SER 321 C Session

SI Session

Sunday, June 16th 2024

6:00 pm - 7:00 pm MST

Agenda

- Review Threading Pitfalls
- Concurrency Structures
  - Structure Analogy
  - Sample Problem: Deadlock
- Threading your Code

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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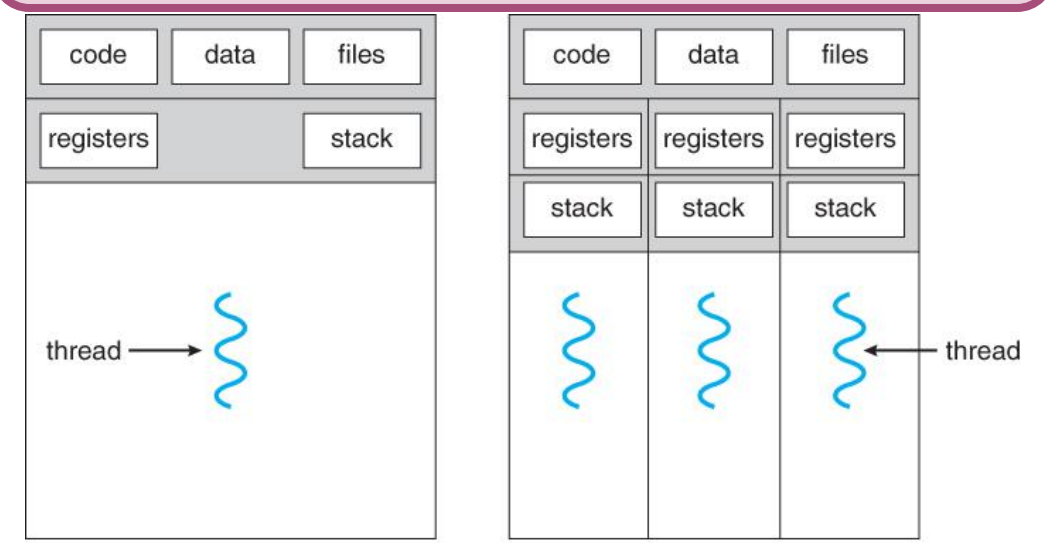
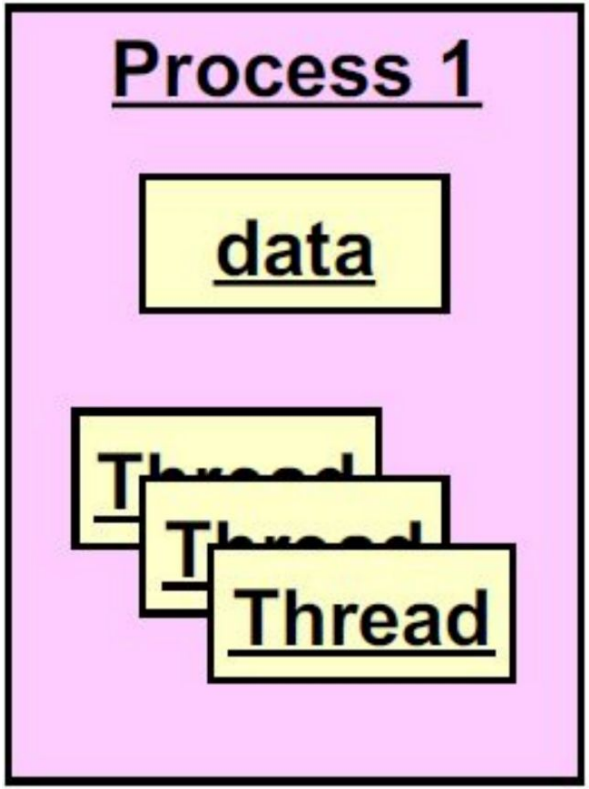
Threads

What does that imply?

Remember that they exist *within* the parent process





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Threading Pitfalls

Check out the recording for the solution!

Race Condition	A thread is only able to acquire some of the resources it needs
Starvation	More than one thread accesses a single resource at the same time
Deadlock	A thread never gains access to the resource it needs

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Concurrency Structures

Can we name some concurrency structures?

Atomic Operations & Variables

Locks

Semaphores

Monitors

Check out the recording for the discussion!

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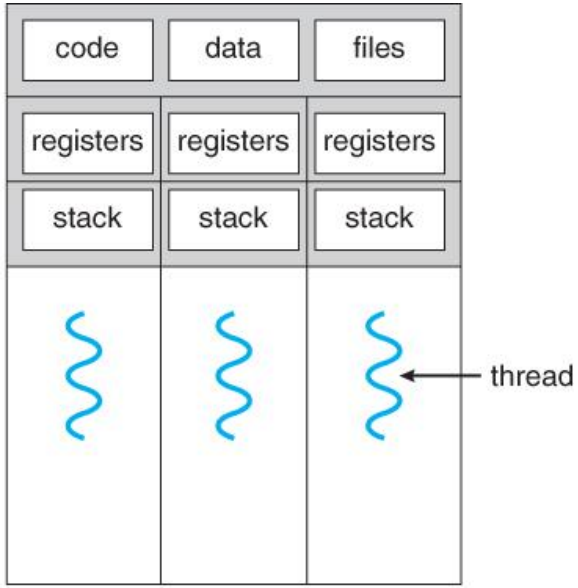
Concurrency Structures

Pros and Cons?

Atomic Operations & Variables

Recall *registers*…

Volatile keyword ensures updates are immediately visible for the local copy in *each and every thread*




```
main:
    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

Check out the recording for the discussion!

Pros and Cons?

Locks

Acquire the Lock → Open & Enter

Close & Lock

Release the Lock → Unlock & Exit

Check out the recording for the discussion!

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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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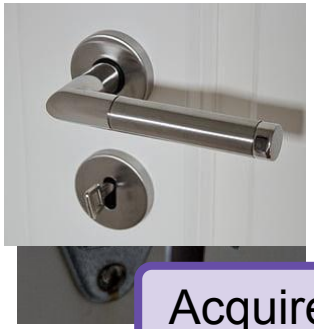
Concurrency Structures

Check out the recording for the discussion!

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

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();
        }
    }
```

Check out the recording for the discussion!

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Concurrency Structures

Options to fix this?

1. Remove the synchronized methods

```
public void bow
```

```
public void bowBack
```

2. Synchronize the `bowBack` call

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

3. Synchronize the `bowBack` call with a synchronized statement

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

4. Synchronize the `run` method calls

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

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

Check out the recording for the discussion!

```
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        }
    }
}
```

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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

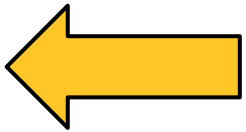
Given the standard server socket steps…

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

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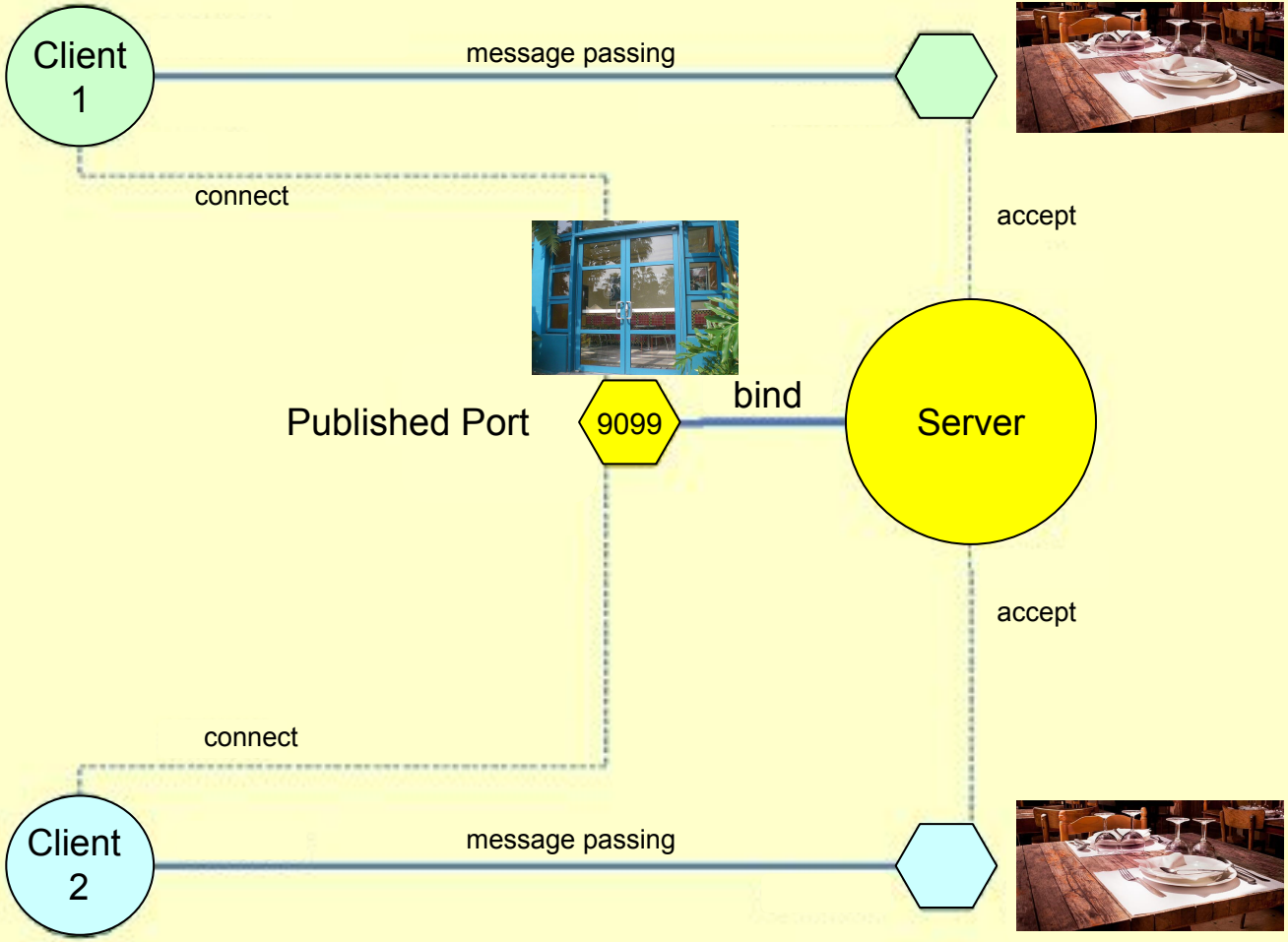
Sockets!



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

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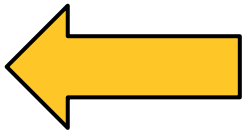
Threaded Server

We send the Client Socket to the thread

Then within the thread we will…

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



1

2

3

4

5

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Scratch Space

Questions?

Survey:

http://bit.ly/ASN2324

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Upcoming Events

SI Sessions:

- Monday, June 17th at 6:00 pm MST
- Thursday, June 20th at 6:00 pm MST
- Sunday, June 23rd at 6:00 pm MST

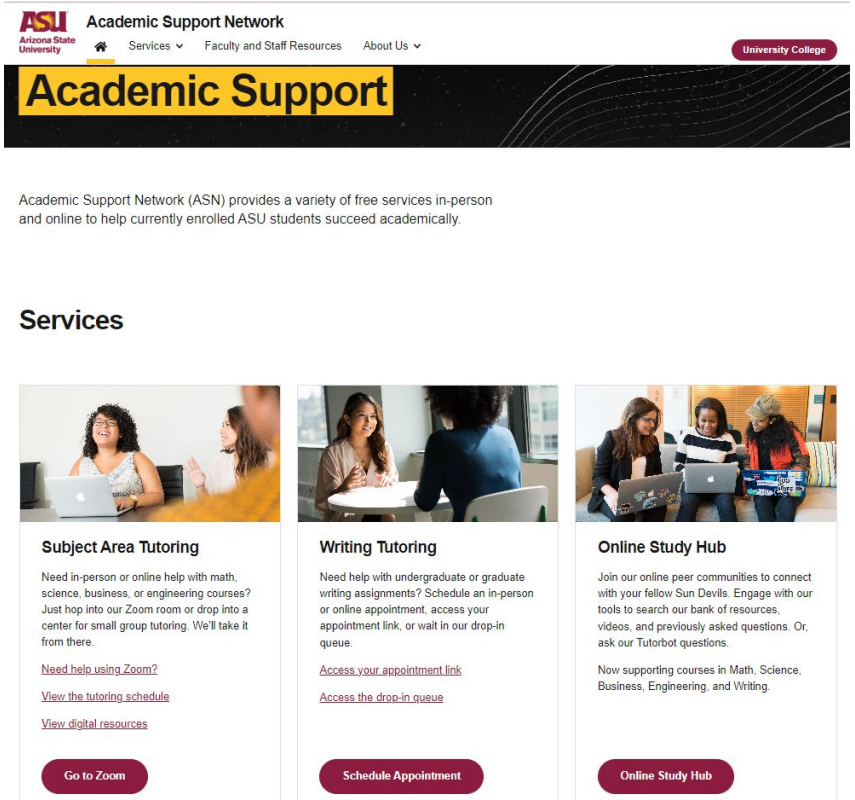
Review Sessions:

- Review Session - **Wednesday**, July 3rd at 6:00 pm MST (2 hr Session)
- Q&A Session - Sunday, July 7th at 6:00 pm MST (Final Session)

More Questions?

Check out our other resources!

tutoring.asu.edu

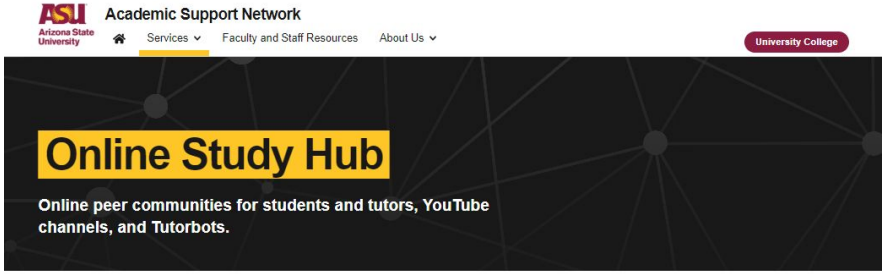


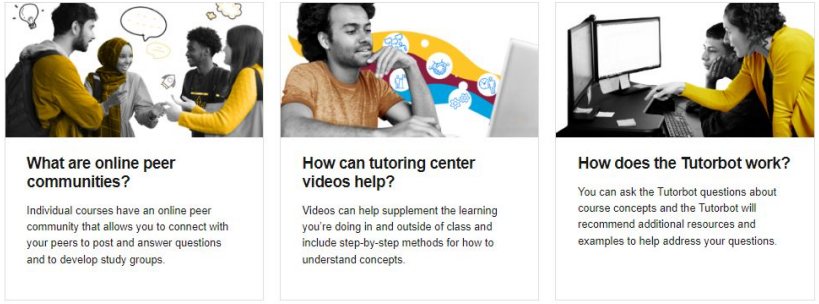
1. **Click on ‘Go to Zoom’ to log onto our Online Tutoring Center.**
2. **Click on ‘View the tutoring schedule’ to see when tutors are available for specific courses.**

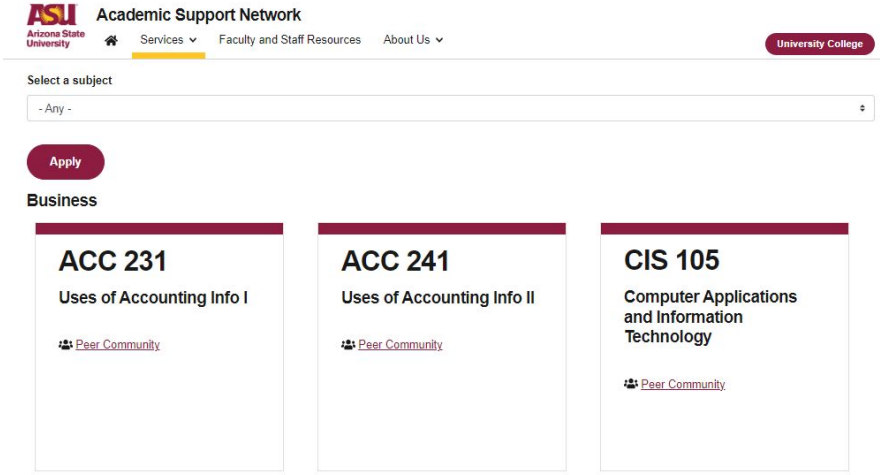
More Questions?

Check out our other resources!

tutoring.asu.edu/online-study-hub



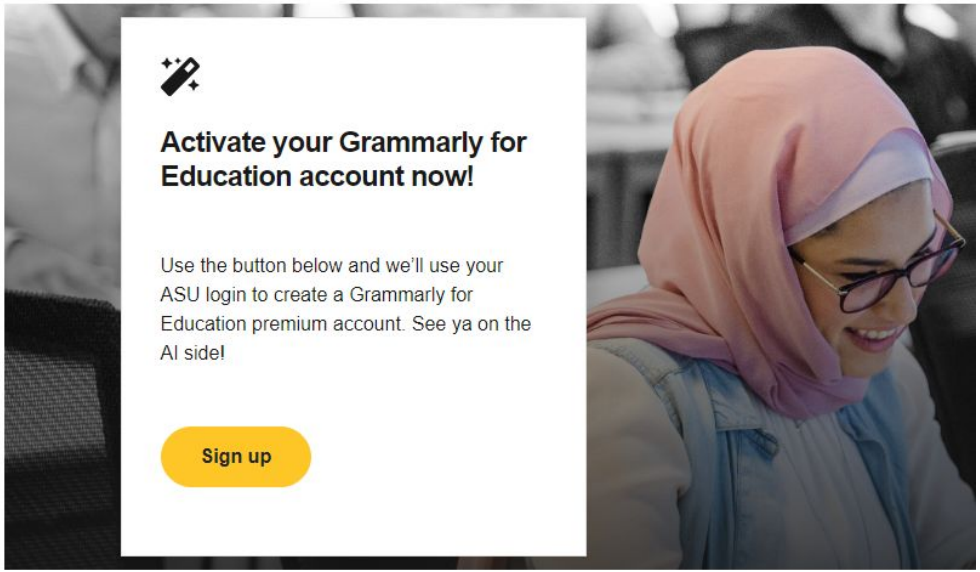




Don't forget to check out the Online Study Hub for additional resources!

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