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# Transportation Engineering: Traffic Control Simulator

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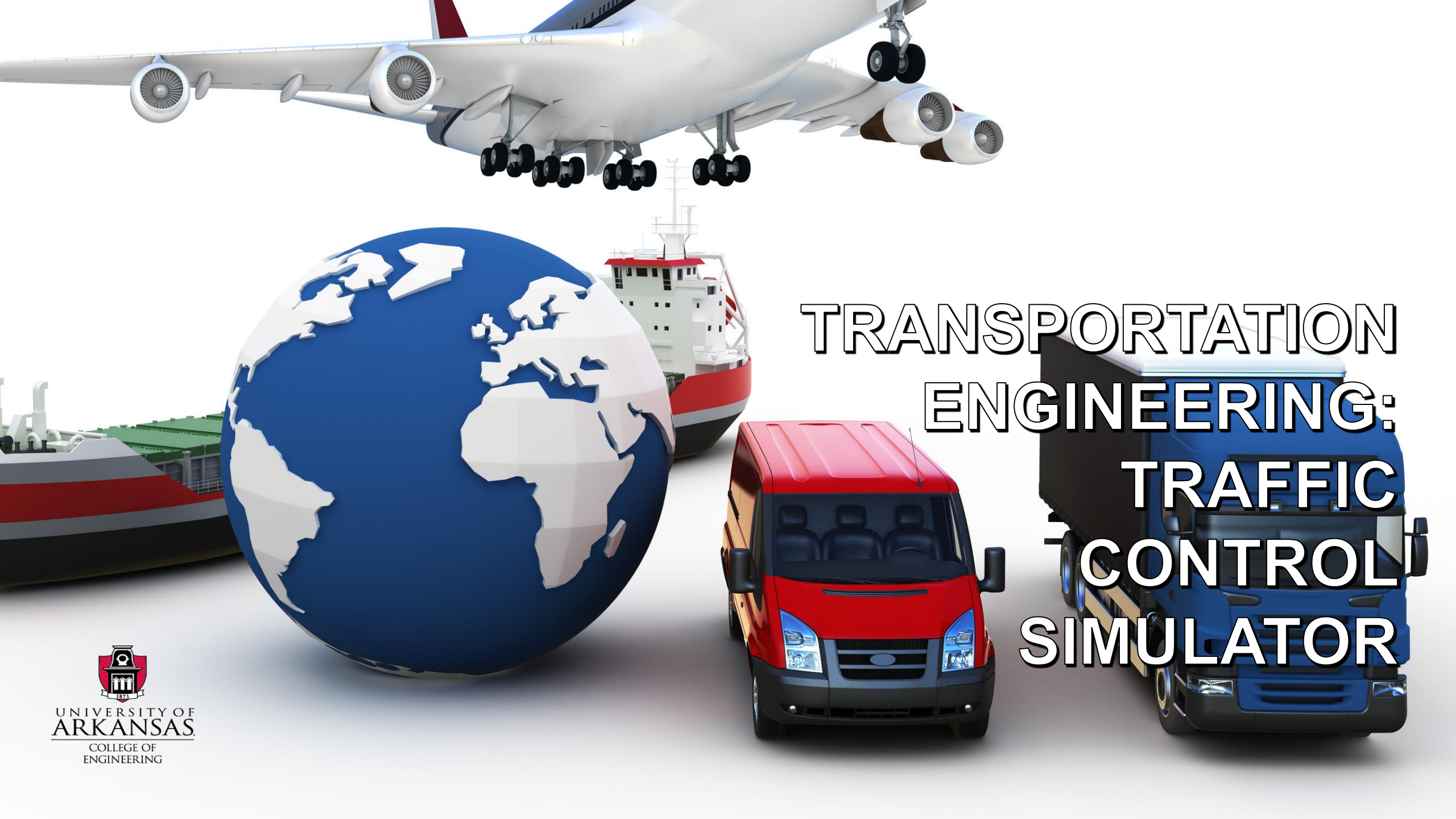


# TRANSPORTATION ENGINEERING: TRAFFIC CONTROL SIMULATOR

UNIVERSITY OF ARKANSAS
COLLEGE OF ENGINEERING

# WHO ARE WE?

**Sarah Hernandez, Ph.D.**

**Assistant Professor**
Department of Civil Engineering
University of Arkansas

**Karla Diaz C**

Junior Civil Engineering student at the University of Arkansas.

**Taslima Akter**

Research Assistant Ph.D. in Civil Engineering at the University of Arkansas.

**Magdalena Asborno**

Research Assistant Ph.D.- Transportation Planning at University of Arkansas.

Fu Durandal

Senior Civil Engineering student with a minor in mathematics .

# WHAT ARE WE GOING TO DO TODAY?

- Learn about transportation engineering and careers offered.
- Introduce essential concepts about signal timing.
- Play with a traffic control simulator.
- Have fun!

# HOW DO YOU GET TO THE MOVIE THEATER?

# WHAT IS TRANSPORTATION ENGINEERING?

# VIDEO

# Careers Options in Transportation:

- City Traffic Engineer or Planner.
- Traffic Engineer Consultant.
- Design Freeways, Mass transit, Rail or streets.
- Design traffic signals.
- Design Intelligent Transportation Systems.
- MANY MORE!!

Which intersection is “better”?

**Gridlock -** A situation of very severe traffic congestion.



Source: https://en.oxforddictionaries.com/definition/gridlock

# GRIDLOCK BUSTER!

Let’s see how good you are at controlling traffic!

# Who got to Level 4??

# There is a prize!!

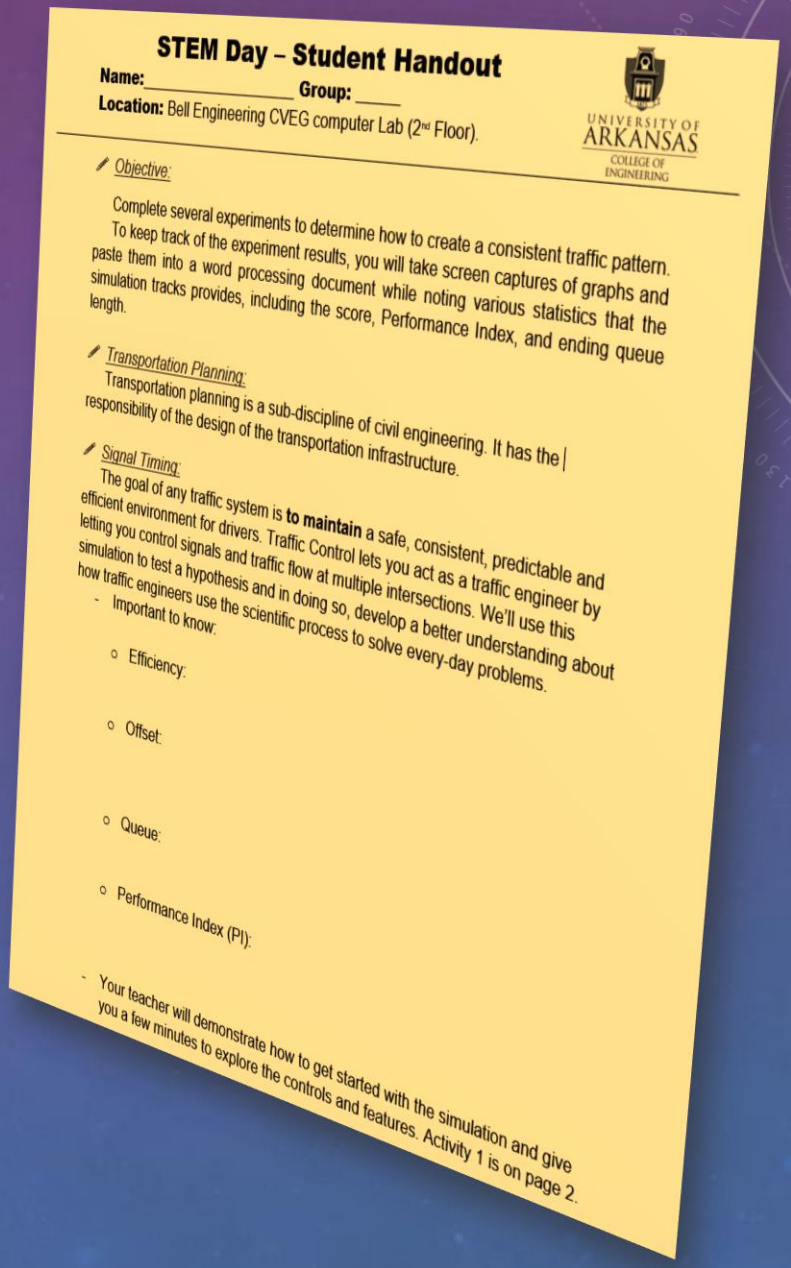
# GRIDLOCK BUSTER!

Did you know that Transportation Engineers use simulation to develop more efficient signal timing patterns?

11 45
BLACK FRIDAY SALE

# INTRODUCTION TO SIGNAL TIMING & TRAFFIC CONTROL

# ACTIVITY 1: SIMULATOR INTERACTION. (FOLLOW HANDOUT)



**STEM Day – Student Handout**

**Name:**_____ **Group:** ____

**Location:** Bell Engineering CVEG computer Lab (2nd Floor).

UNIVERSITY OF ARKANSAS COLLEGE OF ENGINEERING

*Objective:*

Complete several experiments to determine how to create a consistent traffic pattern. To keep track of the experiment results, you will take screen captures of graphs and paste them into a word processing document while noting various statistics that the simulation tracks provides, including the score, Performance Index, and ending queue length.

*Transportation Planning:*

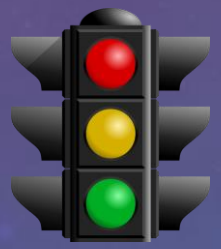
Transportation planning is a sub-discipline of civil engineering. It has the responsibility of the design of the transportation infrastructure.

*Signal Timing:*

The goal of any traffic system is **to maintain** a safe, consistent, predictable and efficient environment for drivers. Traffic Control lets you act as a traffic engineer by letting you control signals and traffic flow at multiple intersections. We'll use this simulation to test a hypothesis and in doing so, develop a better understanding about how traffic engineers use the scientific process to solve every-day problems.

- Important to know:
  - Efficiency:
  - Offset:
  - Queue:
  - Performance Index (PI):
- Your teacher will demonstrate how to get started with the simulation and give you a few minutes to explore the controls and features. Activity 1 is on page 2.

# Important Terms for Traffic Signal Timing

| | |
|---|---|
| | **Delay – When a vehicle has to stop at a red light, the driver experiences delay.** |
| | **Queue** – a line of vehicles waiting at a red light. |
|  | **Efficiency** – How well a traffic signal operates to reduce the amount of traffic delay. |
| | **Performance Index** - queue length + amount of time delayed. |

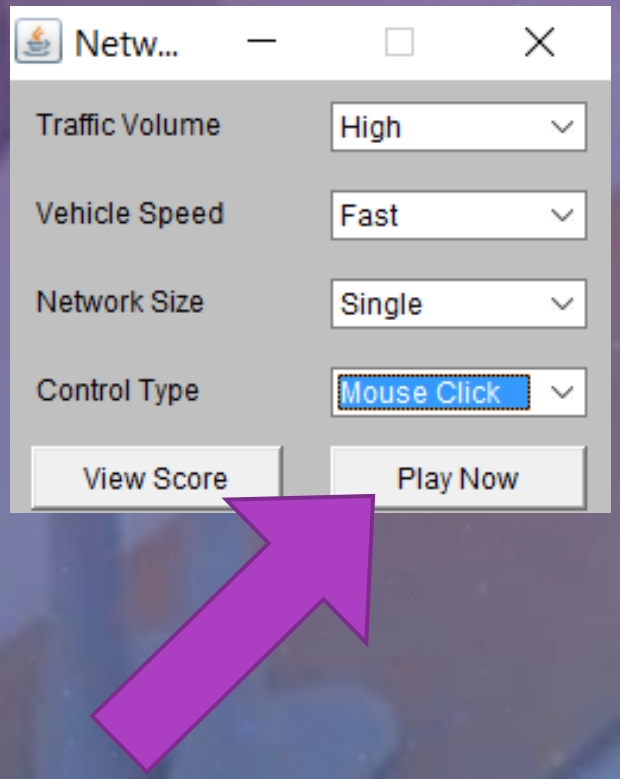
# OBJECTIVES OF TRAFFIC SIMULATION

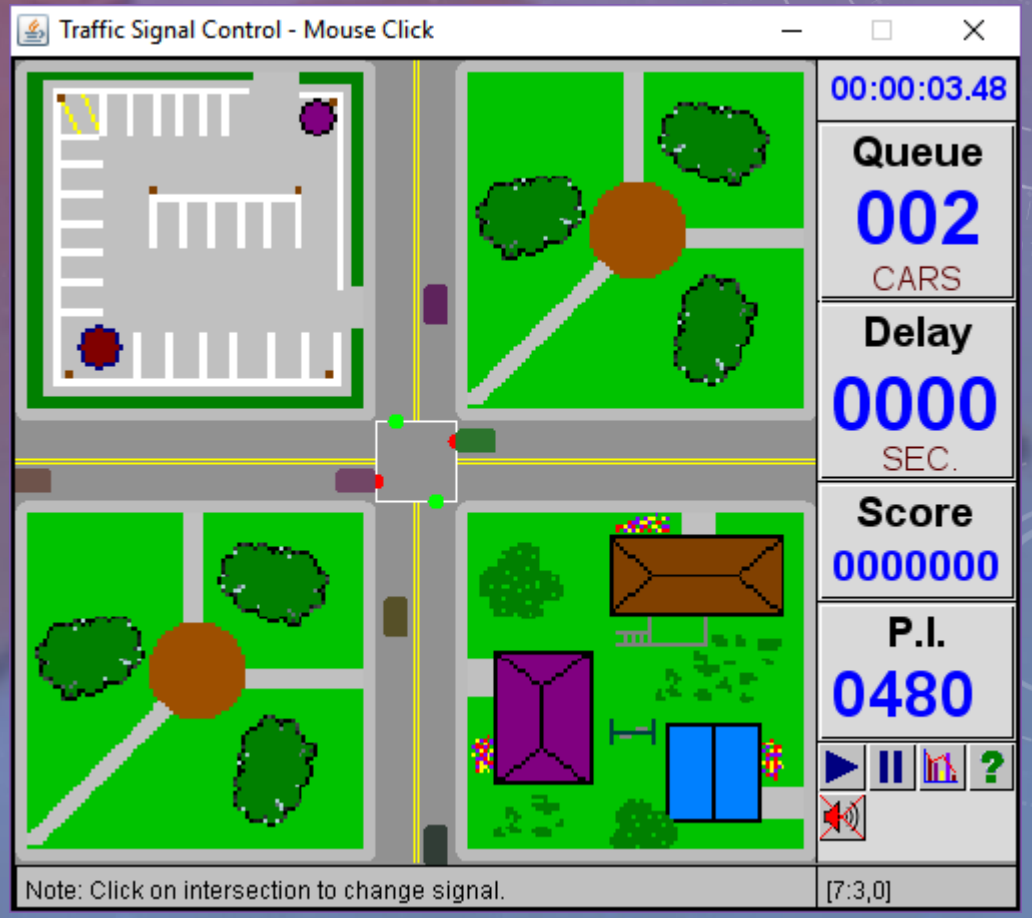
- Traffic engineers use computer simulations to test new traffic signal timing.
- We follow the scientific method to conduct an experiment → which signal timing is the most efficient?
- Compare graphs generated by traffic patterns to select the most efficient traffic signal timing

# 1

# HOW THE SIMULATOR WORKS?

Choose the simulation settings

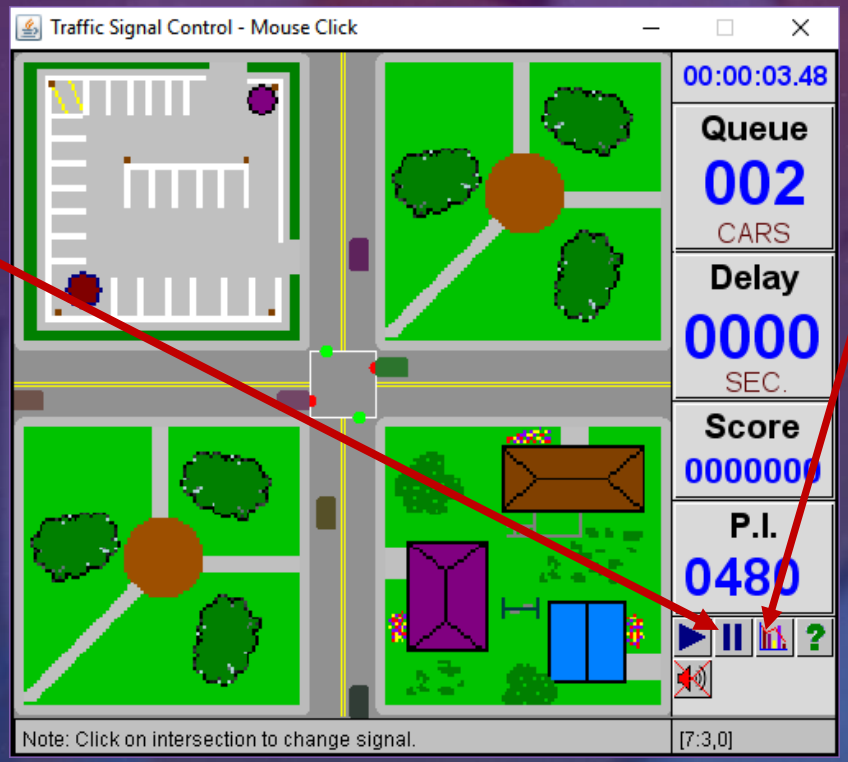


# 2

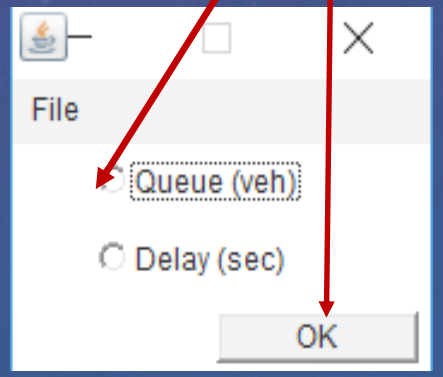
# RUN THE SIMULATION

Play and Pause the simulator




To Generate a Graph

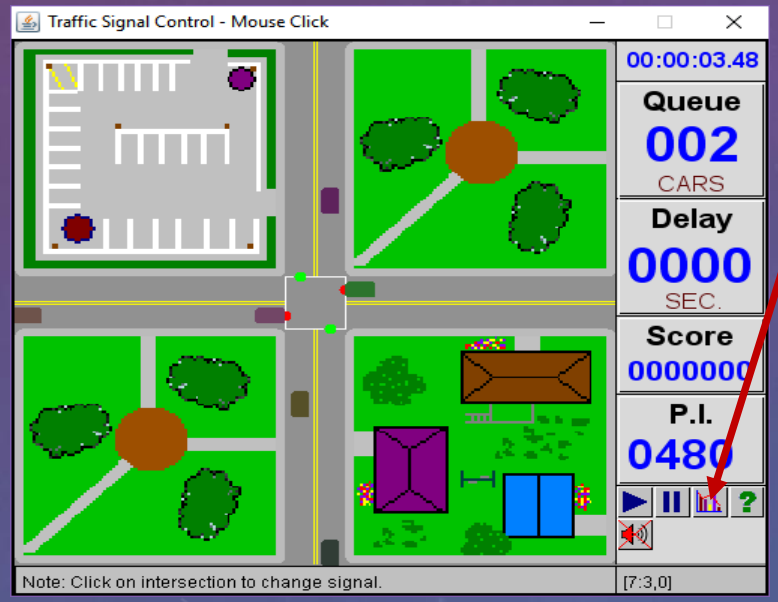
Click here to get Queue (veh) per Time Graph and then OK



NOW IT'S
YOUR TURN.

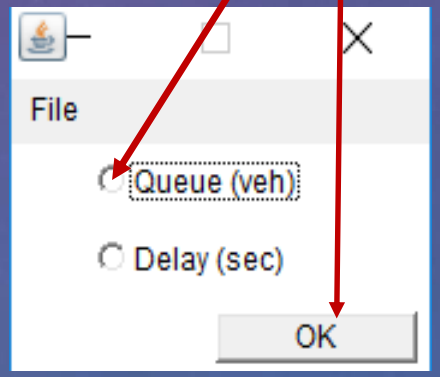
# 3

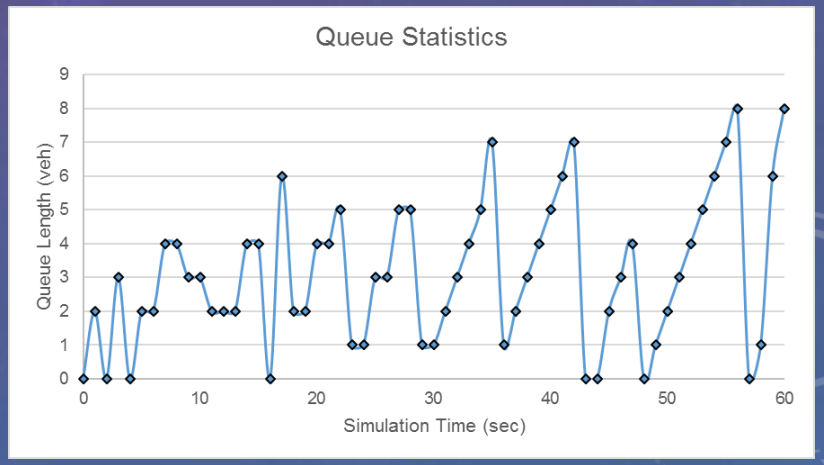
# RECORD YOUR RESULTS




To Generate a Graph

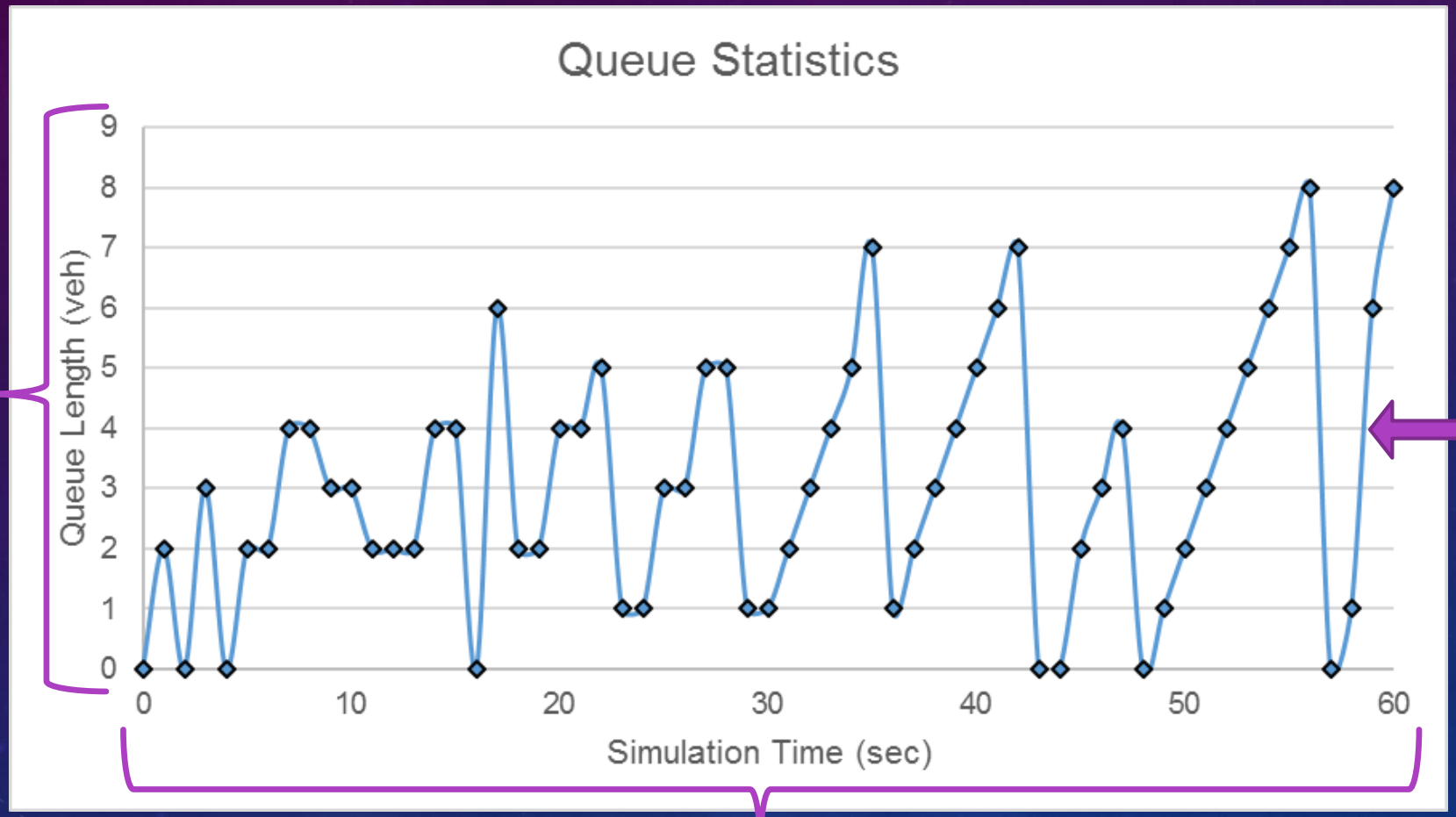
Click here to get Queue (veh) per Time Graph and then OK



# Queue Statistics

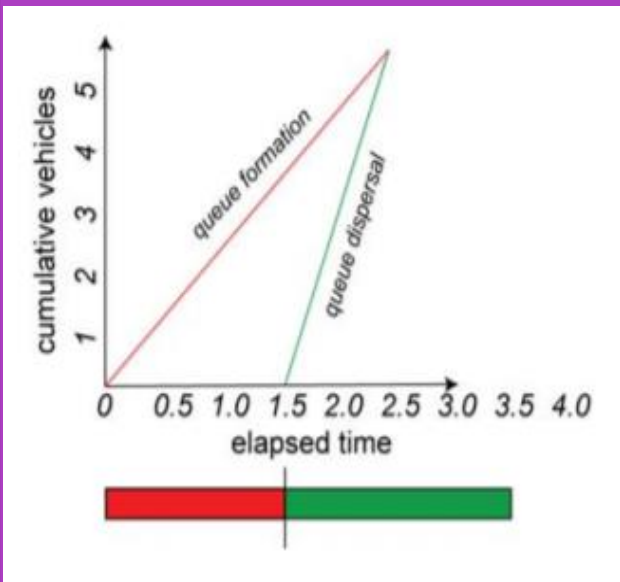
What happens to the line of vehicles during the red phase? When does the queue reach its maximum length?




Y-axis

X-axis

This lines represent the cycles of the system.

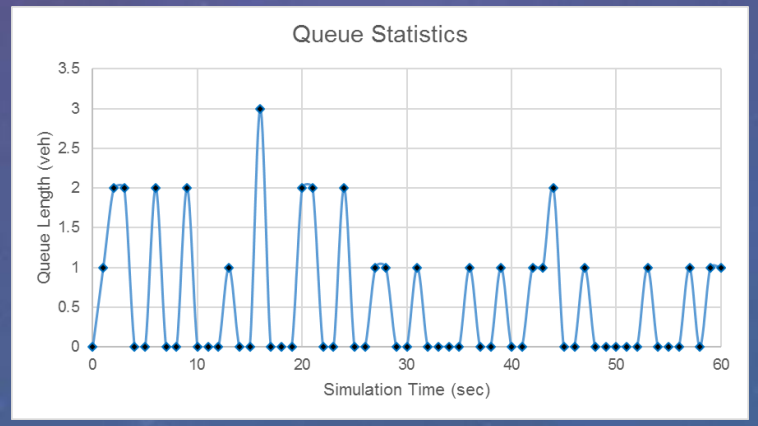


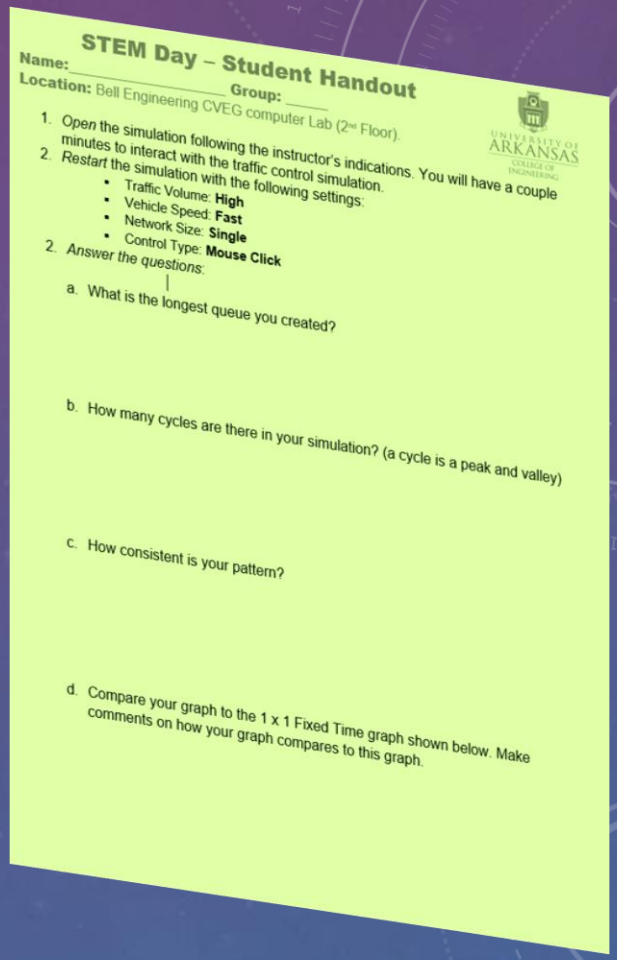
1. What is the longest queue you created?

2. How many cycles are there in your simulation? (a cycle is a peak and valley)

1. How consistent is your pattern?

2. Compare your graph to the 1 x 1 Fixed Time graph shown below. Make comments on how your graph compares to this graph.



STEM Day – Student Handout

Name: _____ Group: _____

Location: Bell Engineering CVEG computer Lab (2nd Floor).

1. *Open* the simulation following the instructor's indications. You will have a couple minutes to interact with the traffic control simulation.
2. *Restart* the simulation with the following settings:
   - Traffic Volume: **High**
   - Vehicle Speed: **Fast**
   - Network Size: **Single**
   - Control Type: **Mouse Click**
2. *Answer the questions*:

a. What is the longest queue you created?

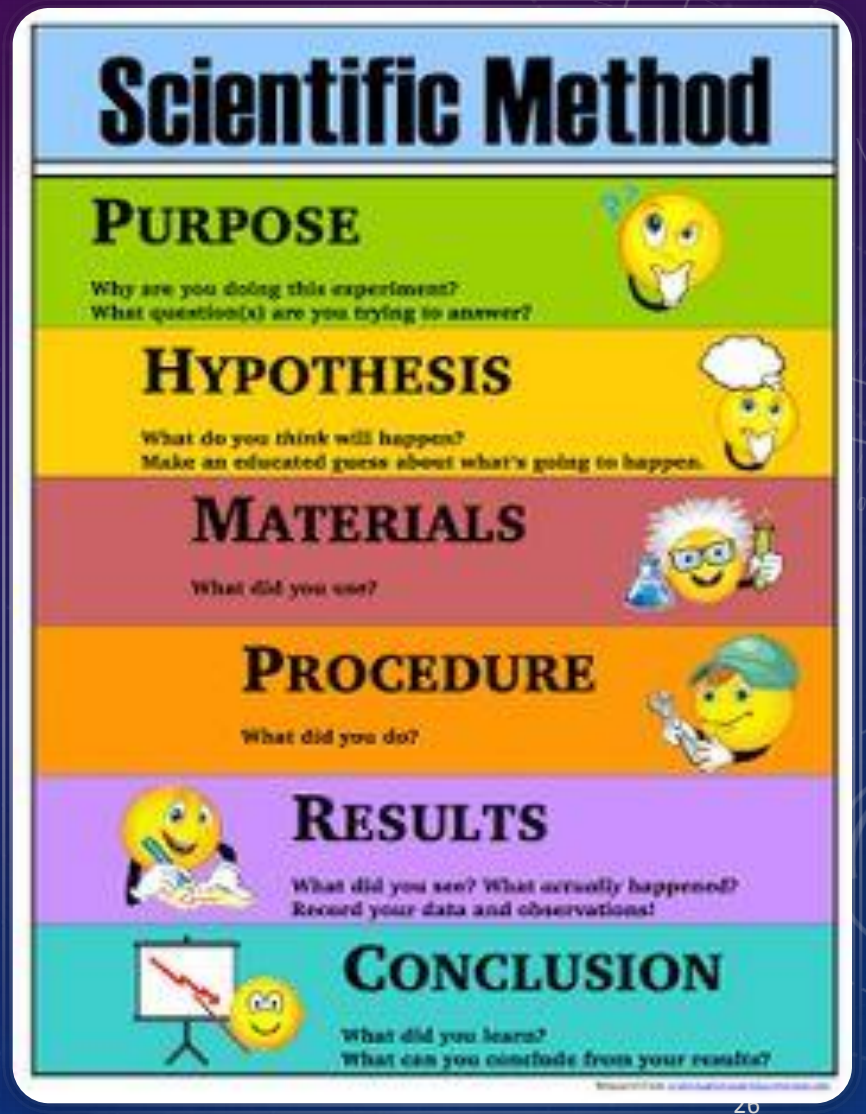
b. How many cycles are there in your simulation? (a cycle is a peak and valley)

c. How consistent is your pattern?

d. Compare your graph to the 1 x 1 Fixed Time graph shown below. Make comments on how your graph compares to this graph.

- You just performed **Manual traffic control!**
- That's the same as what the police do to control a signal after a Razorback baseball game
- However this is not very efficient…would you like to sit at a traffic signal all day???
- Instead, traffic engineers pre-set the traffic signals → This is called **Fixed Time Control**
- Fixed time control can be more efficient if set correctly.

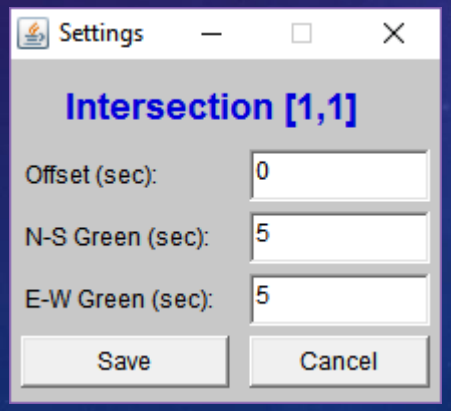
# ACTIVITY 2: THE MOST EFFICIENT SIGNAL

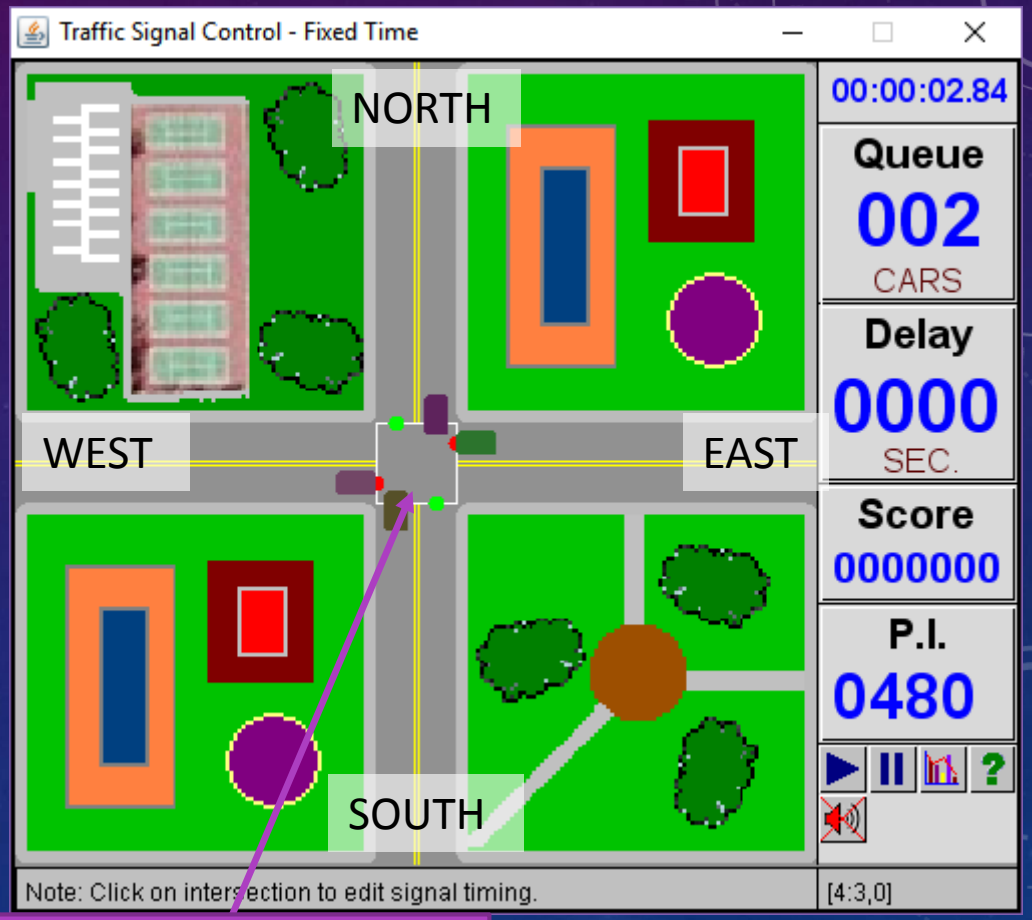


# WHAT CAN YOU CHANGE TO IMPROVE THE SIGNAL TIMING?

- You can change the length of the green light for each approach

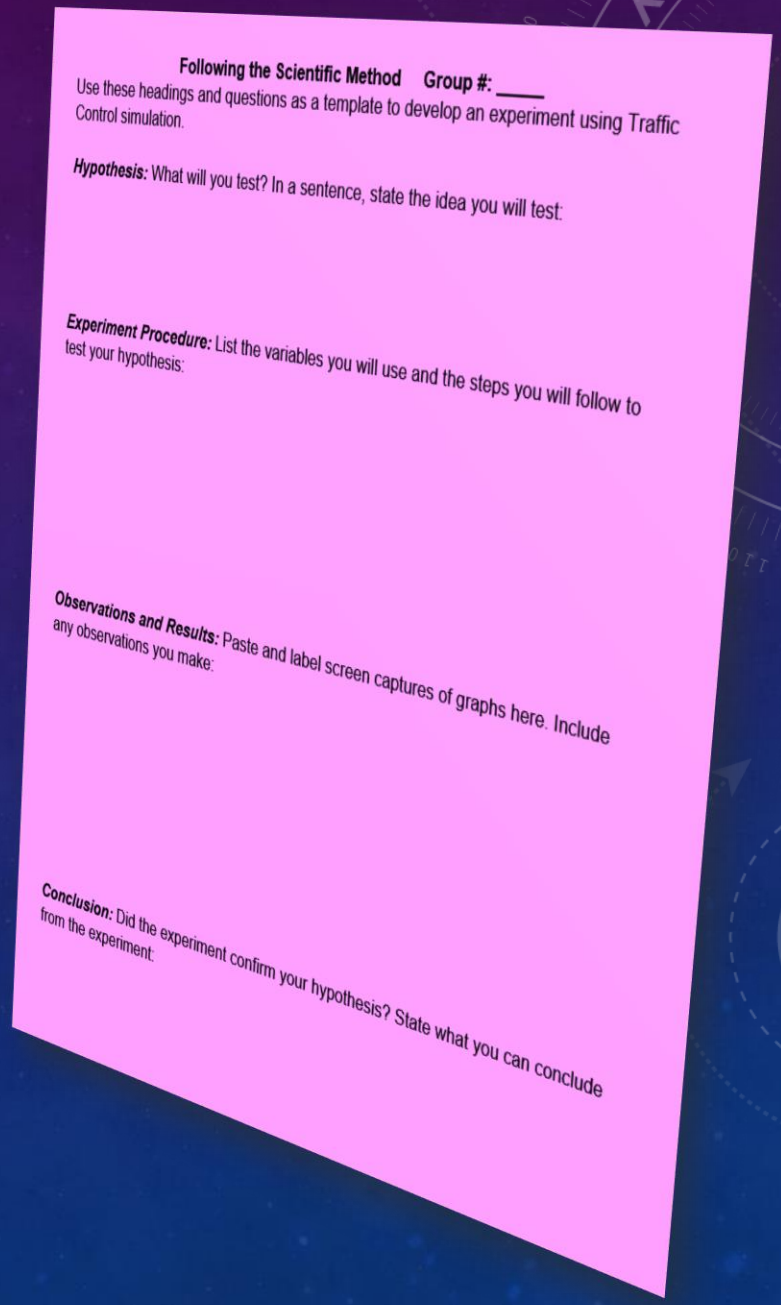
- In our example, we have two approaches
  - East –west
  - North- south




Click in the Intersession to change the settings of the signal timing.

- Design your experiment!
  1. *Create* a hypothesis
  2. *Design* an experiment to test the hypothesis
  3. *Perform* the simulation.
  4. *Create* whatever graphs you need to confirm or contradict the hypothesis
  5. *Form* a conclusion based on your scientific evidence



**Following the Scientific Method** **Group #: ____**

Use these headings and questions as a template to develop an experiment using Traffic Control simulation.

***Hypothesis:*** What will you test? In a sentence, state the idea you will test:

***Experiment Procedure:*** List the variables you will use and the steps you will follow to test your hypothesis:

***Observations and Results:*** Paste and label screen captures of graphs here. Include any observations you make:

***Conclusion:*** Did the experiment confirm your hypothesis? State what you can conclude from the experiment:

- Design your experiment!
  1. *Create* a hypothesis
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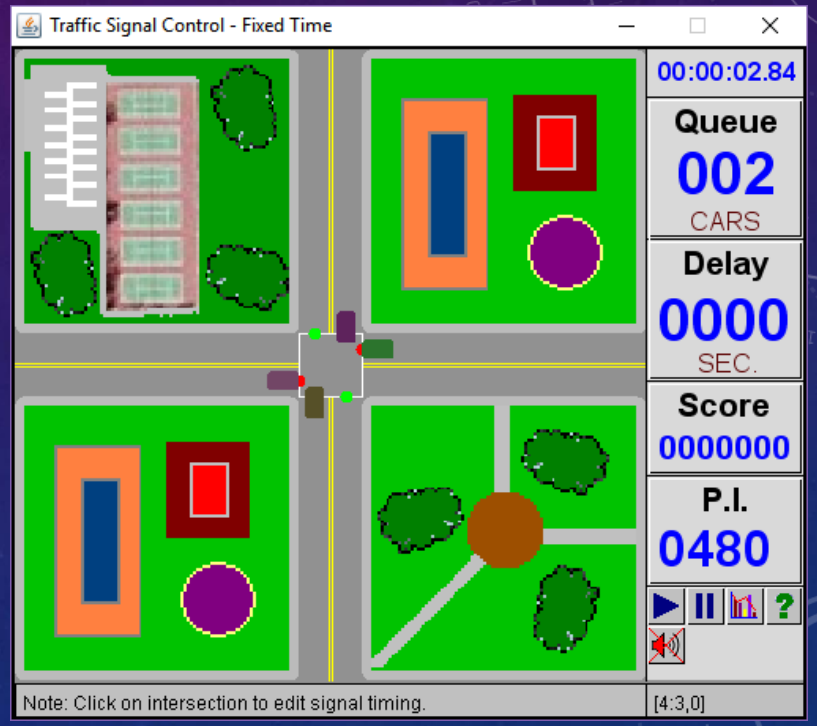
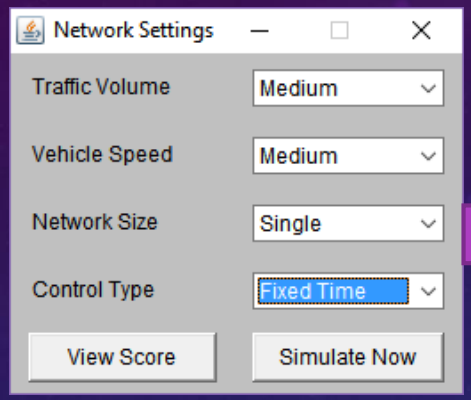
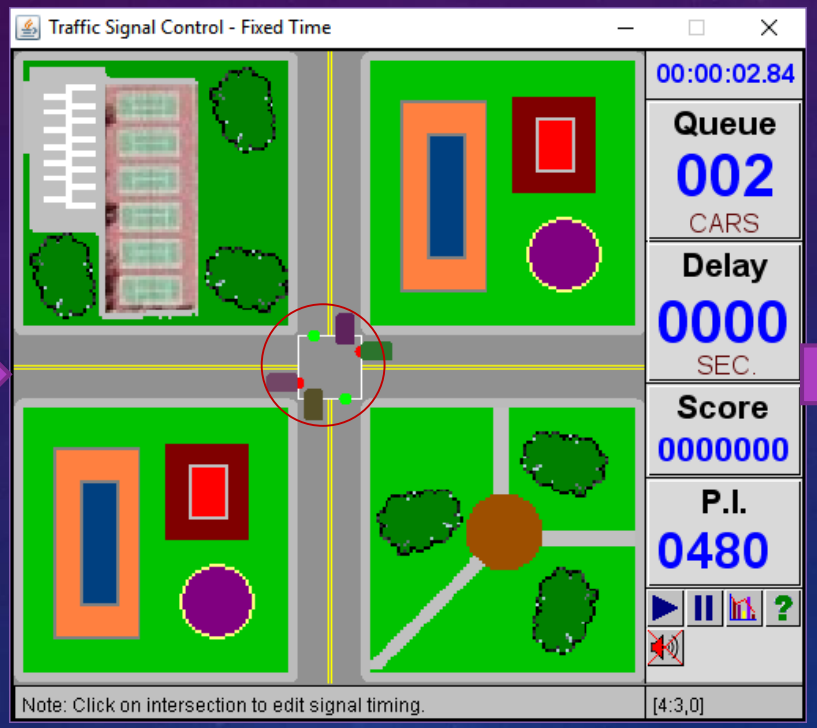


# List of Steps to Modify the Fixed Time Parameters:

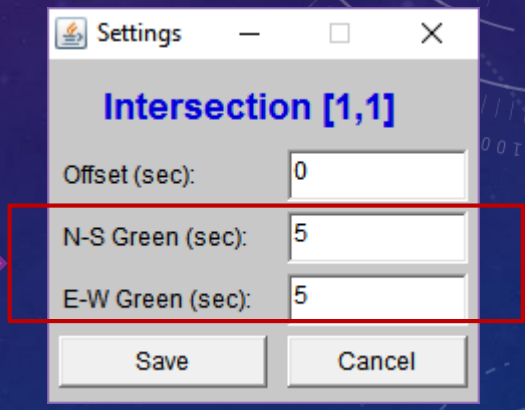
1. Choose Fixed Time Control




2. Pause the game and click on a signal




3. Change the signal timing settings



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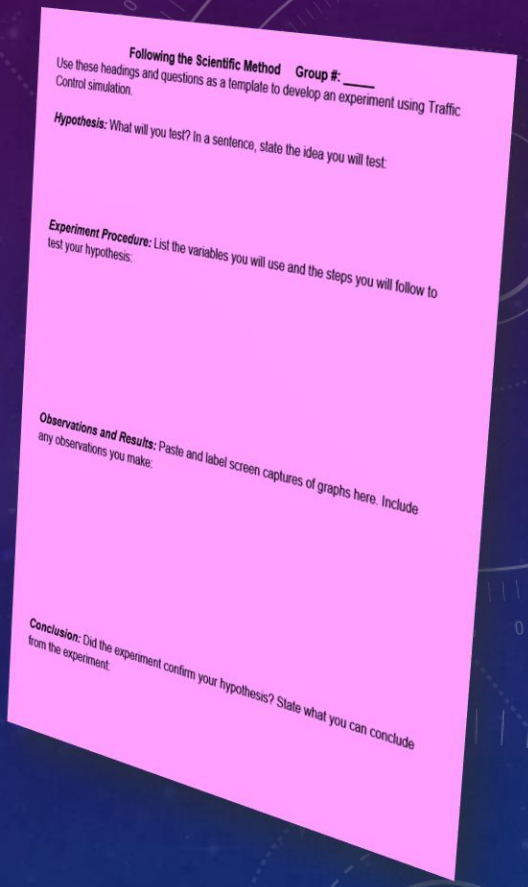

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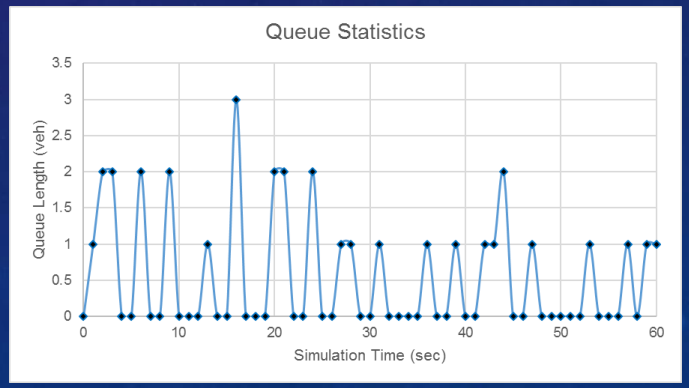

PRESENTATIONS

THANKS