

# Propositional Logic

## What is proposition Logic?

- Propositional Letters stand for “basic” propositions
- Combine into more complex sentences using operators **not**, **and**, **or**, **implies**, **iff**

## Propositional connectives:

$\neg$	represents	<b>negation</b>
$\wedge$	represents	<b>conjunction</b>
$\vee$	represents	<b>disjunction</b>
$\rightarrow$	represents	<b>implication</b>
$\leftrightarrow$	represents	<b>bi-implication</b>

$\neg P$  means “not P”

$P \wedge Q$  means “P and Q”

$P \vee Q$  means “P or Q”

$P \rightarrow Q$  means “If P then Q”

$P \leftrightarrow Q$  means “P if and only if Q”

# Propositional Logic: Negation

## $\neg$ : Negation

- used to negate a proposition, has the meaning “NOT”
- if statement P is true, then  $\neg P$  will be false

## Examples:

- If B: “The sky is blue” is **true**, then  $\neg B$  will be “The sky is not blue”, then  $\neg B$  is **false**
- If Q: “Socrates is not bald” is **false**,  $\neg Q$  will be “Socrates is bald”, then  $\neg Q$  is **true**
- If G: “Grass is green” is **true**,  $\neg G$  will be “Grass is not green” , then  $\neg G$  is **false**
- If S: “The car is red” is **true**,  $\neg S$  will be “The car is not red”, then  $\neg S$  is **false**

# Propositional Logic: Conjunction

## $\wedge$ : Conjunction

- used to conjunct two proposition, eg:  $P \wedge Q$ , has the meaning “AND”
- If both P and Q are **true**, then  $P \wedge Q$  will be **true**
- Otherwise,  $P \wedge Q$  will be false

## Examples:

If we let both R = “Grass is green” and S = “Socrates is bald” be **True**

- $R \wedge S$  = “Grass is green **AND** Socrates is bald ”, which will be **true**
- $R \wedge \neg S$  = “Grass is green **AND** Socrates is not bald ”, which will be **false**
- $\neg R \wedge S$  = “Grass is not green **AND** Socrates is bald ”, which will be **false**
- $\neg R \wedge \neg S$  = “Grass is not green **AND** Socrates is not bald ”, which will be **false**

# Propositional Logic: Disjunction

## $\vee$ : Disjunction

- used to disjunct two proposition, eg:  $P \vee Q$ , has the meaning “OR”
- If both  $P$  and  $Q$  are **false**, then  $P \vee Q$  will be **false**
- Otherwise,  $P \vee Q$  will be true

## Examples:

If we let both  $R$  = “Grass is green” and  $S$  = “Socrates is bald” be **True**

- $R \vee S$  = “Grass is green **OR** Socrates is bald ”, which will be **true**
- $R \vee \neg S$  = “Grass is green **OR** Socrates is not bald ”, which will be **true**
- $\neg R \vee S$  = “Grass is not green **OR** Socrates is bald ”, which will be **true**
- $\neg R \vee \neg S$  = “Grass is not green **OR** Socrates is not bald ”, which will be **false**

Quiz Time!