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2016240
BTech 2016 - CSAM

Artificial Intelligence
Written + Programming Assignment

Question (4)

Let A(x) signify 'x is a vine'
" D(x) " you don't like order 'x'
" E(x) " you eat x
" 'c' " Chenopodium and 'R' signify Radish

~~(1) A(C) ∧ A(R)~~
~~(2) ¬E(x) → D(x) ⇒ E(x) ∨ D(x)~~
(3) ¬E(C) ∧ ¬E(R)
~~(4) D(C)~~

(1) A(C) ∧ A(R) ⇒ (1) A(C) (2) A(R)
(2) A(x) ∧ ¬E(x) → D(x) ⇒ ¬A(x) ∨ E(x) ∨ D(x)
(3) ¬E(C) ∧ ¬E(R) ⇒ (3) ¬E(C) (4) ¬E(R)
T.P → (4) D(C) ∧ D(R) ⇒ (5) D(C) (6) D(R)

(1) – (4) are in CNF form. They are the following in FOL:

(i) A(C) ∧ A(R)
(ii) ∀x [A(x) ∧ ¬E(x) → D(x)]
(iii) ¬E(C) ∧ ¬E(R)
(iv) D(C) ∧ D(R)

on resolution of (3) and (4)

(8) ¬A(C) ∨ D(C)

on resolution of (3) and (5)

(9) ¬A(R) ∨ D(R)

on resolution of (1) and (8)

(10) D(C)

on resolution of (2) and (9)

(11) D(R)

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⑩ and ⑪ are exactly what we needed to prove

Question (3)

Assumptions : The following things are required on behalf of the various departments in college:
(i) permission to use a room
(ii) electricity and various required equipments should be fully functional
(iii) security should be appropriate.

Initial state: PermissionToOrganiseSeminar() AND
permissionForRoomAccess(x) AND
roomAvailable(x) AND
professorAvailable(x) AND
electricityFunctioning() AND
securityForProfessor()

Initial State : Requirement For Lecture(z) AND
lectureTopicknowByProfessor(x,z)

Goal state : LectureDeliveredByProfessor(x) AND
StudentsLearn()

Actions: ~~Step~~ ① ~~InviteProfessor(x)~~
Prec:

steps.

Actions : ① CommunicateWithProfessor(x) // request prof for lecture
Prec : Initial state
Effect : availableTimeForProf()

Steps:

(2) communicateWithAcademic () //require permission for organizing seminar at particular dates
Prec: ProfAvailableOnDate(z)
Effect: PermissionToOrganizeSeminar() OR PermissionDenied()

(3) communicateWithOtherDepartments ()
Prec: PermissionToOrganizeSeminar()
Effect: ElectricityFunctioning() AND securityForProfessor()

(4) PermissionForRoomAccess (Y, day)
Prec: RoomAvailable(Y, Day)
Effect: PermissionAcquired() or PermissionDenied()

(5) InviteProfessor(x)
Prec: ProfessorAvailable(x) AND
PermissionToOrganizeSeminar() AND
roomAvailable(Y) AND
electricityFunctioning() AND
securityForProfessor()

Effect: ProfessorAcceptsInvitation() or
ProfessorRejectsInvitation()

(6) InformStudentsAboutSeminar()
Prec: ProfessorAcceptsInvitation() AND ProfessorArrivingOnDay(day)
Effect: StudentsInformed()

(7) HoldSeminar()
Prec: ProfessorArrivingOnDay(day)
Effect: LectureDeliveredByProfessor(X) AND
StudentsLearn()

Question (1)

a) Let P(x) signify x is a chocolate muffin

$$\exists x \exists y [P(x) \wedge P(y) \wedge (x \neq y) \wedge (\forall z P(z) \rightarrow (z = x) \vee (z = y))]$$

b) Let L(x,y) be x likes y.
Let S(y) be y is smart
Let R(x) be x is rat
Let C(x) be x is cat

$$\forall x \forall y [C(x) \wedge R(y) \wedge S(y) \rightarrow \neg L(x,y)]$$

c) Let A(english, x) signify average of english in year x
" A(math, x) " " " math " " .

$$\forall x [A(\text{english}, x) > A(\text{maths}, x)]$$

d) Let D(x) be x is diamond ornament
" Pl(x) " x " platinum "
" P(x) " " " precious.

$$\forall x [D(x) \vee Pl(x) \rightarrow P(x)]$$

e) Let S be submit assignment in AI.
" G " good grades.

$$\neg S \rightarrow (S \rightarrow G)$$

f) let A(s) be shark attacks
" A(w) " whale "
" H(s) " shark is hungry
" H(w) " whale is "
" Angry(s) " shark is angry
" Angry(w) " whale is "

$[Angry(w) \vee H(s) \rightarrow A(s)] \wedge [Angry(w) \vee H(w) \rightarrow A(w)]$

e

f) let A(x) be x attacks
" Angry(x) " x is angry
" H(x) " x is hungry
" shark(x) " x is a shark
" whale(x) " x is whale.

$\forall x [(shark(x) \vee whale(x)) \wedge (Angry(x) \vee H(x)) \rightarrow A(x)]$

g) It is not the case that some fishes do not swim $\Leftrightarrow$ All fishes swim

let S(x) be x swims
" F(x) " x is a fish

$\forall x [F(x) \rightarrow S(x)]$

h) let $E(x,t)$ be type x candies that marry can eat at time t.

$[\exists x \forall t [E(x,t)]] \wedge [\forall x \exists t [E(x,t)]] \wedge [\exists x \exists t (\neg E(x,t))]$

i) let $S(x)$ be that x is a superhero
" $K(x)$ " " x is a killer
" $F(x)$ " " jar likes x.

$\forall x [S(x) \wedge \neg(K(x)) \rightarrow F(x)]$

j) let $S(x)$ be that shopkeeper sells to customer x
" $M(x)$ " " x has a membership card of shop.

$\exists x [S(x) \rightarrow M(x)]$

Quest (2) Actions : moveArm(A), moveArmToColumn(A, x)

Prec: NOT ArmInPosition(A, x) AND NOT ArmInUse(A)

Effect: ArmInPosition(A, x)

moveArmToRow(A, Y)

Prec: NOT ArmInPosition(A, Y) AND NOT ArmInUse(A)

Effect: ArmInPosition(Y)

moveObjectAlongRow(H_Arm, x, y) // move from x to y.

Prec: cellEmpty(y) AND NOT cellEmpty(x)

Effect: cellEmpty(x) AND NOT cellEmpty(y).

moveObjectAlongColumn(V_Arm, x, y)

Prec: same as prev

Effect: same as prev.

SmashAtPosition(V_Arm, x, y) // smash at cell (x, y)

Prec: ArmInColumn(y) AND NOT cellEmpty(x)

Effect: ArmAtCell(x, y) AND cellEmpty(x, y)

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Assume 0 indexed.

① move object Along Column (V_Arm, (1,0), (4,0))
② move object Along Row (H_Arm, (-9, 1), (7,0))

③ smawn ATposition (V_Arm, 7, 0).
④ move Arm ToRow (H_Arm, 6)
⑤ move object Along Row (H_Arm, (6, 4), (6, 3))
⑥ move Arm To Row (H_Arm, 5)
⑦ move object Along Row (H-Arm, (5, 2), (5, 1))
⑧ move Arm To Column (V_Arm, 2).
⑨ smawn ATposition (V_Arm, 2, 2)
⑩ move object along column (V_Arm, (3, 2), (0, 2))
⑪ move object Along Row (H_Arm, (5, 4), (5, 2))
⑫ smawn ATposition (V_Arm, 5, 2)
⑬ move object Along Row (H_Arm, (5, 6), (5, 2))
⑭ same as (12)
⑮

Similarly, move H-Arm to a row in which objects have to be moved. place object and V_arm to a column in which objects have to be moved. Place objects to be smawned in columns where V_Arm exists, if possible, to smawn them.