

# Guideline

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Homework for week 02. Due: 23h59 on Thursday, 2023-09-14.

Please submit your solutions in a single PDF on Brightspace.

Typewriting is preferred; If you're writing by hand, please ensure your handwriting is legible.

Multiple submissions are possible before the due time; the last submission will be graded.

## Exercise 1 (points = 10)

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Prove that the following are equivalent using truth tables:

### 1. Distributive Law

- $p \wedge (q \vee r)$
- $(p \wedge q) \vee (p \wedge r)$

### 2. Absorption Law

- $p \vee (p \wedge q)$
- $p$

## Exercise 2 (score = 20)

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Determine whether the arguments below are valid. Explanation is needed based on the truth table.

(1)

- premises:  $p \rightarrow q$ ,  $q$
- conclusion:  $p$

(2)

- premises:  $p \rightarrow q$ ,  $\sim p$
- conclusion:  $\sim q$

(3)

- premises:  $p \rightarrow q$ ,  $p$
- conclusion:  $q$

(4)

- premises:  $p \rightarrow q$ ,  $\sim q$
- conclusion:  $\sim p$

## Exercise 3 (score = 10)

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Prove the two statement forms below are logically equivalent using equivalence laws only. State at each step the law used. Be patient because it may involve much calculation.

- $(p \rightarrow q) \wedge (q \rightarrow r) \wedge (r \rightarrow p)$
- $(\sim p \wedge \sim q \wedge \sim r) \vee (p \wedge q \wedge r)$

## Exercise 4 (score = 60)

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Use truth tables to determine whether the arguments below are valid. Explanation is needed (e.g. based on the truth table).

(1)

- Premises:  $p \rightarrow q, \sim p \rightarrow \sim q$
- Conclusion:  $p \vee q$

(2)

- Premises:  $p \vee q, p \rightarrow \sim q, \sim r \rightarrow \sim p$
- Conclusion:  $r$

(3)

- Premises:  $p, \sim q \rightarrow \sim p, \sim q \vee r$
- Conclusion  $r$

(4)

- Premises:  $p \wedge q \rightarrow \sim r, p \vee \sim q, \sim q \rightarrow p$
- Conclusion:  $\sim r$

(5)

- Premises:  $p \rightarrow r, q \rightarrow r$
- Conclusion:  $(p \vee q) \rightarrow r$

(6)

- Premises:  $p \rightarrow (q \vee r), \sim q \vee \sim r$
- Conclusion:  $\sim p \vee \sim r$