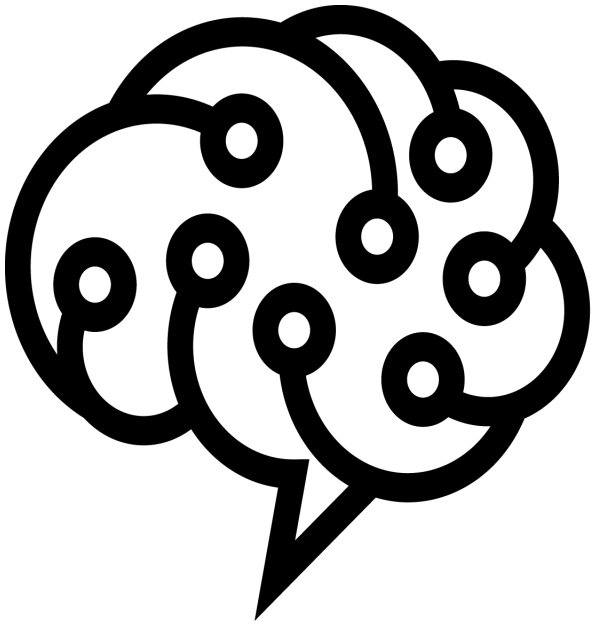
~Inspiring Lives~



school of ai

Raleigh, NC

Jubeen Shah

jnshah2@ncsu.edu

Ver. 1.01.1

Some text collected by Sudha Mantri (Dean, Leesburg School of AI, VA, USA)

Version History

1.0	Created the document, added the chapters until Regression
1.01	Added another chapter “Git and GitHub” completed until three sub sections –> “Using Git”
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1.01.2	Added another section in “Git and Github” –> “git ignore”, “git clone”

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The Dawn

What is School of AI?

An international school dedicated to studying, teaching, and creating Artificial Intelligence to help solve the world's most difficult problems.

Who is the director?

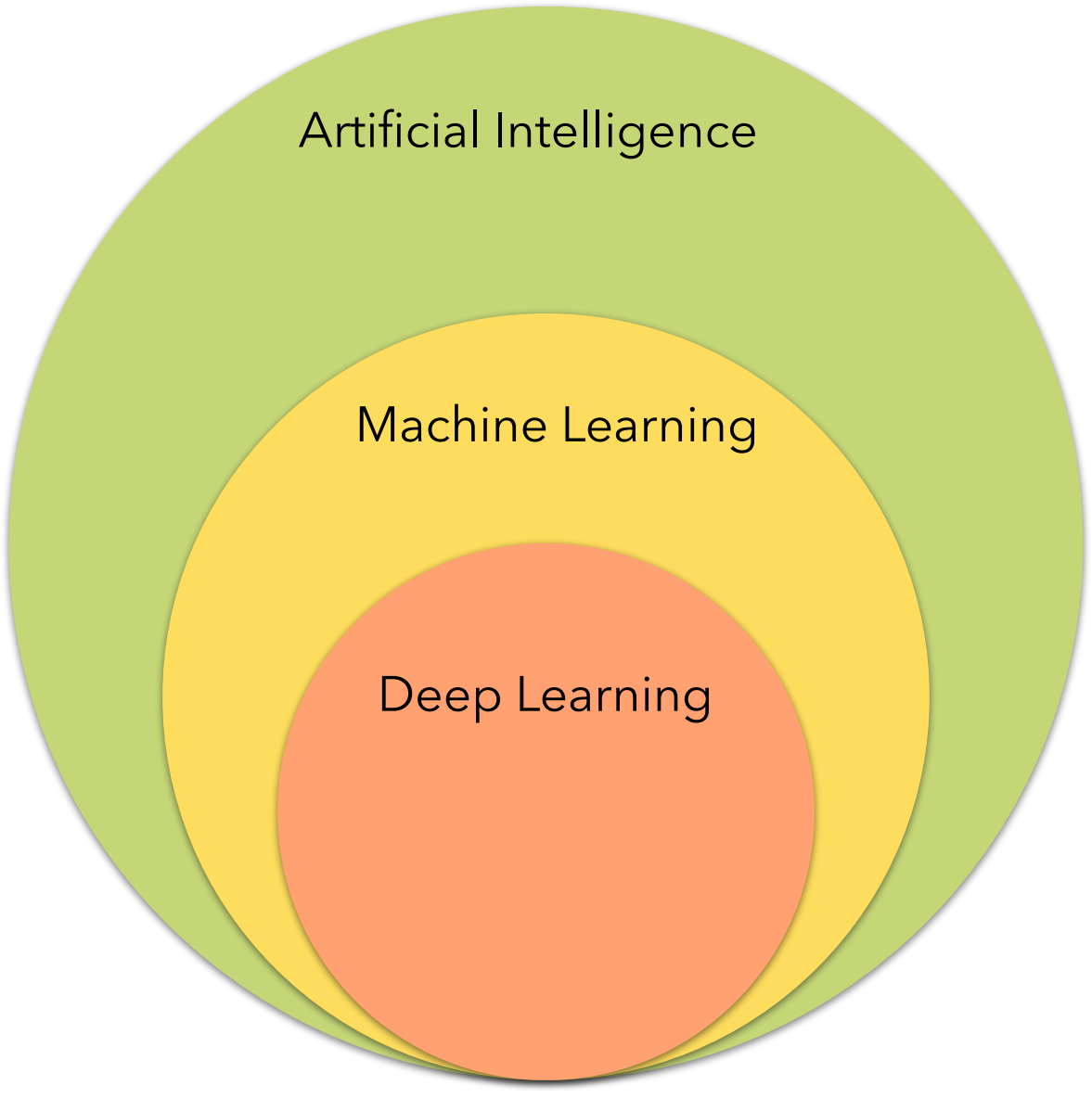
Siraj Raval - He lives to serve all Wizards [the shared moniker of the community]. Inspiring, educating, and guiding them along their journey to help them maximize their positive impact in the world using AI technology.

Who are the deans?

Deans are guardians of our mission - "To offer a world-class AI education to anyone on Earth for free. Our doors are open to all those who wish to learn. We are a learning community that spans almost every country dedicated to teaching our students how to make a positive impact in the world using AI technology, whether that's through employment or entrepreneurship"

What is Artificial Intelligence?

Artificial intelligence is an ability to apply knowledge to real world problems demonstrated by machines. Stuart Russel in his book Artificial Intelligence : A modern approach stated that there are four organized structured definition of AI – *Thinking Humanly, Thinking Rationally, Acting Humanly, and Acting Rationally*. Humans are addictively fascinated with defining and categorizing everything. The benefit I see in that exercise is it makes communication easy (please note I said communication not understanding). There are many definitions for Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL). We can say that right now, AI field is still in its infancy and nomenclature is fluid. There is tremendous opportunity in the field.
Machine learning on the other hand is a subset of artificial intelligence. According to SAS *"Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention."*[1]



[1] https://www.sas.com/en_us/insights/analytics/machine-learning.html

Difference between AI, ML, and DL

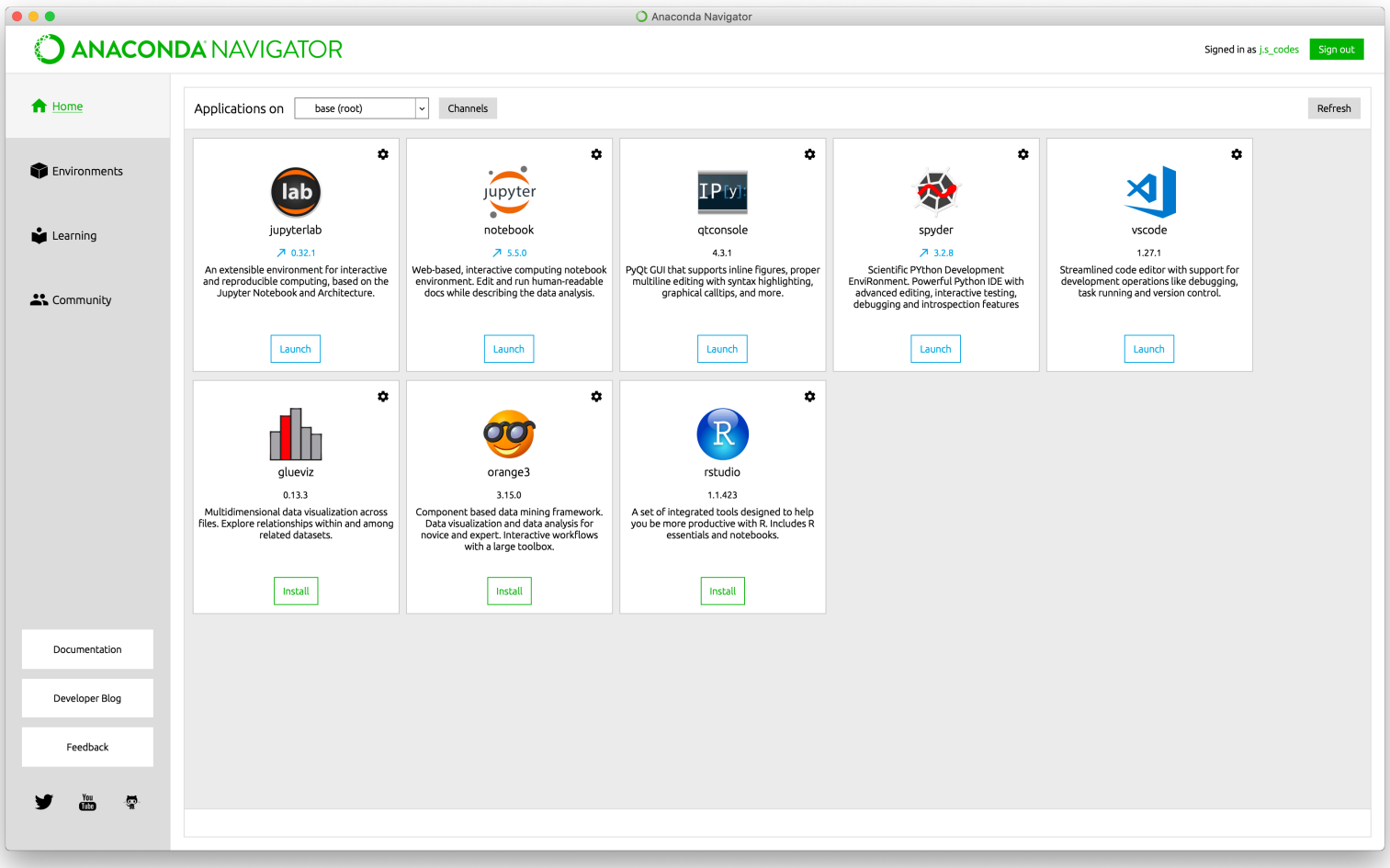
	Artificial Intelligence (AI)	Machine Learning (ML)	Deep Learning (DL)
Definition	Intelligent machines that are meant to imitate/think/act more like human beings	System learns things without being programmed to do so. Logistic Regression. System is able to make predictions or take decisions based on the past data. Model being trained based on features. This can be done on smaller amounts of data.	System thinks and learns like human brain using artificial neural networks. Initial dataset is small with less testing time. Performance improves with more data and continual learning. Concept of weights, bias, variance. Problem solved in an end to end method. Best features are selected by the system
Progress	Era of Weak AI. Machines in their infancy. Any code or technique or algorithm that enables machines to mimic develop and demonstrate human cognition and behavior.	To move from weak AI to strong AI machines need to learn the ways of humans. Techniques and process of ML help machines in this endeavor Machines learn to predict outcomes on the go by recognizing patterns in the input data.	Machines demonstrate ability to learn deeply by drawing meaningful inferences from large data sets. DL requires Artificial Neural Networks (ANN) in layers which are like biological neural networks in humans. ANNs connect and communicate with each other to make sense of vast input data
Types (Just categorization)	1.Reactive machines (Say clothes are clumped on one side in a washing machine, then machine re-centers clothes). No past experience/memory for a new decision 2.Limited memory (Say neural network programmed to identify car). Machine may use short-lived or limited/past information 3.Theory of mind. Systems able to understand human emotions and adjust self-behavior according to the human needs (popularly known as user experience) 4.Self-awareness (self- fixing. Predicting which action is best for the humans – to make human life happy). Systems are aware of themselves and understand their own internal states. Systems predict other people's feelings/actions.	1.Supervised learning: Systems are able to predict future outcomes based on the past data (system learns from bunch of input images. Then it matches a new image). Requires both input and an output to be given to the model for it to be trained 2.Unsupervised learning: Systems are able to identify hidden patterns from the input data provided. By clustering etc., the patterns and similarities/ anomalies become apparent to the system 3.Reinforcement Learning: Systems are given no training. It may learn on the basis of reward/punishment (Yes/No answers)	DL uses different approaches, algorithms to achieve Deeper learning. 1. Multi Layer Perceptrons (MLPs) 2. Convolutional neural net (CNNs)
Examples	News generation – finds news articles based on news feeds, Google command – smart home devices. Amazon prime music, SAAVN, Philips Hue, OLA, NDTV, Zomata, TED, Goibibo, ESPN Cricinfo, Amazon Echo etc., KBS –DENDRAL, MYSIN, XCON/RI	Spam detection, Chats, Mail categories (All mail, Trash, important, spam), search engine result refining (weights - categorized) - Google search.	Sortie (translation) - neural network (different words and patterns) Chat boats – ask a question it gives answer. Specific tasks – IBM deep blue, Google DeepMind, Google AlphaGo. Convert a black and white image to, Automated library categorization of books – translation of handwritten/ printed data to digital form
Future is happening	Detect crimes before they happen, humanoid AI helpers	Increase efficiency in healthcare, better marketing techniques, Finance, sports, trading, trading.	Increase personalization – hyper intelligent systems, decision making.

Tools

Anaconda

Version >5.0, python version 3.x

- About
  - Anaconda is a distribution of packages built for data science.
  - It comes with conda, a package and environment manager.
  - You can use conda to create environments for isolating your projects that use different versions of Python and/or different packages.
- Installation
  - For Windows
  - For MacOS
  - For Linux
- Click here if you're interested in the documentation
- To understand how to use anaconda please visit this site
- For environment creation and management please go through this link. Get a gist of the basics required for installation and management of environments.
  - If you prefer videos as a learning resource. This video provides a very good summary for you to follow.



Jupyter Notebooks

- This is a very interactive tool of learning and teaching python programming.
- Good thing is, it comes preinstalled with anaconda. So you don't have to install anything else.
- Example
  - Want to learn about markdown. Visit this site for information regarding formatting your Jupiter notebooks.
    - There are some magic keywords for you to use in the notebooks. I'll leave it for you to explore.

Windows

```
conda create -n tensorflow python=3.5
activate tensorflow
conda install pandas matplotlib jupyter notebook scipy scikit-learn
pip install tensorflow
```

Hello World ¶

Just a simple a hello world program, to make sure we have tensorflow properly installed

In [1]:
```
import tensorflow as tf

hello_constant = tf.constant("Hello World!")

with tf.Session() as sess:
    output = sess.run(hello_constant)
    print(output)
```

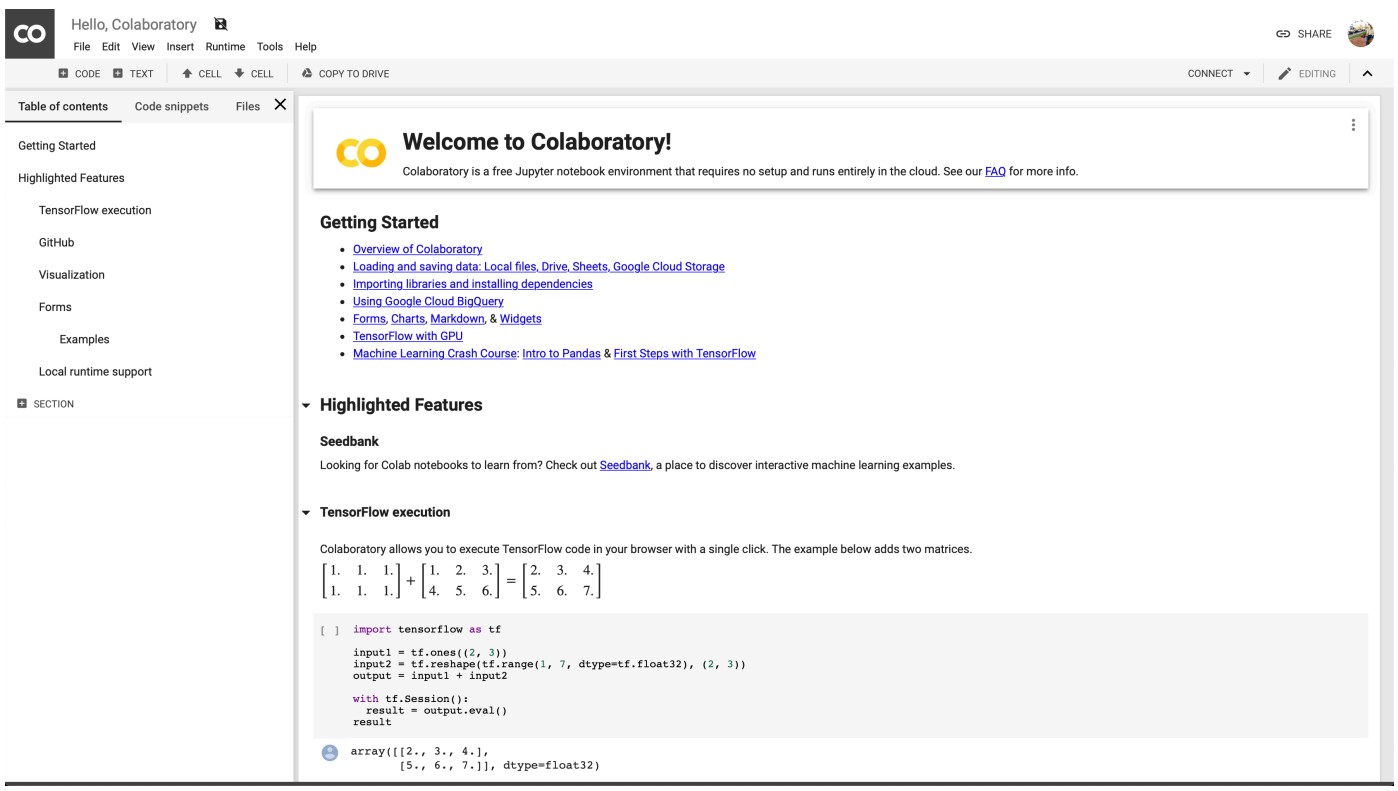
```
/anaconda3/envs/tensorflow/lib/python3.5/importlib/_bootstrap.py:222: RuntimeWarning: compiletime
version 3.6 of module 'tensorflow.python.framework.fast_tensor_util' does not match runtime versio
n 3.5
  return f(*args, **kwds)
b'Hello World!'
```

Awesome!

Great work! Lets move to the next notebook!

Colaboratory

- Alternatively if you would like to directly work with the jupyter notebooks from your web-browser you can use Google's resource
- https://colab.research.google.com/



Git and GitHub

In this chapter, I want to introduce you to using gitHub, to things such as version control, clone repositories, merge repositories, fork, pull requests, and whole bunch of other interesting things.

Version Control

Version control in the simplest form. Let's say that I create a new code file and I write a few lines in it. Now I decide to put it under version control using `git`. And let's say that I call this save point as number one. Now this is my `first version`. Later on as I progress. I write maybe a few more lines of code and at this point I decide to make another save point and I call this my `second version`.

So further down the line I accidentally screw up my entire code file and it's irreparable and I get to the point where I would rather **burn** my entire code file rather than having to try and fix it. You do get into these situations because very often your code is interlinked and each class depends on another and sometimes you can screw up in a way where you know all hope is lost and I simply just want to roll back to the last save point. I can do that using git. I can do that using other tools as well. But the most popular tool and the one that we're going to be talking about is get.

Installing Git

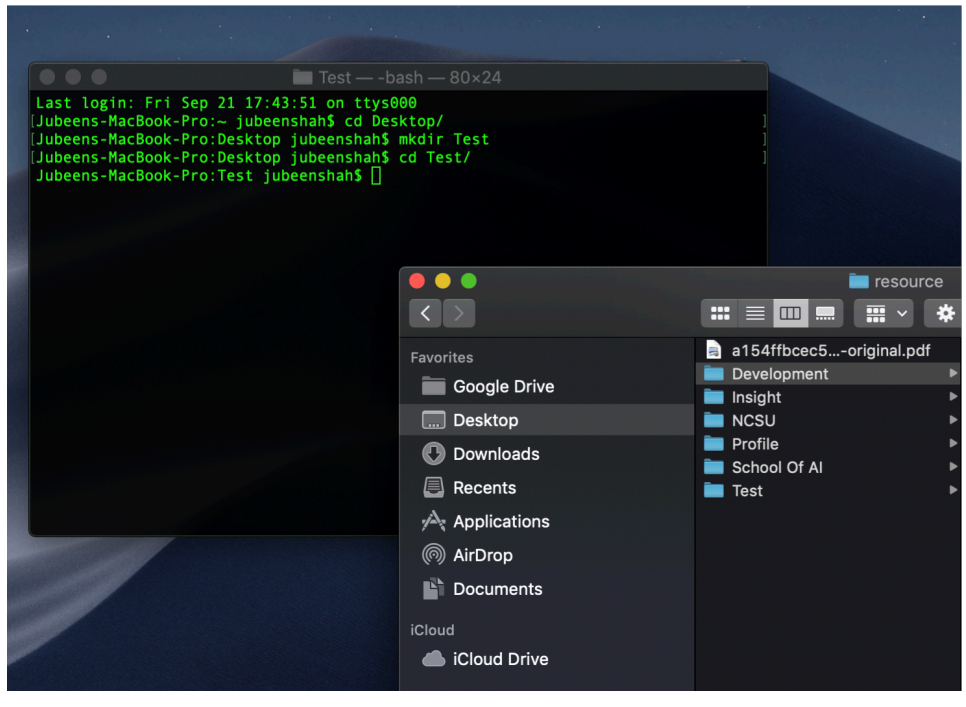
To keep this tutorial much concise, I will not get into the details of installing git. If however, you need help to install `git` onto you pc I would recommend going through this link

Using Git

Assuming, that you have `git` installed, let us move ahead. Again, to keep this chapter concise I will not be talking about how to use git on `Windows` (Sorry, Windows users). Just `MacOS`. However, if you use windows, you can go through this video, which is like a crash course to using `git`. For other users please follow along.

Open your terminal.

```
cd Desktop/
mkdir Test
cd Test/
```



```
git init
```

This is to initialize the `git` repository in the `Test` directory. Then I would ask you to manuall create a text file in the `Test` folder. Just write some random text in it and save it. Alternatively, you can use the `vim` command for doing the same.

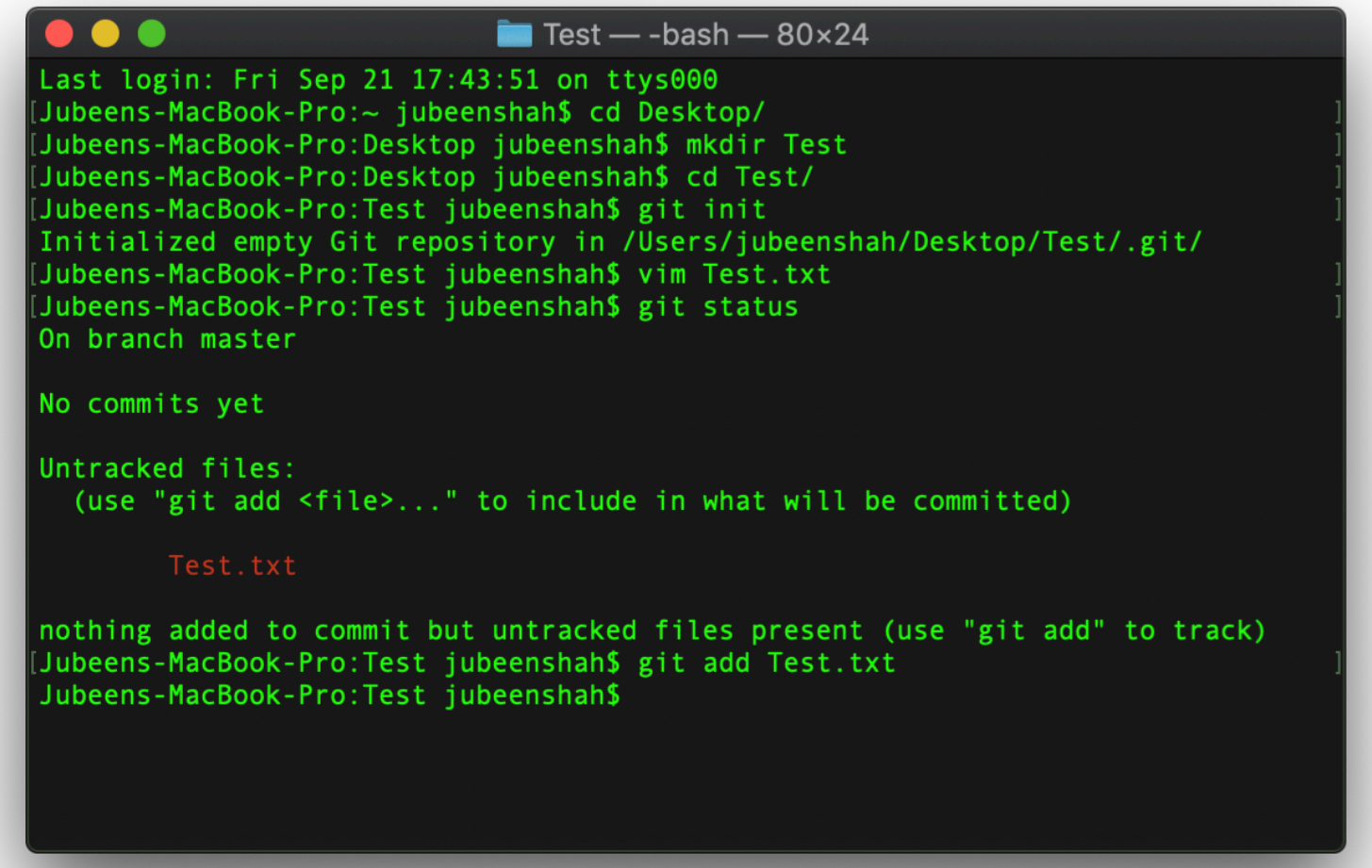
```
vim Test.txt
```

Then type in the text, once done; hit `esc` type in `:wq` and then hit `return / enter`

```
git status
```

This command will tell you that, there some `untracked` files in the repository.

```
git add Test.txt
```




```
git status
```

Now it will show you that a new file is added to the branch. Now you commit the changes

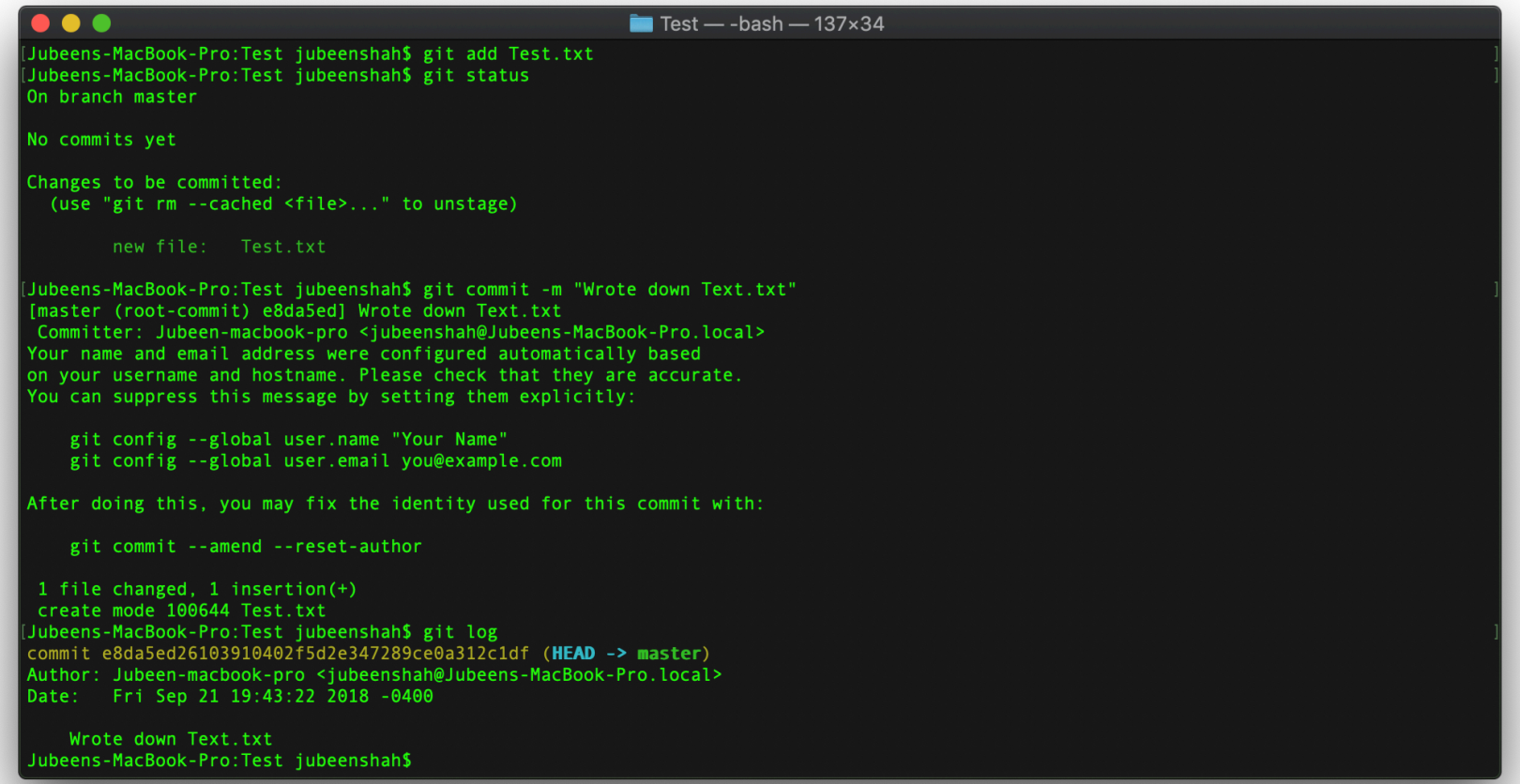
```
git commit -m "Wrote down Text.txt"
git log
```

The `git commit` would help you to commit the changes to your repository, just like you do in a "relationship", you're bound to him/her.

Unless you're like my Ex who has "commitment" issues.

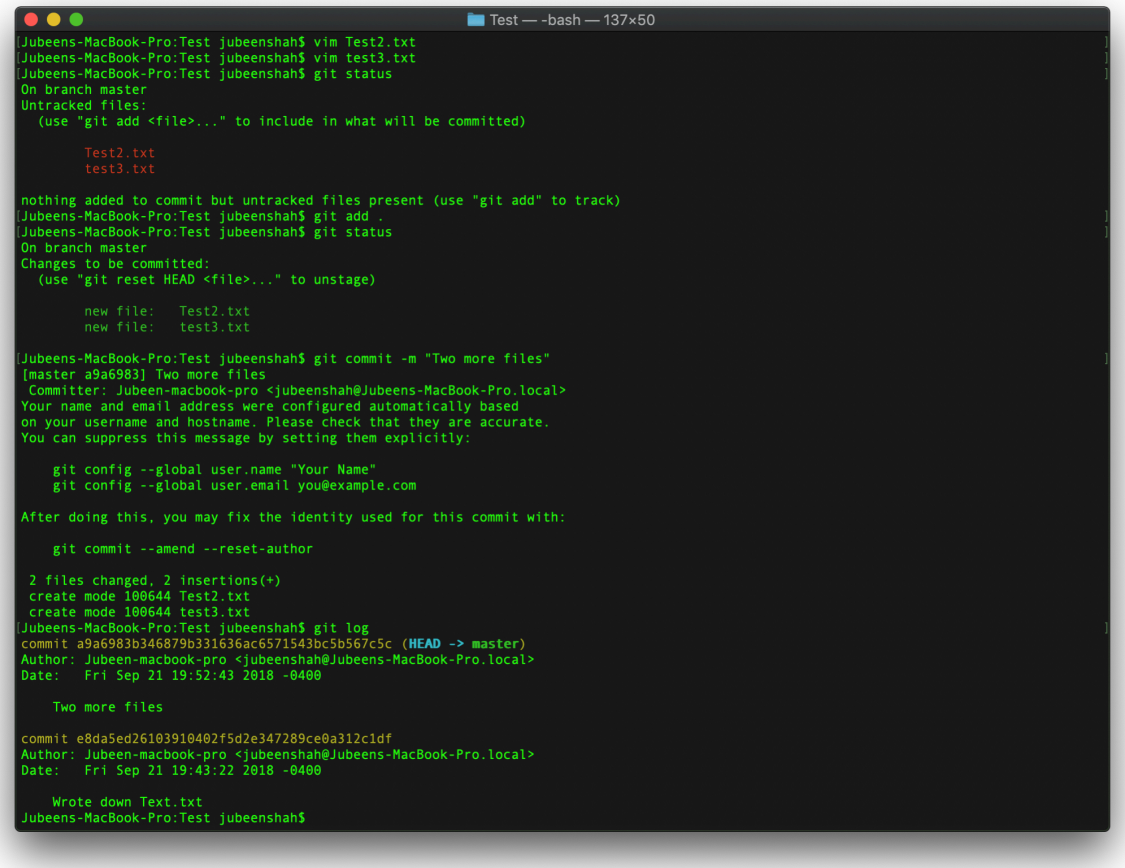
You **Should** use the option `-m` to write commit messages. These messages would help you in the future to recognize the changes that you've made to the file. Then you can use the `git log` command to show you the entire log of all the `commits` that you have ever made.

As you can see there is a `hash` code, also you see who the Author is, and additionally you get the information such as the timestamp. So, unlike a real relationship, you can actually rollback to a previous stage in your `commitment` using the hash code.



I repeated the same steps again, just using one different command

```
git add .
```



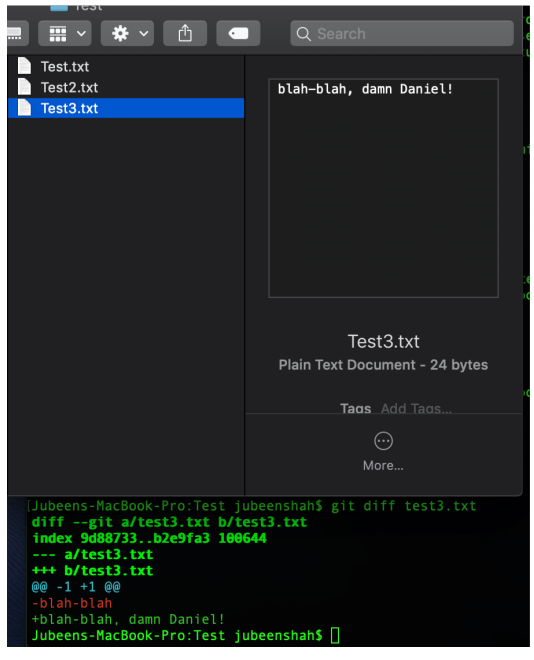
To summarize :

- So the working directory is the one in which you have created the .*txt files.
- Then we push the files to the staging area using the git add . command.
- Then we push the it to the local repository using the command

```
git commit –m “Hello"
```

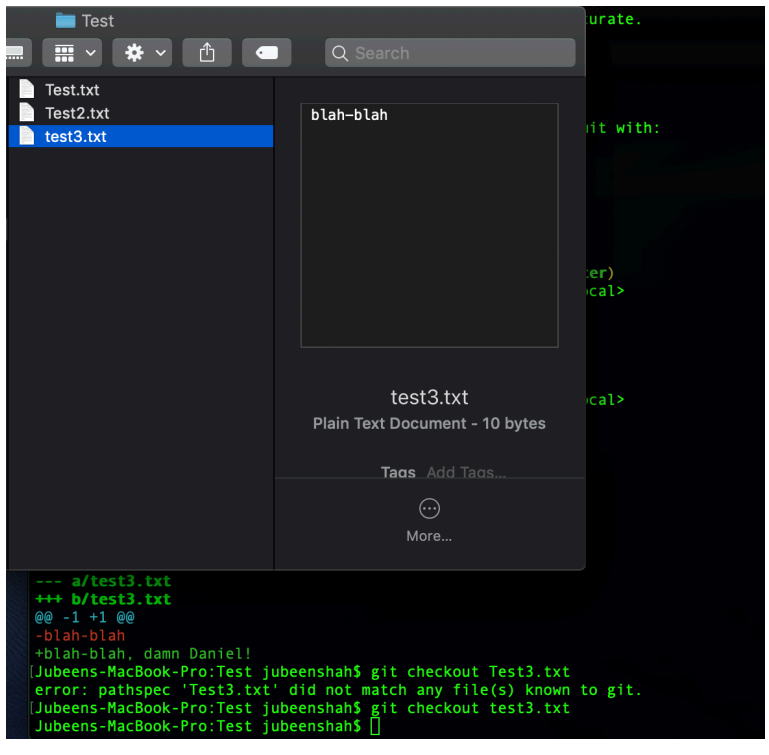
Now I have made some changes in the Test3.txt file but it is something that I do not want to commit to the local repo. To find the difference we can use the command :

```
git diff Test3.txt
```



These are some changes if you don’t want to commit. You can simply use the command :

```
git checkout Test3.txt
```

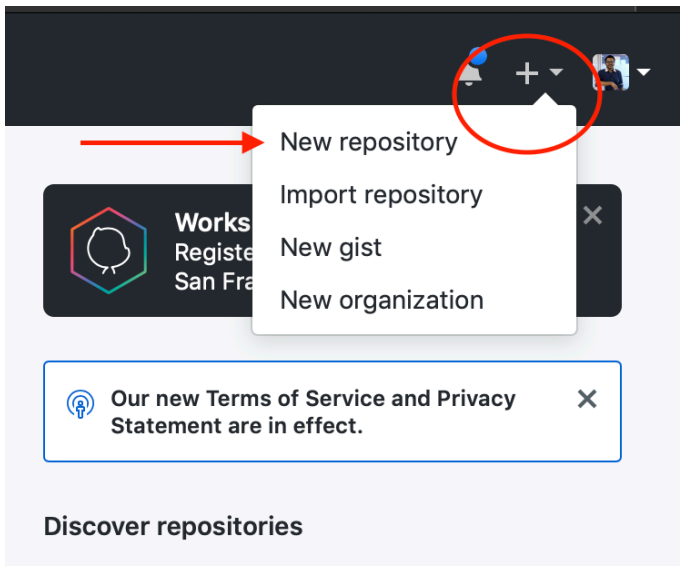


You can see that the roll back happens as soon as you hit enter. Now don’t you wish there was something like this in your relationship. However, it should be noted that this repository is locally available. A better way to use `GitHub` is to use its `remote repositories` functionality.

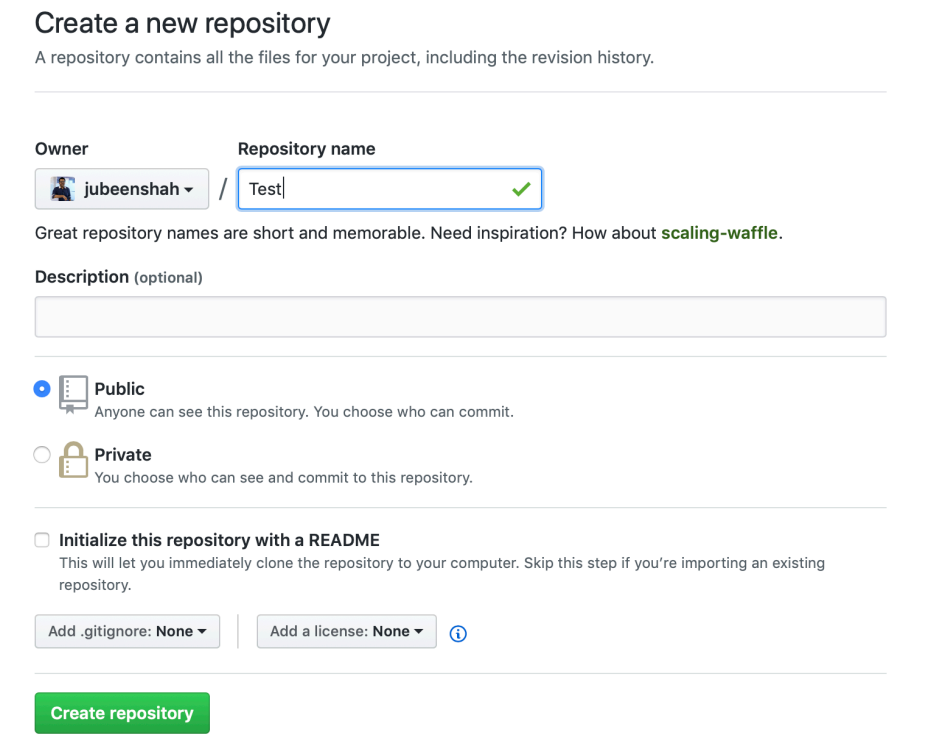
GitHub and Remote Repositories

Now, let's talk about using remote repositories using GitHub. For using this awesome site, you would have to go to Github.com and use that pretty form on the right to set up an account on GitHub. All you need is you email address.

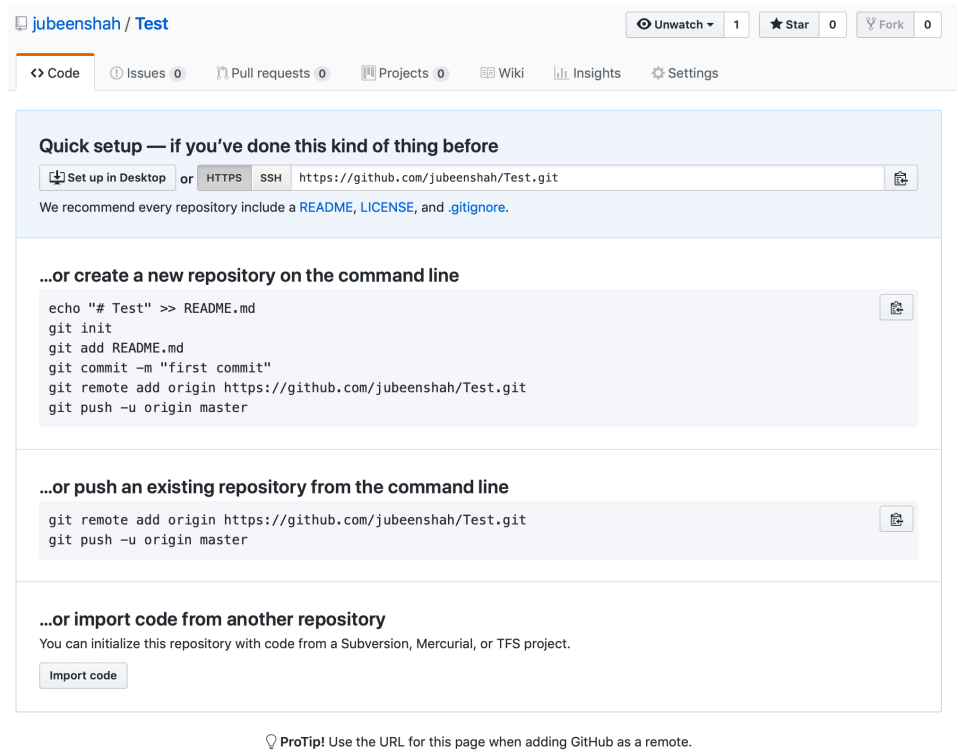
Sign in to you account, and the top right hand side, near your identicon, there should be **+** symbol. Click there, followed by the **New repository option**.



- Add a repoistory name
- Add a description
- By default the deployment option is Public
- Click on Create my repository



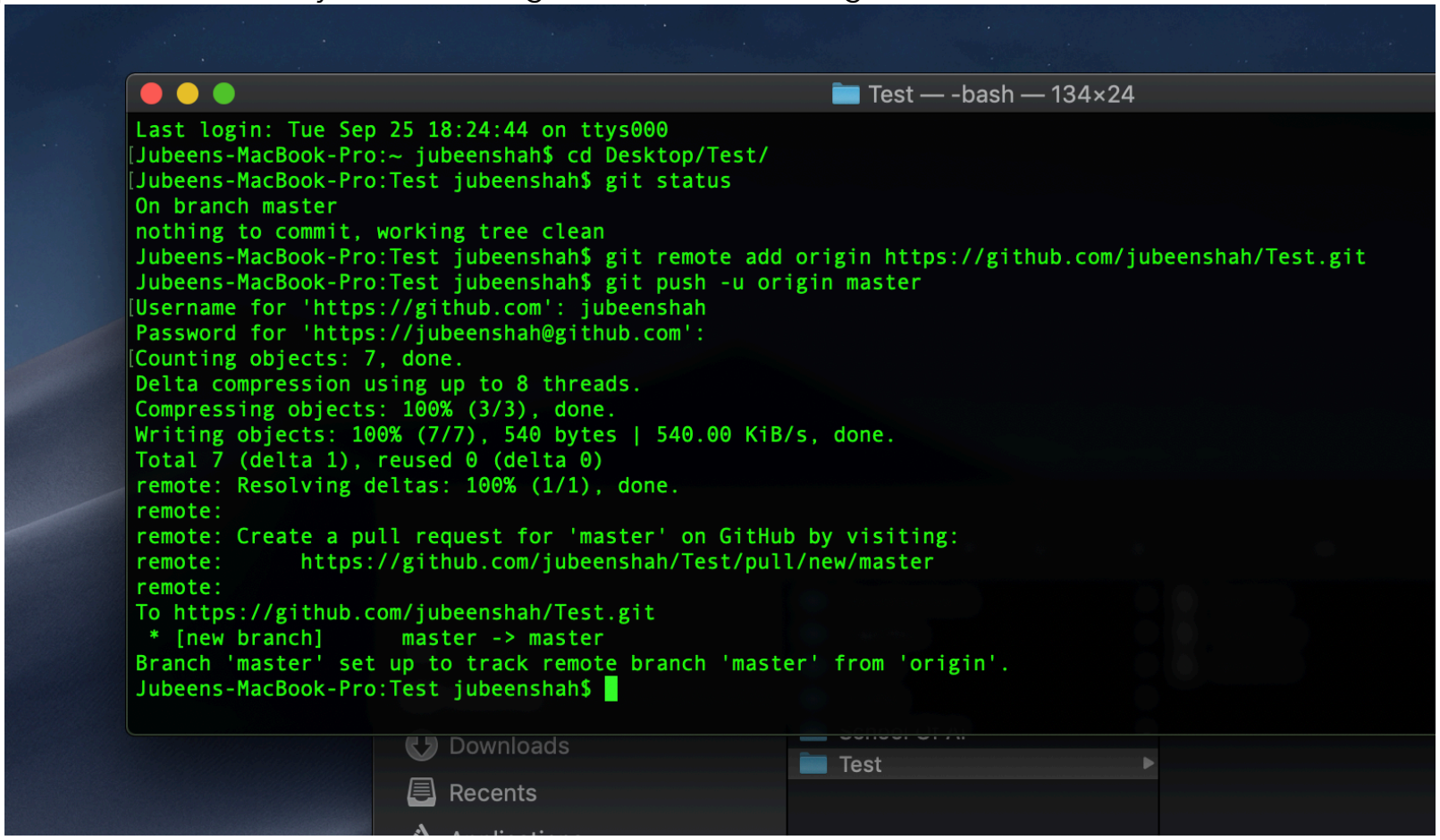
Now you will have a `Quick setup` page shown to you. If you are a big GUI fan, please by all means download the app for Mac or Windows, or you can carry on with the Command Line Interface (CLI) we have been using till now.



If you have followed this chapter diligently, you already have a local repository setup. So you can using the CLI commands from *… or push an existing repository from the command line*
For me it is as follows

```
git remote add origin https://github.com/jubeenshah/Test.git
git push -u origin master
```

So you can copy and paste both the line into your terminal and hit enter. It will prompt you for the username and password. Enter it and you should be greeted with something like this



That is it. You've successfully pushed a local repository onto GitHub. If you reload the page, on your browser you should see all the files that you added.

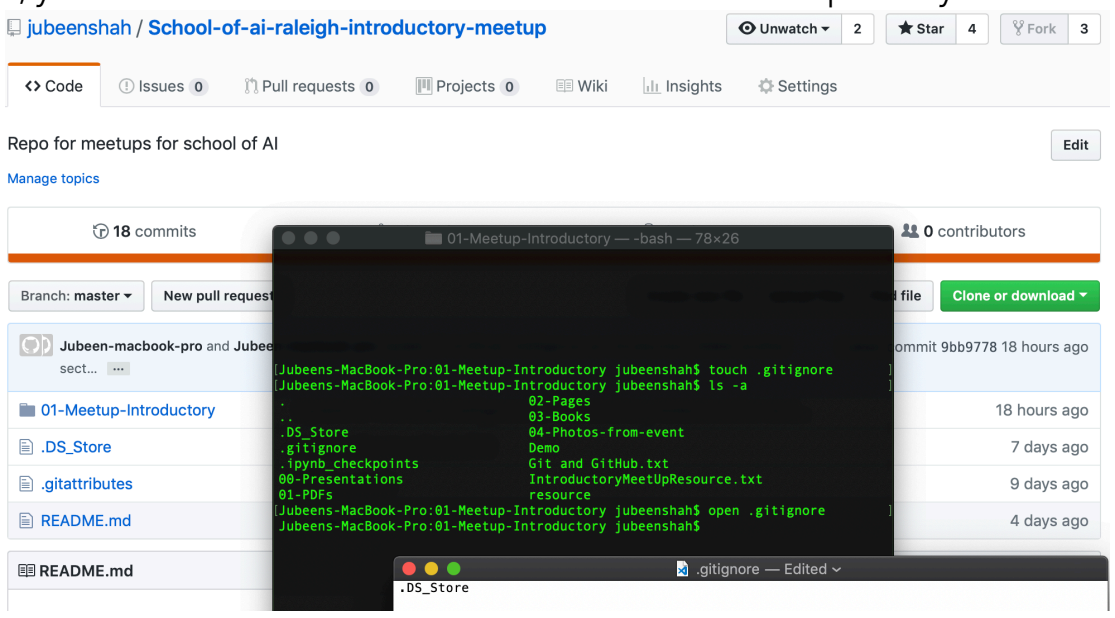
.gitignore

In this section we'll learn about how to set up the repository, in a way that certain files are ignored.
Why do we need to do this? you might ask. Imagine this scenario. You have an Amazon AWS based application, making use of certain API keys. What if you push these API keys, to the the remote repository for everyone to see? Just keep imagining the possibilities.

Let's see an example. Currently, the school-of-ai-introductory-meetup repository has a .DS_Store file. To give it to you quickly. That file is unecessary for everyone else except me.
So what I would do is, go to the folder of the repository on my Mac.

```
cd Desktop/Development/School-of-ai-raleigh/01-Meetup-
Introductory
touch .gitignore
open .gitignore
```

Type in the file names, you do not want to be committed to the remote repository.



Git clone

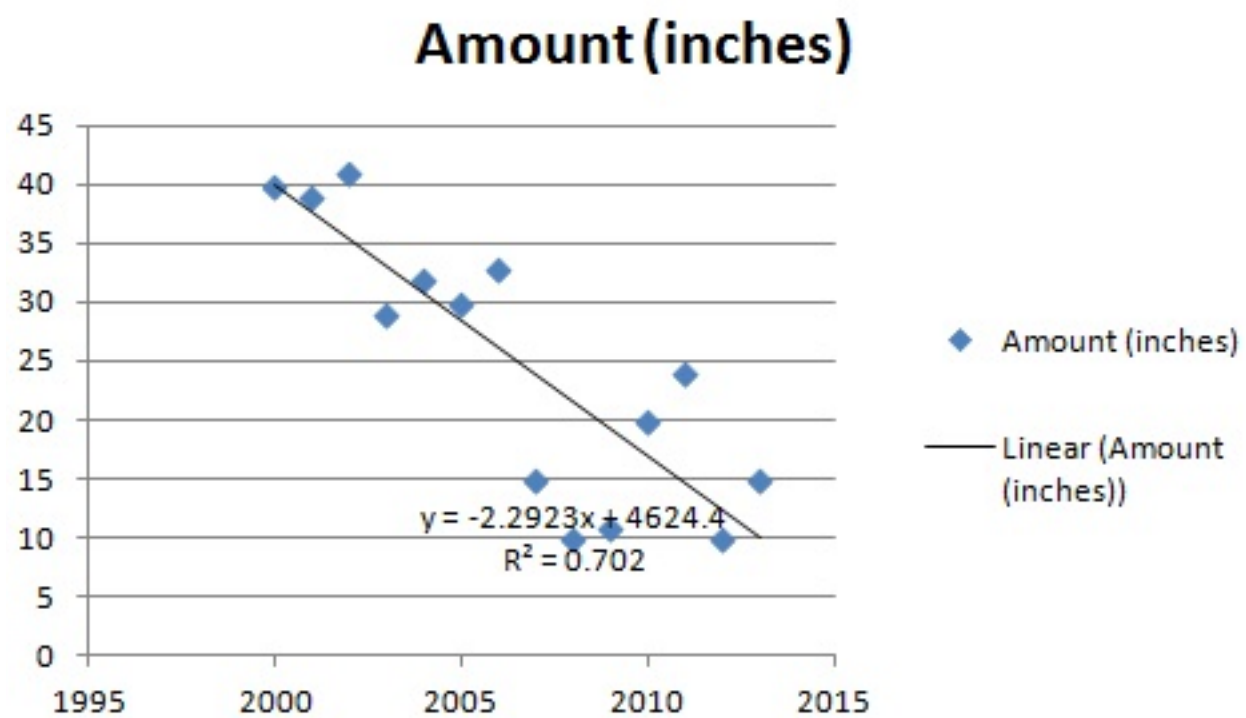
Last section for this chapter. This is simple to do. Very simple in-fact. Using the URL of the repository. go back to the terminal on you mac.

Then you can use the command **git clone + URL**

That is it, for this chapter. From now on I will focus more on the machine learning end of my bargain.

Regression

Regression analysis is used in statistics to find relations between the data. More importantly they are used to find how strongly or weekly the data is correlated. For example, relationship between rash driving and number of road accidents by a driver is best studied through regression.



Src : Analytics Vidhya – https://www.analyticsvidhya.com/blog/2015/08/comprehensive-guide-regression/

Regression Analysis: Introduction

In statistics it is important to analyze data that has been presented to you. However, that might not always be the case, if we're just staring at it. For example, look at the following data set.

In [167]:
```
import pandas as pd
from sklearn.linear_model import LinearRegression

# Assign the dataframe to this variable.

bmi_life_data = pd.read_csv("data.csv")
```

In [168]:
```
bmi_life_data.head()
```

Out[168]:

	Country	Life expectancy	BMI
0	Afghanistan	52.8	20.62058
1	Albania	76.8	26.44657
2	Algeria	75.5	24.59620
3	Andorra	84.6	27.63048
4	Angola	56.7	22.25083

In the notebook in the *demo* folder, you'll be working with data on the average life expectancy at birth and the average BMI for males across the world, using **Linear Regression**. The data comes from Gapminder[2]. The data file can be found under the "data.csv" demo folder. It includes three columns, containing the following data:

- Country – The country the person was born in.
- Life expectancy – The average life expectancy at birth for a person in that country.
- BMI – The mean BMI of males in that country.

[2] https://www.gapminder.org/

Building the model

For your linear regression model, you'll be using `scikit-learn`'s `LinearRegression` class. This class provides the function `fit()` to fit the model to your data.

```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(x_values, y_values)
```

In the example above, the model variable is a linear regression model that has been fitted to the data x_values and y_values. Fitting the model means finding the best line that fits the training data. Let's make two predictions using the model's predict() function.

If you get the error:

> RuntimeWarning: numpy.dtype size changed, may indicate binary incompatibility. Expected 96, got 88
> return f(*args, **kwds)

It is a harmless. It is to do with the numpy version. You can either ignore it or go back to `1.14.5`. The issue Will be fixed in the upcoming 1.15.1. You can visit this page if you would like to learn more about it.

On a side note, we need to define our x and y values, that would be used to `train` the model on.

In [170]:
```
# if you look back, we had our data saved in bmi_life_data, we'll be using that for getting the x and the y values
x, y = bmi_life_data[['BMI']], bmi_life_data[['Life expectancy']]
# in python we can just have a comma between variables to assign value to them
```

```
x,y = 1,3
```

In [171]:
```
# for example
a,b = 1,3
print("a :" + str(a) + " b : " + str(b))
```

```
a :1 b : 3
```

In [172]:
```
x.head()
```

Out[172]:

	BMI
0	20.62058
1	26.44657
2	24.59620
3	27.63048
4	22.25083

In [173]:
```
y.head()
```

Out[173]:

	Life expectancy
0	52.8
1	76.8
2	75.5
3	84.6
4	56.7

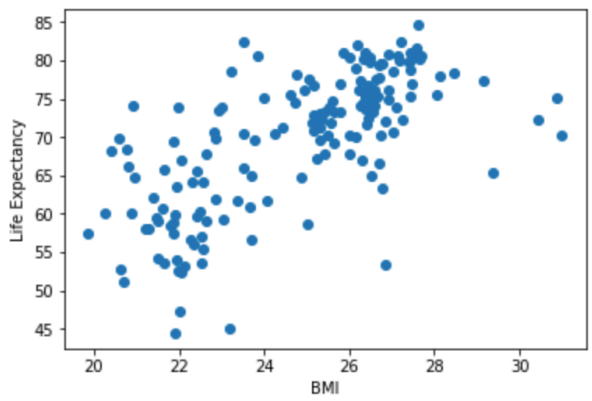
Fitting the model

Once we have set the x and the y values we can use the

model.fit(x_values, y_values)

To fit the model to those values

In [181]:
```
from matplotlib.pyplot import subplots, show
a = x
b = y
fig, ax = subplots()
ax.scatter(a, b)
ax.set_xlabel("BMI")
ax.set_ylabel("Life Expectancy")
show()
```



In [182]:
```
model.fit(x,y)
#Please notice that x and y are float64 data type, and the model.fit() expects x and y as numpy array
# Hence we pass them in '[]' --> model.fit([x],[y])
```

Out[182]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=1, normalize=False)
```

Prediction

So now based on some other `country x` with the males having a average `BMI` rating of lets say `21.9802`
We can predict the average life expectancy using

model.prdict(Value)

In [183]:
```
lifeExpectancy = model.predict(21.9802)
for _ in lifeExpectancy:
    for j in lifeExpectancy: lifeExpectancy = j
print("Life Expectancy of country X is : " + str(lifeExpectancy[0]) + " years")
```

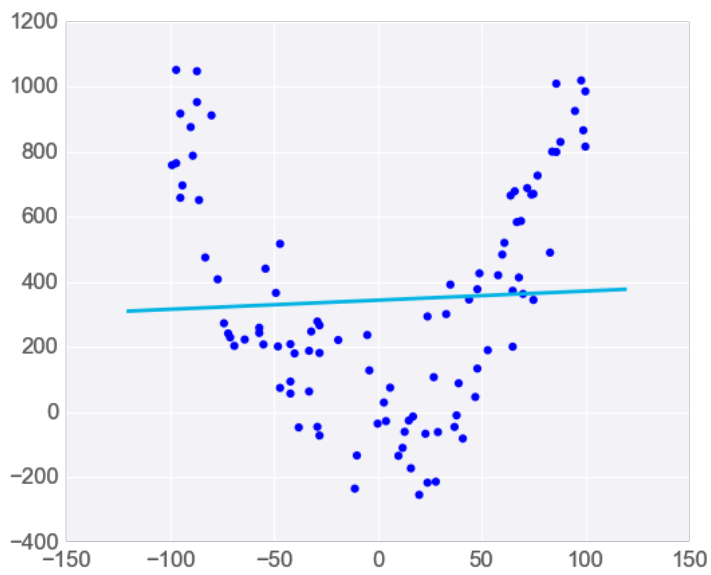
```
Life Expectancy of country X is : 62.58452010568185 years
```

That's awesome. Now you know how to use scikit learn for `linear regression`. Pretty impressive right for the first day at class?

What we saw is known as linear regression. Over time as I add more chapters to this book, I'll cover something known as

Linear regression cons

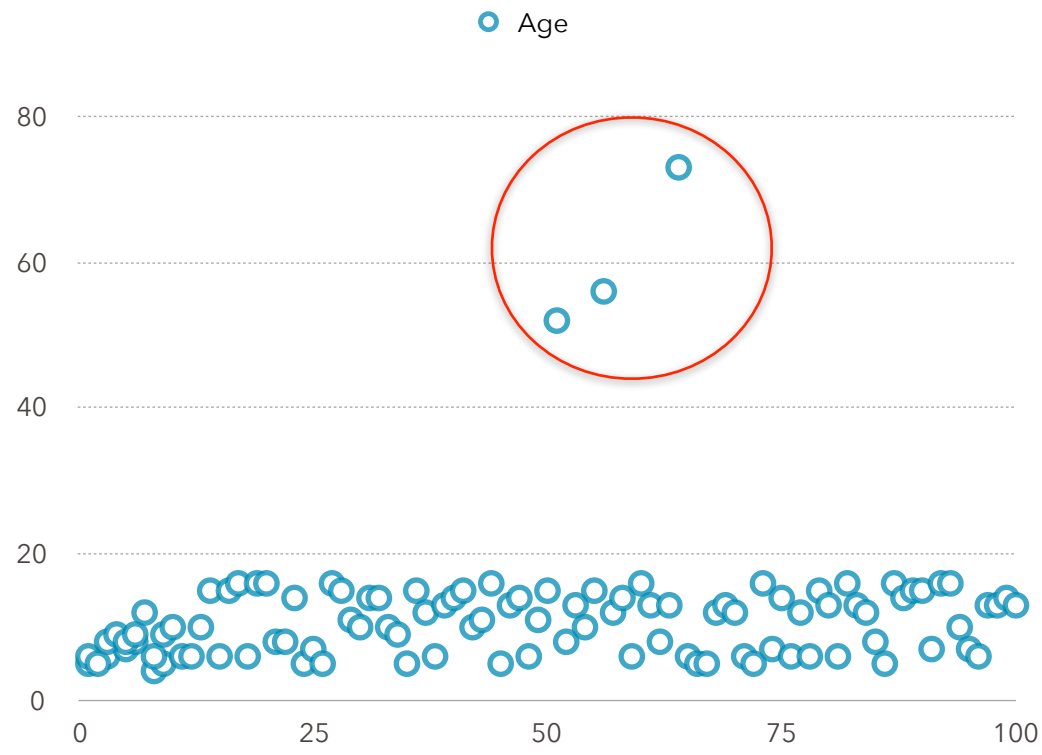
It's not always summer, when it comes to linear regression. As you can see in the diagram below. A single line is not able to fit the model. Hence, we can say that Linear Regression works best when the data provided is linear in nature. To solve this several methods are viable. We can add more features, we can transform the data, or if nothing else works, just use some other model.



Also, Linear Regression is very sensitive to outliers.

What are outliers? I hear you ask.
According to the engineering statistics handbook[3], An *outlier* is an observation that lies an abnormal distance from other values in a random sample from a population. In a sense, this definition leaves it up to the analyst (or a consensus process) to decide what will be considered abnormal. Before abnormal observations can be singled out, it is necessary to characterize normal observations.

What that means is, for example we have a dataset for the age of individuals in a class for elementary school students. It might be normal to find an age group from 5 to 15. If however, you have a datapoint that shows the age of a student to be 45, that would be an outlier.



However, the same might not be the case in a graduate or phD class. So linear regression takes a toll in such scenarios. We will take a look at such scenarios in the future.

[3] https://www.itl.nist.gov/div898/handbook/prc/section1/prc16.htm

References

Code and demos

- Neural net in 11 lines **adding the link**
  - Reference to Andrew Trask
- Deep traffic
  - What is it about
- AI Flappy bird
  - Please note that you need to have anaconda installed on your PC for easy installation of dependencies.
    - It is perfectly fine if you don't understand what is going on

Tools

- Anaconda (Version >5.0, python version 3.x)
  - About
    - Anaconda is a distribution of packages built for data science.
    - It comes with conda, a package and environment manager.
    - You can use conda to create environments for isolating your projects that use different versions of Python and/or different packages.
  - Installation
    - For Windows
    - For MacOS
    - For Linux
  - Click here if you're interested in the documentation
  - To understand how to use anaconda please visit this site
  - For environment creation and management please go through this link. Get a gist of the basics required for installation and management of environments.
    - If you prefer videos. This provides a very good summary for you to follow.
- Jupiter Notebooks
  - This is a very interactive tool of learning and teaching python programming.
  - Good thing is, it comes preinstalled with anaconda. So you don't have to install anything else.
  - Example
    - Want to learn about markdown. Visit this site for information regarding formatting your Jupiter notebooks.
      - There are some magic keywords for you to use in the notebooks. I'll leave it for you to explore.

Additional reading before next meet-up

- Read the part 1 of the deep learning book found here
  - It will give you a brief idea about the math and machine learning concepts to get started with deep learning and being comfortable with it.
- You should use this cheat sheet for understanding any math notation.
- If you're uncomfortable with python programming I would recommend this course to get you started with python.
- Interested in deep learning and machine learning? Sci-kit learn is your go to library
- I recommend you to read up a bit on Perceptrons
  - These are the simplest forms of neural networks out there

- Lets *ascent* the mountain of AI space with gradient descent… ¡wait what!
    - A process by which Machine Learning algorithms learn to improve themselves based on the accuracy of their predictions
- Backpropogation
    - The process by which neural networks learn how to improve individual parameters.
- Need a library for scientific computing? Numpy has you covered.
- Tensorflow we'll get there.

If nothing go through these web pages and make sure you bookmark them for easy access.

Online Courses

- Python course
- Numpy, pandas, matplotlib

Books

- Deep learning book
- Neural Networks and DeepLearning
    - Free online book for you to learn more about deep learning

People

Siraj Raval

- School of AI
- LinkedIn
- YouTube
- Twitter
- Github

Jubeen Shah

- Facebook Group
- Meetup
- Instagram
- LinkedIn
- Github