Working title:

**Automatic Kidney Stone Detection from CT Images using Convolutional Variational Autoencoder-based Representation Learning.**

1. **Target/Goal/Abstract**

This paper investigates the impact of automatic feature learning on the performance of various configurations of Convolutional Neural Network (CNN). Variational autoencoders (VAEs) will be used to learn features from original CT images and a version that has been treated to various distortions and degrading. The main objective of the paper is to investigate how far the algorithm can go in the face of poor-quality input images. It is well-known that the quality of features heavily impacts on the performance of machine learning models and as such poor-quality images should present feature representation challenges to learning algorithms due to inherent noise in the data. Hence, the need to continue to advance the frontiers for the application of automated feature learning.

1. **Introduction**

This section will dwell on the kidney stone burden, the cost of wrong/misdiagnosis, late diagnosis and the dearth of expert renal specialists. It will also give a very strong indication of the challenges faced by existing machine learning methods that have been applied to automatic kidney stone detection. A background to the suitability of the proposed methods will also be succinctly provided as to justify their choice. In effect, this section introduces the problem and objectives of the paper in very concise and clear terms.

1. **Variational Autoencoders**

This section will provide an in-depth discussion on VAEs. The target is to present a lucid, mini-review of VAEs; it should be technically and mathematically sound but so easy to understand for a first-time reader like you. It should comprehensive but not too lengthy.

1. **Representation (Feature) Learning using VAEs:**

This section shall give a very organized description of how VAEs are used for feature learning. Examples of papers that have used it and how they used it shall be given. If there are any issues or challenges with using VAEs for this task, it must be highlighted and possible solution suggested from the literature. This portion must illuminate the task of representation learning by VAEs to the point that you can easily design your own representation learning approach; that which will be experimented and reported in this paper.

1. **Experimental Setup**

This is a critical part of the paper because it demonstrates your contribution to knowledge. It proves that the paper is worth reading and as such publishable. We can individually suggest an architecture and then later combine/harmonize them into one, more comprehensive final architecture for the paper. The architecture is what will be coded and experimented.

1. **Dataset**

This section will provide a description of the dataset and all the treatment that will be given to it. You will almost always see examples of this section in papers. The dataset for our experiments in this paper is a database of CT images from patients who presented for investigation of kidney stone disease at a given hospital. You can take a look at the dataset at <https://github.com/yildirimozal/Kidney_stone_detection/tree/main/Dataset>

1. **Literature Review**

A detailed analysis of the literature to provide context and justification for the research being reported in the paper. Generally, for this paper, literature review should discuss kidney stone disease as a global health burden, the rise and challenges of automated diagnosis using image processing techniques, the application of VAEs for automatic feature learning, and then the novelty in the proposed paper which would naturally become obvious after carefully considering what has been in existence.

1. **Results and Discussion**

Shall present the experimental results in details and analyze same with reference to the literature.

1. **Conclusion**

Recaps what has been presented in the paper

1. **References**

A list of all the sources cited in the paper.

NB:

This paper combines ideas from the following articles, so start with them. Try to understand them well.

1. Yidirim et al, (2021). Deep learning model for automated kidney stone detection using coronal CT images.
2. Zilvan et al (2021). Convolutional variational autoencoder-based feature learning for automatic tea clone recognition.