Logic in computer science
4th quiz

2023. November 21. (Tuesday) 12:00
INBPA0101G-02

Result:
90%
9 / 10

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Name: _____

The test consists of **2 questions**. The available time to solve the quiz is **20 minutes**. Please use a blue coloured pen; the use of any other tools is forbidden.

	a	b	c	d	e	f	g
1.)	☐	☐	☐	☐	☐	☐	☐
2.)	☐	☐	☐	☐	☐	☐	☐

Please copy the multiple choice questions' solution in the attached table. For each correct answer marked, 2 points are awarded; for each incorrect answer marked, -1 point is awarded. There is no limit to the number of correct answers per question. A negative aggregate score will be interpreted as 0 points.

1.) Let $L^{(1)} = \langle LC, Var, (\mathcal{P}(1) \cup \mathcal{P}(2) \cup \mathcal{F}(0) \cup \mathcal{F}(2)), Term, Form \rangle$ be a first-order language so that

$$Var = \{ x_i \,|\, i \in \mathbb{N} \}, \quad \mathcal{P}(1) = \{ P \}, \quad \mathcal{P}(2) = \{ Q \}, \quad \mathcal{F}(0) = \{ c \}, \quad \mathcal{F}(2) = \{ f \}.$$

Which string of symbols are terms or formulas of the language $L^{(1)}$. Select the correct statements.

2 A term of the language $L^{(1)}$ is: $f(f(x_1, x_1), x_2)$

(b) A term of the language $L^{(1)}$ is: $Q(x_1, x_2)$

(c) A term of the language $L^{(1)}$ is: P

(d) A formula of the language $L^{(1)}$ is: $\exists c Q(c, c)$

(e) A formula of the language $L^{(1)}$ is: $\forall x_1 \neg (P(x_1) = c)$

2 A formula of the language $L^{(1)}$ is: $\neg \exists x_1 Q(x_1, c)$

-1 A formula of the language $L^{(1)}$ is: $(x_3 \equiv c)$

2.) Let $L^{(1)}$ be a first-order language defined as follows:

$$L^{(1)} = \langle LC, \{x_1, x_2, \ldots\}, \{P, Q, c\}, Term, Form\rangle$$
$$P \in \mathcal{P}(1), \qquad Q \in \mathcal{P}(2), \qquad c \in \mathcal{F}(0).$$

Let $\langle U, \varrho\rangle$ az $L^{(1)}$ be an interpretation of the language, so that:

- $U = \{u_1, u_2, u_3\}$
- $\varrho(P) = P' \qquad P'(x) = \begin{cases} 1 & \text{if } x = u_1 \\ 0 & \text{otherwise} \end{cases}$
- $\varrho(Q) = Q' \qquad Q'(x, y) = \begin{cases} 1 & \text{if } x = u_1 \text{ and } y = u_1 \\ 0 & \text{otherwise} \end{cases}$
- $\varrho(c) = u_2$

Let v be an assignment relying on the interpretation, so that $v : Var \to U$ and

$$v(x_1) = u_3, \qquad v(x_2) = u_1$$

Which of the formulas below are true?

(a) $|\neg Q(x_2, x_2)|_v^{\langle U,\varrho\rangle}$

(b) $|((c = c) \supset (x_2 = x_1))|_v^{\langle U,\varrho\rangle}$

2 $|\neg P(x_1)|_v^{\langle U,\varrho\rangle}$

(d) $|(P(x_2) \supset Q(x_1, x_2))|_v^{\langle U,\varrho\rangle}$

2 $|(Q(c, c) \equiv P(x_1))|_v^{\langle U,\varrho\rangle}$

2 $|\neg(P(x_1) \vee P(c))|_v^{\langle U,\varrho\rangle}$

(g) $|(\neg P(x_1) \wedge P(c))|_v^{\langle U,\varrho\rangle}$