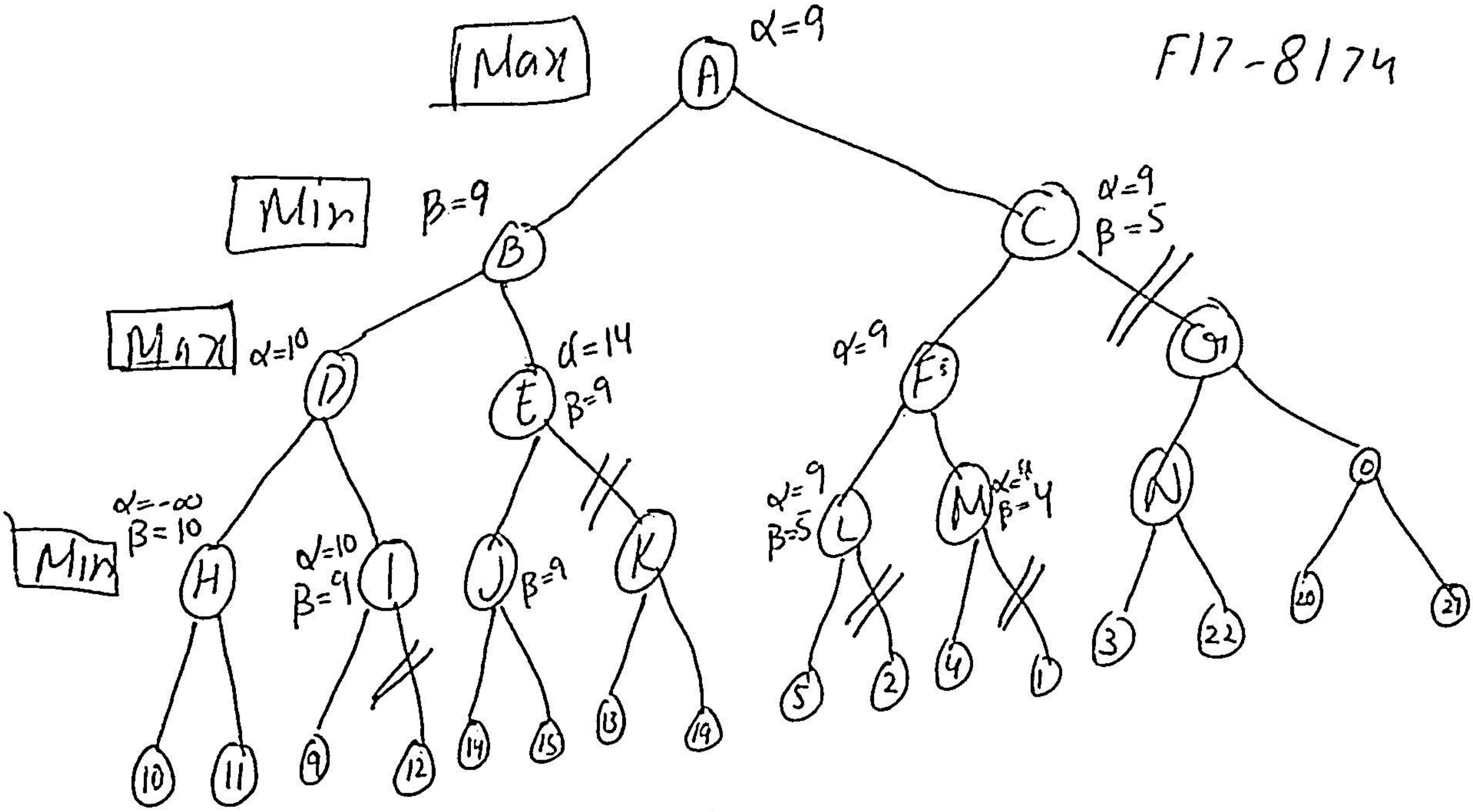
F17-8174



H = 10
I = 9
D = 9

J = 14
E = 14
L = 5

M = 4
F = 5
C = 5

other values discarded

Convert the following sentence into first order logic (FOL)

1) $\forall x \; \exists y \; Butterfly(x) \rightarrow (flower(y) \wedge likes(x,y))$

2) $\forall x \; Butterfly(x) \rightarrow Insect(x)$

3) $\forall x \; \exists y \; flower(x) \rightarrow [(Butterfly(y) \wedge likes(y,x))]$

4) $\forall x \; \forall y \; [Butterfly(x) \wedge flower(y)] \rightarrow likes(x,y)$

5) $\exists x \; Butterfly(x) \wedge In(x, Irvine) \wedge Pretty(x)$

6) $\forall x \; [Butterfly(x) \wedge In(x, Irvine) \rightarrow Pretty(x)$

7) $\forall x \; \exists y \; Butterfly(x) \rightarrow [flower(y) \wedge likes(x,y)]$

8) $\exists x \; \exists y \; Butterfly(x) \rightarrow [flower(y) \wedge likes(x,y)]$

9) $\neg Happy(z) \vee has\ exciting\ life(z)$

10) $\forall x \; Reads(x) \rightarrow Smart(x)$.

F-17-8174

Perceptron Training Rule

$\Rightarrow w_i \leftarrow w_i + \Delta w_i$

$\Delta w_i = \eta (t - o) x_i$

$\Rightarrow w_0 x_0 + w_1 x_1 + w_2 x_2 > 0 = 1$

otherwise -1

① $0 + 1(-10) + 2(-10) = -30$

$= -1$ ✓ OK

② $0 + 3(-10) + 3(-10) = -60$

$= -1$ OK

③ $0 + -3(-10) + 2(-10) = 10$

$= 1$ OK

④ $0 + 3(-10) - 6(-10) = 30$

$= 1$ wrong

⑤ $0 - 4(-10) - 2(-10) = 60$

$= 1$ OK

Calculating weights

$w_0 = 1(-1-1)1 = -2$

$w_0 = 0 - 2 = \underline{-2}$

$w_1 = 1(-1-1)3 = -6$

$= -10 - 6 = \underline{-16}$

$w_3 = 1(-1-1)-6 = 12$

$= -10 + 12 = \underline{2}$

F17-8174

① $-2+1(-16)+2(2) = -14 \Rightarrow -1$ ok

② $-2+3(-16)+3(2) = -44 \Rightarrow -1$ ok

③ $-2+(-3)(-16)+2(2) = 50 \Rightarrow 1$ ok

④ $-2+3(-16)-6(2) = -60 \Rightarrow -1$ ok

⑤ $-2-4(-16)-2(2) = 58 \Rightarrow 1$ ok

Resolution Theorem

F17-8174

A ⇒ [square(1,1) = Breeze] = [(square(1,2) = Pit) v (square(2,1) = Pit)]

square(1,2) = Pit = false ①

square(1,1) = Breeze = true ②

By ① and ②

A ⇒ T = [F v Square(2,1) = Pit]

[Square(2,1) = Pit] = T

"Clustering"

F17-8174

M_1 : $(2.1, 9.5)$
M_2 : $(2.1, 4.9)$
M_3 : $(8, 4)$
M_4 : $(5.1, 7.5)$
M_5 : $(7.1, 4.9)$
M_6 : $(6, 4)$
M_7 : $(1, 2)$
M_8 : $(4.2, 8.9)$

☆ Manhattan Distance $= |x_2 - x_1| + |y_2 - y_1|$

Suppose M_2, M_4 - as centroids

	$(2.1, 4.9)$	$(5.1, 7.5)$	Cluster
M_1 $(2.1, 9.5)$	4.6	5	1
M_2 $(2.1, 4.9)$	0	5.6	1
M_3 $(8, 4)$	6.8	6.4	2
M_4 $(5.1, 7.5)$	5.6	0	2
M_5 $(7.1, 4.9)$	5	4.6	2
M_6 $(6, 4)$	4.8	4.4	2
M_7 $(1, 2)$	4	9.6	1
M_8 $(4.2, 8.9)$	6.1	2.3	2

$\Rightarrow M2 : (2.1, 4.9), (2.1, 9.5), (1, 2)$

$x = (2.1 + 2.1 + 1)/3 = 1.73$

$y = (4.9 + 9.5 + 2)/3 = 5.46$

Mean = (1.73, 5.46)

$\Rightarrow M4 : (5.1, 7.5), (8, 4), (7.1, 4.9), (6, 4) (4.2, 8.9)$.

$x = (5.1 + 8 + 7.1 + 6 + 4.2)/5 = 6.08$

$y = (7.5 + 4 + 4.9 + 4 + 8.9)/5 = 5.86$

Mean = (6.08, 5.86)

	(1.73, 5.46)	(6.08, 5.86)	Cluster
1, (2.1, 9.5)	4.41	7.62	1
2, (2.1, 4.9)	0.93	4.94	1
3, (8, 4)	7.73	3.78	2
4, (5.1, 7.5)	5.41	2.62	2
5, (7.1, 4.9)	5.93	1.98	2
6, (6, 4)	5.73	1.94	2
7, (1, 2)	4.19	8.94	1
8, (4.8, 8.9)	6.51	4.32	2

Clusters are repeated so we stop the process

Convert to CNF

1) $(A \leftrightarrow (B \vee C))$

$(A \rightarrow (B \vee C)) \wedge (B \vee C) \rightarrow A$

$[\neg A \vee (B \vee C)] \wedge [(\neg (B \vee C) \vee A]$

$[\neg A \vee (B \vee C)] \wedge [(\neg B \wedge \neg C) \vee A]$

$[\neg A \vee B \vee C] \wedge [(\neg B \vee A) \wedge (\neg C \vee A)]$

2) $(C \wedge D \rightarrow \neg E)$

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

$\neg C \vee \neg D \vee \neg E$

3) $((A \rightarrow B) \rightarrow C$

$(\neg A \vee B) \rightarrow C \longrightarrow \neg (\neg A \vee B) \vee C$

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

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

4) $A \rightarrow (B \wedge D) \leftrightarrow (E \vee C)$

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

$[\underbrace{[\neg A \vee (B \wedge D)] \rightarrow (E \vee C)}_{①}] \wedge [\underbrace{(E \vee C) \rightarrow (\neg A \vee (B \wedge D))}_{②}] \longrightarrow Ⓡ$

①

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

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

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

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

②

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

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

Putting these values in Ⓡ

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

$$[(A \vee (\neg B \vee D) \vee (\neg A \vee B) \wedge (B \vee \neg A)]$$