



ISTA 421 + INFO 521
Introduction to
Machine Learning

Lecture 1: Introduction

Clay Morrison
claytonm@email.arizona.edu
Harvill 437A
Phone 621-6609

20 August 2018

1

Welcome to ISTA 421 + INFO 521

- Today:
 - Introductions
 - Syllabus
 - Course Structure & Goals
 - Intro to ML

Course Website (also linked from the D2L course webpage)
<http://w3.sista.arizona.edu/~clayton/courses/ml>

Your Instructors

- **Clay Morrison**

- Harvill 437A, 621-6609
- claytonm@email.arizona.edu
- Office Hours:
 - Monday and Wednesday: 4:00pm-5:00pm
 - By appointment (email me!)



- **TA: Farig Sadeque**

- Harvill 456
- farig@email.arizona.edu
- Office Hours:
 - Tuesday and Wednesday:
3:00pm – 4:00pm



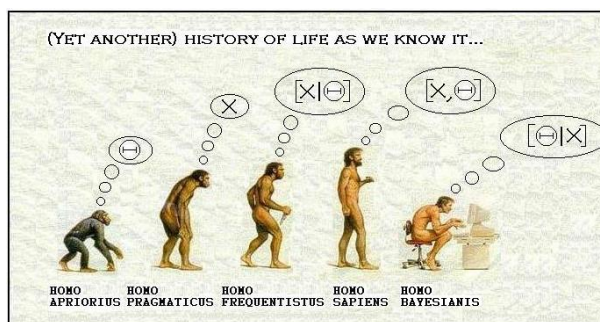
Please contact us **ahead of time** if you plan to attend office hours!

General Email Rule: start subject line with [421] or [521] (doesn't matter which)

3

Course Goals

- Basic literacy in core, modern ML methods
- Practical experience implementing ML algorithms and using them on data

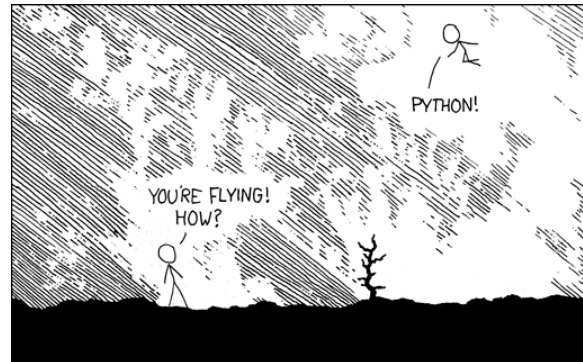


4

Course Texts



<https://xkcd.com/353/>



Python 3.6+

numpy
scipy
matplotlib



http://w3.sista.arizona.edu/~clayton/courses/ml/python_setup.html

6

Topics

- The linear model
 - Regression, Classification
- Classification
 - Probabilistic:
 - Bayes Classifier, Naïve Bayes
 - Logistic Regression
 - Other, *non*-probabilistic
 - K-nearest neighbors
 - Support Vector Machines and kernel methods
- Clustering
 - K-means
 - Mixture Models and EM
- Other Unsupervised methods:
 - Principle Components Analysis
 - Latent Variable Models
- Additional topics (time permitting)
 - Neural networks
 - Gaussian processes, topic modeling
 - Ensembles, boosting, Rand. Forests
- Probability
 - Quantifying uncertainty
 - Bayesian Approach: Prior, Marginal Likelihood, MAP
- Inference Methods
 - Least Squares
 - Maximum Likelihood
 - Bayesian Inference: Direct and Sampling
- Machine Learning algorithm evaluation
- Learning theory
- Feature Selection and Model Selection

7

Homework 1

- **Goal:** Set up and get comfortable with your programming environment, write some very simple scripts and recall some linear algebra.
- **DUE:** Next Friday, August 31, 5pm to the D2L Assignments folder (previously “Dropbox”)
- Worth 24 points

8

What is Machine Learning?

- The goal of machine learning is to build computer systems that can adapt and learn from their experience. (Dietterich, 1999)
- Machine learning usually refers to changes in systems that perform tasks associated with artificial intelligence. Such tasks involve recognition, diagnosis, planning, robot control, prediction, etc. (Nilsson, 1996)
- Some reasons for adaptation:
 - Some tasks can be hard to define except via examples
 - Adaptation can improve a human-built system, or track changes over time
- Goals can be **autonomous** machine performance, or enabling humans to learn from and understand data (data mining and modeling)

Ack: this and some following content adapted from Chris Williams 2006

9

Some of the Roots of Machine Learning

- **Philosophy:** epistemology, philosophy of science, logical inference: *the Problem of Induction*
- **Mathematics:** structure, operations, optimization
- **Physics:** statistical mechanics
- **Statistics:** statistical inference, frequentist & Bayesian
- **Psychological** models (of learning and development)
- **Brain** models, e.g. neural networks
- **Artificial Intelligence:** e.g., discovering rules using decision trees, inductive logic programming, autonomy
- **Engineering:** Statistical pattern recognition, operations research, adaptive control theory

10

From Rob Tibshirani

Greater focus on

- prediction
- analysis of learning algorithms (not just large dataset issues)

What is the difference between Machine Learning and Statistics?

Glossary

Machine learning	Statistics
network, graphs	model
weights	parameters
learning	fitting
generalization	test set performance
supervised learning	regression/classification
unsupervised learning	density estimation, clustering
large grant = \$1,000,000	large grant= \$50,000
nice place to have a meeting: Snowbird, Utah, French Alps	nice place to have a meeting: Las Vegas in August

Greater focus on

- understanding data in terms of models
- interpretability, hypothesis testing

11