

UNITED KINGDOM · CHINA · MALAYSIA

Week 2 - Lecture 3

Control Statements - Iteration

Overview

- Control Structure in C
- Return value of scanf
- break and continue



Control Structure in C

- Sequence structure
- Selection structure
 - if
 - if ... else ...
 - switch
- Iteration structure
 - while
 - do ... while ...
 - for



for Loop in C

for(initialisation; condition; update)

```
/* statements */
                                        Initilization Expression
                                               Test
                                                            False
                                             Expression
                                                  True
                                            for Loop Body
                                          update Expression
```



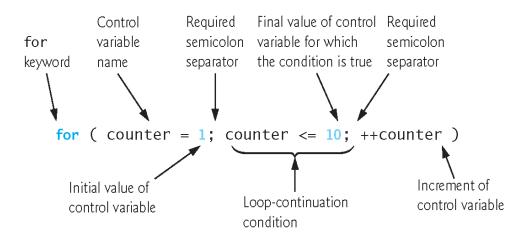
for Loop in C (2)

The general format of the for statement is

```
for ( expression1; expression2; expression3 ) {
 statement
```

where

- expression1 initializes the loop-control variable expression2 is the loop-continuation condition expression3 increments the control variable.



Example: for Loop

```
#include <stdio.h>
 3
     int main (void)
 5
 6
         int input = 0;
 7
         int sum = 0;
 8
 9
         printf("Please enter an input: ");
10
         scanf ("%d", &input);
11
12
         sum = sum + input;
13
         printf("Please enter an input: ");
14
15
         scanf("%d", &input);
16
17
         sum = sum + input;
18
19
         printf("The sum of two numbers is %d\n", sum);
         return 0:
22
```

```
25
     #include <stdio.h>
26
27
     int main (void)
28
   □ {
29
         int counter = 0;
30
         int input = 0;
31
         int sum = 0;
32
         for(counter = 0; counter < 2; counter++)</pre>
33
34
35
              printf("Please enter an input: ");
36
              scanf("%d", &input);
37
38
              sum = sum + input;
39
40
41
         printf ("The sum of two numbers is %d\n", sum);
42
43
         return 0;
44
```



```
#include <stdio.h>
 4
     int main (void)
 5
    ⊟{
 6
         int input = 0;
         int sum = 0;
 8
 9
         printf("Please enter an input: ");
10
         scanf ("%d", &input);
11
12
         sum = sum + input;
13
14
         printf("Please enter an input: ");
15
         scanf ("%d", &input);
16
17
         sum = sum + input;
18
19
         printf ("The sum of two numbers is %d\n", sum);
20
21
         return 0;
22
```

```
25
     #include <stdio.h>
26
27
     int main (void)
28
    □ {
29
         int counter = 0;
30
         int input = 0;
31
         int sum = 0;
32
33
          for(counter = 0; counter < 2; counter++)</pre>
34
35
              printf("Please enter an input: ");
36
              scanf ("%d", &input);
37
38
              sum = sum + input;
39
40
41
         printf("The sum of two numbers is %d\n", sum);
42
43
         return 0;
44
```

Example: for Loop (2)

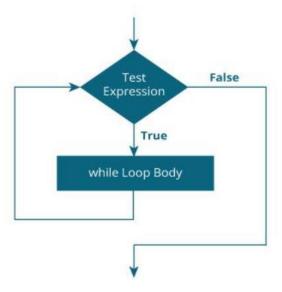
The following examples show methods of varying the control variable in a for statement.

```
Vary the control variable from 1 to 100 in increments of 1.
    for ( i = 1; i <= 100; ++ i )
Vary the control variable from 100 to 1 in increments of -1 (decrements of 1).
    for (i = 100; i >= 1; --i)
Vary the control variable from 7 to 77 in steps of 7.
    for (i = 7; i \le 77; i += 7)
Vary the control variable from 20 to 2 in steps of -2.
    for (i = 20; i >= 2; i -= 2)
Vary the control variable over the following sequence of values: 2, 5, 8, 11, 14, 17.
    for (j = 2; j \leftarrow 17; j \leftarrow 3)
Vary the control variable over the following sequence of values: 44, 33, 22, 11, 0.
    for (i = 44; i >= 0; i -= 11)
```

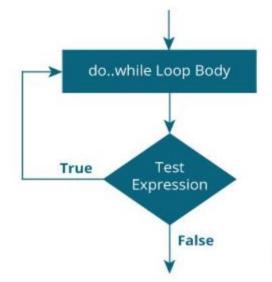
while and do-while Loop in C

```
while(test)
{
    /* statements */
}
```

```
do
{
    /* statements */
}
while(test);
```



Source: https://www.programiz.com/c-programming/c-do-while-loops





Example: while and do-while Loop

```
#include <stdio.h>
                                                          96
                                                          97
                                                               int main (void)
      #include <stdio.h>
70
                                                          98
                                                             □ {
71
                                                          99
                                                                   int counter = 0;
                                                                   int input = 0;
                                                         100
72
     int main (void)
                                                                   int sum = 0;
                                                         101
73
    □{
                                                         102
                                                                   int limit = 0;
74
          int input = 0;
                                                         103
75
          int sum = 0;
                                                                   printf("Please enter the number of input: ");
                                                         104
                                                         105
                                                                   scanf("%d", &limit);
76
                                                         106
77
          do
                                                         107
                                                                   while (counter < limit)
78
                                                         108
79
               printf("Please enter an input: ");
                                                         109
                                                                       printf("Please enter an input: ");
80
               scanf ("%d", &input);
                                                         110
                                                                       scanf ("%d", &input);
81
                                                         111
                                                         112
                                                                       sum = sum + input;
82
               if (input > 0)
                                                         113
                                                                       counter = counter + 1;
83
                                                         114
84
                    sum = sum + input;
                                                         115
85
                                                                   printf("The sum of two numbers is %d\n", sum);
                                                         116
86
                                                         117
          }while(input > 0);
                                                         118
                                                                   return 0;
87
                                                         119 -1
88
89
          printf ("The sum of two numbers is %d\n", sum);
90
91
          return 0;
92
```



```
#include <stdio.h>
 95
 96
 97
      int main (void)
 98
     □ {
 99
          int counter = 0;
          int input = 0;
100
          int sum = 0;
101
102
          int limit = 0;
103
104
          printf("Please enter the number of input: ");
105
          scanf ("%d", &limit);
106
107
          while (counter < limit)
108
109
              printf("Please enter an input: ");
110
               scanf ("%d", &input);
111
112
               sum = sum + input;
113
              counter = counter + 1;
114
115
116
          printf ("The sum of two numbers is %d\n", sum);
117
118
          return 0;
119
```

```
70
     #include <stdio.h>
71
72
     int main (void)
73
    □ {
74
          int input = 0;
75
         int sum = 0;
76
77
          do
78
79
              printf("Please enter an input: ");
80
              scanf ("%d", &input);
81
82
              if (input > 0)
83
84
                  sum = sum + input;
85
86
          }while(input > 0);
87
88
89
         printf("The sum of two numbers is %d\n", sum);
90
91
          return 0;
92
```

Advanced usages

- Omitting expressions
- Iteration structure interchangeable
- Infinite loop

```
for(a = 0;; a++) {...}

for(;;) {...}

While loop

for(; a < 5;) {...}
```



A programming exercise.

Consider the following problem statement:

A person invests \$1000.00 in a savings account yielding 5% interest. Assuming that all interest is left on deposit in the account, calculate and print the amount of money in the account at the end of each year for 10 years. Use the following formula for determining these amounts:

$$a = p(1+r)^n$$

where

p is the original amount invested (i.e., the principal) r is the annual interest rate n is the number of years a is the amount on deposit at the end of the nth year.

This problem involves a loop that performs the indicated calculation for each of the 10 years the money remains on deposit.

A programming exercise.

```
// Fig. 4.6: fig04_06.c
2 // Calculating compound interest.
3 #include <stdio.h>
    #include <math.h>
 5
    // function main begins program execution
    int main( void )
7
8
       double amount: // amount on deposit
9
       double principal = 1000.0; // starting principal
10
       double rate = .05; // annual interest rate
11
       unsigned int year; // year counter
12
13
       // output table column heads
14
       printf( "%4s%21s\n", "Year", "Amount on deposit" );
15
16
       // calculate amount on deposit for each of ten years
17
18
       for ( year = 1; year <= 10; ++year ) {
19
20
          // calculate new amount for specified year
          amount = principal * pow(1.0 + rate, year);
21
22
23
          // output one table row
          printf( \frac{1}{4}u\%21.2f\n'', year, amount );
24
25 } // end for
   } // end function main
```

A programming exercise.

Voor	Amount on denocit	
Year	Amount on deposit	
1	1050.00	
2	1102.50	
3	1157.63	
4	1215.51	
5	1276.28	
6	1340.10	
7	1407.10	
8	1477.46	
9	1551.33	
10	1628.89	

Example: Menu

```
#include <stdio.h>
263
264
265
      int main (void)
266 ⊟{
267
          int keepGoing = 1;
268
269
          do
270 白
271
               // Print the menu and get the user's choice.
                                                                 331
272
              printf("1) Add\n");
                                                                 332
                                                                                    int n2 = 0;
273
              printf("2) Multiply\n");
                                                                 333
                                                                                    printf("Enter second number: ");
274
              printf("3) Mod\n");
                                                                                    scanf("%d", &n2);
                                                                 334
275
              printf("4) Quit\n");
                                                                 335
276
              printf("Enter option: ");
                                                                 336
                                                                                    int ans = n1 * n2:
277
                                                                                   printf("The answer is %d\n\n", ans);
                                                                 337
               int option = 0;
278
                                                                 338
               scanf("%d", &option);
279
                                                                 339
                                                                                else if (option == 3)
280
                                                                 340
281
               if (option == 1)
                                                                 341
                                                                                    // Modulus
                                                                 342
                                                                                    int n1 = 0:
283
                   // Add 2 numbers.
                                                                 343
                                                                                    printf("Enter first number: ");
284
                   int n1 = 0;
                                                                 344
                                                                                    scanf ("%d", &n1);
                   printf("Enter first number: ");
285
                                                                 345
                   scanf("%d", &n1);
286
                                                                 346
                                                                                    int n2 = 0;
                                                                                   printf("Enter second number: ");
                                                                 347
287
                                                                                    scanf("%d", &n2);
288
                                                                 348
                   int n2 = 0;
                                                                 349
                   printf("Enter second number: ");
289
                                                                                    int ans = n1 % n2;
290
                   scanf ("%d", &n2);
                                                                 351
                                                                                    printf("The answer is %d\n\n", ans);
291
                                                                 352
292
                   int ans = n1 + n2;
                                                                 353
                                                                                else if (option == 4)
                   printf("The answer is %d\n\n", ans);
293
                                                                 354
294
                                                                 355
                                                                                    // Quit
295
               else if (option == 2)
                                                                 356
                                                                                    keepGoing = 0;
296
                                                                 357
297
                   // Multiply 2 numbers.
                                                                           }while (keepGoing);
298
                   int n1 = 0;
                                                                 359
                   printf("Enter first number: ");
299
                                                                           return 0;
                   scanf ("%d", &n1);
                                                                 361 -}
```

```
#include <stdio.h>
263
264
265
      int main (void)
266
     □ {
          int keepGoing = 1;
267
268
269
          do
270
          1
271
              // Print the menu and get the user's choice.
272
              printf("1) Add\n");
273
              printf("2) Multiply\n");
274
              printf("3) Mod\n");
              printf("4) Quit\n");
275
276
              printf("Enter option: ");
277
              int option = 0;
278
              scanf ("%d", &option);
279
280
281
              if (option == 1)
282
283
                   // Add 2 numbers.
284
                   int n1 = 0;
285
                  printf("Enter first number: ");
                   scanf("%d", &n1);
286
287
                  int n2 = 0;
288
289
                  printf("Enter second number: ");
290
                   scanf ("%d", &n2);
291
292
                   int ans = n1 + n2;
293
                  printf("The answer is %d\n\n", ans);
294
295
              else if (option == 2)
296
297
                   // Multiply 2 numbers.
298
                   int n1 = 0;
299
                   printf("Enter first number: ");
300
                   scanf ("%d", &n1);
```

```
331
332
                   int n2 = 0;
                  printf("Enter second number: ");
333
334
                   scanf ("%d", &n2);
335
336
                   int ans = n1 * n2;
337
                   printf("The answer is %d\n\n", ans);
338
339
              else if(option == 3)
340
341
                  // Modulus
                  int n1 = 0;
342
343
                   printf("Enter first number: ");
344
                   scanf("%d", &n1);
345
346
                  int n2 = 0;
                  printf("Enter second number: ");
347
                   scanf ("%d", &n2);
348
349
350
                   int ans = n1 % n2;
351
                   printf("The answer is %d\n\n", ans);
352
              else if (option == 4)
353
354
355
                   // Quit
356
                   keepGoing = 0;
357
358
         }while (keepGoing);
359
360
         return 0;
361
```

Overview

- Control Structure in C
- Return value of scanf
- break and continue



Understanding Input Buffer

```
::\Users\z2017233\Desktop>iteration
     #include <stdio.h>
                                                         Please enter an input: 1
 3
                                                         Please enter an input: 2
     int main (void)
                                                         The sum of two numbers is 3
    □ {
         int input = 0;
                                                         C:\Users\z2017233\Desktop>iteration
         int sum = 0;
                                                         Please enter an input: 1 2
                                                         Please enter an input: The sum of two numbers is 3
         printf("Please enter an input: ");
 9
          scanf ("%d", &input);
                                                          :\Users\z2017233\Desktop>iteration
10
                                                         Please enter an input: 1 2 3
11
                                                         Please enter an input: The sum of two numbers is 3
12
          sum = sum + input;
13
                                                          C:\Users\z2017233\Desktop>iteration
14
         printf("Please enter an input: ");
                                                         Please enter an input: 1 2 3 4
          scanf ("%d", &input);
15
                                                         Please enter an input: The sum of two numbers is 3
16
17
          sum = sum + input;
18
19
         printf ("The sum of two numbers is %d\n", sum);
21
         return 0;
22
```

 scanf will read from buffer without waiting for any user input if the buffer is <u>NOT</u> empty.



Return value of scanf()

One way to validate user's input.

```
:\Users\z2017233\Desktop>iteration
                                               Please enter your date of birth (dd/mm/yyyy): 01/02/1234
                                               There are 3 correctly formatted values
      #include <stdio.h>
181
                                               The values are 1, 2 and 1234
182
                                               C:\Users\z2017233\Desktop>iteration
183
      int main (void)
                                               Please enter your date of birth (dd/mm/yyyy): 01 02 1234
184 ⊟{
                                               There are 1 correctly formatted values
           int day = 0;
185
                                               The values are 1, 0 and 0
           int month = 0:
186
187
           int year = 0;
188
           int count = 0;
189
190
           printf("Please enter your date of birth (dd/mm/yyyy): ");
191
           count = scanf("%d/%d/%d", &day, &month, &year);
192
195
           printf("There are %d correctly formatted values\n", count);
194
           printf("The values are %d, %d and %d\n", day, month, year);
195
196
197
           return 0;
198
```



Overview

- Control Structure in C
- Return value of scanf
- break and continue



break vs continue Statement

- The break statement, when executed in a loop (e.g., while), causes an immediate exit from that statement. Program execution continues with the next statement
- The **continue** statement, when executed in loop, skips the remaining statements in the body of that control statement and performs the next iteration of the loop.

break vs continue Statement (2)

```
Completely
                                            Terminates the current
            terminates a loop
                                           iteration of a loop
                                 • int i;
• int i;
                                   for(i = 1; i < 10; i++){
  for(i = 1; i < 10; i++){
                                       if(i < 5)
      if(i == 5)
                                           continue;
         break;
                                       printf("%d ", i);
      printf("%d ", i);
  printf("End = %d\n", i);
```

Displays 5 6 7 8 9

University of Nottingham

Displays 1 2 3 4 End = 5

break vs continue Statement (3)

```
while (testExpression) {
    // codes
    if (condition to break) {
        break;
    }
    // codes
}
// codes

while (testExpression);

do {
    // codes
    if (condition to break) {
        break;
    }
    // codes
}
while (testExpression);
```

Note the directions of the arrows!!

```
for (init; testExpression; update) {
    // codes
    if (condition to break) {
        break;
    }
    // codes
}
```

Source: https://www.programiz.com/c-programming/c-break-continue-statement

```
while (testExpression) {
    // codes
    if (testExpression) {
        continue;
    }
    // codes
}
```

```
do {
    // codes
    if (testExpression) {
        continue;
    }
    // codes
}
while (testExpression);
```

Summary

- Control Structure in C
- Return value of scanf
- break and continue

