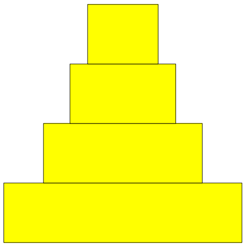
**CS1112 Section (Lab) Exercise 4**

# 1 Build your own step pyramid

Complete the script `stepPyramidSkeleton.m` to draw a step pyramid. The base rectangle is $L$-by-$H$ where $H \leq L$. Each step has the same height $H$. The next rectangle up is 2/3 the length of the rectangle below, and so forth. The top step must have a length no less than $H$.



You will need function `DrawRect`—download it from *Insight*→*Code and Data* (see Sec 5.3) and put it in your current directory (the directory from which you will run your script).

# 2 Fibonacci numbers

You should read *Insight* §3.2 before doing the following exercise. Download the following script:

```
% Fibonacci
clc
f_old = 0;
f_cur = 1;
n = 1;
% f_cur is the nth Fibonacci number
while (n<=10)
   fprintf('%2d %10d\n',n,f_cur)
   % Update:
   f_new = f_old + f_cur;
   f_old = f_cur;
   f_cur = f_new;
   n = n+1;
end
```

It displays the first 10 Fibonacci numbers $f_1, \ldots, f_{10}$.

(a) Modify the script so that it prints all Fibonacci numbers that are greater than ten thousand but less than one million.

(b) Modify the script so that it prints the smallest $n$ so that

$$\left| \frac{f_{n+1}}{f_n} - \frac{1+\sqrt{5}}{2} \right| \leq .000001$$

# 3 Simulating iRobot Create

"The Create" is a robot; it is the Roomba robotic vacuum cleaner without the vacuuming innards! One can program the Create to perform specific tasks, such as move along a wall until it reaches a door, follow a line drawn on the floor, etc. Instead of working with the actual robot, for now we will use a simulator to develop a simple program for the Create.

There are three tasks for today: (1) Download the set of files for the simulator and set MATLAB's *search path* to find those files no matter what your current directory is. (2) Explore several features of the simulator window (GUI—graphical user interface). (3) Run and extend a program that controls the robot (in the simulator).

## 3.1 The simulator and the search path

1. Download the file `iRobotCreateSimulatorToolbox.zip` from the *Exercises* page: click on the file name and then click "open" when asked to open or save the file. You'll see a folder named *iRobotCreateSimulatorToolbox*.

2. Click the Windows icon on the bottom left of the menu bar and then click "Computer." This starts another window. Double-click *Local Disk (C:)* which is the location where you want to put the *iRobotCreateSimulatorToolbox* folder. Now drag the *iRobotCreateSimulatorToolbox* folder to *Local Disk (C:)*.

3. In the MATLAB Command Window, type

   ```
   addpath 'C:\iRobotCreateSimulatorToolbox';
   savepath;
   path        % no semicolon here
   ```

   You'll see a long list of directories that are on Matlab's search path. Near the top of the list you should see `C:\iRobotCreateSimulatorToolbox`. Now you have access to the simulator from any current folder.

## 3.2 Explore the simulator

1. In the Command Window type `SimulatorGUI`. The simulator window—GUI—opens up. The blue circle in the plot area is the robot, at (0,0) by default. The short blue line indicates the robot's heading, east by default. The cursor control keys on the keyboard and the "Manual Control" keys on the right side of the GUI allow you to "drive" the robot. Try them out just for fun; later we won't do much manual driving.

2. When the robot is moving, alternately select the two "Camera Position" buttons on the top right of the screen to see the difference between the "global" and "robot centric" views. Select "global" view again and stop the robot (click "stop" under "Manual Control") before continuing.

3. To place and orient the robot in another location, click the "Set Position" button. Then click once in the plot area to indicate the robot location and click a second time to orient the robot. For example, clicking at (1,2) followed by (1,3) places the robot at (1,2) heading north.

## 3.3 Autonomous Robot

1. As in "autonomous control," i.e., the robot moves according to prepared instructions but *without external interference* (manual control by us). First, download the file `squarePath.m` from the *Exercises* page. This is the control program that we will use to control the robot.

2. Make sure `squarePath.m` is in the current folder. On the bottom right of the GUI click *Start* under "Autonomous." Select the control program `squarePath`. Observe the action of the robot. When it stops, look at the code in `squarePath.m`. Do you understand the commands `travelDist` and `turnAngle`?

3. Modify the code so that the robot completes a square "tour."

We will use the simulator in the next project.

Keep MATLAB running and the simulator files but delete YOUR files!