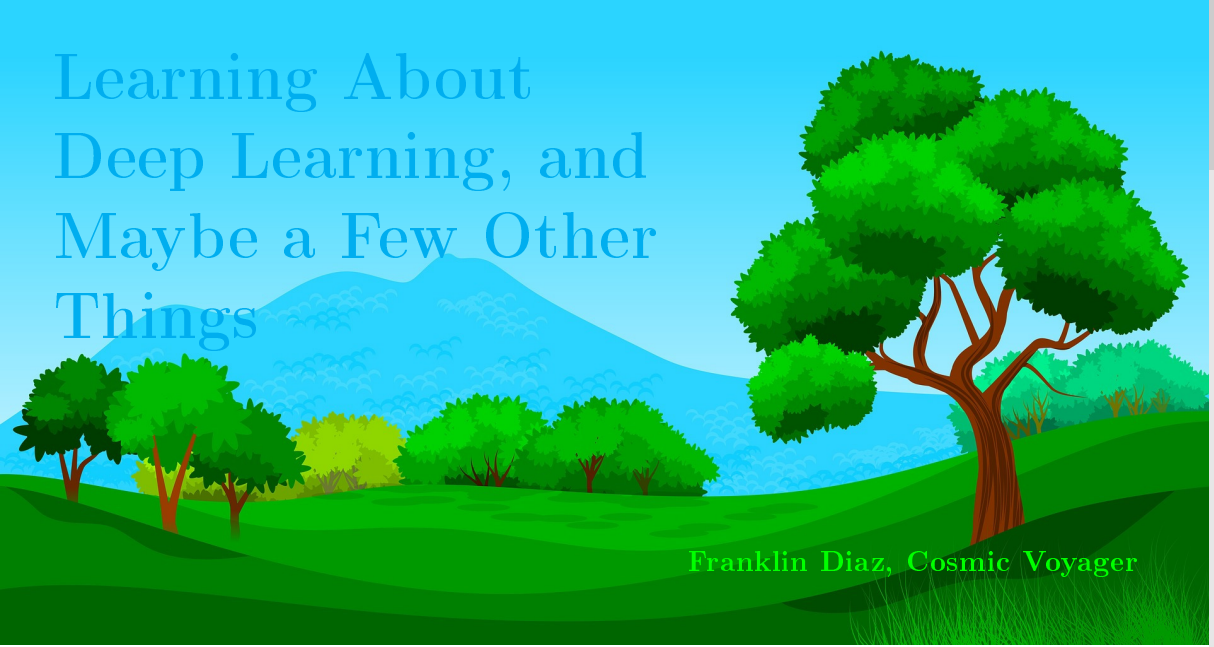
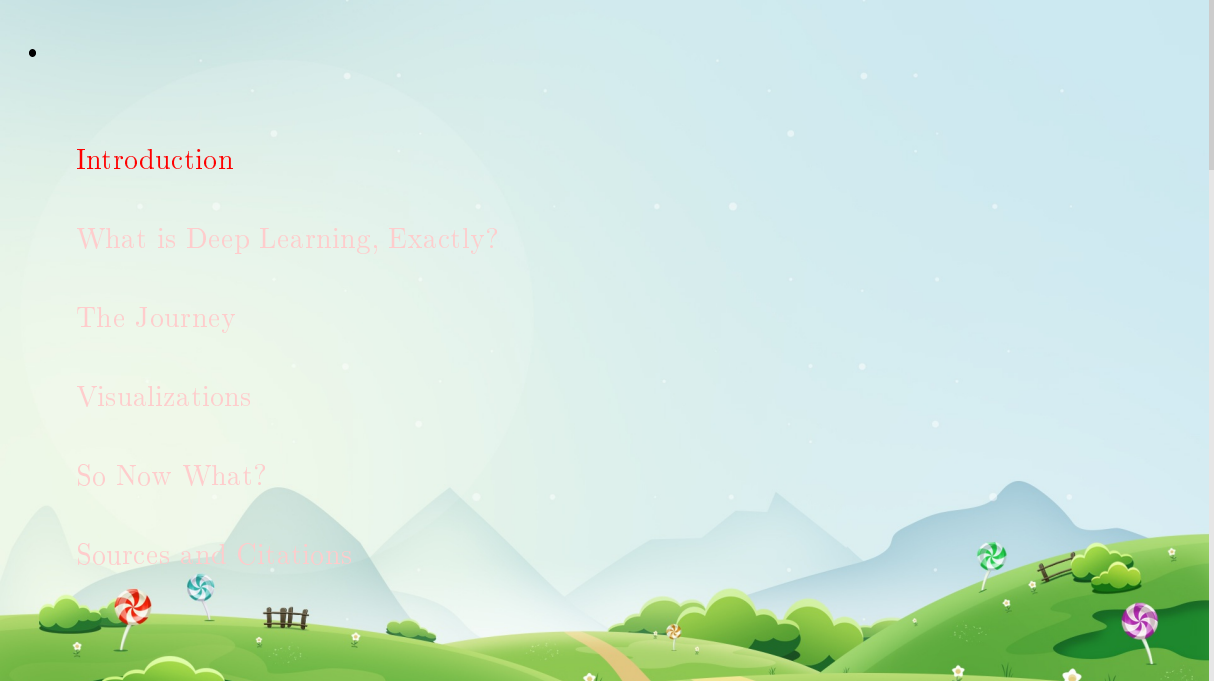
Learning About Deep Learning, and Maybe a Few Other Things



Franklin Diaz, Cosmic Voyager

2022-04-28

- My presentation title is here.
- This talk is about my on-going journey into the world of graph theory and neural networks.
- This is a description of the learning process as well as the project and presenting some results.



This first section is an Introduction to me and my project

About Me

- I am a Security Consultant at Palo Alto Networks, cloud and automation for past 2+ years
- Did Data Eng/DevSecOps at Salesforce for 5 years.
- Been going to security conferences for a while.

• I am a Security Consultant at Palo Alto Networks, cloud and automation for past 2+ years
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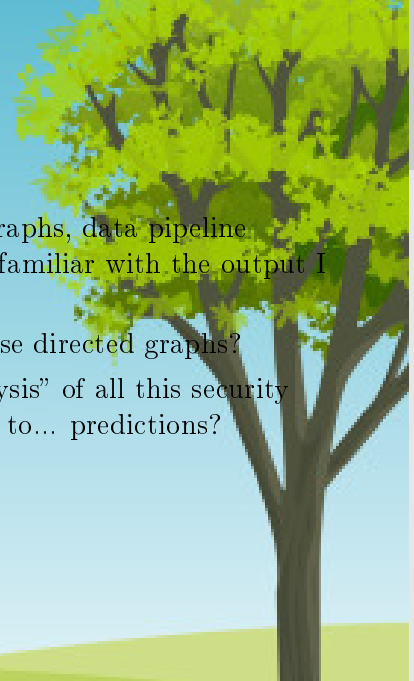
- Here is a picture of me, modified by a popular local artist.
- In my current role as a consultant, I get to work with the major cloud providers.
- In the past I was not a Data Scientist, but did some time on the Security Data Engineering team at Salesforce. This gave me a bit of a head start with data pipelines, directed acyclic graphs, and a few other things.

The Project

- Realized that Terraform can output directed graphs.
- Had done a lot of work at Salesforce with directed graphs, data pipeline orchestration with AirFlow, etc. so I was somewhat familiar with the output I was seeing.
- The first question I had was, what can I do with these directed graphs?
- My hunch was I could “do some processing and analysis” of all this security infrastructure graph data and hoped that could lead to... predictions?



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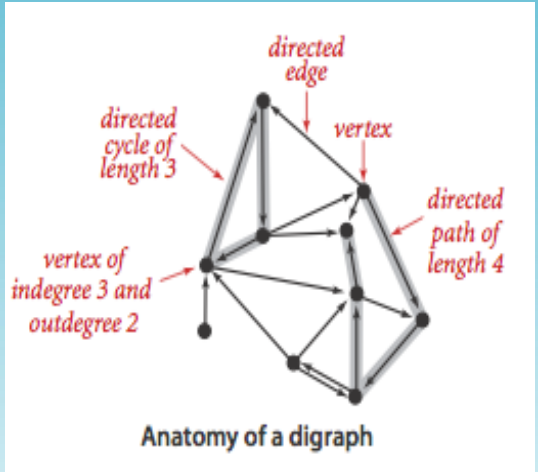
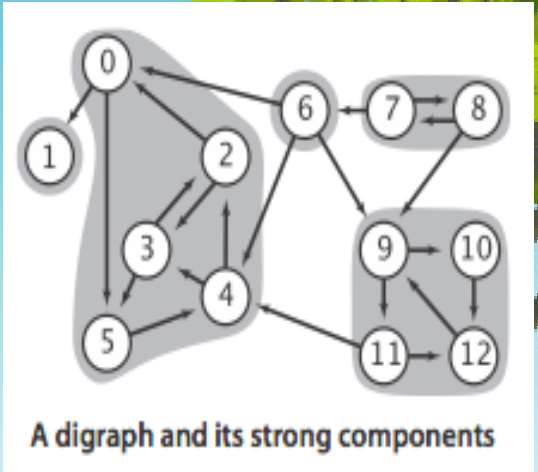
- In case you are not familiar, Terraform is software that allows you to declare resources like network elements in public cloud providers.
- Had and still have this vague notion that if I had enough data I could find “outliers”. Maybe like a modernized version of a Pareto analysis?

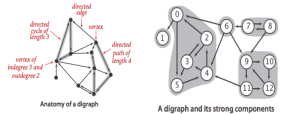
What's a DiGraph?



Anatomy of a digraph



A digraph and its strong components



- The big takeaway here is the idea of "edges" and "nodes"
- Source: Algorithms, 4th Edition, by Robert Sedgewick and Kevin Wayne
- Wrath of Math!

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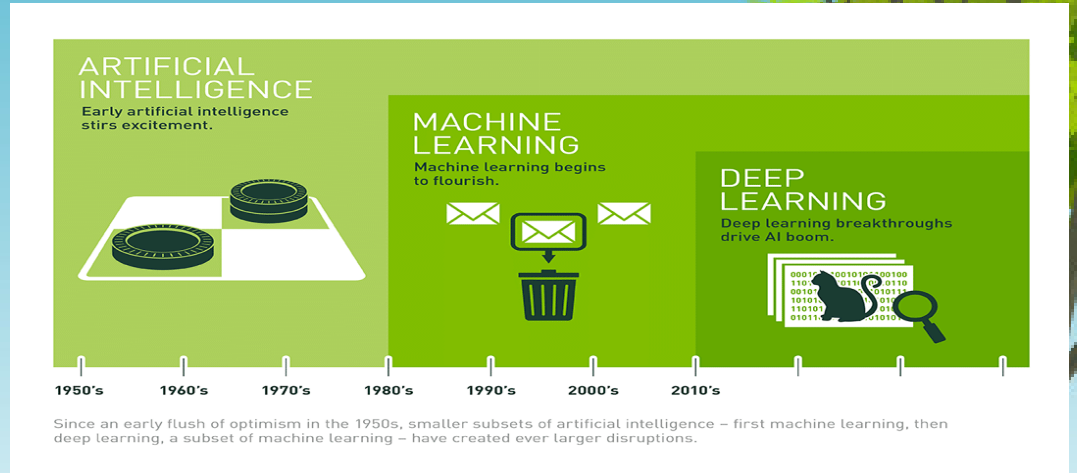
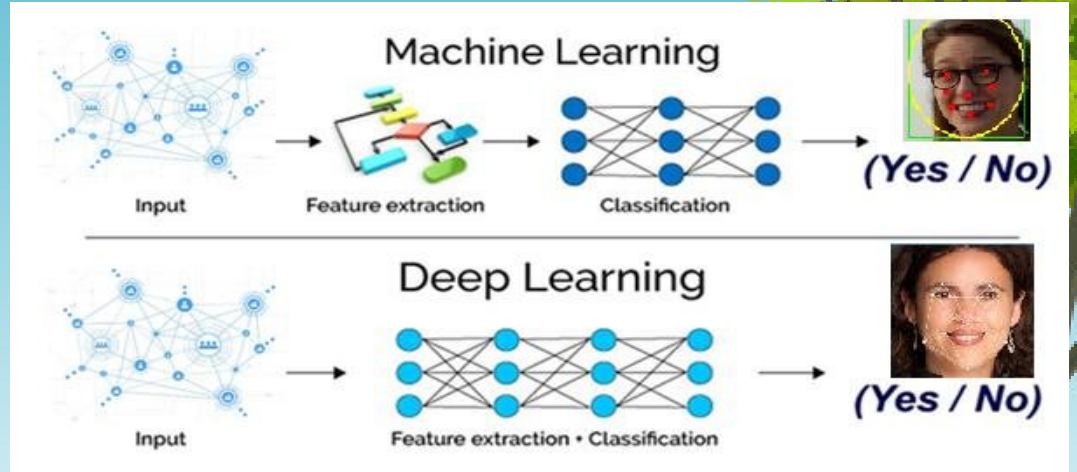
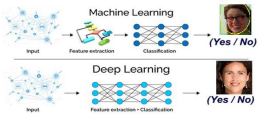
The Rise of Deep Learning



- GPUs have made it possible to expand accessibility to DL
- the CUDA toolkit from Nvidia has made things easier for researchers.

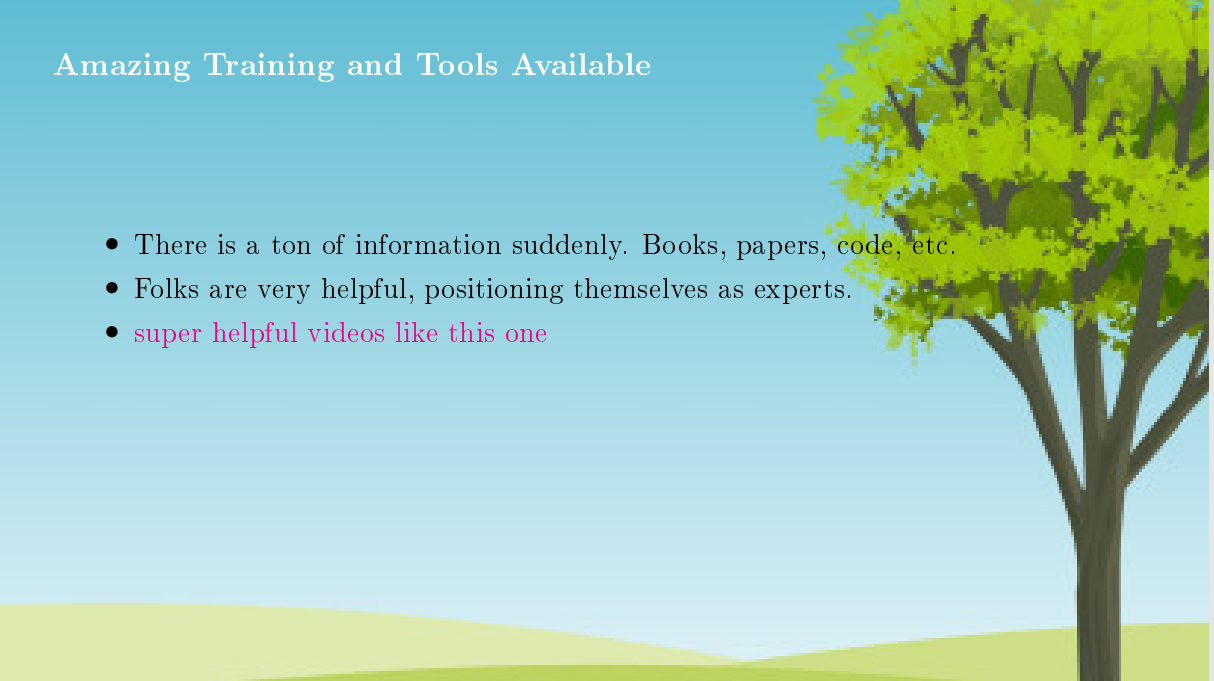
Quick Intro to a Giant Topic





- image source/credit
- ML feature extraction can be a huge undertaking, up to 80% of a project.
- DL attempts to automatically learn features that are most useful for a task from raw data.
- The nodes in a digraph are “neurons” or “units” in the DL/graph theory context.
- The neurons perform two steps. They calculate a “weighted sum” and pass the result through an “activation function” such as a rectifier activation function.
- These neurons or units that go through the rectifier function are called “RelUs” for short. Lot’s of descriptive info in this one term!
- Depth of the GNN is measured by the number of connected layers.
- DL needs very large data sets for accurate feature determination. Data sets with lots of features are known as “high density”.
- We humans interpret the features and output based on what we are trying to model.

Amazing Training and Tools Available



- There is a ton of information suddenly. Books, papers, code, etc.
- Folks are very helpful, positioning themselves as experts.
- super helpful videos like this one

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- Google Deep Learning Container Images
- Continuous Machine Learning (CML) Project
- Kaggle and shared Jupyter Notebooks

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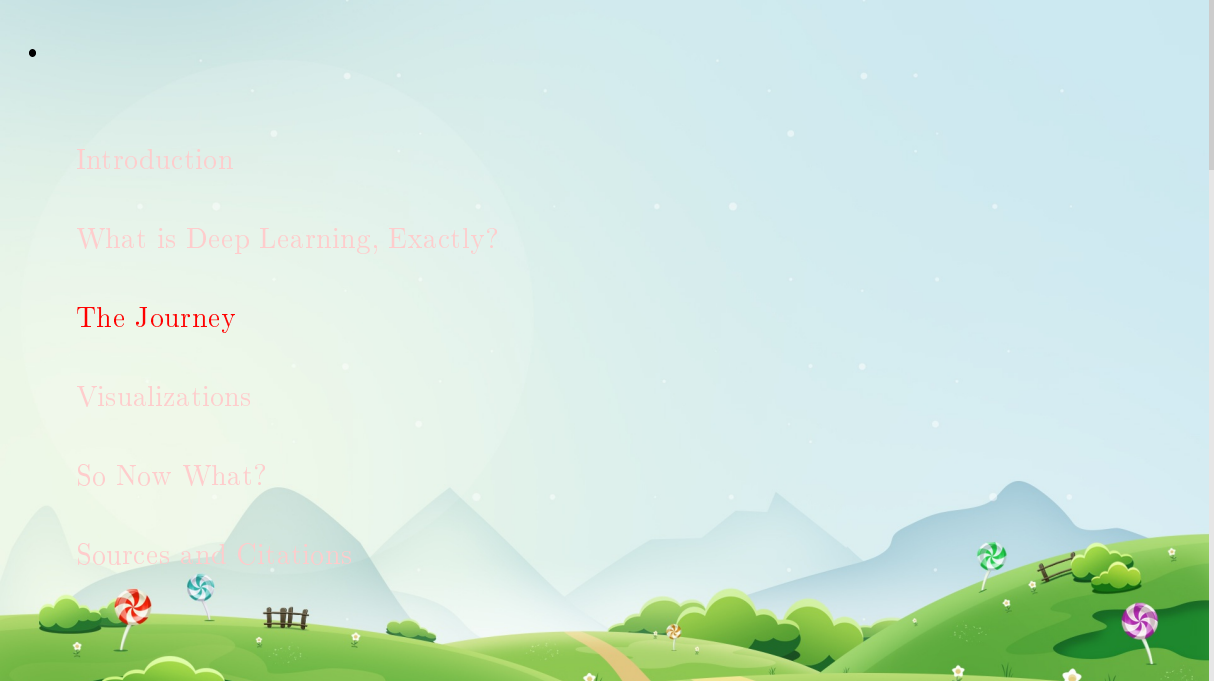
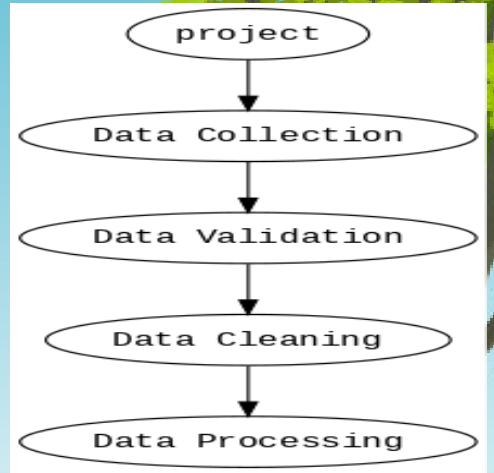


- Now I would like to talk a bit about the shape of the project.

What Have I Gotten Myself Into?

- It didn't take long before I realized the magnitutde of the ocean I was wading into.
- Started reading everything I could find even though I didn't understand most of it.
- I came up with the basic framework you see in the image here.



- It didn't take long before I realized the magnitutde of the ocean I was wading into.
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- Repetition can be a slow and painful way to learn.
- Wasn't even sure what questions to ask. Slow going at first.

Yak Shaving, Side Quests, Endless Rabbit Holes

- Makefiles and GNU Autotools
- NVIDA Jetson Nano as cluster nodes
- SLURM cluster scheduler
- OpenMPI for parallel builds
- Docker and Containers
- k8s and Rancher k3s
- Data Version Control dvc.org
- Storing/accessing data in GCP buckets
- Continuous Machine Learning cml.dev
- Internal Pypi and Debian/Raspbian mirror (used too much bandwidth on home connection)

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- Wasn't sure exactly where to drop this slide in the order.
- Trying to show that there have been a TON of side quests.
- Some of these were useful, some led to spin off projects. A lot of this is bookmarked for later when I get some "spare time" haha.

Dot Data Collection

- A big barrier to entry was removed by the ability to output a Directed Graph from Terraform.
- Click for video

```
# Generate a PNG from Terraform
terraform graph | dot -Tpng > graph.png

# Generate vector graphic from Terraform
terraform graph | dot -Tsvg -o graph.svg
```


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Generate a PNG from Terraform
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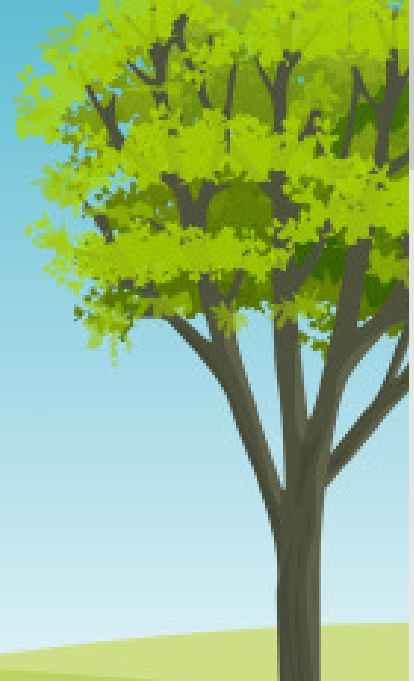
Generate vector graphic from Terraform
terraform graph | dot -Tsvg -o graph.svg

- Was pretty happy I could generate a PNG file. Super easy!
- Then I opened up the file and took a look at the nodes in the graph....

Python Data Collection

This became the basis for collection via Python.
Click for video



This became the basis for collection via Python.
Click for video

Data Processing

github.com/devsecfranklin/model-html/pull/7

Open **testing** #7

devsecfranklin wants to merge 3 commits into `main` from `devs-20211118`

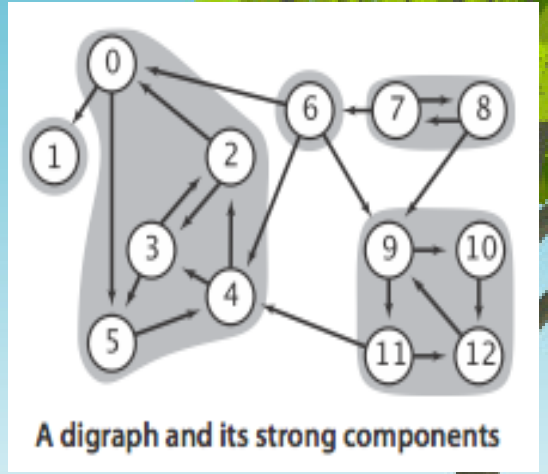
github-actions bot commented on `39f7988` on Nov 19, 2021 — Tip

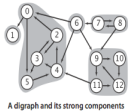
```
Creating data diretory.
Downloading the dataset.
Count: ip 10285
transport 10285
port 10285
server 10285
dtype: int64

Data sample:
+---+--------------+-----------+------+--------------------------------------------------------------------------------+
|   | ip           | transport | port | server                                                                         |
+---+--------------+-----------+------+--------------------------------------------------------------------------------+
| 0 | 160.153.63.6 | tcp       | 443  | ['Apache']                                                                     |
| 1 | 35.197.16.105| tcp       | 80   | ['Apache']                                                                     |
| 2 | 199.19.210.59| tcp       | 443  | ['Apache/2.4.10', '(Unix)', 'OpenSSL/1.0.1f']                                  |
| 3 | 12.130.77.39 | tcp       | 443  | ['Apache']                                                                     |
| 4 | 129.121.5.237| tcp       | 443  | ['Apache']                                                                     |
+---+--------------+-----------+------+--------------------------------------------------------------------------------+
```

generating graph object in networkx — Verified — d14cde9

github-actions bot commented on `d14cde9` on Nov 19, 2021 — Tip

```
Creating data diretory.
Downloading the dataset.
Count: ip 10285
```

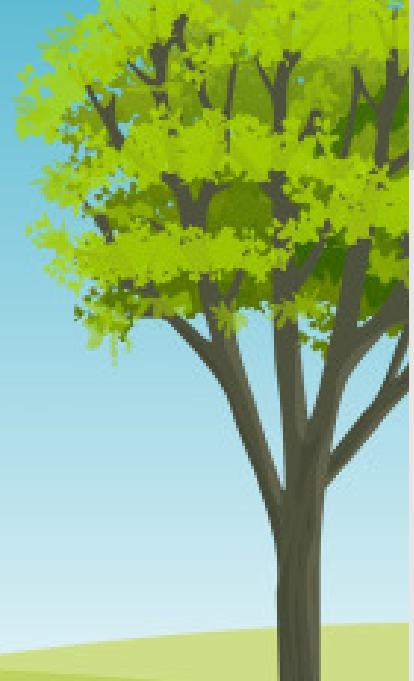




Data Collection Container

Data Storage - Google Cloud

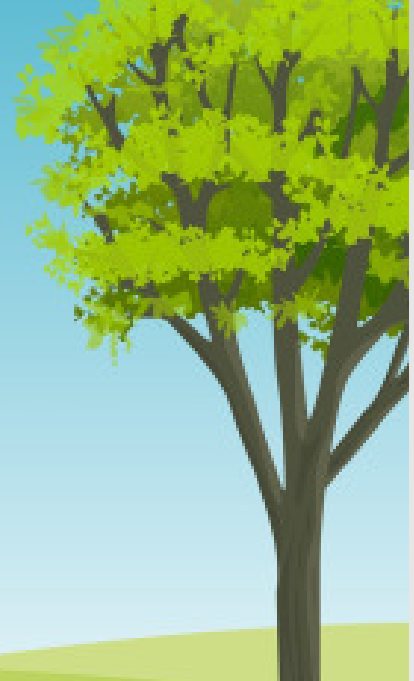
Data storage with GCP because it's (relatively) easy.



Data storage with GCP because it's (relatively) easy.

Data Storage - Kaggle

Data storage and tagging using DVC



Data storage and tagging using DVC

Data Storage - DVC

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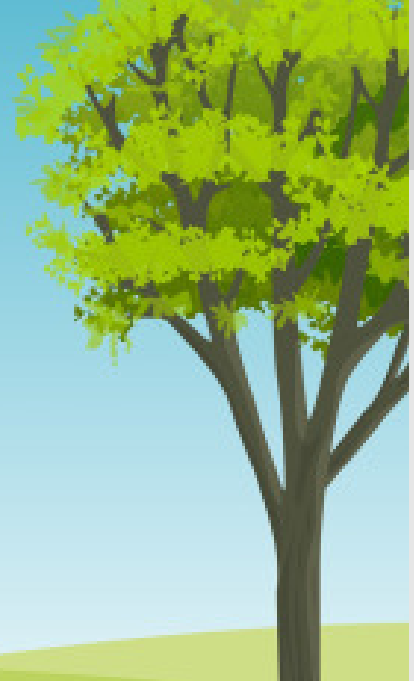
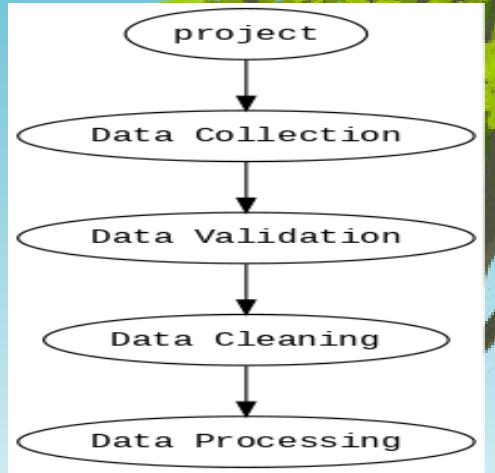


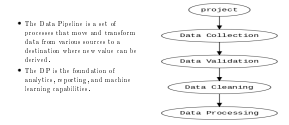
Data storage and tagging using DVC

Data Tagging

Data Pipeline

- The Data Pipeline is a set of processes that move and transform data from various sources to a destination where new value can be derived.
- The DP is the foundation of analytics, reporting, and machine learning capabilities.





- Source: Data Pipelines pocket reference p1-2

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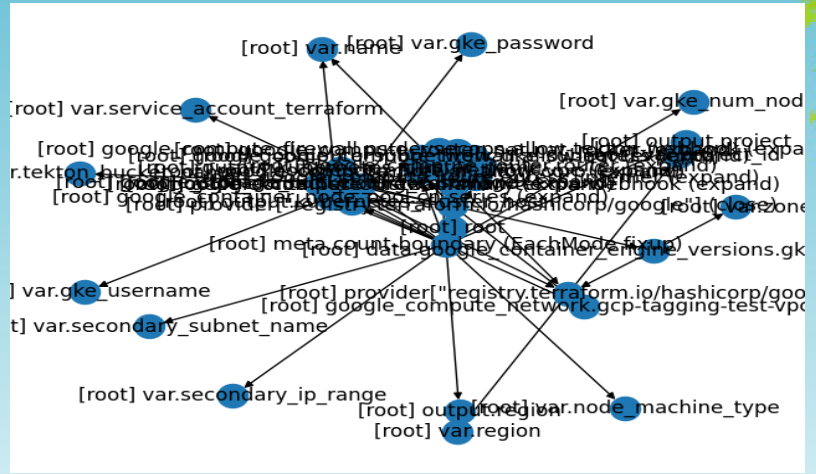
Graphviz/Dot output



- This is the first thing I saw when I started converting the data.
- Was excited here since I was able to change the color of the nodes.
- Obviously this is not yet a usable result.

Gephi

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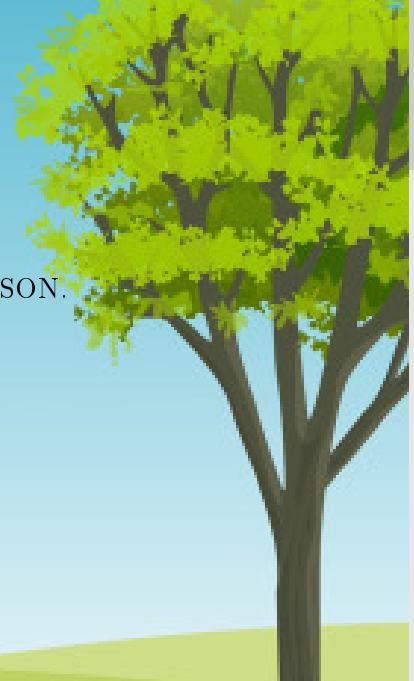
Useful Intermediate Results



- Standardizing my data collection on JSON.
- Made some super cool functions for parsing nested JSON.
- Importing JSON to Pandas dataframes.

So Now What?

- Standardizing my data collection on JSON.
- Made some super cool functions for parsing nested JSON.
- Importing JSON to Pandas dataframes.

- Tabular data in Pandas can be output in all kinds of formats.
- Pandas data frames can be the input for other Machine Learning tools and frameworks.

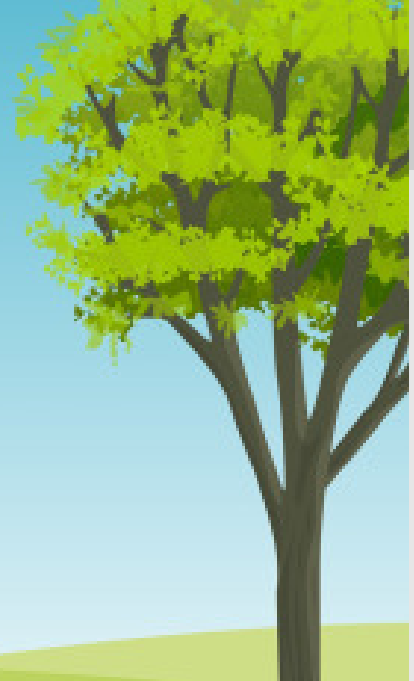
Next Steps for this Project

- See if I can get the training to use my personal GPU/TPU

• See if I can get the training to use my personal GPU/TPU

- Most of this work is relegated to my “free” time.
- Have to spend my days helping people with the cloud.

If Time, Staff, and Money were no Object



- Dreams and stretch goals.

• Dreams and stretch goals.

- this is the “dreams and stretch goals” slide.
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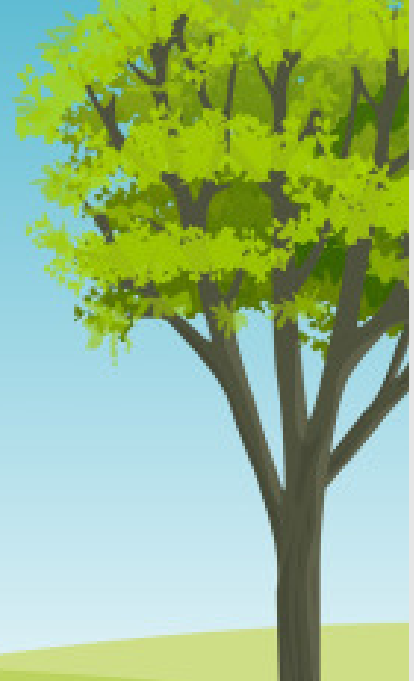
- This is an example of a list.
- Important business information.



• This is an example of a list.
• Important business information.

- point 1
- point 2