Topics: Iteration using `while`; review—developing algorithms
Reading: CFile Chapter 3

Example: n-gon → 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

$$\lim_{n\to\infty} innerArea_n = \pi \qquad \lim_{n\to\infty} outerArea_n = \pi\,.$$

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

```
% Convergence of inner and outer areas.
fprintf('\n  n\t A(n)\t  B(n)\n');

% Initialization









% Compute and print areas until convergence
while  (                                        )

    fprintf('%4d %9.6f %9.6f \n', n, innerA, outerA);


    innerA = (n/2)*sin(2*pi/n);
    outerA = n*sin(pi/n)/cos(pi/n);
end
```

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**
for `k = 1:n` `    % do something` `    % ...` **end**	`% initialization` `% ...` **while** *not stopping signal* `    % do something` `    % ...` `    % update status (variables)` `    % ...` **end**

See script `areaIndef.m` to see a commonly used "indefinite iteration" pattern for soliciting user input.

Example: Times table

Write a script to print a specified range of the times table. Example for the range [1..4]:

1	2	3	4
2	4	6	8
3	6	9	12
4	8	12	16

Example: Brute-force algorithm to find minimum function value

How do you find the minimum value of a general function $f(x)$ within some domain $[L, R]$ where $L < R$?

Example: Is it prime?

Write a program fragment that determines whether a given integer **n** is prime. Assume `n`>2. (Hint: MATLAB function **mod(x,y)** returns the value of the remainder of x divided by y assuming integer values of x, y.)

Example: Are they prime?

Sketch a program that will list all the prime numbers in the range of [**a**,**b**] given integers **a**,**b**>1 and **a** < **b**.

Example: Mode (review question for prelim)

Develop an algorithm for calculating the *mode* of a sequence. The mode is the number in the sequence that occurs with maximum frequency. Assume that the sequence is (a) non-negative, (b) entered one by one and terminated by a negative number, and (c) entered in non-decreasing order. E.g., the mode of the sequence 87,92,92,98,98,98,100 is 98. Assume that only scalar variables are allowed.

The savvy programmer...

- *Learns program patterns* of general utility and *use relevant pattern* for the problem at hand.
- *Seeks inspiration* by systematically working test data by hand. Is introspective and asks: "what am I doing?"
- *Declares variables* for each piece of information maintained when working problem by hand. *Writes comments* that precisely describe the contents of each (important) variable.
- *Decomposes* the problem into manageable tasks.
- *Refines* the algorithm iteratively: solve a simpler problem first.
- *Remembers* the problem's boundary conditions.
- *Validates* the program by tracing it on simple test data.