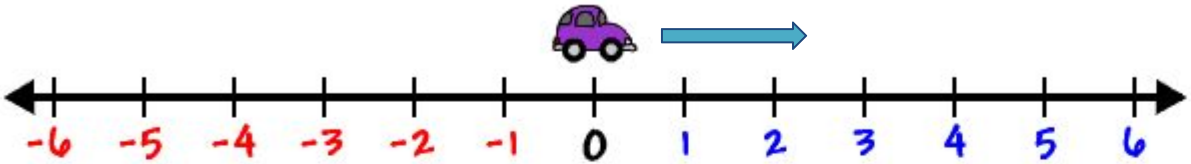
CSCI 103: Introduction to Programming
Lab 5

Lab Goals

- Work individually or in teams of 2 to apply knowledge of Pointers and Dynamic Allocation to complete 1-3 coding challenges
- Provide time to work on Project 2 and get help from the TAs

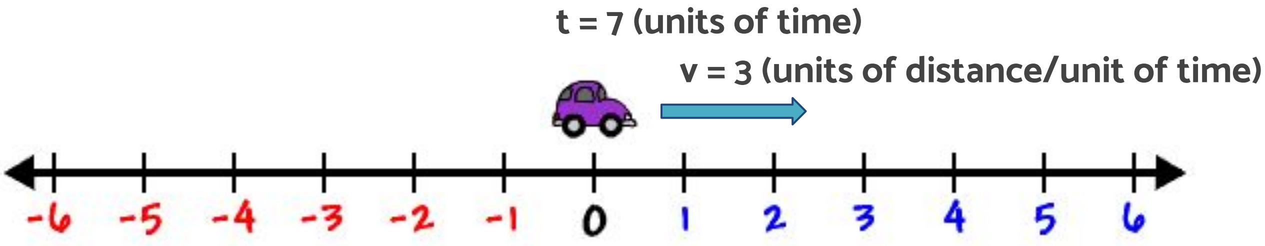
Exercise 1: Kinematics

- Modeling the motion of an object in 1 dimension
- Quick physics review:
  - Position = where you’re located
  - Velocity = how quickly you’re moving and in what direction



Exercise 1: Kinematics

- Your program is responsible for keeping track of an object’s **position** and **velocity** and the current **time**.



t = 7 (units of time)

v = 3 (units of distance/unit of time)

Exercise 1: Kinematics

Users should be able to…

- **elapse time** - The user says that X units of time pass. Update the current time and the object's position.
- **cover distance** - The user says that the object travels X distance. Update the current time and the object's position.
- **get time to position** - Tell the user how long it will take the object to reach a specified position.

Exercise 1: Kinematics

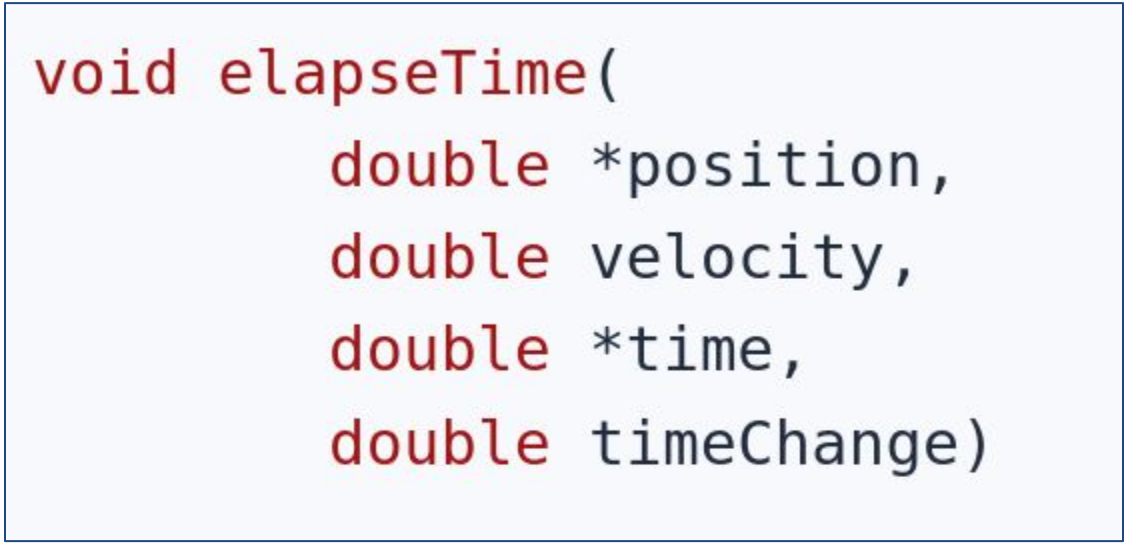
Example 1

```
> set-position 5
> set-velocity 10
> elapse-time 1
> get-stats
Position: 15
Velocity: 10
Time: 1
```

Example 2

```
> set-position 5
> set-velocity 10
> cover-distance 100
> get-stats
Position: 105
Velocity: 10
Time: 10
```

elapseTime() Prototype



```
void elapseTime(
        double *position,
        double velocity,
        double *time,
        double timeChange)
```

Exercise 2: To-Do

Goals:

- Build a todo list application
- Practice dynamic memory allocation and de-allocation
- Gain familiarity with pointers to pointers

Exercise 2: To-Do

Users should be able to…

- **add an item** - Add a new item to the end of the to-do list.
- **remove an item** - Remove the last item from the to-do list.
- **remove all items** - Empty the to-do list.
- **print** - Print out each item in the to-do list.

To-Do Memory Management

Storage demands:

- Up to 1,000 items in the to-do list
- Each item in the to-do list may consist of up to 200 characters

Memory Allocation:

- You can immediately allocate space for 1,000 pointers to to-do list items
- You should dynamically allocate and de-allocate the to-do list items as they are added and removed

Data Type Considerations

- What data type do you use to store the address of a character array?

- What data type would you use to store the address of an array of character arrays?

Exercise 2: To-Do

Example 1

```
> add buy-groceries
> add finish-pr2
> add practice-guitar
> remove-last
> print
Todo List:
buy-groceries
finish-pr2
```

Example 2

```
> add buy-groceries
> add finish-pr2
> remove-all
> add practice-guitar
> print
Todo List:
practice-guitar
```

Exercise 3: Patients

Goals:

- Build a patient data management application
- Practice dynamic memory allocation and de-allocation
- Gain familiarity with pointers to pointers
- Be exposed to different data structures

Exercise 3: Patients

Premise:

- Implement a database to keep track of numerical info about hospital patients, like height or blood pressure.
- Compute percentiles based on values in database.
- Program should work for hospitals of different sizes, such as a local urgent care clinic vs the Keck network

Exercise 3: Patients

Users should be able to…

- **add a patient** - Store a new patient datum.
- **remove a patient** - Remove the most recently added patient datum.
- **compute a percentile** - Determine what proportion of the stored data are less than or equal to a provided value.
- **print** - Print out each stored patient datum.

Patients Memory Management

Memory Allocation:

- You should begin with an array with space for just 1 patient datum
- When the patient array is full and there is a new datum to be added, double the size of the patient array.
- When a patient is removed and the patient array becomes at least 75% empty, halve the size of the patient array.
- Be sure to appropriately allocate and de-allocate memory

Schedule and Checkoff

First hour:

- To get credit: Complete the 1st exercise (`physics`) and start the second exercise (`todo`). Feel free to work on `patients` as a 3rd exercise.

Second hour:

- Work on PR2 with TAs available