MACHINE LEARNING

CS6140

Fall 2019

Predrag Radivojac
BASIC INFORMATION

Class meets:
Time: TF 3:25pm – 5:05pm
Place: Churchill Hall 101

Instructor:
Predrag Radivojac
Office: WVH 310D
Email: predrag@northeastern.edu
Web: https://www.ccs.neu.edu/home/radivojac/

Office Hours:
Time: T 5:30pm-6:30pm
F 5:30pm-6:30pm or by appointment
Place: WVH 310D

Class Web Site:
https://www.ccs.neu.edu/home/radivojac/classes/2019fallcs6140/
TEACHING ASSISTANTS

Girik Malik
Email: malik.gi
Office: WVH 310
Office hours: M 10:00am-11:30am & T 5:30pm-7:00pm (tentative)

Yisu Peng
Email: peng.yis
Office: WVH 310
Office hours: M 2:00pm-3:30pm & T 10:00am-11:30am (tentative)

Daniel Zeiberg
Email: zeiberg.d
Office: WVH 310
Office hours: WR 2:00pm-3:30pm & R 10:00am-11:30am (tentative)
A LITTLE ABOUT ML

• Machine Learning is concerned with developing, analyzing, and applying algorithms that make useful inferences in the real world

• “Learn” functions and rules from data

• Specific problems always in mind, but frameworks are very important

• Balance between theory and application, slanted towards theory

• Probability theory, statistics, computer science
  – artificial intelligence
  – engineering
  – optimization
  – psychology
  – biology
How High Is Your XQ?

Your next job might depend on it

BY ELIZA GRAY

Is it true to say you have never hated anyone? Do you understand why stars twinkle? Have you used a display of emotion to get what you want? Would you rather read or watch TV? Do you usually notice when you are boring people? Do you hate opera singing? Would you consider yourself to be an ordinary person? Are you shy? Do you prefer problems that require a lot of thought? Do you enjoy giving parties? When you are nervous, do you feel especially rebellious? Do you prefer to work with people? Do you believe people get stressed when they try to do something in your day that makes you feel happy? How do you feel when you are uncomfortable accepting help from others? Have you ever stressed at work? Do you think sometimes you feel ill? Do you like to have someone around at work? Would you like to change a lot of things about your job? Do you make new friends all the time? Do you actually pretend to know many people? Do you try to form friendships at work? Would your colleagues agree you are very confident? How much does...
An Example From Reddit

Let Artificial Intelligence guess your attractiveness and age

#howhot
PROFESSOR’S SUMMER (ONLINE ADVERTISING)
A LITTLE MORE DETAIL...

\[ \Gamma(t|k, \theta) = \frac{t^{k-1}e^{-\frac{t}{\theta}}}{\theta^k \Gamma(k)} \]
WHERE ELSE DO WE SEE IT…

What Can Be Automated?
What Cannot Be Automated?
In real situations we have uncertainty
- We have incomplete knowledge of the environment
- Actions of other actors are not provided

Applied everywhere to learn from data and make predictions, some of which facilitate decisions

Utility theory: incorporates an agent’s preferences towards certain scenarios

Decision theory: probability theory + utility theory

Rational decision: decision that maximizes expected utility
Overview of the CS 6140 Course

See online syllabus…

- mathematical foundations of machine learning
- overview of machine learning
- foundations of parameter estimation
- basic unsupervised learning
- classification algorithms (prediction of discrete outputs)
- regression algorithms (prediction of continuous outputs)
- kernel methods (as part of classification/regression)
- ensemble methods
- practical aspects in machine learning
- special topics (if time permits)
TEXTBOOK INFORMATION

Main books:
• Pattern Recognition and Machine Learning - by C. M. Bishop, Springer 2006.

Recommended readings:
• The Elements of Statistical Learning - by T. Hastie et al., Springer, 2009

Supplementary material will be provided in class!
WHAT DO I EXPECT AND ASSUME?

• Basic mathematical skills
  – calculus
  – probabilities
  – linear algebra

• You are patient and hardworking

• Your integrity is impeccable

• You are motivated to learn (machine learning)

• You are motivated to succeed in class
GRADING POLICY

- Midterm exam: 20%
- Final exam: 20%
- Homework assignments (4-5): 30%
- Mini project: 25%
- Class participation: 5%

I decide on the final grade (I don’t necessarily enjoy this)

- Midterm exam – Week 8 (in class)
- Final exam – December, last week of classes
- Thanksgiving break – November 28-29 (no classes)
MORE ON GRADING

• Top performers in the class will get As

• Distributions of scores will be shown (I hope regularly)

• If you don’t know where you stand in class, ask me

• All assignments count, must be typed to show formulas properly! Plan ahead!

• All assignments are individual!

• All the sources used for problem solution must be acknowledged (people, web sites, books, etc.)
# Roadmap

<table>
<thead>
<tr>
<th>September</th>
<th></th>
<th>November</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>October</th>
<th>7</th>
<th>December</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>
# Roadmap

<table>
<thead>
<tr>
<th>September</th>
<th>November</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>9 h1</td>
<td>h4</td>
</tr>
<tr>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>23 H1, h2</td>
<td>18 H4</td>
</tr>
<tr>
<td>30</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>October</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 H2, pp (h3)</td>
<td>2 P, F</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>21 M, PP (H3)</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>
**Late Assignment Policy**

- Homework assignments are due on the specified due date through Blackboard.

- Late assignments will be accepted* according to the following rules:
  - Points (on time)
  - Points x 0.9 (1 day late)
  - Points x 0.7 (2 days late)
  - Points x 0.5 (3 days late)
  - Points x 0.3 (4 days late)
  - Points x 0.1 (5 days late)
  - 0 (after 5 days)

* if there are legitimate circumstances to not apply this policy, please inform me early.
ACADEMIC HONESTY

• The Code of Student Conduct
  – Interesting things there, including that…
  – “Students are expected to display proper respect for the rights and privileges of other members of the University community and their guests.”
  – “Furthermore, students must follow the reasonable directions of University personnel.”
  – “The Code of Student Conduct applies both on and off campus”

• Academic honesty taken seriously!
  – I have to report every incident to the university
MISCELLANEA

• Do not record instructor(s) without explicit permission

• Turn off cell phones and other similar devices during class

• Use laptops if you have to (unless it bothers someone)

• “will u be in ur office after class”; “I need a letter of recommendation.”

• BE NICE TO PEOPLE