

Topics: Iteration using `for`, `while`

Reading: CFile Chapter 2 (Pay close attention to Sec 2.2 on “floating point” system)

Iteration

Important features:

- Task can be accomplished if some step is repeated a number of times
- Must have a starting point
- Must know when to stop \Rightarrow _____
- Must keep track of progress \Rightarrow _____

Example 1: Area of n -gon

Complete the following program to compute and display the areas of inscribed and circumscribed regular n -gons in the unit circle where $n = L, L + 1, \dots, R - 1, R$. Use only scalar variables.

```
L= input('Enter lower bound for n: ');
R= input('Enter upper bound for n: ');
fprintf('\n n\tInner Area\tOuterArea\n');

%Compute and display areas of n-gons
innerA= (n/2)*sin(2*pi/n);
outerA= n*tan(pi/n);
fprintf('%d\t%.6f\t%.6f\n', n, innerA, outerA);
```

Syntax of the for Loop

```
for <index variable> = <lower bound> : <increment> : <upper bound>
    Statements to execute
    Also called loop body
end
```

The index variable takes on the values specified in the loop header *one at a time*, i.e., one value for each pass through the loop.

Examples of index values: The expression **10:2:16** specifies the values 10, 12, 14, and 16. The “increment may be negative. For example, **10:-2:6** specifies the values 10, 8, and 6. MATLAB’s default increment is **1**, so the expression **10:13** specifies the values 10, 11, 12, and 13.

Example 2: “Accumulating” a solution using iteration

Consider the following script. How many passes through the loop will be completed? _____

```
% Average 10 numbers from user input
n= 10;      % number of data values
for k= 1:n
    % read and process input value
    num= input('Enter a number: ');
    total= total + num;
end
ave= total/n % average of n numbers
```

Example 3: n -gon \rightarrow circle

As n increases, the regular inscribed and circumscribed n -gons converge to the circle. Since the area of the unit circle is π , we have

$$\lim_{n \rightarrow \infty} \text{innerArea}_n = \pi \quad \lim_{n \rightarrow \infty} \text{outerArea}_n = \pi .$$

Write a program to find n “sufficiently large” to approximate the area of the unit circle.

Itemize the tasks:

Algorithm:

Syntax of the while Loop

```
while condition
    statements to execute if
    expression evaluates to true
end
```

If the condition (*loop guard*) evaluates to true, the loop body executes and the flow of the program goes back to the loop guard—repetition. When the condition evaluates to false, the loop body is skipped and the program continues after the `end` keyword of the loop.

Two useful patterns

Pattern for doing something n times	Pattern for doing something an indefinite number of times
<pre>for k = 1:n % do something % ... end</pre>	<pre>% initialization % ... while not stopping signal % do something % ... % update status (variables) % ... end</pre>