SER 321 B Session

SI Session

Thursday, November 14th 2024

7:00 pm - 8:00 pm MST

Agenda

- Protobuf PSA
- Threading Pitfalls
- Concurrency 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

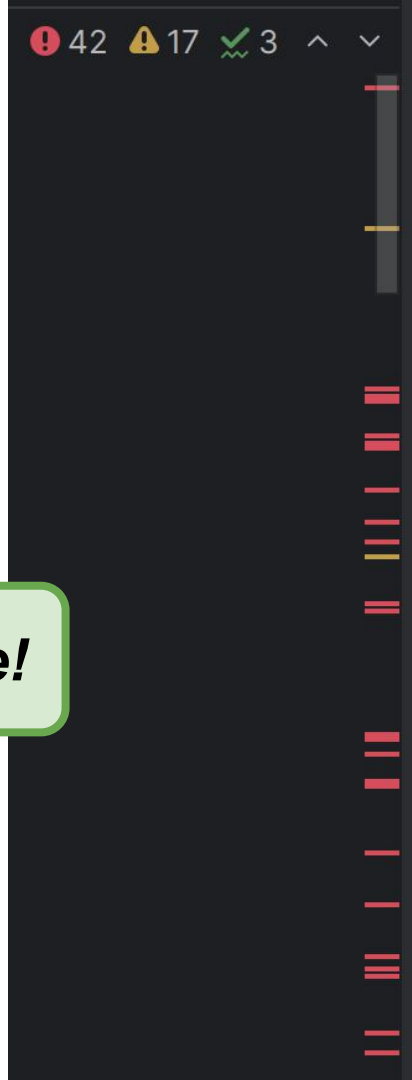
Zoom Chat

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

SER 321
Protobufs

Quick PSA for Protobufs!

You must generate the Protobufs for use!



4-2 Starter Code

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Protobufs

Assignment4.2given Version control Current File

Project

- Assignment4.2given C:\ASU\SI_Stuff\f
  - .gradle
  - .idea
  - gradle
  - src
    - main
      - java
        - client
        - server
          - Game
          - SockBaseServer
      - proto
        - request.proto
        - response.proto
    - test
  - .gitignore
  - build.gradle
  - gradlew
  - gradlew.bat
  - PROTOCOL.md
  - README.md
- External Libraries
- Scratches and Consoles

README.md build.gradle (Assignment4.2given) SockBaseServer.java

```
package server;

import ...

class SockBaseServer {
    static String logFilename = "logs.txt";  3 usages

    // Please use these as given so it works with our test cases
    static String menuOptions = "\nWhat would you like to do? \n 1 - to see
    static String gameOptions = "\nChoose an action: \n (1-9) - Enter an int


    ServerSocket serv = null;  no usages
    InputStream in = null;  3 usages
    OutputStream out = null;  4 usages
    Socket clientSocket = null;  4 usages
    private final int id; // client id  2 usages

    Game game; // current game  3 usages

    private boolean inGame = false; // a game was started (you can de
    private String name; // player name  4 usages

    private int currentState =1; // I used something like this to keep track

    private static boolean grading = true; // if the grading board should be

    public SockBaseServer(Socket sock, Game game, int id) {  1 usage
        this.clientSocket = sock;
        this.game = game;
        this.id = id;
        try {
            in = clientSocket.getInputStream();
```

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Gradle

- Assignment4.2given
  - Tasks
    - build
    - build setup
    - documentation
    - help
    - other
      - arguments
      - compileJava
      - compileTestJava
      - components
      - dependentComponents
      - extractIncludeProto
      - extractIncludeTestProto
      - extractProto
      - extractTestProto
      - generateProto
      - generateTestProto
      - model
      - prepareKotlinBuildScriptMode
      - processResources
      - processTestResources
      - runClient
      - runServer
      - runServerGrading
    - verification
  - Dependencies

Assignment4.2given > src > main > java > server > SockBaseServer 2:1 LF UTF-8 4 spaces

4-2 Starter Code

SER 321

Protobufs

Assignment4.2given Version control Current File

Project

- Assignment4.2given C:\ASU\SI_Stuff\f
  - .gradle
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  - gradle
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        - request.proto
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    - test
  - .gitignore
  - build.gradle
  - gradlew
  - gradlew.bat
  - PROTOCOL.md
  - README.md

README.md build.gradle (Assignment4.2given) SockBaseServer.java

```
1   package server;
2
3   import ...
12
13  class SockBaseServer {
14      static String logFilename = "logs.txt";  3 usages
15
16      // Please use these as given so it works with our test cases
17      static String menuOptions = "\nWhat would you like to do? \n 1 - to see
18      static String gameOptions = "\nChoose an action: \n (1-9) - Enter an in
19
20
21      ServerSocket serv = null;  no usages
22      InputStream in = null;  3 usages
23      OutputStream out = null;  4 usages
24      Socket clientSocket = null;  4 usages
25      private final int id; // client id  2 usages
26
27      Game game; // current game  3 usages
28
29      private boolean inGame = false; // a game was started (you can decide if
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```

42 17 3

Gradle

- Assignment4.2given
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    - build
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    - help
    - other
      - arguments
      - compileJava
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      - components
      - dependentComponents
      - extractIncludeProto
      - extractIncludeTestProto
      - extractProto
      - extractTestProto
      - generateProto
      - generateTestProto
      - model

Terminal Local

```
PS C:\ASU\SI_Stuff\fall24_b\starter_code\Assignment4.2given> gradle generateProto
```

Assignment4.2given > src > main > java > server > SockBaseServer 2:1 LF UTF-8 4 spaces

4-2 Starter Code

SER 321

Protobufs

Assignment4.2given Version control Current File

Project

- Assignment4.2given C:\ASU\SI_Stuff\f
  - .gradle
  - .idea
  - build
  - gradle
  - src
    - main
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        - client
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        - request.proto
        - response.proto
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README.md build.gradle (Assignment4.2given) SockBaseServer.java

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    private final int id; // client id  2 usages
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Gradle

- Assignment4.2given
  - Tasks
    - build
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      - compileJava
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      - components
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      - extractProto
      - extractTestProto

Terminal Local

```
PS C:\ASU\SI_Stuff\fall24_b\starter_code\Assignment4.2given> gradle generateProto
Starting a Gradle Daemon (subsequent builds will be faster)

Deprecated Gradle features were used in this build, making it incompatible with Gradle 9.0.

You can use '--warning-mode all' to show the individual deprecation warnings and determine if they come from your own scripts or plugins.

For more on this, please refer to https://docs.gradle.org/8.10/userguide/command_line_interface.html#sec:command_line_warnings in the Gradle documentation.

BUILD SUCCESSFUL in 33s
3 actionable tasks: 3 executed
PS C:\ASU\SI_Stuff\fall24_b\starter_code\Assignment4.2given>
```

Assignment4.2given > src > main > java > server > SockBaseServer 2:1 LF UTF-8 4 spaces

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Protobufs

Options for Message Creation

```
Response.newBuilder()
 .setResponseType(Response.ResponseType.GREETING)
 .setMessage("Hello " + name + " and welcome to a simple game of Sudoku.")
 .setMenuoptions(menuOptions)
 .setNext(currentState)
 .build();
```

SockBaseServer

Create the message in a single statement

Create the message in increments

```
Request.Builder req = Request.newBuilder();

switch (response.getResponseType()) {
    case GREETING:
        System.out.println(response.getMessage());
        req = chooseMenu(req, response);
        break;
```

SockBaseClient - main

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Protobufs

Options for Message Creation

```java
static Request.Builder chooseMenu(Request.Builder req, Response response) throws IOException {
    while (true) {
        System.out.println(response.getMenuoptions());
        System.out.print("Enter a number 1-3: ");
        BufferedReader stdin = new BufferedReader(new InputStreamReader(System.in));
        String menu_select = stdin.readLine();
        System.out.println(menu_select);
        switch (menu_select) {
            // needs to include the other requests
            case "2":
                // this is not a complete START request!! Just as examp
                req.setOperationType(Request.OperationType.START);
                return req;
            default:
                System.out.println("\nNot a valid choice, p
                break;
        }
    }
}
```

SockBaseClient - chooseMenu

Need one more step…

```java
Request.Builder req = Request.newBuilder();

switch (response.getResponseType()) {
    case GREETING:
        System.out.println(response.getMessage());
        req = chooseMenu(req, response);
        break;
```

SockBaseClient - main

```java
req.build().writeDelimitedTo(out);
```

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Protobufs

Parsing Messages

GETTERS!

```
System.out.println("Got a response: " + response.toString());
```

```
switch (response.getResponseType()) {
    case GREETING:
        System.out.println(response.getMessage());
        req = chooseMenu(req, response);
        break;
```

Fetch a single value

Fetch a *repeated* value

```
for (Entry lead: response3.getLeaderList()){
    System.out.println(lead.getName() + ": " + lead.getPoints());
}
```

Austin Walter's Traffic Comparison

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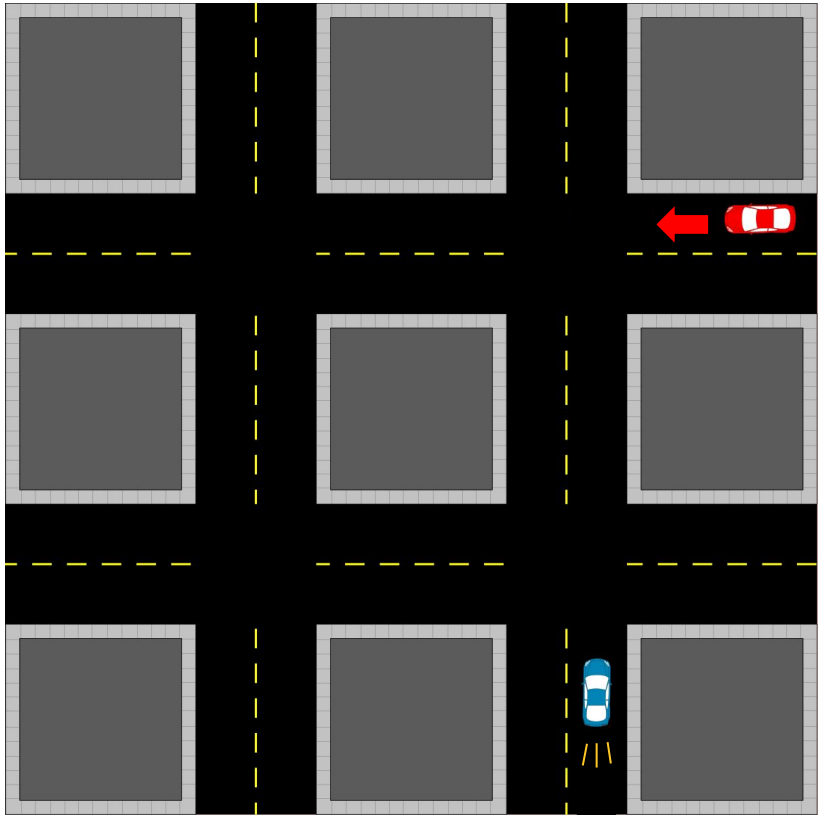
Threading Pitfalls

Race Condition

Crash

More than one thread accesses a single resource at once



Austin Walter's Traffic Comparison

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Threading Pitfalls

Race Condition

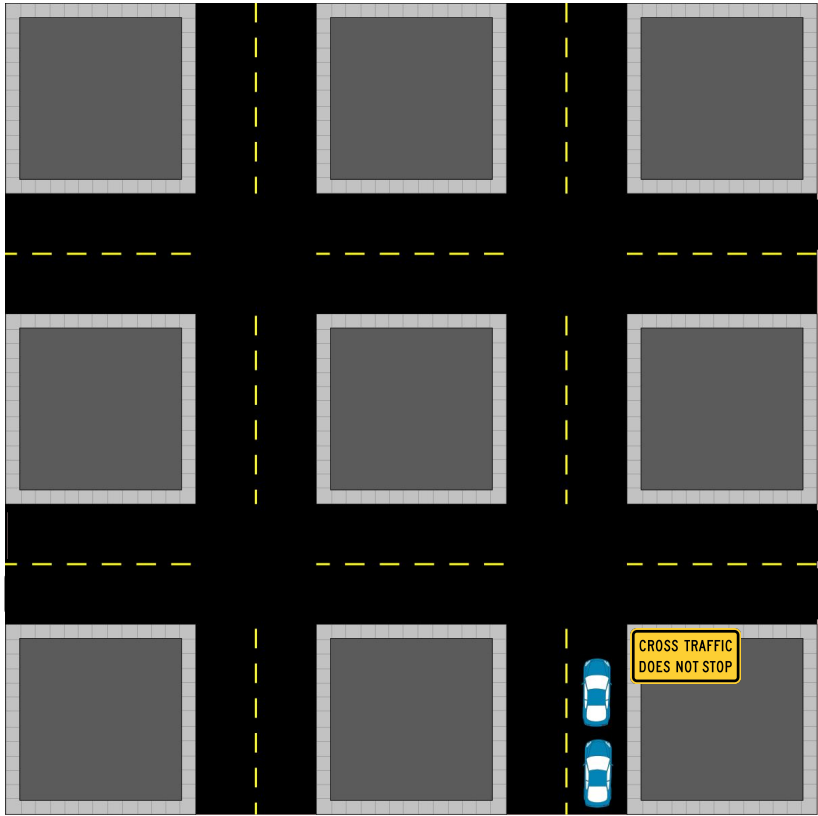
Crash

More than one thread accesses a single resource at once

Starvation

Cross Traffic

A thread never gains access to the resource it needs



Austin Walter's Traffic Comparison

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Threading Pitfalls

Race Condition

Crash

More than one thread accesses a single resource at once

Starvation

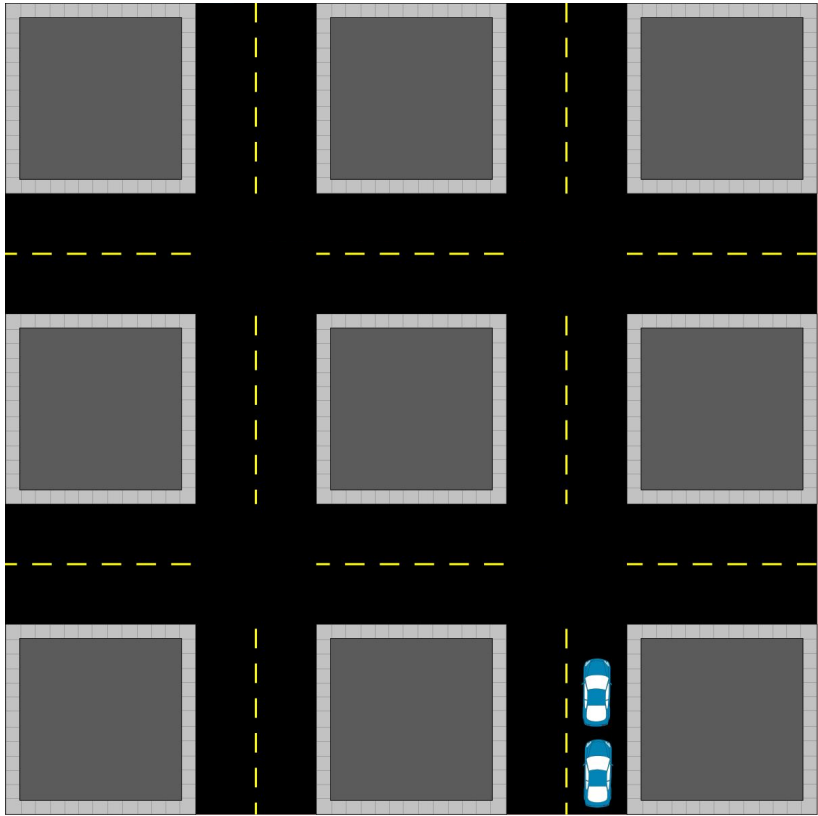
Cross Traffic

A thread never gains access to the resource it needs

Deadlock

Gridlock

A thread is only able to acquire some of the needed resources



Can we name some concurrency structures?

Atomic Operations & Variables

Locks

Semaphores

Monitors

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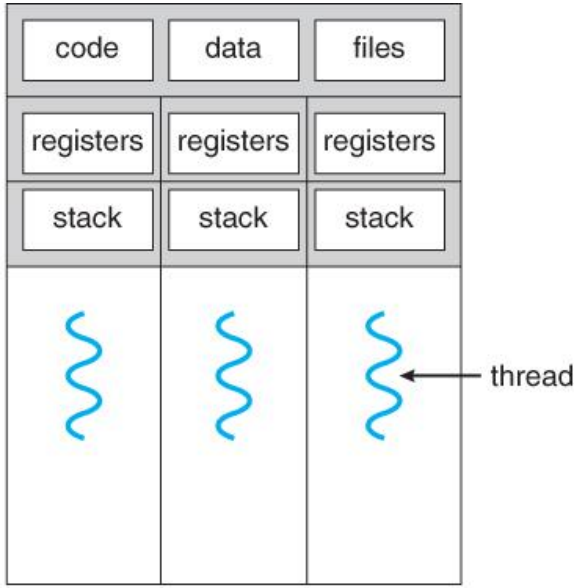
Concurrency Structures

Atomic Operations & Variables

Recall *registers*…

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




```
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
```

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Concurrency Structures

Pros and Cons?

Locks

Acquire the Lock → Open & Enter / Close & Lock

Release the Lock → Unlock & Exit

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Concurrency Structures

How am I different from a lock?

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?

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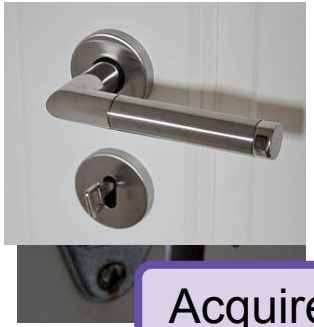
Concurrency Structures

Pros and Cons?

Monitors

You lock the main door instead!



Acquire Lock → { Open & Enter; Close & Lock }

Release Lock → Unlock & Exit

Covers the ***entire object***

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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

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Threaded Server

Given the standard server socket steps…

Ideas on how we could introduce threads?

1. Define Params
2. Create Socket
3-5. Mark Socket to Listen
6. Wait for Connection
7. Handle Client Connection
8. Close Client Connection
9. Continue Listening

Why do we send the *client socket* to the thread?

7. Send Client Socket to thread

JavaThreadSock

SER 321
Threads

1. Define Params
2. Create Socket
3-5. Mark Socket to Listen
6. Wait for Connection
7. Send Client **Socket** to Thread
8. Close Client Connection
9. Continue Listening

1

2 & 3-5

9

6

7

8

```java
public static void main(String args[]) throws IOException {
    Socket sock = null;
    int id = 0;
    try {
        if (args.length != 1) {
            System.out.println
                ("Usage: gradle ThreadedSockServer --args=<port num>");
            System.exit( code: 0);
        }
        int portNo = Integer.parseInt(args[0]);
        if (portNo <= 1024)
            portNo = 8888;
        ServerSocket serv = new ServerSocket(portNo);

        while (true) {
            System.out.println
                ("Threaded server waiting for connects on port " + portNo);
            sock = serv.accept();
            System.out.println
                ("Threaded server connected to client-" + id);
            // create thread
            ThreadedSockServer myServerThread =
                new ThreadedSockServer(sock, id++);
            // run thread and don't care about managing it
            myServerThread.start();
        }
    } catch (Exception e) {
        e.printStackTrace();
    } finally {
        if (sock != null) sock.close();
    }
}
}
```

JavaThreadSock

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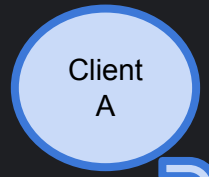
Threads

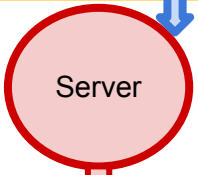
```java
public void run() {
  try {
    // setup read/write channels for connection
    ObjectInputStream in = new ObjectInputStream(conn.getInputStream());
    ObjectOutputStream out = new ObjectOutputStream(conn.getOutputStream());

    // read the digit being send
    String s = (String) in.readObject();
    int index;
    // while client hasn't ended
    while (!s.equals("end")) {
      Boolean validInput = true;

      // checks if input only contains digits
      if (!s.matches( expr: "\\d+")) {
        validInput = false;
        out.writeObject("Not a number: https://gph.is/2yDymkn");
      }
```

```java
    // if it contains only numbers
    if (validInput) {
      // convert to an integer
      index = Integer.valueOf(s);
      System.out.println("From client " + id + " get string " + index);
      if (index > -1 & index < buf.length) {
        // if valid, pull the line from the buffer array above and write it to socket
        out.writeObject(buf[index]);
      } else if (index == 5) {
        // fun surprise for mostly correct
        out.writeObject("Close but out of range: https://youtu.be/dQw4w9WgXcQ");
      } else {
        // really wrong
        out.writeObject("index out of range");
      }
    }
    //  wait for next token from the user
    s = (String) in.readObject();
  }
  // on close, clean up
  System.out.println("Client " + id + " closed connection.");
  in.close();
  out.close();
  conn.close();
} catch (Exception e) {
  e.printStackTrace();
}
}
```






```java
public static void main(String args[]) throws IOException {
  Socket sock = null;
  int id = 0;
  try {
    if (args.length != 1) {
      System.out.println
          ("Usage: gradle ThreadedSockServer --args=<port num>");
      System.exit( code: 0);
    }
    int portNo = Integer.parseInt(args[0]);
    if (portNo <= 1024)
      portNo = 8888;
    ServerSocket serv = new ServerSocket(portNo);

    while (true) {
      System.out.println
          ("Threaded server waiting for connects on port " + portNo);
      sock = serv.accept();
      System.out.println
          ("Threaded server connected to client-" + id);
      // create thread
      ThreadedSockServer myServerThread =
          new ThreadedSockServer(sock, id++);
      // run thread and don't care about managing it
      myServerThread.start();
    }
  } catch (Exception e) {
    e.printStackTrace();
  } finally {
    if (sock != null) sock.close();
  }
}
}
```

JavaThreadSock

SER 321

Threads

```java
public void run() {
  try {
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    // read the digit being send
    String s = (String) in.readObject();
    int index;
    // while client hasn't ended
    while (!s.equals("end")) {
      Boolean validInput = true;

      // checks if input only contains digits
      if (!s.matches( expr: "\\d+")) {
        validInput = false;
        out.writeObject("Not a number: https://gph.is/2yDymkn");
      }
```
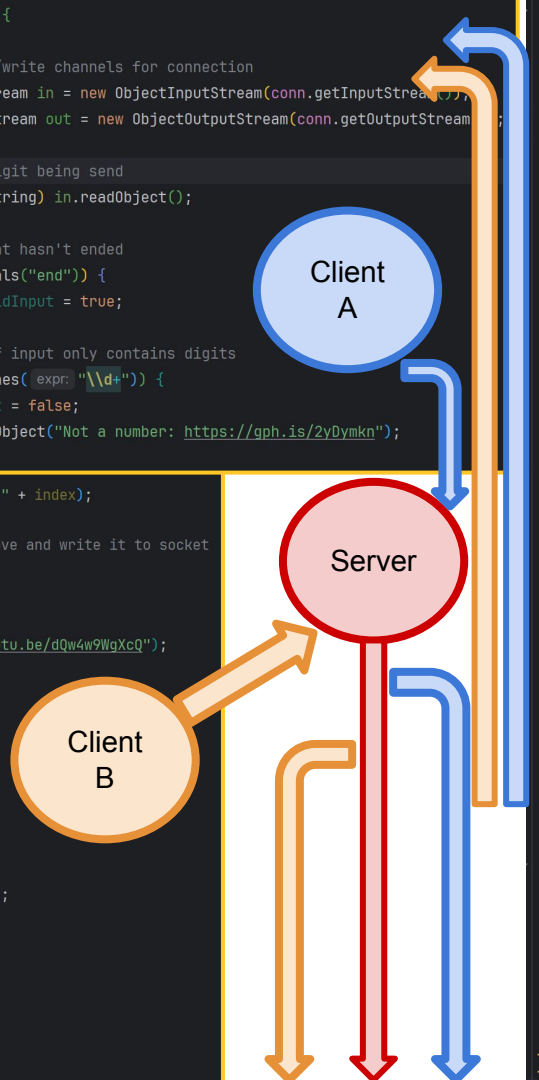

```java
      // if it contains only numbers
      if (validInput) {
        // convert to an integer
        index = Integer.valueOf(s);
        System.out.println("From client " + id + " get string " + index);
        if (index > -1 & index < buf.length) {
          // if valid, pull the line from the buffer array above and write it to socket
          out.writeObject(buf[index]);
        } else if (index == 5) {
          // fun surprise for mostly correct
          out.writeObject("Close but out of range: https://youtu.be/dQw4w9WgXcQ");
        } else {
          // really wrong
          out.writeObject("index out of range");
        }
      }
      //  wait for next token from the user
      s = (String) in.readObject();
    }
    // on close, clean up
    System.out.println("Client " + id + " closed connection.");
    in.close();
    out.close();
    conn.close();
  } catch (Exception e) {
    e.printStackTrace();
  }
}
```




```java
public static void main(String args[]) throws IOException {
  Socket sock = null;
  int id = 0;
  try {
    if (args.length != 1) {
      System.out.println
          ("Usage: gradle ThreadedSockServer --args=<port num>");
      System.exit( code: 0);
    }
    int portNo = Integer.parseInt(args[0]);
    if (portNo <= 1024)
      portNo = 8888;
    ServerSocket serv = new ServerSocket(portNo);

    while (true) {
      System.out.println
          ("Threaded server waiting for connects on port " + portNo);
      sock = serv.accept();
      System.out.println
          ("Threaded server connected to client-" + id);
      // create thread
      ThreadedSockServer myServerThread =
          new ThreadedSockServer(sock, id++);
      // run thread and don't care about managing it
      myServerThread.start();
    }
  } catch (Exception e) {
    e.printStackTrace();
  } finally {
    if (sock != null) sock.close();
  }
}
}
```

JavaThreadSock

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Threads

```java
public void run() {
  try {
    // setup read/write channels for connection
    ObjectInputStream in = new ObjectInputStream(conn.getInputStream());
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    // read the digit being send
    String s = (String) in.readObject();
    int index;
    // while client hasn't ended
    while (!s.equals("end")) {
      Boolean validInput = true;

      // checks if input only contains digits
      if (!s.matches( expr: "\\d+")) {
        validInput = false;
        out.writeObject("Not a number: https://gph.is/2yDymkn");
      }
```

Client A

```java
      // if it contains only numbers
      if (validInput) {
        // convert to an integer
        index = Integer.valueOf(s);
        System.out.println("From client " + id + " get string " + index);
        if (index > -1 & index < buf.length) {
          // if valid, pull the line from the buffer array above and write it to socket
          out.writeObject(buf[index]);
        } else if (index == 5) {
          // fun surprise for mostly correct
          out.writeObject("Close but out of range: https://youtu.be/dQw4w9WgXcQ");
        } else {
          // really wrong
          out.writeObject("index out of range");
        }
      }
      //  wait for next token from the user
      s = (String) in.readObject();
    }
    // on close, clean up
    System.out.println("Client " + id + " closed connection.");
    in.close();
    out.close();
    conn.close();
  } catch (Exception e) {
    e.printStackTrace();
  }
}
```

Server

Client B

```java
public static void main(String args[]) throws IOException {
  Socket sock = null;
  int id = 0;
  try {
    if (args.length != 1) {
      System.out.println
          ("Usage: gradle ThreadedSockServer --args=<port num>");
      System.exit( code: 0);
    }
    int portNo = Integer.parseInt(args[0]);
    if (portNo <= 1024)
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    ServerSocket serv = new ServerSocket(portNo);

    while (true) {
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      // run thread and don't care about managing it
      myServerThread.start();
    }
  } catch (Exception e) {
    e.printStackTrace();
  } finally {
    if (sock != null) sock.close();
  }
}
}
```

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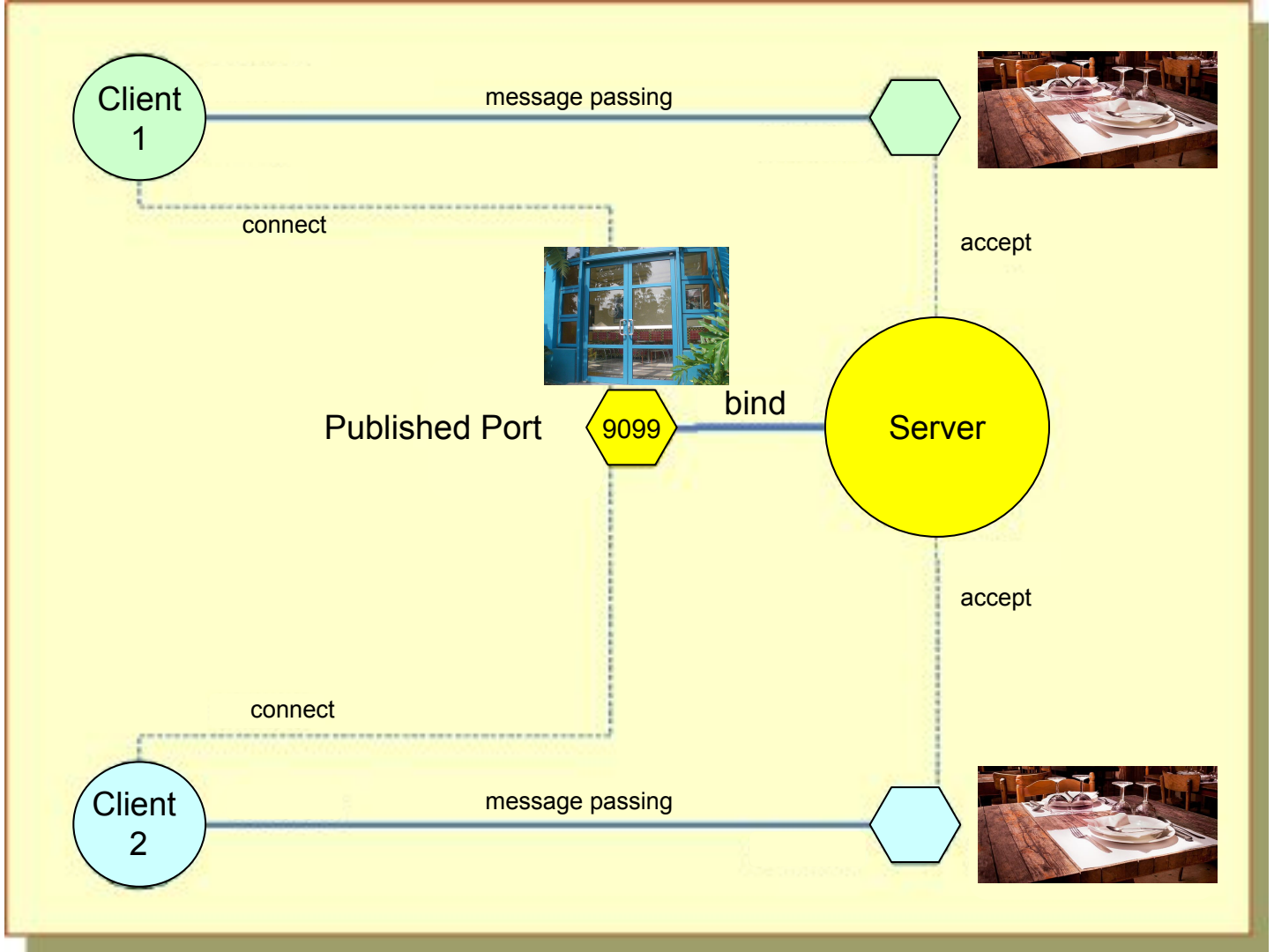
Sockets!



Design of an RFID Vehicle Authentication System: A Case Study for Al-Nahrain University Campus - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Client-and-Server-Socket-Ports_fig4_282671198

SER 321

Scratch Space

Upcoming Events

SI Sessions:

- Sunday, November 17th at 7:00 pm MST
- Tuesday, November 19th at 10:00 am MST
- Thursday, November 21st at 7:00 pm MST

Review Sessions:

- Sunday, December 1st at 7:00 pm MST - **2 hour Review Session**
- Tuesday, December 3rd at 10:00 am MST - **Q&A Session**

Questions?

Survey:

https://asuasn.info/ASNSurvey

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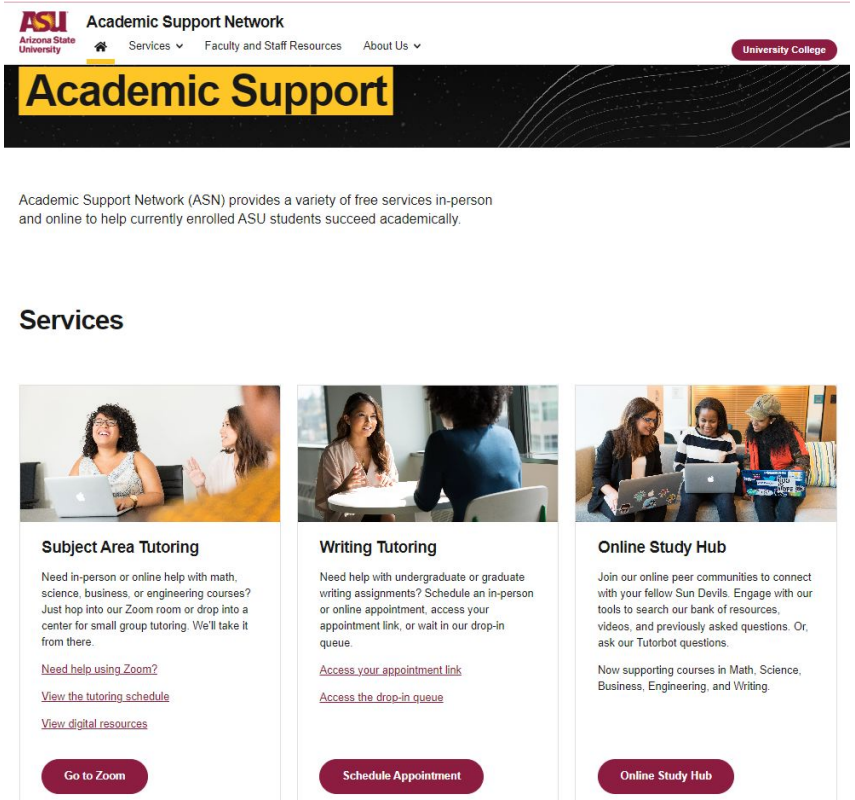
More Questions?

Check out our other resources!

tutoring.asu.edu



1 – Go to Zoom

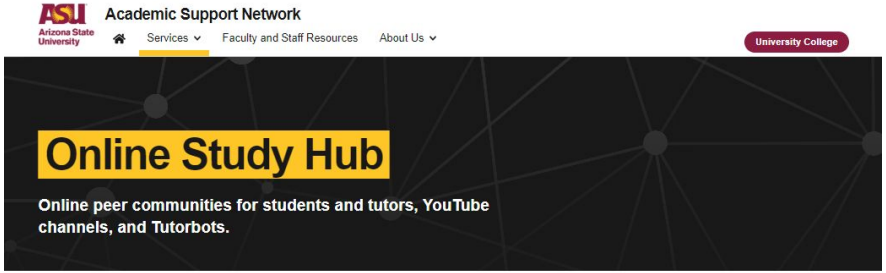
2- Need help using Zoom?
View the tutoring schedule
View digital resources

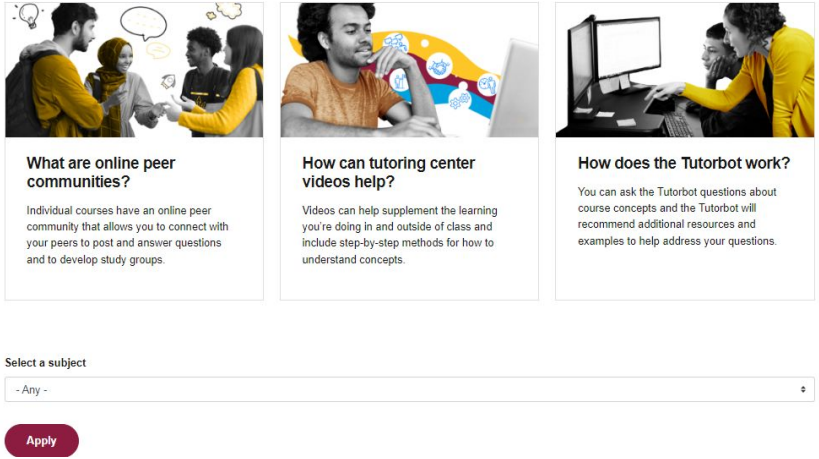
1. **Click on 'Go to Zoom' to log onto our Online Tutoring Center.**
2. **Click on 'View the tutoring schedule' to see when tutors are available for specific courses.**

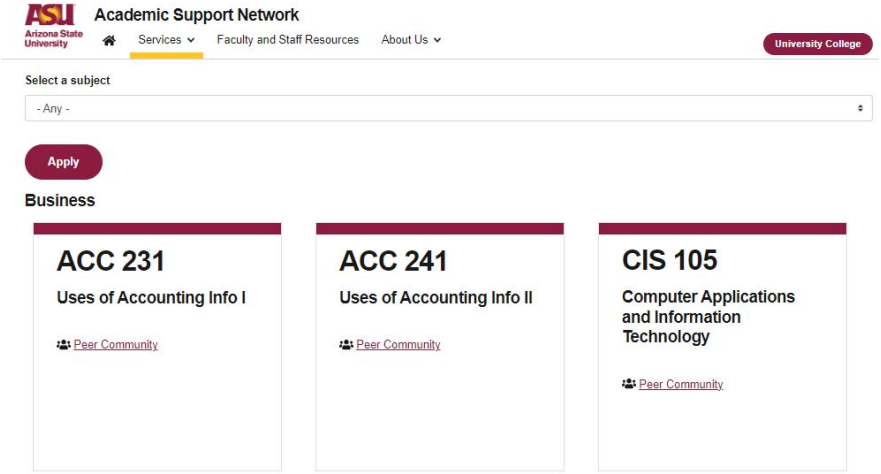
More Questions?

Check out our other resources!

tutoring.asu.edu/online-study-hub



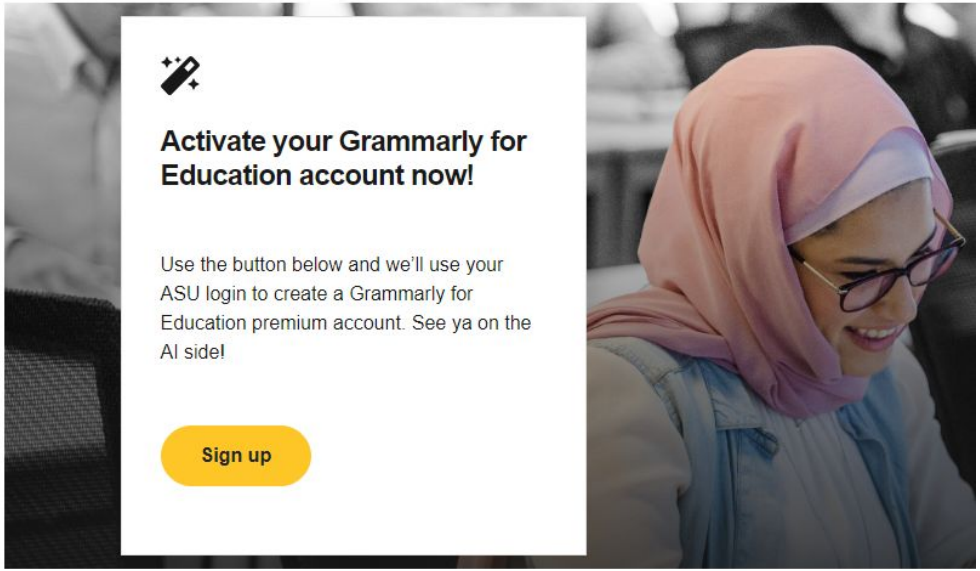




Don't forget to check out the Online Study Hub for additional resources!

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