Scalable Data Science with Dask

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Hi!
I'm Pavithra :)

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- FOSS contributor - Bokeh & Wikimedia
- CSE Student, India
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What’s your experience with Scalable Data Science?

On a scale of 1 - 5

1: *What is scalable compute?*

5: *I understand the challenges and have a solution that works for me*

We’ll talk about

- Big data - What is it?
- Parallel and distributed computing
- Dask for scaling data science
- Coiled - Dask on the cloud

Slides and notebook at:

bit.ly/pyladies-berlin-dask

Big data

What is big data?

- Doesn’t fit on your local machine
- Traditional tools and methods fail

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- Doesn’t fit on your local machine
- Traditional tools and methods fail

Characteristics:

- Volume
- Velocity
- Variety
- Veracity

Scalable compute

Parallel computing

- Working in parallel
- Use all CPU cores
- Multiple processes and shared memory

7 am

2 pm

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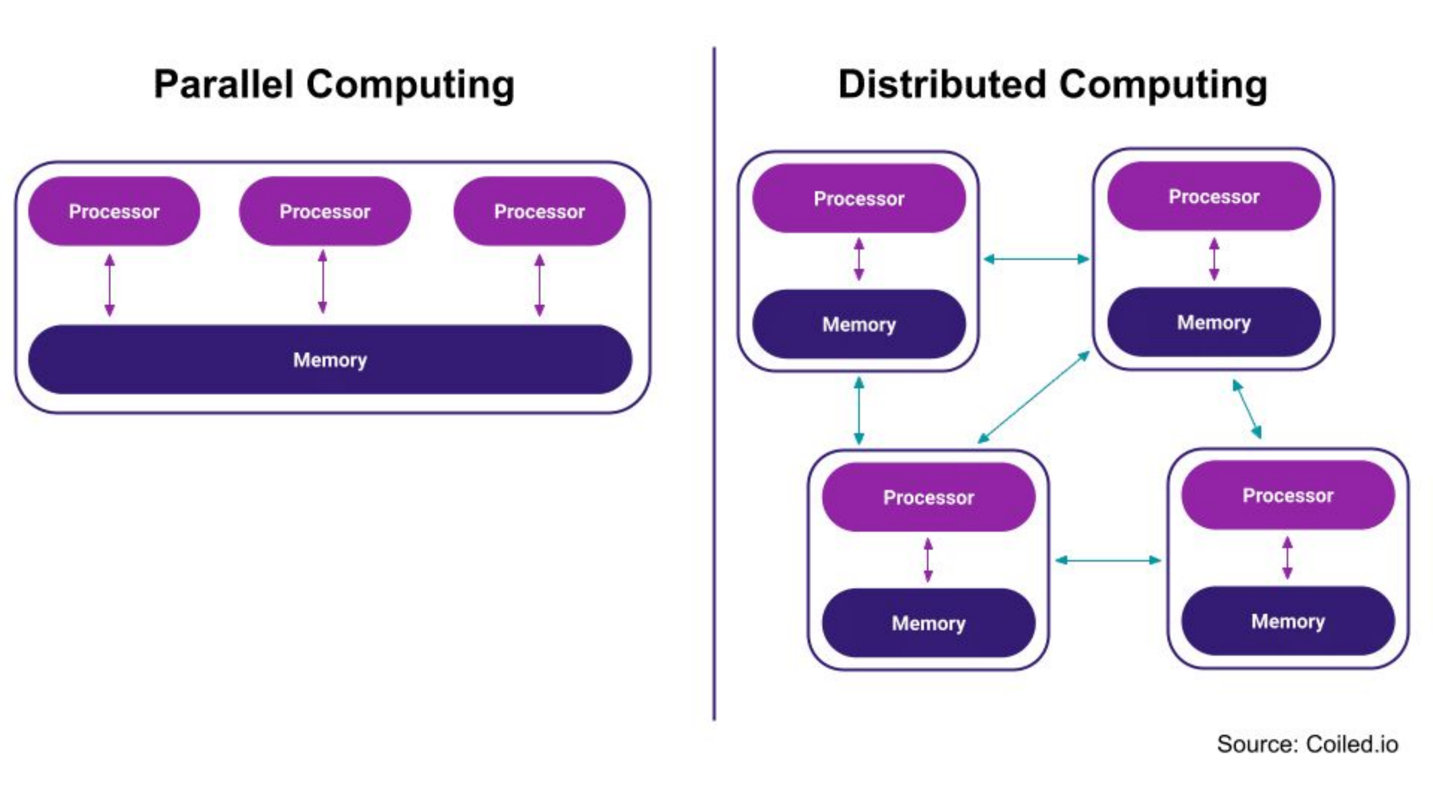
Distributed computing

- Using groups of machines
- Each machine has processors and memory



Parallel Computing

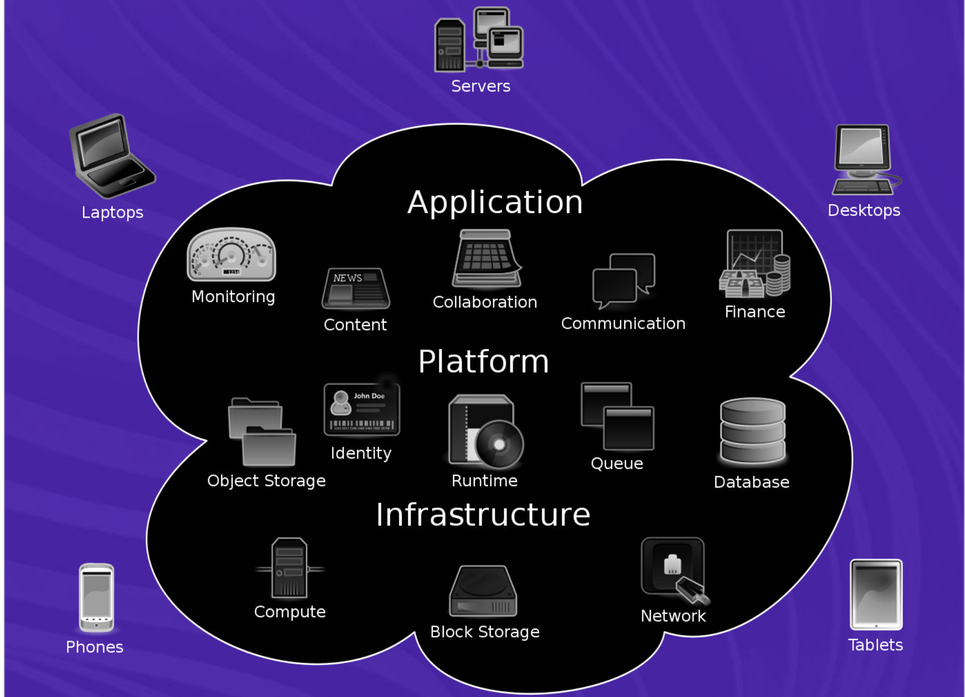
Distributed Computing

Source: Coiled.io

Source: Coiled.io

Cloud computing

- Using cloud resources
- AWS, Azure, GCP
- Lots of storage and computational power



Source: Wikimedia Commons

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Dask

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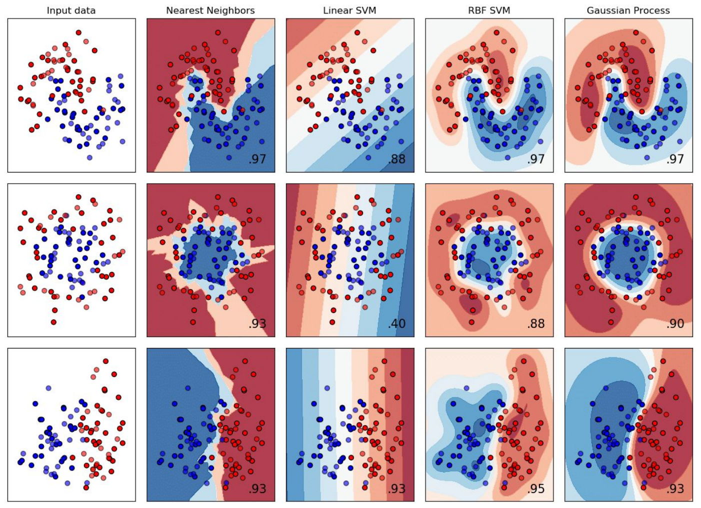
Dask

Library for parallel and distributed computing in Python

Dask

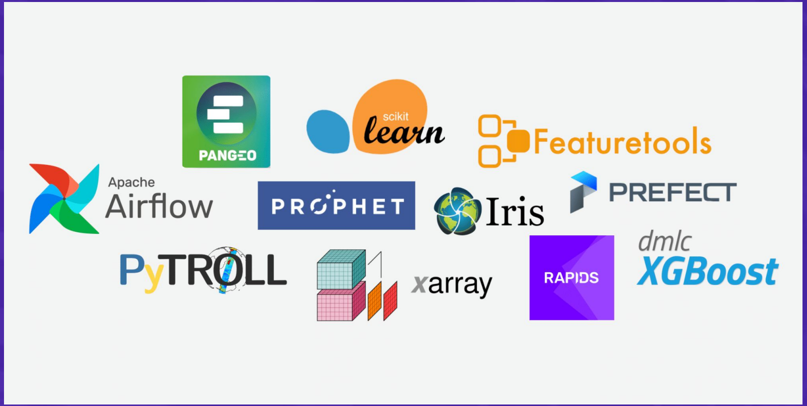
Makes it easy to scale-up your workflows to use all cores in your local machine



Dask

Provides a distributed computing framework

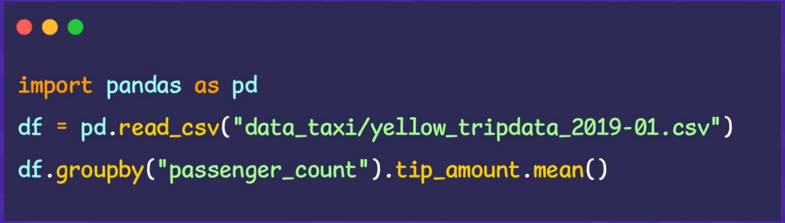
Powers tools like RAPIDS, Airflow, PyTorch, and more!



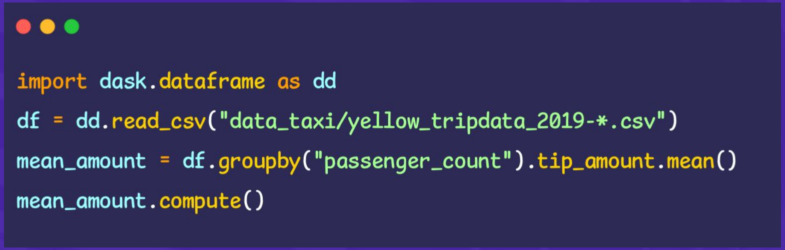
Dask features

Familiar API

Resembles normal pandas, NumPy, scikit-learn code



```
import pandas as pd
df = pd.read_csv("data_taxi/yellow_tripdata_2019-01.csv")
df.groupby("passenger_count").tip_amount.mean()
```

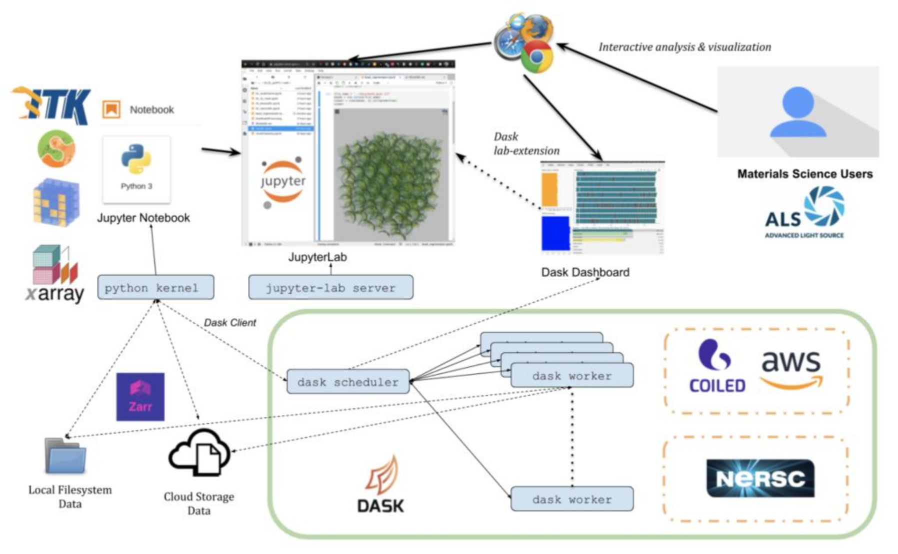


```
import dask.dataframe as dd
df = dd.read_csv("data_taxi/yellow_tripdata_2019-*.csv")
mean_amount = df.groupby("passenger_count").tip_amount.mean()
mean_amount.compute()
```

Dask features

Flexible

Local machine, on-prem, on the cloud, anywhere

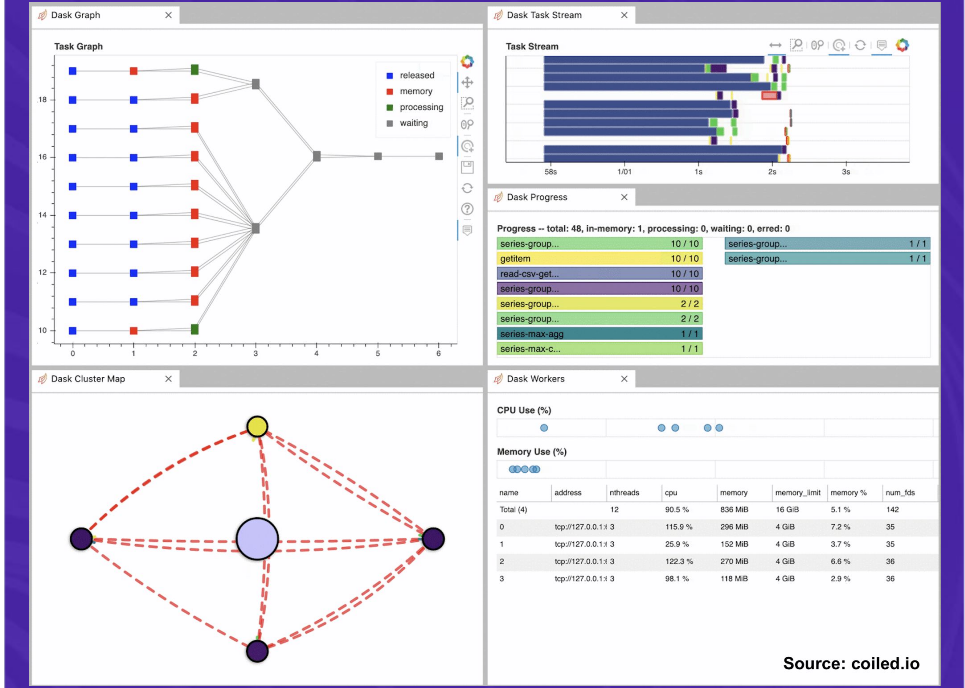


3D microstructure interactive image analysis and visualization system architecture.
Source: [Article presented at Super Computing 2020]

Dask features

Dashboards!

Real-time visualizations



Progress -- total: 48, in-memory: 1, processing: 0, waiting: 0, erred: 0

series-group...	10 / 10	series-group...	1 / 1
getitem	10 / 10	series-group...	1 / 1
read-csv-get...	10 / 10		
series-group...	10 / 10		
series-group...	2 / 2		
series-group...	2 / 2		
series-max-agg	1 / 1		
series-max-c...	1 / 1		

name	address	nthreads	cpu	memory	memory_limit	memory %	num_fds
Total (4)		12	90.5 %	836 MiB	16 GiB	5.1 %	142
0	tcp://127.0.0.1:	3	115.9 %	296 MiB	4 GiB	7.2 %	35
1	tcp://127.0.0.1:	3	25.9 %	152 MiB	4 GiB	3.7 %	35
2	tcp://127.0.0.1:	3	122.3 %	270 MiB	4 GiB	6.6 %	36
3	tcp://127.0.0.1:	3	98.1 %	118 MiB	4 GiB	2.9 %	36

Source: coiled.io

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Dask users in retail

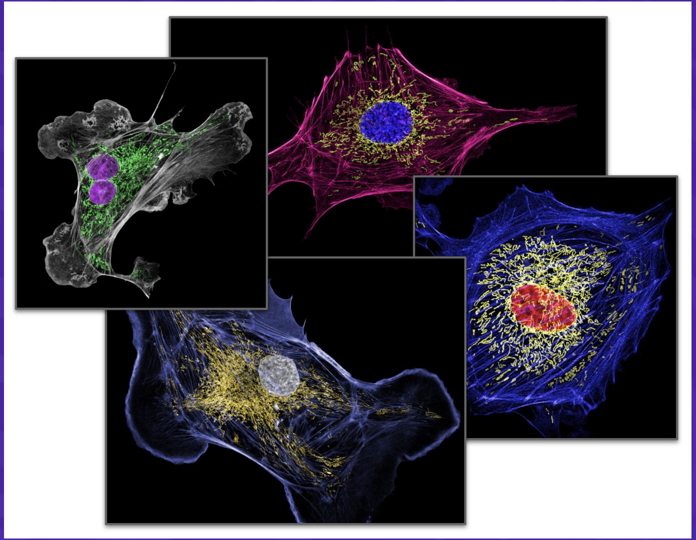
Walmart

- demand forecasting
- 500M+ store combinations
- 100x speedup from RAPIDS and Dask

Dask users in life science

High resolution, 4-dimensional, cellular imagery

- Harvard Medical School
- Howard Hughes Medical Institute
- Chan Zuckerberg Initiative
- UC Berkeley Advanced Bioimaging Center



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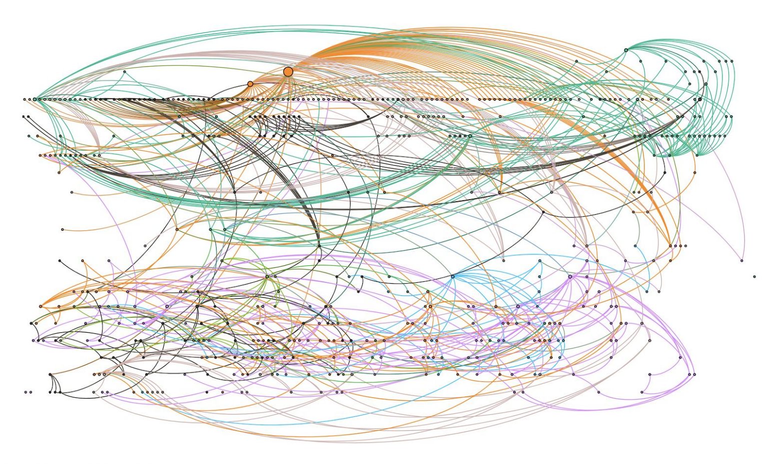
Dask users in finance

Capital One

- ETL and ML pipeline speedup

Barclays

- Financial system modelling



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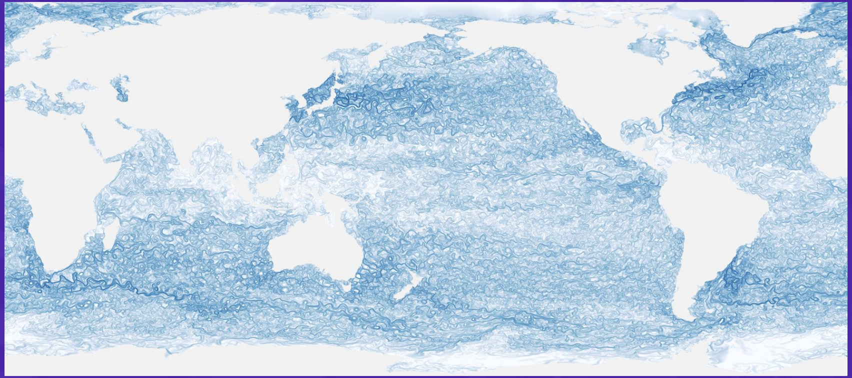
Dask users in Geo

Farallon Institute , Los Alamos National Labs

- Climate Science
- Energy
- Hydrology
- Meteorology
- Satellite Imaging



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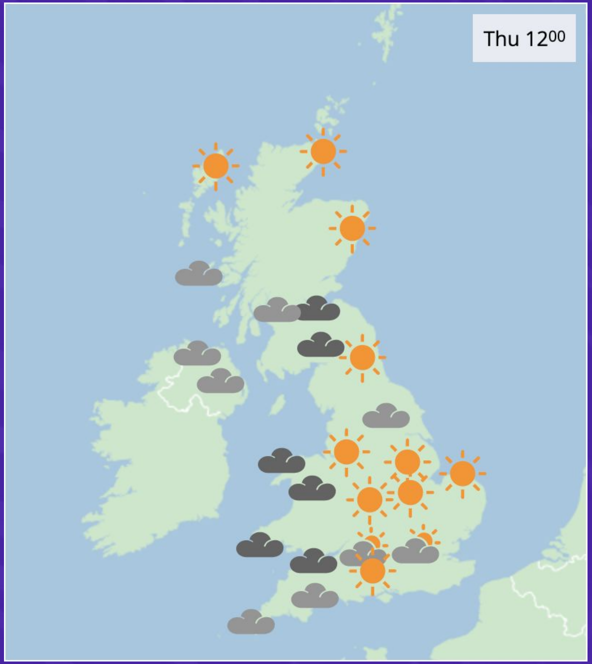
Dask users

Many many more!

NASA

Software Libraries



Demo

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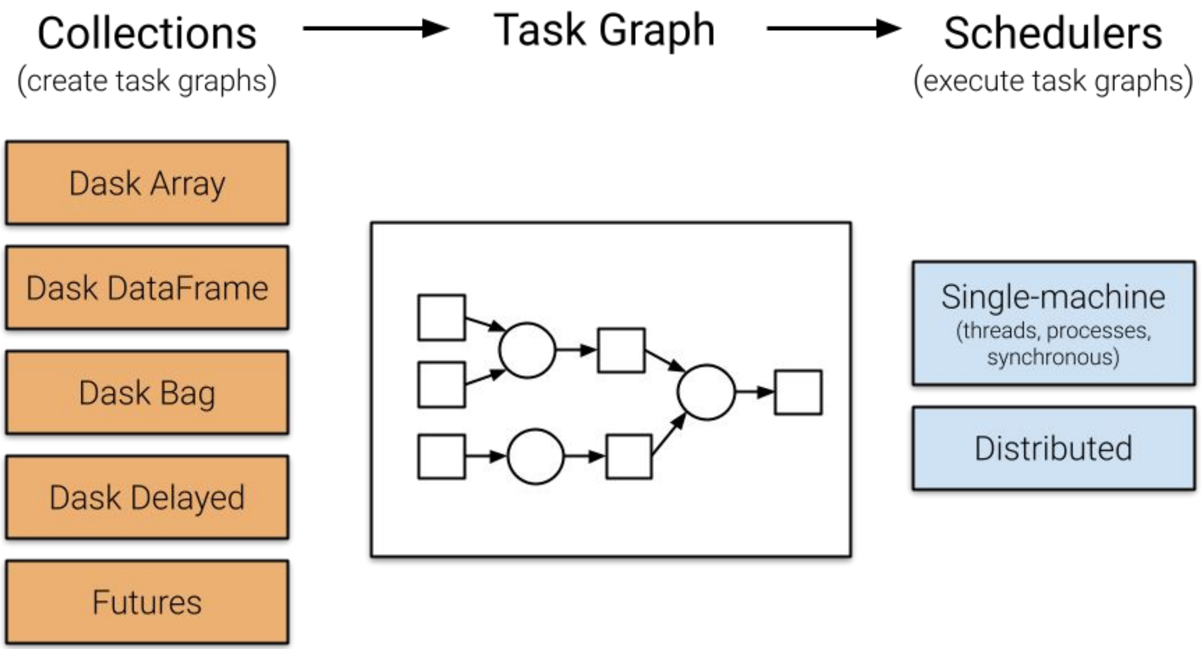
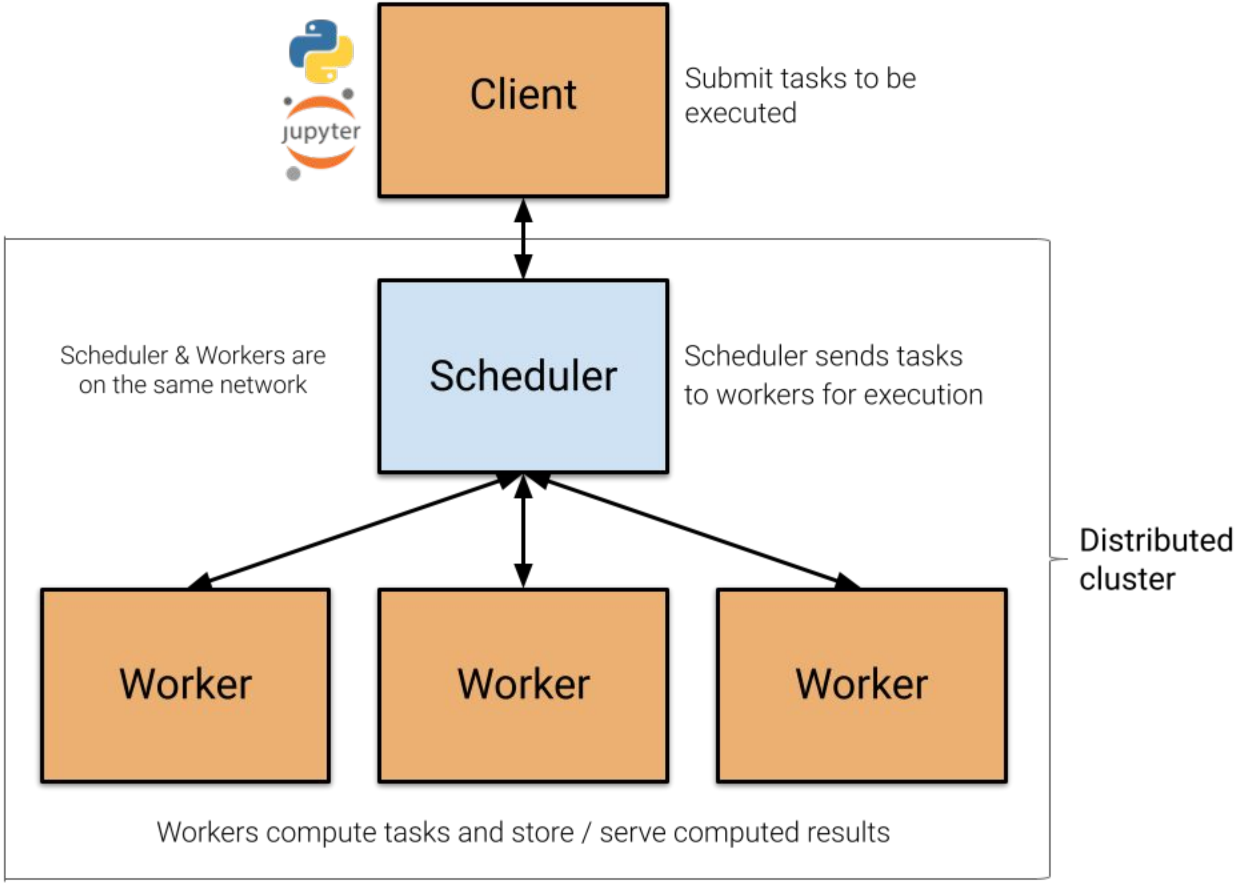
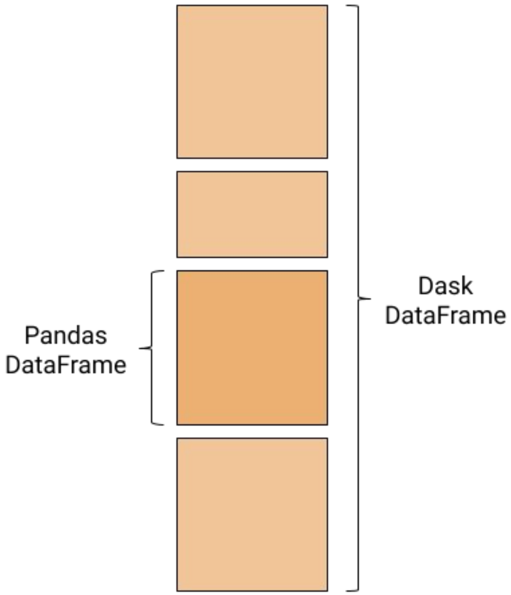


Source: dask.org


jupyter
Client
Submit tasks to be executed
Scheduler
Scheduler & Workers are on the same network
Scheduler sends tasks to workers for execution
Distributed cluster
Worker
Worker
Worker
Workers compute tasks and store / serve computed results

Source: dask.org



Source: dask.org

Shout out to Matthew Rocklin, and the entire Dask community for this material!

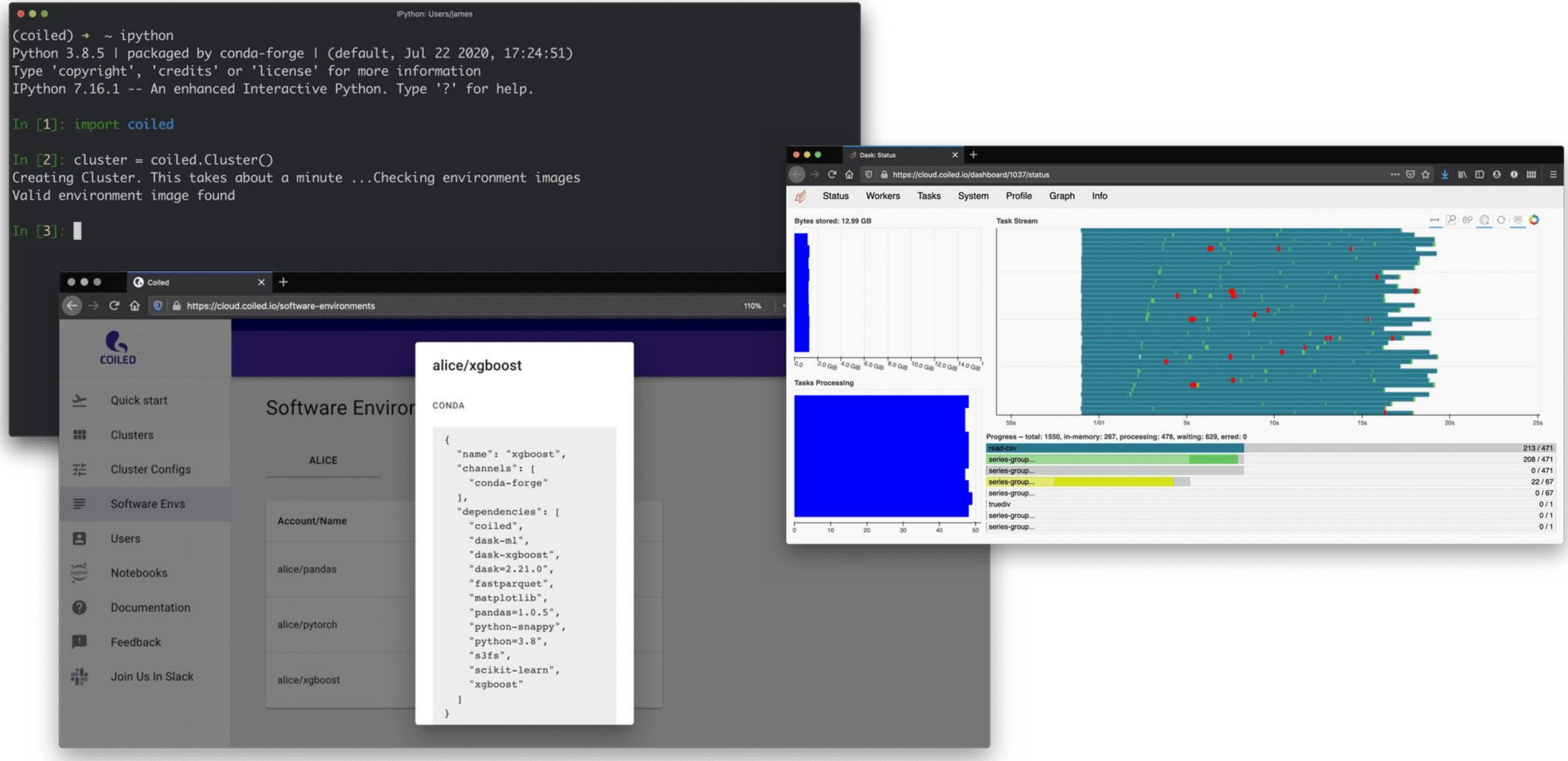
Coiled

Built by Dask maintainers, contributors, and enthusiasts.

Open source culture is at the heart of Coiled.

Cloud computing *has some challenges*

- Security concerns
- Managing software environments
- Cost optimization



```
(coiled) ➜  ~ ipython
Python 3.8.5 | packaged by conda-forge | (default, Jul 22 2020, 17:24:51)
Type 'copyright', 'credits' or 'license' for more information
IPython 7.16.1 -- An enhanced Interactive Python. Type '?' for help.

In [1]: import coiled

In [2]: cluster = coiled.Cluster()
Creating Cluster. This takes about a minute ...Checking environment images
Valid environment image found

In [3]:
```

alice/pandas

alice/pytorch

alice/xgboost

alice/xgboost

CONDA

```
{
  "name": "xgboost",
  "channels": [
    "conda-forge"
  ],
  "dependencies": [
    "coiled",
    "dask-ml",
    "dask-xgboost",
    "dask=2.21.0",
    "fastparquet",
    "matplotlib",
    "pandas=1.0.5",
    "python-snappy",
    "python=3.8",
    "s3fs",
    "scikit-learn",
    "xgboost"
  ]
}
```

```
Progress -- total: 1550, in-memory: 267, processing: 478, waiting: 629, erred: 0
read-csv          213 / 471
series-group...   208 / 471
series-group...     0 / 471
series-group...    22 / 67
series-group...     0 / 67
truediv             0 / 1
series-group...     0 / 1
series-group...     0 / 1
```

Coiled tackles these challenges for you.

welcome.coiled.io

Thank you!

Slides and notebook at:
bit.ly/pyladies-berlin-dask

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