15-440
Distributed Systems
Recitation 11:
Project 4 & Ray Demo

Hend Gedawy

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Carnegie Mellon University Qatar

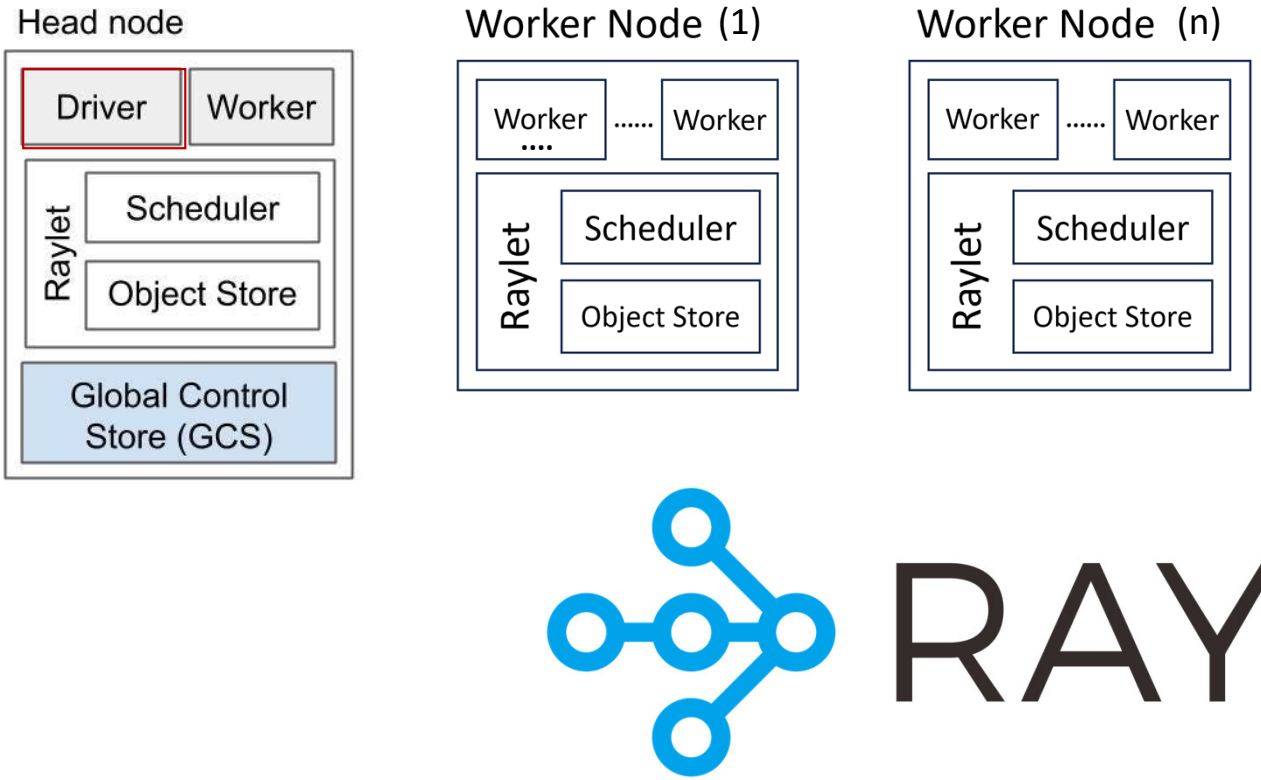
Announcements

- **P4** Out. Due Nov. 30 **(No Grace Days can be used)**
- **P3** Due Today

Project 4 Overview/Objective

- Implement the K-Means clustering algorithm using **Ray**. Two new code files:
  - points_ray.py
  - dna_ray.py
- You will compare and contrast the performance of your MPI K-Means implementation (from P3) against your Ray K-Means implementation from this project
  - Varying the number of data points
  - Varying the cluster size (number of workers/VMs)

Ray Custer



RAY

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Running A Program on Ray Cluster

Default is 6379
Optional argument, you can give it if you'd like to select the port that you want

- Make sure ray is stopped in all nodes (sudo ray stop --force)
- Start Ray @ Head Node:
  - sudo ray start --head --port= 6379 --redis-password=my_password --include-dashboard 1 --dashboard-host headNodeIP
- To include more worker machines:
  - Ssh to the worker node and start ray using the following command:
    - sudo ray start --address='headNodeIP:headPortNum'
- Run the program @Head Node:
  - sudo python3 points_ray.py <Program Parameters>
- To view the dashboard of your cluster, go to your web browser and put headNodeIP:dashboardPortNumber

Given when head started

- When Done, run (sudo ray stop --force) on all nodes

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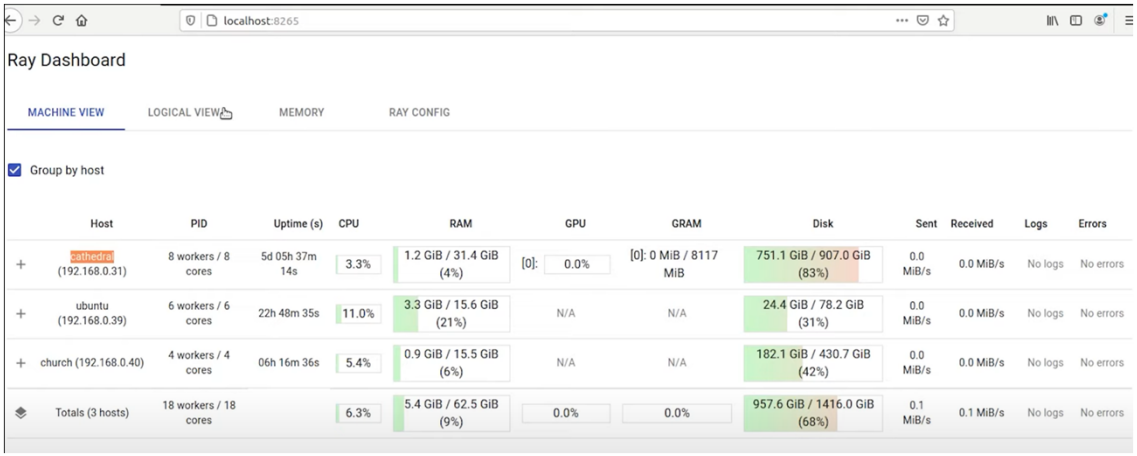
Ray Dashboard



It shows:

- all the machines that you have connected to this cluster (3 in this example)
- Information about them (uptime, CPU, RAM,)

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Parallel Sum Using Ray

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Sequential to Parallel Sum Using Ray

```
import time


if (__name__ == '__main__'):


    startTime = time.time()

    N = 1000

    total_sum=0

    for i in range(0, N):
        total_sum += i



    print("The sum is {0}\n".format(total_sum))
    print("Time ", time.time()-startTime)
```

How to turn this sequential Sum program into a parallel/distributed one using Ray?

K-Means Clustering With Ray – General Guidelines

- Identify the parts of the algorithm that you need to run in parallel or distribute (As we did in MPI)
- Put these parts in separate functions
- Turn these functions into Ray tasks using the @ray.remote decorator
- Every invocation to the function, creates a Ray task that can run in parallel and returns the result objectID as a future
- Wait for the set of futures in your spawned parallel tasks
- Aggregate the returned partial results

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