# 5. Repetition

6. Iteration

7. Other Conditional and Iterative Statements

## The while Statement (1)

```
#include <iostream>
int main() {
   int count = 1; // Initialize counter
   while (count <= 5) {
      std::cout << count << '\n'; // Display counter, then
      count++; // Increment counter
   }
}


while(/*condition*/)
  // statement
```

## The while Statement (2)

```
#include <iostream>
int main() {
   char input;
   int count = 0;
   bool done = false;
   while (!done) {
      std::cout << count << '\n';
      std::cout << "Please enter \"Y\" to continue or \"N\" to quit:";
      std::cin >> input;
      if(input != 'Y' && input != 'y' && input != 'N' && input != 'n')
         std::cout << "\"" << input << "\""
                  << " is not a valid choice" << '\n';
      else if (input == 'Y' || input == 'y')
         count++;
      else if (input == 'N' || input == 'n')
         done = true;
   }
}
```

## The while Statement (3)

```
#include <iostream>
int main() {
   int input = 0,      // Ensure the loop is entered
      sum = 0;         // Initialize sum

   // Request input from the user
   std::cout << "Enter numbers to sum, negative number ends list:";
   while (input >= 0) {        // A negative number exits the loop
      std::cin >> input;       // Get the value
      if (input >= 0)
         sum += input;         // Only add it if it is nonnegative
   }

   std::cout << "Sum = " << sum << '\n'; // Display the sum
}
```

## The while Statement (4)

```
#include <iostream>
int main() {
   int input, sum = 0;
   std::cout << "Enter numbers to sum, type 'q' to end the list:";
   while (std::cin >> input) // ^Z(Windows), ^D(Unix)
      sum += input;

   std::cout << "Sum = " << sum << '\n';
}

-------------------------------------------

#include <limits>
std::cin.clear(); // Clear the error state of the stream
// Empty the keyboard buffer
std::cin.ignore(std::numeric_limits<std::streamsize>::max(), '\n');
```

## The while Statement (5)

```
#include <iostream>
#include <iomanip>
// Print the powers of 10 from 1 to 1,000,000,000
int main() {
   int power = 1;
   while (power <= 1000000000) {
      // Right justify each number in a field 10 wide
      std::cout << std::setw(10) << power << '\n';
      power *= 10;
   }
}
```

## Nested Loops

```cpp
#include <iostream>
int main() {
   int size; // The number of rows and columns in the table
   std::cout << "Please enter the table size: ";
   std::cin >> size;
   // Print a size x size multiplication table
   int row = 1;
   while (row <= size) {       // Table has size rows.
      int column = 1;          // Reset column for each row.
      while (column <= size){ // Table has size columns.
         int product = row*column;    // Compute product
         std::cout << product << " ";// Display product
         column++; // Next element
      }
      std::cout << '\n'; // Move cursor to next row
      row++; // Next row
   }
}
```

## Abnormal Loop Termination (1)

```cpp
#include <iostream>
int main() {
   int input, sum = 0;
   std::cout << "Enter numbers to sum, negative number ends list:";
   while (true) {
      std::cin >> input;
      if (input < 0)
         break; // Exit loop immediately
      sum += input;
   }
   std::cout << "Sum = " << sum << '\n';
}
```

## Abnormal Loop Termination (2)

```
#include <iostream>
int main() {
   int count = 1; // Initialize counter
top:
   if (count > 5)
      goto end;
   std::cout << count << '\n';        // Display counter, then
   count++;                           // Increment counter
   goto top;
end:
   ; // Target is an empty statement
}
```

## Abnormal Loop Termination (3)

```
#include <iostream>
int main() {
   int input, sum = 0;        bool done = false;
   while (!done) {
      std::cout << "Enter positive integer (999 quits): ";
      std::cin >> input;
      if (input < 0) {
         std::cout << "Negative value " << input << " ignored\n";
         continue; // Skip rest of body for this iteration
      }
      if (input != 999) {
         std::cout << "Tallying " << input << '\n';
         sum += input;
      }
      else
         done = (input == 999); // 999 entry exits loop
   }
   std::cout << "sum = " << sum << '\n';
}
```

## Abnormal Loop Termination (4)

```
while (/*condition1*/) {
  // part A
  if(/*condition2*/) {
    // part B
    continue;
  }
  // part C
}

while (/*condition1*/) {
  // part A
  if(/*condition2*/) {
    // part B
  }
  else {
  // part C
  }
}
```

## Infinite Loops

```
while(true) {
   // Do something forever…
}

// Accidental infinite loop
#include <iostream>
int main() {
   int n = 1;
   const int MAX = 20;
   while (n <= MAX) {
      int factor = 1;
      std::cout << n << ": ";
      while (factor <= n)
         if (n % factor == 0) {
            std::cout << factor << " ";
            factor++;
         }
      std::cout << '\n';
      n++;
   }
}
```

```
1: 1
2: 1 2
3: 1
```

## Iteration Examples (1)

```
#include <iostream>
int main() {
   int height;
   std::cout << "Enter height of tree: ";
   std::cin >> height;
   int row = 0;
   while (row < height) {
      int count = 0;
      while (count < height - row) {
         std::cout << " ";
         count++;
      }
      count = 0;
      while (count < 2*row + 1) {
         std::cout << "*";
         count++;
      }
      std::cout << '\n';
      row++;
   }
}
```

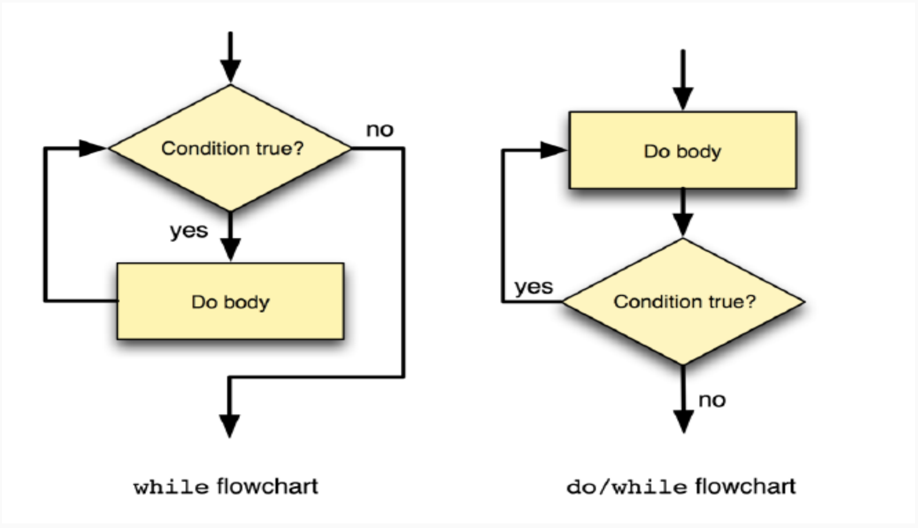
```
Enter height of tree: 5
     *
    ***
   *****
  *******
 *********
```

## Iteration Examples (2)

```
#include <iostream>
int main() {
   int max_value;
   std::cout << "Display primes up to what value? ";
   std::cin >> max_value;
   int value = 2;
   while (value <= max_value) {
      bool is_prime = true;
      int trial_factor = 2;
      while (trial_factor < value) {
         if (value % trial_factor == 0) {
            is_prime = false;
            break;
         }
         trial_factor++;
      }
      if (is_prime)   std::cout << value << " ";
      value++;
   }
}
```

## The do/while Statement (1)

```
do
   // statement
while(/*condition*/);
```



## The do/while Statement (2)

```
#include <iostream>
int main() {
   int in_value = -1;
   std::cout << "Please enter an integer in the range 0-10: ";
   while (in_value < 0 || in_value > 10)
      std::cin >> in_value;
   std::cout << "Legal value entered was " << in_value << '\n';
}
----------------------------------------------------------
#include <iostream>
int main() {
   int in_value;
   std::cout << "Please enter an integer in the range 0-10: ";
   do
      std::cin >> in_value;
   while (in_value < 0 || in_value > 10);
   std::cout << "Legal value entered was " << in_value << '\n';
}
```

## The for Statement (1)

```
for(initialization;condtion;modification)
   // statement



initialization
while(condtion) {
   // statement;
   // modification;
}


#include <iostream>
int main() {
   for (int count = 1; count <= 5; count++)
      std::cout << count << '\n';
}
```

## The for Statement (2)

```
#include <iostream>
int main() {
   int max_value;
   std::cout << "Display primes up to what value? ";
   std::cin >> max_value;
   for (int value = 2; value <= max_value; value++) {
      bool is_prime = true;
      for (int trial_factor = 2;is_prime && trial_factor < value;
         trial_factor++)
         is_prime = (value % trial_factor != 0);

      if (is_prime)
         std::cout << value << " ";
   }
}
```

## The for Statement (3)

```
for (i = 0, j = 100; i < j; i++) {
   …
}

for (; i < 10; i++) {
   …
}

for (i = 0; ; i++) {
   ...
}

for (i = 0; i < 10; i++);

for ( ;; ) {
   …
}

for (i = 0; i < 10; i++){
   if(…) continue;
}
```