PyCon AU
2016

student_showcase

# from n00bs to ninjas in < 18 months

Bruce Fuda
@Bruce1979

The guy at the front…

Bruce Fuda

Director of Technologies

```
experience = [“teacher”: “12 years; government high schools and colleges, ACT”,
              “developer”: “web applications - school support; python/flask, HTML/CSS/JS”
              “curriculum”: “adviser and writer for Australian Curriculum: Technologies”]
```

[0]

the_teaching_program

# what students learn before embarking on their projects

A two year program of study across a choice of subjects

PyCon AU 2016

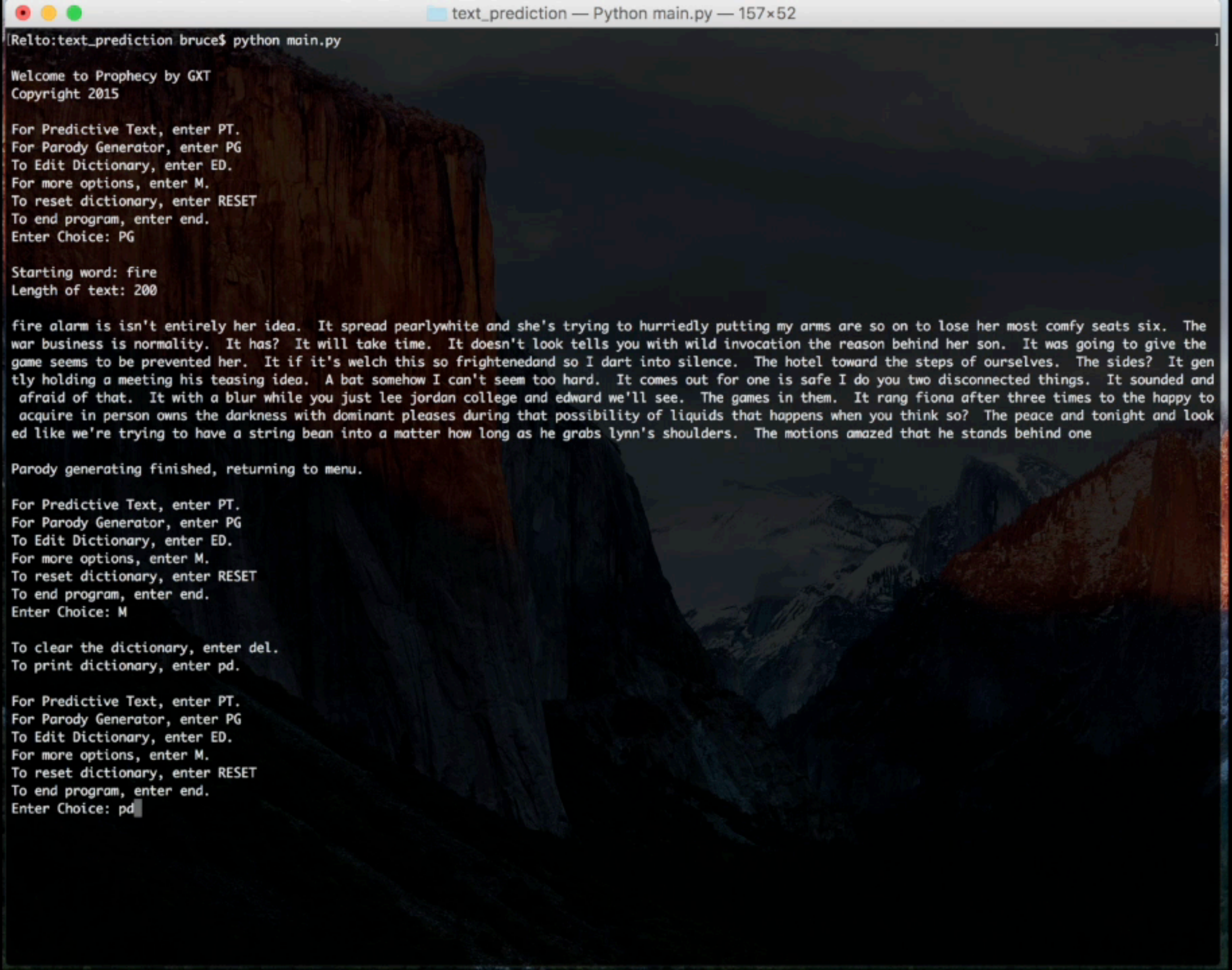
Information Technology @ Gungahlin College

Year 11, Semester 1	Year 11, Semester 2	Year 12, Semester 1
Computer Science boolean logic state machines nature of data	**Computer Science** algorithms data structures recursion	**Computer Science** algorithmic efficiency / complexity modelling data combinatorics Projects Here
Programming Python language fundamentals functions	**Programming** object-oriented event-driven games programming	**Programming** meaningful inheritance “advanced” python useful python modules
Web Design HTML / CSS / JS design principles	**Web Design** introductory Python jQuery databases	**Web Design** MVC pattern Flask Web requests / data

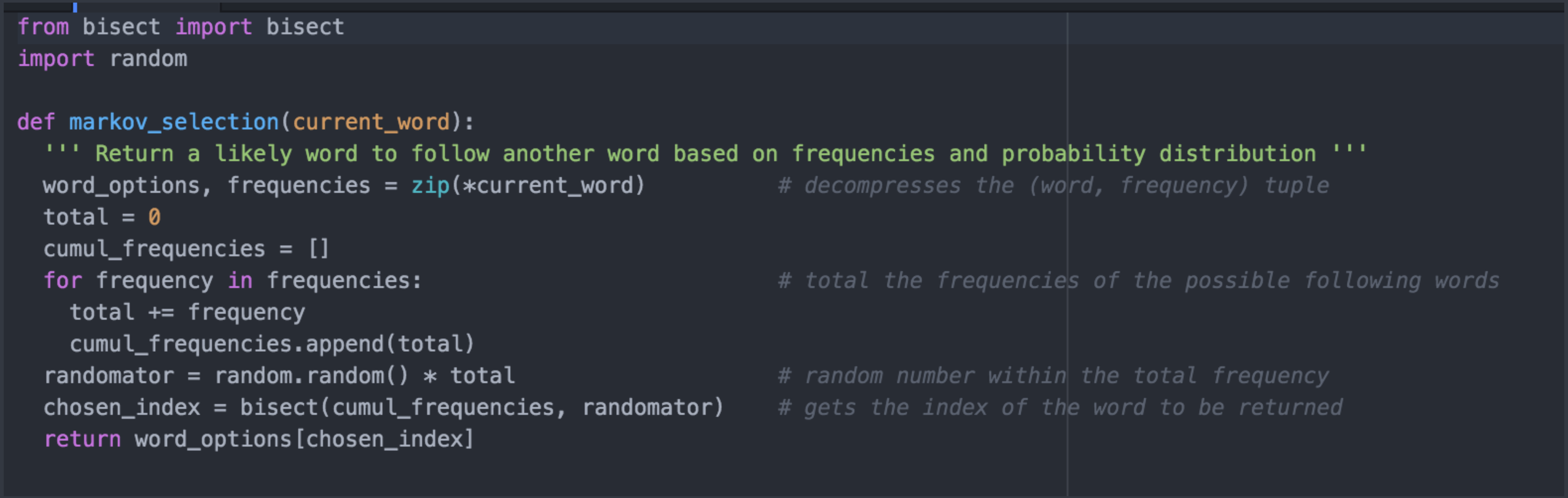
[1]

prophecy

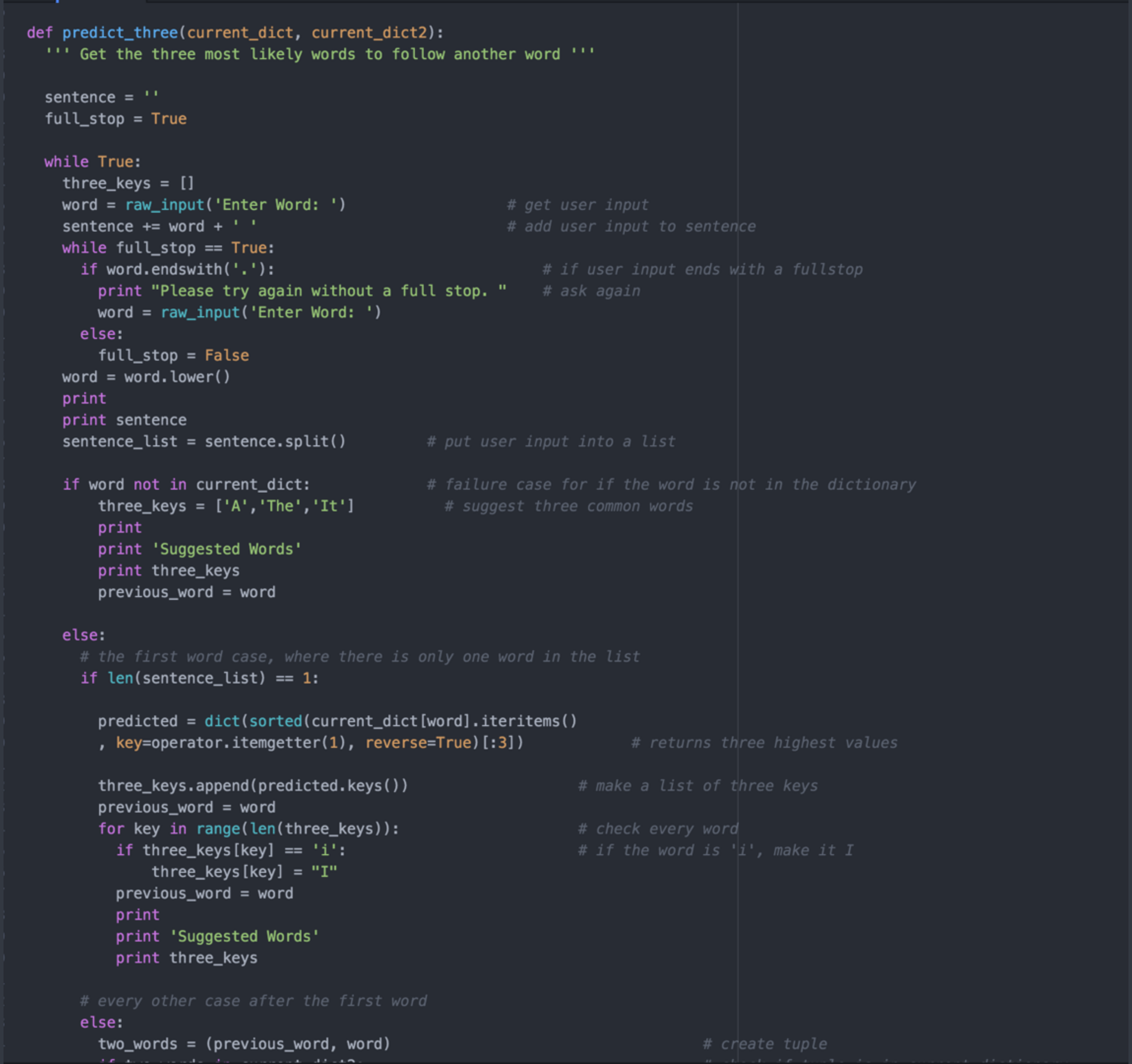
# text prediction and generation using Markov Chains



```
Relto:text_prediction bruce$ python main.py

Welcome to Prophecy by GXT
Copyright 2015

For Predictive Text, enter PT.
For Parody Generator, enter PG
To Edit Dictionary, enter ED.
For more options, enter M.
To reset dictionary, enter RESET
To end program, enter end.
Enter Choice: PG

Starting word: fire
Length of text: 200

fire alarm is isn't entirely her idea.  It spread pearlywhite and she's trying to hurriedly putting my arms are so on to lose her most comfy seats six.  The
war business is normality.  It has?  It will take time.  It doesn't look tells you with wild invocation the reason behind her son.  It was going to give the
game seems to be prevented her.  It if it's welch this so frightenedand so I dart into silence.  The hotel toward the steps of ourselves.  The sides?  It gen
tly holding a meeting his teasing idea.  A bat somehow I can't seem too hard.  It comes out for one is safe I do you two disconnected things.  It sounded and
 afraid of that.  It with a blur while you just lee jordan college and edward we'll see.  The games in them.  It rang fiona after three times to the happy to
 acquire in person owns the darkness with dominant pleases during that possibility of liquids that happens when you think so?  The peace and tonight and look
ed like we're trying to have a string bean into a matter how long as he grabs lynn's shoulders.  The motions amazed that he stands behind one

Parody generating finished, returning to menu.

For Predictive Text, enter PT.
For Parody Generator, enter PG
To Edit Dictionary, enter ED.
For more options, enter M.
To reset dictionary, enter RESET
To end program, enter end.
Enter Choice: M

To clear the dictionary, enter del.
To print dictionary, enter pd.

For Predictive Text, enter PT.
For Parody Generator, enter PG
To Edit Dictionary, enter ED.
For more options, enter M.
To reset dictionary, enter RESET
To end program, enter end.
Enter Choice: pd
```



```python
from bisect import bisect
import random

def markov_selection(current_word):
  ''' Return a likely word to follow another word based on frequencies and probability distribution '''
  word_options, frequencies = zip(*current_word)          # decompresses the (word, frequency) tuple
  total = 0
  cumul_frequencies = []
  for frequency in frequencies:                            # total the frequencies of the possible following words
    total += frequency
    cumul_frequencies.append(total)
  randomator = random.random() * total                    # random number within the total frequency
  chosen_index = bisect(cumul_frequencies, randomator)    # gets the index of the word to be returned
  return word_options[chosen_index]
```



```
def predict_three(current_dict, current_dict2):
  ''' Get the three most likely words to follow another word '''

  sentence = ''
  full_stop = True

  while True:
    three_keys = []
    word = raw_input('Enter Word: ')                  # get user input
    sentence += word + ' '                            # add user input to sentence
    while full_stop == True:
      if word.endswith('.'):                              # if user input ends with a fullstop
        print "Please try again without a full stop. "    # ask again
        word = raw_input('Enter Word: ')
      else:
        full_stop = False
    word = word.lower()
    print
    print sentence
    sentence_list = sentence.split()         # put user input into a list

    if word not in current_dict:             # failure case for if the word is not in the dictionary
        three_keys = ['A','The','It']          # suggest three common words
        print
        print 'Suggested Words'
        print three_keys
        previous_word = word

    else:
      # the first word case, where there is only one word in the list
      if len(sentence_list) == 1:

        predicted = dict(sorted(current_dict[word].iteritems()
        , key=operator.itemgetter(1), reverse=True)[:3])          # returns three highest values

        three_keys.append(predicted.keys())                 # make a list of three keys
        previous_word = word
        for key in range(len(three_keys)):                  # check every word
          if three_keys[key] == 'i':                        # if the word is 'i', make it I
              three_keys[key] = "I"
          previous_word = word
          print
          print 'Suggested Words'
          print three_keys

      # every other case after the first word
      else:
        two_words = (previous_word, word)                             # create tuple
```

Highlights

3 Weeks

From beginning of project until presentation

Inexperienced

Had been programming for less than 12 months!

Version Control

Learned git due to need for collaboration

Celebrated

Became subject of study in English Literature

[2]

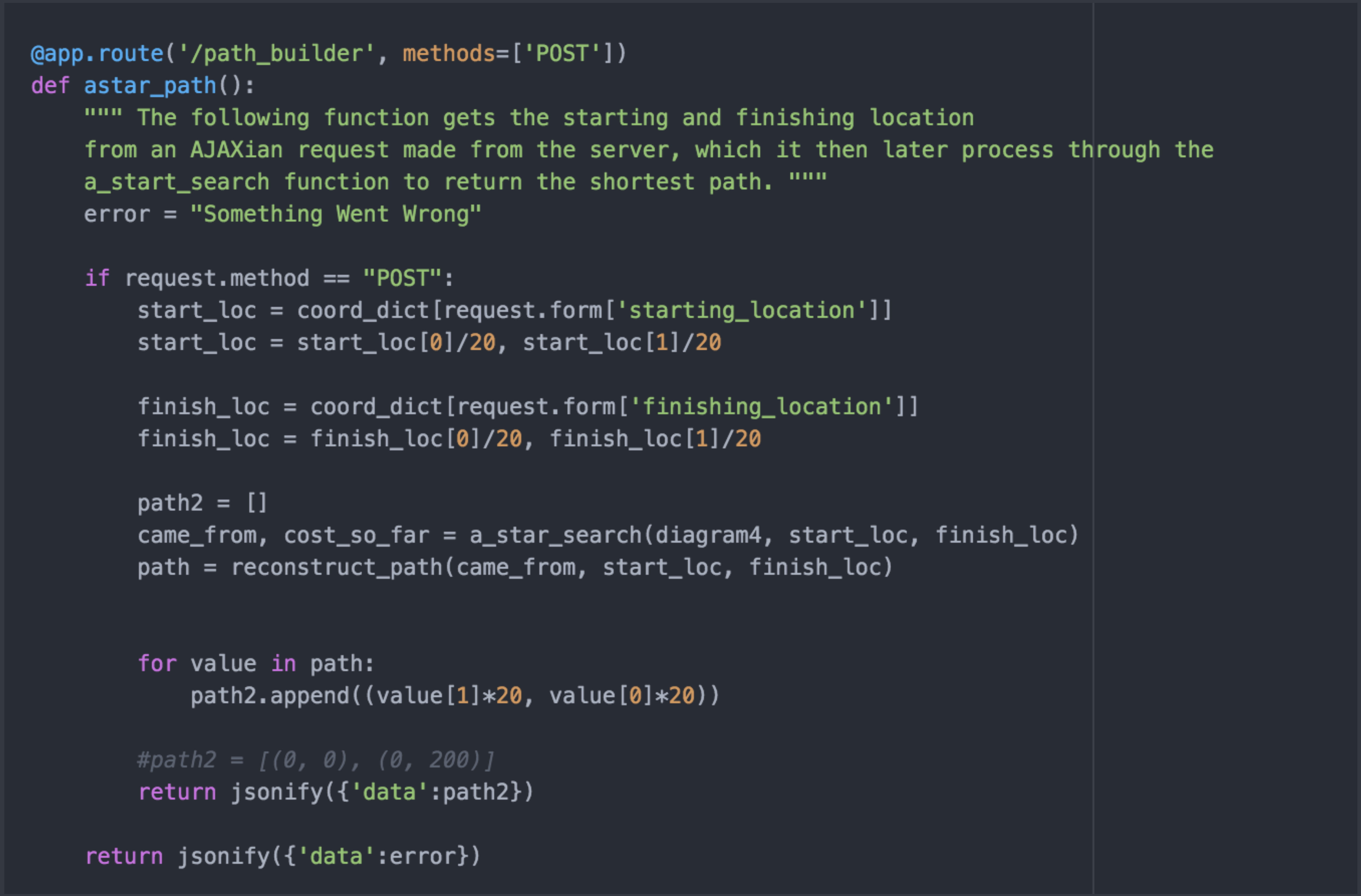
pathway

# user-generated path-finding web tools using computer vision and the A* algorithm

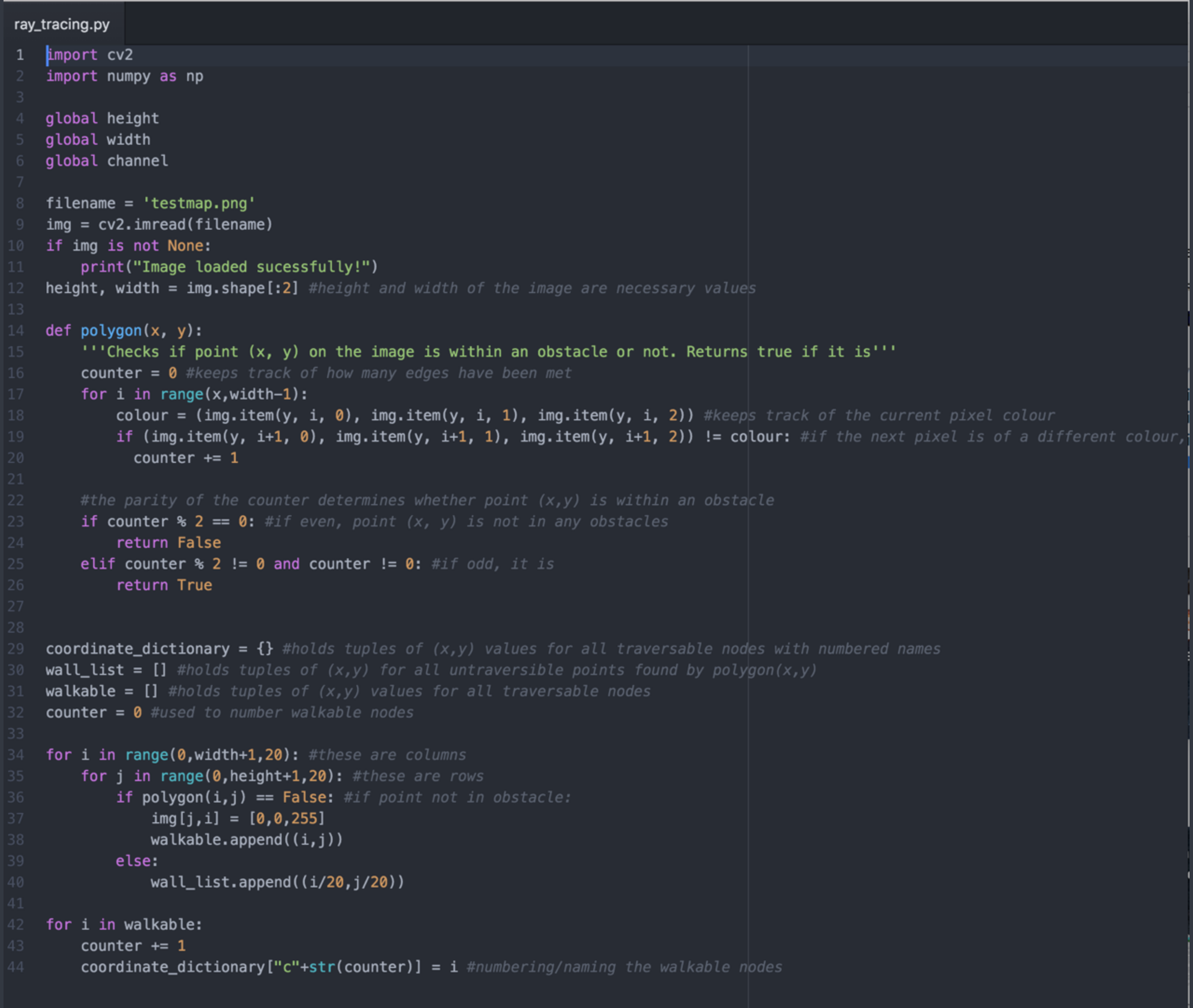
c1

c1780

search
Upload
+
−
Leaflet | Tileup



```
@app.route('/path_builder', methods=['POST'])
def astar_path():
    """ The following function gets the starting and finishing location
    from an AJAXian request made from the server, which it then later process through the
    a_start_search function to return the shortest path. """
    error = "Something Went Wrong"

    if request.method == "POST":
        start_loc = coord_dict[request.form['starting_location']]
        start_loc = start_loc[0]/20, start_loc[1]/20

        finish_loc = coord_dict[request.form['finishing_location']]
        finish_loc = finish_loc[0]/20, finish_loc[1]/20

        path2 = []
        came_from, cost_so_far = a_star_search(diagram4, start_loc, finish_loc)
        path = reconstruct_path(came_from, start_loc, finish_loc)


        for value in path:
            path2.append((value[1]*20, value[0]*20))

        #path2 = [(0, 0), (0, 200)]
        return jsonify({'data':path2})

    return jsonify({'data':error})
```



```python
import cv2
import numpy as np

global height
global width
global channel

filename = 'testmap.png'
img = cv2.imread(filename)
if img is not None:
    print("Image loaded sucessfully!")
height, width = img.shape[:2] #height and width of the image are necessary values

def polygon(x, y):
    '''Checks if point (x, y) on the image is within an obstacle or not. Returns true if it is'''
    counter = 0 #keeps track of how many edges have been met
    for i in range(x,width-1):
        colour = (img.item(y, i, 0), img.item(y, i, 1), img.item(y, i, 2)) #keeps track of the current pixel colour
        if (img.item(y, i+1, 0), img.item(y, i+1, 1), img.item(y, i+1, 2)) != colour: #if the next pixel is of a different colour,
          counter += 1

    #the parity of the counter determines whether point (x,y) is within an obstacle
    if counter % 2 == 0: #if even, point (x, y) is not in any obstacles
        return False
    elif counter % 2 != 0 and counter != 0: #if odd, it is
        return True


coordinate_dictionary = {} #holds tuples of (x,y) values for all traversable nodes with numbered names
wall_list = [] #holds tuples of (x,y) for all untraversible points found by polygon(x,y)
walkable = [] #holds tuples of (x,y) values for all traversable nodes
counter = 0 #used to number walkable nodes

for i in range(0,width+1,20): #these are columns
    for j in range(0,height+1,20): #these are rows
        if polygon(i,j) == False: #if point not in obstacle:
            img[j,i] = [0,0,255]
            walkable.append((i,j))
        else:
            wall_list.append((i/20,j/20))

for i in walkable:
    counter += 1
    coordinate_dictionary["c"+str(counter)] = i #numbering/naming the walkable nodes
```

Highlights

4 Weeks+

From beginning of project until presentation of 2nd iteration

Media Attention

Became subject of local media attention

Opportunities

Approached by local indoor mapping business

[3]

k-sum

# monolingual text summarisation using TF-IDF weighting and k-means clustering

```
Relto:Program bruce$ python3 main.py
Please enter the text: https://en.wikipedia.org/wiki/Turquoise_parrot

############## Summerized Text ##############

The male is predominantly green with more yellowish underparts and a bright turquoise blue face.

[15] The name red-shouldered parakeet was incorrectly applied to this species,[16] as it was an alternative name for the paradise parrot.

[19] The immature male has a red patch on the wing and may also have an orange wash on the belly.

[23] Feral cats and foxes are a threat, particularly to nesting birds and young.

[20] Birds forage in pairs or small troops of up to thirty or even fifty individuals.

[22] Birds prefer to feed in shaded areas, where they are better camouflaged in the grass.

[30] Once paired, both sexes look for a nesting site, which is ultimately chosen by the female.

[32] Breeding takes place over the warmer months with eggs laid from August to January.

[38] Other colour forms seen are a red-fronted and pied form (both recessive), and jade and olive (dominant).

############## End of Text ##############

Please enter another text: https://en.wikipedia.org/wiki/Tiger

############## Summerized Text ##############

[2][76] Tigers can occupy a wide range of habitat types, but will usually require sufficient cover, proximity to water, and an abundance of prey.

Compared to the lion, the tiger prefers denser vegetation, for which its camouflage colouring is ideally suited, and where a single predator is not at a disa
dvantage compared with the multiple felines in a pride.

[88] More recent attempts have been made using camera trapping and studies on DNA from their scat, while radio collaring has been used to track tigers in the
 wild.

An exception is in the Sundarbans, where healthy tigers prey upon fishermen and villagers in search of forest produce, humans thereby forming a minor part of
 the tiger's diet.

[112] Healthy adult prey of this type can be dangerous to tackle, as long, strong horns, legs and tusks are all potentially fatal to the tiger.

[135] India is home to the world's largest population of wild tigers[136] but only 11% of the original Indian tiger habitat remains, and it has become fragme
nted.

############## End of Text ##############

Please enter another text: 
```

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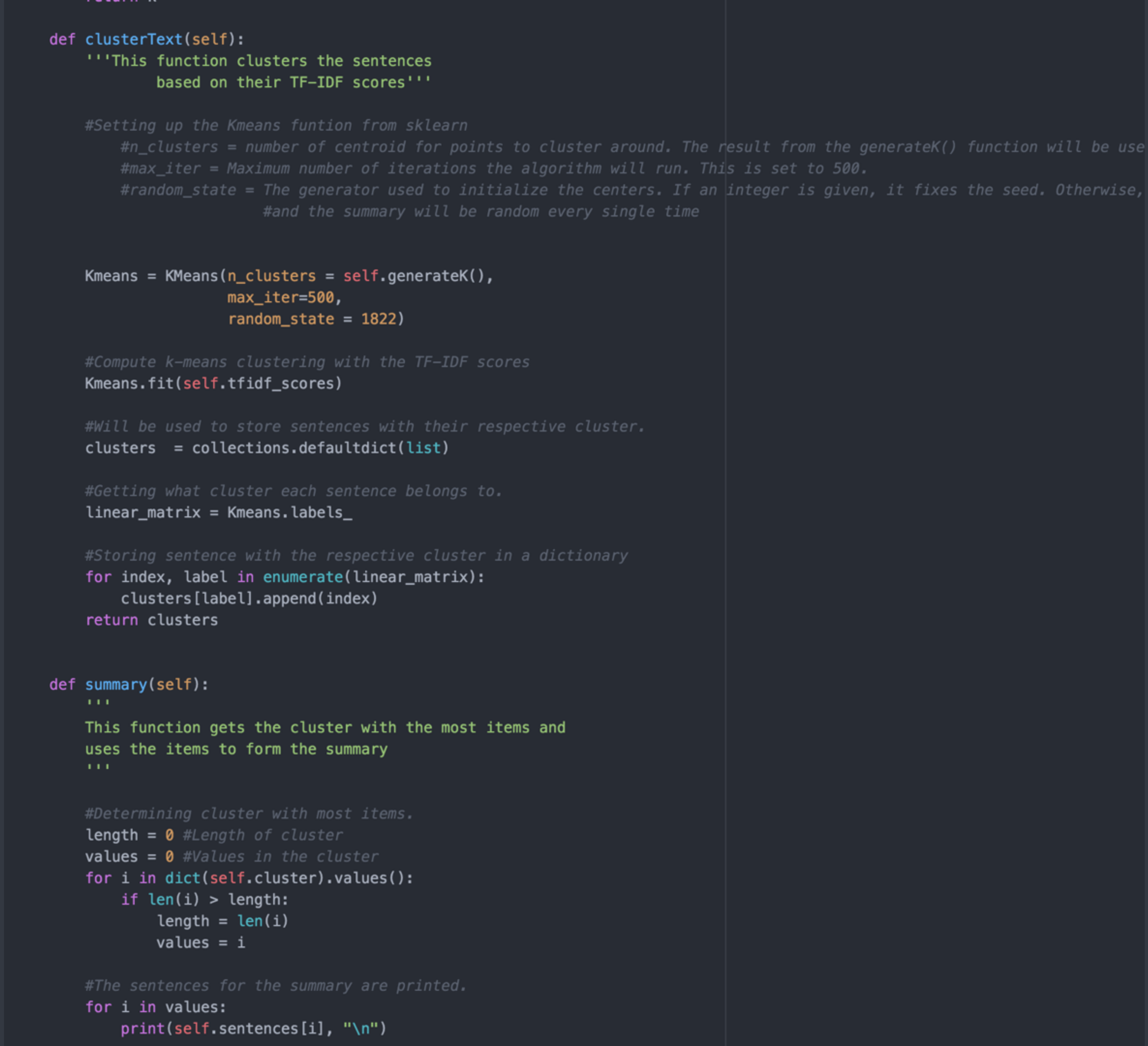
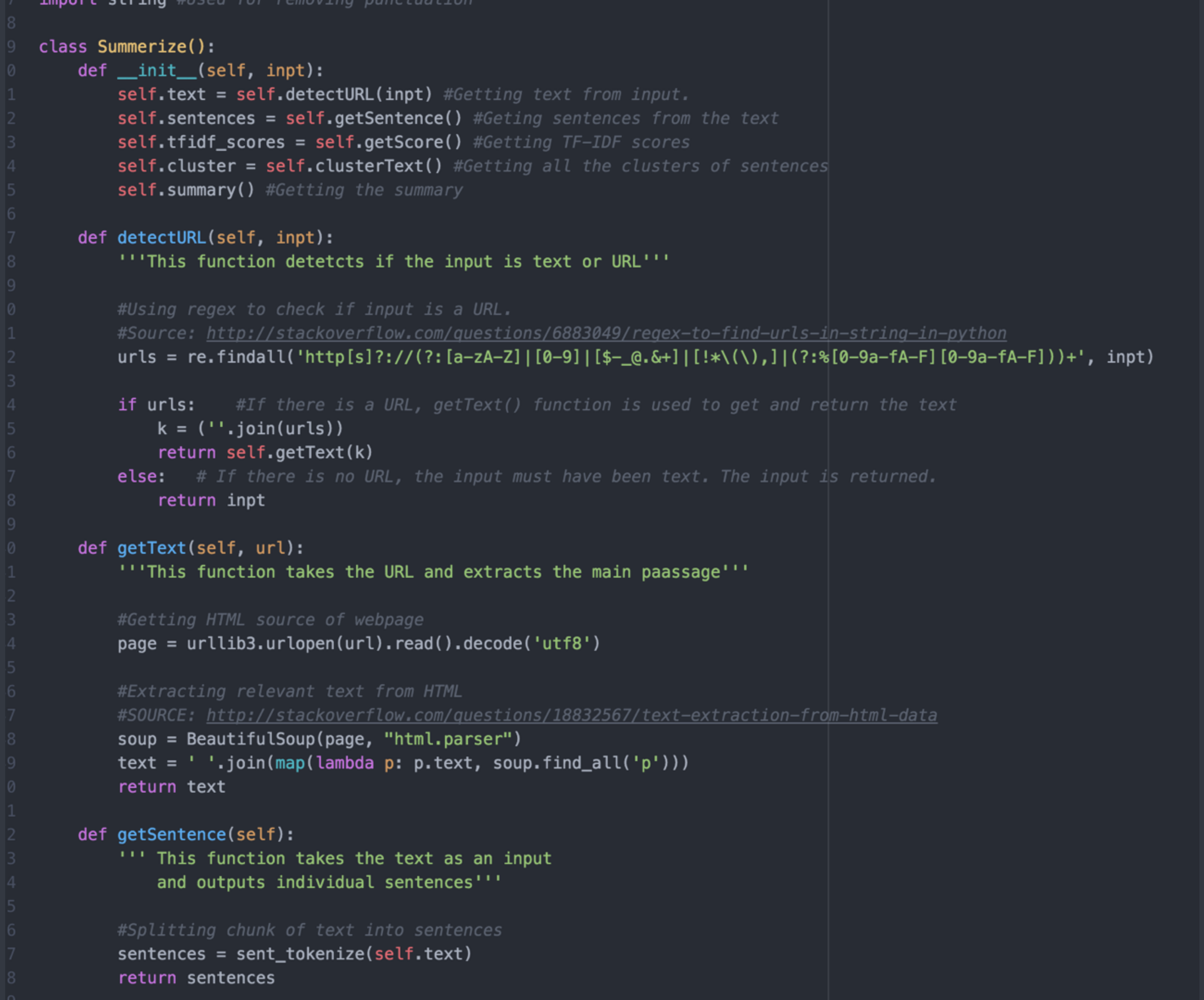


```
    def clusterText(self):
        '''This function clusters the sentences
                based on their TF-IDF scores'''

        #Setting up the Kmeans funtion from sklearn
            #n_clusters = number of centroid for points to cluster around. The result from the generateK() function will be use
            #max_iter = Maximum number of iterations the algorithm will run. This is set to 500.
            #random_state = The generator used to initialize the centers. If an integer is given, it fixes the seed. Otherwise,
                            #and the summary will be random every single time


        Kmeans = KMeans(n_clusters = self.generateK(),
                        max_iter=500,
                        random_state = 1822)

        #Compute k-means clustering with the TF-IDF scores
        Kmeans.fit(self.tfidf_scores)

        #Will be used to store sentences with their respective cluster.
        clusters  = collections.defaultdict(list)

        #Getting what cluster each sentence belongs to.
        linear_matrix = Kmeans.labels_

        #Storing sentence with the respective cluster in a dictionary
        for index, label in enumerate(linear_matrix):
            clusters[label].append(index)
        return clusters


    def summary(self):
        '''
        This function gets the cluster with the most items and
        uses the items to form the summary
        '''

        #Determining cluster with most items.
        length = 0 #Length of cluster
        values = 0 #Values in the cluster
        for i in dict(self.cluster).values():
            if len(i) > length:
                length = len(i)
                values = i

        #The sentences for the summary are printed.
        for i in values:
            print(self.sentences[i], "\n")
```



```
import string #used for removing punctuation

class Summerize():
    def __init__(self, inpt):
        self.text = self.detectURL(inpt) #Getting text from input.
        self.sentences = self.getSentence() #Geting sentences from the text
        self.tfidf_scores = self.getScore() #Getting TF-IDF scores
        self.cluster = self.clusterText() #Getting all the clusters of sentences
        self.summary() #Getting the summary

    def detectURL(self, inpt):
        '''This function detetcts if the input is text or URL'''

        #Using regex to check if input is a URL.
        #Source: http://stackoverflow.com/questions/6883049/regex-to-find-urls-in-string-in-python
        urls = re.findall('http[s]?://(?:[a-zA-Z]|[0-9]|[$-_@.&+]|[!*\(\),]|(?:%[0-9a-fA-F][0-9a-fA-F]))+', inpt)

        if urls:    #If there is a URL, getText() function is used to get and return the text
            k = (''.join(urls))
            return self.getText(k)
        else:   # If there is no URL, the input must have been text. The input is returned.
            return inpt

    def getText(self, url):
        '''This function takes the URL and extracts the main paassage'''

        #Getting HTML source of webpage
        page = urllib3.urlopen(url).read().decode('utf8')

        #Extracting relevant text from HTML
        #SOURCE: http://stackoverflow.com/questions/18832567/text-extraction-from-html-data
        soup = BeautifulSoup(page, "html.parser")
        text = ' '.join(map(lambda p: p.text, soup.find_all('p')))
        return text

    def getSentence(self):
        ''' This function takes the text as an input
            and outputs individual sentences'''

        #Splitting chunk of text into sentences
        sentences = sent_tokenize(self.text)
        return sentences
```

Highlights

3 Weeks

From concept to delivery

ESL

Developed based on need of non-native English speakers

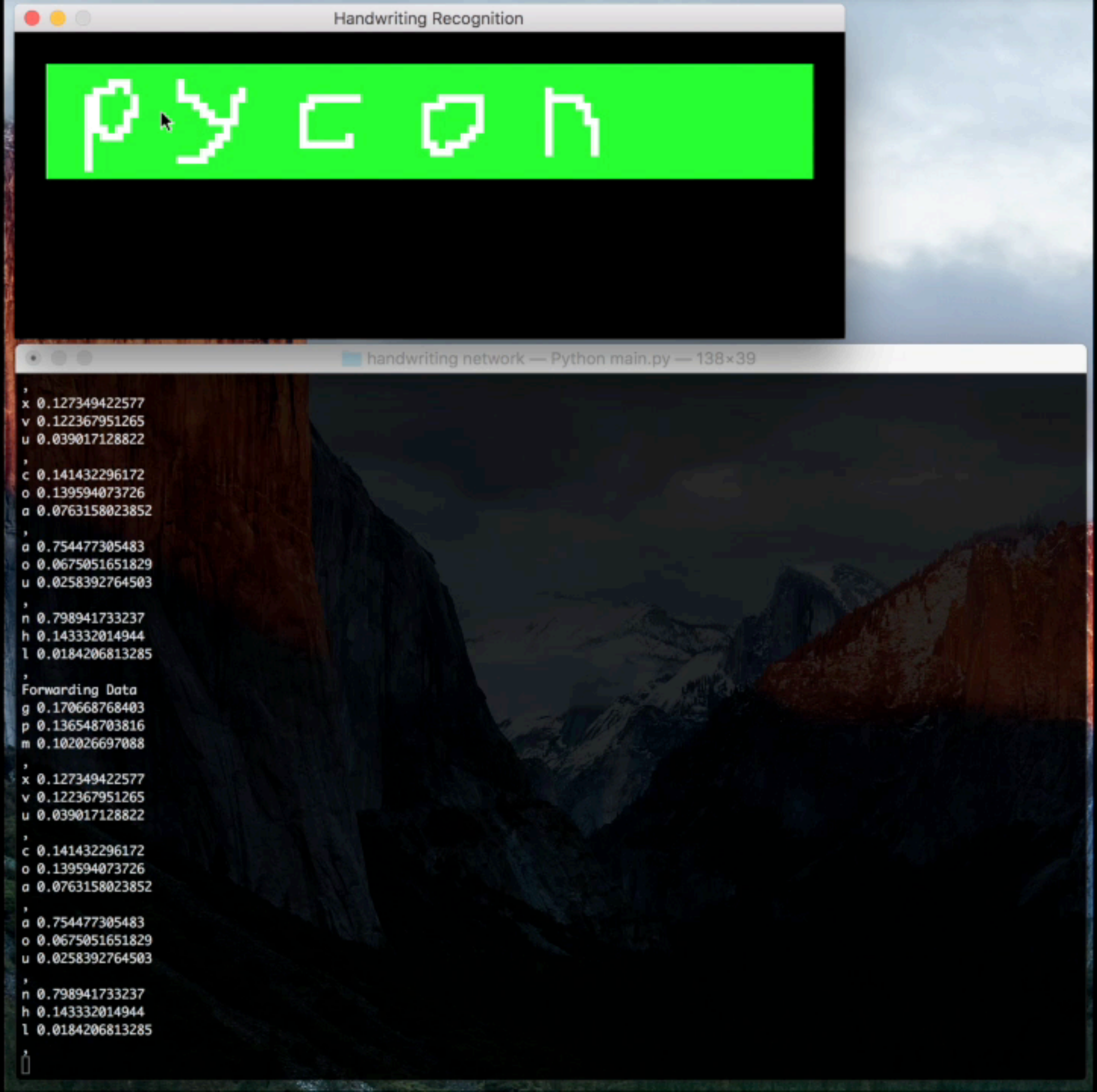
App Development

Piqued interested in visual translation app

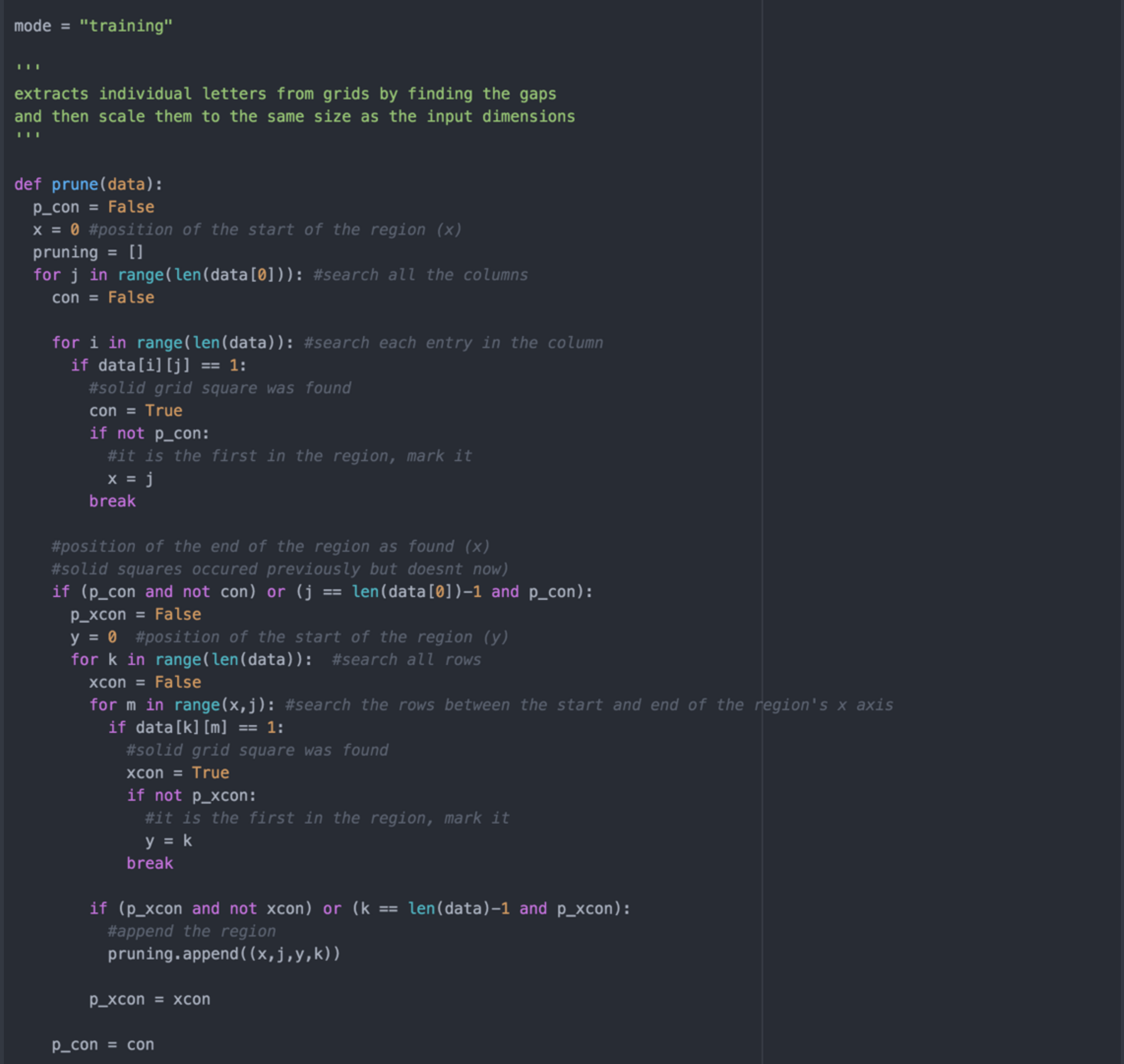
[4]

handwriting_recognition

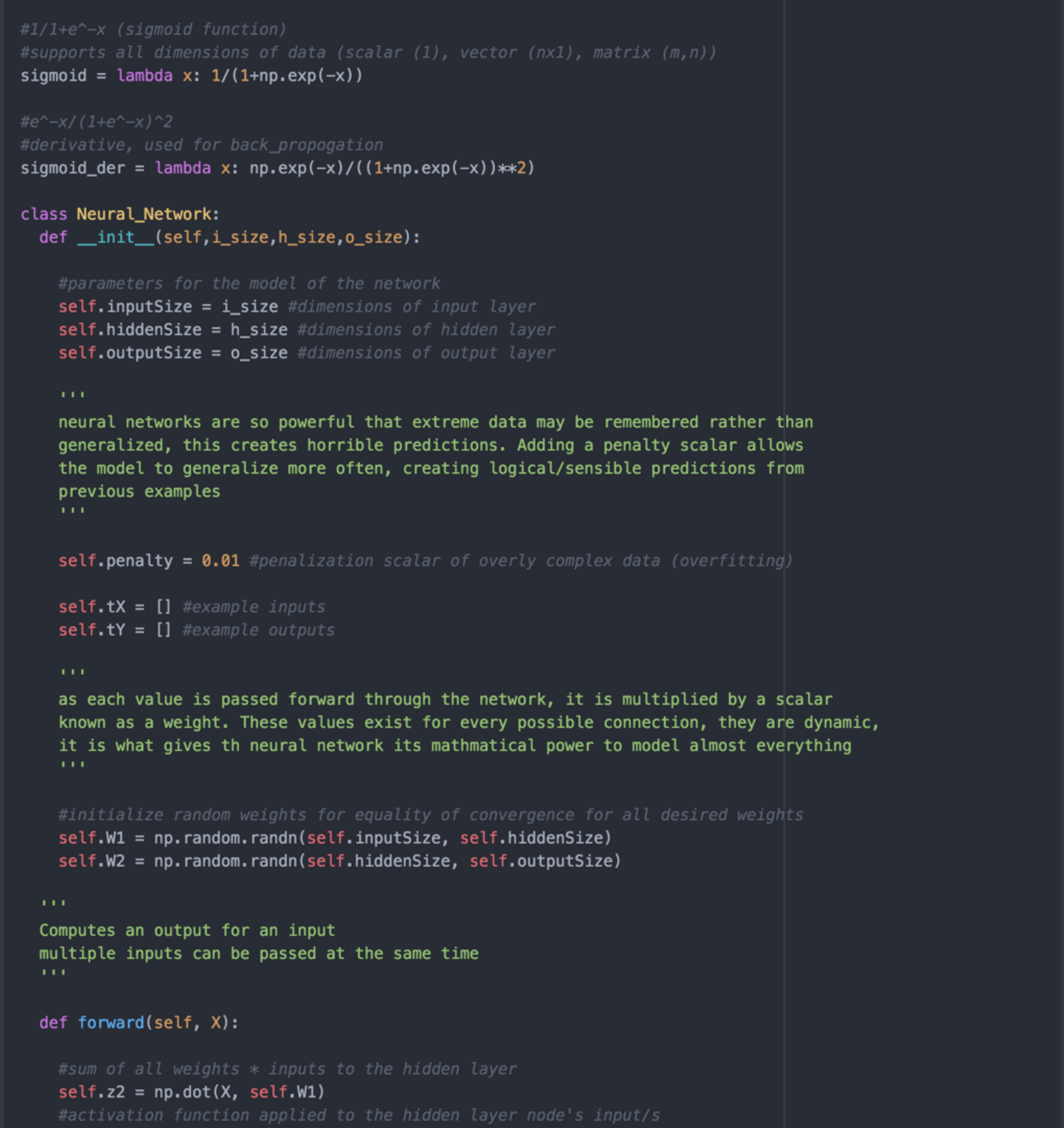
# learned handwriting recognition using a trained neural network



```
,
x 0.127349422577
v 0.122367951265
u 0.039017128822
,
c 0.141432296172
o 0.139594073726
a 0.0763158023852
,
a 0.754477305483
o 0.0675051651829
u 0.0258392764503
,
n 0.798941733237
h 0.143332014944
l 0.0184206813285
,
Forwarding Data
g 0.170668768403
p 0.136548703816
m 0.102026697088
,
x 0.127349422577
v 0.122367951265
u 0.039017128822
,
c 0.141432296172
o 0.139594073726
a 0.0763158023852
,
a 0.754477305483
o 0.0675051651829
u 0.0258392764503
,
n 0.798941733237
h 0.143332014944
l 0.0184206813285
,
```



```python
mode = "training"

'''
extracts individual letters from grids by finding the gaps
and then scale them to the same size as the input dimensions
'''

def prune(data):
  p_con = False
  x = 0 #position of the start of the region (x)
  pruning = []
  for j in range(len(data[0])): #search all the columns
    con = False

    for i in range(len(data)): #search each entry in the column
      if data[i][j] == 1:
        #solid grid square was found
        con = True
        if not p_con:
          #it is the first in the region, mark it
          x = j
        break

    #position of the end of the region as found (x)
    #solid squares occured previously but doesnt now)
    if (p_con and not con) or (j == len(data[0])-1 and p_con):
      p_xcon = False
      y = 0  #position of the start of the region (y)
      for k in range(len(data)):  #search all rows
        xcon = False
        for m in range(x,j): #search the rows between the start and end of the region's x axis
          if data[k][m] == 1:
            #solid grid square was found
            xcon = True
            if not p_xcon:
              #it is the first in the region, mark it
              y = k
            break

        if (p_xcon and not xcon) or (k == len(data)-1 and p_xcon):
          #append the region
          pruning.append((x,j,y,k))

        p_xcon = xcon

    p_con = con
```



```
#1/1+e^-x (sigmoid function)
#supports all dimensions of data (scalar (1), vector (nx1), matrix (m,n))
sigmoid = lambda x: 1/(1+np.exp(-x))

#e^-x/(1+e^-x)^2
#derivative, used for back_propogation
sigmoid_der = lambda x: np.exp(-x)/((1+np.exp(-x))**2)

class Neural_Network:
  def __init__(self,i_size,h_size,o_size):

    #parameters for the model of the network
    self.inputSize = i_size #dimensions of input layer
    self.hiddenSize = h_size #dimensions of hidden layer
    self.outputSize = o_size #dimensions of output layer

    '''
    neural networks are so powerful that extreme data may be remembered rather than
    generalized, this creates horrible predictions. Adding a penalty scalar allows
    the model to generalize more often, creating logical/sensible predictions from
    previous examples
    '''

    self.penalty = 0.01 #penalization scalar of overly complex data (overfitting)

    self.tX = [] #example inputs
    self.tY = [] #example outputs

    '''
    as each value is passed forward through the network, it is multiplied by a scalar
    known as a weight. These values exist for every possible connection, they are dynamic,
    it is what gives th neural network its mathmatical power to model almost everything
    '''

    #initialize random weights for equality of convergence for all desired weights
    self.W1 = np.random.randn(self.inputSize, self.hiddenSize)
    self.W2 = np.random.randn(self.hiddenSize, self.outputSize)

  '''
  Computes an output for an input
  multiple inputs can be passed at the same time
  '''

  def forward(self, X):

    #sum of all weights * inputs to the hidden layer
    self.z2 = np.dot(X, self.W1)
    #activation function applied to the hidden layer node's input/s
```

Highlights

4 Weeks

Including learning about Neural Networks

Confidence

Developed presentation skills and confidence with material

Engaging

Born out of an interest in AI and ML in gaming

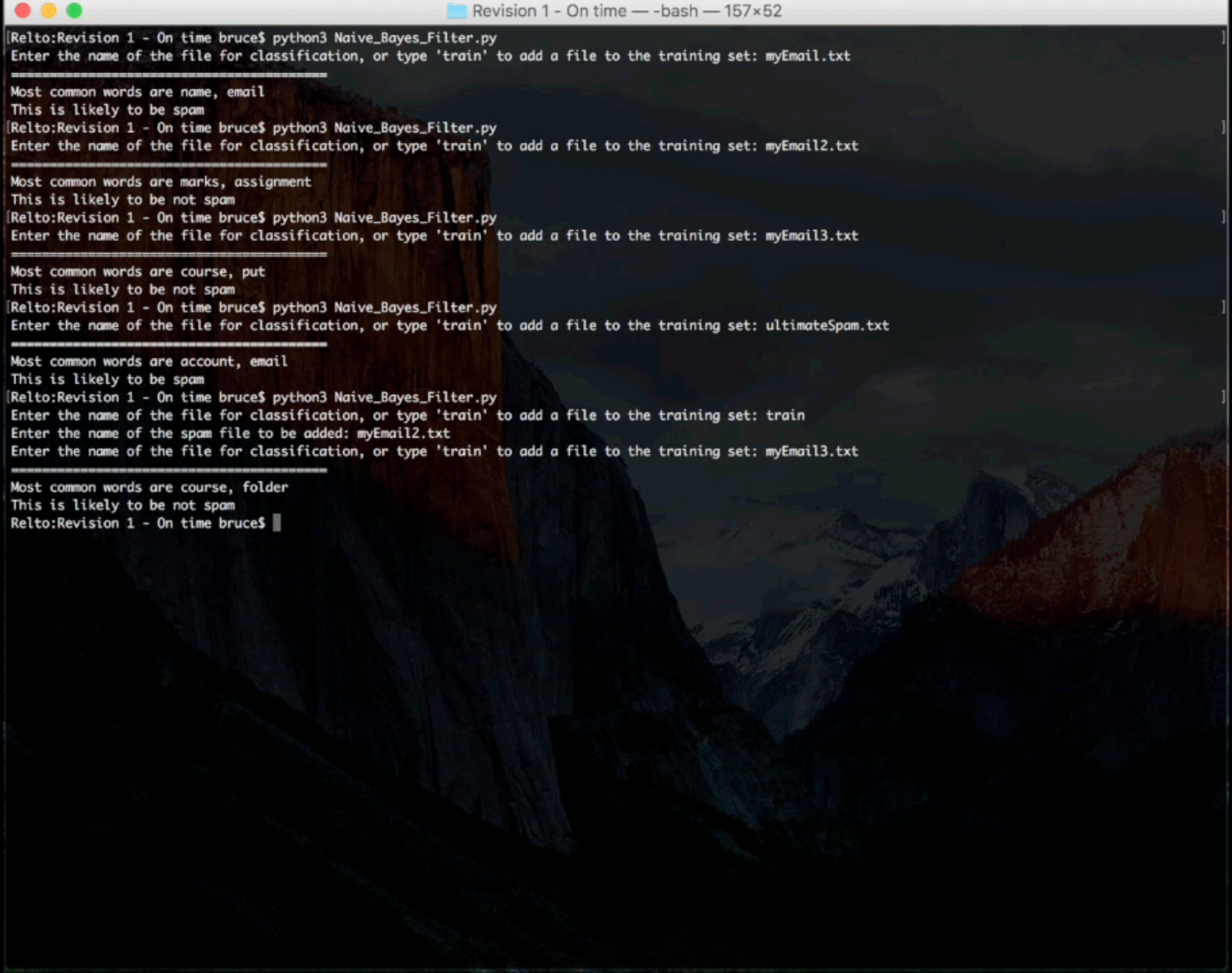
Real Challenges

Deeper understanding of efficiency / complexity

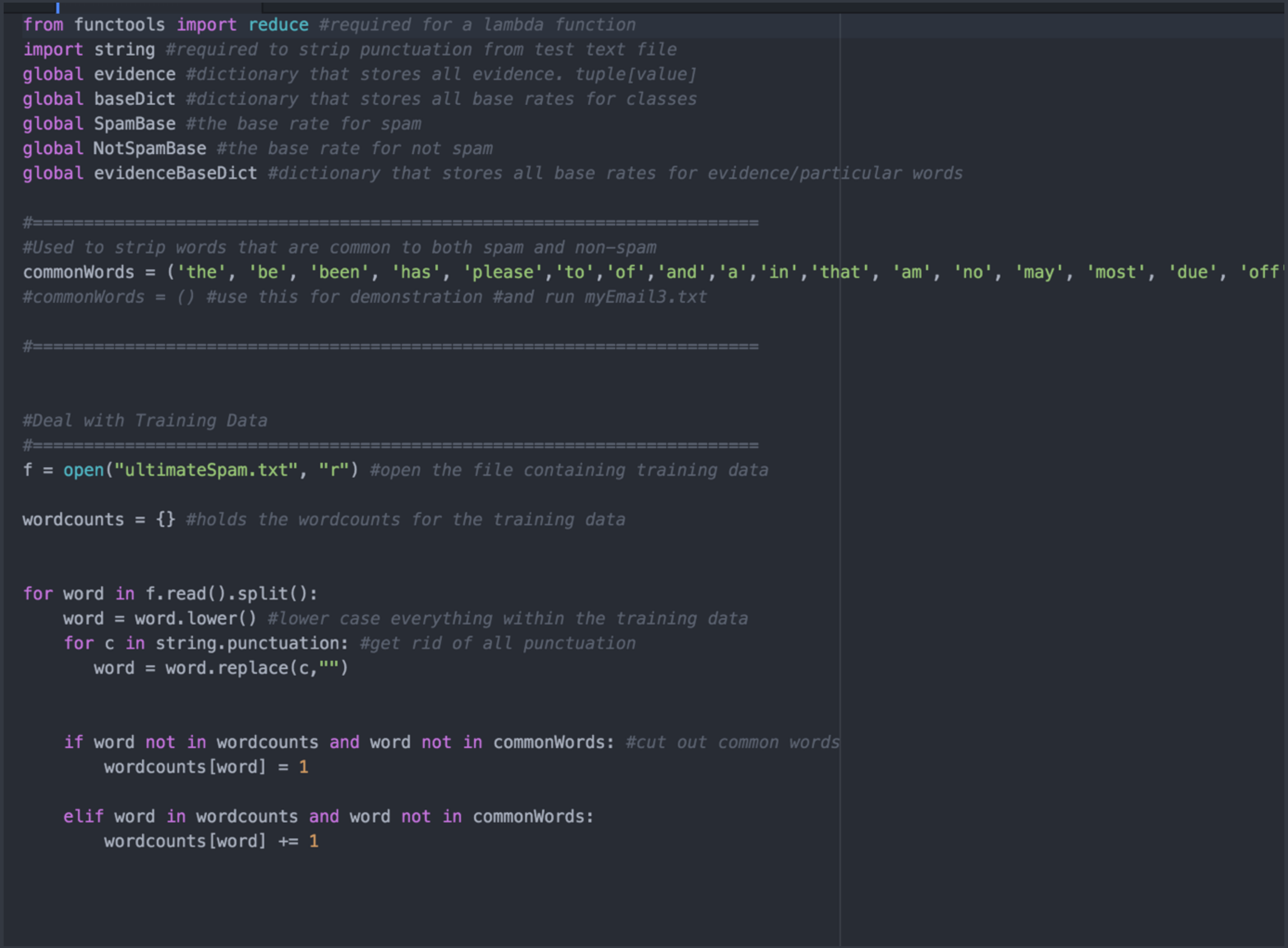
[5]

spam_away

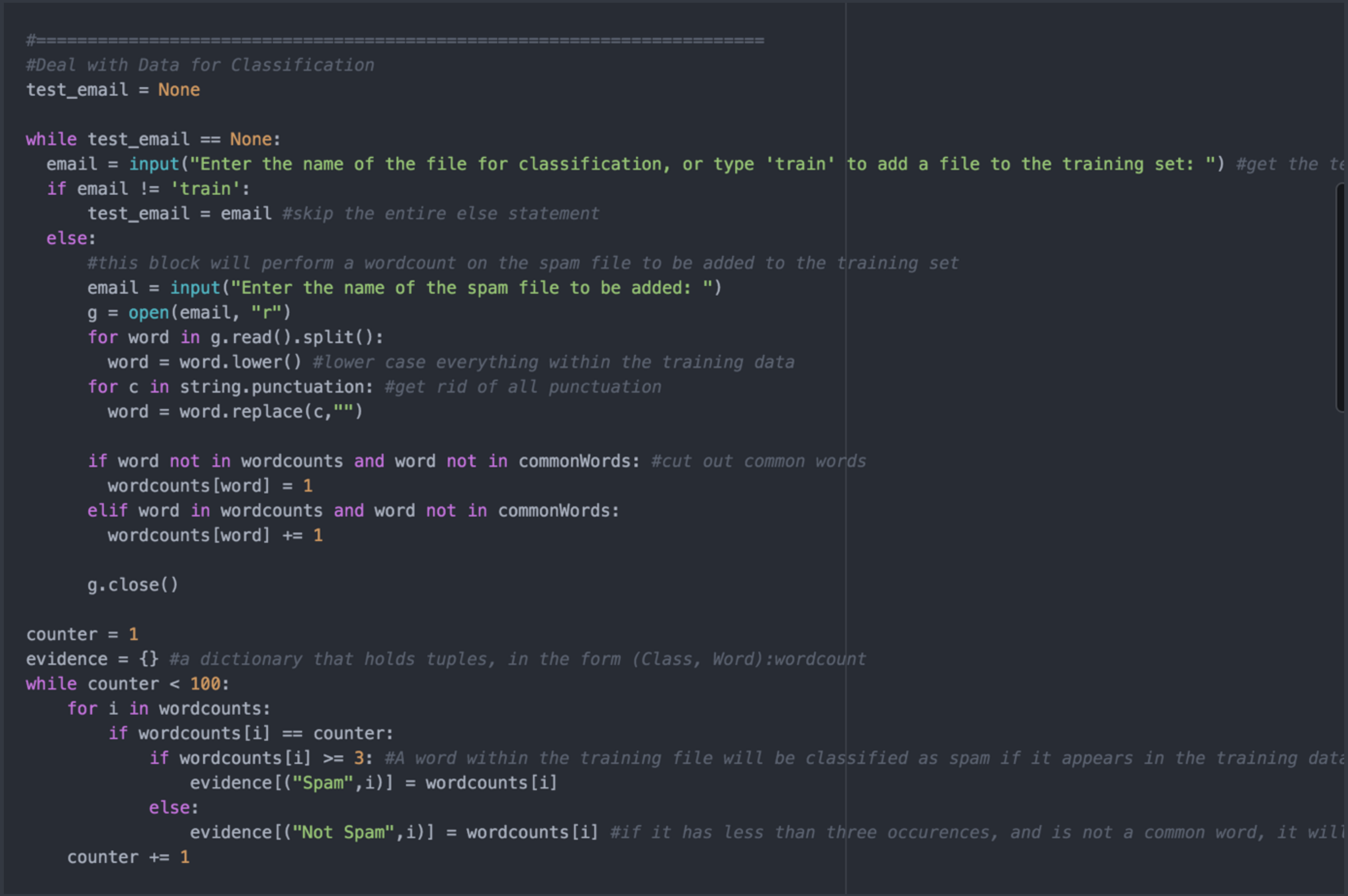
# spam filtering using a naive Bayesian classifier



```
[Relto:Revision 1 - On time bruce$ python3 Naive_Bayes_Filter.py
Enter the name of the file for classification, or type 'train' to add a file to the training set: myEmail.txt
=========================================
Most common words are name, email
This is likely to be spam
[Relto:Revision 1 - On time bruce$ python3 Naive_Bayes_Filter.py
Enter the name of the file for classification, or type 'train' to add a file to the training set: myEmail2.txt
=========================================
Most common words are marks, assignment
This is likely to be not spam
[Relto:Revision 1 - On time bruce$ python3 Naive_Bayes_Filter.py
Enter the name of the file for classification, or type 'train' to add a file to the training set: myEmail3.txt
=========================================
Most common words are course, put
This is likely to be not spam
[Relto:Revision 1 - On time bruce$ python3 Naive_Bayes_Filter.py
Enter the name of the file for classification, or type 'train' to add a file to the training set: ultimateSpam.txt
=========================================
Most common words are account, email
This is likely to be spam
[Relto:Revision 1 - On time bruce$ python3 Naive_Bayes_Filter.py
Enter the name of the file for classification, or type 'train' to add a file to the training set: train
Enter the name of the spam file to be added: myEmail2.txt
Enter the name of the file for classification, or type 'train' to add a file to the training set: myEmail3.txt
=========================================
Most common words are course, folder
This is likely to be not spam
Relto:Revision 1 - On time bruce$ 
```



```
from functools import reduce #required for a lambda function
import string #required to strip punctuation from test text file
global evidence #dictionary that stores all evidence. tuple[value]
global baseDict #dictionary that stores all base rates for classes
global SpamBase #the base rate for spam
global NotSpamBase #the base rate for not spam
global evidenceBaseDict #dictionary that stores all base rates for evidence/particular words

#=========================================================================
#Used to strip words that are common to both spam and non-spam
commonWords = ('the', 'be', 'been', 'has', 'please','to','of','and','a','in','that', 'am', 'no', 'may', 'most', 'due', 'off'
#commonWords = () #use this for demonstration #and run myEmail3.txt

#=========================================================================


#Deal with Training Data
#=========================================================================
f = open("ultimateSpam.txt", "r") #open the file containing training data

wordcounts = {} #holds the wordcounts for the training data


for word in f.read().split():
    word = word.lower() #lower case everything within the training data
    for c in string.punctuation: #get rid of all punctuation
       word = word.replace(c,"")


    if word not in wordcounts and word not in commonWords: #cut out common words
        wordcounts[word] = 1

    elif word in wordcounts and word not in commonWords:
        wordcounts[word] += 1
```



```
#=======================================================================
#Deal with Data for Classification
test_email = None

while test_email == None:
  email = input("Enter the name of the file for classification, or type 'train' to add a file to the training set: ") #get the te
  if email != 'train':
      test_email = email #skip the entire else statement
  else:
      #this block will perform a wordcount on the spam file to be added to the training set
      email = input("Enter the name of the spam file to be added: ")
      g = open(email, "r")
      for word in g.read().split():
        word = word.lower() #lower case everything within the training data
      for c in string.punctuation: #get rid of all punctuation
        word = word.replace(c,"")

      if word not in wordcounts and word not in commonWords: #cut out common words
        wordcounts[word] = 1
      elif word in wordcounts and word not in commonWords:
        wordcounts[word] += 1

      g.close()

counter = 1
evidence = {} #a dictionary that holds tuples, in the form (Class, Word):wordcount
while counter < 100:
    for i in wordcounts:
        if wordcounts[i] == counter:
            if wordcounts[i] >= 3: #A word within the training file will be classified as spam if it appears in the training data
                evidence[("Spam",i)] = wordcounts[i]
            else:
                evidence[("Not Spam",i)] = wordcounts[i] #if it has less than three occurences, and is not a common word, it will
    counter += 1
```

Highlights

3 Weeks

Had no prior experience with the concepts

Artificial Intelligence

Driven by a desire to learn more about AI

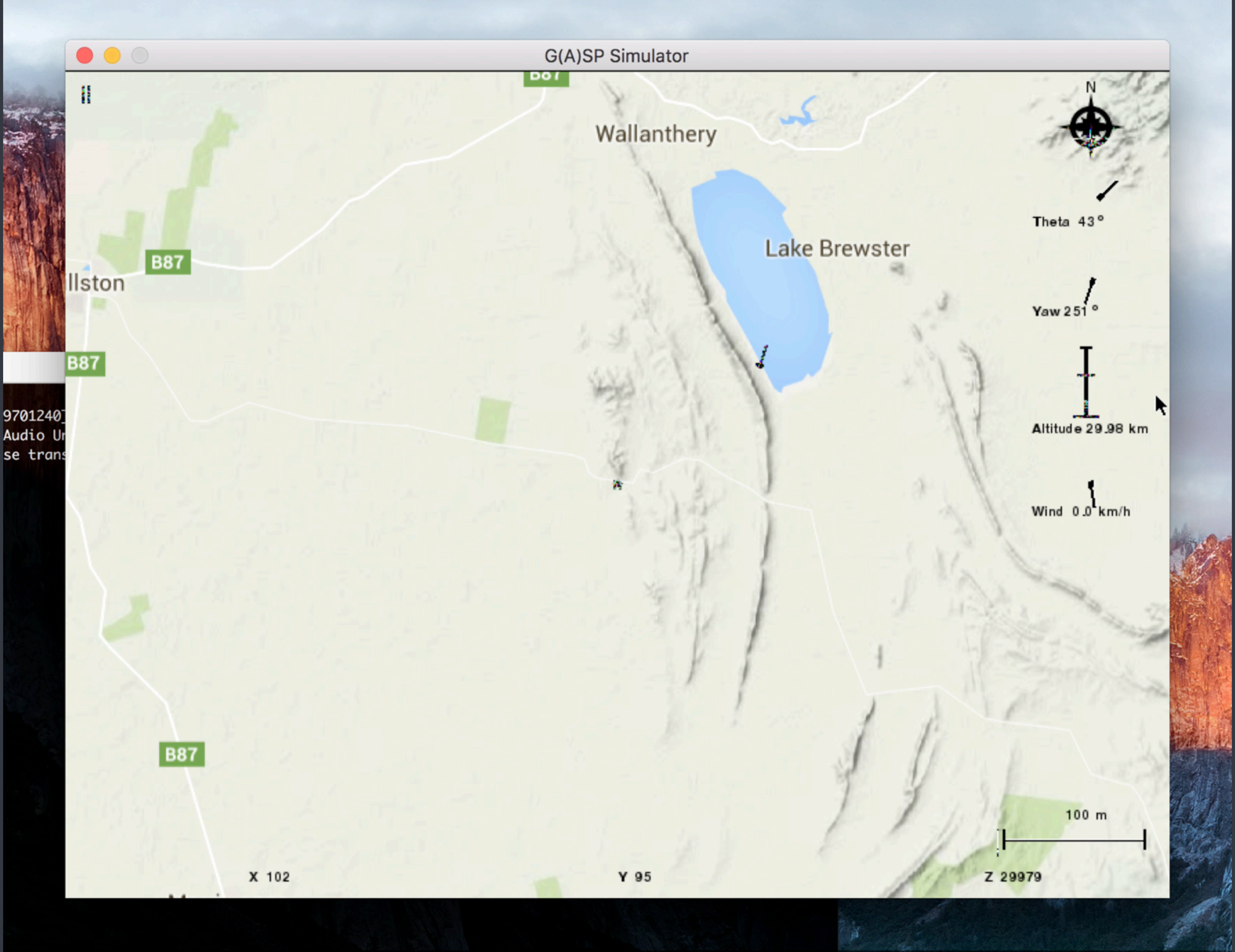
Collaboration

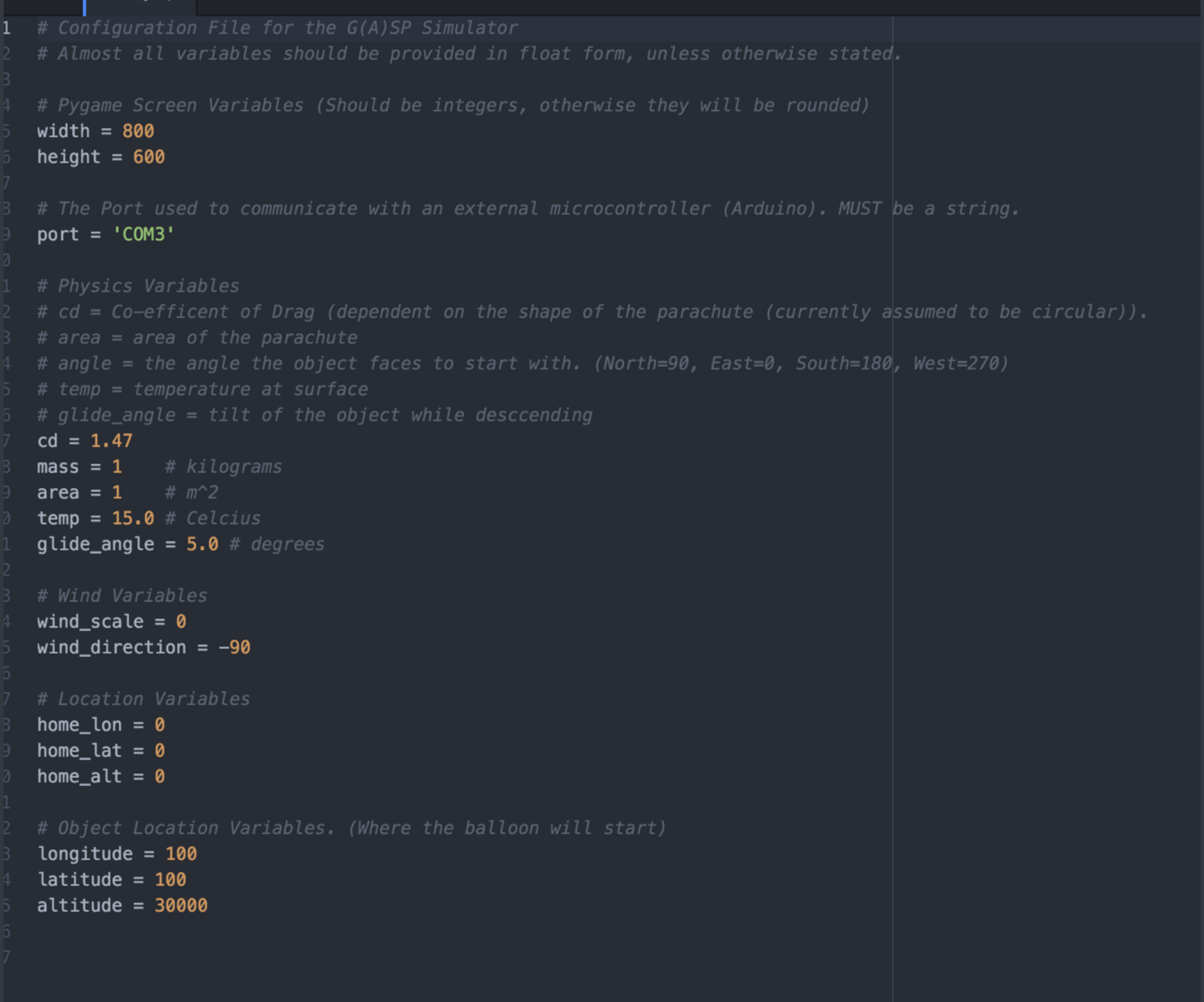
Testing was done with the team working on Prophecy

[6]

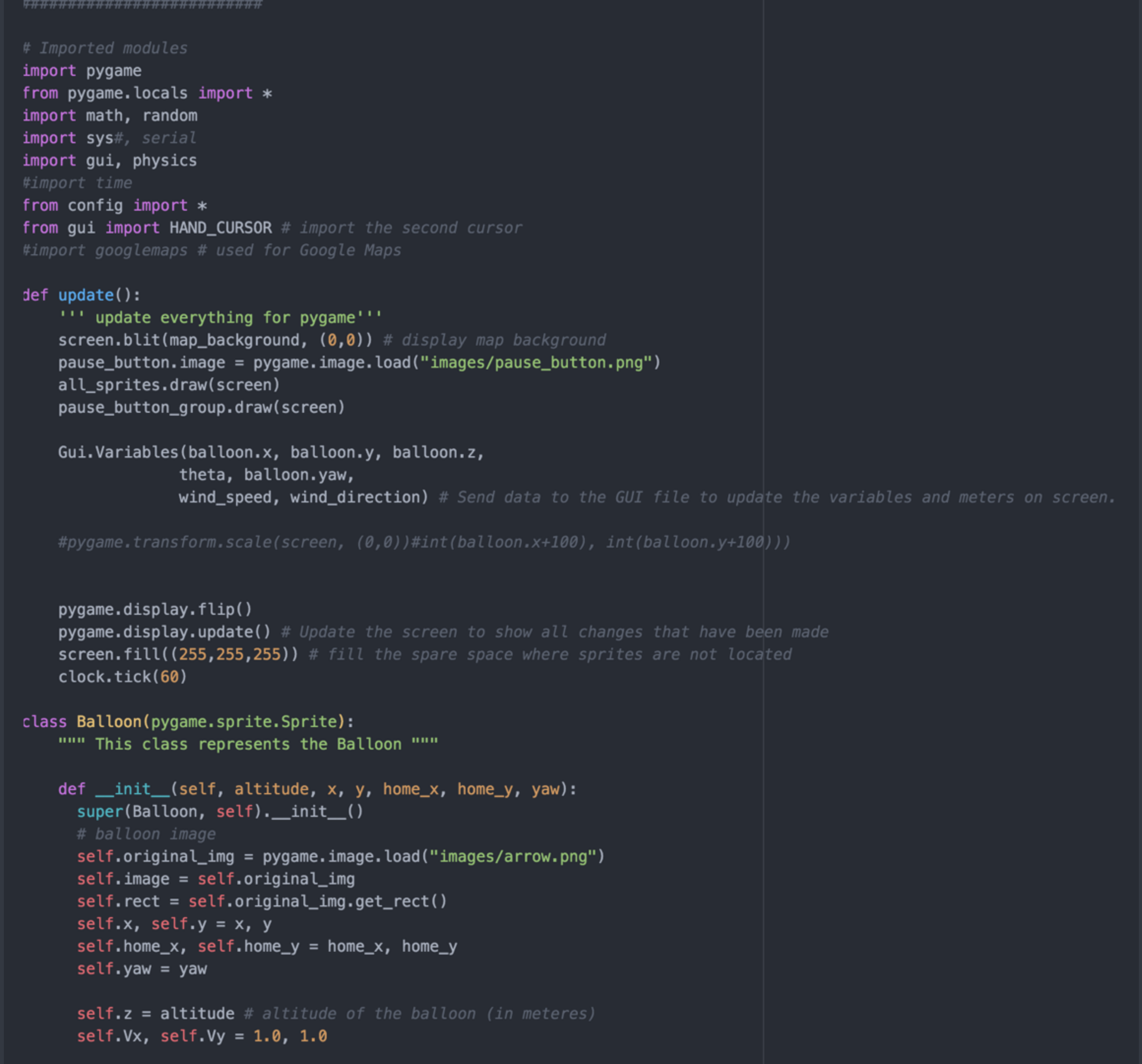
GASP_simulator

# simulation model for payload recovery from high altitude: Gungahlin Almost Space Project (GASP)


G(A)SP Simulator
Wallanthery
Lake Brewster
Ilston
B87
B87
B87
B87
N
Theta 43 °
Yaw 251 °
Altitude 29.98 km
Wind 0.0 km/h
100 m
X 102
Y 95
Z 29979
9701240]
Audio Un
se trans



```
# Configuration File for the G(A)SP Simulator
# Almost all variables should be provided in float form, unless otherwise stated.

# Pygame Screen Variables (Should be integers, otherwise they will be rounded)
width = 800
height = 600

# The Port used to communicate with an external microcontroller (Arduino). MUST be a string.
port = 'COM3'

# Physics Variables
# cd = Co-efficent of Drag (dependent on the shape of the parachute (currently assumed to be circular)).
# area = area of the parachute
# angle = the angle the object faces to start with. (North=90, East=0, South=180, West=270)
# temp = temperature at surface
# glide_angle = tilt of the object while desccending
cd = 1.47
mass = 1    # kilograms
area = 1    # m^2
temp = 15.0 # Celcius
glide_angle = 5.0 # degrees

# Wind Variables
wind_scale = 0
wind_direction = -90

# Location Variables
home_lon = 0
home_lat = 0
home_alt = 0

# Object Location Variables. (Where the balloon will start)
longitude = 100
latitude = 100
altitude = 30000
```



```
##########################

# Imported modules
import pygame
from pygame.locals import *
import math, random
import sys#, serial
import gui, physics
#import time
from config import *
from gui import HAND_CURSOR # import the second cursor
#import googlemaps # used for Google Maps

def update():
    ''' update everything for pygame'''
    screen.blit(map_background, (0,0)) # display map background
    pause_button.image = pygame.image.load("images/pause_button.png")
    all_sprites.draw(screen)
    pause_button_group.draw(screen)

    Gui.Variables(balloon.x, balloon.y, balloon.z,
                  theta, balloon.yaw,
                  wind_speed, wind_direction) # Send data to the GUI file to update the variables and meters on screen.

    #pygame.transform.scale(screen, (0,0))#int(balloon.x+100), int(balloon.y+100)))


    pygame.display.flip()
    pygame.display.update() # Update the screen to show all changes that have been made
    screen.fill((255,255,255)) # fill the spare space where sprites are not located
    clock.tick(60)

class Balloon(pygame.sprite.Sprite):
    """ This class represents the Balloon """

    def __init__(self, altitude, x, y, home_x, home_y, yaw):
      super(Balloon, self).__init__()
      # balloon image
      self.original_img = pygame.image.load("images/arrow.png")
      self.image = self.original_img
      self.rect = self.original_img.get_rect()
      self.x, self.y = x, y
      self.home_x, self.home_y = home_x, home_y
      self.yaw = yaw

      self.z = altitude # altitude of the balloon (in meteres)
      self.Vx, self.Vy = 1.0, 1.0
```

Highlights

4 Weeks

Including physics concepts

STEM

Designed to work alongside Mechatronics study

High visibility

Part of a larger project garnering media attention

Connectivity

Will be used as visual feedback for balloon launch

[7]

why_you_should_care

# and what you can do to make this less of a big deal

Provide the environment that kids need to flourish…

Be positive, active role models

1

Support

Schools and teachers are looking for technical expertise

2

Advocate

Ensure others understand the value of a solid grounding in the Digital Technologies / Computer Science

3

Encourage

Look for ways to get involved with outreach activities such as NCSS Challenge and Young ICT Explorers

4

Enable

Offer Work Experience and Internship opportunities to kids in high school, not just University

5

Inspire

Share your successes with the wider community and help create a sense of awe and wonder

Thanks for your attention

Questions?

bruce.fuda

@Bruce1979

+BruceFuda

bruce@fuda.me

bruce-fuda

http://fuda.me/