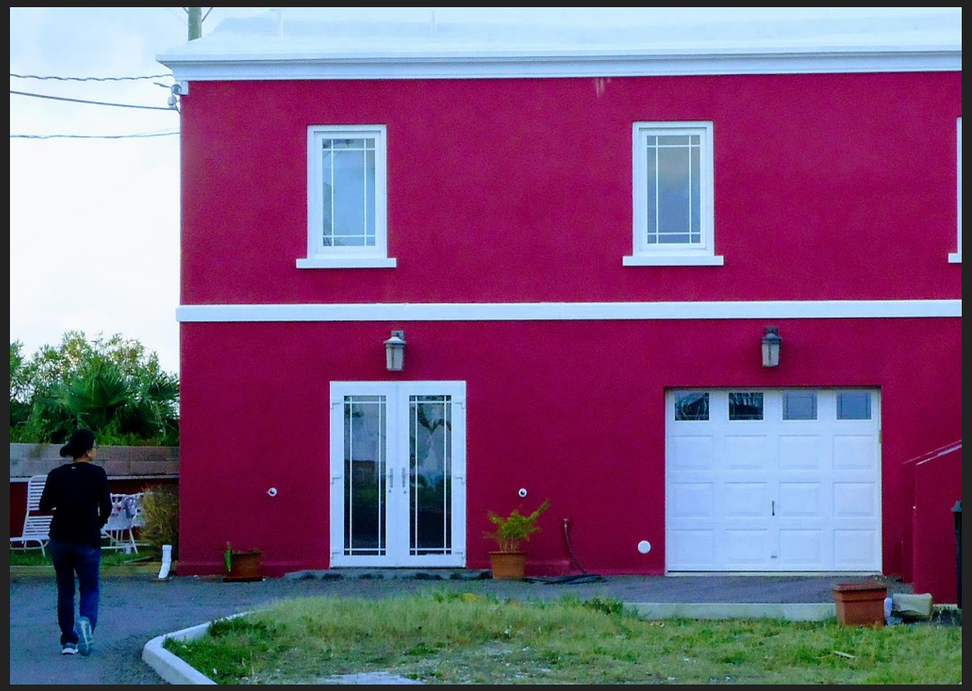
GEORGE MCINTIRE

INTRODUCTION TO MACHINE LEARNING

TABLE OF CONTENTS




208


240

WHAT IS MACHINE LEARNING

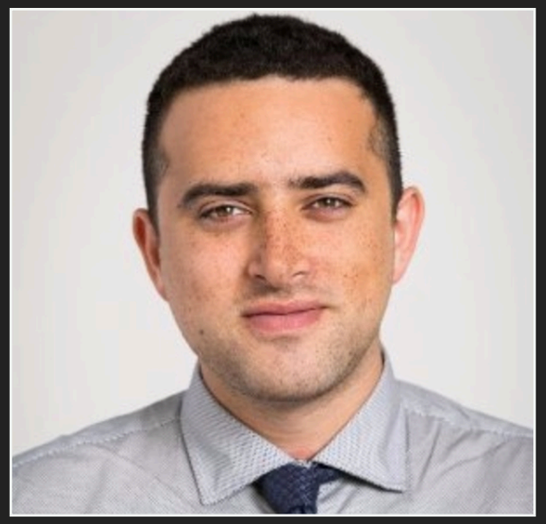
- “A field of study that gives computers the ability to learn without being explicitly programmed” (1959)
  - Arthur Samuel, AI pioneer, coined the term “Machine Learning“

- “The automation of activities that we associate with human thinking, activities such as decision-making, problem solving, learning…” (1978)
  - Richard Bellman, applied mathematician

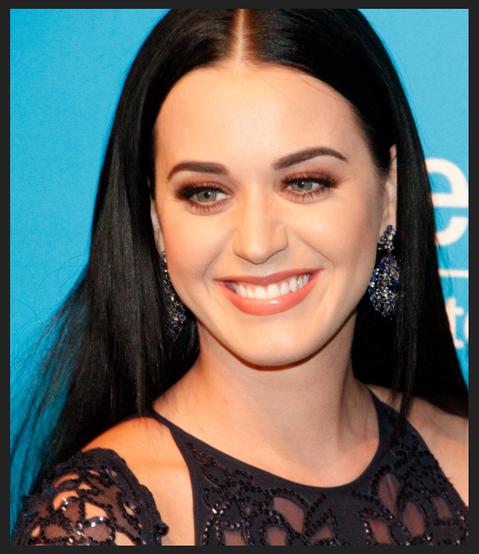
WHAT IS MACHINE LEARNING (CONT.)

- Examples in the form of data are passed through algorithms that look for patterns in that data in order to make predictions and decisions on future data.
- The computer observes that data of a certain category exhibits certain characteristics and data of another category exhibits a whole set of different characteristics. Allows the computer to properly classify data without that labeling.

FACE



FACE



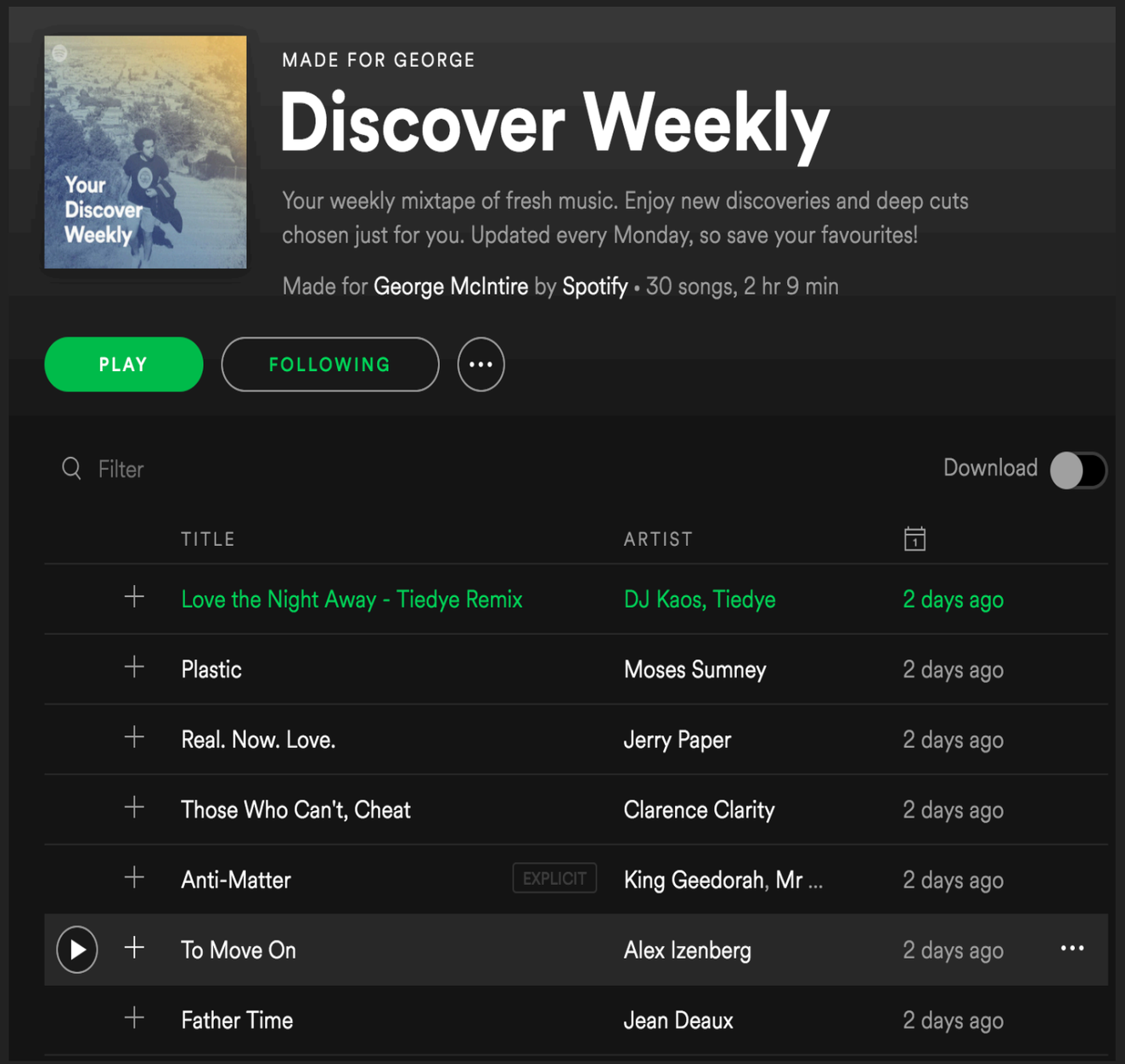
?

NOT A FACE

?

EXAMPLES

- Netflix and Spotify recommendations.
- Credit card fraud detections
- Loan approvals
- Zillow's Zestimate
- Email spam prevention/fake news
- Personal assistant machines: Siri, Alexa, etc…
- Crime pattern detections



TYPES OF MACHINE LEARNING

SUPERVISED

UNSUPERVISED

MAKING PREDICTIONS

FINDING STRUCTURES

SUPERVISED LEARNING

SUPERVISED LEARNING

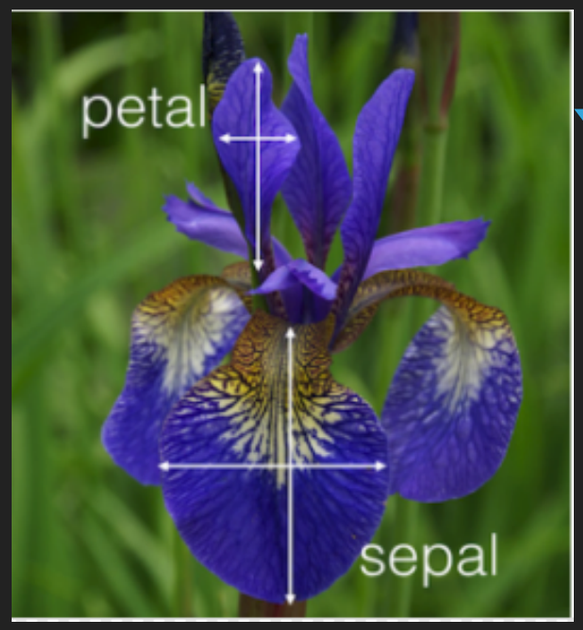
- Main goal is making predictions/classifications. Uses the past to predict the future.
- Data is composed of observations/events/instances.
- Predictors aka “X” aka the independent variables aka the features aka the input aka the attributes.
- Response variable aka “Y” aka the outcome aka the label aka the target aka the dependent variable.

SUPERVISED LEARNING DATASET

Fisher's *Iris* Data

Sepal length	Sepal width	Petal length	Petal width	Species
5.1	3.5	1.4	0.2	*I. setosa*
4.9	3.0	1.4	0.2	*I. setosa*
4.7	3.2	1.3	0.2	*I. setosa*
4.6	3.1	1.5	0.2	*I. setosa*
5.0	3.6	1.4	0.2	*I. setosa*
5.4	3.9	1.7	0.4	*I. setosa*
4.6	3.4	1.4	0.3	*I. setosa*
5.0	3.4	1.5	0.2	*I. setosa*

OBSERVATIONS



PREDICTORS

RESPONSE

TYPES OF SUPERVISED LEARNING

CLASSIFICATION

- Outcome variable is a category:
  - good/bad
  - 1/0
  - sports/tech/politics/style
- Types of algorithms:
  - Logistic Regression, Naive Bayes, K-Nearest Neighbors, Decision Tress

REGRESSION

- Outcome variable is a continuous:
  - 3.6, 9.7, 2.3, 8.9,11.1,18.3, 23.6,4.2, 6.9
- Types of algorithms:
  - Linear regression, Ridge regression, Lasso Regression

CLASSIFICATION EXAMPLE: LOAN DEFAULTS

- **Problem:** Lenders lose money when loanees fail to pay back loans.
- **Goal:** Develop a system that can efficiently identify high risk loans so lenders know which applications to reject
- **Data:** Records of previous loans marked as successful or failure that includes relevant information such as income, credit score, loan term, loan amount, etc…

REGRESSION EXAMPLE: HOUSING PRICES

- **Problem:** A home owner wants to sell her home but can't decide on an asking price.
- **Goal:** Accurately appraise the true value of the property
- **Data:** Home sale records labelled with their sale prices. Dataset features # bedrooms/bathrooms, sq ft, location, year sold, etc…

UNSUPERVISED LEARNING

UNSUPERVISED LEARNING

- Absence of outcome variable/labels. Only features.
- Objective is looser and more exploratory.
  - Find groups of observations that exhibit similar characteristics.
  - Find combinations of features that explain the variation in the data.
- Useful as a preprocessing/exploratory data analysis step but to difficult to evaluate how well you're doing.

Text

Also called as clustering

TYPES OF UNSUPERVISED LEARNING

CLUSTERING

- Make labels from unlabelled data.
- Examples: detect segment of users, derive micro-positions in sports
- Algorithms: KMeans, Hierarchal, DBScan

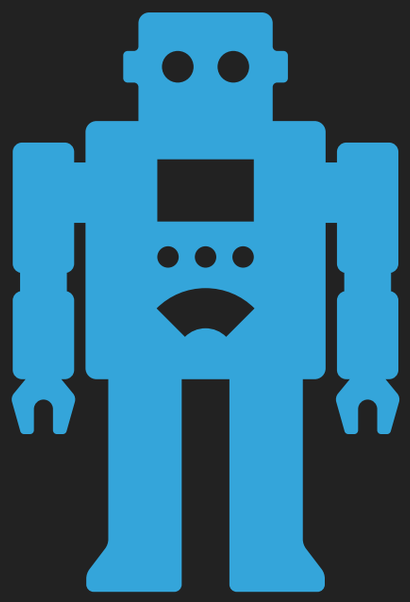
DIMENSIONALITY REDUCTION

- Deals with two many variables. Compresses data
- Great visualizing data with >=4 dimensions
- Algorithms: PCA, Truncated SVD, NMF

Non negative matrix factorization

Clusterving vs Classification:
clustering is a means for creating labels, classification is using the given labels

???QUESTIONS???!!!



FINAL PROJECT

FINAL PROJECT OBJECTIVE

- Conduct a machine learning project in which you build a machine learning model trained on a dataset of your choosing.
- Use the models and tools we learned in this class to create the best possible model.
- Choose classification or regression.
- Unsupervised/clustering is allowed, but I prefer you choose the supervised route.
- If you want to use text data, then please let me know ASAP.

FINAL PROJECT PRESENTATION.

- 1. Introduce issue/problem and the dataset.
  - Give us context. Demonstrate your domain expertise.
- 2. State objective
  - “I am trying to use X to predict y”, “I am trying to analyze the relationship between A and B”, “I want to build a loan approval model”

FINAL PROJECT PRESENTATION 2

- 3. Data acquisition/wrangling/munging/cleaning
  - Tell us where the data came from. Which steps did you take to transform this dataset in to a workable machine-learning dataset.
- 4. Exploratory data analysis.
  - Use visualizations to give the audience a better understanding of the data and the context. Show us what you found interesting about the data. Charts, charts, charts!

FINAL PROJECT PRESENTATION 3

- 5. Modeling
  - Which algorithms did you test? Which algorithms and configurations did you choose as your model? What steps did you take to improve your model?
  - What sort of feature engineering steps did you take to improve the model? Which features did you keep, drop, and transform? What were the best features?

FINAL PROJECTION PRESENTATION 4.

- 4. Model evaluation
  - Show how well your best model did. Use accuracy, sensitivity, recall, precision, and roc auc metrics. Highly recommend you include a roc curve. Scores should be cross validated or tested against a validation set.
- 5. Conclusion/further steps
  - What did you learn? How much of your objective did you achieve? What else could be done to solve this problem?

EXAMPLES AND DATASETS

- Project examples from past GA students:
  - https://github.com/ga-students/DS-SF-40/blob/master/project-examples.md
- Datasets galore:
  - https://github.com/ga-students/DS-SF-40/blob/master/public_data.md
  - https://www.reddit.com/r/datasets
  - https://www.kaggle.com/datasets
  - driven-by-data.net
  - https://data.world/
  - https://github.com/caesar0301/awesome-public-datasets
- Can use work data, ask for permission early and deal with privacy related issues.

FINAL PROJECT PROPOSAL

- What are two or three potential questions you would like to try and answer? What do you want to find out in this project? If possible state your objective.
- What is the data? Where did it come from? Why did you choose it?
- Proposal is due week of December 5. After proposal is submitted, schedule a 1-1 feedback session with me.
- More details here: https://github.com/ga-students/DS-SF-40/blob/master/project.md

FINAL PROJECT TIPS

- Pick a machine learning dataset. Not all datasets can be used for machine learning.
- Don’t pick a very dirty dataset or any other dataset that requires tremendous time and effort to assemble.
- **ITS NEVER TOO EARLY TO START WORK ON YOUR FINAL PROJECT**
- Time management is especially crucial. Budget your time and take advantage of the holiday breaks.
- Use me and your fellow classmates for your help.

???QUESTIONS???