# Informatics Class Final Project Assignment: Optimizing Jello Cubes

## Objective:

Teams will apply Bayesian Optimization to determine the optimal water and colorant ratios for jello cubes, aiming to achieve specific deformation under load and desired optical properties. This project emphasizes practical application of informatics concepts through experimental design, data acquisition, and analysis.

## Materials Provided:

* - Jello powder and various food colorings.
* - Water for preparing jello.
* - Molds for casting 1-inch jello cubes (15-spot capacity).
* - Scales for precise measurements.
* - Raspberry Pi with breakout board, equipped with an LED and an AS7341 light sensor.
* - Protective glass slide for LED.
* - Scripts for running experiments (Bayesian Optimization, Sobol sequence, and light measurement).
* - Instructions for setup and measurement in a controlled environment.

## Team Formation and Tasks:

* - Formation of Two Teams: Students will form two teams, each tasked with optimizing the jello cube formulations.
* - Raspberry Pi Setup: Each team is provided a Raspberry Pi setup for conducting light transmission experiments. The LED should be covered with a glass slide to protect the board from the jello. The light sensor will be placed directly on the jello cube, which in turn is centered over the LED.
* - Experimental Environment: Measurements must be taken in a completely dark room or space to ensure accuracy.

## Experimental Procedure:

* - Initial Sampling: Utilize the Sobol sequence to design your initial set of experiments. Prepare jello cubes with varying ratios of water and colorants. Each composition must be tested with three samples to account for variability and measure uncertainty.
* - Measuring Deformation: Ensure each jello cube deforms from 25.4mm to 22.5mm under a specified load, accurately measuring starting and ending heights.
* - Optical Measurement: Conduct light transmission tests using the Raspberry Pi setup. The AS7341 sensor's readings will be analyzed to determine the optical properties of each jello cube.
* - Bayesian Optimization (BO) Runs: After initial testing, apply the BO script to optimize the formulation based on deformation and light transmission data. Teams are allowed to meet and run the BO campaign four times, limiting them to testing 20 different compositions in total.
* - Validation and Final Testing: Use the insights from the BO process to prepare and test new compositions. Validate the optimization by comparing these results with the initial experiments.

## Deliverables:

* The final deliverable for this project will be a PowerPoint presentation. Teams are required to prepare a presentation summarizing their project's objectives, methodology, findings, and insights. This should include a discussion of the experimental design, data analysis, Bayesian Optimization application, and visual documentation (photographs) of the samples. The improvement towards the objectives as a function of iteration number should be included.
* Due the last day of class

## Evaluation Criteria:

* - Effective teamwork and division of tasks.
* - Accuracy in experimental setup and data collection.
* - Application of Bayesian Optimization and analytical reasoning in optimizing jello cube formulations.
* - Quality and clarity of the final report and presentation.

## Additional Instructions:

* Jello Casting and Refrigeration: Once the jello is mixed with water and colorants, it must be immediately poured into the molds and placed in a refrigerator to set. This step is crucial for achieving the desired consistency and structural integrity of the cubes.
* Timing of Measurements: The measurements of both light transmission and deformation under load must be taken exactly 3 hours after casting. This timing ensures uniformity in the jello's setting process and comparability of results across different samples.
* Photography of Samples: At each iteration, teams are required to take photographs of each of the five samples to document the visual appearance and coloration of the jello cubes. These photographs should be included in the final report to support the analysis and findings.