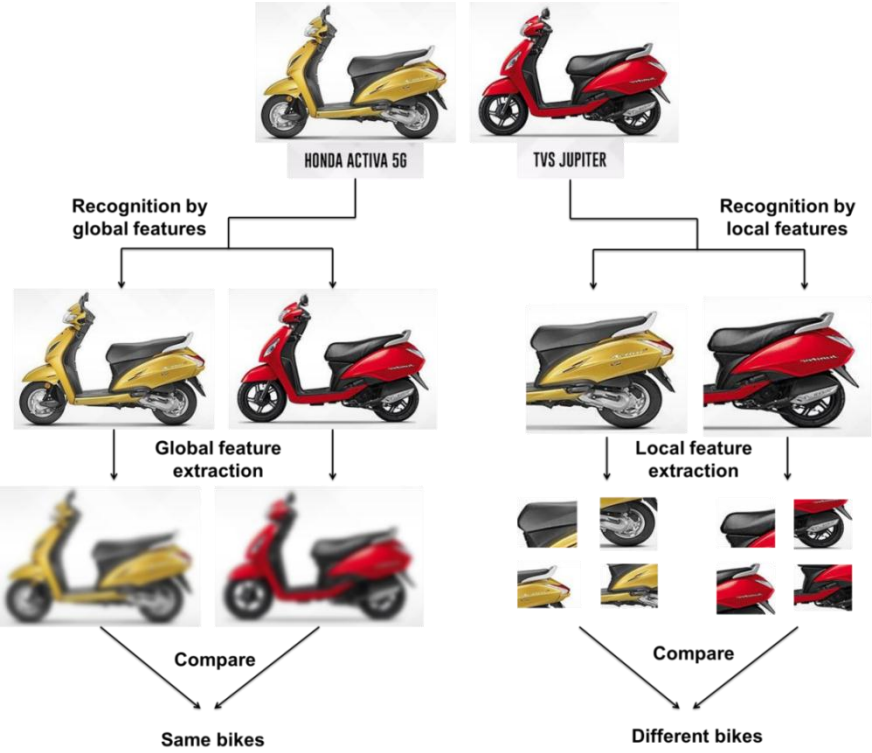
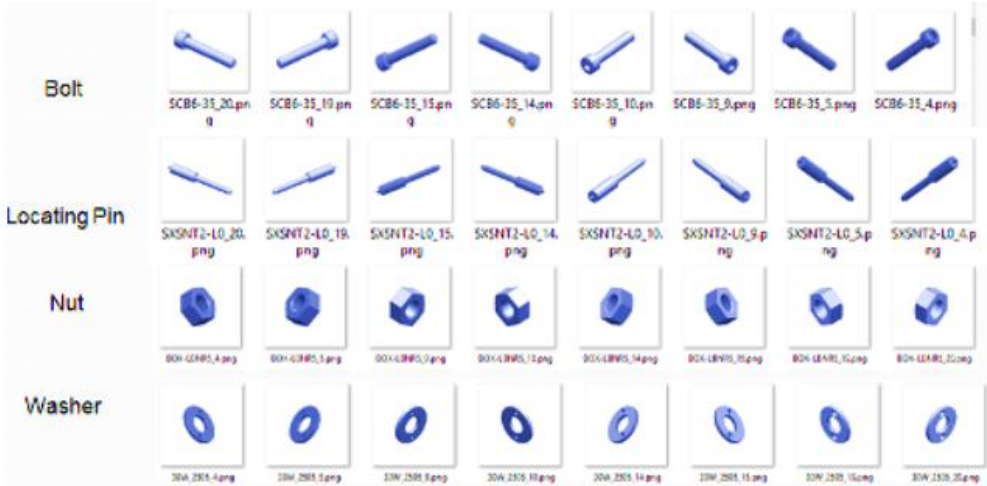
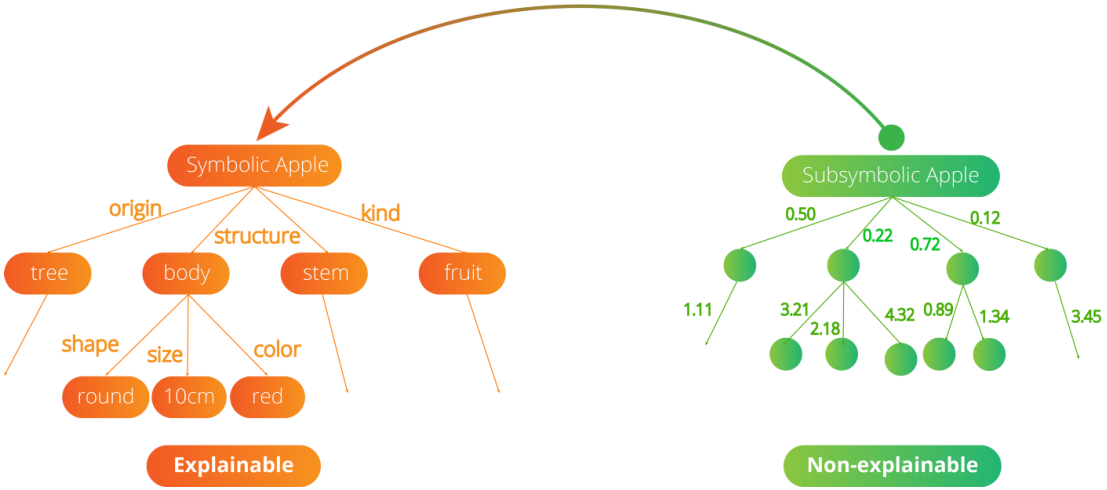
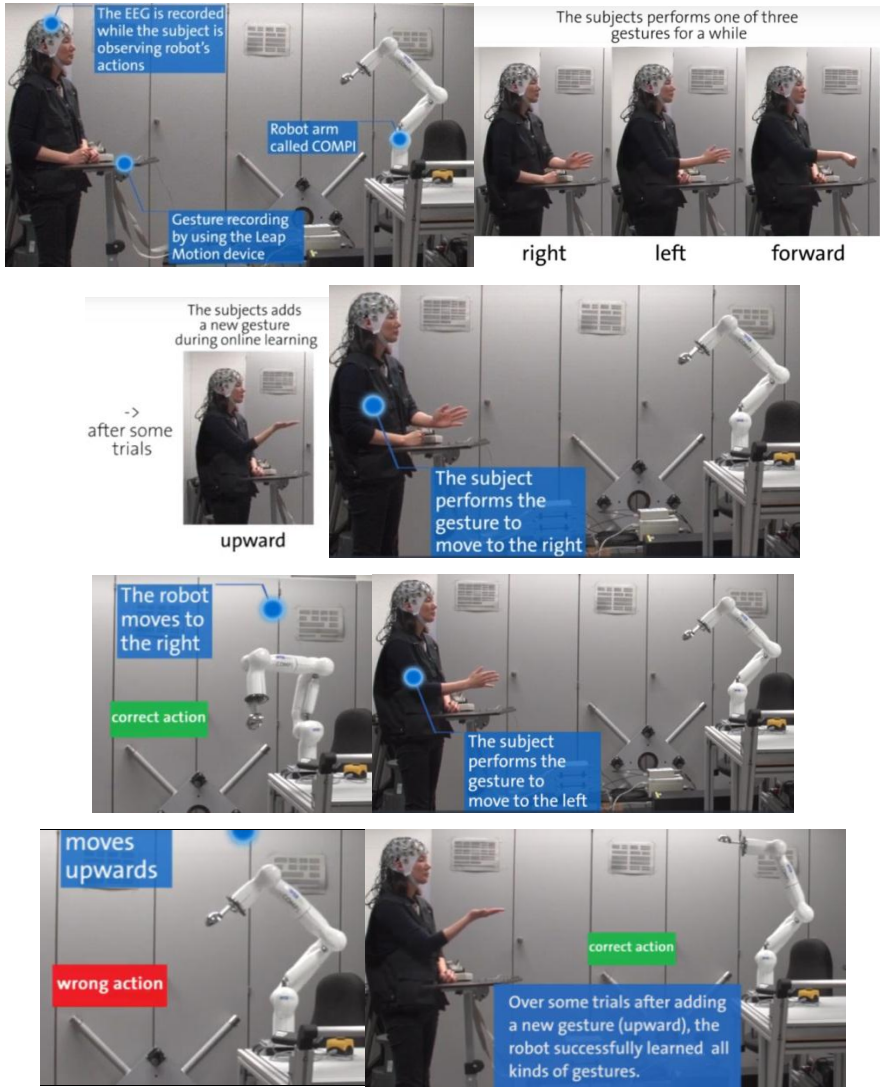
T. E. (Mechanical Engineering) Subject: Artificial Intelligent and Machine Learning

Theoretical approach of examination	Application focused approach of examination
1. Define and explain following terms with respect to example given below. a. Global feature b. Local feature c. High-level feature d. Low-level feature	1. Define and explain following terms with respect to example given below. a. Global feature b. Local feature 
2. Explain supervised and unsupervised machine learning with one example. **OR** write a note on supervised and unsupervised machine learning. Give one example.	2. Suppose you have a several pictures of Nuts, Bolts, Washers and Locating Pins with different orientations. You need to develop an intelligent classification model. Which approach of machine learning will you select – supervised or unsupervised? How? **OR**

	Explain supervised machine learning to deal with classification problem in as shown in picture below. 
3. Explain following approaches to artificial intelligence. a. Symbolic b. Sub-symbolic c. Statistical **OR** write a note on approaches to artificial intelligence such as, a. Symbolic b. Sub-symbolic c. Statistical Give one example.	3. Explain Symbolic & Sub-symbolic approaches to artificial intelligence with respect to following examples. 

4. Explain reinforcement learning with one example. **OR** write a note on reinforcement learning. Give one example.	4. Explain role of reinforcement learning in following example. Identify environment, agent, different actions, reward, punishment etc. Draw its block diagram. 

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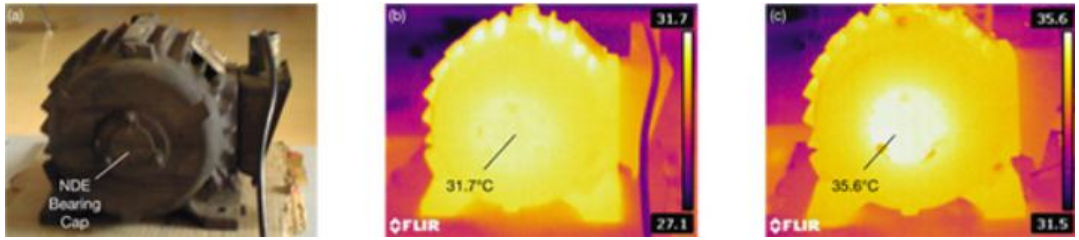
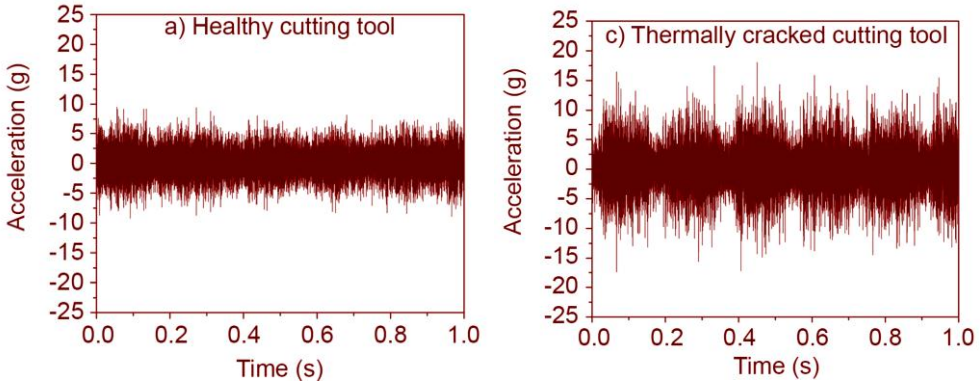
<td>5. List various statistical features and write mathematical expression.
OR
4. What is statistical feature extraction? Explain any 2 features.
OR
4. Explain role of statistical feature extraction in classification problem.</td>
<td>5. Following picture represent an external temperature rise at the non-drive end (NDE) bearing cap of a motor which is detected by comparing normal and abnormal thermographic images.
 

(a) (b) (c)
(a) motor (b) normal thermographic image (c) abnormal thermographic image
In order to develop machine learning based classification model, which features will you extract from these images so as to depict difference between two.

5. Following graphs represent change in vibration signal (in terms of acceleration) with respect to time that depicts 2 conditions i.e. healthy and faulty cutting tool.
 

In order to develop machine learning based classification model, which statistical features will you extract from these vibration plots so as to depict difference between two.</td>
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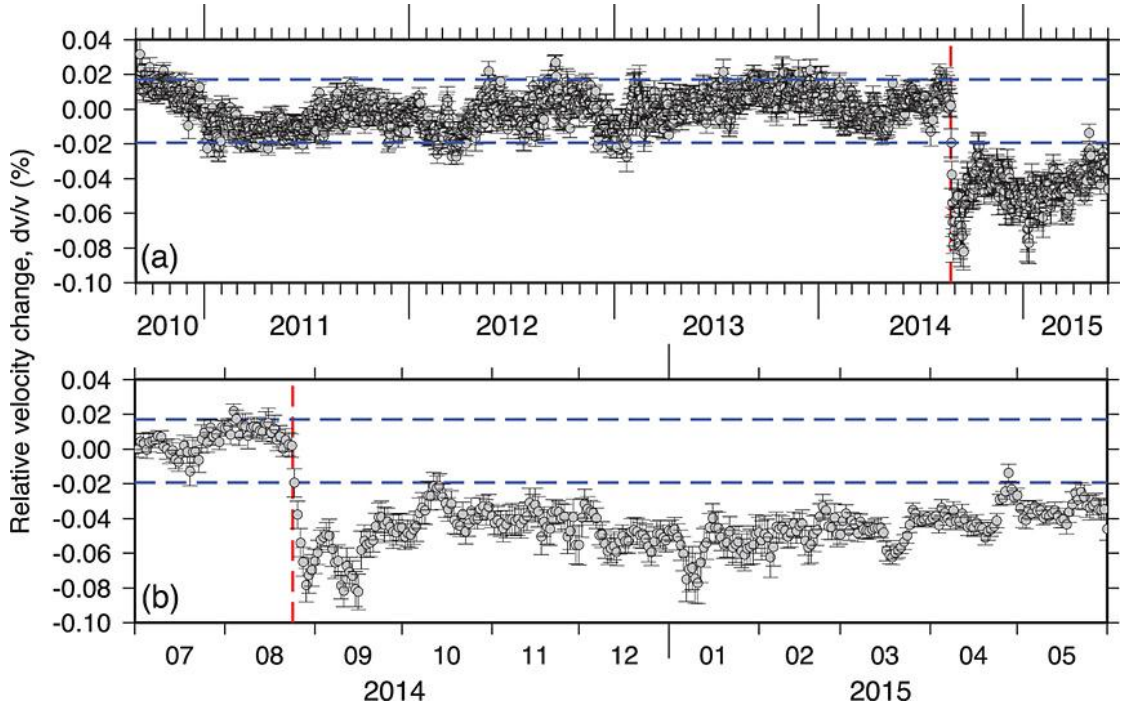
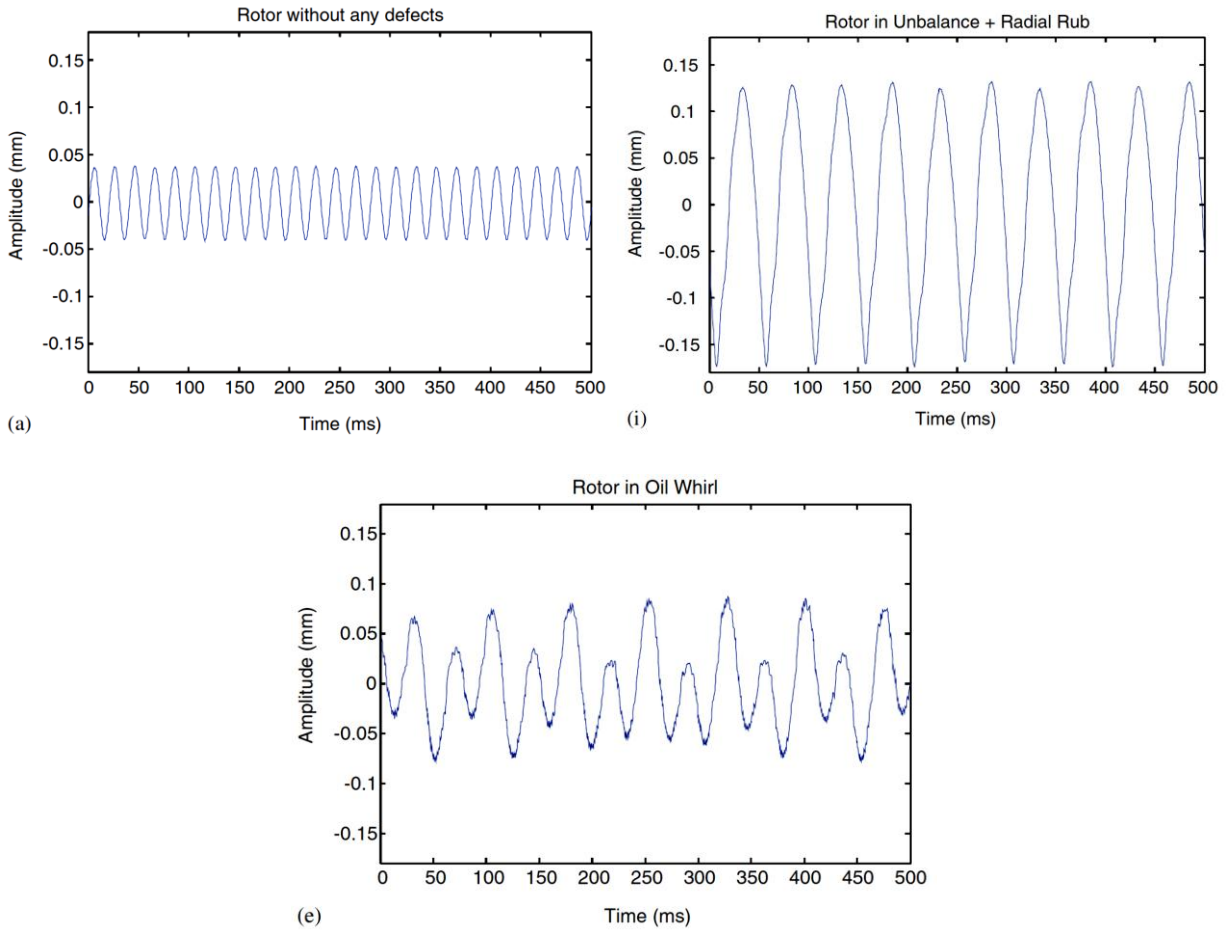
	5. Following figure represent time history of relative velocity change dv/v with two sigma standard deviations for stack of 5 days in the time intervals (a) September 2010 through May 2015 and (b) July 2014 through May 2015. Red dashed line is the occurrence time of the 2014 M_w 6.0 South Napa earthquake. Blue dashed lines indicate the 95th percentile range of dv/v distribution obtained from the time interval 1 September 2010 through 23 August 2014.  In order to develop a machine learning-based prediction model, how do standard deviation and 95th percentile range help?

	5. Following graphs represent change in displacement (in mm) with respect to time that depicts different conditions of rotor.  In order to develop machine learning based classification model, which statistical features will you extract from these vibration plots so as to depict difference between them.

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<td>6. Represent over-fitting, under-fitting and optimum fitting in classification problem pictorially. State one real-life example.</td>
<td>6. In following example, which candidate from A, B, and C would belong to the case of optimum fitting, under-fitting, and over-fitting. Justify your answer.
 
A
Not interested in learning
Class test ~50%
Test ~47%

B
Memorizing the lessons
Class test ~98%
Test ~69%

C
Conceptual Learning
Class test ~92%
Test ~89%</td>
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<td colspan="2">7. Observe the following 3-variate dataset with 10 observations. Each observation consists of 3 features of a fluid flow: viscosity, density, and compressibility.
$$\mathbf{X} = \begin{bmatrix} 7 & 4 & 3 \\ 4 & 1 & 8 \\ 6 & 3 & 5 \\ 8 & 6 & 1 \\ 8 & 5 & 7 \\ 7 & 2 & 9 \\ 5 & 3 & 3 \\ 9 & 5 & 8 \\ 7 & 4 & 5 \\ 8 & 2 & 2 \end{bmatrix}$$</td>
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<tr>
<td colspan="2">8. Consider the two-dimensional fluid flow patterns
(2, 1), (3, 5), (4, 3), (5, 6), (6, 7), (7, 8) Compute the principal component using PCA Algorithm.</td>
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9. Consider the training examples shown in following table below for a binary classification problem.

Instances	α_1	α_2	α_3	Target class (condition of bearing)
1	T	T	1	Cage fault
2	T	T	6	Cage fault
3	T	F	5	Ball fault
4	F	F	4	Cage fault
5	F	T	7	Ball fault
6	F	T	3	Ball fault
7	F	F	8	Ball fault
8	T	F	7	Cage fault
9	F	T	5	Ball fault

a. What are the information gains of α_1 and α_2 relative to these training examples?

b. For α_3 which is a continuous attribute, compute the information gain for every possible split.

c. What is the best split (among α_1, α_2 and α_3) according to the information gain?