# Theory of Algorithms

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1. An array of n elements contains all integers from 0 to n except one. Design a O(n) time algorithm that determines the missing number. Your algorithm must only use O(1) amount of space in addition to A (so no auxiliary array is allowed).
Justify the running time of your algorithm.

2. What would be the best algorithm for finding a number that occurs only once in a list which has all other numbers occurring exactly twice?
Consider the following example: 2, 1, 5, 1, 8, 5, 2
Design a O(n) time algorithm.

3. Construct an example for which Quicksort will use ($n^2$) comparisons when the pivot is chosen by taking the median of the first, last, and middle elements of the sequence. The elements of your sequence must be all distinct.