Algorithm Analysis

Algorithms and Data Structures

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What is ADS about?

- This class is about writing quality code.
- In OOSD we looked at larger scale architectural issues.
- In ADS we will zoom in and look at the details of efficient code.

Algorithms and Data Structures

- Algorithms are step-by-step instructions to perform a task.
- Data structures are used to organise collections of data.
- We will see that a good choice of data structure can help us use a good algorithm.

Evaluating Efficiency

- For a given algorithm, we count the number of “primitive operations” performed.
- In general, this number is a function of the number of inputs into the algorithm.
- An efficient algorithm is one for which the number of operations doen’t increase too quickly.
- We generally compare the function to well-known mathematical functions.

Key Functions

1. $f(x) = c$
2. $f(x) = \log_2(x)$
3. $f(x) = x$
4. $f(x) = x \log_2(x)$
5. $f(x) = x^2$
6. $f(x) = x^k, k > 2$
7. $f(x) = 2^x$

Big-O, Informally

Suppose we analyse the number of primitive operations performed by an algorithm on a list of n items and find that it is characterised by the function
$f(n) = 4n^2 + 3n + 6$
In this case we would say that the algorithm is Big-O of x^2, because in Big-O analysis we ignore coefficients and lower order terms.

Big-O, Formally

Given function $f(n) : \mathbb{Z}^+ \rightarrow \mathbb{R}, g(n) : \mathbb{Z}^+ \rightarrow \mathbb{R}$, we say that $f(n)$ is $O(g(n))$ if there is a real constant $c > 0$ and an integer n_0 such that

$f(n) \leqq cg(n)$, for $n \geqq n_0$

Exercises

R-3.22 through R-3.27
C-3.36
C-3.42
C-3.45

Submit your answers to these and be ready to discuss your solutions next time.