National University of Computer and Emerging Sciences

Discrete Structure (CS1005)

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Course Instructor(s)

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Sessional-I Exam

Total Time: 1 Hours

Total Points: 24

Total Questions: 02

Semester: SP-2024

Campus: Karachi

Dept: Computer Science

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Student Name   Roll No   Section   Student Signature

CLO # 3: Solving computing problems with formal specification and verification in Discrete structure.

Q1: [6*2=12]

a. Let p, q, and r be the propositions:

P: AI builds systems that do intelligent things.   q: ML builds system that learns from experience.

r: NLP builds systems to understand languages.

Write the following propositions using p, q and r and logical connectives (including negation).

  i. It is not the case that NLP does not build systems to understand languages but AI build system that do intelligent things.

  ii. If AI builds systems that do intelligent things, then neither NLP builds systems to understand languages nor ML builds systems that learn from experience.

  iii. ML builds systems that learn from experience unless AI does not build systems that do not do intelligent things.

  iv. NLP builds systems to understand languages iff AI builds systems that do intelligent things.

b. Write the negation of the logical statement (i) and (iii) from part (a).

c. Write inverse of the statement (ii) and contrapositive of statement (iii) from part (a) in English.

d. Determine using truth table that the hypothetical syllogism rule forms tautology, contradiction, or contingency.

e. Using rules of inference, show that the following argument is valid.

$$\left(\left(\neg q \to (s \to \neg r)\right) \wedge (\neg t \to s) \wedge (\neg q \vee p) \wedge (\neg p)\right) \to (r \to t)$$

f. Prove the following logical equivalence using the laws of logics:

$$\left((a \vee b) \wedge (a \to c)\right) \to (b \vee c) \equiv T$$

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CLO # 2: Construct formal logic, proofs and/ or informal for solving problems in discrete structure.

Q2: [6*2=12]

a. Let P(x) means "x is a process", I(x) mean "x generates interrupt", and A(x) mean "x needs API" and domain consists of operating systems process.
Translate the following English statement into logical expression.
    i.   Some processes which generate interrupt need API.

Translate the following quantifier expression into English.

    ii. $\forall x \left(\left(P(x) \wedge A(x) \right) \rightarrow \neg I(x) \right)$

b. Each student in Liberal Arts at some college has a mathematics requirement A and a science requirement B. A poll of 140 sophomore students shows that 60 completed A, 45 completed B and 20 completed both A and B.
Determine the number of students who have completed neither A nor B.

c. Let $A = \{a, b, c\}, B = \{x, y, z\}, C = \{r, s, t\}$. Let $f: A \rightarrow B$ and $g: B \rightarrow C$ be defined by:
$f = \{(a, y), (b, x), (c, y)\}$ and $g = \{(x, s), (y, t), (z, r)\}$.

Find $f \circ g$ and $g \circ f$, if it does not exist, give reason.

d. If $f \circ g$ or $g \circ f$ exists then find is it invertible or not, give reason.

e. Prove or disprove by contradiction that, let $n \in \mathbb{Z}$. If $n^2 - 6n + 5$ is even, then n is odd.

f. Prove using mathematical induction that for all integers $n \geq 1$,
$$\frac{1}{1.2} + \frac{1}{2.3} + \cdots + \frac{1}{n \cdot (n+1)} = \frac{n}{n+1}$$

Good Luck!