Hochiminh City University of Technology
Computer Science and Engineering
[CO1027] - Fundamentals of C++ Programming

Control Flow - Loop

Lecturer: Duc Dung Nguyen
Credits: 3

Today's outline

- Loop statements: while, for, do-while
- Structure programming

Loop statements

while statement

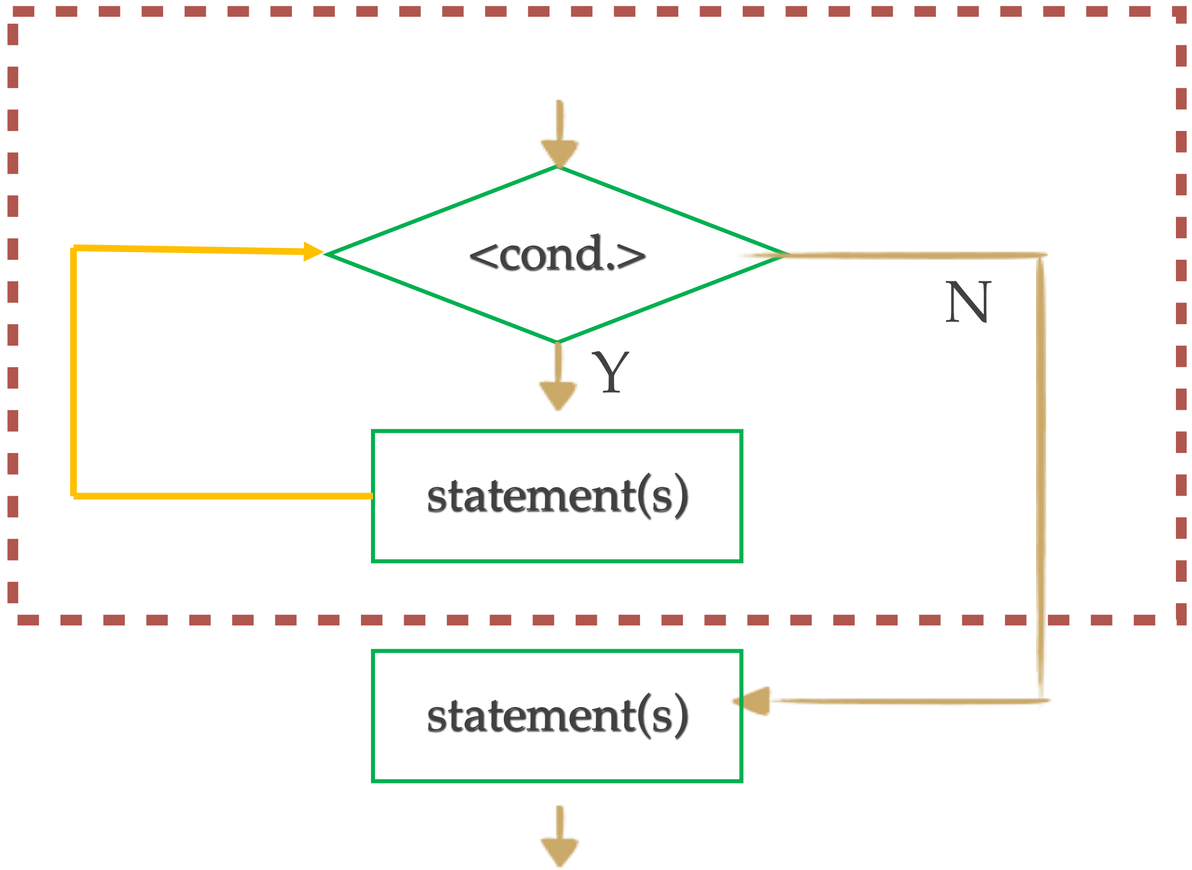
- Why do we need iterations?
  - Waiting for something to happen
  - Operate on several objects
    - List, array of objects
    - String

while loop

- Syntax:
  - `while (<condition>) <statement>;`
  - ```
    while (<condition>) {
        <statements>;
    }
    ```
    ```

while loop

- Flowchart



Example

```
#include<iostream>
using namespace std;

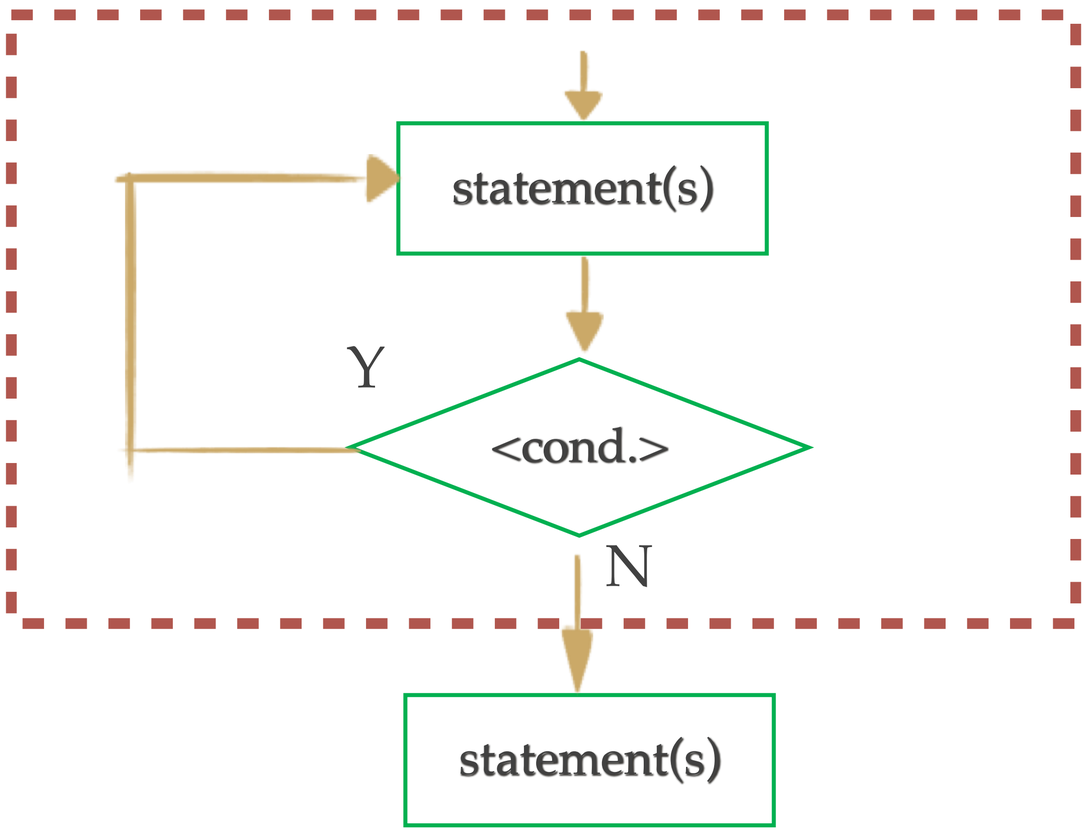
int main() {
   int counter = 0;
   while (counter < 10) {
      cout << counter << " ";
      counter++;
   }
   cout << endl;
   return 0;
}
```

Do-while loop

- Syntax:
  - `do <statement> while (<condition>);`
  - ```
    do {
        <statements>;
    } while (<condition>);
    ```
    ```

Do-while loop

- Flowchart



Example

```
#include<iostream>
using namespace std;

int main() {
   int counter = 0;
   do {
      cout << counter << " ";
      counter++;
   } while (counter < 10);
   cout << endl;
   return 0;
}
```

while statement

- Note:
  - Remember to initialize variables in the condition expression before entering the while statement (at least you know what will happen when you check the condition).
  - Do not forget stopping condition.
  - Take care of counters.

for statement

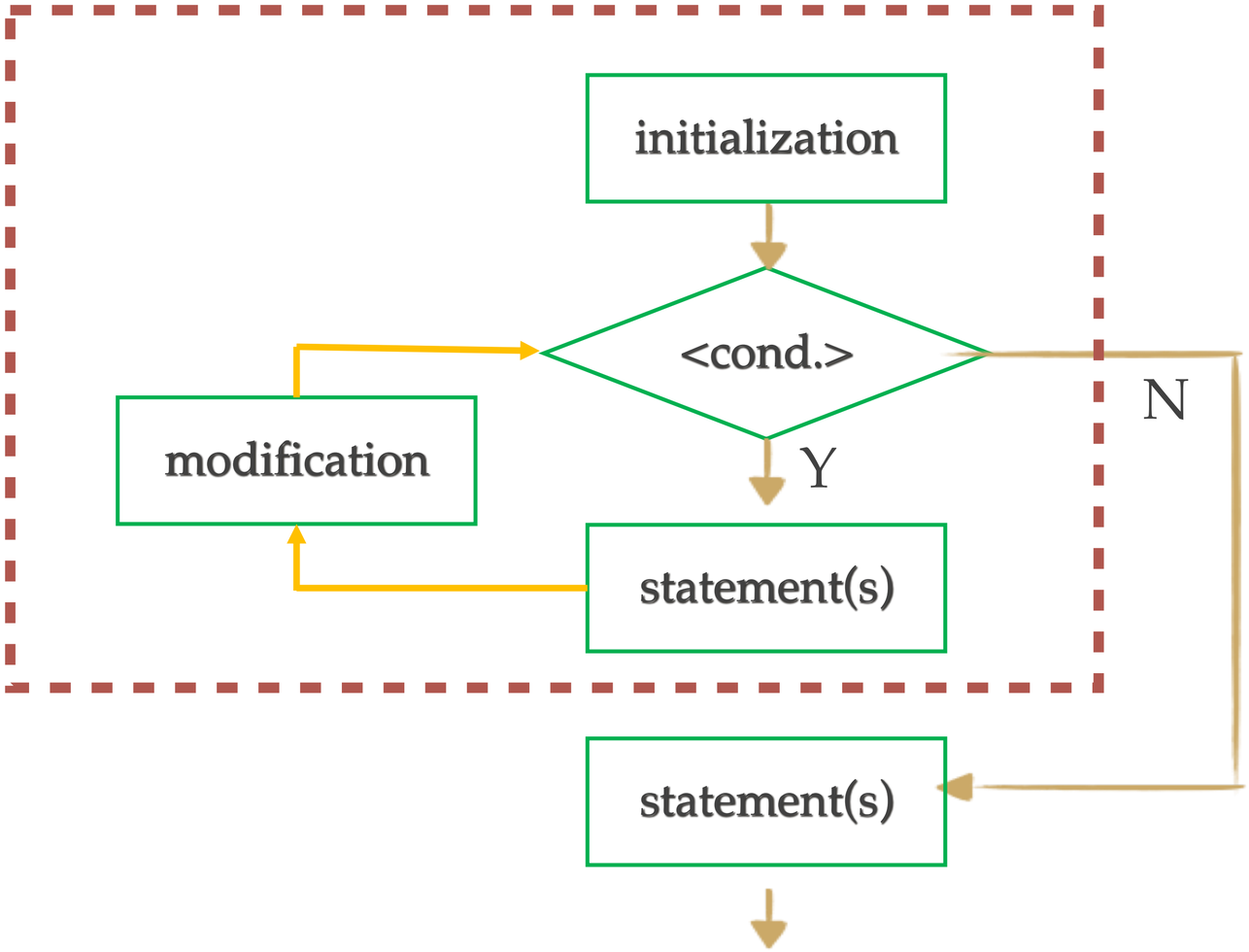
- Why do you need for statement?
  - Just another way to write iteration/loop structure!
  - Counting is a frequent activity
  - for: a specialised loop that package the following tasks in a statement
    - Initialise a counter variable
    - Modify the counter
    - Check complete condition

for statement

- for loop:
  - `for (<initialization>; <condition>; <modification>) <statement>;`
  - ```
    for (<initialization>; <condition>; <modification>) {
        <statements>;
    }
    ```
    ```

for statement

- Flowchart



for statement

- Initialization: set value for the counter
  - Declare one or many counters (same type) and init them at once
  - Initialize many counters if needed
- Condition: a boolean expression that must be evaluated at each loop
- Modification: change value of the counter at each loop

Example

```
#include<iostream>
using namespace std;

int main() {
  for (int i = 0; i < 10; i++)
     cout << i << " ";

  cout << endl;
  return 0;
}
```

for statement

- Note that initialization and modification can contain multiple statements separated by commas.

```
#include <iostream>
using namespace std;

int main() {
   int i, j;
   for (i = 5, j = 10; i + j < 20; i++, j++) {
       cout << "i + j = " << (i + j) << '\n';
   }
   return 0;
}
```

Infinite loops

```
while (100) {
}
while (true) {
}
do {

} while (-20);

for (;;) {
}
```

Exist loops

- The two most commonly used are:
  - break: will end the loop and begin executing the first statement that comes AFTER the end of the loop.
  - continue: force the next iteration to be executed.

Example

```
#include <iostream>
using namespace std;

int main() {
   int count;
   for (count = 1; count <= 10; count++) {
      if (count == 5)
          break;
      cout << count << " ";
   }

   cout << "\nBroke out of loop at count = " << count << endl;
   return 0;
}
```

Example

```
#include <iostream>
using namespace std;

int main() {
   int count;
   for (count = 1; count <= 10; count++) {
      if (count == 5)
          continue;
      cout << count << " ";
   }

   cout << "\nUsed continue to skip printing 5" << endl;
   return 0;
}
```

Nested loop

- A loop can be nested inside a loop.
- ```
  while (<condition 1>) {
      <statements>;
      while (<condition 2>) {
          <statements>;
          while (<condition 3>);
      }
      <statements>;
  }
  ```
  ```

Example

```
#include <iostream>
using namespace std;

int main() {
   int i, j;

   for (i = 2; i<100; i++) {
      for (j = 2; j <= (i / j); j++)
          if (!(i%j)) break; // if factor found, not prime
      if (j >(i / j)) cout << i << " is prime\n";
   }

   return 0;
}
```

Structure programming

Structure programming

- Definition: a programming paradigm aimed at improving the clarity, quality and development time of a computer program by making extensive use of subroutines, block structures and for/while loops
- Structured programming languages: ALGOL, Pascal, PL/I, Ada, **C/C++**, etc.

Structure programming

- Loop and array
  - Loop is good for performing operations on arrays, strings.
  - “while”, “do-while”, “for” are exchangeable.
  - Fixed size data should be processed using finite loops.

Problem solving - example

- Input and draw the following figure in terminal:
  - Input: N (number of lines)
  - Output: (in case N = 5)

```
    *
   * *
  * * *
 * * * *
* * * * *
```

Problem solving - example

- Input and draw the following figure in terminal:
  - Input: N (number of lines)
  - Output: (in case N = 5)

```
*          *
**        **
***      ***
****    ****
*********
```

Problem solving - example

- Input and draw the following figure in terminal:
  - Input: N (number of lines)
  - Output: (in case N = 5)

```
*         *
**       **
* *     * *
*  * *  *
*   *   *
```

Summarise

- Understand loop structures: while, do-while , for
- Implements algorithms with loops