20L-2918

Umair Butt

TOA Assignment 3   6C

(A)

$S \rightarrow TUIV$

$T \rightarrow aTb|\varepsilon$

$U \rightarrow cU|\varepsilon$

$V \rightarrow aVc|W$

$W \rightarrow bW|\varepsilon$

i) No ~~new~~ starting state required

ii) Null production

$T \rightarrow \varepsilon$, $U \rightarrow \varepsilon$, $W \rightarrow \varepsilon$

∴ Remove $T \rightarrow \varepsilon$

$S \rightarrow TUIV | U$

$T \rightarrow aTb | ab$

$U \rightarrow cU | \varepsilon$

$V \rightarrow aVc | W$

$W \rightarrow bW | \varepsilon$

∴ Remove $U \rightarrow \varepsilon$

$S \rightarrow TU|V|U|T$

$T \rightarrow aTb|ab$

$U \rightarrow cU|\varepsilon$

$V \rightarrow aVc|W$

$W \rightarrow bW|\varepsilon$

∴ Remove W → ε

S → TU | V | U | T

T → aTb | ab

U → cUc | c

V → aVc | W | ε

W → bWb | b

∴ Remove V → ε

S → TU | V | U | T | T

T → aTb | ab

U → cUc | c

V → aVc | W | ac

W → bWb | b

iii) Unit production

S → TU | aVc | bWb | b | cUc | c | aTb | ab | ac

T → aTb | ab

U → cUc | c

V → aVc | bWb | b | ac

W → bWb | b

iv) { a, b, c, U, W, S, T }

∴ No useless or unreachable state

v) let $A \to a$, $B \to b$, $C \to c$, $X \to AT$, $Y \to AV$

$S \to TU | YC | BW | b | CU | c | XB | AB | AC$
$T \to XB | AB$
$U \to CU | c$
$V \to YC | BW | b | AC$
$W \to BW | b$

(B)

S → ASA | aB

A → B | S

B → b | ε

X → A

i) S' → S   (new start state)

S → ASA | aB

A → B | S

B → b | ε

X → A

ii) ~~B~~ Null Production

B → ε

S' → S

S → ASA | aB | a

A → B | S | ε

B → b

X → A

∴ remove A→ε

S'→ S

S→ ASA|aB|a|SA|AS|S

A→ B|S

B→ b

X→ ε   ∴ remove X→ε

iii) unit production:-

S'→S, S→S, A→ B, A→S

S'→ ASA|aB|a|SA|AS

S→ ASA|aB|a|SA|AS

A→ b|ASA|aB|a|SA|AS

B→ b

iv) useless states :-

{ b, a, s', s, A, B }

no useless production

v) let @ Y→ a, Z→ AS

S'→ ZA|YB|a|SA|AS|YZ

S→ ZA|YB|a|SA|AS|Z

A→ b|≠ZA|YB|a|SA|AS Z

B→ b

Y→ a

Z→ AS

(c)

$S \rightarrow a \mid aA \mid aB$

$A \rightarrow aBB \mid \varepsilon$

$B \rightarrow Aa \mid b$

i) Null production:-

$S \rightarrow a \mid aA \mid aB \mid$ ∵ remove $A \rightarrow \varepsilon$

$A \rightarrow aBB$

$B \rightarrow Aa \mid b \mid a$

ii) unit production :-

No unit production

iv)

$\{ a, b, S, B, A \}$

No useless productions

v) $S \rightarrow a \mid XA \mid Y$

$A \rightarrow YB$

$B \rightarrow AX \mid b \mid a$

$X \rightarrow a$

$Y \rightarrow XB$