CSE 417 Final Project Yen-Ting Chen

Real Estate Management

***Problem synopsis***

The project is an in depth study of the minimum-cost perfect matching algorithm with application on Real Estate Management. We have learned that flow network is a useful tool for optimization and how there is an economic interpretation of the minimum-cost perfect matching problem with prices. Using a specially constructed flow network tailored for the minimum-cost perfect matching problem given in Chapter 7.13, we are able to modify the Fulkerson Algorithm so that it fits into the purpose of our current project.

***Description of Algorithm***

The algorithm that we are building is realized by many essential parts like the instantiation of the Flow Network, the Dijkstra algorithm, the Binary Min heap that’s being used as a priority queue; however, the main structure used is a generalized Min-cost perfect matching algorithm provided below as pseudo code:

Start with a set of matching M equal to the empty set

Define p(x)=0 for x in X

Define p(y)= minimum cost of all the edges entering y for y in Y.

While M is not a perfect matching

   Find a minimum-cost s-t path P in GM using Dijkstra with prices p

   Augment along P to produce a new matching M’

   Find a set of compatible prices with respect to M’

EndWhile

***Running Time***

Increase\_heap: O(logV)

delete\_min: O(logV)

reheapify: O(V\*logV)

find\_path(): O(E + V\*logV)

min\_cost\_perfectMatching(): O(V/2 \* [EV + V\*logV]) = O(E\*V^2 + V^2\*logV)

***Simple Example***

In this simple demonstration we’d like to solve the given minimum cost perfect matching problem with only two pairs of nodes.

At first step:

Prices: p(P1) = 0, p(P2) = 0, p(H1) = -50, p(H2) = -30, p(S) = 0, p(T) = 0

Augmenting path: S -> P2 -> T

Distance: dp(P1) = 0, dp(P2) = 0, dp(H1) =0, dp(H2) = 0, dp(S) = 0, dp(T) = -50

At second step:

Prices: p(P1) =0, p(P2) = 0, p(H1) =-50, p(H2) = -30, p(S) = 0, p(T) = -50

Augmenting path: S -> P1 -> H2 -> T

Distance: dp(P1) = 0, dp(P2) = 40, dp(H1) =40, dp(H2) = 0, dp(S) = 0, dp(T) = 20

Matching: P1 – H2, P2 – H1

When the matching reaches size 2, which is the total pairs of nodes, there results a perfect matching.

***Advanced Example***

We show a result of a perfect matching of size 10 using randomly generated edge costs:

Since we are trying to make the summation of net value of all the buyers be maximum, we’d flip the sign of the costs for each edge and the prices. Thus we get:

house 1 is of value at 83 to person 1

house 2 is of value at 42 to person 1

house 3 is of value at 79 to person 1

house 4 is of value at 19 to person 1

house 5 is of value at 79 to person 1

house 6 is of value at 42 to person 1

house 7 is of value at 47 to person 1

house 8 is of value at 72 to person 1

house 9 is of value at 14 to person 1

house 10 is of value at 75 to person 1

house 1 is of value at 30 to person 2

house 2 is of value at 32 to person 2

house 3 is of value at 71 to person 2

house 4 is of value at 29 to person 2

house 5 is of value at 74 to person 2

house 6 is of value at 48 to person 2

house 7 is of value at 19 to person 2

house 8 is of value at 43 to person 2

house 9 is of value at 21 to person 2

house 10 is of value at 14 to person 2

house 1 is of value at 37 to person 3

house 2 is of value at 62 to person 3

house 3 is of value at 67 to person 3

house 4 is of value at 30 to person 3

house 5 is of value at 37 to person 3

house 6 is of value at 52 to person 3

house 7 is of value at 48 to person 3

house 8 is of value at 66 to person 3

house 9 is of value at 19 to person 3

house 10 is of value at 28 to person 3

house 1 is of value at 76 to person 4

house 2 is of value at 24 to person 4

house 3 is of value at 20 to person 4

house 4 is of value at 52 to person 4

house 5 is of value at 83 to person 4

house 6 is of value at 75 to person 4

house 7 is of value at 48 to person 4

house 8 is of value at 42 to person 4

house 9 is of value at 11 to person 4

house 10 is of value at 82 to person 4

house 1 is of value at 57 to person 5

house 2 is of value at 51 to person 5

house 3 is of value at 74 to person 5

house 4 is of value at 41 to person 5

house 5 is of value at 80 to person 5

house 6 is of value at 83 to person 5

house 7 is of value at 79 to person 5

house 8 is of value at 60 to person 5

house 9 is of value at 26 to person 5

house 10 is of value at 39 to person 5

house 1 is of value at 84 to person 6

house 2 is of value at 32 to person 6

house 3 is of value at 21 to person 6

house 4 is of value at 38 to person 6

house 5 is of value at 50 to person 6

house 6 is of value at 39 to person 6

house 7 is of value at 23 to person 6

house 8 is of value at 79 to person 6

house 9 is of value at 80 to person 6

house 10 is of value at 40 to person 6

house 1 is of value at 62 to person 7

house 2 is of value at 56 to person 7

house 3 is of value at 58 to person 7

house 4 is of value at 60 to person 7

house 5 is of value at 77 to person 7

house 6 is of value at 54 to person 7

house 7 is of value at 24 to person 7

house 8 is of value at 21 to person 7

house 9 is of value at 32 to person 7

house 10 is of value at 60 to person 7

house 1 is of value at 23 to person 8

house 2 is of value at 10 to person 8

house 3 is of value at 66 to person 8

house 4 is of value at 18 to person 8

house 5 is of value at 32 to person 8

house 6 is of value at 74 to person 8

house 7 is of value at 58 to person 8

house 8 is of value at 61 to person 8

house 9 is of value at 37 to person 8

house 10 is of value at 86 to person 8

house 1 is of value at 41 to person 9

house 2 is of value at 73 to person 9

house 3 is of value at 22 to person 9

house 4 is of value at 81 to person 9

house 5 is of value at 31 to person 9

house 6 is of value at 10 to person 9

house 7 is of value at 61 to person 9

house 8 is of value at 66 to person 9

house 9 is of value at 27 to person 9

house 10 is of value at 48 to person 9

house 1 is of value at 57 to person 10

house 2 is of value at 24 to person 10

house 3 is of value at 66 to person 10

house 4 is of value at 49 to person 10

house 5 is of value at 59 to person 10

house 6 is of value at 42 to person 10

house 7 is of value at 34 to person 10

house 8 is of value at 88 to person 10

house 9 is of value at 15 to person 10

house 10 is of value at 17 to person 10

person 10 is matched with house 8

person 8 is matched with house 10

person 9 is matched with house 4

person 2 is matched with house 3

person 1 is matched with house 1

person 6 is matched with house 9

person 7 is matched with house 5

person 4 is matched with house 6

person 5 is matched with house 7

person 3 is matched with house 2

house 1 is set at price: 55

house 2 is set at price: 62

house 3 is set at price: 67

house 4 is set at price: 53

house 5 is set at price: 70

house 6 is set at price: 52

house 7 is set at price: 48

house 8 is set at price: 66

house 9 is set at price: 25

house 10 is set at price: 59

***Sources:***

[**http://en.wikipedia.org/wiki/Dijkstra's\_algorithm**](http://en.wikipedia.org/wiki/Dijkstra's_algorithm)

[**http://en.wikipedia.org/wiki/Ford%E2%80%93Fulkerson\_algorithm**](http://en.wikipedia.org/wiki/Ford%E2%80%93Fulkerson_algorithm)

[**http://en.wikipedia.org/wiki/Binary\_heap**](http://en.wikipedia.org/wiki/Binary_heap)