CS 1112 Introduction to Computing Using MATLAB
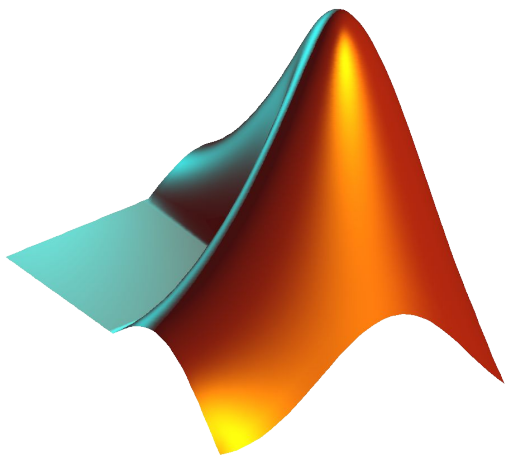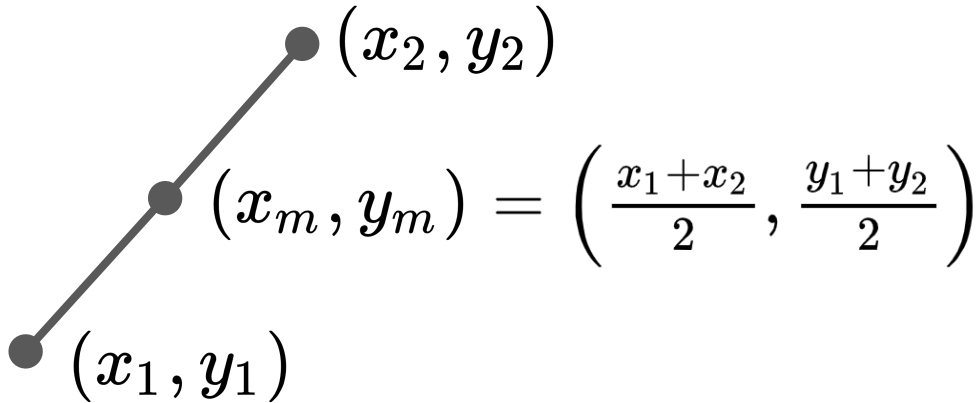
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Website: https://www.cs.cornell.edu/courses/cs1112/2022fa/

Easy example: compute the midpoint of a line

(x_2, y_2)

$(x_m, y_m) = \left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2} \right)$

(x_1, y_1)

```
% 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

$$(x_m, y_m) = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$
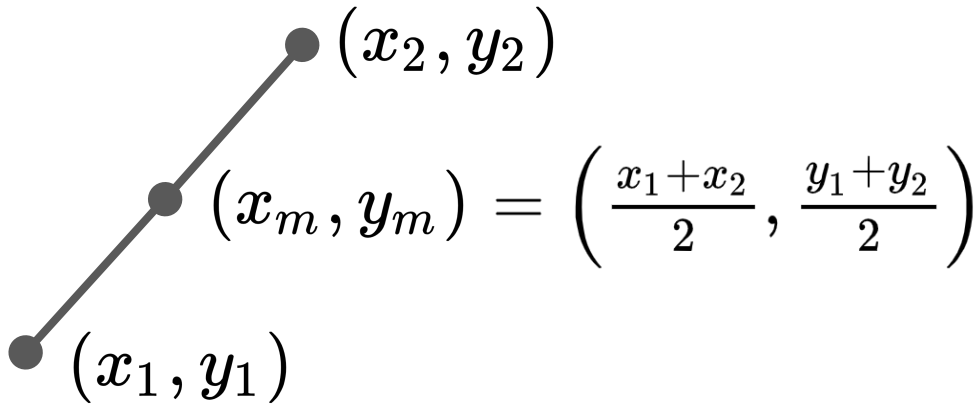
Your first MATLAB code!

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

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

% the midpoint
xm = (x1 + x2)/2;
ym = (y1 + y2)/2;
```

Announcements

- Prelim conflicts
- See website for office hours and 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 θ in [0, pi/2] and want to calculate cos(θ/2)?

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

Interactive computation in <u>Command Window</u>
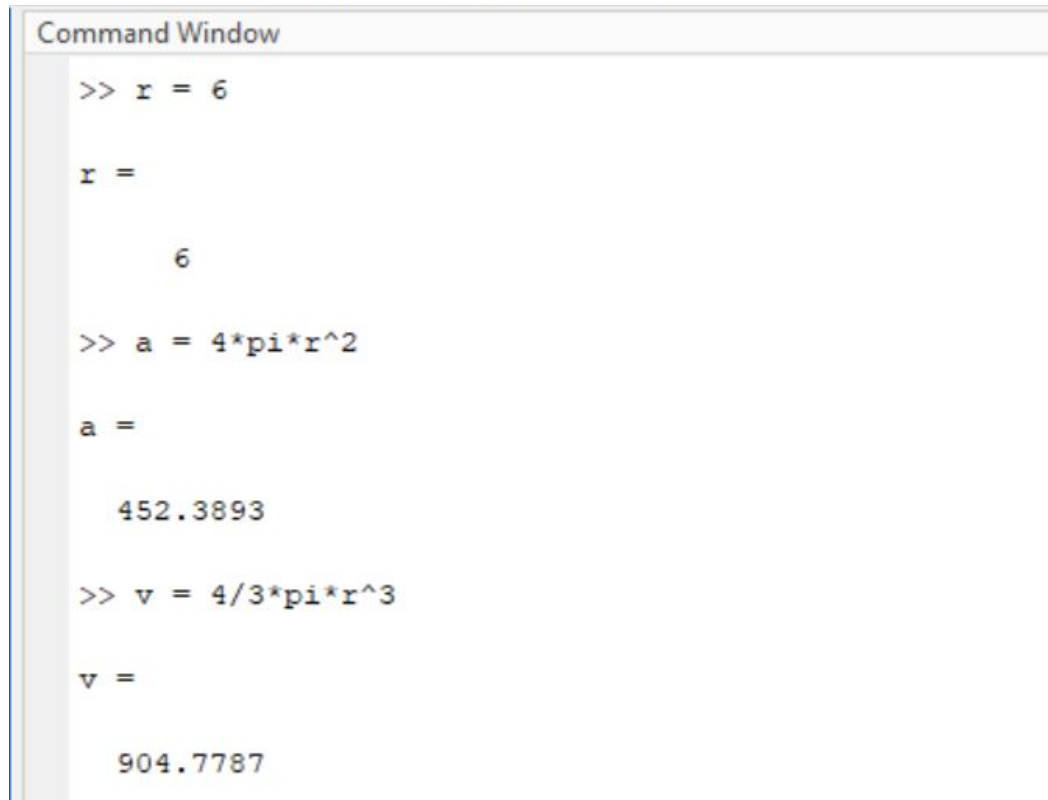
```
>> r = 6

r =

     6

>> a = 4*pi*r^2

a =

     452.3893

>> v = 4/3*pi*r^3

v =

     904.7787
```



```
Command Window
>> r = 6

r =

     6

>> a = 4*pi*r^2

a =

     452.3893

>> v = 4/3*pi*r^3

v =

     904.7787
```
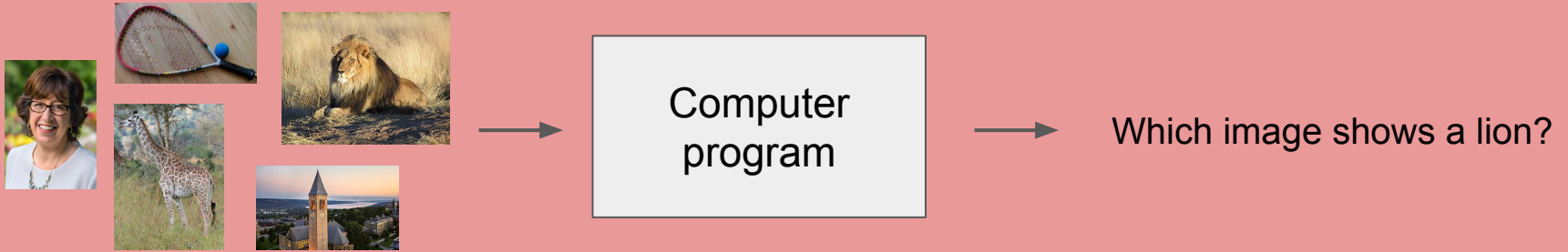
MATLAB script that computes the surface area of spheres

```
% 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)
```
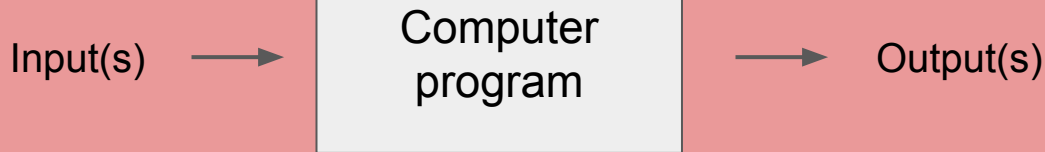
This is a computer program! What is a computer program?

A computer program

Sample computer program

Computer program → Which image shows a lion?

General computer program
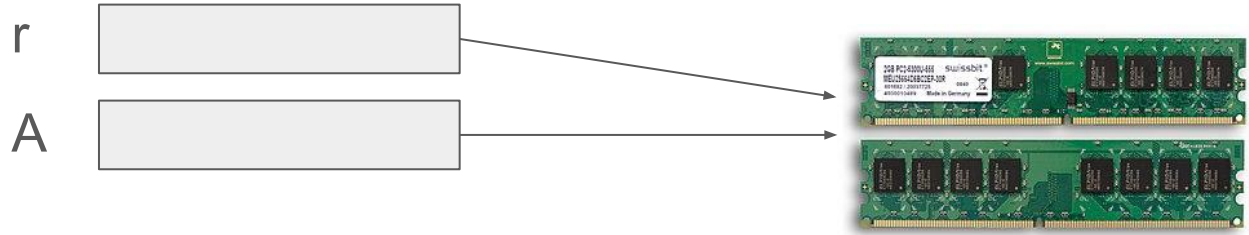
Input(s) → Computer program → Output(s)

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

r

A

- 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*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:

```
x = 2*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 <u>initialized</u>

MATLAB's built-in functions

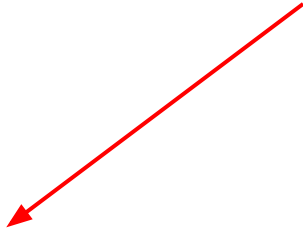- Expression on the right hand side is evaluated before assignment operation

- Examples:

  x = 2*3.14

  y = 1 + x

  One of MATLAB's built-in functions

  z = 4^2 - `cos(y)`

  Argument (or input) passed to the function

- Can we reverse the order of the three statements above?

  No! Any variable showing up on the right hand side must be initialized

Script execution (how to run MATLAB code)

A script (or "m-file") is a file with a sequence of statements.

Recall the quadratic formula: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

```matlab
% 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);
```

Memory space

a	1
b	5
c	6
d	1
x1	-3
x2	-2

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!

Memory space

x   ~~10~~ 5
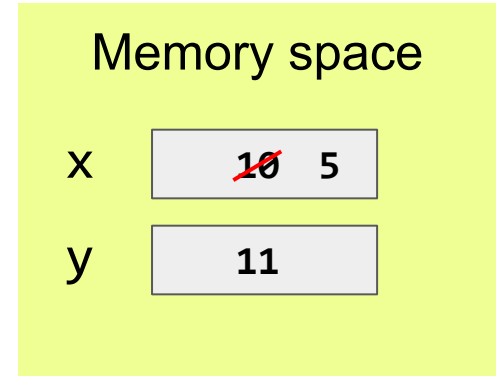
y   11

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);
```

%f is replaced by the value stored in A

Example

```
numCats = input('Enter the number of cats Frank owns');

fprintf('Frank has %d cats', numCats);
```