SER 321 A Session

SI Session

Sunday, September 17th 2023

6:00 - 7:00 pm MST

Agenda

- Distributed Algorithms
  - Main Hurdles
  - Approaches
- Consensus
- This Assignment

SI Session Expectations

Thanks for coming to the **SER 321** SI session. We have a packed agenda and we are going to try to get through as many of our planned example problems as possible. This session will be recorded and shared with others.

- If after this you want to see additional examples, please visit the drop-in tutoring center.
- We will post the link in the chat now and at the end of the session.
  - tutoring.asu.edu
- Please keep in mind we are recording this session and it will be made available for you to review 24-48 hours after this session concludes.
- Finally, please be respectful to each other during the session.

Interact with us:

Zoom Features

Zoom Chat

- Use the chat feature to interact with the presenter and respond to presenter's questions.
- Annotations are encouraged

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Assignment 4

How was assignment 4?

Any issues you didn’t figure out?

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Protocol Organization

The more organized

The easier for you!

```markdown
# Protocol #
<!-- TOC -->
* [Protocol](#protocol-)
  * [Leader Responses](...)
    * [Client Responses](...)
      * [General](#general-)
      * [Specifics](...)
        * [Connected Signal](...)
        * [Menu Signal](...)
        * [Borrowed Signal](...)
        * [Returned Signal](...)
        * [Error Signal](...)
    * [Node Responses](...)
      * [General](...)
      * [Specifics](...)
        * [Connected Signal](...)
        * [Exit Signal](...)
        * [Available Signal](...)
        * [Release Signal](...)
        * [Borrow Signal](...)
        * [Return Signal](...)
        * [Update Signal](...)
        * [Listing Signal](...)
  * [Client Requests](...)
    * [General](...)
    * [Specifics](...)
      * [Start Request](...)
      * [Login Request](...)
      * [Borrow Request](...)
      * [Return Request](...)
      * [Exit Request](...)
  * [Node Requests](...)
    * [General](...)
    * [Specifics](...)
      * [Connect Signal](...)
      * [Waiting Signal](...)
      * [Error Signal](...)
      * [Available Result](...)
      * [Release Result](...)
      * [Borrow Result](...)
      * [Return Result](...)
      * [Update](#update-)
<!-- TOC -->
```

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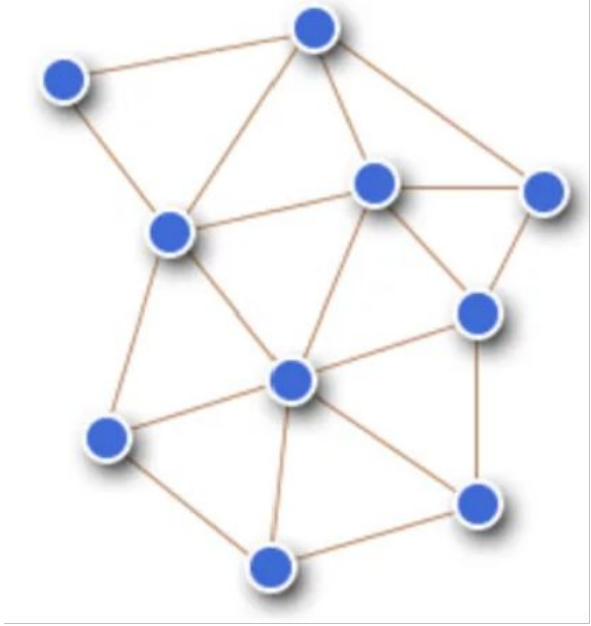
Distributed Systems



Many nodes working together to form a **single system**

We can think of a node as an individual computer

Each node needs to communicate with the other nodes to form the single system as seen from the outside

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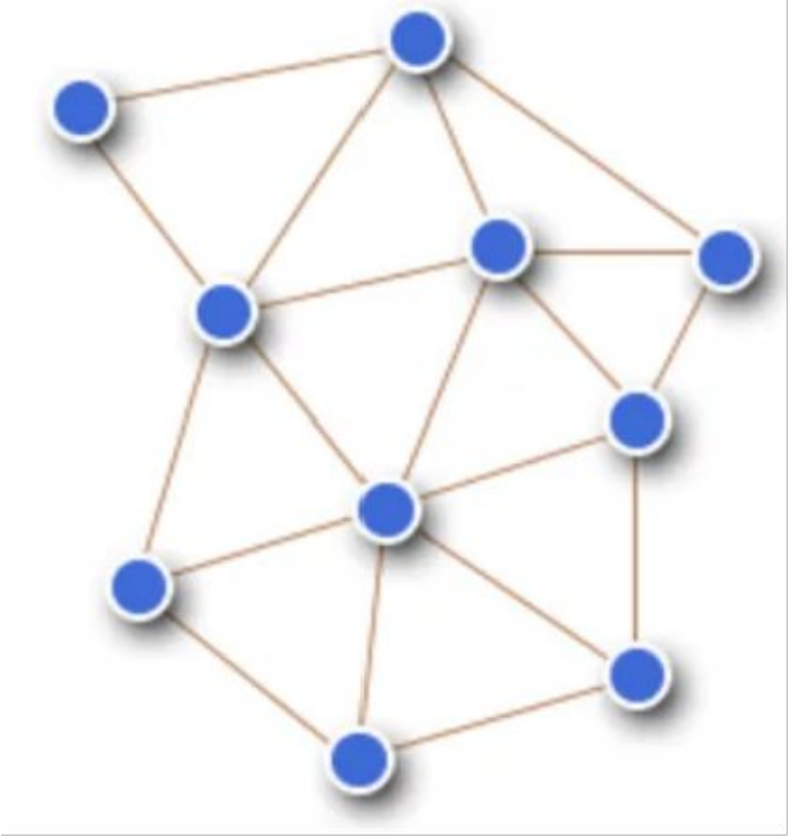
Distributed Systems

Big Takeaways

Nodes operate in *reality* not in a vacuum

- Nodes will fail
- The network will go down occasionally
- Sometimes a transmission will take forever
- Transmissions will not always take the same path



The nodes will experience problems and *we as the developers need to account for them*

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Distributed Systems

Distributed Algorithms can provide faster execution ***when done correctly***

Needs to be worth it!

In terms of time/speed

In terms of memory and overhead

Remember you also have to reconcile each result individually

EX) sort array means you have to merge it all back together in the end!

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Distributed Systems

Maintain good programming practices to avoid common issues

- Handle Node failures
- Account for latency
- Account for network failures
- Protection of shared resources
- Prevention of deadlocks
- Execution safety - no errors or gross, bad stuff
- Ensuring liveliness and that everyone eventually gets a turn

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Distributed Systems in Practice

So what do we do? How do we manage all this?

There are several ways of managing structure and addressing issues

- Main and Worker
- Peer to Peer

- Consensus algorithms
- Leader Elections

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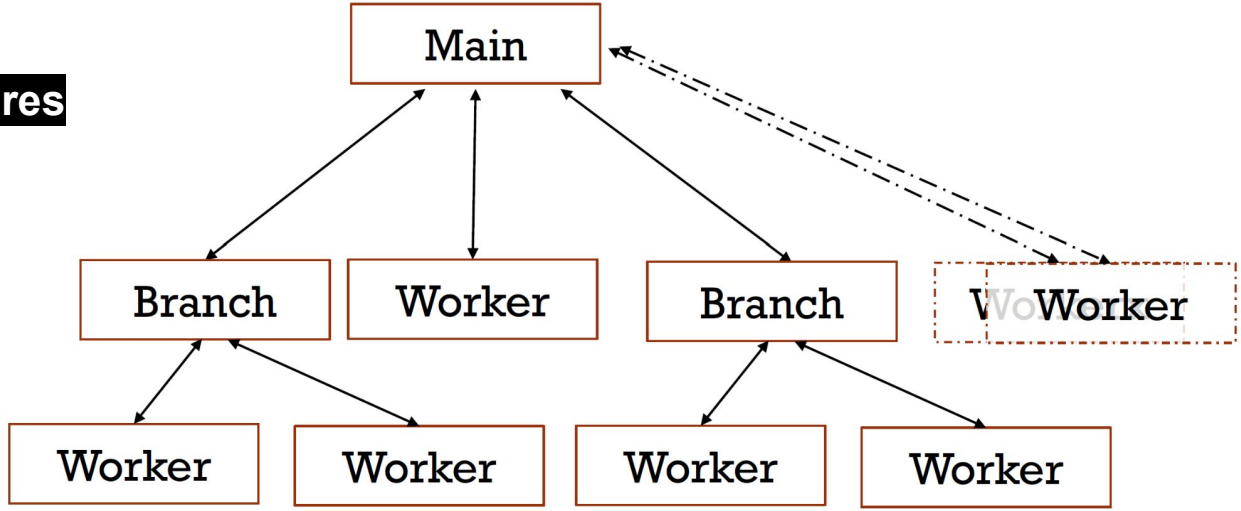
Distributed Systems Structures

Main and Worker

Pros & Cons



_____ construction!

Communication is _____

_____ scalable

Certain nodes have/are _____ than others

_____ can be progressive and get out of _____

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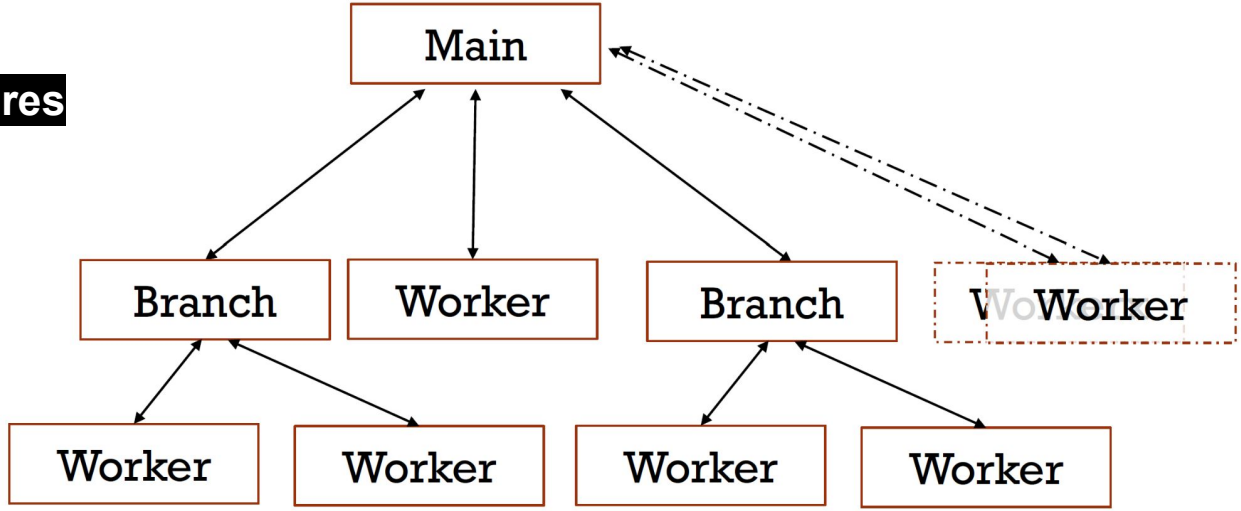
Distributed Systems Structures

Main and Worker

Pros & Cons



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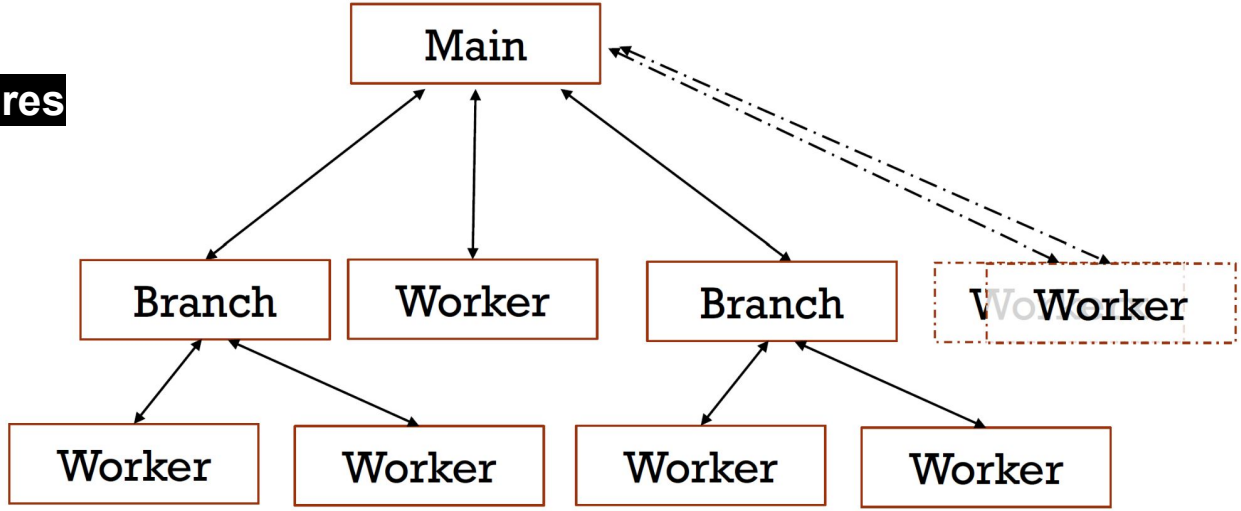

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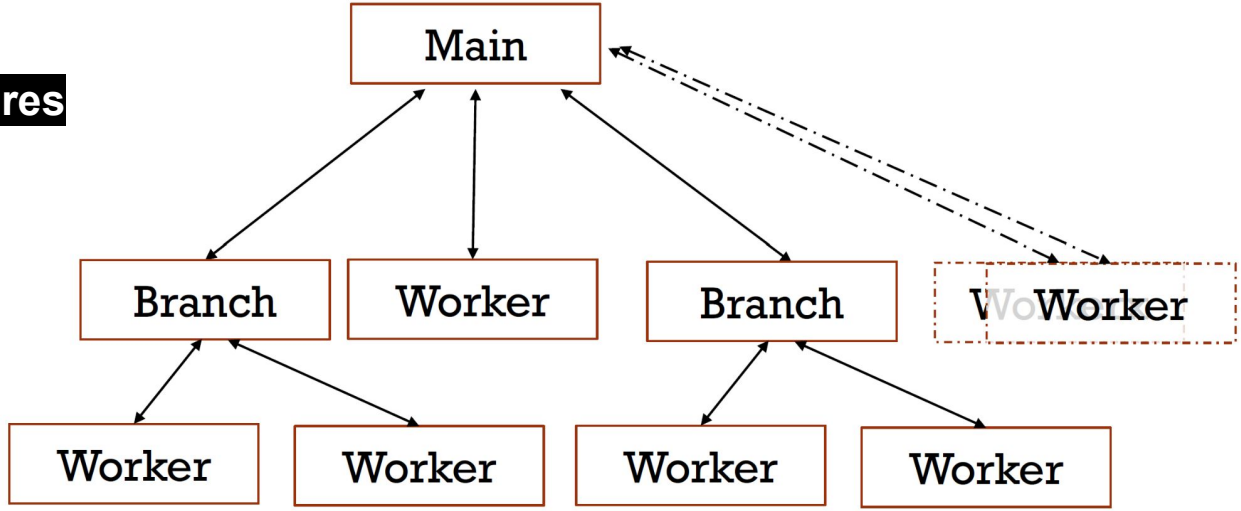

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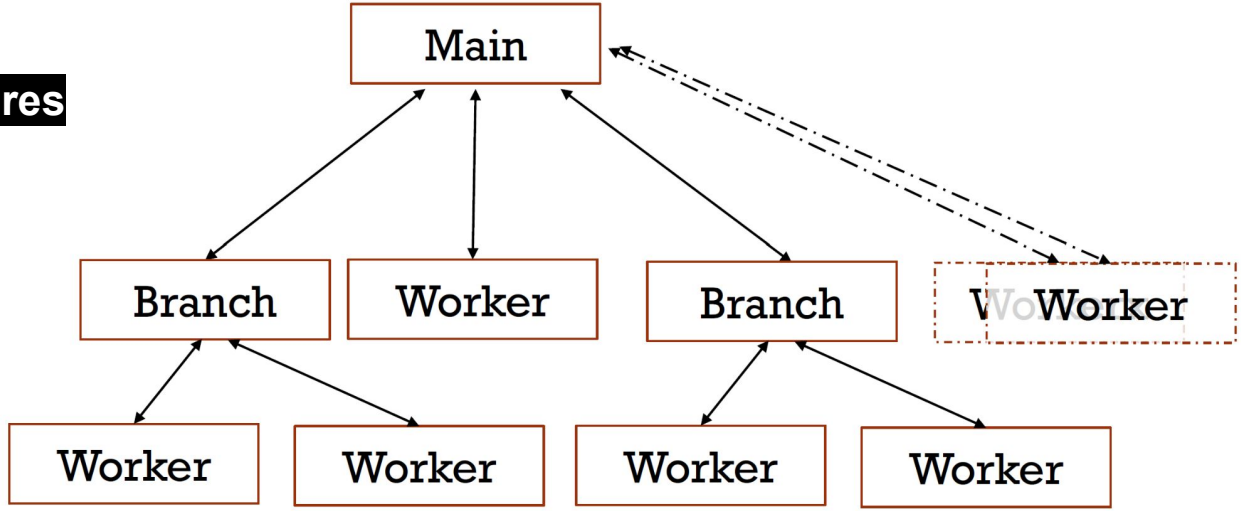

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Distributed Systems Structures

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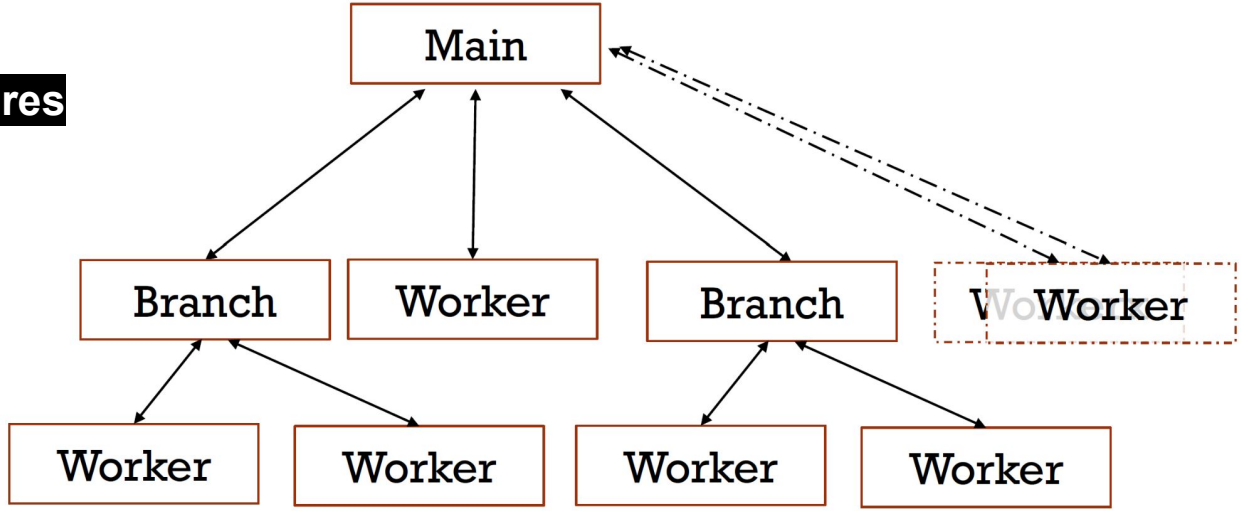

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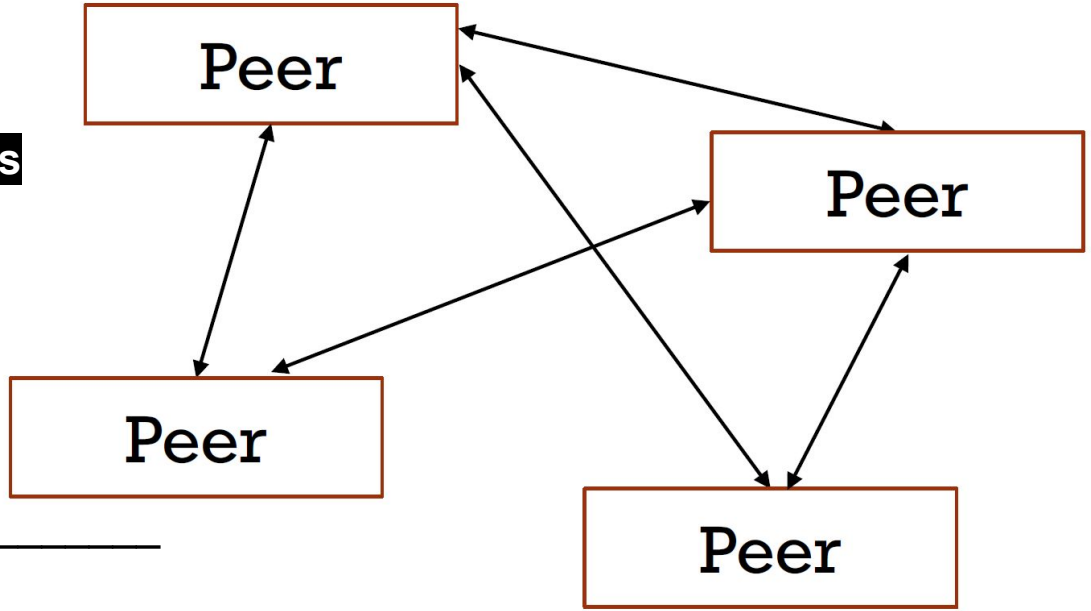

Peer to Peer
Pros & Cons

All peers are _____
Failed peers are _____
Peers ___ join
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Communication is _____!
Handling ____ connections is _____

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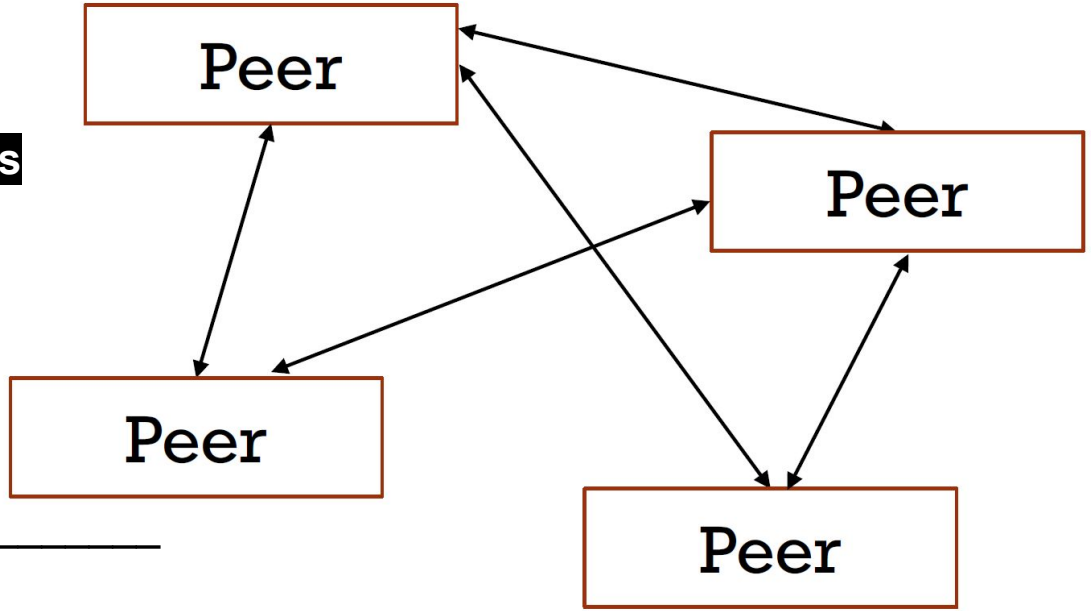

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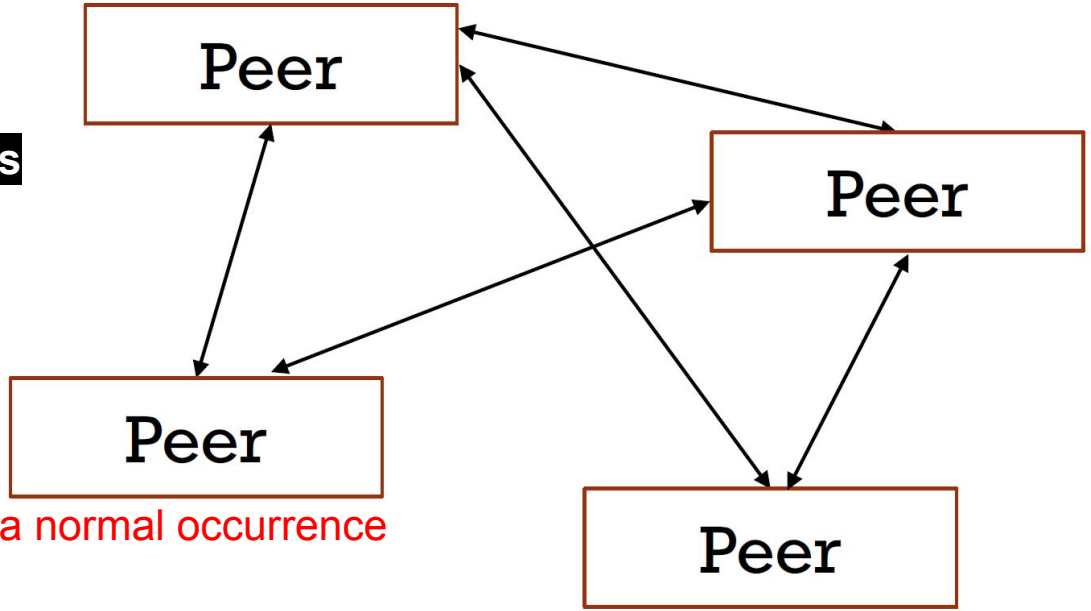

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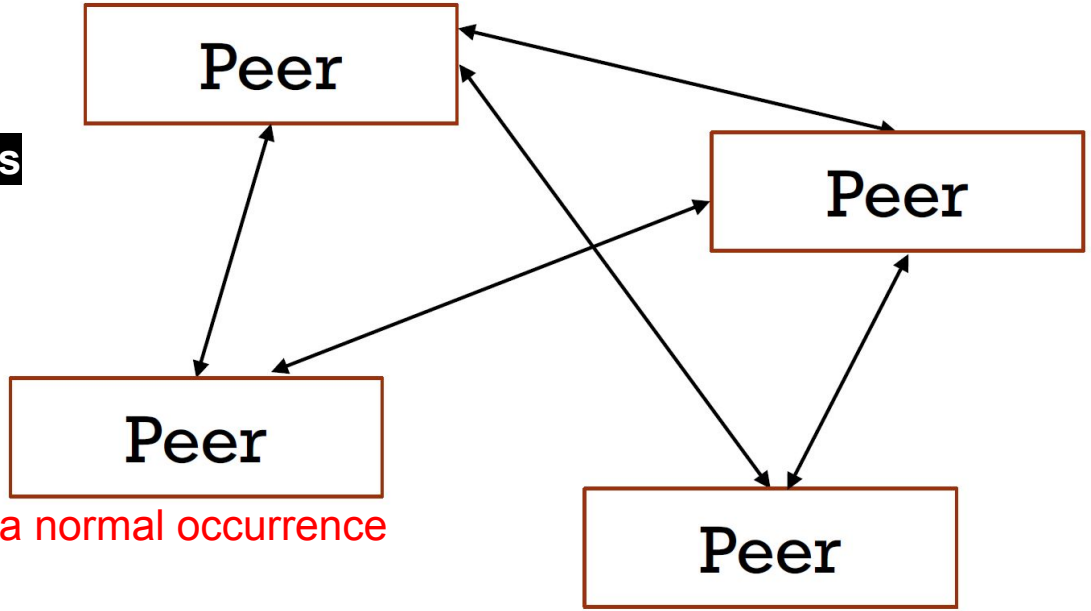

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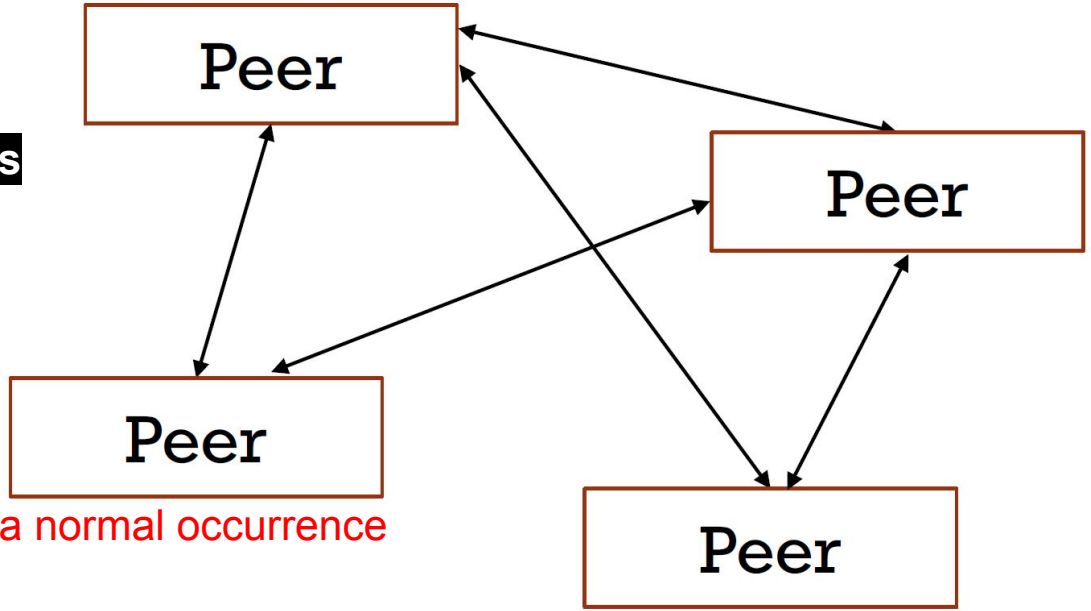

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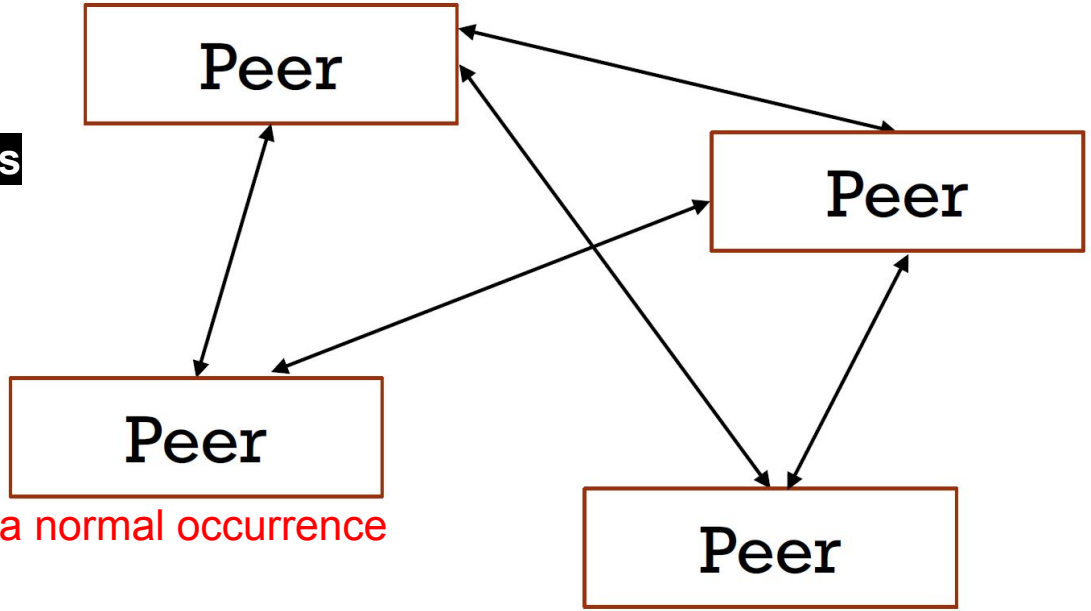

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Handling ____ connections is _____

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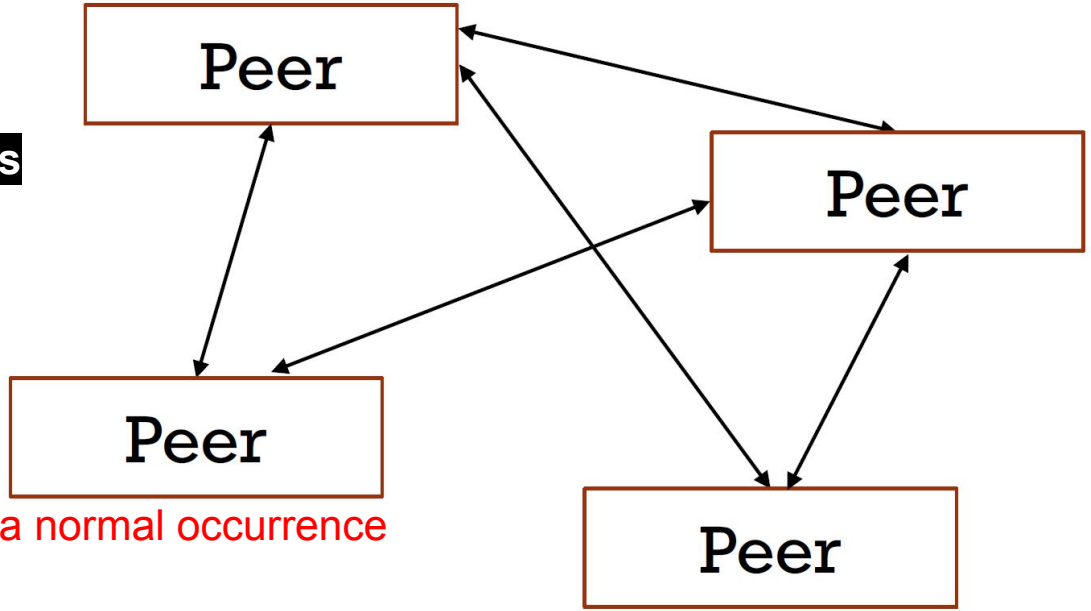
Distributed Systems Structures



Peer to Peer
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Communication is complicated!
Handling client connections is _____

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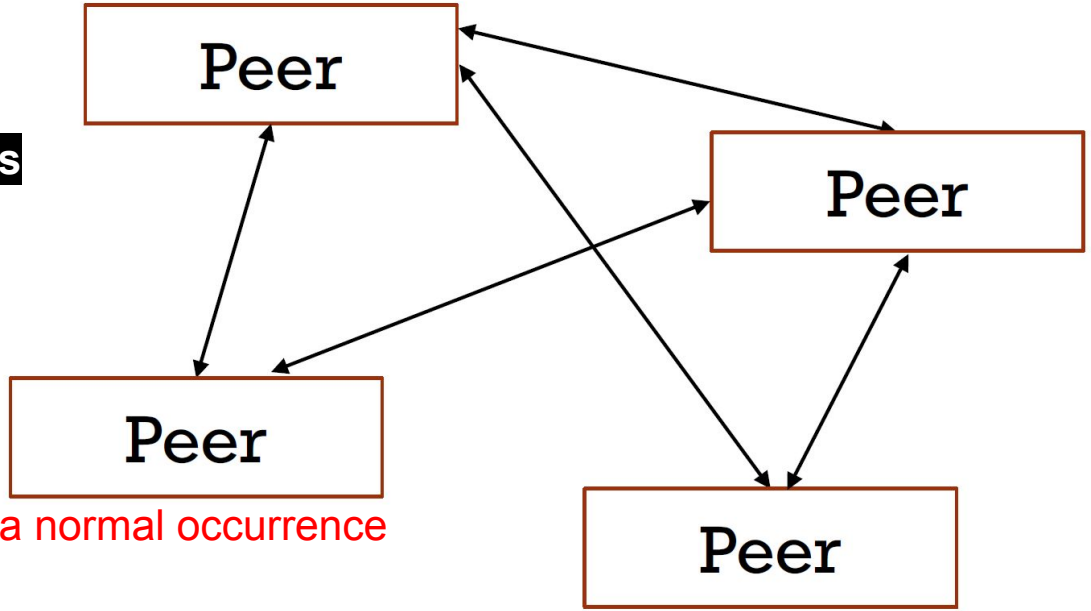
Distributed Systems Structures



Peer to Peer
Pros & Cons

All peers are equal/connected
Failed peers are easy to handle/a normal occurrence
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Easily/Is scalable

Communication is complicated!
Handling client connections is different/more complex

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Threading Pitfalls

- Race Condition
  - One thread is only able to acquire access to part its resources
- Starvation
  - One thread never gets access to the resource it needs
- Deadlock
  - More than one thread accesses a single resource at one time

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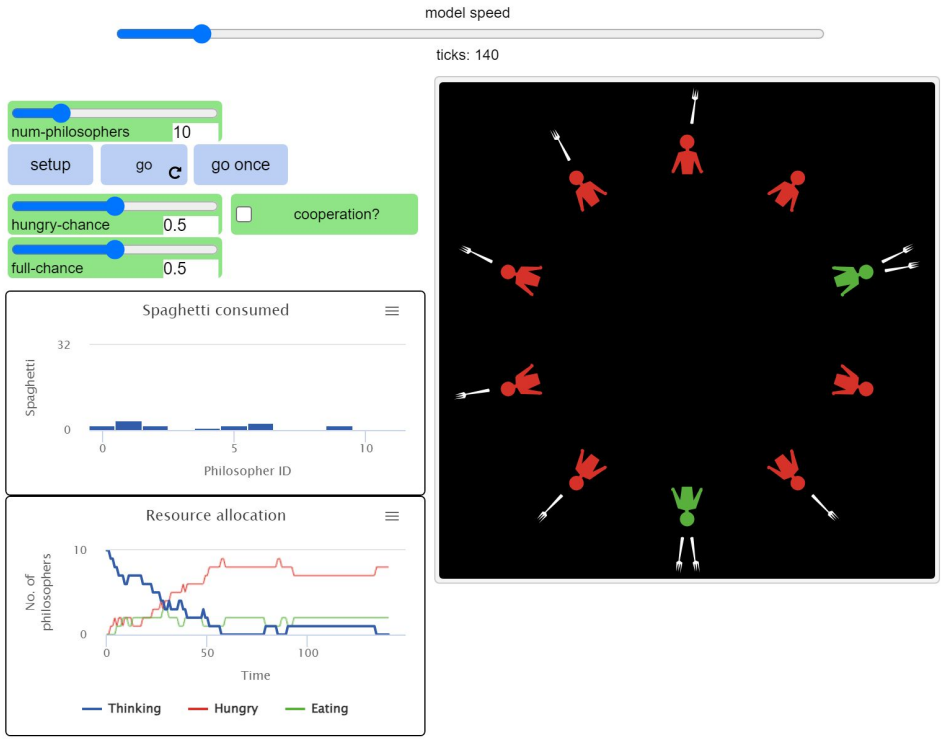
Dining Philosophers Again

Interactive



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Consensus

Consensus is what keeps our nodes consistent

Allows a node to verify or validate something

- Think of it like checking your work
  - I got x=42, what did you get?
- Applies to all data for that node
  - Node *always* checks with the other nodes before assuming a value is correct

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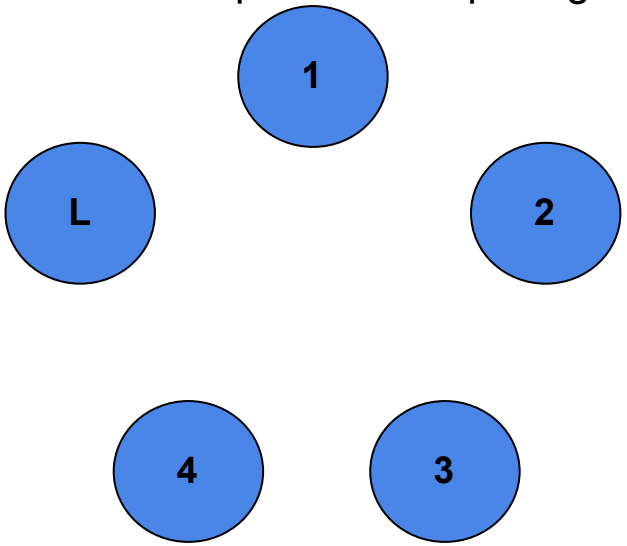
What is a Leader

The **leader** is the node that is in charge

Leader Election algorithms exist with methods for choosing a leader

This leader is the node that is responsible for polling and checking all the other nodes



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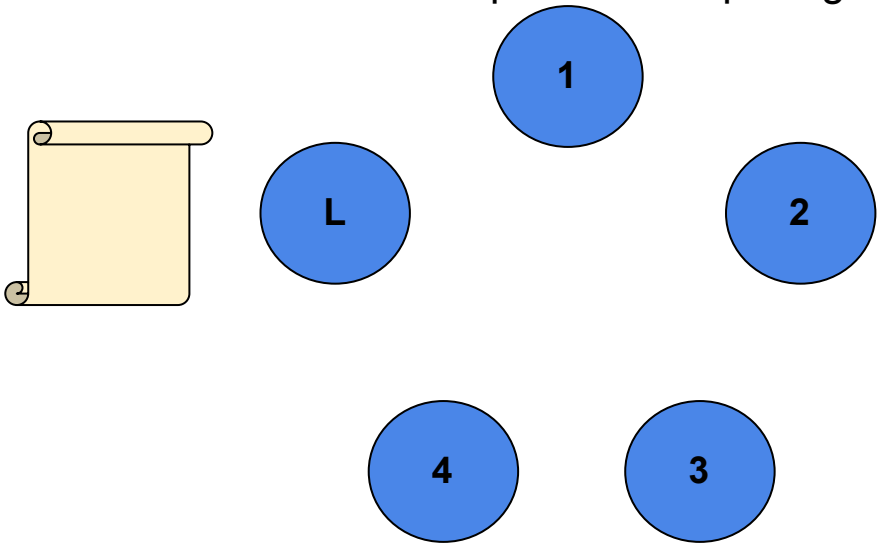

- Poll for consensus
- Determine verdict of consensus polls
- Verify node data matches leader data

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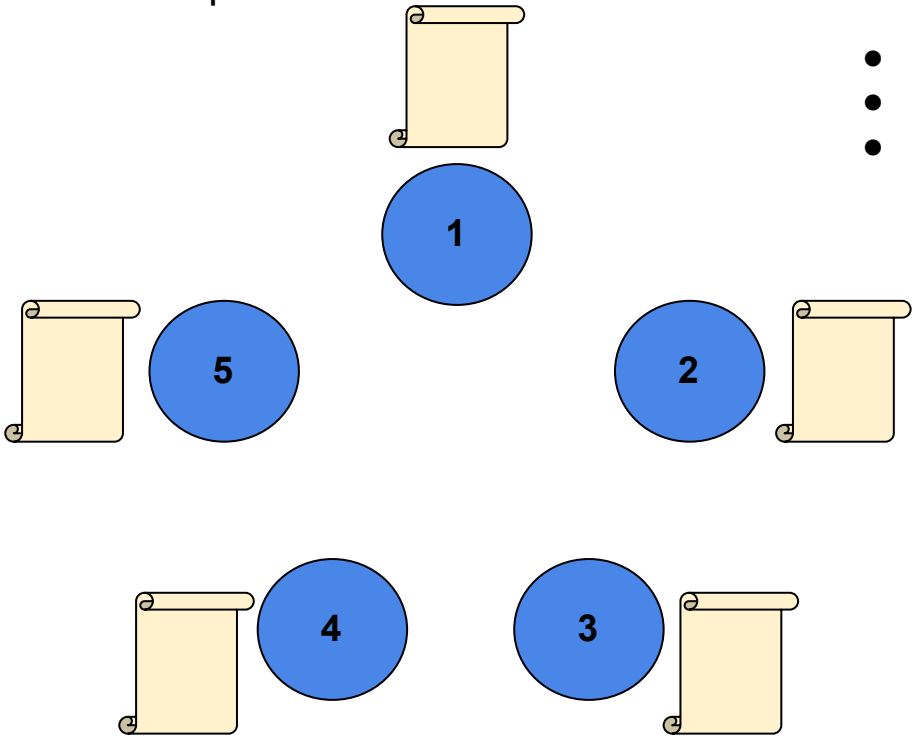
What about Peer to Peer with no leader?

Each node would be responsible its own data and consensus



- Poll other nodes for consensus
- Track poll responses
- Determine if data is valid

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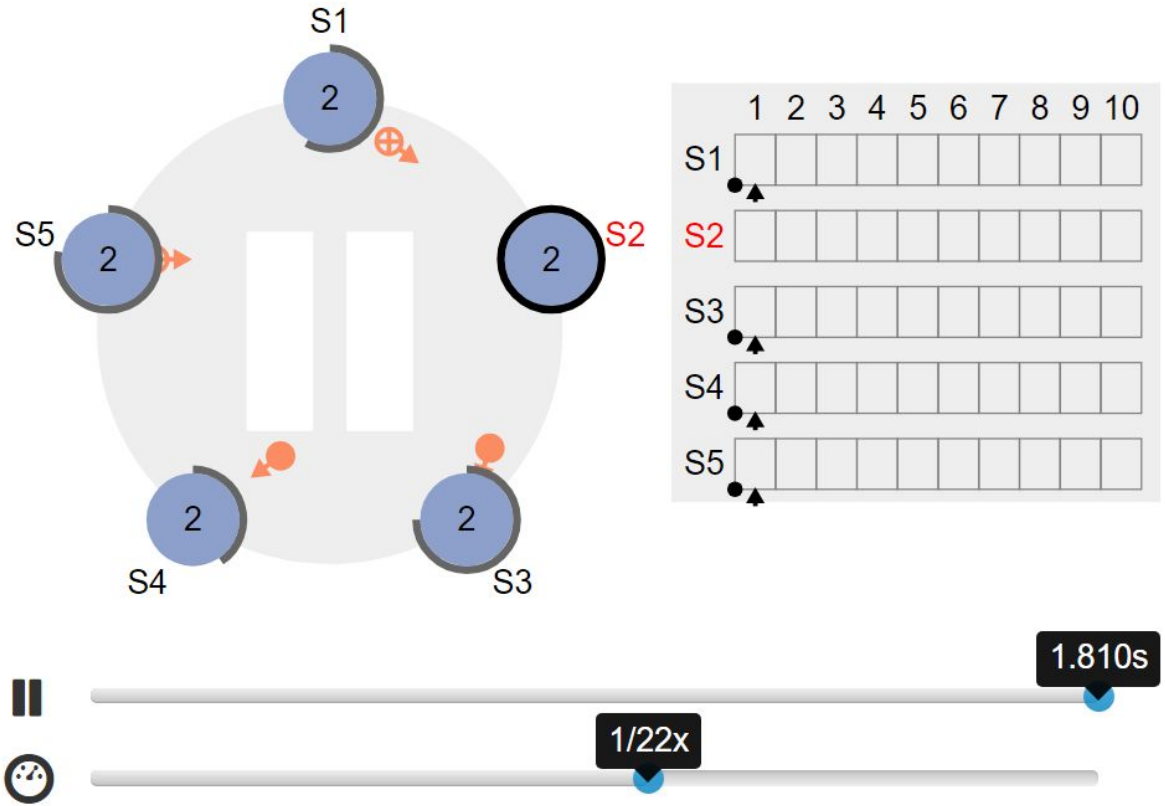
Raft

Consensus Algorithm

Cool interactive here



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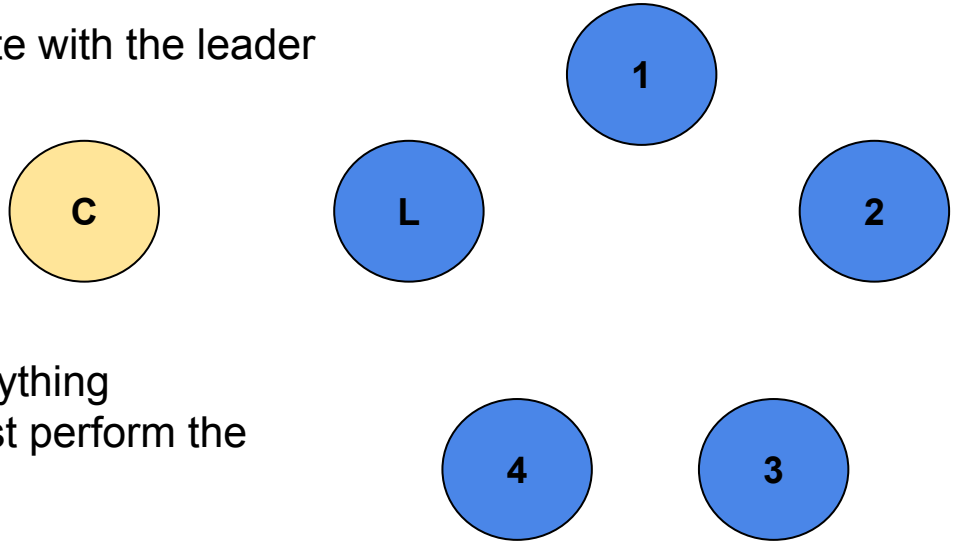
Assignment

You are starting from scratch here - but don't be intimidated!

You are allowed to use code from the examples repo as a base to get you started

Your client will *only* communicate with the leader



The leader is in charge of everything
The nodes are workers that just perform the given task

Questions?

Survey:

https://bit.ly/asn_survey

35

Upcoming Events

SI Sessions:

- Tomorrow Monday September 18th 2023 6:00 pm MST

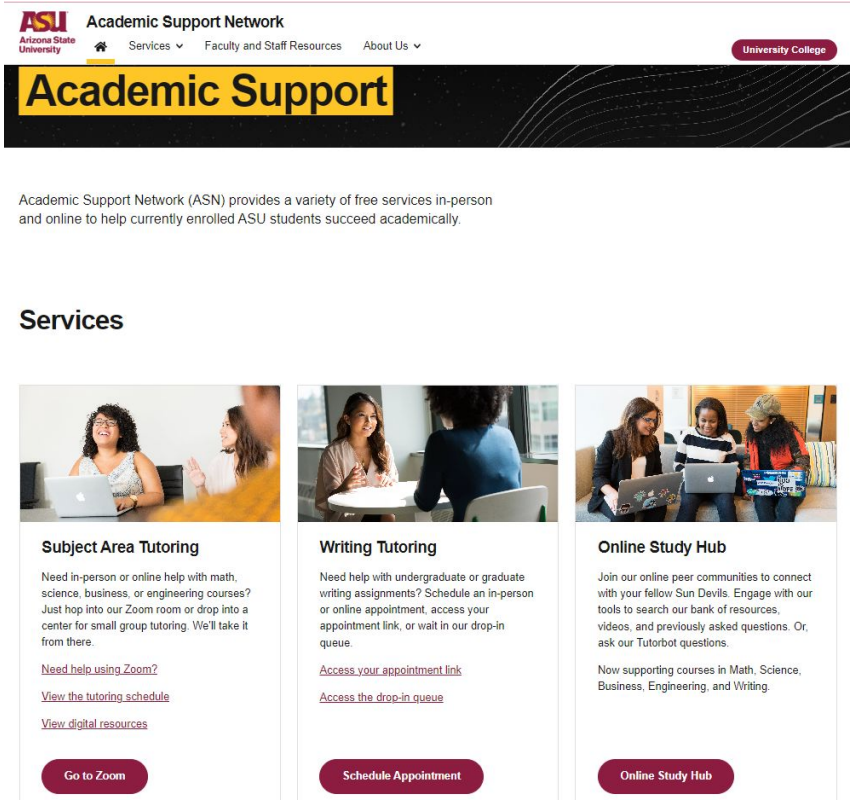
Review Sessions:

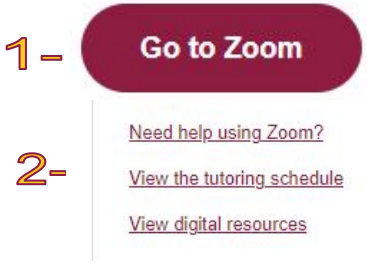
- TBD

More Questions?

Check out our other resources!

tutoring.asu.edu



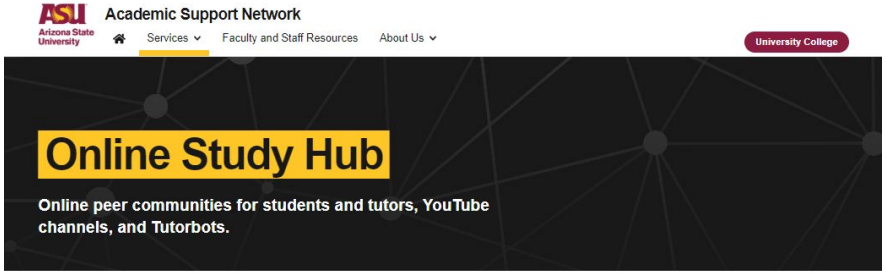


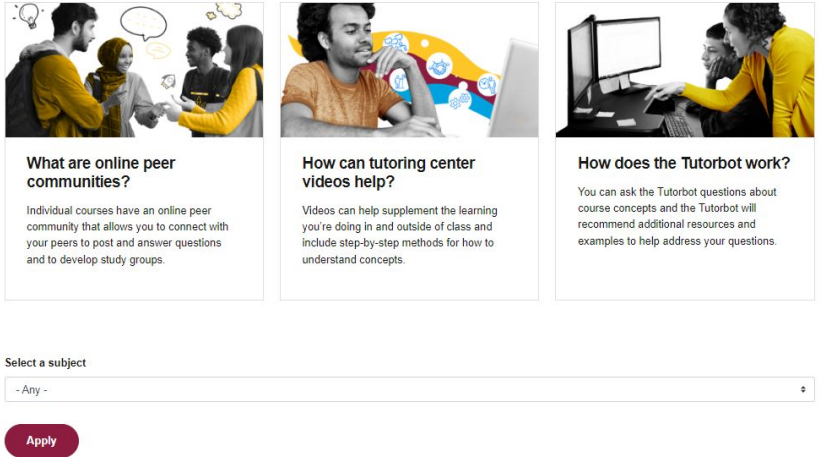
1. **Click on 'Go to Zoom' to log onto our Online Tutoring Center.**
2. **Click on 'View the tutoring schedule' to see when tutors are available for specific courses.**

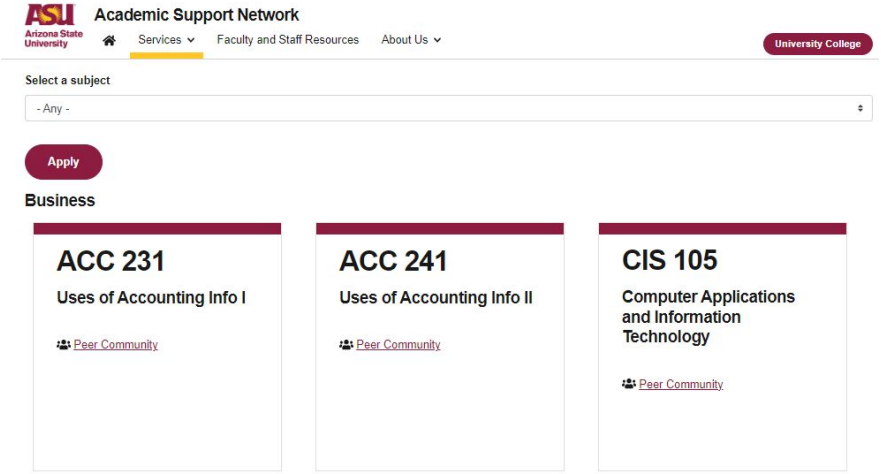
More Questions?

Check out our other resources!

tutoring.asu.edu/online-study-hub







Don't forget to check out the Online Study Hub for additional resources!

Additional Resources

Dining Philosophers Interactive
Raft Interactive