While Statements

- We often need to execute code (statements) many times.
- if statements only allow us to execute or not execute code. in other words they allow us to execute code 0 or 1 times
  
while statements allow us to execute code 0 or more times
- Like if, while statements have a controlling expression
  but while statements execute their body until the controlling expression is false

while (EXPRESSION) {
  stmt1;
  stmt2;
  ...
  stmtn;
}

while Loop - Loop Counter Example

```c
// read an integer n
// print n asterisks
int loop_counter, n;

printf("How many asterisks? ");
scanf("%d", &n);

loop_counter = 0;
while (loop_counter < n) {
    printf("*");
    loop_counter = loop_counter + 1;
}

printf("\n");
```

while Loop - Loop Counter Pattern

Here is the programming pattern for a while that executes n times:

```c
loop_counter = 0;
while (loop_counter < n) {     
    // statements the loop needs to perform
    //
    loop_counter = loop_counter + 1;
}
```
While Statements - Termination

- Can control termination (stopping) of while loops in many ways.
- Easy to write while loop that do not terminate.
- Often a sentinel variable is used to stop a while loop when a condition occurs in the body of the loop.

while Loop - Sentinel Variable Example

```c
// read numbers printing whether even or odd
// stop if zero read
int stop_loop, numbers;

stop_loop = 0;
while (stop_loop != 1) {
    scanf("%d", &number);
    if (number == 0) {
        stop_loop = 1;
    } else if (number % 2 == 1) {
        printf("%d is odd.\n", number);
    } else {
        printf("%d is even.\n", number);
    }
}
```

while Loop - Sentinel Variable Pattern

Here is the programming pattern for a while that executes \( n \) times:

```c
stop_loop = 0;
while (stop_loop != 1) {
    // statements the loop needs to perform
    //
    if (.......) {
        stop_loop = 1;
    }
    // perhaps more statements
    //
}
```

Nested While Loops

- Often need to nest while loops.
- Need a separate loop counter variable for each nested loop.

```c
// print a square of 10x10 asterisks
int i, j;

i = 0;
while (i < 10) {
    j = 0;
    while (j < 10) {
        printf("*");
        j = j + 1;
    }
    printf("\n");
    i = i + 1;
}
```