Question 7

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7.1 (a)

Given a 2-dimensional grid with sizes (L_1, L_2),

- For coordinates (x_1, x_2), index $I = x_2 L_1 + x_1$.
- For index I, coordinates (x_1, x_2) are given by $x_2 = I // L_1, x_1 = I \mod L_1$, where $//$ denotes integer division.

7.2 (a)

Given a d-dimensional grid with sizes $(L_1, L_2, L_3, \ldots, L_d)$,

- For coordinates $(x_1, x_2, \ldots, x_d)$, index

$$\begin{aligned} I &= L_1 L_2 \cdots L_{d-1} x_d + \cdots + L_1 L_2 x_3 + L_1 x_2 + x_1 \\ &= x_1 + \sum_{k=2}^{d} \left(\prod_{m=1}^{k-1} L_m \right) x_k \end{aligned}$$

- For index I, coordinates $(x_1, x_2, \ldots, x_d)$ are given by the following iterative process with the initial value $I_d = I$

$$\begin{aligned} x_j &= I_j \ // \ \left(\prod_{m=1}^{j-1} L_m \right), \quad j = 2, \ldots, d \\ I_{j-1} &= x_j \mod \left(\prod_{m=1}^{j-1} L_m \right), \quad j = 2, \ldots, d \\ x_1 &= I_1 \end{aligned}$$