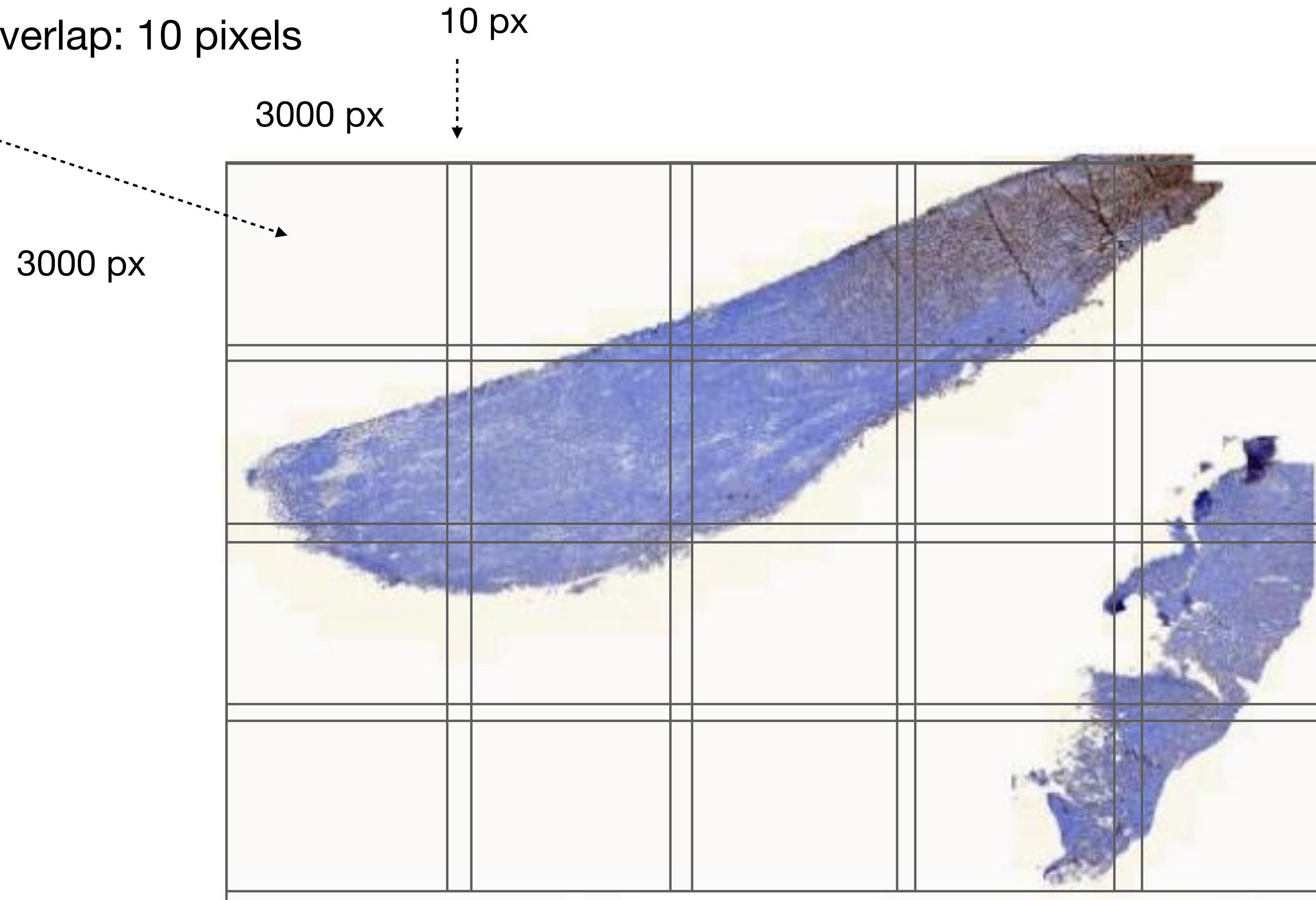


H & E Image Processing

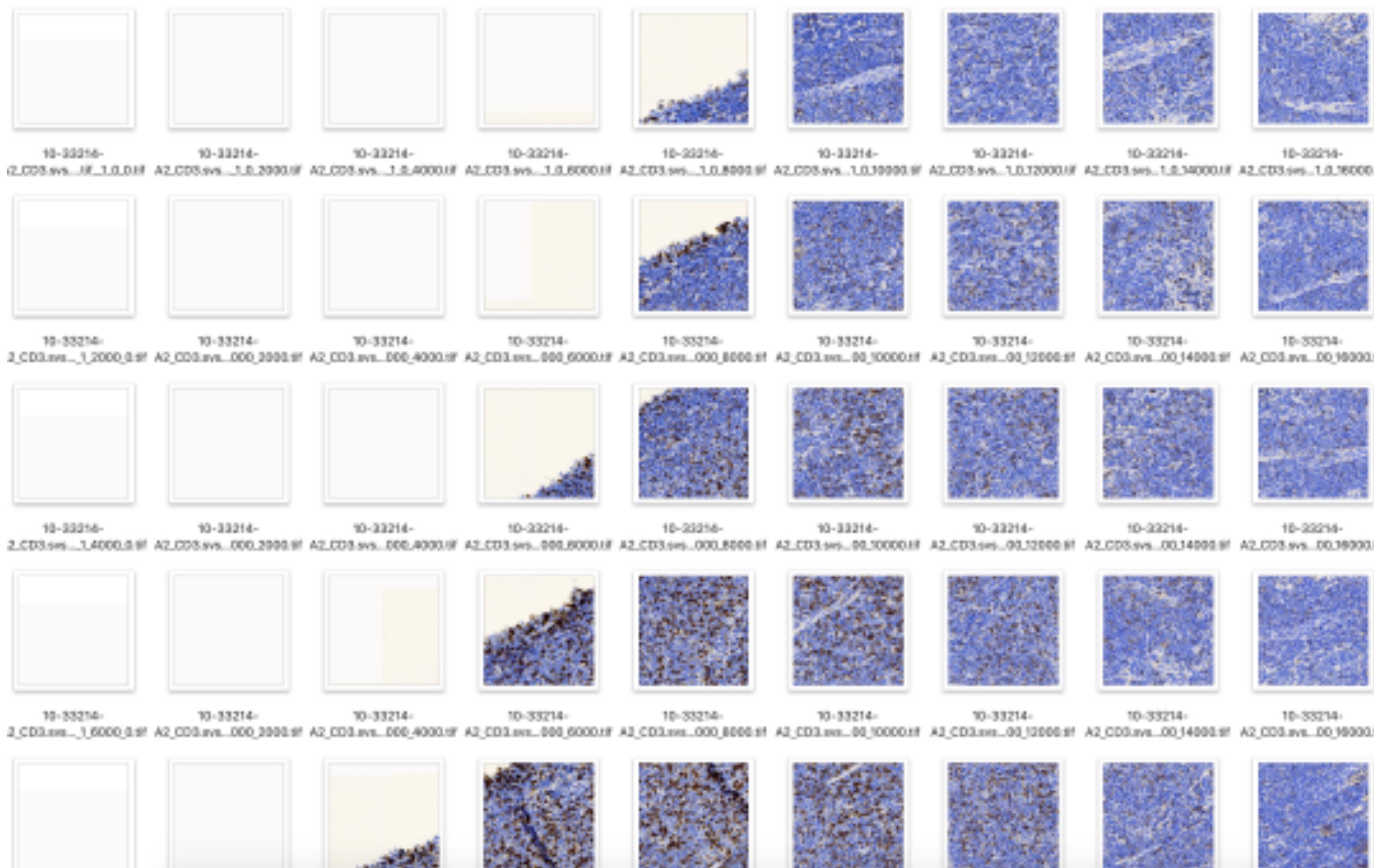
Hoa Tran
18 Sept 2020, Roth Lab

Step1: divide big tissue area into multiple patches

- Crop original tissue image into multiple patches (small images, blocks)
- Each patch: 3000 x 3000 pixels, overlap: 10 pixels



Step1: divide big tissue area into multiple patches

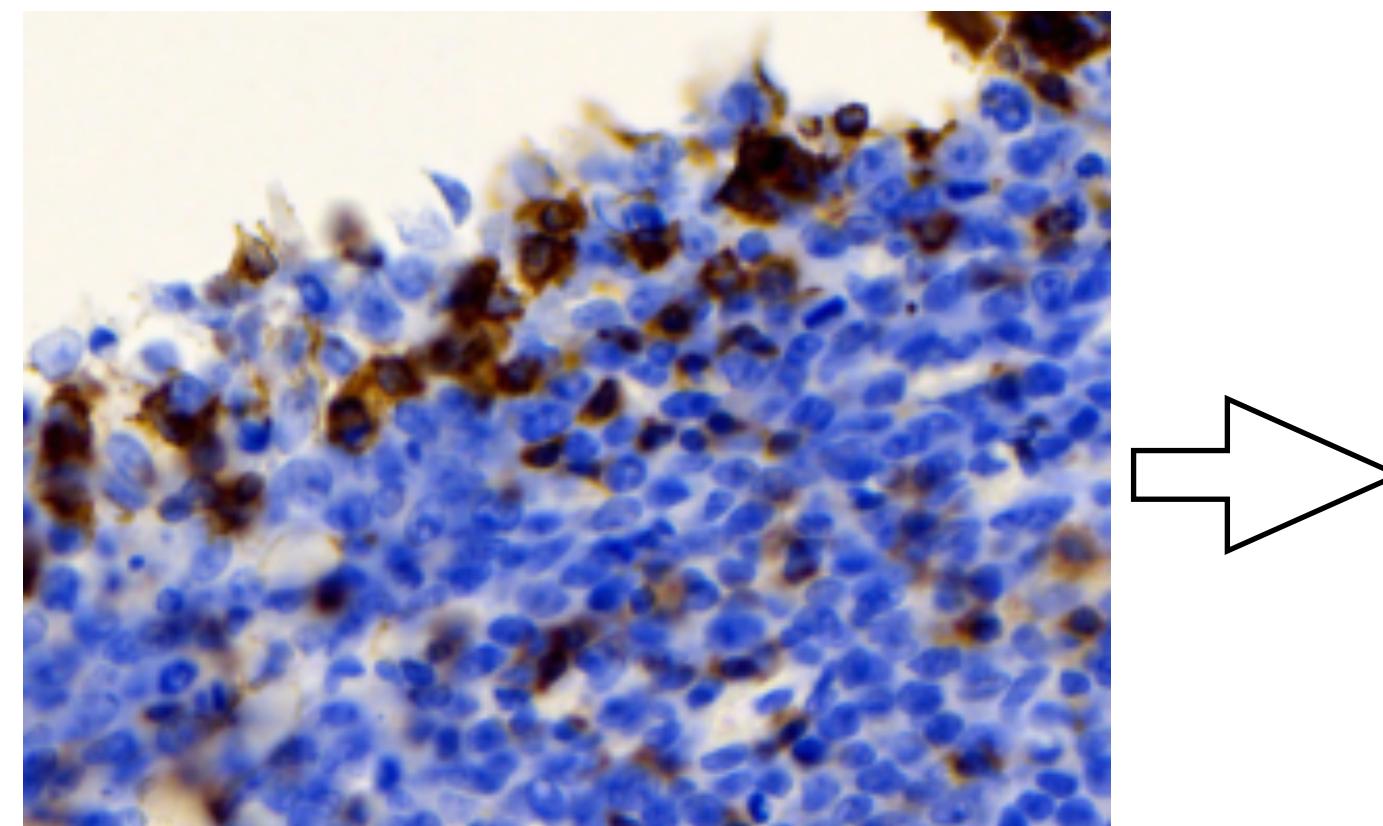


Step 2: Color Deconvolution H & E

Color Deconvolution H&E tool:

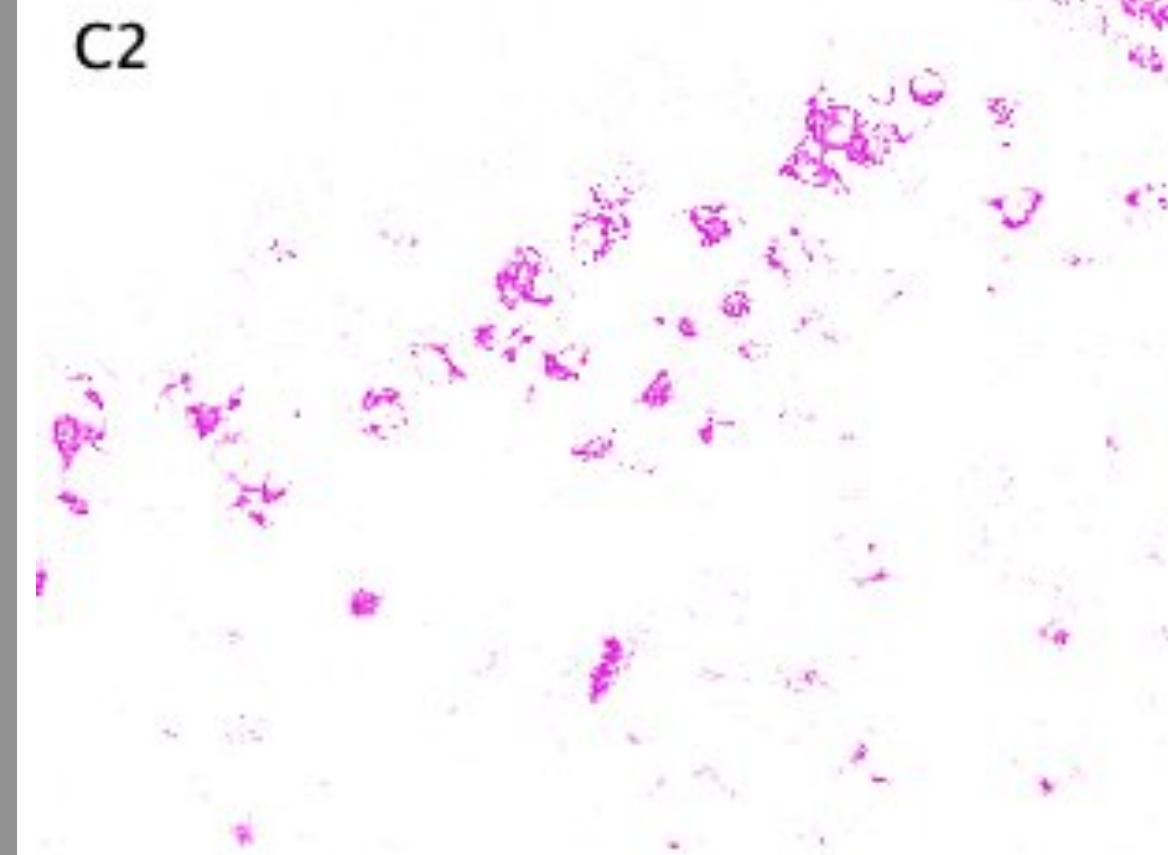
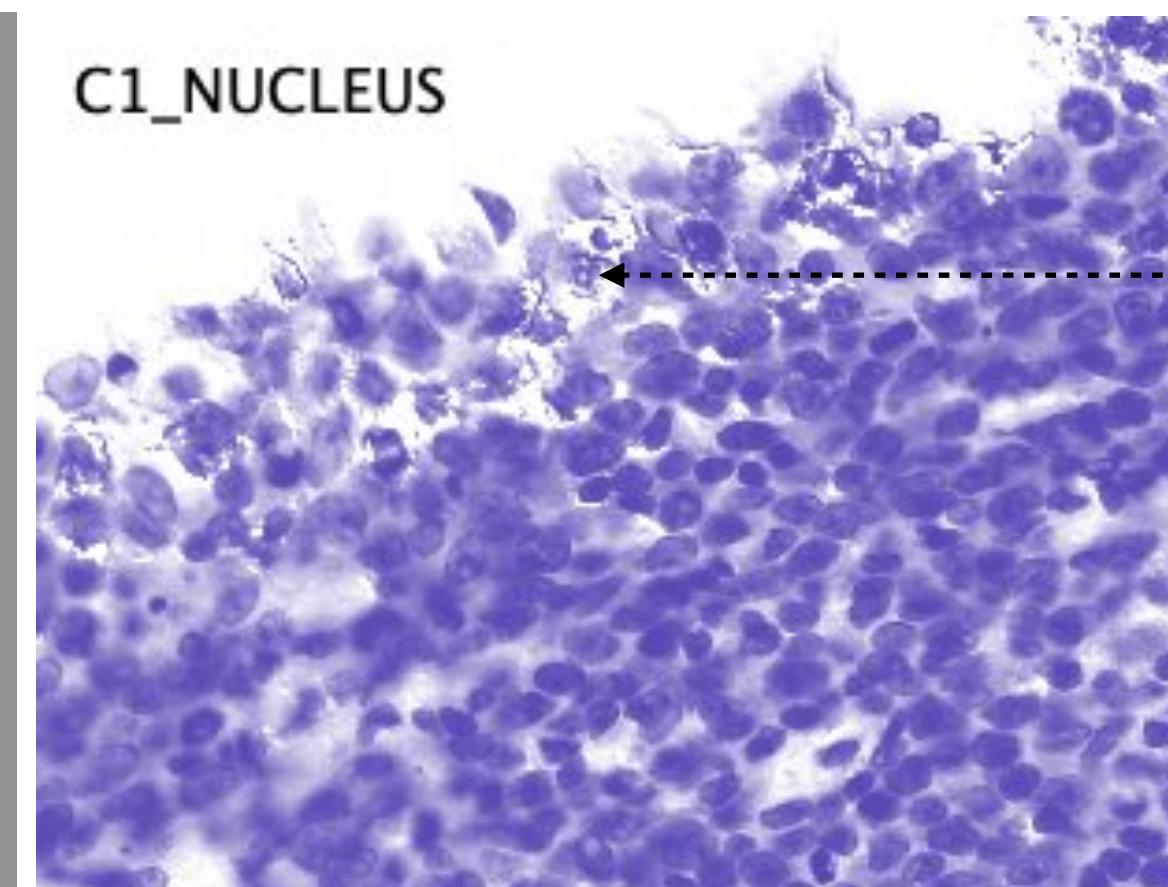
Separate nuclei channel C1,
from stain channel: C3

- Haematoxylin and Eosin (H&E) (two different ones)
- ■ Haematoxylin and DAB (H DAB)
- Feulgen Light Green
- Giemsa
- Fast Red, Fast Blue and DAB
- Methyl green and DAB
- ■ Haematoxylin, Eosin and DAB (H&E DAB)
- Haematoxylin and AEC (H AEC)
- Azan-Mallory
- Masson Trichrome
- Alcian blue & Haematoxylin
- Haematoxylin and Periodic Acid – Schiff (PAS)
- RGB subtractive
- CMY subtractive



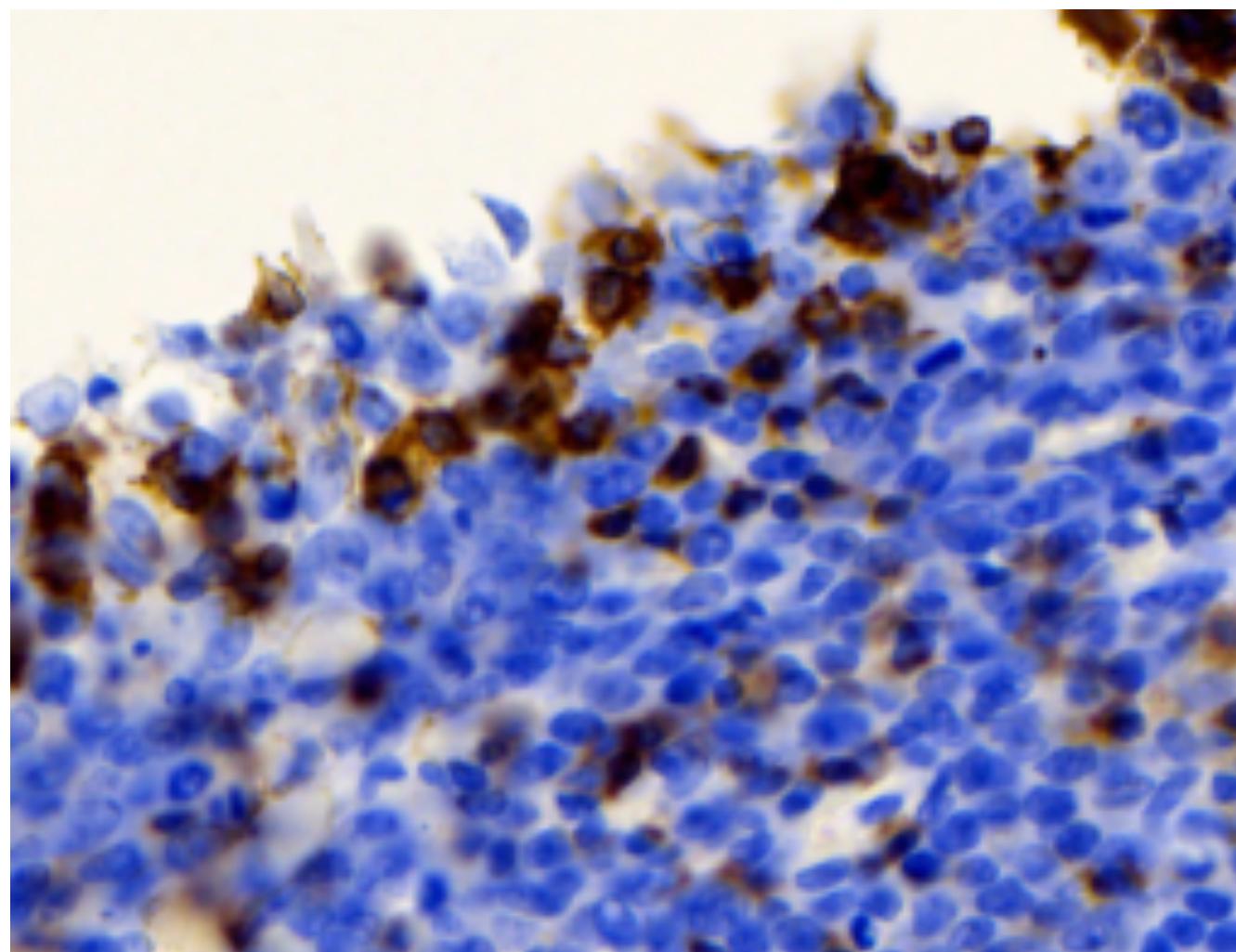
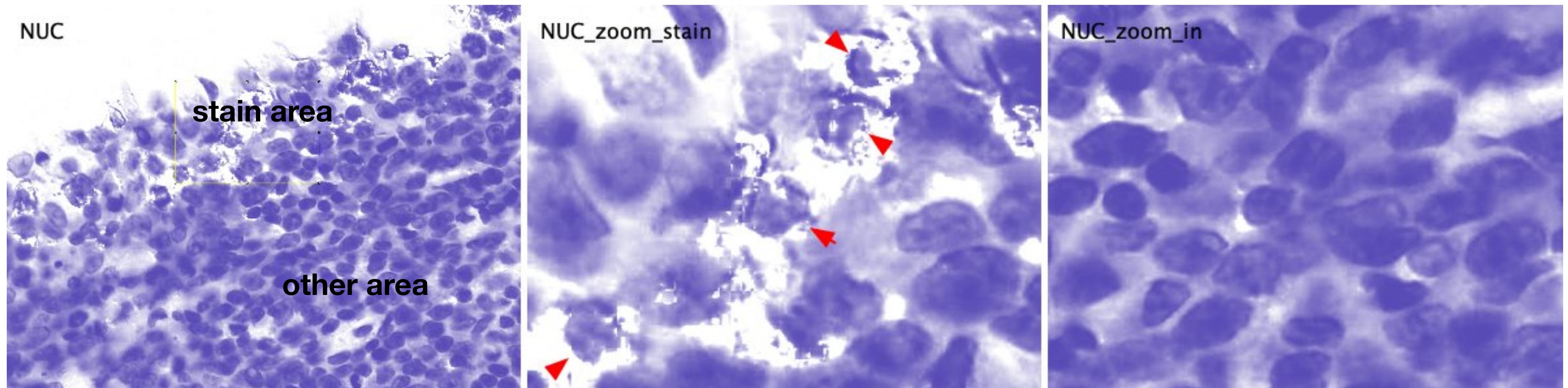
| Colour deconvolution: H&E DAB | | |
|-------------------------------|-------------------------------------------|--|
| Colour_1 | R:0.6500286, G:0.704031, B:0.2860126 | |
| Colour_2 | R:0.07213324, G:0.99183214, B:0.105194315 | |
| Colour_3 | R:0.26814753, G:0.57031375, B:0.77642715 | |

Already tested all color deconvolution strategies and got the best possible



Problem
at
stain
area

Step 2: Color Deconvolution H & E



stain area
Nucleus (cell) at stain marker area
(ex: CD3) are broken, can not retrieve
the perfect shape

other area
Nucleus (cells) at other area
have good shape but high noise level
(difficult to detect objects)

Step 3: Nucleus Detection

- Our data contain high background noise level and broken nucleus shape. Need a good method to detect objects and segment objects.
- Applying spot segmentation to detect nucleus objects.

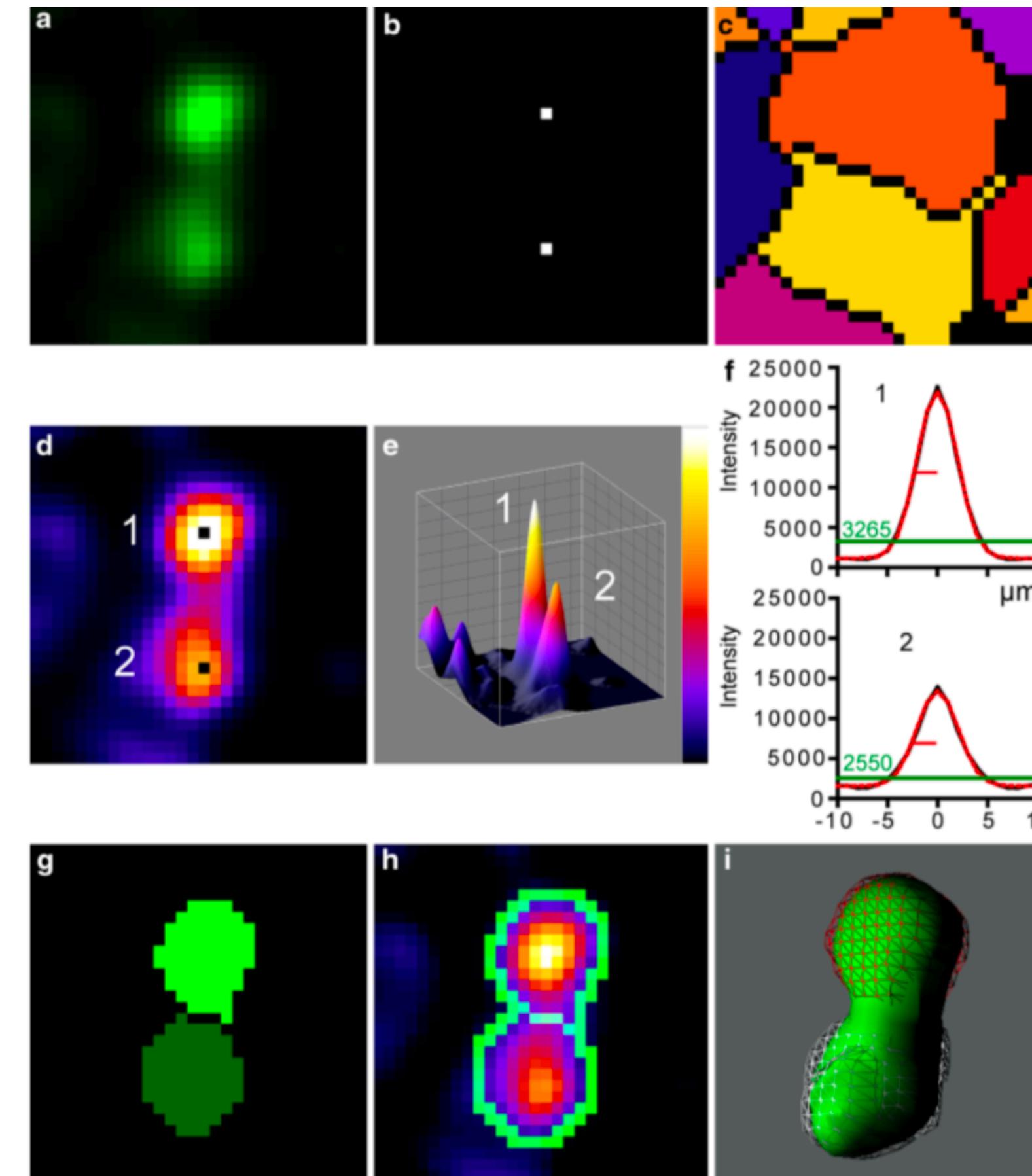


Figure : Steps of nuclei segmentation.

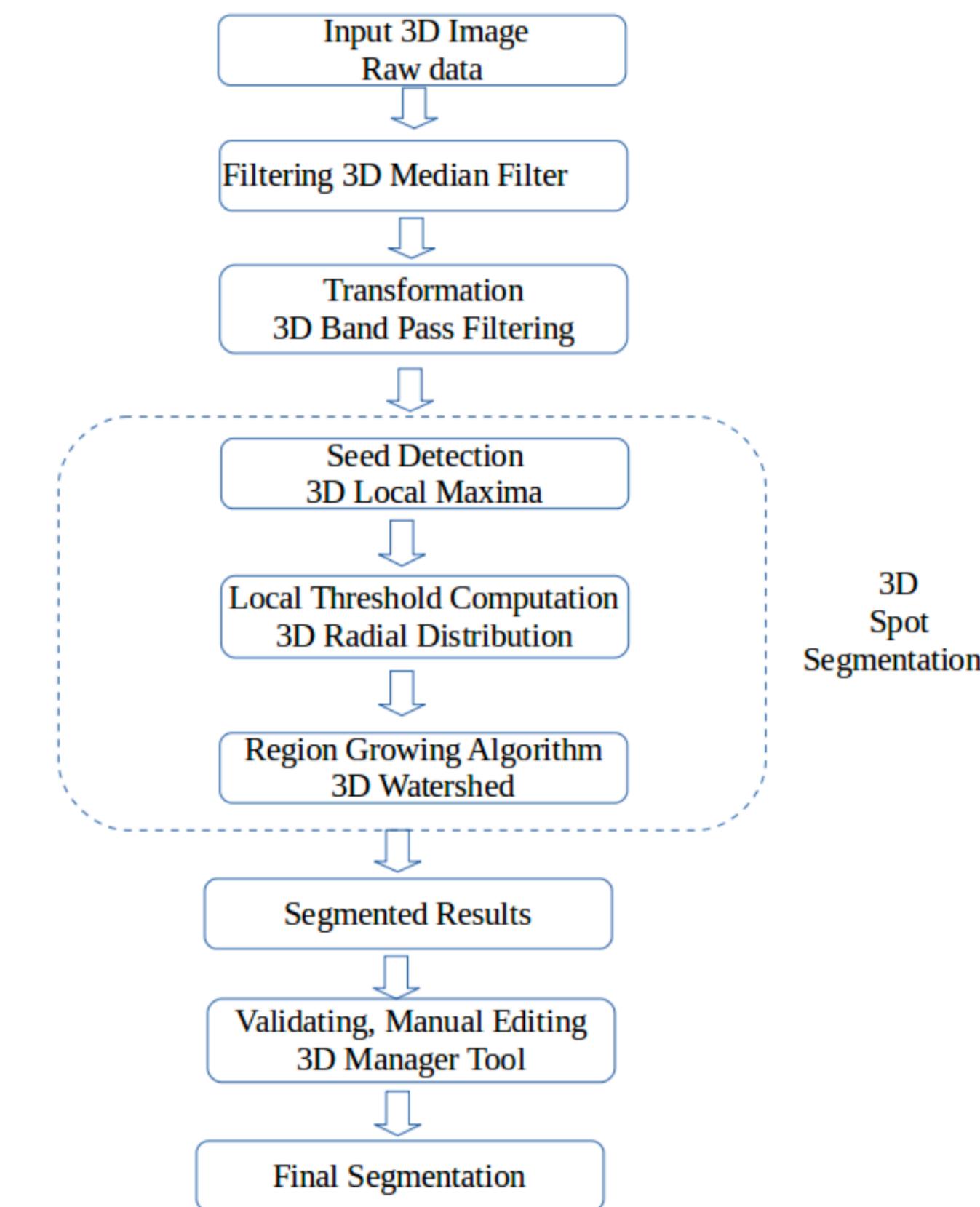
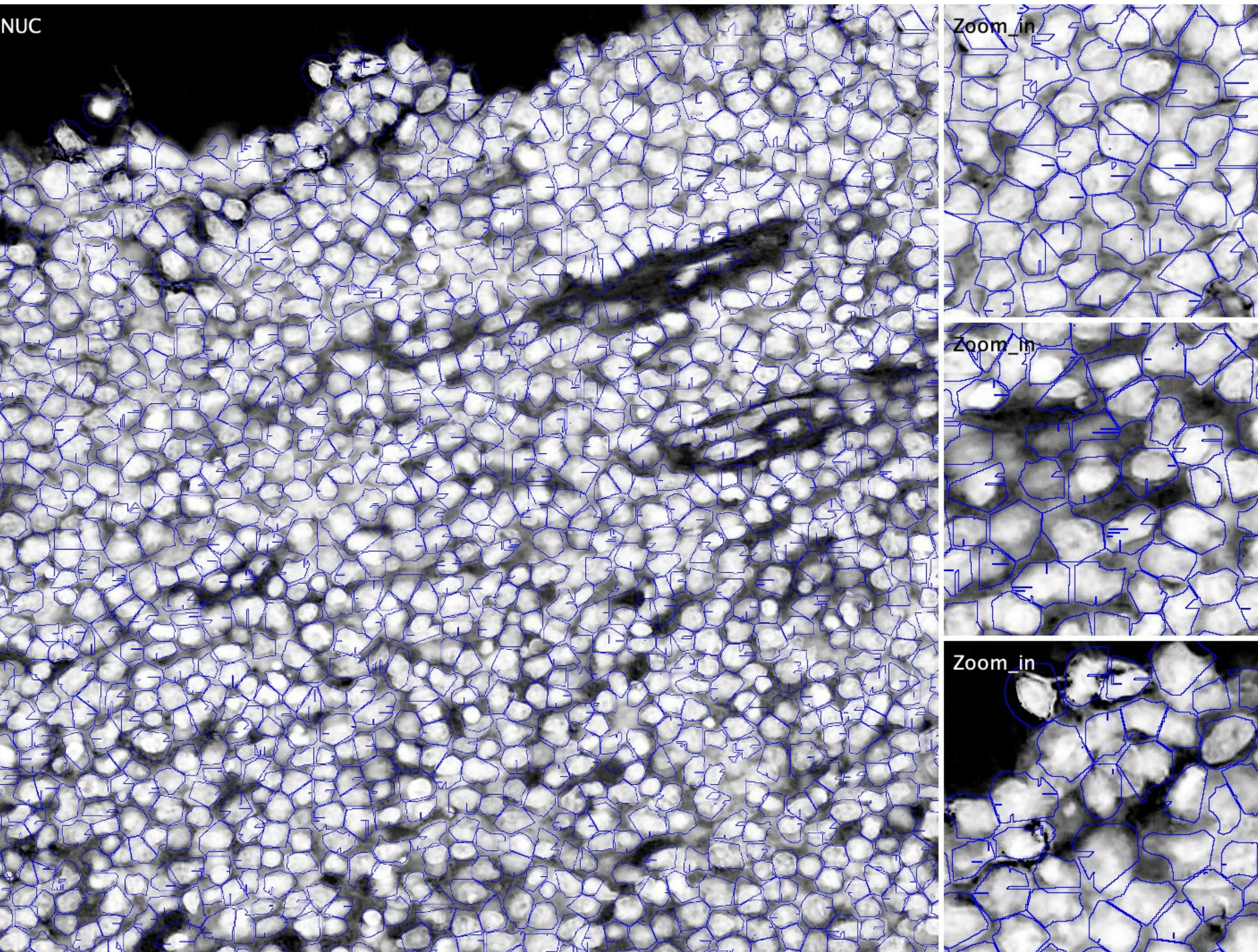
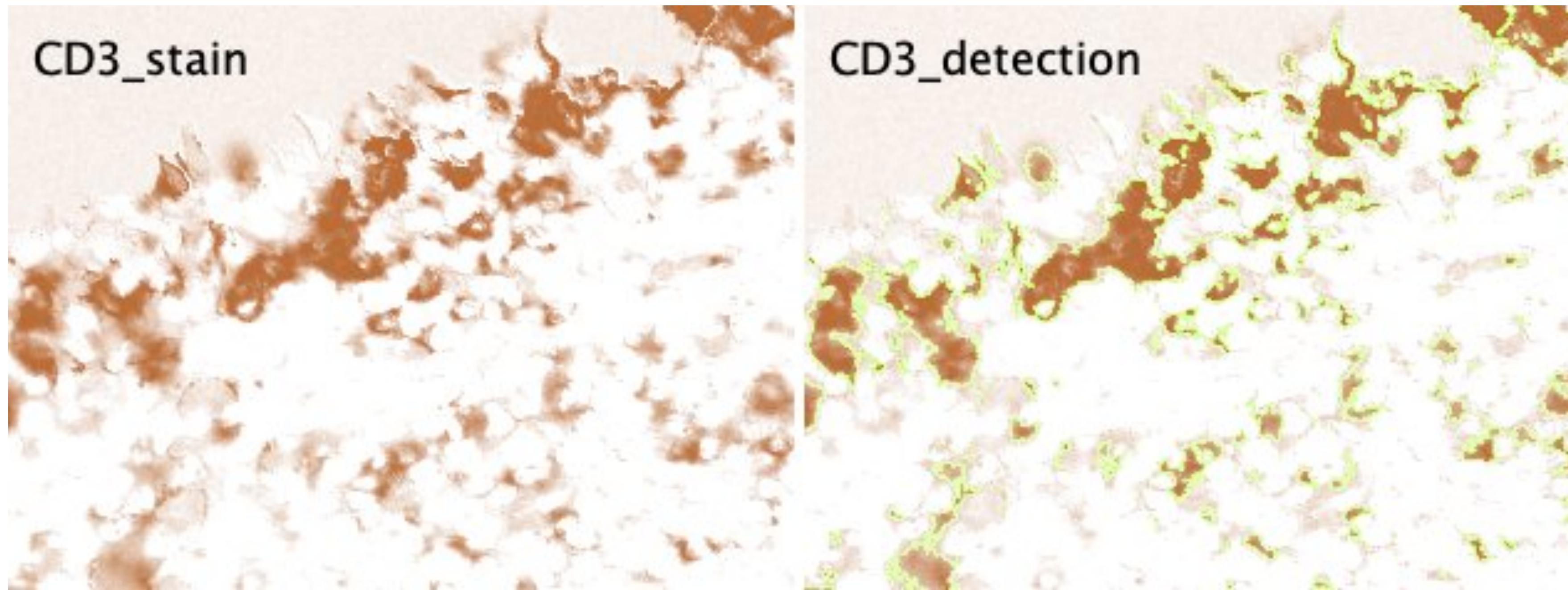


Figure : Diagram of nuclei segmentation [1].

Step 3: Nucleus Detection



Step 4: marker - stain area detection



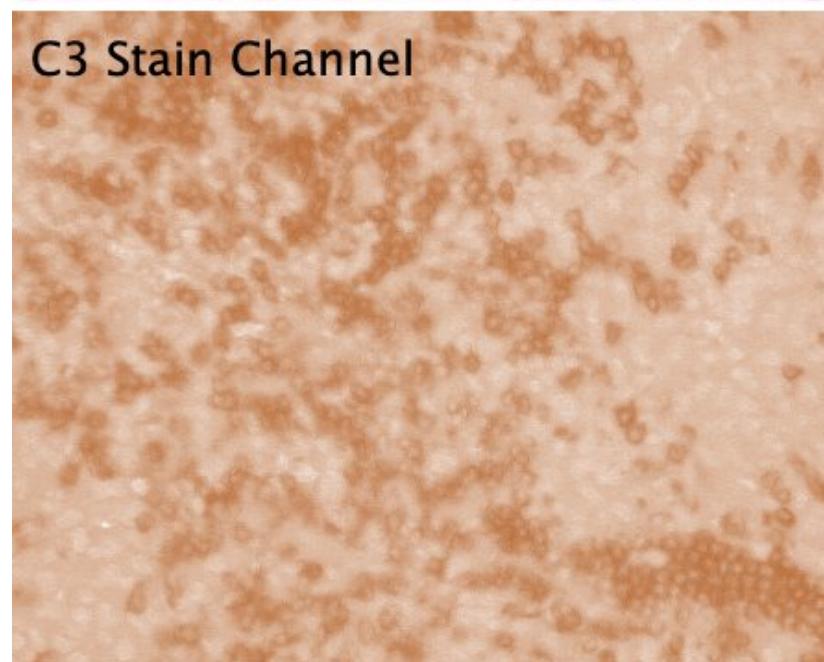
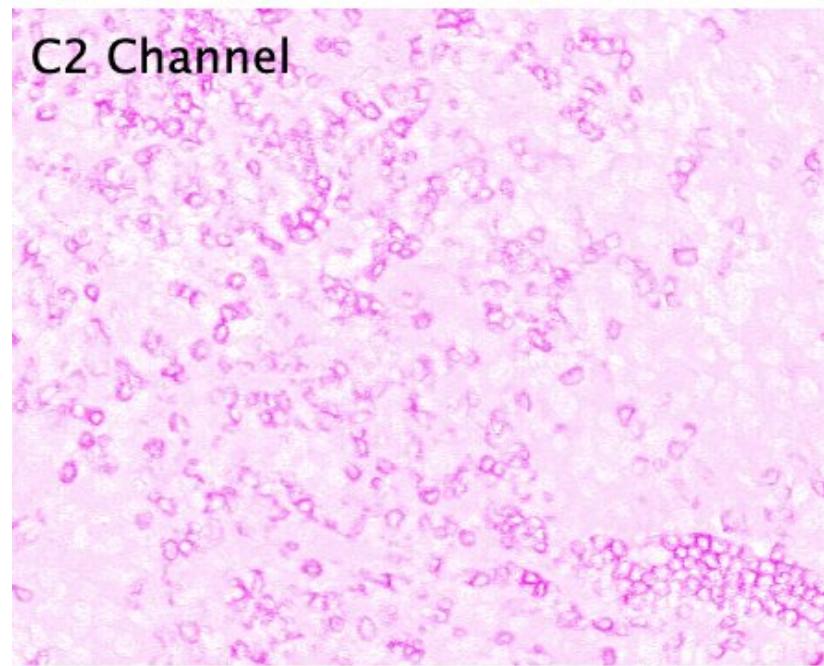
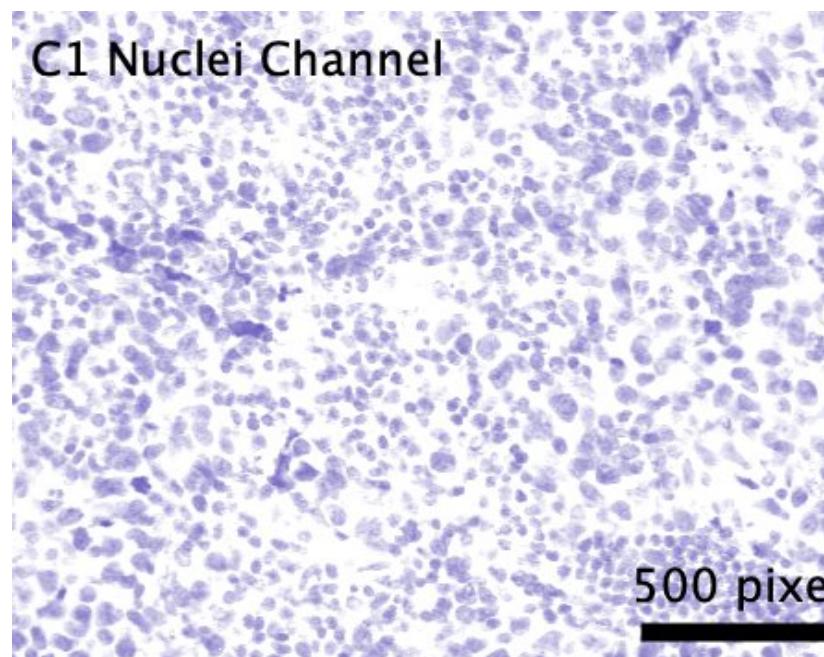
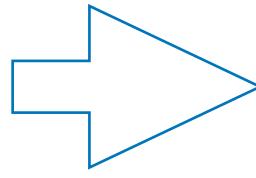
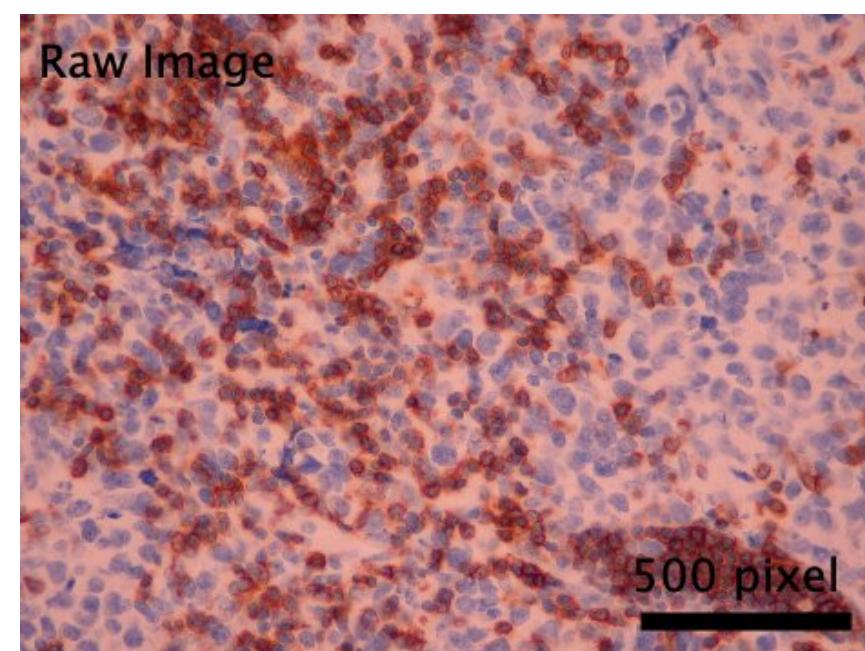
Raw CD3 image

Green contour area: stain CD3 marker area

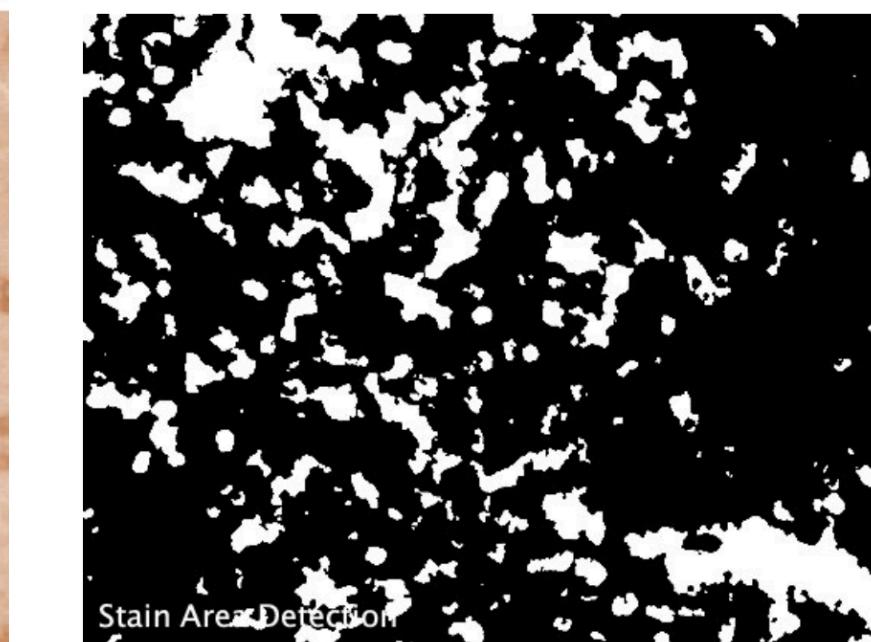
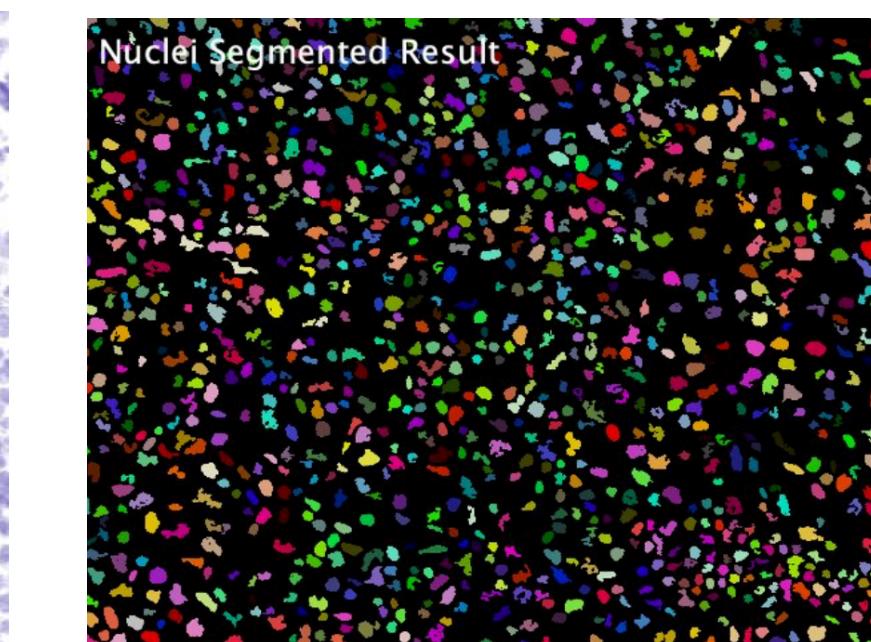
- Applying advanced auto threshold method + mathematical morphology to detect stain area

Image Processing Workflow

Color Deconvolution

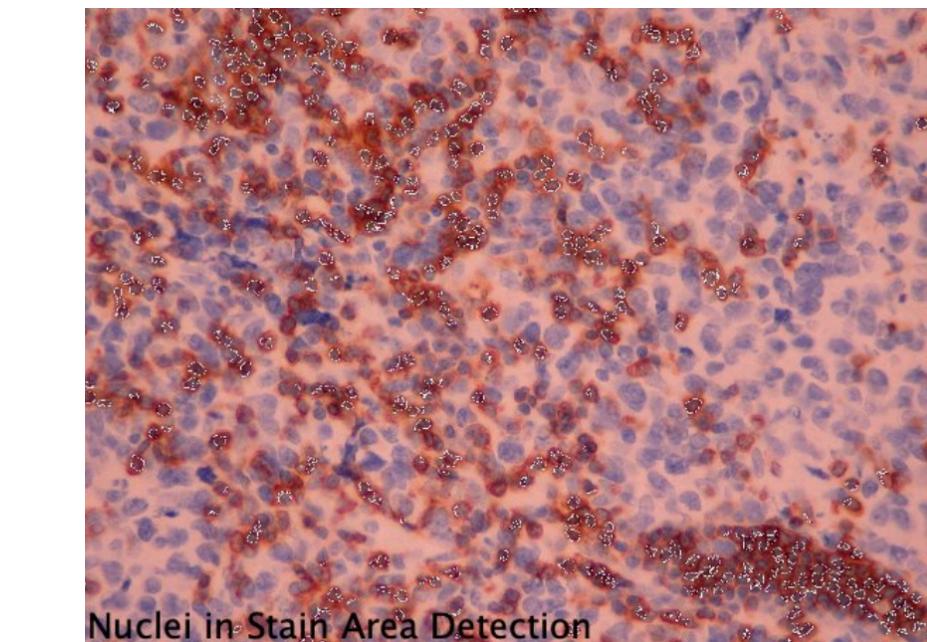
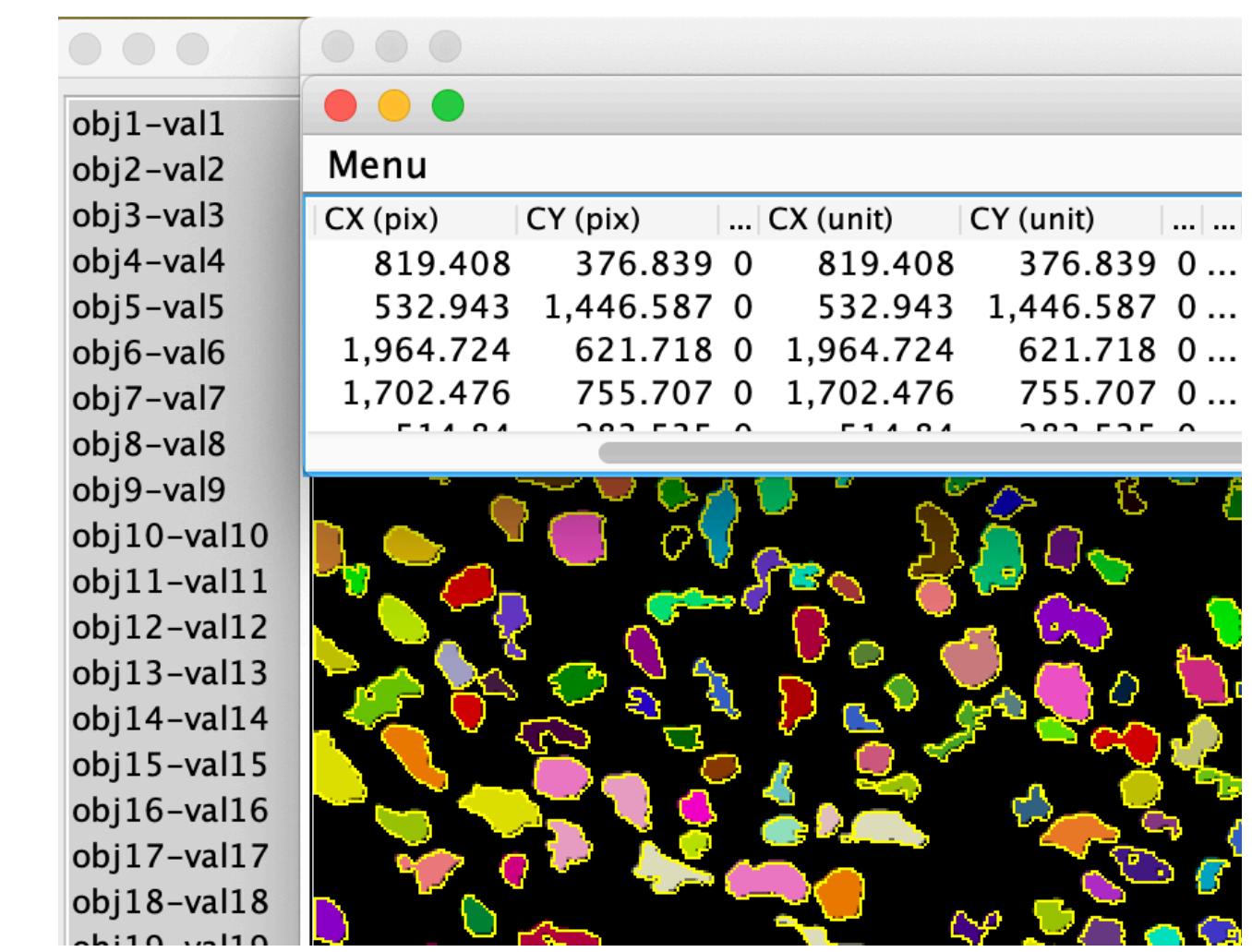


Nuclei Segmentation



Determine stain area

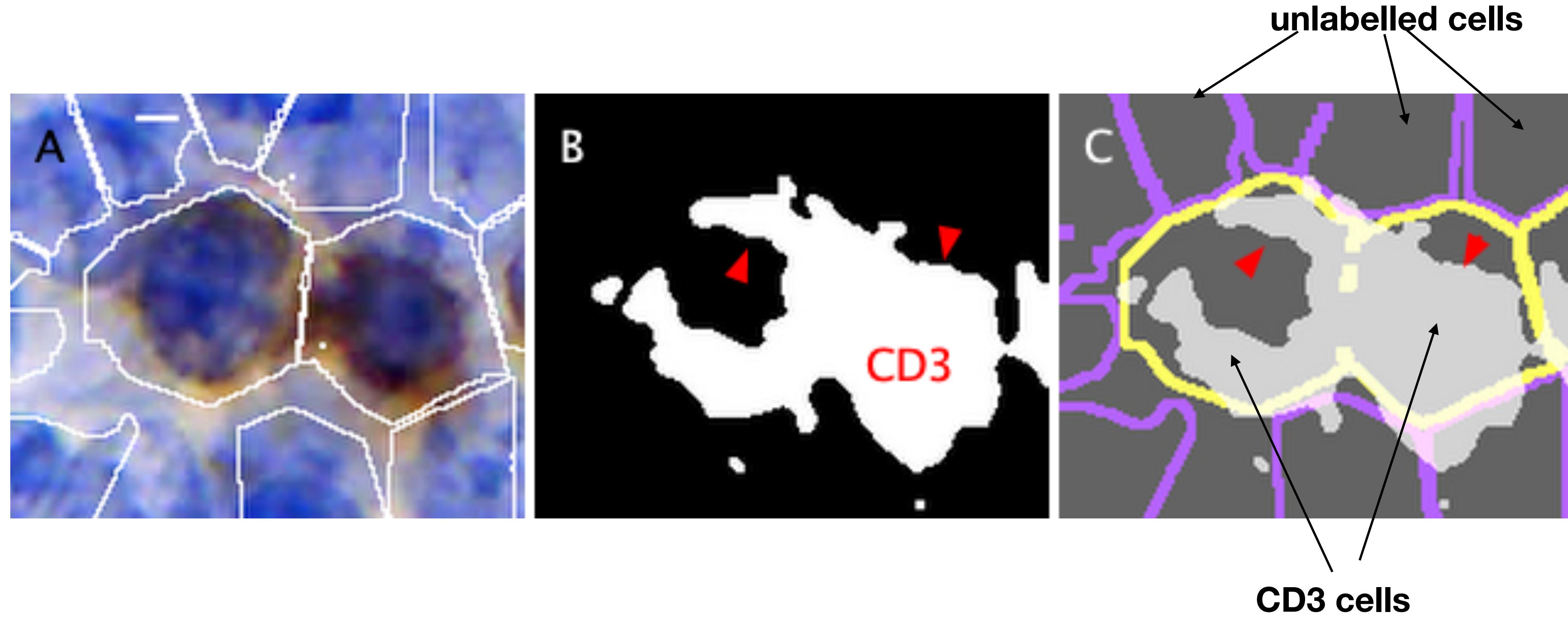
Summary Results



Count nb nuclei at stain area
and non stain area

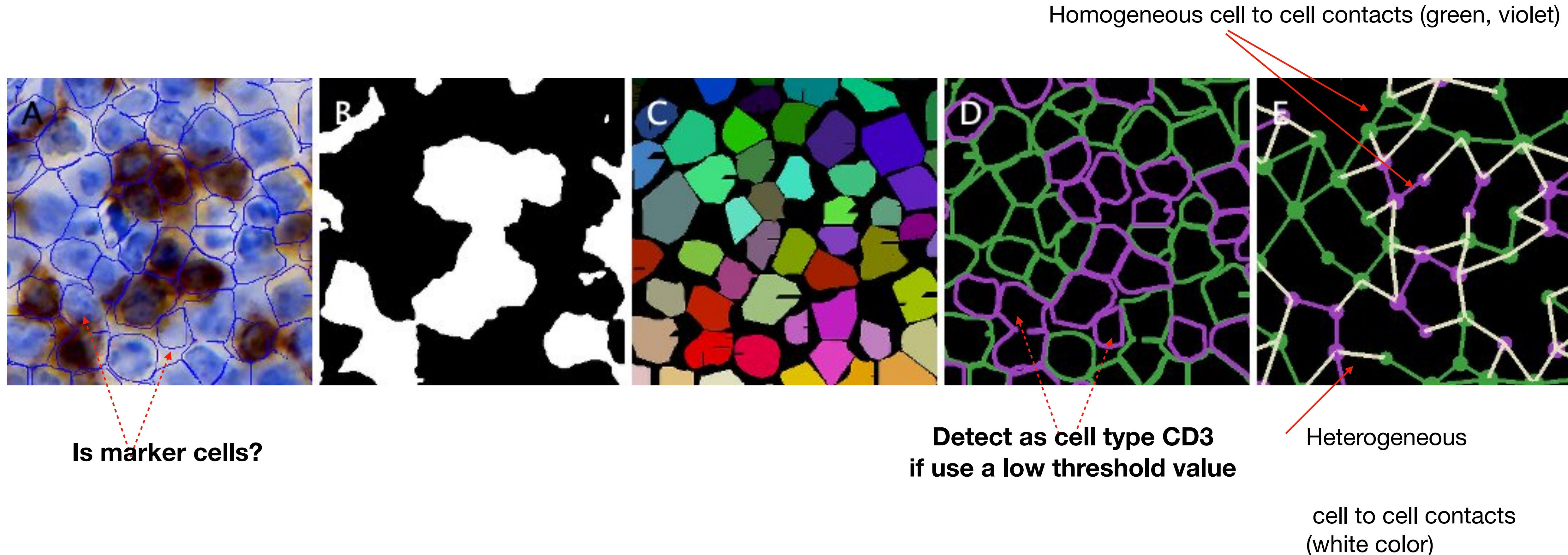


Step 5: Cell Type Detection



- 35% of stain marker in cell area → assign cells to this cell type

Step 7: Cell Networks



- Cell type: unlabelled cells, CD3, CD4, CD57, CD8 cell type
- Cell Networks: cells with its adjacent boundary > cells contact, use an edge to connect 2 cells, cells represent by its centers

Cell Networks Demo

