



Northeastern University, Khoury College of Computer Science

CS 6220 Data Mining — Assignment 6

Due: March 29, 2023(100 points)

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GitHub repo: [hrcheung/arrhythmia-detection](https://github.com/hrcheung/arrhythmia-detection)
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Your assignment for this week will be to send us a 2-page project proposal. The Google Docs version of this proposal is available [here](#). You can choose the format you want to use, but make sure to include the following information to your document:

1. What problem are you going to be tackling on your project?
2. Why is that an interesting/useful application of data mining?
3. What models/techniques (clustering/classification/etc.) are you envisioning to apply?
4. Where are you going to get the data?

To complete your proposal submission, create your project's repository in your own Github namespace, and upload your provide your URL in Gradescope. For example, my Git handle is kni-neu, and my project repository is:

<https://github.com/kni-neu/project>

You can use my template or any other template that you might find appropriate. (Or, it is acceptable to use no template at all.) An example set of a set of organized proposal sections is shown below.

1 Problem

Make sure you make clear what problem are you going to solve in as concise and unambiguous manner. This section is typically 2-3 sentences.

We are going to develop algorithms and train accurate models for automated arrhythmia detection, helping doctors diagnose and intervene arrhythmia in the earlier stage.

2 Background

This is where you tell us why this solving this problem is important. What will people be able to do once you've solved this problem? How could it conceivably help people? What makes this application of data mining useful?

Arrhythmias are a type of heart rhythm disorder that can have serious consequences, including heart failure, stroke, and sudden cardiac arrest. Accurate and timely diagnosis is critical to ensure appropriate treatment and management of the condition. Automated arrhythmia detection algorithms can help healthcare professionals to diagnose arrhythmias quickly and accurately, even in cases where the condition is asymptomatic. This can lead to earlier arrhythmia diagnosis, intervention, and patient treatment.

3. Approach

Here, you can start detailing some specifics. Be sure to cover: Where are you going to get data? What data mining techniques will you use?

We are using MIT-BIH arrhythmia database from [PhysioNet](#). Initially, a set of 4000 samples is recorded by Boston's Beth Israel Hospital between 1975 and 1979. Each contains ambulatory ECG recordings of duration of 24 hours from mixed population of patients of different ages. From the sample, 23 records are chosen as normal, and 25 records are chosen that clinically proven arrhythmias, across 47 subjects. All 48 half-hour records are thoroughly checked by expert cardiologists, and based on the approvals of the specialist physicians the database is produced. The recording is done at 360 samples/second per channel.

Feature Engineering

We conduct 3-step feature engineering on the raw data. First, we do the data inspection. This database contains two sets of data: annotation and ECG signal, where annotation classify the clinical categories of each fiducial point (heartbeat). Hereby, fiducial points refer the P-wave, QRS complex, and T-wave, includes the corresponding onset, offset, and peak points. Fiducial point can be detected based on polygonal approximation. By meticulously engineering features from the MIT-BIH Arrhythmia Database, we aim to enhance the performance of automated arrhythmia detection algorithms.

Modelling

For modelling part, this problem can be considered as a supervised anomaly detection question. We have the label N denoting normal heart rate and A denoting abnormal data.

Potential models include Support Vector Machine, Decision Tree, Random Forest and Neural Networks. We will start with Random Forest because this model takes advantage of multiple decision trees and it is usually more interpretable, compared to deep learning models. SVM is another valid option because it is easier to visualize the result with hyperplane.

We have considered transfer learning as a stretch step to use knowledge of pre-trained neural model. In transductive transfer learning strategy, the domains of the source and target tasks are not exactly the same but interrelated uses the Transductive Transfer Learning strategy. The learning process can derive similarities between the source and target tasks.