Universität Bielefeld
Technische Fakultät, AG Genominformatik
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Advanced Algorithmic Techniques for Bioinformatics

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Exercise sheet no. 7 (out: 23 Jan. 2008, in: 30 Jan. 2008)

1. **Minimal number of coins. (Try!)**

   Construct an algorithm to compute the minimal number of coins needed for representing a number M. In other words, find the length of a shortest decomposition $(c_1, \ldots, c_k)$ of M (where the length of c is $|c| = \sum_i c_i$). Demonstrate how the algorithm works using the example $a_1 = 3, a_2 = 5, a_3 = 7$, and $M = 15$ from the lecture.

2. **String scrabble. (Do!)**

   (a) How many different strings can be built by using all characters of the string `BRIGHT` exactly once? Compute the actual number, not just a formula. For example, for `ABC`, there are six such strings: `ABC, ACB, BAC, BCA, CAB`, and `CBA`.

   (b) How many different strings can be built by using all characters of the string `BUBBLE` exactly once? Compute the actual number, not just a formula. For example, for `ABA`, there are three such strings, `AAB`, `ABA`, and `BAA`.

   (c) Try to find a general formula. Note that for `BRIGHT`, this number depends solely on the length of the string, while for `BUBBLE`, also on something else. What?

3. **Finding all decompositions. (Don't.)**

   Find all decompositions of 20 over $\{3, 6, 8, 9\}$. List all calls of the recursive algorithm FAD from the lecture, in the order they appear.

4. **Crystal ball gazing. (Do!)**

   What is the meaning of the values $D[m]$ in the following one-dimensional array of size $M + 1$? (The values for $m < 0$ are just defined as 0 for the calculations, but not really put in the array.)

$$D[m] = \begin{cases} (\ 0 & \text{for } m < 0 \ ) \\ 1 & \text{for } m = 0 \\ \sum_{i=1}^{k} D[m - a_i] & \text{for } 0 < m \leq M \end{cases}$$