Homework – Sept 16

Shikhar Bakhda
UNI: ssb2189

Problem 10a

The pseudo code below shows the algorithm used for this program.

i=32
j=20

r = remainder(i/j) = remainder(32/20) =12
i=j=20
r != 0,
    j = r = 12

r = remainder(i/j) = remainder(20/12) =8
i=j=12
r != 0,
    j = r = 8

r = remainder(i/j) = remainder(12/8) =4
i=j=8
r != 0,
    j = r = 4

r = remainder(i/j) = remainder(8/4) =0
i=j=8
r = 0,
    print(j)

The final output is 4.

Problem 10b

i=32
j=0

r = remainder(i/j) = remainder(32/0) = DIVIDE BY 0 ERROR

It is not possible to execute step 2, as it gives a divide by 0 error. Dividing a number by zero is not possible.

We can modify the algorithm by inserting an additional step immediately after step 1:

If J is equal to zero, print "Cannot divide by 0. Enter a positive integer.", and call the new number that is entered J. Repeat this step if J=0.

Problem 11

The total number of different paths for 20 cities is 20!.

$$20! = 2.433 \times 10^{18}$$

The total time T to analyse the routes will be

$$T = \frac{2.433 \times 10^{18}}{10^7} = 2.433 \times 10^{11} \text{ seconds} = \frac{2.433 \times 10^{11}}{60 \times 60 \times 24 \times 365} \text{ years}$$

$$= 7715 \text{ years}$$

The computer will thus take 7715 years to analyse all the paths.
This is **not** a feasible program, as the time it will take to come up with the answer is too long.

To reduce the calculation time, I would use the following process.

Choose an arbitrary starting city. Analyse the distance between that city and the other 19 cities, and choose the nearest city as the 2nd city. Analyse the distance between the 2nd city and other 18 cities, and choose the nearest city as the 3rd city, and so forth. This will dramatically reduce the number of calculations to be made:

$$Calculations = 19 + 18 + 17 + 16 + 15 + 14 + 13 + 12 + 11 + 10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 = \sum_{i=2}^{19} i = 189$$

Repeat the above process, but choose another starting city.

As there are 20 possible starting cities, the total number of calculations will then be:

$$Calculations = 20 \sum_{i=2}^{19} i = 3780$$

Using this procedure, it will take just 3.8×10^{-4} seconds to calculate the path. However, while this will be a fast path, this is not the optimal solution to this problem.

Problem 18a

9

Problem 18b

Get values for n and m, the size of the text and the pattern, respectively
Increment m by 2
Set P_1 to ' ' [blank space]
Set P_m to ' ' [blank space]
Get values for both the text $T_1, T_2, \dots T_n$ and the pattern $P_1, P_2, \dots P_m$

```
Set k, the starting location for the attempted match, to 1
While (k ≤ (n − m + 1)) do
    Set the value of i to 1
    Set the value of Mismatch to NO
    While both (i ≤ m) and (Mismatch = NO) do
        If P_i ≠ T_{k+(i−1)} then
            Set Mismatch to YES
        Else
            Increment i by 1 (to move to the next character)
    End of the loop
    If Mismatch = NO then
        Print the message 'There is a match at position'
        Print the value of k
    Increment k by 1
End of the loop
Stop
```

Problem 25

Get the value for n, the size of the sequence
Get values for the sequence $S_1, S_2 \dots S_n$
Set i, the starting location for the sequence, to 1
Set the value of Adjacent to NO
While $(S_{i+1} \neq -1)$, do
    If $S_i = S_{i+1}$
        Set the value of Adjacent to YES

Set the value of *i* to *n* (to exit While loop)
End of loop

If Adjacent = YES
Print the message “Yes”
Else
Print the message “No”
Stop

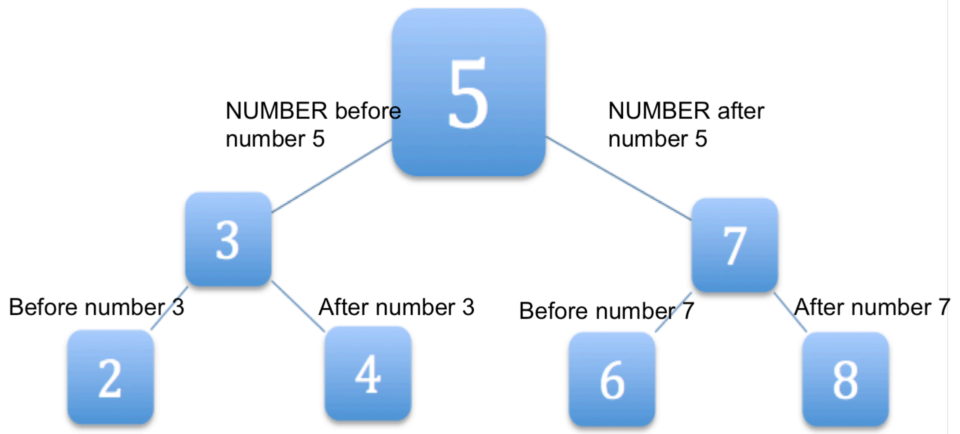
Problem 31a

1,2,8,-5

Problem 31b

n	[lg(n)]
2	2
3	2
4	3
5	3
6	3
7	3
8	4

Problem 31c



n	Number of Compares, Worst Case
2	2
3	2
4	3
5	3
6	3
7	3
8	4

Problem 36a

BCABD

The second graph has no Euler path

Problem 36b

(i) All nodes are even nodes. As there are 0 odd nodes, an Euler path exists. It is ACBDAFBEA
(ii) There is no Euler path as there are 4 odd nodes (nodes C, D, E, F).
(iii) There are exactly 2 odd nodes (nodes C and D), so an Euler path exists. It is CDAEBFACBD.

Problem 36c

Step 8 is of the order $O(n^2)$, as i goes from 1 through n, and for each i, j goes from 1 through n.

Problem 36d

The Euler path problem is NOT intractable, as it works in polynomial time $O(n^2)$.