MA2252 Introduction to Computing

Lecture 8
Part 1: Iteration

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Learning outcomes

At the end of lecture, students will be able to understand and create

- For-Loop
- While-Loop

Iteration

running your code block to do a task again & again until a desired result is reached.

Iteration means to perform a task repeatedly.

Example:

To find the sum of first n natural numbers, addition of two numbers taken at a time should be done repeatedly.

$$1+2+3+4+\cdots n = \frac{n(n+1)}{2}$$

Iteration (repetitive work)

$3+3=6$

$6+4=10$

$10+5=15$

Iteration (contd.)

In MATLAB, iteration can be done via

1. For-loop
2. While-loop

For-Loop

Construction:

for looping variable = looping array
  code block
end

```
for x = linspace(2:2:10)
y=sinx ;
end
```

sin2
sin4
[2 4 6 8 10]
sin6
sin8
sin10

Function: For-loop executes the code block for values of looping variable from first to last element of looping array.

For-Loop (contd.)

$\frac{n(n+1)}{2} = \frac{\cancel{10}^{5} \times 11}{\cancel{2}} = 55$

Example 1:

$Sum = 1+2+3+4+\dots N$

$1 \qquad 10$

Find the sum of first n natural numbers.

```
clc
clear all
sum=1;
N=10;
for n=2:N
    sum=sum+n;
end
```

looping variable

$[2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10]$

3

$sum = 1, \quad sum = 1+2 = 3$

$sum = 1+2+3 = 6$

1st iteration $Sum = sum + 2$

$sum = 1+2 = 3$

2nd iteration: $sum = sum + 3 = 3+3 = 6$

For-Loop (contd.)

Example 2:

Find the following sum:

$$\sum_{n=1}^{10} n \times (n+1) = \sum_{n=1}^{10} (n^2 + n) = \sum_{n=1}^{10} n^2 + \sum_{n=1}^{10} n$$

$$1\text{x}2 + 2\text{x}3 + 3\text{x}4 + \cdots + 10\text{x}11$$

$2 + 6 + 12$

$=$

```
clc
clear all
product=0;
for n=1:10
   product = product + n*(n+1);
end
```

product = 0

1st iteration: $2 = 0 + 1 \times 2$

$n=2$: $8 = 2 + 2 \times 3$

$n=3$: $20 = 8 + 3 \times 4$

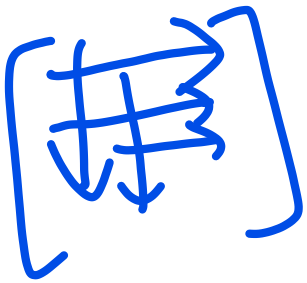
$\vdots$

$( ) = ( ) + 10 \times 11$

For-Loop (contd.)

Demo

very useful when iterating in more than one dimension



Nested For-Loops

A for-loop entirely contained in other for-loop is called a nested for-loop.

2 for loops nested

3 for loops nested

For-Loop (contd.)

Example: Create a 4x4 identity matrix using nested for-loops.

```
N=4;
A=zeros(N);
for i=1:N
   for j=1:N
      if i==j
         A(i,j)=1;
      else
         A(i,j)=0;
      end
   end
end

disp(A)
```

→ dimension of matrix

→ good idea

→ i is row index

A(i,j)

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}_{4\times 4}$$

eye(4) =

1st iteration:

i=1 first row

j=1 A(1,1)=1

j=2 A(1,2) = 0

For-Loop (contd.)

Fn + F5 → shortcut to run your ~~code~~ script file

Demo

For-Loop (contd.)

Using break and continue keywords

you want to exit earlier

- break is used to exit the for-loop.
- continue skips the rest of for-loop's code and begins the next iteration.

next value of looping value

Note: In nested for-loops, break only exits the inner-most for-loop in which it is contained.

for
for
break
end
end

For-Loop (contd.)

Example:

$i = 2, 3, 4, \ldots, 38$

Write a function to test if a given number (greater than 2) is prime or not.

```
function s = test_prime(x)
for i = 2:x-1
   if mod(x,i)==0
      s=sprintf('%d is not prime',x);
      break
   elseif i==x-1
      s=sprintf('%d is prime',x);
   else
      continue
   end
end
```

x is natural number input by user

all possible factors

39 is not prime. $39 = 3 \times 13$

37 is prime

$39/2$

$39/3 = 13$

mod(x,i) → gives remainder when x is divided by i

2, 3, 4, ... 36

Conti.

For-Loop (contd.)

Demo

While-Loop

A while loop executes the code as long as a given logical expression is true.

Construction:

doesn't have a looping array

```
while logical expression
code block
end
```

While-Loop (contd.)

Example:

Find all square numbers less than 50.

$1, 4, 9, 16, 25$

$\| \quad \| \quad \| \quad \| \quad \|$

perfect $2^2 \quad 3^2 \quad 4^2 \quad 5^2$

squares

$1^2, 2^2, 3^2, 4^2$

$1, 4, 9, 16 \ldots 49$

$\| \; 7^2$

```
clc
clear all
x=1;
while x^2<50
   disp(x^2)
   x=x+1;
end
```

$x = 1+1 = 2$

While-Loop (contd.)

Demo

Activity

A student wrote an alternative code to find all square numbers less than 50. What is happening with this code?

```
clc
clear all
x=1;
y=x^2;
while y<50
   disp(y)
   x=x+1;
end
```

Open your MATLAB, write this code and interpret the output.

Infinite Loop

An infinite loop runs forever.

Note: In this scenario, use ctrl+c to stop the code execution by MATLAB.

End of Part 1

Please provide your feedback here