Welcome to CSCI4155/CSCI6505

Machine Learning 2017

Administrivia

- Instructor: Dr. Thomas Trappenberg
- Email: tt@cs.dal.ca
- Meeting Times:
  - Lectures in LSC-COMMON AREA C244
    - TR 1305-1425
  - Lab in SIR JAMES DUNN 304:
    - W 1635-1725
- Office hours: Write email
- Course Website: https://projects.cs.dal.ca/hallab/CSCI4155/CSCI6505_(2017)
  - All materials including manuscripts **will** found here.

Evaluation Criteria

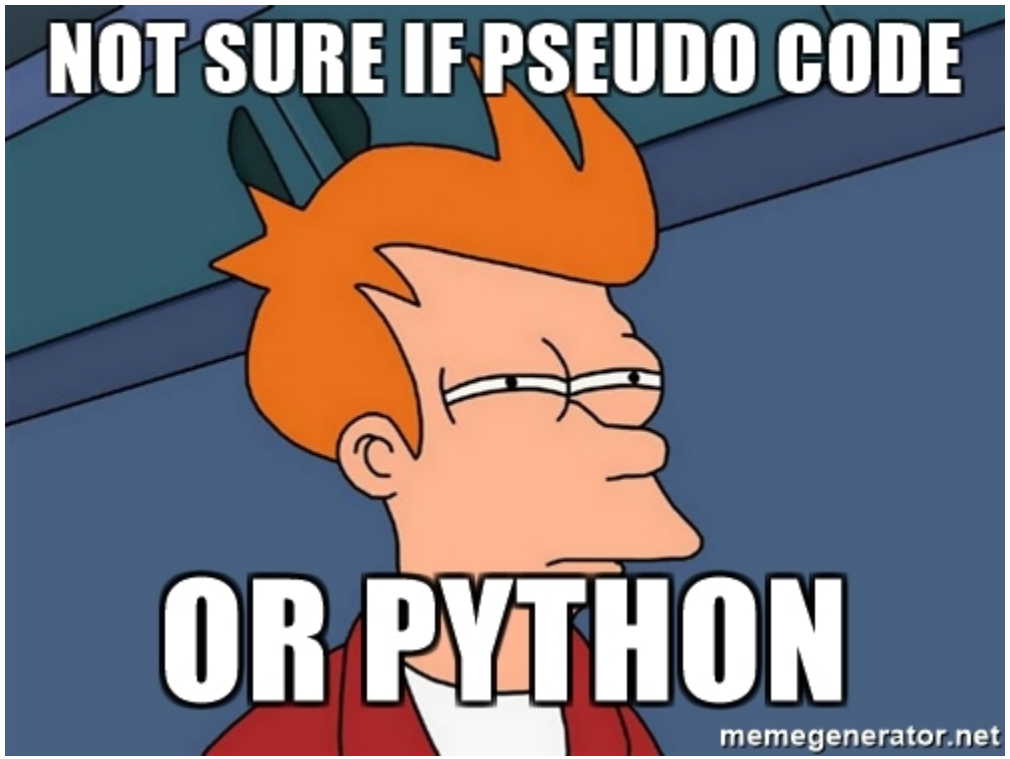
- Evaluation Criteria (CSCI4155)
  - 1. Assignments (50%)
    - Late assignments will be discounted by 10% per day.
    - Assignments must be submitted electronically on Brightspace.
    - No collaboration is permitted on the assignments.
    - All assignments will be checked with the Rubber Gasket plagiarism detection software.
  - 2. Midterm Exam (20%)
    - To be held during class (Oct 12).
  - 3. Final Exam (30%)
    - To be held during class (Nov 30).
    - Will cover all material in the course.

- Evaluation Criteria (CSCI6505)
  - 1. Assignments (30%)
    - Late assignments will be discounted by 10% per day.
    - Assignments must be submitted electronically on Brightspace.
    - No collaboration is permitted on the assignments.
    - All assignments will be checked with the Rubber Gasket plagiarism detection software.
  - 2. Presentation (20%)
    - To be held during tutorial time in the second half of the course.
  - 3. Midterm Exam (20%)
    - To be held during class (Oct 12).
  - 4. Final Exam (30%)
    - To be held during class (Nov 30).
    - Will cover all material in the course.

Submissions

- You must submit your assignments on Brightspace
  - https://dal.brightspace.com
  - Look for the course space for CSCI4155 or CSCI6505

- You will need Dal Net ID and password to log in
  - If you have any questions, contact the CS Help Desk in the Goldberg CS Building, or email them at cshelp@cs.dal.ca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Install Python, sklearn, tensorflow

- You need to install the Python programming environment (Version 3.5 or higher). Make sure your installation includes Numpy, Matplotlib, Spyder, sklearn, tensorflow, and Lea.
  - On Windows we recommend **WinPython** which should include everything except Lea.
  - On Macs we recommend **Anaconda** which includes all but tensorflow and Lea.
  - **Please consult the CS helpdesk if you have problems with the installation (Goldberg CS Building, cshelp@cs.dal.ca).**

Check installed modules and versions

- Check installed modules:

  import sys

  sys.version

  “module name” in sys.module

    Module name: time, numpy, scipy, matplotlib, pandas, sklearn, ggplot, bokeh, seaborn, altair, holoviews

  - Or import module

- Check Version:

  import module

  module.__version__

Control Flow and functions

- if/elif/else

  If *conditional statement* **:**

  do something

- for/range

  for i **in range(**n**):**

  do something

- while/break/continue

  while *conditional statement* **:**

  do something

  If *sub-conditional statement* :

  break/continue

- Conditional statements: ==,!=,>,<,<=, >=, and, or
- Defining function

  def *function_name*(arg1 , arg2, ...):

  Do something

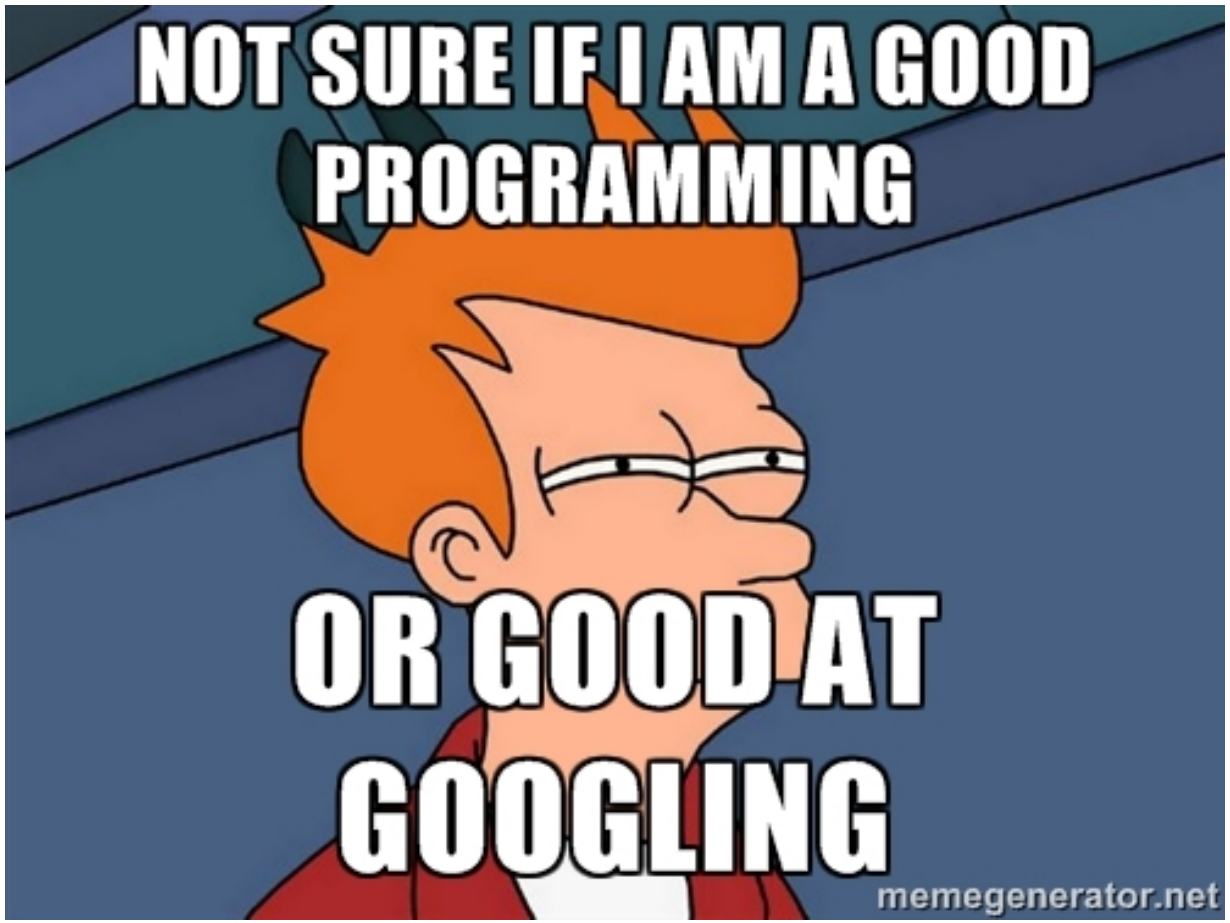
  return result1, result2, …

Basic data types in python

- integer, float, complex, Booleans, string
- Type(), %whos, ?,
- useful operations: =,+, -, *, /, %, **
- Containers:
  - Lists (list=[1,2,3] or list = ['a','b','c','d','e'])
    - 0 based indexing: list[-1], list[-2]
    - Slicing syntax: list[start:stop:stride] (start <= i < stop)
    - Discovering methods: list.<tab>
  - Arrays vs Matrixes (numpy)
    - dtype, ndim, size, shape, vstack(), hstack(), >, <, ==, :,transpose(), T, dot(),@, nonzero(), arange(), zeros(), ones(), random.rand(), unique(), reshape(), sort, squeeze, max, min, mean, std, sum, sqrt, exp, floor, ceil, single, int, float, randn, seed, savetxt, loadtxt, linalg, fft, ifft, linspace, meshgrid...

Other useful functions or modules

- itertools.combinations()
- time.clock()
- matplotlib.pyplot
  - The basic steps to creating plots with matplotlib are:
    1. Prepare data
    2. Create plot (figure)
    3. Plot (subplot, plot, bar, errorbar, hist, scatter, imshow, pcolor, …)
    4. Customize plot (subplots_adjust,legend, axis, colorbar, anonate, set_xlim, set_ylim, title, xlabel, ylabel, set,…)
    5. Save plot (savefig)
    6. Show plot (show)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Example 1:

Write a program to calculate Y:

$$y_0 = x_0 \times \mathrm{a} + \mathrm{b}$$
$$y_1 = x_1 \times \mathrm{a} + \mathrm{b}$$
$$y_2 = x_2 \times \mathrm{a} + \mathrm{b}$$
$$y_3 = x_3 \times \mathrm{a} + \mathrm{b}$$
$$\dots$$
$$y_{n-1} = x_{n-1} \times \mathrm{a} + \mathrm{b}$$

Where a=4, b=5, n=10

a=3; b=4, n=10

params = np.array([a,b])

x=np.array(np.arange (1,n+1)) or x=np.arange(1,n+1)

x=np.vstack((x,np.ones(n)))

y = np.dot(params,x) or y = np.dot(x.T,params)

Using python libraries

```
##-----------------Linear regression Using numpy --------------------------
import matplotlib.pyplot as plt
import numpy as np
hsize=np.array([937, 1150, 1170, 1290, 1275, 1410, 1550, 1730, 1910])
price=np.array([187,  222,  330,  310,  290,  440,  600,  550,  600])
slope, intercept = np.polyfit(hsize,price,1)
# Plot outputs
plt.scatter(hsize, price, label='Original data',  color='black')
plt.plot(hsize, slope*hsize+intercept, label='Fitted line', color='blue', linewidth=3)
plt.xticks(())
plt.yticks(())
plt.legend()
plt.title('Linear regression Using numpy')
plt.show()
```

```
##-----------------Linear regression Using scipy --------------------------
import matplotlib.pyplot as plt
from scipy import stats
import numpy as np
hsize=np.array([937, 1150, 1170, 1290, 1275, 1410, 1550, 1730, 1910])
price=np.array([187,  222,  330,  310,  290,  440,  600,  550,  600])
slope, intercept, r_value, p_value, std_err = stats.linregress(hsize,price)
# Plot outputs
plt.scatter(hsize, price, label='Original data',  color='black')
plt.plot(hsize, slope*hsize+intercept, label='Fitted line', color='blue', linewidth=3)
plt.xticks(())
plt.yticks(())
plt.legend()
plt.title('Linear regression Using scipy')
plt.show()
```

```
#-----------------Linear regression Using sklearn --------------------------
import matplotlib.pyplot as plt
import numpy as np
from sklearn import linear_model
# Create matrix and vectors
hsize=np.array([937, 1150, 1170, 1290, 1275, 1410, 1550, 1730, 1910])[:, np.newaxis]
price=np.array([187,  222,  330,  310,  290,  440,  600,  550,  600])[:,np.newaxis]
# Create linear regression object
regr = linear_model.LinearRegression()
# Train the model using the training sets
regr.fit(hsize, price)
# Plot outputs
plt.scatter(hsize, price, label='Original data',  color='black')
plt.plot(hsize, regr.predict(hsize), label='Fitted line', color='blue', linewidth=3)
plt.xticks(())
plt.yticks(())
plt.legend()
plt.title('Linear regression Using sklearn')
plt.show()
```