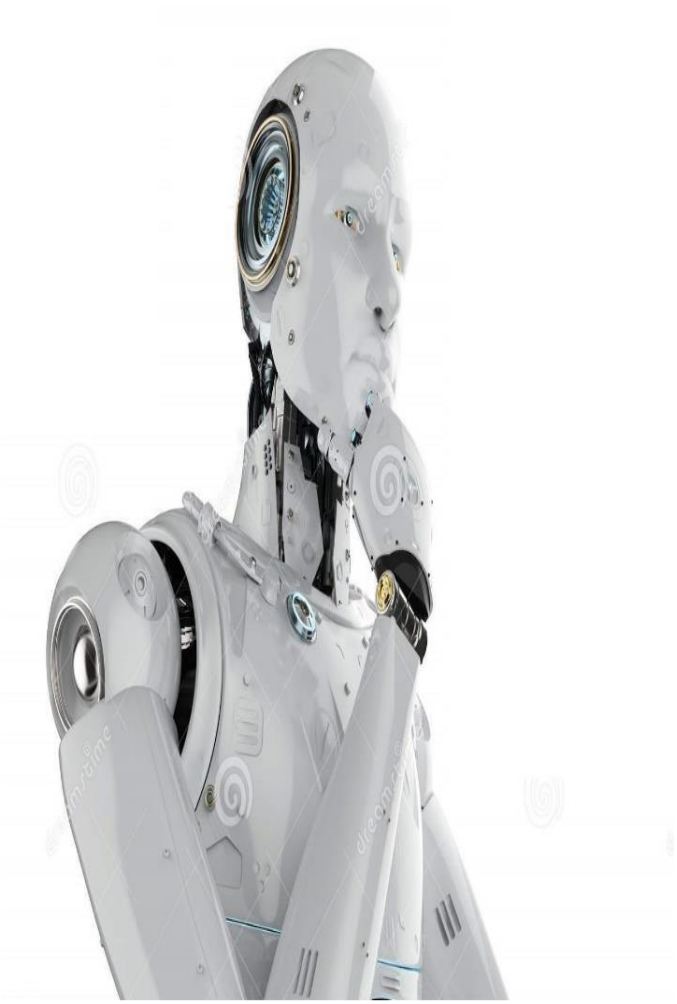
Istanbul University - Cerrahpaşa Computer Engineering Artificial Intelligence and Expert Systems



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8-Puzzle

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

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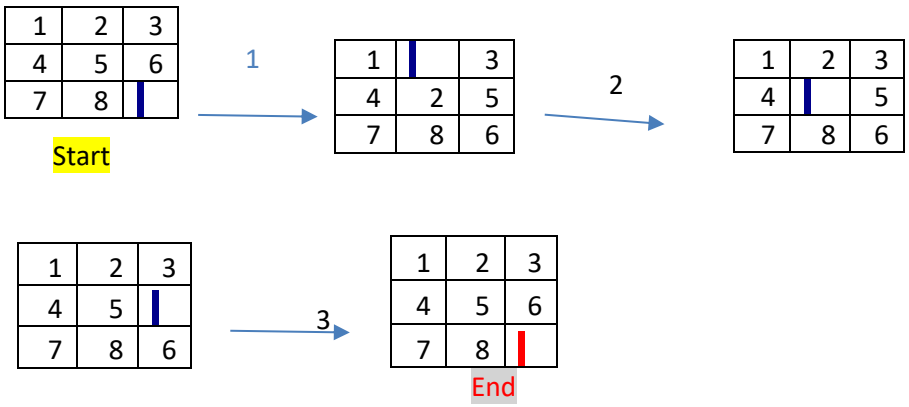
Create Problem

The 8 puzzle consists of 8 numbered, movable tiles put in a 3 X 3 frame . One location of the se is always free thus it makes it possible to move an adjacent numbered tile into the free location.

Example:

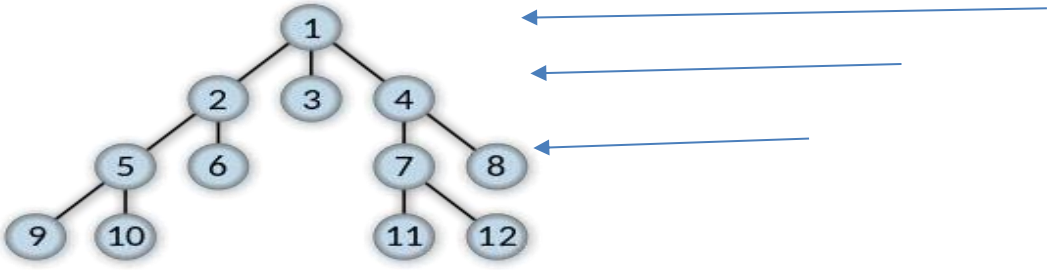


Problem Configuration:

- **Situations**: it is a n array of size of 9.
- **Start Point**: new input or random created in file ./samples.txt.
- **Actions**: movements [UP , DOWN , LEFT , RIGHT]
- One movement can be applied depending on the location of blank
- **Movement model**: takes [situation+ start point] --------- > **return** current state.
- Represented by *swap* method.
- **End Check**: check whether it is the End state or not.
- **Path Cost**: One step costs 1, Thus path cost is the number of steps in the path.

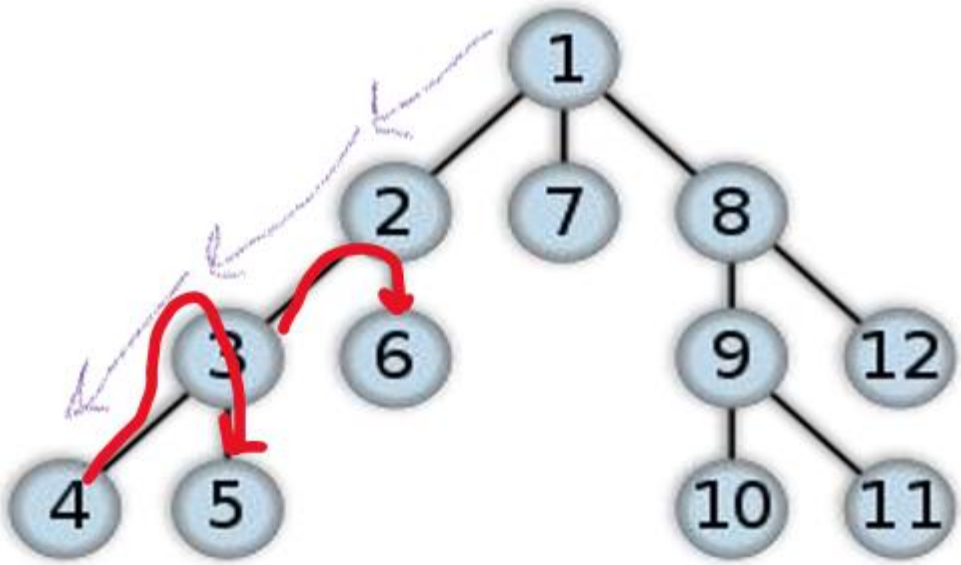
Search algorithms

Breadth-first search(BFS) is a simple strategy in which the root node is expanded first, then all the successors of the root node are expanded next, then their successors, and so on.



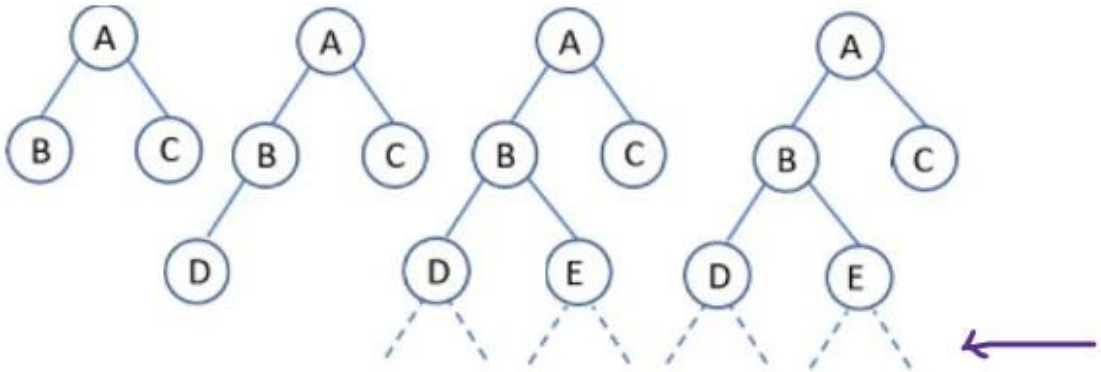
Depth-first search(DFS)

DFS is an algorithm for exploring or searching tree or graph in data structure. it starts at the root node and expand along as it is possible to the deepest depth before it goes backtracking.



Depth limited search (DLS)

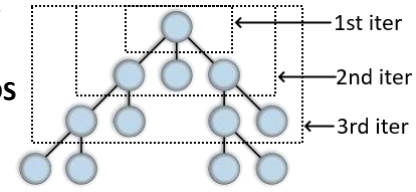
DLS is an algorithm that resembles to DFS, however DLS the depth of it is predetermined . Node at deepest depth are handled as they have no successors.



Iterative deepening depth-first search (IDS)

IDS is a version of DFS which runs which runs repeatedly with increasingly depth limits until the goal is found

IDS : is an optimal version which uses less memory 1at each iteration . IDS is an optimal alg such as BFS but uses less memory ; at each loop , it explores nodes in the search tree in the same order as DFS , but the



cumulative order in which nodes are first visited is effectively breadth-first.

Applying the algorithm on 10 random problems:

PROBLEM	Type	1	2	3	4	5	6	7	8	9	10	11
TIME	BFS	0.352	0.001	0.083	0.004	0.002	0.023	0.005	1.722	0.078	0.016	0.228
	DFS	151.9	0.102	25.Haz	0.181	0.001	27.Haz	Haz.95	12.Haz	Mar.69	0.041	22.86
	DLS [5]	-	0.001	-	-	0.001	-	0.001	-	-	-	0.001
	DLS [10]	-	0.005	0.049	0.015	0.027	0.013	0.04	-	-	0.021	0.024
	DLS [15]	0.066	0.05	0.21	0.096	0.067	0.11	0.032	-	0.284	0.238	0.128
	DLS [20]	0.837	0.12	0.91	0.153	0.692	0.827	0.072	1.796	0.242	0.96	0.660
	DLS [25]	1.134	1.304	Şub.37	1.643	1.986	2.565	0.625	4.268	0.77	2.974	1.963
	IDS	0.67	0.002	0.067	0.007	0.001	0.022	0.004	2.877	0.132	0.024	0.380
DEPTH	BFS	15	3	10	6	3	8	5	18	11	8	8.Tem
	DFS	88939	829	40574	2194	27	40568	23753	28878	17771	458	24399.1
	DLS [5]	-	3	-	-	3	-	5	-	-	-	3.666
	DLS [10]	-	9	10	6	3	8	5	-	-	8	7
	DLS [15]	15	9	10	12	15	8	11	-	11	8	11
	DLS [20]	19	19	20	20	19	8	19	20	17	20	18.Oca
	DLS [25]	25	19	24	22	21	24	25	24	23	24	23.Oca
	IDS	15	3	10	6	3	8	5	18	11	8	8.Tem
EXPANDED	BFS	5667	13	590	68	15	219	55	22458	1177	236	3049.8
	DFS	94292	845	41788	2240	27	41782	24361	29617	18191	467	25361
	DLS [5]	-	19	-	-	19	-	31	-	-	-	23
	DLS [10]	-	45	263	194	265	87	427	-	-	306	226.7
	DLS [15]	978	489	3073	1410	1032	1017	473	-	4196	3493	1795.6
	DLS [20]	10439	1769	12361	2361	10109	10092	1168	22801	3785	13227	8811.2
	DLS [25]	14511	16566	30966	22587	26060	30276	6769	51335	10933	38568	24857.1
	IDS	9631	12	881	81	12	309	64	41310	1819	310	5442.9
FRINGE	BFS	5820	20	612	80	18	237	69	20590	1201	248	2889.5
	DFS	113352	1060	51628	2800	39	51619	30212	36722	22604	589	31062.5

	DLS [5]	-	8	-	-	9	-	9	-	-	-	8.Haz
	DLS [10]	-	15	15	14	15	15	15	-	-	15	14.Ağu
	DLS [15]	22	21	21	21	23	21	23	-	21	21	21.May
	DLS [20]	29	28	27	27	29	29	29	27	22	27	27.Nis
	DLS [25]	35	34	34	34	36	35	36	33	34	34	34.5
	IDS	22	5	15	9	7	13	9	25	16	12	13.Mar

Conclusion

By comparing these algorithms , keeping in mind cost =1 , and each one has its pros and cons

BFS

Pros

1- Every time find solution
2- Solution would be optimized with regarding to depth

CONS

1- BIG USE OF MEMORY

DFS

Pros

1- Every time find solution

CONS

1- BIG USE OF MEMORY
2- Explore a lot of nodes

DLS

Pros

1- High speed in running (depends on limit of depth)

CONS

1- Not able to get solution if case depth is small

IDS

Pros

1- Every time find solution
2- Optimized use of memory
3- Optimized solution

CONS

1- It would be not quick if the solution is