Your data fits in RAM:
How to avoid cluster computing

PYDATA MIAMI 2019

Aaron Richter

@rikturr

DATA SCIENTIST (DATA ENGINEER) PHD CANDIDATE

Gary Bernhardt
@garybernhardt

Consulting service: you bring your big data problems to me, I say "your data set fits in RAM", you pay me $10,000 for saving you $500,000.

6:03 PM · 5/19/15 · GRB t app

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Eduardo Arino de la Rubia
Domino Data Lab
0:01 / 3:00
1x

Cluster computing has its place

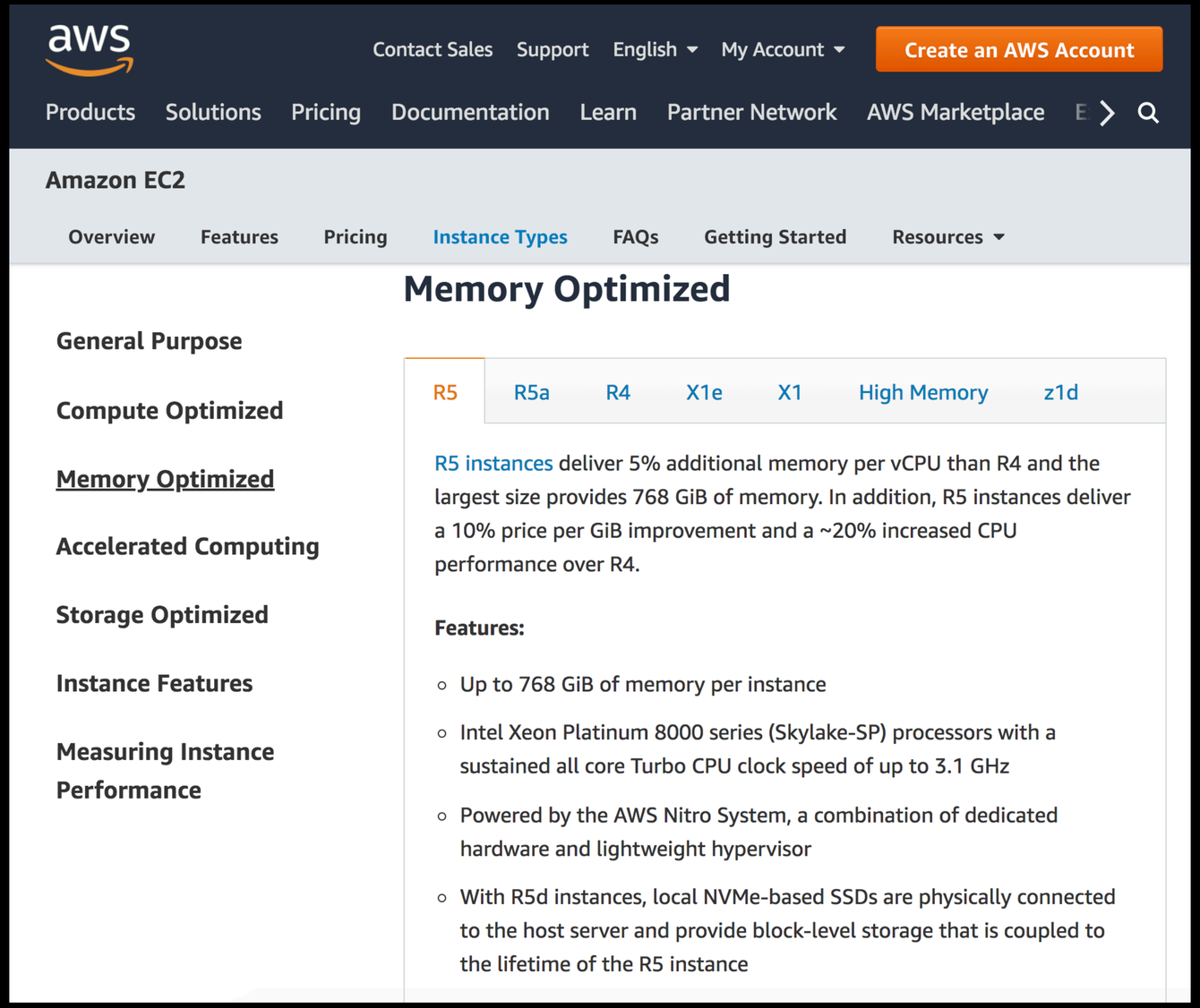
The cloud is your friend

Your laptop is stronger than you think

The cloud is your friend

Your laptop is stronger than you think


There is no cloud
it's just someone else's computer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Instance Features
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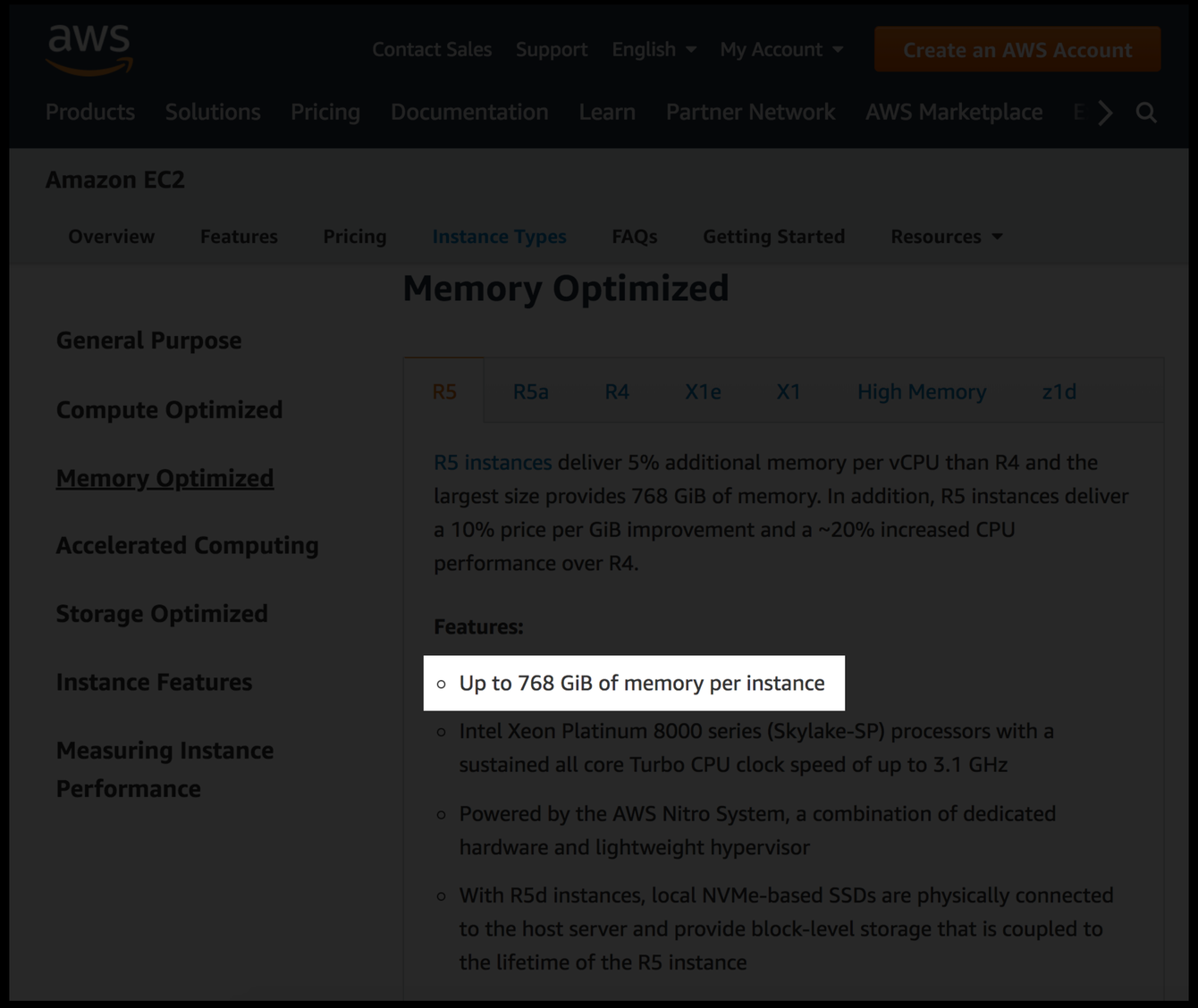
R5
R5a
R4
X1e
X1
High Memory
z1d
R5 instances deliver 5% additional memory per vCPU than R4 and the largest size provides 768 GiB of memory. In addition, R5 instances deliver a 10% price per GiB improvement and a ~20% increased CPU performance over R4.
Features:
Up to 768 GiB of memory per instance
Intel Xeon Platinum 8000 series (Skylake-SP) processors with a sustained all core Turbo CPU clock speed of up to 3.1 GHz
Powered by the AWS Nitro System, a combination of dedicated hardware and lightweight hypervisor
With R5d instances, local NVMe-based SSDs are physically connected to the host server and provide block-level storage that is coupled to the lifetime of the R5 instance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P2

P2 instances are intended for general-purpose GPU compute applications.

Features:

- High frequency Intel Xeon E5-2686 v4 (Broadwell) processors
- High-performance NVIDIA K80 GPUs, each with 2,496 parallel processing cores and 12GiB of GPU memory
- Supports GPUDirect™ for peer-to-peer GPU communications

Model	GPUs	vCPU	Mem (GiB)	GPU Memory (GiB)
p2.xlarge	1	4	61	12
p2.8xlarge	8	32	488	96
p2.16xlarge	16	64	732	192

GPU Instances - Current Generation

p2.xlarge	4	12	61	EBS Only	$0.9 per Hour
p2.8xlarge	32	94	488	EBS Only	$7.2 per Hour
p2.16xlarge	64	188	732	EBS Only	$14.4 per Hour

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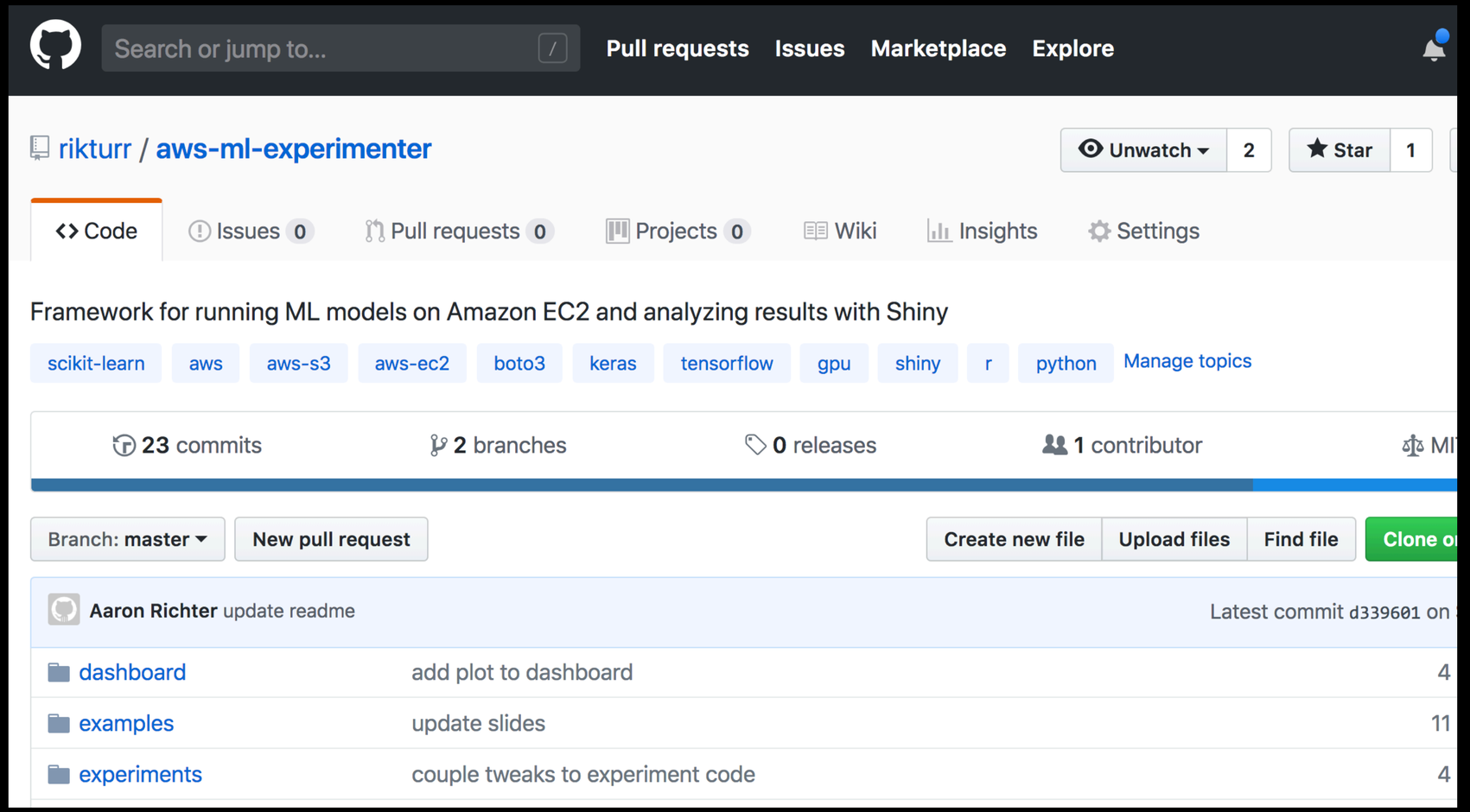
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0 releases
1 contributor
Branch: master
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Create new file
Upload files
Find file
Clone o
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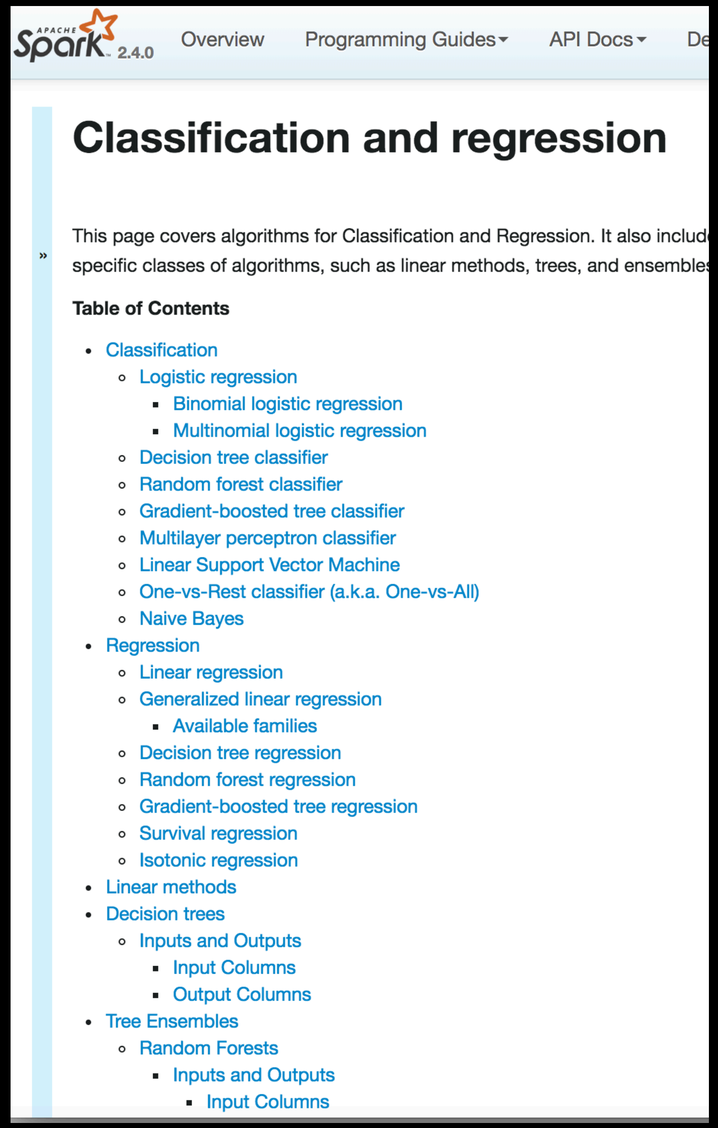
dashboard
add plot to dashboard
4
examples
update slides
11
experiments
couple tweaks to experiment code
4

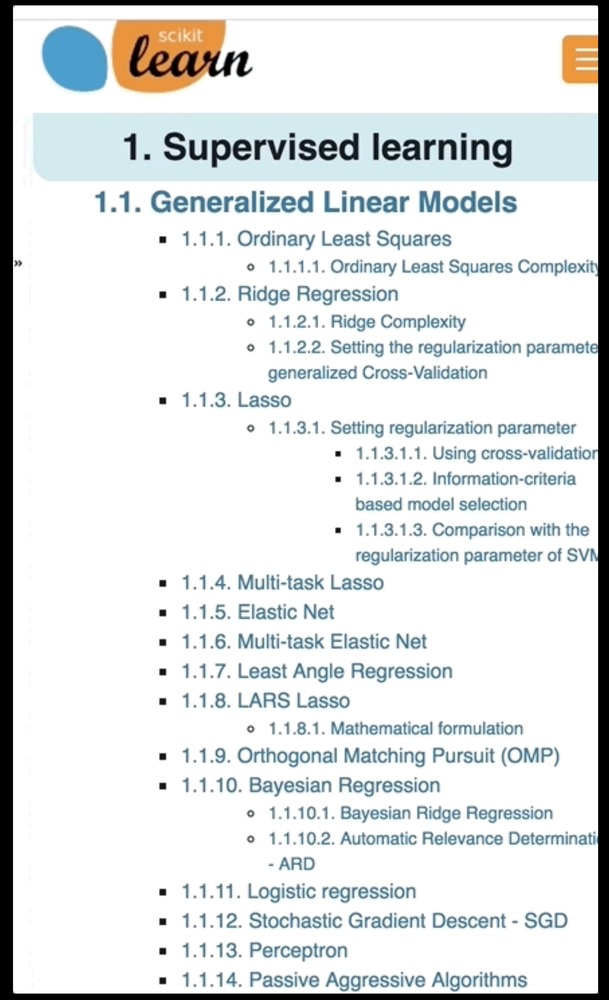
https://github.com/rikturr/aws-ml-experimenter

https://youtu.be/JIasG2DfDVc

Use your libraries



Use your libraries



Do you need all the data?

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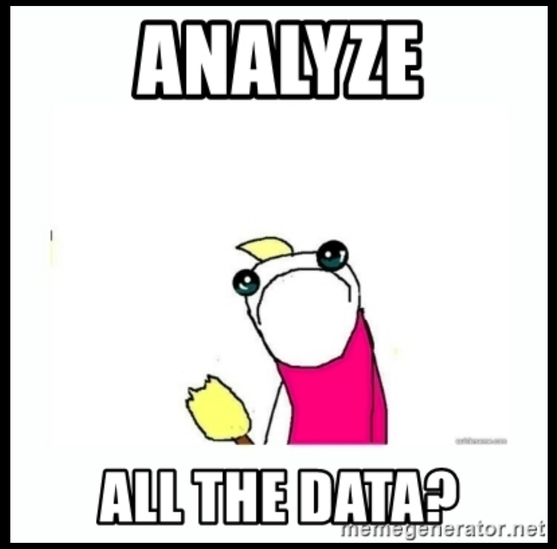
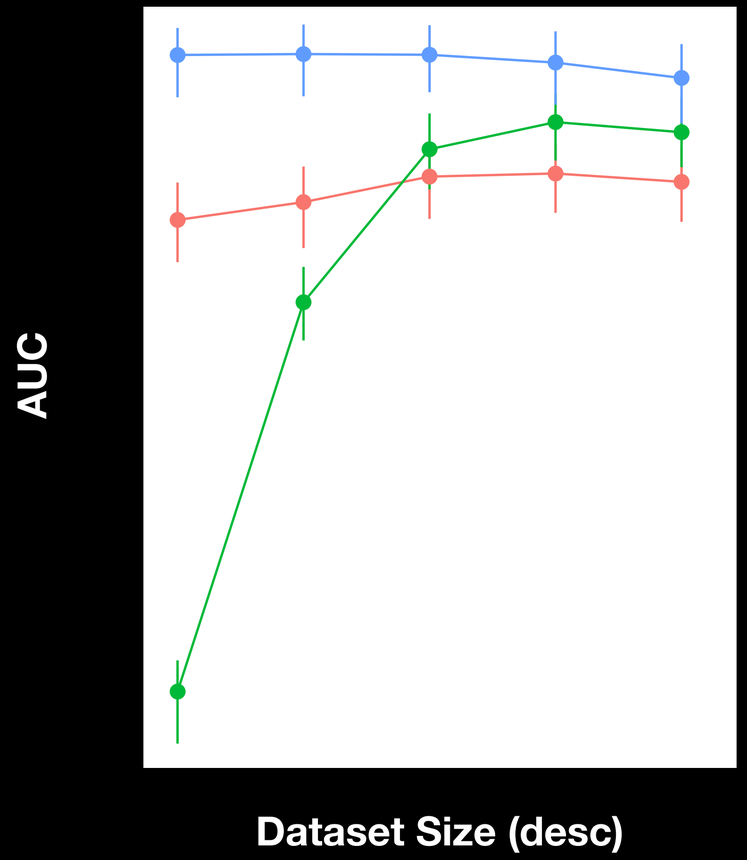
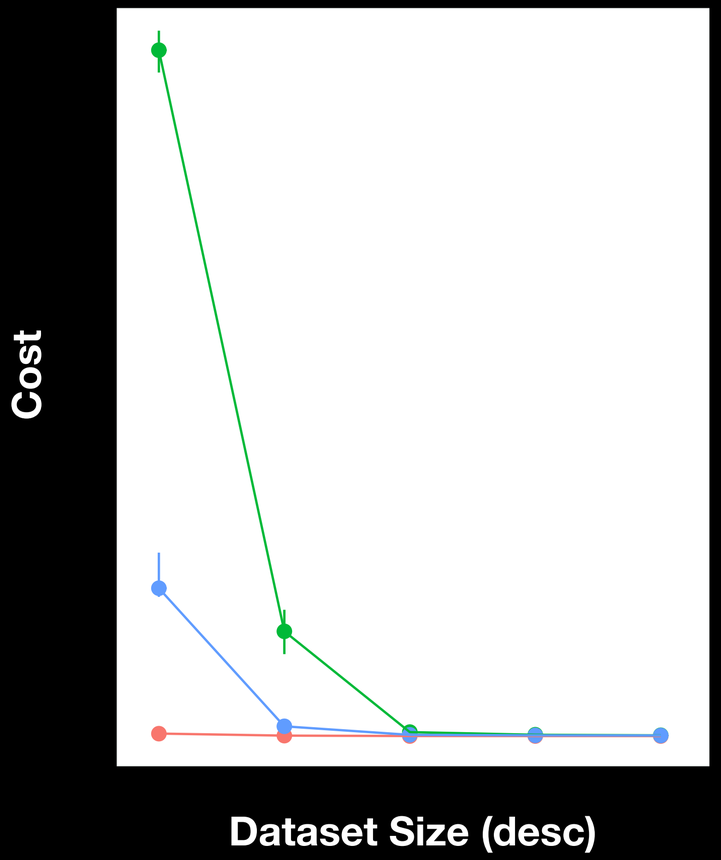



AUC
Dataset Size (desc)


Cost
Dataset Size (desc)

File formats are key

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`database` `excel` `csv` `parquet` `feather` `hdf5`

In [136]:
```
1 !ls -alh 2015_partB_miami.txt
```

```
-rw-r--r--  1 aaron.richter  staff    11M Jan 20  2018 2015_partB_miami.txt
```

In [140]:
```
1 df = pd.read_csv('2015_partB_miami.txt', sep='\t')
2 df.to_parquet('2015_partB_miami.parquet')
```

In [141]:
```
1 !ls -alh 2015_partB_miami.parquet
```

```
-rw-r--r--  1 aaron.richter  staff   2.7M Jan  8 18:44 2015_partB_miami.parquet
```

File formats are key

database excel csv parquet feather hdf5

https://gist.github.com/rikturr/888c402e788e560e38380a7f6ac352d7

Sparse matrices

Sparse matrices

`scipy` `pandas` `sklearn` `libsvm` `arff`

```
6 one_hot
```

Out[122]:
```
array([[  1.00301111e+09,   0.00000000e+00,   0.00000000e+00, ...,
          0.00000000e+00,   0.00000000e+00,   0.00000000e+00],
       [  1.00301711e+09,   0.00000000e+00,   0.00000000e+00, ...,
          0.00000000e+00,   0.00000000e+00,   0.00000000e+00],
       [  1.00302358e+09,   0.00000000e+00,   0.00000000e+00, ...,
          0.00000000e+00,   0.00000000e+00,   0.00000000e+00],
       ...,
       [  1.99297706e+09,   0.00000000e+00,   0.00000000e+00, ...,
          0.00000000e+00,   0.00000000e+00,   0.00000000e+00],
       [  1.99299449e+09,   0.00000000e+00,   0.00000000e+00, ...,
          0.00000000e+00,   0.00000000e+00,   0.00000000e+00],
       [  1.99299752e+09,   0.00000000e+00,   0.00000000e+00, ...,
          0.00000000e+00,   0.00000000e+00,   0.00000000e+00]])
```

In [123]:
```
1 one_hot.shape, one_hot.shape[0] * one_hot.shape[1]
```

Out[123]:
```
((5740, 2185), 12541900)
```

In [124]:
```
1 np.count_nonzero(one_hot)
```

Out[124]:
```
56550
```

In [126]:
```
1 import scipy.sparse as sp
2
3 one_hot_sparse = sp.csc_matrix(one_hot)
4 one_hot_sparse
```

Out[126]:
```
<5740x2185 sparse matrix of type '<class 'numpy.float64'>'
        with 56550 stored elements in Compressed Sparse Column format>
```

In [130]:
```
1 np.save('dense.npy', one_hot)
2 sp.save_npz('sparse.npz', one_hot_sparse)
```

In [132]:
```
1 !ls -alh dense.npy
```

```
-rw-r--r--  1 aaron.richter  staff    96M Jan  8 18:36 dense.npy
```

In [133]:
```
1 !ls -alh sparse.npz
```

```
-rw-r--r--  1 aaron.richter  staff   186K Jan  8 18:36 sparse.npz
```

The cloud is your friend

Your laptop is stronger than you think

Use your cores

Use your cores

`multiprocessing` `pyspark` `dask` `RAPIDS`

`snow` `multidplyr` `sparklyr`

Don’t be patient

Time is $$

Use the internet

https://lmgtfy.com/

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Get the code!

https://github.com/rikturr/pydata-your-data-fits-in-ram