MIPS Lab

Multimedia Interaction Perception Society

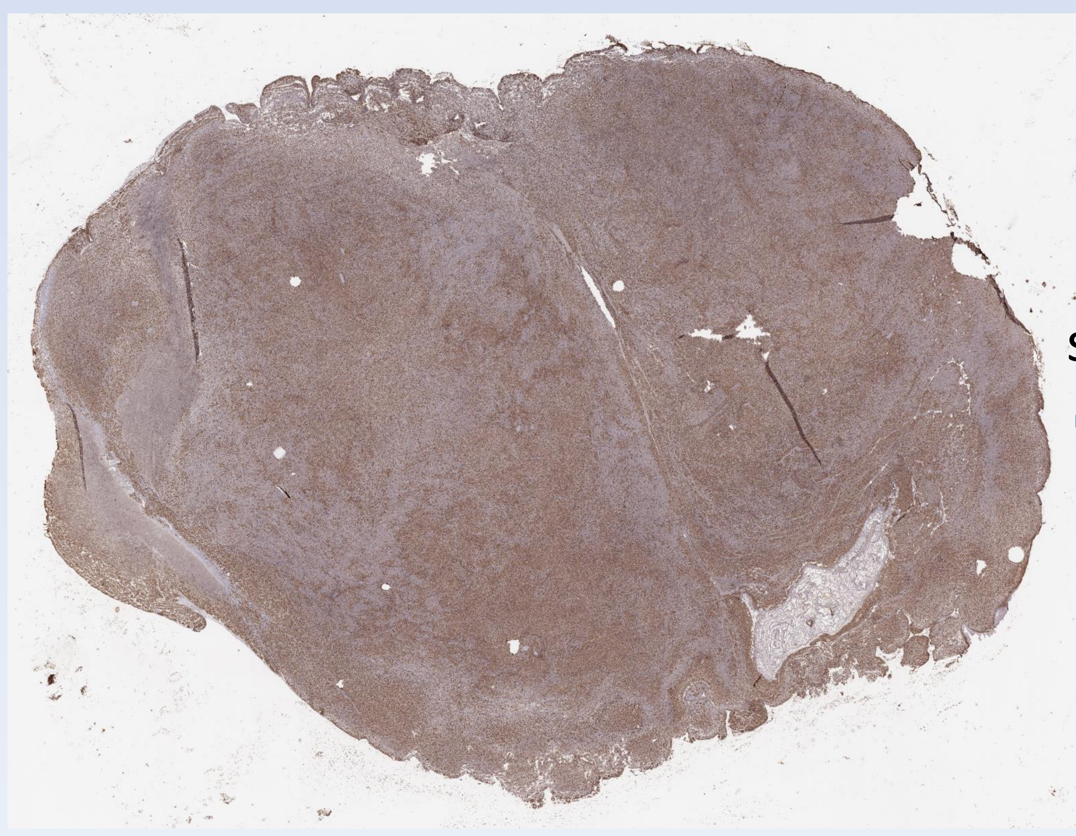
UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI INFORMATICA

Automatic quantification of histochemical images of cancerous tissue samples: a method based on a computational model of human color vision

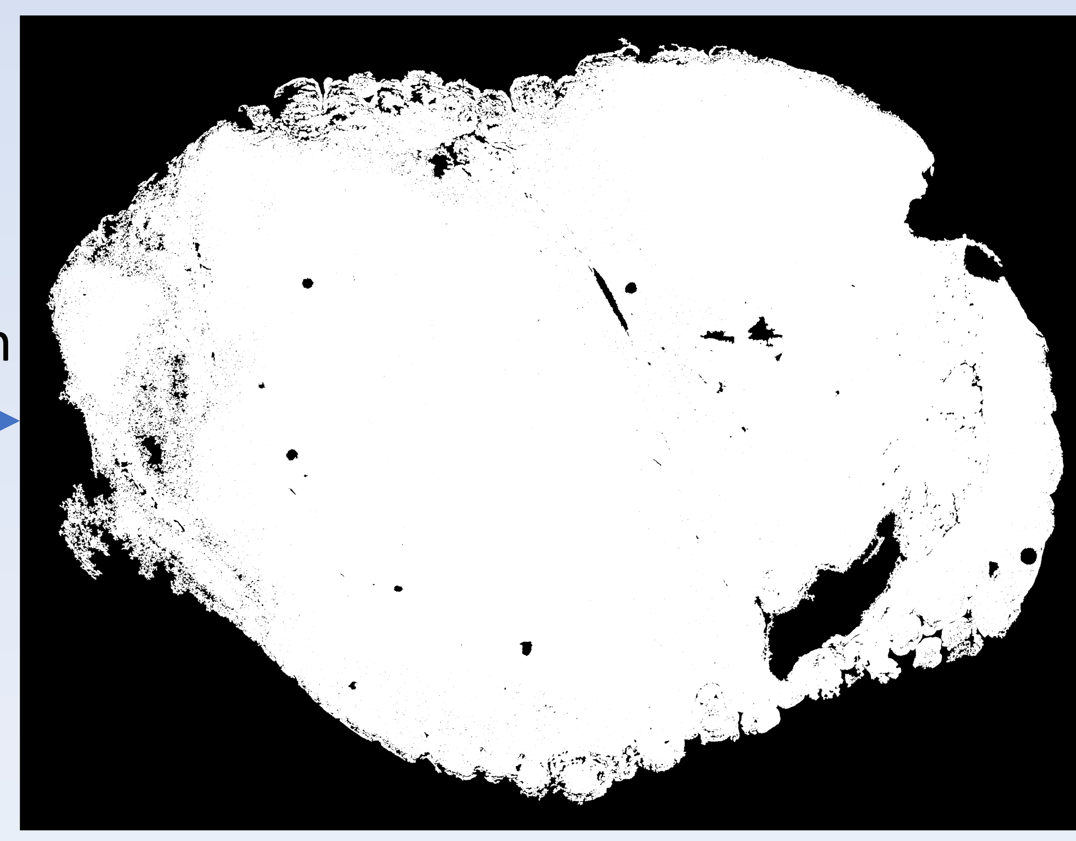
di Elena Casiraghi[a], Barbara Vergani[b], Barbara Rita Barricelli[a], Simone Liberini[a], Biagio Eugenio Leone[b], Alessandro Rizzi[a]
[a]Università degli Studi di Milano, Department of Computer Science, Via Celoria 18, 20133 Milano, Italy
[b]Università degli Studi di Milano-Bicocca, School of Medicine and Surgery, Via Cadore 48, Monza, 20900 Italy

Corresponding author: Elena Casiraghi – Dipartimento di Informatica "Giovanni Degli Antoni", Università degli Studi di Milano, Via Celoria 18, 20133 Milano, Italy.
Tel: +39 02 50316275 - +39 02 50316285, fax: +39 02 50316373, e-mail a: elena.casiraghi@unimi.it

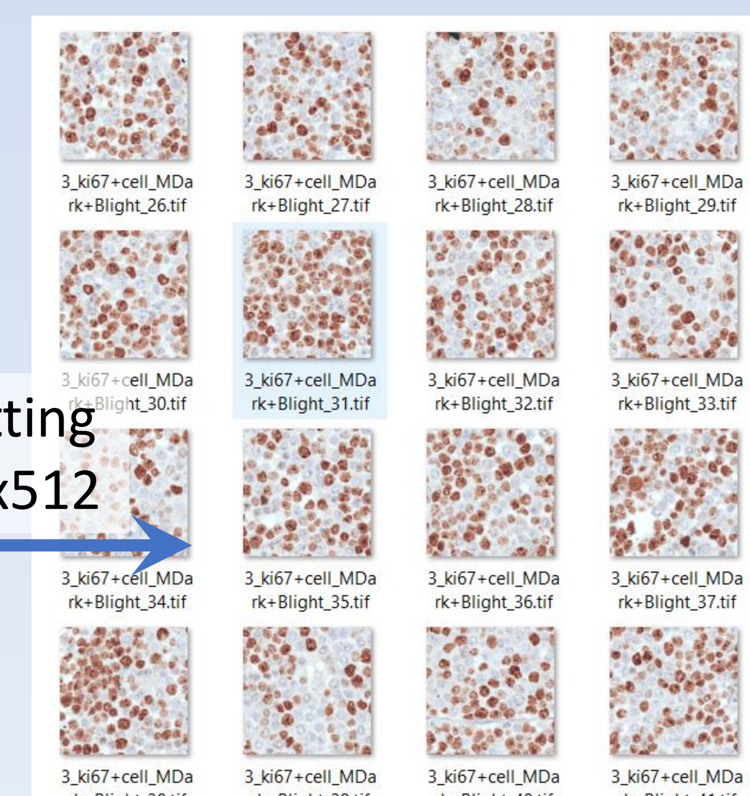
Protein Ki67 is present in replicating nuclei. It is therefore used as a marker of tumor aggressiveness. Its quantification is important for diagnostic and prognostic evaluations. For pKi67 quantification, the Ki67-index is estimated by clinicians. Ki67 index: the percentage of marked tumor nuclei with respect to all tumour nuclei. BUT: histochemical images have high dimension and high resolution.
Human counting procedures are labourious, time consuming, error prone, affected by high inter and intra-variability.
Clinicians need automatic counting procedures to aid their work.



Tissue area segmentation

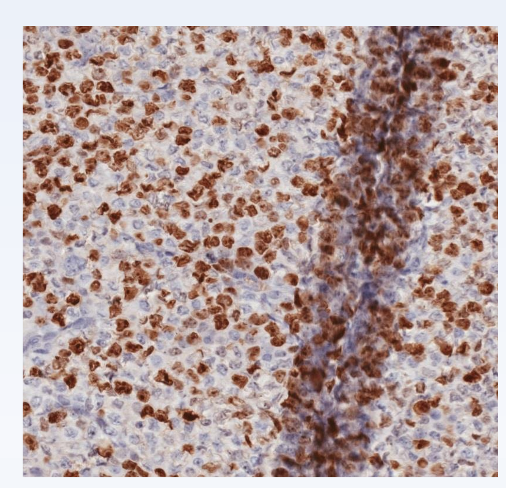


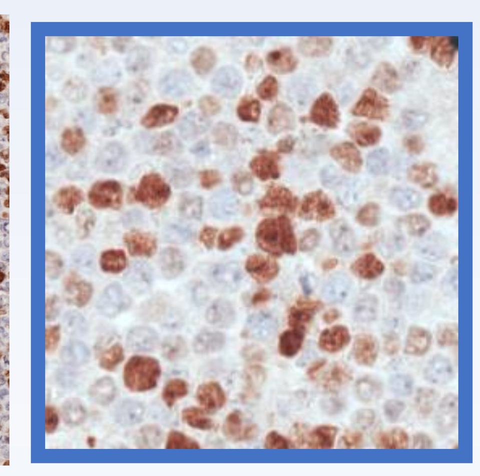
Splitting 512x512



Database: 10000 histochemical subimages marked for Ki67

15 sections (marked for pKi67) of cancerous tissue. They show: high color/luminance variability, problems due to the biological procedures applied for tissue staining (tissue cuts, tissue folds, unwanted and unspecific colorations) and image acquisition acquisition (blur, noise)

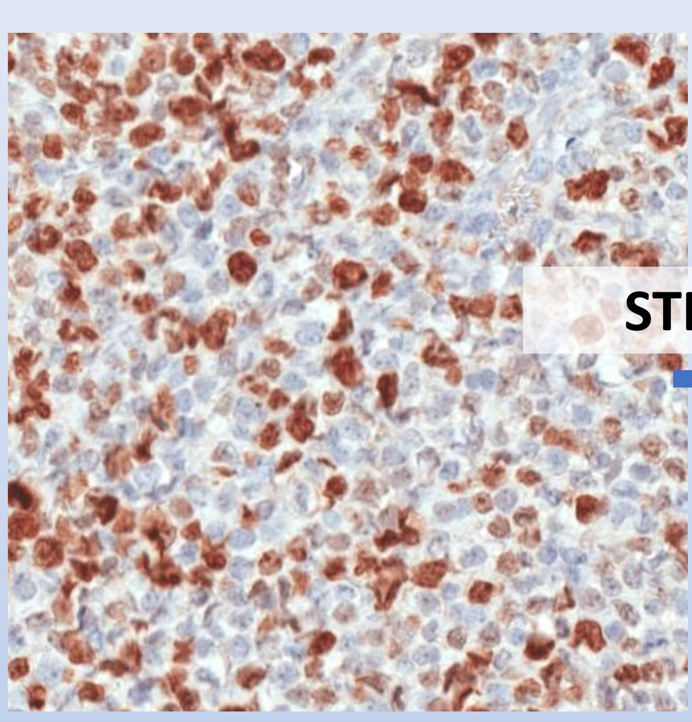




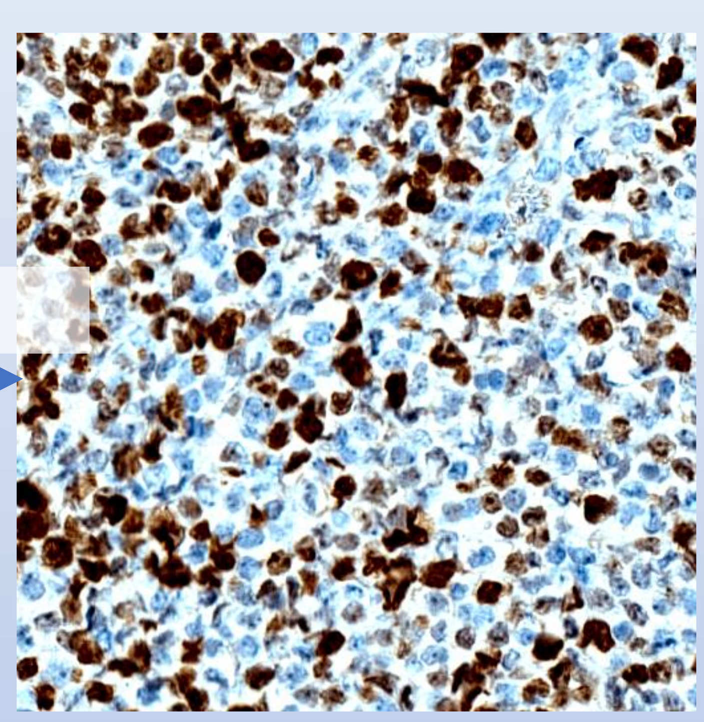
The aim. develop an automatic system estimating the Ki67-index: the percentage of replicating cells (brownish) with respect to all cells (brownish+bluish)

Problem solved with stress + simple thresholding+ supervised learner (bayesian tree)

Expert users manually select three training sample sets: 1) marked nuclei; 2) not marked nuclei; 3) background tissue. The color of each training pixel p is coded as Color(p)=[R(p),B(p),H(p)] and a bayesian tree is trained (R,B from RGB color space, H from HSV color space). Training sets allow computing the median area of marked nuclei (medAOn), and the median area of not-marked nuclei (medAOff).

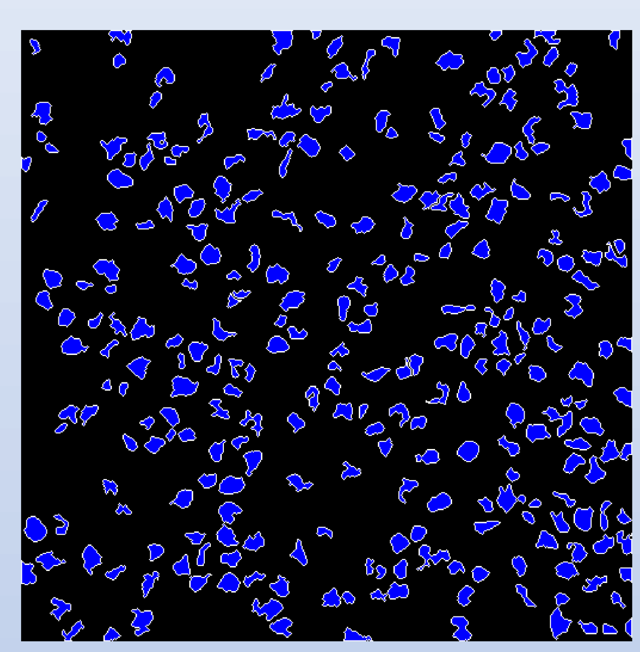


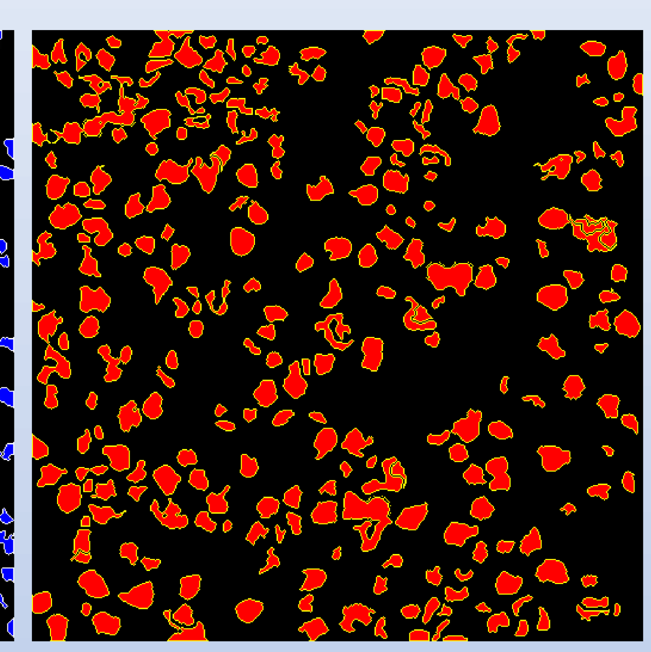
STRESS

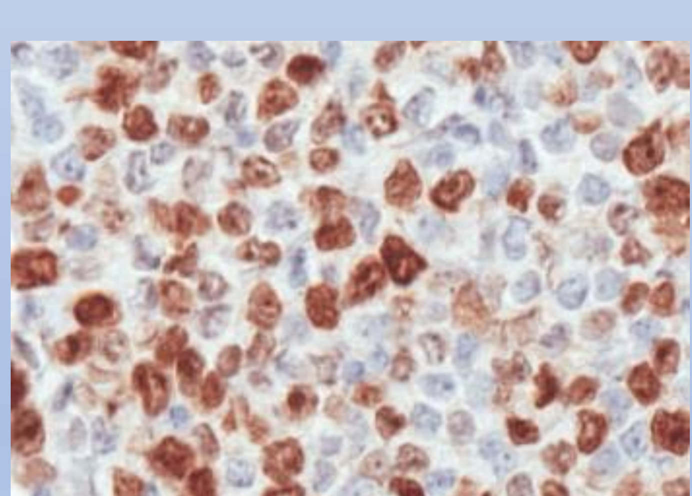


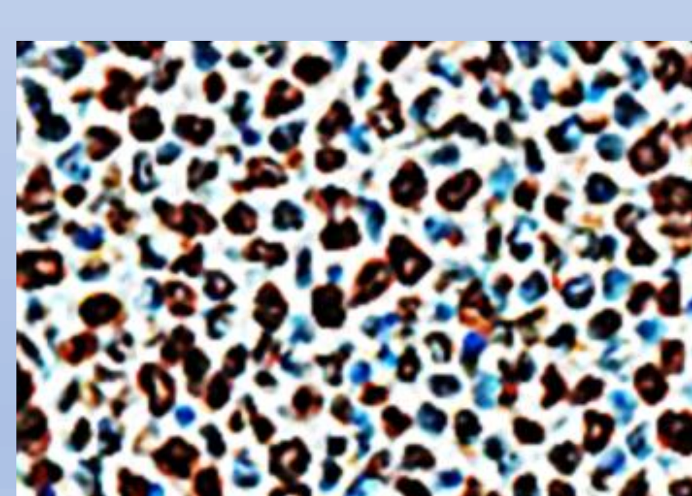
Thresholding to identify all pixels belonging to nuclei (marked and not marked)

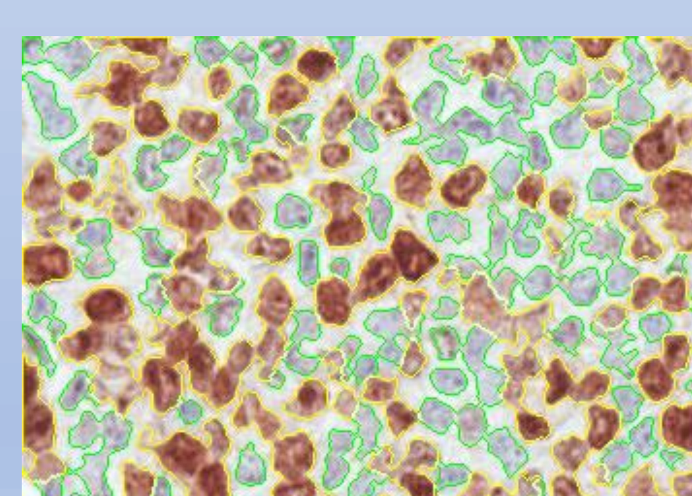
Selected pixels are classified by bayesian tree as belonging to marked nuclei (OnPixels) or not marked nulei (OffPixles)











Two index estimations:

$$IE1 = \frac{\#OnPixels}{(\#OnPixels + \#OffPixels)}$$

$$IE2 = \frac{\frac{\#OnPixels}{medAOn}}{\frac{\#OnPixels}{medAOn} + \frac{\#OffPixels}{medAOff}}$$

Correlation(IE1,E30) > Correlation(IE1,E15)
Correlation(IE2,E30) > Correlation(IE2,E15)

E15 = estimates of expert with 15 years of experience
E30 = estimates of expert with 15 years of experience