



## Task 1: Check reasoning in propositional logic

**Individual variant:** Scheme of reasoning according to the student number

### Subtasks:

- 1) Compose a single formula in Boolean algebra to check reasoning via proving that the formula is tautology
- 2) Compose a truth table
- 3) Use algebraic transformations of formula to prove that it is a tautology. Otherwise compare remaining terms with zeroes of the truth table.
- 4) Check whether the formula is a tautology using Z3 online.
- 5) Offer a few verbal interpretations for the given reasoning scheme.
- 6) Provide final conclusions.

**Optional study:** resolution reasoning.

### Directions:

- Composing a formula on a given scheme of inference, represent it in the form of: conjunction of all premises, implication of the conclusion.
- Composing the truth table create columns for each Boolean operation in the formula following the operation priorities.
- For algebraic transformations, rewrite the formula for each applied law of Boolean algebra; provide an explicit reference to the corresponding law (with its general pattern written on margins).
- Using examples in supplemental materials, transform the formula into prefix notation for inputting into Z3.
- To prove tautology with Z3, we prove contradiction (unsatisfiability) of the formula negation.
- For incorrect reasoning (satisfiability of the formula negation), ask for a model, and compare the model with zeroes of the truth table and remaining terms of equivalent transformations.

**Questions to muse:** How to use Z3 to generate all models (in case of incorrect reasoning)

**Supplemental materials:** Overview of propositional logic

**Task variants:** in the end of Overview of propositional logic

