

## Contents

### 1 Lecture 2

#### 1.1 Agenda

##### 1.1.1 Proof of Correctness of Insertion Sort

##### 1.1.2 Counting Steps

#### 1.2 Proof of Correctness

- Loop Invariant: The prefix of the array is sorted
  - Initialization:  $A[1]$  is sorted
  - Maintenance: If  $A[1:j-1]$  is sorted then  $A[1:j]$  is sorted
  - Termination:  $A[1:n]$  is sorted
- Consider the Flowchart diagram as a directed graph and prove the invariant at the incoming edge to the vertex corresponding to the conditional statement for the loop.

#### 1.3 Counting Steps

- Use the same Flowchart and count the number of times each edge/vertex is being traversed.
  - Sum the total count
- Best-Case Analysis
- Average-Case Analysis
- Worst-Case Analysis
- Sanity check by fitting curve on timing instances of varying sizes

#### 1.4 Need for Asymptotic Notation

##### 1.4.1 Order Growth