Premise

- proposition on the basis of which we would able to draw a conclusion.
- an evidence or assumption
- Therefore, initially we assume something is true and on the basis of that assumption, we draw a conclusion

Conclusion

- a proposition that is reached from the given set of premises.
- Result of an assumptions that we made in an argument

If premise then conclusion

Arguments

- sequences of statements that ends with a conclusion
- It is a set of one or more premises and a conclusion

Valid Argument

- An argument is said to be valid **if and only** if it is not possible to make all premises true **and** a conclusion false.
- That means, if all premises are true then for a valid argument, conclusion must be true

- For Example:

P1: If I love discrete mathematics, then I will study propositional logic
P2: I love discrete mathematics
C: Therefore, I will study propositional logic

Here,
If,
p = I love discrete mathematics
q = I will study propositional logic

Initially, $p \rightarrow q$ and p is true as both are premises.
As q = P2 premises is true, so q in $p \rightarrow q$ is also true.
According to implication truth table, if q is true and $p \rightarrow q$ is true then surely p must be true.
So conclusion (C = p) is true

So as there is no way of making conclusion false by taking premises true, this is a valid argument

P1: If I will study propositional logic, then I love discrete mathematics
P2: I love discrete mathematics
C: Therefore, I will study propositional logic

Is this argument valid or not valid ??

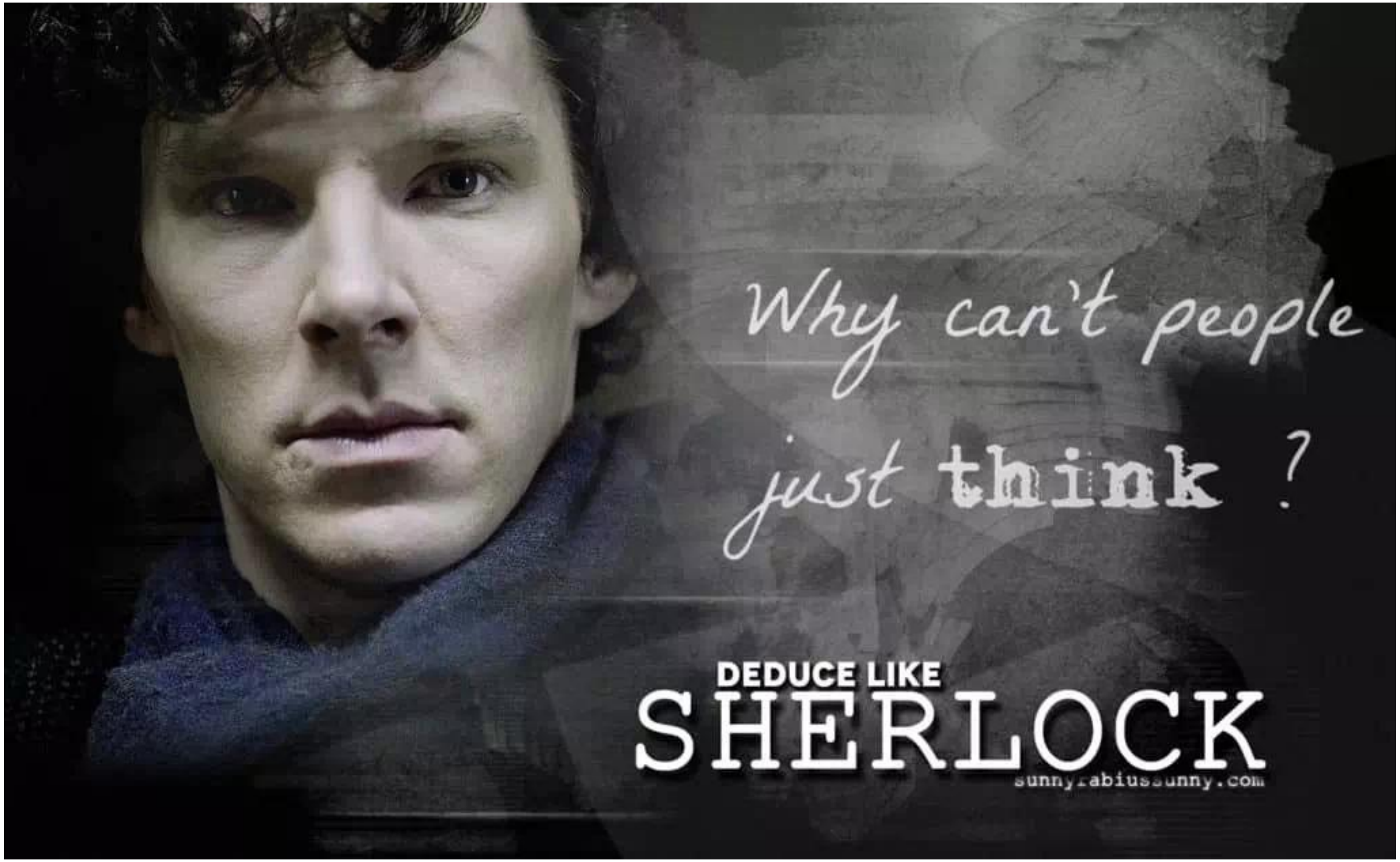
Here,
p = I will study propositional logic
q = I love discrete mathematics
So,
P1 : $p \rightarrow q$
P2: q
C: p

F T
$p \rightarrow q$ T
and q T
So p F

Initially premises ($p \rightarrow q$, q) are true.
For making this whole argument is true, we have to make conclusion true for all true premises.
As q is true initially, so q in $p \rightarrow q$ is also true
According to implication truth table, $p \rightarrow q$ can be true if p is false and q is true. So Conclusion (C = p) is also false.
So we can prove conclusion false for all true premises ($p \rightarrow q$, q)

So arguments **NOT VALID**

Inference: Deriving conclusion from evidence
Rules of Inference: template for constructing valid arguments



Modus Poneus:

$$[(p \rightarrow q) \wedge p] \rightarrow q$$

Or

Modus Tollens:

$$\begin{array}{ll} & p \rightarrow q \\ \text{and} & \neg q \\ \hline \text{So} & \neg p \end{array}$$

Or

$$[(p \rightarrow q) \wedge \neg q] \rightarrow \neg p$$

Hypothetical Syllogism:

$$\begin{array}{ll} & p \to q \\ \text{and} & q \to r \\ \hline \text{So} & p \to r \end{array}$$

Or

$$[(p \to q) \wedge (q \to r)] \to (p \to r)$$

Disjunctive Syllogism:

$$\begin{array}{ll} & p \vee q \\ \text{and} & \neg p \\ \hline \text{So} & q \end{array}$$

Or

$$[(p \vee q) \wedge \neg p] \to q$$

Addition:

So $$\frac{p}{p \vee q}$$

Or

$$p \rightarrow (p \vee q)$$

Simplification:

$$\frac{p \wedge q}{p}$$ or $$\frac{p \wedge q}{q}$$

Or

$$(p \wedge q) \rightarrow p \quad \text{or} \quad (p \wedge q) \rightarrow q$$

Example 1

Premises:
Karim works hard, If karim works hard, then he is a dull boy, If karim is a dull boy, then he will not get the job
Conclusion:
Karim will not get the job

Let,
X = karim works hard
Y = Karim is a dull boy
Z = Karim will get the job

So
Premises:
X
$X \rightarrow \mathbf{Y}$
$\mathbf{Y} \rightarrow \neg \mathbf{Z}$

Now we will use rules of inference to prove our arguments are true

- Pick any two or one premises and apply rules of inference
- Conclusion of two/one premises can work as premises for next rule

Option 1:

$$\frac{\begin{array}{l} X \\ X \rightarrow Y \end{array}}{Y}$$

Using Modus Poneus

$$\frac{\begin{array}{l} Y \\ Y \rightarrow \neg Z \end{array}}{\neg Z}$$

Using Modus Poneus

So ¬Z = Karim will not get the job

Option 2:

$$\frac{\begin{array}{c} X \rightarrow Y \\ Y \rightarrow \neg Z \end{array}}{X \rightarrow \neg Z}$$

Using Hypothetical Syllogism

$$\frac{\begin{array}{l} X \rightarrow \neg Z \\ X \end{array}}{\neg Z}$$

Using Modus Poneus

So $\neg Z$ = Karim will not get the job

Example 2

Text:

(1) It is not sunny this afternoon and it is colder than yesterday.
(2) We will go swimming only if it is sunny.
(3) If we do not go swimming then we will take a canoe trip.
(4) If we take a canoe trip, then we will be home by sunset.

Propositions:

1.p = It is sunny this afternoon,
2.q = it is colder than yesterday,
3.r = We will go swimming ,
4.s= we will take a canoe trip
5. t= We will be home by sunset

Propositions:

p = It is sunny this afternoon,

q = it is colder than yesterday,

r = We will go swimming ,

s= we will take a canoe trip

t= We will be home by sunset

Translation:

(1) $\neg p \wedge q$,

(2) $r \rightarrow p$,

(3) $\neg r \rightarrow s$,

(4) $s \rightarrow t$

(1) It is not sunny this afternoon and it is colder than yesterday.

(2) We will go swimming only if it is sunny.

(3) If we do not go swimming then we will take a canoe trip.

(4) If we take a canoe trip, then we will be home by sunset.

We want to show: t

Proof:

1. $\neg p \wedge q$	Hypothesis
2. $\neg p$	Simplification
3. $r \rightarrow p$	Hypothesis
4. $\neg r$	Modus tollens (step 2 and 3)
5. $\neg r \rightarrow s$	Hypothesis
6. s	Modus ponens (steps 4 and 5)
7. $s \rightarrow t$	Hypothesis
8. t	Modus ponens (steps 6 and 7)

end of proof