SER 321 B Session

SI Session

Thursday November 9th 2023

7:00 - 8:00 pm MST

Agenda

- Threading Pitfalls & Concurrency
- Distributed Systems
- Different Structures
- Consensus

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

SER 321
Review Session PSA

Scheduling Poll is live in #si_channel

We have roughly 5 sessions remaining, followed by the Review Session

If the Review Session is on Monday (11/27), we can have our regularly scheduled session the day before on Sunday, November 26th

Thursday, November 23rd (Thanksgiving!)
Session is Cancelled for the Holiday

Austin Walter's Traffic Comparison

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Threading Pitfalls

- Race Condition → More than one thread accesses a single resource at one time

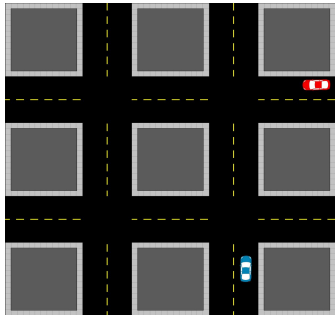
  Crash

- Starvation → One thread never gets access to the resource it needs

  Cross Traffic

- Deadlock → A thread is only able to acquire access to part of its resources

  Gridlock



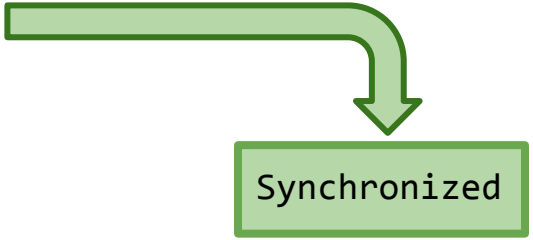
Handling Threaded Pitfalls

Need to prevent threads from stepping on each other!

Mutual Exclusion

Like using a talking stick!

- Locks and semaphores
  - aka Mutex
  - Different types with different capabilities
- Atomic Variables
- Monitor



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Handling Concurrency

Bow and BowBack are both synchronized

The Synchronized keyword marks that method as a *critical section*

So we should be fine, right?

```
Deadlock [:Deadlock.main()]
Deadlock [:Deadlock.main()]: Running 8 sec
:Deadlock.main() 8 sec

9:44:55 PM: Executing ':Deadlock.main()'...

> Task :compileJava
> Task :processResources NO-SOURCE
> Task :classes

> Task :Deadlock.main()
Alphonse: Gaston  has bowed to me!
Gaston: waiting to bow back
Gaston: Alphonse  has bowed to me!
Alphonse: waiting to bow back
```

Deadlock from the examples repo

```java
public class Deadlock {
    6 usages  amehlhase316 *
    static class Friend {
        5 usages
        private final String name;
        2 usages  amehlhase316
        public Friend(String name) { this.name = name; }
        amehlhase316
        public String getName() { return this.name; }
        /* See the README.md for a reference on 'synchronized' methods */
        2 usages  amehlhase316 *
        public synchronized void bow(Friend bower) {
            System.out.format("%s: %s" + "  has bowed to me!%n", this.name, bower.getName());
            System.out.format("%s: waiting to bow back%n", bower.getName());
            bower.bowBack( bower: this);
        }
        1 usage  amehlhase316 *
        public synchronized void bowBack(Friend bower) {
            System.out.format("%s: waiting", this.name);
            System.out.format("%s: %s" + " has bowed back to me!%n", this.name, bower.getName());
        }
    }
    amehlhase316 *
    public static void main(String[] args) {
        final Friend alphonse = new Friend( name: "Alphonse");
        final Friend gaston = new Friend( name: "Gaston");
        /* start two threads - both operating on the same objects */
        amehlhase316
        new Thread(new Runnable() {
            amehlhase316
            public void run() { alphonse.bow(gaston); }
        }).start();
        amehlhase316
        new Thread(new Runnable() {
            amehlhase316
            public void run() { gaston.bow(alphonse); }
        }).start();
    }
}
```

SAME OBJECT
Cannot both be called at once

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Handling Concurrency

How do we fix this?

```
Deadlock [:Deadlock.main()]
Deadlock [:Deadlock.main()]: success 626 ms
> Task :Deadlock.main()
Alphonse: Gaston  has bowed to me!
Gaston: waiting to bow back
Gaston: Alphonse  has bowed to me!
Alphonse: waiting to bow back
Alphonse: waiting
Alphonse: Gaston has bowed back to me!
Gaston: waiting
Gaston: Alphonse has bowed back to me!
```

We can synchronize the `run` method of both threads

or

```java
public class Deadlock {
    6 usages  amehlhase316 *
    static class Friend {
        5 usages
        private final String name;
        2 usages  amehlhase316
        public Friend(String name) { this.name = name; }
        amehlhase316
        public String getName() { return this.name; }
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            System.out.format("%s: waiting to bow back%n", bower.getName());
            bower.bowBack( bower: this);
        }
        1 usage  amehlhase316 *
        public synchronized void bowBack(Friend bower) {
            System.out.format("%s: waiting", this.name);
            System.out.format("%s: %s" + " has bowed back to me!%n", this.name, bower.getName());
        }
    }
    amehlhase316 *
    public static void main(String[] args) {
        final Friend alphonse = new Friend( name: "Alphonse");
        final Friend gaston = new Friend( name: "Gaston");
        /* start two threads - both operating on the same objects */
        amehlhase316 *
        new Thread(new Runnable() {
            new *
            public synchronized void run() { alphonse.bow(gaston); }
        }).start();
        amehlhase316 *
        new Thread(new Runnable() {
            new *
            public synchronized void run() { gaston.bow(alphonse); }
        }).start();
    }
}
```

Deadlock from the examples repo

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Handling Concurrency

How do we fix this?

Deadlock [:Deadlock.main()]

Deadlock [:Deadlock.main()]: success 480 ms

```
> Task :Deadlock.main()
Alphonse: Gaston  has bowed to me!
Gaston: waiting to bow back
Gaston: waiting
Gaston: Alphonse has bowed back to me!
Gaston: Alphonse  has bowed to me!
Alphonse: waiting to bow back
Alphonse: waiting
Alphonse: Gaston has bowed back to me!
```

or

Or we can synchronize the `bowBack` method call

```java
public class Deadlock {
    6 usages  amehlhase316 *
    static class Friend {
        5 usages
        private final String name;
        2 usages  amehlhase316
        public Friend(String name) { this.name = name; }
        amehlhase316
        public String getName() { return this.name; }
        /* See the README.md for a reference on 'synchronized' methods */
        2 usages  amehlhase316 *
        public synchronized void bow(Friend bower) {
            System.out.format("%s: %s" + "  has bowed to me!%n", this.name, bower.getName());
            System.out.format("%s: waiting to bow back%n", bower.getName());
            synchronized(this) {
                bower.bowBack( bower: this);
            }
        }
        1 usage  amehlhase316 *
        public synchronized void bowBack(Friend bower) {
            System.out.format("%s: waiting%n", this.name);
            System.out.format("%s: %s" + " has bowed back to me!%n", this.name, bower.getName());
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            public void run() { gaston.bow(alphonse); }
        }).start();
    }
}
```

Deadlock from the examples repo

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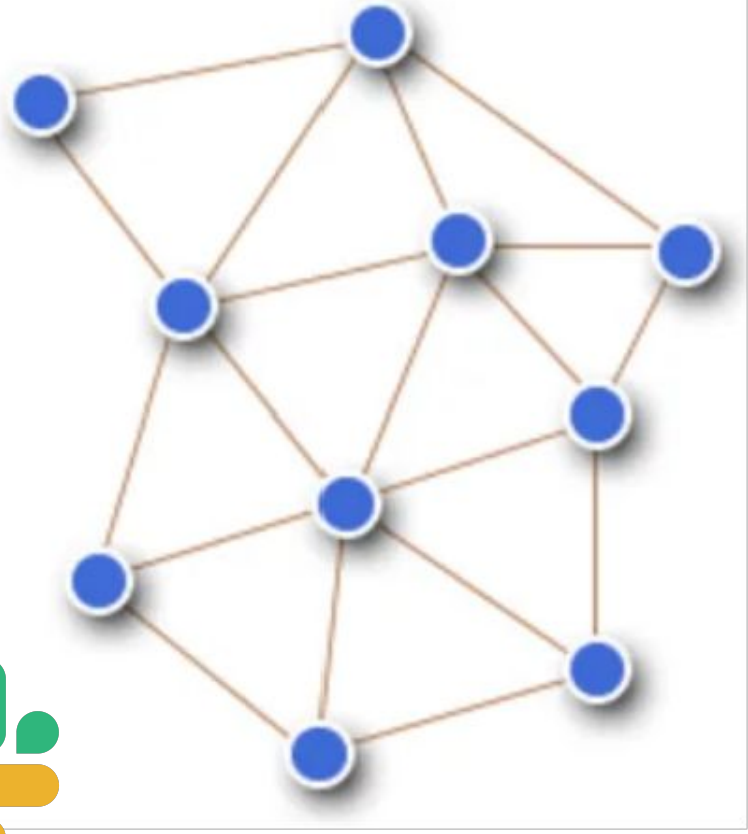
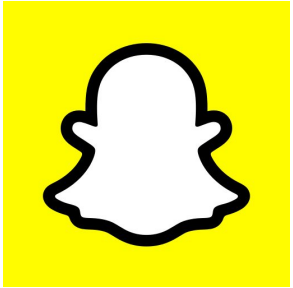
Distributed Algorithms

What's a distributed system again?



Many *nodes* working together that *appear* to be a single system from the outside



zoom

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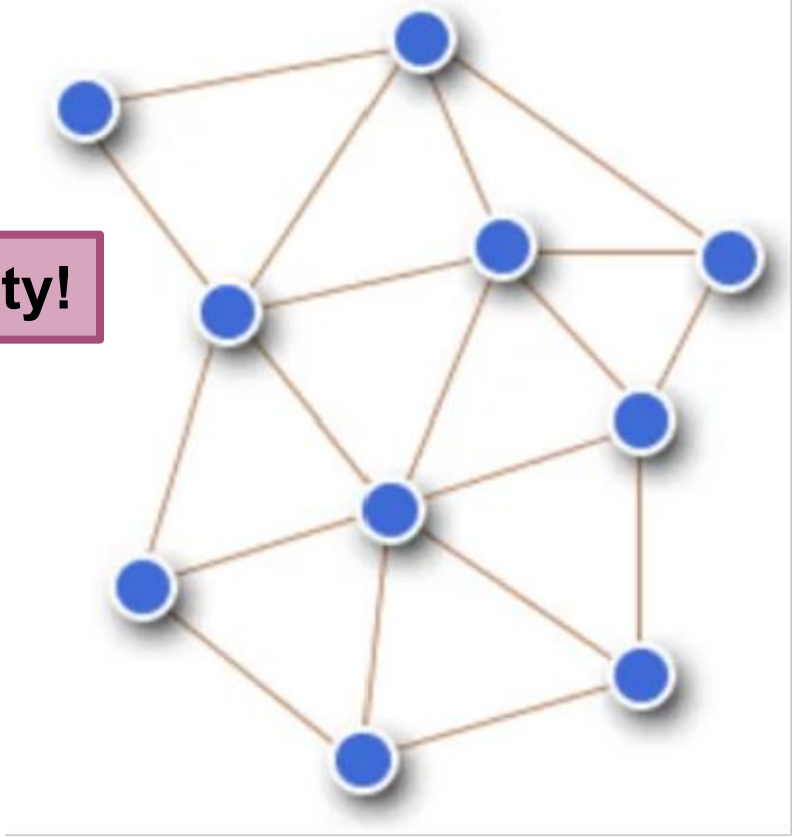
Distributed Algorithms

Common Issues: **aka working in reality!**

- 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 - everyone goes eventually



We look at two main structure forms:

Peer to Peer

Main and Worker

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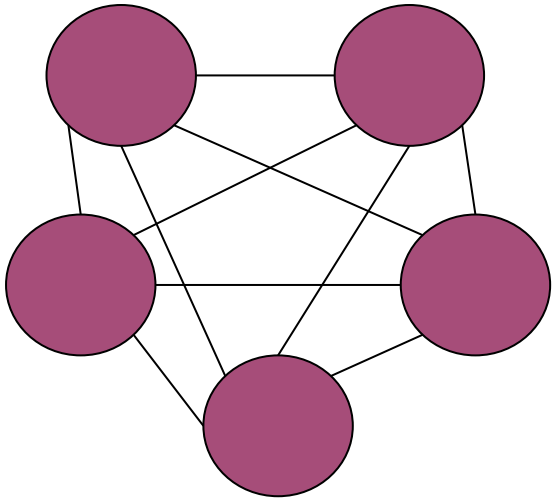
Distributed Algorithms

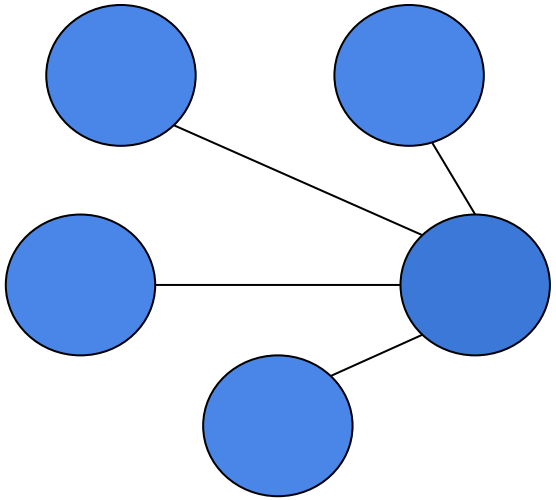
Which is which?

Main and Worker

Peer to Peer

Check out the recording for the solution!





Pros and Cons

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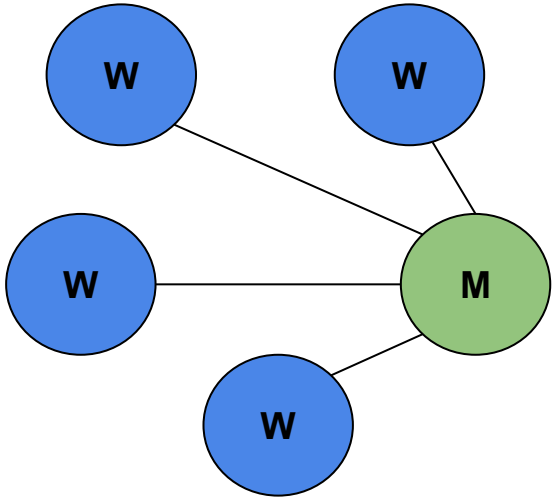
Distributed Algorithms



PRO

CON

Check out the recording for the solution!

Pros and Cons

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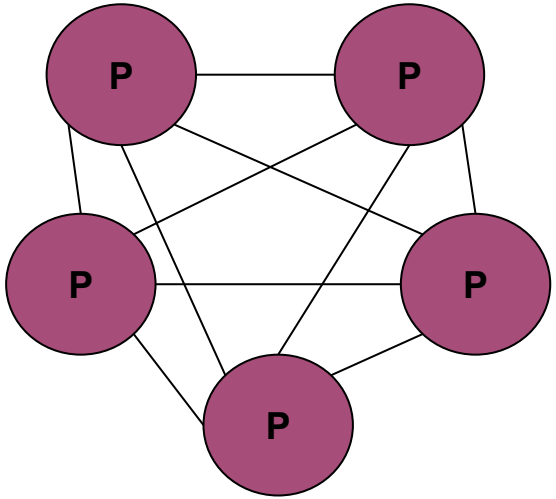
Distributed Algorithms



PRO

CON

Check out the recording for the solution!

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Consensus

What is Consensus?

A. Systematic calculating and recording of information about a given population

B. General agreement or trust amongst a group

C. Controversial; causing or likely to cause an argument

D. No Idea…

Check out the recording for the solution!

Questions?

Survey:

https://bit.ly/asn_survey

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Upcoming Events

SI Sessions:

- Sunday, November 12th 2023 at 7:00 pm MST
- Monday, November 13th 2023 at 4:00 pm MST
- Thursday, November 16th 2023 at 7:00 pm MST
- Sunday, November 19th 2023 at 7:00 pm MST
- Monday, November 20th 2023 at 4:00 pm MST

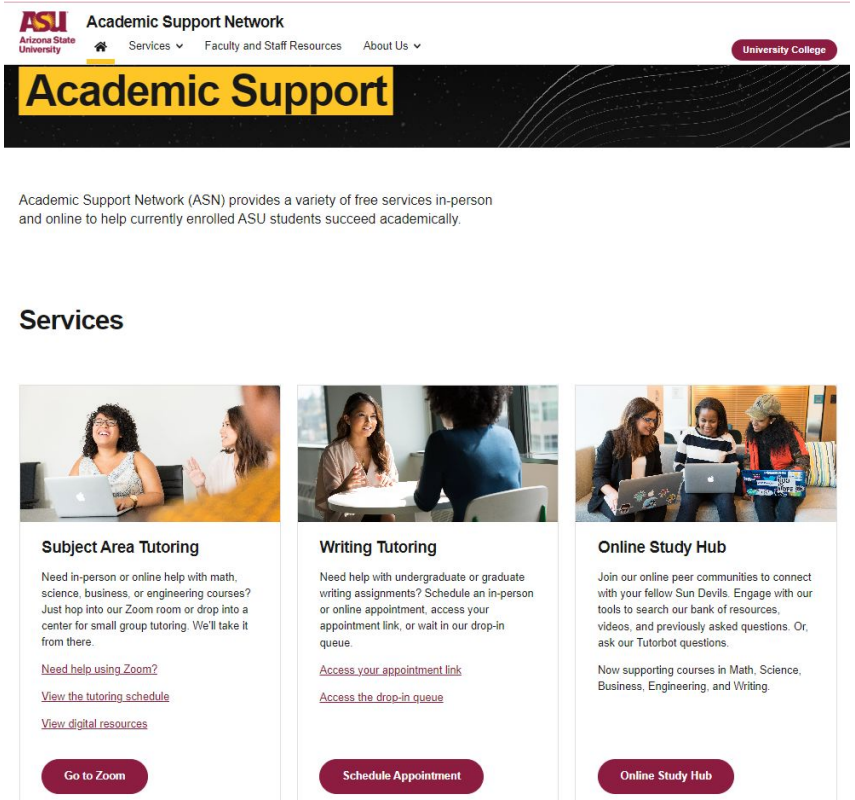
Review Sessions:

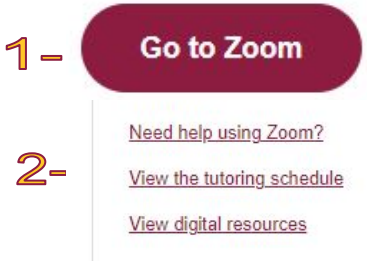
- Survey is LIVE in the #si_channel
- Sunday, November 26th or Monday November 27th

More Questions?

Check out our other resources!

tutoring.asu.edu



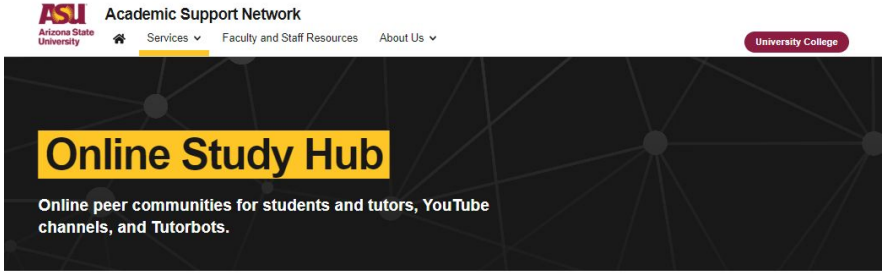


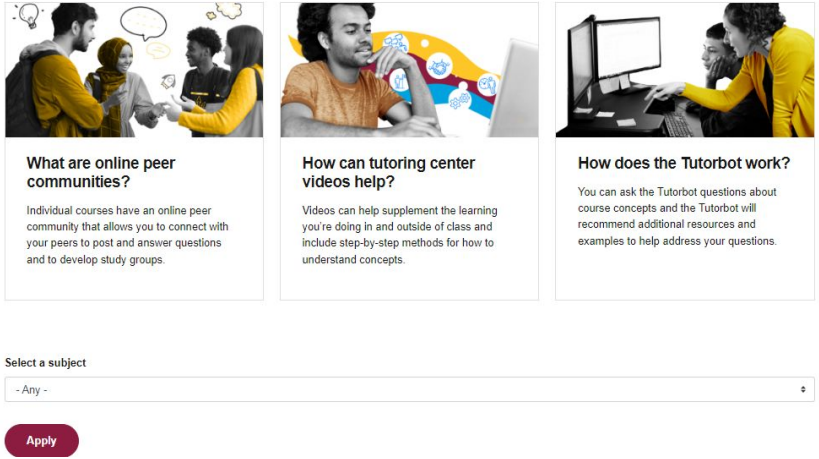
1. **Click on 'Go to Zoom' to log onto our Online Tutoring Center.**
2. **Click on 'View the tutoring schedule' to see when tutors are available for specific courses.**

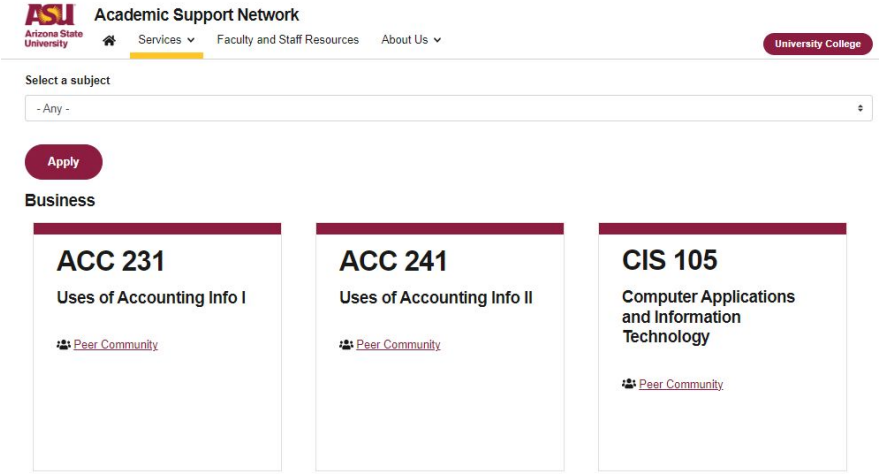
More Questions?

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

CoureRepo

Dining Philosophers Interactive

Austin Walter’s Traffic Comparison

RAFT