2020/03/11 Algorithm Homework

Note: When the exercise asks you to "design an algorithm for…," it always means that "designs an EFFICIENT algorithm for … and ANALYZES your algorithm". You should keep this in mind when writing solutions.

1. Prove that each of the following sorting algorithms is stable or show that it is unstable by giving a counter example; moreover, determine whether it is in place: *bubble sort*, *insertion sort*, *quick sort*, *merge sort*, *heap-sort*.

2. Given a positive integer n, design an algorithm for computing $\lfloor \sqrt{n} \rfloor$.(要寫Code)

3. How to implement merge-sort such that the extra space used is about $n/2$ where n is the number of input elements?

4. Design a data structure to represent a set with elements being positive integers, and then design algorithms for the following operations: (要寫Code)
   Compute the union of two sets.
   Compute the intersection of two sets.
   Determine if a given element is in a given set.

5. Given two **sorted** arrays $x[1]\ldots x[m]$, $y[1]\ldots y[n]$, design an algorithm to compute $\min i, j \mid x[i] - y[j] \mid$. (要寫Code)

6. Solve the recurrence $T(n)=2T(n/2)+n-1$ where $n=2^k$ is assumed. And assume that $T(n)$ is constant if $n \leq 2$.

7. Given a set S of n integers and another integer x, determines whether or not there exist k elements in S whose sum is exactly x. And determines the difference that k is a given constant number and k is an input parameter.