When you have completed the lab, show this sheet and any associated programs to your lab instructor, who will record that you have completed the lab. If you do not finish this exercise during the lab, show the instructor what you have done at the end of the lab and be sure to complete it in the next few days.

If you have any questions, **ask** your lab instructor or a consultant immediately! They are in the lab to help you learn the material.

CS100M course web page

`http://www.cs.cornell.edu/courses/cs100m/`

Answer the following questions:

1. What is the reading assignment given in the last lecture? _____
2. What is CMS? (Do not log on.) _____
3. Where are the AEWs held and when is the first meeting? _____
4. What does the CS100 AI policy say about code found on the Internet? _____

MATLAB built-in functions... fun with MATLAB

MATLAB provides numerous built-in variables and functions. For each line below, type in the text and press <*Enter*> to see what happens. Fill in the blanks below with the screen output for that line.

```
% This is a comment

% Variables, constants, and simple calculations:
  a= 100
  b= 99  % Take a look at the Workspace Pane
  format compact
  a/b                       % ______________________________
  ans
  y = ans                   % ______________________________
  format long
  y
  format short
  y
  p= (3*2)^2
  q= (3*2)^2;  % Look at the Workspace Pane:  q is created but its value is
               % not shown in the command window.

  x = 2;  y = x^x;  z = y^y  % ______________________________
  format loose

% Functions:
  sqrt(x)
  pi  % a built-in variable
  cos(pi)                    % ______________________________
  abs(ans)
  abs(cos(pi))               % ______________________________
  exp(ans)
  mod(5,2)  % What does function mod do?  If you're not sure, try a few more
            % examples: mod(9,7), mod(10,6)... ______________________________

  rand(1)  % Generate one random number in the range of (0,1)
  help rand
```

```
lookfor magic  % MATLAB searches its documentation for the keyword 'magic'
               % Wait a few seconds.  If this command takes too long to
               % complete, press <Ctrl><c> to make it stop.
```

The expanding Earth

Download the file `diffArea.m` from the *Exercises* or *Lecture Materials* page to the *Desktop* of your computer. (You can use a directory/path different from *Desktop*, but be sure to write down the location of your file.)

In MATLAB, set the *Current Directory* to be the directory in which you have stored your file `diffArea.m`. You should now see the file listed in the *Current Directory Pane*.

To read the program (also called a *script*), open the file in the *Editor Window*: select menu options *File→Open* and then select or type the file name `diffArea.m`. (Or in the *Current Directory Pane* double click on the file name.) To run a program, in the *Command Window* type the file name without the extension `.m`.

Assume that the Earth is a sphere with a radius of 4000 miles. By running the program `diffArea` three times, determine the increase in surface area if the Earth is uniformly paved with 1, 5, and 10 inches of cement. (Please don't let this happen in real life!) Write down the answers in the table below.

Now modify `diffArea` so that it *also* computes the approximate surface area increase via the following formula:

$$\Delta A = A(r + \Delta r) - A(r) \approx 8\pi r \Delta r.$$

Compare the two methods using the following choices for r and Δr:

r	Δr	ΔA from original program	ΔA from approximation formula
4000	1		
4000	5		
4000	10		
4000	1000		

Now, experiment with the print *format*. Currently, the *substitution sequenc* `%f` is used to print the value in the variable `incr`. The character `f` stands for *fixed point* and MATLAB determines the number of decimal places to show. If you want the value to be printed to 7 decimal places, then use the substitution sequence

```
%.7f
```

Make the above change in your program and observe the printed output. Next, if you want to use 20 character spaces for printing the entire value (including the decimal point) with 7 decimal places shown, then use the substitution sequence

```
%20.7f
```

Again, make this change and observe the printed output.

Aside, i.e., you don't have to learn this: The above formula follows from the derivative of $A(r)$, which can be approximated very well by a divided difference if Δr is very much smaller than r:

$$A'(r) \approx \frac{A(r + \Delta r) - A(r)}{\Delta r}.$$

The Earth, an oblate spheroid (a *what*?)

→ a sphere flattened at the poles

The surface area of an oblate spheroid such as the Earth is given by $A = 4\pi r_1 r_2$ where r_1 is the equatorial radius and r_2 is the polar radius. Write a program that reads in these two radii and computes the difference between $4\pi r_1 r_2$ and $4\pi((r_1 + r_2)/2)^2$. Use the Earth data $r_1 = 3963$, $r_2 = 3957$. Call the program `oblateArea`. Show your program to a lab staff.