For this laboratory, a plot and a GIF were created to demonstrate the relation between the surface brightness fluctuations and the distance of a galaxy. The goal of the plot was to prove that there is an almost perfect proportional relation between the inverse of the distance and the relative variance of the measured flux. To do so, 3 functions were created. The first one creates random star positions in a 2d coordinate system distributed on an assigned number of squared pixels. The second function takes the random positions of the stars and sort them in an 2d histogram (2d array) containing the bin information: how many stars there is per bin. To add complexity and make the simulation more realistic, these functions weight the flux of each stars by giving random gaussian distributed brightnesses to each star. Finally, the third function computes the standard deviation of the flux, i.e. the relative difference between the number of stars (weighted with their brightness) of each defined square pixels. The distance is defined as the square root of the distance by geometric calculations available in the PDF file present in the directory. Each of those functions were run in a loop with different fluxes and distances, generated by an increasing number of stars. The inverse of the distance over the flux variance was then plotted with all the data, and a linear fit was provided for comparison.

In addition, for part of the bonus, a 2d colored histogram plot, with the stars, their brightness, and their positions, was created with the data provided by the histogram. The histogram corresponding to each distance were saved, and a GIF was made with the plot of all increasing distances. This brings a nice simulation of how this surface brightness fluctuations looks like as the distance increase.

Finally, to make the code more realistic, the number of pixels could be increased. Ideally the flux of each stars would be measured. Also, some assumptions were made, making the code less realistic. It was approximated that all stars are being equally far away in a galaxy. Also, that there was a complete random distribution in the star position within a galaxy, that the surface density within a galaxy is constant. Making a code taking into considerations those factors would make the whole thing more realistic. For example, adding a surface density function for stars (instead of true randomness) based on observations would be a good step.

Also, using real data as reference to calibrate our simulation would make it far more realistic. This could include not only real star positions, but real fluxes measurements.