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PART B Q4: Comparing A-Star Heuristics for Eight Puzzle

←---------Number of States Explored ----------→

Example File	Initial State	Optimal Path Length	AStar Hamming	AStar Euclidean	AStar Manhattan	AStar Custom	BFS
puzzle0	[0, 1, 2, 3, 4, 5, 6, 7, 8]	0	0	0	0	0	0
puzzle1a	[1, 0, 2, 3, 4, 5, 6, 7, 8]	1	1	1	1	1	2
puzzle2a	[3, 1, 2, 4, 0, 5, 6, 7, 8]	2	2	2	2	2	9
puzzle4a	[1, 4, 2, 3, 7, 0, 6, 8, 5]	5	5	5	5	**12**	161
puzzle12a	[4, 5, 0, 1, 2, 3, 6, 7, 8]	8	21	29	29	22	946
puzzle10a	[3, 1, 2, 6, 8, 7, 5, 4, 0]	10	80	30	21	**61**	3375
puzzle14a	[4, 5, 0, 1, 2, 8, 3, 7, 6]	14	524	144	209	194	--
puzzle16a	[0, 8, 2, 1, 7, 4, 3, 6, 5]	16	1552	778	421	285	--

We can see that with simpler searches (fewer optimal moves), all heuristics perform similarly. However, with starting states that have longer solution paths, the dominance of heuristics is easy to see.

Manhattan outperforms Euclidean which outperforms Hamming.
The Custom Metric (Linear Conflict Based) performs close enough in efficiency to Manhattan, and sometimes outperforms all heuristics.

An interesting contrast is BFS, which struggles to find the optimal path quickly, and shows how much faster any decent heuristic with AStar can be.