Machine Learning applied to Planetary Sciences

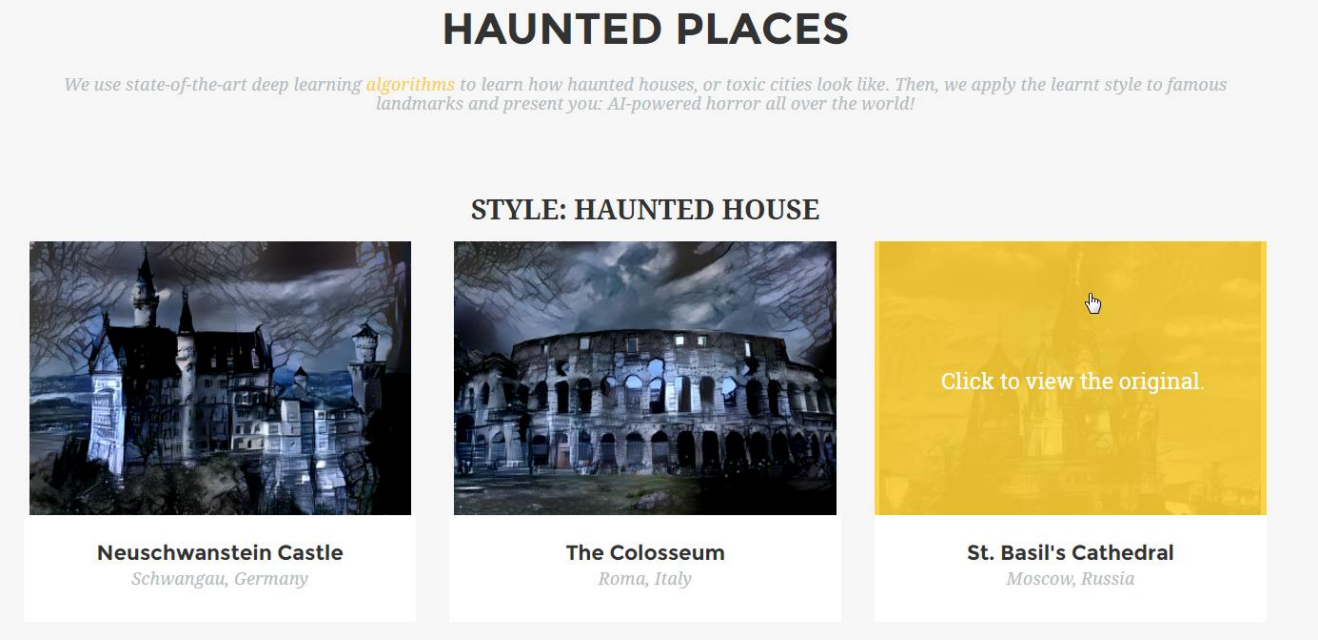
PTYS 595B/495B

Leon Palafox

https://leonpalafox.github.io/MLClass/

Happy Halloween!

- Generate scary images



http://nightmare.mit.edu/

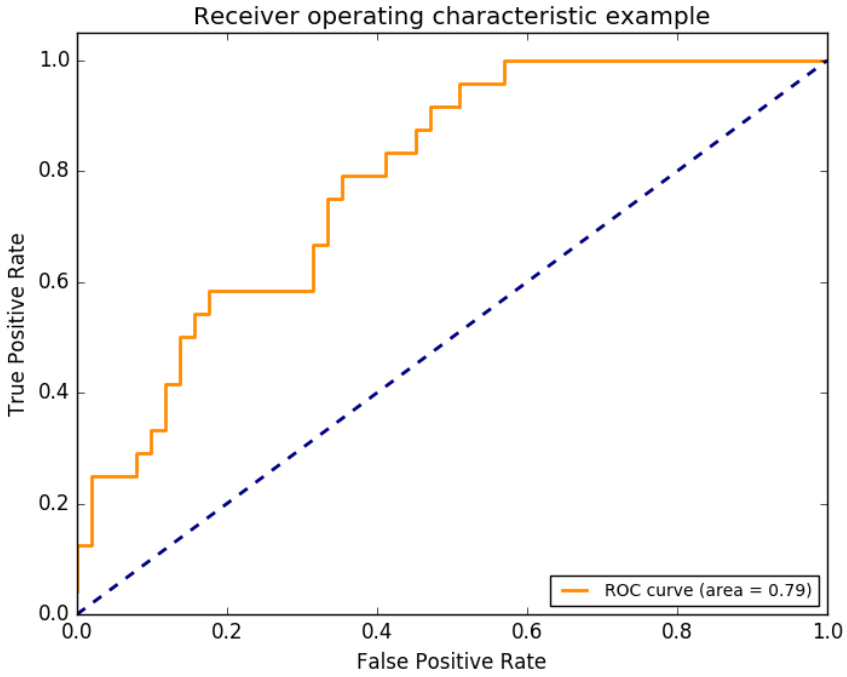
Validation Methods

ROC Plot

- Classifiers generally give us a number between 0 and 1.
- Generally we use a threshold of 0.5
- By changing the threshold, we can become more or less sensitive to TP or FP.

ROC Plot

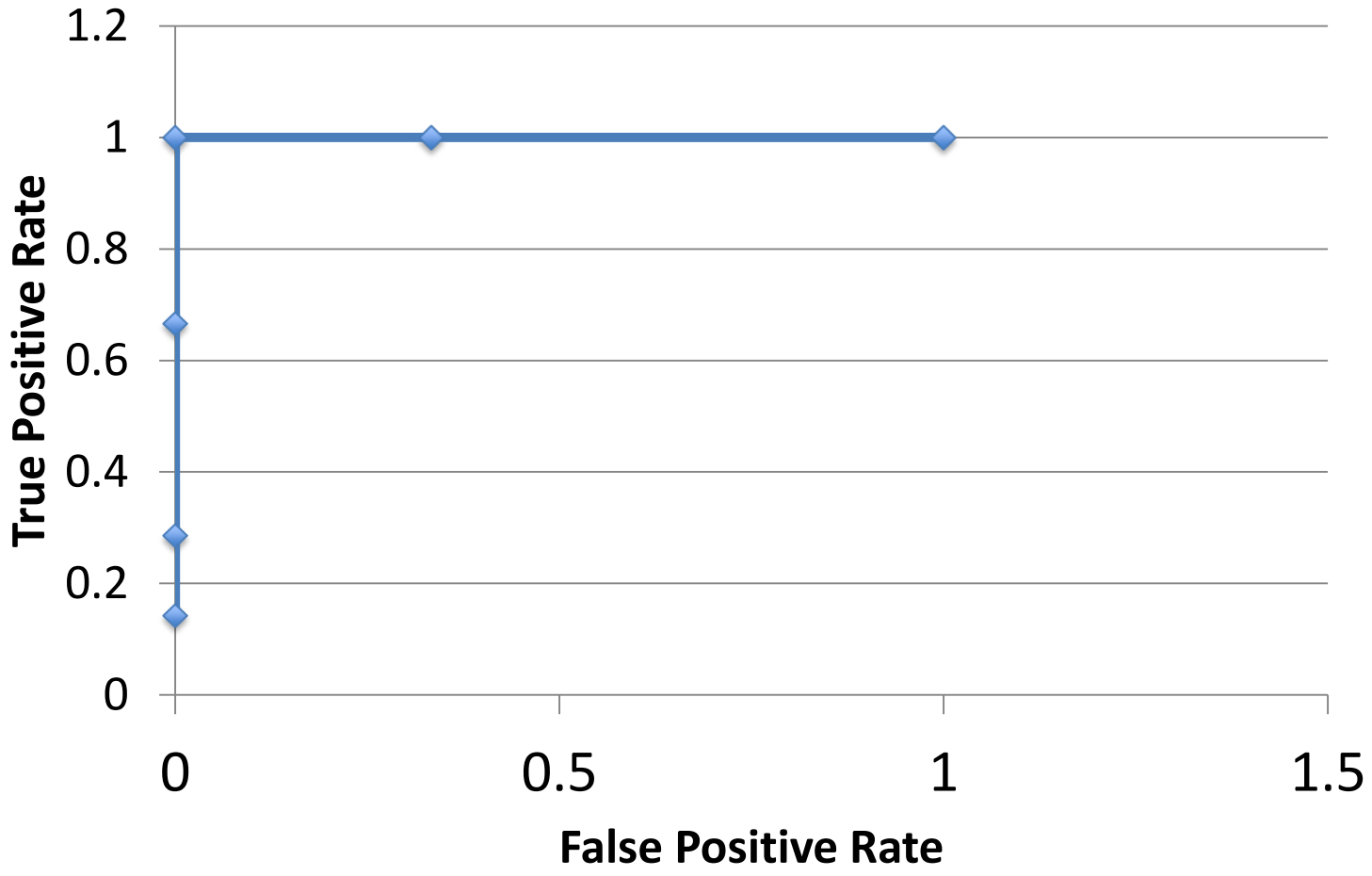
- Train classifier
  - Set threshold to 0.1
    - Obtain TPR and FPR
    - Set a point
  - Set threshold to 0.2
    - Repeat
  - ……..



Example

Label	Output	0.1	0.3	0.5	0.7	0.8	0.9
1	0.89	1	1	1	1	1	0
0	0.12	1	0	0	0	0	0
1	0.61	1	1	1	0	0	0
1	0.71	1	1	1	1	0	0
0	0.21	1	0	0	0	0	0
0	0.31	1	1	0	0	0	0
1	0.71	1	1	1	1	0	0
1	0.61	1	1	1	0	0	0
1	0.52	1	1	1	0	0	0
1	0.91	1	1	1	1	1	1
FPR		3/(3+0)	1/(1+2)	0/(0+3)	0/(0+3)	0/(0+3)	0/(0+3)
TPR		7/(7+0)	7/(7+0)	7/(7+0)	4/(4+2)	2/(2+5)	1/(1+6)

ROC Plot


1.2
1
0.8
0.6
0.4
0.2
0
True Positive Rate
0
0.5
1
1.5
False Positive Rate

Applications of Supervised Learning

Useful applications

- Big data is exploding:
  - Landsat : 625 TBytes of data processed
  - Mars Reconnaissance Orbiter: 33 Tbytes
  - Atacama Large Millimeter Array: ~40 Tbytes a day!

Note: Astronomy is exploding because is “easier” to retrieve the data.

Planetary Science

- Landform detection
  - Craters, dunes, etc. (etc here is actually not very extensive
- Boulder detection
  - Landing site evaluation
    - Landing on Mars-Moon
    - Landing on an asteroid
- Automated mineral detection (CRISM)

Remote Sensing

- Change detection:
  - Rainforest
  - Urbanization
- Oil prospecting ($$)
  - Detection of likely oil fields.
- Hazard prevention:
  - Volcanic ash or magma.