CSCI-UA 9473,
Introduction to Machine Learning
Additional questions for the final

December 2018

Part VI: Clustering

29. Give the three main classes of clustering algorithms and describe each class briefly.

30. Explain K-means, K-medoid (detail each step and give the pseudo-code. you can also use a drawing). What are the respective strengths, weaknesses of each approach ?

31. Give four possible initializations for K-means and describe each of them briefly.

32. What are the two main approaches in hierarchical clustering?

33. In Agglomerative clustering, there are three main criteria used to select the two clusters to be merged. List those criteria and characterize each of them in terms of the dissimilarity used.

34. Give one particular example of a divisive clustering algorithm. How are the clusters split in this particular algorithm?

Part VII: Dimensionality reduction and latent variable models

35. Describe Principal Component Analysis. What criterion does the method minimize ? What is the objective of the method (i.e. what do you want the method to return) ? Give an easy way to compute the solution from a matrix $\boldsymbol{X}$ encoding the prototypes.

36. Represent on a simple 2D dataset, the first and second principal directions.

37. What is sparse PCA ? List three applications of this extension.

38. What is ICA? Give 3 applications of this decomposition. Give two possible approaches at computing the decomposition of a signal into independent components.

39. What is a mixture of Gaussian (GMM)? Give the mathematical expression of such model. There are two common mixture models in learning, what are those models?

40. The EM algorithm is an important algorithm to learn the parameters of a GMM. How does this algorithm work?

41. How does K-means compare to the EM algorithm. Give some of the strengths and weaknesses of each method.

Part VIII: Manifolds

42. Manifold learning is useful in numerous applications. List 4 examples of such applications

43. We have studied several manifold learning approaches. Describe 3 methods of your choice and explain how they compute the low dimensional representation of the data.

Part IX: Reinforcement learning

44. In Reinforcement learning, one can make the distinction between two models depending on the feedbacks that the agent receives. What are those models?

45. List the four key elements that define a reinforcement learning method.

46. Explain what is the k-armed bandit problem and give one possible algorithm to get a solution to that problem.