# Assignment 3

(1)

17 Convert following EBNF to BNF

$S \Rightarrow A \{bA\}$
$A \Rightarrow a[b]A$

Solution $\Rightarrow$

Converting $\langle S \rangle \Rightarrow \langle S \rangle b \langle A \rangle | \langle A \rangle$
$\langle A \rangle \Rightarrow a \langle A \rangle | ab \langle A \rangle$

23 Finding weakest ~~pre~~ precondition

a) $a = 2 * (b-1) - 1 \{a > 0\}$

$\Rightarrow \{2 * (b-1) - 1 > 0\}$
$\Rightarrow \{2 * b - 3 > 0\}$
$\Rightarrow \{b > 3/2\}$

b) $b = (c + 10) / 3 \{b > 6\}$

$\Rightarrow \{(c+10)/3 > 6\}$

$\Rightarrow \{c + 10 > 18\}$

$\Rightarrow \{c > 8\}$

c) $a = a + 2 * b - 1 \; \{a > 1\}$

$\Rightarrow \{a + 2 * b - 1 > 1\}$

$\Rightarrow \{a + 2 * b > 2\}$

$\Rightarrow \{2 * b > 2 - a\}$

$\Rightarrow \{b > (2 - a)/2\}$

$\Rightarrow \{b > 1 - (a/2)\}$

d) $x = 2 * y + x - 1 \; \{x > 11\}$

$\Rightarrow \{2 * y + x - 1 > 11\}$

$\Rightarrow \{2 * y + x > 12\}$

$\Rightarrow \{2 * y > 12 - x\}$

$\Rightarrow \{y > 6 - (x/2)\}$

24

(1) $a = 2 * b + 1;$
$b = a - 3$
$\{ b < 0 \}$

$\Rightarrow$ $a = 2 * b + 1;$ — (I)
$b = a - 3$ — (II)
$b < 0$

Applying Axiom to (I) & (II)

$\Rightarrow \{ a - 3 < 0 \}$
$\{ a < 3 \}$ — (III)

$\Rightarrow \{ 2 * b + 1 < 3 \}$
$\{ 2 * b < 2 \}$
$\{ b < 1 \}$

$b < 1$ is weakest for both (I) & (II)

(II) $a = 3 * (2 * b + a);$
$b = 2 * a - 1$
$\{ b > 5 \}$

$\Rightarrow$ Applying Axiom to both Statements
$\{ 2 * a - 1 > 5 \}$
$\{ 2 * a > 6 \}$
$\{ a > 3 \}$

So ~~{a>3}~~ $\{a>3\}$ is weakest for statement 2 and becomes post condition for statement 1

$\{3*(2*b+a)>3\}$

$\{2*b+a>1\}$

$\{a>1-2*b\}$

therefore $\{a>1-2*b\}$ is weakest

25

a) if (a == b)

b = 2*a + b

else

b = 2*a;

$\{b>1\}$

post condition = b > 1 So

$\Rightarrow 2*a+1 > 1 \rightarrow 2*a > 0 \rightarrow a > 0$

$\Rightarrow 2*a > 1 \rightarrow a > 1/2$

$\Rightarrow a > 1/2 \rightarrow a > 0$ ~~always~~

as
but $a > 0 \not\rightarrow a > 1/2$

$\{a > \frac{1}{2}\}$

b) if (x<y)

x = x+1

else

x = 3*x

$\{x < 0\}$

postcondition $\Rightarrow x < 0$

so,

$\Rightarrow x+1 < 0 \rightarrow x < -1$

$\Rightarrow 3*x < 0 \rightarrow x < 0$

$\Rightarrow x < -1 \rightarrow x < 0$

$x < 0 \not\rightarrow x < -1$

$\Rightarrow \{x < -1\}$

c

if (x > y)

$y = 2 * x + 1$

else

$y = 3 * x - 1;$

$\{ y > 3 \}$

post condition $\Rightarrow y > 3$

$= 2 * x + 1 > 3 \Rightarrow 2 * x > 2 \Rightarrow x > 1$

$\Rightarrow 3 * x - 1 > 3 \Rightarrow 3 * x > 4 \Rightarrow x > \frac{4}{3}$

$= x > \frac{4}{3} \Rightarrow x > 1$

$x > 1 \not\Rightarrow x > \frac{4}{3}$

The weakest precondition $\{ x > \frac{4}{3} \}$

2

Problems, 1, 2, 4, 5, 6, 8

1

ⓐ $A \Rightarrow aB \mid b \mid cBB$

ⓑ $B \Rightarrow aB \mid bA \mid aBb$

ⓒ $C \Rightarrow aaA \mid b \mid CaB$

⇒ Grammer

a) $A\ aB \mid b \mid cBB$

⇒ RHS for Non terminal A FIRSTs value

$FIRST(aB) = \{a\}$

$FIRST(b) = \{b\}$

$FIRST(cBB) = \{c\}$

all of these are pairwise disjoint to each other

b) B aB | bA | aBb

→ RHS of nonterminal B First value

FIRST (aB) = {a}
FIRST (bA) = {b}
FIRST (aBb) = {a}

the ~~first~~ FIRST (ab) and FIRST (aBb) have comon elements "a"

c) C aaA | b | caB

FIRST (aaA) = {a}
FIRST (b) = {b}
FIRST (caB) = {c}

All the ~~pairs are~~ sets are pairwise disjoint to each other

2

a) $S \Rightarrow aSb \mid b \mid bAA$

FIRST $(aSb) = \{a\}$
FIRST $(b) = \{b\}$
FIRST $(bAA) = \{b\}$

intersection of FIRST$(aSb) \cap$ First$(b)$
So,
FIRST$(aSb) \cap$ First$(b) = \phi$

intersection of First $(aSb) \cap$ First $(bAA) = \phi$
~~intl~~ intersection of First $(b) \cap$ First$(bAA) = \phi$

FIRST $(b)$ and ~~First~~ FIRST $(bAA)$ have element 'b' in common, ~~the~~ So, the grammer fail

b) $A \Rightarrow b \{aB\} \mid a$

$A b \{aB\} \mid a$

FIRST $(b\{aB\}) = \{b\}$
FIRST $\{a\} = \{a\}$

Intersection of FIRST $(b\{aB\}) \cap$ FIRST$(a)$
So,
FIRST $(b\{aB\}) \cap$ FIRST$(a) = \phi$

The grammer pass the test as the right hand sid of Non terminal A satisfies pairwise disjoint

c) B → aB | a

Ba B | a

First (aB) = {a}
FIRST (a) = {a}

Intersection FIRST(aB) ∩ FIRST(a) = a

The the grammer fails to pass the test as the right hand side of non terminal symbol B does' not satisfies pairwise disjoint

4 The trace for recursive descent parsing

1) · Next token is 11, Next Lexeme is a
Enter
Enter
Enter <factor>

2) Next token is 23, Next lexeme is *
Exit

Next token is 25, Next lexeme is C
Enter

Next token is 11: Next lexem is b
Enter
Enter
Enter <factor>

Next token is 21: Next lexeme is +
Exit
Exit

Next token is 11: Next lexeme is c
Enter
Enter <factor>

Next token is 26: Next lexeme is )
Exit
Exit
Exit

Next token is -1: Next lexem is EOF
Exit
Exit
Exit