Tin học cơ sở 4

Control Flow

Outline

- Making choices/Branching:
  - The if construct
  - if-else
  - switch
- Repetition:
  - while
  - do-while
  - for

The *if* construct

The if statement allows choice between two execution paths. One form:

```
if (expression){
   statement
}
```

- Used to decide if *statement* should be executed.
- There is no explicit boolean type in C
  - In C: zero is regarded as "*false*", non-zero is regarded as "*true*"
- *statement* is executed if the evaluation of *expression* is true.
- *statement* is NOT executed if the evaluation of *expression* if false.
- *statement* could be a single instruction, or a series of instructions enclosed in { } – **always** use {}

The *if* construct (cont.)

Another form:

```
if (expression){
    statement1
}else {
    statement2
}
```

- Used to decide if *statement1 or statement2* should be executed.
- *statement1* is executed if the evaluation of *expression* is true.
- *statement2* is executed if the evaluation of *expression* if false.

The *if* construct example

Here is an example

```
int x;
printf("x = ");
scanf("%i", &x);
if (x){
    printf( " x is non-zero");
}else{
    printf("x is zero");
}
```

Style

- As you can see from the code examples, indentation is very important in promoting the readability of the code.
- Each logical block of code is indented.
- Each ’{’ and ’}’ are indented to the appropriate logical block level.

Style 1	**Style 2 (preferred)**

if(x)
{
   statement;
}
	if (x){
	   statement;
	}

- For this course, we insist you always use curly braces even when there is only one statement inside.

Complex if-else

- When you nest two or more *if* statements together:

```
if (expression1)
    if (expression2)
      if (expression3)
          statement1
      else
          statement2
```

- The rule is that the last *else* is associated with the closest previous if statement that does not have an *else* component.

Avoid dangling *else*

- To force the else to be associated differently, use { } braces:

```
if (expression1){
    if (expression2){
        if (expression3){
            statement1
        }
    }else {
            statement2
    }
}
```

- It is good programming style to always include braces, for clarity.

The else-if

- To create a multi-way decision chain:

```
if ($condition_1$) {
        $statements_1$;
}
else if ($condition_2$) {
        $statements_2$;
}
 ...
else if ($condition_{n-1}$) {
        $statements_{n-1}$;
}
else {
        $statements_n$;
}
```

- Evaluates conditions until finds a *True* one
- Then executes corresponding statements.
- Then finishes *if* statement

If example: Dating for CS

```
int age;
printf("How old are you: “);
scanf(“%i “, &age);
if (age < 18) {
   printf(“Do you have an older sister/brother?”);
} else if (age < 25) {
   printf("Doing anything tonight?”);
} else if (age < 35) {
   printf("Do you have an younger sister/brother?”);
} else if (age < 65) {
   printf("Do you have a daughter/son?”);
} else {
   printf("Do you have a granddaughter/grandson?”);
}
```

Conditional Expression

- Conditional expressions have the form:

  expr1? expr2 : expr3
- Typical usage:

if (x < a){ z = x; } else{ z = a; }	Equivalent to: z = (x < a)? x : a;

```
if (x < a){
   z = x;
} else{
   z = a;
}
```

```
Equivalent to:

 z = (x < a)? x : a;
```

- Because it is an expression, it can be used whenever any expression are used. Use with caution!
- You are advised to parenthesize expr1 because of precedence.

Single or double equals

- Note the difference between = and ==

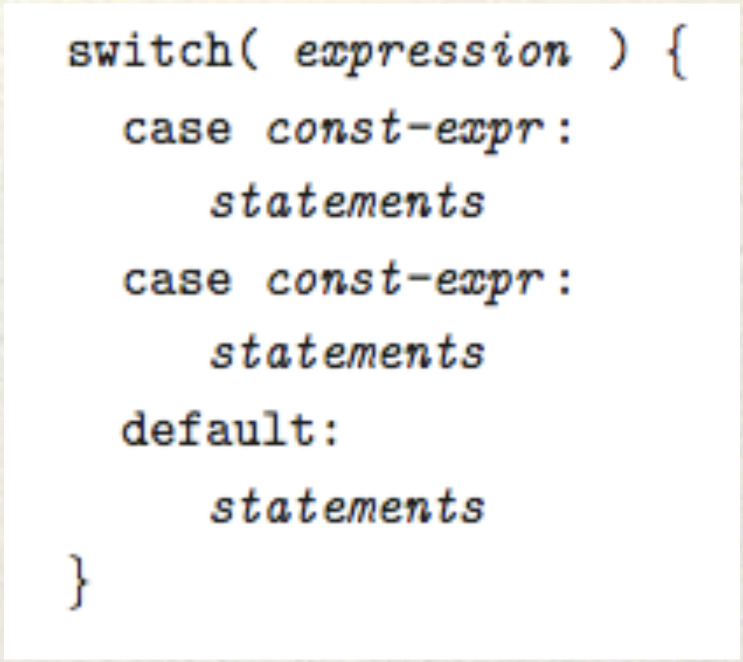
  x = y; // store the value of y into x

  if (x == y)… // check if values of x, y are equal

- In C an assignment evaluates to the value assigned:
  - if (a = 10) … is always true
  - if (a = 0) … is always false
  - if (a = b) … is equivalent to if ((a=b) != 0) …

The switch statement

- Like the multi-way else-if statement, the switch statement behaves in a similar manner:



```
switch( expression ) {
  case const-expr:
      statements
  case const-expr:
      statements
  default:
      statements
}
```

The switch statement (cont.)

- Each *case* must be a constant integer and not an expression.
- The *default* is optional.
- If a case matches the expression value, the execution starts at that case.
- If none of the cases match, then the default action is executed.
- If there is no default and no cases match, then no action takes place.
- The case and default can occur in any order (but only one default is allowed per switch statement)

The switch statement (cont.)

- *break* is used to force an immediate exit from the *switch* statement upon a case *const-expr* match.
- If *break* is omitted, then execution will flow on into the next case label, this is called "*falling though*" from one case to another.
- It is good practice to put a break at the end of the default even it it not necessary.
- *Fall through* code is not considered a good practice and should be avoided where possible. If it cannot, then make sure you flag this in your comments and make it very obvious.

Example of switch

```
switch (month) {
  case 2:
    length =  ( year%4 == 0 &&
        (year%100!=0 || year%400==0))? 29: 28;
    break;
  case 4: case 6: case 9: case 11:
    length = 30;
    break;
  default:
    length = 31;
    break;
}
```

Repetition

- C has several control structures for repetition:
  - while: zero or more times
  - do .. while: one or more times
  - for: zero or more time with initialization and update.

Repetition

- All repetition structures control:
  - A single statement or
  - A block of statements in {…}
- Repetition statements are also called loops.
- The control statement(s) are called the loop body.

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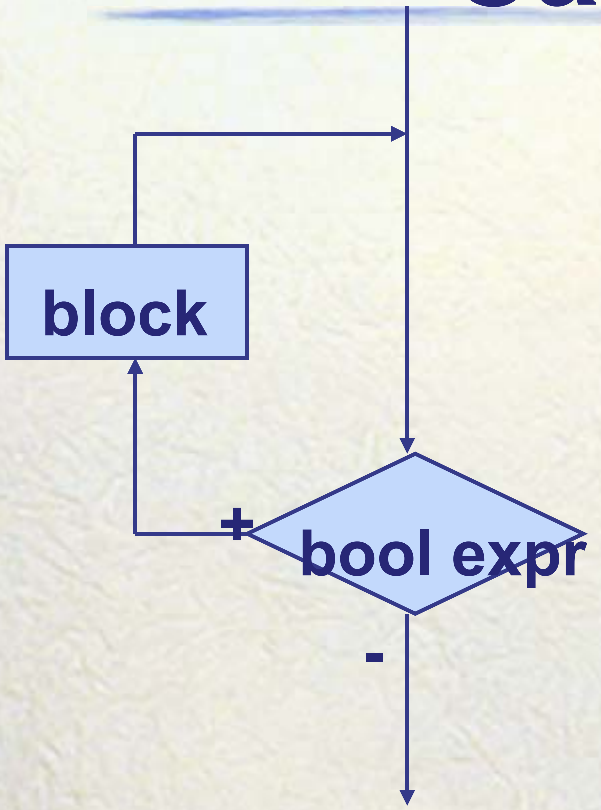

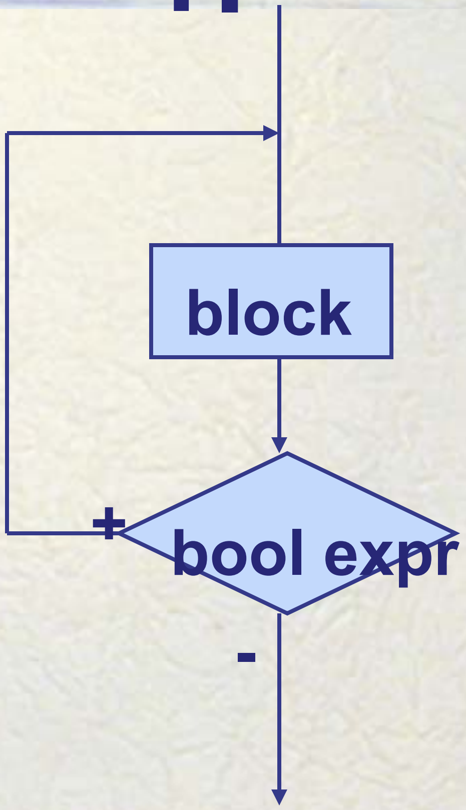

The while statement

- Repetition is controlled by a continuation condition, tested **before** the loop body is executed. Its general form is:

```
while (condition){
        statement
}
```

- Effect:
  - Test the continuation condition
  - If FALSE, end the while statement
  - If TRUE, execute the statements
  - Repeat the above three steps.

while example

- Compute the sum of the first 50 positive integers:

```
int sum, num;
sum = 0;
num = 1;
while (num <= 50){
    sum = sum + num;
    num = num + 1;
}
```

The do while statement

- Repetition is controlled by a continuation condition, tested **after** the loop body is executed. Its general form is:

```
do {
        statement
} while (condition);
```

- Effect:
  - Execute the statements
  - Test the continuation condition
  - If FALSE, end the do..while statement
  - If TRUE, repeat the above three steps.

The for statement

- The for statement is shorthand for a common pattern of usage of while:

```
init;
while (condition){
        statements;
        next;
}
```

```
for (init; condition; next){
   statements;
}
```

- *init* sets state for first iteration, *next* sets state for next iteration.
- Any of *init*, *condition*, or *next* may be omitted.
- *for* is normally used for a fixed number of iterations.

Example of for

```
int n, i, factorial;
printf(“n = “);
scanf(“%i “, &n);
for (i = 1, factorial = 1; i <=n; i++){
    factorial = factorial * i;
}
printf(“%d ! = %d\n”, n, factorial);
```

break **and** ***continue***

- *break* causes a loop to terminate; no more iterations are performed, and execution moves to whatever comes after the loop.
- *continue* causes the current iteration of the loop to terminate; execution moves to the next iteration:
  - Note the difference between *for* loop and *while/do-while*.
- Avoid using *break* and *continue* in this course

References

- [K&R] Chapter 3.