Bonus #1

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We know the definition of branching factor b^* to be defined as

$$N = b^* + (b^*)^2 + \cdots + (b^*)^d$$

With N being the total number of nodes being generated, and d being the solution depth. From this, we can get an estimate for the effective branching factor as follows:

$$b^* = N^{\frac{1}{d}}$$

Note this is not a perfect equation, and has the possibility for high error tolerances; for our purposes, it should be okay. The two heuristics for this assignment are as follows:

$$\begin{aligned} h_1 &= \text{Score Difference} \\ &= \frac{\text{Quota} - \text{Current Score}}{\text{Max Swaps} - \text{Current Swaps}} \\ h_2 &= \text{Homogeneous Board} \\ &= \text{Standard Deviation of the} \\ &= \text{Number of Devices Types on the Board} \end{aligned}$$

Results can be found in Table 1. Essentially, the branching factors are similar, but the Homogeneous Board heuristic has a tendency to explore more of the board.

Table 1: The computations for the effective branching factor.

Input	**Heuristic**	**Nodes Generated** (N)	**Solution Depth** (d)	**Branching Factor** (b^*)
Puzzle #1	Score Difference	4	1	4
	Homogeneous Board	4	1	4
Puzzle #2	Score Difference	99	11	1.52
	Homogeneous Board	144	10	1.64
Puzzle #3	Score Difference	94	12	1.46
	Homogeneous Board	890	25	1.31