Divide-and-conquer (DC) algorithmic technique

1. Divide-and-Conquer algorithm – three steps:
   - **Divide** the problem into a number of (independent) subproblems
   - **Conquer** subproblems by solving them *recursively*. If the subproblem sizes are small enough, however, just solve them in a straightforward manner.
   - **Combine** the solutions to the subproblems into the solution of the original problem

2. Examples of DC algorithms:
   (a) MergeSort (vs. Insert sort)
   (b) Finding the maximum and minimum values
   (c) Finding a maximum subarray
   (d) Strassen’s algorithm for matrix multiplication
   (e) the closest pair of points in one dimension.
   (f) Searching for index $i$ such that $A[i] = i$ in a sorted array $A$
   (g) Integer multiplication
   (h) $k$-way merge operation

Definitions and concepts

1. Mathematical induction
2. Growth of functions and asymptotic notation: $O, \Omega, \Theta$
3. Best-case, worst-case and average-case complexity
4. Recurrence relations
5. Explicit substitution (iteration) method for solving simple linear and DC recurrence relations
6. The master theorem for solving DC recurrences

Math

1. Set notation and set of functions used in asymptotic notation
2. Summation formulas: $\sum_{i=1}^{n} i = ?, \sum_{i=0}^{n} x^i = ?, \sum_{i=1}^{n} \frac{1}{i} = ?$
3. Binomial coefficients
4. Floor and ceiling
5. Logarithm and exponential
6. L’Hôpital’s rule