Data Structures and Algorithms Assignment 4

1. What is the divide and conquer strategy?

   The divide and conquer strategy solve a problem by:

   - Breaking it into subproblems that are themselves smaller instances of the same types of problem
   - Recursively solving these subproblems
   - Appropriately combining their answers

   The real work is done by partitioning the problems into subproblems. These subproblems when they become so small at the tail end of the recursion they are solved and all the subsequent subproblems are solved and are glued together to form the final answer. These processes are held and coordinated by the algorithms core recursive structure.

2. What is binary search and how does it work?

   Binary Search is a fundamental algorithm in computer science. This algorithm finds the position of a target value within a sorted array. Binary search compares the target value to the middle element of the array. If they are not equal, the half in which the target cannot lie is eliminated and the search continues the remaining half, again taking the middle elements to compare to the target value and repeating this until the target values if found. If the search ends with the remaining half being empty, the target is not in the array.

   They have a time complexity of **O (n log n).** They are faster than linear search for a very in large arrays. The only catch with a binary search is that the array must be in sorted.

   Implementation:

```
class BinarySearchExample{
 public static void binarySearch(int arr[], int first, int last, int key){
  int mid = (first + last)/2;
  while( first <= last ){
    if ( arr[mid] < key ){
      first = mid + 1;
    }else if ( arr[mid] == key ){
      System.out.println("Element is found at index: " + mid);
```

```
        break;
      }else{
        last = mid - 1;
      }
      mid = (first + last)/2;
    }
    if ( first > last ){
      System.out.println("Element is not found!");
    }
  }
  public static void main(String args[]){
        int arr[] = {10,20,30,40,50};
        int key = 30;
        int last=arr.length-1;
        binarySearch(arr,0,last,key);
  }
}
```

3. Explain the distinction between a list and a tuple.

   - A list is a mutable data structure while a tuple is immutable in nature.
   - List consumes more memory in comparison to a tuple.
   - Lists are more appropriately used where there are extensive insertion and deletion of data. While tuples are comparatively helpful for read-only operations such as accessing elements.
   - Lists are comparatively more error prone due to unexpected alterations and changes. They tuples due to its immutable natural are much less error prone.

4. Can you explain how python manages memory?

   Memory Management: - Memory management is the process by which applications read and write data. A memory manager determines where to put an application's data. Since there is finite chunk of memory there is a process of providing memory generally called memory allocation. When this memory is no longer needed, they are deleted, that is unused memory is freed.

   Interpreter: - Python is an interpreted programming language. Python get compiled to a more computer readable instruction called bytecode. These instructions get interpreted

by a virtual machine when the code is run. Cpython, Iron Python, Jython and PyPy are examples of examples of python interpreters.

Global Interpreter Lock: - The GIL is used in dealing with shared resources like memory. When writing multi-threaded applications, the GIL locks the interpreter making it not possible for one thread to step on the current one.

Garbage Collector: - Python store a count of the number of times a variable, or object is used or referenced in a program. If the reference counter reduces to zero, then that memory is freed.

5. What is the difference between pickling and unpickling?

Pickling and unpickling are used for transferring python objects from one machine to another machine and vice versa.

Pickling: - Pickling is the process by which objects are converted to byte streams. Pickling is about serializing the object structure in python. The pickle module accepts any python objects and converts it into a string representation and dumps it into a file using a dump () method, this process is called as pickling.

Unpickling: - Unpickling is the process of retrieving original python objects from the stored string representation from the pickle file. It is the process of converting a byte stream into the python object.

6. What are the different types of search algorithms?

Linear Search: - A linear search is a sequential search, it's a method for finding an element within a list. This algorithm sequentially checks each element of the list until a match is found or the whole list has been searched. It has the worst times complexity of **O(n).**

Binary search: - Binary search is used to find the position of a specific value contained in a sorted array. Binary search algorithm works on the principle of divide& conquer and it is considered the best searching algorithm because of its faster speed to search in a sorted data. It starts by searching in the middle of the array and going down the first lower or upper half of the sequence. If the median value is lower than the target value, that means that the search needs to go higher, if not, then it needs to tell on the descending portion of the array. They have a time complexity of **O(logn).**

Jump Search: - Jump search works on sorted arrays. They check for fewer elements by jumping ahead by fixed steps or skipping some elements in place of searching all elements. They have a time complexity of **O**(√ n).

Interpolation search: - Interpolation search is an improved variant of binary search. This search algorithm works on the probing position of the required value. This algorithm works only if the data collection is in a sorted and equally distributed manner.

Exponential search: - This mechanism is used to find the range where the search key may be present. Time complexity is **O (log n).** They work by finding the range where element is present then they do a binary search on it.

Sublist search: - They are used to detect the presence of one list in another list.

Fibonacci search: - A sorted array uses a divide and conquer algorithm that narrows down possible locations with the aid of Fibonacci numbers.