In this exercise we will add noise to the GI simulation and use compressive sensing for the reconstruction.

1. Add Noise to the Simulation

In ghost imaging experiments, two primary types of noise typically affect the measurements:

- **Shot Noise**: This noise results from the quantized nature of light and can be modelled using Poisson statistics. In simulation, you can use `numpy.random.poisson` to apply this type of noise to the beam. Instead of using a uniform intensity matrix, generate Poisson-distributed intensities.
- **Thermal Noise**: Originating from the detector, this noise can be simulated using Gaussian distributions. Use `numpy.random.normal` to add thermal noise to the measurements.

A noisy bucket measurement incorporating both types of noise can be modeled as: `buckets = numpy.random.poisson(lambda_param) * masks * object + numpy.random.normal(mu, sigma)`

- `lambda_param`: Mean intensity of the beam
- `mu`: Mean of thermal noise
- `sigma`: Standard deviation of thermal noise

Task: Add noise to your simulation and examine how varying `lambda_param`, `mu`, and `sigma` affects the reconstruction quality.

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2. Explore Object Properties and Their Effects on Reconstruction

- **Object Shape and Size**: Modify the spatial dimensions of the object and assess the impact on the reconstruction.
- **Object Contrast**: Change the contrast between features in the object (e.g., setting pixel values to 0.9 and 1) and observe how it affects the clarity and accuracy of the reconstructed image.

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3. Experiment with Mask Contrast

- Adjust the contrast levels of the light patterns (`ref`) and analyze their influence on the reconstruction process.

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4. Test Different Reconstruction Methods

Compare different approaches for reconstructing the object from the test data:

- **Pseudoinverse Reconstruction**
  numpy.linalg.pinv
- **Least Squares Optimization**
  scipy.optimize.least_squares
- **Total Variation Regularization**
  TV Regularization Example

Task: Compare the reconstructed results using each method, and evaluate performance based on reconstruction accuracy and robustness to noise.

Good luck!