Game Playing

In the past weeks, we discussed intelligent agents and how they can use tree searching techniques to solve abstracted problems. In this assignment, you will implement chess-playing agent and answer some theoretical questions.

**Question 1.** Open the following google colaboratory notebook. Follow all the steps specified in it. Include link to your solved notebook in your submission. Optional: implement your own chess-playing agent and we will run a small competition between agents of other students (you can work in teams).

**Question 2.** Why do we assume that we play against an optimal opponent in the minimax algorithm. What happens otherwise?

**Question 3.** What kind of node exploration is the minimax algorithm using? Depth-first or breadth-first?

**Question 4.** What is the time complexity of the naive minimax algorithm? Prove it.

**Question 5.** Explain why minimax algorithm with $\alpha - \beta$ pruning is more efficient than naive minimax. What is the complexity and why it depends on the ordering of the elements?

**Question 6.** Why did we introduce EVAL function instead of UTILITY for some games? Explain what is a good EVAL function for chess and how it affects the minimax algorithm.

**Question 7.** What is a Horizon effect and Quiescence?

**Question 8.** Under what kind of transformation the behaviour of minimax algorithm is preserved in case of a game with no chance nodes? In case of a game with chance nodes?

Logic

**Translate the following English sentences into propositional logic**

**Question 9.** A and B are both true.

**Question 10.** If A is true, then B must be true as well.

**Question 11.** If a student studies for a test, they will do well on it. We can also tell that if a student did well on a test, then they must have studied for it.

**Question 12.** If a student is completely dry and it is raining outside, it is because they have an umbrella or a hoodie and it is not raining heavily.
Question 13. Simplify and translate the following propositional logic sentence into English: \( A \lor (A \land B) \iff \neg (A \land B \land C) \)

Question 14. Is the following sentence valid? \( A \lor B \)

Question 15. Is the following sentence satisfiable? \( A \implies B \)

Question 16. Is the following sentence unsatisfiable? \( (A \land (B \lor C)) \land ((A \land B) \lor (A \land C)) \)