CS 685 Section 1 – Cognitive Computing
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Assignment 1
Due: Tuesday Oct. 24nd by 11:59pm

Note 1: Submit your solution as a PDF to silvestri@cs.uky.edu.

Note 2: This assignment is an individual effort.

Note 3: Answers should be exhaustive and complete.

1- (15pt) Explain the Fourier transform and discuss its advantages and disadvantages in analyzing human activities using accelerometer data.

2- (15pt) Discuss 3 features of your choice that are used in analyzing human activities using accelerometer data

3- (15pt) What are the limitations and the advantages of Naïve Bayesian Classifiers?

4- (15pt) Given a set of examples, several decision trees can be derived that correctly classify them. However not all these trees are useful for the purpose of classification. Discuss what are the desirable properties for a decision tree.

5- (20pt) Consider the following problem. We have a set of activities \( A = \{a_1, \ldots, a_n\} \), each activity \( a_i \) has a starting time \( s_i \) and an end time \( e_i \), and it takes place in the open interval \([s_i, e_i)\). Two activities \( a_i \) and \( a_j \) overlap either if \( s_i \in [s_j, e_j) \) or \( s_j \in [s_i, e_i) \). We want to find the maximum number of activities that do not overlap.
Prove or disprove that:
- This problem can be modeled using an Independent System
- This problem can be modeled using a Matroid

A counter example can be provided to for disproof.

6- (20pt) Consider a set of vectors \( V = \{ v_1, \ldots, v_n \} \), where \( v_i \in \mathbb{R}^n \). Each vector \( v_i \) has a value \( w_i \) and a cost \( c_i \). We want to find the set of linearly independent vectors \( V^* \subseteq V \) that maximizes the sum of the values and have a cost within a budget \( B \). Formally:

\[
\text{argmax}_{U \subseteq V} \sum_{v_i \in U} w_i \text{ s.t. } \sum_{v_i \in U} c_i \leq B
\]

This problem is clearly NP-Hard, due to the easy reduction from Knapsack. However, we can provide a solution with a given approximation bound, how?