

Assignment 2

Ques . Write a Prolog program to search a road route from any city to any other city using this data.

It should work for both cities that are directly connected (say, Ahmedabad to Indore) as well as for two cities that are not directly connected (say, Agartala to Hubli).

a). Show Depth First Search and Best-first search on the given data.

Depth First Search

Code :-

```
% knowledge base
% facts for different cities and also cost of reaching there from one city to other
% conversion of csv file to facts

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edge(kolhapur,nasik,456).

edge(kolhapur,panjim,254).
edge(kolhapur,patna,2047).
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edge(kolhapur,pune,247).

edge(lucknow,ahmedabad,1247).
edge(lucknow,banglore,1934).
edge(lucknow,bhubaneshwar,1254).
edge(lucknow,bombay,1366).
edge(lucknow,calcutta,1089).
edge(lucknow,chandigarh,740).
edge(lucknow,cochin,2572).
edge(lucknow,delhi,499).
edge(lucknow,hyderabad,1332).
edge(lucknow,indore,768).
edge(lucknow,jaipur,598).
edge(lucknow,kanpur,79).
edge(lucknow,lucknow,0).
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edge(lucknow,nasik,1182).
edge(lucknow,panjim,1883).
edge(lucknow,patna,566).
edge(lucknow,pondicherry,2296).
edge(lucknow,pune,1391).

edge(ludhiana,ahmedabad,1220).
edge(ludhiana,banglore,2358).
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edge(ludhiana,chandigarh,105).
edge(ludhiana,cochin,3027).
edge(ludhiana,delhi,310).
edge(ludhiana,hyderabad,1756).
edge(ludhiana,indore,1115).
edge(ludhiana,jaipur,570).
edge(ludhiana,kanpur,790).
edge(ludhiana,lucknow,803).
edge(ludhiana,madras,2552).
edge(ludhiana,nagpur,1280).
edge(ludhiana,nasik,1528).
edge(ludhiana,panjim,2091).

edge(ludhiana,patna,1395).
edge(ludhiana,pondicherry,2720).
edge(ludhiana,pune,1726).

edge(madras,ahmedabad,1821).
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edge(madras,chandigarh,2489).
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edge(madras,delhi,2243).
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edge(madras,indore,1795).
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edge(madras,kanpur,2049).
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edge(madras,nagpur,1272).
edge(madras,nasik,1366).
edge(madras,panjim,909).
edge(madras,patna,2096).
edge(madras,pondicherry,168).
edge(madras,pune,1157).

edge(madurai,ahmedabad,1922).
edge(madurai,banglore,432).
edge(madurai,bhubaneshwar,1687).
edge(madurai,bombay,1458).
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edge(meerut,ahmedabad,1092).

edge(meerut,banglore, 2072).

edge(meerut,bhubaneshwar,1822).

edge(meerut,bombay,1468).

edge(meerut,calcutta,1497).

edge(meerut,chandigarh,381).

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edge(nagpur,calcutta,1163).

edge(nagpur,chandigarh,1217).

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edge(panjim,jaipur,2496).
edge(panjim,kanpur,1813).
edge(panjim,lucknow,1883).
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edge(pondicherry,hyderabad,867).
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edge(pondicherry,jaipur,2368).
edge(pondicherry,kanpur,2217).
edge(pondicherry,lucknow,2296).
edge(pondicherry,madras,168).
edge(pondicherry,nagpur,1440).
edge(pondicherry,nasik,1363).
edge(pondicherry,panjim,739).
edge(pondicherry,patna,2264).
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edge(pune,ahmedabad,664).

edge(pune,banglore, 826).
edge(pune,bhubaneshwar,1587).
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edge(pune,cochin,1181).
edge(pune,delhi,1417).
edge(pune,hyderabad,545).
edge(pune,indore,623).
edge(pune,jaipur,1371).
edge(pune,kanpur,1312).
edge(pune,lucknow,1391).
edge(pune,madras,1157).
edge(pune,nagpur,909).
edge(pune,nasik,209).
edge(pune,panjim,501).
edge(pune,patna,1738).
edge(pune,pondicherry,1154).
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edge(ranchi,bombay,1816).
edge(ranchi,calcutta,414).
edge(ranchi,chandigarh,1480).
edge(ranchi,cochin,2455).
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edge(ranchi,kanpur,723).
edge(ranchi,lucknow,912).
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edge(shillong,bhubaneshwar,1640).

edge(shillong,bombay,3011).
edge(shillong,calcutta,1281).
edge(shillong,chandigarh,2416).
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edge(shillong,delhi,2126).
edge(shillong,hyderabad,1309).
edge(shillong,indore,2309).
edge(shillong,jaipur,2229).
edge(shillong,kanpur,1699).
edge(shillong,lucknow,1670).
edge(shillong,madras,2911).
edge(shillong,nagpur,2114).
edge(shillong,nasik,2800).
edge(shillong,panjim,2925).
edge(shillong,patna,1019).
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edge(shillong,pune,2860).

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edge(shimla,bhubaneshwar,2127).
edge(shimla,bombay,1753).
edge(shimla,calcutta,1839).
edge(shimla,chandigarh,99).
edge(shimla,cochin,3056).
edge(shimla,delhi,365).
edge(shimla,hyderabad,1812).
edge(shimla,indore,1171).
edge(shimla,jaipur,636).
edge(shimla,kanpur,846).
edge(shimla,lucknow,659).
edge(shimla,madras,2588).
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edge(shimla,nasik,1567).
edge(shimla,panjim,2130).
edge(shimla,patna,1434).
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edge(shimla,pune,1782).

edge(surat,ahmedabad,263).
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edge(surat,bombay,301).

edge(surat,calcutta,1912).
edge(surat,chandigarh,1325).
edge(surat,cochin,1593).
edge(surat,delhi,1182).
edge(surat,hyderabad,983).
edge(surat,indore,607).
edge(surat,jaipur,932).
edge(surat,kanpur,1296).
edge(surat,lucknow,1375).
edge(surat,madras,1695).
edge(surat,nagpur,749).
edge(surat,nasik,262).
edge(surat,panjim,913).
edge(surat,patna,1742).
edge(surat,pondicherry,1789).
edge(surat,pune,412).

edge(trivandrum,ahmedabad,2197).
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edge(trivandrum,cochin,218).
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edge(trivandrum,hyderabad,1261).
edge(trivandrum,indore,2156).
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edge(trivandrum,kanpur,2611).
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edge(trivandrum,madras,748).
edge(trivandrum,nagpur,1834).
edge(trivandrum,nasik,1742).
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edge(trivandrum,patna,2827).
edge(trivandrum,pondicherry,622).
edge(trivandrum,pune,1533).

edge(varanasi,ahmedabad,1373).
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edge(varanasi,bhubaneshwar,968).
edge(varanasi,bombay,1597).
edge(varanasi,calcutta,695).

edge(varanasi,chandigarh,1032).
edge(varanasi,cochin,2331).
edge(varanasi,delhi,745).
edge(varanasi,hyderabad,1189).
edge(varanasi,indore,925).
edge(varanasi,jaipur,835).
edge(varanasi,kanpur,315).
edge(varanasi,lucknow,286).
edge(varanasi,madras,1985).
edge(varanasi,nagpur,713).
edge(varanasi,nasik,1399).
edge(varanasi,panjim,1524).
edge(varanasi,patna,280).
edge(varanasi,pondicherry,2153).
edge(varanasi,pune,1459).

edge(vijayawada,ahmedabad,1705).
edge(vijayawada,banglore, 637).
edge(vijayawada,bhubaneshwar,775).
edge(vijayawada,bombay,973).
edge(vijayawada,calcutta,1198).
edge(vijayawada,chandigarh,1959).
edge(vijayawada,cochin,1174).
edge(vijayawada,delhi,1716).
edge(vijayawada,hyderabad,269).
edge(vijayawada,indore,1255).
edge(vijayawada,jaipur,1660).
edge(vijayawada,kanpur,1519).
edge(vijayawada,lucknow,1598).
edge(vijayawada,madras,432).
edge(vijayawada,nagpur,742).
edge(vijayawada,nasik,1428).
edge(vijayawada,panjim,876).
edge(vijayawada,patna,1664).
edge(vijayawada,pondicherry,598).
edge(vijayawada,pune,842).

edge(vishakapatnam,ahmedabad,1815).
edge(vishakapatnam,banglore, 1093).
edge(vishakapatnam,bhubaneshwar,445).
edge(vishakapatnam,bombay,1754).
edge(vishakapatnam,calcutta,868).
edge(vishakapatnam,chandigarh,2127).

```

edge(vishakapatnam,cochin,1449).
edge(vishakapatnam,delhi,1881).
edge(vishakapatnam,hyderabad,599).
edge(vishakapatnam,indore,1433).
edge(vishakapatnam,jaipur,1838).
edge(vishakapatnam,kanpur,1687).
edge(vishakapatnam,lucknow,1765).
edge(vishakapatnam,madras,762).
edge(vishakapatnam,nagpur,910).
edge(vishakapatnam,nasik,1596).
edge(vishakapatnam,panjim,1206).
edge(vishakapatnam,patna,1334).
edge(vishakapatnam,pondicherry,930).
edge(vishakapatnam,pune,1658).

```

```

% Assuming if city x has path to y then city y has also path to x with
% same cost of travel below is function to represent the same.

```

```

connected(X,Y,L):-edge(X,Y,L);edge(Y,X,L).

```

```

% solve function would be called by the user to find the path between the node and goal and
% solve function will internally calls the depth_first_search.
% it will return path and the cost to travel to node to goal node.
% reverse function is called to just reverse the list of city which are travel and return the list of
city from node to goal

```

```

solve(Node,Goal,Solution1,Cost):-
    depth_first_search(Node,Goal,[Node],Solution,Cost),
    reverse(Solution,Solution1).
    %write("path is : "),write(Solution),nl,
    %write("Cost is : "),write(Cost),nl.

```

```

% simplest search if the cities are directly connected then we simple return the path and the
cost of city

```

```

depth_first_search(Node,Goal,Path,[Goal|Path],Cost):-
    connected(Node,Goal,Cost).

```

```

% if the cities are not connected directly then we need to find the path through some
intermediate nodes
% I have call connected to search for the cities which are directly or

```



```
% indirectly connected to the given node after that to avoid the cycle
% that we do not consider the same city again and again I am calling
% member function to check if i have included the city in list already
% if not then call the depth_first_search recursively to find the goal
% node. and computing its cost to travel there.
```

```
depth_first_search(Node,Goal,Visited,Path,Cost):-
    connected(Node,Node1,C),
    Node1\=Goal,
    \+member(Node1,Visited),
    depth_first_search(Node1,Goal,[Node1|Visited],Path,Cost1),
    Cost is C+Cost1.
```

Output:-

```
SWI-Prolog (AMD64, Multi-threaded, version 8.4.0)
File Edit Settings Run Debug Help
?-
% c:/Users/Sakshi/Desktop/AI/Assignment2/depth_first_search.pl compiled 0.02 sec, 0 clauses
?- solve(ahmedabad,indore,Sol,Cost).
Sol = [ahmedabad, indore],
Cost = 442 ,

?- solve(agartala,hubli,Sol,Cost).
Sol = [agartala, ahmedabad, hubli],
Cost = 4406 ;
Sol = [agartala, ahmedabad, banglore, hubli],
Cost = 5186 ;
Sol = [agartala, ahmedabad, banglore, agra, bhubaneshwar, hubli],
Cost = 9841 ,

?-
| solve(ahmedabad,ahmedabad,Sol,Cost).
Sol = [ahmedabad, ahmedabad],
Cost = 0 ,

?- solve(patna,surat,Sol,Cost).
Sol = [patna, surat],
Cost = 1742 ;
Sol = [patna, ahmedabad, surat],
Cost = 1919 ;
Sol = [patna, ahmedabad, banglore, surat],
Cost = 4410 ;
Sol = [patna, ahmedabad, banglore, agartala, bhubaneshwar, surat],
Cost = 10835 ;
Sol = [patna, ahmedabad, banglore, agartala, bhubaneshwar, bombay, surat],
Cost = 11236 ;
Sol = [patna, ahmedabad, banglore, agartala, bhubaneshwar, bombay, calcutta, surat],
Cost = 14859 ;
Sol = [patna, ahmedabad, banglore, agartala, bhubaneshwar, bombay, calcutta, chandigarh, surat],
Cost = 15993 ;
Sol = [patna, ahmedabad, banglore, agartala, bhubaneshwar, bombay, calcutta, chandigarh, cochin,...],
Cost = 18226 ;
Sol = [patna, ahmedabad, banglore, agartala, bhubaneshwar, bombay, calcutta, chandigarh, cochin,...],
Cost = 20533 ,

?- █
```

Best First Search:-

Code:-

% knowledge base

% facts for different cities and also cost of reaching there from one city to other

% conversion of csv file to facts

```
edge(agartala,ahmedabad,3305).
edge(agartala,banglore,3824).
edge(agartala,bhubaneshwar,2286).
edge(agartala,bombay,3593).
edge(agartala,calcutta,1863).
edge(agartala,chandigarh,2998).
edge(agartala,cochin,4304).
edge(agartala,delhi,2708).
edge(agartala,hyderabad,3330).
edge(agartala,indore,2891).
edge(agartala,jaipur,2801).
edge(agartala,kanpur,2281).
edge(agartala,lucknow,2252).
edge(agartala,madras,3493).
edge(agartala,nagpur,2696).
edge(agartala,nasik,3365).
edge(agartala,panjim,3507).
edge(agartala,patna,1681).
edge(agartala,pondicherry,3661).
edge(agartala,pune,3442).
```

```
edge(agra,ahmedabad,878).
edge(agra,banglore,1848).
edge(agra,bhubaneshwar,1578).
edge(agra,bombay,1202).
edge(agra,calcutta,1300).
edge(agra,chandigarh,448).
edge(agra,cochin,2278).
edge(agra,delhi,200).
edge(agra,hyderabad,1246).
edge(agra,indore,591).
edge(agra,jaipur,230).
edge(agra,kanpur,290).
edge(agra,lucknow,369).
```

edge(agra,madras,2048).
edge(agra,nagpur,770).
edge(agra,nasik,1005).
edge(agra,panjim,1715).
edge(agra,patna,885).
edge(agra,pondicherry,2210).
edge(agra,pune,1214).

edge(ahmedabad,ahmedabad,0).
edge(ahmedabad,banglore,1490).
edge(ahmedabad,bhubaneshwar,1697).
edge(ahmedabad,bombay,552).
edge(ahmedabad,calcutta,2068).
edge(ahmedabad,chandigarh,1157).
edge(ahmedabad,cochin,1845).
edge(ahmedabad,delhi,911).
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edge(ahmedabad,nasik,504).
edge(ahmedabad,panjim,1165).
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edge(ahmedabad,pondicherry,1818).
edge(ahmedabad,pune,664).

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edge(allahbad,banglore,1686).
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edge(allahbad,bombay,1457).
edge(allahbad,calcutta,817).
edge(allahbad,chandigarh,912).
edge(allahbad,cochin,2216).
edge(allahbad,delhi,650).
edge(allahbad,hyderabad,1084).
edge(allahbad,indore,803).
edge(allahbad,jaipur,713).
edge(allahbad,kanpur,193).
edge(allahbad,lucknow,234).

edge(allahbad,madras,2011).
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edge(allahbad,nasik,1155).
edge(allahbad,panjim,1419).
edge(allahbad,patna,402).
edge(allahbad,pondicherry,1077).
edge(allahbad,pune,1364).

edge(amritsar,ahmedabad,1356).
edge(amritsar,banglore,2496).
edge(amritsar,bhubaneshwar,2224).
edge(amritsar,bombay,1849).
edge(amritsar,calcutta,1919).
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edge(amritsar,cochin,3163).
edge(amritsar,delhi,445).
edge(amritsar,hyderabad,1892).
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edge(meerut,lucknow,453).
edge(meerut,madras,2266).
edge(meerut,nagpur,994).
edge(meerut,nasik,1242).
edge(meerut,panjim,1805).
edge(meerut,patna,934).
edge(meerut,pondicherry,2434).
edge(meerut,pune,1440).

edge(nagpur,ahmedabad,965).
edge(nagpur,banglore, 1078).
edge(nagpur,bhubaneshwar,830).
edge(nagpur,bombay,849).
edge(nagpur,calcutta,1163).
edge(nagpur,chandigarh,1217).
edge(nagpur,cochin,1608).
edge(nagpur,delhi,971).
edge(nagpur,hyderabad,476).
edge(nagpur,indore,445).
edge(nagpur,jaipur,928).
edge(nagpur,kanpur,777).
edge(nagpur,lucknow,856).
edge(nagpur,madras,1272).
edge(nagpur,nagpur,0).
edge(nagpur,nasik,700).
edge(nagpur,panjim,1247).
edge(nagpur,patna,993).
edge(nagpur,pondicherry,1440).
edge(nagpur,pune,909).

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edge(nasik,bhubaneshwar,1516).
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edge(nasik,kanpur,1103).

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edge(nasik,patna,1679).
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edge(panjim,chandigarh,2028).
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edge(panjim,delhi,1782).
edge(panjim,hyderabad,765).
edge(panjim,indore,1115).
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edge(pondicherry,calcutta,1798).
edge(pondicherry,chandigarh,2657).
edge(pondicherry,cochin,530).
edge(pondicherry,delhi,2411).
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edge(pondicherry,kanpur,2217).
edge(pondicherry,lucknow,2296).
edge(pondicherry,madras,168).
edge(pondicherry,nagpur,1440).
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edge(pondicherry,panjim,739).
edge(pondicherry,patna,2264).
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edge(pune,ahmedabad,664).
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edge(pune,calcutta,2058).
edge(pune,chandigarh,1663).
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edge(pune,indore,623).
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edge(pune,kanpur,1312).
edge(pune,lucknow,1391).
edge(pune,madras,1157).

edge(pune,nagpur,909).
edge(pune,nasik,209).
edge(pune,panjim,501).
edge(pune,patna,1738).
edge(pune,pondicherry,1154).
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edge(ranchi,banglore, 2098).
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edge(ranchi,kanpur,723).
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edge(ranchi,pondicherry,1935).
edge(ranchi,pune,1675).

edge(shillong,ahmedabad,2839).
edge(shillong,banglore, 3242).
edge(shillong,bhubaneshwar,1640).
edge(shillong,bombay,3011).
edge(shillong,calcutta,1281).
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edge(shillong,cochin,3599).
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edge(shillong,indore,2309).
edge(shillong,jaipur,2229).
edge(shillong,kanpur,1699).
edge(shillong,lucknow,1670).
edge(shillong,madras,2911).
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edge(shillong,nasik,2800).

edge(shillong,panjim,2925).
edge(shillong,patna,1019).
edge(shillong,pondicherry,3079).
edge(shillong,pune,2860).

edge(shimla,ahmedabad,1256).
edge(shimla,bangalore, 2395).
edge(shimla,bhubaneshwar,2127).
edge(shimla,bombay,1753).
edge(shimla,calcutta,1839).
edge(shimla,chandigarh,99).
edge(shimla,cochin,3056).
edge(shimla,delhi,365).
edge(shimla,hyderabad,1812).
edge(shimla,indore,1171).
edge(shimla,jaipur,636).
edge(shimla,kanpur,846).
edge(shimla,lucknow,659).
edge(shimla,madras,2588).
edge(shimla,nagpur,1336).
edge(shimla,nasik,1567).
edge(shimla,panjim,2130).
edge(shimla,patna,1434).
edge(shimla,pondicherry,2759).
edge(shimla,pune,1782).

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edge(surat,bangalore, 1264).
edge(surat,bhubaneshwar,1579).
edge(surat,bombay,301).
edge(surat,calcutta,1912).
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edge(surat,cochin,1593).
edge(surat,delhi,1182).
edge(surat,hyderabad,983).
edge(surat,indore,607).
edge(surat,jaipur,932).
edge(surat,kanpur,1296).
edge(surat,lucknow,1375).
edge(surat,madras,1695).
edge(surat,nagpur,749).
edge(surat,nasik,262).
edge(surat,panjim,913).

edge(surat,patna,1742).
edge(surat,pondicherry,1789).
edge(surat,pune,412).

edge(trivandrum,ahmedabad,2197).
edge(trivandrum,banglore, 696).
edge(trivandrum,bhubaneshwar,1953).
edge(trivandrum,bombay,1376).
edge(trivandrum,calcutta,2376).
edge(trivandrum,chandigarh,3051).
edge(trivandrum,cochin,218).
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edge(trivandrum,hyderabad,1261).
edge(trivandrum,indore,2156).
edge(trivandrum,jaipur,2782).
edge(trivandrum,kanpur,2611).
edge(trivandrum,lucknow,2690).
edge(trivandrum,madras,748).
edge(trivandrum,nagpur,1834).
edge(trivandrum,nasik,1742).
edge(trivandrum,panjim,792).
edge(trivandrum,patna,2827).
edge(trivandrum,pondicherry,622).
edge(trivandrum,pune,1533).

edge(varanasi,ahmedabad,1373).
edge(varanasi,banglore, 1791).
edge(varanasi,bhubaneshwar,968).
edge(varanasi,bombay,1597).
edge(varanasi,calcutta,695).
edge(varanasi,chandigarh,1032).
edge(varanasi,cochin,2331).
edge(varanasi,delhi,745).
edge(varanasi,hyderabad,1189).
edge(varanasi,indore,925).
edge(varanasi,jaipur,835).
edge(varanasi,kanpur,315).
edge(varanasi,lucknow,286).
edge(varanasi,madras,1985).
edge(varanasi,nagpur,713).
edge(varanasi,nasik,1399).
edge(varanasi,panjim,1524).
edge(varanasi,patna,280).

edge(varanasi,pondicherry,2153).
edge(varanasi,pune,1459).

edge(vijayawada,ahmedabad,1705).
edge(vijayawada,banglore, 637).
edge(vijayawada,bhubaneshwar,775).
edge(vijayawada,bombay,973).
edge(vijayawada,calcutta,1198).
edge(vijayawada,chandigarh,1959).
edge(vijayawada,cochin,1174).
edge(vijayawada,delhi,1716).
edge(vijayawada,hyderabad,269).
edge(vijayawada,indore,1255).
edge(vijayawada,jaipur,1660).
edge(vijayawada,kanpur,1519).
edge(vijayawada,lucknow,1598).
edge(vijayawada,madras,432).
edge(vijayawada,nagpur,742).
edge(vijayawada,nasik,1428).
edge(vijayawada,panjim,876).
edge(vijayawada,patna,1664).
edge(vijayawada,pondicherry,598).
edge(vijayawada,pune,842).

edge(vishakapatnam,ahmedabad,1815).
edge(vishakapatnam,banglore, 1093).
edge(vishakapatnam,bhubaneshwar,445).
edge(vishakapatnam,bombay,1754).
edge(vishakapatnam,calcutta,868).
edge(vishakapatnam,chandigarh,2127).
edge(vishakapatnam,cochin,1449).
edge(vishakapatnam,delhi,1881).
edge(vishakapatnam,hyderabad,599).
edge(vishakapatnam,indore,1433).
edge(vishakapatnam,jaipur,1838).
edge(vishakapatnam,kanpur,1687).
edge(vishakapatnam,lucknow,1765).
edge(vishakapatnam,madras,762).
edge(vishakapatnam,nagpur,910).
edge(vishakapatnam,nasik,1596).
edge(vishakapatnam,panjim,1206).
edge(vishakapatnam,patna,1334).
edge(vishakapatnam,pondicherry,930).
edge(vishakapatnam,pune,1658).

connected(X,Y,L):-edge(X,Y,L),edge(Y,X,L).

% make heuristic for one city ahmedabad from all other cities

% only work when we have ahmedabad as the goal city

heuristic(agra,878).

heuristic(agartala,3305).

heuristic(ahmedabad,0).

heuristic(bangalore,1400).

heuristic(bhubaneshwar,1670).

heuristic(bombay,552).

heuristic(calcutta,2068).

heuristic(chandigarh,1157).

heuristic(cochin,1845).

heuristic(delhi,911).

heuristic(hyderabad,1436).

heuristic(indore,442).

heuristic(jaipur,648).

heuristic(kanpur,1168).

heuristic(lucknow,1247).

heuristic(madras,1821).

heuristic(nagpur,965).

heuristic(nasik,504).

heuristic(panjim,1165).

heuristic(patna,1656).

heuristic(pondicherry,1818).

heuristic(pune,664).

heuristic(allahbad,1251).

heuristic(amritsar,1356).

heuristic(asansol,1842).

heuristic(bangalore,1490).

heuristic(baroda,119).

heuristic(bhopal,523).

heuristic(bhubaneshwar,1647).

heuristic(calicut,1648).

heuristic(coimbatore,1669).

heuristic(delhi,911).

heuristic(gwalior,919).

heuristic(hubli,1101).

heuristic(hyderabad,1436).

heuristic(imphal,3240).

heuristic(jabalpur,901).

heuristic(jamshedpur,1225).

```

heuristic(jullundur,1285).
heuristic(kolhapur,911).
heuristic(ludhiana,1220).
heuristic(madurai,1922).
heuristic(meerut,1092).
heuristic(ranchi,1781).
heuristic(shillong,2839).
heuristic(shimla,1256).
heuristic(surat,263).
heuristic(trivandrum,2197).
heuristic(varanasi,1373).
heuristic(vijayawada,1705).
heuristic(vishakapatnam,1815).

```

```

% best first search main function
% user have to call in this format best_first_search([[jaipur]],ahmedabad, Solution) hubli can be
replaced by any other city
% and goal node will remain same as ahmedabad

```

```

best_first_search([[Goal|Path]]_,Goal,[Goal|Path]).

```

```

% best_first_search will call different functions internally, like extend to find all the neighbors of
the node
% append to add the append New_Path to Queue
% sortQueue will sort the Queue data based on heuristic values
% then called the best_first_search recursively

```

```

best_first_search([Path|Queue],Goal,FinalPath) :-
    extend(Path,New_Path),
    append(Queue,New_Path,Queue1),
    sortQueue(Queue1,NewQueue),
    best_first_search(NewQueue,Goal,FinalPath).

```

```

% function extend function will call the inbuilt function of the prolog findall function to find all the
neighbors of the nodes

```

```

extend([Node|Path],New_Path) :-
    findall([New_Node,Node|Path],
        (connected(Node,New_Node,_),
        \+ member(New_Node,Path)),
        New_Path).

```

```

% sort function will be used to sort the data of the Queue recursively.

```

```
sortQueue(L,L2) :-  
    swap(L,L1), !,  
    sortQueue(L1,L2).
```

```
sortQueue(L,L).
```

% swap function will be comparing the heuristic value of the cities and, based on that arranging the nodes


```
swap([[A1|B1],[A2|B2]|T],[[A2|B2],[A1|B1]|T]) :-  
    hdist(A1,W1),  
    hdist(A2,W2),  
    W1>W2.
```

```
swap([A|T],[A|V]) :-  
    swap(T,V).
```

% hdist is just an alias of the fact heuristic, and we check that either the correct value is stored in a heuristic or not; it should be a number

```
hdist(State, Value) :-  
    heuristic(State,Value),  
    number(Value), !.
```

Output:-

 SWI-Prolog (AMD64, Multi-threaded, version 8.4.0)

File Edit Settings Run Debug Help

?-

% c:/Users/Sakshi/Desktop/AI/Assignment2/best_first_search.pl compiled 0.02 sec, 1,000 clauses

?- best_first_search([[ahmedabad]],ahmedabad,Solution).

Solution = [ahmedabad] .

?- best_first_search([[jaipur]],ahmedabad,Solution).

Solution = [ahmedabad, jaipur] .

?- best_first_search([[patna]],ahmedabad,Solution).

Solution = [ahmedabad, patna] ;

Solution = [ahmedabad, ahmedabad, patna] ;

Solution = [ahmedabad, indore, patna] ;

Solution = [ahmedabad, ahmedabad, indore, patna] ;

Solution = [ahmedabad, indore, indore, patna] ;

Solution = [ahmedabad, ahmedabad, indore, indore, patna] .

?- █

