

Q1. $S \rightarrow bS$

$$S \rightarrow aA$$

$$S \rightarrow A|$$

$$S \rightarrow A$$

$$A \rightarrow aA|$$

$$A \rightarrow bA$$

$$A \rightarrow \#$$

Q2. $S \rightarrow aSa \mid a \mid aaA \mid B$

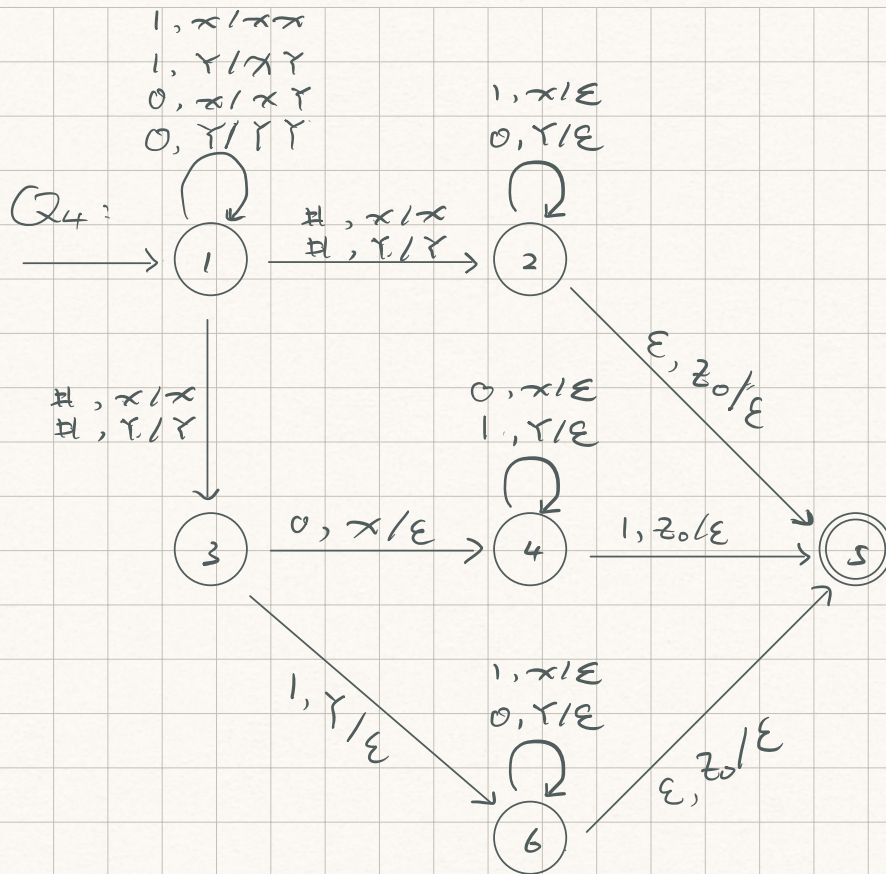
$$A \rightarrow aA$$

$$B \rightarrow bbaa \mid bb$$

Q3.

```
boolean valid = 1
int position = 1
for i = 0 to |out(z)| - 1 :
    boolean match = 0
    for j = position to |z| :
        if out(z)[i] = z[j]
            position = j + 1
            match = 1
    b = b && match
```

the complexity of the algorithm above is $O(n^3)$ and it could determine subword w' is $O(n^3)$ or not. Since CYK algorithm is also having complexity $O(n^3)$, $out(z) \cap L(G)$ is $O(n^3)$.



1-2-5 accept words that $\text{bin}(w) = \text{bin}(w^R)$

1-3-4-5 accept words that $\text{bin}(w) + 1 = \text{bin}(w^R)$

and $\text{bin}(w)$ is odd

1-3-6-5 accepts words that $\text{bin}(w) + 1 = \text{bin}(w^R)$

and $\text{bin}(w)$ is even.