**MACHINE LEARNING COMPLETE SYLLABUS**

1. **REVIEW OF LINEAR ALGEBRA:**
   1. **Concept of feature vector representation**
   2. **Norms of vectors**
   3. **Vector and matrix operations**
   4. **Vector space**
   5. **Basis vectors**
   6. **Linear independence**
   7. **Orthogonality**
   8. **Vector sub-spaces,projections**
   9. **Eigenvectors and eigen values**
   10. **Properties of symmetric matrices**
2. **REVIEW OF PROBABILITY THEORY:**
   1. **Basic definitions**
   2. **Independent events**
   3. **Joint probability**
   4. **Marginal probability**
   5. **Conditional probability**
   6. **Sum rule**
   7. **Product rule**
   8. **Bayes theorem**
   9. **Concept of probability distribution**
   10. **Likelihood**
3. **RANDOM PROCESS AND RANDOM VARIABLE:**
   1. **Definitions**
   2. **Continuous and discrete random variables**
   3. **Expectation**
   4. **Variance**
   5. **Covariance**
4. **EVALUATION OF ML MODELS:**
   1. **Test/train/validation split**
   2. **Underfitting**
   3. **Overfitting**
   4. **Generalization**
   5. **Bias vs. Variance**
   6. **Validation curves**
5. **METRICS:**
   1. **Confusion matrix:** [**https://www.youtube.com/watch?v=prWyZhcktn4**](https://www.youtube.com/watch?v=prWyZhcktn4) **,** [**https://www.youtube.com/watch?v=sHHnCmy6q00**](https://www.youtube.com/watch?v=sHHnCmy6q00)
   2. **Accuracy**
   3. **Precision**
   4. **Recall**
   5. **Specificity**
   6. **F1score**
   7. **Precision recall or PR curve:** [**https://www.youtube.com/watch?v=R7zI4PjzIqE**](https://www.youtube.com/watch?v=R7zI4PjzIqE)
   8. **ROC (Receiver operating characteristics) curve**
   9. **PR vs ROC curve:** [**https://www.youtube.com/watch?v=ZNVaqjJGLwg**](https://www.youtube.com/watch?v=ZNVaqjJGLwg)
6. **DECISION TREES**
   1. **ID3 for classification over categorical and real valued features (threshold split in 1-d and threshold split in 2-d)**
   2. **Overfitting: principle of occam’s razor, early stopping, decision tree pruning**
   3. **CART**
   4. **C4.5**
7. **K-NN** [**https://www.youtube.com/watch?v=PNglugooJUQ&list=PLIg1dOXc\_acbdJo-AE5RXpIM\_rvwrerwR&index=12**](https://www.youtube.com/watch?v=PNglugooJUQ&list=PLIg1dOXc_acbdJo-AE5RXpIM_rvwrerwR&index=12)
   1. **Practice solved example:** [**https://www.youtube.com/watch?v=HZT0lxD5h6k**](https://www.youtube.com/watch?v=HZT0lxD5h6k)
   2. **Weighted k-nn**

[**https://www.youtube.com/watch?v=tD2YGm2rbPw**](https://www.youtube.com/watch?v=tD2YGm2rbPw)

[**https://www.youtube.com/watch?v=kCNpLbCUo7g**](https://www.youtube.com/watch?v=kCNpLbCUo7g)

1. **LINEAR REGRESSION** **<https://www.youtube.com/watch?v=PPLop4L2eGk&list=PLLssT5z_DsK-h9vYZkQkYNWcItqhlRJLN> Lecture 2.1 to Lecture 2.7 and Lecture 4.1 to 4.6**
   1. **Least square error**
   2. **Gradient descent optimization**
   3. **Linear regression with normal equation**
2. **LOGISTIC REGRESSION**

[**https://www.youtube.com/watch?v=PPLop4L2eGk&list=PLLssT5z\_DsK-h9vYZkQkYNWcItqhlRJLN**](https://www.youtube.com/watch?v=PPLop4L2eGk&list=PLLssT5z_DsK-h9vYZkQkYNWcItqhlRJLN) **Lecture 6.1 to Lecture 7.4**

1. **NAÏVE BAYES CLASSIFIER**
   1. **Practice solved examples:** [**https://www.youtube.com/watch?v=XzSlEA4ck2I**](https://www.youtube.com/watch?v=XzSlEA4ck2I)
   2. [**https://www.youtube.com/watch?v=z8K-598fqSo**](https://www.youtube.com/watch?v=z8K-598fqSo)
   3. [**https://www.youtube.com/watch?v=fOK9DiKUGYs**](https://www.youtube.com/watch?v=fOK9DiKUGYs)
   4. [**https://www.youtube.com/watch?v=yRl8Yq0M3TY**](https://www.youtube.com/watch?v=yRl8Yq0M3TY)
   5. [**https://www.youtube.com/watch?v=iTqBC8GEZqs**](https://www.youtube.com/watch?v=iTqBC8GEZqs)
   6. [**https://www.youtube.com/watch?v=kufuBE6TJew**](https://www.youtube.com/watch?v=kufuBE6TJew)
2. **FEATURE SELECTION AND FEATURE EXTRACTION**



* 1. [**https://www.youtube.com/watch?v=KTzXVnRlnw4&list=PLJ5C\_6qdAvBGaabKHmVbtryZW9KpICiHC&index=13**](https://www.youtube.com/watch?v=KTzXVnRlnw4&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC&index=13)
  2. [**https://www.youtube.com/watch?v=FwbXHY8KCUw&list=PLJ5C\_6qdAvBGaabKHmVbtryZW9KpICiHC&index=14**](https://www.youtube.com/watch?v=FwbXHY8KCUw&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC&index=14)
  3. **PCA EXAMPLE:** [**https://www.youtube.com/watch?v=Y1evuHZuxa4**](https://www.youtube.com/watch?v=Y1evuHZuxa4)

1. **SUPPORT VECTOR MACHINES**
   1. [**https://www.youtube.com/watch?v=gidJbK1gXmA&list=PLJ5C\_6qdAvBGaabKHmVbtryZW9KpICiHC&index=24**](https://www.youtube.com/watch?v=gidJbK1gXmA&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC&index=24)
   2. [**https://www.youtube.com/watch?v=YOsrYl1JRrc&list=PLJ5C\_6qdAvBGaabKHmVbtryZW9KpICiHC&index=25**](https://www.youtube.com/watch?v=YOsrYl1JRrc&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC&index=25)
   3. [**https://www.youtube.com/watch?v=WLhvjpoCPiY&list=PLJ5C\_6qdAvBGaabKHmVbtryZW9KpICiHC&index=26**](https://www.youtube.com/watch?v=WLhvjpoCPiY&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC&index=26)
   4. [**https://www.youtube.com/watch?v=GcCG0PPV6cg&list=PLJ5C\_6qdAvBGaabKHmVbtryZW9KpICiHC&index=27**](https://www.youtube.com/watch?v=GcCG0PPV6cg&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC&index=27)
   5. [**https://www.youtube.com/watch?v=Z0CtYBPR5sA&list=PLJ5C\_6qdAvBGaabKHmVbtryZW9KpICiHC&index=28**](https://www.youtube.com/watch?v=Z0CtYBPR5sA&list=PLJ5C_6qdAvBGaabKHmVbtryZW9KpICiHC&index=28)
   6. **EXAMPLES:** [**https://www.youtube.com/watch?v=ivPoCcYfFAw**](https://www.youtube.com/watch?v=ivPoCcYfFAw)



* 1. [**https://www.youtube.com/watch?v=03IrkMM4E6M**](https://www.youtube.com/watch?v=03IrkMM4E6M)



1. **UNSUPERVISED K-MEANS CLUSTERING**



* 1. [**https://www.youtube.com/watch?v=xn4UMAZg6qg**](https://www.youtube.com/watch?v=xn4UMAZg6qg)

1. **FUZZY C-MEANS CLUSTERING**



* 1. [**https://www.youtube.com/watch?v=mrdBOKEasTg**](https://www.youtube.com/watch?v=mrdBOKEasTg)

1. **ARTIFICIAL NEURAL NETWORK**
   1. **Perceptron model and learning**



[**https://www.youtube.com/watch?v=du5fyS44DR8&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=35**](https://www.youtube.com/watch?v=du5fyS44DR8&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=35)

[**https://www.youtube.com/watch?v=zmIzNBMsQYQ&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=36**](https://www.youtube.com/watch?v=zmIzNBMsQYQ&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=36)

[**https://www.youtube.com/watch?v=uxmNDNb0u9A&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=37**](https://www.youtube.com/watch?v=uxmNDNb0u9A&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=37)

[**https://www.youtube.com/watch?v=dM\_8Y41EgsY&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=38**](https://www.youtube.com/watch?v=dM_8Y41EgsY&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=38)

* 1. **Perceptron Convergence theorem and limitations**



[**https://www.youtube.com/watch?v=L7u3CesVMHE**](https://www.youtube.com/watch?v=L7u3CesVMHE)

* 1. **Applications of linear perceptron model**
  2. **Fischer’s Linear Discriminant- Linear Discriminant Ananlysis**

[**https://www.youtube.com/watch?v=JpLjNJGNDqk**](https://www.youtube.com/watch?v=JpLjNJGNDqk)

* 1. **Multi layer perceptron**



[**https://www.youtube.com/watch?v=hxpGzAb-pyc**](https://www.youtube.com/watch?v=hxpGzAb-pyc)

* 1. **Error back propogation**

[**https://www.youtube.com/watch?v=T6WLIbOnkvQ**](https://www.youtube.com/watch?v=T6WLIbOnkvQ)

**practice questions**

[**https://www.youtube.com/watch?v=XN5IRqtFhOY&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=44**](https://www.youtube.com/watch?v=XN5IRqtFhOY&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=44)

[**https://www.youtube.com/watch?v=tUoUdOdTkRw&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=45**](https://www.youtube.com/watch?v=tUoUdOdTkRw&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=45)

[**https://www.youtube.com/watch?v=n2L1J5JYgUk&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=46**](https://www.youtube.com/watch?v=n2L1J5JYgUk&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=46)

[**https://www.youtube.com/watch?v=AWhboi1aTxI&list=PL4gu8xQu0\_5JBO1FKRO5p20wc8DprlOgn&index=47**](https://www.youtube.com/watch?v=AWhboi1aTxI&list=PL4gu8xQu0_5JBO1FKRO5p20wc8DprlOgn&index=47)

1. **REINFORCEMENT LEARNING**



[**https://www.youtube.com/watch?v=7QYz-sKKE48**](https://www.youtube.com/watch?v=7QYz-sKKE48)

[**https://www.youtube.com/watch?v=jGfd4XsjGxM**](https://www.youtube.com/watch?v=jGfd4XsjGxM)