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Chapter 1

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`allPairsSP`	
Test Cases	1×25
Compilation	5
`allPairsSP` Total	30
Total	100

Chapter 2

Metadata

2.1 Submitted Files

handin.time

```
10/26/2019 20:25:47 fsandhu: csce310h0mework03part01.cpp          - OK
10/26/2019 20:25:49 fsandhu: csce310h0mework03part01.h    - OK
10/26/2019 20:25:51 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:25:54 fsandhu: csce310h0mework03part02.h    - OK
10/26/2019 20:25:57 fsandhu: csce310h0mework03part03.h    - OK
10/26/2019 20:25:59 fsandhu: csce310h0mework03part03.cpp          - OK
10/26/2019 20:33:03 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:35:01 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:36:24 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:38:09 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:38:43 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:39:52 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:41:12 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:42:27 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:46:32 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:47:52 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 20:51:29 fsandhu: csce310h0mework03part02.cpp          - OK
10/26/2019 21:30:09 fsandhu: csce310h0mework03part01.cpp          - OK
10/26/2019 21:30:12 fsandhu: csce310h0mework03part01.h    - OK
10/26/2019 21:32:08 fsandhu: csce310h0mework03part01.cpp          - OK
10/26/2019 21:33:11 fsandhu: csce310h0mework03part01.cpp          - OK
10/26/2019 21:33:42 fsandhu: csce310h0mework03part01.cpp          - OK
10/26/2019 21:39:23 fsandhu: csce310h0mework03part01.cpp          - OK
10/28/2019 14:06:25 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 13:37:12 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 14:05:45 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 14:08:50 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 14:09:57 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 14:13:49 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 14:30:55 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:02:19 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:02:50 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:04:00 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:15:12 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:18:24 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:21:06 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:22:48 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:31:27 fsandhu: csce310h0mework03part01.cpp          - OK
10/29/2019 15:34:14 fsandhu: csce310h0mework03part02.cpp          - OK
10/29/2019 15:34:17 fsandhu: csce310h0mework03part03.cpp          - OK
10/30/2019 13:44:35 fsandhu: csce310h0mework03part01.cpp          - OK
```

```
10/30/2019 13:45:52 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 13:48:11 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 13:52:50 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 13:53:51 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 13:57:09 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 13:58:08 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:01:00 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:02:29 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:26:39 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:28:15 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:38:58 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:40:14 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:41:10 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:43:24 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:47:31 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 14:55:44 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:02:03 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:04:12 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:13:04 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:22:52 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:23:57 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:24:48 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:24:51 fsandhu: csce310h0mework03part01.h   - OK
10/30/2019 15:29:51 fsandhu: csce310h0mework03part01.cpp         - OK
10/30/2019 15:29:53 fsandhu: csce310h0mework03part01.h   - OK
10/30/2019 15:30:05 fsandhu: csce310h0mework03part02.cpp         - OK
10/30/2019 15:30:10 fsandhu: csce310h0mework03part02.h   - OK
10/30/2019 15:30:16 fsandhu: csce310h0mework03part03.cpp         - OK
10/30/2019 15:30:21 fsandhu: csce310h0mework03part03.h   - OK
10/30/2019 21:27:51 fsandhu: hw3.pdf     - OK
```

2.2 webgrader Runs

webgrader.time

```
2019-10-26T20:26:12-0500 97.98.163.171  fsandhu 003
2019-10-26T20:33:05-0500 97.98.163.171  fsandhu 003
2019-10-26T20:35:03-0500 97.98.163.171  fsandhu 003
2019-10-26T20:36:27-0500 97.98.163.171  fsandhu 003
2019-10-26T20:38:11-0500 97.98.163.171  fsandhu 003
2019-10-26T20:38:46-0500 97.98.163.171  fsandhu 003
2019-10-26T20:39:09-0500 97.98.163.171  fsandhu 003
2019-10-26T20:39:47-0500 97.98.163.171  fsandhu 003
2019-10-26T20:39:56-0500 97.98.163.171  fsandhu 003
2019-10-26T20:41:14-0500 97.98.163.171  fsandhu 003
2019-10-26T20:42:29-0500 97.98.163.171  fsandhu 003
2019-10-26T20:43:37-0500 97.98.163.171  fsandhu 003
2019-10-26T20:46:34-0500 97.98.163.171  fsandhu 003
2019-10-26T20:47:55-0500 97.98.163.171  fsandhu 003
2019-10-26T20:51:31-0500 97.98.163.171  fsandhu 003
2019-10-26T21:30:15-0500 97.98.163.171  fsandhu 003
2019-10-26T21:30:28-0500 97.98.163.171  fsandhu 003
2019-10-26T21:32:10-0500 97.98.163.171  fsandhu 003
2019-10-26T21:33:13-0500 97.98.163.171  fsandhu 003
2019-10-26T21:33:44-0500 97.98.163.171  fsandhu 003
2019-10-26T21:39:25-0500 97.98.163.171  fsandhu 003
2019-10-28T14:06:38-0500 10.43.86.250  fsandhu 003
2019-10-29T13:37:17-0500 10.43.43.198  fsandhu 003
2019-10-29T14:05:47-0500 10.43.43.198  fsandhu 003
2019-10-29T14:08:52-0500 10.43.43.198  fsandhu 003
```

```
2019-10-29T14:09:19-0500 10.43.43.198  fsandhu 003
2019-10-29T14:10:06-0500 10.43.43.198  fsandhu 003
2019-10-29T14:13:57-0500 10.43.43.198  fsandhu 003
2019-10-29T14:30:58-0500 10.43.43.198  fsandhu 003
2019-10-29T15:02:20-0500 10.43.43.198  fsandhu 003
2019-10-29T15:02:59-0500 10.43.43.198  fsandhu 003
2019-10-29T15:04:02-0500 10.43.43.198  fsandhu 003
2019-10-29T15:15:15-0500 10.43.43.198  fsandhu 003
2019-10-29T15:16:10-0500 10.43.43.198  fsandhu 003
2019-10-29T15:18:33-0500 10.43.43.198  fsandhu 003
2019-10-29T15:21:25-0500 10.43.43.198  fsandhu 003
2019-10-29T15:22:49-0500 10.43.43.198  fsandhu 003
2019-10-29T15:31:28-0500 10.43.43.198  fsandhu 003
2019-10-30T13:29:50-0500 10.43.107.14  fsandhu 003
2019-10-30T13:44:54-0500 10.43.107.14  fsandhu 003
2019-10-30T13:45:54-0500 10.43.107.14  fsandhu 003
2019-10-30T13:48:13-0500 10.43.107.14  fsandhu 003
2019-10-30T13:48:51-0500 10.43.107.14  fsandhu 003
2019-10-30T13:52:51-0500 10.43.107.14  fsandhu 003
2019-10-30T13:53:53-0500 10.43.107.14  fsandhu 003
2019-10-30T13:57:10-0500 10.43.107.14  fsandhu 003
2019-10-30T13:58:09-0500 10.43.107.14  fsandhu 003
2019-10-30T14:01:02-0500 10.43.107.14  fsandhu 003
2019-10-30T14:02:31-0500 10.43.107.14  fsandhu 003
2019-10-30T14:02:41-0500 10.43.107.14  fsandhu 003
2019-10-30T14:26:41-0500 10.43.107.14  fsandhu 003
2019-10-30T14:28:17-0500 10.43.107.14  fsandhu 003
2019-10-30T14:39:01-0500 10.43.107.14  fsandhu 003
2019-10-30T14:40:10-0500 10.43.107.14  fsandhu 003
2019-10-30T14:40:31-0500 10.43.107.14  fsandhu 003
2019-10-30T14:41:12-0500 10.43.107.14  fsandhu 003
2019-10-30T14:43:26-0500 10.43.107.14  fsandhu 003
2019-10-30T14:47:32-0500 10.43.107.14  fsandhu 003
2019-10-30T14:55:46-0500 10.43.107.14  fsandhu 003
2019-10-30T15:02:05-0500 10.43.107.14  fsandhu 003
2019-10-30T15:04:13-0500 10.43.107.14  fsandhu 003
2019-10-30T15:13:06-0500 10.43.107.14  fsandhu 003
2019-10-30T15:22:55-0500 10.43.107.14  fsandhu 003
2019-10-30T15:23:59-0500 10.43.107.14  fsandhu 003
2019-10-30T15:24:35-0500 10.43.107.14  fsandhu 003
2019-10-30T15:24:52-0500 10.43.107.14  fsandhu 003
2019-10-30T15:26:45-0500 10.43.107.14  fsandhu 003
2019-10-30T15:30:46-0500 10.43.107.14  fsandhu 003
2019-10-30T18:57:24-0500 76.84.50.181  fsandhu 003
2019-10-30T21:28:00-0500 76.84.50.181  fsandhu 003
2019-12-15T19:52:44-0600 76.84.219.87  fsandhu 003
```

2.3 diffs

submission.diffs

Chapter 3

Written Exercises

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NUID: 17286643

Assignment 3 → written part

Q1)

a). Input : AVL tree of real numbers

Output : range.

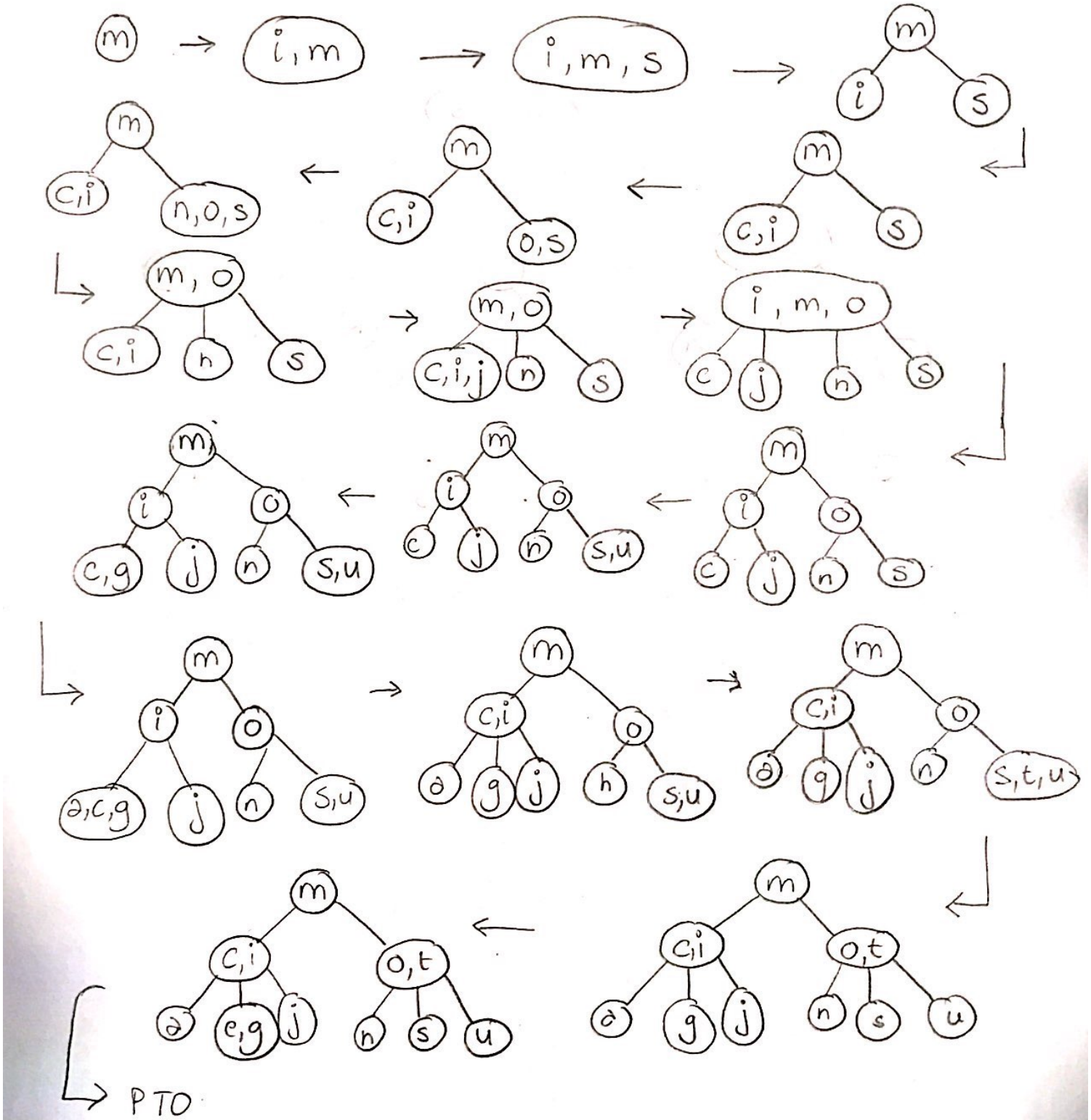
```
presentNode ← root
while (presentNode.leftChild != NULL)
    presentNode ← presentNode.leftChild
    smallest ← presentNode.value

presentNode ← root
while (presentNode.rightChild != NULL)
    presentNode ← presentNode.rightChild
    Largest ← presentNode.value

range ← largest - smallest

output range
```

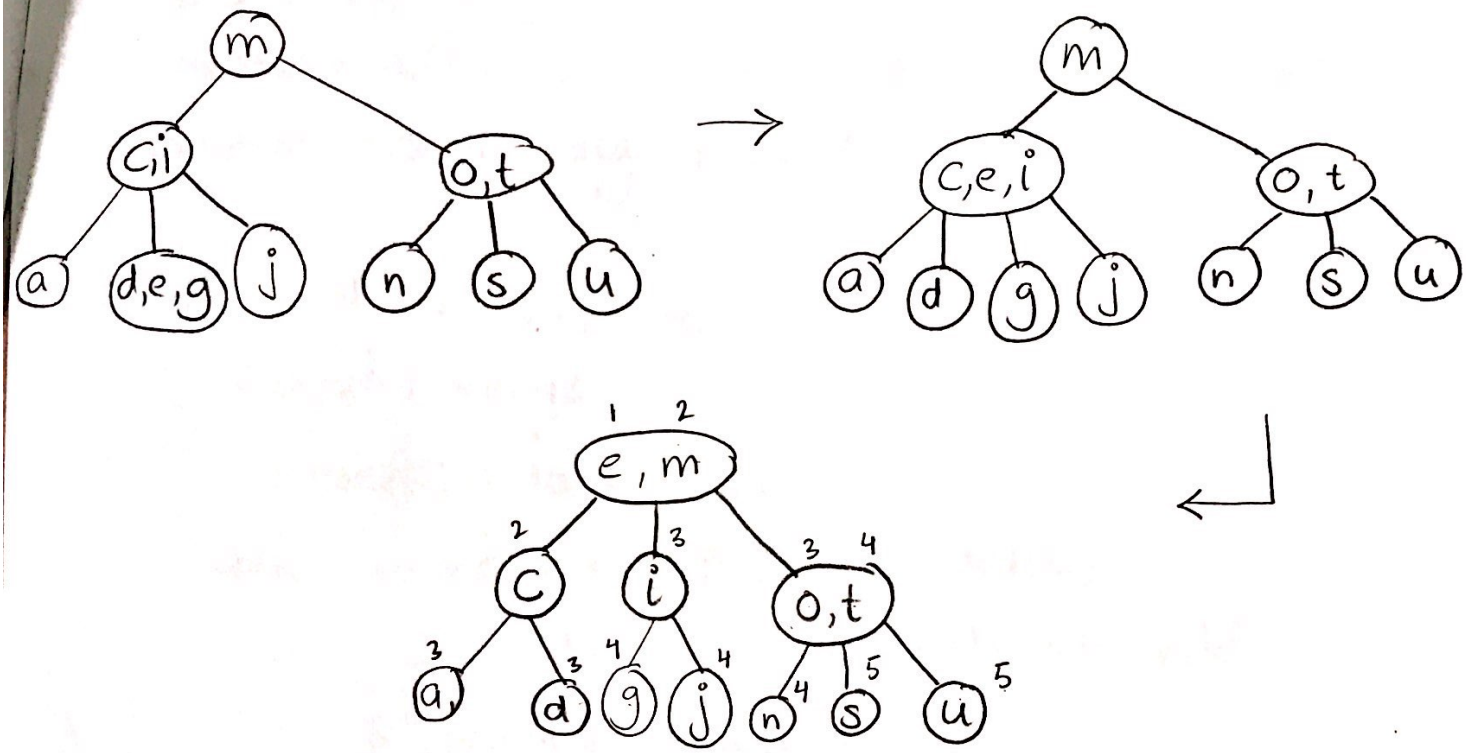
☆ worst case efficiency
$O(\log(n))$

b). False, smallest value in AVL will always be the leftmost
largest will always be the rightmost

(Q2)

The 2-3 tree will look like





b) The largest number of comparisons will be 5

average no. of comparison :

$$\frac{1+2+2+3+3+3+4+4+3+4+4+5+5}{13}$$

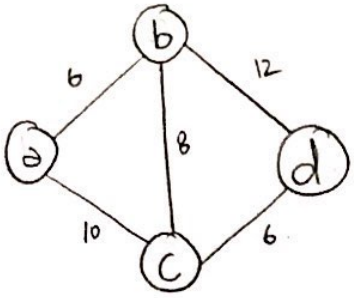
$$\Rightarrow \quad 3.3076 \text{ comparisons}$$

Q3) In 2-3 tree, the leftmost node's left element has the smallest value and the rightmost node's right element has the largest value.

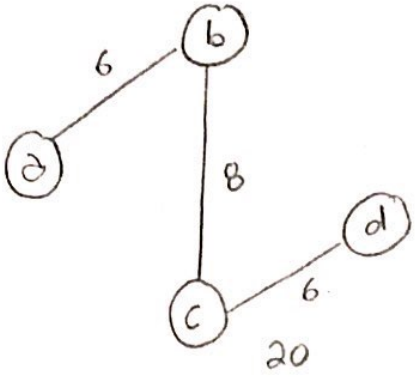
```
Input : A 2-3 tree
Output : Range
    presentNode ← root
while (presentNode.leftChild != NULL)
        presentNode ← presentNode.leftChild
    if (presentNode is a 3 node)
        smallest ← presentNode.leftElementValue
    else
        smallest ← presentNode.value
    presentNode ← root
while (presentNode.rightChild != NULL)
    presentNode ← presentNode.LeftChild
    if (presentNode is a 3 node)
largest ← presentNode.rightElementValue
    else
        largest ← presentNode.Value
range ← largest - smallest
    output range
```

★ worst case
O(log(n))

04) No, we can give a counter example

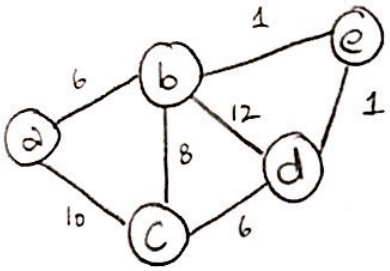


Minimum Spanning Tree

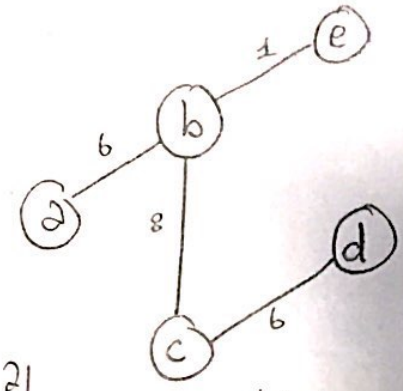


20

If we add a new vertex and new edges



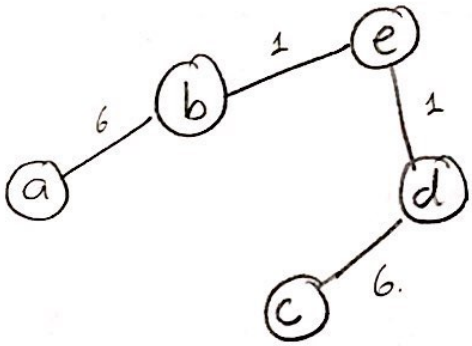
according to the question, we can add any one edge



21

✗ which is not the correct MST

actual minimum spanning tree will now be



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Algorithm is not valid

The added vertex may have edges to other nodes which may change the steps to proceed in Prim's algorithm.

Chapter 4

Programming Exercises

4.1 csce310h0mework03part01

4.1.1 Test 01

diff

part01test01.diff

Input

part01test01.matrix.input

```
0 7 0 7 7 2 2 4
7 0 9 3 11 12 12 1
0 9 0 5 5 7 7 3
7 3 5 0 1 5 8 0
7 11 5 1 0 9 15 6
2 12 7 5 9 0 3 4
2 12 7 8 15 3 0 1
4 1 3 0 6 4 1 0
```

Submission Output

part01test01.output

```
Maximum spanning tree value: 69
```

Solution Output

part01test01.solution

```
Maximum spanning tree value: 69
```

stderr

part01test01.err

4.1.2 Test 02

diff

part01test02.diff

Input

part01test02.matrix.input

```
0 1 6 9
1 0 7 1
6 7 0 8
9 1 8 0
```

Submission Output

part01test02.output

```
Maximum spanning tree value: 24
```

Solution Output

part01test02.solution

```
Maximum spanning tree value: 24
```

stderr

part01test02.err

4.1.3 Test 03

diff

part01test03.diff

Input

part01test03.matrix.input

```
0 4 6 2 0 1 4 5 5
4 0 10 6 4 17 10 7 3
6 10 0 10 2 7 17 8 1
2 6 10 0 6 10 11 10 3
0 4 2 6 0 3 3 1 4
1 17 7 10 3 0 7 11 2
4 10 17 11 3 7 0 4 3
5 7 8 10 1 11 4 0 3
5 3 1 3 4 2 3 3 0
```

Submission Output

part01test03.output

```
Maximum spanning tree value: 83
```

Solution Output

part01test03.solution

```
Maximum spanning tree value: 83
```

stderr

part01test03.err

4.1.4 Test 04

diff

part01test04.diff

Input

part01test04.matrix.input

```
0 0 0 1 7 2 8 6 3 3
0 0 0 1 2 1 2 4 3 6
0 0 0 1 9 9 1 2 1 9
1 1 1 0 7 5 1 10 3 8
```

```
7 2 9 7 0 9 5 13 6 3
2 1 9 5 9 0 3 12 9 8
8 2 1 1 5 3 0 3 0 0
6 4 2 10 13 12 3 0 2 5
3 3 1 3 6 9 0 2 0 0
3 6 9 8 3 8 0 5 0 0
```

Submission Output

part01test04.output

```
Maximum spanning tree value: 83
```

Solution Output

part01test04.solution

```
Maximum spanning tree value: 83
```

stderr

part01test04.err

4.1.5 Test 05

diff

part01test05.diff

Input

part01test05.matrix.input

```
0 6 1 4 8 6 3 5 9
6 0 9 17 9 8 3 8 8
1 9 0 13 11 5 4 5 6
4 17 13 0 2 11 11 8 9
8 9 11 2 0 8 10 2 4
6 8 5 11 8 0 14 8 4
3 3 4 11 10 14 0 1 8
5 8 5 8 2 8 1 0 0
9 8 6 9 4 4 8 0 0
```

Submission Output

part01test05.output

```
Maximum spanning tree value: 92
```

Solution Output

part01test05.solution

```
Maximum spanning tree value: 92
```

stderr

part01test05.err

4.1.6 Test 06

diff

part01test06.diff

Input

part01test06.matrix.input

```
0 0 4 2 1
0 0 5 4 4
4 5 0 1 0
2 4 1 0 8
1 4 0 8 0
```

Submission Output

part01test06.output

```
Maximum spanning tree value: 21
```

Solution Output

part01test06.solution

```
Maximum spanning tree value: 21
```

stderr

part01test06.err

4.1.7 Test 07

diff

part01test07.diff

Input

part01test07.matrix.input

```
0 8 6
8 0 1
6 1 0
```

Submission Output

part01test07.output

```
Maximum spanning tree value: 14
```

Solution Output

part01test07.solution

```
Maximum spanning tree value: 14
```

stderr

part01test07.err

4.1.8 Test 08

diff

part01test08.diff

Input

part01test08.matrix.input

```
0 9 8 4 2 7 1
9 0 4 12 12 8 7
8 4 0 7 9 14 8
4 12 7 0 13 9 4
2 12 9 13 0 9 8
7 8 14 9 9 0 2
1 7 8 4 8 2 0
```

Submission Output

part01test08.output

```
Maximum spanning tree value: 65
```

Solution Output

part01test08.solution

```
Maximum spanning tree value: 65
```

stderr

part01test08.err

4.1.9 Test 09

diff

part01test09.diff

Input

part01test09.matrix.input

```
0 9 5 3 5 7 7 8 7
9 0 6 4 10 5 9 5 3
5 6 0 6 15 3 11 9 4
3 4 6 0 14 8 12 6 4
5 10 15 14 0 3 10 18 8
7 5 3 8 3 0 6 4 0
7 9 11 12 10 6 0 8 4
8 5 9 6 18 4 8 0 1
7 3 4 4 8 0 4 1 0
```

Submission Output

part01test09.output

```
Maximum spanning tree value: 94
```

Solution Output

part01test09.solution

```
Maximum spanning tree value: 94
```

stderr

part01test09.err

4.1.10 Test 10

diff

part01test10.diff

Input

part01test10.matrix.input

```
0 0 2 0 7 3 9 6 8
0 0 7 0 4 4 3 9 7
2 7 0 9 10 8 10 4 4
0 0 9 0 9 2 9 8 1
```

```
7 4 10 9 0 4 10 13 6
3 4 8 2 4 0 9 2 0
9 3 10 9 10 9 0 9 5
6 9 4 8 13 2 9 0 6
8 7 4 1 6 0 5 6 0
```

Submission Output

part01test10.output

```
Maximum spanning tree value: 77
```

Solution Output

part01test10.solution

```
Maximum spanning tree value: 77
```

stderr

part01test10.err

4.1.11 Test 11

diff

part01test11.diff

Input

part01test11.matrix.input

```
0 7 7 4 4 1 8
7 0 9 12 7 13 1
7 9 0 13 6 9 7
4 12 13 0 2 12 7
4 7 6 2 0 3 0
1 13 9 12 3 0 8
8 1 7 7 0 8 0
```

Submission Output

part01test11.output

```
Maximum spanning tree value: 61
```

Solution Output

part01test11.solution

```
Maximum spanning tree value: 61
```

stderr

part01test11.err

4.1.12 Test 12

diff

part01test12.diff

Input

part01test12.matrix.input

```
0 0 6 6 6 7 6 2
0 0 8 4 4 3 4 7
6 8 0 14 8 8 6 4
6 4 14 0 11 7 4 1
6 4 8 11 0 3 5 4
7 3 8 7 3 0 0 0
6 4 6 4 5 0 0 0
2 7 4 1 4 0 0 0
```

Submission Output

part01test12.output

```
Maximum spanning tree value: 61
```

Solution Output

part01test12.solution

```
Maximum spanning tree value: 61
```

stderr

part01test12.err

4.1.13 Test 13

diff

part01test13.diff

Input

part01test13.matrix.input

```
0 1 9 6 5 4 3 4 6
1 0 6 11 11 15 4 8 1
9 6 0 12 9 5 13 15 4
6 11 12 0 9 10 15 12 8
5 11 9 9 0 6 12 13 1
4 15 5 10 6 0 5 8 8
3 4 13 15 12 5 0 13 1
4 8 15 12 13 8 13 0 2
6 1 4 8 1 8 1 2 0
```

Submission Output

part01test13.output

```
Maximum spanning tree value: 99
```

Solution Output

part01test13.solution

```
Maximum spanning tree value: 99
```

stderr

part01test13.err

4.1.14 Test 14

diff

part01test14.diff

Input

part01test14.matrix.input

```
0 0 4 8 1 4 9
0 0 8 2 8 9 8
4 8 0 11 9 11 1
8 2 11 0 15 12 5
1 8 9 15 0 17 7
4 9 11 12 17 0 1
9 8 1 5 7 1 0
```

Submission Output

part01test14.output

```
Maximum spanning tree value: 69
```

Solution Output

part01test14.solution

```
Maximum spanning tree value: 69
```

stderr

part01test14.err

4.1.15 Test 15

diff

part01test15.diff

Input

part01test15.matrix.input

```
0 0 5 9 2 5 9 4 5 5
0 0 7 7 2 1 9 8 1 6
5 7 0 13 10 15 9 10 12 2
9 7 13 0 9 7 8 3 11 5
2 2 10 9 0 2 1 12 10 1
5 1 15 7 2 0 3 12 4 5
9 9 9 8 1 3 0 8 8 0
4 8 10 3 12 12 8 0 12 7
5 1 12 11 10 4 8 12 0 8
5 6 2 5 1 5 0 7 8 0
```

Submission Output

part01test15.output

```
Maximum spanning tree value: 99
```

Solution Output

part01test15.solution

```
Maximum spanning tree value: 99
```

stderr

part01test15.err

4.1.16 Test 16

diff

part01test16.diff

Input

part01test16.matrix.input

```
0 0 7 2 2 4 2 6
0 0 8 3 4 7 1 4
7 8 0 12 13 4 8 6
2 3 12 0 10 9 8 4
2 4 13 10 0 6 4 1
4 7 4 9 6 0 0 0
2 1 8 8 4 0 0 0
6 4 6 4 1 0 0 0
```

Submission Output

part01test16.output

```
Maximum spanning tree value: 63
```

Solution Output

part01test16.solution

```
Maximum spanning tree value: 63
```

stderr

part01test16.err

4.1.17 Test 17

diff

part01test17.diff

Input

part01test17.matrix.input

```
0 0 5 4 0 3 1 4 8
0 0 2 9 0 8 9 6 4
5 2 0 9 3 6 8 8 8
4 9 9 0 4 13 8 1 1
0 0 3 4 0 3 4 9 2
3 8 6 13 3 0 2 5 4
1 9 8 8 4 2 0 0 0
4 6 8 1 9 5 0 0 0
8 4 8 1 2 4 0 0 0
```

Submission Output

part01test17.output

```
Maximum spanning tree value: 73
```

Solution Output

part01test17.solution

```
Maximum spanning tree value: 73
```

stderr

part01test17.err

4.1.18 Test 18

diff

part01test18.diff

Input

part01test18.matrix.input

```
0 0 9 0 2 3 8 3 8
0 0 1 0 6 5 3 4 1
9 1 0 5 9 6 12 8 4
0 0 5 0 4 4 3 2 3
2 6 9 4 0 5 10 5 2
3 5 6 4 5 0 9 4 6
8 3 12 3 10 9 0 1 8
3 4 8 2 5 4 1 0 0
8 1 4 3 2 6 8 0 0
```

Submission Output

part01test18.output

```
Maximum spanning tree value: 67
```

Solution Output

part01test18.solution

```
Maximum spanning tree value: 67
```

stderr

part01test18.err

4.1.19 Test 19

diff

part01test19.diff

Input

part01test19.matrix.input

```
0 9 0 1 0 9 8 3 3 9
9 0 3 9 9 5 6 2 4 9
0 3 0 4 0 9 8 9 9 8
1 9 4 0 8 12 7 7 3 8
0 9 0 8 0 8 7 6 7 1
9 5 9 12 8 0 5 6 3 9
8 6 8 7 7 5 0 2 5 2
3 2 9 7 6 6 2 0 0 0
3 4 9 3 7 3 5 0 0 0
9 9 8 8 1 9 2 0 0 0
```

Submission Output

part01test19.output

```
Maximum spanning tree value: 83
```

Solution Output

part01test19.solution

```
Maximum spanning tree value: 83
```

stderr

part01test19.err

4.1.20 Test 20

diff

part01test20.diff

Input

part01test20.matrix.input

```
0 4 0 2 4
4 0 5 6 1
0 5 0 9 4
2 6 9 0 0
4 1 4 0 0
```

Submission Output

part01test20.output

```
Maximum spanning tree value: 23
```

Solution Output

part01test20.solution

```
Maximum spanning tree value: 23
```

stderr

part01test20.err

4.1.21 Test 21

diff

part01test21.diff

Input

part01test21.matrix.input

```
0 0 4 2 8 9
0 0 9 6 3 2
4 9 0 12 3 7
2 6 12 0 1 7
8 3 3 1 0 0
9 2 7 7 0 0
```

Submission Output

part01test21.output

```
Maximum spanning tree value: 45
```

Solution Output

part01test21.solution

```
Maximum spanning tree value: 45
```

stderr

part01test21.err

4.1.22 Test 22

diff

part01test22.diff

Input

part01test22.matrix.input

```
0 1 8 8 0 3
1 0 11 18 3 3
8 11 0 7 9 5
8 18 7 0 4 7
0 3 9 4 0 2
3 3 5 7 2 0
```

Submission Output

part01test22.output

```
Maximum spanning tree value: 53
```

Solution Output

part01test22.solution

```
Maximum spanning tree value: 53
```

stderr

part01test22.err

4.1.23 Test 23

diff

part01test23.diff

Input

part01test23.matrix.input

```
0 0 2 8 4 8 2 4
0 0 3 6 6 9 7 5
2 3 0 7 13 5 10 2
8 6 7 0 8 4 7 0
4 6 13 8 0 12 11 8
8 9 5 4 12 0 16 7
2 7 10 7 11 16 0 1
4 5 2 0 8 7 1 0
```

Submission Output

part01test23.output

```
Maximum spanning tree value: 74
```

Solution Output

part01test23.solution

```
Maximum spanning tree value: 74
```

stderr

part01test23.err

4.1.24 Test 24

diff

part01test24.diff

Input

part01test24.matrix.input

```
0 0 3 9 4 7 7
0 0 8 6 6 9 8
3 8 0 8 9 3 5
9 6 8 0 12 15 4
4 6 9 12 0 10 2
7 9 3 15 10 0 6
7 8 5 4 2 6 0
```

Submission Output

part01test24.output

```
Maximum spanning tree value: 62
```

Solution Output

part01test24.solution

```
Maximum spanning tree value: 62
```

stderr

part01test24.err

4.1.25 Test 25

diff

part01test25.diff

Input

part01test25.matrix.input

```
0 0 8 6
0 0 9 6
8 9 0 3
6 6 3 0
```

Submission Output

part01test25.output

```
Maximum spanning tree value: 23
```

Solution Output

part01test25.solution

```
Maximum spanning tree value: 23
```

```
stderr
```

part01test25.err

4.1.26 Source Code

csce310h0mework03part01.h

```
#ifndef CSCE310H0MEWORK03PART01_H
#define CSCE310H0MEWORK03PART01_H
#include <vector>
using namespace std;

double maximumST( vector< vector<double> > );

#endif
```

csce310h0mework03part01.cpp

```
/**
 * Author: Fateh Karan Singh Sandhu
 *
 * This program uses Prim's algorithm to produce a maximum spanning tree
 * from a given adjacency matrix
 */

#include <vector>
#include "csce310h0mework03part01.h"
#include <cmath>
#include <iostream>
#include<algorithm>

using namespace std;

double maximumST( vector< vector<double> > adjacencyMatrix ){

  double maximumSpanningTree = 0;
  vector<int> nodesVisited; //initialize vector
  nodesVisited.push_back(0); //start at the first node
  int maxElement = 0;
  int row = 0;
  int column = 0;

 for (int l = 0 ; l < adjacencyMatrix.size() ; l++) {
  for (int i = 0 ; i < nodesVisited.size() ; i++) {
    for (int j = 0 ; j < adjacencyMatrix.size() ; j++) {
      if (adjacencyMatrix[nodesVisited[i]][j] > maxElement) {
        maxElement = adjacencyMatrix[nodesVisited[i]][j]; //get max
        row = i;
        column = j;
      }
    }
  }
  maximumSpanningTree += maxElement; //add maxEdge to Tree
  for (int k = 0 ; k < adjacencyMatrix.size() ; k++) {
    if (l == 0) {
      adjacencyMatrix[k][row] = 0; //take column 0 out of consideration for first node
    }
    adjacencyMatrix[k][column] = 0; //take columns out of consideration
  }
  nodesVisited.push_back(column); //push back node visited
```

```
43    row = 0;
44    column = 0;
45    maxElement = 0;
46    }
47
48    return maximumSpanningTree;
49  }
```

4.2 csce310h0mework03part02

4.2.1 Test 01

diff

part02test01.diff

Input

part02test01.matrix.input

```
0 -1 -1 9 3 9
-1 0 -1 -1 -1 -1
-1 -1 0 3 2 3
9 -1 3 0 6 8
3 -1 2 6 0 -1
9 -1 3 8 -1 0
```

part02test01.i.input

```
5
```

Submission Output

part02test01.output

```
0 -1 5 8 3 8
-1 0 -1 -1 -1 -1
5 -1 0 3 2 3
8 -1 3 0 5 6
3 -1 2 5 0 5
8 -1 3 6 5 0
```

Solution Output

part02test01.solution

```
0 -1 5 8 3 8
-1 0 -1 -1 -1 -1
5 -1 0 3 2 3
8 -1 3 0 5 6
3 -1 2 5 0 5
8 -1 3 6 5 0
```

stderr

part02test01.err

4.2.2 Test 02

diff

part02test02.diff

Input

part02test02.matrix.input

```
0 -1 4 -1 1
-1 0 4 -1 9
4 4 0 -1 1
-1 -1 -1 0 -1
1 9 1 -1 0
```

part02test02.i.input

```
5
```

Submission Output

part02test02.output

```
0 6 2 -1 1
6 0 4 -1 5
2 4 0 -1 1
-1 -1 -1 0 -1
1 5 1 -1 0
```

Solution Output

part02test02.solution

```
0 6 2 -1 1
6 0 4 -1 5
2 4 0 -1 1
-1 -1 -1 0 -1
1 5 1 -1 0
```

stderr

part02test02.err

4.2.3 Test 03

diff

part02test03.diff

Input

part02test03.matrix.input

```
0 -1 3 -1 9 -1 9
-1 0 7 -1 2 -1 5
3 7 0 -1 -1 6 -1
-1 -1 -1 0 -1 -1 -1
9 2 -1 -1 0 7 -1
-1 -1 6 -1 7 0 5
9 5 -1 -1 -1 5 0
```

part02test03.i.input

```
2
```

Submission Output

part02test03.output

```
0 -1 3 -1 9 -1 9
-1 0 7 -1 2 -1 5
3 7 0 -1 9 6 12
-1 -1 -1 0 -1 -1 -1
9 2 9 -1 0 7 7
-1 -1 6 -1 7 0 5
9 5 12 -1 7 5 0
```

Solution Output

part02test03.solution

```
0 -1 3 -1 9 -1 9
-1 0 7 -1 2 -1 5
3 7 0 -1 9 6 12
-1 -1 -1 0 -1 -1 -1
9 2 9 -1 0 7 7
-1 -1 6 -1 7 0 5
9 5 12 -1 7 5 0
```

stderr

part02test03.err

4.2.4 Test 04

diff

part02test04.diff

Input

part02test04.matrix.input

```
0 9 -1 1
9 0 -1 8
-1 -1 0 -1
1 8 -1 0
```

part02test04.i.input

```
4
```

Submission Output

part02test04.output

```
0 9 -1 1
9 0 -1 8
-1 -1 0 -1
1 8 -1 0
```

Solution Output

part02test04.solution

```
0 9 -1 1
9 0 -1 8
-1 -1 0 -1
1 8 -1 0
```

stderr

part02test04.err

4.2.5 Test 05

diff

part02test05.diff

Input

part02test05.matrix.input

```
0 7 -1 5 2 7 4 6 6 1
7 0 5 5 17 5 16 4 6 7
-1 5 0 1 1 2 2 4 1 5
5 5 1 0 14 10 6 9 6 5
2 17 1 14 0 13 9 3 7 3
7 5 2 10 13 0 8 8 13 1
4 16 2 6 9 8 0 6 11 5
6 4 4 9 3 8 6 0 3 -1
6 6 1 6 7 13 11 3 0 7
1 7 5 5 3 1 5 -1 7 0
```

part02test05.i.input

```
9
```

Submission Output

part02test05.output

```
0 7 3 4 2 5 4 5 4 1
7 0 5 5 6 5 7 4 6 6
3 5 0 1 1 2 2 4 1 3
4 5 1 0 2 3 3 5 2 4
2 6 1 2 0 3 3 3 2 3
5 5 2 3 3 0 4 6 3 1
4 7 2 3 3 4 0 6 3 5
5 4 4 5 3 6 6 0 3 6
4 6 1 2 2 3 3 3 0 4
1 6 3 4 3 1 5 6 4 0
```

Solution Output

part02test05.solution

```
0 7 3 4 2 5 4 5 4 1
7 0 5 5 6 5 7 4 6 6
3 5 0 1 1 2 2 4 1 3
4 5 1 0 2 3 3 5 2 4
2 6 1 2 0 3 3 3 2 3
5 5 2 3 3 0 4 6 3 1
4 7 2 3 3 4 0 6 3 5
5 4 4 5 3 6 6 0 3 6
4 6 1 2 2 3 3 3 0 4
1 6 3 4 3 1 5 6 4 0
```

`stderr`

part02test05.err

4.2.6 Test 06

`diff`

part02test06.diff

Input

part02test06.matrix.input

```
0 9 2 4 2 4
9 0 14 4 7 9
2 14 0 3 5 8
4 4 3 0 -1 -1
2 7 5 -1 0 -1
4 9 8 -1 -1 0
```

part02test06.i.input

```
2
```

Submission Output

part02test06.output

```
0 9 2 4 2 4
9 0 11 4 7 9
2 11 0 3 4 6
4 4 3 0 6 8
2 7 4 6 0 6
4 9 6 8 6 0
```

Solution Output

part02test06.solution

```
0 9 2 4 2 4
9 0 11 4 7 9
2 11 0 3 4 6
4 4 3 0 6 8
2 7 4 6 0 6
4 9 6 8 6 0
```

`stderr`

part02test06.err

4.2.7 Test 07

`diff`

part02test07.diff

Input

part02test07.matrix.input

```
0 -1 -1 7 7
-1 0 -1 9 3
-1 -1 0 1 4
7 9 1 0 -1
7 3 4 -1 0
```

part02test07.i.input

```
2
```

Submission Output

part02test07.output

```
0 -1 -1 7 7
-1 0 -1 9 3
-1 -1 0 1 4
7 9 1 0 12
7 3 4 12 0
```

Solution Output

part02test07.solution

```
0 -1 -1 7 7
-1 0 -1 9 3
-1 -1 0 1 4
7 9 1 0 12
7 3 4 12 0
```

stderr

part02test07.err

4.2.8 Test 08

diff

part02test08.diff

Input

part02test08.matrix.input

```
0 4 2 2 2 6
4 0 9 9 1 2
2 9 0 7 6 3
2 9 7 0 -1 -1
2 1 6 -1 0 -1
6 2 3 -1 -1 0
```

part02test08.i.input

```
5
```

Submission Output

part02test08.output

```
0 3 2 2 2 5
3 0 5 5 1 2
2 5 0 4 4 3
2 5 4 0 4 7
2 1 4 4 0 3
5 2 3 7 3 0
```

Solution Output

part02test08.solution

```
0 3 2 2 2 5
3 0 5 5 1 2
2 5 0 4 4 3
2 5 4 0 4 7
2 1 4 4 0 3
5 2 3 7 3 0
```

stderr

part02test08.err

4.2.9 Test 09

diff

part02test09.diff

Input

part02test09.matrix.input

```
0 7 7 5 1
7 0 3 -1 -1
7 3 0 7 3
5 -1 7 0 -1
1 -1 3 -1 0
```

part02test09.i.input

```
2
```

Submission Output

part02test09.output

```
0 7 7 5 1
7 0 3 12 8
7 3 0 7 3
5 12 7 0 6
1 8 3 6 0
```

Solution Output

part02test09.solution

```
0 7 7 5 1
7 0 3 12 8
7 3 0 7 3
5 12 7 0 6
1 8 3 6 0
```

stderr

part02test09.err

4.2.10 Test 10

diff

part02test10.diff

Input

part02test10.matrix.input

```
0 -1 7 4 1 8 -1 6
-1 0 -1 -1 -1 -1 -1 -1
7 -1 0 3 11 6 -1 3
4 -1 3 0 14 12 -1 8
1 -1 11 14 0 13 -1 1
8 -1 6 12 13 0 -1 8
-1 -1 -1 -1 -1 -1 0 -1
6 -1 3 8 1 8 -1 0
```

part02test10.i.input

```
6
```

Submission Output

part02test10.output

```
0 -1 7 4 1 8 -1 2
-1 0 -1 -1 -1 -1 -1 -1
7 -1 0 3 8 6 -1 3
4 -1 3 0 5 9 -1 6
1 -1 8 5 0 9 -1 1
8 -1 6 9 9 0 -1 8
-1 -1 -1 -1 -1 -1 0 -1
2 -1 3 6 1 8 -1 0
```

Solution Output

part02test10.solution

```
0 -1 7 4 1 8 -1 2
-1 0 -1 -1 -1 -1 -1 -1
7 -1 0 3 8 6 -1 3
4 -1 3 0 5 9 -1 6
1 -1 8 5 0 9 -1 1
8 -1 6 9 9 0 -1 8
-1 -1 -1 -1 -1 -1 0 -1
2 -1 3 6 1 8 -1 0
```

stderr

part02test10.err

4.2.11 Test 11

diff

part02test11.diff

Input

part02test11.matrix.input

```
0 -1 -1 5 3
-1 0 -1 3 3
-1 -1 0 -1 -1
5 3 -1 0 -1
3 3 -1 -1 0
```

part02test11.i.input

```
2
```

Submission Output

part02test11.output

```
0 -1 -1 5 3
-1 0 -1 3 3
-1 -1 0 -1 -1
5 3 -1 0 6
3 3 -1 6 0
```

Solution Output

part02test11.solution

```
0 -1 -1 5 3
-1 0 -1 3 3
-1 -1 0 -1 -1
5 3 -1 0 6
3 3 -1 6 0
```

stderr

part02test11.err

4.2.12 Test 12

diff

part02test12.diff

Input

part02test12.matrix.input

```
0 -1 -1 -1 7 -1 4 4
-1 0 -1 -1 3 -1 3 6
-1 -1 0 -1 4 -1 3 8
-1 -1 -1 0 -1 -1 -1 -1
7 3 4 -1 0 -1 -1 -1
-1 -1 -1 -1 -1 0 -1 -1
4 3 3 -1 -1 -1 0 -1
4 6 8 -1 -1 -1 -1 0
```

part02test12.i.input

```
7
```

Submission Output

part02test12.output

```
0 7 7 -1 7 -1 4 4
7 0 6 -1 3 -1 3 6
7 6 0 -1 4 -1 3 8
-1 -1 -1 0 -1 -1 -1 -1
7 3 4 -1 0 -1 6 9
-1 -1 -1 -1 -1 0 -1 -1
4 3 3 -1 6 -1 0 8
4 6 8 -1 9 -1 8 0
```

Solution Output

part02test12.solution

```
0 7 7 -1 7 -1 4 4
7 0 6 -1 3 -1 3 6
7 6 0 -1 4 -1 3 8
-1 -1 -1 0 -1 -1 -1 -1
7 3 4 -1 0 -1 6 9
-1 -1 -1 -1 -1 0 -1 -1
4 3 3 -1 6 -1 0 8
4 6 8 -1 9 -1 8 0
```

`stderr`

part02test12.err

4.2.13 Test 13

`diff`

part02test13.diff

Input

part02test13.matrix.input

```
0 -1 -1 8 1
-1 0 -1 6 4
-1 -1 0 6 3
8 6 6 0 -1
1 4 3 -1 0
```

part02test13.i.input

```
3
```

Submission Output

part02test13.output

```
0 -1 -1 8 1
-1 0 -1 6 4
-1 -1 0 6 3
8 6 6 0 9
1 4 3 9 0
```

Solution Output

part02test13.solution

```
0 -1 -1 8 1
-1 0 -1 6 4
-1 -1 0 6 3
8 6 6 0 9
1 4 3 9 0
```

stderr

part02test13.err

4.2.14 Test 14

diff

part02test14.diff

Input

part02test14.matrix.input

```
0 -1 1 1
-1 0 8 7
1 8 0 -1
1 7 -1 0
```

part02test14.i.input

```
2
```

Submission Output

part02test14.output

```
0 -1 1 1
-1 0 8 7
1 8 0 2
1 7 2 0
```

Solution Output

part02test14.solution

```
0 -1 1 1
-1 0 8 7
1 8 0 2
1 7 2 0
```

stderr

part02test14.err

4.2.15 Test 15

`diff`

part02test15.diff

Input

part02test15.matrix.input

```
0 -1 -1 9 6 8 3 2 5 2
-1 0 -1 3 7 3 8 8 7 4
-1 -1 0 4 8 3 8 1 2 1
9 3 4 0 5 16 8 16 5 2
6 7 8 5 0 5 2 7 -1 -1
8 3 3 16 5 0 4 6 5 3
3 8 8 8 2 4 0 6 4 1
2 8 1 16 7 6 6 0 8 2
5 7 2 5 -1 5 4 8 0 -1
2 4 1 2 -1 3 1 2 -1 0
```

part02test15.i.input

```
5
```

Submission Output

part02test15.output

```
0 12 13 9 6 8 3 2 5 2
12 0 7 3 7 3 8 8 7 4
13 7 0 4 8 3 8 1 2 1
9 3 4 0 5 6 7 5 5 2
6 7 8 5 0 5 2 7 10 7
8 3 3 6 5 0 4 4 5 3
3 8 8 7 2 4 0 5 4 1
2 8 1 5 7 4 5 0 3 2
5 7 2 5 10 5 4 3 0 3
2 4 1 2 7 3 1 2 3 0
```

Solution Output

part02test15.solution

```
0 12 13 9 6 8 3 2 5 2
12 0 7 3 7 3 8 8 7 4
13 7 0 4 8 3 8 1 2 1
9 3 4 0 5 6 7 5 5 2
6 7 8 5 0 5 2 7 10 7
8 3 3 6 5 0 4 4 5 3
3 8 8 7 2 4 0 5 4 1
2 8 1 5 7 4 5 0 3 2
5 7 2 5 10 5 4 3 0 3
2 4 1 2 7 3 1 2 3 0
```

`stderr`

part02test15.err

4.2.16 Test 16

`diff`

part02test16.diff

Input

part02test16.matrix.input

```
0 -1 2 -1 4
-1 0 3 -1 4
2 3 0 -1 -1
-1 -1 -1 0 -1
4 4 -1 -1 0
```

part02test16.i.input

```
5
```

Submission Output

part02test16.output

```
0 5 2 -1 4
5 0 3 -1 4
2 3 0 -1 6
-1 -1 -1 0 -1
4 4 6 -1 0
```

Solution Output

part02test16.solution

```
0 5 2 -1 4
5 0 3 -1 4
2 3 0 -1 6
-1 -1 -1 0 -1
4 4 6 -1 0
```

stderr

part02test16.err

4.2.17 Test 17

diff

part02test17.diff

Input

part02test17.matrix.input

```
0 -1 -1 9 9 4 8
-1 0 -1 5 7 3 8
-1 -1 0 -1 -1 -1 -1
9 5 -1 0 3 -1 -1
9 7 -1 3 0 6 9
4 3 -1 -1 6 0 -1
8 8 -1 -1 9 -1 0
```

part02test17.i.input

```
4
```

Submission Output

part02test17.output

```
0 14 -1 9 9 4 8
14 0 -1 5 7 3 8
-1 -1 0 -1 -1 -1 -1
9 5 -1 0 3 8 13
9 7 -1 3 0 6 9
4 3 -1 8 6 0 11
8 8 -1 13 9 11 0
```

Solution Output

part02test17.solution

```
0 14 -1 9 9 4 8
14 0 -1 5 7 3 8
-1 -1 0 -1 -1 -1 -1
9 5 -1 0 3 8 13
9 7 -1 3 0 6 9
4 3 -1 8 6 0 11
8 8 -1 13 9 11 0
```

stderr

part02test17.err

4.2.18 Test 18

diff

part02test18.diff

Input

part02test18.matrix.input

```
0 -1 5 8 -1 1 7 1 1
-1 0 2 7 -1 2 7 2 1
5 2 0 7 -1 4 5 2 9
8 7 7 0 -1 -1 -1 -1 -1
-1 -1 -1 -1 0 -1 -1 -1 -1
1 2 4 -1 -1 0 -1 -1 -1
7 7 5 -1 -1 -1 0 -1 -1
1 2 2 -1 -1 -1 -1 0 -1
1 1 9 -1 -1 -1 -1 -1 0
```

part02test18.i.input

```
5
```

Submission Output

part02test18.output

```
0 7 5 8 -1 1 7 1 1
7 0 2 7 -1 2 7 2 1
5 2 0 7 -1 4 5 2 3
8 7 7 0 -1 9 12 9 8
-1 -1 -1 -1 0 -1 -1 -1 -1
1 2 4 9 -1 0 8 2 2
7 7 5 12 -1 8 0 7 8
1 2 2 9 -1 2 7 0 2
1 1 3 8 -1 2 8 2 0
```

Solution Output

part02test18.solution

```
0 7 5 8 -1 1 7 1 1
7 0 2 7 -1 2 7 2 1
5 2 0 7 -1 4 5 2 3
8 7 7 0 -1 9 12 9 8
-1 -1 -1 -1 0 -1 -1 -1 -1
1 2 4 9 -1 0 8 2 2
7 7 5 12 -1 8 0 7 8
1 2 2 9 -1 2 7 0 2
1 1 3 8 -1 2 8 2 0
```

stderr

part02test18.err

4.2.19 Test 19

diff

part02test19.diff

Input

part02test19.matrix.input

```
0 -1 -1
-1 0 3
-1 3 0
```

part02test19.i.input

```
1
```

Submission Output

part02test19.output

```
0 -1 -1
-1 0 3
-1 3 0
```

Solution Output

part02test19.solution

```
0 -1 -1
-1 0 3
-1 3 0
```

stderr

part02test19.err

4.2.20 Test 20

diff

part02test20.diff

Input

part02test20.matrix.input

```
0 3 -1 9 4
3 0 -1 5 5
-1 -1 0 -1 -1
9 5 -1 0 -1
4 5 -1 -1 0
```

part02test20.i.input

```
3
```

Submission Output

part02test20.output

```
0 3 -1 8 4
3 0 -1 5 5
-1 -1 0 -1 -1
8 5 -1 0 10
4 5 -1 10 0
```

Solution Output

part02test20.solution

```
0 3 -1 8 4
3 0 -1 5 5
-1 -1 0 -1 -1
8 5 -1 0 10
4 5 -1 10 0
```

`stderr`

part02test20.err

4.2.21 Test 21

`diff`

part02test21.diff

Input

part02test21.matrix.input

```
0 -1 4 1
-1 0 4 3
4 4 0 -1
1 3 -1 0
```

part02test21.i.input

```
2
```

Submission Output

part02test21.output

```
0 -1 4 1
-1 0 4 3
4 4 0 5
1 3 5 0
```

Solution Output

part02test21.solution

```
0 -1 4 1
-1 0 4 3
4 4 0 5
1 3 5 0
```

stderr

part02test21.err

4.2.22 Test 22

diff

part02test22.diff

Input

part02test22.matrix.input

```
0 -1 3 6
-1 0 7 2
3 7 0 -1
6 2 -1 0
```

part02test22.i.input

```
4
```

Submission Output

part02test22.output

```
0 8 3 6
8 0 7 2
3 7 0 9
6 2 9 0
```

Solution Output

part02test22.solution

```
0 8 3 6
8 0 7 2
3 7 0 9
6 2 9 0
```

stderr

part02test22.err

4.2.23 Test 23

diff

part02test23.diff

Input

part02test23.matrix.input

```
0 8 9 1 5
8 0 4 1 3
9 4 0 -1 -1
1 1 -1 0 -1
5 3 -1 -1 0
```

part02test23.i.input

```
4
```

Submission Output

part02test23.output

```
0 2 6 1 5
2 0 4 1 3
6 4 0 5 7
1 1 5 0 4
5 3 7 4 0
```

Solution Output

part02test23.solution

```
0 2 6 1 5
2 0 4 1 3
6 4 0 5 7
1 1 5 0 4
5 3 7 4 0
```

stderr

part02test23.err

4.2.24 Test 24

diff

part02test24.diff

Input

part02test24.matrix.input

```
0 -1 -1 -1 5 5 3
-1 0 -1 -1 -1 -1 -1
-1 -1 0 -1 -1 -1 -1
-1 -1 -1 0 2 3 7
5 -1 -1 2 0 5 -1
5 -1 -1 3 5 0 3
3 -1 -1 7 -1 3 0
```

part02test24.i.input

```
4
```

Submission Output

part02test24.output

```
0 -1 -1 -1 5 5 3
-1 0 -1 -1 -1 -1 -1
-1 -1 0 -1 -1 -1 -1
-1 -1 -1 0 2 3 7
5 -1 -1 2 0 5 8
5 -1 -1 3 5 0 3
3 -1 -1 7 8 3 0
```

Solution Output

part02test24.solution

```
0 -1 -1 -1 5 5 3
-1 0 -1 -1 -1 -1 -1
-1 -1 0 -1 -1 -1 -1
-1 -1 -1 0 2 3 7
5 -1 -1 2 0 5 8
5 -1 -1 3 5 0 3
3 -1 -1 7 8 3 0
```

stderr

part02test24.err

4.2.25 Test 25

diff

part02test25.diff

Input

part02test25.matrix.input

```
0 -1 -1 -1
-1 0 -1 -1
-1 -1 0 7
-1 -1 7 0
```

part02test25.i.input

```
1
```

Submission Output

part02test25.output

```
0 -1 -1 -1
-1 0 -1 -1
-1 -1 0 7
-1 -1 7 0
```

Solution Output

part02test25.solution

```
0 -1 -1 -1
-1 0 -1 -1
-1 -1 0 7
-1 -1 7 0
```

stderr

part02test25.err

4.2.26 Source Code

csce310h0mework03part02.h

```
1 #ifndef CSCE310H0MEWORK03PART02_H
2 #define CSCE310H0MEWORK03PART02_H
3 #include <vector>
4 using namespace std;
5
6 vector< vector<double> > allPairsSP( vector< vector<double> > , int );
7
8 #endif
```

csce310h0mework03part02.cpp

```
/**
 * Author: Fateh Karan Singh Sandhu
 *
 * This program uses Floyds's algorithm to produce a all pairs shortest path tree
 * from a given adjacency matrix, output is computed upto the i'th stage.
 */

#include <vector>
#include "csce310h0mework03part02.h"
#include <cmath>
#include <iostream>

using namespace std;

vector< vector<double> > allPairsSP( vector< vector<double> > adjacencyMatrix , int i ){

  for (int k = 0 ; k < i ; k++) {
    for (int j = 0 ; j < adjacencyMatrix.size() ; j++) {
      for (int l = 0 ; l < adjacencyMatrix.size() ; l++) {
        if (adjacencyMatrix[j][l] == -1) {
          adjacencyMatrix[j][l] = 100000; //set -1 to a large value
        }
        adjacencyMatrix[j][l] = min(adjacencyMatrix[j][l], adjacencyMatrix[j][k]+adjacencyMatrix[k][l]);
      }
    }
  }

  for (int a = 0 ; a < adjacencyMatrix.size() ; a++) {
      for (int b = 0 ; b < adjacencyMatrix.size() ; b++) {
        if (adjacencyMatrix[a][b] == 100000) {
          adjacencyMatrix[a][b] = -1; //change large value back to -1
        }
      }
    }

  return adjacencyMatrix;
}
```

4.3 csce310h0mework03part03

4.3.1 Test 01

diff

part03test01.diff

Input

part03test01.coeffs.input

```
-3
-2
-3
3
2
-3
```

part03test01.x.input

```
0
```

Submission Output

part03test01.output

```
The value of -3x^5-2x^4-3x^3+3x^2+2x^1-3 at 0 is -3
```

Solution Output

part03test01.solution

```
The value of -3x^5-2x^4-3x^3+3x^2+2x^1-3 at 0 is -3
```

stderr

part03test01.err

4.3.2 Test 02

diff

part03test02.diff

Input

part03test02.coeffs.input

```
-2
2
-3
2
```

part03test02.x.input

```
-2
```

Submission Output

part03test02.output

```
The value of -2x^3+2x^2-3x^1+2 at -2 is 32
```

Solution Output

part03test02.solution

```
The value of -2x^3+2x^2-3x^1+2 at -2 is 32
```

stderr

part03test02.err

4.3.3 Test 03

diff

part03test03.diff

Input

part03test03.coeffs.input

```
2
-1
-1
```

part03test03.x.input

```
-2
```

Submission Output

part03test03.output

```
The value of 2x^2-1x^1-1 at -2 is 9
```

Solution Output

part03test03.solution

```
The value of 2x^2-1x^1-1 at -2 is 9
```

stderr

part03test03.err

4.3.4 Test 04

diff

part03test04.diff

Input

part03test04.coeffs.input

```
-1
-3
-1
2
3
```

part03test04.x.input

```
2
```

Submission Output

part03test04.output

```
The value of -1x^4-3x^3-1x^2+2x^1+3 at 2 is -37
```

Solution Output

part03test04.solution

```
The value of -1x^4-3x^3-1x^2+2x^1+3 at 2 is -37
```

stderr

part03test04.err

4.3.5 Test 05

diff

part03test05.diff

Input

part03test05.coeffs.input

```
-2
2
-1
3
```

part03test05.x.input

```
3
```

Submission Output

part03test05.output

```
The value of -2x^3+2x^2-1x^1+3 at 3 is -36
```

Solution Output

part03test05.solution

```
The value of -2x^3+2x^2-1x^1+3 at 3 is -36
```

stderr

part03test05.err

4.3.6 Test 06

diff

part03test06.diff

Input

part03test06.coeffs.input

```
-3
-1
3
-2
2
3
```

part03test06.x.input

```
-1
```

Submission Output

part03test06.output

```
The value of -3x^5-1x^4+3x^3-2x^2+2x^1+3 at -1 is -2
```

Solution Output

part03test06.solution

```
The value of -3x^5-1x^4+3x^3-2x^2+2x^1+3 at -1 is -2
```

stderr

part03test06.err

4.3.7 Test 07

diff

part03test07.diff

Input

part03test07.coeffs.input

```
3
3
```

part03test07.x.input

```
2
```

Submission Output

part03test07.output

```
The value of 3x^1+3 at 2 is 9
```

Solution Output

part03test07.solution

```
The value of 3x^1+3 at 2 is 9
```

stderr

part03test07.err

4.3.8 Test 08

diff

part03test08.diff

Input

part03test08.coeffs.input

```
1
2
-2
3
```

part03test08.x.input

```
-1
```

Submission Output

part03test08.output

```
The value of 1x^3+2x^2-2x^1+3 at -1 is 6
```

Solution Output

part03test08.solution

```
The value of 1x^3+2x^2-2x^1+3 at -1 is 6
```

stderr

part03test08.err

4.3.9 Test 09

diff

part03test09.diff

Input

part03test09.coeffs.input

```
1
3
-3
-1
-1
-3
```

part03test09.x.input

```
-2
```

Submission Output

part03test09.output

```
The value of 1x^5+3x^4-3x^3-1x^2-1x^1-3 at -2 is 35
```

Solution Output

part03test09.solution

```
The value of 1x^5+3x^4-3x^3-1x^2-1x^1-3 at -2 is 35
```

stderr

part03test09.err

4.3.10 Test 10

diff

part03test10.diff

Input

part03test10.coeffs.input

```
1
3
1
```

part03test10.x.input

```
0
```

Submission Output

part03test10.output

```
The value of 1x^2+3x^1+1 at 0 is 1
```

Solution Output

part03test10.solution

```
The value of 1x^2+3x^1+1 at 0 is 1
```

stderr

part03test10.err

4.3.11 Source Code

csce310h0mework03part03.h

```
1 #ifndef CSCE310H0MEWORK03PART03_H
2 #define CSCE310H0MEWORK03PART03_H
3 #include <vector>
4 using namespace std;
5
6 int hornersRule( vector<int> , int );
7
8 #endif
```

```cpp
/**
 * Author: Fateh Karan Singh Sandhu
 *
 * This program computes a polynomial at a given value using Horners's rule
 */

#include <vector>
#include "csce310h0mework03part03.h"
#include <cmath>
#include <iostream>
#include <vector>

using namespace std;

int hornersRule( vector<int> coeffs , int value ){

  double result = coeffs[0]; //set the first coeff
  for (int i = 1 ; i < coeffs.size() ; i++) {
    result = (result * value) + coeffs[i];
  }
  return result;
}
```