Moore’s Law for Apple

Data Visualization
Michael Campo

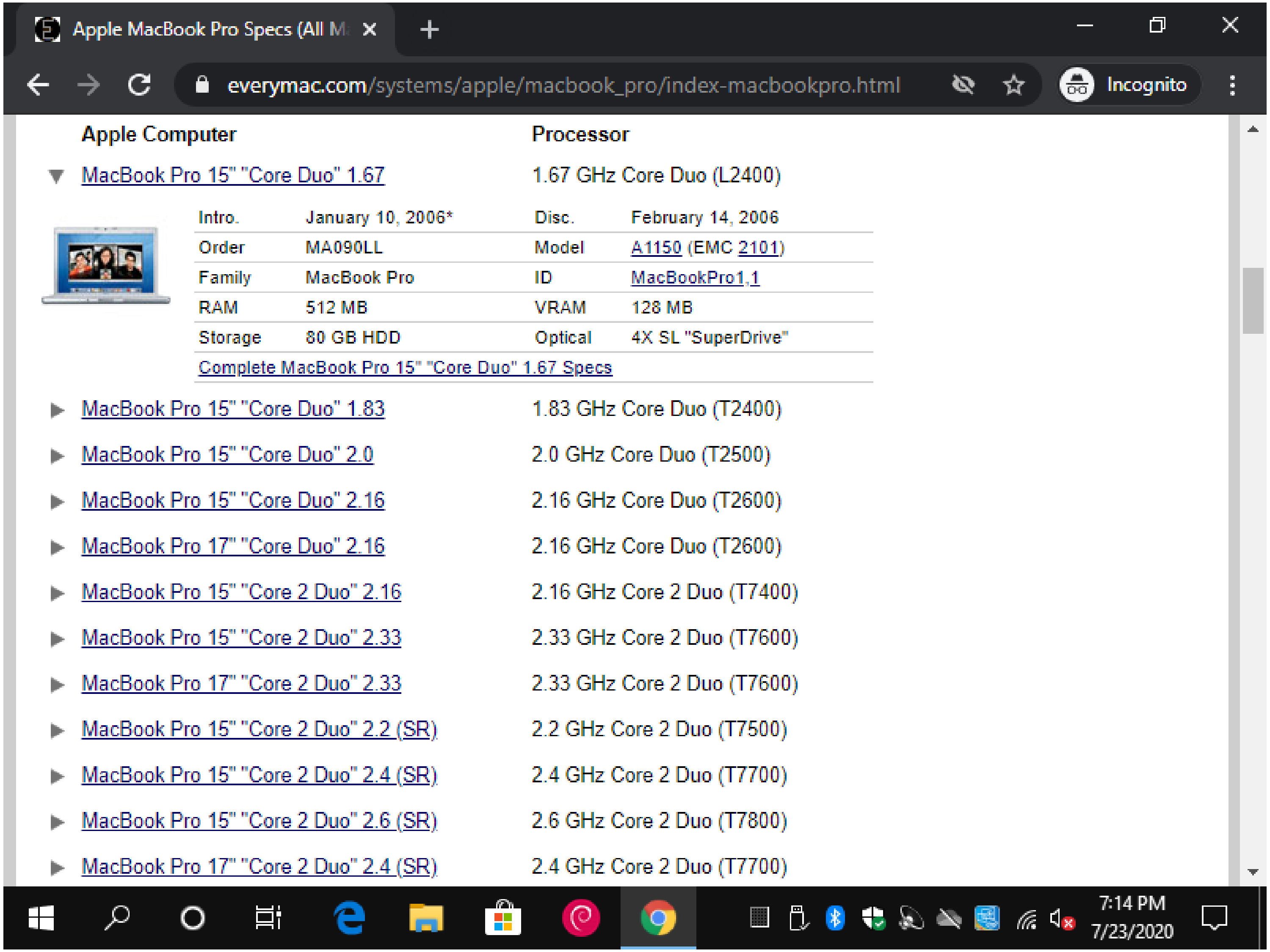
Overview

- Moore’s law is interesting
- Apple products are interesting
- Let’s combine the two
- Scrape Macbook Pro data from everymac.com
- Create a website that illustrates Moore’s law using MacBook Pros for measuring technological progress

Technologies Used

- NodeJS + request + cheerio to scrape data
- SQLite to store data
- Jupyter Notebook: Pandas + Plotly for planning
- Final visualizations using Python+Flask to deliver data and BootStrap+Plotly.js to display data

STEP 1: Data Scraping



everymac.com/systems/apple/macbook_pro/index-macbookpro.html

Apple Computer	Processor
▼ MacBook Pro 15" "Core Duo" 1.67	1.67 GHz Core Duo (L2400)

Intro.	January 10, 2006*	Disc.	February 14, 2006
Order	MA090LL	Model	A1150 (EMC 2101)
Family	MacBook Pro	ID	MacBookPro1,1
RAM	512 MB	VRAM	128 MB
Storage	80 GB HDD	Optical	4X SL "SuperDrive"

Complete MacBook Pro 15" "Core Duo" 1.67 Specs

Apple Computer	Processor
▶ MacBook Pro 15" "Core Duo" 1.83	1.83 GHz Core Duo (T2400)
▶ MacBook Pro 15" "Core Duo" 2.0	2.0 GHz Core Duo (T2500)
▶ MacBook Pro 15" "Core Duo" 2.16	2.16 GHz Core Duo (T2600)
▶ MacBook Pro 17" "Core Duo" 2.16	2.16 GHz Core Duo (T2600)
▶ MacBook Pro 15" "Core 2 Duo" 2.16	2.16 GHz Core 2 Duo (T7400)
▶ MacBook Pro 15" "Core 2 Duo" 2.33	2.33 GHz Core 2 Duo (T7600)
▶ MacBook Pro 17" "Core 2 Duo" 2.33	2.33 GHz Core 2 Duo (T7600)
▶ MacBook Pro 15" "Core 2 Duo" 2.2 (SR)	2.2 GHz Core 2 Duo (T7500)
▶ MacBook Pro 15" "Core 2 Duo" 2.4 (SR)	2.4 GHz Core 2 Duo (T7700)
▶ MacBook Pro 15" "Core 2 Duo" 2.6 (SR)	2.6 GHz Core 2 Duo (T7800)
▶ MacBook Pro 17" "Core 2 Duo" 2.4 (SR)	2.4 GHz Core 2 Duo (T7700)

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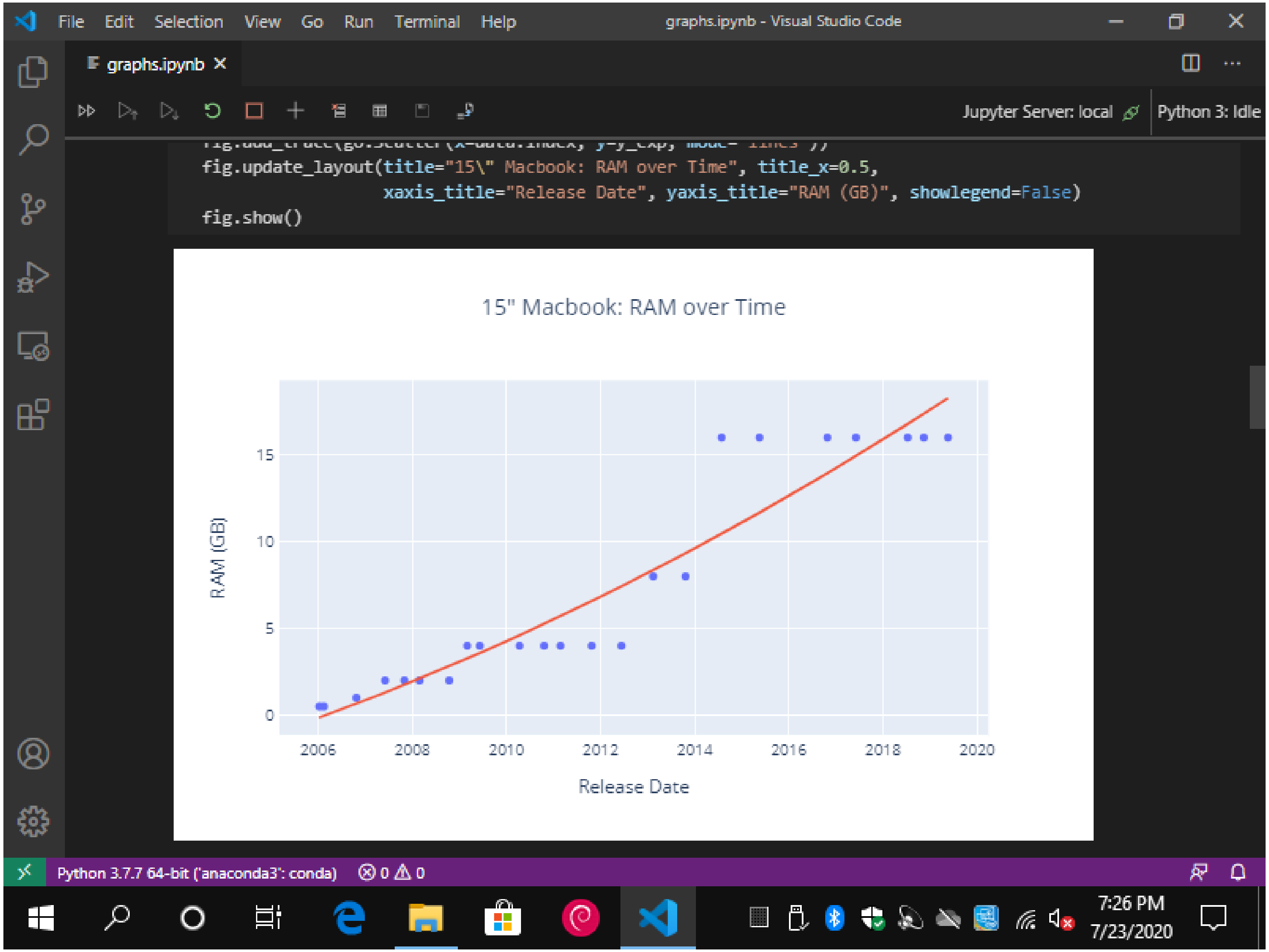
STEP 1: Data Scraping

- Data was scraped from the MacBook Pro section of everymac.com
- NodeJS was chosen for web scraping because JavaScript is the native language of the web, and it provided some new libraries to play with.
- NodeJS has a requests library similar to Python. Cheerio is like jQuery, but server side.
- After data was scraped into memory, it was then written to a SQLite database (also using NodeJS) to meet project requirements.

STEP 2: Analyze the data

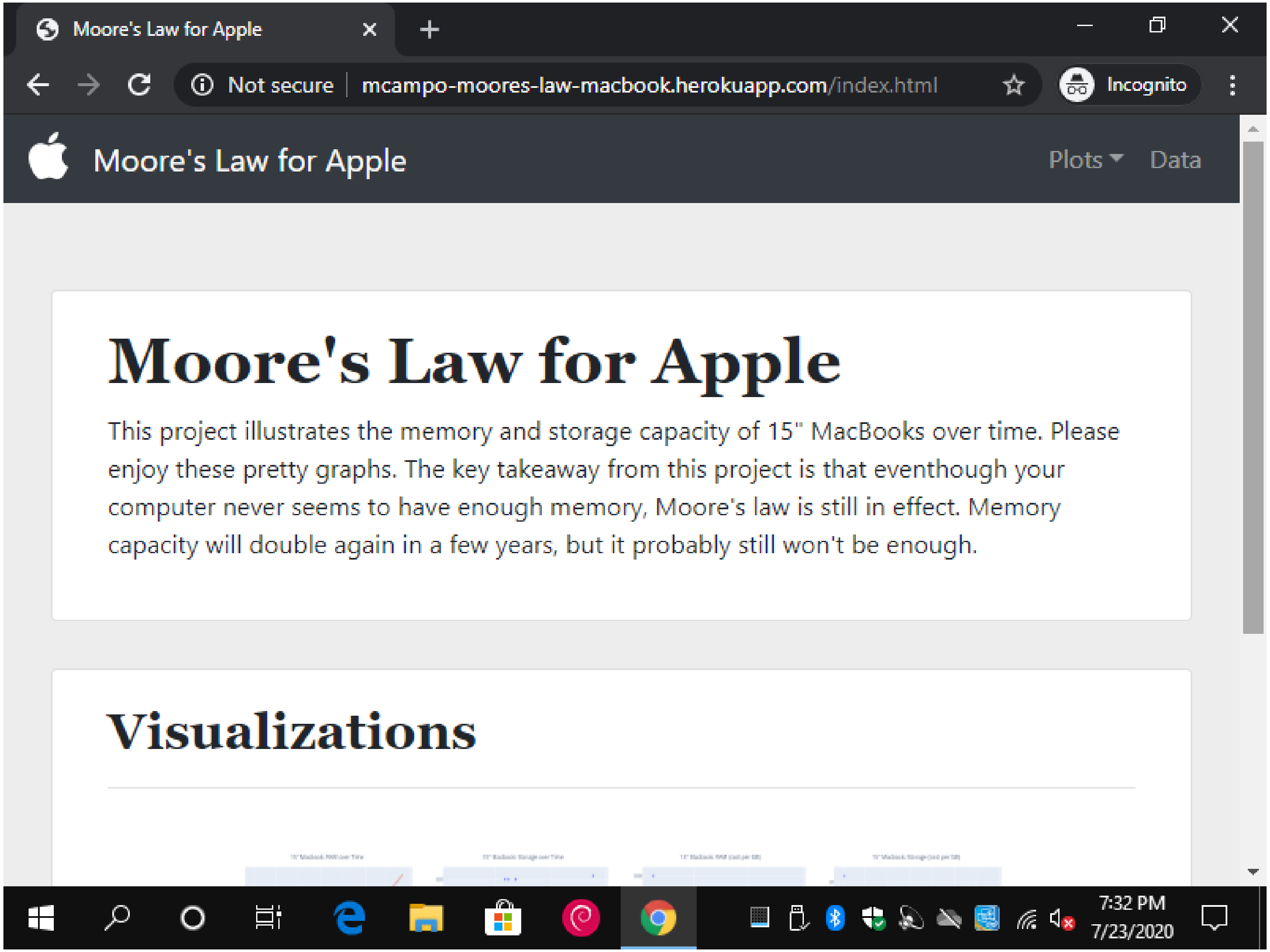


```
fig.add_trace(go.Scatter(x=data.index, y=y_exp, mode='lines'))
fig.update_layout(title="15\" Macbook: RAM over Time", title_x=0.5,
                  xaxis_title="Release Date", yaxis_title="RAM (GB)", showlegend=False)
fig.show()
```

STEP 2: Analyze the data

- From the start, I new I wanted a web dashboard with Plotly graphs. This way I could play with the data/graphs in Jupyter and apply minimal changes to the code to get it running with JavaScript
- Early on I decided to use the entry level 15” MacBook to view Moore’s Law
- I was able to create 4 time series graphs in Jupyter:
  - MacBook RAM
  - MacBook Storage
  - MacBook RAM: $USD per GB
  - MacBook Storage: $USD per GB

STEP 3: Create Website



Moore's Law for Apple

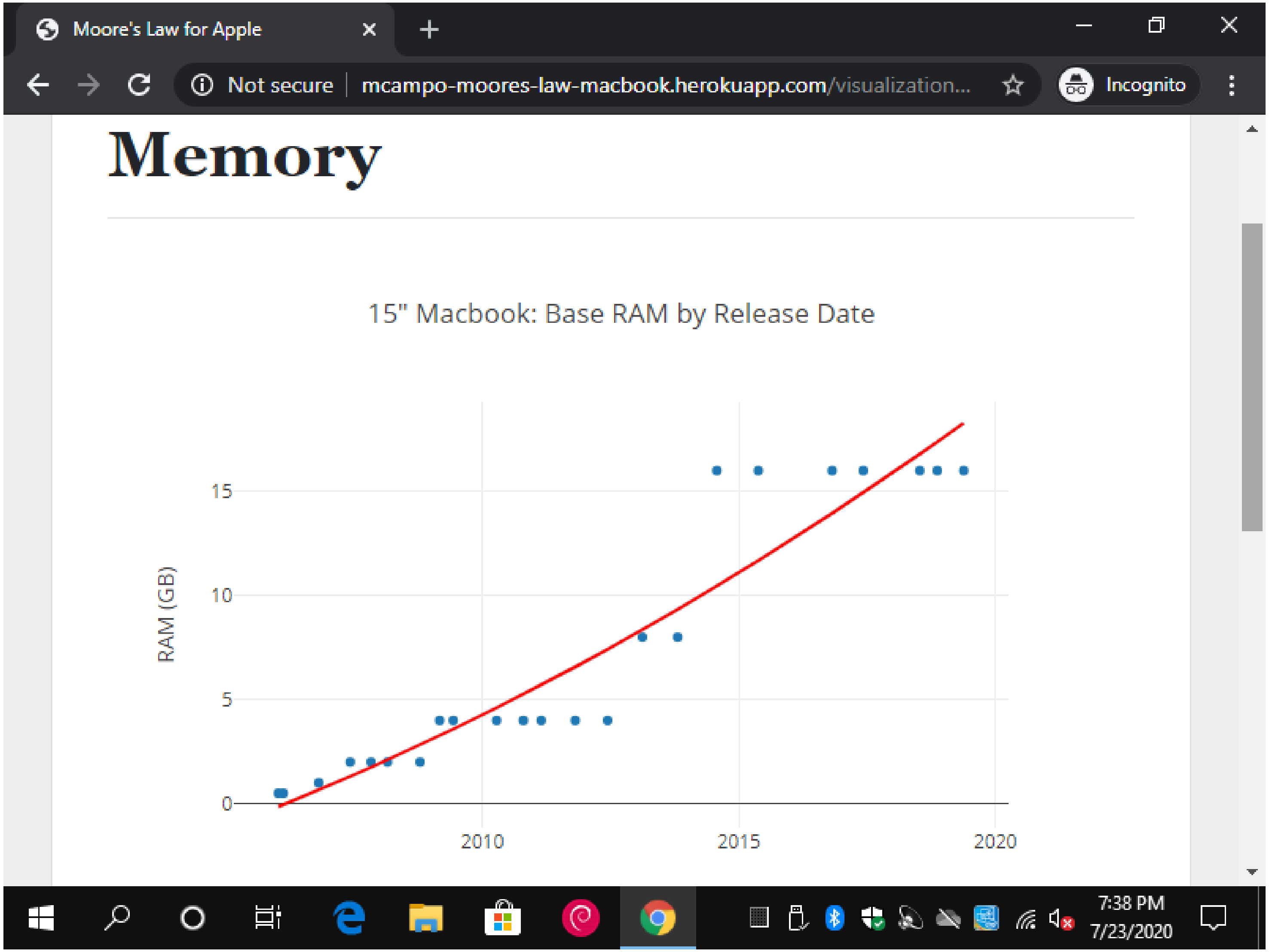
This project illustrates the memory and storage capacity of 15" MacBooks over time. Please enjoy these pretty graphs. The key takeaway from this project is that eventhough your computer never seems to have enough memory, Moore's law is still in effect. Memory capacity will double again in a few years, but it probably still won't be enough.

Visualizations

STEP 3: Create Website

- I Reused the layout from one of the previous homeworks to save time
- I exported the graphs and PNGs for the plot thumbnails
- Then I copied and pasted the code from the jupyter notebook into the a Python file, and made some minor modifications so the Flask app would serve JS files with the data I had used to build the graphs.
- https://github.com/mcampo2/moores-law-macbooks/blob/master/app.py

Screenshots



Moore's Law for Apple
Not secure
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Incognito

Memory

15" Macbook: Base RAM by Release Date
RAM (GB)
15
10
5
0
2010
2015
2020
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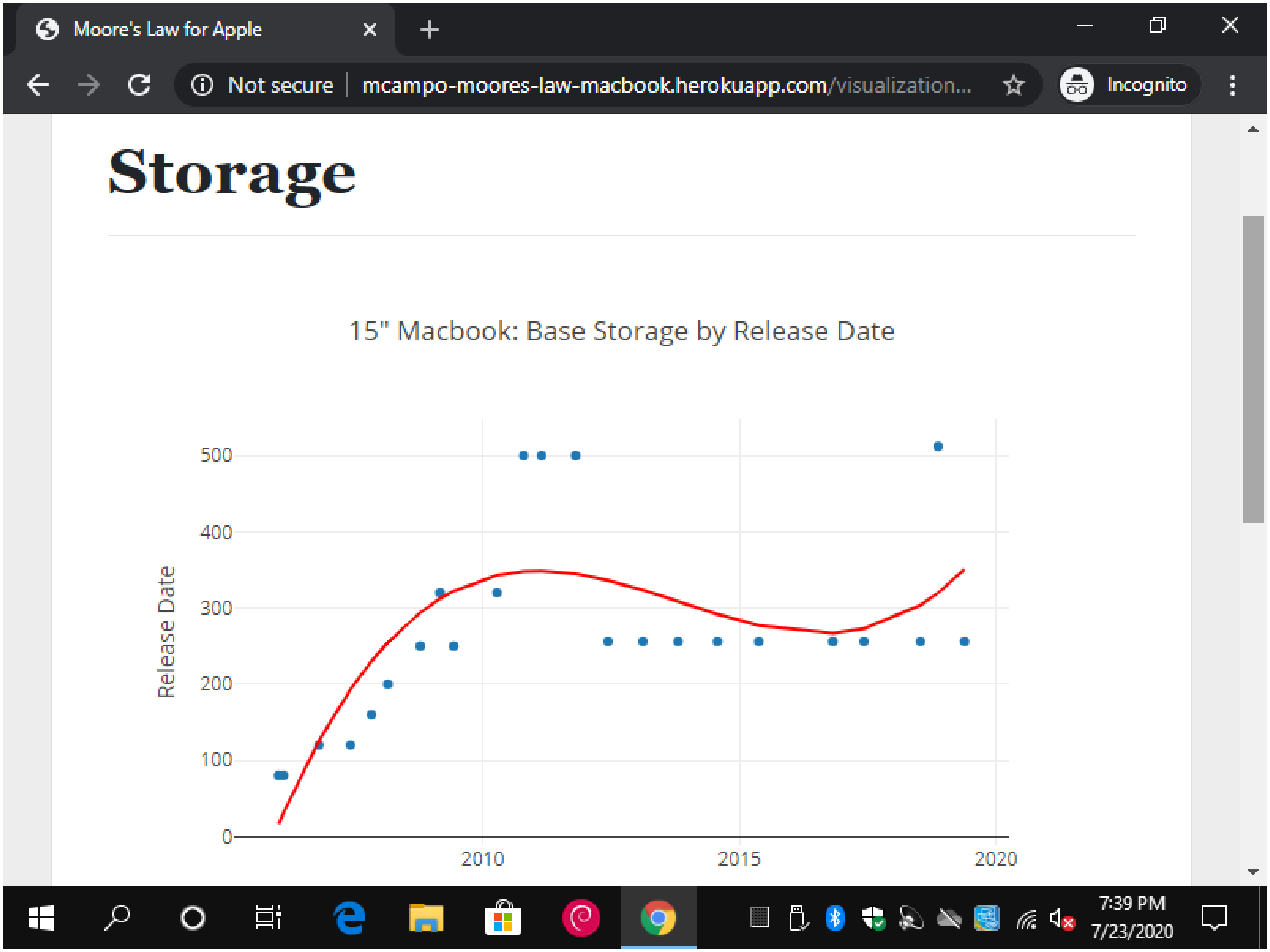
7/23/2020

Screenshots



Moore's Law for Apple
Not secure
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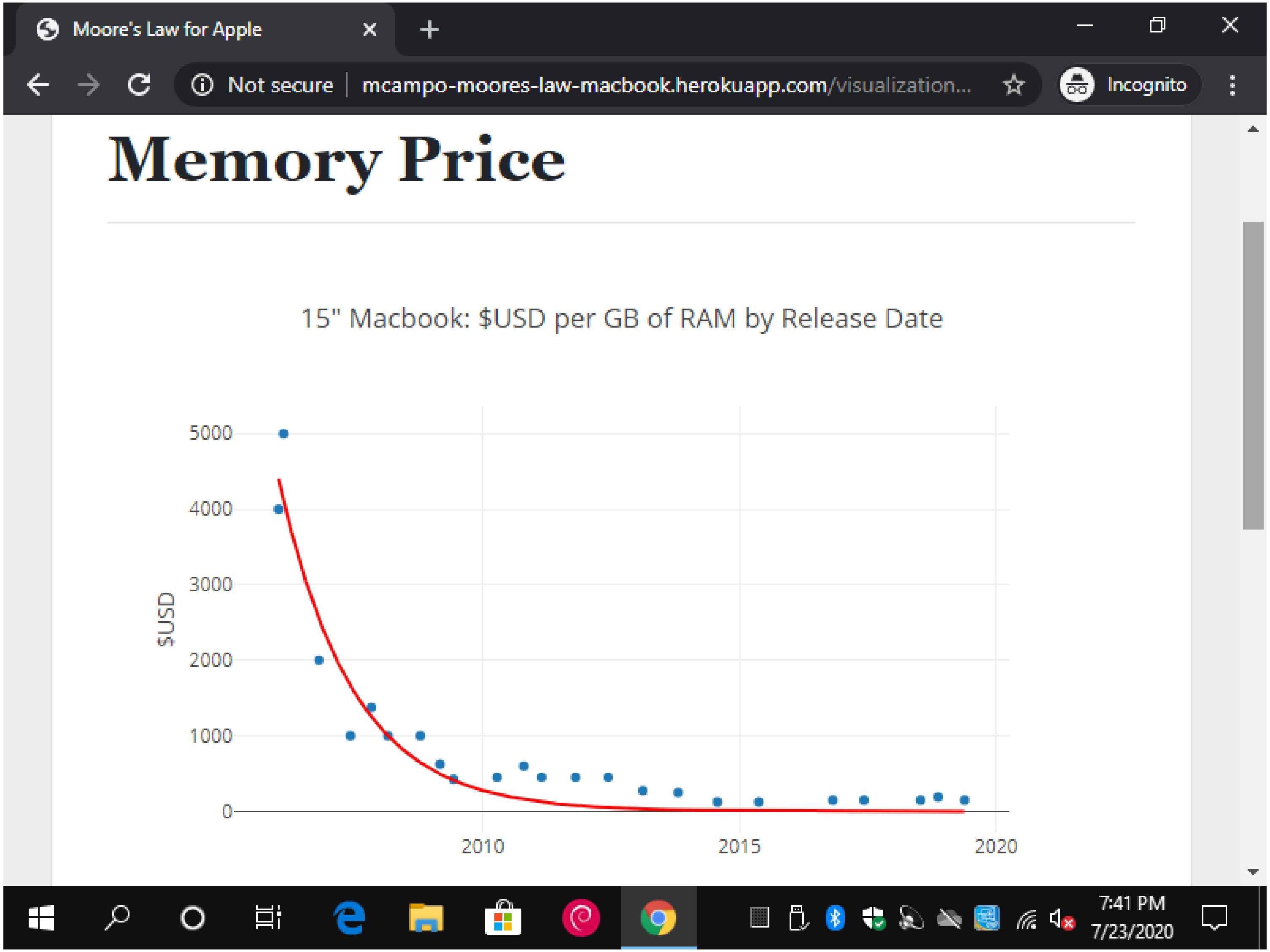
Incognito

Storage

15" Macbook: Base Storage by Release Date
Release Date
500
400
300
200
100
0
2010
2015
2020
7:39 PM
7/23/2020

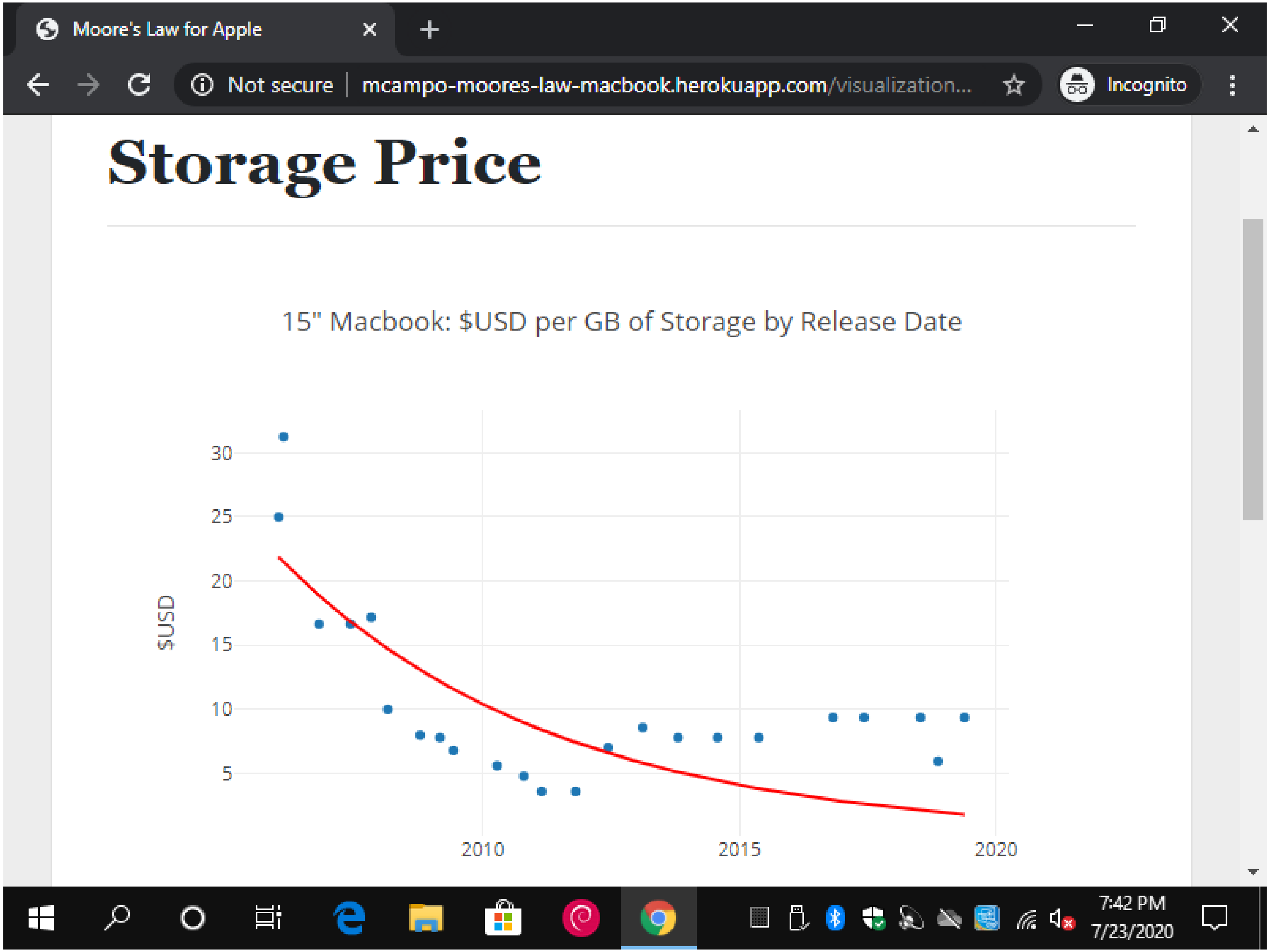
Screenshots



Memory Price

15" Macbook: $USD per GB of RAM by Release Date

Screenshots



Storage Price

15" Macbook: $USD per GB of Storage by Release Date

Website

- Website is live at:
- http://mcampo-moores-law-macbook.herokuapp.com/
- Heroku Dino make take a minute to spin up

Version 2

- There is a lot more data that could be added. iMac have been around since 1998. Also it would be interesting to see the same graphs for iPhones and iPads.
- The charts could be more polished. Specifically the hovertext could be more informative.
- I will probably build on this project as it makes a good portfolio piece.

Questions?