Introduction to Python for Social Science

Lecture 1 - Introduction to Python

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1st Week Hilary 2020

Course Overview

Schedule

8-week long course will take place on Wednesdays at the IT Lab in the Manor Road Building. Each week will consist of a three-hour session divided roughly as follows:

- 1615-1715: Lecture
- 1715-1725: Break
- 1725-1825: Workshop
- 1825-1925: Clinic

Mention that class in 3rd week (5th Feb) will be moved to Monday (3rd Feb).

Lecture

- During the lectures I will discuss a mixture of theory and methods. The slides will be made available at the following:
  - https://github.com/muhark/dpir-intro-python
  - Canvas?
- Please feel free to stop me and ask questions! I have alloted time for this.

Slides are generated with `reveal.js`. Should be viewable on any device with a browser.

Workshop

- In the workshop, you will work through a number of set programming problems and discussion questions.
- Answers will be discussed as a class for the final 10 minutes.

Clinic

- Each week, there will be tasks and projects for you to try in your own time, if you wish.
- I'll be available for an hour after each session to answer questions one-to-one or in small groups.

Course Structure

1. Introduction to Python and the Development Environment
2. Data Structures and `pandas` I
3. Data Structures and `pandas` II
4. Data Visualisation
5. Machine Learning with `scikit-learn` I
6. Machine Learning with `scikit-learn` II
7. Mining the Web
8. Introduction to Natural Language Processing

Feedback

Week 1: Introduction to Python and the Development Environment

What is Python?...

Open-Source

- Built by a community
- Maintained by a community
- Free to use for all

General-Purpose

- If you're doing it on a computer and there's some repetitive element, then you can automate it in Python.
- Python isn't limited to Data Science, but it's very popular with data scientists!

Large community means that a larger number of people create, contribute to, and maintain the data analysis tools that we all use.

Scripting

- No strict definition for what a “script” is.
- Series of commands to automate some task.
- Like a pipeline: takes some inputs, does some things to these inputs, and gives back some outputs.

It’s good to keep the input-output framework in your head.

and what can I use Python for?

I want to...

- Clean up my messy data!
- Run analyses with (hundreds of) millions of data points
  - it won't fit into an excel spreadsheet!
- I want to automate downloading several decades of newspaper articles!
- I want to create beautiful (interactive) visuals to accompany my analyses!
- I want to uncover hidden structures linking parliamentary committees!
- ... and more!

Python vs R

Basic Coding Tools

Anaconda

- Environment and software manager.
- Can be used from the command line (`cli`) or browser-like interface (anaconda-navigator).

At this point, I switch windows to open up the anaconda navigator, and go through the various relevant tabs. These include the launcher for various apps and the environment manager.

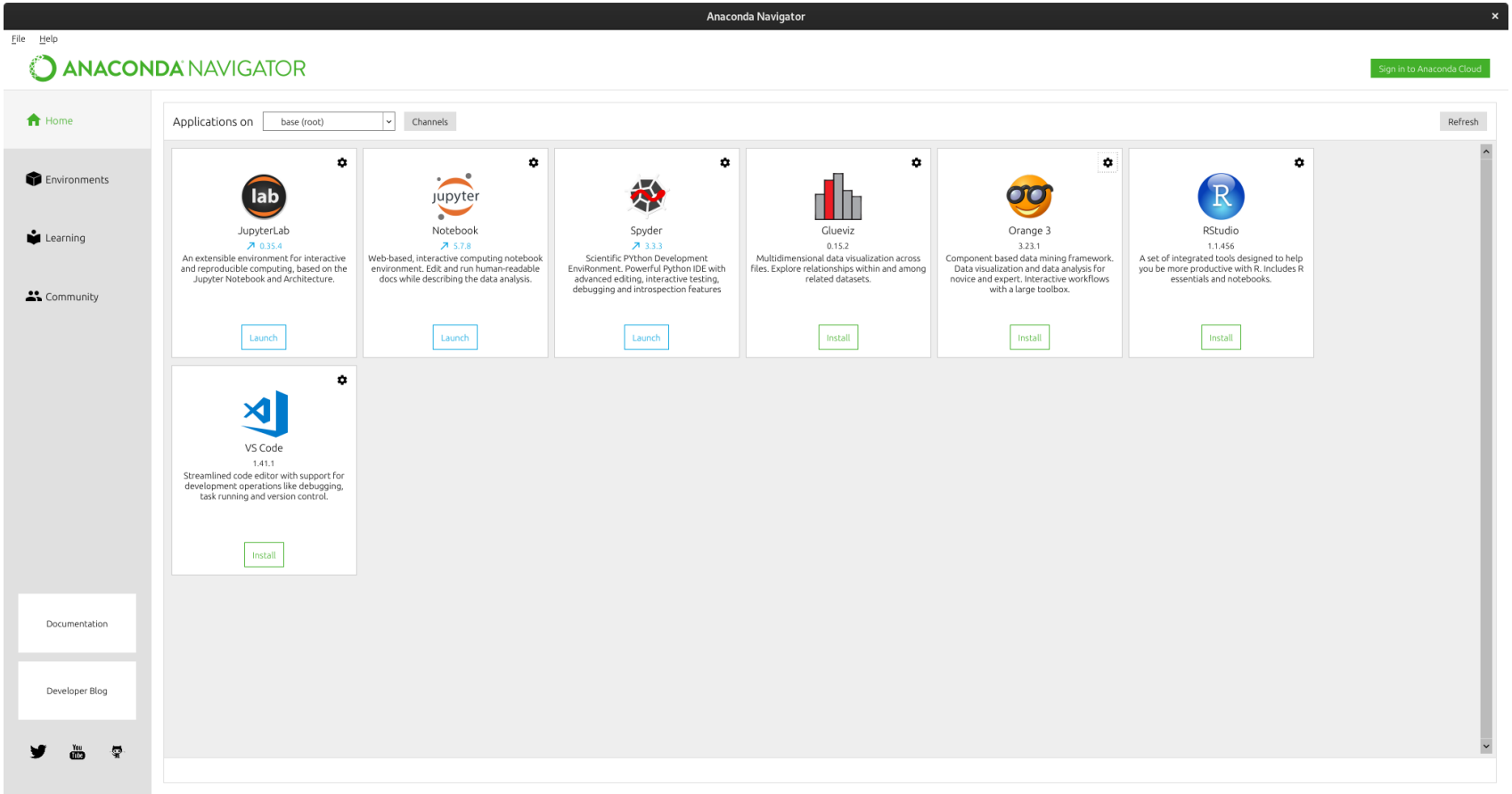


Figure 1: Anaconda Navigator

- Make sure students can find navigator, and open applications from it.

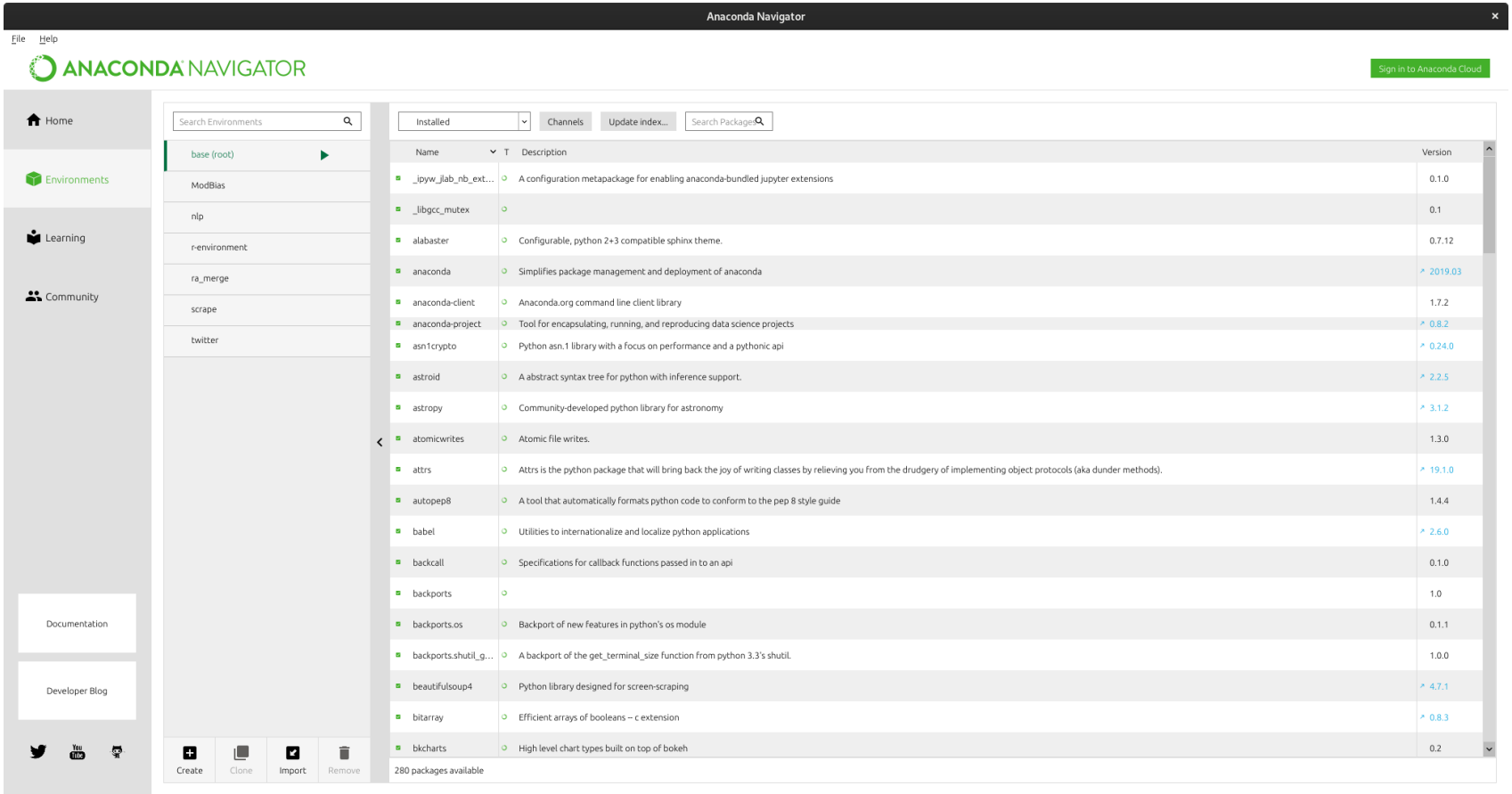


Figure 2: Environment Manager

- Show students how to install packages here. Also mention that this can be done from the command line.

Jupyter

- Interactive code editor.
- Popular, but has its detractors.
- I don't use it, but I started off with it. I recommend that you give it a go.

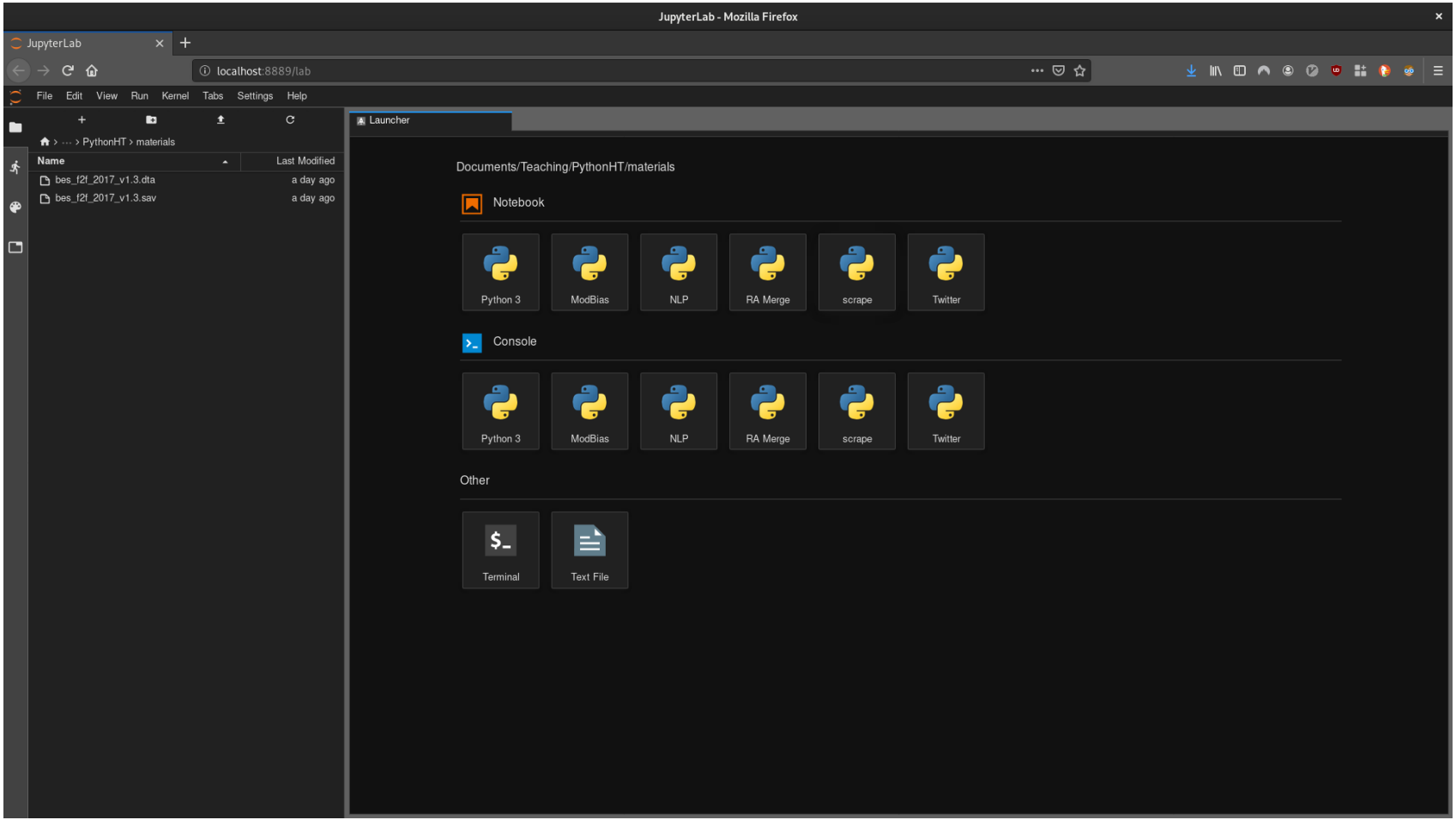


Figure 3: Jupyter Lab Launcher

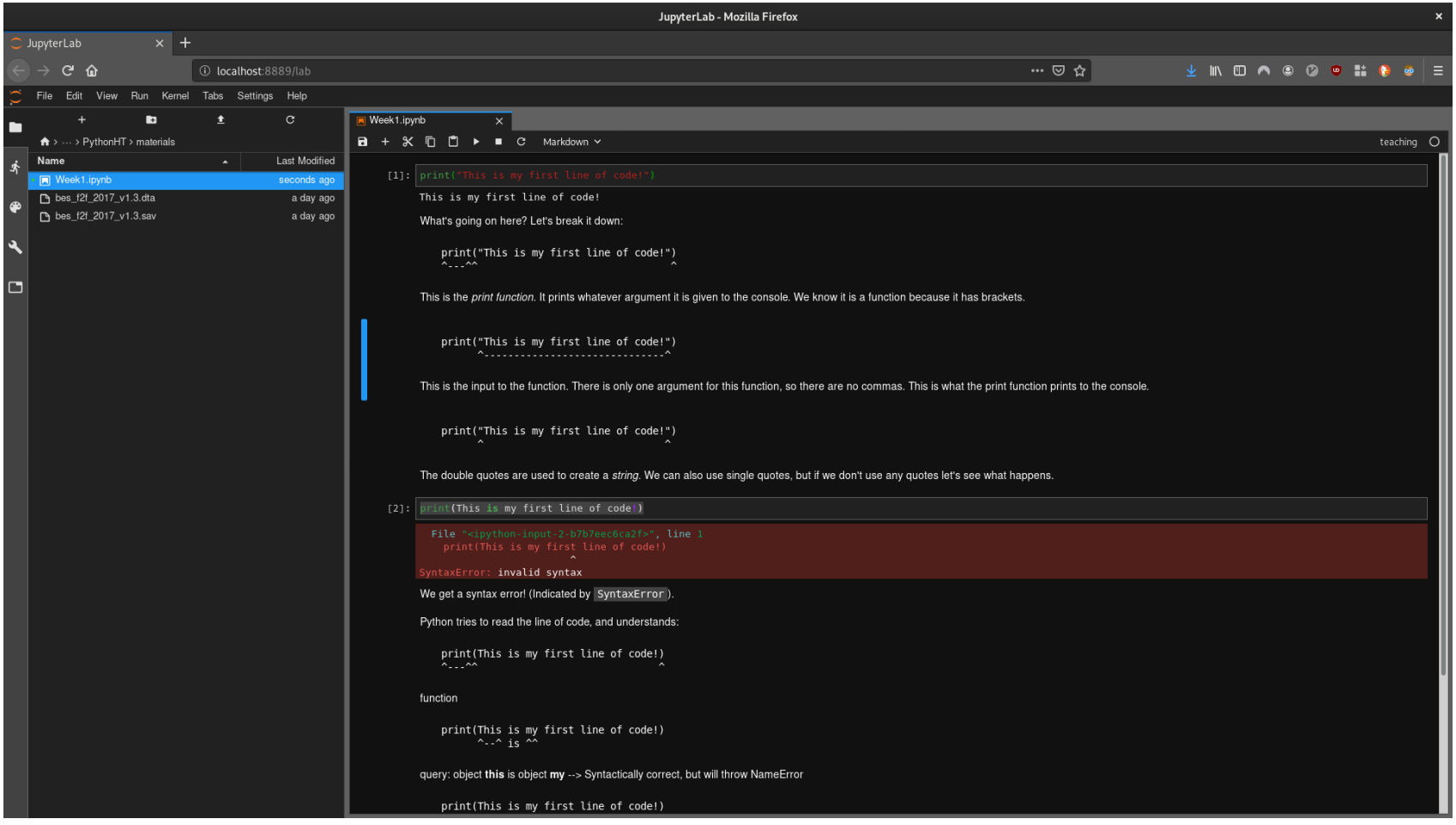


Figure 4: Jupyter Lab Editor

Launch Jupyter Lab session. Show how you can navigate a file tree, and then create a new notebook and name it.

Other Options

- I prefer to use Atom with Hydrogen
- PyCharm is popular with developers
- If you've spent a lot of time with RStudio, you may prefer Spyder.

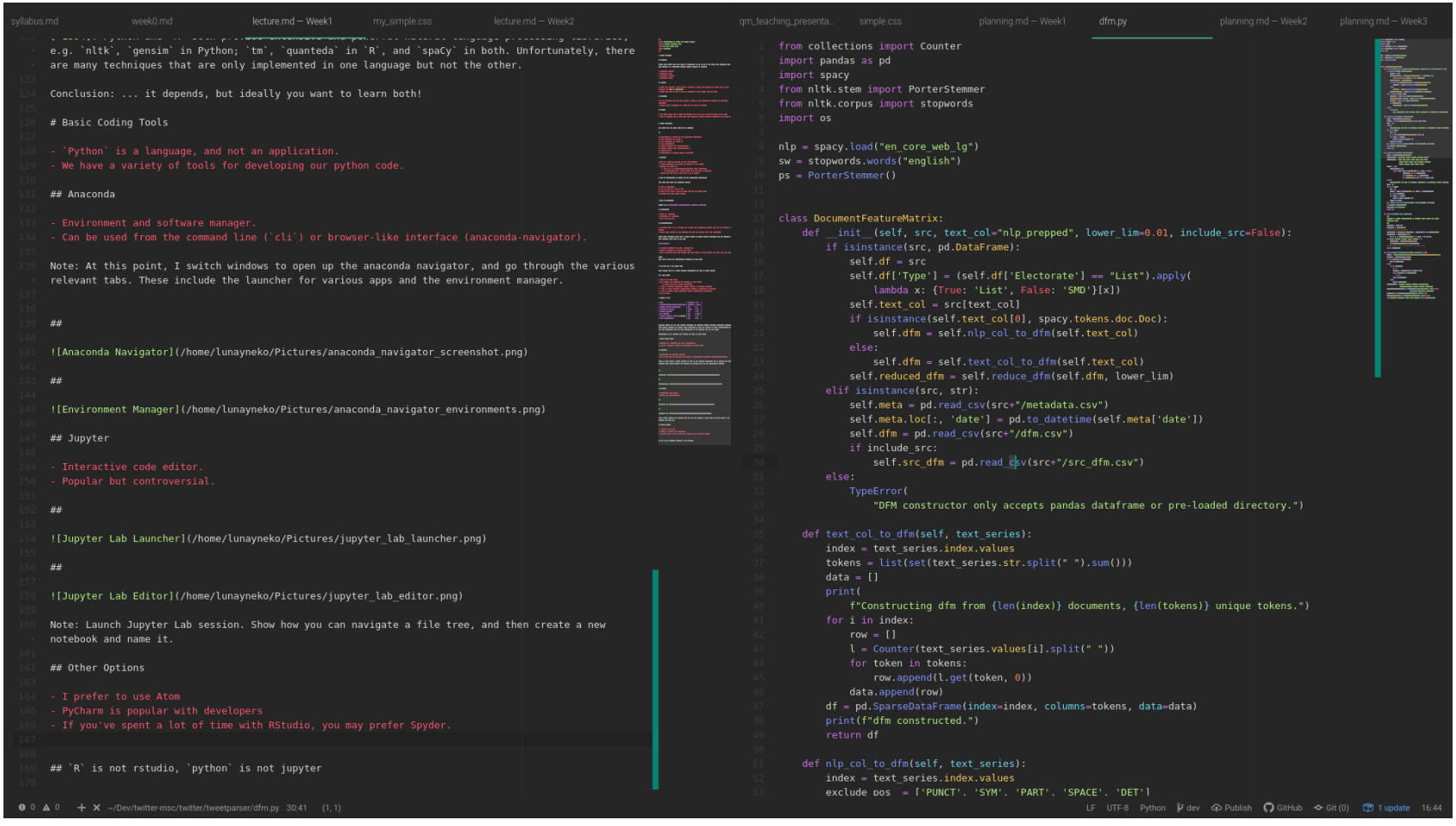


Figure 5: Atom

Basic Workflow

Motivation for Today's Coding Lesson

Why Automate?

- In general, as social scientists using computational methods, our goal is to automate some component of our analysis.
- The advantage of automation is cost, scale, and scope.
- But in order to harness these methods, we need to structure our information in a way that algorithms and programs can utilise.
  - This process of quantifying and structuring our observations usually entails the loss of some information.
- Some qualitative scholars I speak to contend that the validity of the quantitative endeavour ends there.
  - Are there unquantifiable things?
- I'm more optimistic about what is possible, and think that the key to having valid quantitative inferences is to be extremely clear on the connection between the data in your analysis and the actual events you are measuring.

Bridging the Gap between Qualitative and Quantitative Methods

- Choosing a representation of your information that retains relevant properties is key.
- To read more about this particular debate, a good starting point is Stevens (1946).
- I would love to discuss this further, but this isn't really that kind of methods class.

Data Types

Some (statistical) data types:

- Numerical
  - Interval
  - Ratio
  - Count
- Text
- Date and time
- Logical
- Categorical

(*Before points*) - What do I mean when I talk about different "types" of data? - Small exercise: what are instances of each of these?

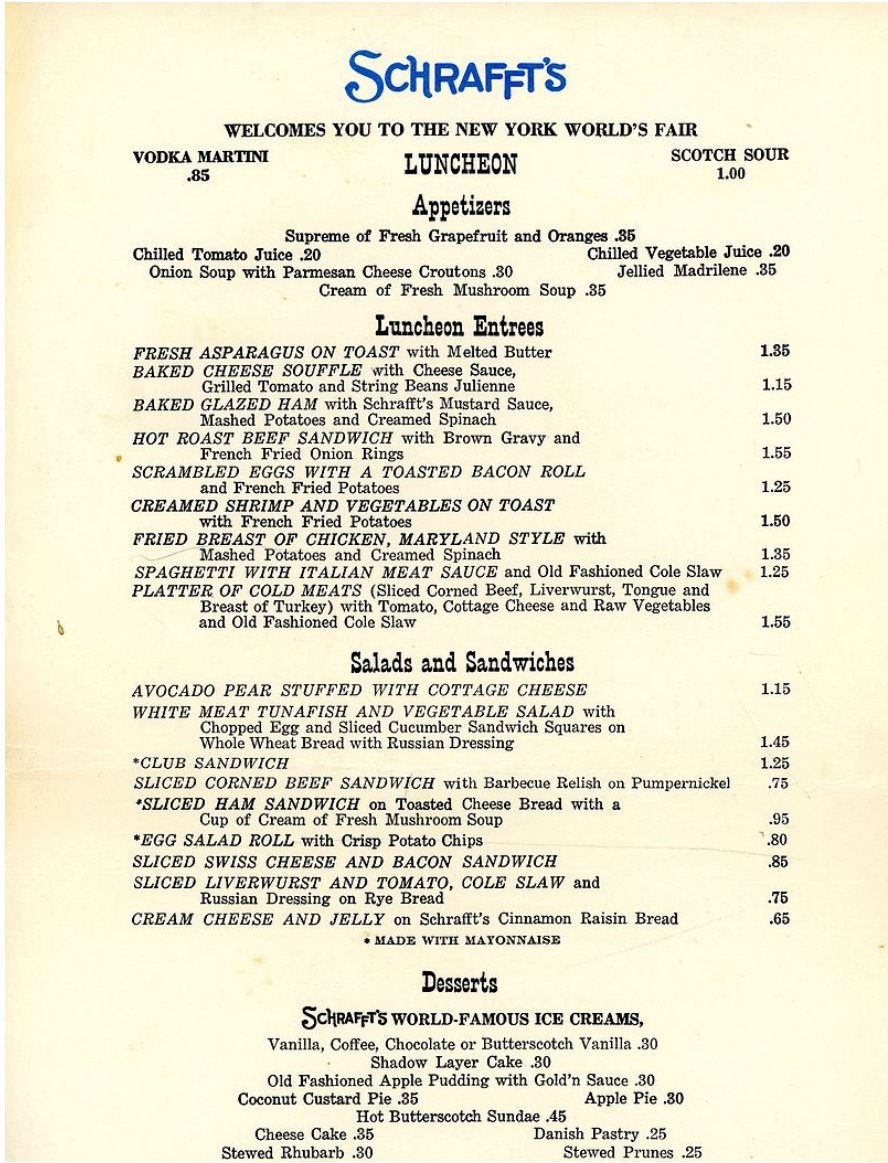
Representing Data on a Computer

- *Good news:*
  - Python, like most modern programming languages, has ways to represent each of the data types listed above.
- *Bad news:*
  - At a fundamental level, this is being stored as 0's and 1's.
- *Take away:*
  - Take the time to understand the relationship between:
    - your empirical observations,
    - the abstracted representation of them in your mathematical model,
    - the approximation of this in your computational model.
- I'm making a bit of an assumption here about the theory-generating workflow, in that a stylised mathematical model is usually prior to a computational/empirical approach.

Data Structures

- Data types are concerned with the representation of individual data points, or observations.
- Data structures are concerned with the relations between observations.
  - Are the data points members of the same set?
  - Are the data points members of the same sequence?
  - Are the data points different features of single empirical unit?

Exercise



SCHRAFFT'S

WELCOMES YOU TO THE NEW YORK WORLD'S FAIR

VODKA MARTINI .85 — SCOTCH SOUR 1.00

LUNCHEON

Appetizers

Supreme of Fresh Grapefruit and Oranges .35

Chilled Tomato Juice .20 — Chilled Vegetable Juice .20

Onion Soup with Parmesan Cheese Croutons .30 — Jellied Madrilene .35

Cream of Fresh Mushroom Soup .35

Luncheon Entrees

FRESH ASPARAGUS ON TOAST with Melted Butter	1.35
BAKED CHEESE SOUFFLE with Cheese Sauce, Grilled Tomato and String Beans Julienne	1.15
BAKED GLAZED HAM with Schrafft's Mustard Sauce, Mashed Potatoes and Creamed Spinach	1.50
HOT ROAST BEEF SANDWICH with Brown Gravy and French Fried Onion Rings	1.55
SCRAMBLED EGGS WITH A TOASTED BACON ROLL and French Fried Potatoes	1.25
CREAMED SHRIMP AND VEGETABLES ON TOAST with French Fried Potatoes	1.50
FRIED BREAST OF CHICKEN, MARYLAND STYLE with Mashed Potatoes and Creamed Spinach	1.35
SPAGHETTI WITH ITALIAN MEAT SAUCE and Old Fashioned Cole Slaw	1.25
PLATTER OF COLD MEATS (Sliced Corned Beef, Liverwurst, Tongue and Breast of Turkey) with Tomato, Cottage Cheese and Raw Vegetables and Old Fashioned Cole Slaw	1.55

Salads and Sandwiches

AVOCADO PEAR STUFFED WITH COTTAGE CHEESE	1.15
WHITE MEAT TUNAFISH AND VEGETABLE SALAD with Chopped Egg and Sliced Cucumber Sandwich Squares on Whole Wheat Bread with Russian Dressing	1.45
**CLUB SANDWICH*	1.25
SLICED CORNED BEEF SANDWICH with Barbecue Relish on Pumpernickel	.75
**SLICED HAM SANDWICH* on Toasted Cheese Bread with a Cup of Cream of Fresh Mushroom Soup	.95
**EGG SALAD ROLL* with Crisp Potato Chips	.80
SLICED SWISS CHEESE AND BACON SANDWICH	.85
SLICED LIVERWURST AND TOMATO, COLE SLAW and Russian Dressing on Rye Bread	.75
CREAM CHEESE AND JELLY on Schrafft's Cinnamon Raisin Bread	.65

* MADE WITH MAYONNAISE

Desserts

SCHRAFFT'S WORLD-FAMOUS ICE CREAMS,

Vanilla, Coffee, Chocolate or Butterscotch Vanilla .30

Shadow Layer Cake .30

Old Fashioned Apple Pudding with Gold'n Sauce .30

Coconut Custard Pie .35 — Apple Pie .30

Hot Butterscotch Sundae .45

Cheese Cake .35 — Danish Pastry .25

Stewed Rhubarb .30 — Stewed Prunes .25

Figure 6: Menu

- Question to discuss with partner, how would you represent this

And now. . .

Let's get to coding!

Coding Recap

Variable Assignment

Variables can be assigned with =.

Four Basic Data Types

There are four basic data types in Python. These are:

- String
- Integer
- Float
- Boolean

String

- *A sequence of characters*.
- Behaves like a sequence; can be indexed with `[index]`

Integer

- Whole numbers.
- Can be positive or negative.

Float

- Decimal numbers.
- Behave unexpectedly. Remember: `0.1*3==0.3` returns `False`.

Boolean

- True/False
- Behaves similarly to integers 0 and 1.

Two basic data structures

We learned about two basic data structures:

- Lists
- Dictionaries

Lists

- Lists are an ordered sequence of values.
- Created by writing a sequence of comma-separated values between square brackets:
  - i.e. `[1, 2, 5, "some string"]`
- Lists are mutable; values can be changed in place without creating a new variable.
- Lists can be indexed the same way as strings:
  - `[n]` to get the n+1th element.
  - `[m:n]` to get all elements from m+1 to n.

Dictionaries

- Unordered mapping of *keys* to *values*.
  - Cannot be indexed numerically, and if iterated over, will not return values in the same order.
- Created by writing a list of `key:value` pairs separated by commas between curly braces.
  - i.e. `{"cat": "meow", "dog": "bork"}`
- `some_dict[some_key]` returns the corresponding value for `some_key` in `some_dict`
- To see all of the keys, use the `.keys()` method of the dict, i.e. `some_dict.keys()`
- To see all of the values, use the `.values()` method of the dict, i.e. `some_dict.values()`

Next Week: Data Structures and `pandas` I