CHAPTER 18

Artificial Intelligence

(Solutions to Review Questions and Problems)

Review Questions

Q18-1. An interrogator asks a set of questions that are forwarded to a computer and a human being. The interrogator receives two sets of responses: one from the computer and one from the human. After careful examination of the two sets, if the interrogator cannot definitely tell which set has come from the computer, the computer has passed the intelligent test. Some experts think that this is an accurate definition of an intelligent system; some think that the test is not necessarily the definition of an intelligent system.

Q18-3. LISP is a programming language that manipulates lists. LISP treats data, as well as a program, as a list,. This means a LISP program can change itself. This feature matches with the idea of an intelligent agent that can learn from the environment and improves its behavior. PROLOG is a language that can build a database of facts and a knowledge base of rules. A program in PROLOG can use logical reasoning to answer questions that can be inferred from the knowledge base.

Q18-5. Propositional logic is a language made of a set of sentences that can be used to do logical reasoning about the world. In propositional logic, a symbol that represents a sentence is atomic; it cannot be broken to find some information about its components. To do so, we need predicate logic, the logic that defines the relation between the parts in a proposition.

Q18-7. A ruled-based system represents knowledge using a set of rules that can be used to deduce some new facts from already-known facts. The semantic network is a graphical representation of entities and their relationships.

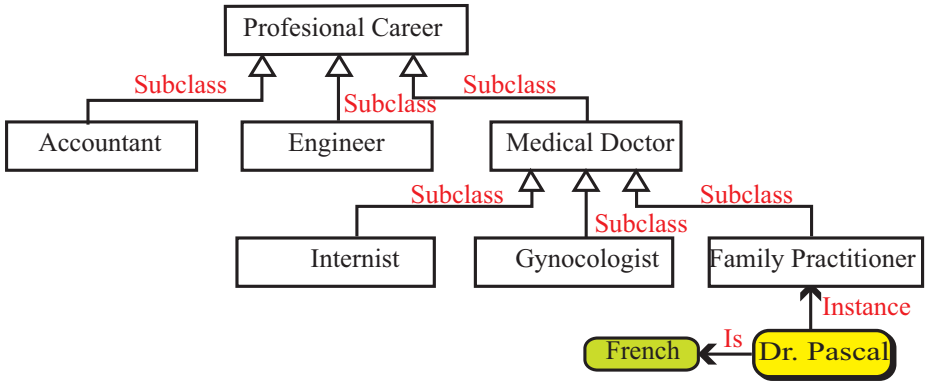
Q18-9. The five stages of image processing are edge detection, segmentation, finding depth, finding orientation, and object recognition.

Q18-11. Neural networks try to simulate the learning process of the human brain using a networks of artificial neurons.

Problems

P18-1. The semantic network is shown in Figure 18.1.

Figure 18.1 *Solution to P18-1*



a. $\neg R$

b. $\neg S$

c. $(\neg R) \vee (\neg S)$

d. $R \wedge S$

e. $S \rightarrow (\neg R)$

f. $R \rightarrow (\neg S)$

g. $S \leftrightarrow (\neg R)$ or $(\neg R) \leftrightarrow S$

h. $\neg[R \rightarrow (\neg S)]$

P18-5.

a. $\exists x[Fl\ (x) \wedge Wh\ (x)]$

b. $\exists x[Fl\ (x) \wedge \neg\ Re(x)]$

c. $\neg\forall x[Fl\ (x) \rightarrow Re\ (x)]$

d. $\exists x\{Fl\ (x) \wedge [Re\ (x) \vee Wh\ (x)]\}$

e. $\neg\exists x[Fl\ (x) \wedge \mathrm{Gr}(x)]$

f. $\neg\exists x[Fl\ (x) \wedge \mathrm{Gr}(x)]$

g. $\exists x[Fl\ (x) \wedge \neg\ Wh(x)]$

P18-7.

a. $\forall x[Expensive\ (x)]$

b. $\forall x[Cheap\ (x)]$

c. $\forall x[Cheap\ (x) \rightarrow Buys\ (\mathrm{Bob}, x)]$

d. $\forall x[Expensive\ (x) \rightarrow Sells\ (\mathrm{John}, x)]$

e. $\neg\forall x[Expensive\ (x)]$

f. $\neg\forall x[Cheap\ (x)]$

g. $\exists x\{[\ Cheap\ (x)] \rightarrow \neg\ Expensive\ (x)\}$

P18-9. The truth table is shown below. The argument {P → Q, P} |– Q is valid.

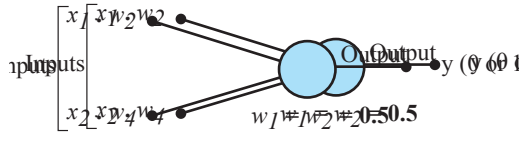
P	*Q*	*P* → Q	*P*	*Q*	
F	F	T	F	F	
F	T	T	F	T	
T	F	F	T	F	
T	T	T	T	T	**OK**
		Premise	Premise	Conclusion	

P18-11. The truth table is shown below. The argument {P ∧ Q, P} |– Q is valid:

P	*Q*	*P* ∧ Q	*P*	*Q*	
F	F	F	F	F	
F	T	F	F	T	
T	F	F	T	F	
T	T	T	T	T	**OK**
		Premise	Premise	Conclusion	

P18-13. The design of the neural network, with weights $w_1 = w_2 = 0.5$ and the threshold of $T = 0.5$, is shown in Figure 18.2.

Figure 18.2 *Solution to P18-13*

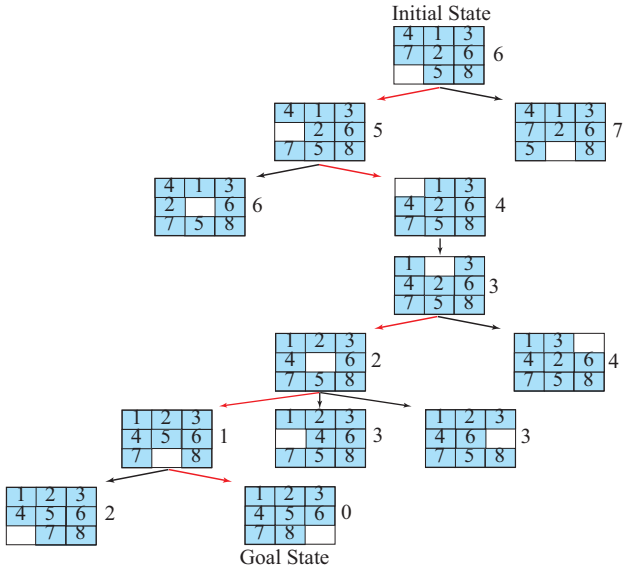


The truth table for this neural network is shown below. It is the same as the truth table for an OR gate.

Inputs		$S = x_1 \cdot w_1 + x_2 \cdot w_2$	*Compare S with T*	*Output*
0	0	0	$S < T$	0
0	1	0.5	$S = T$	1
1	0	0.5	$S = T$	1
1	1	1	$S > T$	1

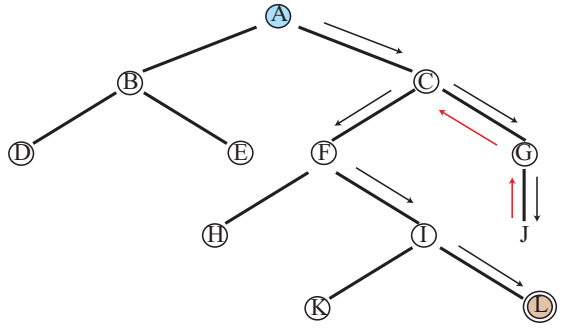
P18-15. The heuristic search tree for solving the puzzle is shown in Figure 18.3.

Figure 18.3 *Solution to P18-15*



P18-17. Figure 18.4 shows the depth-first search for the tree diagram..

Figure 18.4 *Solution to P18.17*



P18-19. Figure 18.5 shows the breadth-first search.

Figure 18.5 *Solution to P18-19*