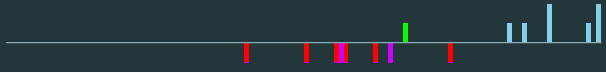
E: Excruciating Elevators

Problem author: Albert Eikelenboom



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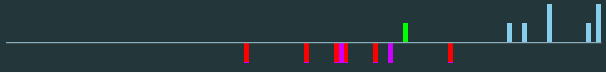

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Observation 1: Label the elevators A,B,C,D. We can assume that A starts on floor 0. Indeed, if no elevator starts on floor 0, we can move each elevator ahead until one does.

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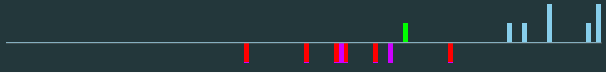

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Observation 2: Consider a directed graph on the elevators, by drawing an edge from X to Y whenever X arrives perfectly on time at some point where Y was used most recently. Then from each used elevator, there must be a path in this graph to elevator A. Otherwise, we can move all reachable elevators ahead until a new edge emerges.

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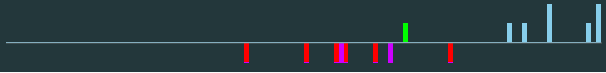

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Conclusion: We can assume there is an edge from B to A, from C to at least one of A or B, and from D to at least one of A or B or C, giving 6 graphs to consider.

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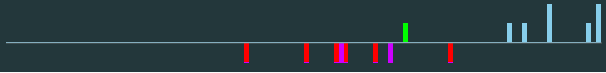

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Solution: Iterate all 6 graphs and all n^3 possible floors where the perfect transitions take place. This determines the starting positions of all elevators, from which we can simulate the corresponding solution.

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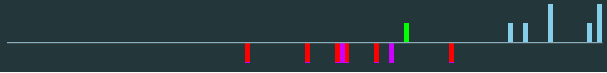

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Running time: For k elevators, with $\mathcal{O}(kn)$ time per simulation, the running time is $\mathcal{O}(k!n^k)$.

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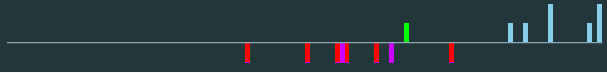

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Statistics: 16 submissions, 1 accepted, 7 unknown