Computing and Software 701

Logic and Discrete Mathematics In Software Engineering

Fall 2004

Exercise Group 3

Due November 4, 2004

Revised: 20 October 2004

Justify your answers in each of the following exercises.

1. [5 pts.] Exercise 4 on p. 100 of Grimaldi.
2. [4 pts.] Exercise 8 on p. 101 of Grimaldi.
3. [4 pts.] Exercise 18 on p. 102 of Grimaldi.
4. [3 pts.] Exercise 20 on p. 103 of Grimaldi.
5. [4 pts.] Exercise 24 on p. 103 of Grimaldi.
6. [4 pts.] Exercise 8 on p. 116 of Grimaldi.
7. [5 pts.] Exercise 10 on pp. 116–7 of Grimaldi.
8. [4 pts.] Exercise 14 on p. 117 of Grimaldi.
9. [4 pts.] Exercise 24 on p. 117 of Grimaldi.
10. Formalize the following theories in FOL:
    (a) [4 pts.] The theory of graphs (N, E) where N is a set of nodes and $E \subseteq N \times N$ is a set of edges between nodes.
    (b) [4 pts.] The theory of bipartite graphs (B, R, E) where B is a set of blue nodes, R is a set of red nodes, and $E \subseteq B \times R$ is a set of edges between blue and red nodes.

11. [4 pts.] Define what it means for a formula of FOL to be in *prenex normal form*. Let L be a language of FOL. Write an algorithm that, given a formula A of L as input, returns a formula A' as output such that A' is in prenex normal form and $A \Leftrightarrow A'$ is valid.

12. [6 pts.] Use the compactness theorem for FOL to show that every FOL theory that has arbitrarily large finite models has an infinite model. Is there an FOL theory of all finite models for a language L?