9631407 - علی نوری پور

تمرین سری پنجم

(1)

(a) $\Big(\big(\exists \text{book}(Ali, history) \wedge \exists \text{book}(Ali, philosophy)\big) \wedge \neg \text{Sad}(Ali)\Big) \vee$

$\big(\neg(\exists \text{book}(Ali, history) \wedge \exists \text{book}(Ali, philosophy)) \wedge \text{Sad}(Ali)\big)$

(b) $\forall x,y \ (\text{likes}(Ali) = \text{likes}(x)) \wedge (\text{likes}(Ali) = \text{likes}(y)) \Rightarrow x = y \ \wedge$

$(x \neq y) \wedge (x \neq Ali)$

(c) $\exists \text{people} \ \exists t_1 \ \text{supper}(\text{people}, t_1) \wedge \forall \text{people} \ \forall t_2 \ \neg \text{supper}(\text{people}, t_2)$

(d) $\forall p_1, p_2 \ \forall \text{match} \ (\text{winner}(\text{match}, p_1) \wedge \neg \text{winner}(\text{match}, p_2)) \vee (\neg \text{winner}(\text{match}, p_1) \wedge$

$\text{winner}(\text{match}, p_2))$

(e) $\neg(\forall x \ \text{course}(x) \Rightarrow (\text{difficult}(x), \text{Useless}(x)))$

(f) $\forall x \ \text{Car}(x) \wedge \neg(\text{isPride}(x) \vee \text{isPeykan}(x)) \Rightarrow \text{isSafe}(x)$

(1) FOL: $\forall n$ buys $(x, \text{cheese}) \Rightarrow (\text{Owns}(x, \text{mouse}) \wedge \neg \text{Owns}(x, \text{store})) \vee (\neg \text{Owns}(x, \text{mouse}) \wedge \text{Owns}(x, \text{store}))$ (2)

CNF: $\equiv \neg \forall n \text{ buys}(x, \text{cheese}) \vee (\text{Owns}(x, \text{mouse}) \wedge \neg \text{Owns}(x, \text{store})) \vee (\neg \text{Owns}(x, \text{mouse}) \wedge \text{Owns}(x, \text{store}))$

$\equiv \exists n \neg \text{buys}(x, \text{cheese}) \vee (\text{Owns}(x, \text{mouse}) \wedge \neg \text{Owns}(x, \text{store})) \vee (\neg \text{Owns}(x, \text{mouse}) \wedge \text{Owns}(x, \text{store}))$

$\equiv \neg \text{buys}(x, \text{cheese}) \vee (\text{Owns}(x, \text{mouse}) \wedge \neg \text{Owns}(x, \text{store})) \vee (\neg \text{Owns}(x, \text{mouse}) \wedge \text{Owns}(x, \text{store}))$

$\equiv (\text{Owns}(x, \text{mouse}) \vee \text{Owns}(x, \text{store}) \vee \neg \text{buys}(x, \text{cheese})) \wedge (\neg \text{Owns}(x, \text{mouse}) \vee \neg \text{Owns}(x, \text{store}) \vee \text{buys}(x, \text{cheese}))$

(2) FOL: $\forall \text{cat} \exists \text{mouse}$ chases(cat, mouse) CNF: chases(cat, mouse)

(3) FOL: buys(peter, cheese) CNF: buys(peter, cheese)

(4) FOL: $\forall x, y$ Owns$(x, \text{mouse}) \wedge$ chases$(y, \text{mouse}) \Rightarrow$ hates(x, y)

CNF: $\equiv \neg \forall x, y$ Owns$(x, \text{mouse}) \wedge$ chases$(y, \text{mouse}) \vee$ hates(x, y)

$\equiv \exists x, y \neg \text{Owns}(x, \text{mouse}) \vee \neg \text{chases}(y, \text{mouse}) \vee \text{hates}(x, y)$

$\equiv \neg \text{Owns}(x, \text{mouse}) \vee \neg \text{chases}(y, \text{mouse}) \vee \text{hates}(x, y)$

(5) FOL: Owns(Alex, cat) CNF: Owns(Alex, cat)

(6) FOL: $\exists x, y, t$ Owns$(x, t) \wedge$ hates$(y, t) \Rightarrow \neg$ areFriends(x, y)

CNF: $\equiv \neg \exists x, y, t$ Owns$(x, t) \wedge$ hates$(y, t) \vee \neg$ areFriends

$\equiv \forall x, y, t \neg \text{Owns}(x, t) \vee \neg \text{hates}(y, t) \vee \neg \text{areFriends}$

$\equiv \neg \text{Owns}(x, t) \vee \neg \text{hates}(y, t) \vee \neg \text{areFriends}$

(7) FOL: $\neg$Owns(peter, store) $\Rightarrow \neg$areFriends(peter, Alex)

CNF: Owns(peter, store) $\vee \neg$areFriends(peter, Alex)

KB $\wedge \neg \alpha$: $(\text{Owns}(x, \text{mouse}) \vee \text{Owns}(x, \text{store}) \vee \neg \text{buys}(x, \text{cheese})) \wedge (\neg \text{Owns}(x, \text{mouse}) \vee \neg \text{Owns}(x, \text{store}) \vee \text{buys}(x, \text{cheese})) \vee \text{chases}(\text{cat}, \text{mouse}) \wedge \text{buys}(\text{peter}, \text{cheese}))$

$\wedge (\neg \text{Owns}(x, \text{mouse}) \vee \neg \text{chases}(y, \text{mouse}) \vee \text{hates}(x, y)) \wedge \text{Owns}(\text{Alex}, \text{cat})$

$\wedge (\neg \text{Owns}(x, t) \vee \neg \text{hates}(y, t) \vee \neg \text{areFriends}(x, y))$

$\wedge (\text{Owns}(\text{peter}, \text{store}) \vee \neg \text{areFriends}(\text{peter}, \text{Alex})) \equiv \emptyset \Rightarrow KB \models \alpha$

(a) $\theta = \{G(x,x) / y\}$ $S_1 \Rightarrow \{P(G(x,x), G(x,x)); P(G(x,x), G(A,B))\}$ (3)

$\theta = \{x / A\}$ $S_2 \Rightarrow \{P(G(x,x), G(x,x)); P(G(x,x), G(x,B))\}$

$\theta = \{x / B\}$ $S_3 \Rightarrow \{P(G(x,x), G(x,x)); P(G(x,x), G(x,x))\}$ ✓

(b) $\theta = \{g(y) / x\}$ $S_1 \Rightarrow \{P(g(y), y); P(g(y), f(g(y)))\}$

$\theta = \{f(g(y)) / y\}$ X

(c) $\theta = \{x / b\}$ $S_1 \Rightarrow \{Q(x, f(a, g(y))); Q(x, f(z, w))\}$

$\theta = \{a / z\}$ $S_2 \Rightarrow \{Q(x, f(a, g(y))); Q(x, f(a, w))\}$

$\theta = \{g(y) / w\}$ $S_3 \Rightarrow \{Q(x, f(a, g(y))); Q(x, f(a, g(y)))\}$ ✓

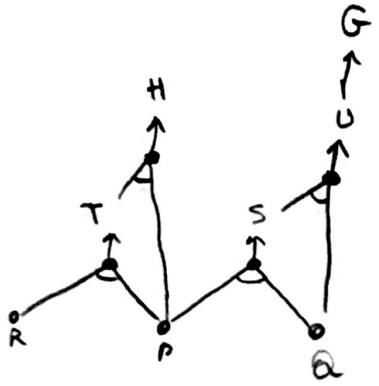
(d) $\theta = \{brother(y) / x\}$ $S_1 \Rightarrow \{Knows(brother(y), brother(y)); Knows(brother(y), y)\}$

$\theta = \{brother(y) / y\}$ X

(a) $\neg(A \Rightarrow A) \rightarrow \neg(\neg A \vee A) \rightarrow A \wedge \neg A \equiv \emptyset$ درست (4)

(b) $(A \vee B) \wedge \neg(\neg A \vee B) \rightarrow (A \vee B) \wedge (A \wedge \neg B)$ نادرست - مثال نقض: $A = \emptyset$

(c) $C \vee (\neg A \wedge \neg B) \rightarrow (C \vee \neg A) \wedge (C \vee \neg B) \rightarrow (A \Rightarrow C) \wedge (B \Rightarrow C)$ درست



(5)

agenda = {P, Q, R}

inferred = {0, 0, 0, 0, 0, 0, 0, 0}

P Q R T S H U G

(I)

(a) P P
(b) Q Q
(c) R R
(d) $P \wedge Q \rightarrow S$
(e) $Q \wedge S \rightarrow U$
(f) $U \rightarrow G$
(g) $Q \wedge S \rightarrow U$
(h) $P \wedge T \rightarrow H$
(i) $P \wedge R \rightarrow T$

count$(P \wedge Q \rightarrow S) = 2$
count$(Q \wedge S \rightarrow U) = 2$
count$(U \rightarrow G) = 1$
count$(Q \wedge S \rightarrow U) = 2$
count$(P \wedge T \rightarrow H) = 2$
count$(P \wedge R \rightarrow T) = 2$

agenda = {Q, R} inferred = {1, 0, 0, - - , 0} (II)

(d) 1
(e) 2
(f) 1
(g) 2
(h) 1
(i) 1

agenda = {R} inferred = {1, 1, 0, - - , 0} (III)

(d) 0
(e) 1
(f) 1
(g) 1
(h) 1
(i) 1

agenda = {S} inferred = {1, 1, 1, 0, - - 0} (IV)

(d) 0
(e) 1
(f) 1
(g) 1
(h) 1
(i) 0

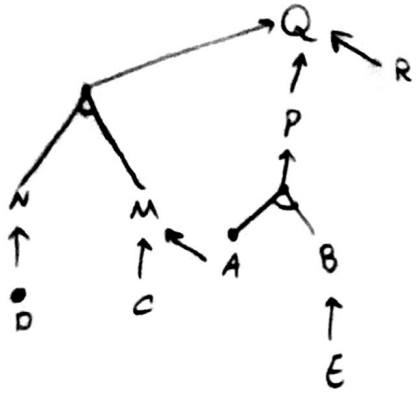
agenda = {T} inferred = {1, 1, 1, 0, 1, 0, 0, 0} (V)

(d) 0
(e) 0
(f) 1
(g) 0
(h) 1
(i) 0

agenda = {U} inferred = {1, 1, 1, 1, 1, 0, 0, 0} (VI)

(d) 0
(e) 0
(f) 1
(g) 0
(h) 0 ✓ ⟵ H در پایان مقدار دهی شده صحیح است
(i) 0

(6)



فرض: $A = D = 1$

$$Q=1 \Rightarrow \begin{cases} (a)\ P \to Q \Rightarrow P=1 \\ (c)\ R \to Q \Rightarrow R=1 \\ (d)\ M \wedge N \Rightarrow M=N=1 \end{cases}$$

$$P=1 \Rightarrow \{ (e)\ A \wedge B \to P \Rightarrow A=B=1$$

$$M=1 \Rightarrow \begin{cases} (f)\ A \to M \Rightarrow A=1 \\ (g)\ C \to M \Rightarrow C=1 \end{cases}$$

$$N=1 \Rightarrow \{ (h)\ D \to N \Rightarrow D=1$$

$$B=1 \Rightarrow \{ (b)\ E \to b \Rightarrow E=1$$

هیچ تناقض وجود ندارد؛ پس Q صحیح است.

(7) فرض می کنیم عبارت داده شده satisfiable است؛ همچنین تیک نیز داده:

$\neg D=1 \Rightarrow D=0,\ E=1$

$$(A \vee B \vee \neg C) \wedge (A \vee \neg B \vee D) \wedge \neg D \wedge (\neg C \vee D) \wedge (B \vee \neg E) \wedge E$$

$E=1$

$D=0$

$B=1$

$C=\cancel{1}\ 0$

$A=1$

$(A \vee B \vee \neg C) \to 1$

$(A \vee \neg B \vee D) \to A \vee \neg B \to A \to 1$

$\neg D \to 1$

$(\neg C \vee D) \to C \to$ True

$(B \vee \neg E) \to B \to 1$

$E \to 1$

عبارت داده شده با مقادیر: $A=1,\ B=1,\ C=0,\ D=0,\ E=1$ ارضاپذیر است.