

SER 321 B Session

SI Session

Thursday, April 11th 2024

7:00 pm - 8:00 pm MST

Agenda



Concurrency Constructs

Deadlock Examples and Solutions

Distributed Structures

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

Concurrency Structures

Can we name some concurrency structures?

Atomic Operations &
Variables

Locks

Semaphores

Monitors

SER 321

Concurrency Structures

Atomic Operations & Variables

Recall *registers*...

Ensures updates are immediately visible for the local copy in *each thread*

```
int main() {  
    int w = 5;  
    int x = 3 + 9;  
    int y = w + 7;  
    int z = x + y;  
    printf("Calculated: %d\n", z);  
    return 0;  
}
```

main:

```
pushq    %rbp  
movq     %rsp, %rbp  
subq     $48, %rsp  
call     __main  
movl     $5, -4(%rbp)  
movl     $12, -8(%rbp)  
movl     -4(%rbp), %eax  
addl     $7, %eax  
movl     %eax, -12(%rbp)  
movl     -8(%rbp), %edx  
movl     -12(%rbp), %eax  
addl     %edx, %eax  
movl     %eax, -16(%rbp)  
movl     -16(%rbp), %eax  
movl     %eax, %edx  
leaq     .LC0(%rip), %rax  
movq     %rax, %rcx  
call     printf  
movl     $0, %eax  
addq     $48, %rsp  
popq     %rbp  
ret
```

SER 321

Concurrency Structures

Atomic Operations &
Variables

Recall *registers...*

Ensures updates are
immediately visible for
the local copy in
each thread

Thread X

Copy of Data

Process 1

data

Thread

Thread

Thread

The *shared* data variable
is only updated if needed

SER 321

Concurrency Structures

Pros and Cons?

Locks

Acquire the Lock



Open & Enter

Close & Lock

Release the Lock

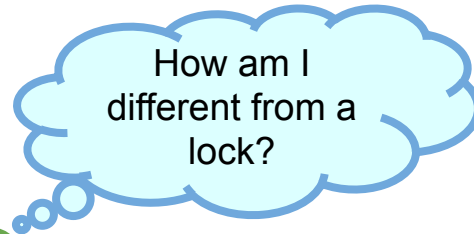


Unlock & Exit



SER 321

Concurrency Structures



Semaphores



More
than one
stall!

Acquire Lock



Open & Enter

Close & Lock

Release Lock



Unlock & Exit

Semaphores support
more than one acquirer

When would that be beneficial?

SER 321

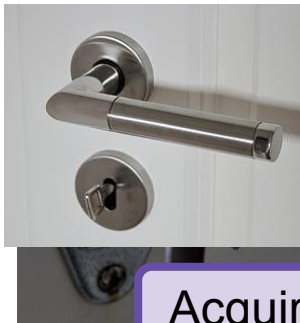
Concurrency Structures

Pros and Cons?

Monitors



You lock
the main
door
instead!



Covers the
entire object

Acquire Lock



Open & Enter

Close & Lock

Release Lock



Unlock & Exit

SER 321

Threading Pitfalls

As the project name implies, we encounter a **deadlock**.

But what happened?

```
class SockClient {  
    public static void main (String args[]) throws Exception {  
        Socket      sock = new Socket( host: "localhost", port: 8888);    //Any IP name  
  
        ObjectInputStream in = new ObjectInputStream(sock.getInputStream());  
        ObjectOutputStream out = new ObjectOutputStream(sock.getOutputStream());  
  
        String s = (String) in.readObject();  
        out.writeObject("Back at you");  
  
        in.close();  
        out.close();  
        sock.close();  
    }  
}
```

Client

```
class SockServer {  
    public static void main (String args[]) throws Exception {  
  
        int count = 0;  
        ServerSocket      serv = new ServerSocket( port: 8888);  
  
        Socket sock = serv.accept();  
  
        ObjectInputStream in = new ObjectInputStream(sock.getInputStream());  
        ObjectOutputStream out = new ObjectOutputStream(sock.getOutputStream());  
  
        String s = (String) in.readObject();  
        System.out.println("Received " + s);  
        out.writeObject("Back at you");  
        System.out.println("Received " + s);  
  
        in.close();  
        out.close();  
        sock.close();  
    }  
}
```

Server

```
PS C:\ASU\SER321\examples_repo\ser321examples\Threads\NetworkDeadlock> gradle  
server  
<=====--> 75% EXECUTING [1m 33s]  
> :server  
█
```

```
PS C:\ASU\SER321\examples_repo\ser321examples\Threads\NetworkDeadlock> gradle  
client  
Starting a Gradle Daemon, 1 busy and 1 stopped Daemons could not be reused, use  
--status for details  
<=====--> 75% EXECUTING [53s]  
> :client  
█
```

Deadlock

SER 321

Concurrency Structures

How can we fix this?

What happened??

```
PS C:\ASU\SER321\examples_repo\ser321examples\Threads\DeadLock> gradle run
Starting a Gradle Daemon (subsequent builds will be faster)
```

```
> Task :run
```

```
Alphonse: Gaston has bowed to me!
```

```
Gaston: waiting to bow back
```

```
Gaston: Alphonse has bowed to me!
```

```
Alphonse: waiting to bow back
```

```
<=====----> 75% EXECUTING [18s]
```

```
> :run
```

```
public class Deadlock {
    6 usages
    static class Friend {
        5 usages
        private final String name;
        2 usages
        public Friend(String name) { this.name = name; }
        public String getName() { return this.name; }
        /* See the README.md for a reference on 'synchronized' methods */
        2 usages
        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
        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());
        }
    }

    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 */
        new Thread(new Runnable() {
            public void run() { alphonse.bow(gaston); }
        }).start();
        new Thread(new Runnable() {
            public void run() { gaston.bow(alphonse); }
        }).start();
    }
}
```

Deadlock

SER 321

Concurrency Structures

How can we fix this?

Remove the synchronized methods

```
public void bow
```

```
public void bowBack
```

Synchronize the bowBack call

```
synchronized(bower.bowBack(this));
```

Synchronize the bowBack call with a synchronized statement

```
synchronized (this) { bower.bowBack( bower: this); }
```

Synchronize the run method calls

```
public synchronized void run() { alphonse.bow(gaston); }
```

```
public synchronized void run() { gaston.bow(alphonse); }
```

```
public class Deadlock {
    6 usages
    static class Friend {
        5 usages
        private final String name;
        2 usages
        public Friend(String name) { this.name = name; }
        public String getName() { return this.name; }
        /* See the README.md for a reference on 'synchronized' methods */
        2 usages
        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
        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());
        }
    }

    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 */
        new Thread(new Runnable() {
            public void run() { alphonse.bow(gaston); }
        }).start();
        new Thread(new Runnable() {
            public void run() { gaston.bow(alphonse); }
        }).start();
    }
}
```

Deadlock

SER 321

Concurrency Structures

Remove the synchronized methods

```
public void bow      public void bowBack
```

Synchronize the bowBack call

```
synchronized(bower.bowBack(this));
```

Synchronize the bowBack call with a synchronized statement

```
synchronized (this) { bower.bowBack( bower: this); }
```

Synchronize the run method calls

```
public synchronized void run() { alphonse.bow(gaston); }
```

```
public synchronized void run() { gaston.bow(alfonse); }
```

How can we fix this?



RACE

```
public class Deadlock {  
    6 usages  
    static class Friend {  
        5 usages
```

> Task :run

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!

+ " has bowed back to me!\n",

> Task :run

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!

Deadlock

SER 321

Concurrency Structures

How can we fix this?

Remove the synchronized methods



```
public void bow
```

```
public void bowBack
```

Synchronize the bowBack call



```
synchronized(bower.bowBack(this));
```

Synchronize the bowBack call with a synchronized statement

```
synchronized (this) { bower.bowBack( bower: this); }
```

Synchronize the run method calls

```
public synchronized void run() { alphonse.bow(gaston); }
```

```
public synchronized void run() { gaston.bow(alphonse); }
```

```
public class Deadlock {
    6 usages
    static class Friend {
        5 usages
        private final String name;
        2 usages
        public Friend(String name) { this.name = name; }
        public String getName() { return this.name; }
        /* See the README.md for a reference on 'synchronized' methods */
        2 usages
        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
        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());
        }
    }
}
```

Required type: Object

Provided: void

© Deadlock.Friend

```
public void bowBack(
    @NotNull Deadlock.Friend bower
) {
    // same objects */
}
```

Deadlock.main

```
}).start();
```

Deadlock

SER 321

Concurrency Structures

How can we fix this?

Remove the synchronized methods



```
public void bow      public void bowBack
```

Synchronize the bowBack call



```
synchronized(bower.bowBack(this));
```

Synchronize the bowBack call with a synchronized statement



```
synchronized (this) { bower.bowBack( bower: this); }
```

Synchronize the run method calls



```
public synchronized void run() { alphonse.bow(gaston); }
```

```
public synchronized void run() { gaston.bow(alfonse); }
```

```
public class Deadlock {  
    6 usages  
    static class Friend {  
        5 usages  
        private final String name;  
        2 usages  
        public Friend(String name) { this.name = name; }  
        public String getName() { return this.name; }  
        /* See the README.md for a reference on 'synchronized' methods */  
    }  
    2 usages  
}
```

> Task :run

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!

Deprecated Gradle features were used in

You can use '--warning-mode all' to show

See <https://docs.gradle.org/7.4.2/userguide>

BUILD SUCCESSFUL in 1s

2 actionable tasks: 2 executed

SER 321

Concurrency Structures

RECAP

Atomic Operations &
Variables

YOU control the
locks directly

Locks

YOU control the
locks directly

Semaphores

YOU control the
locks directly

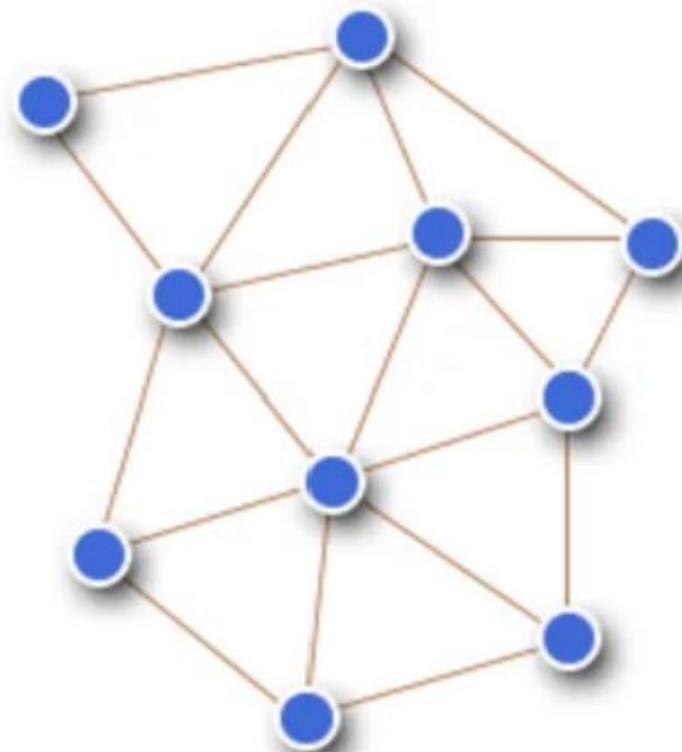
Monitors

Locks managed
for you

SER 321

Distributed Systems

What do we mean by
“Distributed Systems”
or
“Distributed Algorithms”?



SER 321

Scratch Space

Questions?

Survey:

<http://bit.ly/ASN2324>



Upcoming Events

SI Sessions:

- Sunday, April 14th at 7:00 pm MST
- Monday, April 15th at 7:00 pm MST
- Thursday, April 18th at 7:00 pm MST

Review Sessions:

- Sunday, April 21st at 7:00 pm MST
- **Thursday, April 25th Session is *cancelled***

More Questions?

Check out our other resources!

tutoring.asu.edu



Academic Support

Academic Support Network (ASN) provides a variety of free services in-person and online to help currently enrolled ASU students succeed academically.

Services



Subject Area Tutoring

Need in-person or online help with math, science, business, or engineering courses? Just hop into our Zoom room or drop into a center for small group tutoring. We'll take it from there.

[Need help using Zoom?](#)

[View the tutoring schedule](#)

[View digital resources](#)

Go to Zoom



Writing Tutoring

Need help with undergraduate or graduate writing assignments? Schedule an in-person or online appointment, access your appointment link, or wait in our drop-in queue.

[Access your appointment link](#)

[Access the drop-in queue](#)

Schedule Appointment



Online Study Hub

Join our online peer communities to connect with your fellow Sun Devils. Engage with our tools to search our bank of resources, videos, and previously asked questions. Or, ask our Tutorbot questions.

Now supporting courses in Math, Science, Business, Engineering, and Writing.

Online Study Hub

1-

Go to Zoom

2-

[Need help using Zoom?](#)

[View the tutoring schedule](#)

[View digital resources](#)



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

 **Academic Support Network**

 [Services](#)  [Faculty and Staff Resources](#) [About Us](#) 

[University College](#)

Online Study Hub

Online peer communities for students and tutors, YouTube channels, and Tutorbots.



What are online peer communities?

Individual courses have an online peer community that allows you to connect with your peers to post and answer questions and to develop study groups.



How can tutoring center videos help?

Videos can help supplement the learning you're doing in and outside of class and include step-by-step methods for how to understand concepts.



How does the Tutorbot work?

You can ask the Tutorbot questions about course concepts and the Tutorbot will recommend additional resources and examples to help address your questions.

Select a subject

- Any -

[Apply](#)



Academic Support Network



[Services](#) 

[Faculty and Staff Resources](#)

[About Us](#) 

[University College](#)

Select a subject

- Any -

[Apply](#)

Business


ACC 231

Uses of Accounting Info I

 [Peer Community](#)

ACC 241

Uses of Accounting Info II

 [Peer Community](#)

CIS 105

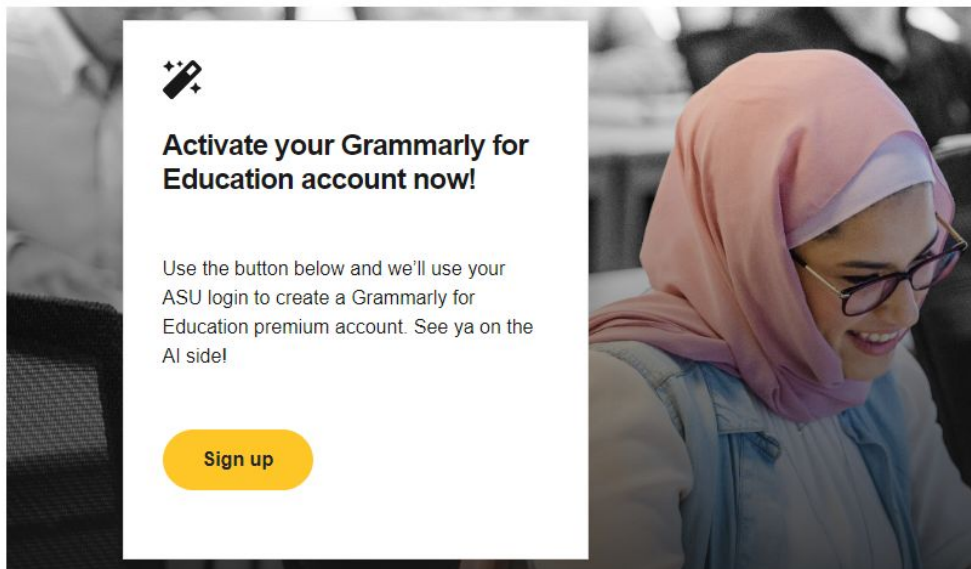
Computer Applications and Information Technology

 [Peer Community](#)

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

Expanded Writing Support Available

Including Grammarly for Education, at no cost!



tutoring.asu.edu/expanded-writing-support

*Available slots for this pilot are limited

Additional Resources

- [Course Repo](#)
- [Gradle Documentation](#)
- [GitHub SSH Help](#)
- [Linux Man Pages](#)
- [OSI Interactive](#)
- [MDN HTTP Docs](#)
 - [Requests](#)
 - [Responses](#)
- [JSON Guide](#)
- [org.json Docs](#)
- [javax.swing package API](#)
- [Swing Tutorials](#)
- [Dining Philosophers Interactive](#)
- [Austin G Walters Traffic Comparison](#)