Name Surname: Group №:

Introduction to AI
Final Exam Spring 2022

Rules:
Print your name and group number carefully at the top of all pages. This is a closed book exam and requires no external materials Any cheating/misconduct will result in a mark of 0 and report to the Educational Dept. Make all answers in pen – no remarks will be given to those using pencil. Exam will last 110 min from call of time. There are 6 questions and 50 marks available – this test making up 25% of your final grade:

1. Provide the Isaac Asimov's laws of robotics. [5pt]

2. The piece of Romanov's family tree is given, most of the members are intentionally omitted, please ignore them. You should use PROLOG to answer the questions given below.
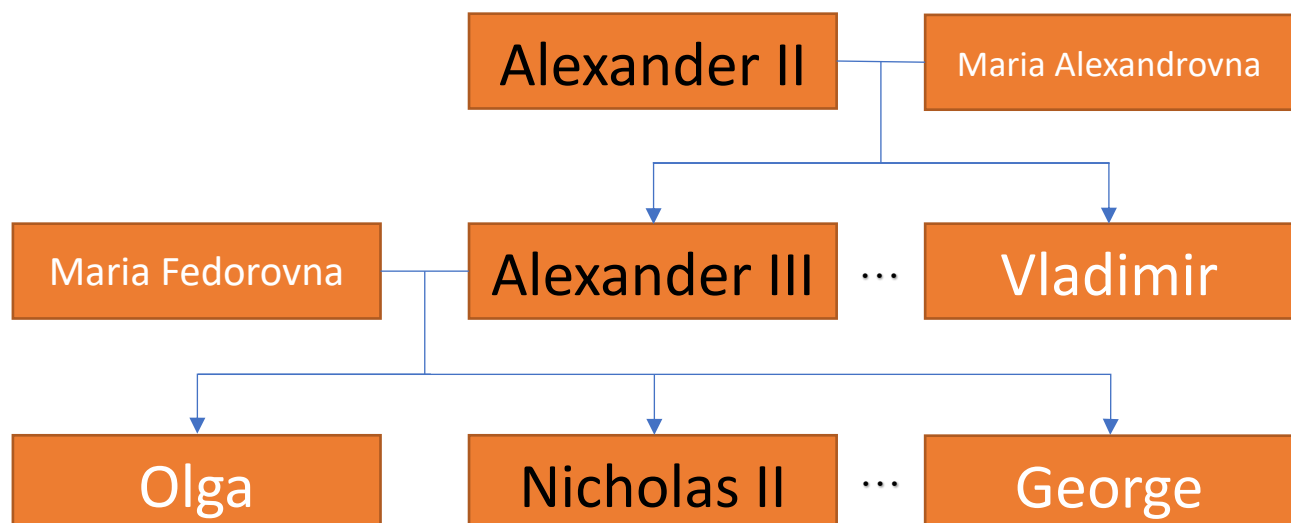
a. Write the knowledge base for the tree using female(X), male(X), parent(X,Y). [5pt]
   Write facts:

   Specify rules (ignore creation of duplicates in answers):
   - father(X,Y) :=
   - mother(X,Y) :=
   - grandfather(X,Y) :-
   - grandmother(X,Y) :-
   - brother(X,Y) :-
   - sister(X,Y) :-
   - aunt(X,Y) :-
   - uncle(X,Y) :-

b. Resolve the following queries using given facts and rules [5pt]:
   - Was Alexander II the parent of Alexander III?
     Query:

     Answer:

   - Who were the parents of Nicholas II?
     Query:

     Answer:

   - Show all male nephews, make the rule ultimate for even a bigger tree.
     Query:

     Answer:

   - Show all pairs of males with daughters.
     Query:

     Answer:

3. What is the difference between GBEST and LBEST PSO versions? Draw examples of topologies for both versions [6pt]

4. What formula is used for the selection of a leaf in Monte Carlo Tree Search and how? Explain the variable meanings and which part of the formula is responsible for exploitation and which for exploration. [7pt]

5. Provide pseudo-code for a general evolutionary algorithm's main loop. Then give a description of evolutionary strategy (representation, selection, crossover and mutation).
    a. EA pseudo-code: [5pt]

    b. ES description:
        i. Representation [1pt]:

        ii. Selection [1pt]:

        iii. Crossover [1pt]:

        iv. Mutation and its versions [2pt]:

6. Show 3 perceptrons with activation functions and weights:
   a. Show a perceptron which implements AND. [4pt]

   b. Show a perceptron which implements OR. [4pt]

   c. Show a perceptron which implements NOT. [4pt]