Image Processing 2

+ machine learning!

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OUTLINE

- Segmentation (clustering)
- Cell segmentation (random forest)

IMAGE PROCESSING: CHAGAS

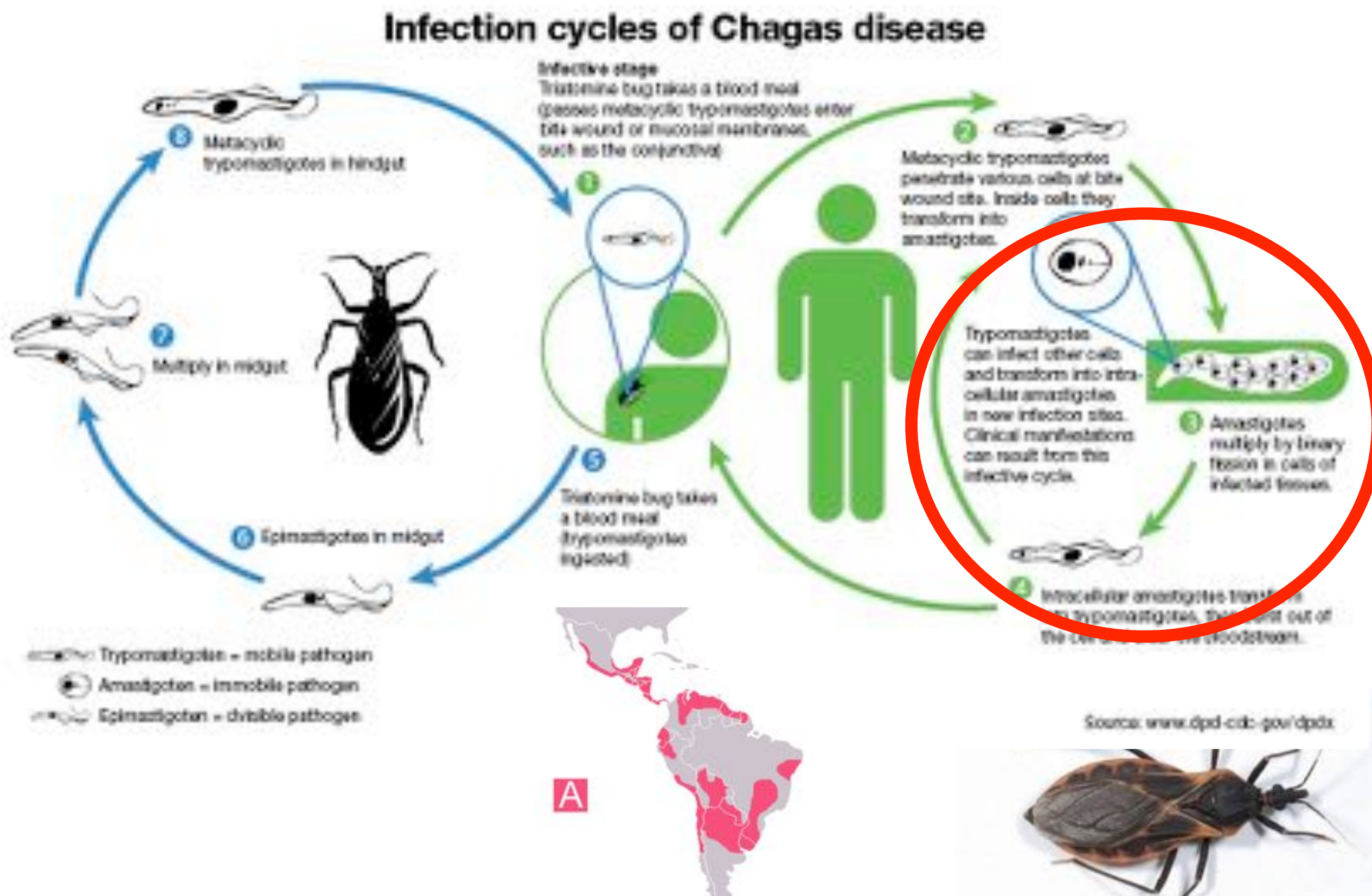
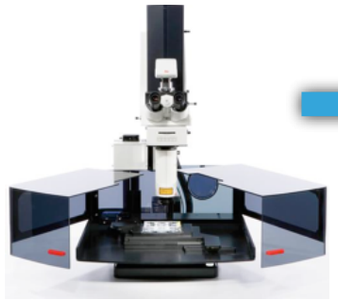


IMAGE PROCESSING: PARASITES



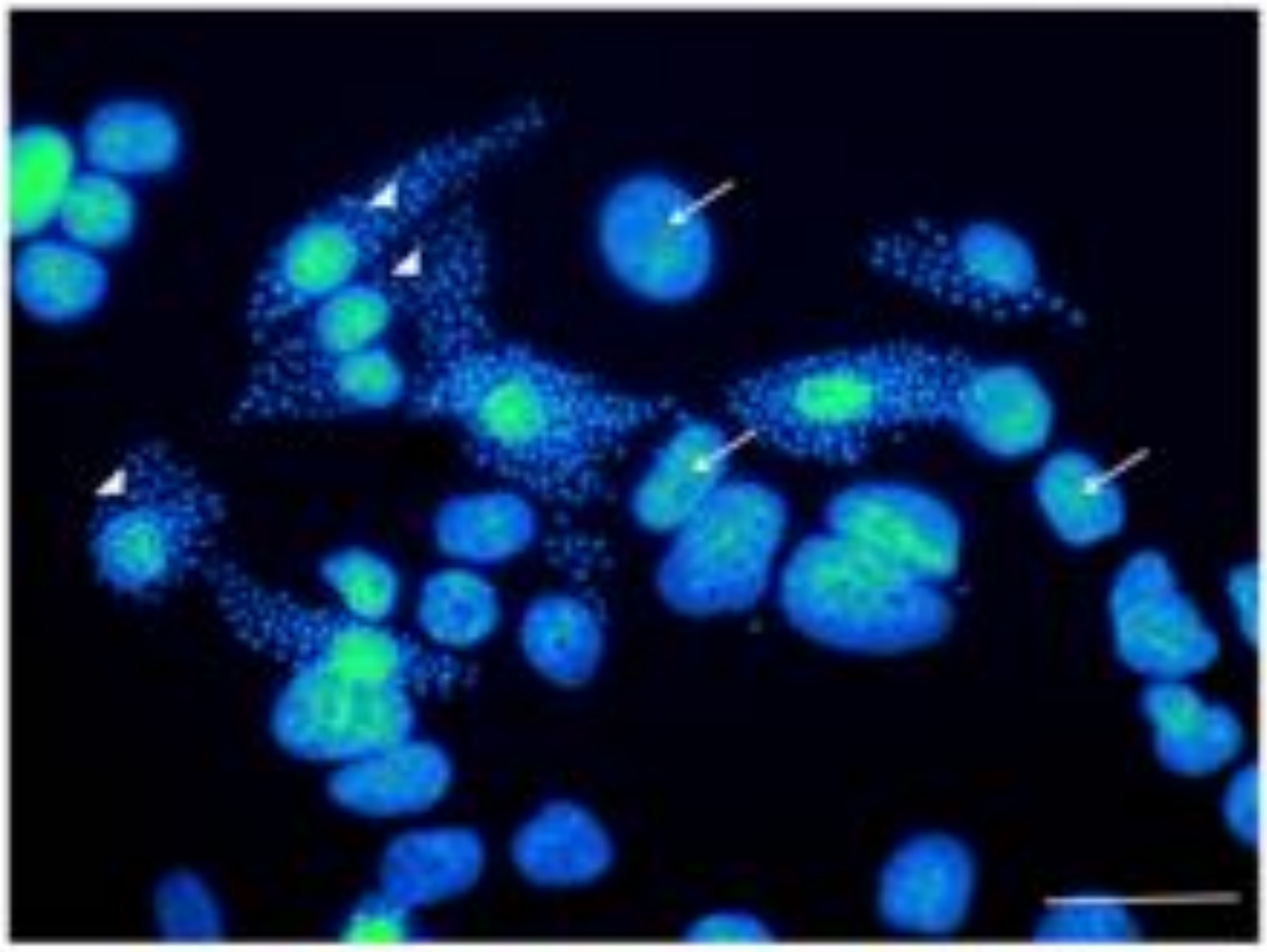
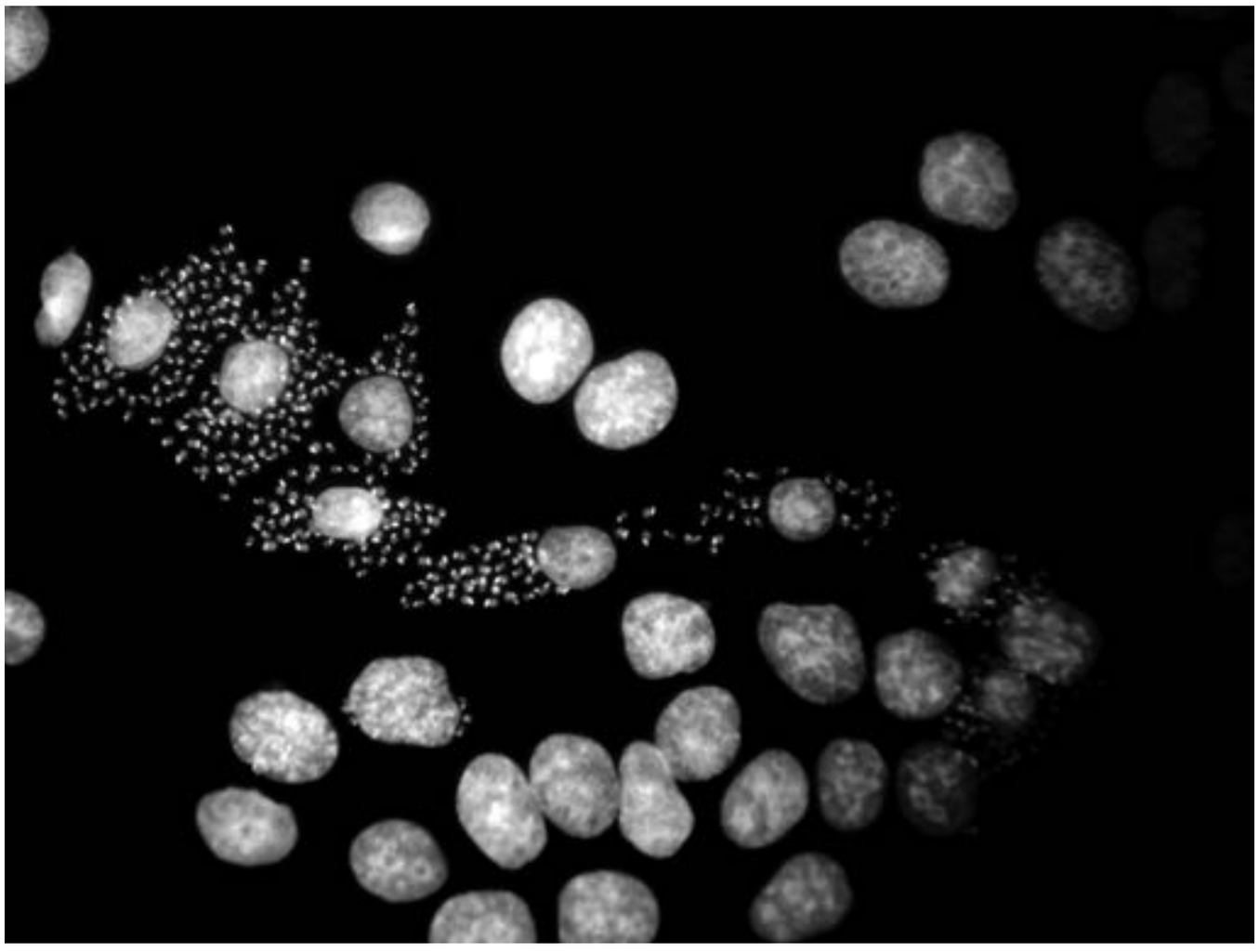


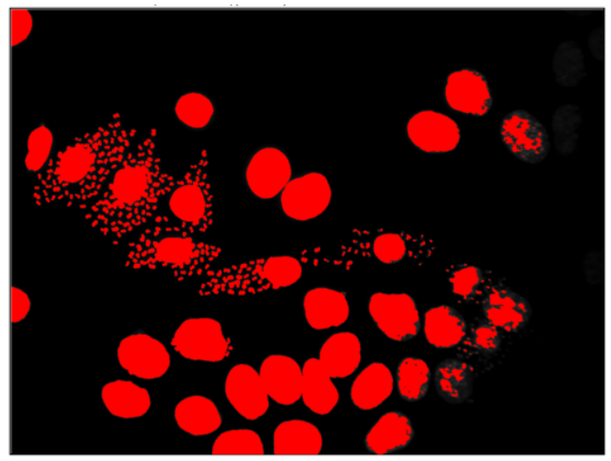
Fig. 1. Infection of BeWo cells with *T. cruzi* amastigotes. BeWo cells were challenged with *T. cruzi* Ypsilon strain trypomastigotes at a parasite:cell ratio of 1:1 for 24 h and were processed for DAPI staining after 48 h. The arrows show BeWo cell nuclei, and the arrowheads show intracellular amastigotes. Scale bar: 10 µm.

- Pregnancy?

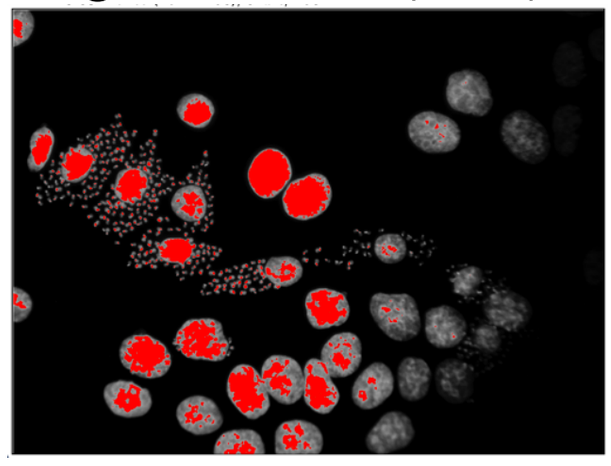
- The simplest segmentation… a manual global threshold



raw image

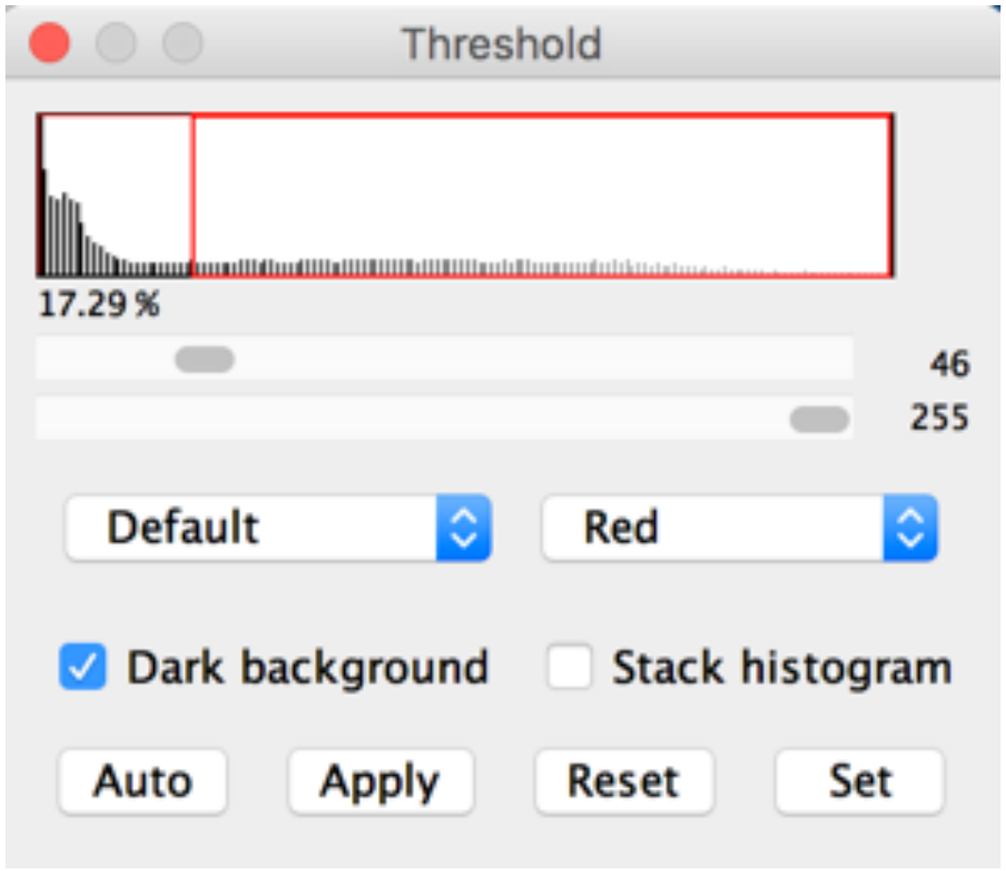


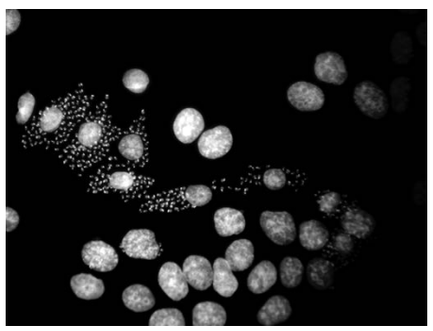
segmentation (>46)



segmentation (>158)

- How to define the threshold ? ...





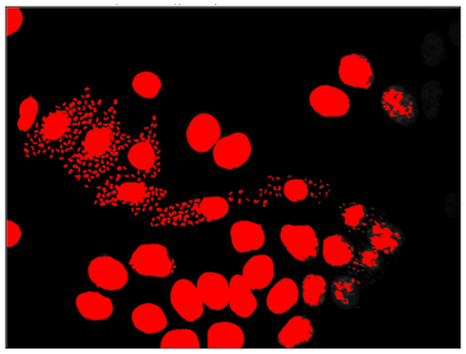


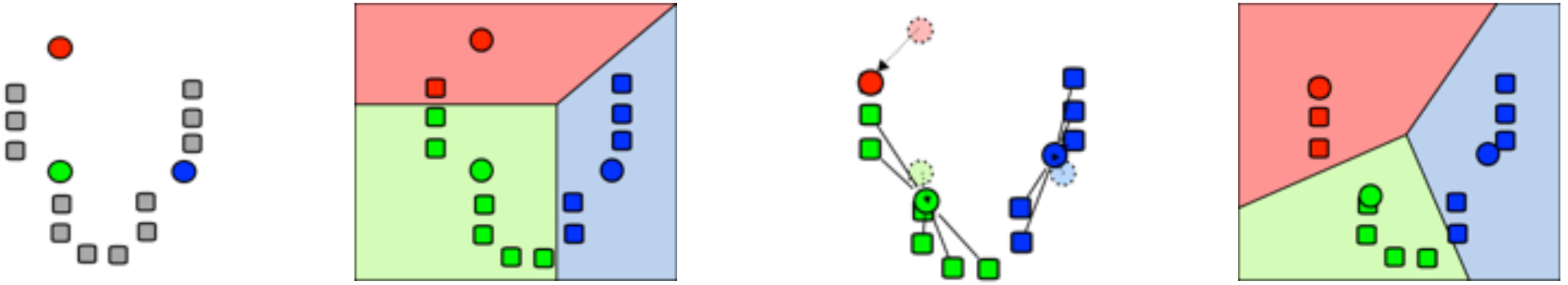
IMAGE SEGMENTATION

- We don't have examples (!)
- We know there are two groups (or three?): cells, and background.

- This is another kind of learning problem:
  - Supervised: regression, classification
  - Unsupervised: **clustering**

IMAGE SEGMENTATION: UNSUPERVISED APPROACH

- We can model it as how to discover the best k groups or clusters at a pixel level.
- K-means clustering (k=3):



Random centroids

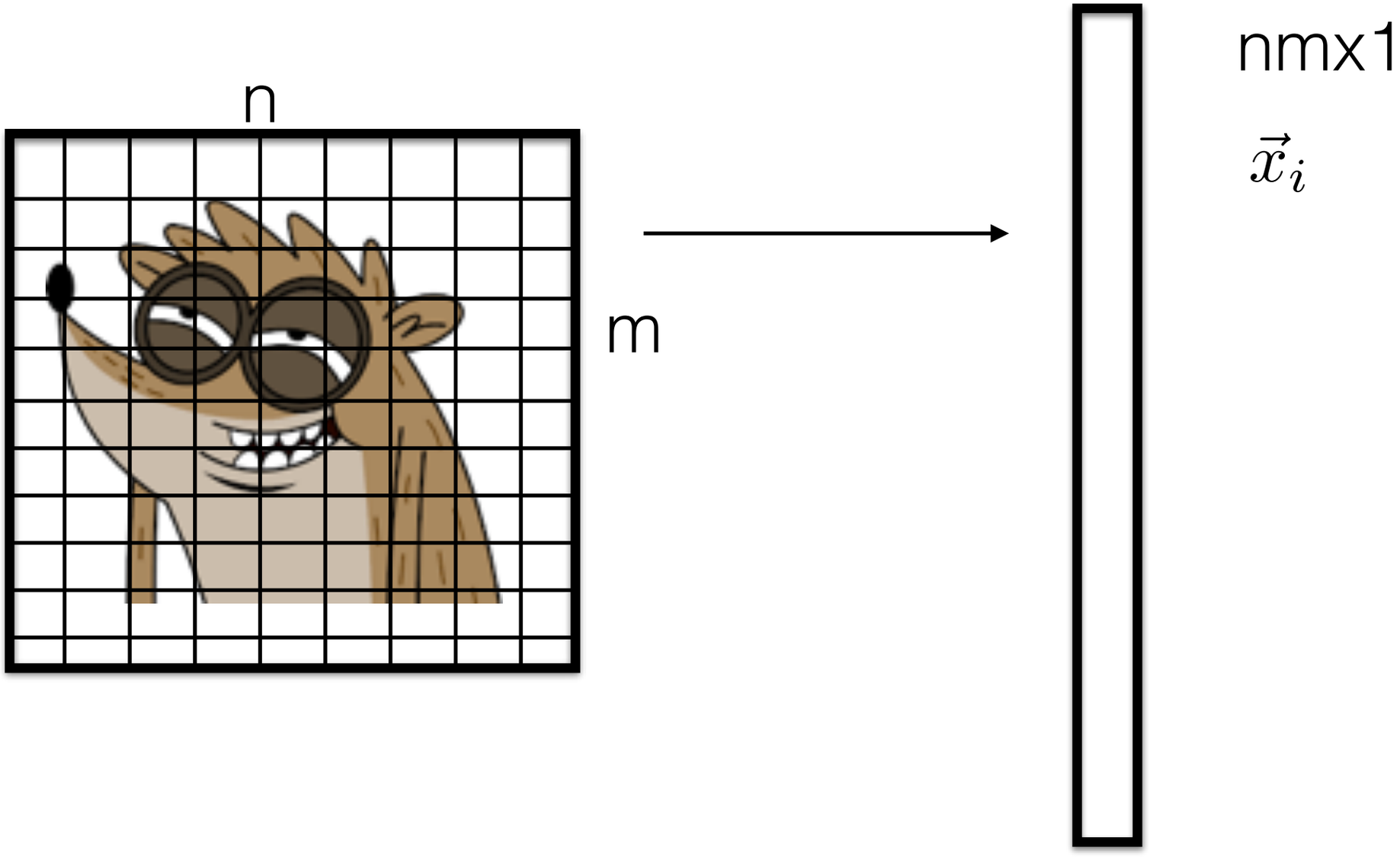
clusters assignation + voronoi diagram

centroids re-computation

cluster assignation + voronoi diagram

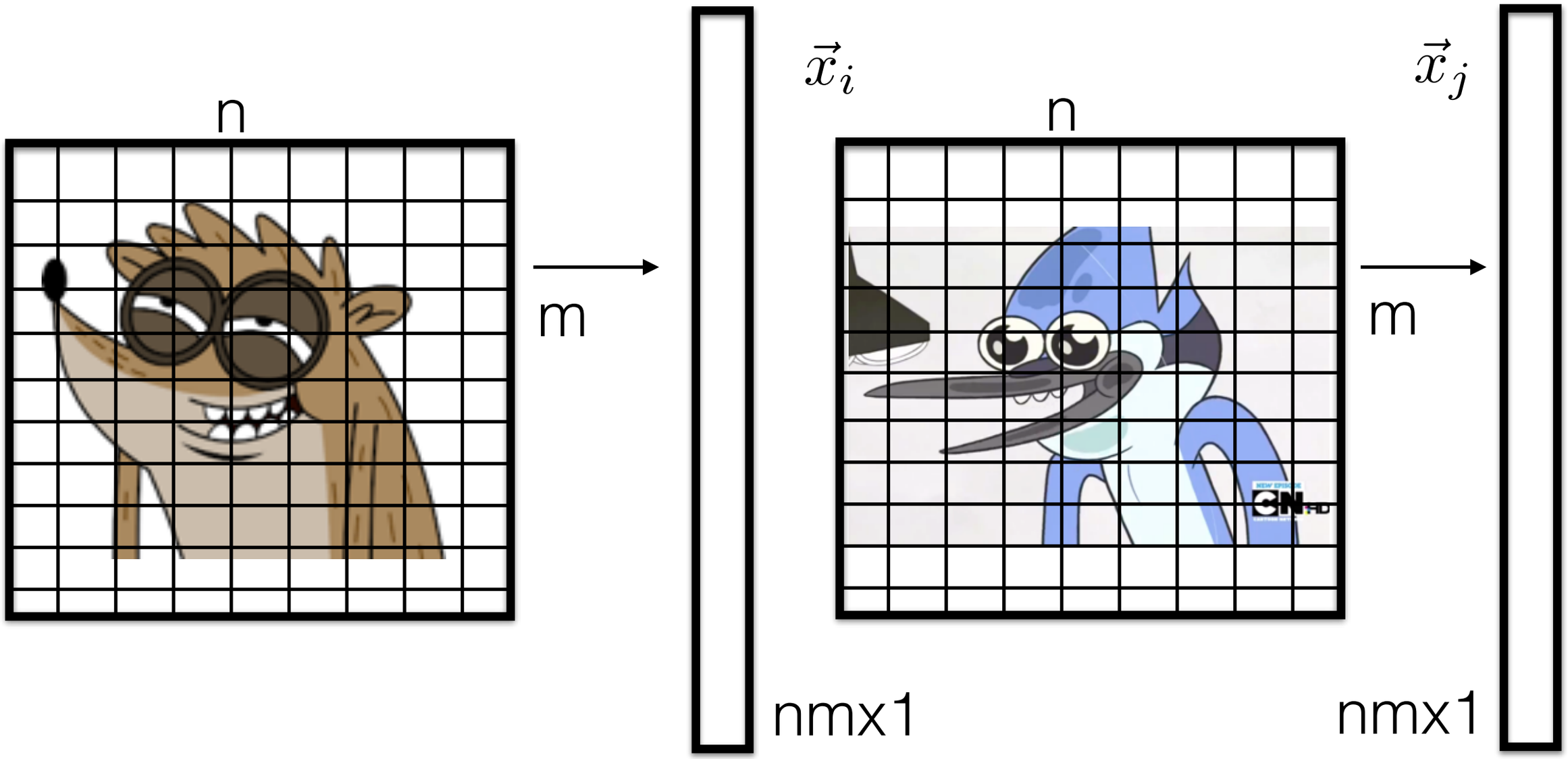
- **EXERCISE: Use K-Mean code [python notebook]**

- How to understand an image in high dimension?



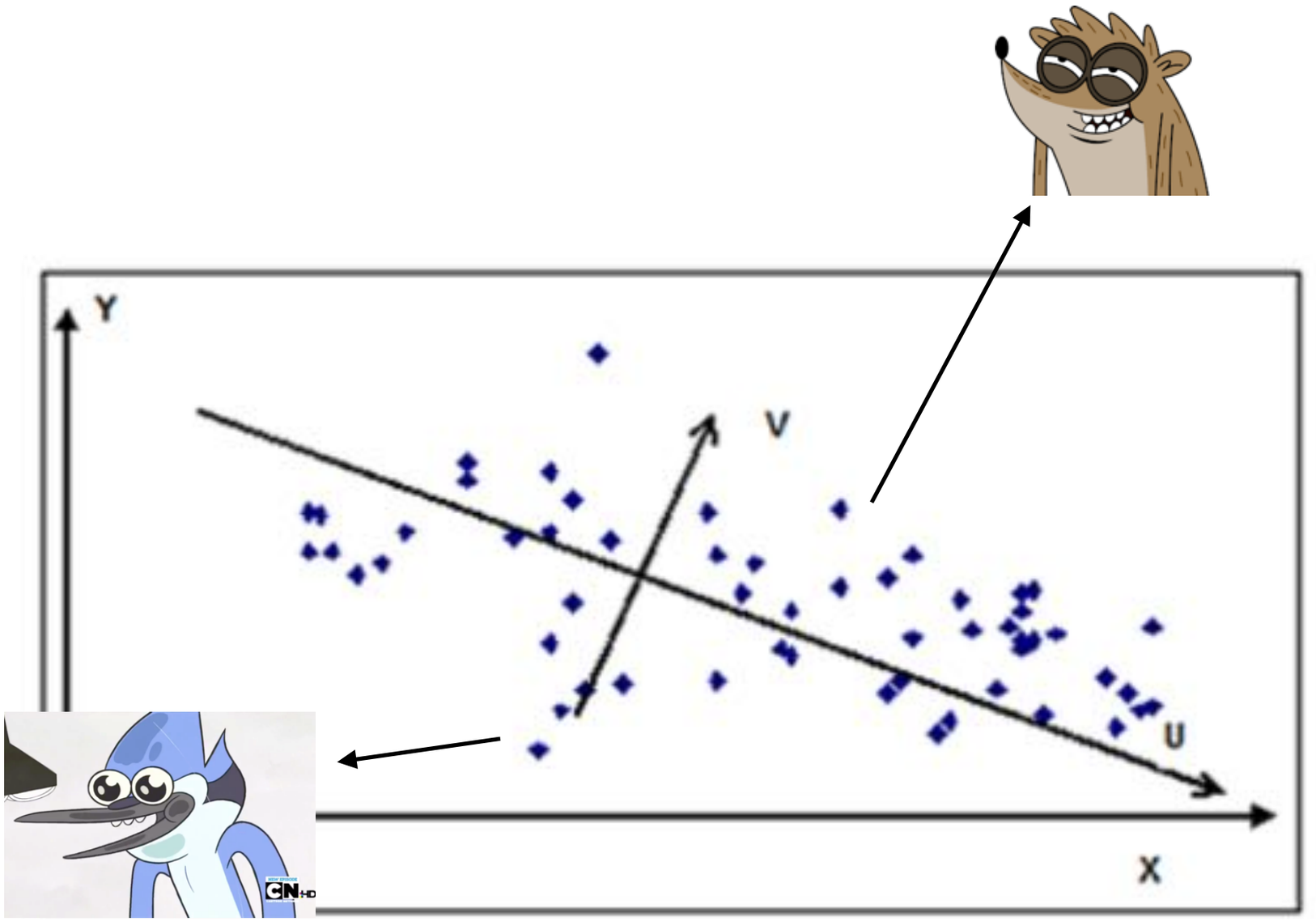
SHAPE DESCRIPTION: HIGH DIMENSION?

- For 2D images, we now have a nm size vector per image

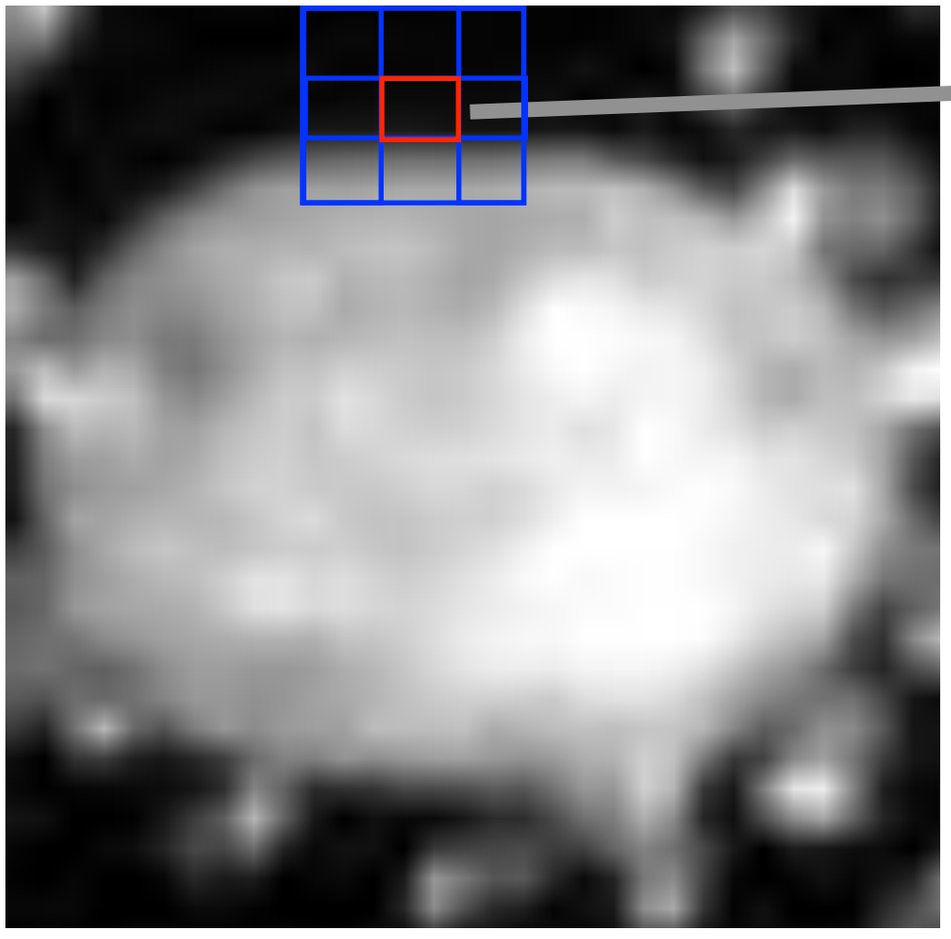


SHAPE DESCRIPTION: HIGH DIMENSION?

- Now, each image is a point in your feature space.



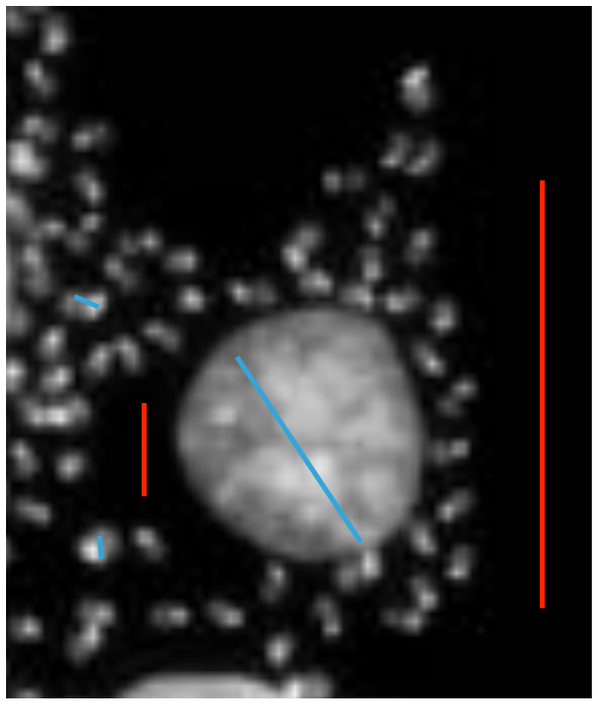
- But, we can understand images in **HIGHER** dimensions.



- Intensity (0)
- Variance 3x3
- Mean 3x3
- Sobel 3x3
- (any convolution)
- Others

IMAGE SEGMENTATION: SUMMARY

- We can quickly build examples.
- Switch from unsupervised to supervised problem.



- Class A (background)
- Class B (objects)

- **EXERCISE: Use weka to train a random forest to segment nuclei + parasites.**