Previous Lecture:
- Intro to the course, “Computational senses”
- Running a program in Matlab

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

Announcements
- Due to fixed lab capacity, you must attend the discussion section in which you are enrolled
- Consulting begins Sunday in ACCEL Green Room (Carpenter Hall)
- “InstallFests” for remote MATLAB to be announced
**Formula**

- **Surface area of a sphere?**
  
  \[ A = 4\pi r^2 \]

- **Have the cosine of some angle and want \( \cos(\theta/2) \)?**
  
  \[ \cos(\theta / 2) = \sqrt{\frac{1 + \cos(\theta)}{2}} \]
% 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
', A)
A computer program
Variable & assignment

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

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

r
A
Variable & assignment

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

- **Assignment**: putting a value into a variable

- **Assignment operator**: =

- An assignment statement: \( r = 2 \times 4.5 \)

- **Expression on right-hand-side (rhs)** is evaluated before the assignment operation
Assignment

- **Expression on rhs** is evaluated before the assignment operation

- **Examples:**
  \[
  x = 2 \times 3.14 \\
  y = 1 + x \\
  z = 4^2 - \cos(y)
  \]

- **Question:** can we reverse the order of the 3 statements above?
Assignment

- **Expression on rhs** is evaluated before the assignment operation

- Examples:
  
  \[
  \begin{align*}
  x &= 2 \times 3.14 \\
  y &= 1 + x \\
  z &= 4^2 - \cos(y)
  \end{align*}
  \]

- Question: can we reverse the order of the 3 statements above?

- NO! Any variable on the rhs must be initialized.
Assignment

- Expression on rhs is evaluated before the assignment operation

- Examples:
  \[
  x = 2 \times 3.14 \\
  y = 1 + x \\
  z = 4^2 - \cos(y)
  \]

- Question: can we reverse the order of the 3 statements above?

- NO! Any variable on the rhs must be initialized.
Matlab’s built-in functions

- Expression on rhs is evaluated before the assignment operation
- Examples:
  \[ x = 2 \times 3.14 \]
  \[ y = 1 + x \]
  \[ z = 4^2 - \cos(y) \]
- Question: can we reverse the order of the 3 statements above?
- NO! Any variable on the rhs must be initialized.
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)
Script execution
(A script is a sequence of statements, an “m-file”)

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

```matlab
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

<table>
<thead>
<tr>
<th>a</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>6</td>
</tr>
<tr>
<td>d</td>
<td>1</td>
</tr>
<tr>
<td>r1</td>
<td>-3</td>
</tr>
<tr>
<td>r2</td>
<td>-2</td>
</tr>
</tbody>
</table>
Statements in a program are executed in sequence

%% A program fragment . . .
\begin{verbatim}
x = 2*3.14
y = 1+x
x = 5
\end{verbatim}
%% What is y now?

A: 6  B: 7.28  C: some other value, or error
% 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)
Input & output

- `variable = input('prompt')`
  
  ```
  r = input('Enter radius: ')
  ```

- `fprintf('message to print')`
  
  ```
  fprintf('Increase is %f inches\n', x)
  fprintf('Position (%d,%d)\n', x,y)
  ```
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
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 in mile$^2$ 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: ');

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: ');
newr = r + ((delta/12)/5280);
A = 4*pi*r^2;
newA = 4*pi*newr^2;
incr = newA - A;
fprintf('Increase in mile^2 is %f.\n', incr)