Lecture 7: Control Statements – Part IV

Class page: https://github.com/tsung-wei-huang/cs1410-40

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Announcement

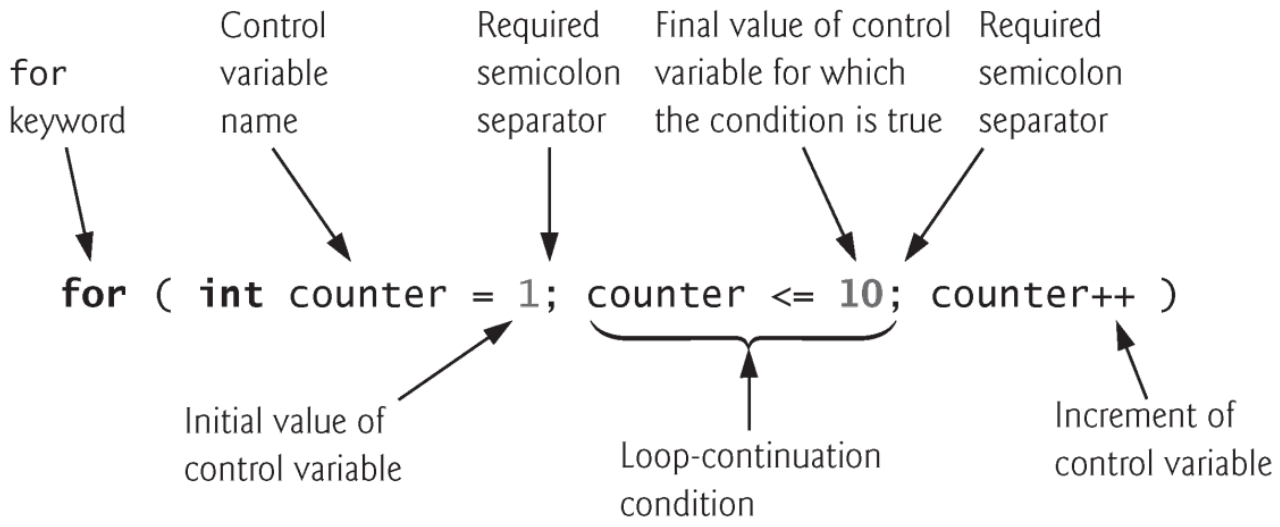
- **LAB will go virtual starting this Friday**
  - Potential exposure by Department of Public Health
  - Will resume to physical lab when situations got resolved
- **Please log into the TA's zoom links**
  - GitHub: https://github.com/tsung-wei-huang/cs1410-40
  - First three sections: Dian-Lun Lin
    - https://utah.zoom.us/j/94816252792
  - Second two sections: Yasin Zamani
    - https://utah.zoom.us/j/99070521933
- **TA released office hours at zoom**
  - Dian-Lun: 12-1 PM every Thursday
  - Yasin: 2-3 PM every Monday

for Repetition Statement Example

```
1
2  // Counter-controlled repetition with the for statement.
3  #include <iostream>
4  using namespace std;
5
6  int main()
7  {
8     // for statement header includes initialization,
9     // loop-continuation condition and increment.
10    for ( int counter = 1; counter <= 10; counter++ )
11       cout << counter << " ";
12
13    cout << endl; // output a newline
14 } // end main
```

```
1 2 3 4 5 6 7 8 9 10
```

for Repetition Statement



do…while Repetition Statement

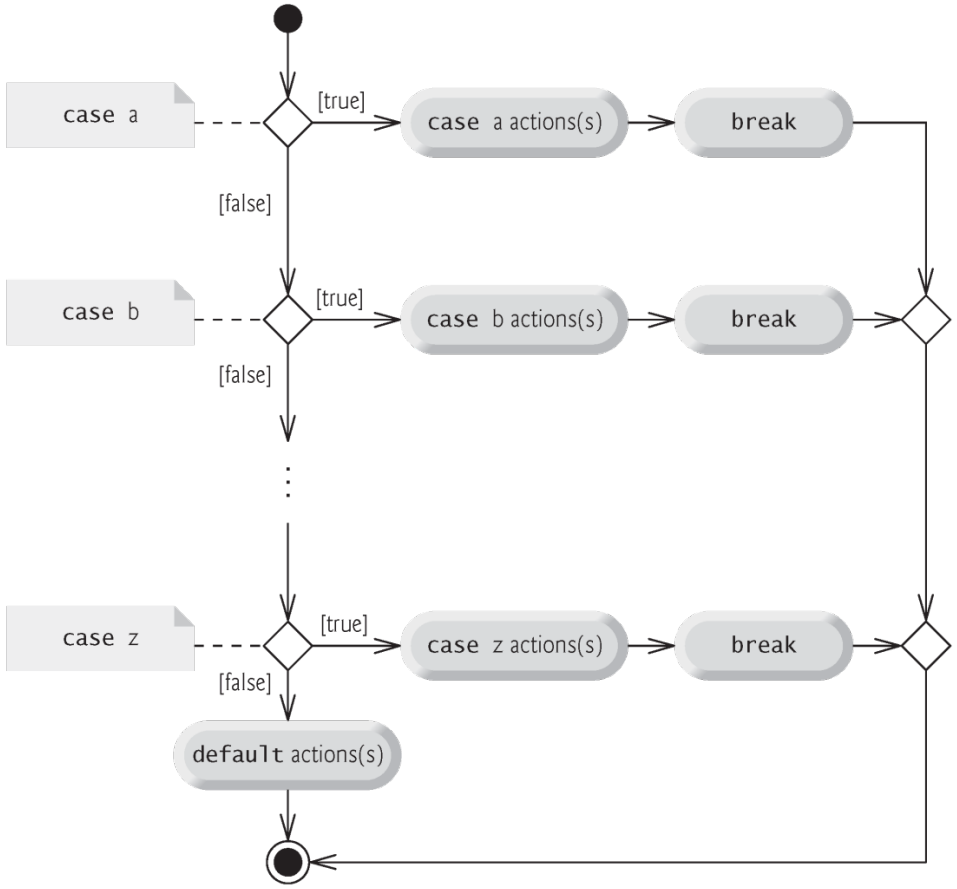
```
1
2  // do...while repetition statement.
3  #include <iostream>
4  using namespace std;
5
6  int main()
7  {
8     int counter = 1; // initialize counter
9
10    do
11    {
12       cout << counter << " "; // display counter
13       counter++; // increment counter
14    } while ( counter <= 10 ); // end do...while
15
16    cout << endl; // output a newline
17 } // end main
```

```
1 2 3 4 5 6 7 8 9 10
```

switch Multiple-Selection Statement

- **The switch multiple-selection statement performs many different actions based on the possible values of a variable or expression.**
- **Each action is associated with the value of a constant integral expression**
  - i.e., any combination of character and integer constants that evaluates to a constant integer value.

switch Multiple-Selection Statement



switch Multiple-Selection Statement

```
1
2  // Using a switch statement to count A, B, C, D and F grades.
3  #include <iostream>
4  using namespace std;
5
6  int main()
7  {
8     int grade; // letter grade entered by user
9     int aCount; // count of A grades
10    int bCount; // count of B grades
11    int cCount; // count of C grades
12    int dCount; // count of D grades
13    int fCount; // count of F grades
14
15    cout << "Enter the letter grades." << endl
16       << "Enter the EOF character to end input." << endl;
17
```

switch Multiple-Selection Statement

```
18      // loop until user types end-of-file key sequence
19      while ( ( grade = cin.get() ) != EOF )
20      {
21         // determine which grade was entered
22         switch ( grade ) // switch statement nested in while
23         {
24            case 'A': // grade was uppercase A
25            case 'a': // or lowercase a
26               aCount++; // increment aCount
27               break; // necessary to exit switch
28
29            case 'B': // grade was uppercase B
30            case 'b': // or lowercase b
31               bCount++; // increment bCount
32               break; // exit switch
33
34            case 'C': // grade was uppercase C
35            case 'c': // or lowercase c
36               cCount++; // increment cCount
37               break; // exit switch
38
```

switch Multiple-Selection Statement

```
39          case 'D': // grade was uppercase D
40          case 'd': // or lowercase d
41             dCount++; // increment dCount
42             break; // exit switch
43
44          case 'F': // grade was uppercase F
45          case 'f': // or lowercase f
46             fCount++; // increment fCount
47             break; // exit switch
48
49          case '\n': // ignore newlines,
50          case '\t': // tabs,
51          case ' ': // and spaces in input
52             break; // exit switch
53
54          default: // catch all other characters
55             cout << "Incorrect letter grade entered."
56                << " Enter a new grade." << endl;
57             break; // optional; will exit switch anyway
58       } // end switch
59    } // end while
60
```

switch Multiple-Selection Statement

```
61      // output summary of results
62      cout << "\n\nNumber of students who received each letter grade:"
63         << "\nA: " << aCount // display number of A grades
64         << "\nB: " << bCount // display number of B grades
65         << "\nC: " << cCount // display number of C grades
66         << "\nD: " << dCount // display number of D grades
67         << "\nF: " << fCount // display number of F grades
68         << endl;
69   } // end function main
```

switch Multiple-Selection Statement

- The `switch` statement consists of a series of case labels and an optional default case.
- The `switch` statement compares the value of the controlling expression with each `case` label.
- If a match occurs, the program executes the statements for that `case`.
- Listing `case`s consecutively with no statements between them enables the `case`s to perform the same set of statements.
- The `break` statement causes program control to proceed with the first statement after the `switch`.

```
switch ( grade ) // switch statement nested in while
{
   case 'A': // grade was uppercase A
   case 'a': // or lowercase a
      aCount++; // increment aCount
      break; // necessary to exit switch
```

switch Multiple-Selection Statement

- **Each `case` can have multiple statements.**
  - The `switch` selection statement does not require braces around multiple statements in each `case`.
- **Without `break` statements, the statements for that `case` and subsequent `case`s are all executed when a match occurs**
  - Until a `break` statement or the end of the `switch` is encountered.
  - Referred to as "falling through" to the subsequent `case`s.
- **If no match occurs between the controlling expression's value and a `case` label, the `default` case executes.**
- **If a `switch` statement does not contain a `default` case, program control continues with the first statement after the `switch` when no match occurs**

```
   case '\n': // ignore newlines,
   case '\t': // tabs,
   case ' ': // and spaces in input
      break; // exit switch

   default: // catch all other characters
      cout << "Incorrect letter grade entered."
         << " Enter a new grade." << endl;
      break; // optional; will exit switch anyway
} // end switch
```

switch Multiple-Selection Statement

- The `cin.get()` function reads one character from the keyboard.
- A character is stored as a "number" in the computer according to its **ASCII code**.
- Normally, characters are stored in variables of type **char**; however, characters can be stored in any integer data type.
- Can treat a character either as an integer or as a character, depending on its use. For example:

```
cout << "The character (" << 'a' << ") has the value "
   << static_cast< int > ( 'a' ) << endl;
```

prints the character `a` and its integer value as follows:

```
The character (a) has the value 97
```

ASCII Code

ASCII Table

Dec	Hex	Oct	Char	Dec	Hex	Oct	Char	Dec	Hex	Oct	Char	Dec	Hex	Oct	Char
0	0	0		32	20	40	[space]	64	40	100	@	96	60	140	`
1	1	1		33	21	41	!	65	41	101	A	97	61	141	a
2	2	2		34	22	42	"	66	42	102	B	98	62	142	b
3	3	3		35	23	43	#	67	43	103	C	99	63	143	c
4	4	4		36	24	44	$	68	44	104	D	100	64	144	d
5	5	5		37	25	45	%	69	45	105	E	101	65	145	e
6	6	6		38	26	46	&	70	46	106	F	102	66	146	f
7	7	7		39	27	47	'	71	47	107	G	103	67	147	g
8	8	10		40	28	50	(	72	48	110	H	104	68	150	h
9	9	11		41	29	51	)	73	49	111	I	105	69	151	i
10	A	12		42	2A	52	*	74	4A	112	J	106	6A	152	j
11	B	13		43	2B	53	+	75	4B	113	K	107	6B	153	k
12	C	14		44	2C	54	,	76	4C	114	L	108	6C	154	l
13	D	15		45	2D	55	-	77	4D	115	M	109	6D	155	m
14	E	16		46	2E	56	.	78	4E	116	N	110	6E	156	n
15	F	17		47	2F	57	/	79	4F	117	O	111	6F	157	o
16	10	20		48	30	60	0	80	50	120	P	112	70	160	p
17	11	21		49	31	61	1	81	51	121	Q	113	71	161	q
18	12	22		50	32	62	2	82	52	122	R	114	72	162	r
19	13	23		51	33	63	3	83	53	123	S	115	73	163	s
20	14	24		52	34	64	4	84	54	124	T	116	74	164	t
21	15	25		53	35	65	5	85	55	125	U	117	75	165	u
22	16	26		54	36	66	6	86	56	126	V	118	76	166	v
23	17	27		55	37	67	7	87	57	127	W	119	77	167	w
24	18	30		56	38	70	8	88	58	130	X	120	78	170	x
25	19	31		57	39	71	9	89	59	131	Y	121	79	171	y
26	1A	32		58	3A	72	:	90	5A	132	Z	122	7A	172	z
27	1B	33		59	3B	73	;	91	5B	133	[	123	7B	173	{
28	1C	34		60	3C	74	<	92	5C	134	\	124	7C	174	|
29	1D	35		61	3D	75	=	93	5D	135	]	125	7D	175	}
30	1E	36		62	3E	76	>	94	5E	136	^	126	7E	176	~
31	1F	37		63	3F	77	?	95	5F	137	_	127	7F	177	

ASCII Table

- ***You cannot type the value –1 as the sentinel value.*** **(ASCII code is 0~255)**
- **`EOF` stands for "end-of-file". Commonly used as a sentinel value for characters.**
- **`EOF` is a symbolic integer constant defined in the `<iostream>` header file.**
  - The `EOF` has type int
- **The keystroke combinations for entering *end-of-file* are system dependent.**
  - Windows: Ctrl-Z ; UNIX: Ctrl-D

ASCII Code

- **To have the program read the characters, we must send them to the computer by pressing the *Enter key*.**
- **This places a newline character in the input after the character we wish to process.**
  - Often, this newline character must be specially processed.
- **The `cin.get()` function can ignore the newline character automatically**
  - Some functions can do this, but some functions cannot.

break and continue statements

- The **break statement**, when executed in a `while`, `for`, `do…while` or `switch` statement, causes immediate exit from that statement.
- Program execution continues with the next statement.
- Common uses of the `break` statement are to escape early from a loop or to skip the remainder of a `switch` statement.

break and continue statements

```
1
2  // break statement exiting a for statement.
3  #include <iostream>
4  using namespace std;
5
6  int main()
7  {
8     int count; // control variable also used after loop terminates
9
10    for ( count = 1; count <= 10; count++ ) // loop 10 times
11    {
12       if ( count == 5 )
13          break; // break loop only if x is 5
14
15       cout << count << " ";
16    } // end for
17
18    cout << "\nBroke out of loop at count = " << count << endl;
19 } // end main
```

```
1 2 3 4
Broke out of loop at count = 5
```

break and continue statements

- **The continue statement skips the remaining statements in its body and proceeds with the next iteration of the loop.**
  - When executed in a `while`, `for` or `do…while` statement
- **In `while` and `do…while` statements, the loop-continuation test evaluates immediately after the `continue` statement executes.**
- **In the `for` statement, the increment expression executes, then the loop-continuation test evaluates.**

break and continue statements

```
1
2  // continue statement terminating an iteration of a for statement.
3  #include <iostream>
4  using namespace std;
5
6  int main()
7  {
8     for ( int count = 1; count <= 10; count++ ) // loop 10 times
9     {
10       if ( count == 5 ) // if count is 5,
11          continue;      // skip remaining code in loop
12
13       cout << count << " ";
14    } // end for
15
16    cout << "\nUsed continue to skip printing 5" << endl;
17 } // end main
```

```
1 2 3 4 6 7 8 9 10
Used continue to skip printing 5
```

Usage in Infinite Loop

- **Infinite loops are helpful when the termination condition is generated inside the loop**

```
while (1) {
.....
ans = a * b;
    if (ans == 0) break;
    .....
}
```

1 (non-zero value) means always TRUE

- **Should be used with `break` to terminate the loop**
  - Make sure the condition will eventually become TRUE
- **If sentinel-controlled loop can be used instead, use it !!**
  - Infinite loops are not easy to debug

Summary

- while loop statement
- do...while loop statement
- for loop statement
- switch statement
- continue and break