

## SOLUTIONS - QUIZ 2011

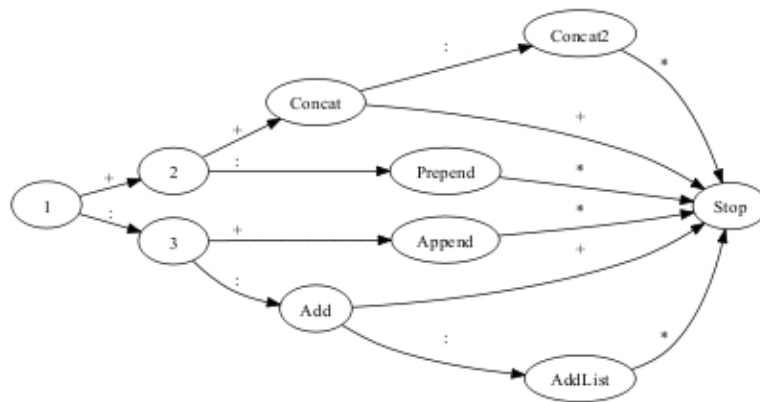
### PROBLEM 1

a)

- i) Concat2, Add, Prepend, Append, Prepend
- ii) Concat2, Concat2, AddList, Append, Prepend

b)

For example something like this, where after reaching the Stop state the character input is reset by one.



### PROBLEM 2

### PROBLEM 3

## PROBLEM 4

a)

```

nStart: [[body]]
        [[cond]]
        if_eq nStart

```

b)

```

        [[ assignments ]]
nWhile:  [[exponent > 0 ]]
        if_eq nAfter1
        [[ (exponent & 1) == 1 ]
        if_eq nAfter2
        [[result = (result * base ) % m ]]
nAfter2: [[exponent = exponent >> 1 ]]
        [[ base = (base * base ) %m ]]
        goto nWhile
n After1: [[return result]]

```

c) [[result = (result \* base) % m ]] =

```

    iload_3
    iload 5
    imult
    iload_2
    irem
    istore_3

```

[[ (exponent &amp; 1) == 1 ]] =

```

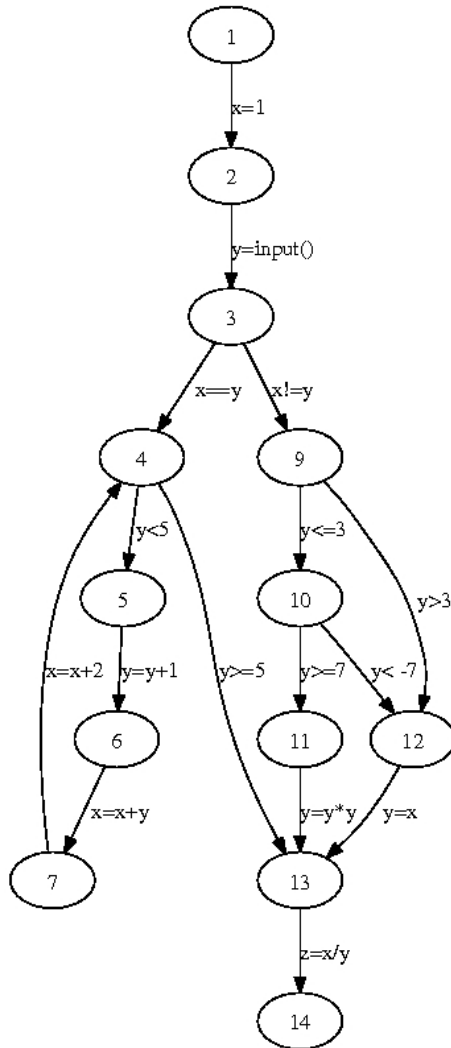
    iload 4
    iconst_1
    iand
    iconst_1
    if_icmpeq nTrue
    iconst_0
    goto nAfter

```

nTrue iconst\_1

nAfter

## PROBLEM 5



The following intervals hold if we assume that the analysis is smart enough to terminate the while loop when  $y$  stabilizes, as  $y$  is the only variable involved in the condition. For the last part c), our analysis tells us, that we may get a division by zero in the last step.

	x	y
1:	bottom	bottom
2:	[1,1]	bottom
3:	[1,1]	[-128, 127]
4:	[1, 23]	[1, 5]
5:	[1, 16]	[1, 4]
6:	[1, 16]	[2, 5]
7:	[3, 21]	[2, 5]
8:	[5, 23]	[2, 5]
9:	[1,1]	[-128, 127]
10:	[1,1]	[-128, 3]
11:	[1,1]	[-7, 3]
12:	[1,1]	[-128, 127]
13:	[1, 23]	[-21, 49]
14:	[1, 23]	[-21, 49]