

CMSC330 Spring 2021 Midterm 2 Solution

1. OCaml

1. B, C, D
2. $x := 6$
3. C
4. B

2. NFA/DFA

1. False
2. $abb^*|baa^*$ (or $ab^+|ba^+$)
3. A
4. 1, 3
5. 2, 3
6. 2
7. X, Y
8. C

3. CFG

1. A, D, E
2. $S \rightarrow \text{epsilon} \mid e \mid f \mid g \mid eSe \mid fSf \mid gSg$
3. D

4. FIRST sets

1. A, B, C, D, E

2. *First apply left factoring:*

$S \rightarrow aL \mid T$

$L \rightarrow b \mid T$

$T \rightarrow bM$

$M \rightarrow c \mid \text{epsilon}$

But now L has overlapping first sets. Simplify L and T:

$S \rightarrow aL \mid bM$

$L \rightarrow b \mid bM$

$M \rightarrow c \mid \text{epsilon}$

And now apply left factoring to L:

$S \rightarrow aL \mid bM$

$L \rightarrow bT$

$T \rightarrow M \mid \text{epsilon}$

$M \rightarrow c \mid \text{epsilon}$

Again, T has overlapping first sets, but we can combine M into T:

$S \rightarrow aL \mid bT$

$L \rightarrow bT$

$T \rightarrow c \mid \text{epsilon}$

(you were not required to show all of this work, and any equivalent CFG with non-overlapping first sets would be accepted)

3. $S \rightarrow VaS \mid V$

$V \rightarrow a \mid b \mid c$

4. $S \rightarrow aSa \mid T$

$T \rightarrow bSb \mid c$

5. OpSem

1. B
2. C
3. D
4. #1: A; e2 -> v2
#2: x2:v2; e2 -> v

6. Security

1. A (C language)
2. True
3. B
4. Reason: password is not sanitized, and simple string interpolation is used
Fix: prepared statements, sanitize password like username, escaping, etc.