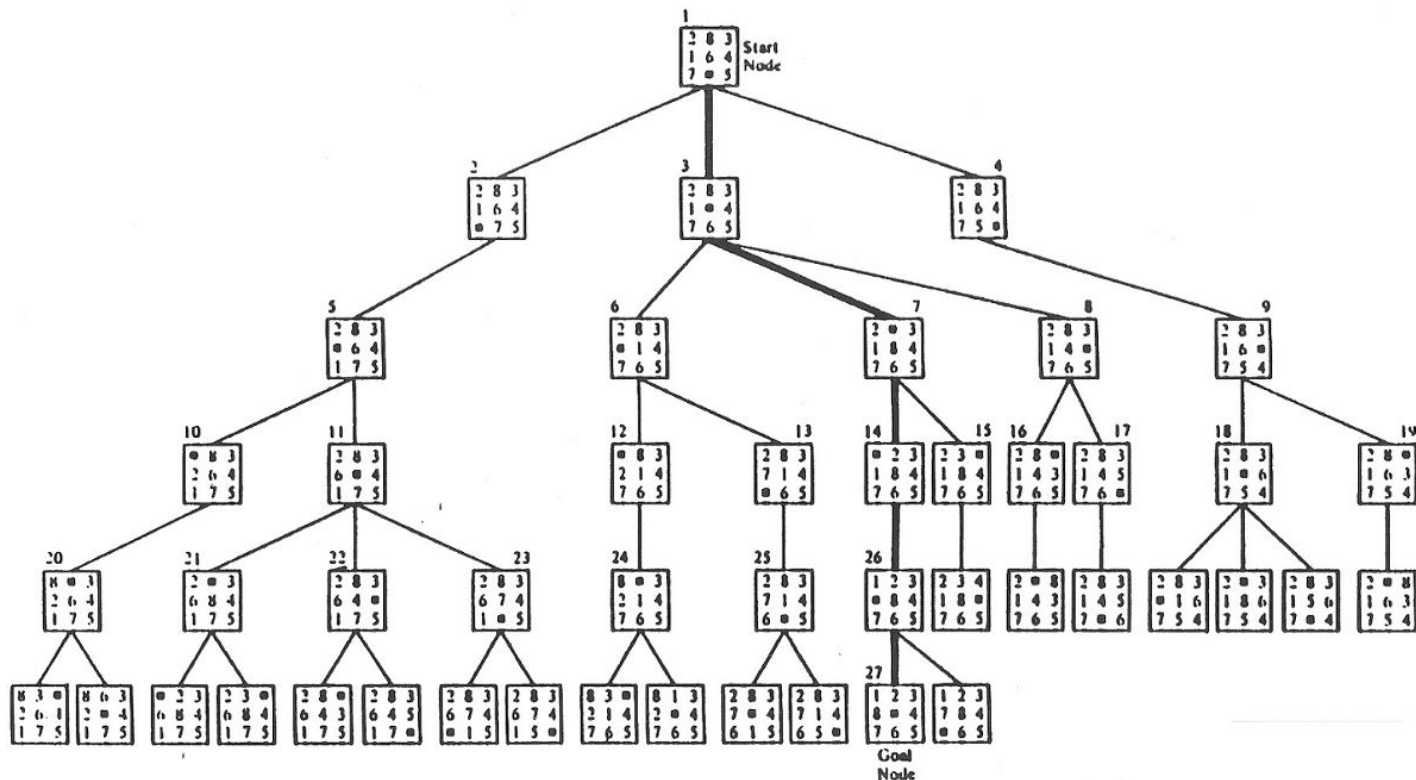


Each exercise is worth 1 point out of the grade of the written exam.  
You can accumulate up to 11 points if everything is solved properly.  
The time required for solving the exam is 2h 30 min.

Good Luck!

0. Consider the following image depicting the search tree in an 8-puzzle game:



Draw with three different colours the way the DFS, BFS and the A\* algorithms perform the search in the depicted search space and explain the idea behind each of the three search methods.

1. Compare Hill Climbing and Simulated Annealing, emphasizing how Simulated Annealing improves on Hill Climbing. Illustrations will improve your answer.
2. Describe, using illustrative drawings if needed how a genetic algorithm would try to search for solutions in the search space given in Exercise 0. You must specify:
  - What does a chromosome represent?
  - What is genetic recombination?
  - What is the fitness of a chromosome in this case?
  - What is mutation?

- What is the “survival of the fittest” principle?
3. Can a single perceptron perform binary classification? Justify your answer by describing what a single perceptron does. Use mathematical formulae and drawings to make a more compelling argument.
  4. Give the name of a movie related to a notion from the realm of Machine Learning. Argue what is the message of the chosen movie with respect to recent advancements in Machine Learning.
  5. Compare and contrast the notions of neuron and nervous system from biology and the notions of perceptron and artificial neural networks from machine learning.
  6. Describe the three stages of training a machine learning algorithm :
    - data preprocessing, analysis and understanding
    - training of the algorithm
    - evaluating the performance of the algorithm
  7. What is supervised learning? What is unsupervised learning? What are the two classes of problems from the domain of supervised learning?
  8. Choose one human sense (sight, hearing, smell, taste, touch) and explain the functioning of the deep learning mechanism that tries to mimic its behaviour.
  9. Describe the mechanism of backpropagation in an artificial neural network. Use a small network for exemplification and compute the math (give mathematical formulae) required to explain what backpropagation of errors actually is.
  10. Write a short essay (4 - 5 paragraphs) expressing your opinion on the relationship between the three historic stages of Artificial Intelligence: Classical AI → Machine Learning → Deep Learning.