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12SCS21

Second Semester M.Tech. Degree Examination, June/July 2014
Formal Models in Computer Science

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Use 7, $\rightarrow$, $\wedge$ and $\vee$ to express the following declarative sentences in propositional logic, in each state what are your respective propositional atoms P, Q etc.:
   i) My sister wants a white and black cat.
   ii) Today it will rain or shine, but not both. **(06 Marks)**

   b. Prove $(p \wedge q) \rightarrow r, r \rightarrow s, q \wedge \neg s \vdash \neg p$ is valid. **(07 Marks)**

   c. Show $(P \wedge Q) \vee (P \wedge \neg Q) \equiv P$ (Note: $\neg$ is negation). **(07 Marks)**

2 a. Use mathematical induction to show that $1 + 2 + \ldots\ldots n = n(n + 1) / 2$ for all natural numbers $n \geq 1$ and also comment with respect to propositional logic. **(08 Marks)**

   b. State HORN formula of propositional logic and also prove
   $(p \wedge q \wedge w \rightarrow \perp) \wedge (t \rightarrow \perp) \wedge (r \rightarrow p) \wedge (T \rightarrow r) \wedge (T \rightarrow q) \wedge (u \rightarrow s) \wedge (t \rightarrow u)$. **(12 Marks)**

3 a. Find appropriate predicate and their specification to translate the following into predicate logic:
   i) All red things are in the box.
   ii) Only red things are in the box.
   iii) No animal in both a cat and a dog.
   iv) Evenry prize was won by a boy.
   v) A boy won every prize. **(10 Marks)**

   b. Write proof rules universal quantification in brief. **(03 Marks)**

   c. Write the parse tree of a predicate logic formula and illustrate free and bound occurrences of variables and also use the substitution to solve the $(\forall x\ (P(x) \wedge Q(x))) \rightarrow (\neg\ P(x) \vee Q(y)))$ (Note: $\neg$ is negation). **(07 Marks)**

4 a. Explain the terms mode, term backus Naur, modes Tollens and modus proties. **(05 Marks)**

   b. Prove the validity of the following sequent's in predicate logic, where F, G, P and Q have arity 1, and S has arity 0 (a 'propositional atom'):
   $\forall x\ (P(x) \wedge Q(x)) \vdash \forall x\ P(x) \wedge \forall x\ Q(x)$. **(10 Marks)**

   c. Write short note on alloy and micro models of software. **(05 Marks)**

5 a. Explain linear-time temporal logic and syntax of LTL. **(05 Marks)**

   b. Explain synchronous and asynchronous of mutual exclusion using SMV and NUSMV with help of a suitable code. **(10 Marks)**

   c. Write the parse trees for the LTL formulas
   $Fp \wedge Gq \rightarrow pWr$
   $F(p \rightarrow Gr) \vee \neg\ qUp$
   Note: ($\neg$ is negation). **(05 Marks)**

6 a. Discuss the important equivalences between CTL formulas. **(06 Marks)**

b. What is CTL? Give syntax. **(08 Marks)**

c. Explain CTL mode-checking algorithm with help of pseudo-code. **(06 Marks)**

7 a. Why should we verify and specify, convert the informal description R of requirements of an application domain into an equivalent formula ϕ_R of some symbolic logic. **(08 Marks)**

b. Define Hoare Triples. **(05 Marks)**

c. Show that $\vdash_{par} \{y = 5\}\ x = y + 1\ \{x = 6\}$ is valid using proof rule for assignment and implication on required. **(07 Marks)**

8 a. Why is Z-notation important? Discuss different aspects and benefits. **(05 Marks)**

b. What is schema? Explain the structure of schema, its various forms; its uses declaration etc with specific examples. **(10 Marks)**

c. Give the syntax of qualified expressions in the z-notation. **(05 Marks)**

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