Logical expressions

- **Why logical expression?**

- Value of logical expression → Boolean value : **true, false** (true: 1, false: 0)

- **bool variable**
  Example: bool jobDone;
  bool taxable;

- **logical operators**

Relational	**Equility**	**Logical**
< less than	== equal to	&& and
<= less than and equal to	!= not equal to	|| or
> greater than		! not
>= greater than and equal to		

notes:
1. no space between the two symbols in : <=, >=, !=, ==
2. difference between = (assignment operator) and == (equal to operator)
   example:
   int A=1, B=2;
   A=B;
   bool C;
   C = (A==B);

- logical operation truth table

x	**!x**
false	**true**
true	**false**

x	y	**x&&y**	**x||y**
true	true	**true**	**true**
true	false	**false**	**true**
false	true	**false**	**true**
false	false	**false**	**false**

- Operator precedence

  ! -
  * / %
  + -
  < <= > >=
  == !=
  &&
  ||
  =

  highest
  ↓
  lowest

- In C++, logical expressions are evaluate in a "short circuit fashion":

It sets the resulting value as soon as it is known, the expression may not be completely evaluated.

false && (anything) → **false**
true || (anything) → **true**

Practice questions:

- Evaluate the following logical expressions:

```
int      x=5, y=-3, z=2;
float    A=3.0, B=2.5;
char     student = 'S', teacher = 't', chairman='c';
string   firstTeam = "UT", secondTeam="Vanderbilt";
```

a (x>z) == (A>B)

b student < teacher != firstTeam < secondTeam

c (x<z) &&(student != teacher)

d A !=B || firstTeam != secondTeam

e !(x < (y+7))

f !(x>y) || ((y+z) >= (x-z))

- Write C++ logical statement to express the following :
  a a patient's blood pressure is below 70, and above 55 inclusive (55<=bloodPressure<=70)

  b the student's first lab or the second lab score is 100

  c The difference between the two radius measurements is less than 0.001

  d The number is a multiple of 3 or it is greater than 100

  e The number is divisible by 5 and it is a multiple of 10

- Write the equivalent logical expression by applying the DeMorgan's law to the following expressions:
  a ! (year%100 == 3 && month == 12)

  b ! (taxRate > 0.35 || income < 80000)