



# Project: Classification of Traditional Iranian Music Dastgahs \*

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## Question 4: Dastgah Classification (60 Points)

### Project Background

Traditional Iranian music is principally divided into two main parts: seven **Dastgahs** (modal systems) and five **Avazes** (derivative modes). A Dastgah is a sequence of musical pitches and a collection of several melodies (Gushehs) that are harmonically related in terms of scale, tuning, and note intervals. The seven Dastgahs in traditional Iranian music are: **Shur, Nava, Mahur, Homayun, Segah, Chahargah, and Rast-Panjgah**.

Relationships exist between different Dastgahs, which can sometimes make identification difficult. For example, distinguishing between the Mahur and Rast-Panjgah Dastgahs can be challenging due to their significant similarities in scale.

A group of students from the Tehran University of Art collected a number of Iranian music pieces, ranging in length from 20 to 600 seconds, along with their corresponding Dastgah labels. They provided this data in the form of an audio dataset to an AI-focused knowledge-based company. In the first step, engineers at this company converted the audio data into a numerical format and then performed feature extraction to create a dataset suitable for artificial intelligence applications.

This dataset is available to you via [this link](#). The encoding for the Dastgahs in this dataset is provided in Table 1.

Table 1: Encoding for the Dastgahs in the dataset's 'dastgah' column.

Code	Dastgah Name
D0	Shur
D1	Segah
D2	Mahur
D3	Homayun
D4	Rast-Panjgah
D5	Nava
D6	Chahargah

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\*Based on a midterm project for the "Introduction To Artificial Intelligence" course (Spring 2025) at [K. N. Toosi University of Technology](#).

## Required Tasks

- a) **Data Preparation and Analysis:** Split the data into at least two sets: **training** and **testing**. Display the class distribution of your training and test sets using a bar chart. Plot the **correlation matrix**. Identify and display the most important features, either through analysis or by using a feature selection algorithm.
- b) **MLP Classification:** Using an **MLP-based classifier**, classify the music Dastgahs. Present the results accurately and completely for each class in the form of a **confusion matrix** (displayed as percentages). Investigate and analyze the difference in results when using two different **activation functions**. (For subsequent parts requiring re-implementation, implementation with one activation function is sufficient).
- c) **Hyperparameter Tuning:** Using methods such as **GridSearch**, optimize and tune at least one hyperparameter of your choice from part (b) as much as possible. You must also utilize **K-Fold Cross Validation** in finding the optimal value for your chosen hyperparameter. (Hyperparameter tuning is only required once for this entire question; you may use the optimized value(s) in subsequent steps).
- d) **Feature Engineering with Autoencoders:** Extract at least one **new feature** from the data. Given the audio nature of the data's origin, what kind of feature did you extract? Next, design an **Autoencoder** and use it as a feature extractor. Repeat part (b) and report and analyze the results. Plot the **training and validation loss** graph for your Autoencoder. Which parts of the autoencoder network did you use for this process, and why?
- e) **Real-World Application:** Assume the song "*Be Sokoot-e Sard-e Zaman*" by Master Shajarian is provided to you, and it has been converted into the numerical data available at [this link](#) using pre-prepared algorithms. Can you create a system to determine the Dastgah of this data using one of the models you trained in the previous sections? Implement this and report the result.
- f) **Conclusion and Future Work:** In your opinion, what are the potential **applications** of this project? What types of models might perform better for this application?

**Bonus Improving Performance:** As bonus points, you can use another classification method (e.g., SVM, Random Forest, CNN) and demonstrate that this new method achieves better results than the MLP.