Input/output

Victor Eijkhout and Charlie Dey

spring 2017

Formatted output

Default output

Normally, output of numbers takes up precisely the space that it needs:

```
cout << "Unformatted:" << endl;
for (int i=1; i<200000000; i*=10)
  cout << "Number: " << i << endl;
cout << endl;
```

Output

```
Unformatted:
Number: 1
Number: 10
Number: 100
Number: 1000
Number: 10000
Number: 100000
Number: 1000000
Number: 10000000
Number: 100000000
```

Reserve space

You can specify the number of positions, and the output is right aligned in that space by default:

```
cout << "Width is 6:" << endl;
for (int i=1; i<200000000; i*=10)
  cout << "Number: " << setw(6) << i << endl;
cout << endl;
```

(Only applies to immediately following number)

Output

```
Width is 6:
Number:      1
Number:     10
Number:    100
Number:   1000
Number:  10000
Number: 100000
Number: 1000000
Number: 10000000
Number: 100000000
```

Padding character

Normally, padding is done with spaces, but you can specify other characters:

```
cout << "Padding:" << endl;
for (int i=1; i<200000000; i*=10)
cout << "Number: " << left << setfill('.') << setw(6) << i
cout << endl;
```

Note: single quotes denote characters, double quotes denote strings.

Output

```
Padding:
Number: .....1
Number: ....10
Number: ...100
Number: ..1000
Number: .10000
Number: 100000
Number: 1000000
Number: 10000000
Number: 100000000
```

Left alignment

Instead of right alignment you can do left:

```
  cout << "Padding:" << endl;
for (int i=1; i<200000000; i*=10)
  cout << "Number: " << left << setfill('.') << setw(6) <<
cout << endl;
```

Output

```
Padding:
Number: 1.....
Number: 10....
Number: 100...
Number: 1000..
Number: 10000.
Number: 100000
Number: 1000000
Number: 10000000
Number: 100000000
```

Number base

Finally, you can print in different number bases than 10:

```
cout << "Base 16:" << endl;
cout << setbase(16) << setfill(' ');
for (int i=0; i<16; i++) {
  for (int j=0; j<16; j++)
    cout << i*16+j << " " ;
  cout << endl;
}
cout << endl;
```

Output

```
Base 16:
0 1 2 3 4 5 6 7 8 9 a b c d e f
10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
30 31 32 33 34 35 36 37 38 39 3a 3b 3c 3d 3e 3f
etc
```

Exercise 1

Make the above output more nicely formatted:

```
00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f
10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f
20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f
```

Exercise 2

Use integer output to print fixed point numbers aligned on the decimal:

```
  1.345
 23.789
456.1234
```

Use four spaces for both the integer and fractional part.

Floating point formatting

Floating point precision

Use `setprecision` to set the number of digits before and after decimal point:

```
x = 1.234567;
for (int i=0; i<10; i++) {
  cout << setprecision(4) << x << endl;
  x *= 10;
}
```

Output

```
1.235
12.35
123.5
1235
1.235e+04
1.235e+05
1.235e+06
1.235e+07
1.235e+08
1.235e+09
```

(Notice the rounding)

Fixed point precision

Fixed precision applies to fractional part:

```
cout << "Fixed precision applies to fractional part:" << en
x = 1.234567;
cout << fixed;
for (int i=0; i<10; i++) {
  cout << setprecision(4) << x << endl;
  x *= 10;
}
```

Output

```
1.2346
12.3457
123.4567
1234.5670
12345.6700
123456.7000
1234567.0000
12345670.0000
123456700.0000
1234567000.0000
```

Aligned fixed point output

Combine width and precision:

```
x = 1.234567;
cout << fixed;
for (int i=0; i<10; i++) {
  cout << setw(10) << setprecision(4) << x << endl;
  x *= 10;
}
```

Output

```
     1.2346
    12.3457
   123.4567
  1234.5670
 12345.6700
123456.7000
1234567.0000
12345670.0000
123456700.0000
1234567000.0000
```

Scientific notation

```
cout << "Combine width and precision:" << endl;
x = 1.234567;
cout << scientific;
for (int i=0; i<10; i++) {
  cout << setw(10) << setprecision(4) << x << endl;
  x *= 10;
}
```

Output

```
Combine width and precision:
1.2346e+00
1.2346e+01
1.2346e+02
1.2346e+03
1.2346e+04
1.2346e+05
1.2346e+06
1.2346e+07
1.2346e+08
1.2346e+09
```