Pandas Recipes for New Python Users

SHARCNET: General Interest Webinar

Tyler Collins
HPC Analyst, Brock University

Outline: Today's Aim

- Introduce Pandas
- Explain motivation
- Live demo
- Recap
- Question period

Hopefully at the end of this talk, you will use Pandas in your own projects!

This webinar and its materials can be found on GitHub, here:
https://github.com/Andesha/sharcnet-pandas

Some Python Commentary

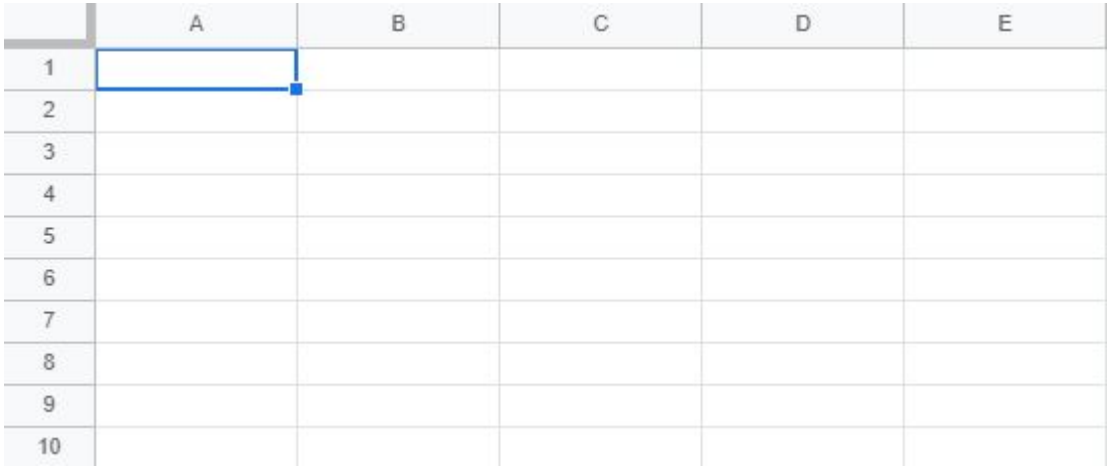
- Python sure is awesome - but awesome isn't free!
- Even other languages have this narrative:
  - "There are no zero cost abstractions!" - Chandler Carruth, 2019
- "Each abstraction must provide more benefit than cost"
  - From the same talk as above
- What about when you need **advanced** data structure processing?
  - You suffer presumably…

What is Pandas?

- **Pandas is a fast, powerful, flexible and easy to use open source data analysis and manipulation tool, built on top of the Python programming language**
- Intelligent label-based slicing, fancy indexing, and subsetting of large data sets
- Time series-functionality: date range generation and frequency conversion, moving window statistics, date shifting and lagging. Even create domain-specific time offsets and join time series without losing data

With the support of:

What is Pandas?



What is Pandas?

	A	B	C	D	E	F	G	H	I	J
1	mpg	cylinders	displacement	horsepower	weight	acceleration	model_year	origin	name	
2	18	8	307	130	3504	12	70	1	chevrolet chevelle malibu	
3	15	8	350	165	3693	11.5	70	1	buick skylark 320	
4	18	8	318	150	3436	11	70	1	plymouth satellite	
5	16	8	304	150	3433	12	70	1	amc rebel sst	
6	17	8	302	140	3449	10.5	70	1	ford torino	
7	15	8	429	198	4341	10	70	1	ford galaxie 500	
8	14	8	454	220	4354	9	70	1	chevrolet impala	
9	14	8	440	215	4312	8.5	70	1	plymouth fury iii	
10	14	8	455	225	4425	10	70	1	pontiac catalina	
11	15	8	390	190	3850	8.5	70	1	amc ambassador dpl	
12	15	8	383	170	3563	10	70	1	dodge challenger se	
13	14	8	340	160	3609	8	70	1	plymouth 'cuda 340	
14	15	8	400	150	3761	9.5	70	1	chevrolet monte carlo	
15	14	8	455	225	3086	10	70	1	buick estate wagon (sw)	
16	24	4	113	95	2372	15	70	3	toyota corona mark ii	
17	22	6	198	95	2833	15.5	70	1	plymouth duster	
18	18	6	199	97	2774	15.5	70	1	amc hornet	
19	21	6	200	85	2587	16	70	1	ford maverick	
20	27	4	97	88	2130	14.5	70	3	datsun pl510	

What is Pandas?

What if I want to do **ALL** of the following tasks:

- Create a new column based on ratio of two columns
- Make sure there are no NaN values in the data
- Convert *origin* to a string instead of an “enum”
- Slice the data such that you get a view of all ford cars made after 1975 when their horsepower is less than the original average
- Based on some list of pairs containing *name* as it appears in the dataset, overwrite *origin* with the full origin date of the car

What is Pandas?

If you're anything like me in the past you would:

- Export to CSV
- Write a quick Python script to ingest the data
- Treat everything as a list, and do the various conditional mappings
- Write it back to CSV
- Done!

What if the data was already in memory and was *massive*? Why write to a file and create dependencies?

What is Pandas?

Assume the input is a TSV, and the output must be CSV:

quick_parse.py > ...

```python
import pandas as pd

df = pd.read_csv('mpg.tsv', sep='\t')
df = df.dropna()
df['disp_div_cyl'] = df['displacement'].div(df['cylinders'])
df['origin'] = df['origin'].map({1:'NA', 2:'EU', 3:'AS'})
avg_hp = df['horsepower'].mean()
sub_df = df[(df['car_name'].str.contains('ford'))]
sub_df = sub_df[(sub_df['horsepower'] > avg_hp) & (sub_df['model_year'] > 75)]
sub_df.to_csv('sub_mpg.csv', index=False)
```

Are You Not Entertained?

- Strong and safe IO
- Flexible conditional slicing
- Intuitive mapping

How easy is it to learn and use really?

What about speed?

- Critical code paths are written in Cython or C
- Lots of academic/commercial studies to review if performance is a concern

Live Demo

- We will be working with the MPG data discussed previously
  - Quinlan,R. (1993). Combining Instance-Based and Model-Based Learning. In Proceedings on the Tenth International Conference of Machine Learning, 236-243, University of Massachusetts, Amherst. Morgan Kaufmann.
- Reference material is on GitHub here:
  - https://github.com/Andesha/sharcnet-pandas
- We will be using Jupyter lab
  - The starting notebook and a completed notebook are on GitHub

DEMO TIME - WHAT COULD GO WRONG? :)

Post Demo Discussion

- Hopefully you're convinced
- Things we did not have time to discuss but totally exist and are awesome:
  - Other forms of serialization
  - All sorts of datetime functionality
  - Grouping and aggregating data together
  - Pivoting
  - Unpivot aka melting
  - Complexity and runtime

Express your desired operation to Google and let Stack Overflow do its work!

Takeaways

- Pandas provides a very strong set of tools that can deal with a multitude of data types
- Wide amount of support on the internet including excellent API documentation
- Many other popular libraries support Pandas

Thanks very much!

tk11br@sharcnet.ca

Questions?