Nested if Lesson Outline

1. Nested if Lesson Outline
2. A Complicated if Example #1
3. A Complicated if Example #2
4. A Complicated if Example #3
5. A Complicated if Example #4
6. A Complicated if Example Run #1
7. A Complicated if Example Run #2
8. A Complicated if Example Run #3
9. Nested if Blocks
10. Nesting
11. Nested if Block Example #1
12. Nested if Block Example #2
13. How Nested if Blocks Work #1
14. How Nested if Blocks Work #2
15. Nested if Indentation
16. Nested if Block Example #1
17. Nested if Block Example #2
18. Nested if Block Example #3
19. Nested if Block Example #4
#include <stdio.h>
#include <stdlib.h>

int main ()
{
  /* main */

  const int int_code = 1, float_code = 2;
  const int program_failure_code = -1;
  const int program_success_code = 0;
  float float_input_value, float_output_value;
  int   int_input_value,   int_output_value;
  int   data_type_code;

  printf("I'm going to calculate the absolute value\n");
  printf(" of a number that you input.\n");
A Complicated if Example #2

printf("Would you like to input an int or a float?\n");
printf(" (Enter %d for an int or %d for a float.)\n", int_code, float_code);
scanf("%d", &data_type_code);
if ((data_type_code != int_code) &&
    (data_type_code != float_code)) {
    printf("ERROR: I don't recognize data type code %d.\n", data_type_code);
    exit(program_failure_code);
} /* if ((data_type_code != int_code) ... */
if (data_type_code == int_code) {
    printf("What is the int value?\n");
    scanf("%d", &int_input_value);
} /* if (data_type_code == int_code) */
else if (data_type_code == float_code) {
    printf("What is the float value?\n");
    scanf("%f", &float_input_value);
} /* if (data_type_code == float_code) */

Idiotproofing
A Complicated if Example #3

```c
if (data_type_code == int_code) {
    if (int_input_value < 0) {
        int_output_value = -int_input_value;
    } /* if (int_input_value < 0) */
    else {
        int_output_value = +int_input_value;
    } /* if (int_input_value < 0)...else */
} /* if (data_type_code == int_code) */
else if (data_type_code == float_code) {
    if (float_input_value < 0) {
        float_output_value = -float_input_value;
    } /* if (float_input_value < 0) */
    else {
        float_output_value = +float_input_value;
    } /* if (float_input_value < 0)...else */
} /* if (data_type_code == float_code) */
```

Note that we’re using an int variable, `data_type_code`, to **encode** a **quality** rather than a **quantity**.
A Complicated if Example #4

```c
if (data_type_code == int_code) {
    printf("The absolute value of %d is %d.\n", int_input_value, int_output_value);
} /* if (data_type_code == int_code) */
else if (data_type_code == float_code) {
    printf("The absolute value of %f is %f.\n", float_input_value, float_output_value);
} /* if (data_type_code == float_code) */

return program_success_code;
}
```

/* main */
A Complicated if Example Runs #1

% gcc -o absvalbytype absvalbytype.c
% absvalbytype
I'm going to calculate the absolute value of a number that you input.
Would you like to input an int or a float?
(Enter 1 for an int or 2 for a float.)
0
ERROR: I don't recognize data type code 0.
A Complicated if Example Runs #2

% absvalbytype
I'm going to calculate the absolute value of a number that you input. 
Would you like to input an int or a float? 
(Enter 1 for an int or 2 for a float.)
1
What is the int value?
5
The absolute value of 5 is 5.

% absvalbytype
I'm going to calculate the absolute value of a number that you input. 
Would you like to input an int or a float? 
(Enter 1 for an int or 2 for a float.)
1
What is the int value?
-5
The absolute value of -5 is 5.
A Complicated if Example Runs #3

% absvalbytype
I'm going to calculate the absolute value of a number that you input.
Would you like to input an int or a float? (Enter 1 for an int or 2 for a float.)

2
What is the float value?
5.5
The absolute value of 5.500000 is 5.500000.

% absvalbytype
I'm going to calculate the absolute value of a number that you input.
Would you like to input an int or a float? (Enter 1 for an int or 2 for a float.)

2
What is the float value?
-5.5
The absolute value of -5.500000 is 5.500000.
Nested if Blocks

if (condition) {
    if (condition) {
        statement;
        statement;
    } /* if (condition) */
    else if (condition) {
        statement;
        statement;
    } /* if (condition) */
    else {
        statement;
        statement;
    } /* if (condition)...else */
} /* if (condition) */
else if (condition) {
    if (condition) {
        statement;
        if (condition) {
            statement;
            statement;
        } /* if (condition) */
        statement;
    } /* if (condition) */
    else if (condition) {
        statement;
    } /* if (condition) */
    else {
        if (condition) {
            statement;
        } /* if (condition) */
        else {
            statement;
            statement;
        } /* if (condition)...else */
    } /* if (condition)...else */
} /* if (condition)...else */
Nesting means putting something inside something else. For example, one if block can be nested inside another if block.

We refer to the inner if block as “the inner if block,” and we refer to the outer if block as “the outer if block.” Go figure.
Nested if Block Example #1

```c
#include <stdio.h>

int main ()
{
    const int minimum_number = 1;
    const int maximum_number = 10;
    const int computers_number = 5;
    const int close_distance = 1;
    int users_number;

    printf("I'm thinking of a number between %d and %d.\n", minimum_number, maximum_number);
    printf("What number am I thinking of?\n");
    scanf("%d", &users_number);
}
```
Nested if Block Example #2

if ((users_number < minimum_number) ||
    (users_number > maximum_number)) {
    printf("Hey! That’s not between %d and %d!\n", minimum_number, maximum_number);
} /* if ((users_number < minimum_number) || ... */
else if (users_number == computers_number) {
    printf("That’s amazing!\n");
} /* if (users_number == computers_number) */
else {
    printf("Well, at least you were within the range\n");
    if (abs(users_number - computers_number) <=
        close_distance) {
        printf(" and you were close!\n");
    } /* if (abs(users_number-computers_number) <= ...) */
    else if (users_number < computers_number) {
        printf(" but you were way too low.\n");
    } /* if (users_number < computers_number) */
    else {
        printf(" but you were way too high.\n");
    } /* if (users_number < computers_number)...else */
} /* main */
Suppose that an if block is nested inside another if block. What will happen?

Well, the sequence of statements inside a clause of an if block is executed only in the event that:

- the clause’s condition evaluates to true (1),

AND

- all prior conditions within the if block evaluate to false (0).

Or, in the case that the clause is an else clause, its sequence of statements will be executed only in the event that all of the if block’s conditions evaluate to false (0).
How Nested \texttt{if} Blocks Work #2

On the other hand, an \texttt{if} statement is a normal executable statement (more or less).

So, in order for the inner \texttt{if} statement to be reached, and therefore executed:

- the outer clause that contains it must have a condition that evaluates to true (1), and
- all of the outer \texttt{if} block’s prior clauses must have conditions that evaluate to false (0).

Or, in the case of an outer \texttt{else} clause, \textbf{all} of the conditions of the outer \texttt{if} block’s prior conditions must evaluate to false (0).

Once the inner \texttt{if} block is reached, it will be executed exactly like any other \texttt{if} block.
Nested if Indentation

Notice that the statements inside the nested if blocks are indented several extra spaces, so that it’s obvious which statements are inside which blocks.

In CS1313 programming projects, statements should be indented an extra four spaces for each block that they are inside. We’ll see later that this rule applies not only to if blocks but to other kinds of blocks as well (for example, while loops).
Nested if Block Example #1

```c
#include <stdio.h>

int main ()
{
    /* main */
    const int minimum_number = 1;
    const int maximum_number = 10;
    const int computers_number = 5;
    const int close_distance = 1;
    int users_number;

    printf("I'm thinking of a number between %d and %d.\n", minimum_number, maximum_number);
    printf("What number am I thinking of?\n");
    scanf("%d", &users_number);

```
Nested if Block Example #2

```c
if ((users_number < minimum_number) ||
    (users_number > maximum_number)) {
    printf("Hey! That’s not between %d and %d!\n", minimum_number, maximum_number);
} /* if ((users_number < minimum_number) || ... */
else if (users_number == computers_number) {
    printf("That’s amazing!\n");
} /* if (users_number == computers_number) */
else {
    printf("Well, at least you were within the range\n");
    if (abs(users_number - computers_number) <=
        close_distance) {
        printf(" and you were close!\n");
    } /* if (abs(users_number-computers_number) <= ...) */
    else if (users_number < computers_number) {
        printf(" but you were way too low.\n");
    } /* if (users_number < computers_number) */
    else {
        printf(" but you were way too high.\n");
    } /* if (users_number < computers_number)...else */
    printf("My number was %d.\n", computers_number);
} /* if (users_number == computers_number)...else */
} /* main */
```
Nested if Block Example #3

% gcc -o nestedif nestedif.c
% nestedif
I’m thinking of a number between 1 and 10.
What number am I thinking of?
0
Hey! That’s not between 1 and 10!
% nestedif
I’m thinking of a number between 1 and 10.
What number am I thinking of?
11
Hey! That’s not between 1 and 10!
% nestedif
I’m thinking of a number between 1 and 10.
What number am I thinking of?
10
Well, at least you were within the range
but you were way too high.
My number was 5.
% nestedif
I’m thinking of a number between 1 and 10.
What number am I thinking of?
1
Well, at least you were within the range
but you were way too low.
My number was 5.
Nested if Block Example #4

% nestedif
I’m thinking of a number between 1 and 10.
What number am I thinking of?
4
Well, at least you were within the range
and you were close!
My number was 5.

% nestedif
I’m thinking of a number between 1 and 10.
What number am I thinking of?
6
Well, at least you were within the range
and you were close!
My number was 5.

% nestedif
I’m thinking of a number between 1 and 10.
What number am I thinking of?
5
That’s amazing!