# ADA 2021 Assignment 1

## Answer 1

1. (a) Algorithm: 4 points
    i. If checking the middle element. 1 point
    ii. Left/Right recursion. 1 point
    iii. Correct condition for going left/right. 1 point
    iv. Base case. 1 point
   (b) Correctness: 2 points
    i. Making the claim/stating $A[i] - i$ is non-decreasing. (Full marks)
    ii. Implicitly implying the above claim (1 point / Relevant partial marks)
   (c) Time Complexity: 1 point
    i. If able to conclude $logn$. (0.5 point)
    ii. Correct justification. (0.5 point)
2. (a) Algorithm: 2 points (no partial marking)
    i. A[1] = 1
   (b) Correctness: 1 point
    i. Making the claim/stating $A[i] - i$ is non-decreasing. (Full marks)
    ii. Implicitly implying the above claim (0.5 point / Relevant partial marks)

## Answer 2

1. (a) Cruel correct: 1.5 points
    i. Valid hypothesis: 0.5 point
    ii. Correct proof: 1 point
    iii. Time complexity: 2 points
        A. Recurrence: 1 point
        B. Correct answer: 2 points
   (b) Unusual correct: 3.5 points
    i. Merging statement: 1 point (could also be in the proof of cruel)
    ii. Induction hypothesis: 0.5 point
    iii. Correct argument: 2 points
    iv. Time complexity: 3 points
        A. Recurrence: 1 point
        B. Correct answer: 2 points

## Answer 3

1. (a) Algorithm/Observing that it can be reduced to inversion. 1 point
   (b) Correctness: 1 point
2. (a) Observing that intersecting lines are intersecting intervals and defining overlapping, intersecting and distinct intervals: 1 point
   (b) Algorithm: 2 points
      i. Divide and Conquer: 1 mark
      ii. Correct conquer step: 1 mark
   (c) Correctness: 2 marks:
      i. Finding the 3 cases properly: 1 point
      ii. How the 3 cases are equivalent to the original problem: 1 point
3. (a) Algorithm: 2 points
      i. Observation of don't need to sort at each call
      ii. Correct merge call: 1 point
   (b) Correctness: 1 point
4. If you do c part algorithm correctly, the b part algorithm full marks.
5. Alternate solution:
   (a) Observing that intersecting lines are intersecting intervals and defining overlapping, intersecting and distinct intervals: 1 point
   (b) Array construction L correctly: 1.5 points
   (c) Array construction B correctly: 1.5 points
   (d) The L - 2B statement: 1 point
   (e) Correctness: 3 points