- Previous Lecture (and Lab):
  - Intro to the course, "Computational senses"
  - The Matlab Command Window

- Today's Lecture:
  - Anatomy of a program
  - Variables, assignment, mathematical operations
  - Functions for input & output

- Announcements
  - Due to the fixed lab capacity, you must attend the discussion section in which you are enrolled
  - Consulting begins Tuesday in ACCEL Green Room (Carpenter Hall)

Formula

- Surface area of a sphere?

$$A = 4\pi r^2$$

- Have the cosine of some angle and want cos(θ/2)?

$$\theta \in \left[0, \frac{\pi}{2}\right]$$

$$\cos(\theta/2) = \sqrt{\frac{1+\cos(\theta)}{2}}$$

```
% Example 1_1:  Surface area of a sphere
% A: surface area of the sphere
% r: radius of the sphere

r= input('Enter the radius: ');
A= 4*3.14159*r*r;
fprintf('Surface area is %f!\n', A)
```

A computer program

Variable & assignment

- **Variable**: a named computer memory space for storing a value

  r [   ]

  A [   ]

- Valid names start with a letter, can contain digits
- Use meaningful variable names!

Variable & assignment

- **Variable**: a named space for storing a value

  r [   ]

- **Assignment**: putting a value into a variable
- Assignment operator: **=**
- An assignment statement: `r= 2*4.5`
- **Expression** on **right-hand-side (rhs)** is evaluated before the assignment operation

Assignment

- Expression on rhs is evaluated before the assignment operation
- Examples:
```
x= 2*3.14
y= 1+x
z= 4^2 – cos(y)
```
- Question: can we reverse the order of the 3 statements above?

Lecture 2   15

Matlab's built-in functions

- Expression on rhs is evaluated before the assignment operation
- Examples:
```
x= 2*3.14
y= 1+x
z= 4^2 – cos(y)
```

Function name

Argument (value) passed to the function

- Question: can we reverse the order of the 3 statements above?
- NO! Any variable on the rhs must be initialized.

Lecture 2   19

Script execution
(A script is a sequence of statements, an "m-file")

```
% Quad1
% Solves x^2 + 5x + 6 = 0

  a  = 1;
  b  = 5;
  c  = 6;
  d  = sqrt(b^2 - 4*a*c);
  r1 = (-b - d)/(2*a)
  r2 = (-b + d)/(2*a)
```

Memory space

Lecture 2   21

Statements in a program are executed in sequence

```
% A program fragment ...
x= 2*3.14
y= 1+x
x= 5
% What is y now?
```

| A: 6 | B: 7.28 | C: *some other value, or error* |

Lecture 2   23

Input & output

- *variable* = **input**('*prompt* ')

```
r= input('Enter radius: ')
```

- **fprintf**('*message to print* ')

```
fprintf('Increase ')
fprintf('is %f inches\n', x)
fprintf('Position (%d,%d)\n', x,y)
```

Lecture 2   27

Substitution sequences
(conversion specifications)

%f	fixed point (or floating point)
%d	decimal—whole number
%e	exponential
%g	general—Matlab chooses a format
%c	character
%s	string

Examples: %f   %15.2f

Lecture 2   28

Comments

- For readability!
- A comment starts with % and goes to the end of the line
- Start each program (script) with a concise description of what it does
- Define each important variable/constant
- Top a block of code for a specific task with a concise comment

Example

Modify the previous program to calculate the increase in surface area given an increase in the radius of a sphere.

Note: 1 mile = 5280 feet

```
% Example 1_2:  Surface area increase
% given an increase in the radius

r= input('Enter radius r in miles: ');
delta= input('Enter delta r in inches: ');
```
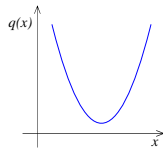
What's next?

- So far, all the statements in our scripts are executed in order
- We do not have a way to specify that some statements should be executed only under some condition
- We need a new language construct…

Consider the quadratic function

$$q(x) = x^2 + bx + c$$

on the interval $[L , R]$:

- Is the function strictly increasing in $[L , R]$?
- Which is smaller, $q(L)$ or $q(R)$?
- What is the minimum value of $q(x)$ in $[L , R]$?

Problem 1

Write a code fragment that prints "yes" if q(x) increases across the interval and "no" if it does not.