

Welcome to CSC411



Y. Nikulin and R. Novak, Exploring the Neural Algorithm of Artistic Style

CSC411: Machine Learning and Data Mining, Winter 2018

Michael Guerzhoy and Lisa Zhang

Machine Learning

- Tasks which are hard to solve programmatically:
 - Recognizing faces
 - Recommending movies based on a person's ratings
 - Deciding which web pages are relevant to a given Google search query

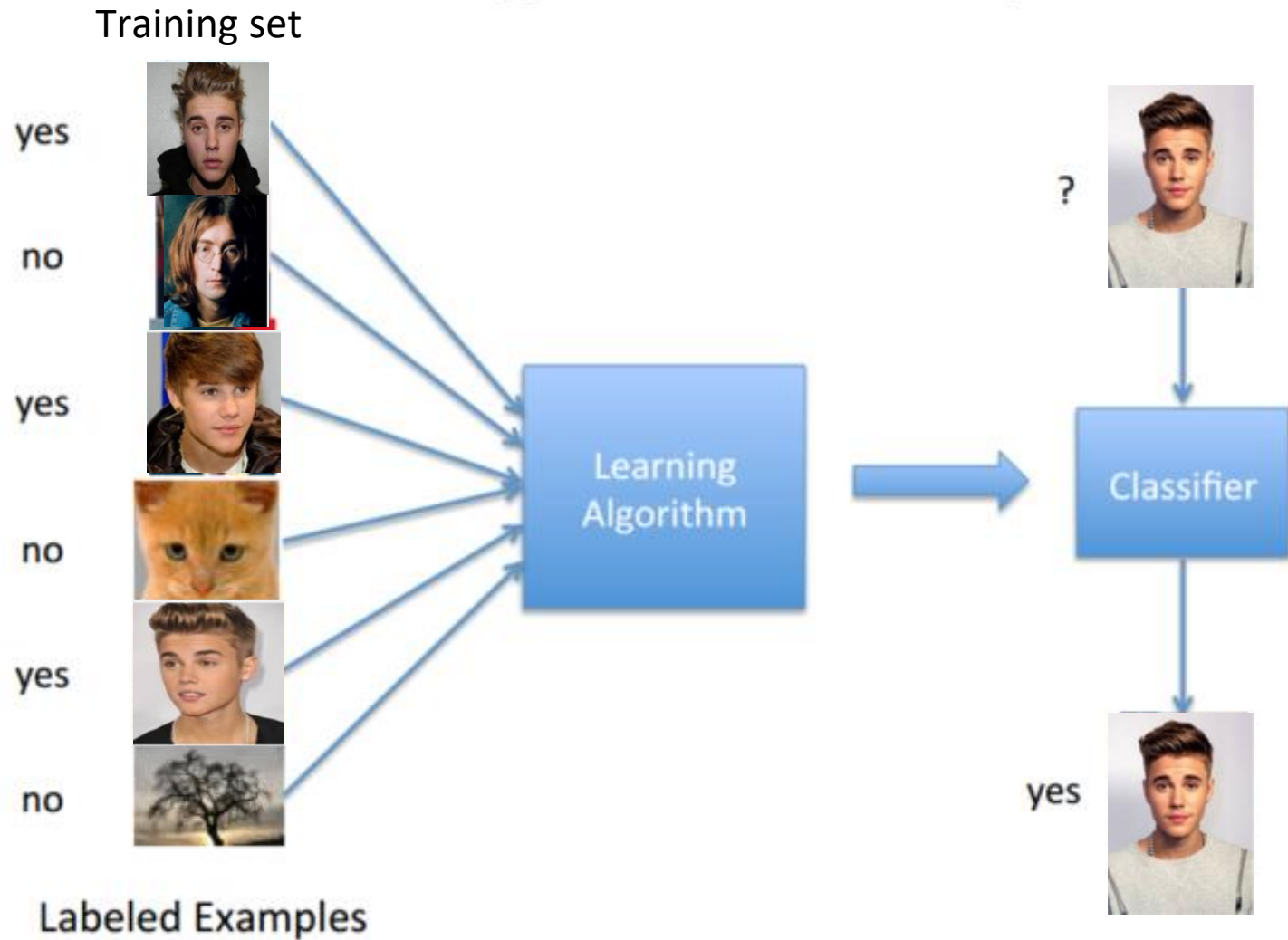
A simple task: Recognizing Justin Bieber



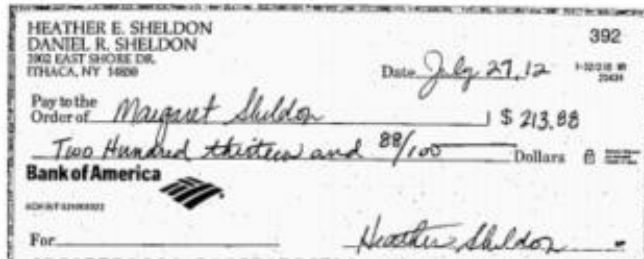
To a computer, this is what Justin Bieber looks like

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114 112 171 234 212 108 26 36 27 32 35 27 41 28 28 30 23 51 80 101 111 114 116 115 122 122 124 126 128 127 130 136 198 219 172 50 31 99 92 127 123 131 152 150 176 131

Machine Learning: Learn From Examples



Machine Learning Applications



Neural Network Applications



ML watches YouTube for three straight days!
(and learns to recognize cats)

<http://www.npr.org/2012/06/26/155792609/a-massive-google-network-learns-to-identify>

Building High-level Features Using Large Scale Unsupervised Learning

Quoc V. Le, Marc'Aurelio Ranzato, Rajat Monga, Mathieu Devin, Kai Chen, Greg S. Corrado, Jeffrey Dean, and Andrew Y. Ng

Course Goals

- Learn the basic building blocks and the general principles of designing machine learning algorithms
 - Understand the mathematical ideas needed for understanding and designing machine learning/neural networks algorithms
- Learn basic machine learning algorithms
- Learn the methodology of applying machine learning algorithms to data and evaluate their performance
- Apply the principles of machine learning in the context of neural networks and (probably) reinforcement learning

Required math background

- Calculus: derivatives, derivatives as the slope of the function; integrals (a little bit)
- Probability: random variables, expectation, independence
- Linear Algebra: vectors: the dot product, vector norm, vector addition; matrices: matrix multiplication. (Probably: eigenvectors)
- Other topics may be needed, but will be covered in class
- It really helps to *like and be comfortable with* math: you probably won't enjoy this class if you dislike math

Other Logistics

- Course Website:
 - <http://www.teach.cs.toronto.edu/~csc411h/winter/>
 - All announcements will be made on Piazza
 - Please ask questions on **Piazza** if they are relevant to everyone!

Section	Instructor	Office Hour	Email
Day (T1-3,Th2-3)	Lisa Zhang	Th10-12(BA3219)	lczhang at
Night (Th6-9)	Michael Guerzhoy	M6-7,W6-7(BA3219)	guerzhoy at

Administrative details

- Marking scheme to be finalized and posted within the next few days
- **Tentative** marking scheme
 - 4 projects worth 40%
 - First one to be done individually, others probably can be done in teams of two
 - A midterm worth 15-30%
 - Scheduled for Friday March 2 6pm-8pm (alternate timeslots available in case of documented conflicts)
 - An (undergrad) exam / (grad) project worth about 30-45%
 - Must receive at least 40% on the exam/project (after adjustment) to pass the course

Machine Learning

Supervised
Learning

Unsupervised
Learning

Reinforcement
Learning

...etc...

Machine Learning: types

Supervised Learning

- Learn to estimate a target y using data x .
 - x : an image
 - y : Justin Bieber?
 - x : text
 - y : Spam?
 - x : house size, location, age, n of bedrooms
 - y : house sell price
- Training set: examples $(x^{(i)}, y^{(i)})$

Machine Learning: types

- Learn something about the datapoints x
 - No targets y
- x : Youtube videos
 - Automatically divide videos into categories (“clustering”)
 - *or* Generate images of objects that appear in the videos often
 - Useful for categorizing
 - Useful for automatically learning concepts from videos
- x : User behaviour logs
 - What is the probability that the behaviour would be observed (if it’s small, the behaviour might be fraudulent)
- Training set: datapoints $x^{(i)}$

Unsupervised
Learning

Machine Learning: types

Reinforcement Learning

- No training set initially
- Get data by interacting with the environment
- Goal: interact with the environment in a way that maximizes the reward you get in the long term
 - Control a robot
 - Try different things, see what gets it to walk the farthest
 - Play Go
 - Play against yourself, try different ways to generate moves, see what strategies allow you to win the most
 - Playing video games

Machine Learning

- What functions are *efficiently* learnable from example data? (ML Theory)
- How can we apply machine learning without compromising data privacy?
- How to make sure machine learning algorithms don't result in unfair discrimination against people?

...etc...

Main focus for most of course:

Supervised
Learning

- **Classification:** categorical outputs \mathbf{y}
- **Regression:** numerical (continuous) outputs \mathbf{y}

This week

- We will discuss two very different algorithms:
 - K-Nearest Neighbours
 - Linear Regression