

MATH/EECS 1028 First test practice problems
Winter 2018

1. Propositional Logic.

- (a) Construct a truth table for the implication $p \rightarrow \neg q$
- (b) Let p be the proposition “You have the flu”, q be the proposition “You miss the final examination” and r be the proposition “You pass the course”. Express the following as an English sentence: $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$.
- (c) Let p be the proposition “You get an A on the final exam”, q be the proposition “You do every exercise in the book” and r be the proposition “You get an A in this course”. Write down the following using p, q and r and logical connectives (including negations): “Getting an A on the final and doing every exercise in the book is sufficient for getting an A in this class”.

2. Propositional equivalences

- (a) Use truth tables to verify the absorption law: $p \vee (p \wedge q) \equiv p$
- (b) Show that $p \leftrightarrow q$ and $(p \wedge q) \vee (\neg p \wedge \neg q)$ are logically equivalent.

3. Inference.

- (a) For the following premises, what relevant conclusion(s) can be drawn? Explain the rules of inference used to obtain each conclusion.
 - 1. I am either dreaming or hallucinating.
 - 2. I am not dreaming.
 - 3. If I am hallucinating, I see elephants running down the road.

4. Sets

- (a) Construct Venn diagrams for each of these combinations of the sets A, B, C .
 - (i) $A \cap (B \cup C)$ (ii) $\overline{A} \cap \overline{B} \cap \overline{C}$
- (b) Recall that the power set of a set A is the set of all subsets of A . Show that if A is a subset of B then the power set of A is a subset of the power set of B .

5. Find the sum $1*2+2*3+3*4+\dots+99*100$.

6. A fly starts at the origin and goes 1 unit up, $1/2$ unit right, $1/4$ unit down, $1/8$ unit left, $1/16$ unit up, etc., ad infinitum. In what coordinates does it end up?

7. Suppose that $\log_4 x = y$ where x is a positive real number. What is $\log_{16} x$ in terms of y ?

8. Functions: define a function f from $\mathbb{Z} \times \mathbb{Z} \rightarrow \mathbb{Z}$ as $f(m, n) = m^2 - n^2$. Is this function onto? Prove your answer.