A simple simulation of the ghost imaging process can be done as follows:

1. **Create a 2D matrix representing the object.**
   For example, let the object have dimensions of 100×200 pixels. We'll refer to this matrix as `obj`.
2. **Create a 3D matrix representing the different light patterns.**
   For instance, use a set of 2D random matrices. The dimensions should be 100×200×N, where **N** is the number of realizations (i.e., the number of light patterns). We'll refer to this as `ref`.
3. **Create the test measurements.**
   Multiply each 2D light pattern by the `obj` matrix and sum the result to obtain the total transmitted intensity. This should produce a vector of length **N**.
4. **Reconstruct the object using covariance.**
   A simple reconstruction can be achieved by computing the covariance:

   `rec = cov(ref, test) = ⟨ref * test⟩ − ⟨ref⟩ * ⟨test⟩`[1]

   where ⟨X⟩ denotes the mean value of X (taken across the realizations).

Suggestions for further exploration:

To begin, write a basic simulation and explore how the following parameters affect the reconstruction quality. You may consider plotting the Signal-to-Noise Ratio (SNR) as a function of:

- The number of realizations (**N**)
- The object's dimensions
- The size/scale of the noise features in `ref` (this one is slightly trickier)

Later, you can introduce noise into the simulation and observe its effect on the reconstruction.

Good luck!

[1] See here: https://doi.org/10.1364/OE.20.016892