Exercises for MTP lecture on Algorithms

Thursday 8 September 2010

1. Express the function $\dfrac{n^3}{1000} - 100n^2 - 100n + 3$ 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*.

```java
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.