CMPS 3120

Algorithm Analysis

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Example: sorting

- Input: A sequence of N numbers $a_1 ... a_n$
- Output: the permutation (reordering) of the input sequence such that $a_1 \leq a_2 \ldots \leq a_n$.
- Possible algorithms you’ve learned so far
  - Insertion, selection, bubble, quick, merge, ...
  - More in this course
- We seek algorithms that are both *correct* and *efficient*
Insertion Sort

InsertionSort(A, n) {
    for j = 2 to n {
        ▶ Pre condition: A[1..j-1] is sorted
        ▶ Post condition: A[1..j] is sorted
    }
}

sorted
An Example: Insertion Sort

InsertionSort(A, n) {
    for j = 2 to n {
        key = A[j];
        i = j - 1;
        ▷ Insert A[j] into the sorted sequence A[1..j-1]
    }
}

1 i j

sorted

Key
An Example: Insertion Sort

```java
InsertionSort(A, n) {
    for j = 2 to n {
        key = A[j];
        i = j - 1;
        // Insert A[j] into the sorted sequence A[1..j-1]
        while (i > 0) and (A[i] > key) {
            A[i+1] = A[i];
            i = i - 1;
        }
        A[i+1] = key
    }
}
```

![Diagram showing the insertion sort process](image-url)
Insertion Sort

InsertionSort(A, n) {
    for j = 2 to n {
        key = A[j];
        i = j - 1;
        while (i > 0) and (A[i] > key) {
            A[i+1] = A[i];
            i = i - 1;
        }
        A[i+1] = key
    }
}

1  i  j

sorted

Key
Example of insertion sort
Example of insertion sort

1 2 4 5 6 3

Done!
Example of insertion sort

1 2 3 4 5 6 3

Done!