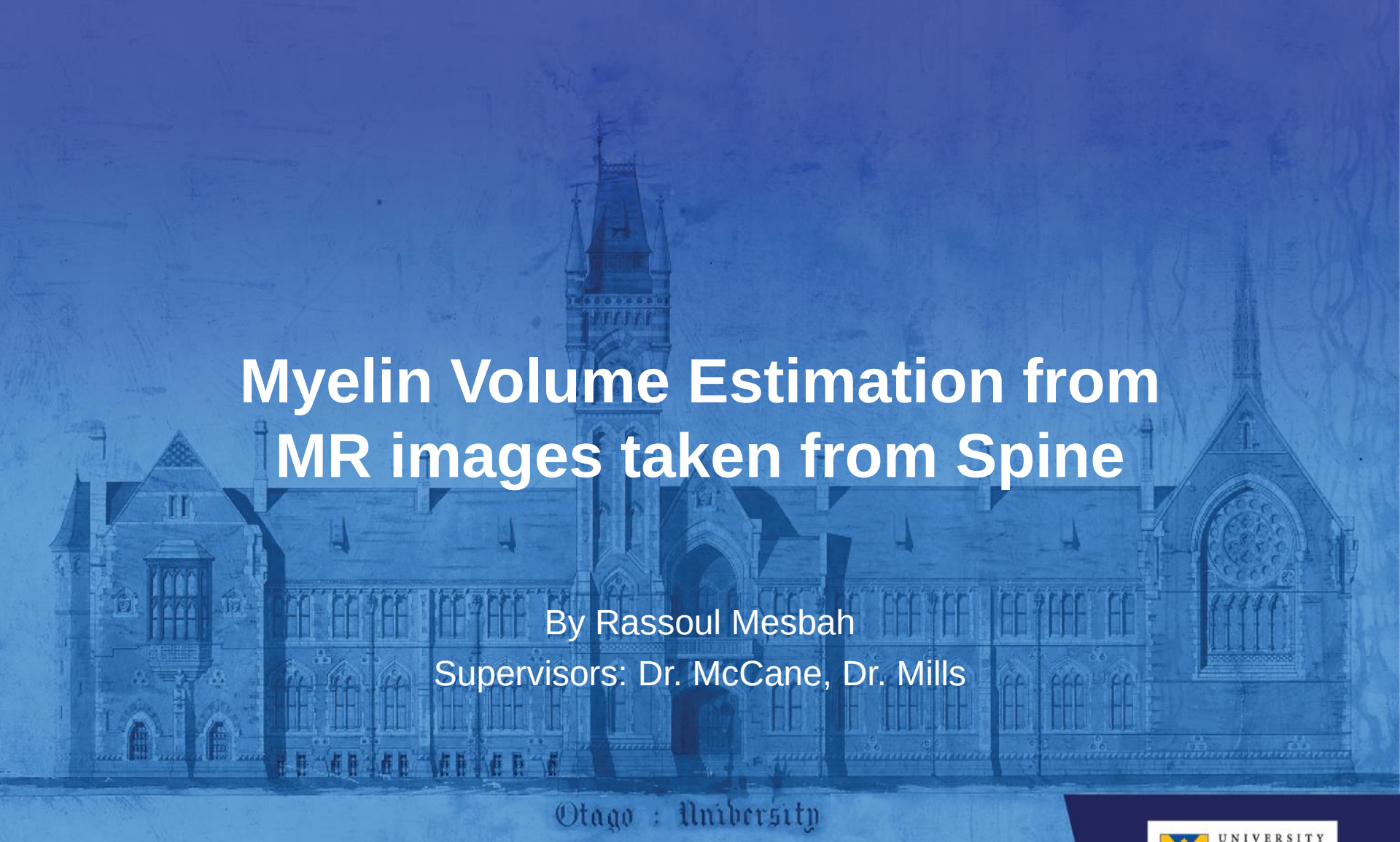
Myelin Volume Estimation from MR images taken from Spine

By Rassoul Mesbah

Supervisors: Dr. McCane, Dr. Mills



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Joey

Leukodystrophy

- Decreased Motor Function
- Muscle Rigidity
- Degeneration of Sight and Hearing

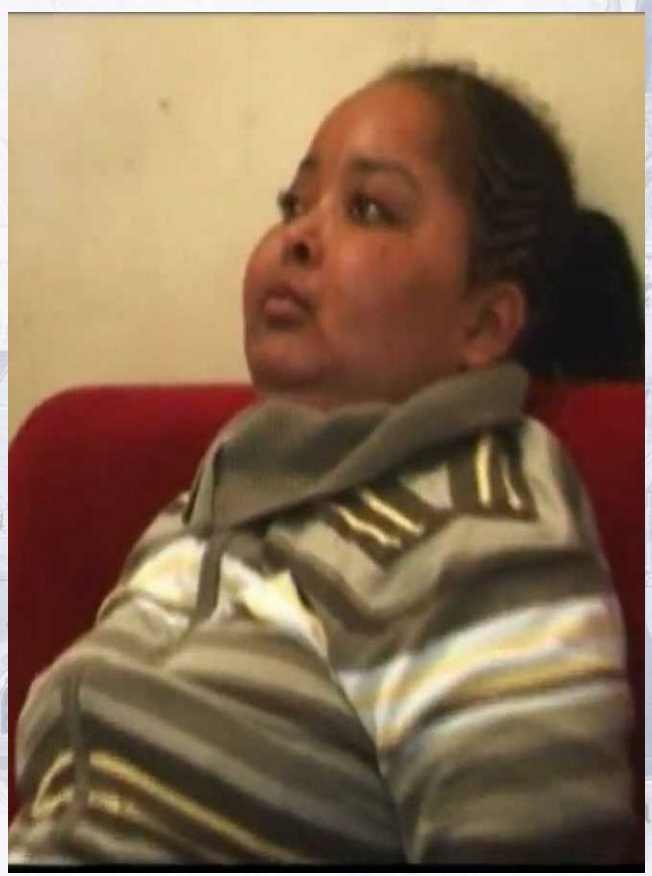
Pearl

Charcot-Marie-Tooth

progressive loss of
- muscle tissue
- touch sensation

across various parts of the body

Carol

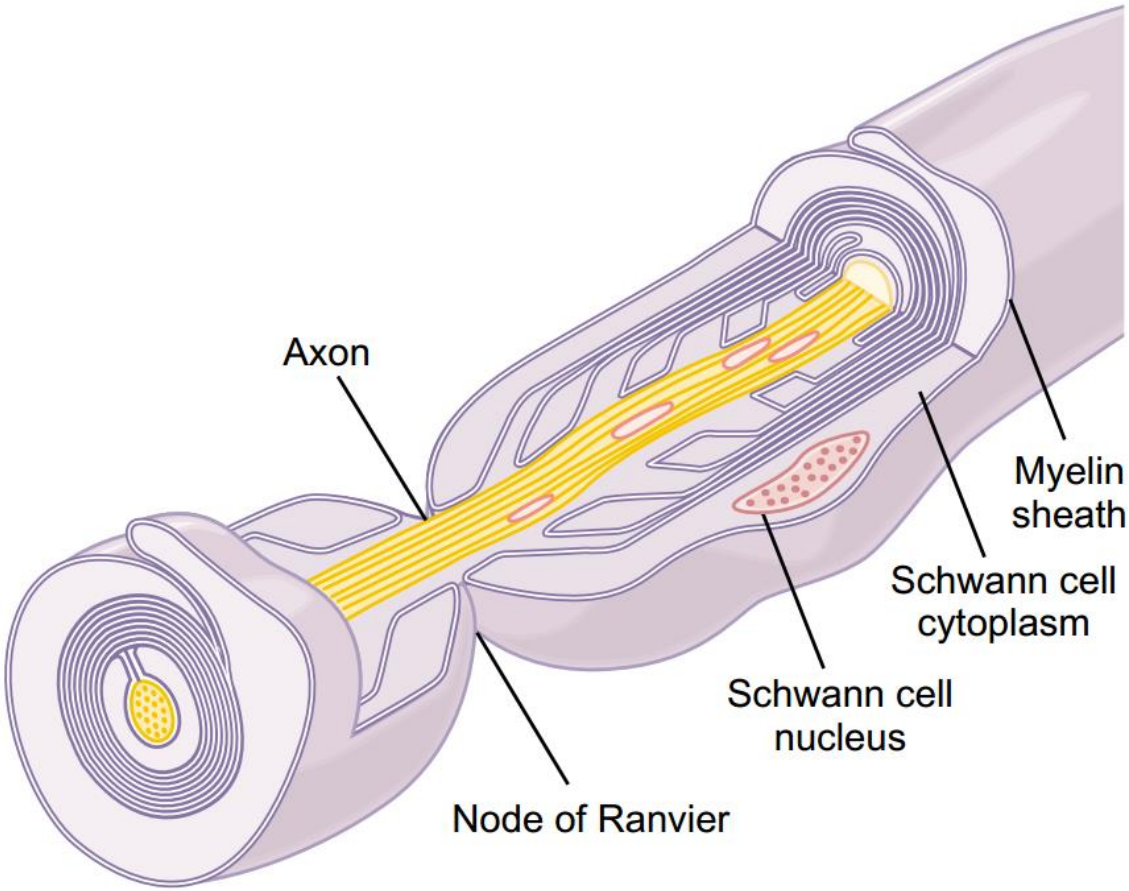


Multiple Sclerosis

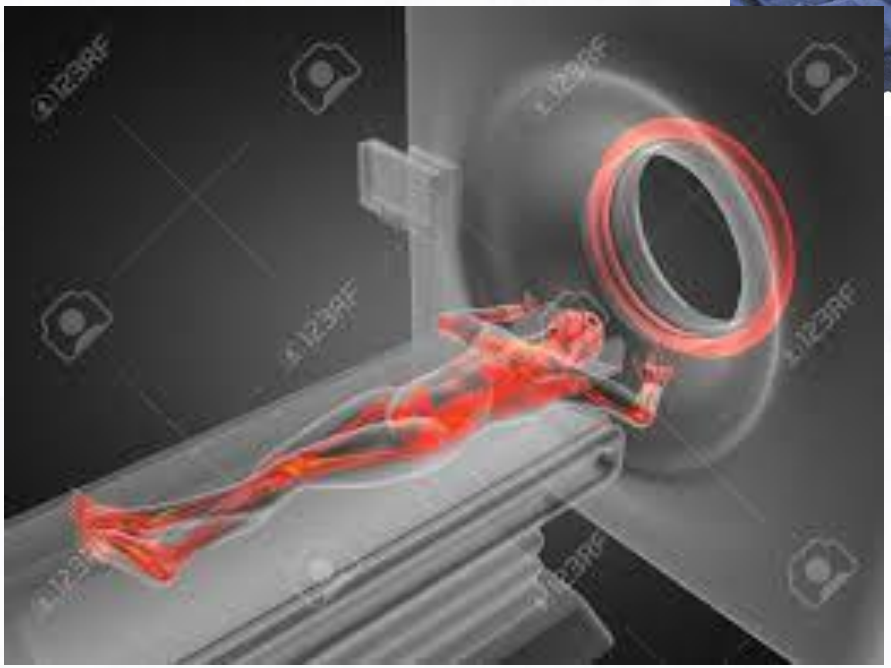
- Physical
- Mental
- psychiatric

DEMYELINATION

myelin ?!



MR Imaging



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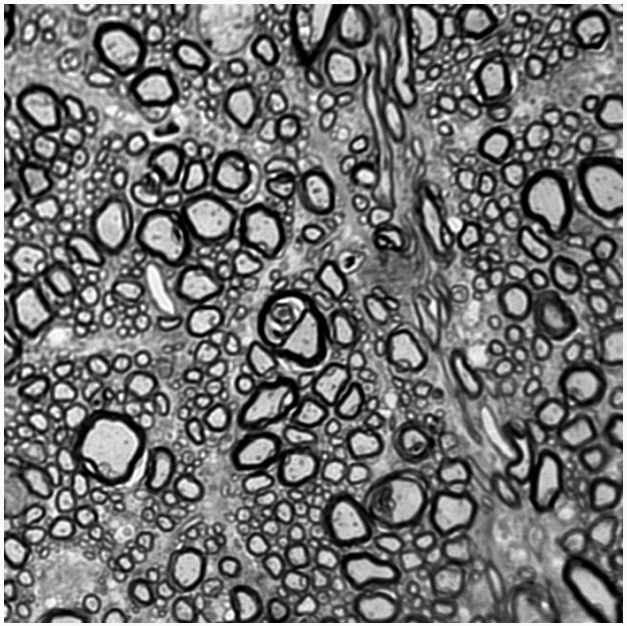

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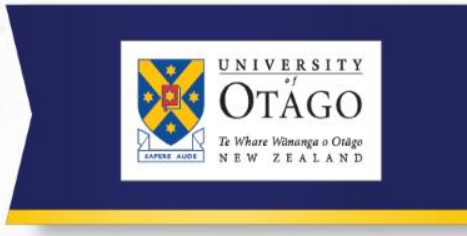
SAPERE AUDE

AUTOMATIC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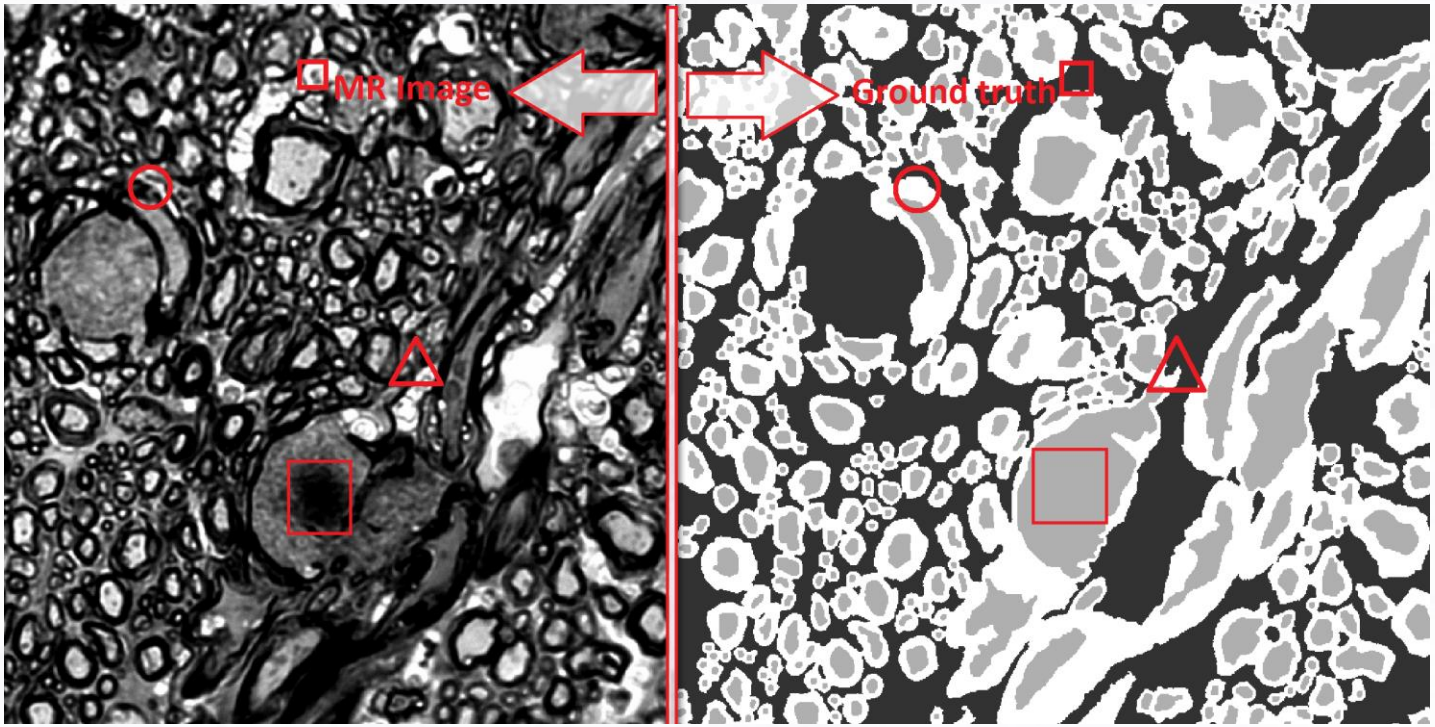
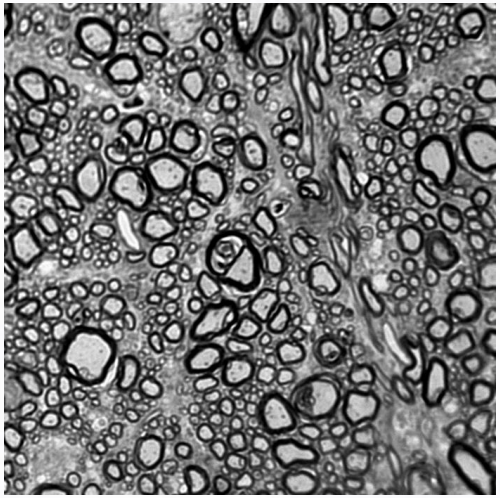
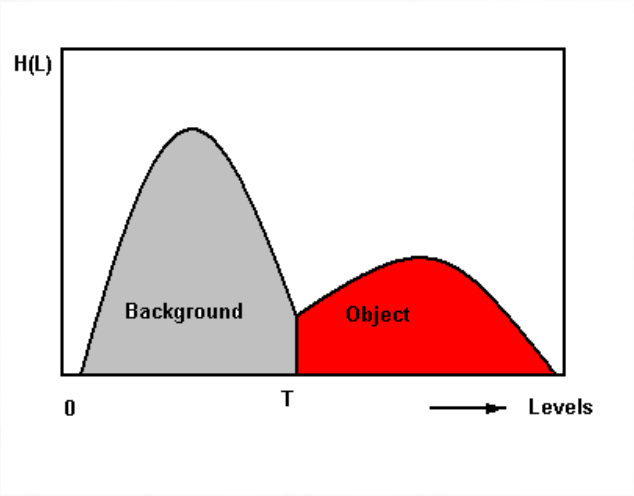
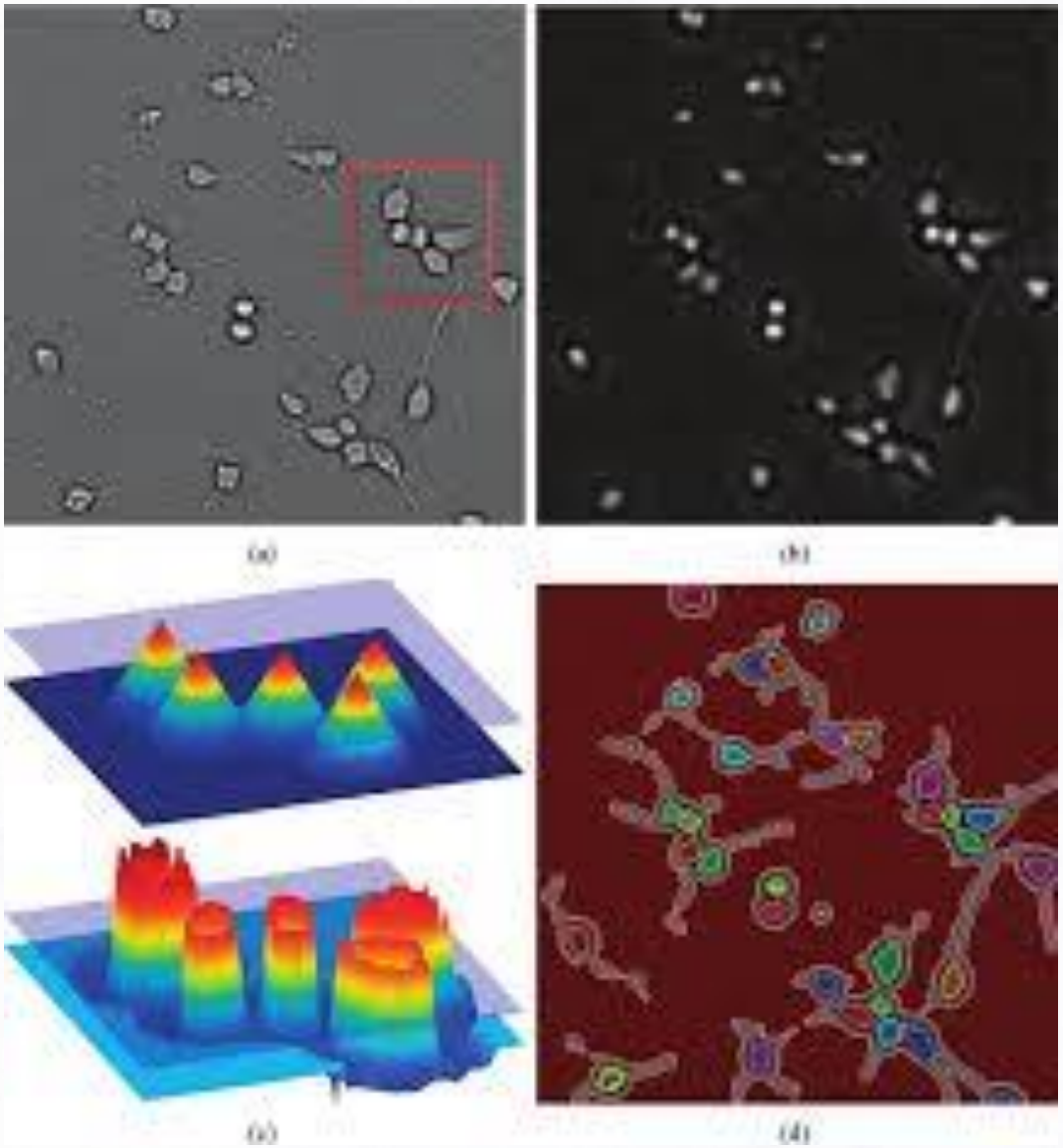
Problem Definition



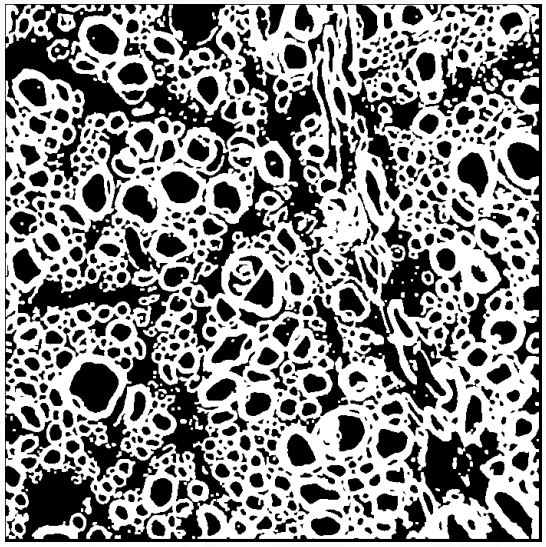
Thresholding





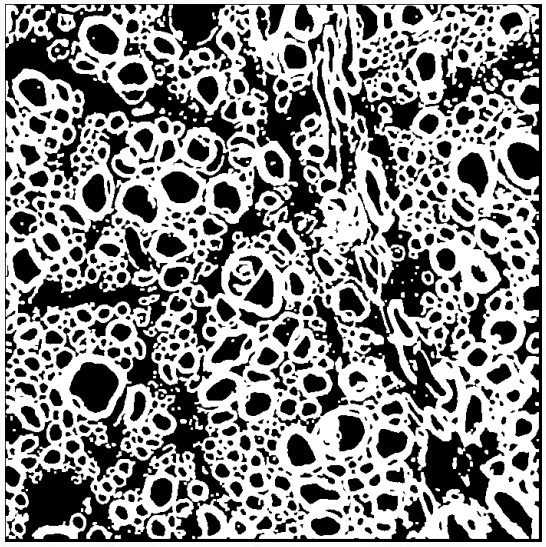


Otsu



VS

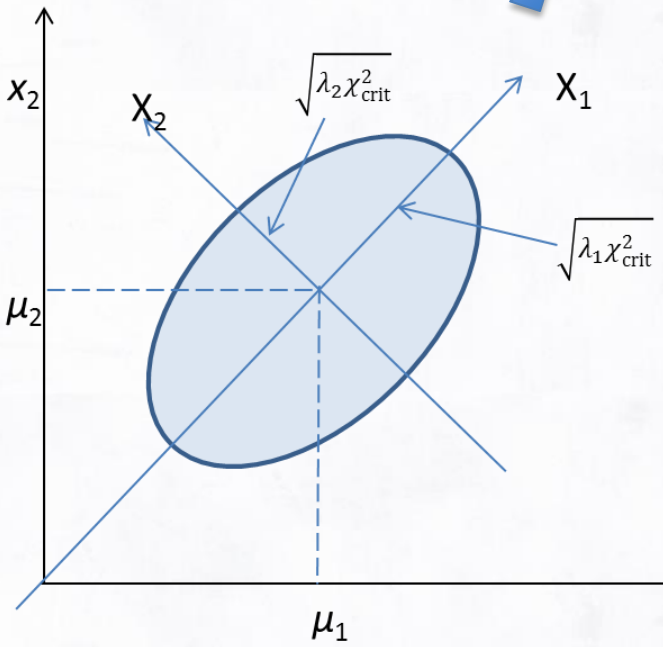
Fukunaga



Intensity is not the only feature!

Ellipse Fitting

$$ax^2 + bxy + cy^2 + dx + ey + f = 0$$

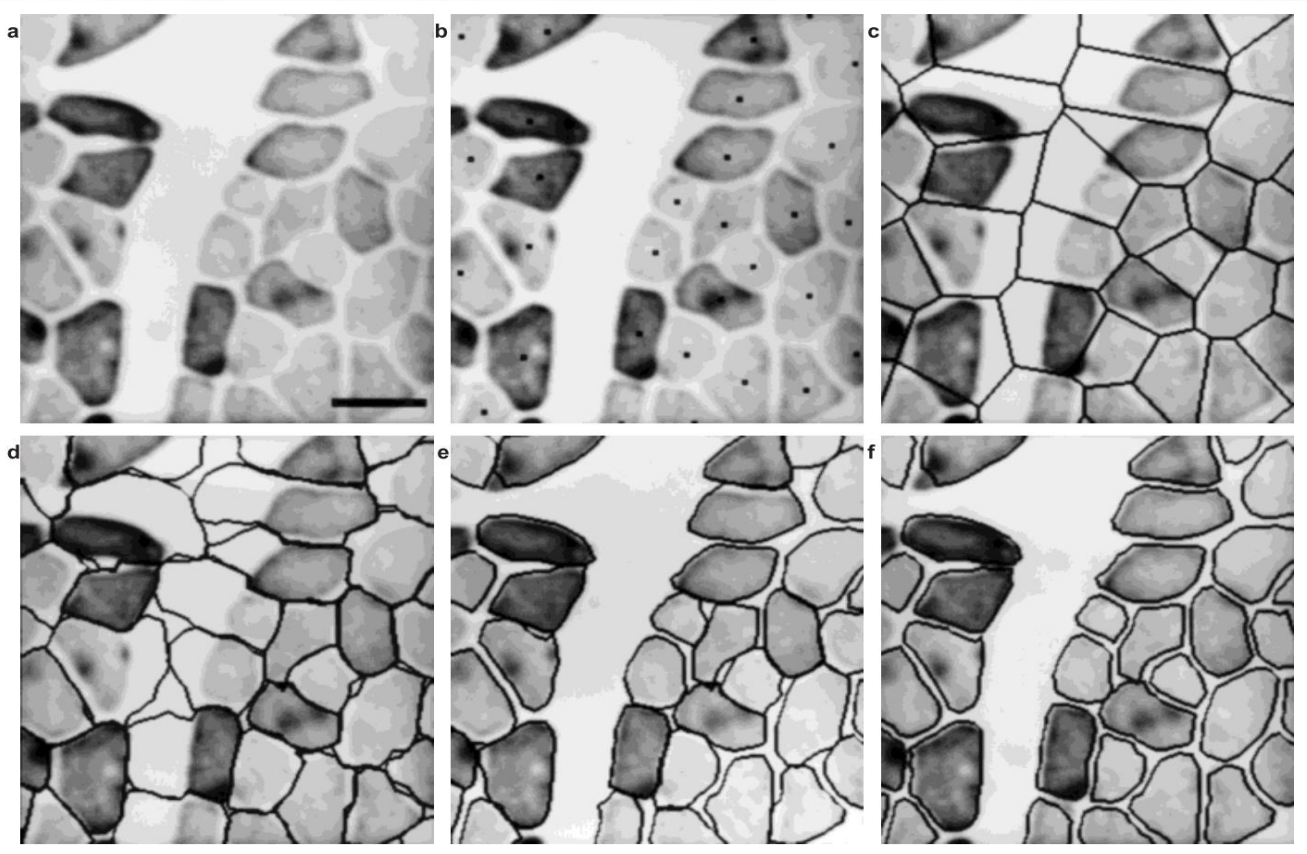


Very Sensitive to noise!

Active Contour Model

$$E^*_{snake} = \int_0^1 E_{snake}(v(s))ds$$

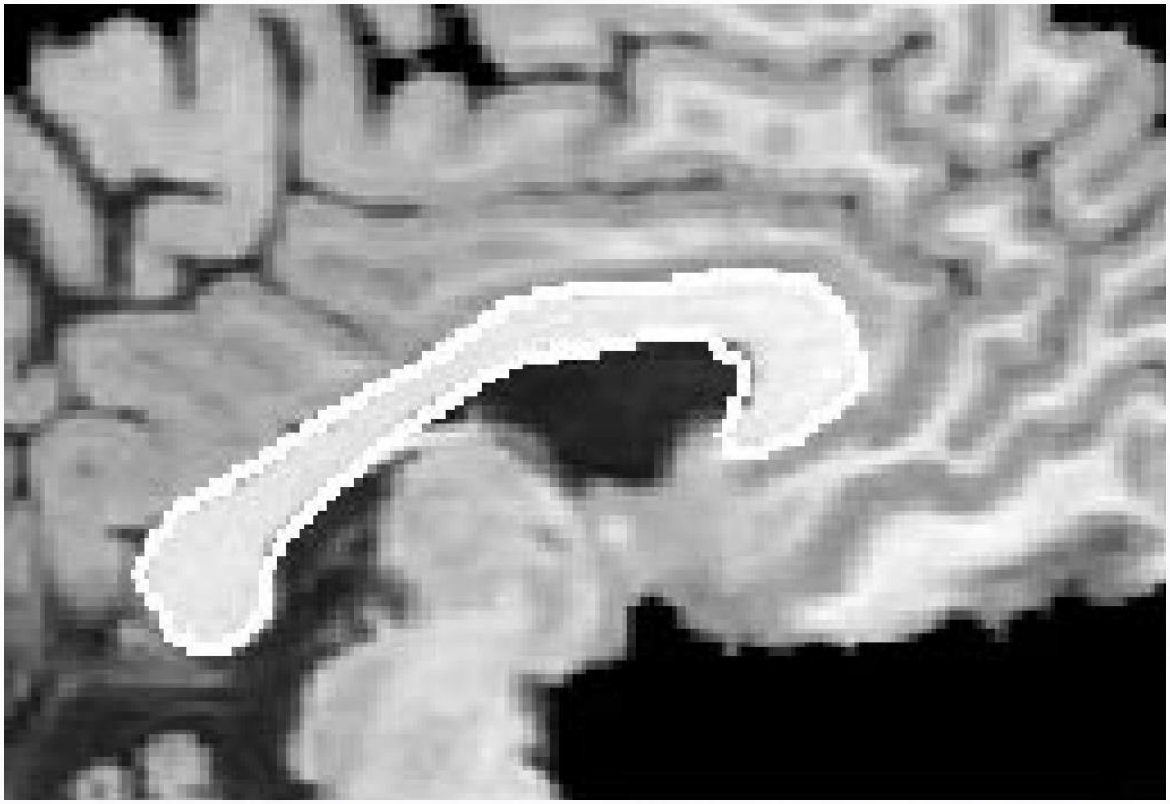
$$= \int_0^1 \{E_{internal}(v(s)) + E_{image}(v(s)) + E_{constraint}(v(s))\}\, ds$$



- **Very Sensitive to noise!**
- **Initialization!**

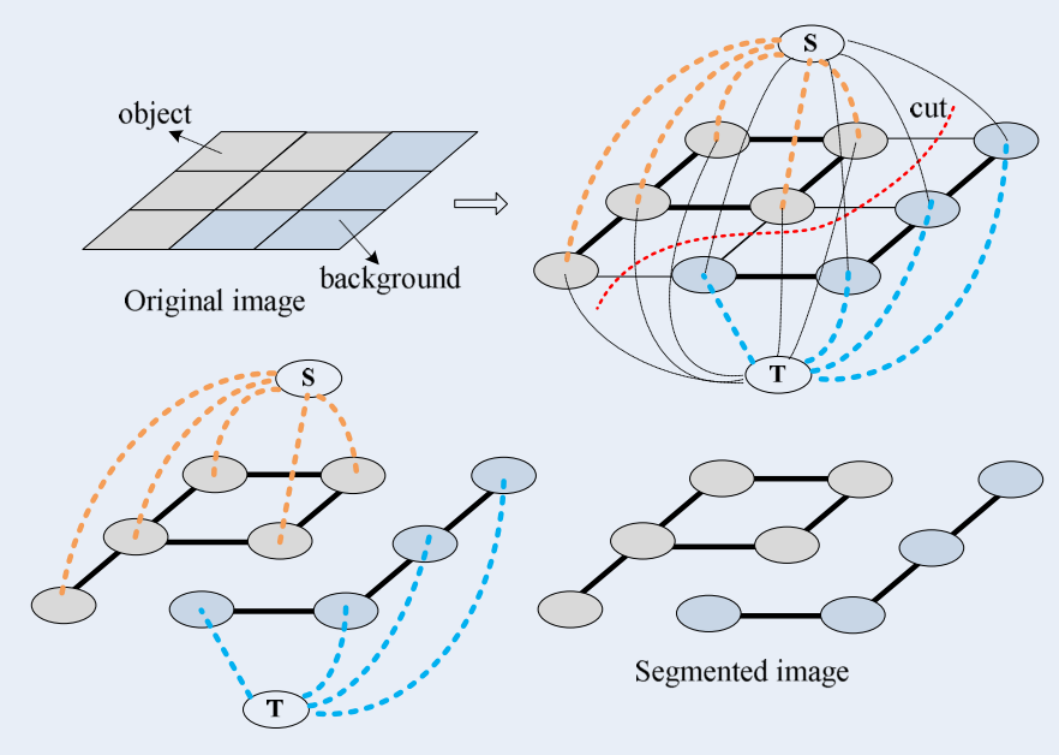
Active Shape Model

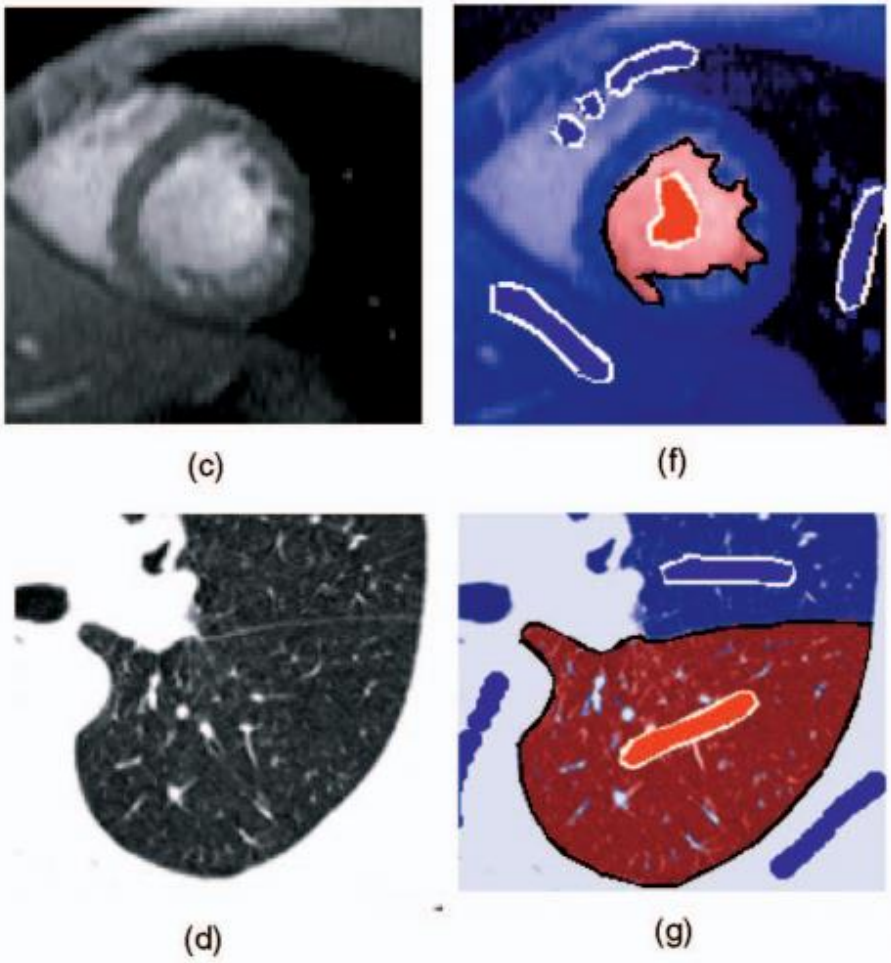
1. *Most Probable Shape*
2. *Possible Variances*
3. *Statistical Model*



Lack of flexibility - unseen variances**!**

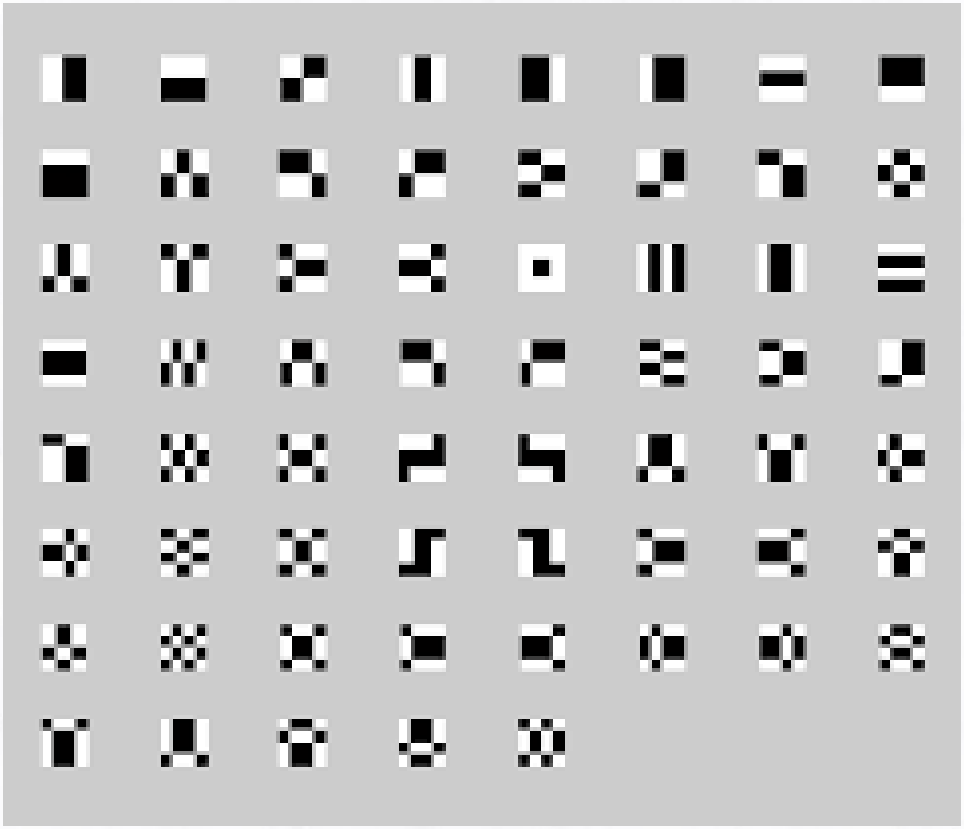
Graph Cut

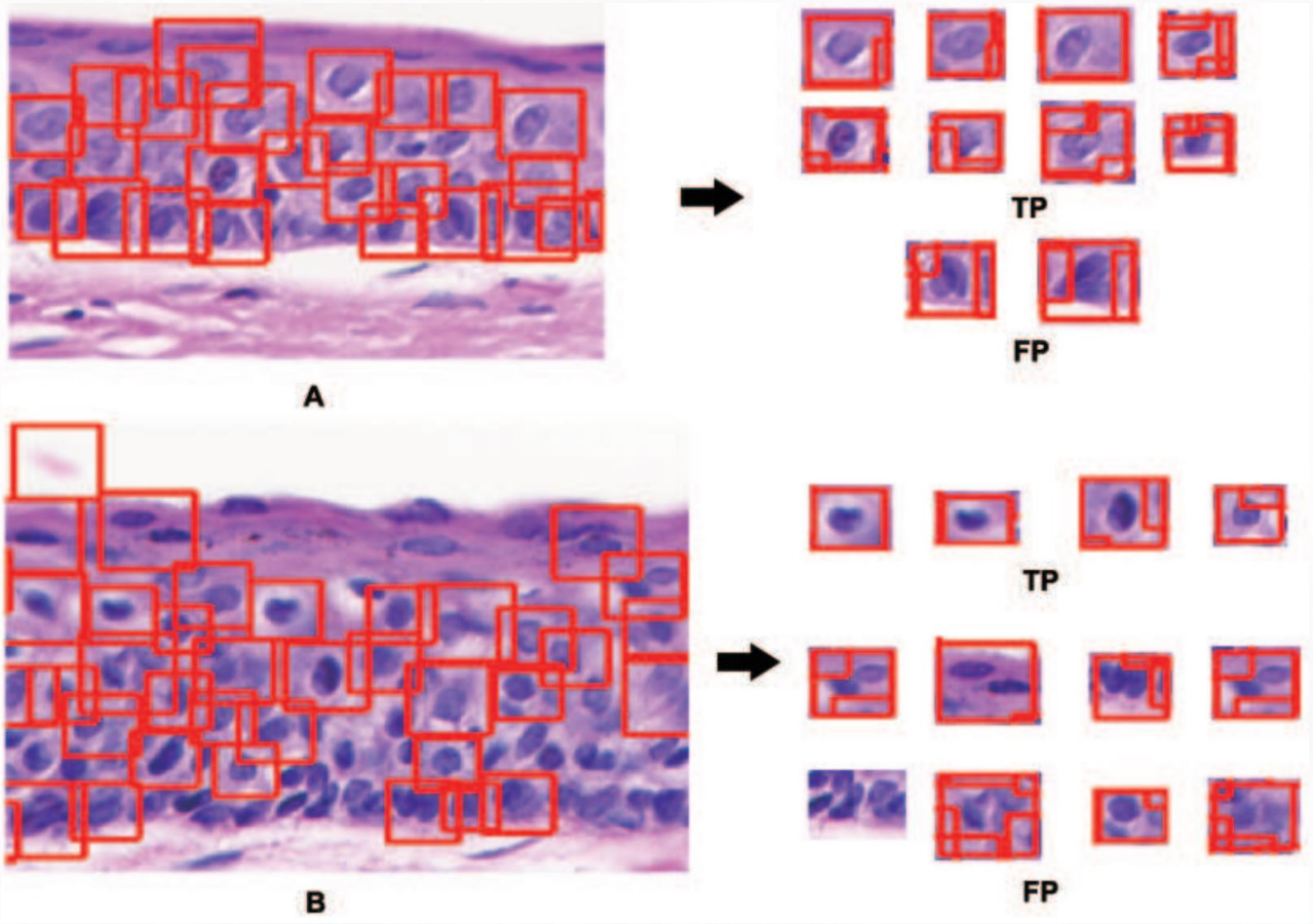




Many similar and close proximity features or objects with imperceptible edges!

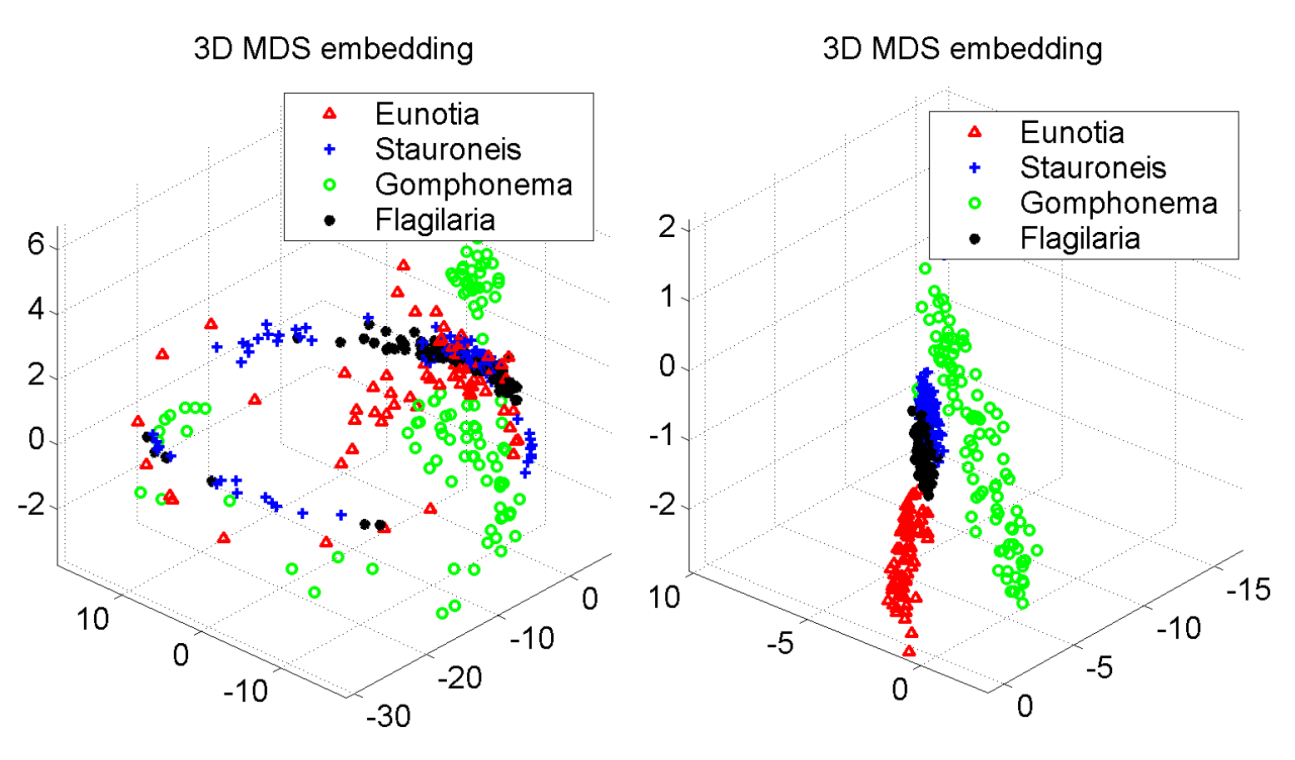
Haar Cascade Classifier

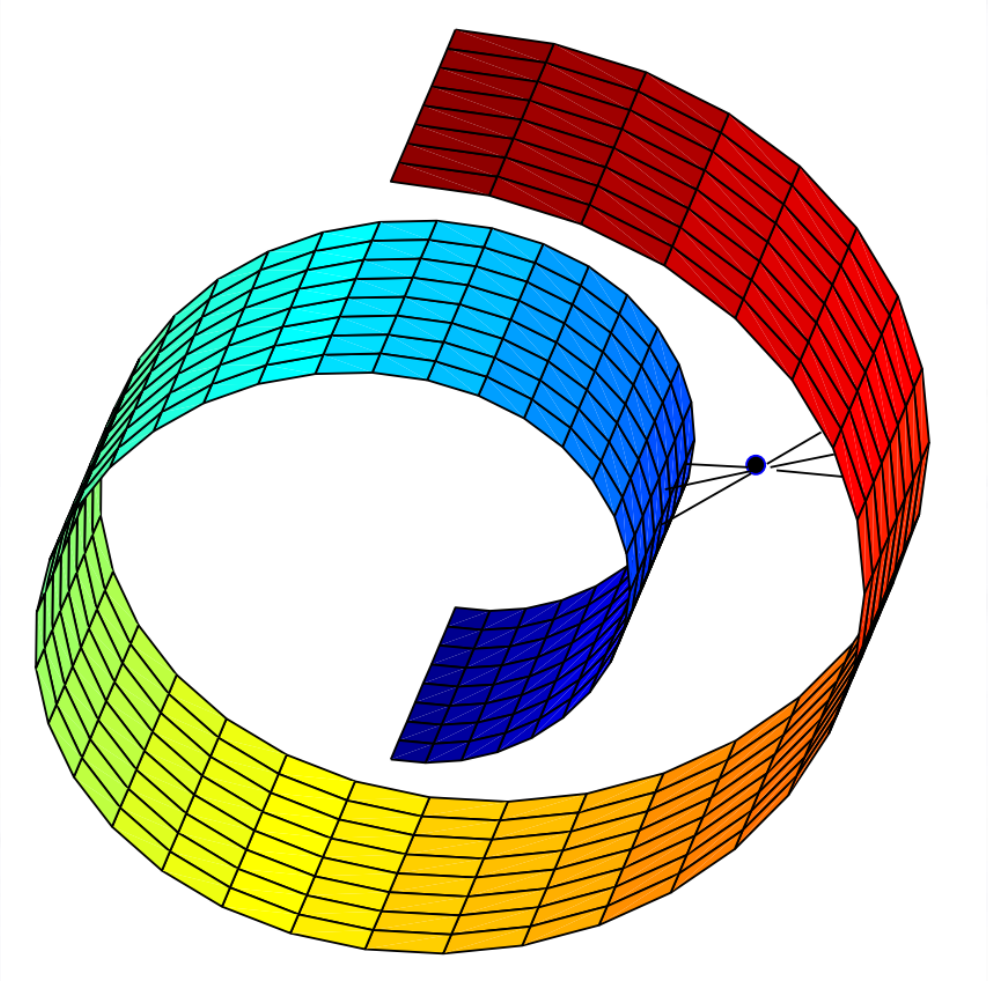




It generates many false positive detections in images with more Complex structures**!**

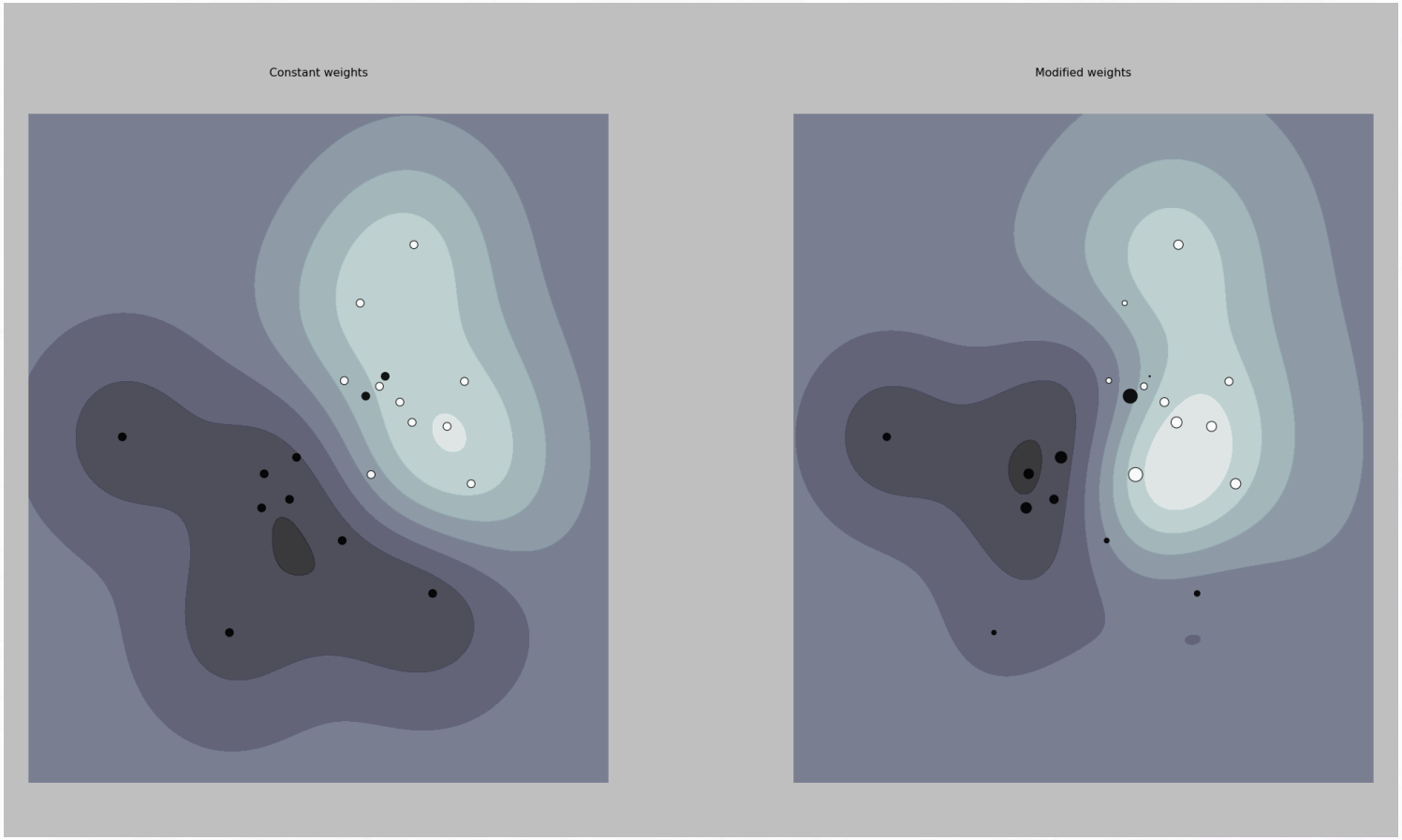
Manifold Clustering of Shapes

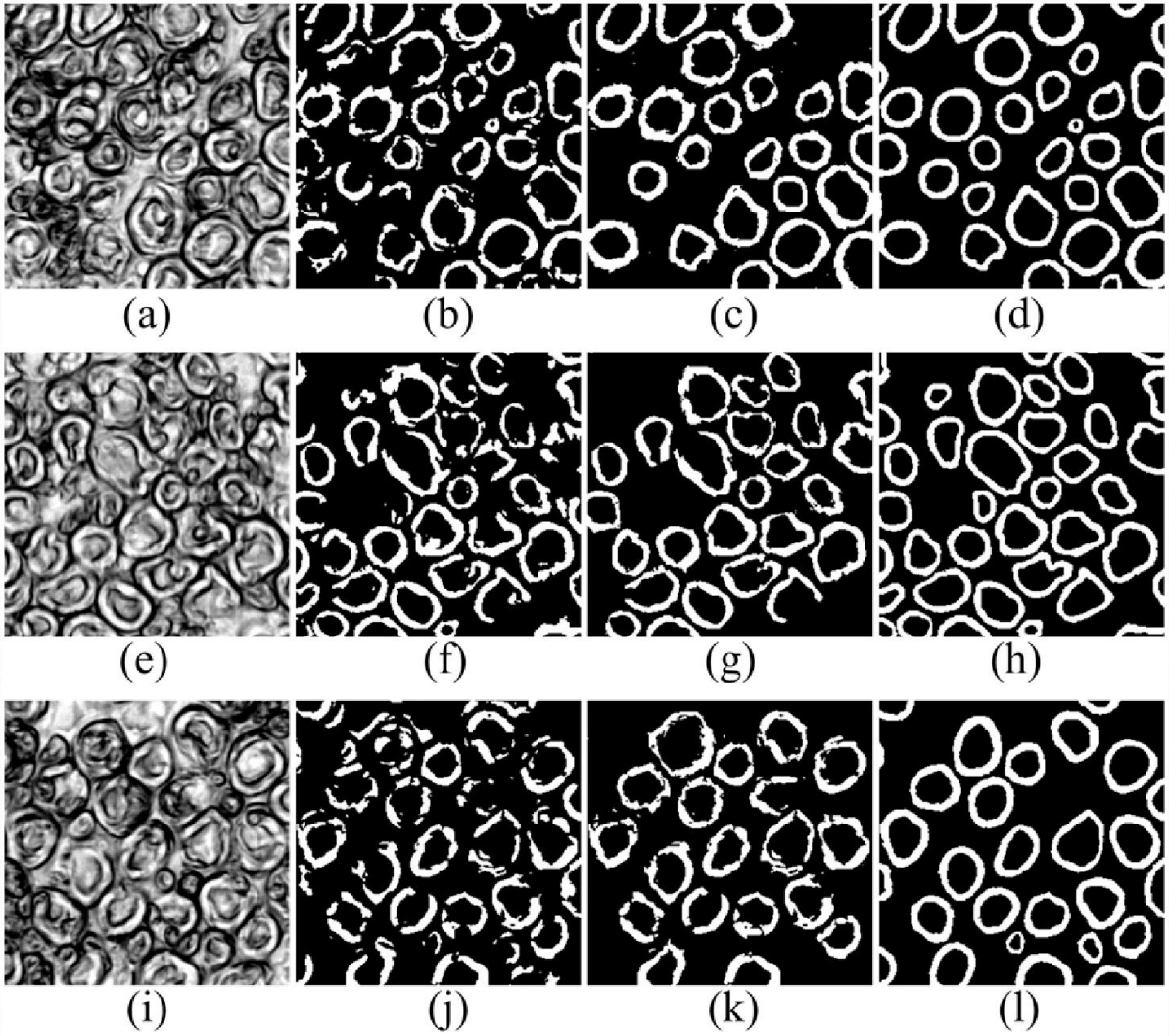




- Topologically unstable**!**
- Pre-processing step to extract shapes!

Support Vector Machine





- Hit-or-Miss**!**
- Need combination with other methods!

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SOLUTION?!

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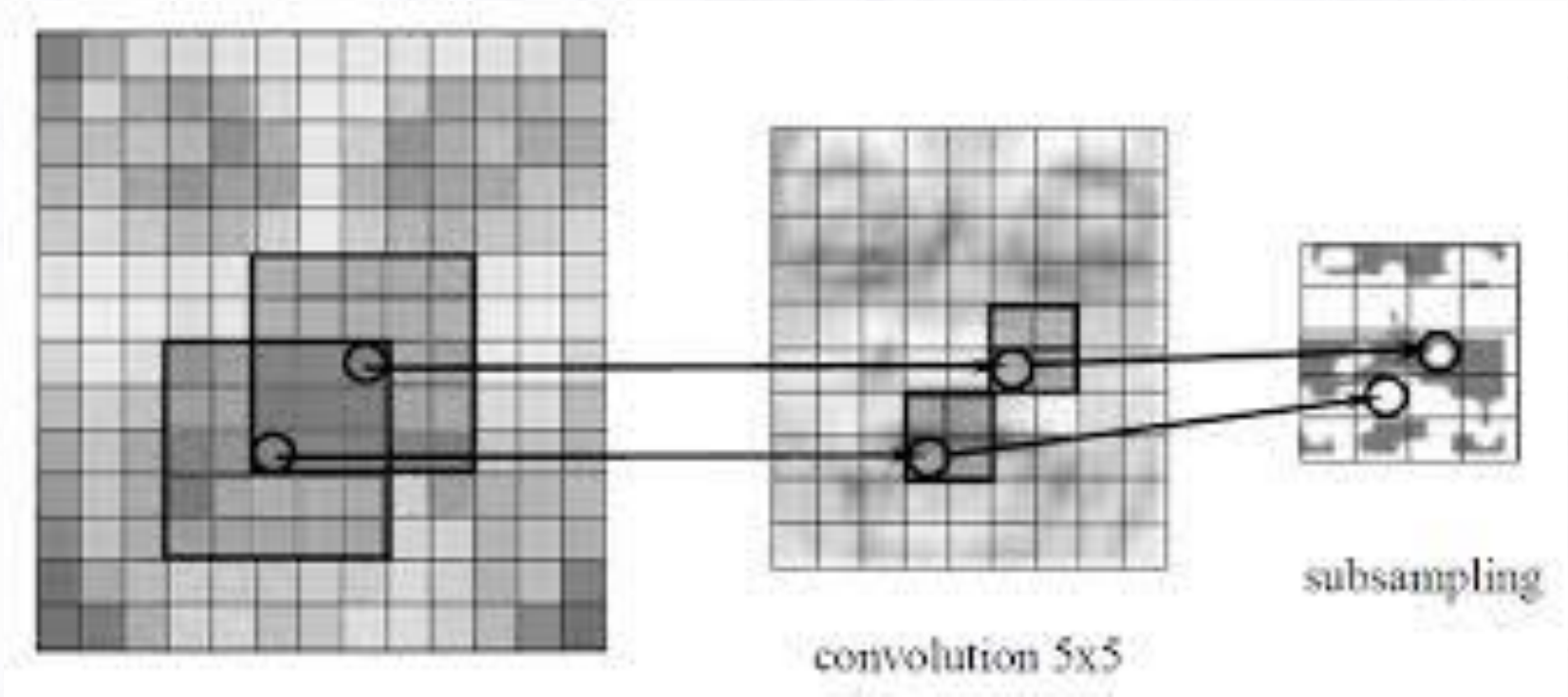
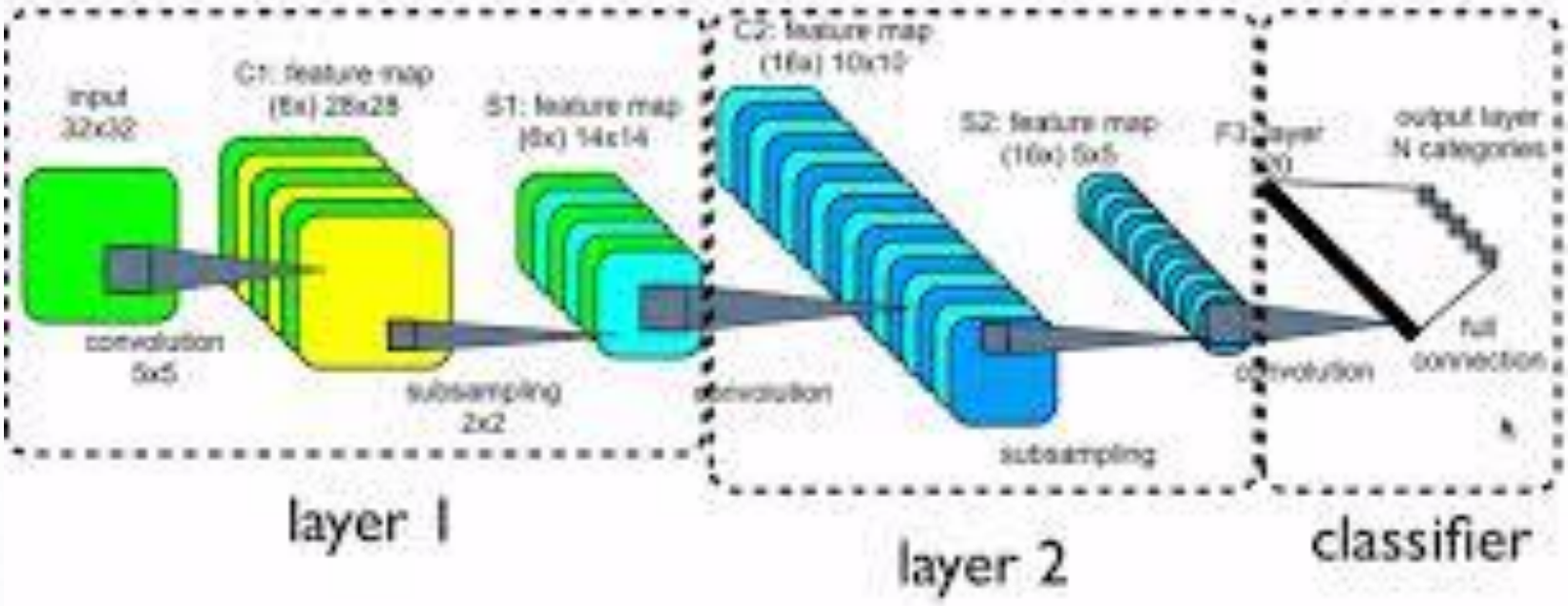
Convolutional Neural Networks



Convolutional Neural Networks



- Extracting Features
- Scale, Rotation, Location Invariance
- Robust to Noise
- …

THANK YOU

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