University of M'sila,
Faculty of Mathematics & Computer Science (CS),
Department of CS.

Course: Diagnosis Methods for Master1 (AI) **Year: 2020-2021**

Duration: 1:30

Final Exam Solution

Q1. (5 points, one point for each definition)

Define the following concepts: Diagnosis, Artificial Intelligence (AI), Fault isolation, SADT, ANN.

Diagnosis: is the identification of the probable cause of the failure (s) using logical reasoning based on a set of information from an inspection, control or a test.
Artificial Intelligence (AI): is well-defined as a stream of science and engineering.
Fault isolation: find the root cause, by isolating the system component(s) whose operation mode is not nominal.
SADT: Structured Analysis and Design Technique is a structured analysis modelling language, which uses two types of diagrams: *activity* models and *data* models.
ANN: Artificial Neural Network is a massively parallel, distributed processor made up of simple processing units (artificial neurons).

Q2. (6 points, one point for each correct choice)

Select one choice from the following:

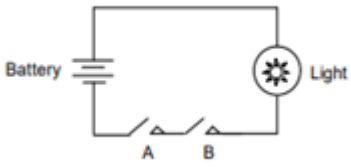
1. SADT means:
    a. Structured Analysis and Design Term
    b. Systematic Analysis and Design Technique
    c. Structured Analysis and Design Technique
    d. None of the mentioned
2. A permanent interruption of a system's ability to perform a require function under specified operating conditions:
    a. Malfunction
    b. Fault
    c. Neuron
    d. Failure
3. Learn the connection weights from a set of training examples:
    a. Activation functions
    b. Learning Algorithms
    c. Fault trees
    d. All of the mentioned
4. Approaches that use an analytic or physical model of the system:
    a. ANN

b. External fault
c. Networking
d. SADT

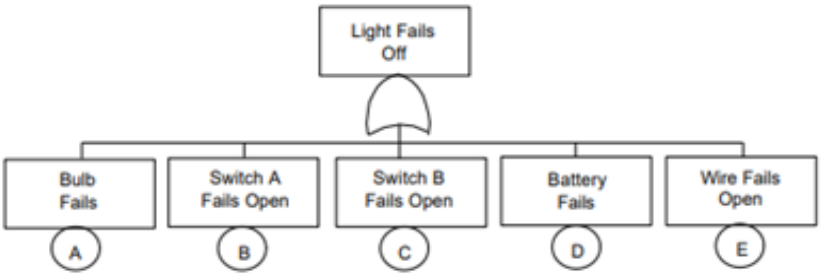
5. A lazy learning algorithm since the processing of the training examples is postponed until making predictions:
   a. KNN
   b. SADT
   c. ANN
   d. Fault tree
6. The diagnostic system must respond quickly to detect and diagnose process failures. This is called:
   a. Separability
   b. Robustness
   c. Adaptability
   d. None of the mentioned

Q3. **(4 points, 0.5 point for each component and 0.5 point for the general design)**

Construct a fault tree for the following system. The light is off if one of the components fails.



The Fault Tree:



Q4. (5 points)

You have the following 4 training examples:

Feature X1	Feature X2	Class
7	7	Bad
7	4	Bad
3	4	Good
1	4	Good

Use K Nearest Neighbors KNN algorithm to classify the new example with feature X1=3 and feature X2=7.

The Euclidean distances between the new example (3, 7) and the training examples are given:

Feature X1	Feature X2	Euclidean distances	Class
7	7	4	Bad
7	4	5	Bad
3	4	3	Good
1	4	3.6	Good

Assume K=3, answer the following questions:

- What are the nearest neighbors of the new example? Explain……..**(2 points)**
  Since K=3, we will select three nearest neighbors based on the short distances. The following examples are the three nearest neighbors of the new example:
  (3, 4)- (1, 4)- (7, 7).
- Find the class of the new example? Explain……**(2 points)**
  Based on the class of each nearest neighbor, we have 2 **Good** and 1 **Bad**. Since 2>1, we conclude that the new example (3, 7) will be classified as **Good**.
- What is the best (optimal) value of k? ……**(1 points)**
  The optimal value of k is the **square root of N,** where N is the total number of samples. K=$\sqrt{N}$=2.