Due: Monday October 20, beginning of tutorial.

This assignment is worth 10% of final grade

1. Here are the total scores from the vote on the list of possible course topics (in alphabetical order).

- Artificial Intelligence (AI) 31
- Computing as a Commodity (COMMODITY) 29
- Cryptography (CRYPT) 15
- Fortran (and programming languages) (FORTRAN) 6
- Human Computer Interaction (HCI) 16
- Linear Programming (LP) 17
- Model Checking (MC) 3
- Relational Data Bases (RDB) 22
- Search Engines (SEARCH) 44
- Social Networks (SN) 49
- TCP/IP (TCP) 8
- Turing machines (TM) 10

(a) Draw a “balanced” binary search tree $T$ for this list of topics using the abbreviated topic name as the key. By balanced we want the depth of any node in the tree $T$ to be $k$ or $k + 1$ for some positive integer $k$.

(b) Convert each total vote into a probability $p_i$ of being accessed. That is, let $v_i$ be the total vote for topic $i$ and let $V = \sum_i v_i$. Then the probability of accessing the $i^{th}$ topic is $p_i = \frac{v_i}{V}$. Compute the expected search time of an access to a topic for your binary search tree $T$. The expected length of a search (when we are assuming all searches are successful) is $\sum_i[(d_i + 1) \cdot p_i]$ where $d_i$ is the depth of the node representing the $i^{th}$ keyword.

(c) Can you construct another binary search tree $T'$ (perhaps not balanced) that has a smaller expected search time?

2. Design a Turing machine that will decide membership in the following set of strings: Let $\Sigma = \{a, b\}$ and then define $bE2a = \{w \in \Sigma^* | w = a^n b^{2n} \text{ for some integer } n \geq 0\}$. Describe your Turing machine by the kind of state diagram provided for the example of palindromes.