

Tutorial 1 – Propositional Logic

Exercise 1: Write the semantics (i.e., truth table) for the following logical connectives: negation, conjunction, disjunction, implication, equivalence, XOR, NAND, and NOR.

Exercise 2: Formalize into the propositional logic:

- It's raining or it's dark.
- Either the sun is shining, or it's dark.
- If it gets dark, it will be night.
- It's raining, and it's dark outside. This night will not be short.
- If my account balance improves, I'll go for a beer.
- I'll go for a beer only if my account balance improves.
- A natural number is even if and only if it is divisible by two.
- It is not true that two is both even and odd.
- If 6 is even, then it is not a prime number.

Exercise 3: Determine the truth function using a truth table. Decide whether the formula is satisfiable, a tautology, or a contradiction. If the formula is satisfiable, determine all its models.

- $(p \wedge \neg q) \supset (\neg p \supset (q \vee p))$
- $[(p \vee \neg q) \wedge \neg(p \wedge q)] \supset (\neg p \vee q)$
- $(p \supset q) \equiv (p \wedge \neg q)$
- $(p \supset q) \equiv (\neg q \supset \neg p)$
- $[(p \vee \neg(p \wedge q)) \supset (\neg p \vee q \vee p)] \supset (p \equiv q)$



Exercise 4:

Formalize and decide, using a truth table, whether the argument is valid (i.e., for every evaluation where the premises are true, the conclusion is also true):

- If I can choose, then I will choose the iPhone.
I can choose.

I'll choose the iPhone.

- If I can choose, I'll choose iPhone.
I can't choose.

I don't choose iPhone.

- If I can choose, I'll choose the iPhone.
I can't choose.

I'll get a Huawei.

- d) Either I'll play football, or I'll play the piano.
I won't play the piano.

I'll play football.

- e) The sun is not shining, or I'm wearing sunglasses.
The sun's not shining.

I don't wear sunglasses.

- f) He's either in class or hanging around the school.
If he's in class, he's a model student.

If he's not a model student, then he's wandering around the school.

- g) It is not true that the student knows both Java and C++. The student doesn't know Java.

The student doesn't know C++.

- h) The sun is shining, and it's raining.
It's not raining.

I'm drinking beer.