Faculty of Science and Engineering
Department of Computer Science and Engineering
Semester: Spring 2024 Batch: Day

Assignment

Course Name: Artificial Intelligence

Course Code: CSE 417

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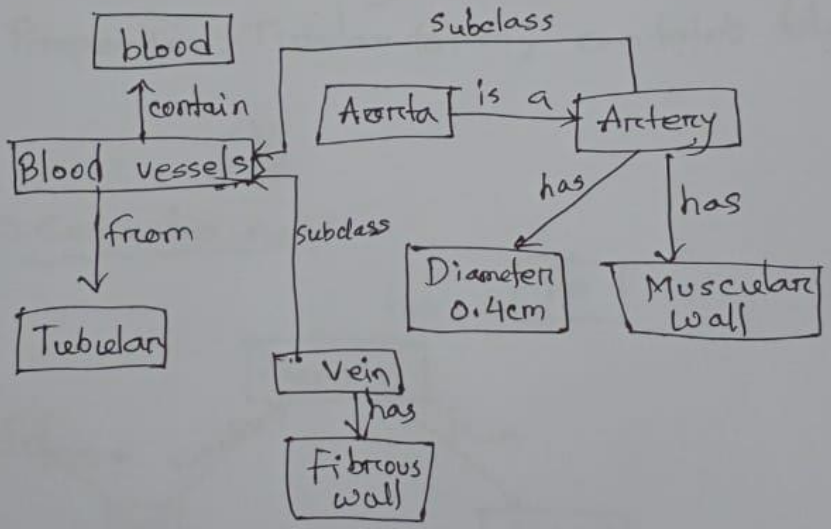
Answer to question no. 01

(a)

(i) **Semantic net:** A semantic network is a graph consisting of nodes representing concepts and edges representing relations between those concepts.



(ii) **Frame:** A frame is a data structure for representing a stereotype situation, like a collection of slots and slot-values.

Frame: Blood vessel

subclass: Arteery

Diameter: 0.4 cm

wall-type: Muscular

subclass: Vein

wall-type: fibrous

subclass: Aorta

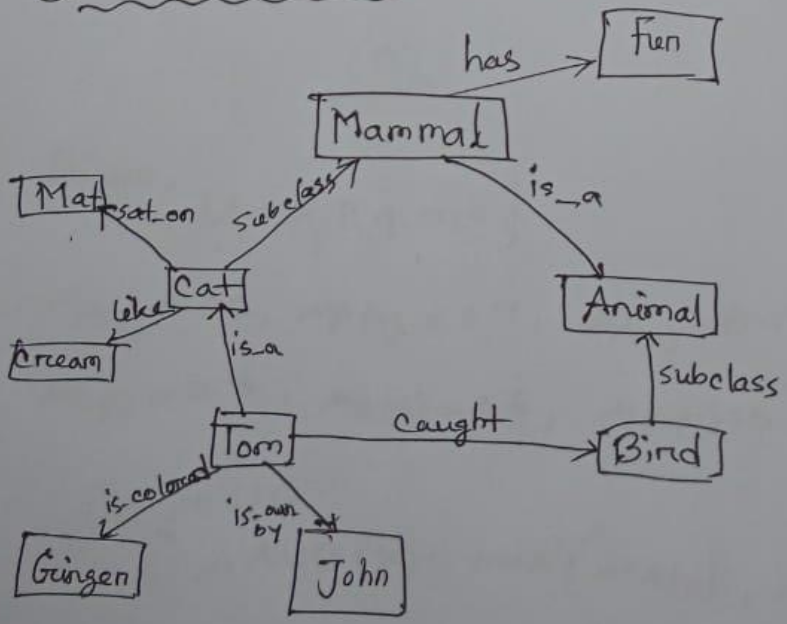
Diameter: 2.5 cm

is_a : Arteery

Properties: Tubular form, contains blood.

(b)

① Semantic net:



(ii) Frame:

Frame: Animal
subclass: Mammal
Properties: Fur

Subclass: Cat
Instance: Tom
Caught: Bird
Owned by: John
Color : Ginger
Action : Sat-on-mat
likes : Cream
Subclass: Bird
Instance: Generic-bird

(c)

Given, $U = \{p, q, r, s\}$

$\mu_{A(p)} = 0.2$, $\mu_{A(q)} = 0.7$, $\mu_{A(r)} = 0.18$

$\mu_{B(p)} = 0.3$, $\mu_{B(q)} = 0.6$, $\mu_{B(r)} = 0.15$, $\mu_{B(s)} = 0.1$

(1) A ∪ B

$\mu_{A \cup B}(x) = \max(\mu_{A(x)}, \mu_{B(x)})$

$\therefore \mu_{A \cup B(p)} = \max(0.2, 0.3) = 0.3$
$\mu_{A \cup B(q)} = \max(0.7, 0.6) = 0.7$
$\mu_{A \cup B(r)} = \max(0.18, 0.15) = 0.18$
$\mu_{A \cup B(s)} = \max(0, 0.1) = 0.7$

(2) $A \cap B$

$$\mu_{A\cap B}(x) = \min\left(\mu_A(x), \mu_B(x)\right)$$

$\therefore \mu_{A\cap B}(p) = \min(0.2, 0.3) = 0.2$

$\mu_{A\cap B}(q) = \min(0.7, 0.6) = 0.6$

$\mu_{A\cap B}(r) = \min(0.18, 0.15) = 0.15$

$\mu_{A\cap B}(s) = \min(0, 0.1) = 0$

(3) $B^{\wedge C}$

$\mu_{B^c}(x) = 1 - \mu_B(x)$

$\therefore \mu_{B^c}(p) = 1 - 0.3 = 0.7$

$\mu_{B^c}(q) = 1 - 0.6 = 0.4$

$\mu_{B^c}(r) = 1 - 0.15 = 0.85$

$\mu_{B^c}(s) = 1 - 0.1 = 0.9$

(v)

① Difference between fuzzy set and crisp set.

Features	Fuzzy set	Crisp set
Basic	Vague or ambiguous properties prescribed it.	Defined by precise and specific characteristics.
Definition	Set of components with different membership degree in the set.	Set of objects with the same countability and finiteness qualities
Applications	commonly utilized in fuzzy controllers.	commonly utilized in digital designs.
Membership	Shows incomplete membership.	Shows complete membership
Logic	Follows the infinite-valued logic.	Follows the bivalued logic
Value	Specifies the number between 0 and 1, which includes both 0 and 1.	Specifies the value as either 0 or 1.
Degree	Defines degree to which anything is true.	Reffered to as classical set.

(ii) Difference between ~~big~~ linguistic variable and value:-

(a) linguistic variable:-

↳ A variable whose values are words or sentences from a natural language.

(B) Linguistic value:-

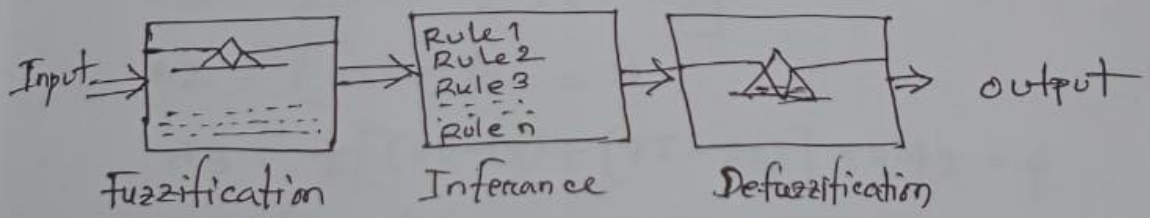
↳ The value taken by linguistic variable.

Answer to question no. 02

(a)

Fuzzy interface system consists of three parts; fuzzification, inferance and Defuzzification.

Fuzzification is the process of converting a crisp input value or conventional numerical data of to a fuzzy value based on our knowledge on using grade of MF.

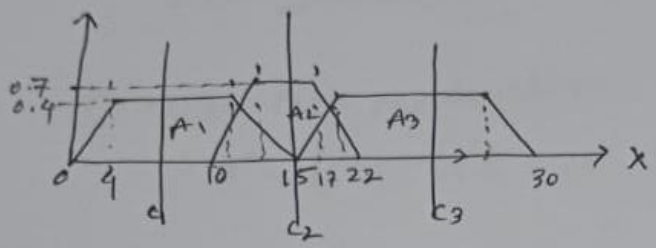


De-fuzzification is the reversed way i.e. fuzzy to crisp convertion.

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic.

(b)

(i) cos method, $x^* = \frac{\sum A_i C_i}{\sum A_i}$



$A_1 = \frac{1}{2}[(15-0)+(11-4)] \times 0.4 = 4.4$

$C_1 = (15+0)/2 = 7.5$

$A_2 = \frac{1}{2}[(22-10)+(17-13)] \times 0.7 = 5.6$

$C_2 = (22+10)/2 = 16$

$A_3 = \frac{1}{2}[(30-15)+(25-20)] \times 0.42 = 4$

$C_3 = (30+15)/2 = 22.5$

$$X^* = \frac{\sum C_i A_i}{\sum A_i} = \frac{(4.4 \times 7.5 + 5.6 \times 16 + 4 \times 22.5)}{4.5+5.6+4}$$

$= 18$ ——— Ans.

(ii) Centroid method,

$$x^* = \frac{\sum G_i A_i}{\sum A_i}$$

$A_1 = \frac{1}{2}[(15-0)+(11-4)] \times 0.4 = 4.4$, $G_1 = (15+0)/2 = 7.5$

$A_2 = \frac{1}{2}[(22-10)+(17-13)] \times 0.7 = 5.6$ $G_2 = (22+10)/2 = 16$

$A_3 = \frac{1}{2}[(30-15)+(25-20)] \times 0.4 = 4$ $G_3 = (30+15)/2 = 22.5$

$$\therefore x^* = \frac{4.4 \times 7.5 + 5.6 \times 16 + 4 \times 22.5}{4.4 + 5.6 + 4}$$

$$= 18 \quad \text{Ans.}$$

(iii) Mean Max membership,

$$x^* = (13+17)/2 = 15$$

(iv) Weighted average method,

$$x^* = \frac{\Sigma w_i c_i}{\Sigma w_i}$$

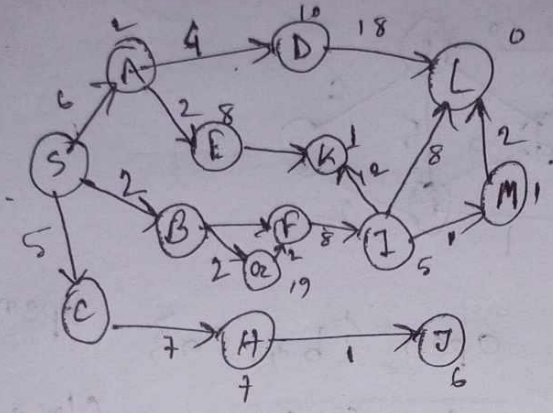
$$x^* = \frac{(0.4 \times 7.5) - 0.7 \times 16 + 0.4 \times 22.5}{0.4 + 0.7 + 0.4}$$

$$= 15.47 \quad \text{Ans.}$$

3 (a)

Start a, Goal L

A* algorithm



Open { A }

Close { }

Open { E_{10}, D_{14} }

Close { A }

Open { K_{11}, D_{14} }

Close { A, E }

Open { L_{18} }

Close { A, E, K, D }

Open { }

Close { A, E, K, D, L }

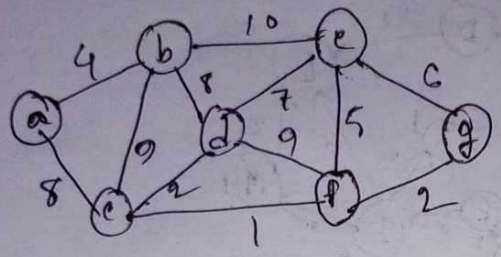
Final path

A
↓
E
↓
K
↓
D
↓
L

3(b)

Start a , goal g

Best first Search



Open {a}
close { }

open {b 4, c 9}
close {a}

open {d 8, c 9, e 10}
close {a, b}

Open {c 2, e 7, f 9}
Close {a, b, d, }

open {g f, e 7}
Close { a, b, d, c}

Open {g 2, e 5}
Close {a, b, d, e, f}

open {e 5 }
close {a, b, d, e, f, g}

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```
  C3 C2 C1
   T W O
 + T W O
-------
 F O U R
```

```
  T  7
  W  6
-----
  O  5
-----
  F  1
-----
  U  3
-----
  R  0
-----
```

C1, C2, C3 = Carry

```
    7 6 5
  + 7 6 5
---------
  1 5 3 0
```

carry

if, T = 5 we get 5+5+1 = 11

O = 1 not possible

if, T = 6 we get 6+6+1 = 13

O = 3

Then, O+O = 3+3 = 6

but no carry

So, T = 7, 7+7+ = 15

O = 5

if W = 6 6+6+1 = 13

∴ U = 3

(a)

```
  C R O S S
+ R O A D S
-----------
D A N G E R
```

```
  9 6 2 3 3
+ 6 2 5 1 3
-----------
1 5 8 7 4 6
```

$S+S = R$ (even) $\Rightarrow R \in \{0, 2, 4, 6, 8\}$ Let $S = 2$, $R = 4$

$$C+4 = A+10$$

$$\Rightarrow C+4+1 = A+10$$

$$\Rightarrow C = A+6$$

$\therefore C >= 6$

$C+R = 9+4 = 13$

$\therefore A = E = 3 \Rightarrow$ conflict

Now, $R = 6$ $S = 3$

$6+0 = N$

4 (b)

S-1:

(B, T, Gr, Grn) → (B, T, 0, 0) [fail]
(B, 0, Gr, 0) → Valid
(B, 0, 0, Grn) [fail]

S-2: (B, 0, Gr, 0) → (B, T, 0, Grn)
R L

S-3: (B, T, 0, Grn) → (B, T, Gr, 0)
(B, 0, Gr, Grn)
R

S-4:

(B, T, Gr, 0) → (B, 0, 0, Grn) [fail]
(B, T, 0, Grn) (Repeat)
(B, 0, Gr, Grn) (Left)

S-5:

(B, 0, Gr, Grn) → (B, T, Gr, 0)
(B, T, 0, Grn)
[B, T, Gr, 0] → [B, T, 0, Grn]
(B, 0, Gr, 0)

S-6:

(B, 0, Gr, 0) → (B, T, Gr, Grn)

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student(meena)

hardworker(meena)

sincere(x) :- student(x)

succeed_in_career(x) :- sincere(x), hardworker(x)

?- succeed_in_carrier(meena)

out : True.

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move(state(m, o_box, m, hnot) grabs(m, o_box, m, s))

move(state(P1, on_f, P1, H) climb, State(P, o_box, H))

move(state(P1, on_f, P1, H) push(P1, P2), State(P2, on_f, P2, H))

move(state(P1, on_f, B, H) walk(P1, P2), State(P2, on_f, B, H))

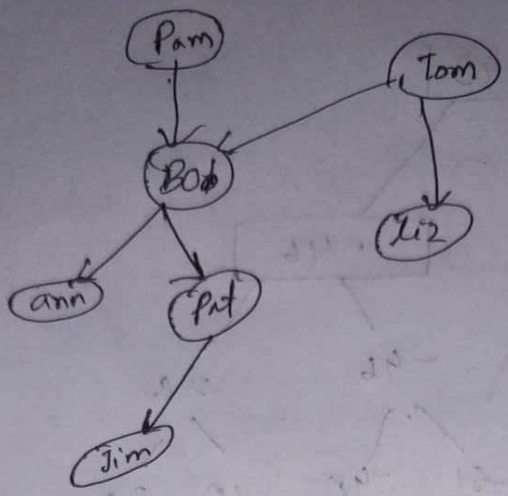
Canget(state(_, _, _, H))

Canget(state1) :-

move(state1, _, state2)

canget(state2).

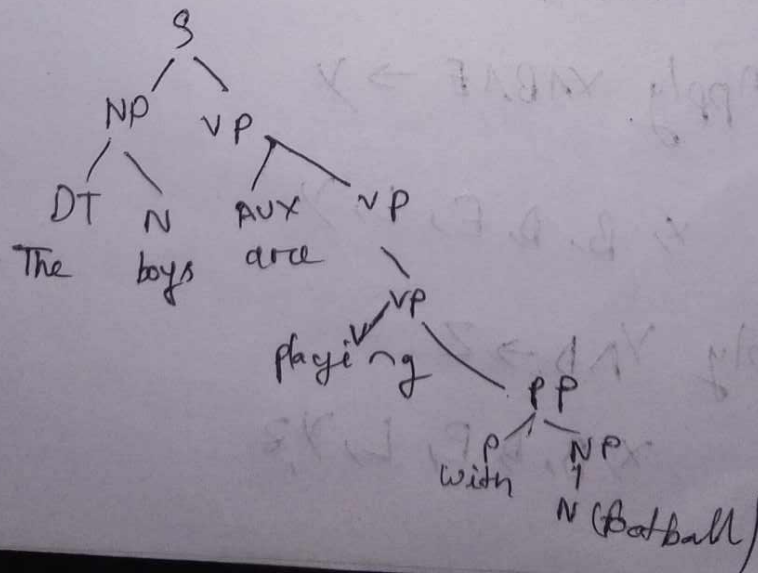
4(e)



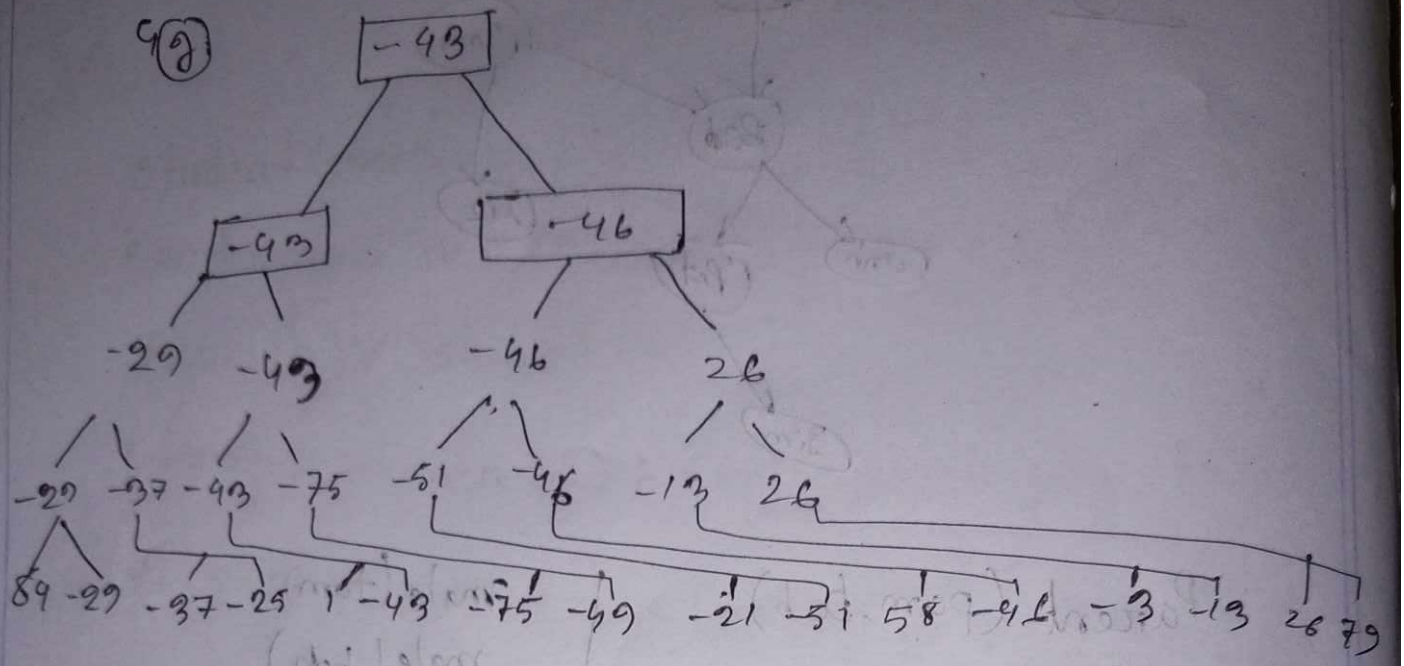
Parent (pam, bob)
Parent (tom, bob)
Parent (tom, liz)
Parent (bob, ann)
Parent (bob, pat)
Parent (pat, jim)

male (tom)
male (bob)
male (jim)
female (pam)
female (liz)
female (pat)
female (ann)

4)(f)



4(a)



4(b)

Apply $A \rightarrow X$

X, B, C, D, E

Apply $C \rightarrow L$

X, B, D, E, L

Apply $X \wedge B \wedge E \rightarrow Y$

X, B, D, E, L, Y

Apply $Y \wedge D \rightarrow Z$

X, B, D, E, L, Y, Z

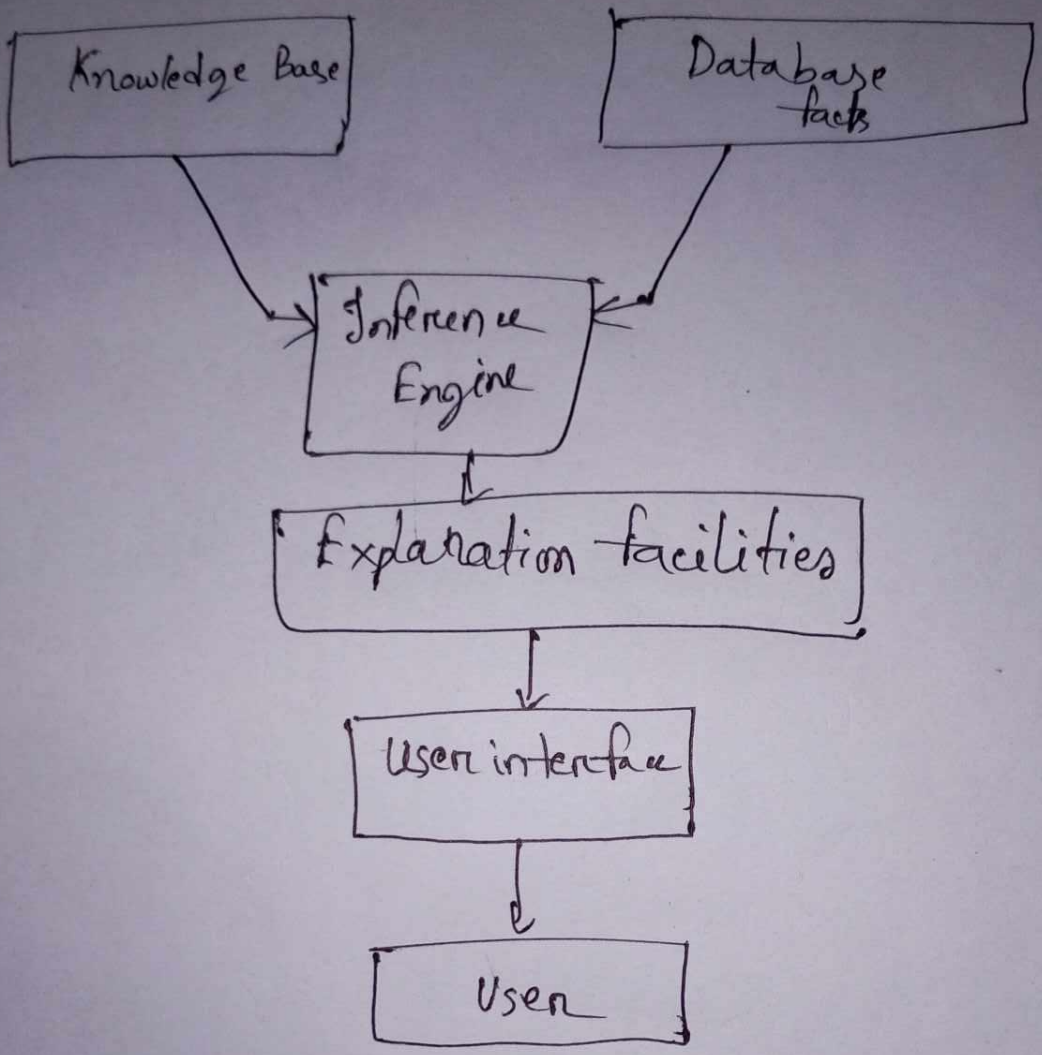
$L \wedge M \rightarrow N$

M is unknown. So cannot infer N.

final derived facts:

A
B
C
D
E
X
L
Y
Z

4(c)


Knowledge Base
Database facts
Inference Engine
Explanation facilities
User interface
User