

More Flow of Control Part Deux

CS 211

Adam Sweeney

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Wichita State University, EECS

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2017-09-07

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- Do Homework 1
- Finish off Chapter 3
- Continue Example for Homework 2

└ Introduction

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- Finish off Chapter 3
- Continue Example for Homework 2

- Introduction to Scope
- Some More Loop Information
- Designing a Loop
- Debugging a Loop

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└─ Agenda

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- Some More Loop Information
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- Debugging a Loop

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More Flow of Control Part Deux
└ Introduction to Scope

Introduction to Scope

Introduction to Scope

- We've discussed compound statements
- Compound statements are identified by and contained within
- Our main function is a compound statement
- Our loop bodies that use `while` contain compound statements
- We may want to declare a variable within one of these compound statements

- Any variable declared within a compound statement, or block, exists solely within that block
- Variables declared in an outer block exist in any nested blocks

Introduction to Scope (cont.)

```
int main(void)
{
    int count = 2;

    for (int i = 1; i <= 3; i++) {
        int count = 4 + i;
        cout << count << endl;
    }

    cout << count << endl;

    return 0;
}
```

More Flow of Control Part Deux

└ Introduction to Scope

└ Introduction to Scope (cont.)

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```

1. How many different variables do I have? [A: 3]
2. count is declared twice
3. The loop variable i is local to the for loop, i.e., it does not exist outside of the loop body
4. A second variable called count also exists only within the for loop block, body, compound statement
5. What should I expect to see printed to the screen?

The output is the following:

5
6
7
2

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5
6
7
2

1. Because I declared a variable inside the for loop, it only exists there
2. Even though it has the same name as another variable, the more local variable of that name is what is used

Introduction to Scope (cont.)

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    int count = 2;

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More Flow of Control Part Deux

└ Introduction to Scope

└ Introduction to Scope (cont.)

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}
```

1. What's different about this code now? [A: I have one less variable than last time]
2. How does it affect my output?

The output is the following:

5
6
7
7

1. Because the variable count is not declared inside the for loop, it is using what was declared at the beginning of the main function

- Scope can be our friend, or our enemy
- Now that we are more aware of it, we can utilize it to our benefit

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More Flow of Control Part Deux

└ Introduction to Scope

└ Introduction to Scope (cont.)

- Introduction to Scope (cont.)
- Scope can be our friend, or our enemy
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Some More Loop Information

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More Flow of Control Part Deux
└─ Some More Loop Information

Some More Loop Information

- What loop should I use?
 - That is up to you
 - Some loop syntaxes feel more natural in certain situations
 - Numeric calculations with a variable that changes by a constant amount?
 - A for loop suits this well
 - Don't know when your loop will end?
 - A while or do-while is a good choice
 - Is there the possibility that your loop won't execute at all?
 - A while loop is the way to go
 - Need to execute at least once?
 - do-while is the best equipped

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1. At the end of the day, the choice of loop is up to you

More Loop Information (cont.)

More Flow of Control Part Deux

Some More Loop Information

More Loop Information (cont.)

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- Loop variables need to be initialized
- "Just avoid infinite loops"
- The break statement is not exclusive to switch
 - It can be used in any loop, if there is a need to stop the iterations prematurely
 - Do not rely on break for normal exits
 - Design your loops properly, break is an exception, not the rule

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1. We can avoid infinite loops by examining our loop starting conditions, our Boolean expression, and our update action

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More Flow of Control Part Deux
└─ Designing a Loop

Designing a Loop

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- There are three things we need to design
 1. The body of the loop
 2. The initializing statements
 3. The end conditions
- How should we go about designing these parts?

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Designing a Loop (cont.)

More Flow of Control Part Deux

└─ Designing a Loop

└─ Designing a Loop (cont.)

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- Say what you want to do
- Take what you said and create pseudo-code
- Let's try some examples

- Say what you want to do
- Take what you said and create pseudo-code
- Let's try some examples

1. Many times, simply saying it to yourself, even out loud, can give you a clue as to what your code should look like
2. pseudocode is not formal code, but sentence fragments written/typed that resembles code in form and behavior
3. pseudocode is effective for designing your whole program, not just a loop

- Say I want to take integer input from the user a certain number of times, and return the sum of the numbers entered
- Assume we know how many times we will prompt the user, and have stored this information in the variable `thisMany`

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- Some possible ways we might say it to ourselves
 - "I need to get `thisMany` numbers and add them up"
 - "For each number I read, up to `thisMany`, I need to keep track of a total sum"
- Both imply repeated tasks, so we know a loop is needed
- The second way of saying it to ourselves takes it a step further
 - Implies the loop style that might suit us best

└ Designing a Loop

└ Designing a Loop (cont.)

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- Both imply repeated tasks, so we know a loop is needed
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- Now, let's consider the first of the three things we need to design
- The body of the loop
 - What is it exactly that our loop needs to do?
 - Read an amount of numbers from the user, then add them to a running total sum
- What does pseudocode look like?

- Now, let's consider the first of the three things we need to design
- The body of the loop
 - What is it exactly that our loop needs to do?
 - Read an amount of numbers from the user, then add them to a running total sum
- What does pseudocode look like?

Our pseudocode (in progress)

```
repeat thisMany times  
  get number from user  
  add to total sum
```

1. We will be adding to this pseudocode, and then using it to write our actual code

Designing a Loop (cont.)

More Flow of Control Part Deux

└─ Designing a Loop

└─ Designing a Loop (cont.)

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- Let's move on to the second thing we should design, the initializing statements
- What needs to be initialized?
- What should they be initialized to?

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- What needs to be initialized?
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1. A: The sum variable, and our loop counter

Designing a Loop (cont.)

More Flow of Control Part Deux

└─ Designing a Loop

└─ Designing a Loop (cont.)

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Our pseudocode (in progress)

```
sum = 0
repeat from i = 1 to thisMany times
  get number from user
  add to total sum
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Designing a Loop (cont.)

More Flow of Control Part Deux

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└─ Designing a Loop (cont.)

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- Finally, our end conditions
- What is our end condition?
- How do we get there?

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- What is our end condition?
- How do we get there?

1. Our end condition taking `thisMany` inputs
2. We get there by incrementing our counter


```
sum = 0
repeat from i = 1 to thisMany, step i by +1
  get number from user
  add to total sum
```

Our final pseudocode

```
sum = 0
repeat from i = 1 to thisMany, step i by +1
  get number from user
  add to total sum
```

Designing a Loop (cont.)

Now that we have a final pseudocode, writing the actual code becomes trivial

```
sum = 0
repeat from i = 1 to thisMany, step i by +1
    get number from user
    add to total sum
```

Becomes

```
int sum = 0;
for (int i = 1; i <= thisMany; i++) {
    cin >> input;
    sum += input;
}
```

More Flow of Control Part Deux

└ Designing a Loop

└ Designing a Loop (cont.)

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Designing a Loop (cont.)

Now that we have a final pseudocode, writing the actual code becomes trivial

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Becomes

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    cin >> input;
    sum += input;
}
```

1. Note how minimal the changes were to our pseudocode in order to get working code
2. Note also how we did the bulk of the work before ever trying to write any code
3. When we have a blueprint to follow, our code just comes right out
4. Naturally, we can and should do this in chunks, especially as our programs get larger
5. What changes would we have to make if we wanted a total product instead of a sum?

- How can we end a loop?
- There are four ways
 1. List headed by size
 2. Ask before iterating
 3. List ended with sentinal value
 4. Running out of input

└─ Designing a Loop

└─ Designing a Loop (cont.)

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- There are four ways
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Designing a Loop (cont.)

- List headed by size
 - If we can know ahead of time how many iterations there are, we can simply loop 'n' times
- Ask before iterating
 - As it states, we can get feedback from the user on whether we should iterate again
- List ended with sentinel value
 - Ending a list with a value that could never appear under normal circumstances
 - A list of names terminated with the integer -1
 - -1 is the sentinel value
- Running out of input
 - Most common when reading from a while
 - Keep reading until there's nothing left

More Flow of Control Part Deux

└ Designing a Loop

└ Designing a Loop (cont.)

1. Generally, the method to use is intuitive
2. A wrong method will feel wrong when running the program
3. For example prompting the user at each iteration when they have a large list to enter

- List headed by size
 - If we can know ahead of time how many iterations there are, we can simply loop 'n' times
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└ Debugging a Loop

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- Mistakes happen, even to pros
- A big difference that separates pros from "others" is how they handle the mistakes
- So, here are some tips for debugging loops

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- A big difference that separates pros from "others" is how they handle the mistakes
- So, here are some tips for debugging loops

Debugging a Loop (cont.)

- Off-by-one errors
 - Many errors occur on the first or last iteration
 - Loop iterates one too many or one too few times
 - Check your endpoint. Should you be using $<$ or $<=$ (same goes for $>$)
 - If a loop can zero times, does it handle that appropriately?

More Flow of Control Part Deux

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└ Debugging a Loop (cont.)

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- Infinite loops
 - Typically a mistake in the Boolean expression or update action
 - Attempting to terminate through test for equality
 - Very dangerous with doubles (due to decimal approximation)
 - Still not safe for integers

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 - Typically a mistake in the Boolean expression or update action
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 - Still not safe for integers

1. Saw a few infinite loops in lab
2. Still not safe for ints just because there is only one way to satisfy equality

Debugging a Loop (cont.)

More Flow of Control Part Deux

└ Debugging a Loop

└ Debugging a Loop (cont.)

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- Make sure the problem is actually in the loop
- Trace your variables
- Always Be Testing
 - This not throwing code to see what sticks
 - This is controlled testing, with constant feedback to guide us

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- Trace your variables
- Always Be Testing
 - This not throwing code to see what sticks
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1. Tracing means watch the values change across a few iterations
2. Use cout, or a debugger if you so choose