Homework 4 Solutions

February 22, 2013

1 TL13

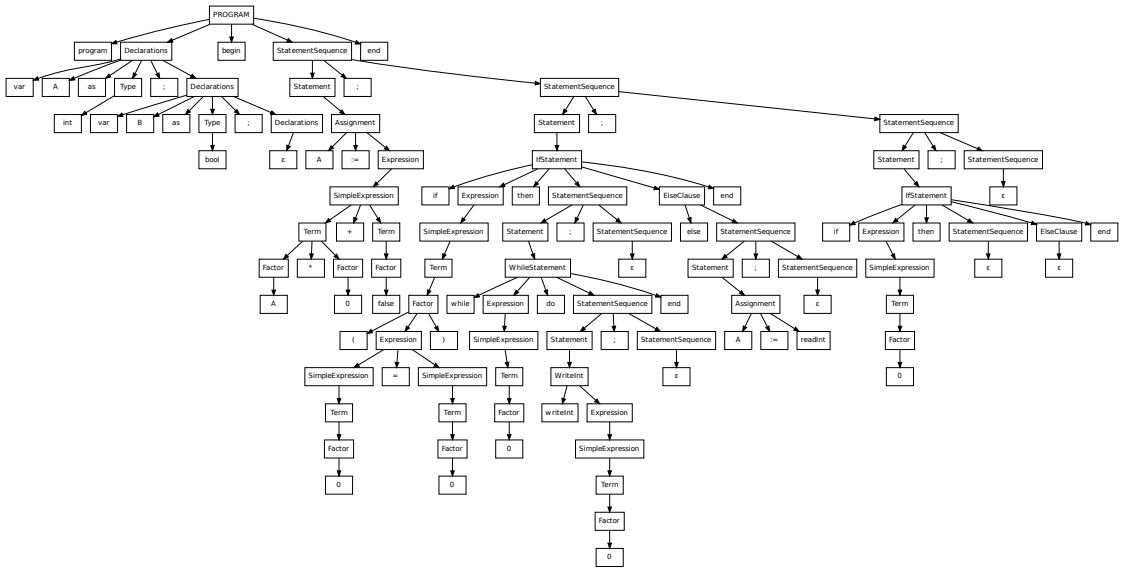
a)

```
PROGRAM
  VAR ident AS INT SC
  VAR ident AS BOOL SC
BEGIN
  ident ASGN ident OP2 num OP3 boollit SC
  IF LP num OP4 num RP THEN
    WHILE num DO
      WRITEINT num SC
    END SC
  ELSE
    ident ASGN READINT SC
  END SC
  IF num THEN END SC
END
```

b)

```
program
  var A as int ;
  var B as bool ;
begin
  A := A * 0 + false ;
  if ( 0 = 0 ) then
    while 0 do
      writeInt 0 ;
    end ;
  else
    A := readInt ;
  end ;
  if 0 then end ;
end
```

c)



2 Regular Expressions

a) $(1100(1100)*(11|\varepsilon))|(0011(0011)*(00|\varepsilon))$

b) (1*01*01*)+|(0*10*10*)+

c) a*b*c*d*e*f*g*h*i*j*k*l*m*n*o*p*q*r*s*t*u*v*w*x*y*z*

d)

(a|b|c|d)(a|b|c|d)*az(a|b|c|d)(a|b|c|d)*a|

(a|b|c|d)(a|b|c|d)*bz(a|b|c|d)(a|b|c|d)*b|

(a|b|c|d)(a|b|c|d)*cz(a|b|c|d)(a|b|c|d)*c|

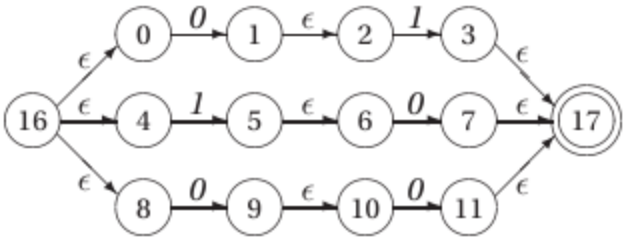
(a|b|c|d)(a|b|c|d)*dz(a|b|c|d)(a|b|c|d)*d

e) Regular expressions are unable to describe matching parenthesis.

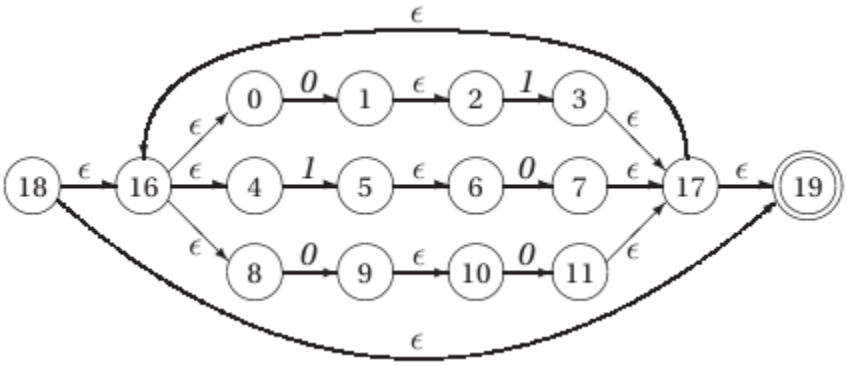
3 Thompson's and Subset Construction

a) Build NFAs for for strings:

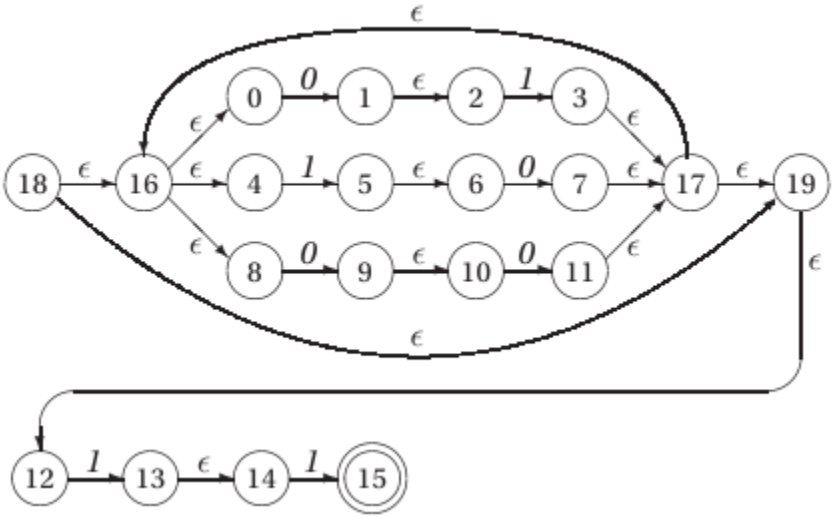
Combine NFAs with OR operations in (01|10|00):



Add states and transitions for Kleene operator.



Concetate NFA for 11 onto end:



b)

Initialization:

$s_0 \leftarrow \varepsilon$-closure(18) = {18,16,0,4,8,19,12}

Round 1:

$s_1 \leftarrow \varepsilon$-closure($\delta(s_0, 0)$) = {1,9,2,10}

$s_2 \leftarrow \varepsilon$-closure($\delta(s_0, 1)$) = {5,13,6,14}

Round 2:

$s_3 \leftarrow \varepsilon$-closure($\delta(s_1, 0)$) = {11,17,16,0,4,8,19,12}

$s_4 \leftarrow \varepsilon$-closure($\delta(s_1, 1)$) = {3,17,16,0,4,8,19,12}

$s_5 \leftarrow \varepsilon\text{-closure}(\delta(s_2, 0)) = \{7,17,16,0,4,8,19,12\}$

$s_6 \leftarrow \varepsilon\text{-closure}(\delta(s_2, 1)) = \{15\}$

Round 3:

$\varepsilon\text{-closure}(\delta(s_3, 0)) = s_1$

$\varepsilon\text{-closure}(\delta(s_3, 1)) = s_2$

$\varepsilon\text{-closure}(\delta(s_4, 0)) = s_1$

$\varepsilon\text{-closure}(\delta(s_4, 1)) = s_2$

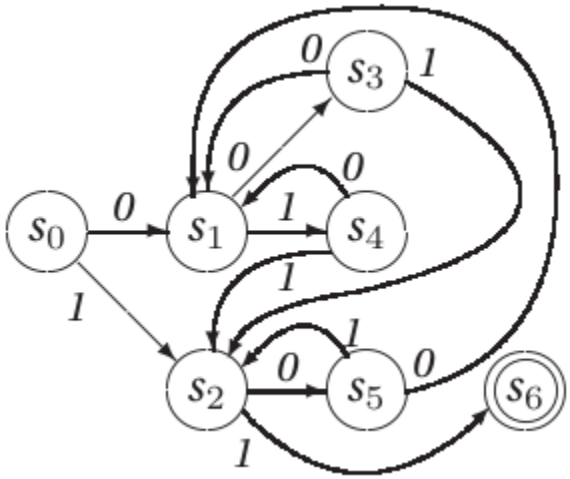
$\varepsilon\text{-closure}(\delta(s_5, 0)) = s_1$

$\varepsilon\text{-closure}(\delta(s_5, 1)) = s_2$

$\varepsilon\text{-closure}(\delta(s_6, 0)) = \emptyset$

$\varepsilon\text{-closure}(\delta(s_6, 1)) = \emptyset$

Worklist is now empty. The resulting DFA:



4 Direct Coded Scanner

```
fun ParseNum =
        if s.peek in [1..9]
                concatenate(s.next,ParseNum')
        else if s.next == 0
                ParseNum''

fun ParseNum' =
        if s.peek in [0..9]
                concatenate(s.next,ParseNum')
        else if s.peek == empty
                empty
    else
                Error

fun ParseNum'' =
```

```
if s.peek == empty
        0
else
        Error
```

5 Make Grammar Unambiguous

<ALT> ::= <ALT> “|” <CON> | <CON>

<CON> ::= <CON><CLO> | <CLO>

<CLO> ::= <CLO>* | <PAR>

<PAR> ::= (<ALT>) | <TERMSYM>

<TERMSYM> ::= a | b | c | d | e | f | g | h | i | j