Bio-image analysis with Python

Dataset download and description:

You find the raw image data with additional information here: https://data.broadinstitute.org/bbbc/BBBC013/

Image analysis:

Measure nuclear transport by calculating the ratio of: "**mean intensity FKHR-GFP in cytoplasm region" and "mean intensity FKHRGFP in nucleus region"** for each cell.

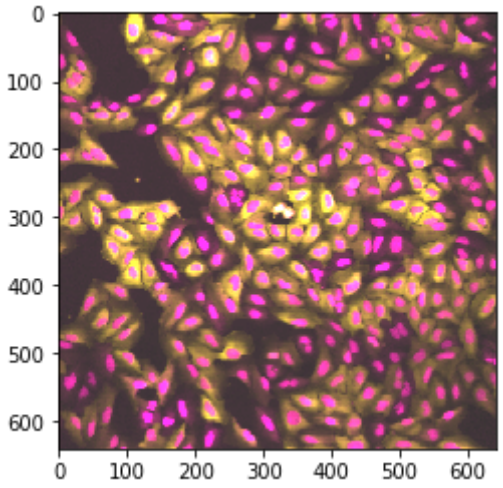
Image processing:

In this section, at first importing all images to numpy array. Please note in this project we have a set of images which gathered by two channels: the channel 1 shows the whole cells membrane while in channel 2 we can just see the exact location of nucleus in each cell.

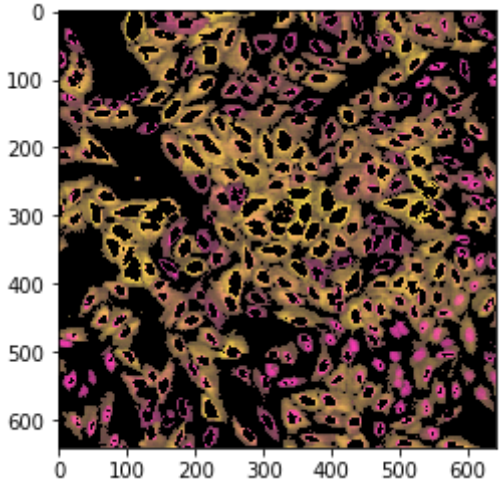
In this project, we aim to distinguish the nucleus region and cytoplasm region in each cell. For achieving this goal:

1- Making colorful two image of each cell.
2- Overlapping two images
3- Extracting the nucleus and cytoplasm region of each cell in overlapped images by color threshold.

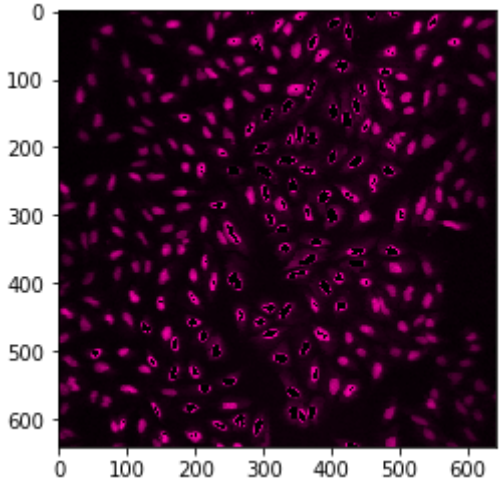
In the below you see two images of an overlapped image that nicely specified the cytoplasm region and nucleus region in each cell:



Overlapped image



Cytoplasm region of each cell



Nucleus region of each cell

Aggregation and descriptive data analysis

For plotting dose-response curve for each drug, we aggregated all nuclear transport for each dose in each drug and plot the result.

Statistics:

Z- factor:

For answering to this question that dose each drug (Wortmanin and LY2) has significant effect on nuclear transport, we used the Z-factor parameter. The Z'-factor was calculated either combining both drugs as positive controls, and also for each of the two drugs separately.

The Z-factor is defined in terms of four parameters: the means and standard deviation of both the positive (p) and negative (n) controls :

$$\text{Z-factor} = 1 - \frac{3(\sigma_p + \sigma_n)}{|\mu_p - \mu_n|}$$

Statistical hypothesis test:

For answering to this question that if Wortmanin and LY2 of effects on nuclear transport are significantly different with each other, we used there statistical hypothesis test as below:

1- **Student's t-test**

Tests whether the means of two independent samples are significantly different.

2- **Analysis of Variance Test (ANOVA)**

ANOVA is another widely popular test which is used to test how independent two samples are of each other.

3- **Pearson's Correlation Coefficient**

A statistical test for checking correlation between two samples and whether they have a linear relationship.