



COMPUTER VISION

Dani Ushizima, Ph.D.

Staff Scientist, CRD, LBNL

Data Scientist, BIDS, UC Berkeley

Affiliate Faculty, BCHSI, UC San Francisco



BERKELEY LAB
Bringing Science Solutions to the World

OUTLINE

1. Berkeley Lab
2. Computer Vision
 - ❖ Definition
 - ❖ Applications
3. Getting Started

<http://bit.ly/techwomen2021>

Bringing Science Solutions to the World



LAWRENCE BERKELEY NATIONAL LABORATORY

Berkeley Lab fosters the groundbreaking fundamental science that brings transformational solutions to the world's most urgent energy and environmental challenges and a greater understanding of the universe.



BERKELEY LAB

Bringing Science Solutions to the World

TECHWOMEN



BERKELEY LAB
Bringing Science Solutions to the World



4

COMPUTER VISION

COMPUTER VISION

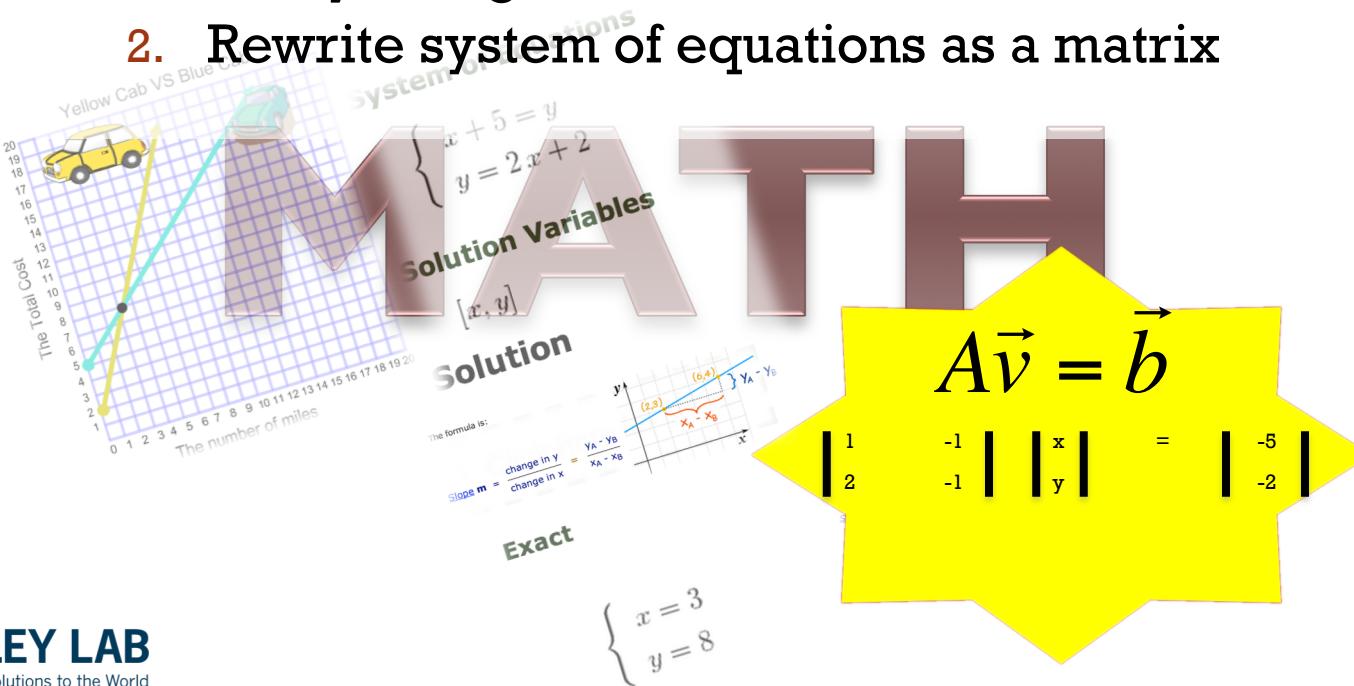
- **Goal:** use of mathematical methods to extract information from digital images.
 - Examples: counting people, finding faces, detecting cancer cells, evaluating quality of batteries, discovering new materials;
- **Def.1.** science area focused on automating and integrating a wide range of algorithms and representations for vision perception, e.g. image processing and statistical pattern classification [Ballard and Brown 82]
- **Def.2.** Machine learning for pictures



WHAT VISION



1. Can you organize data in a **matrix**?
2. Rewrite system of equations as a matrix





WHATEVER IS YOUR
CHOICE

Images will be there with
you

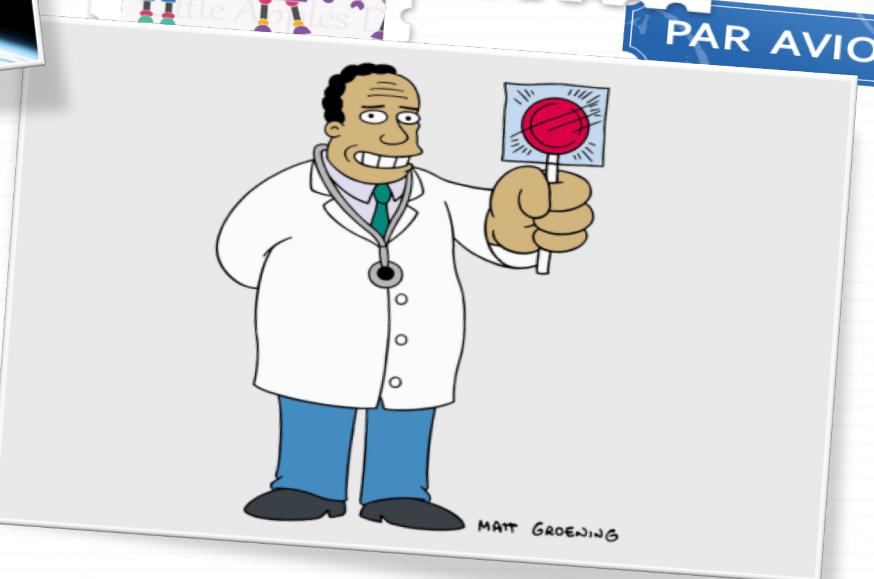
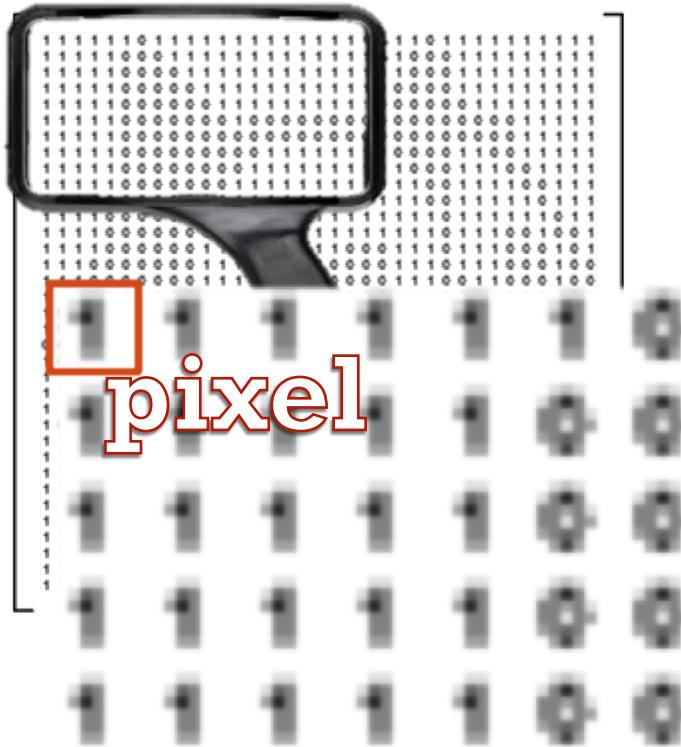
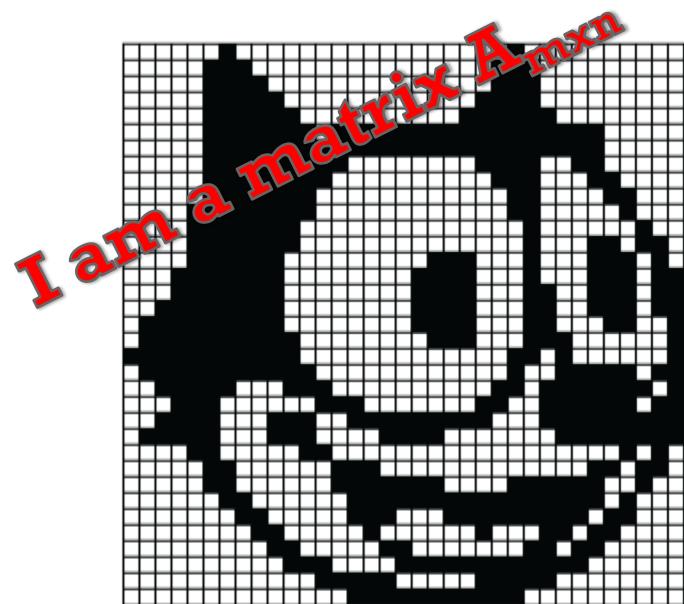


IMAGE AND MATRIX



THREE MAIN FLAVORS OF IMAGES



binary



grayscale



color



IMAGE PROCESSING

original



bilateral filtering



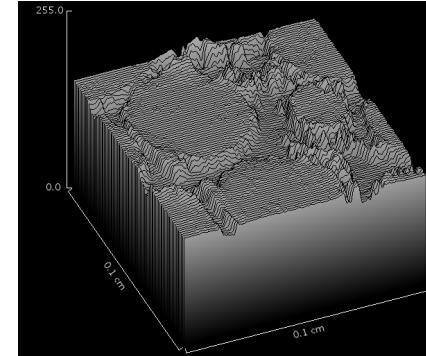
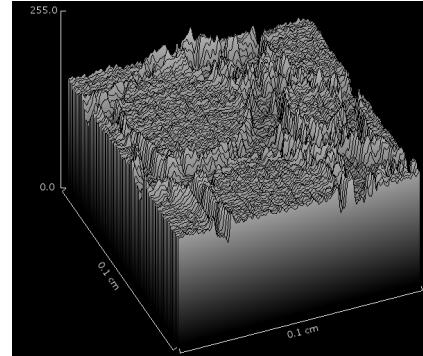
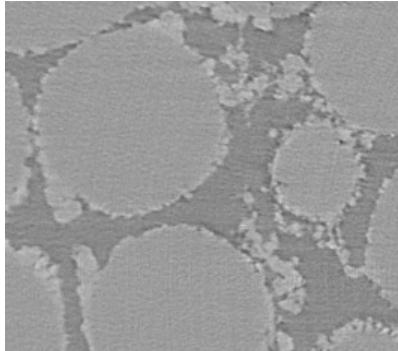
BILATERAL FILTERING

Ref. Tomasi et al, Bilateral filtering for gray and color images, ICCV (1998)

- Smooth and preserve edges: weighted average of local neighborhood – weights based on spatial and intensity (range) distances;

$$h(x) = k^{-1}(x) \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(\xi) c(\xi, x) s(f(\xi), f(x)) d\xi$$

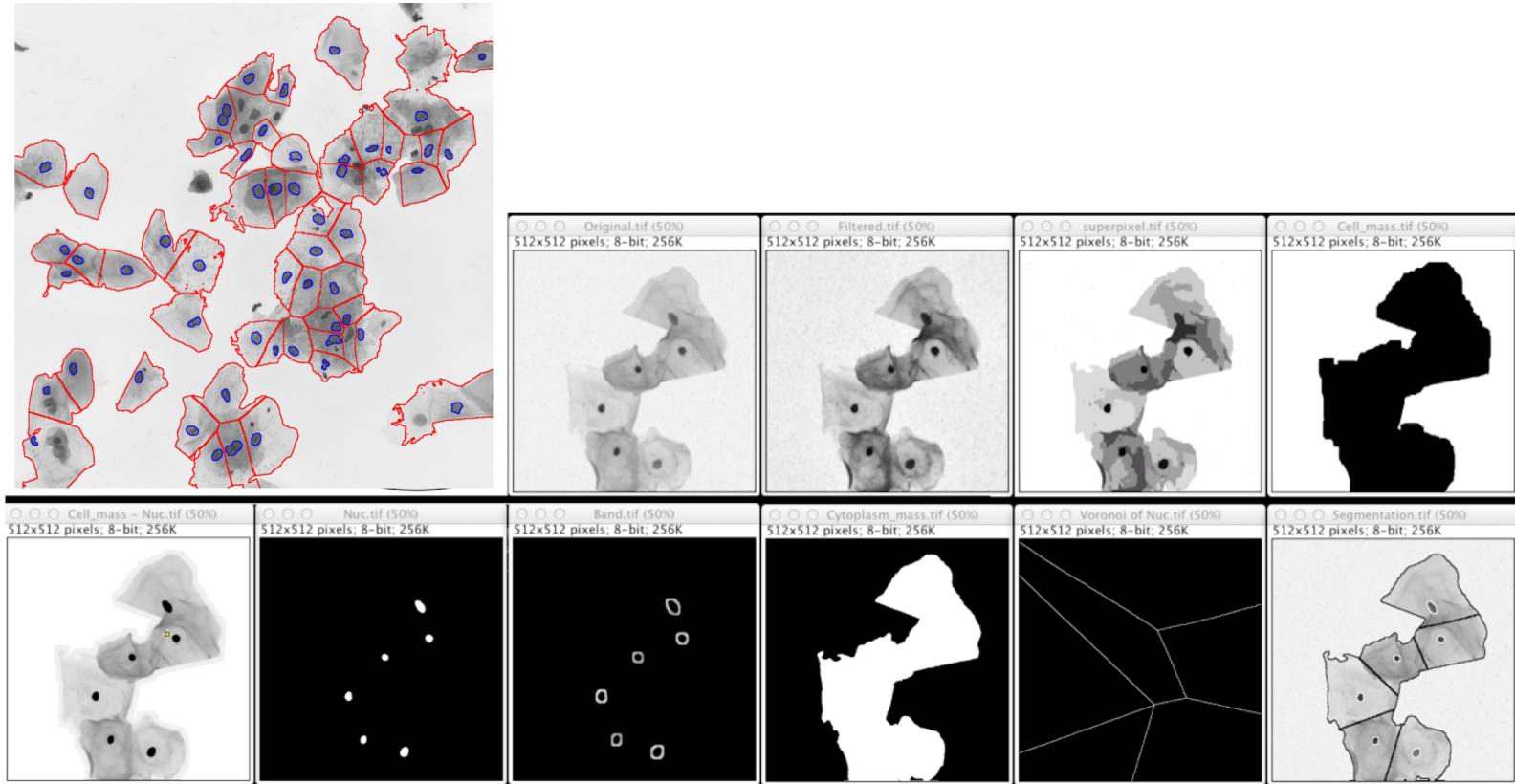
$$k(x) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} c(\xi, x) s(f(\xi), f(x)) d\xi$$



BERKELEY LAB
Bringing Science Solutions to the World



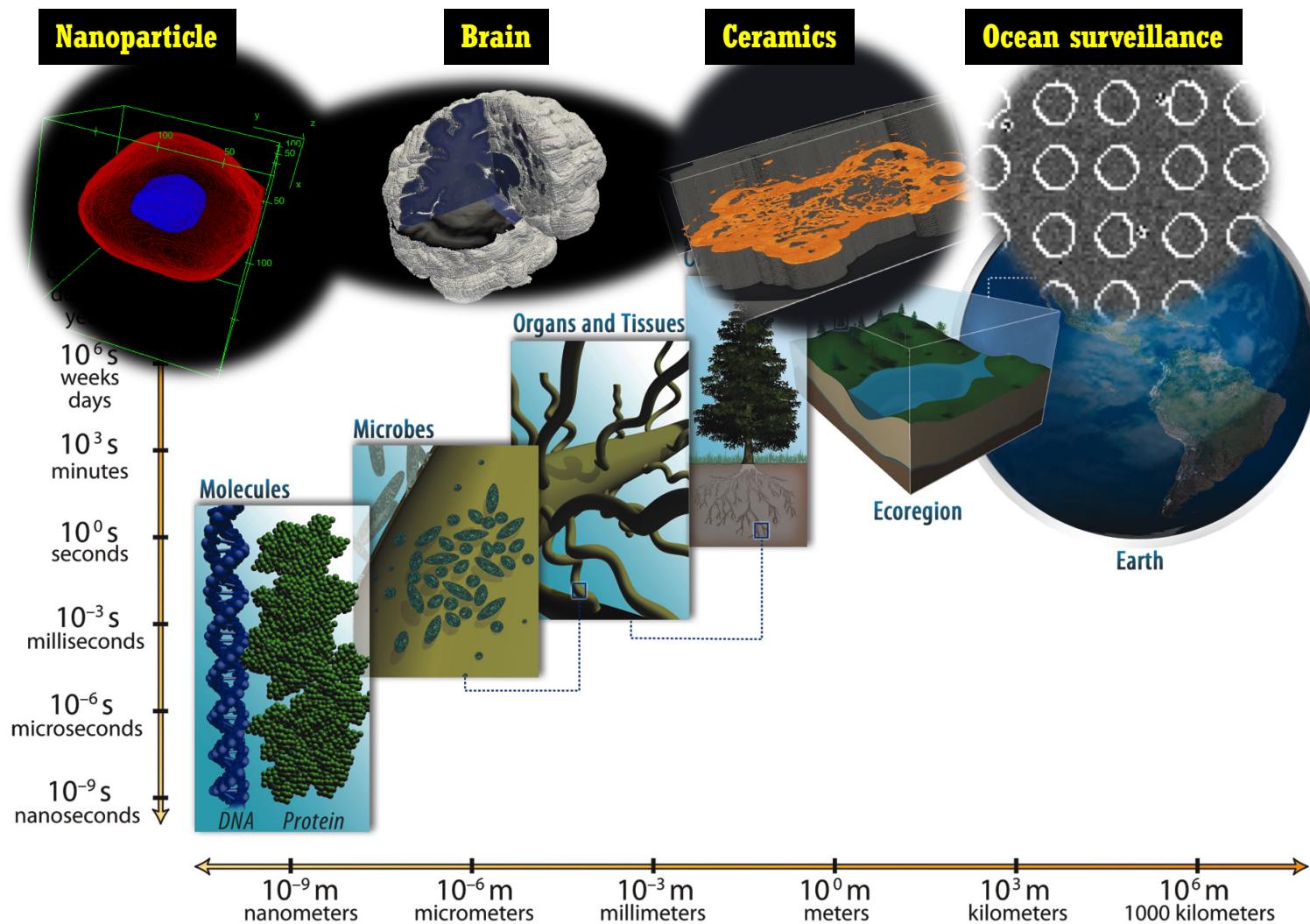
MACHINE LEARNING FOR SEGMENTATION





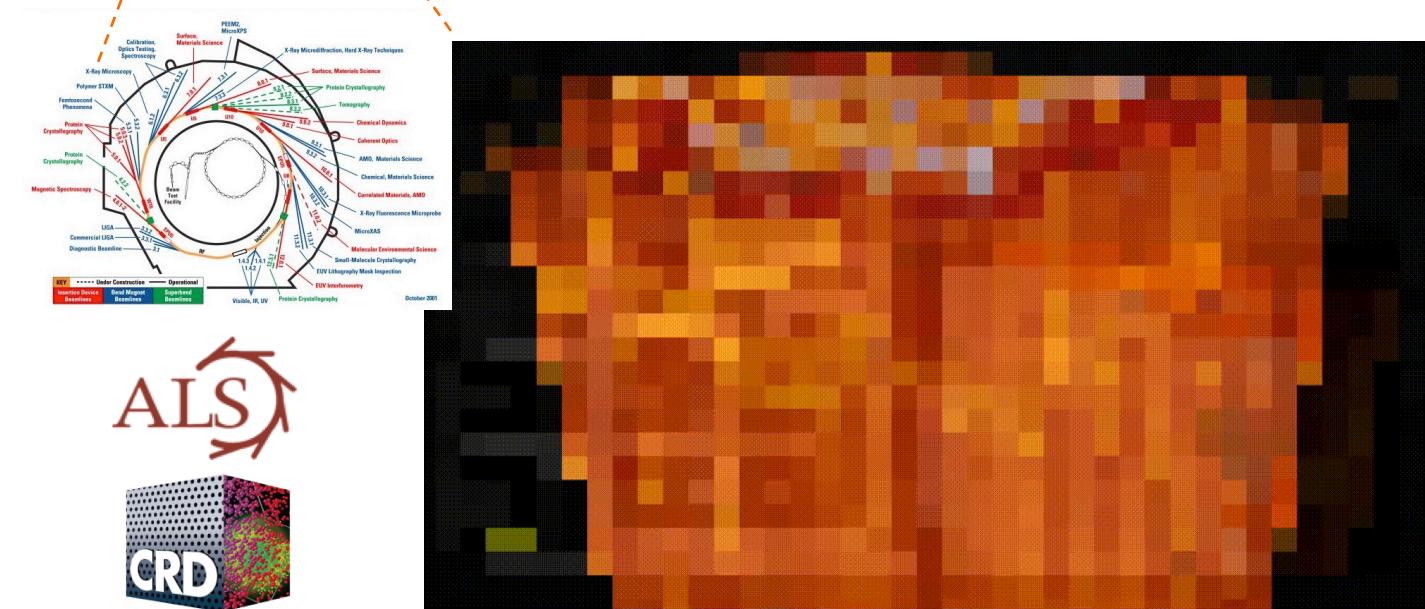
13

APPLICATIONS





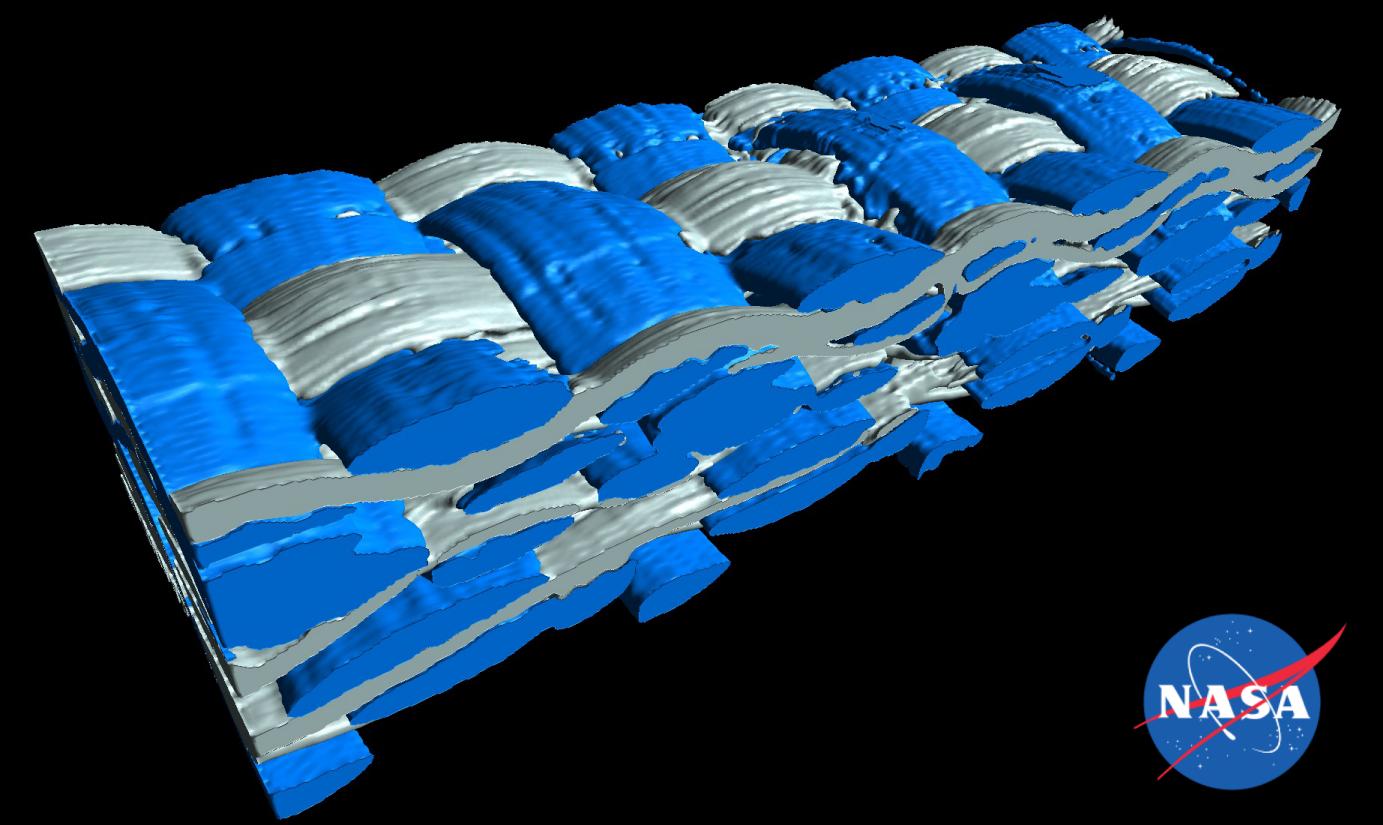
X-RAY IMAGING



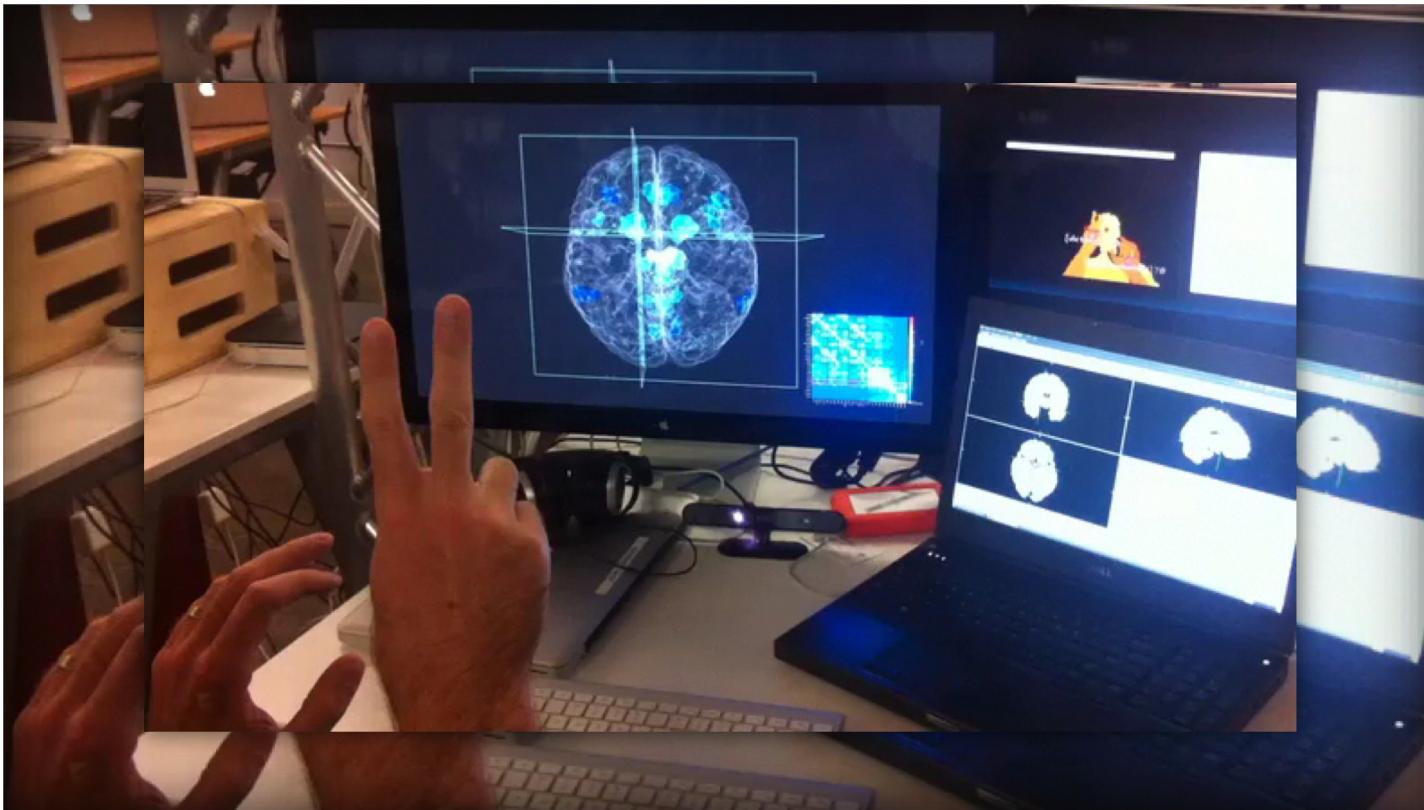
STORAGE OF CARBONIC ACID

500 μm

AIRCRAFT HEATSHIELD

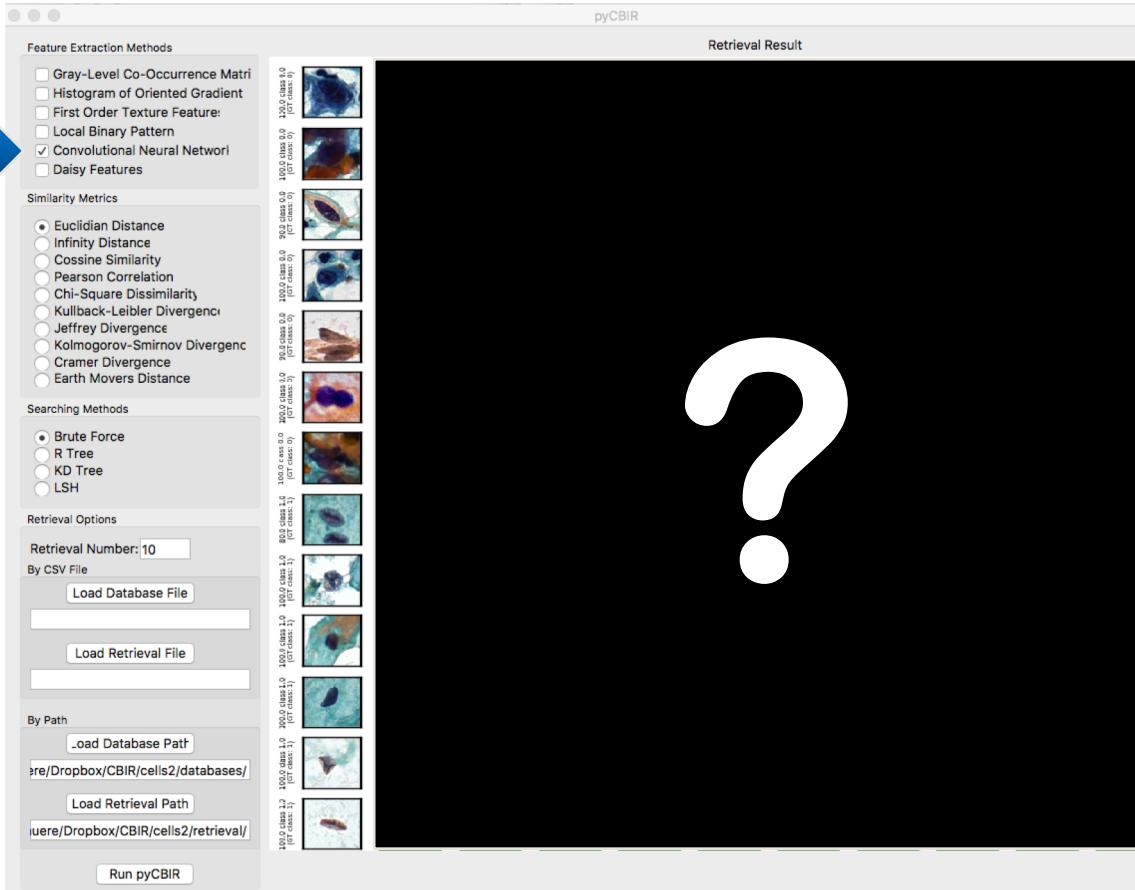


PROTOTYPE OF AN INTERACTIVE DASHBOARD



SEARCH AND RANKING CELLS BY SIMILARITY

Convnet





GETTING STARTED



There is no shame in learning a new skill, learn to program!

COOKING IDEAS WITH THE COMPUTER

Baking a cake

- Flour, eggs, oil
- Cooking pan
- Supermarket
- Cake mix

Programming

- Python
- Jupyter notebooks
- Anaconda
- Packages

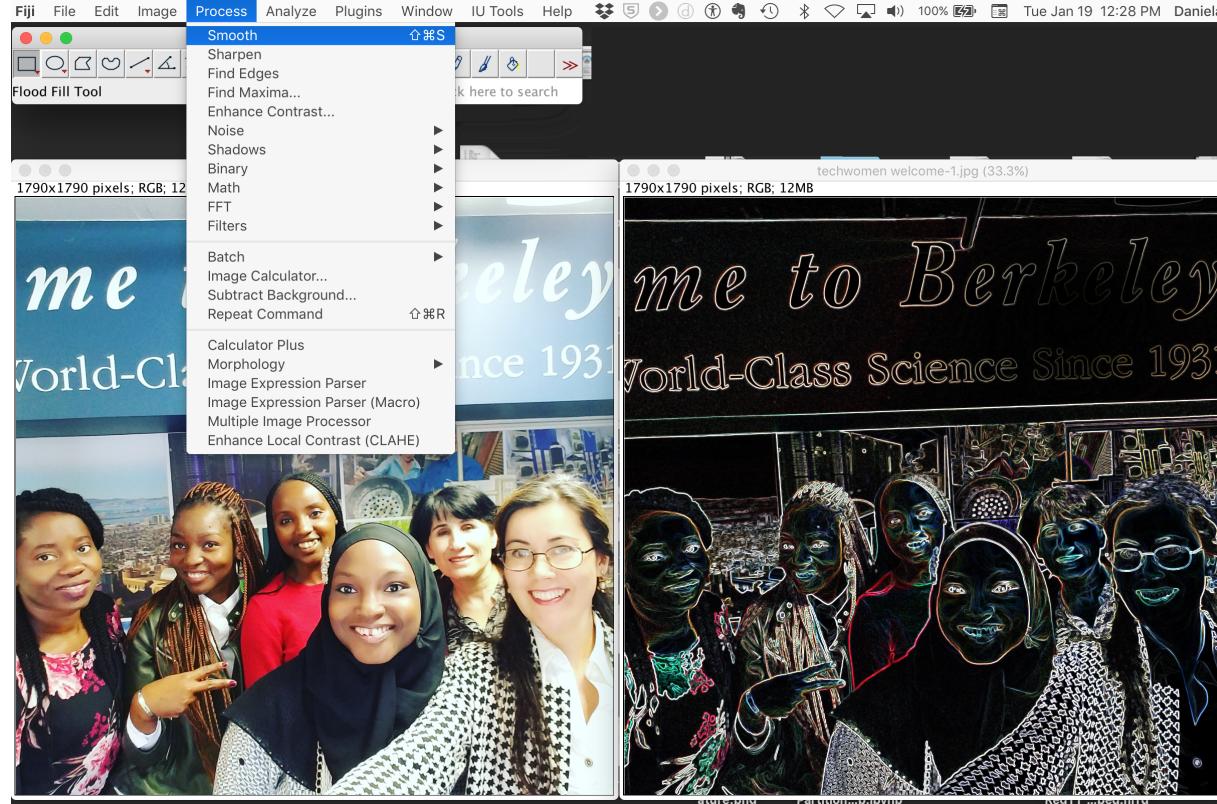
Free courses:

Python: <https://v4.software-carpentry.org/python/index.html>

Image processing: <https://datacarpentry.org/image-processing/>



PROTOTYPING WITH FIJI





We miss you here... Resist and let's fight against COVID-19 together!





THANKS

<http://bit.ly/techwomen2021>

TECHWOMEN