Introduction to Computer Science

Final Exam 6/20/2005

1. (10%) If a hashed file is partitioned into 11 buckets, what is the probability of at least two out of three arbitrary records hashing into the same section? (Assume the hash algorithm gives no bucket priority over the others.) How many records must be stored in the file until it is more likely for collisions to occur than not?

2. A partial index was built with the (Key field, Segment number) pairs: (13C08, 1), (23G19, 2), (26X28, 3), (36Z05, 4).

(a) (6%) Indicate which segment should be retrieved when searching for the record with each of the key field values, 24X17, 12N67, 32E75, 26X28, respectively.

(b) (4 %) What is the largest key filed value in the file? What is the smallest?

3. Suppose the eight-puzzle game has the start state shown below

1 3
4 2 6
7 5 8

(a) (10 %) Draw the exhaustive search tree to resolve the puzzle.

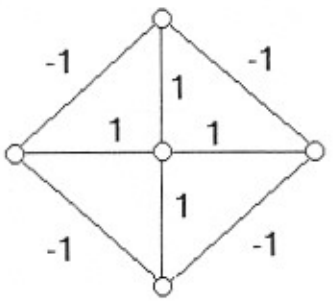
(b) (10 %) If the heuristic metric, "the intermediate state with the smallest sum of distances to the destinations for all tiles is explored first", can be applied to facilitate the problem solving, what would be the alternative search tree?

(c) (6 %) What are the differences between using heuristic algorithms and applying the optimal algorithms for problems solving?

4 The diagram below represents an associative memory as describe in the text. If the center unit has a threshold value of 2.5 and the threshold of the surrounding nodes of 0.5.

(a) (8%)Under what condition will it become excited?

(b) (8%)What would happen if it were given an initial pattern in which only two opposing nits on the perimeter were excited?



5 (8%)(a)Use RSA public key encryption to encrypt the message 110 using public keys n= 91 and e =5.

(8%)(b) Use RSA public key encryption to decrypt the message 111 using public keys n= 133 and d =5.

6. (8%) Is a problem in $O(n^3)$ more complex than a problem in $O(n^2)$? Explain your answer.

7. (14%) The knap problem is to find which numbers from a list are the ones whose sum is a particular value. For example, the number 257, 388 and 782 are the entries in the list

   642 257 771 388 391 782 304

   whose sum is 1427. Fine the entries whose sum is 1723.

   (7%)What algorithm do you apply.

   (7%)What is the complexity of the algorithm.