DPST1091 / CPTG1391

Introduction to Programming

Week 2 – Lecture 1

Lecturer and Course Convener:

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Control Flow

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Agenda

- **Last week**
  - Welcome
  - Vlab and hello world
  - Memory, Variables, Constants
  - Arithmetic Operators

- **Today**
  - Control Flow
  - Logical Operators

Input/Output Recap

printf()

What is printf?

printf is a function from the **<stdio.h>** library used to **print output to the screen.**

```c
#include <stdio.h>

int main(void) {

    int number = 10;
    double price = 4.5;

    // Print an integer
    printf("Number: %d\n", number);

    // Print a double with 2 decimal places
    printf("Price: %.2f\n", price);

    // Print text and values together
    printf("Total items: %d, Total cost: %.2f\n", number, price);

    return 0;
}
```

Input/Output Recap

scanf()

What is scanf?

scanf is a function from **<stdio.h>** used to **read input from the keyboard**.

```
1  #include <stdio.h>
2
3  int main(void) {
4      int age;
5      double height;
6
7      // Ask the user for their age
8      printf("Enter your age: ");
9      scanf("%d", &age);
10
11     // Ask the user for their height
12     printf("Enter your height in meters: ");
13     scanf("%lf", &height);
14
15     // Display the input values
16     printf("Age: %d\n", age);
17     printf("Height: %.2f m\n", height);
18
19     return 0;
20 }
```

Control Flow

many problems require executing statements only in **some circumstances**

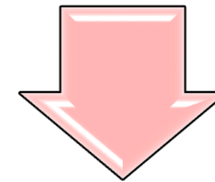
- e.g read two integers and print largest one

sometimes called **control flow**, **branching** or **conditional execution**

In C if Statement can do this.

if

Determines the result of a **Boolean** (**true/false**) question



if **true, do something**

eg: if an int x is even, print it out

Understanding true and false in C

There is **no** “**boolean**” type in **C**.

anything **non-zero** is regarded as “**TRUE**”

0 is regarded as “**FALSE**”

if statement syntax

```
if (expression) {
        statement1;
        statement2;
        ...
}
```

`statement1`, `statement2`, ... are executed if `expression` is **non-zero**.

`statement1`, `statement2`, ... are **NOT executed** if `expression` is **zero**.

Example

```c
1  int main(void) {
2      int number = 10;
3  
4      // Check if the number is positive
5      if (number > 0) {
6          printf("The number is positive.\n");
7      }
8  
9      return 0;
10 }
```

The else keyword

```
if (expression) {
        statement1;
        statement2;
        ...
} else {
        statement3;
        statement4;
        ...
}
```

`statement1`, `statement2`, ... are executed if `expression` is **non-zero**.

`statement3`, `statement4`, ... are **executed** if `expression` is **zero**.

Example

```
 1 int main(void) {
 2 
 3     int number = -3;
 4 
 5     // Check if the number is positive
 6     if (number > 0) {
 7         printf("The number is positive.\n");
 8     }
 9     // If the number is not positive, execute this block
10     else {
11         printf("The number is zero or negative.\n");
12     }
13 
14     return 0;
15 }
```

Multiple if statements can be chained together:

```
int a, b;
printf("Please enter two numbers, a and b: ");
scanf("%d %d", &a, &b);

if (a > b) {
    printf("a is greater than b\n");
} else if (a < b) {
    printf("a is less than b\n");
} else {
    printf("a is equal to b\n");
}
```

Relational Operators

C provides the usual **comparison operators** for numbers:

Operator	Meaning	C Example	Result
>	Greater than	5 > 3	1 (true)
>=	Greater than or equal to	5 >= 5	1 (true)
<	Less than	2 < 4	1 (true)
<=	Less than or equal to	4 <= 3	0 (false)
!=	Not equal to	10 != 8	1 (true)
==	Equal to	6 == 6	1 (true)

Important notes:

⟶ Be cautious when comparing **doubles** using == or !=

⟶ Doubles represent **approximations**, so exact equality may not hold as expected.

⟶ **All evaluate to either true (1) or false (0)**

Logical Operators

Logical operators are used to **combine or invert conditions**.

```
&&   and operator
||   or operator
!    not operator
```

Operator	Meaning	Example	Evaluation	Result
&&	True if **both** operands are true	2 > 0 && 2 < 10	1 && 1	1 (true)
||	True if **either** operand is true	24 > 42 || 2 < 10	0 || 1	1 (true)
!	True if operand is **false**	!(24 > 42)	!0	1 (true)

logical operators return:

⟶ the **int 0** for **false**

⟶ the **int 1** for **true**

Logical Operators - Conditional evaluation

→ **The C operator && || have a useful property.**

They **always** evaluate their **left-hand side first**.

They **only** evaluate their **right-hand** side **if needed**.

&& will **not** evaluate right-hand side if left-hand side is false (zero).

|| will **not** evaluate right-hand side if left-hand side is true (non-zero).

For example, we can write `x != 0 && y/x > 2` **without risking division by zero**.

Example:

```c
#include <stdio.h>

int main(void) {
    int a = 5;
    int b = -3;

    // AND: true only if both conditions are true
    if (a > 0 && b > 0) {
        printf("Both a and b are positive.\n");
    } else {
        printf("At least one of a or b is not positive.\n");
    }

    // OR: true if at least one condition is true
    if (a > 0 || b > 0) {
        printf("At least one of a or b is positive.\n");
    }

    // NOT: invert a condition
    if (!(b > 0)) {
        printf("b is not positive.\n");
    }

    return 0;
}
```

Demo

- →if_int.c
- →if_decimal.c
- →if_char.c
- →if_nested.c

Live lecture code is written for teaching, not perfection.
It may include extra comments and may not always follow ideal coding style

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IT'S BREAK TIME!

10 MINUTES BREAK!

```
#include <stdio.h>
#define ON_BREAK 1
int main(){
    // Time for a 10 minutes break! Switch to PARTY_MODE
    #define PARTY_MODE ON_BREAK
    if {PARTY_MODE == ON_BREAK) ;
        print("Program will resume in 10 minutes...");
        sleep(600.);    // Take a break
        exit(0);
}
```

BRB

CHIPS

Relax... We'll be back soon!

loops

Sometimes we need to **execute code multiple times**.

if statements allow us to **execute code only once or not at all** — in other words, **0 or 1** time.

while loops allow us to **execute code repeatedly**, **0 or more** times.

Both ***if*** statements and ***while*** loops use a **condition** to decide whether to run the code.

For ***while*** loops, the **body of the loop keeps executing** as long as the condition remains **true**.

while syntax

```
while (CONDITION) {
      statement1;
      statement2;
      ...
      statementn;
}
```

⟶ C has other looping constructs - but ***while*** is all you need

⟶ ***for*** loops can be a little more concise/convenient. We'll see them later - for now use ***while***

⟶ Often use a **loop counter** variable to count loop repetitions

⟶ Can then have a ***while*** loop execute **n** times.

Example:

```
// read an integer n
// print n asterisks
int loop_counter, n;

printf("How many asterisks? ");
scanf("%d", &n);

loop_counter = 0;
while (loop_counter < n) {
    printf("*");
    loop_counter = loop_counter + 1;
}
printf("\n");
```

while Loop

Loop Counter Pattern

Here is the programming pattern for a while that executes **n** times:

```
int i = 0;
while (i < n) {
    //
    // statements the loop needs to perform
    //

    i = i + 1;
}
```

While Statements

Termination

You can control termination (stopping) of ***while* loops** in many ways.

Easy to write ***while*** loop that **do not terminate**.

Often a **sentinel variable** is used to stop a while loop when a condition occurs in the body of the loop

```
// read numbers printing whether even or odd
// stop if zero read
int stop_loop, numbers;

stop_loop = 0;
while (stop_loop != 1) {
    scanf("%d", &number);
    if (number == 0) {
        stop_loop = 1;
    } else if (number % 2 == 1) {
        printf("%d is odd.\n", number);
    } else {
        printf("%d is even.\n", number);
    }
}
```

while Loop – Sentinel Variable Pattern

Here is the programming pattern for a ***while* loop** that executes until the **sentinel variable** is changed.

```
stop_loop = 0;
while (stop_loop != 1) {
    //
    // statements the loop needs to perform
    //
    if (.......) {
        stop_loop = 1;
    }
    //
    // perhaps more statements
    //
}
```

Demo

- →while_count.c
- →while_count_odd.c
- →while_count_sum.c
- →while_sentinel.c
- →while_sentinel_average.c

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Voice of the Student

Anonymous ongoing feedback
Anything you wanted to share with me

26T1 Voice of the Student – Fill out form

See you soon …