Operators

Propositional Operators

Symbol	Name	Word	Example
¬	Negation	NOT	¬p means "not p"
∧	Conjunction	AND	p ∧ q means "p and q"
∨	Disjunction	OR	p ∨ q means "p or q"
⟶	Implication	IF	p → q means "if p, then q"
⟷	Bi-Implication	IIF	p ↔ q means "p if and only if q"
⊕	Exclusive OR	XOR	p ⊕ q means "either p or q, but not both"

- Operators must be applied according to precedence.
- When two operators conflict, the operator with the lower precedence value is applied first.
- Parenthesis are always applied before operators.

Operator	Precedence
¬	1
∧	2
∨	3
⇒	4
⇔	5
⊕	6

Negation

p	¬p
T	F
F	T

```
p = "The weather is good"

Example expression:
¬p

i.e. "NOT p"

e.g. "The weather is not good."
```

Conjunction

p	q	p ∧ q
T	T	T
T	F	F
F	T	F
F	F	F

```
p = "The sky is clear"
q = "It is warm"

Example expression:
p ∧ q

i.e. "p AND q"

e.g. "The sky is clear and it is warm."
```

Disjunction

p	q	p ∨ q
T	T	T
T	F	T
F	T	T
F	F	F

```
p = "The music is playing"
q = "The guests are talking"

Example expression:
p V q

i.e. "p OR q"

e.g. "The music is playing or the guests are talking"
```

Implication

p	q	p → q
T	T	T
T	F	F
F	T	T
F	F	T

```
p = "It is pouring"
r = "The old man is snoring"

Example expression:
p → r

i.e. "If p, then r."

e.g. "If it is pouring, then the old man is snoring."
```

Bi-Implication

p	q	p ↔ q
T	T	T
T	F	F
F	T	F
F	F	T

```
p = "A triangle has three equal sides"
q = "The triangle is equilateral"

Example expression:
p ⇔ q

i.e. "p IFF q"

e.g. "A trinangle has three equal sides, if and only if the triangle is
equilateral."
```

Exclusive OR

p	q	p ⊕ q
T	T	F
T	F	T
F	T	T
F	F	F

```
p = "The light is green"
q = "The light is red"

Example expression:
p ⊕ q

i.e. "p XOR q"

e.g. "The light is green or the light is red, but not both."
```

Set Operators

Operation	Notation	Definition	Description
Intersection	A ∩ B	{ x : x ∈ A and x ∈ B }	The set of elements shared by A and B.

Operation	Notation	Definition	Description
Union	A ∪ B	{ x : x ∈ A or x ∈ B or both }	Elements of A and B are joined with no duplicates.
Difference	A - B	{ x : x ∈ A and x ∉ B }	Every element shared with B is removed from A.
Symmetric difference	A ⊕ B	{ x : x ∈ A - B or x ∈ B - A }	Union of unshared elements between A and B.
Complement	$\overline{A}$	{ x : x ∉ A }	Every element in the universal set not in A.

Set Assertions

Condition	Notation	Definition	Description
Subset	A ⊆ B	∀x(x ∈ A → x ∈ B)	Every element of A is in B.
Proper Subset	A ⊂ B	∀x(x ∈ A → x ∈ B) ∧ ∃x(x ∈ B ∧ x ∉ A)	Every element of A is in B, but B has more elements.
Not Subset	A ⊄ B	∀x(x ∈ B → x ∉ A)	Every element of A is not in B.