

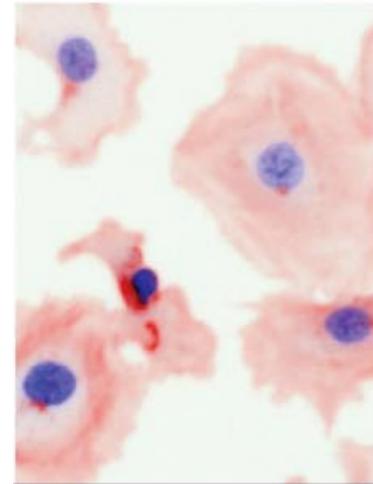
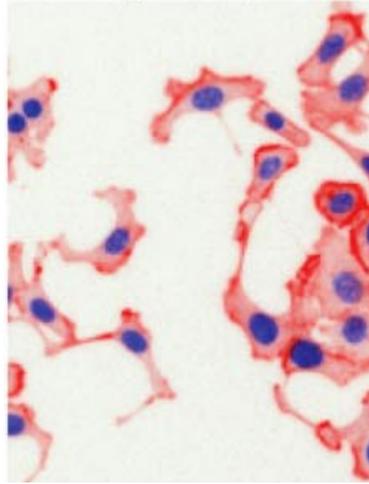
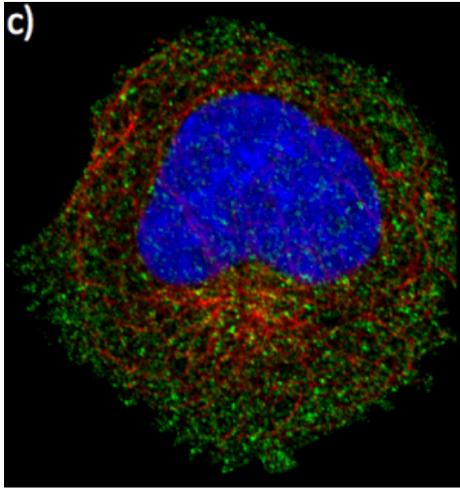
# Introduction: Machine learning on microscopy images

CS/CME/Biophys/BMI 371

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# Structure of a cell vs. structure of a protein



- The structure of a protein can be specified by listing the spatial coordinates of each atom
  - The atoms move relative to one another, but by a limited amount
- In a cell, many of the molecules can move from one side of the cell to another
  - We could specify the position of every molecule, but that will vary substantially from one point in time to another (for a given cell) or between genetically and functionally identical cells
- Instead, we want a *statistical* description
- “Machine learning” = statistics

# Classifiers vs. generative models

- Classifier (Discriminative):
  - Given a person's height, tell me their sex (i.e., whether they're male or female)
  - Given an image, tell me which cell type it corresponds to
- Generative model:
  - Given a person's sex, generate samples of their possible heights, from the right probability distribution
  - Given a cell type, generate images that might match what you'd observe under the microscope
- One of the papers for Monday's class does classification, and one creates generative models (for different types of proteins)

# Tracking cells over time

- The third paper presents a method to track cells in videos
- The problem is complicated by the facts that:
  - They want to track cell *lineages*, meaning they have to keep track of which cells divide into which other cells
  - The density of cells in the images can be very high
- They use machine learning (classifiers) in a couple different ways
  - Classifying background objects
  - Predicting cell types

# Background

- Fluorescence microscopy
  - Slides from CS 279: <http://web.stanford.edu/class/cs279/lectures/lecture11.pdf>
  - Review paper: <http://www.nature.com/nmeth/journal/v2/n12/pdf/nmeth817.pdf>
- Generative vs. discriminative machine learning algorithms
  - <http://stackoverflow.com/questions/879432/what-is-the-difference-between-a-generative-and-discriminative-algorithm>