

Assignment Six

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February 21, 2023

1 Question One

$A \rightarrow BcDA'$
 $A' \rightarrow eD \mid \epsilon$
 $B \rightarrow xBB'$
 $B' \rightarrow yD \mid zD \mid \epsilon$
 $D \rightarrow Z$

2 Question Two

$A \rightarrow wA'$
 $A' \rightarrow xA' \mid yA' \mid \epsilon$

3 Question Three

$A \rightarrow wA' \mid yzA'$
 $A' \rightarrow xA' \mid \epsilon$

4 Question Four

$A \rightarrow Bx$
 $B \rightarrow Cy \mid Dz$
 $C \rightarrow Awp \mid z$
 $D \rightarrow t$

For $i = 1$, there is no immediate left recursion

When $i = 2$ there is also no immediate left recursion

When $i = 3$ we substituted A in C :

$A \rightarrow Bx$
 $B \rightarrow Cy \mid Dz$
 $C \rightarrow Bxwp \mid z$
 $D \rightarrow t$

Then B :

$A \rightarrow Bx$
 $B \rightarrow Cy \mid Dz$
 $C \rightarrow Cyxwp \mid Dzxwp \mid z$

D $\rightarrow$ t

And remove the immediate left recursion in C:

A $\rightarrow$ Bx

B $\rightarrow$ Cy | Dz

C $\rightarrow$ Dz xwp | zC'

C' $\rightarrow$ yxwpC' | ϵ

D $\rightarrow$ t

When $i = 4$, there's no left recursion

5 Question Five

A $\rightarrow$ Bx | Cy

B $\rightarrow$ Cz

C $\rightarrow$ Bw | v

When $i = 1$, no immediate left recursion

When $i = 2$, no immediate left recursion

When $i = 3$, we substitute B in C

A $\rightarrow$ Bx | Cy

B $\rightarrow$ Cz

C $\rightarrow$ Cz w | v

, which we remove the immediate left recursion from

A $\rightarrow$ Bx | Cy

B $\rightarrow$ Cz

C $\rightarrow$ vC'

C' $\rightarrow$ zwC' | ϵ

6 Question Six

$\text{first}(A) = \text{first}(B) \setminus \epsilon \cup \text{first}(x) \cup \text{first}(y) = \{t, w, u, x, y\}$

$\text{first}(B) = \text{first}(C) \cup \text{first}(u) \cup \{\epsilon\} = \{t, w, u, \epsilon\}$

$\text{first}(C) = \text{first}(t) \cup \text{first}(w) = \{t, w\}$

$\text{follow}(A) = \{\$ \} \cup \text{follow}(B) = \{\$, x\}$

$\text{follow}(B) = \{x\}$

$\text{follow}(C) = \text{follow}(A) \cup \{z\} = \{\$, x, z\}$

7 Question Seven

$\text{first}(A) = \text{first}(C) = \text{first}(E) = \{x, z\}$

$\text{first}(B) = \text{first}(a) \cup \{\epsilon\} = \{a, \epsilon\}$

$\text{first}(C) = \text{first}(E) = \{x, z\}$

$\text{first}(D) = \text{first}(b) \cup \{\epsilon\} = \{b, \epsilon\}$
 $\text{first}(E) = \text{first}(x) \cup \text{first}(z) = \{x, z\}$

$\text{follow}(A) = \{\$ \} \cup \text{first}(y) = \{\$, y\}$
 $\text{follow}(B) = \text{follow}(A) = \{\$, y\}$
 $\text{follow}(C) = \text{first}(B) \setminus \epsilon \cup \text{follow}(B) = \{a, \$, y\}$
 $\text{follow}(D) = \text{follow}(C) = \{a, \$, y\}$
 $\text{follow}(E) = \text{first}(D) \setminus \epsilon \cup \text{follow}(D) = \{b, a, \$, y\}$