CS 1112 Introduction to Computing Using MATLAB

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Website:
https://www.cs.cornell.edu/courses/cs1112/2022fa/
Easy example: compute the midpoint of a line

\[ (x_m, y_m) = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \]

% the first point
x1 = 1;
y1 = 1;

% the second point
x2 = 10;
y2 = 3;

% the midpoint
xm = (x1 + x2)/2;
ym = ???
Easy example: compute the midpoint of a line

\[(x_m, y_m) = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)\]

% the first point
\[x_1 = 1;\]
\[y_1 = 1;\]

% the second point
\[x_2 = 10;\]
\[y_2 = 3;\]

% the midpoint
\[x_m = (x_1 + x_2)/2;\]
\[y_m = (y_1 + y_2)/2;\]
Announcements

● Prelim conflicts
● See website for office hours and consulting hours (starting this Friday!)
● Highly recommended readings will be posted ~2 days before each lecture
Lecture 2: Programming basics

● Previous lecture & discussion
  ○ Intro to the course
  ○ What are programming and MATLAB?
  ○ Running commands and a program in MATLAB

● Today
  ○ Variables, assignment, and math operations
  ○ Functions input and output

● Announcements
  ○ First project posted after next Tues. lecture
  ○ First exercise due next Tuesday
Formulas

Surface area of a sphere?

\[ A = 4\pi r^2 \]

If we have the cosine of some angle \( \theta \) in \([0, \pi/2]\) and want to calculate \( \cos(\theta/2) \):

\[ \cos(\theta/2) = \sqrt{\frac{1+\cos(\theta)}{2}} \]
Interactive computation in **Command Window**

```plaintext
>> r = 6
r =
  6
>> a = 4*pi*r^2
a =
  452.3893
>> v = 4/3*pi*r^3
v =
  904.7787
```
MATLAB script that computes the surface area of spheres

% Example 1_1: Surface area of a sphere
% r: radius of the sphere [unit]
% A: surface area of the sphere [unit^2]

r = input('Enter the radius: ');
A = 4*pi*r^2;
fprintf('Surface area is %f!\n', A)

This is a computer program! What is a computer program?
A computer program

Sample computer program

General computer program

For the code on the previous slide, what are the input(s) and what are the output(s)?

Input: radius
Output: area
Variable and assignment

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

  - Valid variable names start with a letter, can contain digits and some characters
  - Use meaningful variable names!
  - Create a variable by assigning a value to it
  - By default, a number has the type (class) double, for “double precision floating point number”
Variable and assignment

- **Variable**: a named computer memory space for storing a value
  
  \[ r \]

- **Assignment**: putting a value into a variable
- Assignment operator: `=`
- An assignment **statement**: \( r = 2 \times 4.5 \)
- Expression on the right hand side is evaluated before the assignment operation
- Update variable’s value with another assignment statement
  
  \[ r = 7 \]
Assignment

- Expression on the right hand side is evaluated before assignment operation
- Examples:
  
  \[
  \begin{align*}
  x &= 2 \times 3.14 \\
  y &= 1 + x \\
  z &= 4^2 - \cos(y)
  \end{align*}
  \]
- Can we reverse the order of the three statements above?
  
  No! Any variable showing up on the right hand side must be initialized
MATLAB’s built-in functions

- Expression on the right hand side is evaluated before assignment operation
- Examples:
  
  \[
  x = 2 \times 3.14 \\
  y = 1 + x \\
  z = 4^2 - \cos(y)
  \]
- Can we reverse the order of the three statements above?

  No! Any variable showing up on the right hand side must be initialized.
A script (or “m-file”) is a file with a sequence of statements.

Recall the quadratic formula: 

\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

% Quadratic Formula script
% solves x^2 + 5x + 6 = 0

a = 1;
b = 5;
c = 6;
d = sqrt(b^2 - 4*a*c);
x1 = (-b - d)/(2*a);
x2 = (-b + d)/(2*a);
Statements in a program are executed in sequence

% some sample statements

x = 2*5

y = 1 + x

x = 5

% What value is stored in y now?

11!

y does not get changed when x changes at the end.
Input and output

Variable = input('prompt');  % getting input from user
r = input('Enter radius');

fprintf('message to print');  % print out message for user

fprintf('CS 1112 is my favorite class!');
A = 4*pi*r^2;
fprintf('Area of the circle is: %f', A);

numCats = input('Enter the number of cats Frank owns');
fprintf('Frank has %d cats', numCats);