Structured Programming - Formatted I/O

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With Thanks to Dr. Xin Feng and Dr. Haipeng Guo

Outline

- Write output to screen - printf
- Read input from keyboard– scanf

printf

- Format: `printf(format_string, arg1, arg2, …,argn);`
- Display the output

```
printf("The results are %d and %d\n", a, b);
```

Format_string - included in a pair of " "

arg1

arg2

printf

- Format string contains (optional):
  - literal text: printed without any variation
  - escape sequences: preceeded by \, used to print special characters
  - conversion specifiers : % followed by a single character (printf char)
    - Conversion specifier indicates (usually) that the value of a variable is to be displayed at this location. The variables to be printed must appear as arg1, arg2, ….in the order that they appear in the format string.

printf

```
printf("The results are %d and %d\n", a, b);
```

literal text

literal text

escaped sequences

conversion specifiers and printf char

conversion specifiers and printf char

If a = 10 and b = 20, we have the following output:

```
The results are 10 and 20
```

Conversion Specifiers

Conversion Specifier	Meaning
%c	Single character
%d	Signed decimal integer
%x	Hexadecimal number
%f	Decimal floating point number
%e	Floating point in “scientific notation”
%s	Character string (more on this later)
%u	Unsigned decimal integer
%%	Just print a % sign
%ld, %lld	long, and long long

More Conversion Specifiers

- More conversion specifiers are available.
- They can be found in the Internet and reference books.
- Feel free to search via Google or Bing. Better NOT use Baidu for scientific search.

- https://www.tutorialspoint.com/format-specifiers-in-c
- https://www.geeksforgeeks.org/format-specifiers-in-c/
- http://crasseux.com/books/ctutorial/Formatted-output-conversion-specifiers.html

Escape Sequences

Sequence	Meaning
\a	Bell (an alert sound)
\b	Backspace
\n	Newline
\t	Horizontal tab
\\	Backslash
\'	Single quote
\"	Double quotation
\xhh	ASCII char specified by hex digits hh
\ooo	ASCII char specified by octal digits oo

Exercises

- What is the output of the following program

```
#include <stdio.h>
int main()
{
  char c, d;
  float f;
  c = 'd';
  d = 97;
  f = 23.5;
  printf("c = %c, d = %c \nf = %f, f = %e", c,
         d, f, f);
}
```

Exercises

- What is the output of the following program

```
#include <stdio.h>
int main()
{
  char c, d;
  float f;
  c = 'd';
  d = 97;
  f = 23.5;
  printf("d = %d \tf = %d", d, f);
}
```

Exercises

- What is the output of the following program

```
#include <stdio.h>
int main() {
  int ten = 10, x = 42;
  char ch1 = 'o', ch2 = 'f';
  printf("%d%% %c%c %d is %f\n",
          ten, ch1, ch2, x, 1.0 * x / ten );
  return 0;
}
```

scanf

- Format: `scanf(format_string, arg1, arg2, …,argn);`
- Read the input
- Format string is similar to that in printf

```
scanf("value=%d,ratio=%f", &value,&ratio);
```

Format_string - included in a pair of " "

arg1

arg2

&: means "address of". Will be explained in the later chapter.

scanf

```
scanf("value=%d,ratio=%f", &value,&ratio);
```

Input: `value=10,ratio=15.9`

scanf

```
scanf("value=%d,ratio=%f", &value,&ratio);
```

Input: `value=10,ratio=15.9`

```
scanf("%d%f", &value,&ratio);
```

Input: `10 15.9`

Exercises

- What is the output of the following program

```
#include <stdio.h>
int main() {
  int percentage, x;
  char ch1, ch2;
  scanf("%d%c%c%d”, &percentage, &ch1, &ch2, &x);
  printf("%d%% %c%c %d is %f\n",
         percentage, ch1, ch2, x, 1.0 * x *
         percentage / 100);
  return 0;
}
```

- what does this program do?
- What is the output if the input is 25 o f 60

Exercises Answer

```
#include <stdio.h>
int main() {
  int percentage, x;
  char ch1, ch2;
  scanf("%d%c%c%d”, &percentage, &ch1, &ch2, &x);
}
```

•If the input is 25 o f 60, the output is:
25% o -858993460 is -214748365.000000

•The %d conversion specifier expects the input text to be formatted as a decimal integer. If it isn't, the conversion fails and the character that caused the conversion to fail is left in the input stream.

Initialization

```
#include <stdio.h>
int main() {
  int percentage = 0, x = 0;
  char ch1 = 0, ch2 = 0;
  scanf("%d%c%c%d", &percentage, &ch1, &ch2, &x);
}
```

Therefore, it is recommended that all the variables should be initialized. It will be a good behaviors for your program debug. If the variables are not initialized, the compiler will use magic numbers to initialized them.

https://www.asawicki.info/news_1292_magic_numbers_in_visual_c

What's More

```
#include <stdio.h>
int main() {
  int percentage=0, x=0;
  char ch1=0, ch2=0;
  scanf("%d %c %c %d", &percentage, &ch1, &ch2, &x);
}
```

Use spaces to separate the format string if you want to separate the inputs by using spaces.

Try input as 25 o f 60 again and you will find the output:

25% of 60 is 15.000000

https://www.asawicki.info/news_1292_magic_numbers_in_visual_c

Summary

- Make the output in a specific format
- How to read from keyboard