Program Design

Lecture 7

Submittable Lab – 20%

Next week (week 5)

Boolean Expressions

- X>Y
- A==B
- C<=D

Logic of IF statements

When will the below statement be printed?

```
If (x == 15)
    If(y < 10)
            print('x and y have appropriate values')
    EndIf
EndIf
```

Logic of IF statements

When will the below statement be printed?

```
If (x == 15)
    print('x and y have appropriate values')
EndIf
If(y < 10)
    print('x and y have appropriate values')
EndIf
```

Boolean Operators – Combining Expressions

- Often we will want out Boolean expression to be dependent on more than one condition. We can use multiple conditions in a single expression using Boolean operators.
- In the following 0 means false and 1 means true

Truth Table for Boolean Operator - And

- An and operation is true if both operands are true
- Symbol: $\wedge$
- In python
  the operand is `and`
- p = Today is Monday
- q = Today is my birthday
- $p \wedge q$ = “Today is Monday and today is my birthday”

And operator		
A	B	A and B
0	0	0
0	1	0
1	0	0
1	1	1

Boolean Operators -Or

- An or operation is true if either operands are true
- Symbol: $\vee$
- In python
  the operand is `or`
- *p* = Today is Monday
- *q* = Today is my birthday
- $p \vee q$ = "Today is Monday or today is my birthday (or possibly both)"

Or operator		
A	B	A or B
0	0	0
0	1	1
1	0	1
1	1	1

Boolean Operator - Not

- A not operation switches (negates) the truth value
- Symbol: ¬, ~
- In python
  the operand is `not`
- *p* = “Today is Friday”
- ¬*p* = “Today is not Friday”

Not operator	
A	Not A
1	0
0	1

Precedence of Boolean Operators

Relative precedence of not, and, or

- 1st not
- 2nd and
- 3rd or

Examples

- Rain – Boolean variable - true false
- Cold– Boolean variable
- If it rains or if it’s cold I’ll wear a coat

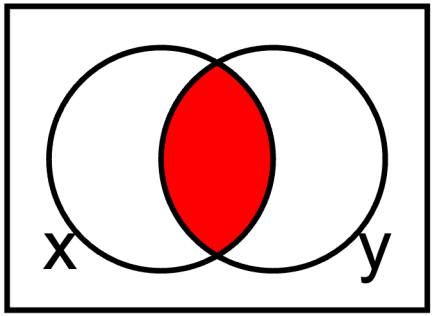
Or operator		
Rain	Cold	Rain or cold (coat)
0	0	0
0	1	1
1	0	1
1	1	1

Examples

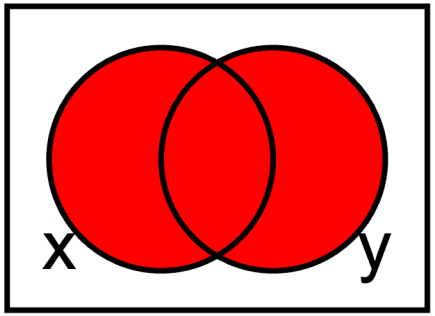
- Rain – Boolean variable - true false
- Getting a lift – Boolean variable
- If it rains and I don’t get a lift I’ll wear a coat

And operator		
Rain	Lift	Rain and not Lift (Coat)
0	0	0
0	1	0
1	0	1
1	1	0

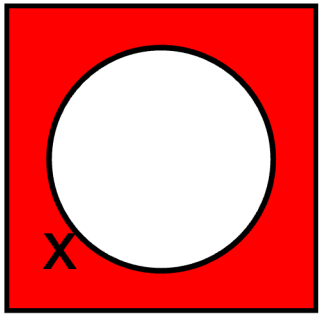
Venn Diagrams



$x \wedge y$

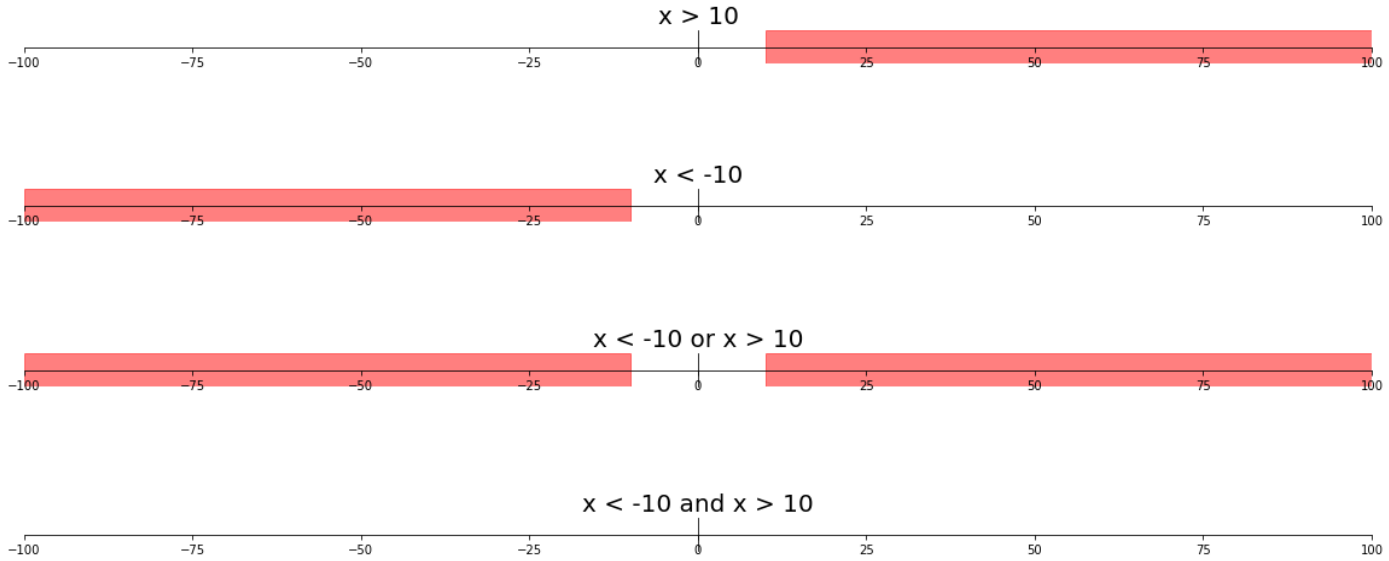


$x \vee y$



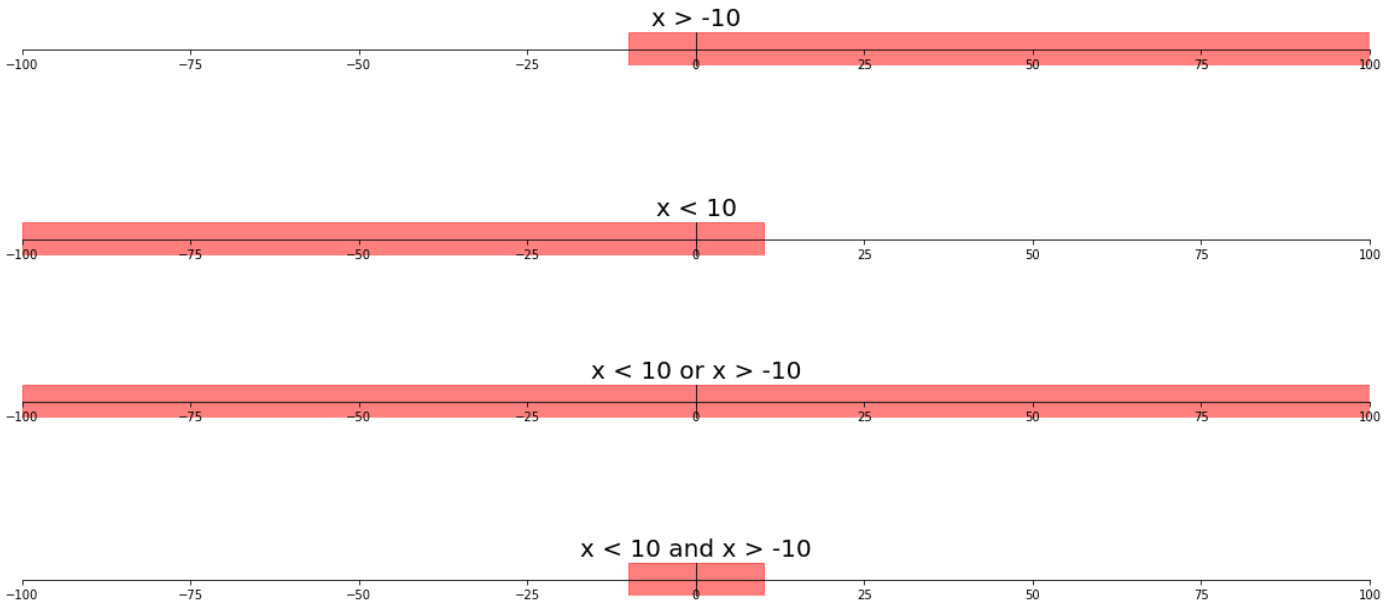
$\neg x$

Number Line Visualisation for integers/floats - single variable ranging (highlighted parts are values for which the statement is true)



Number Line Visualisation

(highlighted parts are values for which the statement is true)



Try Writing a Ranging Statement

Fare program:

- Read in age of customer
- If the age is less than 6 the fare should be 0
- If the age is 67 or greater the fare should be 0
- Otherwise, the fare should be set to 5

```
Program Fare_decider
        Prompt age
        get age
        If age < 6 or age >= 67
                fare = 0
        Else
                fare = 5
        EndIf
```

```
Program Fare_decider
        Prompt age
        get age
        If age >= 6 and age < 67
                fare = 5
        Else
                fare = 0
        EndIf
```

Truth Tables and Boolean Expressions

- Take a compound expression and identify simple Boolean expressions.
- Evaluate for each possible truth value of each simple expression.

e.g. !(x < 3 and y > 2) => !(a and b)

a	b	!(a and b)
0	0	1
0	1	1
1	0	1
1	1	0

Truth Tables and Boolean Expressions

- Try for `!(x < 3) or !(y > 2)`

Truth Tables and Boolean Expressions

- Try for `!a or !b`

a	b	`!a or !b`
0	0	1
0	1	1
1	0	1
1	1	0