Q1 (Sol): Pumping Lemma for Context Free Language?

$$L = \{ a^{2^k} \; k \geq 0 \}$$

U	Λ	a^{2^p-p}	a^n	a^{2^p-p-n}
V	a^r	a^r	a^s	a^n
W	a^s	a^s	a^t	a^s
X	a^t	a^t	a^r	a^t
Y	a^{2^p-p}	Λ	a^{2^p-p-n}	a^r

4 Marks

Note: $p = r + s + t$

$$Using\ String = (a^r)^i\, a^s\, (a^t)^i\, a^{2p-p}$$

2 Marks

Selecting $i = 2$

$= (a^r)^2 a^s\, (a^t)^2\, a^{2^p-p}$

$= a^{2^p}\, a^{r+t}$

$= a^{2^p}\, a^{r+t} \leq a^{2^p}\, a^p \leq a^{2^p}\, a^{2^p} \leq a^{2^{p+1}}$

4 Marks

As new string does not belongs to Language hence Language does not belongs to CFL.

Q2 (Sol): Rotation Checking TM?

Matching pair checking: 7 Marks
Handling Mismatch forward pass with sliding window: 8 Marks
Other part with relocation: 5 Marks