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5. $\langle R \rangle \longrightarrow \langle R \rangle \text{'|'} \langle R_1 \rangle \mid \langle R_1 \rangle \mid (R)$

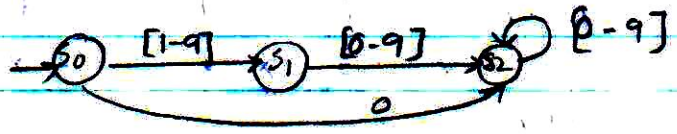
$\langle R_1 \rangle \longrightarrow R_1 \cdot R_2 \mid R_2 \mid R$

$\langle R_2 \rangle \longrightarrow R_2^* \mid R_3 \mid R$

$R_3 \longrightarrow \langle TERMSYM \rangle$

$\langle TERMSYM \rangle \longrightarrow a \mid b \mid c \mid \ldots \mid i \mid j$

4. The DFA for recognizing Num in TL13 is following



Pseudocode:

```
State = 'S0'
For each character in given word
    case
        state 'S0' :
            case [1-9] :
                state = 'S1'
            case [0] : state 'S2'
            else REPORT ERROR
        State 'S1' :
            case [0-9] :
                State = 'S2'
            else REPORT ERROR
        State 'S2' :
            case [0-9] : state = 'S2'
            else Report ERROR
Report Success and return NUM.
```

1. (a)

```
Program
    var x as int ;
    var Y as bool ;
begin
    x := readInt ;
    if Y = true then
        x := x div 2 ;
        x := x - 1 ;
    end ;

    while Y <= false do
        if ( x + Y 1 = 100 ) then
            x := x * (1 + x) ;
        else
            Y := false ;
        end ;
    end ;
    WriteInt x ;

end
```

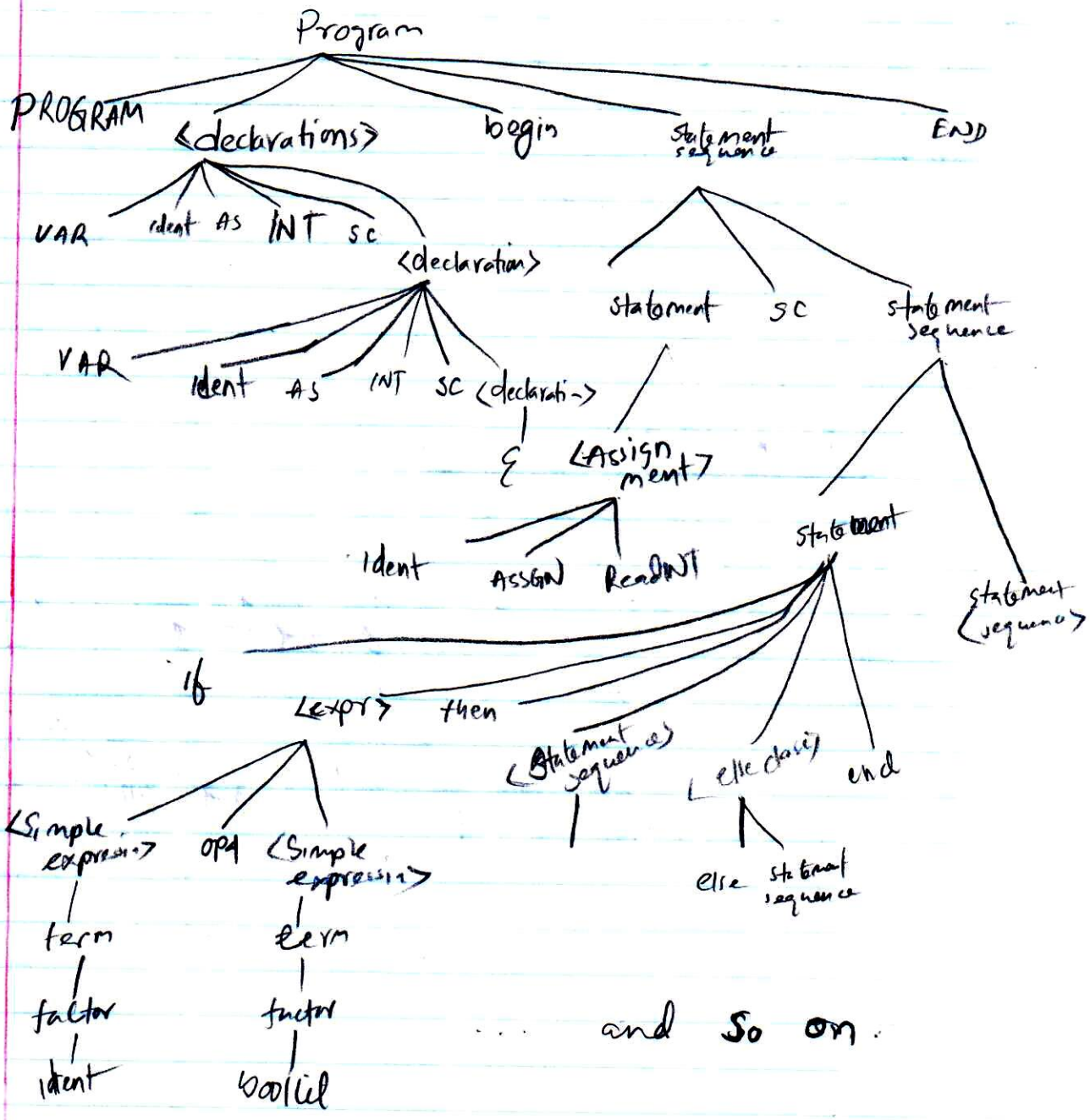
1.
(b)

```
Program
        VAR ident AS INT ;
        VAR ident AS INT
begin
        ident ASSGN READINT ;
        If ident ASSGN bool then
            ident ASSGN ident OP2 num ;
            ident ASSGN ident OP3 num ;
        end ;
        While ident OP4 boollit do
              if (ident OP3 ident OP4 num) then
                 ident ASSGN ident OP2 LP num -
                                      OP3 ident RP ;
              else
                 ident ASSGN boollit ;

              end;
        end ;
        WRITEINT ident ;
end ;
```

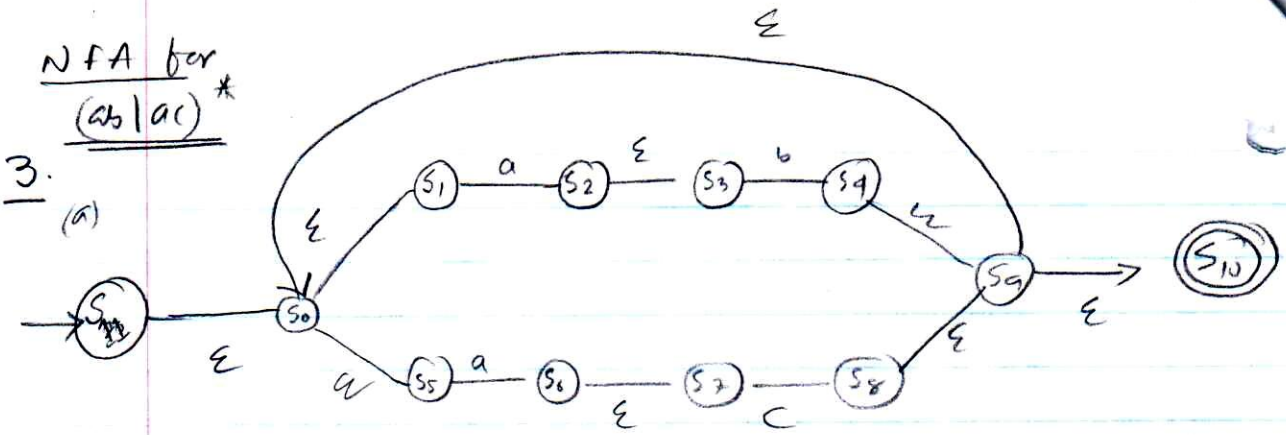
1

(c)


Program
PROGRAM
<declarations>
begin
statement sequence
END
VAR
ident
AS
INT
SC
<declaration>
statement
SC
statement sequence
VAR
ident
AS
INT
SC
<declarati->
ε
<Assign ment>
Ident
ASSIGN
ReadINT
statement
statement sequence
if
<expr>
then
<Statement sequence>
<elle clause>
end
<Simple expression>
OP4
<Simple expression>
else
statement sequence
term
term
factor
factor
ident
boolLit
... and So on.

3. (a)

NFA for $(ab|ac)^*$



NFA for $(01)^*11001^*$: