CONTROL STRUCTURES

CONDITIONAL EXPRESSIONS

Take the construction like this:

```
if (conditional expression)
      statement(s) we do if the condition is true
else
      statement(s) we do if the condition is false
```

Simple example:

```
int grade=85;
if (x>=90)
       printf("Grade A");
else if (x>=80)
       printf("Grade B");
else if (x>70)
       printf("Uhm");
```

Another example:

```
int myheading = 10;
int myTargetBearing = 90;

printf("Are we there yet!?\n");

diff = myTargetBearing – myheading;
if (abs(diff) < 5)
{
       if (diff==0)
           printf("You are right on the target!");
       else
           printf("You are off by %d, but you are closed enough!", abs(diff) );
}
else
{
       printf("You need to turn about %d degrees ", abs(diff));

       if (diff>0)
              printf("clockwise");
       else
              printf("counter-clockwise");
}
```

The key is "<the condition>" will be evaluated down to become 1 or 0, i.e true or false. Therefore, the following sample also works:

```
if (1)
   printf("yeah!");
```

CONDITIONAL LOOPS

Two ways to repeat a set of instructions: while clause and for clause

WHILE CLAUSE

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

Check out the difference the following code segments:

Sample 1	Sample 2	Sample 3

`int x = 1;`
`while (x > 0)`
`{`
`  printf("number %d \n", x);`
`  --x;`
`}`
	`int x = 1;`
	`while (--x > 0)`
	`  printf("number %d \n", x);`
		`int x = 1;`
		`while (x-- > 0)`
		`  printf("number %d \n", x);`

FOR CLAUSE

for (<initial setup> ; <conditional expressions>; <update at the next iteration) {
    things we want to do a given
    number of times
}

Example:

```
for (x=100; x > 0; x--)
        printf("number %d\n", x);
```

Summarize briefly:

All these 3 loops do the same thing:

```
int i = 0;
while (i < 10)
{
    cout << "value: " << i;
    i = i+1
}
```

```
int i = 0;
while (i < 10)
{
    cout << "value: " << i;
    ++i;
}
```

```
for (int i=0; i<10; i++)
{
    cout << "value: " << i;

}
```

DO… WHILE CLAUSE

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

```
int i=0;
do
{
    cout << "value: " << i;
    i = i+1;
} while (i < 10);
```

This may generate different result from while clause above. Do you know what that may be?

BREAK OUT OF THE LOOPS (BREAK)

```
while (  conditional expression )
{
   do something…
   if (something is true) {
         break ;
   }
   ....
   more to do…
   ....
}
....
```

JUMP BACK TO THE BEGINNING OF THE LOOP (CONTINUE)

```
while (  conditional expression )
{
   do something…
   if (something is true) {
         continue;
   }
   ....
   more to do…
   ....
}
....
```

RELATIONAL AND LOGICAL OPERATORS

Relational operators : (will be further discussed on Day 2)

- == > < >= <= !

Logical operators: (will be further discussed on Day 2)

- && ||

SWITCH

- substitute for long "if"statements
- compare a variable to several int/char values.
- programming structure:

```
switch ( <variable> ) {
        case value1:
                Code to execute if <variable> == this-value
                break;
        case value2:
                Code to execute if <variable> == that-value
                break;
        case ...:
                ....
        default:
                Code to execute if <variable> does not equal any value in the "cases"
                break;
}
```

Example:

```
int age= 50;
int x = age / 10;
switch ( age ) {
  case 5:
    printf("Keep active!");
    break;
  case 4:
    printf("Still cool!");
    break;
  case 3:
     printf("Still young!");
    break;
  case 2:
    printf("Yeah! College is Cool!");
    break;
  case 1:
    printf("You can't drink! ");
    break;
  default:
    printf("Don't want to say\n";
    break;
  }
```

PRACTICE EXERCISES

1. Ask user to enter 4 numbers. Your program will produce the largest and the smallest number. You are allowed to use only 4 "if"s expressions though.

2. Write a function that outputs a right-side-up triangle of height *n* and width *2n-1*; the output for *n = 6* would be:

```
     *
    ***
   *****
  *******
 *********
***********
```

3. Write a program that prompts the user for a sentence, and prints each word on its own line.

4. Write a program to ask user to enter a number, and generate the factorial of that number. If user enters 5, answer = 120. If user enters 6, answer = 720.

5. Write a program to calculate a gcd with two numbers using Euclid Algorithm. This is how it works:

N	M	R= N % M
300	64	44 = 300 % 64
64	44	20 = 64 % 44
44	20	4 = 44 % 20
20	4	0 = 20 % 4

6. Write a program to calculate a square root of a number using Newton's method. This is how it works:
   e.g. user wishes to find out square root of 3:

N	N/M	M	Average of N/M and M
3	3	1	2
	1.5	2	1.75
	1.71429	1.75	1.73214
	1.73196	1.7314	1.73205
	1.73205	**1.73205**	1.73205

Your get your answer when:

$$| M_{(current)} - M_{(previous)} | <= M * \frac{1}{10000}$$

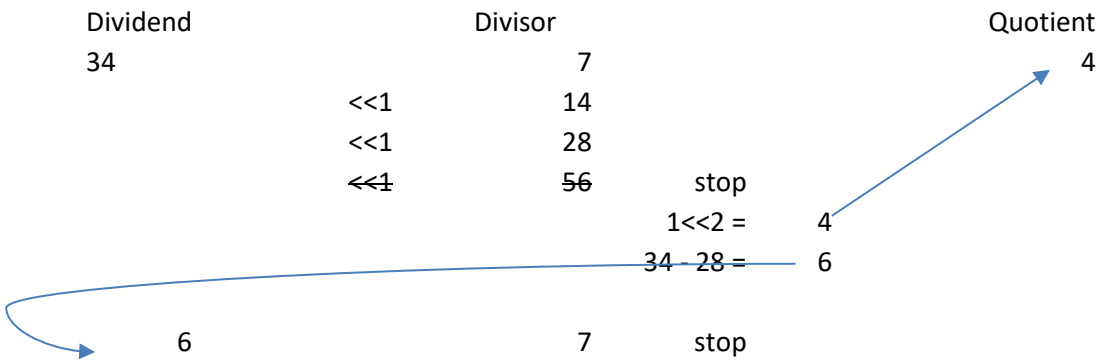
7. There are two numbers with different number system, i.e. A_{b1} == B_{b2} where b1 and b2 are bases. Eg. 419_{47} == 792_{35} == 8892. You will write a program which will be calculate b1 and b2 for each of the following set of numbers. Assuming all numbers here < 1000.

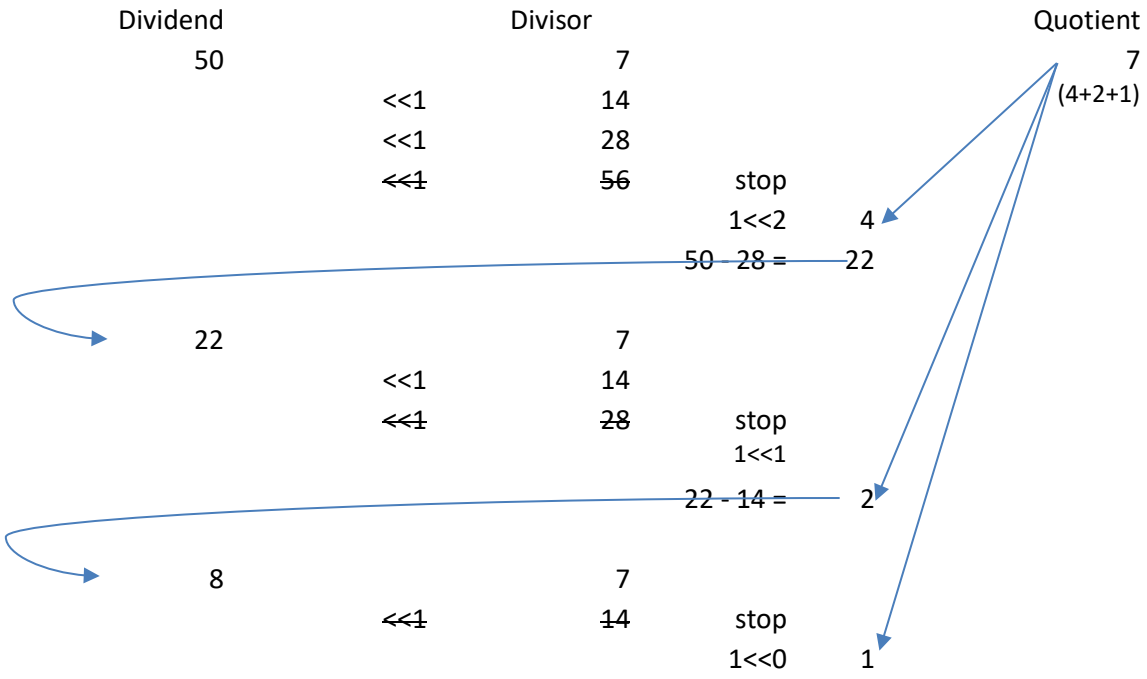
The numbers	b1	b2
419_{b1} 792_{b2}	47	35
582_{b1} 232_{b2}	2213	1565
846_{b1} 598_{b2}	918	1452
252_{b1} 529_{b2}	3275	4142
365_{b1} 644_{b2}	1849	1170
473_{b1} 719_{b2}	2241	1585

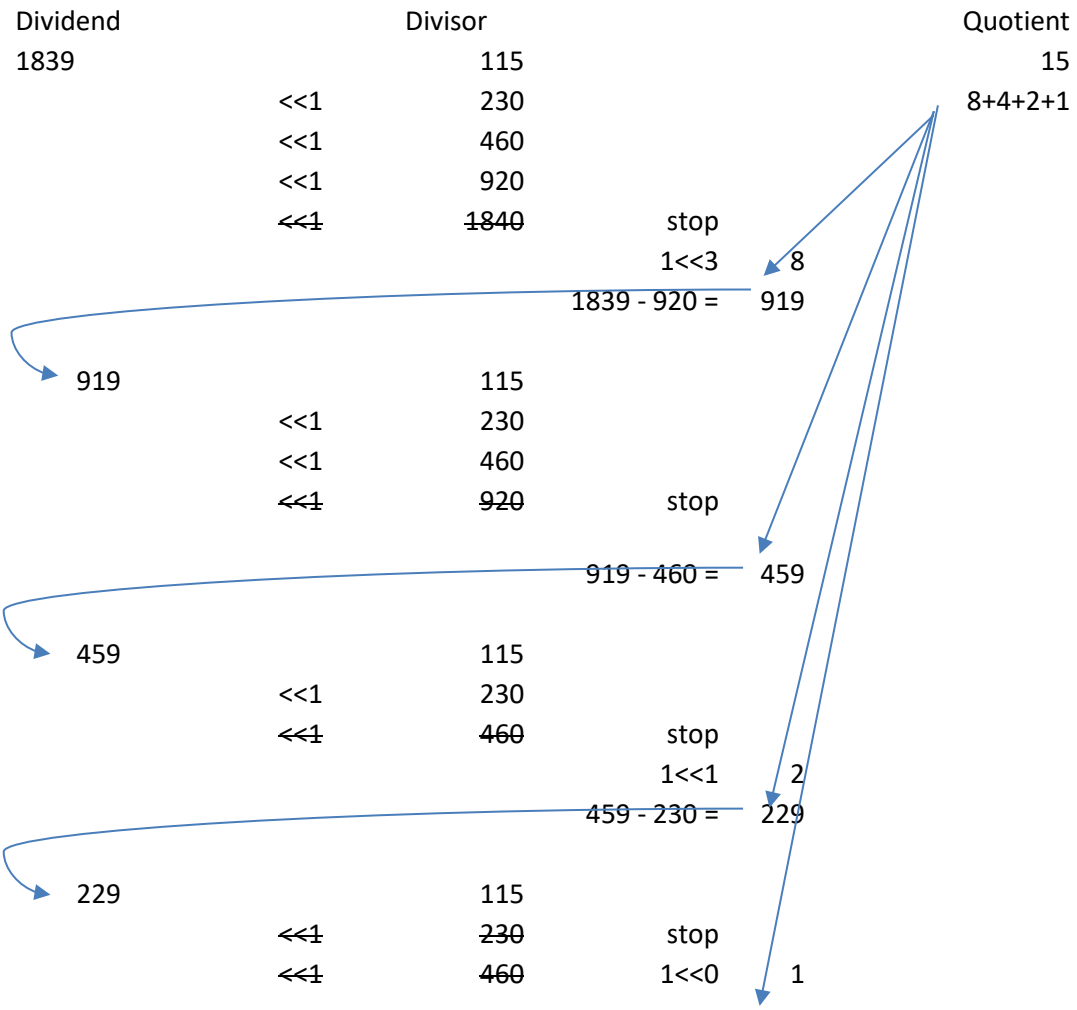
The following exercises are Only for those who know bit-wise operation. Write the following functions to print out all the bits of an data field:

8. Perform division with bits operation. No arithmetic operators, "+", "-", "/", "*" is allowed. In order to come up with the solutions, you need to think about:
   - Pattern
   - What operation will help you to know whether you need to carry over.
   - What operation will help you to do "*" and "/"
   - How to know it is an odd or even

   Hint for division:






Dividend
Divisor
Quotient
1839
115
15
<<1
230
8+4+2+1
<<1
460
<<1
920
<<1
1840
stop
1<<3
8
1839 - 920 =
919
919
115
<<1
230
<<1
460
<<1
920
stop
919 - 460 =
459
459
115
<<1
230
<<1
460
stop
1<<1
2
459 - 230 =
229
229
115
<<1
230
stop
<<1
460
1<<0
1