Matthew Lee
Principles of Programming Languages Homework 1
Section 02

1

1.1 $f(x) = x + 1, x > 0$

Rules

1. $\$ \rightarrow |$
2. $|\# \rightarrow |$

Sequence

1. $\$|||\# \rightarrow ||||\#$ (Rule 1)
2. $||||\# \rightarrow ||||$ (Rule 2)

1.2 $f(x) = 2x, x > 0$

Rules

1. $| \rightarrow ||$
2. $\$| \rightarrow |$
3. $|\# \rightarrow |$

Sequence

1. $\$|||\# \rightarrow \$||||||\#$ (Rule 1)
2. $\$||||||\# \rightarrow ||||||\#$ (Rule 2)
3. $||||||\# \rightarrow ||||||$ (Rule 3)

1.3 $f(x, y) = x + y, x, y > 0$

Rules

1. $\& \rightarrow NULL$
2. $\$| \rightarrow |$
3. $|\# \rightarrow |$

Sequence

1. $\$||\&|||\# \rightarrow \$|||||$(Rule 1)
2. $\$|||||\# \rightarrow |||||\#$(Rule 2)
3. $|||||\# \rightarrow |||||$ (Rule 3)

2

2.1 Rules

1. $(0 + 0) \rightarrow 0$
2. $(0 + 1) \rightarrow 1$
3. $(1 + 0) \rightarrow 1$
4. $(0 + 2) \rightarrow 2$
5. $(2 + 0) \rightarrow 2$
6. $(1 + 1) \rightarrow 2$
7. $(1 + 2) \rightarrow 0$
8. $(2 + 1) \rightarrow 0$
9. $(2 + 2) \rightarrow 1$

2.2 Sequence Example

Sequence 1: $(0 + (1 + 2))$

1. $((1 + 2) + 0) \rightarrow (0 + 0)$ (Rule 7)
2. $(0 + 0) \rightarrow 0$ (Rule 1)

Sequence 2: $(1 + (2 + 2))$

1. $(1 + (2 + 2)) \rightarrow (1 + 1)$ (Rule 9)
2. $(1 + 1) \rightarrow 2$ (Rule 6)

2.3

No, in $((1 + 1) + (2 + 2))$ 2 rules can be applied

3

3.1

Yes: $r^+ = r\&r^*$

3.2

No: At least one of those operators is necessary to express an infinite quantity

4

$R = (digit)^+.(digit)^+(\epsilon(digit)^+|\epsilon)$

5

5.1

All strings/combinations over the alphabet a, b including the empty string

5.2

All strings over the alphabet $0, 1$ which begin with 1 and end in 001 or 011

6

6.1

$R = (b^*c|a|c|d)^*b^*$

6.2

$R = a^*(b|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*$
$|a^*(c|\epsilon)a^*(b|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*$
$|a^*(c|\epsilon)a^*(c|\epsilon)a^*(b|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*$
$|a^*(c|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*(b|\epsilon)a^*(c|\epsilon)a^*$
$|a^*(c|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*(c|\epsilon)a^*(b|\epsilon)a^*$