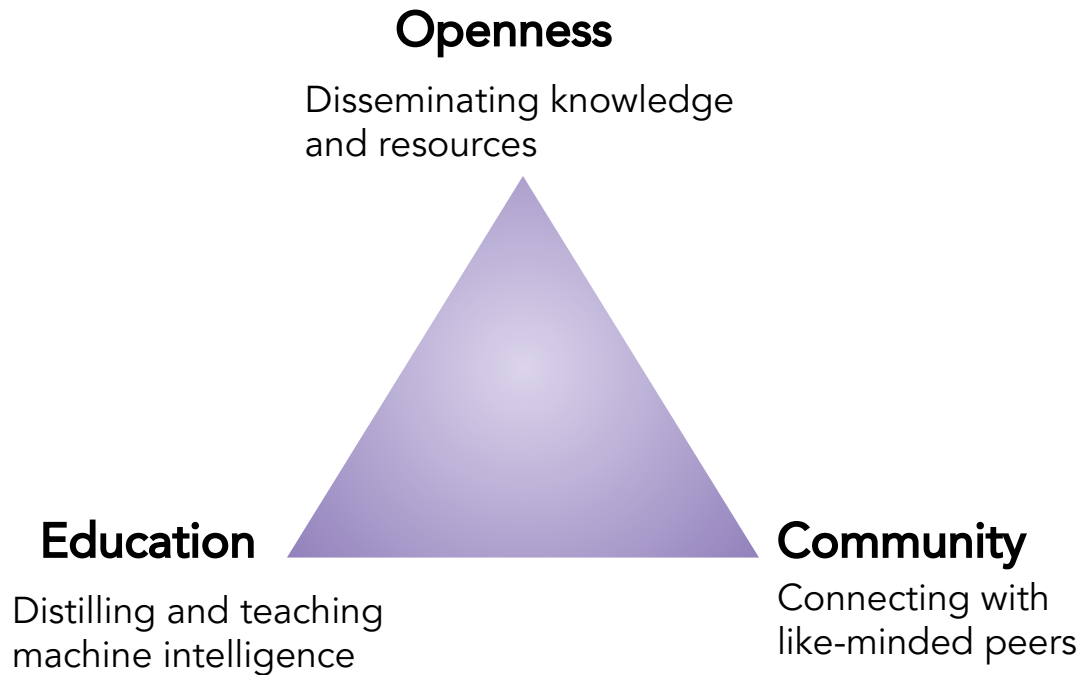December 15th, 2016
Rocket AI was founded

The Machine Intelligence Community is an organization focused on providing opportunities for students to learn about machine intelligence in a community environment.

Who are we?

Our Core Values

Openness

Disseminating knowledge and resources

Education

Distilling and teaching machine intelligence

Community

Connecting with like-minded peers

Goals of Workshop Series

1. Introduce the field of deep learning

2. Familiarity with terminology, history, concepts, current events, and papers

3. Learn how to read research papers

4. Meet others interested in machine intelligence

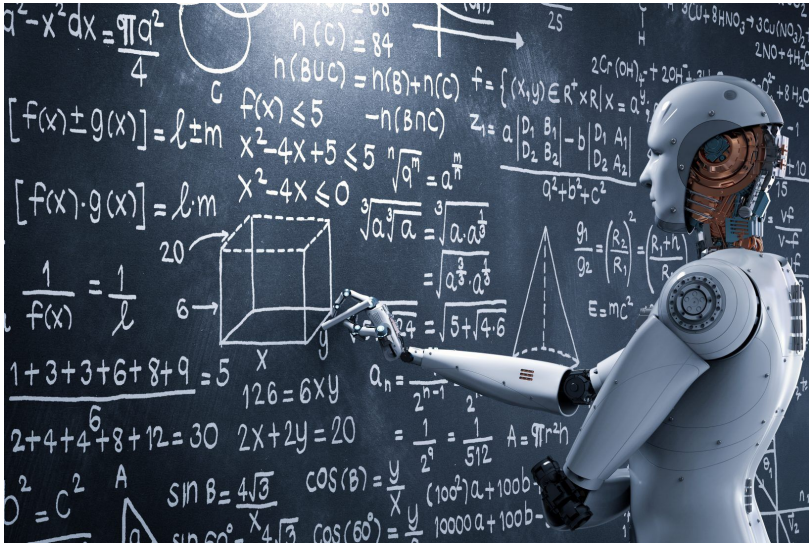5. Develop skill set to start your own deep learning projects

Workshop Topics

1. Machine Intelligence (you are here!)
2. Linear Algebra Foundations in Deep Learning
3. Gradient-Based Learning
4. Neural Networks
5. Regularization
6. Compositional Data
7. Transfer Learning
8. Sequential Data
9. Deep Reinforcement Learning
10. Unsupervised Learning
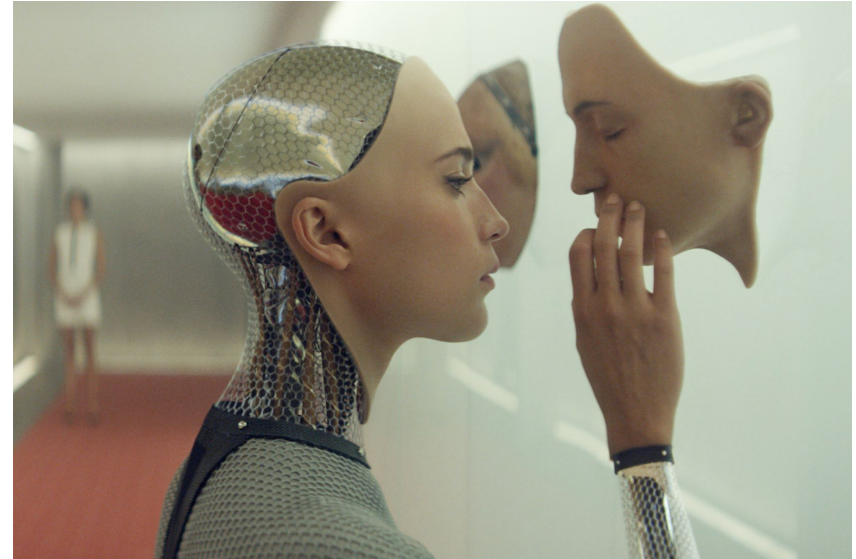11. Evolutionary Algorithms

AI, Machine Learning, & Deep Learning

Let's clear some things up...

What is Artificial Intelligence?

https://www.forbesmiddleeast.com/en/artificial-intelligence-to-add-182-billion-to-u-a-e-s-economy-by-2035/

https://afisha.tut.by/news/anews/475339.html?crnd=48542

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https://afisha.tut.by/news/anews/47...id=48542

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What is Artificial Intelligence, really?

http://n2citrus.com/wall_e_pages/wallepics.html

Thinking humanly - "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning ..." (Bellman, 1978)

Thinking rationally - "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)

Acting humanly - "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)

Acting rationally - "Computational Intelligence is the study of the design of intelligent agents." (Poole et al., 1998)

What is Machine Learning?

Coined by Arthur Samuel in 1959 - "A field of study that gives computers the ability to learn without being explicitly programmed."
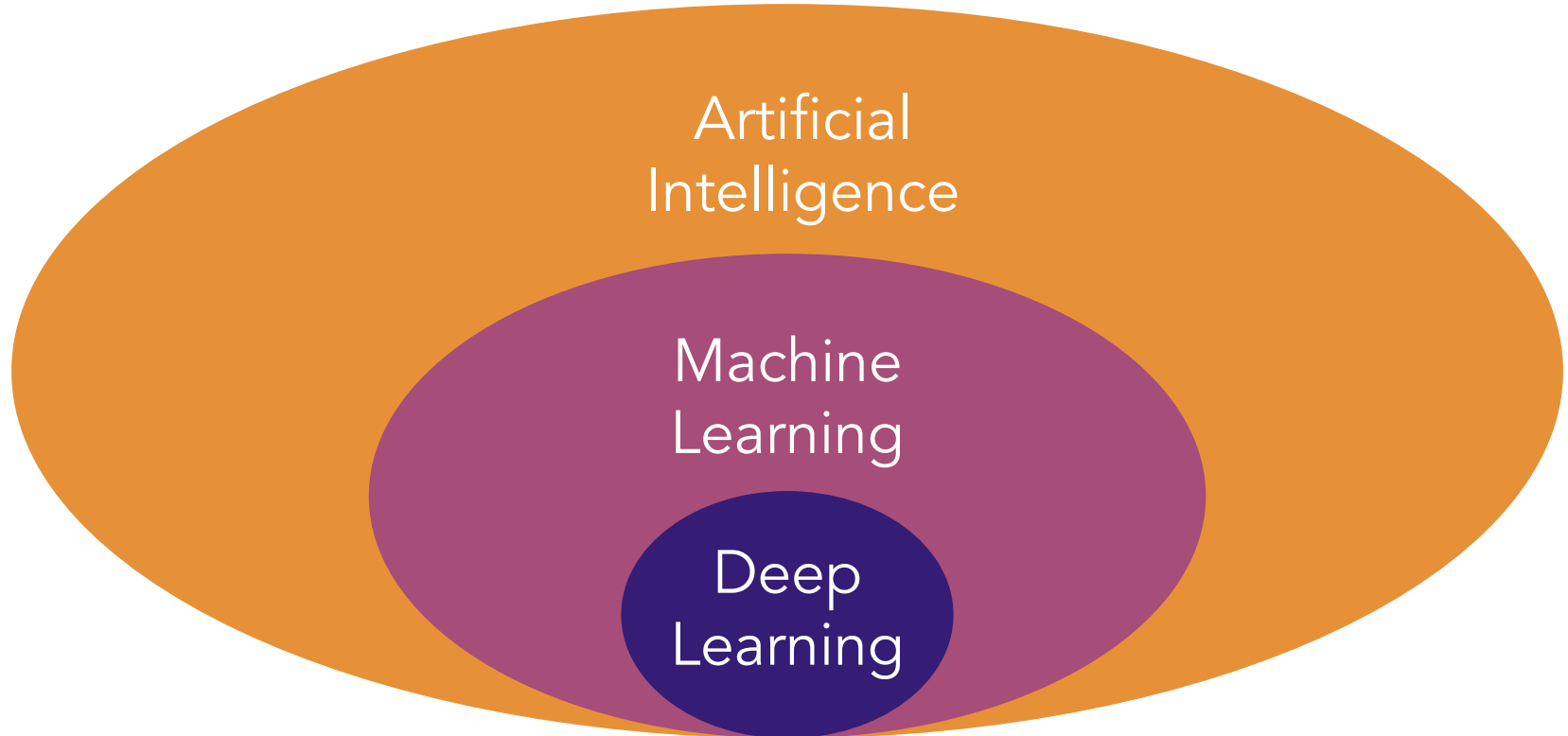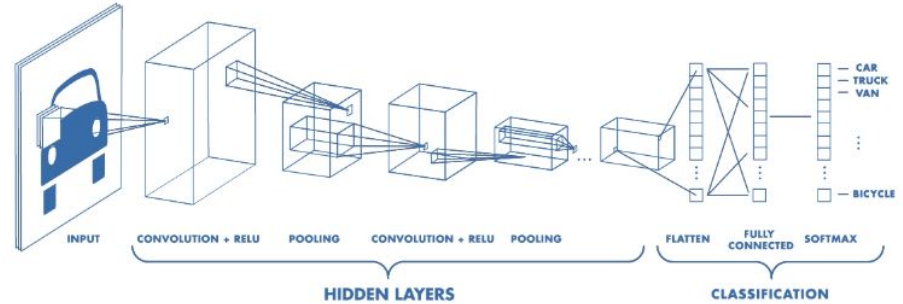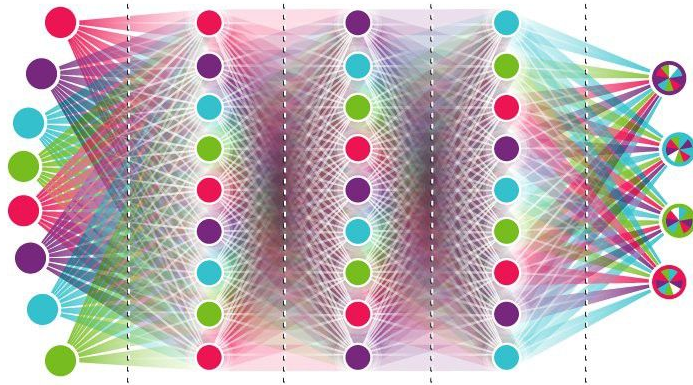
Applied statistics

Data-driven

Prediction

https://history-computer.com/ModernComputer/thinkers/Samuel.html

What is Deep Learning?

Artificial Intelligence

Machine Learning

Deep Learning

What is Deep Learning?

https://medium.freecodecamp.org/an-intuitive-guide-to-convolutional-neural-networks-260c2de0a050

DEEP NEURAL NETWORK

Input layer → Hidden layer 1 → Hidden layer 2 → Hidden layer 3 → Output layer

neuralnetworksanddeeplearning.com - Michael Nielsen, Yoshua Bengio, Ian Goodfellow, and Aaron Courville, 2016.

What is Deep Learning, really?

Calculus

$$\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta)$$

Linear Algebra

$$\begin{bmatrix} x_{11} & x_{12} & x_{13} & \dots & x_{1n} \\ x_{21} & x_{22} & x_{23} & \dots & x_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{d1} & x_{d2} & x_{d3} & \dots & x_{dn} \end{bmatrix}$$

Probability & Statistics

$$P(y = j | x) = \frac{e^{x^T w_j}}{\sum_{n=1}^{N} e^{x^T w_n}}$$
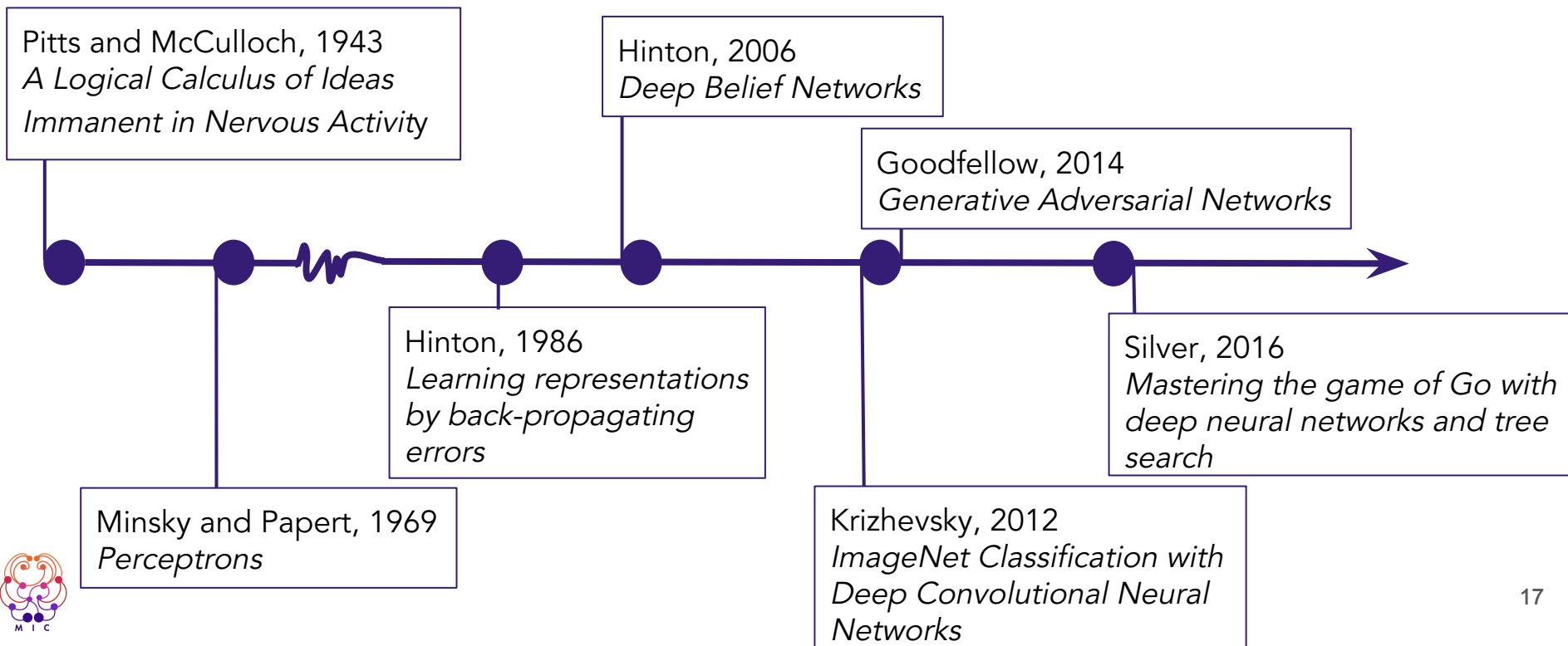
Optimization Theory

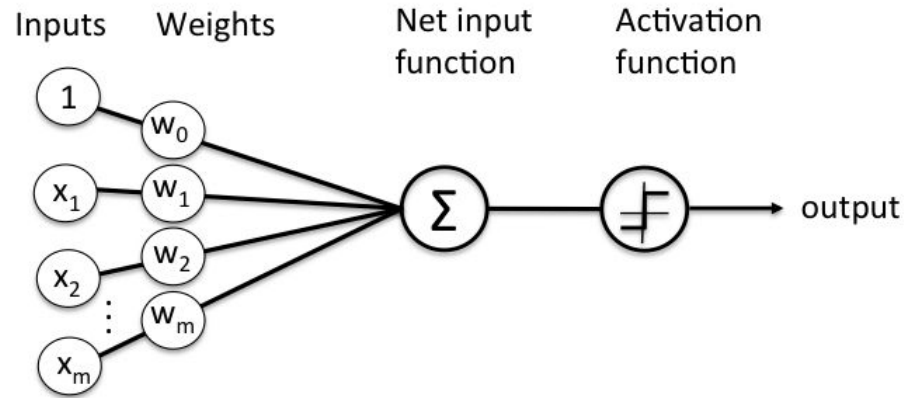$$J(\theta) = \frac{1}{2} \sum_{i=1}^{m} (h_\theta(x^{(i)}) - y^{(i)})^2$$

Learning Theory

$$Q_{\hat{\pi}}(s_t, a_t) = \mathbb{E}[R_t + \lambda \max_a Q_{\hat{\pi}}(S_{t+1}, a)]$$

Deep Learning Milestones

Pitts and McCulloch, 1943
*A Logical Calculus of Ideas
Immanent in Nervous Activity*

Hinton, 2006
Deep Belief Networks

Goodfellow, 2014
Generative Adversarial Networks

Hinton, 1986
*Learning representations
by back-propagating
errors*

Silver, 2016
*Mastering the game of Go with
deep neural networks and tree
search*

Minsky and Papert, 1969
Perceptrons

Krizhevsky, 2012
*ImageNet Classification with
Deep Convolutional Neural
Networks*

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Rosenblatt's Perceptron

Schematic of Rosenblatt's perceptron.

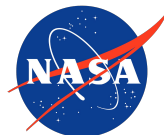https://sebastianraschka.com/Articles/2015_singlelayer_neurons.html
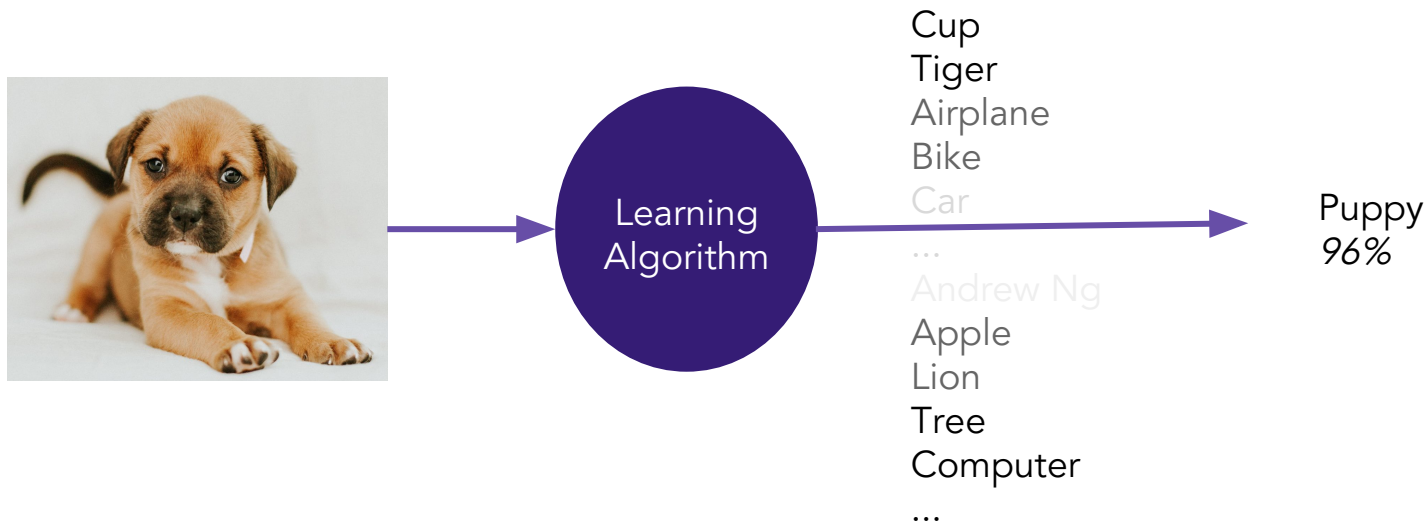
Where is Deep Learning?

What Can Machines Learn?

Classification, Regression, & Generation
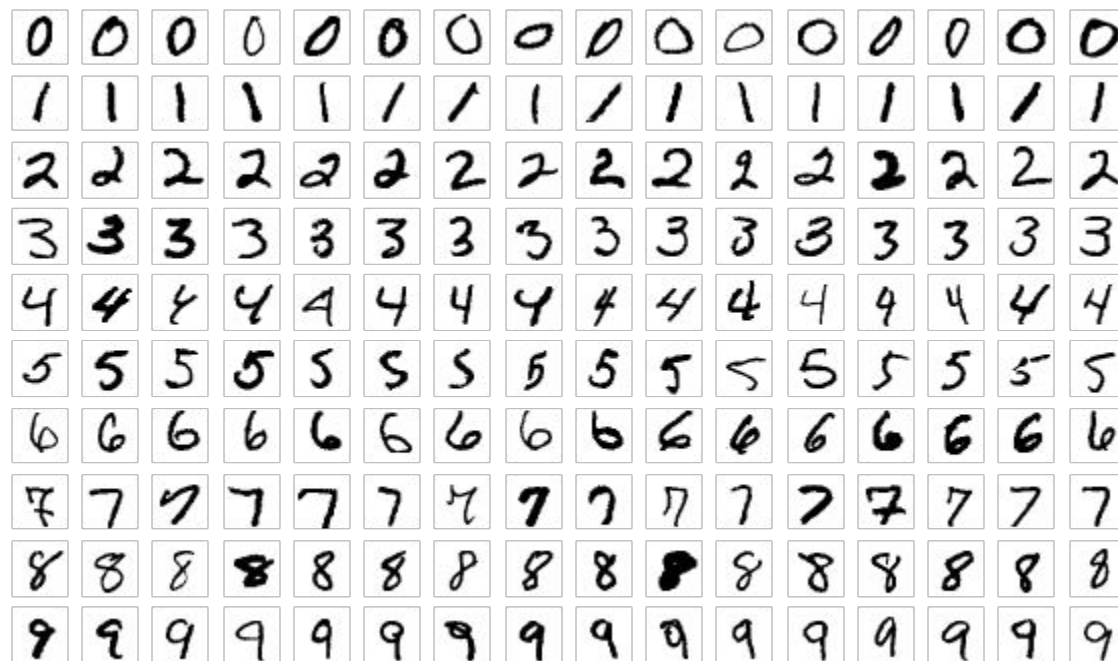
Classification

Cup
Tiger
Airplane
Bike
Car
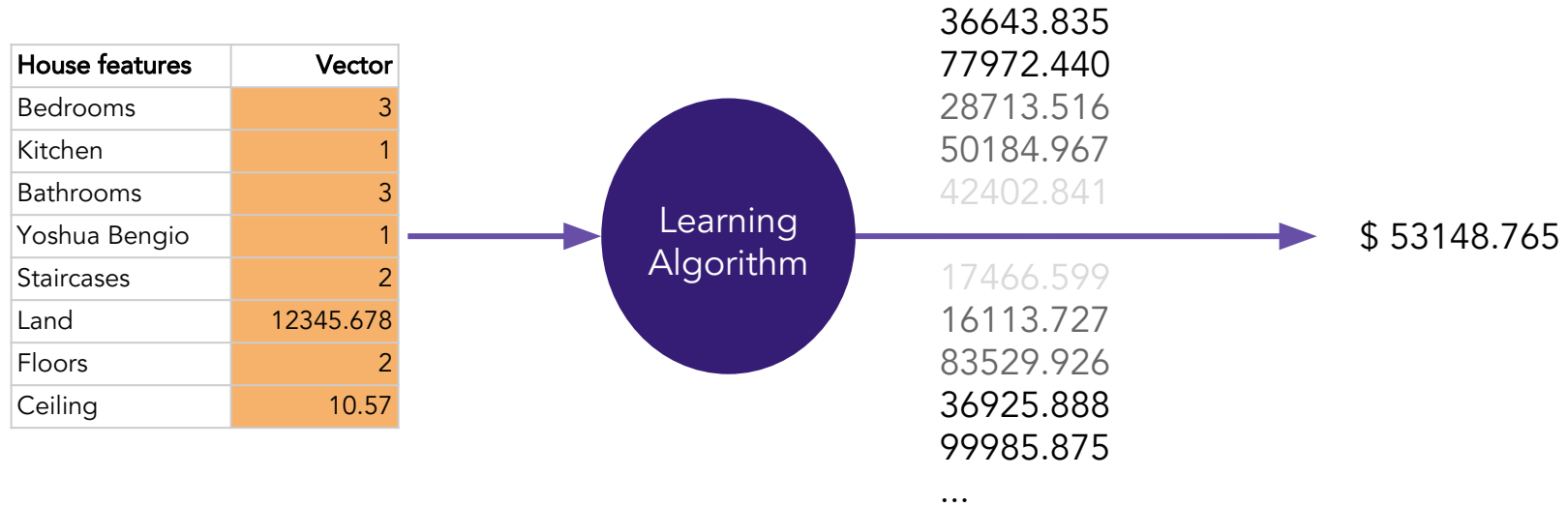...
Andrew Ng
Apple
Lion
Tree
Computer
...

Learning Algorithm

Puppy
96%

Classification involves predicting classes, where each class is a **discrete value**.

Classification: MNIST

Regression

House features	Vector
Bedrooms	3
Kitchen	1
Bathrooms	3
Yoshua Bengio	1
Staircases	2
Land	12345.678
Floors	2
Ceiling	10.57

Learning Algorithm

36643.835
77972.440
28713.516
50184.967
42402.841

17466.599
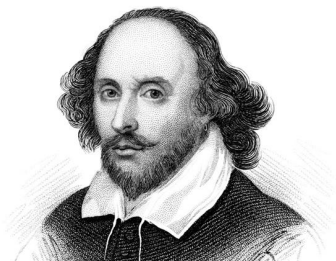16113.727
83529.926
36925.888
99985.875
...

$ 53148.765

Regression involves prediction of **continuous real values**.

Generation

Do you bite your thumb at us, sir?

Learning Algorithm

PANDARUS:
Alas, I think he shall be come approached and the day When little srain would be attain'd into being never fed, And who is but a chain and subjects of his death, I should not sleep. Second

Senator:
They are away this miseries, produced upon my soul, Breaking and strongly should be buried, when I perish The earth and thoughts of many states.

Geoffrey Hinton: Well, your wit is in the care of side and that.
…

Generative algorithms model and generate the **original distribution of the training data**.

Generation

Keaton Patti ✔
@KeatonPatti
Following

I forced a bot to watch over 1,000 hours of Diners, Drive-Ins, and Dives and then asked it to write a Diners, Drive-Ins, and Dives episode of its own. Here is the first page.

DINERS, DRIVE-INS, AND DIVES

INT. PARKING LOT

GUY FIERI sits in a convertible. He looks like America.

                    GUY FIERI
          I'm Guy Fieri and there's nothing
          you can do about it. Today I'm
          eating it all.

Guy takes a bite out of his hair.

INT. DINER'S KITCHEN

Guy and a CHEF stand in a kitchen. Guy has 3 pairs of sunglasses on. The sun can't get him.

                    GUY FIERI
          Prove to me you can panini!

The chef starts boiling a pot of milk. He's scared.

                    CHEF
          Flavortown is near.

How Do Machines Learn?

Learning Algorithms, Data, Training & Testing
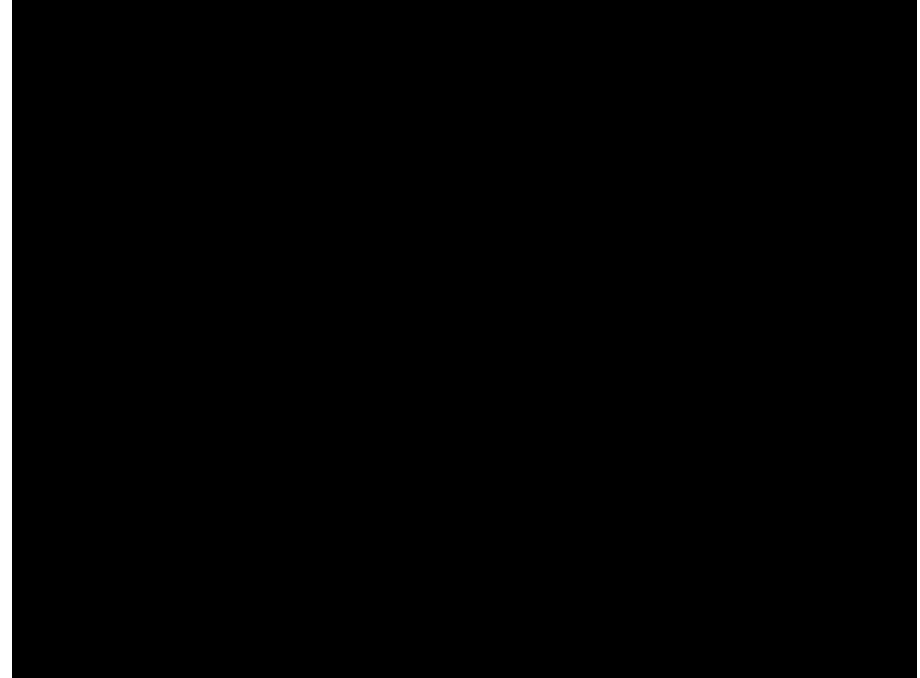
Types of Learning

Supervised - labeled dataset

Semi-supervised - partially labeled dataset

Unsupervised - unlabeled dataset

Reinforcement - punishment and reward

Meta - learning to learn

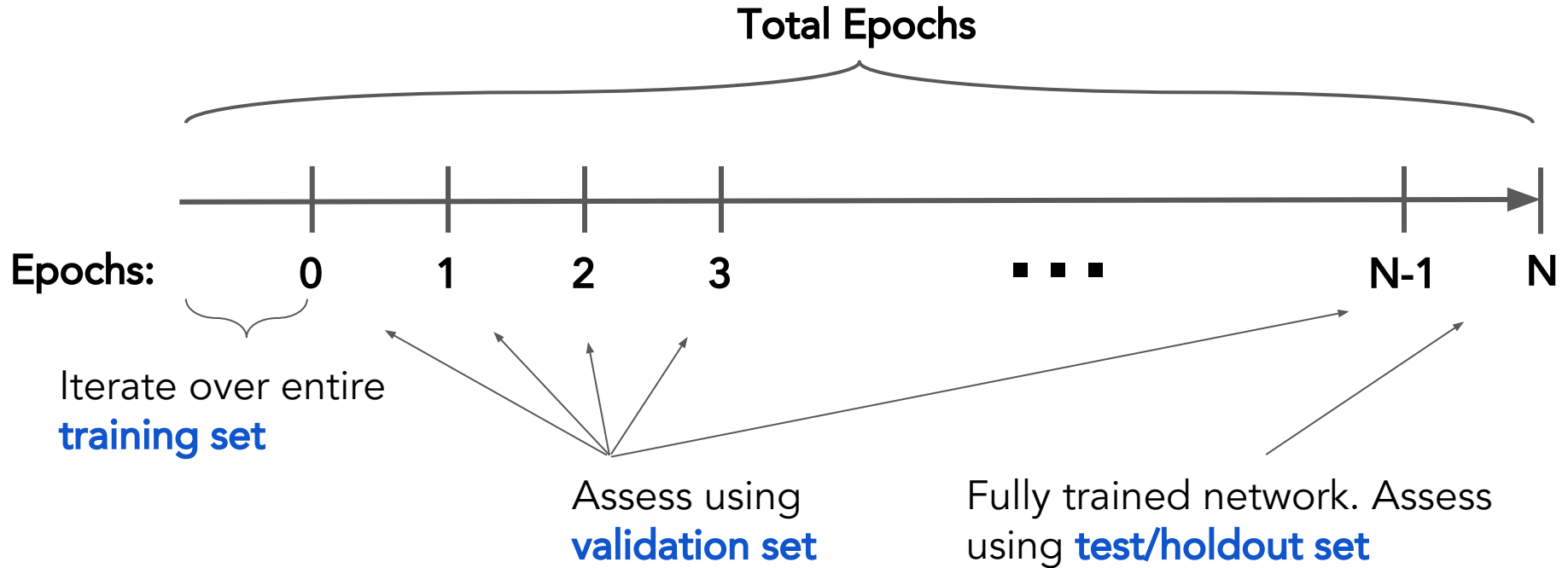**Transfer** - use learned parameters from a similar task

Dataset

Split - percentages depend on available data

TRAINING
~70%

VALIDATION
~10%

TEST/
HOLDOUT
~20%

Balance - data distributed close to uniformly

Training, Validation, & Testing

Total Epochs

Epochs: 0   1   2   3   · · ·   N-1   N

Iterate over entire **training set**

Assess using **validation set**

Fully trained network. Assess using **test/holdout set**

References and Further Reading

1. Russell, Stuart, Peter Norvig, and Artificial Intelligence. "A modern approach." Artificial Intelligence. Prentice-Hall, Englewood Cliffs 25 (1995): 27.
2. McCulloch, Warren S., and Walter Pitts. "A logical calculus of the ideas immanent in nervous activity." The bulletin of mathematical biophysics 5.4 (1943): 115-133.
3. Ivakhnenko, Alekseĭ Grigor'evich, and Valentin Grigorévich Lapa. Cybernetic predicting devices. No. TR-EE66-5. PURDUE UNIV LAFAYETTE IND SCHOOL OF ELECTRICAL ENGINEERING, 1966.
4. LeCun, Yann, et al. "Gradient-based learning applied to document recognition." Proceedings of the IEEE 86.11 (1998): 2278-2324.
5. Krizhevsky, Alex, Ilya Sutskever, and Geoffrey E. Hinton. "Imagenet classification with deep convolutional neural networks." Advances in neural information processing systems. 2012.
6. Halevy, Alon, Peter Norvig, and Fernando Pereira. "The unreasonable effectiveness of data." IEEE Intelligent Systems 24.2 (2009): 8-12.

Additional reading topics: General adversarial networks, neural turing machines, defeat of Lee Sedol with AlphaGo

Follow us for cool MI things!

https://www.facebook.com/BostonUniversityMIC/
and
https://www.facebook.com/groups/1017831178363028/

https://goo.gl/KHRCxw

http://eepurl.com/c2lXqn

Upcoming Events with BUMIC

- Next workshop: **Linear Algebra Foundations in Deep Learning**
- First Hack Night:
- First paper discussion: TBD

Thank you for joining us!

See you next week...