Computer Programming

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Session: “while” and “do while” statements in C++

Quick Recap of Relevant Topics

- Iteration idioms in programming
- Necessity and convenience of iteration
- Glimpse of iteration constructs in C++

Overview of This Lecture

- Iteration using "while" and "do … while" statements in C++
- "break" statement in loops

Recall Generic Iteration Construct

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Loop Condition

Part of program before iteration

Iteration initialization (setting up initial values, etc)

Iterate/Repeat as long as a logical condition stays true

{

Block of statements

Optional instructions to execute at end of every iteration

}

Loop

Part of program after iteration

Loop Body

“while” Statement in C++

Part of program before execution

```
while (loop condition)
 {

    Block of statements  (Body of “while” loop)

 }
```

Part of program after iteration

Flowchart Representation of “while”

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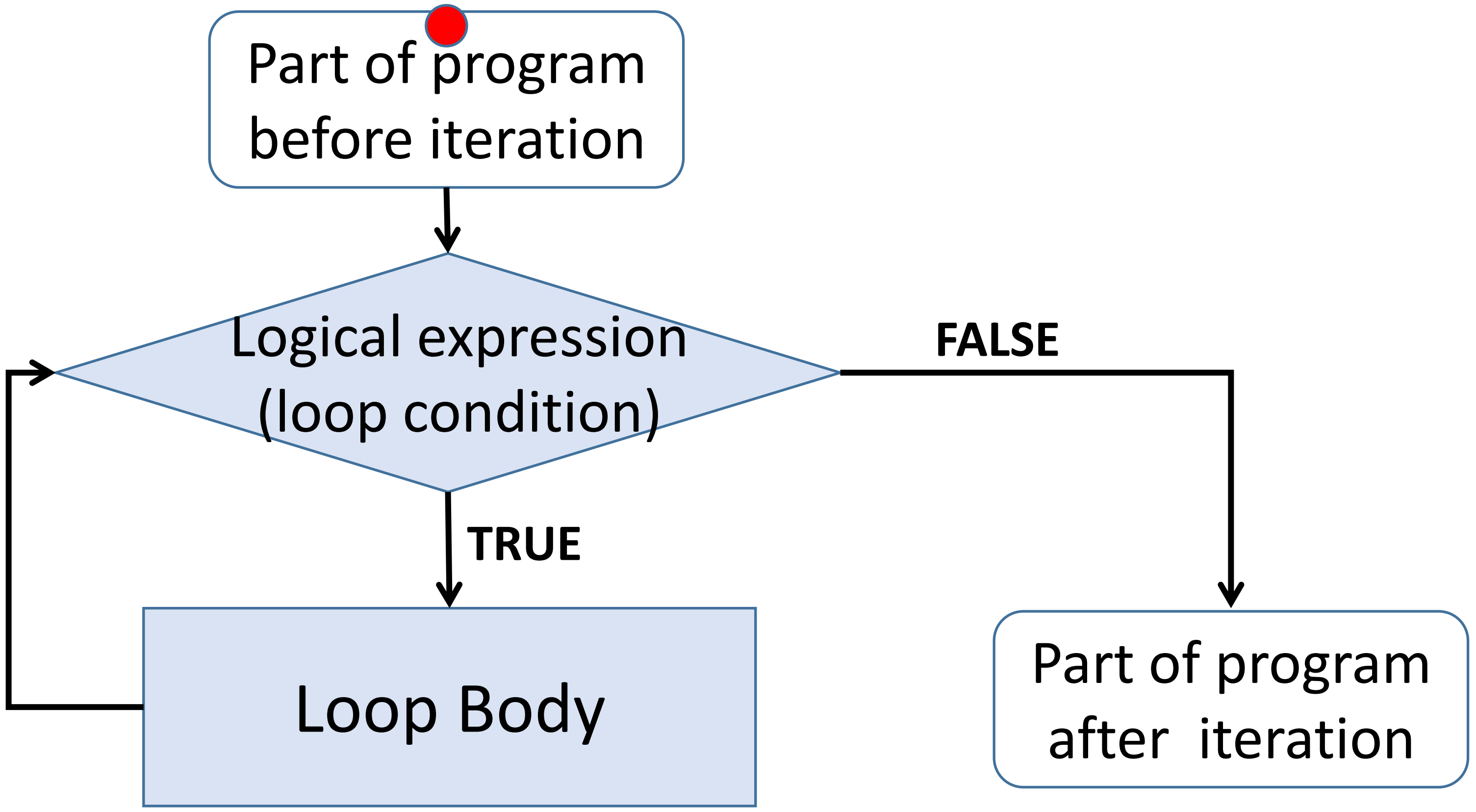
Part of program before iteration
Logical expression (loop condition)
FALSE
TRUE
Loop Body
Part of program after iteration

Points To Remember About “while”

while (loop condition) { Loop Body }

- Loop condition checked **before** executing loop body

  Can lead to zero executions of loop body
- Number of times loop condition is checked =

  Number of times loop body executed + 1, if loop terminates
- If loop condition is not changed in loop body, inifinite loop (non-terminating program) possible

Back To Our Problem

Read number of students in CS101, read quiz 1 marks of all CS101 students and print their sum, average, maximum and minimum

Flowchart Representation

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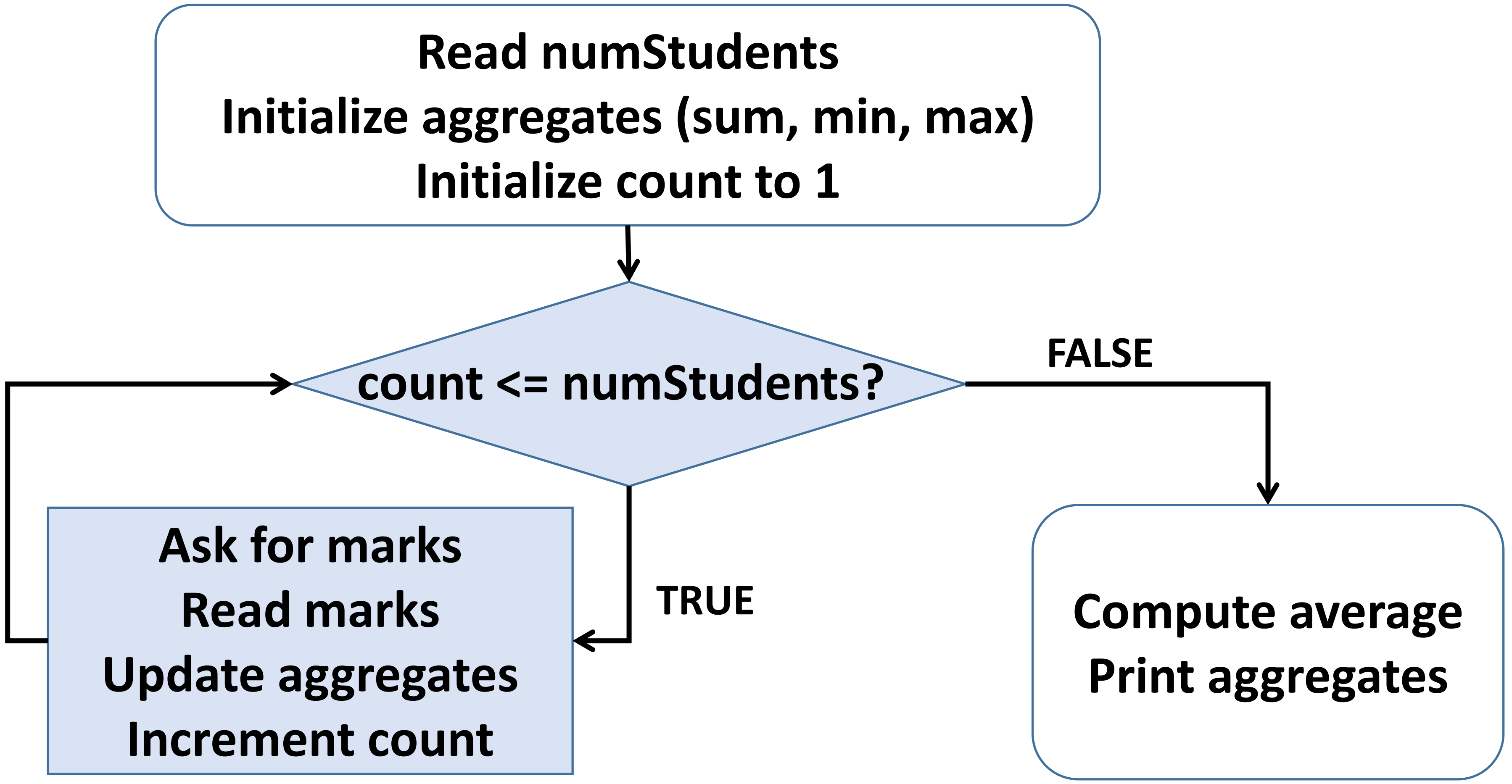

C++ program with “while”

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```
int main() {
   int marks, sum = 0, min, max, numStudents;
   float average, count; // Variable declarations
   cout << “Give number of students: “;    cin >> numStudents;
   count = 1.0;  // Count of student marks processed
   while (count <= numStudents) {
      cout << “Give marks of student “ << count << “: “;    cin >> marks;
      // Update sum, max, min
      count = count + 1;
   }
   average = sum/count;
   // Print  average, sum, min, max
   return 0;
}
```

C++ program with “while”

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```
int main() {
   int marks, sum = 0, min, max, numStudents;
   float average, count;    // Variable declarations
   cout << “Give number of students: “;    cin >> numStudents;
   count = 1.0; // Count of student marks processed
   while (count <= numStudents) {
      cout << “Give marks of student “ << count << “: “;    cin >> marks;
      // Update sum, max, min
      count = count + 1;
   }
   average = sum/count;
   // Print  average, sum, min, max
   return 0;
}
```

C++ program with “while”

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```
int main() {
   int marks, sum = 0, min, max, numStudents;
   float average, count;    // Variable declarations
   cout << “Give number of students: “;    cin >> numStudents;
   count = 1.0; // Count of student marks processed
   while (count <= numStudents) {
      cout << “Give marks of student “ << count << “: “;    cin >> marks;
      // Update sum, max, min
      count = count + 1;
   }
   average = sum/count;
   // Print  average, sum, min, max
   return 0;
}
```

C++ program with “while”

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```
int main() {
   int marks, sum = 0, min, max, num
   float average, count;    // Variable
   cout << “Give number of students:
   count = 1.0; // Count of student m
   while (count <= numStudents) {
      cout << “Give marks of student “ << count << “: “;    cin >> marks;
      // Update sum, max, min
      count = count + 1;
   }
   average = sum/count;
   // Print  average, sum, min, max
   return 0;
}
```

```
sum = sum + marks;
if (count == 1) { min = marks; max = marks; }
else {
   min = (min > marks) ? marks: min;
   max = (max < marks) ? marks: max;
}
```

C++ program with “while”

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```
int main() {
   int marks, sum = 0, min, max, numStudents;
   float average, count;    // Variable declarations
   cout << “Give number of students: “;    cin >> numStudents;
   count = 1.0; // Count of student marks processed
   while (count <= numStudents) {
      cout << “Give marks of student “ << count << “: “;    cin >> marks;
      // Update sum, max, min
      count = count + 1;
   }
   average = sum/count;
   // Print  average, sum, min, max
   return 0;
}
```

Accumulation or Aggregation in Loops

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```
int main() {
   int marks, sum = 0, min, max
   float average, count;    // Va
   cout << "Give number of stu
   count = 1.0; // Count of stud
   while (count <= numStudent
      cout << "Give marks of stu
      // Update sum, max, min
      count = count + 1;
   }
   average = sum/count;
   // Print  average, sum, min,
   return 0;
}
```

Inputs were provided one after another: "streaming" inputs

We did not remember all inputs seen so far, only some aggregates

Aggregates: "summary" of streaming inputs seen so far so that we can compute final result

Accumulation or aggregation: key to programming with loops for streaming inputs

A Variant Of Our Problem

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Read quiz 1 marks of CS101 students one at a time

Stop reading if -1000 is entered as marks

Print number of marks entered, sum, average, maximum and minimum

- Difference from earlier version:

  We do not know a priori how many marks will be entered

  Indicated by special end-of-inputs marks (-1000)

  We'll know when to stop only after reading -1000 as marks

Modifying Our Earlier C++ program

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```
int main() {
   int marks, sum = 0, min, max;
   float average, count;    // Variable declarations
   count = 1.0; // Count of student marks processed
   while (true) {
      cout << “Give marks of student “ << count << “: “;    cin >> marks;
      if (marks == -1000) { … exit loop … }
      else {  … Update sum, max, min … }
      count = count + 1;
   }
   average = sum/(count – 1);
   // Print  count – 1, average, sum, min, max
   return 0;
}
```

Infinite loop !!!

C++ provides an easy way to do this

"break" Statement In "while" Loop

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```
while (true) {
    cout << "Give marks of student " << count << ": ";
    cin >> marks;
    if (marks == -1000) { break; }
    else {  … Update sum, max, min … }
    count = count + 1;
 }
```

Recall "break" from "switch … case … "

Can We Do Without “break”?

```
bool exitFlag = false;
while (! exitFlag) {
     cout << “Give marks of student “ << count << “: “;
     cin >> marks;
     if (marks == -1000) {exitFlag = true;}
     else {
          … Update sum, max, min …
          count = count + 1;
     }
}
```

Include within “else” block to preserve behaviour of program with “break”

Convenience Of “break” In Loops

```
while (true) {
      cout << “Give marks of student “ << count << “: “;
      cin >> marks;
      if (marks == -1000) { break; }
      else {  … Update sum, max, min … }
      count = count + 1;
  }
```

“break” avoids such annoying complications

Recap: “while” Statement in C++

Part of program before execution

```
while (loop condition)
 {

    Block of statements  (Body of “while” loop)

 }
```

Part of program after iteration

“do … while …” Statement in C++

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Part of program before execution

```
do
 {

    Block of statements  (Body of “do-while” loop)

 }  while (loop condition)
```

Part of program after iteration

“do … while …” Statement Flowchart

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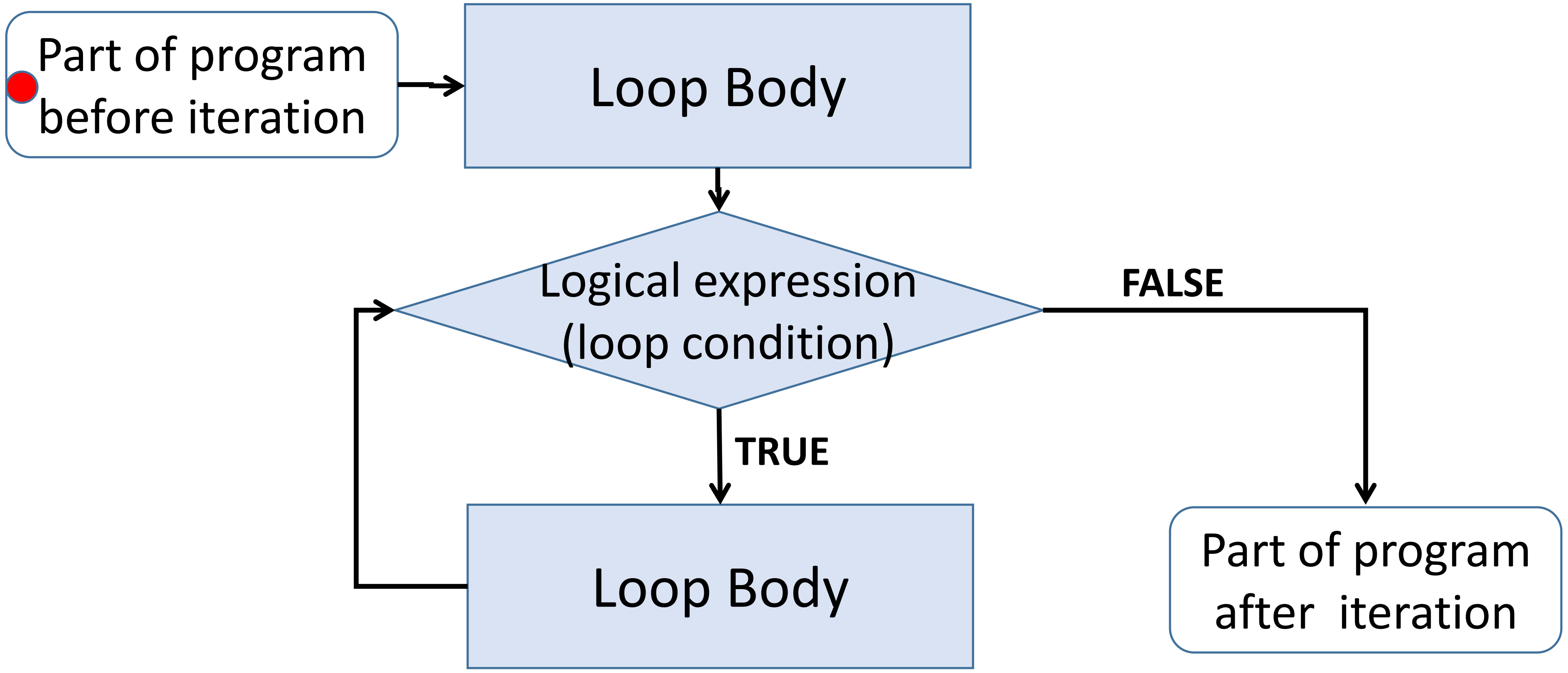
Part of program before iteration
Loop Body
Logical expression (loop condition)
FALSE
TRUE
Loop Body
Part of program after iteration

From “while …” to “do … while …”

```
while (loop condition) {
   Loop Body
}
```

```
if (loop condition) {
   do {
         Loop Body
   } while (loop condition);
}
```

From “do … while …” to “while …”

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```
Loop Body;
while (loop condition) {
   Loop Body
}
```

```
do {
        Loop Body
 } while (loop condition);
```

“break” statements can be used in “do … while …” in same manner as in “while …”

"do … while …" vs "while …"

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- Almost the same
- Prefer "do … while …" when we are guaranteed to execute loop body at least once
- Prefer "while …" if loop body may not be executed at all
- Programmer's choice

Summary

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- “while” statement in C++
- “do … while …” statement in C++
- Use of “break” statements