



University of Colombo School of Computing
SCS 1308 - Foundations of Algorithms
Tutorial - 02

1. Disprove the claim: "For all integers x , $x^2 - 3x + 2 \geq 0$ ".
2. Find out the loop invariant conditions in the following selection sort algorithm.

```
min_idx = 0

for (i = 0; i < n-1; i++)
{
    min_idx = i;
    for (j = i+1 to n-1)
        if (arr[j] < arr[min_idx])
            min_idx = j;

    swap(&arr[min_idx], &arr[i]);
}
```

3. Prove that the sum of the first n powers of 2 is $2^n - 1$ is correct.
4. Find out the loop invariant conditions in the following insertion sort algorithm.

```
for (i = 1 to n-1)
{
    key = arr[i];
    j = i-1;
    while (j >= 0 and arr[j] > key)
    {
        arr[j+1] = arr[j];
        j = j-1;
    }
    arr[j+1] = key;
}
```

5. Prove the correctness of the insertion sort algorithm using loop invariant.

```
algorithm insertionSort(a):
    // INPUT
    //     a = an array of n real numbers (1-based indexing)
    // OUTPUT
    //     The non-decreasingly ordered permutation of a

    for j <- 2 to n:
        x <- a[j]
        i <- j - 1
        while i > 0 and a[i] > x:
            a[i + 1] <- a[i]
            i <- i - 1
        a[i + 1] <- x
    return a
```

6. Prove the correctness of the following algorithm to compute the sum of elements in an array:

```
1 #include <stdio.h>
2
3 int main() {
4     int n;
5     printf("Enter the number of elements in the array: ");
6     scanf("%d", &n);
7
8     int A[n], sum = 0; // Initialize the array and the sum
9     printf("Enter the elements of the array:\n");
10    for (int i = 0; i < n; i++) {
11        scanf("%d", &A[i]); // Input each element
12    }
13    // Compute the sum directly in the main function
14    for (int i = 0; i < n; i++) {
15        sum += A[i]; // Add each element to the sum
16    }
17
18    printf("The sum of the array elements is: %d\n", sum);
19    return 0;
20 }
```