16-1

$a^n b^n c^n$ $\quad \Sigma = \{a, b, c\}$

(almost $0^n 1^n$)

"RVFA" = 0-PDA

"PDA" = 1-PDA

2-PDA

"TM" = 3-PDA

$a^n b^x c^y$ s.t. $x + y = 2n$

~~a a a b b b~~

$\neg$ CFPP ( $a^n b^n c^n$ )

$\forall p \in N$

$\exists (w \in A \mid |w| \geq p)$

$\forall (u, v, x, y, z \in \Sigma^* \mid w = uvxyz$

$\wedge \; |vy| > 0$

$\wedge \; |vxy| \leq p)$

$\exists i \in N$

$uv^i xy^i z \notin A$

$\forall$ = given

$\exists$ = choosen

Given: $p$ Choose: $w = a^p b^p c^p$

Given: $u, v, x, y, z$ $w = uvxyz$ $|vy| > 0$ $|vxy| \leq p$

| | $vxy$ contains 1 char | contains 2 char | contains 3 |
|---|---|---|---|
| | | ac: impossible! | |
| a: | see below | ab: see below | $u = a^{\hat{u}}$ $vxy = a^{\hat{i}} b^{\hat{j}} c^{\hat{k}}$ |
| b: | see below | bc: so tired, ugh! | $z = c^{\hat{z}}$ |
| c: | $u = a^p b^p c^{\hat{u}}$ | | $\hat{i} + p + \hat{j} \leq p$ |
| | $vxy = c^{\hat{v}}$ $z = c^{\hat{z}}$ | | $\hat{i} + \hat{j} \leq 0$ |
| | $= c^{\hat{v}} c^{\hat{x}} c^{\hat{y}}$ | | impossible |

$\hat{v} + \hat{v} i + \hat{x} + \hat{y} i + \hat{z} = p$

$\hat{v} + \hat{v} + \hat{x} + \hat{y} + \hat{z} = p$

$(i-1) + (i-1) = 0$

$2i = 2 \quad i = 1$

choose any $i \neq 1$.

16-2

$\{ a^i b^j c^k \mid 0 \le i \le j \le k \} \notin CFL$

$\{ ww \mid \Sigma = \text{whatever} \} \notin CFL$

$\{ x \# y \mid x \neq y \} \in CFL$

$\{ xy \mid x \neq y \wedge |x| = |y| \} \in CFL$

$\{ w \# t \mid w = x t y \text{ for some } x \text{ and } y \} \notin CFL$

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$S_1 \to 0 S_1 0 \mid 1 S_1 1 \mid \varepsilon \mid 0 \mid 1$ — palindromes

$S_2 \to 0 S_2 1 \mid \varepsilon$ — balanced 0s & 1s

$S_3 \to 0 S_3 1 S_3 \mid 1 S_3 0 S_3 \mid \varepsilon$ — equal # of 0s & 1s

— palindrome AND
equal # of 0s and 1s