	Efficiency	
	latt.txt	tvlm.txt
breadthFirst	0.5714286	0.2857143
depthFirst	1.0	1.0
branchAndBound	0.5	0.5

The result for breadthFirst for the vlm.txt document is law because it gave an incorrect result of just “TV playback” where the full sentence was meant to be “TV playback channel”. Apart from this anomaly, we can see that branchAndBound is the most efficient searching algorithm, breadthFirst is the second most efficient and depthFirst is the least efficient algorithm

depthFirst for the tvlm.txt gave “five eight” which is completely incorrect path.

branchAndBound for the tvlm.txt gave “TV playback channel” which is the correct path.

This therefore shows us that branch and bound finds the best path through the word lattice and is the most admissible. Depth first, isn’t admissible and has poor efficiency and breadth first is rather admissible but not completely and has an efficiency only slightly worse than branch and bound.

Further Experimentation:

>as the complexity of the lattice increases the number of iterations required to find the path increases too. Take for example branchAndBound for the latt.txt, this took 8 iterations, whereas for tvlm.txt it took 10 iterations.

```
Starting branchAndBound Search
-------------------------
iteration no 1
open is
node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
Current node: node with state (Lattice State: *start* 0 0 0) parent state (null)
local cost (0) global cost (0)
-------------------------
iteration no 2
open is
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
Current node: node with state (Lattice State: please 0 10 20) parent state
(Lattice State: *start* 0 0 0) local cost (20) global cost (20)
-------------------------
iteration no 3
open is
```

```
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
please 0 10 20) local cost (30) global cost (50)
Current node: node with state (Lattice State: flea 0 9 30) parent state (Lattice
State: *start* 0 0 0) local cost (30) global cost (30)
-------------------------
iteration no 4
open is
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
please 0 10 20) local cost (30) global cost (50)
Current node: node with state (Lattice State: freeze 0 10 40) parent state
(Lattice State: *start* 0 0 0) local cost (40) global cost (40)
-------------------------
iteration no 5
open is
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
please 0 10 20) local cost (30) global cost (50)
Current node: node with state (Lattice State: let 10 18 30) parent state
(Lattice State: please 0 10 20) local cost (30) global cost (50)
-------------------------
iteration no 6
open is
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: useless 18 31 200) parent state (Lattice State:
let 10 18 30) local cost (200) global cost (250)
node with state (Lattice State: us 18 30 90) parent state (Lattice State: let 10
18 30) local cost (90) global cost (140)
Current node: node with state (Lattice State: lettuce 10 30 100) parent state
(Lattice State: please 0 10 20) local cost (100) global cost (120)
-------------------------
iteration no 7
open is
node with state (Lattice State: useless 18 31 200) parent state (Lattice State:
let 10 18 30) local cost (200) global cost (250)
node with state (Lattice State: us 18 30 90) parent state (Lattice State: let 10
18 30) local cost (90) global cost (140)
node with state (Lattice State: know 30 36 50) parent state (Lattice State:
lettuce 10 30 100) local cost (50) global cost (170)
Current node: node with state (Lattice State: us 18 30 90) parent state (Lattice
State: let 10 18 30) local cost (90) global cost (140)
```

```
-------------------------
iteration no 8
open is
node with state (Lattice State: useless 18 31 200) parent state (Lattice State:
let 10 18 30) local cost (200) global cost (250)
node with state (Lattice State: know 30 36 50) parent state (Lattice State:
lettuce 10 30 100) local cost (50) global cost (170)
Current node: node with state (Lattice State: know 30 36 50) parent state
(Lattice State: lettuce 10 30 100) local cost (50) global cost (170)
===========================

Search Succeeds
Efficiency 0.5
Solution Path

node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: know 30 36 50) parent state (Lattice State:
lettuce 10 30 100) local cost (50) global cost (170)




Starting depthFirst Search
-------------------------
iteration no 1
open is
node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
Current node: node with state (Lattice State: *start* 0 0 0) parent state (null)
local cost (0) global cost (0)
-------------------------
iteration no 2
open is
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
Current node: node with state (Lattice State: freeze 0 10 40) parent state
(Lattice State: *start* 0 0 0) local cost (40) global cost (40)
-------------------------
iteration no 3
open is
```

```
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
freeze 0 10 40) local cost (100) global cost (140)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
freeze 0 10 40) local cost (30) global cost (70)
Current node: node with state (Lattice State: let 10 18 30) parent state
(Lattice State: freeze 0 10 40) local cost (30) global cost (70)
-------------------------
iteration no 4
open is
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
freeze 0 10 40) local cost (100) global cost (140)
node with state (Lattice State: useless 18 31 200) parent state (Lattice State:
let 10 18 30) local cost (200) global cost (270)
node with state (Lattice State: us 18 30 90) parent state (Lattice State: let 10
18 30) local cost (90) global cost (160)
Current node: node with state (Lattice State: us 18 30 90) parent state (Lattice
State: let 10 18 30) local cost (90) global cost (160)
-------------------------
iteration no 5
open is
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
freeze 0 10 40) local cost (100) global cost (140)
node with state (Lattice State: useless 18 31 200) parent state (Lattice State:
let 10 18 30) local cost (200) global cost (270)
node with state (Lattice State: know 30 36 50) parent state (Lattice State: us
18 30 90) local cost (50) global cost (210)
Current node: node with state (Lattice State: know 30 36 50) parent state
(Lattice State: us 18 30 90) local cost (50) global cost (210)
==========================

Search Succeeds
Efficiency 1.0
Solution Path

node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
freeze 0 10 40) local cost (30) global cost (70)
```

```
node with state (Lattice State: us 18 30 90) parent state (Lattice State: let 10
18 30) local cost (90) global cost (160)
node with state (Lattice State: know 30 36 50) parent state (Lattice State: us
18 30 90) local cost (50) global cost (210)
```

```
Starting breadthFirst Search
-------------------------
iteration no 1
open is
node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
Current node: node with state (Lattice State: *start* 0 0 0) parent state (null)
local cost (0) global cost (0)
-------------------------
iteration no 2
open is
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
Current node: node with state (Lattice State: please 0 10 20) parent state
(Lattice State: *start* 0 0 0) local cost (20) global cost (20)
-------------------------
iteration no 3
open is
```

```
node with state (Lattice State: flea 0 9 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
please 0 10 20) local cost (30) global cost (50)
Current node: node with state (Lattice State: flea 0 9 30) parent state (Lattice
State: *start* 0 0 0) local cost (30) global cost (30)
-------------------------
iteration no 4
open is
node with state (Lattice State: freeze 0 10 40) parent state (Lattice State:
*start* 0 0 0) local cost (40) global cost (40)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
please 0 10 20) local cost (30) global cost (50)
Current node: node with state (Lattice State: freeze 0 10 40) parent state
(Lattice State: *start* 0 0 0) local cost (40) global cost (40)
-------------------------
iteration no 5
open is
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
please 0 10 20) local cost (30) global cost (50)
Current node: node with state (Lattice State: lettuce 10 30 100) parent state
(Lattice State: please 0 10 20) local cost (100) global cost (120)
-------------------------
iteration no 6
open is
node with state (Lattice State: let 10 18 30) parent state (Lattice State:
please 0 10 20) local cost (30) global cost (50)
node with state (Lattice State: know 30 36 50) parent state (Lattice State:
lettuce 10 30 100) local cost (50) global cost (170)
Current node: node with state (Lattice State: let 10 18 30) parent state
(Lattice State: please 0 10 20) local cost (30) global cost (50)
-------------------------
iteration no 7
open is
node with state (Lattice State: know 30 36 50) parent state (Lattice State:
lettuce 10 30 100) local cost (50) global cost (170)
node with state (Lattice State: useless 18 31 200) parent state (Lattice State:
let 10 18 30) local cost (200) global cost (250)
node with state (Lattice State: us 18 30 90) parent state (Lattice State: let 10
18 30) local cost (90) global cost (140)
Current node: node with state (Lattice State: know 30 36 50) parent state
(Lattice State: lettuce 10 30 100) local cost (50) global cost (170)
=========================
```

```
Search Succeeds
Efficiency 0.5714286
Solution Path

node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
node with state (Lattice State: please 0 10 20) parent state (Lattice State:
*start* 0 0 0) local cost (20) global cost (20)
node with state (Lattice State: lettuce 10 30 100) parent state (Lattice State:
please 0 10 20) local cost (100) global cost (120)
node with state (Lattice State: know 30 36 50) parent state (Lattice State:
lettuce 10 30 100) local cost (50) global cost (170)
```

```
Starting branchAndBound Search
-------------------------
iteration no 1
open is
node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
Current node: node with state (Lattice State: *start* 0 0 0) parent state (null)
local cost (0) global cost (0)
-------------------------
iteration no 2
open is
node with state (Lattice State: TV 0 10 20) parent state (Lattice State: *start*
0 0 0) local cost (20) global cost (20)
node with state (Lattice State: five 0 15 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
Current node: node with state (Lattice State: TV 0 10 20) parent state (Lattice
State: *start* 0 0 0) local cost (20) global cost (20)
-------------------------
iteration no 3
open is
node with state (Lattice State: five 0 15 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
```

```
node with state (Lattice State: playback 10 25 30) parent state (Lattice State:
TV 0 10 20) local cost (30) global cost (50)
node with state (Lattice State: one 10 15 40) parent state (Lattice State: TV 0
10 20) local cost (40) global cost (60)
Current node: node with state (Lattice State: five 0 15 30) parent state
(Lattice State: *start* 0 0 0) local cost (30) global cost (30)
-------------------------
iteration no 4
open is
node with state (Lattice State: playback 10 25 30) parent state (Lattice State:
TV 0 10 20) local cost (30) global cost (50)
node with state (Lattice State: one 10 15 40) parent state (Lattice State: TV 0
10 20) local cost (40) global cost (60)
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
Current node: node with state (Lattice State: playback 10 25 30) parent state
(Lattice State: TV 0 10 20) local cost (30) global cost (50)
-------------------------
iteration no 5
open is
node with state (Lattice State: one 10 15 40) parent state (Lattice State: TV 0
10 20) local cost (40) global cost (60)
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: one 10 15 40) parent state
(Lattice State: TV 0 10 20) local cost (40) global cost (60)
-------------------------
iteration no 6
open is
```

```
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: down 15 25 50) parent state
(Lattice State: five 0 15 30) local cost (50) global cost (80)
-------------------------
iteration no 7
open is
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: channel 25 40 30) parent state
(Lattice State: playback 10 25 30) local cost (30) global cost (80)
-------------------------
iteration no 8
open is
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
```

```
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: on 40 50 60) parent state (Lattice State:
channel 25 40 30) local cost (60) global cost (140)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
Current node: node with state (Lattice State: radio 15 25 60) parent state
(Lattice State: five 0 15 30) local cost (60) global cost (90)
-------------------------
iteration no 9
open is
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: on 40 50 60) parent state (Lattice State:
channel 25 40 30) local cost (60) global cost (140)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
Current node: node with state (Lattice State: eight 15 35 60) parent state
(Lattice State: five 0 15 30) local cost (60) global cost (90)
-------------------------
iteration no 10
open is
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: on 40 50 60) parent state (Lattice State:
channel 25 40 30) local cost (60) global cost (140)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
```

```
Current node: node with state (Lattice State: four 40 50 10) parent state
(Lattice State: channel 25 40 30) local cost (10) global cost (90)
============================

Search Succeeds
Efficiency 0.5
Solution Path

node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
node with state (Lattice State: TV 0 10 20) parent state (Lattice State: *start*
0 0 0) local cost (20) global cost (20)
node with state (Lattice State: playback 10 25 30) parent state (Lattice State:
TV 0 10 20) local cost (30) global cost (50)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
```

```
Starting depthFirst Search
-------------------------
iteration no 1
open is
node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
Current node: node with state (Lattice State: *start* 0 0 0) parent state (null)
local cost (0) global cost (0)
-------------------------
iteration no 2
open is
node with state (Lattice State: TV 0 10 20) parent state (Lattice State: *start*
0 0 0) local cost (20) global cost (20)
node with state (Lattice State: five 0 15 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
Current node: node with state (Lattice State: five 0 15 30) parent state
(Lattice State: *start* 0 0 0) local cost (30) global cost (30)
-------------------------
iteration no 3
open is
```

```
node with state (Lattice State: TV 0 10 20) parent state (Lattice State: *start*
0 0 0) local cost (20) global cost (20)
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
Current node: node with state (Lattice State: eight 15 35 60) parent state
(Lattice State: five 0 15 30) local cost (60) global cost (90)
-------------------------
iteration no 4
open is
node with state (Lattice State: TV 0 10 20) parent state (Lattice State: *start*
0 0 0) local cost (20) global cost (20)
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
Current node: node with state (Lattice State: nine 35 50 100) parent state
(Lattice State: eight 15 35 60) local cost (100) global cost (190)
===========================

Search Succeeds
Efficiency 1.0
Solution Path

node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
node with state (Lattice State: five 0 15 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
```

```
Starting breadthFirst Search
-------------------------
iteration no 1
open is
node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
Current node: node with state (Lattice State: *start* 0 0 0) parent state (null)
local cost (0) global cost (0)
-------------------------
iteration no 2
open is
node with state (Lattice State: TV 0 10 20) parent state (Lattice State: *start*
0 0 0) local cost (20) global cost (20)
node with state (Lattice State: five 0 15 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
Current node: node with state (Lattice State: TV 0 10 20) parent state (Lattice
State: *start* 0 0 0) local cost (20) global cost (20)
-------------------------
iteration no 3
open is
```

```
node with state (Lattice State: five 0 15 30) parent state (Lattice State:
*start* 0 0 0) local cost (30) global cost (30)
node with state (Lattice State: playback 10 25 30) parent state (Lattice State:
TV 0 10 20) local cost (30) global cost (50)
node with state (Lattice State: one 10 15 40) parent state (Lattice State: TV 0
10 20) local cost (40) global cost (60)
Current node: node with state (Lattice State: five 0 15 30) parent state
(Lattice State: *start* 0 0 0) local cost (30) global cost (30)
-------------------------
iteration no 4
open is
node with state (Lattice State: playback 10 25 30) parent state (Lattice State:
TV 0 10 20) local cost (30) global cost (50)
node with state (Lattice State: one 10 15 40) parent state (Lattice State: TV 0
10 20) local cost (40) global cost (60)
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
Current node: node with state (Lattice State: playback 10 25 30) parent state
(Lattice State: TV 0 10 20) local cost (30) global cost (50)
-------------------------
iteration no 5
open is
node with state (Lattice State: one 10 15 40) parent state (Lattice State: TV 0
10 20) local cost (40) global cost (60)
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: one 10 15 40) parent state
(Lattice State: TV 0 10 20) local cost (40) global cost (60)
-------------------------
iteration no 6
```

```
open is
node with state (Lattice State: radio 15 25 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: radio 15 25 60) parent state
(Lattice State: five 0 15 30) local cost (60) global cost (90)
-------------------------
iteration no 7
open is
node with state (Lattice State: down 15 25 50) parent state (Lattice State: five
0 15 30) local cost (50) global cost (80)
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: down 15 25 50) parent state
(Lattice State: five 0 15 30) local cost (50) global cost (80)
-------------------------
iteration no 8
open is
node with state (Lattice State: six 15 25 70) parent state (Lattice State: five
0 15 30) local cost (70) global cost (100)
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
```

```
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: six 15 25 70) parent state
(Lattice State: five 0 15 30) local cost (70) global cost (100)
-------------------------
iteration no 9
open is
node with state (Lattice State: eight 15 35 60) parent state (Lattice State:
five 0 15 30) local cost (60) global cost (90)
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
Current node: node with state (Lattice State: eight 15 35 60) parent state
(Lattice State: five 0 15 30) local cost (60) global cost (90)
-------------------------
iteration no 10
open is
node with state (Lattice State: channel 25 40 30) parent state (Lattice State:
playback 10 25 30) local cost (30) global cost (80)
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
Current node: node with state (Lattice State: channel 25 40 30) parent state
(Lattice State: playback 10 25 30) local cost (30) global cost (80)
-------------------------
iteration no 11
open is
node with state (Lattice State: volume 25 45 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
```

```
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
node with state (Lattice State: on 40 50 60) parent state (Lattice State:
channel 25 40 30) local cost (60) global cost (140)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
Current node: node with state (Lattice State: volume 25 45 100) parent state
(Lattice State: playback 10 25 30) local cost (100) global cost (150)
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iteration no 12
open is
node with state (Lattice State: off 25 40 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
node with state (Lattice State: on 40 50 60) parent state (Lattice State:
channel 25 40 30) local cost (60) global cost (140)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
Current node: node with state (Lattice State: off 25 40 50) parent state
(Lattice State: playback 10 25 30) local cost (50) global cost (100)
-------------------------
iteration no 13
open is
node with state (Lattice State: two 25 30 50) parent state (Lattice State:
playback 10 25 30) local cost (50) global cost (100)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
node with state (Lattice State: on 40 50 60) parent state (Lattice State:
channel 25 40 30) local cost (60) global cost (140)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
Current node: node with state (Lattice State: two 25 30 50) parent state
(Lattice State: playback 10 25 30) local cost (50) global cost (100)
-------------------------
iteration no 14
open is
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
node with state (Lattice State: nine 35 50 100) parent state (Lattice State:
eight 15 35 60) local cost (100) global cost (190)
```

```
node with state (Lattice State: on 40 50 60) parent state (Lattice State:
channel 25 40 30) local cost (60) global cost (140)
node with state (Lattice State: four 40 50 10) parent state (Lattice State:
channel 25 40 30) local cost (10) global cost (90)
node with state (Lattice State: three 30 50 60) parent state (Lattice State: two
25 30 50) local cost (60) global cost (160)
Current node: node with state (Lattice State: seven 25 50 100) parent state
(Lattice State: playback 10 25 30) local cost (100) global cost (150)
============================

Search Succeeds
Efficiency 0.2857143
Solution Path

node with state (Lattice State: *start* 0 0 0) parent state (null) local cost
(0) global cost (0)
node with state (Lattice State: TV 0 10 20) parent state (Lattice State: *start*
0 0 0) local cost (20) global cost (20)
node with state (Lattice State: playback 10 25 30) parent state (Lattice State:
TV 0 10 20) local cost (30) global cost (50)
node with state (Lattice State: seven 25 50 100) parent state (Lattice State:
playback 10 25 30) local cost (100) global cost (150)
```