

Problem:

2 workers Claude and Gemma work on a Multi-Conveyer Pipeline to assemble ragdolls.

Each regdoll assembly consists of n steps.

Given:

- C and G are 1-indexed arrays of size n representing amount of time for Claude and Gemma to complete each step respectively.
- Switching between Claude and Gemma take constant time of 1 unit.
- Setup time and packaging time for Claude: C_s, C_p
- Setup time and packaging time for Gemma: G_s, G_p
- The person who performs step 1 must also setup. (as clarified in Ed post #110)
- The person who performs step n must also package. (as clarified in Ed post #110)

Minimize the total time to produce a ragdoll.

Solution:

1. Definition

Let $T(w, i)$ = the minimum time to complete the first i steps, with the last worker being w .

Range of variables:

$w = 0..1$ (0 being Claude, 1 being Gemma)

$i = 1..n$

2. Recurrence in terms of smaller subproblems:

Base case:

$$T(0, 1) = C_s + C[1]$$

$$T(1, 1) = G_s + G[1]$$

Recurrence:

$$T(0, i) = C[i] + \min\{T(0, i-1), T(1, i-1) + 1\}$$

$$T(1, i) = G[i] + \min\{T(1, i-1), T(0, i-1) + 1\}$$

where $i=2..n$

3. Complexity analysis:

- Number of subproblems: $O(n)$
- Runtime for table fill: $O(n)$
- Return extraced as: $\text{return } \min\{T(0, n) + C_p, T(1, n) + G_p\}$
- Runtime of return extraction: $O(1)$