Probability	*Hypothesis*		
	$i = 1$	$i = 2$	$i = 3$
$p(H_i)$	0.40	0.35	0.25
$p(E_1 \mid H_i)$	0.3	0.8	0.5
$p(E_2 \mid H_i)$	0.9	0.0	0.7
$p(E_3 \mid H_i)$	0.6	0.7	0.9

Assume that we first observe evidence E_3. The expert system computes the posterior probabilities for all hypotheses as

$$p(H_i|E_3)=\frac{p(E_3|H_i)\times p(H_i)}{\sum_{k=1}^{3} p(E_3|H_i)\times p(H_k)}, \qquad i=1,2,3$$

Thus,

$$p(H_1|E_3)=\frac{0.6\cdot 0.40}{0.6\cdot 0.40+0.7\cdot 0.35+0.9\cdot 0.25}=0.34$$

$$p(H_2|E_3)=\frac{0.7\cdot 0.35}{0.6\cdot 0.40+0.7\cdot 0.35+0.9\cdot 0.25}=0.34$$

$$p(H_3|E_3)=\frac{0.9\cdot 0.25}{0.6\cdot 0.40+0.7\cdot 0.35+0.9\cdot 0.25}=0.32$$

Suppose now that we observe evidence E_1. The posterior probabilities are calculated as

$$p(H_i|E_1E_3)=\frac{p(E_1|H_i)\times p(E_3|H_i)\times p(H_i)}{\sum_{k=1}^{3} p(E_1|H_i)\times p(E_3|H_i)\times p(H_k)}, \qquad i=1,2,3$$

Hence,

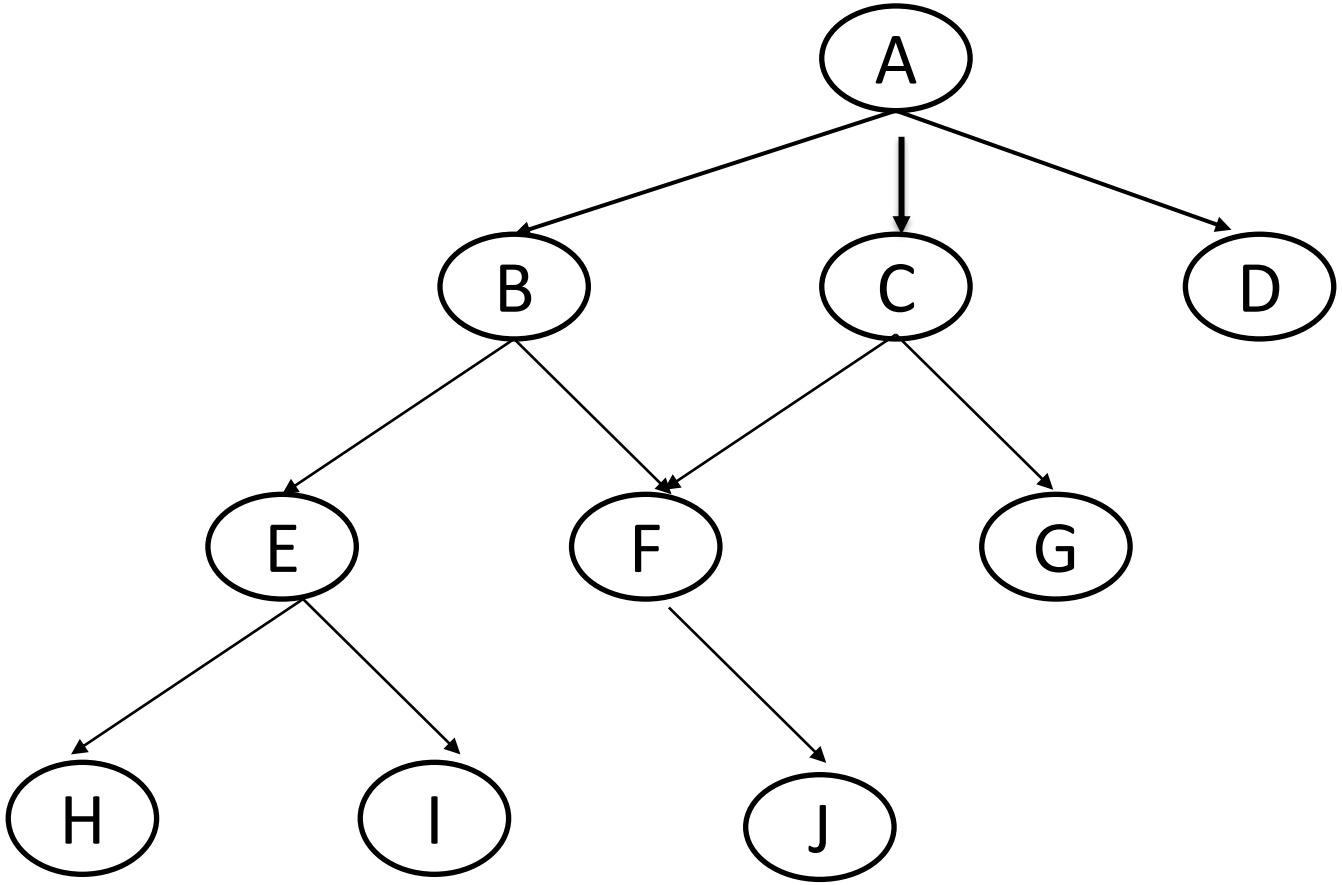
$$p(H_1|E_1E_3)=\frac{0.3\cdot 0.6\cdot 0.40}{0.3\cdot 0.6\cdot 0.40+0.8\cdot 0.7\cdot 0.35+0.5\cdot 0.9\cdot 0.25}=0.19$$

$$p(H_2|E_1E_3)=\frac{0.8\cdot 0.7\cdot 0.35}{0.3\cdot 0.6\cdot 0.40+0.8\cdot 0.7\cdot 0.35+0.5\cdot 0.9\cdot 0.25}=0.52$$

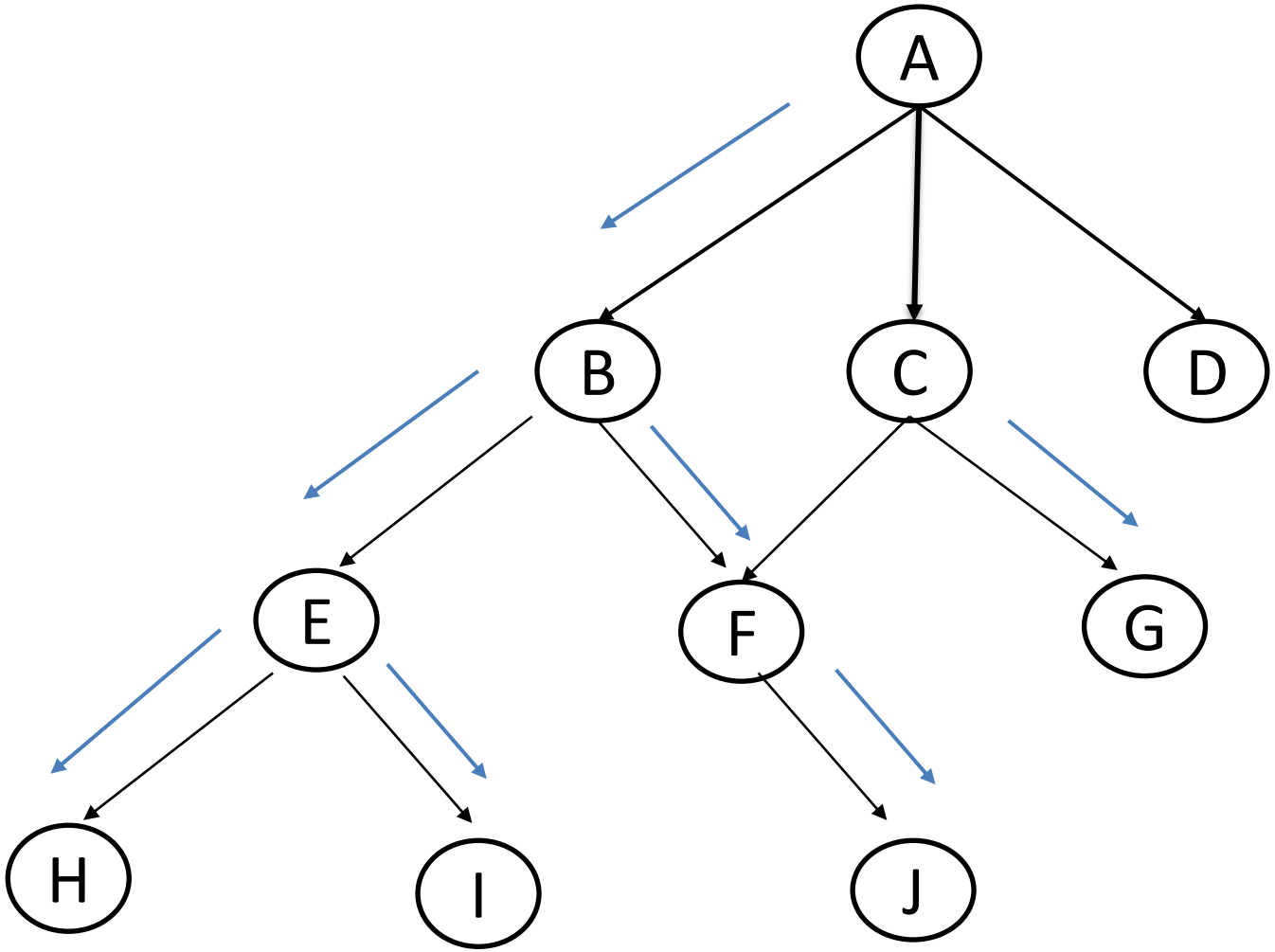
$$p(H_3|E_1E_3)=\frac{0.5\cdot 0.9\cdot 0.25}{0.3\cdot 0.6\cdot 0.40+0.8\cdot 0.7\cdot 0.35+0.5\cdot 0.9\cdot 0.25}=0.29$$

Hypothesis H_2 has now become the most likely one.

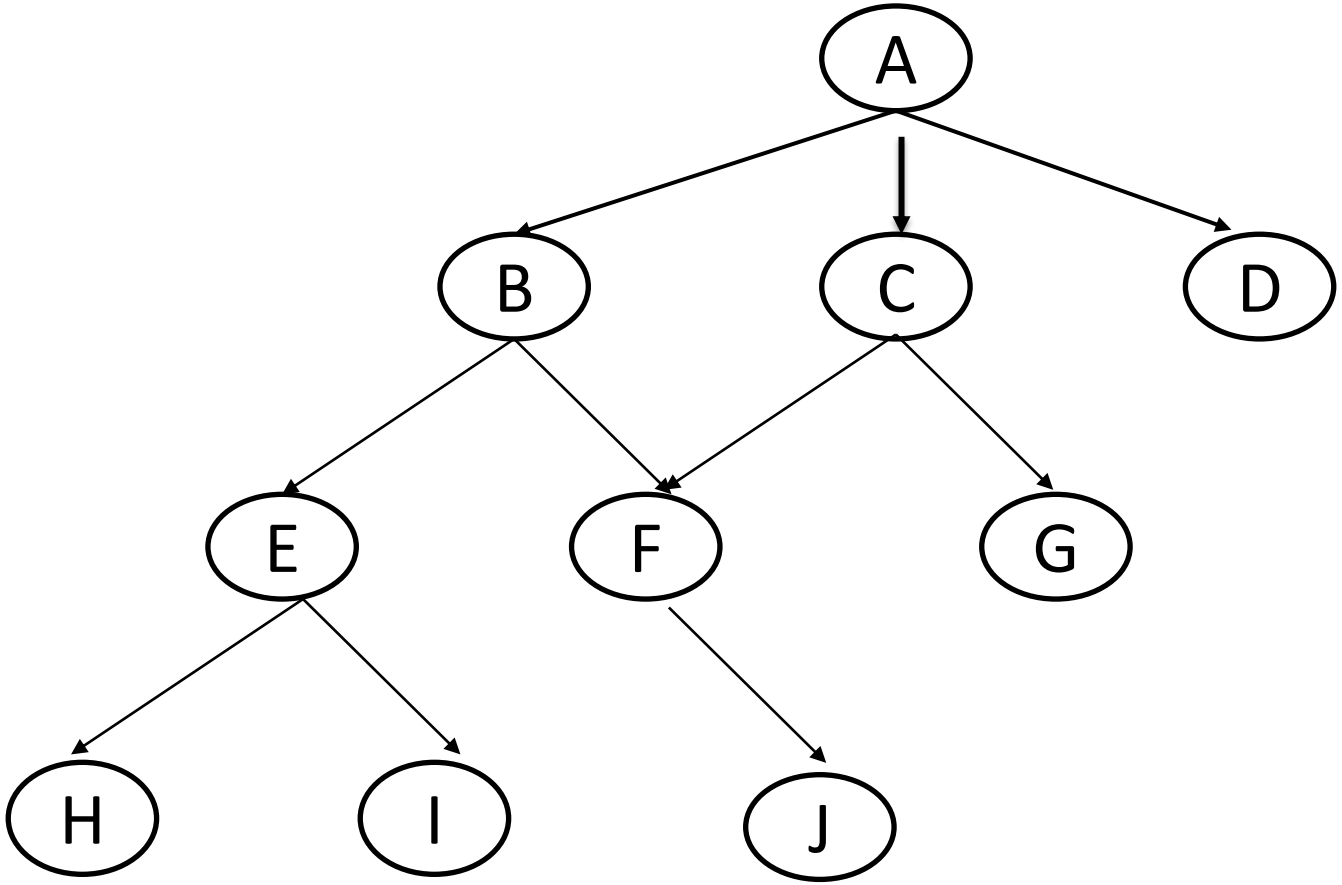
Apply the depth first search algorithm on the following graph, where the start state is (A) and the desired goal state is (G)



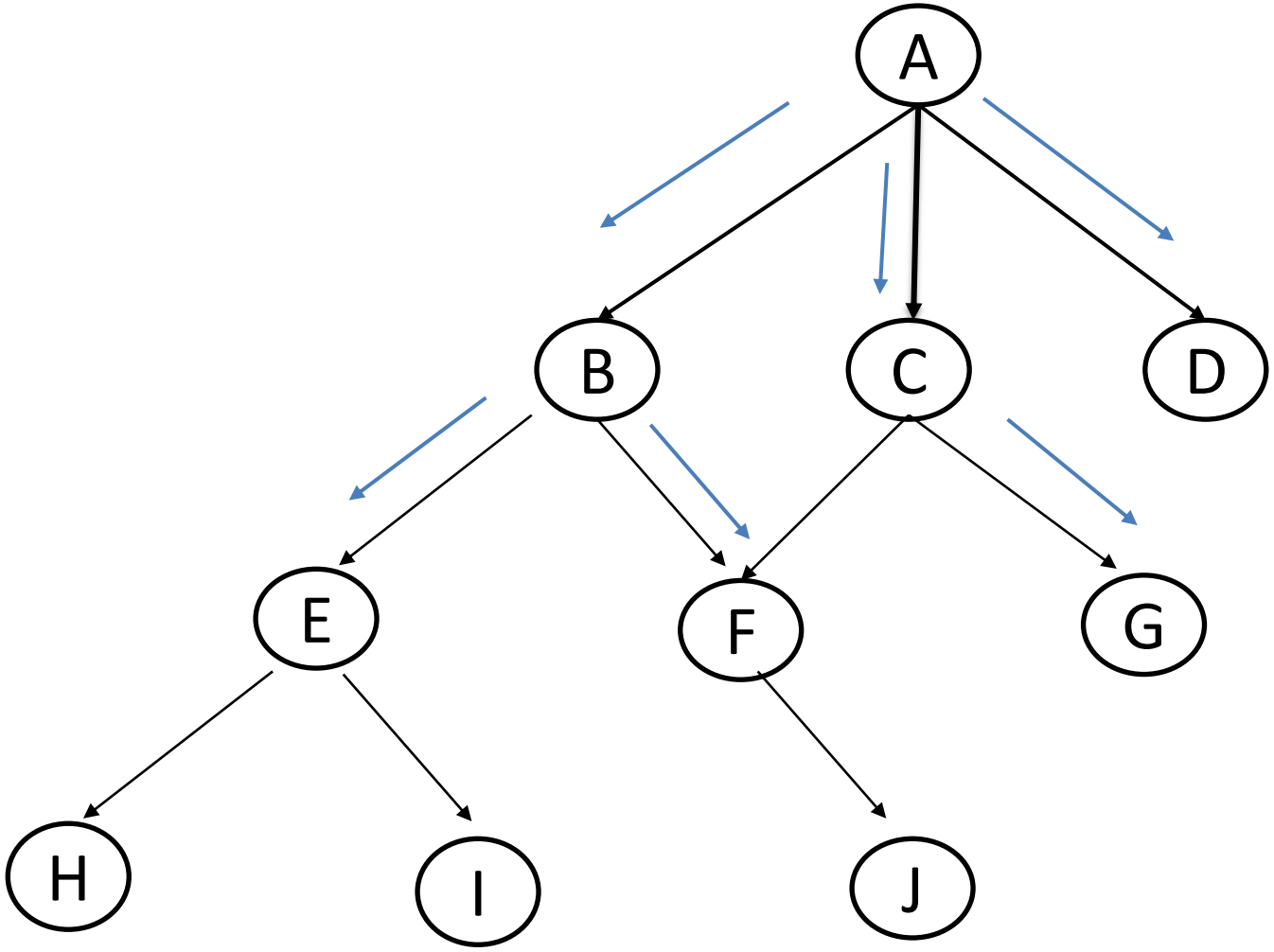
Iteration	X	Open	Closed
0	-	[A]	[]
1	A	[BCD]	[A]
2	B	[EFCD]	[BA]
3	E	[HIFCD]	[EBA]
4	H	[IFCD]	[HEBA]
5	I	[FCD]	[IHEBA]
6	F	[JCD]	[FIHEBA]
7	J	[CD]	[JFIHEBA]
8	C	[GD]	[CJFIHEBA]
9	G	G is the goal	



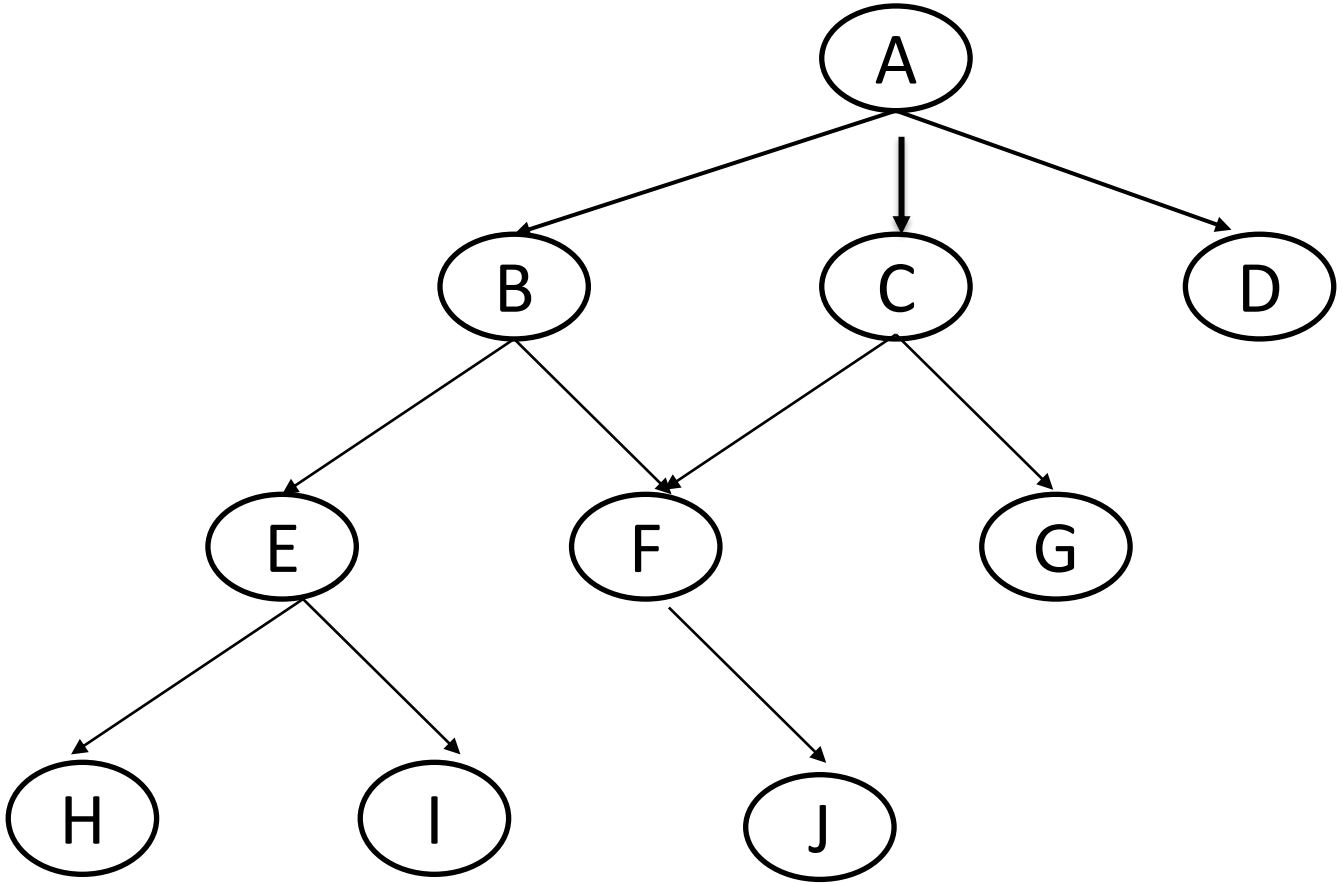
Apply the Breadth first search algorithm on the following graph, where the start state is (A) and the desired goal state is (G)



Iteration	X	Open	Closed
0	-	[A]	[]
1	A	[BCD]	[A]
2	B	[CDEF]	[BA]
3	C	[DEFG]	[CBA]
4	D	[EFG]	[DCBA]
5	E	[FGHI]	[EDCBA]
6	F	[GHIJ]	[FEDCBA]
7	G	G is the goal	

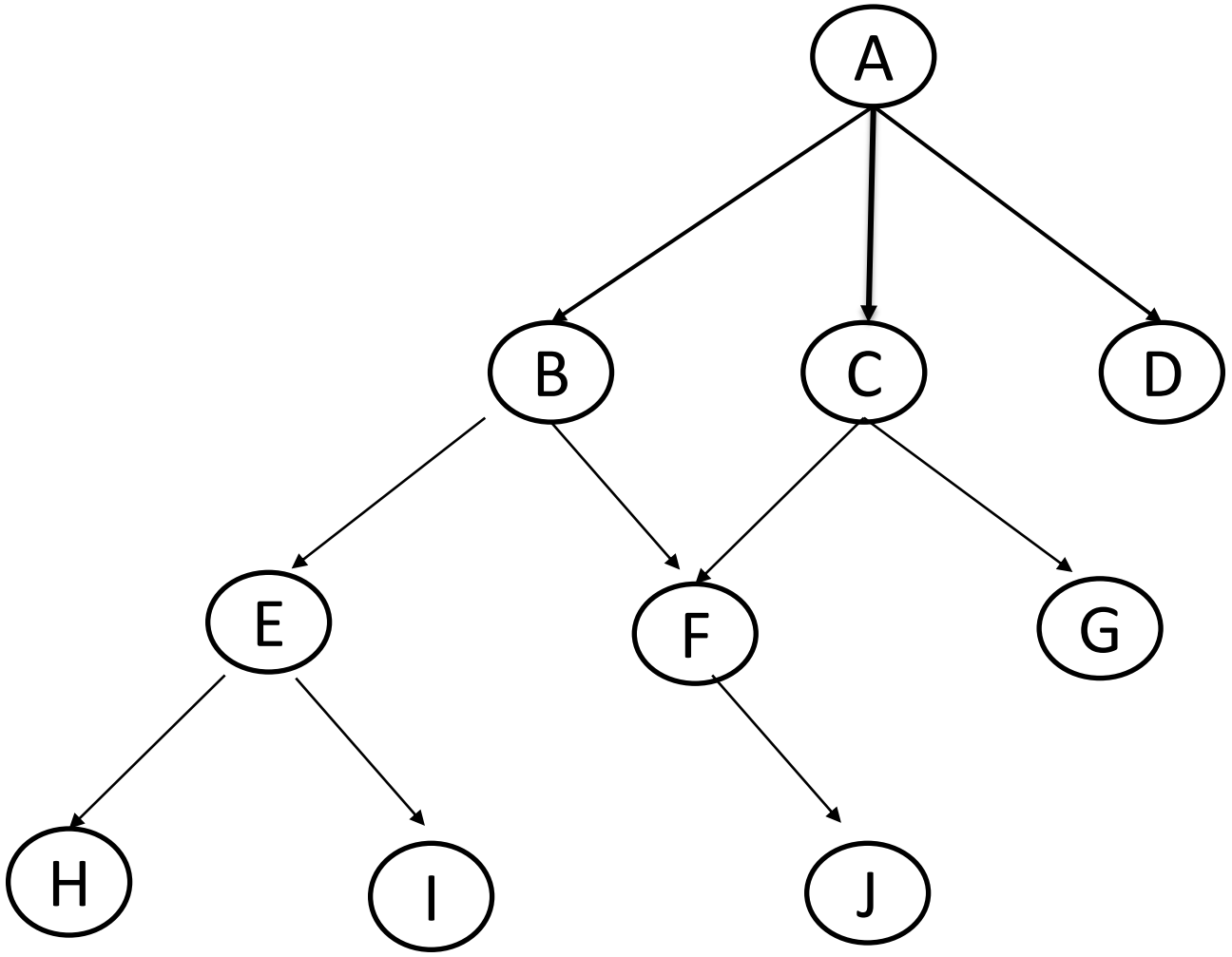


Apply the BackTrack search algorithm on the following graph, where the start state is (A) and the desired goal state is (G)

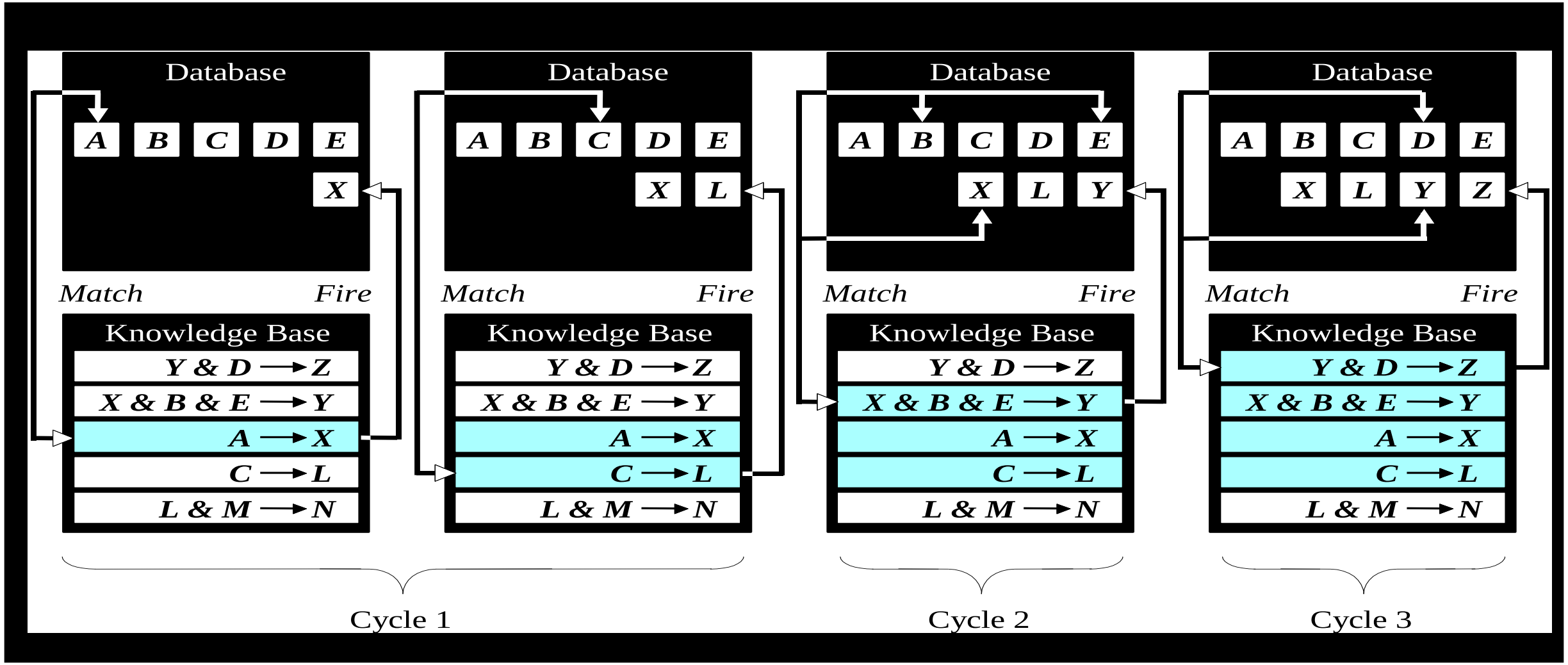


الالجوزيم هنا ليه طريقين
أولا: ان Node ليها children فكدا هيضيفها في SL ويضيف ال children بتوعها في NSL وال DE زي ما هي هسيبها
ثانيا: ان Node دي ملهاش children فكدا هيكرر مجموعه من الخطوات تحت شرط ان CS تساوي اول عنصر ف SL فكدا هضيف ال nodeدي في DE وهحذف اول عنصر في SLو NSL وهاخد اول عنصر ف NSL وأحطه في CS

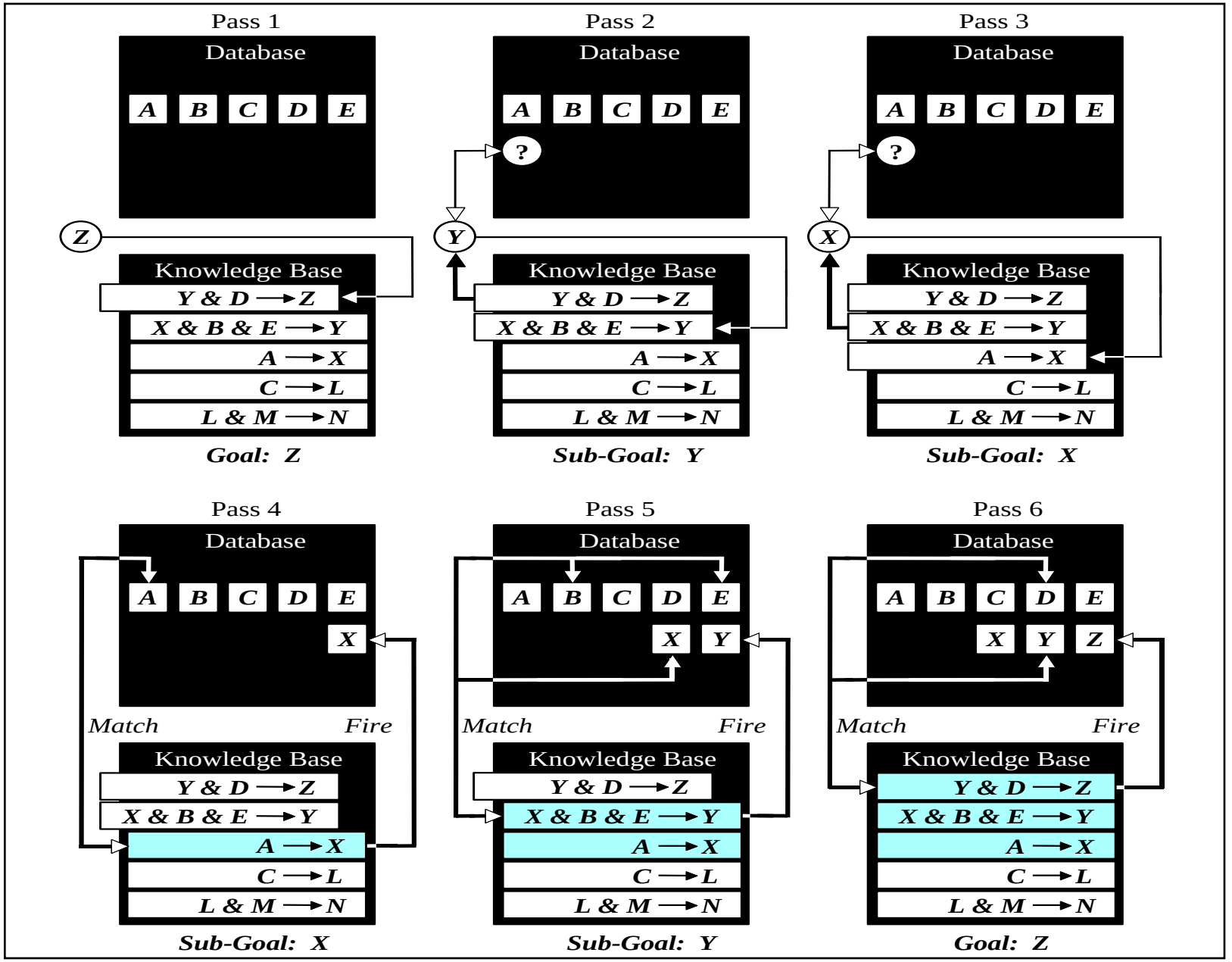
Iteration	CS	SL	NSL	DE
0	A	[A]	[A]	[]
1	B	[BA]	[BCDA]	[]
2	E	[EBA]	[EFBCDA]	[]
3	H	[HEBA]	[HIEFBCDA]	[]
	I	[EBA]	[IEFBCDA]	[H]
4	I	[IEBA]	[IEFBCDA]	[H]
	E	[EBA]	[EFBCDA]	[IH]
	F	[BA]	[FBCDA]	[EIH]
5	F	[FBA]	[FBCDA]	[EIH]
6	J	[JFBA]	[JFBCDA]	[EIH]
	F	[FBA]	[FBCDA]	[JEIH]
	B	[BA]	[BCDA]	[FJEIH]
	C	[A]	[CDA]	[BJEIH]
7	C	[CA]	[CDA]	[BJEIH]
8	G	[GCA]	[GCDA]	[BJEIH]
9	G is the goal, path = GCA			

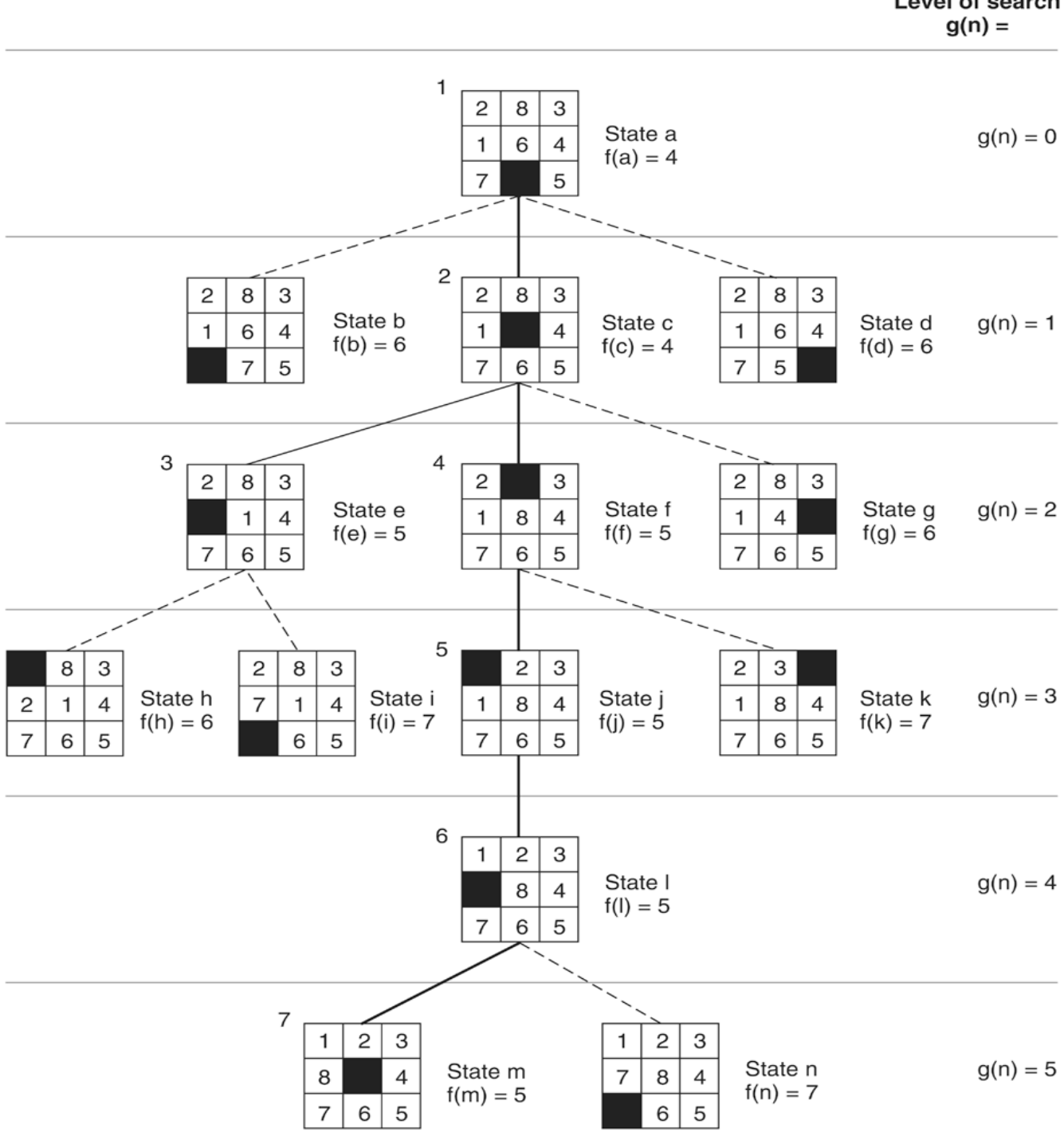


Forward chaining



Backward chaining




Level of search
g(n) =
1
State a
f(a) = 4
g(n) = 0
2
State b
f(b) = 6
State c
f(c) = 4
State d
f(d) = 6
g(n) = 1
3
State e
f(e) = 5
4
State f
f(f) = 5
State g
f(g) = 6
g(n) = 2
State h
f(h) = 6
State i
f(i) = 7
5
State j
f(j) = 5
State k
f(k) = 7
g(n) = 3
6
State l
f(l) = 5
g(n) = 4
7
State m
f(m) = 5
State n
f(n) = 7
g(n) = 5

The successive stages of **open** and **closed** that generate this graph are:

1. **open = [a4];**
   closed = [ ]
2. **open = [c4, b6, d6];**
   closed = [a4]
3. **open = [e5, f5, b6, d6, g6];**
   closed = [a4, c4]
4. **open = [f5, h6, b6, d6, g6, l7];**
   closed = [a4, c4, e5]
5. **open = [j5, h6, b6, d6, g6, k7, l7];**
   closed = [a4, c4, e5, f5]
6. **open = [l5, h6, b6, d6, g6, k7, l7];**
   closed = [a4, c4, e5, f5, j5]
7. **open = [m5, h6, b6, d6, g6, n7, k7, l7];**
   closed = [a4, c4, e5, f5, j5, l5]
8. **success, m = goal!**

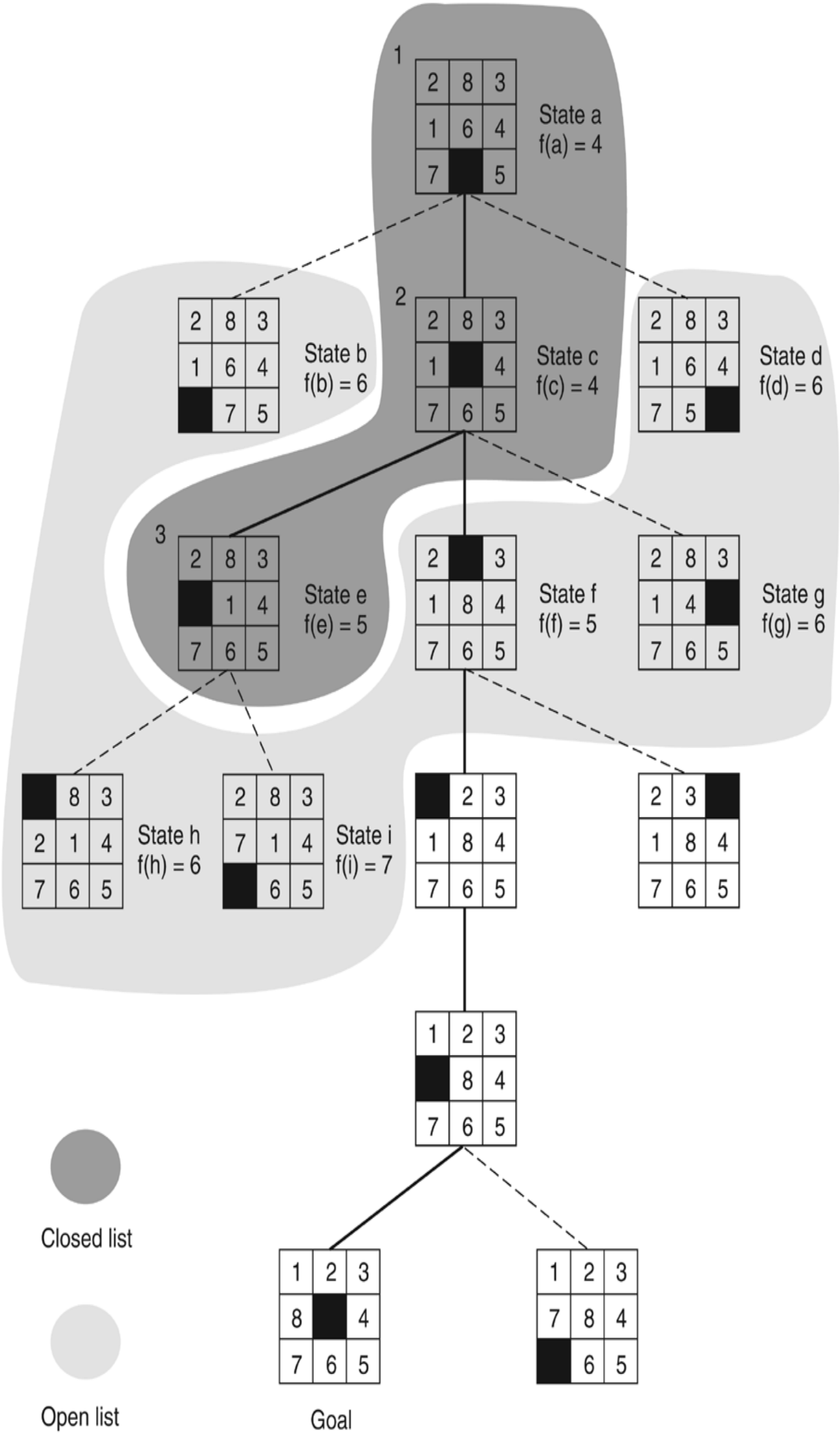
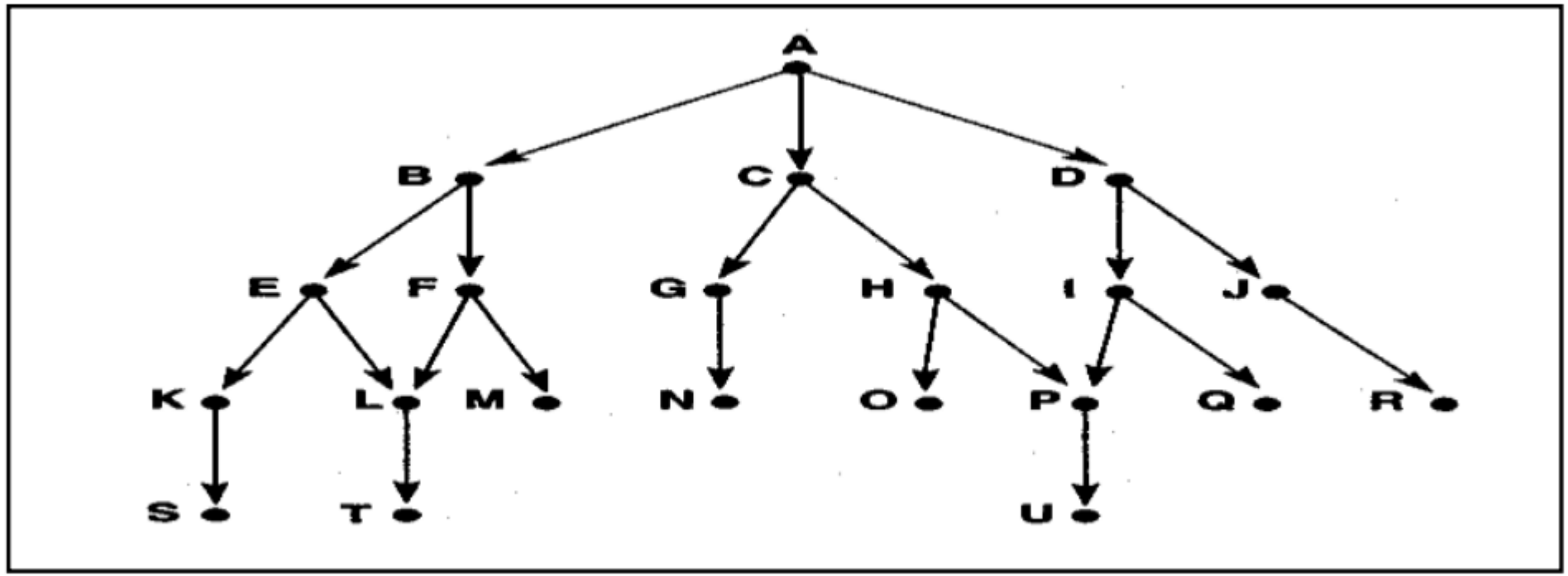
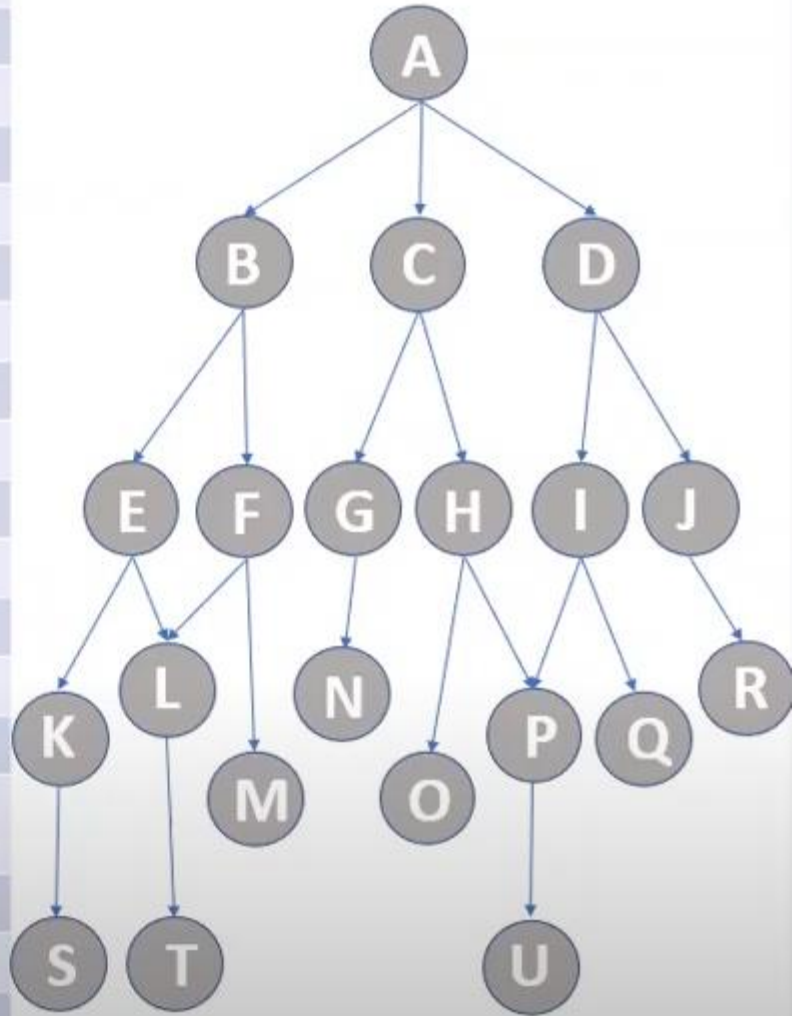


Figure 4.11: **open** and **closed** as they appear after the third iteration of heuristic search.


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U

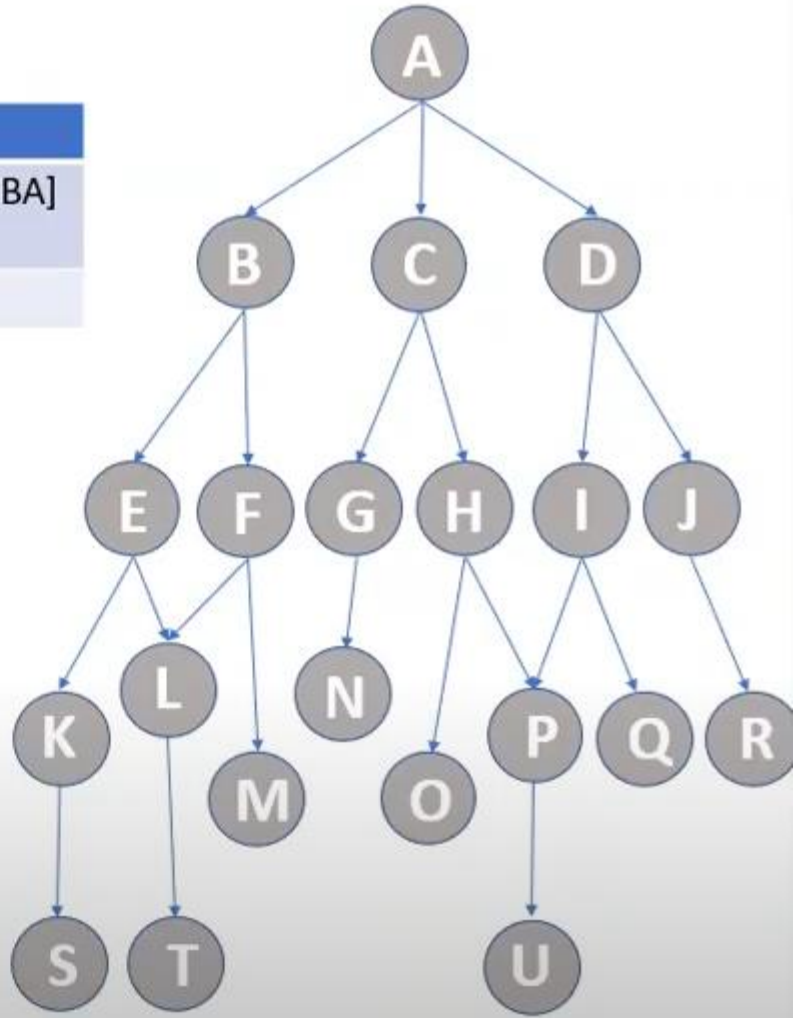
DFS

Iteration	X	Open	Closed
0	-	[A]	[]
1	A	[BCD]	[A]
2	B	[EFCD]	[BA]
3	E	[KLFCD]	[EBA]
4	K	[SLFCD]	[KEBA]
5	S	[LFCD]	[SKEBA]
6	L	[TFCD]	[LSKEBA]
7	T	[FCD]	[TLSKEBA]
8	F	[MCD]	[FTLSKEBA]
9	M	[CD]	[MFTLSKEBA]
10	C	[GHD]	[CMFTLSKEBA]
11	G	[NHD]	[GCMFTLSKEBA]
12	N	[HD]	[NGCMFTLSKEBA]
13	H	[OPD]	[HNGCMFTLSKEBA]
14	O	[PD]	[OHNGCMFTLSKEBA]
15	P	[UD]	[POHNGCMFTLSKEBA]
16	U	[D]	[UPOHNGCMFTLSKEBA]
17	D	[IJ]	[DUPOHNGCMFTLSKEBA]
18	I	[QJ]	[IDUPOHNGCMFTLSKEBA]
19	Q	[J]	[QIDUPOHNGCMFTLSKEBA]



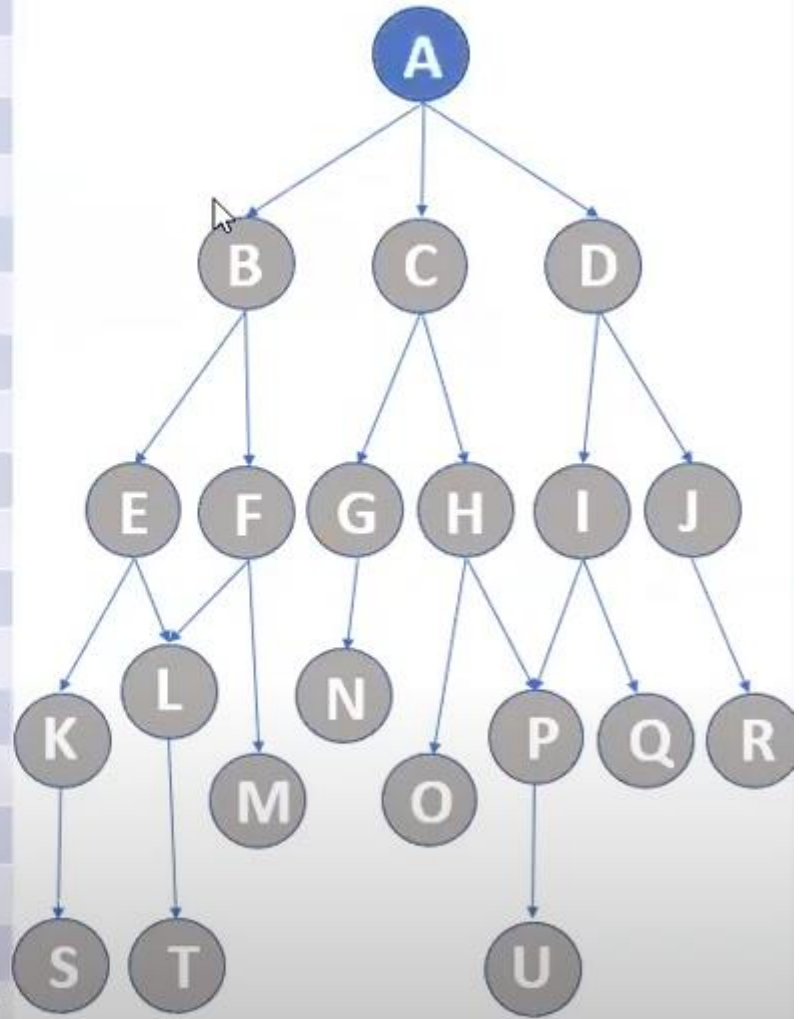
DFS

Iteration	X	Open	Closed
20	J	[R]	[JQIDUPOHNGCMFTLSKEBA]
21	R		R is the goal



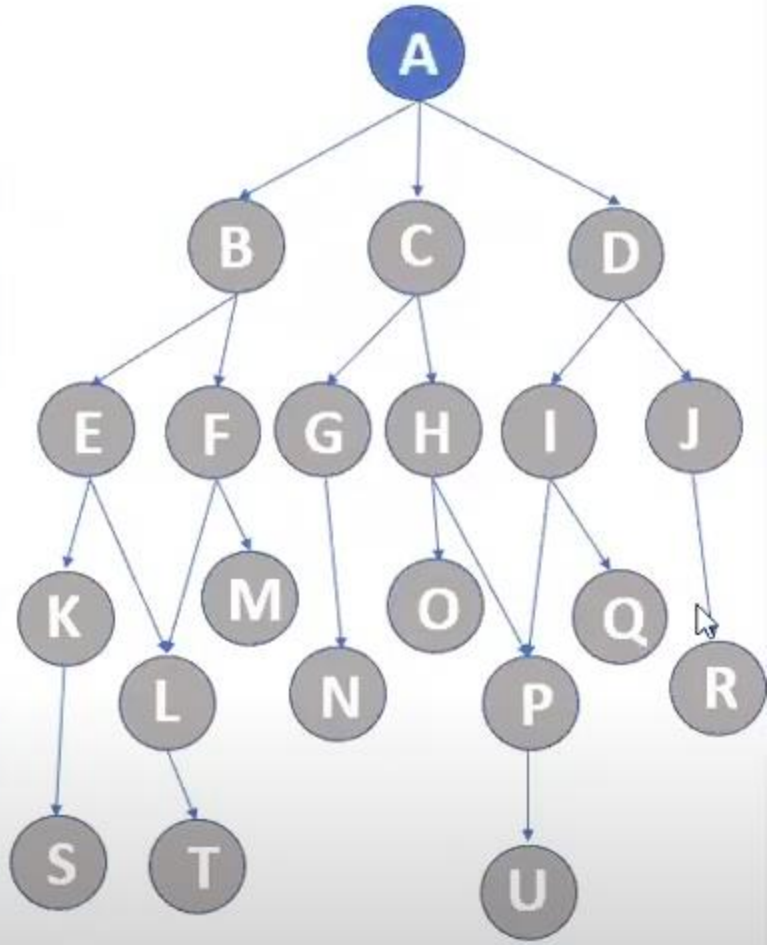
BFS

Iteration	X	Open	Closed
0	-	[A]	[]
1	A	[BCD]	[A]
2	B	[CDEF]	[BA]
3	C	[DEFGH]	[CBA]
4	D	[EFGHIJ]	[DCBA]
5	E	[FGHIJKL]	[EDCBA]
6	F	[GHIJKLM]	[FEDCBA]
7	G	[HIJKLMN]	[GFEDCBA]
8	H	[IJKLMNOP]	[HGFEDCBA]
9	I	[JKLMNOPQ]	[IHGFEDCBA]
10	J	[KLMNOPQR]	[JIHGFEDCBA]
11	K	[LMNOPQRS]	[KJIHGFEDCBA]
12	L	[MNOPQRST]	[LKJIHGFEDCBA]
13	M	[NOPQRST]	[MLKJIHGFEDCBA]
14	N	[OPQRST]	[NMLKJIHGFEDCBA]
15	O	[PQRST]	[ONMLKJIHGFEDCBA]
16	P	[QRSTU]	[PONMLKJIHGFEDCBA]
17	Q	[RSTU]	[QPONMLKJIHGFEDCBA]
18	R	R is the goal	



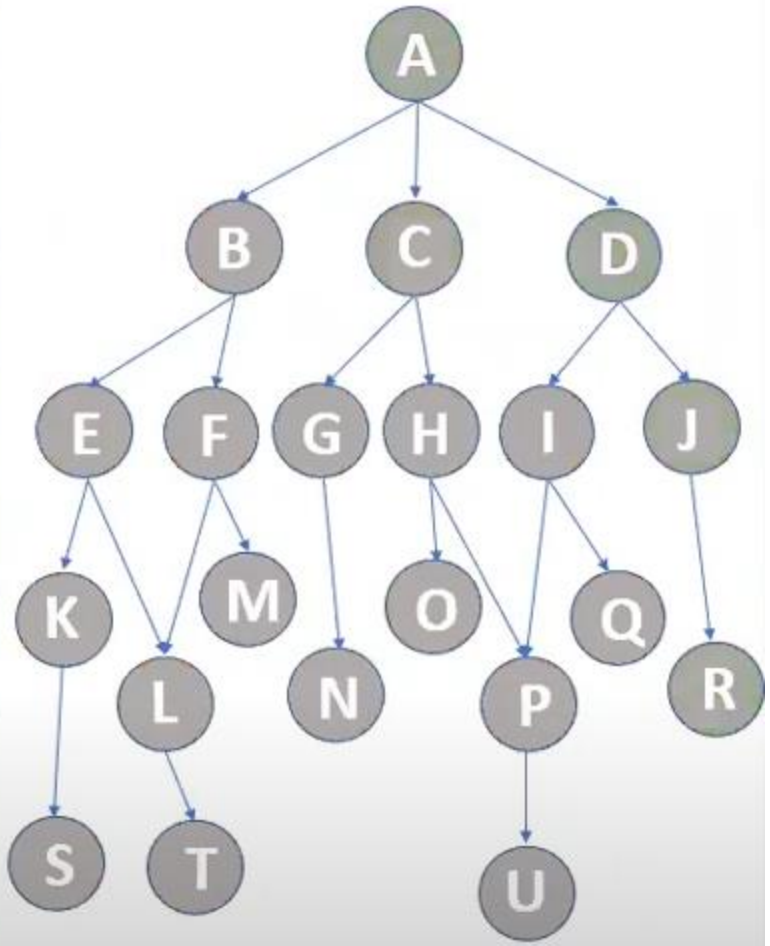
Backtrack

Iteration	CS	SL	NSL	DE
0	A	[A]	[A]	[]
1	B	[BA]	[BCDA]	[]
2	E	[EBA]	[EDBCDA]	[]
3	K	[KEBA]	[KLEFBCDA]	[]
4	S	[SKEBA]	[SKLEFBCDA]	[]
5	L	[LEBA]	[LEFBCDA]	[KS]
6	T	[TLEBA]	[TLEFBCDA]	[KS]
7	F	[FBA]	[FBCDA]	[ELTKS]
8	M	[MFBA]	[MFBCDA]	[ELTKS]
9	C	[CA]	[CDA]	[BFMELTKS]
10	G	[GCA]	[GHCDA]	[BFMELTKS]
11	N	[NGCA]	[NHCDA]	[BFMELTKS]



Iteration	CS	SL	NSL	DE
12	H	[HCA]	[HCDA]	[GNBFMELTKS]
13	O	[OHCA]	[OPHCDA]	[GNBFMELTKS]
14	P	[PHCA]	[PHCDA]	[OGNBFMELT KS]
15	U	[UPHCA]	[PHCDA]	[OGNBFMELT KS]
16	D	[DA]	[DA]	[CHPUONBFM ELTKS]
17	I	[IDA]	[IJDA]	[CHPUONBFM ELTKS]
18	Q	[QIDA]	[QIJDA]	[CHPUONBFM ELTKS]
19	J	[JDA]	[JDA]	[IQCHPUONB FMELTKS]
20	R	[RJDA]	[RJDA]	[IQCHPUONB FMELTKS]

Backtrack



R is the goal and the path is

A -> D -> J -> R

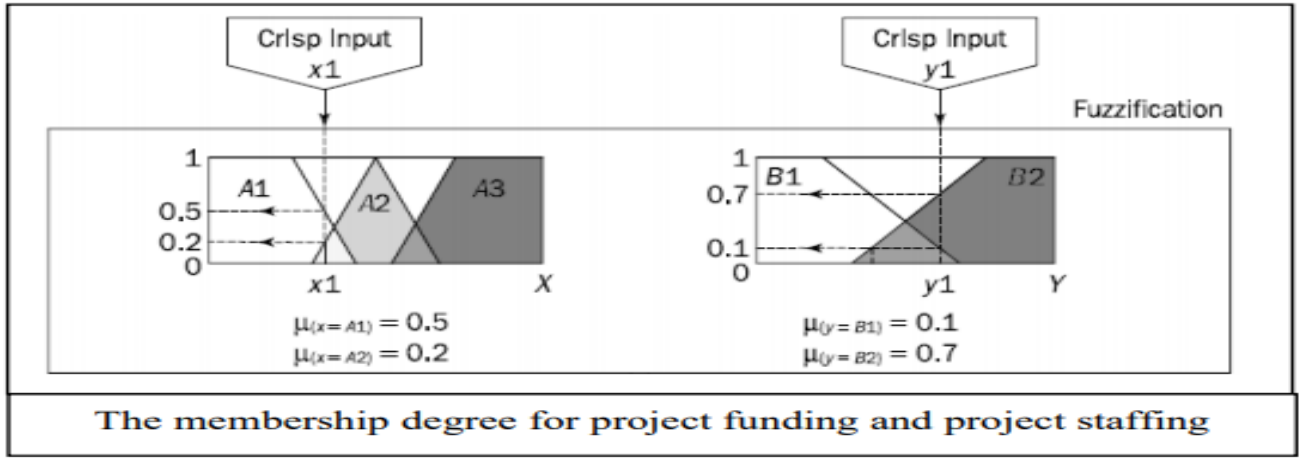
Question Three:

Draw the basic structure (Mamdani-style) that simulate the Fuzzy inference(Fuzzification, Rule evaluation, Aggregation of rule consequents, Defuzzification) for the following rules

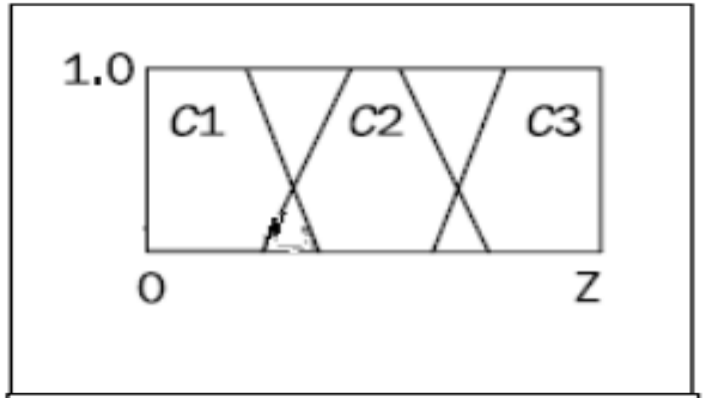
1. *IF project_funding is adequate*
   OR project_staffing is small
   THEN risk is low
2. *IF project_funding is marginal*
   AND project_staffing is large
   THEN risk is normal
3. *IF project_funding is inadequate*
   THEN risk is high

Suppose the ranges of project funding and project staffing between 1 to 100 per cent.
And the crisp input x1=0.35 and y1=0.6

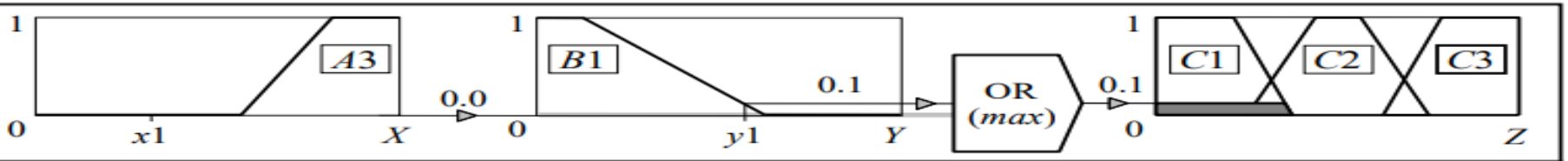
The membership degree for project funding and project staffing and risk as follow:



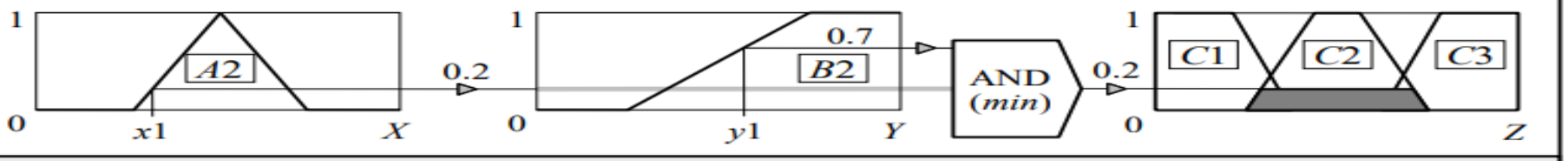
The membership degree for project funding and project staffing



The membership degree for risk



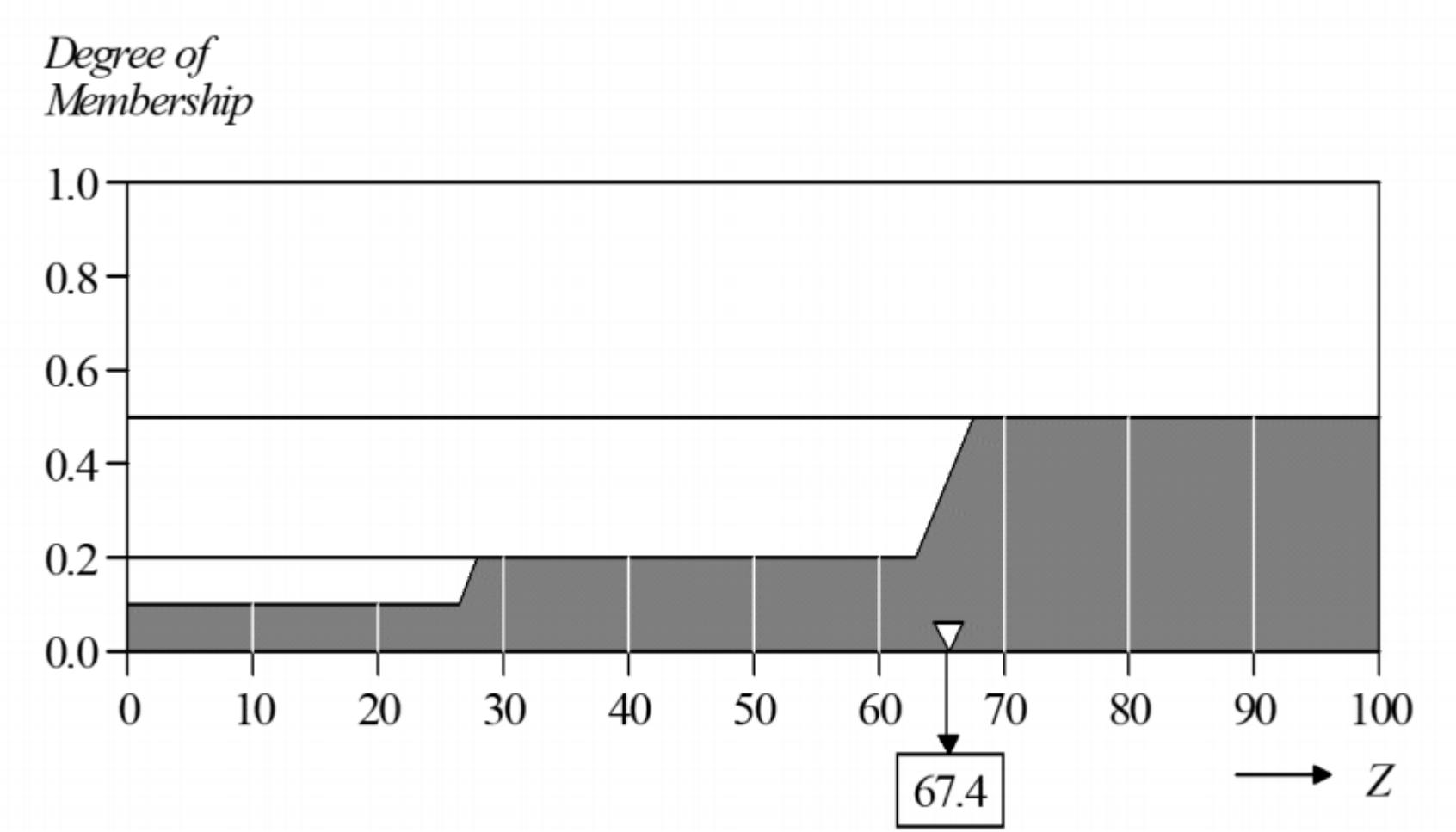
Rule 1: IF x is $A3$ (0.0) OR y is $B1$ (0.1) THEN z is $C1$ (0.1)



Rule 2: IF x is $A2$ (0.2) AND y is $B2$ (0.7) THEN z is $C2$ (0.2)

Rule 3: IF x is $A1$ (0.5) THEN z is $C3$ (0.5)

$$COG = \frac{(0+10+20)\times 0.1+(30+40+50+60)\times 0.2+(70+80+90+100)\times 0.5}{0.1+0.1+0.1+0.2+0.2+0.2+0.2+0.5+0.5+0.5+0.5} = 67.4$$



Question Four:

a. Define the ontology.

b. How to develop an ontology.

c. Consider the following tabular data (bibliography) and answer the following questions.

Books					
Id	Title	Author	Publisher	Category	ISBN
1	Introduction to computers	Jim Hendler	springer	Semantic Web	978-0-12-385965-5
2	Essential bioinformatics	JIN XIONG	springer	Bioinformatics	978-0-470-02001-2
3	Pattern discovery in bioinformatics	David L. Olson	springer	Data Mining	978-3-540-76916-3
4	Advanced databases	Borko Furht	springer	Cloud Computing	978-1-4419-6523-3
5	Algorithms of bioinformatics	Frédéric Dardel	springer	Bioinformatics	978-0-470-12321-2

1. Convert the tabular data into XML formats where the "id", "title", "author", "publisher", "category" and "ISBN" are attributes for the element book and the root element is library.

2. Convert the tabular data into the RDF representation using the following:

i. The global URI for the rdf namespace is http://www.w3.org/1999/02/22-rdf-syntax-ns#.

ii. "bib" stands for http://www.amazon.com/books-used-books-textbooks.

(Convert 2 records only).

a. Define the ontology.

An **ontology** is a formal explicit description of concepts in a domain of discourse (**classes** (sometimes called **concepts**)), properties of each concept describing various features and attributes of the concept (**slots** (sometimes called **roles** or **properties**)), and restrictions on slots (**facets** (sometimes called **role restrictions**)).

An ontology together with a set of individual **instances** of classes constitutes a **knowledge base**. In reality, there is a fine line where the ontology ends and the knowledge base begins.

b. How to develop an ontology

defining classes in the ontology

arranging the classes in a taxonomic (subclass–superclass) hierarchy,

defining slots and describing allowed values for these slots,

filling in the values for slots for instances.

c. 1.

```
<?xml version="1.0" encoding="UTF-8"?>
<library>
<book>
<ID> 1 </ID>
<title> Introduction to computers</title>
<author>Jim Hendler</author>
<publisher>springer</publisher>
<category>Semantic Web</category>
<ISBN>978-0-12-385965-5</ISBN>
</book>
<book>
<ID> 2 </ID>
<title>Essential Bioinformatics</title>
<author>JIN XIONG</author>
<publisher>springer</publisher>
<category> Bioinformatics</category>
<ISBN>978-0-470-02001-2</ISBN>
</book>
</library>
```

```
2.<rdf:RDF
xmlns:bib="http://www.amazon.com/textbooks#"
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntaxns#"
<bib:Book rdf:about="http://www.amazon.com/textbooks#Book1">
<bib:id>1</bib:id>
<bib:title> Introduction to computers </bib:title>
 <bib:author> Jim Hendler</bib:author>
<bib:publisher> springer</bib:publisher>
<bib:category> Semantic Web</bib:category>
<bib:ISBN>978-0-12-385965-5</bib:ISBN>
</bib:Book>
<bib:Book rdf:about="http://www.amazon.com/textbooks#Book2">
<bib:id>2</bib:id>
<bib:title>Essential Bioinformatics</bib:title >
<bib:author> JIN XIONG</bib:author>
<bib:publisher> springer</bib:publisher>
<bib:category> Bioinformatics </bib:category>
<bib:ISBN>978-0-470-02001-2</bib:ISBN>
</bib:Book>
 </rdf:RDF>
```

Question Five:

By using the tabular data in the question 3 answer the following:

a. By using the graph representation, represent the relation between

i. The publisher and the title of the book (published)

ii. The title and the author of the book (wroteby)

iii. Merge the two graphs in one graph.

a. By using the graph representation, represent the relation between

A. The publisher and the title of the book (published)

B. The title and the author of the book (wroteby)

C. Merge the two graphs in one graph.

MINISTRY OF HIGH EDUCATION
Obour High Institute
For Management & Informatics

معاهد العبور
Obour Institutes

FINAL EXAM

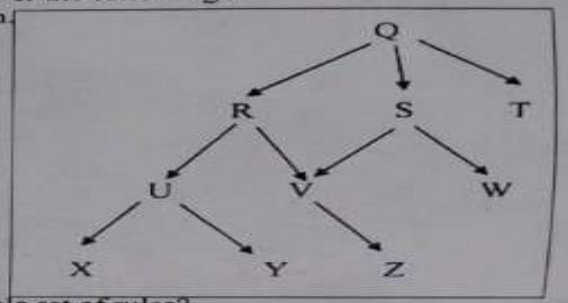
Course Name: Artificial Intelligence	Term: First Academic Year: 2019-2020
Course Code: CS6411	Date: 30/12/2019
Intake & Major: Computer Science	Time: 2 Hours
Course Professor:Prof. Khaled ElBahnasy	No. of Questions:4 No. of Pages:1

Answer the following questions

Question One: **[30 Marks]**

By using the following graph and from start state Q to goal state W answer the followings:

a) Write and trace the algorithms of Depth-first and Breadth-First search.
b) Write and trace the algorithm of Backtrack search.
Keep track of the successive value of NSL, SL, CS and DE.
Where SL for state list, NSL for new state list, CS for current state and DE for dead ends.



Question Two: **[20 Marks]**

Let you have the following rules
Rule 1: IF Y is true AND D is true THEN Z is true
Rule 2: IF X is true AND B is true AND E is true THEN Y is true
Rule 3: IF A is true THEN X is true
Rule 4: IF C is true THEN L is true
Rule 5: IF L is true AND M is true THEN N is true
And the facts A, B, C, D and E are true.
Show: how forward chaining and backward chaining works for this simple set of rules?

Question Three: **[10 Marks]**

Write and trace of the execution of best_first_search by using evaluation function f(n) for following state space generated in heuristic search of the 8-puzzle graph.
Consider the evaluation function $f(n)=g(n)+h(n)$,
where n is any state encountered in the search.
g(n) is the cost of n from the start state.
h(n) is the heuristic estimate of the cost of going from n to the goal.
What is the role of the g(n), answer byanother trace with $f(n)=h(n)$.
Write your comments.

2	8	3
1	6	4
7		5

Start State

1	2	3
8		4
7	6	5

Goal State

Question Four: **[10 Marks]**

a. Define the ontology.
b. How to develop an ontology.
c. Consider the following tabular data (bibliography) and answer the following questions.

Books

Id	Title	Author	Publishd	Category	ISBN
1	Introduction to computers	Jim Hendler	springer	Semantic Web	978-0-12-385965-5
2	Essential bioinformatics	JIN XIONG	springer	Bioinformatics	978-0-470-02001-2
3	Pattern discovery in bioinformatics	David L. Olson	springer	Data Mining	978-3-540-76916-3
4	Advanced databases	Borko Furht	springer	Cloud Computing	978-1-4419-6523-3
5	Algorithms of bioinformatics	Frédéric Dardel	springer	Bioinformatics	978-0-470-12321-2

Convert the tabular data into the RDF representation using the following:
i. The global URI for the rdf namespace is http://www.w3.org/1999/02/22-rdf-syntax-ns#.
ii. "bib" stands for http://www.amazon.com/books-used-books-textbooks.
(Convert 2 records only).

Good Luck