1. (35 points) Suppose the space in the 8-puzzle tries to move in the following order: up, right, down, left.

\[
\begin{array}{ccc}
2 & 8 & 3 \\
1 & 6 \\
7 & 5 & 4
\end{array}
\quad
\begin{array}{ccc}
1 & 2 & 3 \\
8 & 4 \\
7 & 6 & 5
\end{array}
\]

Given the above two configurations, we try to find a path from the first to the second using the following search methods. Please list the first 8 configurations in the order they are expanded (if a solution is found before expanding 8 nodes, then list the solution). We assume that no repeated nodes in the path.

(a) The breadth-first search
(b) The depth-first search
(c) A* using the displaced tiles (If two nodes have the same weight, the newer one explores first.)

2. (30 points) The clauses (1)-(5) are satisfiable:

\[
\begin{align*}
(1) & \quad \neg p \lor q \lor r \\
(2) & \quad \neg p \lor \neg q \\
(3) & \quad \neg q \lor r \\
(4) & \quad p \lor \neg r \\
(5) & \quad q \lor \neg r
\end{align*}
\]

You are asked to use the local search method to find a model of the clauses (1)-(5) starting from the initial assignment \((p, q, r) = (1, 1, 1)\), where 1 stands for \textit{true} and 0 for \textit{false}. The evaluation function in the local search is the number of false clauses under the current assignment. Note that a neighbor of an assignment is obtained by flipping the truth value of one variable. Please show what is the best neighbor in each move. If the search finds a local optimum, you have to choose a neighbor of the same value to replace the current assignment. If every neighbor is worse than the current assignment or a model is found, the search stops.
3. (35 points) During a recent police investigation, Chief Inspector Stone was interviewing five local villains to try and identify who stole Mrs Archer’s cake from her kitchen. Below is a summary of their statements:

- Arnold: (i) it wasn’t Edward; (ii) it was Brian.
- Brian: (i) it wasn’t Charlie; (ii) it wasn’t Edward.
- Charlie: (i) it was Edward; (ii) it wasn’t Arnold.
- Derek: (i) it was Charlie; (ii) it was Brian.
- Edward: (i) it was Derek; (ii) it wasn’t Arnold.

It was well known that each suspect told exactly one lie.

(a) Express their statements in propositional logic sentences using five propositional variables A, B, C, D, and E, which mean “it was Arnold”, “it was Brian”, “it was Charlie”, “it was Derek”, and “it was Edward”, respectively.

(b) Convert the five sentences into clauses (conjunctive normal forms).

(c) Provide a model of the five sentences if they are satisfiable; otherwise show that they are unsatisfiable.