

2020 Spring Artificial Intelligence, HW-2

제출일: 5 월 10 일 11:59 p.m. AjouBb 를 통해 제출 할 것

1. Transform the following sentence into predicate formula with giving your ontology. (5 Points).

- 1) Some students took French in spring 2015.
- 2) Every student who takes French passes it.
- 3) Only one student took Greek in spring 2015.
- 4) All Germans speak the same languages.
- 5) There was a spy who took Greek in spring 2015.

(Solution)

Ontology

Constant symbols: English, French, German, Greek Spring-2015

Predicate symbols

Take-in(x, y, z): x takes course y in z .

Pass-in(x, y, z): x passes y in z .

Speak(x, y): x speaks language y .

Higher-than(x, y): x is higher than y .

Student(x): x is a student.

German(x) x is a German.

Spy(x): x is a spy

- 1) $\exists x \text{ Student}(x) \wedge \text{Take-in}(x, \text{English}, \text{Spring-2015})$
- 2) $\forall x, y \text{ Student}(x) \wedge \text{Take-in}(x, \text{English}, y) \Rightarrow \text{Pass-in}(x, \text{English}, y)$
- 3) $\exists x \text{ Student}(x) \wedge \text{Take-in}(x, \text{French}, \text{Spring-2015}) \wedge$
 $(\forall y (\text{Student}(y) \wedge \text{Take-in}(y, \text{French}, \text{Spring-2015})) \Rightarrow y=x)$
- 4) $\forall x, y \text{ German}(x) \wedge \text{Speak}(x, y) \Rightarrow (\forall z \text{ German}(z) \Rightarrow \text{Speak}(z, y))$ or
 $\forall x, y, z \text{ German}(x) \wedge \text{Speak}(x, y) \wedge \text{German}(z) \Rightarrow \text{Speak}(z, y)$
- 5) $\exists x \text{ Spy}(x) \wedge \text{Take-in}(x, \text{Greek}, \text{Spring-2015})$

2. Read the following paragraph and answer the questions.

Every man does not hit a woman whom he marries. John and Bill are

men and Mary is a woman. Mary marries either John or Bill. Bill hit Mary. Does Mary marries John?

- a) Represent the above sentences into FOL (First Order Logic) formulas with defining your ontology. (4 Points)
- b) In order to give the correct answer, if you need additional knowledge give the additional FOL formulas. And write the question (answer) into FOL formula (2 Points).
- c) Prove the answer is true by the refutation-resolution. (4 Points)

(Solution)

a) Ontology:

Constants: John, Bill, Mary

Predicates: $\text{man}(x)$; x is a man.

$\text{woman}(x)$; x is a woman.

$\text{marries}(x,y)$; x is marries with y.

$\text{hits}(x,y)$; x hits y.

formulas:

$\text{man}(\text{John}) \text{ man}(\text{Bill}) \text{ woman}(\text{Mary})$

$\forall x \forall y \text{ man}(x) \wedge \text{woman}(y) \wedge \text{marries}(x,y) \Rightarrow \neg \text{hits}(x,y)$

$\text{marriess}(\text{John}, \text{Mary}) \vee \text{marriess}(\text{Bill}, \text{Mary})$

$\text{hits}(\text{Bill}, \text{Mary})$

b) Additional knowledge: $\forall x \forall y \text{ marries}(x,y) \Rightarrow \text{marries}(y,x)$

Query: $\text{marries}(\text{Mary}, \text{John})$

c) Transform to CNF

$\text{man}(\text{John})_1 \text{ man}(\text{Bill})_2 \text{ woman}(\text{Mary})_3$

$\neg \text{man}(x) \vee \neg \text{woman}(y) \vee \neg \text{marries}(x,y) \vee \neg \text{hits}(x,y)_4$

$\text{marries}(\text{John}, \text{Mary}) \vee \text{marries}(\text{Bill}, \text{Mary})_5$

$\text{hits}(\text{Bill}, \text{Mary})_6$

$\neg \text{marries}(s,t) \vee \text{marries}(t,s)_7$; Renaming is required.

Refute the query: $\neg \text{marries}(\text{Mary}, \text{John})_8$

Resolution(2, 4): $\neg \text{woman}(y) \vee \neg \text{marries}(\text{Bill}, y) \vee \neg \text{hits}(\text{Bill}, y)_9$

Resolution(3, 9): $\neg \text{marries}(\text{Bill}, \text{Mary}) \vee \neg \text{hits}(\text{Bill}, \text{Mary})_{10}$

Resolution(6, 10): $\neg \text{marries}(\text{Bill}, \text{Mary})_{11}$

Resolution(5, 11): $\text{marries}(\text{John}, \text{Mary})_{12}$

Resolution(7, 12): $\text{marries}(\text{Mary}, \text{John})_{13}$

Resolution(8, 13): $\{\}$