

TT1-Q2

Monday, February 8, 2021

6:18 PM



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Aids Allowed: Your *own notes* taken during lectures and office hours, the lecture *slides and recordings* (for all sections), and the *Course Notes* (textbook).

Submission Instructions

- Submit your work directly on [MarkUs](#)—even if you are late!
- You may type your answers or hand-write them *legibly*, on paper or using a tablet and stylus.
- You may write your answers directly on the question paper, or on another piece of paper/document.
- You may submit your answers as a single document or as multiple documents.
- You may name your file(s) any way you want (there is no “required file”).
- You must submit your answers in PDF or as photos (JPEG/JPG/GIF/PNG/HEIC/HEIF).
Other formats (e.g., Word documents, L^AT_EX source files) **are NOT accepted**—you must **export** or **compile** documents to PDF, and **convert** images into a supported format.

2. [10 marks] **Translations.** Let P be the set of all people and C be the set of all courses, and suppose we define the following predicates:

- $Enrolled(s, c)$: “ s is enrolled in course c ”, where $s \in P$ and $c \in C$.
- $Teaches(p, s)$: “ p teaches s ”, where $p \in P$ and $s \in P$ ($Teaches(x, y)$ is *not* the same as $Teaches(y, x)$).

Translate each of the following statements into predicate logic. No explanation is necessary. *Do not define any of your own predicates or sets, and use only the quantifiers and propositional operators from class.* You may use $=$ and \neq to compare whether two people or courses are the same.

- (a) [2 marks] There is exactly one person who teaches everyone.

$$\exists p \in P, \forall s \in P, Teaches(p, s) \wedge \forall p_0 \in P, Teaches(p_0, s) \Rightarrow p = p_0$$

- (b) [2 marks] Everyone who doesn't teach anybody is enrolled in a course.

$$\forall p \in P, \forall s \in P, \neg Teaches(p, s) \Rightarrow \exists c \in C, Enrolled(p, c)$$

- (c) [2 marks] Some student takes every course.

$$\exists s \in P, \forall c \in C, Enrolled(s, c)$$

- (d) [2 marks] Everyone teaches themselves and at least one other person.

$$\forall p \in P, Teaches(p, p) \wedge \exists s \in P, Teaches(p, s)$$

- (e) [2 marks] There is a course with exactly two people enrolled.

$$\exists c \in C, \exists s, p \in P, (Enrolled(s, c) \wedge Enrolled(p, c)) \wedge \forall s_0, p_0 \in P, \\ (Enrolled(s_0, c) \wedge Enrolled(p_0, c)) \Rightarrow s = s_0 \wedge p = p_0$$

Don't forget: there are two more questions in this test, in separate documents!