UNIT 9

*Do together with Unit 4*

*Write these NEATLY*

# Logical connectives (From Unit 4)

* These are actually called logical connectives

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | AND | OR | If… Then  (implication) | If and only if (Biconditional) | Its not the case that |
| Math Symbol |  |  |  |  | not |
| C++ | && | || | If, else | if | ! |
| Logical |  |  | → | ↔ | ¬ |

Negation

Biconditional

Conditional

Disjunction

Conjunction

AND Conjunction - Like in C++, any statements with false parts cause the WHOLE argument to be false.

Compound statement

|  |  |  |
| --- | --- | --- |
| P | Q | P Q |
| T | T | T |
| T | F | F |
| F | T | F |
| F | F | F |

OR Disjunction - Like in C++, any statements are usually true until both statements are false which causes the entire argument to be false

Compound statement

|  |  |  |
| --- | --- | --- |
| P | Q | P Q |
| T | T | T |
| T | F | T |
| F | T | T |
| F | F | F |

Conditional statement

“**If** *condition* **then** *conclusion*”

p is hypothesis/condition

q is conclusion

p q

IF, ELSE Conditional – Only if the first condition is met then the conclusion is true.

*ONLY false when p is true and f is false*

Compound statement

|  |  |  |
| --- | --- | --- |
| P | Q | P Q |
| T | T | T |
| T | F | F |
| F | T | T |
| F | F | T |

NOT Negation – Like the ! (NOT) operator, changes the value of the statement

|  |  |
| --- | --- |
| P | P |
| T | F |
| F | T |

IF, Biconditional – Only true if the statements have the same truth value.

*ONLY true when both are true or both are false*

Compound statement

|  |  |  |
| --- | --- | --- |
| P | Q | PQ |
| T | T | T |
| T | F | F |
| F | T | F |
| F | F | T |

* Truth tables really aren’t hard. You just need to know operations by head. Also WRITE NEATLY, it helps follow the flow of them.

Example – Truth table with three statements

|  |  |  |
| --- | --- | --- |
| P | Q | R |
| T | T | T |
| T | T | F |
| T | F | T |
| T | F | F |
| F | F | F |
| F | F | T |
| F | T | F |
| F | T | T |

## Tautology

* *A compound statement is a tautology if it is true for its component statements*
* So if the last column is all true then there is tautology

Example : They came into the room one after the other in succession

## Contradiction

* *A compound statement is a contradiction if it is false for its component statements*
* So if the last column is all false then there is tautology

Example: Always tell the truth even if you have to lie to do it

## CHEAT SHEET

*p* ↔ *q is logically equivalent to (p* → *q)* ∧ *(q* → *p),*

*p* → *q is logically equivalent to ¬ p* ∨ *q,*

Example 1 (LEARN THESE)

p → q

≡¬p ∨ q by the implication law (the first law in Table 7.)

≡q ∨ (¬p) by commutative laws

≡¬(¬q) ∨ (¬p) by double negation law

≡¬q → ¬p by implication law