

Theory (40 marks)

Each group should choose one of the following topics:

1. Develop a polynomial algorithm for Horn clause reasoning, and analyze the detailed time and space complexity. (easy)
2. Show that any arbitrary propositional formula can be equivalently transformed into a 3CNF formula in polynomial time by allowing auxiliary variables. (easy)
3. Show that the transitive closure problem cannot be represented in classical first-order logic.
4. Translate the proposed 20 math questions into their formal representations.
5. Embed first-order logic and proposed probabilistic logic into assertional logic.

Practice (40 marks)

Each group should choose one of the following topics:

1. Randomly generate 10000 3CNF formulas with 50 variables whose number of clauses vary. Use MINISAT to check whether they are SAT or UNSAT. Illustrate the phase transition phenomenon. Construct their corresponding extended implication graph and find the longest cycle in it. Consider the connections between the formula's satisfiability and the length of the longest cycle in its corresponding extended

implication graph.

2. Implement the stable model semantics, and show at least 10 case studies.
3. Solve the proposed 20 math questions automatically by machines.
4. Implement the MCMC algorithm for Markov logic network, and show at least 10 case studies.
5. Solve the proposed 100 sequence IQ test questions automatically by using symbolic approaches.
6. Implement the TransE algorithm for knowledge base completion, show how it really works.
7. Implement a robot exploration and navigation system by using Markov decision process.
8. Implement a simple semantic parser, and show at least 10 case studies.