

Hidy Gábor

Stain normalisation techniques for  
histopathology images

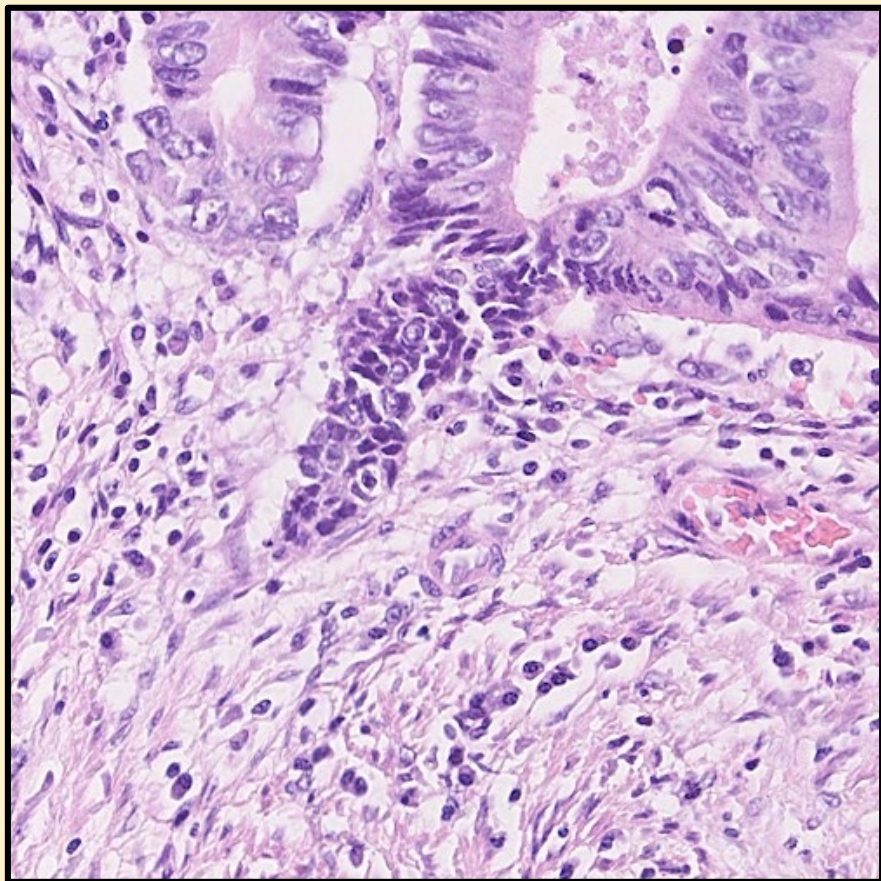
Project supervisor: dr. Lukács András

# Tissue staining

---

## Tissue staining

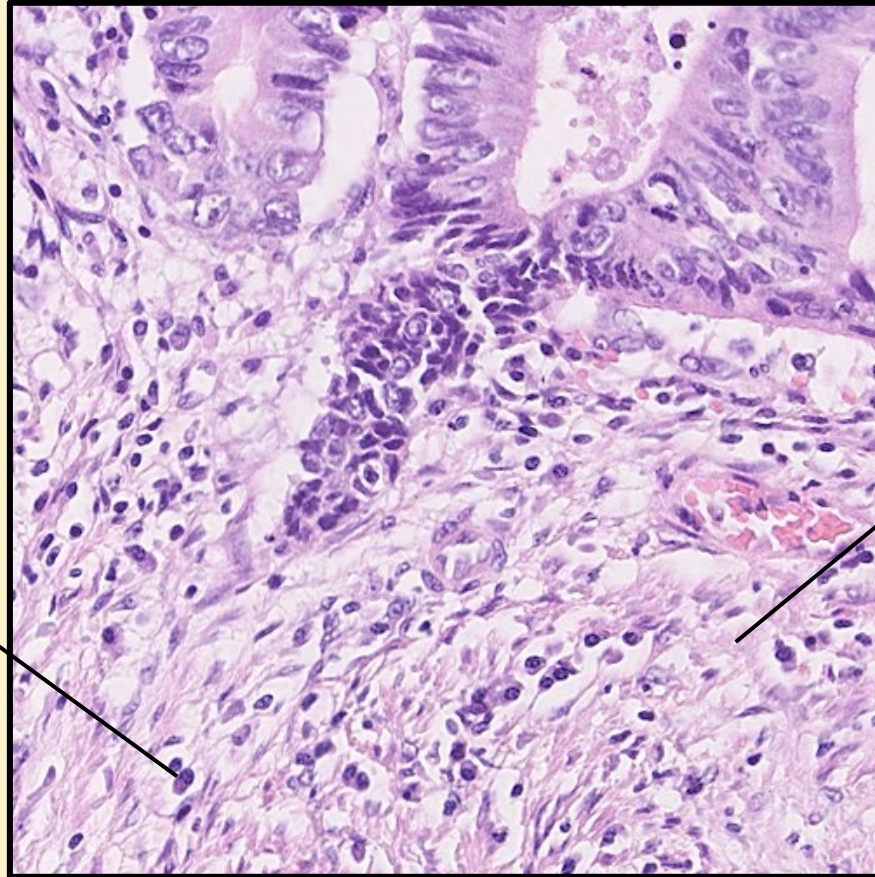
---



## Tissue staining

---

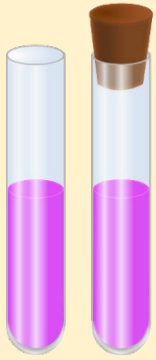
haematoxylin  
nucleus  
blueish purple



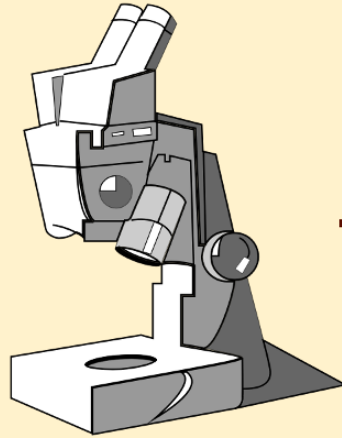
eosin  
cytoplasm  
pink

# Tissue staining

---



staining



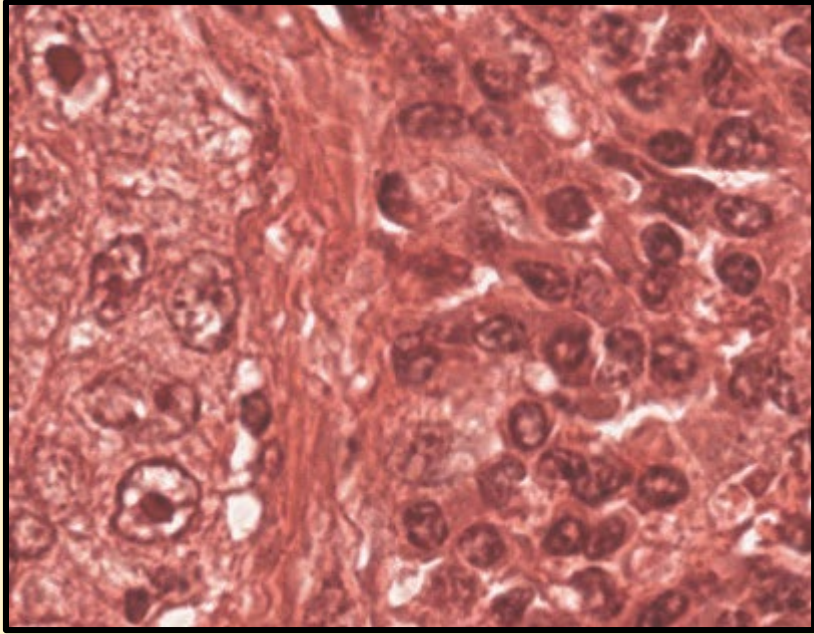
scanning



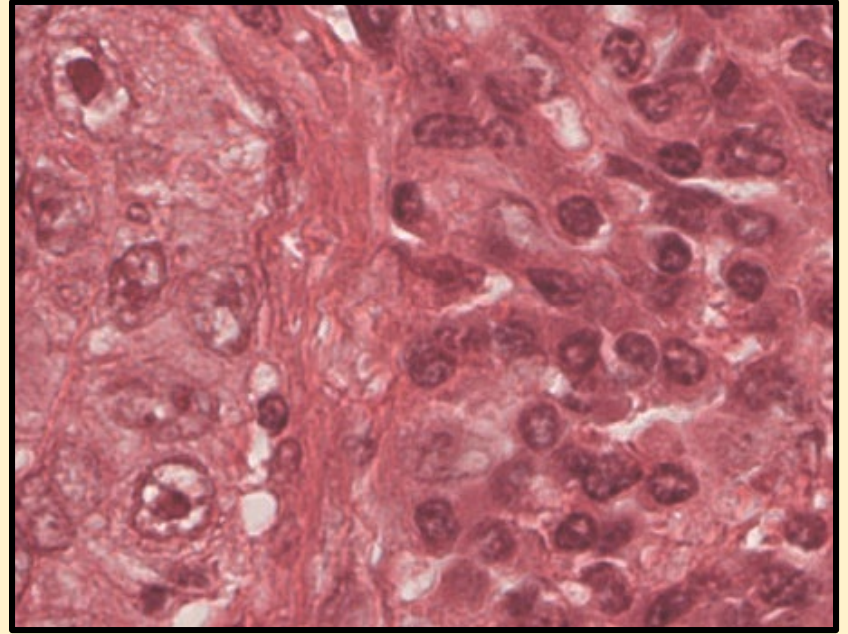
display

## Tissue staining

---



(a) Aperio scanner



(b) Hamamatsu scanner

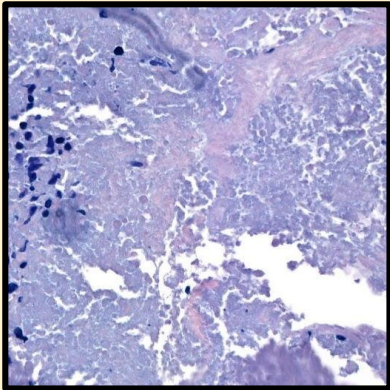
# Stain normalisation

---

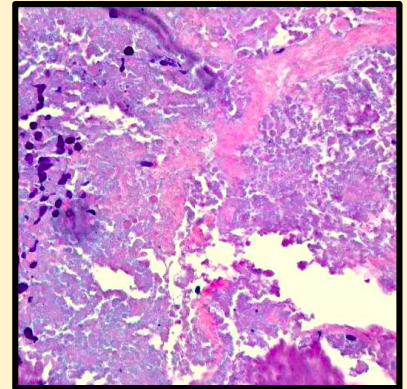
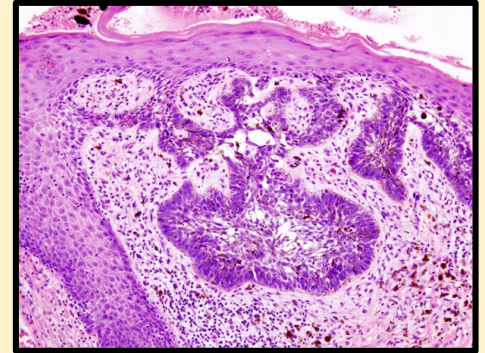
# Stain normalisation

---

source



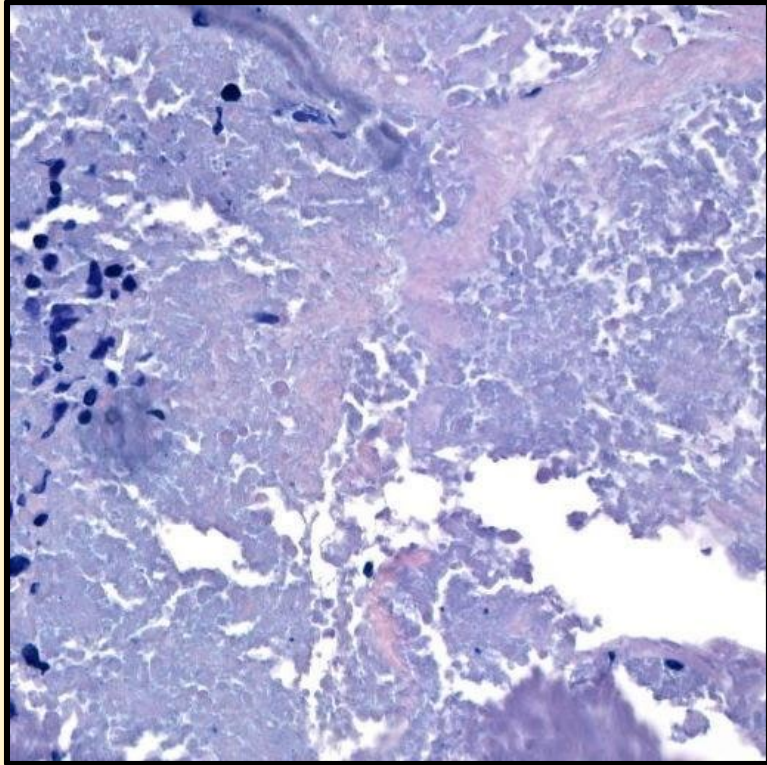
target



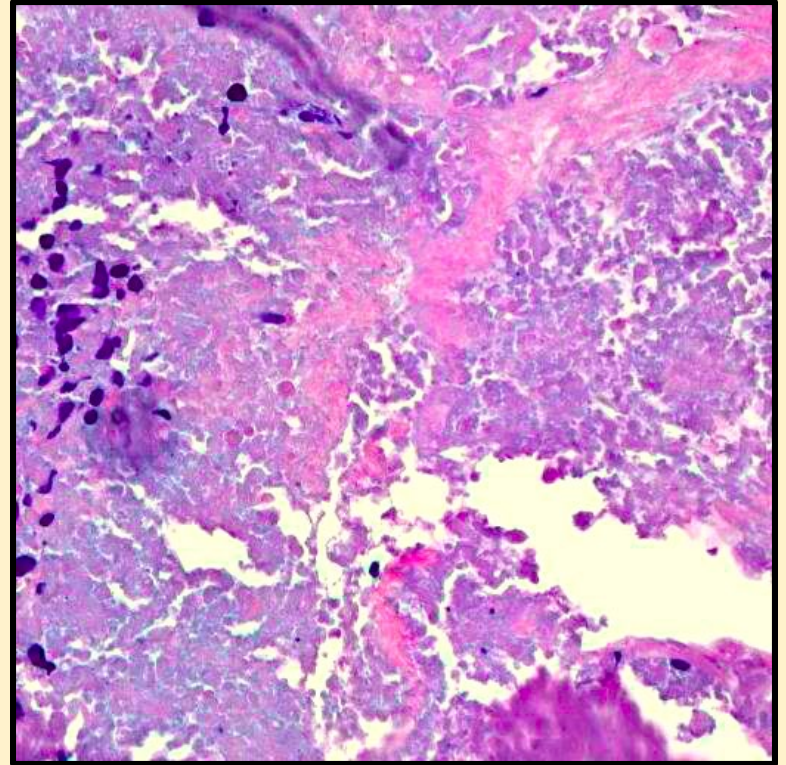


## Stain normalisation

---



(a) original

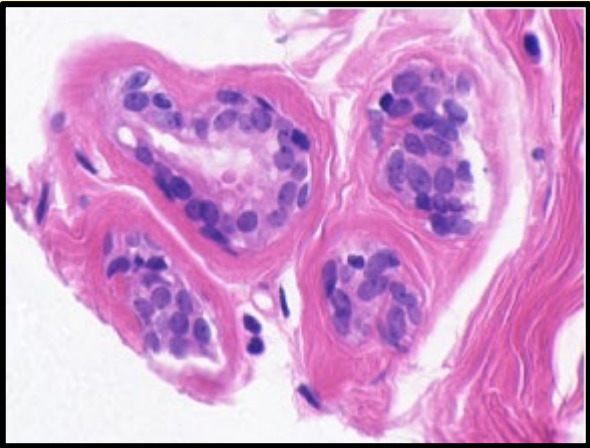


(b) transformed image

# Stain separation

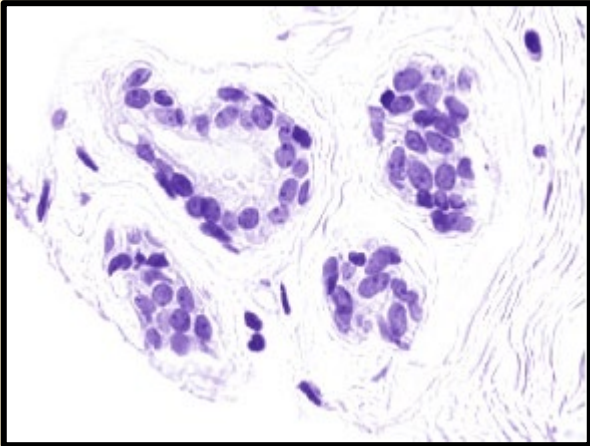
---

# Stain separation

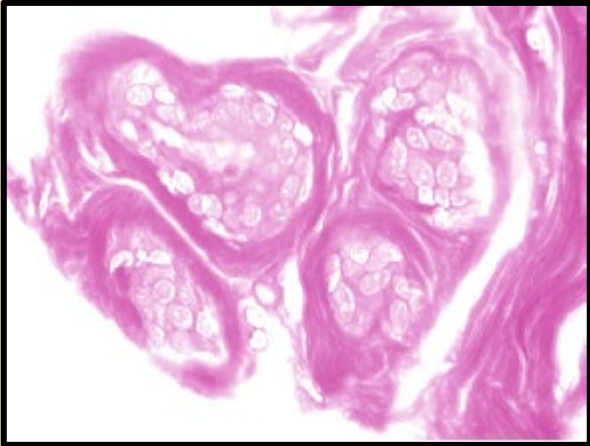


original

haematoxylin

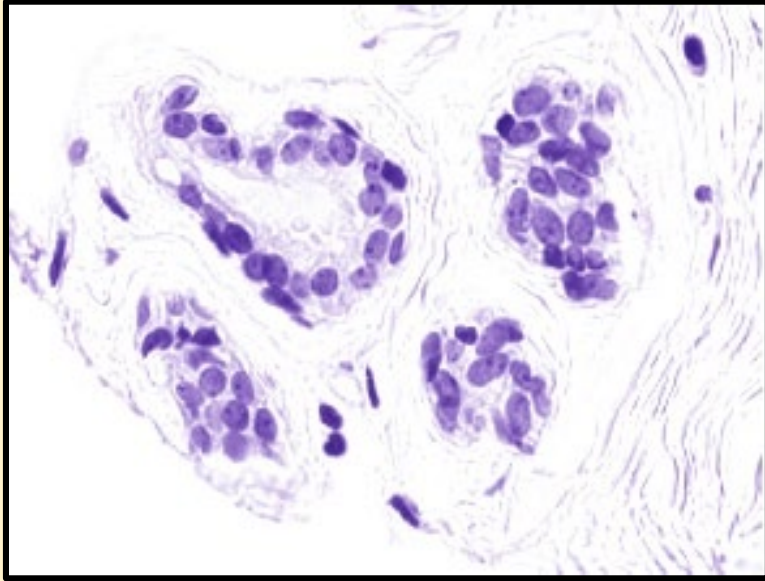


eosin

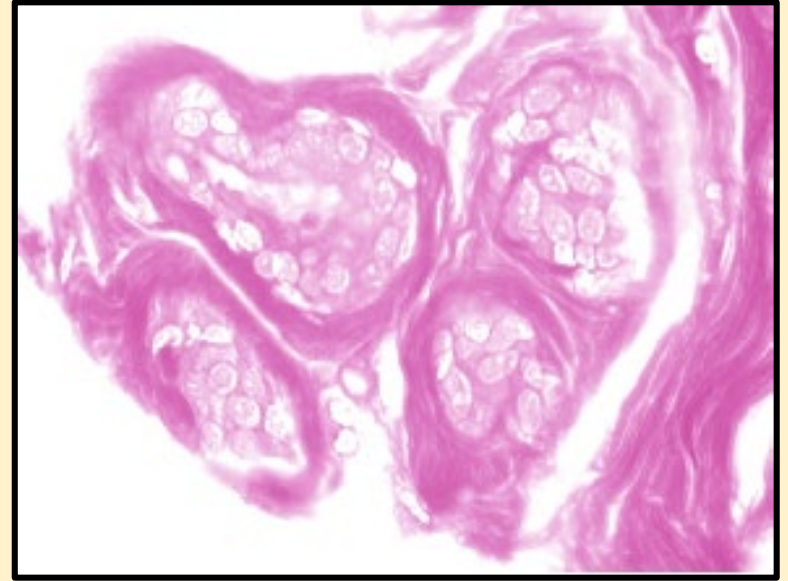


## Stain separation

---



(a) haematoxylin



(b) eosin

## Closing remarks

---

## References

---

- S. Roy, A. k. Jain, S. Lal, J. Kini. A study about color normalization methods for histopathology images. *Micron* **114**, November 2018, pp. 42–61
- E. Reinhard, M. Adhikhmin, B. Gooch, P. Shirley. Color transfer between images. *IEEE Computer Graphics and Applications* **21**, September–October 2001, pp. 34–41
- A. Ruifork and D. Johnston. Quantification of histochemical staining by color deconvolution. *Analytical and Quantitative Cytology and Histology* **23**, August 2001, pp. 291–299
- M. Macenko *et al.* A method for normalizing histology slides for quantitative analysis. *2009 IEEE International Symposium on Biomedical Imaging*, 2009, pp. 1107–1110
- A. Vahadane *et al.* Structure-preserving color normalization and sparse stain separation for histological images. *IEEE Transactions on Medical Imaging* **35**, August 2016, pp. 1962–1971
- A. Khan, N. Rajpoot, D. Treanor, D. Magee. A non-linear mapping approach to stain normalisation in digital histopathology images using image-specific colour deconvolution. *IEEE Transactions on Biomedical Engineering* **61**, June 2014, pp. 1729–1738
- F. G. Zanjani *et al.* Stain normalization of histopathology images using generative adversarial networks. *2018 IEEE 15<sup>th</sup> International Symposium on Biomedical Imaging*, April 2018, pp. 573–577
- P. Salehi and A. Chalechale. Pix2Pix-based Stain-to-Stain Translation: a solution for robust stain normalization in histopathology images analysis. *2020 International Conference on Machine Vision and Image Processing*, February 2020, pp. 1–7