Exercise 7.1 - Bin packing

Consider the following sequence $I$ of items:

$$
\frac{1}{31} + \epsilon, \ldots, \frac{1}{31} + \epsilon, \frac{1}{9} + \epsilon, \ldots, \frac{1}{9} + \epsilon, \frac{1}{3} + \epsilon, \ldots, \frac{1}{3} + \epsilon, \frac{1}{2} + \epsilon, \ldots, \frac{1}{2} + \epsilon \quad (m \in \mathbb{N})
$$

- Construct an optimal packing and the packing which results after applying the First Fit method. Provide $OPT(I)$ and $FF(I)$.
- Apply the offline strategy First Fit Decreasing to $I$. Construct the resulting packing and provide $FFD(I)$.

Exercise 7.2 - Matrix-chain Multiplication

Find the optimal parenthesization of a matrix-chain product whose sequence $P$ of dimensions is $(44, 43, 3, 29, 35, 19)$. Specify all values $m[i, j]$ and $s[i, j]$. Finally, provide the optimal parenthesization for $A_1 \cdot A_2 \cdot A_3 \cdot A_4 \cdot A_5$.

Exercise 7.3 - Optimal search trees

Let keys $k_1, k_2, k_3, k_4, k_5$ be given the following query frequencies:

$$
\begin{array}{cccccccc}
(-\infty, k_1) & (k_1, k_2) & k_2 & (k_2, k_3) & k_3 & (k_3, k_4) & k_4 & (k_4, k_5) & k_5 & (k_5, \infty) \\
4 & 5 & 3 & 3 & 2 & 7 & 1 & 6 & 4 & 5 & 3
\end{array}
$$

Compute an optimal search tree, use the method presented in the lecture. For every optimal search tree $T(i, j)$, give the values $W(i, j)$, $P(i, j)$ and $r(i, j)$.

Exercise 7.4 - Edit distance

Consider two strings $A = ARDUOUS$ and $B = ABSTRUSE$.

- Show the corresponding trace graph for transforming $A$ into $B$. For each node draw only the feasible edges (i.e. edges that lead to the corresponding minimum value of the node).
- Mark an optimal trace (i.e. an optimal path in the trace graph).
- Specify the corresponding sequence of edit operations and $D(A, B)$.

Exercise 7.5 - Text search (Ukkonen)

By using the Ukkonen algorithm, construct the explicit suffix-tree for the string $t = BAGGAGE$. For each phase $i = 1, \ldots, |t|$, draw the implicit suffix-tree $T_i$ and specify the applied rules. Finally, draw the explicit suffix-tree $T$ and insert all suffix links.