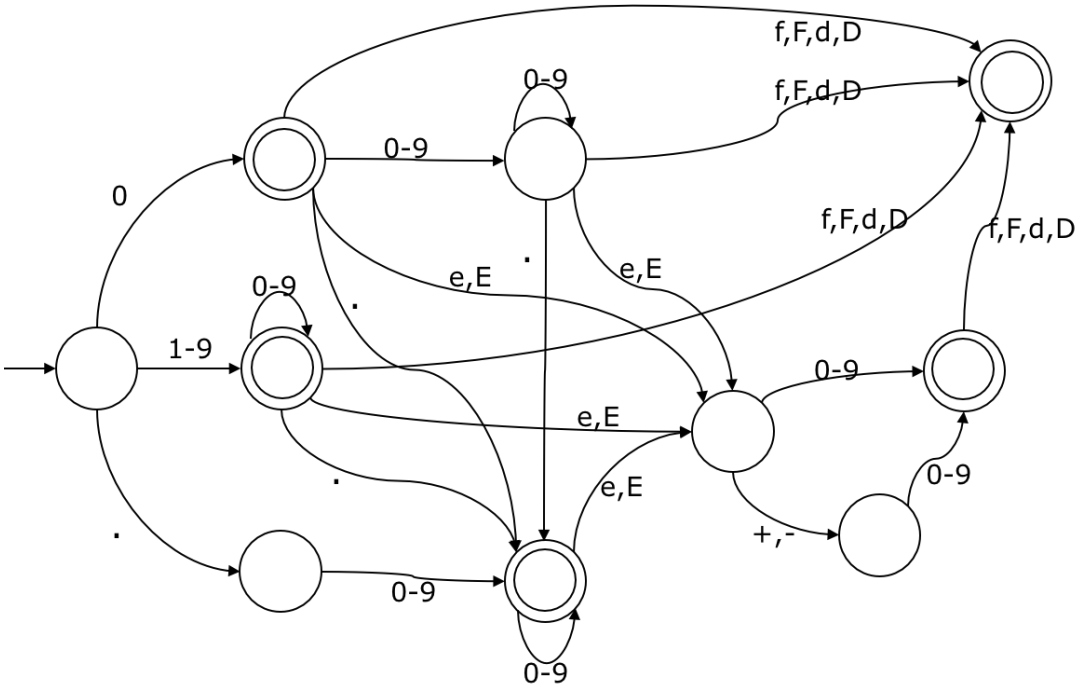
# Solution

## Problem 1: (24 points)

1.

| | |
|---|---|
| FloatPoint | Digits.(Digits)?(Exponent)?(TypeSuffix)? \| |
| | .Digits(Exponent)?(TypeSuffix)? \| |
| | Digits Exponent(TypeSuffix)? |
| | Digits(Exponent)?TypeSuffix |
| Exponent | (e\|E)(+\|-)?Digits |
| TypeSuffix | f \| F \| d \| D |

2.

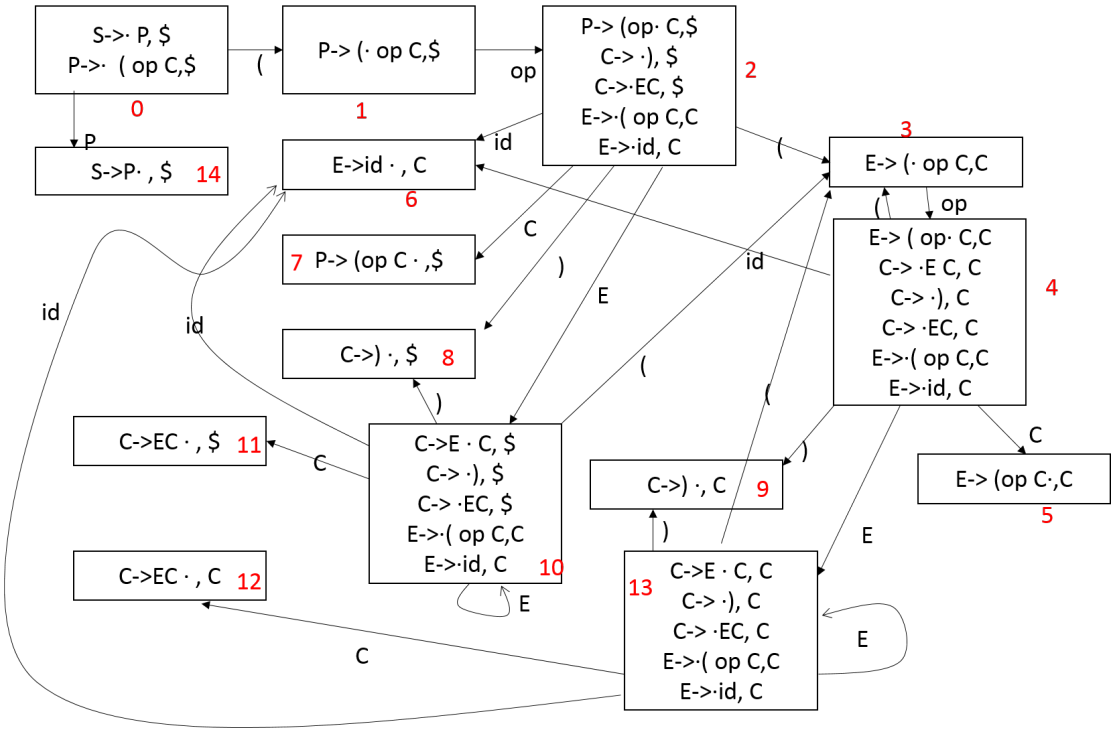



3

output: 315242524253332515

## Problem 2: (30 points)

1.




Note: first(C)={(,),id}

2.

| | $ | ( | ) | id | op | P | C | E |
|---|---|---|---|---|---|---|---|---|
| 0 | | S 1 | | | | G 14 | | |
| 1 | | | | | S 2 | | | |
| 2 | | S 3 | S 8 | S 6 | | | G 7 | G 10 |
| 3 | | | | | S 4 | | | |
| 4 | | S 3 | S 9 | S 6 | | | G 5 | G 13 |
| 5 | | R 4 | R 4 | R 4 | | | | |
| 6 | | R 5 | R 5 | R 5 | | | | |
| 7 | R 1 | | | | | | | |
| 8 | R 2 | | | | | | | |
| 9 | | R 2 | R 2 | R 2 | | | | |
| 10 | | S 3 | S 8 | S 6 | | | G 11 | G 10 |
| 11 | R 3 | | | | | | | |
| 12 | | R 3 | R 3 | R 3 | | | | |
| 13 | | S 3 | S 9 | S 6 | | | G 12 | G 13 |
| 14 | A | | | | | | | |

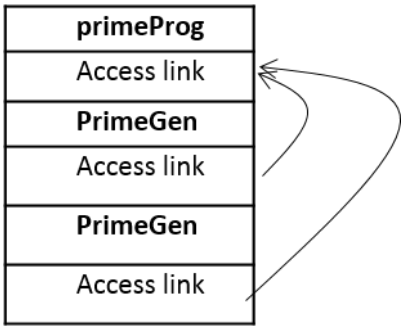
3.

| Stack | Action |
|---|---|
| | S 3 |
| ( op id | R 5 |
| ( op E | S 3 |
| ( op E ( op ) | R 2 |
| ( op E ( op C | R 4 |
| ( op E E | S 3 |
| ( op E E ( op id | R 5 |
| ( op E E ( op E | S 1 |
| ( op E E ( op E ) | R 2 |
| ( op E E ( op E C | R 3 |
| ( op E E ( op C | R 4 |
| ( op E E E | S 1 |
| ( op E E E ) | R 2 |
| ( op E E E C | R 3 |
| ( op E E C | R 3 |
| ( op E C | R 3 |
| ( op C | R 1 |
| P | S 1 |
| P$ | accept |

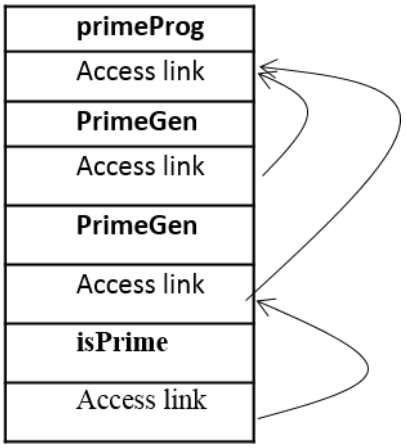
## Problem 3: (18 points)

1.

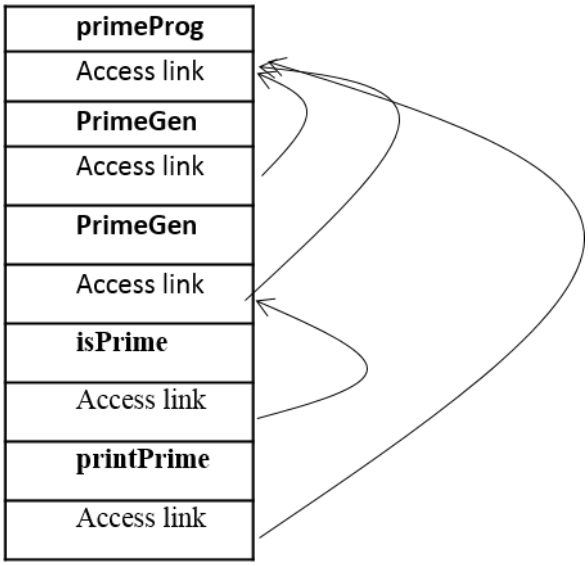
(1)




(2)

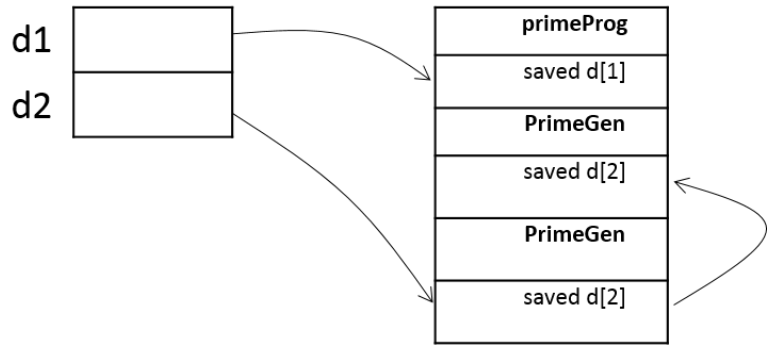



(3)

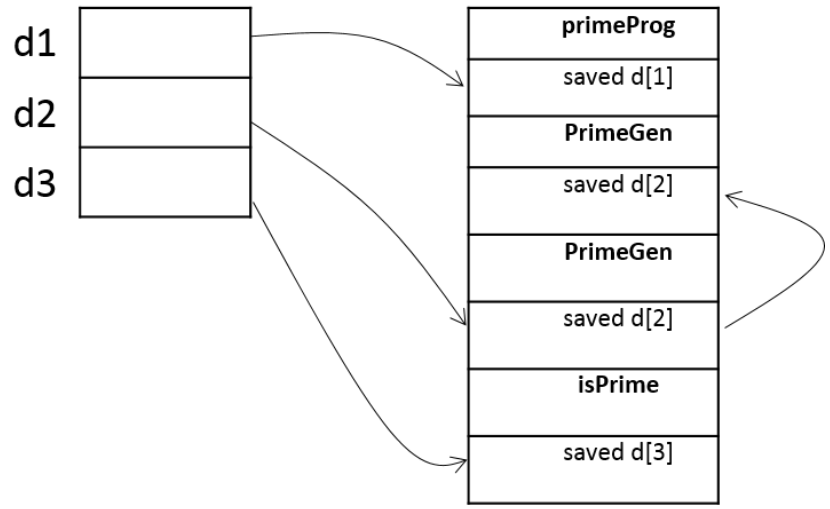


2.

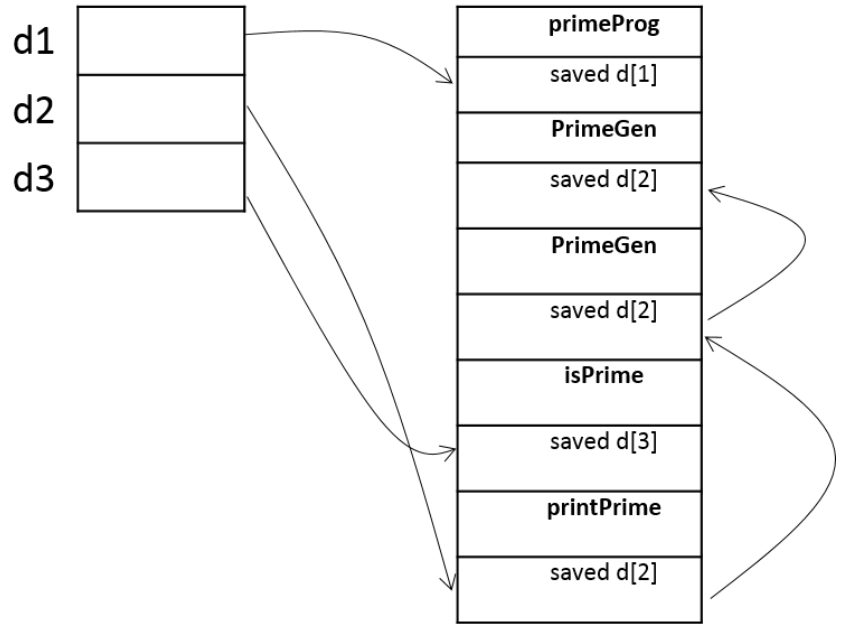
(1)


d1
d2
primeProg
saved d[1]
PrimeGen
saved d[2]
PrimeGen
saved d[2]

(2)

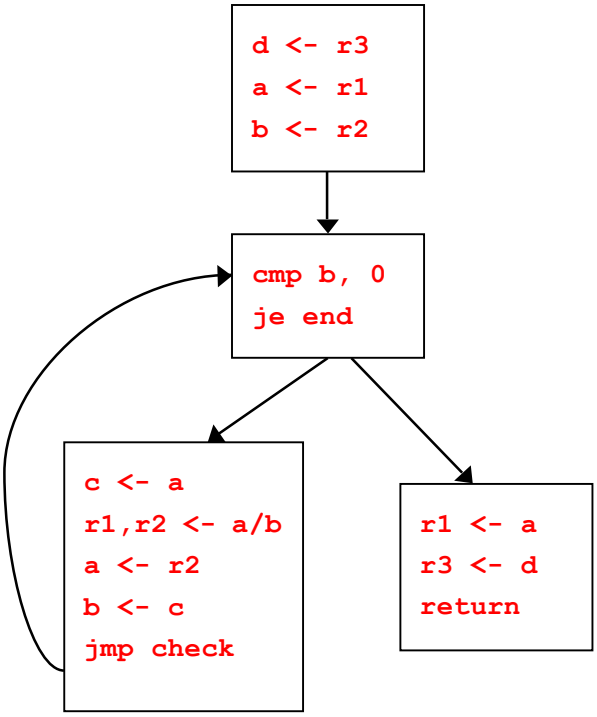

d1
d2
d3
primeProg
saved d[1]
PrimeGen
saved d[2]
PrimeGen
saved d[2]
isPrime
saved d[3]

(3)


d1
d2
d3
primeProg
saved d[1]
PrimeGen
saved d[2]
PrimeGen
saved d[2]
isPrime
saved d[3]
printPrime
saved d[2]

## Problem 4: (28 points)

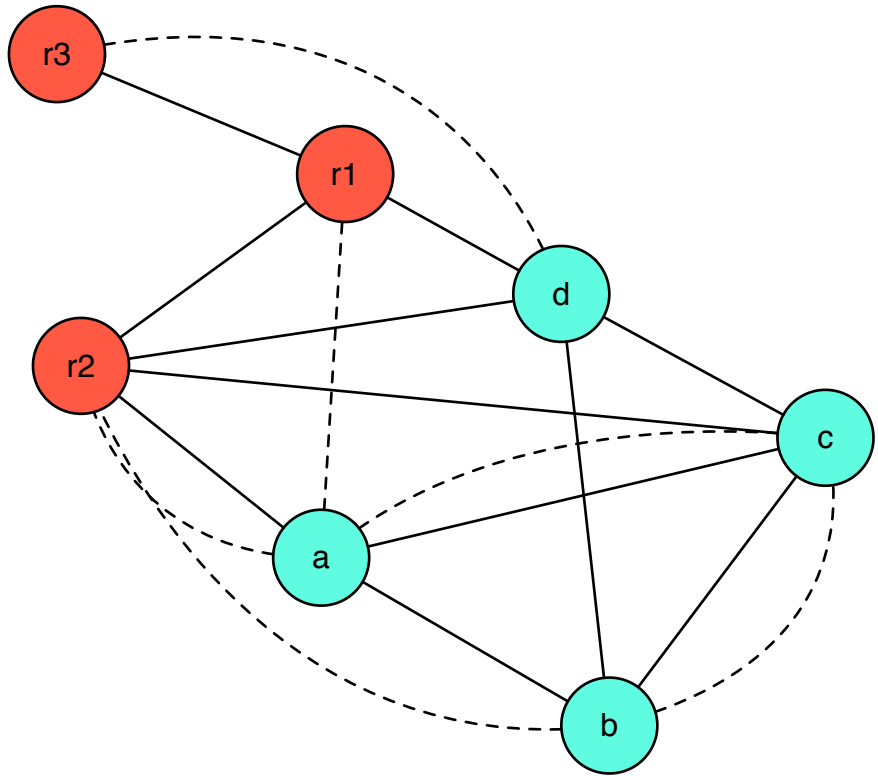
1.




2.

| instr | def | use | in | out |
|---|---|---|---|---|
| d <- r3 | d | r3 | r1,r2,r3 | r1,r2,d |
| a <- r1 | a | r1 | r1,r2,d | r2,a,d |
| b <- r2 | b | r2 | r2,a,d | a,b,d |
| cmp b,0 | - | b | a,b,d | a,b,d |
| je ret | - | - | a,b,d | a,b,d |
| c <- a | c | a | a,b,d | a,b,c,d |
| r1,r2 <- a/b | r1,r2 | a,b | a,b,c,d | c,d,r2 |
| a <- r2 | a | r2 | c,d,r2 | c,a,d |
| b <- c | b | c | c,a,d | a,b,d |
| jmp check | - | - | a,b,d | a,b,d |
| r1 <- a | r1 | a | a,d | d,r1 |
| r3 <- d | r3 | d | d,r1 | r1,r3 |
| return | - | - | r1,r3 | r1,r3 |

3.




4.

```
gcd:   M[loc(d)] <- r3
check: cmp r2,0
       je end
loop:  r3 <- r1
       r1,r2 <- r1/r2
       r1 <- r2
       r2 <- r3
       jmp check
end:   r3 <- M[loc(d)]
       return
```