Instructional Days: 13-14

Topic Description: This lesson introduces the linear and binary search algorithms.

Objectives:

The students will be able to:

- Describe the linear search algorithm
- Describe the binary search algorithm
- Explain conditions under which each search might be appropriate

Outline of the Lesson:

- Tower Building Activity (55 minutes)
- Model tower building algorithm (25 minutes)
- Model binary search (15 minutes)
- Comparison of linear and binary search (15 minutes)

Student Activities:

- In pairs complete the Tower Building Activity.
- Model the tower building algorithm.
- Students participate in the activity modeling binary search.

Teaching/Learning Strategies:

- Tower Building Activity
  - o   Have students complete the Tower Building Activity with their elbow partner and write their solutions in their journals.
- Model tower building activity.
  - o   Have students share their solutions with another elbow partner pair.
  - o   Have one set of students use 10 legos (or checkers or some other easily manipulated piece) to model the algorithm for solving the problem in front of the entire class.
  - o   Note: The solution is to start by taking half of the height of the tower and create that number of stacks of 2. Continue halving the number of stacks and doubling the height (plus one stack of any remainder) until the desired height is reached. This foreshadows binary search. (See sample solutions.)
- Model binary search.
  - o   Use 2 copies of the same dictionary. Hand one dictionary to 2 students and have them pick out a word in the dictionary.
  - o   Choose 2 other students to count the number of times you choose a word from the dictionary to search for the students' word.
    - ▪   Start by using a linear search. It should not take long for students to suggest that this is not a good strategy. Ask them to provide a better strategy.
    - ▪   Guide them to binary search.

- o Discuss the number of guesses required and how this is similar to the tower building problem.
- Comparison of linear and binary search.
    - o Linear—start at the beginning, look at each item until you find it or there is no more data. Data can be sorted or not.
    - o Binary—look at middle item, eliminate the half where the value is not located. Find the new middle element and continue the process until you find it, or there is no more data. Ask students to describe what is necessary in order to use a binary search—the list must be sorted.
    - o Have students provide examples of where each type of search is appropriate and why.
        - ▪ Note that decisions often need to be made about whether to maintain lists in sorted order, provide an option for sorting should it be necessary, etc. based on the types of searches that are expected to be performed on the data.

Resources:

- Shasha, Dennis. The Puzzling Adventures of Doctor Ecco. Mineola, New York: Dover Publications, Inc., 1998.
- Tower Building Activity

Tower Building Activity

Donald Trump wants to build a 100 meter high tower as quickly as possible. He has unlimited resources and an unlimited budget and is willing to spend any amount to get the job done.

He has chosen to build the tower with blocks that are 100 meters long and 100 meters wide, but only 1 meter tall. The blocks interlock on top and bottom (like legos). They cannot be stacked sideways.

Using special lifters, putting one stack on top of another stack takes one week regardless of how high the stacks are.

What is the shortest amount of time that it will take to build the tower?

Suggestions:

- Use something like legos or a graph to help solve this problem.
- Start with a smaller tower of 5 or 10—solve a smaller problem.
- Extend that knowledge to the larger problem.