CSC 180, Exam III

Exam III Notes

- You may bring one page of notes (front and back) to the exam. This page may be handwritten or typed.
- Computer access will not be permitted during the exam.
- Cell phones must be put away at all times
- You may not wear earbuds or headphones
- Don't hesitate to contact me if you have any questions!

Exam III Concepts

- Running time, Number of Operations, and Big Theta notation
    - $\theta(1)$ vs. $\theta(\log_2 n)$ vs $\theta(n)$ vs $\theta(n^2)$ vs $\theta(n!)$, etc
- Cleanup Algorithms and their running times
    - Shuffle-left
    - Copy-over
    - Converging pointers
- Searching Algorithms and their running times
    - Sequential Search
    - Binary search
- Sorting Algorithms and their running times
    - Select sort
    - Quicksort
- The Traveling Salesman Problem and it's running time
    - Fundamental Counting Rule
    - Heuristic for the Traveling Salesman problem and it's running time

Practice Problems

1. The algorithm below uses a *while* loop to count the number of times the number 7 appears in a list. Find the total number of operations (assignments, additions, comparisons, and print statements) that are executed and the order of magnitude (theta notation) for the running time under the following scenarios:

    a. The number 7 does *not* appear in the list
    b. The number 7 appears 1 time in the list
    c. Every element in the list is the number 7

```
n ← length of the list
index ← 0
count ← 0
while index < n :
     if mylist[index] == 7 :
          count ← count + 1
     index ← index + 1

Output the count
```

For questions 2 – 4, use the given *clean up* algorithm to clean up the following list: [1, 0, 2, 0, 4, 0]. Note that a 0 is an invalid value. Then repeat questions 2 – 4 for the list: [0, 3, 4, 0, 2, 6]

2. After each iteration of the Shuffle left algorithm, state the following:
    a. The value of *num_valid*
    b. The elements in the list

3. In the Copy-over algorithm, we first iterate through each element of the list and count the number of valid elements, which is *num_valid* = 3 for the first list. After each iteration of the second loop, state the elements that are in the copy list.

4. After each iteration of the *Converging pointers* algorithm, state the following:
    a. The values of *left* and *right*
    b. The value of *num_valid*
    c. The values in the list

5. Consider the list containing the integers: 1, 3, 4, 5, 7, 8, 9, 10, 11
    a. Show the binary search tree for this list, following the algorithm in the notes
    b. What is the maximum number of comparisons that are needed to determine whether or not a number is in the list
    c. If sequential search were used, what would the maximum number of comparisons be?

For questions 6 – 7, use the specified *sorting* method to put the elements in sorted order (from smallest to largest): [19, 20, 3, 2, 6, 10, 9]. Then repeat these questions using the list: [13, 8, 4, 5, 9, 1]. Note: you should check your answers using the Practice Notebook under Sorting Algorithms in the Notes section.

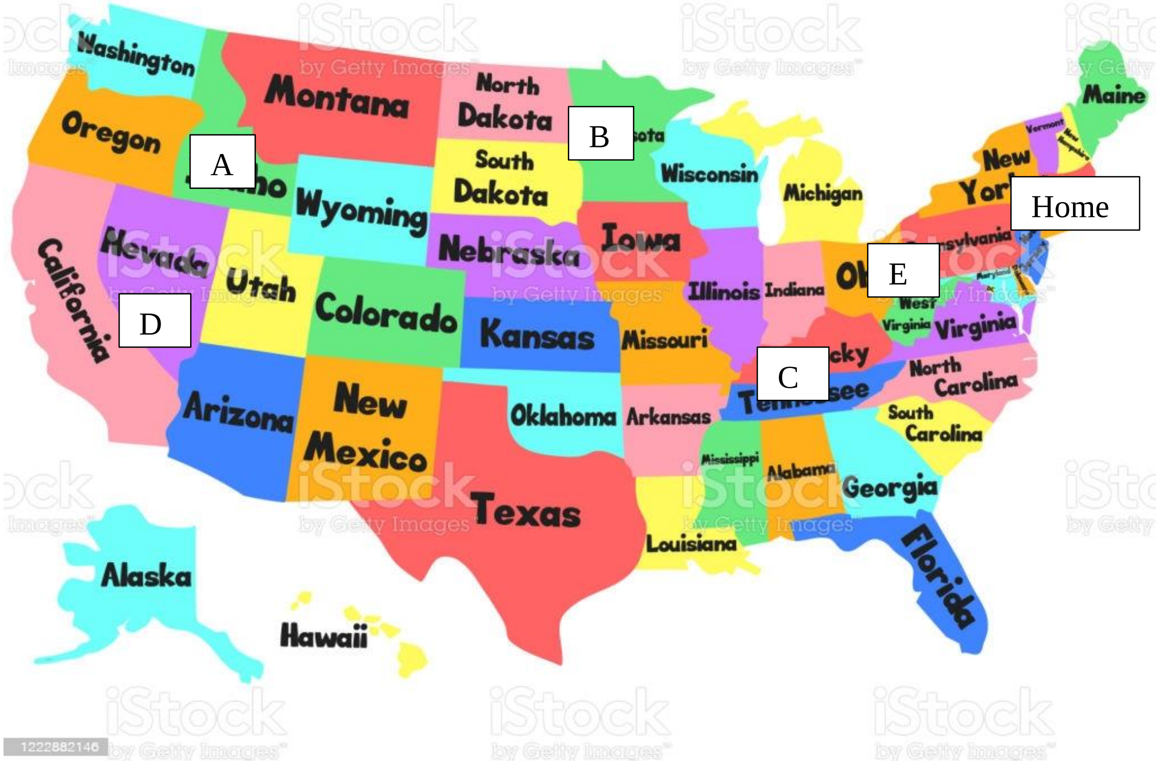
6. Use *selection sort* to sort the given list. For each iteration of the loop, state the following:
    a. The maximum number found

    b. The two values that are swapped
    c. The updated list after the elements are swapped

7. Use *quicksort* to sort the given list. Create a binary tree that shows the following, similar to the trees in pages 16-17 of the notes:
    a. The list being looked at
    b. The list after all swaps from the *partition* algorithm

8. For the Traveling Salesman problem, how many ways are there to visit 6 different cities before returning home?

9. Using the nearest city heuristic for the Traveling Salesman problem, find the route to visit the cities labeled A – E in the image below. How many comparisons are needed for this heuristic?


A
B
C
D
E
Home
Washington
Montana
North Dakota
Oregon
South Dakota
Wisconsin
Michigan
Maine
New York
Wyoming
Nevada
Utah
California
Nebraska
Iowa
Illinois
Indiana
West Virginia
Virginia
Colorado
Kansas
Missouri
North Carolina
Arizona
New Mexico
Oklahoma
Arkansas
South Carolina
Mississippi
Alabama
Georgia
Texas
Louisiana
Florida
Alaska
Hawaii