

Exercises on Algorithms

1. Express the function $\frac{n^3}{1000} - 100n^2 - 100n + 3$ in Θ notation.

2. The following algorithm returns the index of the first occurrence of an item, x , in an array A . Block structure is indicated using indentation only and 1-based indexing is used.

```
SEARCH(A,x)
  for i = 1 to a.length()
    if A[i] == x
      return i
  return null
```

What are the worst- and best-case running times of this algorithm?

3. The following algorithm finds the first occurrence of a string, s , in a text, t .

```
public static Integer simpleSearch(String s, String t) {
    for (int i = 0; i < t.length(); i++) {
        for (int j = 0; j < s.length(); j++) {
            if (i+j < t.length() && s.charAt(j) != t.charAt(i+j))
                break;
            else if (j == s.length() - 1)
                return i;
        }
    }
    return null;
}
```

What is the worst-case running time of this algorithm in O notation? Denote the length of t by n and the length of s by m .

4. Implement insertion sort and merge sort in your favourite programming language.