COMP1511 - Programming Fundamentals

Week 2 - Lecture 4

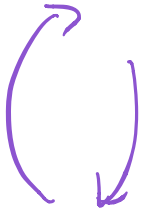
Executing the same code more than once

Sometimes we need to repeat our work

- C normally executes in order, line by line
- if statements allow us to “turn on or off” parts of our code
- But up until now, we don’t have a way to repeat code
- Copy-pasting the same code again and again is not a feasible solution

可行的

While Loops 循环



```
// expression is checked at the start of every loop
while (expression) {
    // this will run again and again
    // until the expression is evaluated as false
}
// When the program reaches this }, it will jump
// back to the start of the while loop
```

While Loop Control

We can use a variable to control how many times a while loop runs

- We call this variable a "loop counter" 循环计数器
- It's an **int** that's declared outside the loop
- It's "termination condition" can be checked in the while expression
- It will be updated inside the loop

We can also use a variable to decide to exit a loop at any time

- We call this variable a "sentinel" 哨兵
- It's like an on/off switch for the loop

While Loop with a Loop Counter 计算

```
// an integer outside the loop
int counter = 0;

while (counter < 10) {
    // this code has run counter number of times

    counter = counter + 1;
}
// When counter hits 10 and the loop's test fails
// the program will exit the loop
```

10 times

Using a Sentinel Variable with While Loops

A sentinel is a variable we use to decide when to exit a while loop

```
// an integer outside the loop
int endLoop = 0;

// The loop will exit if it reads an odd number
while (endLoop == 0) {
    int inputNumber;
    printf("Please type in a number: ");
    scanf("%d", &inputNumber);
    if (inputNumber % 2 == 0) {
        printf("Number is even.\n");
    } else {
        printf("Number is odd.\n");
        endLoop = 1;
    }
}
```

endLoop = 0

A loop within a loop

```
int y = 0;
// loop through and print multiple rows
while (y < 10) { // we have printed y rows
    // print a single row
    int x = 0;
    while (x < 10) { // we have printed x stars in this row
        printf("*");
        x = x + 1;
    }
    // the row is finished, start the next line
    printf("\n");
    y = y + 1;
}
```

What do the curly brackets do?

What goes on inside the curly braces stays inside the curly braces.

- Look closely at the declaration of `int x` in the grid drawing code
- The use of `x` is contained inside a set of curly braces `{}`
- This means that x will only exist inside those braces
- The variable `x` will actually disappear each time the `y` loop finishes!

Curly braces create the "scope" of a program

- Anything created inside them only lasts as long as they do!

Dice Statistics, a Looping Program

The following program:

I need a program that will show me all the different ways to roll two dice

If I pick a number, it will tell me all the ways those two dice can reach that total

It will also tell me what my odds are of rolling that number

Break it down

What components will we need?

- We need all possible values of the two dice
- We need all possible totals of adding them together
- Seems like we're going to be looping through all the values of one die and adding them to all the values of the other die

Let's start with this simple program then go for our bigger goals later

Code for all dice rolls

```
int main (void) {
    int diceOneSize;
    int diceTwoSize;

    // User decides the two dice sizes
    printf("Please enter the size of the first die: ");
    scanf("%d", &diceOneSize);
    printf("Please enter the size of the second die: ");
    scanf("%d", &diceTwoSize);

    // Then loop through both dice
```

Code for all dice rolls continued

```
// loop through and see all the values that the two dice can roll
int die1 = 1; 骰子设0
while (die1 <= diceOneSize) { // seen die1 - 1 values
    int die2 = 1;
    while (die2 <= diceTwoSize) { // seen die2 - 1 values
        printf( "%d, %d. Total: %d\n", die1, die2, die1 + die2 );
        die2++;
    }
    die1++; = die1 = die1 + 1
}
```

We can now see all possible dice rolls

- We have all possibilities listed
- We know all the totals
- We could also count how many times the dice were rolled

Let's try now isolating a single target number

- Check the targets of the rolls and output only if they match our target value

Now with a target number

```
int main (void) {
    int diceOneSize;
    int diceTwoSize;
    int targetValue;

    // User decides the two dice sizes and target
    printf("Please enter the size of the first die: ");
    scanf("%d", &diceOneSize);
    printf("Please enter the size of the second die: ");
    scanf("%d", &diceTwoSize);
    printf("Please enter the target value: ");
    scanf("%d", &targetValue);
```

Output the rolls that match the target

```
// loop through and output rolls with totals that match the target
int die1 = 1;
while (die1 <= diceOneSize) { // seen die1 - 1 values
    int die2 = 1;
    while (die2 <= diceTwoSize) { // seen die2 - 1 values
        int total = die1 + die2;
        if (total == targetValue) {
            printf(
                "%d, %d. Total: %d\n",
                die1, die2, total
            );
        }
        die2++;
    } // die2 = diceTwoSize + 1
    die1++;
} // die1 = diceOneSize + 1
```

Getting there!

We now have a program that can identify the correct rolls

- If we want the odds, we just compare the target rolls vs the rest
- If we count the number of rolls that added to the target value
- And we count the total number of rolls
- We can do some basic maths and divide the successful rolls by the total
- That should give us our chances of getting that number

Measuring Successes

Adding some variables to count results

- **integers (`diceOneSize, diceTwoSize`)** for the two dice sizes
- **integer (`targetValue`)** for the target value
- **integer (`numSuccesses`)** for the number of successes
- **integer (`numRolls`)** for the number of rolls

Making sure our loop records results

```
// loop through and output rolls with totals that match the target
int die1 = 1;
while (die1 <= diceOneSize) { // seen die1 - 1 values
    int die2 = 1;
    while (die2 <= diceTwoSize) { // seen die2 - 1 values
        numRolls++;
        int total = die1 + die2;
        if (total == targetValue) { // target match
            numSuccesses++;
            printf("%d, %d. Total: %d\n",
                    die1, die2, total);
        }
        die2++;
    }
    die1++;
}
```

possible combos

possible match the target

Output our Percentage

```
// Calculate percentage chance of success
int percentage = numSuccesses/numRolls * 100;
printf("Percentage chance of getting your target number is: %d\n",
        percentage);
```

There's an issue with the previous code …

Did you notice the issue?

- Our code outputs 0 percent a lot more than it should
- This is even after we know it's counting the successes correctly

Integers do weird things with division in C

int / int 只有 0, 1

- After a division, the integers will throw away any fractions
- Since our "`numSuccesses/numRolls`" will always be between zero and 1
- Our result can only be the integers 0 or 1
- And anything less than 1 will end up having its fraction dropped!

Doubles to the rescue

Luckily we have a variable type that will store a fraction

- Result of a division will be a double if one of the variables in it is a double
- We could change one of the variables in our division to a double
- This could be done in the declaration of the variable
- But we can also just do it at the point it is used!

```
// int * double = double
// The second number will appear as a double to the division!
int percentage = numSuccesses/(numRolls * 1.0) * 100;
```