# UNIVERSITY OF KARACHI
# (UOK)

## ACADEMIC YEAR-2021

## DEPARTMENT OF COMPUTER SCIENCE

**MORNING PROGRAMME**

**MCS (FINAL)- 4th SEMESTER**

**COURSE TITLE: *"ARTIFICIAL INTELLIGENCE"***
**COURSE CODE: CS-616**

**SUBMITTED TO:**

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**SUBMITTED BY:**


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**SEAT NO:** P19101049
**ENROLLMENT NO:** SCI/DCS/KU-7276/2019

# ASSIGNMENT # '03'

## QUESTION # 01:-

8-Puzzle Number of tiles out of places:-

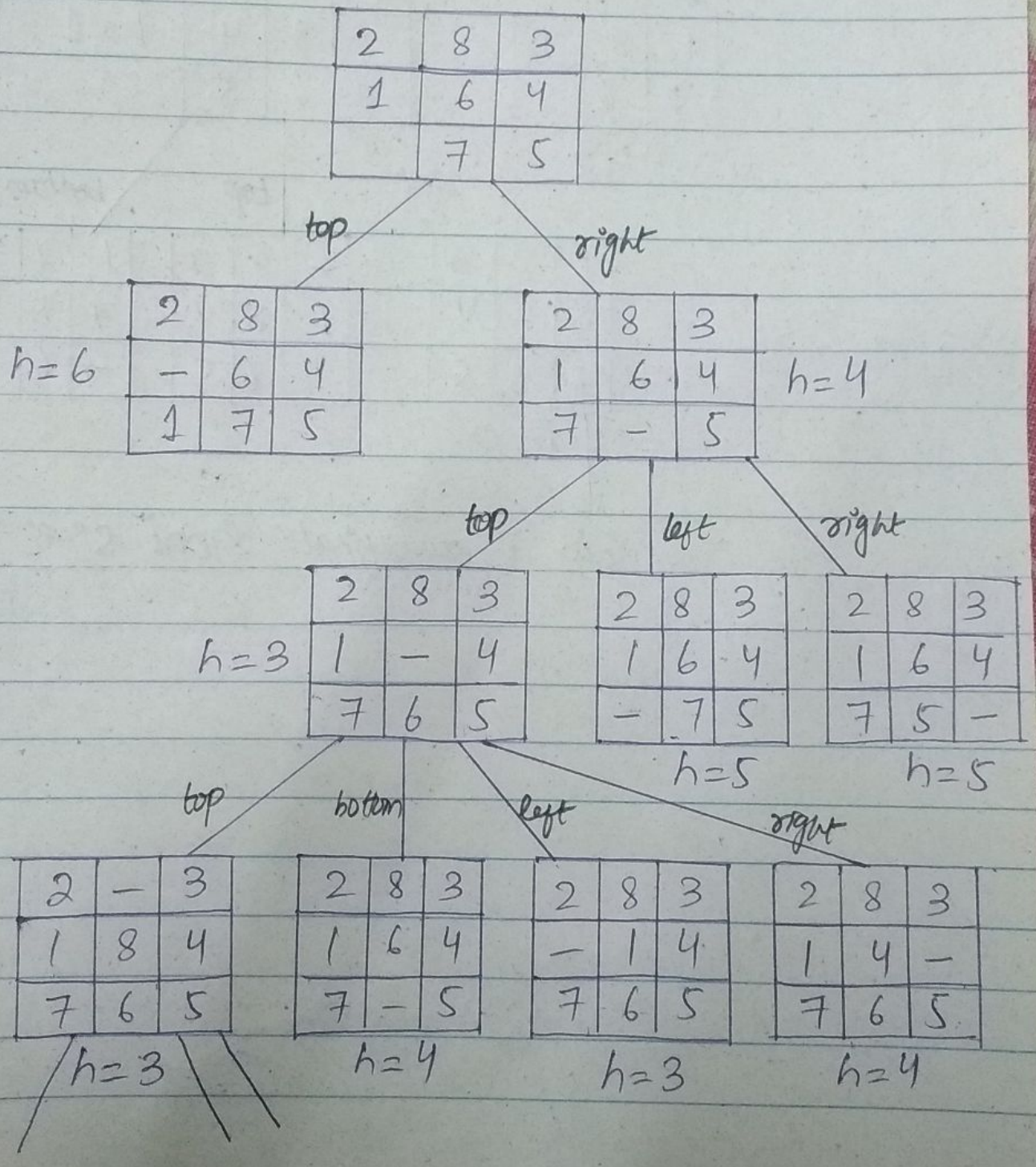
| | | |
|---|---|---|
| 2 | 8 | 3 |
| 1 | 6 | 4 |
| | 7 | 5 |

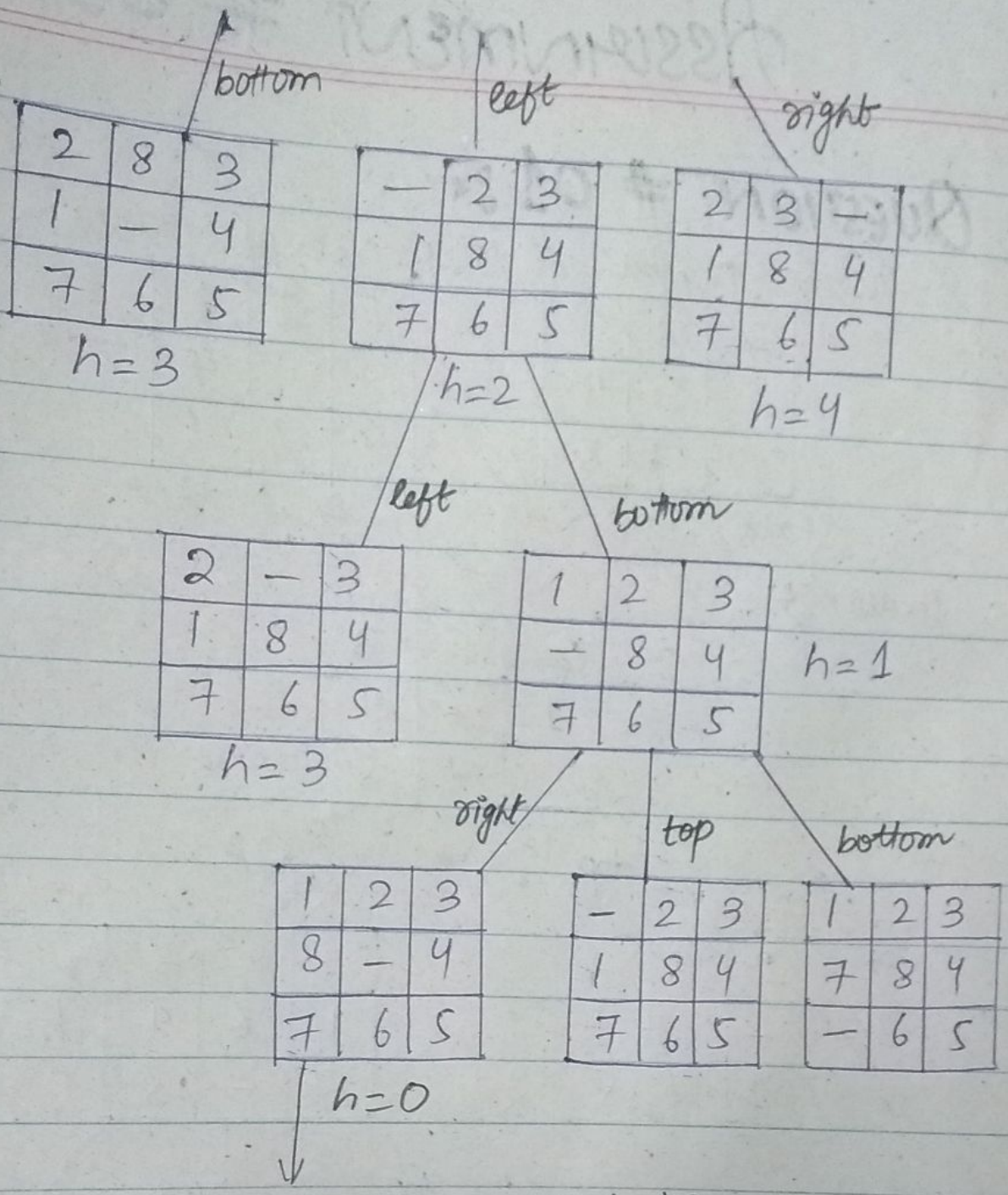
Start State

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 8 | | 4 |
| 7 | 6 | 5 |

Final State

Solution:-

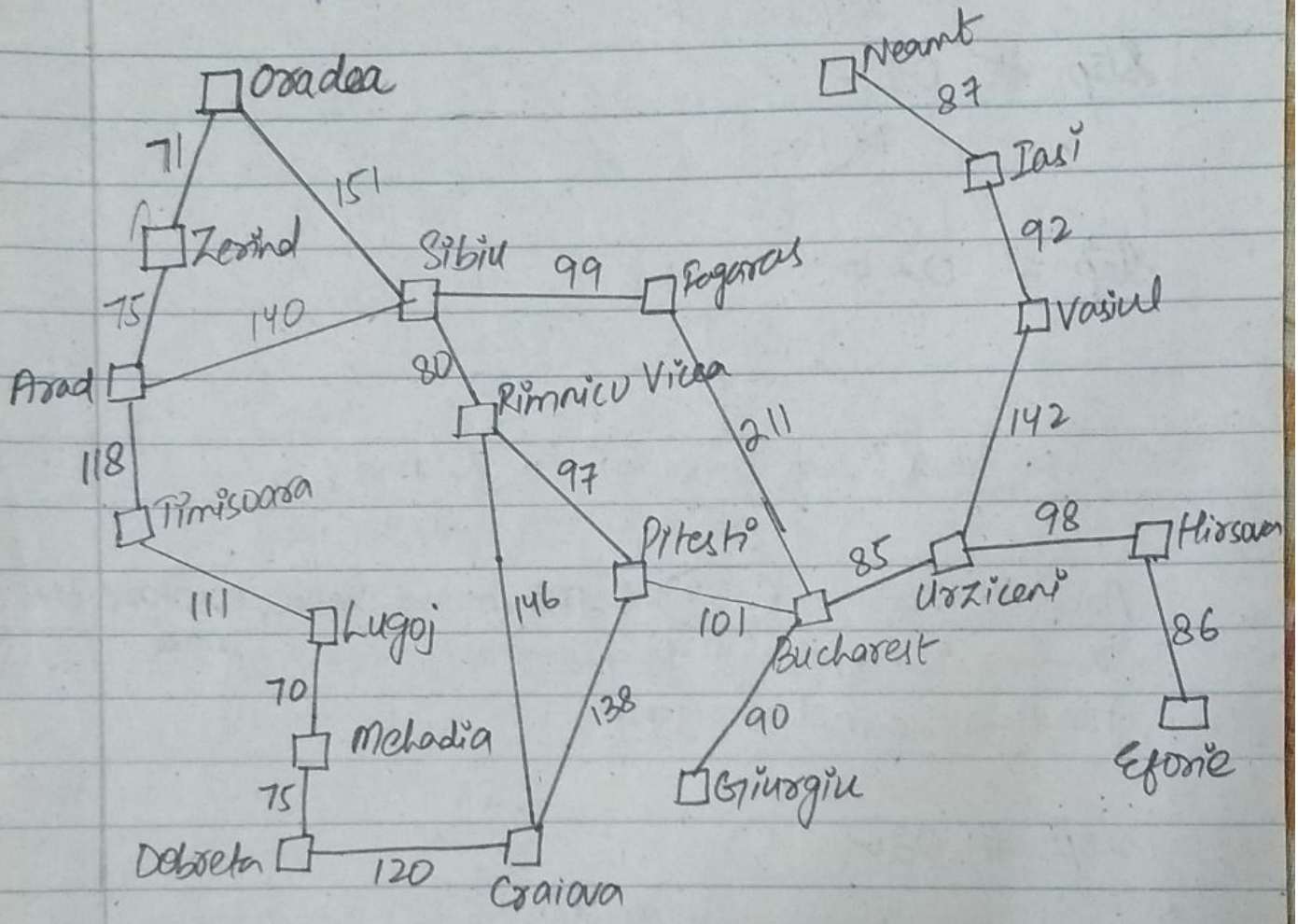





This is our final "GOAL STATE".

# QUESTION # 03:

## GREEDY BEST-FIRST SEARCH:




Straight line Distance to Bucharest.

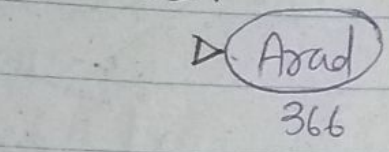
| | | | | | |
|---|---|---|---|---|---|
| Arad | 366 | Iasi | 226 | Timisoara | 329 |
| Bucharest | 0 | Lugoj | 244 | Urziceni | 80 |
| Craiova | 160 | Mehadia | 241 | Vaslui | 199 |
| Dobreta | 242 | Neamt | 234 | Zerind | 374 |
| Eforie | 161 | Oradea | 380 | | |
| Fagaras | 176 | Pitesti | 100 | | |
| Giurgiu | 77 | Rimnicu Vilcea | 193 | | |
| Hirsova | 151 | Sibiu | 253 | | |

Solution:

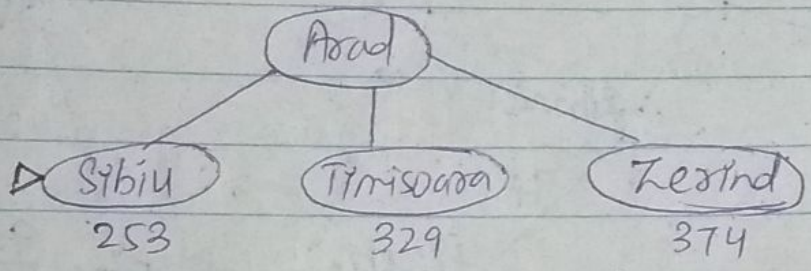
Evaluation function $f(n) = h(n)$

where $h(n)$ = straight line distance from n to Bucharest.

Step # 01:-




Step # 02:

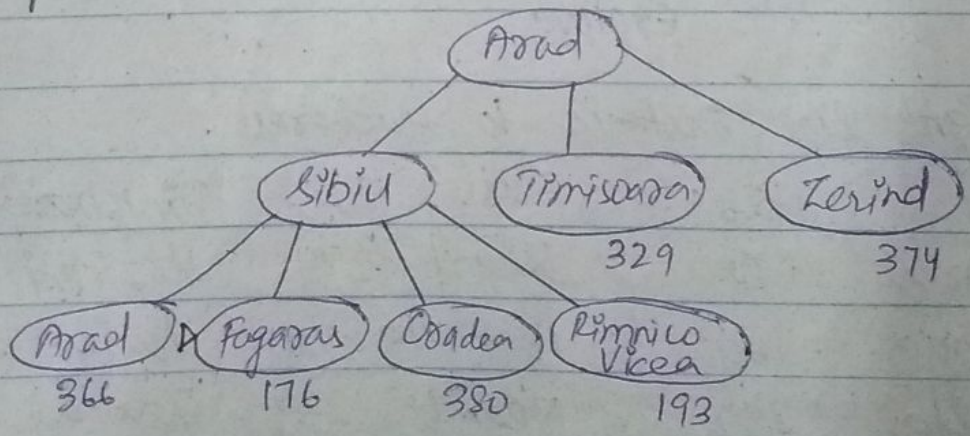



Arad → Sibiu = (253) → Minimum value, explore this node.

Arad → Timisoara = 329

Arad → Zerind = 374

Step # 03:



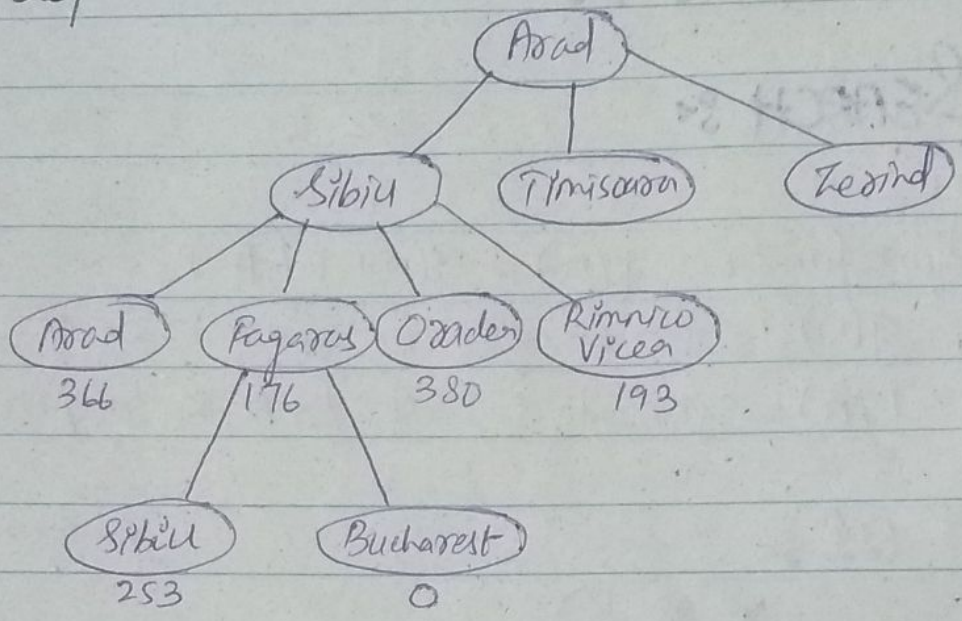

Arad → Sibiu → Arad = 366

Arad → Sibiu → Fagaras = (176) → Choose min value.

Arad → Sibiu → Oradea = 380

Arad → Sibiu → Rimnico Vicea = 193

Step # 04 :-




The minimum route to reached at goal state based on heuristic function:

Arad → Sibiu → Fagaras → Bucharest

$253 + 176 + 0 = 429$ Ans

# Question # 04 :-

## A* Search :-

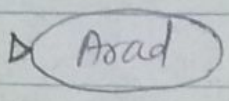
Solution :-

Evaluation function $f(n) = g(n) + h(n)$

where, $g(n)$ = cost so far to reach n.

$h(n)$ = estimated cost from n to goal.

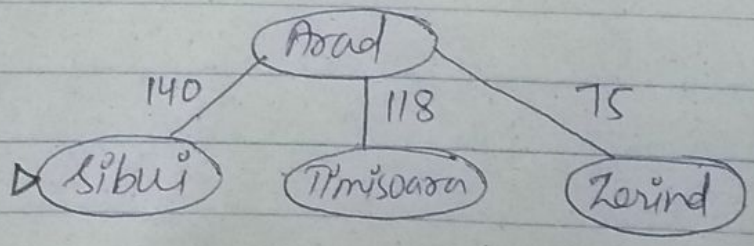
### Step # 01 :-




$f(n) = g(n) + h(n)$

$= 0 + 366 = \boxed{366}$

### Step # 02 :-




From Arad to Sibiu :-

$f(n) = 140 + 253$

$\boxed{f(n) = 393}$ → Choose minimum value and explore this node in next step.

From Arad to Timisoara :-

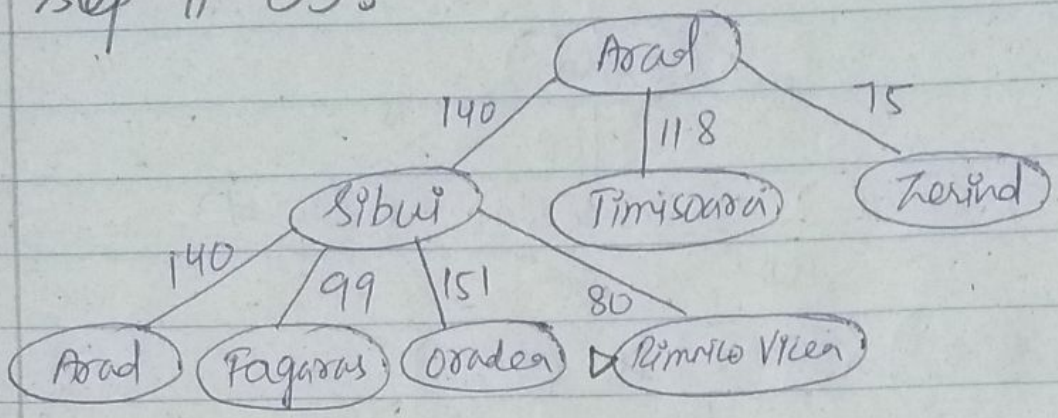
$f(n) = 118 + 329$

$\boxed{f(n) = 447}$

From Arad to Zerind :-

$f(n) = 75 + 374 = \boxed{449}$

Step # 03:-




From Arad → Sibiu → Arad :-

$f(n) = g(n) + h(n)$

$= (140 + 140) + 366$

$\boxed{f(n) = 646}$

From Arad → Sibiu → Fagaras :-

$f(n) = (140 + 99) + 176$

$\boxed{f(n) = 415}$

From Arad → Sibiu → Oradea :-

$f(n) = (140 + 151) + 380$

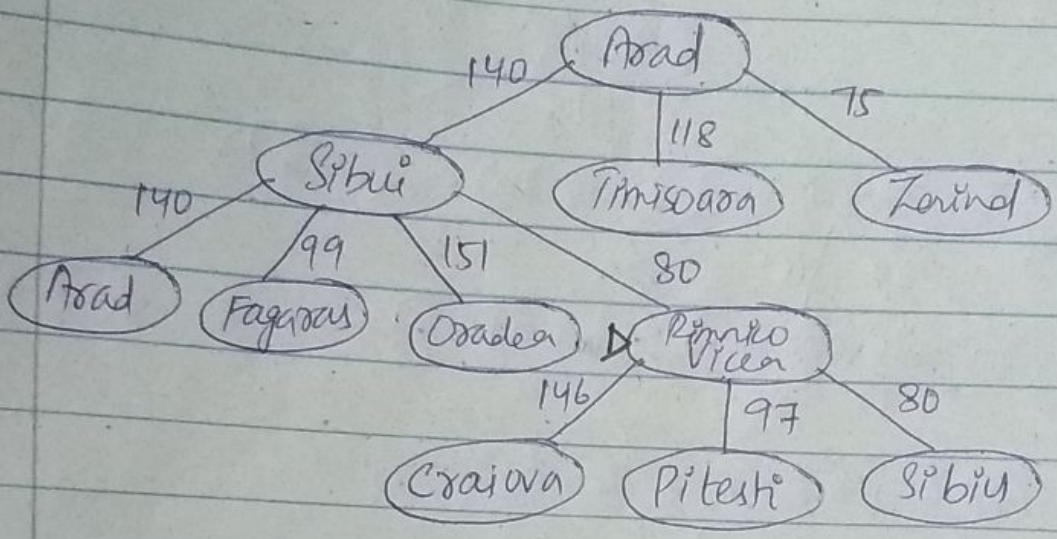
$\boxed{f(n) = 671}$

From Arad → Sibiu → Rimnicu Vilcea :-

$f(n) = (140 + 80) + 193$

$\boxed{f(n) = 413}$ → choose this minimum distance.

Step # 04:-




From Arad → Sibiu → Rimnicu Vicea → Craiova :-

$f(n) = g(n) + h(n)$

$f(n) = (140 + 80 + 146) + 160$

$\boxed{f(n) = 526}$

From Arad → Sibiu → Rimnicu Vicea → Pitesti :-

$f(n) = (140 + 80 + 97) + 100$

$\boxed{f(n) = 417}$

From Arad → Sibiu → Rimnicu Vicea → Sibiu :-

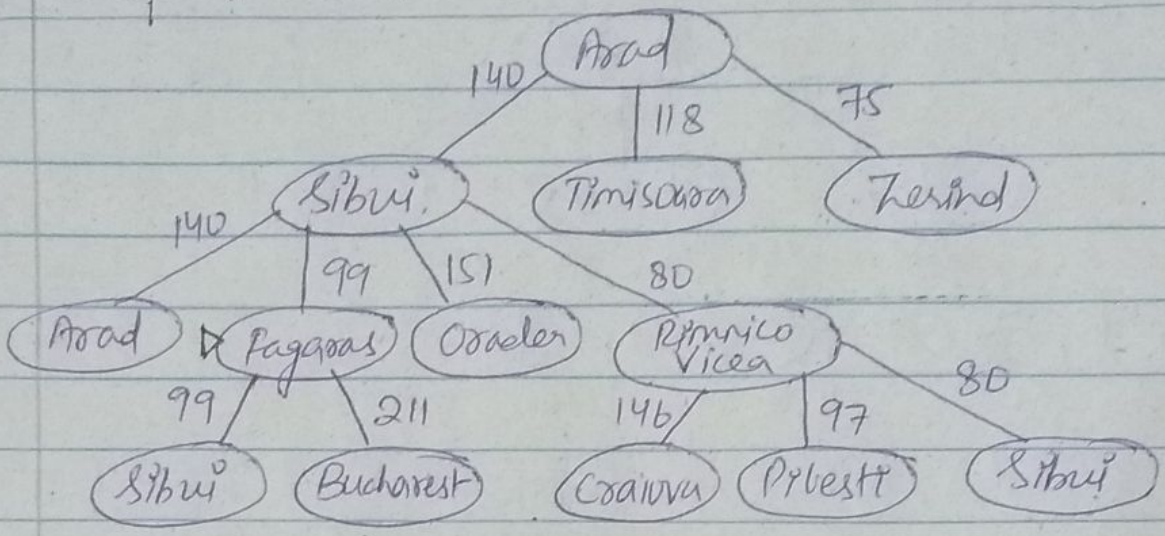
$f(n) = (140 + 80 + 80) + 253$

$\boxed{f(n) = 553}$

The route from Arad → Sibiu → Fagaras = 415 and the route from Arad → Sibiu → Rimnicu vicea → Pitesti = 417

So we choose Minimum distance 415, and explore the node Fagaras.

Step # 05 :-




From Arad → Sibiu → Fagaras → Sibiu :-

$f(n) = (140 + 99 + 99) + 253$

$\boxed{f(n) = 591}$

From Arad → Sibiu → Fagaras → Bucharest :-

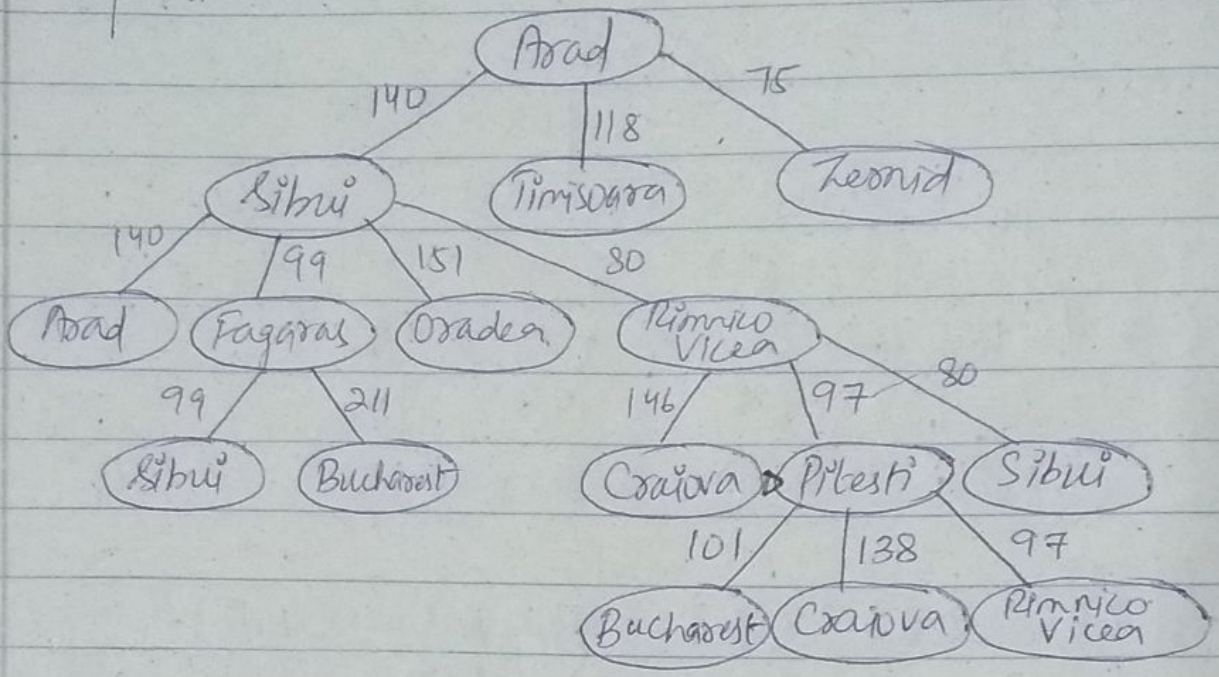
$f(n) = (140 + 99 + 211) + 0$

$\boxed{f(n) = 450}$

Now we get back to the second minimum path :-

From Arad → Sibiu → Rimnicu Vicea → Pitesti = 417 and explore the node Pitesti.

Step # 06 :-




From Arad → Sibiu → Rimnicu Vicea → Pitesti → Bucharest.

$f(n) = (140 + 80 + 97 + 101) + 0$

$\boxed{f(n) = 418}$

From Arad → Sibiu → Rimnicu Vicea → Pitesti → Craiova

$f(n) = (140 + 80 + 97 + 138) + 160$

$\boxed{f(n) = 615}$

From Arad → Sibiu → Rimnicu Vicea → Pitesti → Rimnicu Vicea :-

$f(n) = (140 + 80 + 97 + 97) + 193$

$\boxed{f(n) = 607}$

So, the final route from Arad to Bucharest will be

Arad → Sibiu → Rimnicu Vicea → Pitesti → Bucharest

that will be $\boxed{418}$ Ans