
CS:1010 DISCRETE STRUCTURES

ASSIGNMENT 1

Instructions

- Answer all the questions.
 - Please submit a PDF file preferably compiled using a LaTeX editor.
 - Max marks: 10, Due date: January 22, 2021
- (1) We have discussed in class that the Continuum Hypothesis is an example of a theorem that can neither be proved nor disproved using ZFC axioms. Can you give another example of a result that can neither be proved nor disproved using ZFC axioms. Please explain the result (not the proof) in your own words and provide details (like an example or a counterexample) that gives an intuition on why ZFC axioms won't help. (2 marks)
- (2) Show that n lines separate a plane into $(n^2+n+2)/2$ regions if no two lines are parallel and no three pass through a common point. (See figure for example). (3 marks)

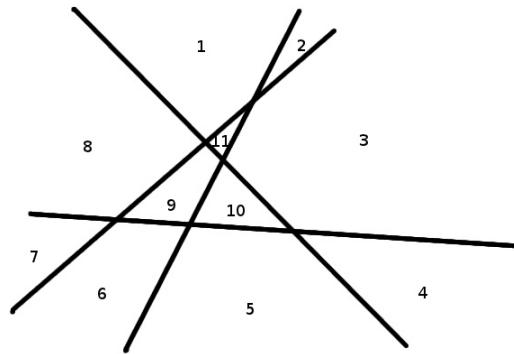


FIGURE 0.1. plane divided into 11 regions for $n = 4$

- (3) Do you think the following argument is valid?
- “If Superman were able and willing to prevent evil, he would do so. If Superman were unable to prevent evil, he would be impotent. If he were unwilling to prevent evil, he would be malevolent. Superman does not prevent evil. If Superman exists, he is neither impotent nor malevolent. Therefore, Superman does not exist.”

State which rules of inference you use, and use p, q, r variables to verify your claim. (3 marks)

- (4) You are given the following (all letters are logical propositions):

$$(t \rightarrow (r \vee p)) \rightarrow ((\neg r \vee k) \wedge \neg k)$$

Prove that this implies $\neg r$. Write down a proof using inference rules. Derive inference rules from tautologies as needed. (2 marks)