
CS 245 Midterm Exam

Spring 2004, Instructor: P. van Beek

Thursday, June 10, 4:30pm-6:30pm, MC 4042 and MC 4061

INSTRUCTIONS

- No books, no notes, no computers, no calculators.
- Time limit: 2 hours
- Write the exam that has your name on it.
- Explain your answers.
- This exam has 11 pages (including this cover page).
Check that your exam is complete.

Question	Mark	Max	Marker
1		10	
2		10	
3		10	
4		10	
5		10	
6		10	
7		10	
8		10	
9		10	
10		10	
Total		100	

1 (10 Marks) Short Answer

Explain your answers.

- What does $p_1, p_2, \dots, p_n \vdash q$ mean?
- Can we prove that a propositional logic formula p is a contradiction using a transformational proof? If not, why not? If yes, what would we prove about formula p ?
- If a formula p is consistent, is it possible for $\neg p$ to be a tautology?

2 (10 Marks) Propositional Logic: Formalization

Formalize the following sentences in propositional logic. Show the English phrase that each prime proposition represents.

(a) We will go skydiving even though there are strong winds.

(b) We will go snowboarding or skiing only if it doesn't rain the night before.

(c) If the weather is warm we will go for a walk and if the weather is not warm we won't go for a walk.

3 (10 Marks) Propositional Logic: Logical Implication

Answer this question using a truth table and explain your answer.
Do the premises logically imply the conclusion?

$$A \vee \neg B, A \Rightarrow C \quad \models \quad B \Rightarrow C$$

4 (10 Marks) Propositional Logic: Transformational Proof

Prove the following using transformational proof:

$$\neg(A \Rightarrow (\neg C \wedge (A \Rightarrow C))) \iff A$$

[illegible]

5 (10 Marks) Propositional Logic: Natural deduction

Answer this question by giving a natural deduction proof. Do not use any logical laws from transformational proof in your natural deduction proof.

Given $p \wedge q, p \Rightarrow r, (p \wedge r) \Rightarrow s$, show $q \wedge s$ using natural deduction.

6 (10 Marks) Propositional Logic: Natural Deduction

Answer this question by giving a natural deduction proof. Do not use any logical laws from transformational proof in your natural deduction proof.

Given $\neg p \Rightarrow q, p \Rightarrow r$, show $q \vee r$ using natural deduction.

7 (10 Marks) Propositional Logic: Semantic Tableaux

Using a semantic tableaux, show whether the following set of formulas is consistent. Explain.

$$p \wedge (r \Rightarrow q), \neg q \Rightarrow \neg p, q \Rightarrow \neg r$$

8 (10 Marks) Propositional Logic: Semantic Tableaux

Answer this question by giving a semantic tableaux proof. Do not use any logical laws from transformational proof in your semantic tableaux proof.

Given $\neg p \vee (q \Rightarrow \neg r)$, p , show $\neg q \vee \neg r$ using semantic tableaux.

9 (10 Marks) Predicate Logic: Formalization

Formalize the following sentences in predicate logic. Be sure to give the intended meaning of each of the constants and predicates that you use. Do not use types in your answer.

(a) All paranoids are disliked by everyone.

(b) No one likes anyone who does not like them.

(c) Every paranoid is afraid of everyone except their friends.

10 (10 Marks) Predicate Logic: Interpretations

Show that the following argument is invalid by providing a counter example. Explain.

$$\forall x \bullet p(x) \Rightarrow q(x) \quad \vdash \quad \exists x \bullet p(x) \wedge q(x)$$