HW #1: Problem Definition (Term Paper)

Due: Wednesday, Sept 17th, 6:00 PM

Submission: On Canvas

The purpose of this assignment is to help you clearly define the research problem that will guide your term paper. A strong problem definition sets the foundation for your entire project by identifying what you are studying, why it matters, and what research questions you intend to answer. In this stage, you are expected to articulate the problem in form of computational and machine learning analysis of natural surface structures, drawing connections between natural patterns (e.g., leaves, shells, feathers, seeds, insect bodies) and their potential applications in engineering or science.

Your write-up should be concise (no more than 500 words) and structured around the following elements:

1. Clearly explain the central problem you aim to investigate. Describe the specific surface structures or patterns of interest and how data-driven methods (classical machine learning, deep learning, or hybrid approaches) can be applied to analyze them.
2. Define the boundaries of your work. Indicate which datasets, features, or computational approaches you intend to explore. You may focus on traditional algorithms, deep learning techniques (e.g., CNNs, autoencoders), or a combination.
3. Explain why the problem is important. Highlight how analyzing natural surface structures can inspire innovative engineering solutions, improve predictive modeling of material properties, or uncover structural–functional relationships.
4. Formulate clear, answerable research questions that your project will address. These may relate to classification of patterns, prediction of structural properties, clustering of textures, or the evaluation of different algorithmic approaches.

The objective is not to provide results at this stage, but to demonstrate that you have identified a meaningful and original problem supported by initial literature exploration. Use references where appropriate and cite them properly.

Note: Don’t forget to cite references, if you have used any.