MCS 380/590 Intro To Artificial Intelligence
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Homework Assignment Solutions #5
Artificial Intelligence (Russell / Norvig)

7.2 There are other possible answers to this problem. These are just one example of each given the following vocabulary:

$Takes(x, c)$	student x takes course c;
$Fails(x, c)$	student x fails course c;
$Score(x, c)$	the score obtained by student x in course c;
H	a specific history course;
B	a specific biology course;
$Dislikes(x, y)$	person x dislikes person y
$Shaves(x, y)$	person x shaves person y
$Man(x), Woman(x), \ldots$	predicates satisfied by members of the corresponding categories.
$Fools(x, y, t)$	person x fools person y at time t.

7.2a Not all students take both History and Biology.

$$\neg\forall\, x\;\; Student(x) \Rightarrow (Takes(x, H)\;\wedge\; Takes(x, B))$$

7.2b Only one student failed History.

$$\exists\, x\;\; Student(x) \wedge Fails(x, H) \wedge \forall\, y\;\; Student(y) \wedge Fails(x, H) \Rightarrow x = y$$

7.2c Only one student failed both History and Biology.

$$\exists\, x\;\; Student(x) \wedge Fails(x, H) \wedge Fails(x, B) \wedge \forall\, y\;\; Student(y) \wedge Fails(x, H) \wedge Fails(x, B) \Rightarrow x = y$$

7.2d The best score in History was better than the best score in Biology.

$$\exists\, x\;\; \forall\, y\;\; Score(x, H) > Score(y, B)$$

7.2e Every person who dislike all vegetarians is smart.

$$\forall\, x\;\; Person(x)\;\wedge\;(\forall\, y\;\; Vegetarian(y) \Rightarrow Dislikes(x, y)) \Rightarrow Smart(x)$$

7.2f No person likes a smart vegetarian.

$$\forall\, x, y \;\; Person(x) \;\wedge\; Smart(y) \;\wedge\; Vegetarian(y) \Rightarrow \neg Likes(x, y)$$

7.2g There is a woman who likes all men who are not vegetarians.

$$\exists\, x \;\; Woman(x) \;\wedge\; \forall\, y \;\; Man(y) \;\wedge\; \neg Vegetarian(y) \Rightarrow Likes(x, y)$$

7.2h There is a barber who shaves all men in town who do not shave themselves.

$$\exists\, x \;\; Barber(x) \;\wedge\; \forall\, y \;\; Man(y) \;\wedge\; \neg Shaves(y, y) \Rightarrow Shaves(x, y)$$

7.2i No person likes a professor unless the professor is smart.

$$\forall\, x, y \;\; Person(x) \;\wedge\; Professor(y) \;\wedge\; \neg Smart(y) \Rightarrow \neg Likes(x, y)$$

7.2j Politicians can fool some of the people all of the time, and they can fool all of the people some of the time, but they can't fool all of the people all of the time.

$$\forall\, x \;\; Politician(x) \Rightarrow (\exists\, y \;\; \forall\, t \;\; Person(y) \wedge Fools(x, y, t)) \wedge (\exists\, t \;\; \forall\, y \;\; Person(y) \Rightarrow Fools(x, y, t)) \;\wedge\; \neg(\forall\, t \;\; \forall\, y \;\; Person(y) \Rightarrow Fools(x, y, t))$$

7.3a One more outburst like that and you'll be in contempt of court.

Intended: $Outburst \Rightarrow Contempt$
Straight: $Outburst \;\wedge\; Contempt$
Consequence: $Contempt(regardlessofOutburst)$

7.3b Annie Hall is on TV tonight, if you're interested.

Intended: $AnnieHallOn \;\wedge\; (Interested \Rightarrow CanWatch)$
Straight: $Interested \Rightarrow AnnieHallOn$

7.3c Either the Red Sox win or I'm out ten dollars.

Intended: $Prevent(RedSoxWin, OutTenDollars)$
Straight: $RedSoxWin \lor OutTenDollars$

7.3d The special this morning is ham and eggs

Intended: $Special(Combination(Ham, Eggs)$
Straight: $Special(Ham \land Eggs)$

7.3e Maybe I'll come to the party and maybe I won't

Intended: $Undecided(I, Come(I, Party))$
Straight: $Maybe(Come(I, Party)) \land Maybe(Not(Come(I, Party)))$

7.3f Well, I like Sandy and I don't like Sandy.

Intended: $\exists\, way_1, way_2\ Like(I, Sandy, way_1 \land \neg Like(I, Sandy, way_2)$
Straight: $Like(I, Sandy) \land \neg(I, Sandy)$

7.3g I don't jump off the Empire State Building implies if I jump off the Empire State Building then I float safely to the ground.

Intended: $\neg Do(Jump) \Rightarrow Cause(Jump, Float)$
Straight: $\neg Jump \Rightarrow (Jump \Rightarrow Float)$

7.3h It is not the case that if you attempt this exercise you will get an F. Therefore you will attempt this exercise.

Intended: $\neg Do(Jump) \Rightarrow Cause(Jump, Float)$
Straight: $\neg Jump \Rightarrow (Jump \Rightarrow Float)$

7.3i If you lived here you would be home now. If you were home now, you would not be here. Therefore, if you lived here you would not be here.

Intended: $(Here \Rightarrow At(Home_{hyp})) \wedge (At(Home_{real} \Rightarrow \neg Here) \models Here \Rightarrow \neg Here$
Straight: $(Here \Rightarrow Home) \wedge (Home \Rightarrow \neg Here) \models (Here \Rightarrow \neg Here)$

7.4 Give a predicate calculus sentence such that every world in which it is true contains exactly one object.

$\forall\, x, y \quad x = y$

7.5 Represent the sentence "All Germans speak the same languages" in predicate calculus. Use $Speaks(x, l)$, meaning that person speaks language l.

$\forall\, x, y, l \; German(x) \wedge German(y) \wedge Speaks(x, l) \Rightarrow Speaks(y, l)$

7.14 How hard would it be to build a successful wumpus world agent by writing a program in your favorite programming language? Compare this to the logical reasoning agent.

This required you to do some thinking and reasoning about your favorite programming language. You needed to talk about how you would go about finding a safe path in the environment. Some comparing and contrasting was also required. There is no one right or wrong answer.

9.1a $P(A, B, B), P(x, y, z)$

$\{x/A, y/B, z/B\}$ (or some permutation of this)

9.1b Q(y, G(A,B)), Q(G(x,x),y)

No unifier for x can bind to both A and B.

9.1c $Older(Father(y), y), Older(Father(x), John)$

$\{y/John, x/John\}$

9.1d $Knows(Father(y), y), Knows(x, x)$

No unifier (b/c the $occurs$ check prevents unification of y w/$Father(y)$)