

CS113: Lecture 2

Topics:

- Relational, Equality, and Logical operators
- Decision and Control statements (e.g. if-else, switch, while, etc.)

if statement

- Basic form:

```
if( condition )  
    statement;
```

(Statement executed if, and only if, the condition is “true”)

- Example (fragment):

```
if( 5 > 3 )  
    printf( "5 is strictly greater than 3.\n" );
```

- The statement can be a block of code containing more than one statement - enclosed in curly braces:

```
if( a > 0 ) {  
    printf( "a is positive.\n" );  
    printf( "In case you didn't hear me,  
           I said that a is positive.\n" );  
}
```

- Be careful! What happens here?

```
a = -5;  
if( a > 0 )  
    printf( "a is positive.\n" );  
    printf( "In case you didn't hear me,  
           I said that a is positive.\n" );
```

Relational and Equality operators

- In actuality, expressions like “5 > 3” are evaluated to integer values: 1 for true, 0 for false. Thus the program

```
void main() {  
    printf( "Result of 1 > 2: %d\n", 1 > 2 );  
    printf( "Result of 6 < 8: %d\n", 6 < 8 );  
}
```

gives as output:

```
Result of 1 > 2: 0  
Result of 6 < 8: 1
```

- Relational operators: >, >=, <, <=
- Equality operators: ==, !=
 - IMPORTANT! == (two equals) versus = (one equal) is an extremely common source of programmer errors in C. One equal, =, is an assignment operator.

More on our friend if

- if executes the statement (or statement block) after it when the specified condition is non-zero.
- Thus, the following fragment prints: Hi!

```
if( 18 )  
    printf( "Hi!\n" );  
if( 0 )  
    printf( "Bye.\n" );
```

- What does the following fragment do?

```
int a;  
printf( "Enter a number:" );  
scanf( "%d", &a );  
if( a = 3 )  
    printf( "You typed 3.\n" );
```

- Notice that there is no semicolon after the condition of an if statement.

Conditional Expressions

Consider the following code:

```
if (a < 13)
    b = 3;
else
    b = 18;
```

C has a construct that lets you encapsulate the choice as part of the expression assigned to the variable `b`. The following code is equivalent:

```
b = (a < 13) ? 3 : 18;
```

The general form is `test ? expr1 : expr2`. The test `test` is evaluated first. If it is nonzero, the entire expression evaluates to `expr1`, otherwise it evaluates to `expr2`.

Since the whole term is itself an expression, we can nest conditional expressions:

```
grade = (percent > 80) ? 'A' :
        ((percent > 70) ? 'B' : 'C');
```

Logical Operators

- `&&`, `||` (logical AND, logical OR) are binary operators: two arguments.
- `expression1 && expression2` evaluates to 1 (“true”) if both expressions are non-zero, otherwise evaluates to 0 (“false”).
- `expression1 || expression2` evaluates to 1 (“true”) if either or both expressions are non-zero, otherwise evaluates to 0 (“false”).
- `!expression` evaluates to 1 (“true”) if the expression is zero, otherwise evaluates to 0 (“false”).
- `A XOR B: ((!A && B) || (A && !B))`
- Example

```
if(( 3 >= 5 ) || !(2 > 4)) {
    printf( "The OR is true.\n" );
}
if(( 3 >= 5 ) && !(2 > 4)) {
    printf( "The AND is true.\n" );
}
```
- “Short-circuit evaluation” used.
(The `!(2 > 4)` in second if not evaluated.)

if-else

- Basic form:

```
if( condition )
    statement1;
else
    statement2;
```

- As before, each statement can be either a single command (terminated with a semicolon), or a block of commands delimited by curly braces.
- Example.

```
if(( year % 4 == 0 && year % 100 != 0 ) ||
    ( year % 400 == 0 )) {
    printf( "%d is a leap year\n", year );
} else {
    printf( "%d is not a leap year\n", year );
}
```

More on if-else

- Is there a difference between

```
if( condition )  
    statement1;  
else  
    statement2;
```

and

```
if( !condition )  
    statement2;  
else  
    statement1;
```

- Common usage for a series of if-elses:

```
if( expression1 )  
    statement1;  
else if( expression2 )  
    statement2;  
else if( expression3 )  
    statement3;  
...  
else  
    statement;
```

The temptation is to continually indent.

Under what conditions is `statement3` executed?

An example

- Example.

```
void main() {
    int num;
    printf( "Please enter a positive integer:\n" );
    scanf( "%d", &num );

    if( num % 3 == 0 )
        printf( "%d is divisible by 3.\n", num );
    else if( num % 2 == 0 )
        printf( "%d is divisible by 2, but not 3.\n",
            num );
    else
        printf( "%d is not divisible by 3 nor 2.\n",
            num );
}
```

The “dangling else problem”

- The following code is ambiguous. Never write anything like this!

```
if( a == 3 )
if( a == 5 )
    printf( "a is 5.\n" );
else
    printf( "Doh!\n" );
```

- Instead, use braces:

```
if( a == 3 ) {
    if( a == 5 )
        printf( "a is 5.\n" );
    else
        printf( "Doh!\n" );
}
```

switch statement

- Similar to a chain of if/else statements, but more restricted in terms of functionality.
- Useful when one wants to branch based on the value of an expression.
- General form:

```
switch( expression ) {  
    case constant1:  
        statement1;  
        [break;]  
    case constant2:  
        statement2;  
        [break;]  
    ...  
    default:  
        statement;  
        [break;]  
}
```

The fall-through property

- Use breaks! What happens if the breaks are removed?

```
switch( num ) {  
    case 1:  
        printf( "Behind Door 1 is nothing.\n" );  
        break;  
    case 2:  
        printf( "Behind Door 2 is a goat.\n" );  
        break;  
    case 3:  
        printf( "Behind Door 3 is a pot of gold.\n" );  
        break;  
}
```

- Sometimes we can exploit the fall-through property:

```
switch( month ) {  
    case 1: case 3: case 5: case 7:  
    case 8: case 10: case 12:  
        printf( "31 days.\n" );  
        break;  
    case 2:  
        printf( "28 or 29 days.\n" );  
        break;  
    default:  
        printf( "30 days.\n" );  
}
```

while statement

- Nice and simple:

```
while( condition )  
    statement;
```

- A break statement inside the statement block causes the loop to be stopped.

- A variant:

```
do  
    statement;  
while( expression );
```

- The statement is always executed at least once.
Equivalent to:

```
statement;  
while( expression )  
    statement;
```

while example

- Keeping a running sum.

```
void main() {
    int sum = 0, number = 0;
    while( number != -1 ) {
        sum += number;
        printf( "The running sum is: %d\n", sum );
        printf( "Enter a pos. integer (-1 quits):" );
        scanf( "%d", &number );
    }
}
```

- Another way to do it.

```
void main() {
    int sum = 0, number;
    while( 1 ) {
        printf( "The running sum is: %d\n", sum );
        printf( "Enter a pos. integer (-1 quits):" );
        scanf( "%d", &number );
        if( number == -1 ) break;
        sum += number;
    }
}
```

Note: `while( 1 )` is conventional for “infinite” loops

for statement

- General form:

```
for( initial-stmt; condition; iteration-stmt )  
    body-stmt;
```

- Equivalent to:

```
initial-stmt;  
while( condition ) {  
    body-stmt;  
    iteration-stmt;  
}
```

- break can also be used, within the body-stmt.
- break in general applies to innermost loop (while, do/while, for) or switch statement.
- continue statement (not frequently used) causes the next iteration to be executed - jumps to condition-test of innermost loop (while, do/while) or next increment statement (for).

for example

- Summing the first ten positive even numbers (2, 4, 6, ..., 20).

```
void main() {  
    int i, sum = 0;  
    for( i = 1; i <= 10; i++ )  
        sum += 2 * i;  
    printf( "The sum is %d\n", sum );  
}
```

- Another way to do it.

```
void main() {  
    int i, sum = 0;  
    for( i = 2; i <= 20; i += 2 )  
        sum += i;  
    printf( "The sum is %d\n", sum );  
}
```

- Notice: no semicolon after the condition of the for.

Something new: goto statement

- General form:

```
statements;
...
goto label;
...
label:
    code ...
```

- Never necessary. Almost always bad programming practice, except ...

```
for( ... ) {
    for( ... ) {
        ... /* 50th nested loop/if statement */
        if( disaster )
            goto error;
    }
    ...
}
...

error:
    clean up stuff
```