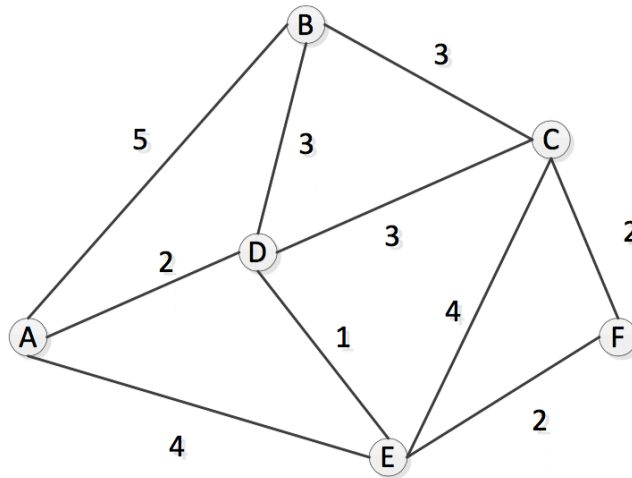


1. A simple file contains the five characters: c, d, n, p, s, in the following frequency: c(12), d(25), n(6), p (19), s(3).
  - (a) Use Huffman's algorithm to construct the code with intermediate steps. (20 marks)
  - (b) Show the code of each character. (10 marks)
2. Given the following undirected weighted graph.



- (a) Show the adjacency matrix of the graph. (10 marks)
  - (b) Use Prim's algorithm to build the minimum spanning tree of the graph. You are required to show each step of your computation. (Highlight vertices and edges as shown in the figure in page 11 of Lecture 7) (10 marks)
  - (c) Use Kruskal's algorithm to build the minimum spanning tree of the graph. You are required to show each step of your computation. (Incrementally add edges as shown in the figure in page 17 of Lecture 7) (10 marks)
3. Use the dynamic programming to show the optimal binary search tree, as given the following words and their associated probabilities:

Word	Probability
A	0.05
B	0.10
C	0.25
D	0.20
E	0.10
F	0.08
G	0.02
H	0.15
I	0.05

- (a) You are required to write a Python program to calculate the all the intermediate results in a table. Print the contents of the table that records the intermediate results in the following format (it is just a sample format, the number in it is random). The

number below X..Y means the optimal search time for the subtree constructed from  $Key_x$  to  $Key_y$ . The letter behind the number means the root of the subtree. (30 marks)

Iteration = 1

A..A | B..B | C..C | D..D | E..E | F..F | G..G | H..H | I..I |  
 0.13 | A | 0.16 | B | 0.22 | C | 0.04 | D | 0.10 | E | 0.08 | F | 0.02 | G | 0.15 | H | 0.15 | I

Iteration = 2

A..B | B..C | C..D | D..E | E..F | F..G | G..H | H..I |  
 0.22 | B | 0.41 | C | 0.62 | C | 0.43 | D | 0.28 | E | 0.15 | F | 0.14 | H | 0.22 | H |

Iteration = 3

A..C | B..D | C..E | D..F | E..G | F..H | G..I |  
 0.63 | C | 0.82 | C | 0.91 | D | 0.67 | D | 0.30 | E | 0.32 | H | 0.19 | H |

Iteration = 4

A..D | B..E | C..F | D..G | E..H | F..I |  
 1.08 | C | 1.39 | C | 1.29 | D | 0.71 | D | 0.62 | F | 0.45 | H |

Iteration = 5

A..E | B..F | C..G | D..H | E..I |  
 1.31 | C | 1.51 | D | 1.22 | D | 1.09 | E | 0.79 | H |

Iteration = 6

A..F | B..G | C..H | D..I |  
 1.69 | C | 1.51 | D | 1.62 | D | 1.28 | E |

Iteration = 7

A..G | B..H | C..I |  
 1.52 | C | 1.78 | D | 1.80 | D |

Iteration = 8

A..H | B..I |  
 2.30 | D | 2.22 | D |

Iteration = 9

A..I |  
 2.54 | D |

(b) Show the final optimal binary search tree. (10 marks)