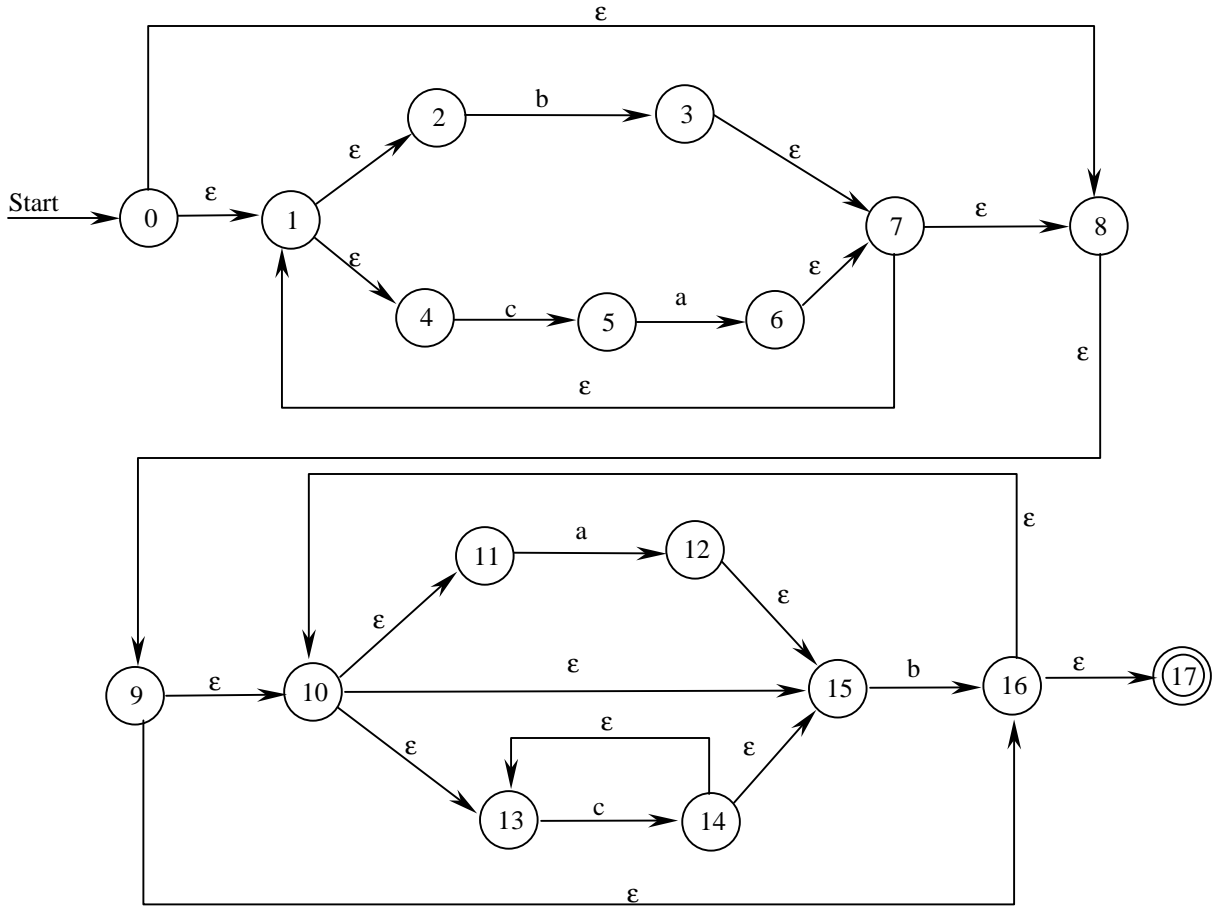


Solution Midterm Exam

Question 1:



Question 2:

$$\text{Closure}(1) = \{1, 4\} = A$$

$$\text{DFAedge}(A, a) = \text{closure}(\text{edge}(A, a)) = \text{closure}(\{2\}) = \{2\} = B$$

$$\text{DFAedge}(A, b) = \text{closure}(\text{edge}(A, b)) = \text{closure}(\{3\}) = \{3\} = C$$

$$\text{DFAedge}(B, a) = \text{closure}(\text{edge}(B, a)) = \text{closure}(\{\}) = \{\}$$

$$\text{DFAedge}(B, b) = \text{closure}(\text{edge}(B, b)) = \text{closure}(\{1, 3, 4\}) = \{1, 3, 4\} = D$$

$$\text{DFAedge}(C, a) = \text{closure}(\text{edge}(C, a)) = \text{closure}(\{6\}) = \{6\} = E\text{-accepting}$$

$$\text{DFAedge}(C, b) = \text{closure}(\text{edge}(C, b)) = \text{closure}(\{\}) = \{\}$$

$$\text{DFAedge}(D, a) = \text{closure}(\text{edge}(D, a)) = \text{closure}(\{2, 6\}) = \{2, 6\} = F\text{-accepting}$$

$$\text{DFAedge}(D, b) = \text{closure}(\text{edge}(D, b)) = \text{closure}(\{3\}) = \{3\} = C$$

$$\text{DFAedge}(E, a) = \text{closure}(\text{edge}(E, a)) = \text{closure}(\{\}) = \{\}$$

$$\text{DFAedge}(E, b) = \text{closure}(\text{edge}(E, b)) = \text{closure}(\{5\}) = \{2, 5\} = G$$

$$\text{DFAedge}(F, a) = \text{closure}(\text{edge}(F, a)) = \text{closure}(\{\}) = \{\}$$

$$\text{DFAedge}(F, b) = \text{closure}(\text{edge}(F, b)) = \text{closure}(\{1, 3, 5\}) = \{1, 2, 3, 4, 5\} = H$$

$$\text{DFAedge}(G, a) = \text{closure}(\text{edge}(G, a)) = \text{closure}(\{4\}) = \{4\} = I$$

$$\text{DFAedge}(G, b) = \text{closure}(\text{edge}(G, b)) = \text{closure}(\{1, 3\}) = \{1, 3, 4\} = D$$

$$\text{DFAedge}(H, a) = \text{closure}(\text{edge}(H, a)) = \text{closure}(\{2, 4, 6\}) = \{2, 4, 6\} = J\text{-accepting}$$

$$\text{DFAedge}(H, b) = \text{closure}(\text{edge}(H, b)) = \text{closure}(\{1, 3\}) = \{1, 3, 4\} = D$$

$$\text{DFAedge}(I, a) = \text{closure}(\text{edge}(I, a)) = \text{closure}(\{\}) = \{\}$$

$$\text{DFAedge}(I, b) = \text{closure}(\text{edge}(I, b)) = \text{closure}(\{3\}) = \{3\} = C$$

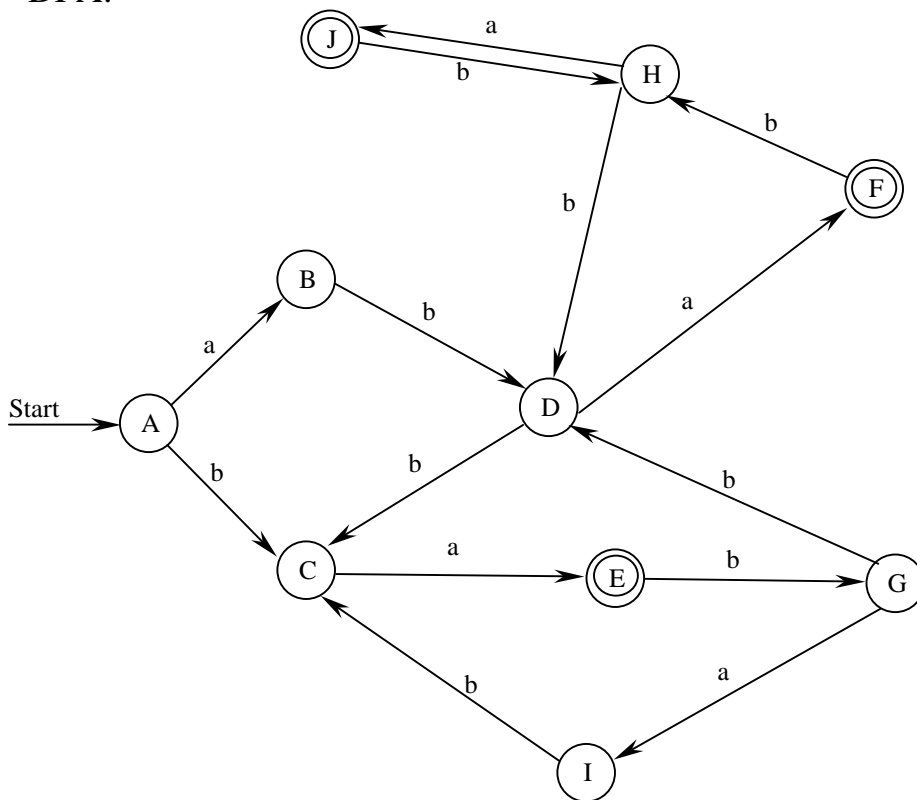
$$\text{DFAedge}(J, a) = \text{closure}(\text{edge}(J, a)) = \text{closure}(\{\}) = \{\}$$

$$\text{DFAedge}(J, b) = \text{closure}(\text{edge}(J, b)) = \text{closure}(\{1, 2, 3, 4, 5\}) = \{1, 2, 3, 4, 5\} = H$$

State transition table

State	a	b
A	B	C
B	-	D
C	E	
D	F	C
E	-	G
F	-	H
G	I	D
H	J	D
I	-	C
J	-	H

DFA:



Question 3

First we make our grammar compatible for LL(1) parsing by introducing another production:

$B \rightarrow B S$
 $B \rightarrow S$
 $S \rightarrow i = E;$
 $S \rightarrow i [E] = E;$
 $E \rightarrow E . i$
 $E \rightarrow i$

Then we eliminate left recursion

$B \rightarrow S B'$
 $B' \rightarrow S B'$
 $B' \rightarrow \epsilon$
 $S \rightarrow i = E;$
 $S \rightarrow i [E] = E;$
 $E \rightarrow i E'$
 $E' \rightarrow . i E'$
 $E' \rightarrow \epsilon$

Next we do left factoring

$B \rightarrow S B'$
 $B' \rightarrow S B'$
 $B' \rightarrow \epsilon$
 $S \rightarrow i X$
 $X \rightarrow = E;$
 $X \rightarrow [E] = E;$
 $E \rightarrow i E'$
 $E' \rightarrow . i E'$
 $E' \rightarrow \epsilon$

Now we are ready to construct the FIRST and FOLLOW sets (we use \$ as end-of-file marker):

	Nullable	FIRST	FOLLOW
B		i	\$
B'	Yes	i	\$
S		i	i \$
X		= [;\$
E		i];
E'	Yes	.];

Then we construct the *predictive parsing table*

	;	=	.	[]	i	\$
B						B->SB'	
B'						B'->SB'	B'-> ϵ
S						S->i X	
X		X->= E;		X->[E] = E;			
E						E->i E'	
E'	E'-> ϵ		E' -> . i E		E'-> ϵ		

Because each entry contains at most one production, the grammar is LL(1).