CS 1622. Homework 1

1) ((0 1 1)*0) 1 (001)

NFA

NFA State Table

	0	1	ε
A	LFJ	G	BKCIDE
B	FJ	G	CIDE
C	F	G	DE
D	F		
E		G	
F	FJ	G	HCIDE
G	FJ	G	HCIDE
H	FJ	G	CIDE
I	J		
J			P
K	L		
L	M		
M		N	
N			P

DFA

DFA STATE TABLE

	0	1
ABKCIDE	LFJ	G
LFJ	MFJ	G
G	FJ	G
MFJ	FJ	NG
FJ	FJ	G
NG	FJ	G

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1.0
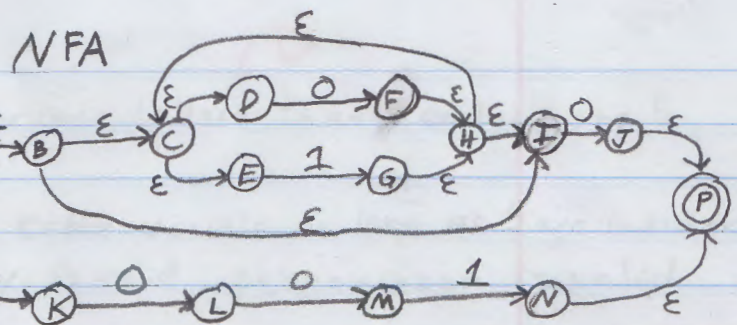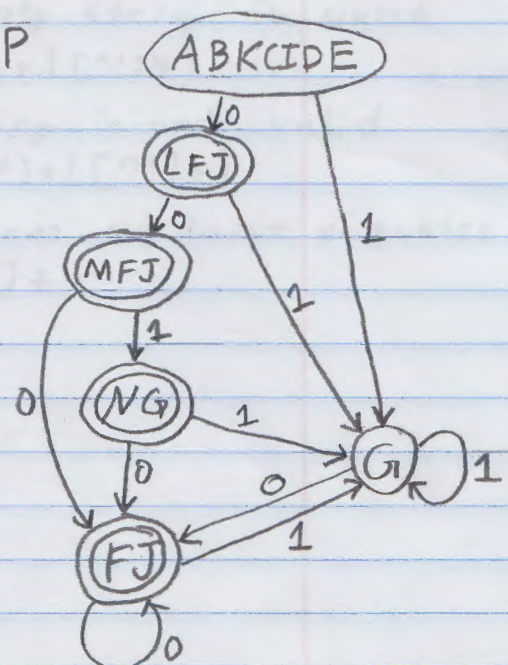
2)a) All strings of lowercase letters that contain the 5
    vowels in order
   - assuming there can be extra vowels as long as 5 are in order
     ie zadue iouy is valid   zabeauiozuv is valid
        $L = [a-z]*$
        $RE = \{L\}a\{L\}e\{L\}i\{L\}o\{L\}u\{L\}$

   - assuming there can be only one instance of each vowel
        $L = [bcdfghjklmnpqrstvwxyz]$
        $RE = \{L\}a\{L\}e\{L\}i\{L\}o\{L\}u\{L\}$

   - assuming vowels can appear multiple times but must be ordered
     ie aaeziou is valid   aeaiou is not
        $La = [abcdfghjklmnpqrstvwxyz]$ $Le = [bcdefghjklmnpqrstvwxyz]$
        $Li = [bcdfghijklmnpqrstvwxyz]$ $Lo = [bcdfghjklmnopqrstvwxyz]$
        $Lu = [bcdfghjklmnpqrstuvwxyz]$
        $RE = \{La\}a\{Le\}e\{Li\}i\{Lo\}o\{Lu\}u\{Lu\}$

   b) Strings with an even number of quotes in them.
      - assuming a quote with zero quotes is
        valid, assuming the empty string is valid
        $RE = (([^']*'[^']*'[^']*) + |[^']*)$
      - assuming the empty string is not valid
        $RE = (([^']*'[^']*'[^']*) + |[^']+)$
      - assuming the string requires at least 2 quotes
        $RE = ([^']*'[^']*'[^']*)+$

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3)a) Set of strings with an equal number of
1's and 0's

$$S \rightarrow 1S0 \mid 0S1 \mid SS \mid \varepsilon$$

This grammer works because any time
a 1 is added a 0 is also added

b) Set of strings with an unequal number of
1's and 0's
- language with more 1's than 0's
$$S_1 \rightarrow A1S_1 \mid A1A$$
$$A \rightarrow 0A1 \mid 1A0 \mid AA \mid \varepsilon$$
- language with more 0's than 1's
$$S_0 \rightarrow A0S_0 \mid A0A$$
$$A \rightarrow 0A1 \mid 1A0 \mid AA \mid \varepsilon$$
- Combine these two
$$S \rightarrow S_1 \mid S_0$$
$$S_1 \rightarrow A1S_1 \mid A1A$$
$$A \rightarrow 0A1 \mid 1A0 \mid AA \mid \varepsilon$$
$$S_0 \rightarrow B0S_2 \mid B0B$$
$$B \rightarrow 0B1 \mid 1B0 \mid BB \mid \varepsilon$$

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4) Construct the First and Follow sets for
$$A \rightarrow BAcIFE$$
$$B \rightarrow bEFIg$$
$$E \rightarrow eI\varepsilon$$
$$F \rightarrow fIEH$$
$$H \rightarrow h$$

$First(A) = First(B) + First(F) = \{b,g\} + \{f,e,h\}$
$\qquad = \{b,g,f,e,h\}$

$First(B) = \{b,g\}$

$First(E) = \{e,\varepsilon\}$

$First(F) = \{f\} + First(E) - \varepsilon + First(H) = \{f\} + \{e\} + \{h\}$
$\qquad = \{f,e,h\}$

$First(H) = \{h\}$ ✓

$Follow(A) = \{\$\} + First(c) = \{\$\} + \{c\} = \{\$,c\}$

$Follow(B) = First(A) = \{b,g,f,e,h\}$

$Follow(E) = First(F) + Follow(A) + First(H) = \{f,e,h\} + \{\$,c\}$
$\qquad + \{h\} = \{f,e,h,\$,c\}$

$Follow(F) = First(E) - \varepsilon + Follow(A) + Follow(B)$
$\qquad \{e\} + \{\$,c\} + \{b,g,f,e,h\} = \{b,g,f,e,h,\$,c\}$

$Follow(H) = Follow(F) = \{b,g,f,e,h,\$,c\}$

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5) Determine if the grammers are LL(1)

a) $S \to [S] \mid A$ $\checkmark First([S]) = \{[\}$

$A \to [A] \mid \varepsilon$ $First(A) = \{[, \varepsilon\}$

Not LL1 $First([S]) \cap First(A) = \{[\} \neq \emptyset$

b) $S \to ABc$ LL(1) because for $A + B$ when

$A \to a \mid \varepsilon$ the derive ε the last $First(\alpha) \cap Follow(A)$

$B \to b \mid \varepsilon$ $= \emptyset$ $(\{a\} \cap First(b) \{b\} = \emptyset)$

            $(\{b\} \cap \{c\} = \emptyset)$

c) $S \to ABBA$ $First(a) = \{a\}$ $First(b) = \{b\}$ $First(\varepsilon) = \{\varepsilon\}$

$A \to a \mid \varepsilon$ $A \checkmark First(a) \cap First(\varepsilon) = \emptyset$

$B \to b \mid \varepsilon$ $\checkmark$ only ε derivies ε

          $\checkmark$ B derives ε + $First(a) \cap Follow(A)$

            $Follow(A) = First(B) + Follow(S)$

                $= \{b; \$\}$

             $\{a\} \cap \{b, \$\} = \emptyset$

          B) $Follow(B) = First(B) + First(A)$

                $= \{b, a, \varepsilon\}$

           $\{b\} \cap \{b, a, \varepsilon\} = \{b\} \neq \emptyset$

           Not LL(1)

D) $S \to aAbc \mid bAc$ $\checkmark First(aAbc) \cap First(bAc) = \emptyset$

$A \to b \mid \varepsilon$ $\{a\} \cap \{b\} = \emptyset$

         $\checkmark$ neiter derives ε

       A) $\checkmark First(b) \cap first(\varepsilon) = \emptyset$

         $\checkmark$ only ε derives ε

          $Follow(A) = \{b, c\}$

           $First(b) \cap \{b, c\}$

             $\{b\} \cap \{b, c\} = \{b\} \neq \emptyset$

         Not LL(1)