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HPC  
SIMULATION  
BIG DATA

# Forum Teratec

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11 & 12 JUIN  
JUNE 11 & 12 2019

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investisseurs du monde numérique

NUMERIC  
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ILLUMINATE

# Histopathologie Numérique

ou le microscope du  
XXI<sup>ème</sup> siècle



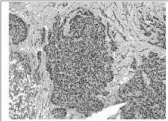
# Présentation de l'histopathologie



Form

### Analyze the Image of Tumor Cells and RNA Molecules

**Original Image:** 

**Tumor Cells:** 

**Result Image:** (red: cells edge, yellow: RNAs in nuclei, green: RNAs in cytoplasm)  
Select ROI:

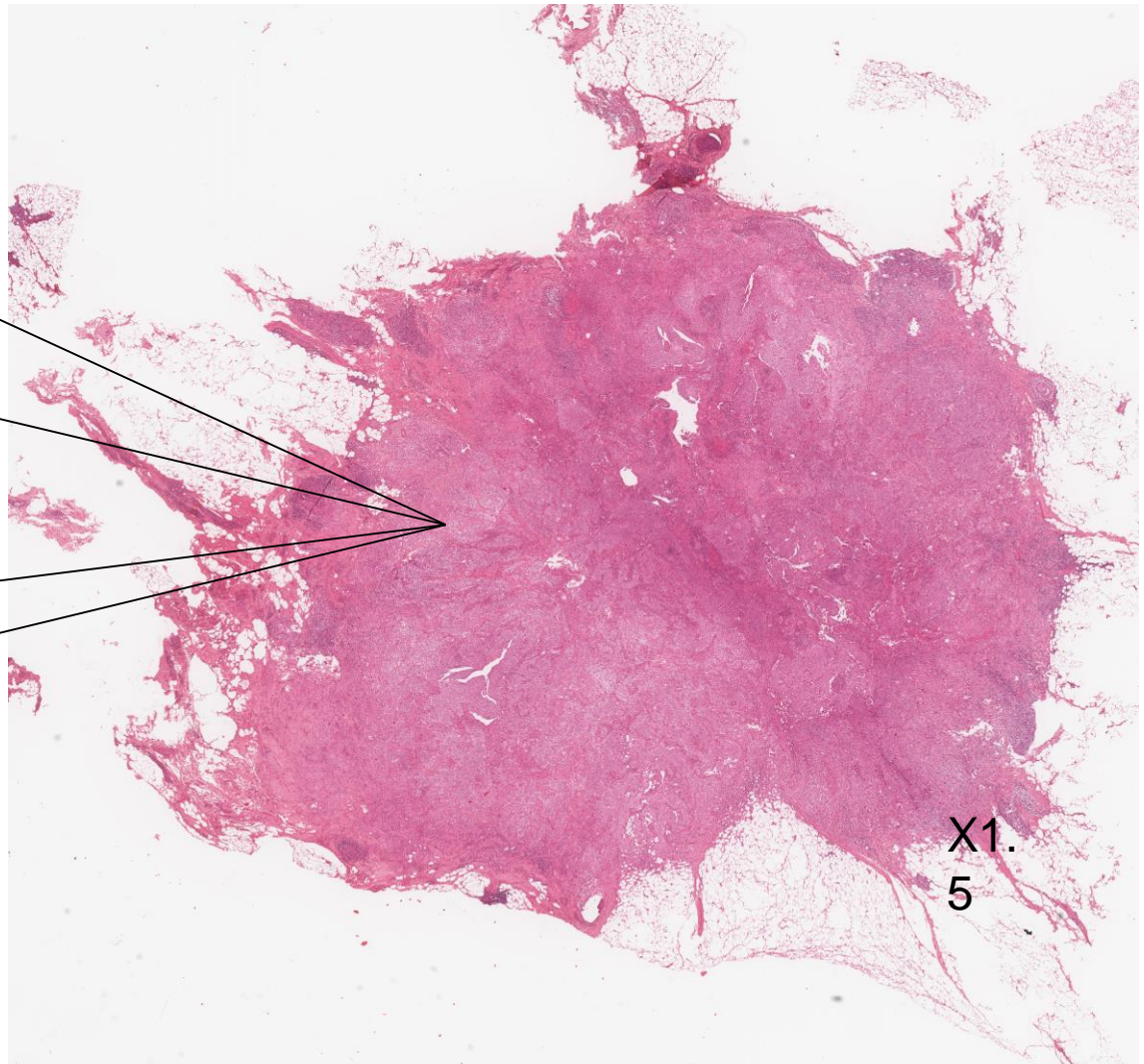
**Max Cells radius:** 8 (pixels)

**Result information:**

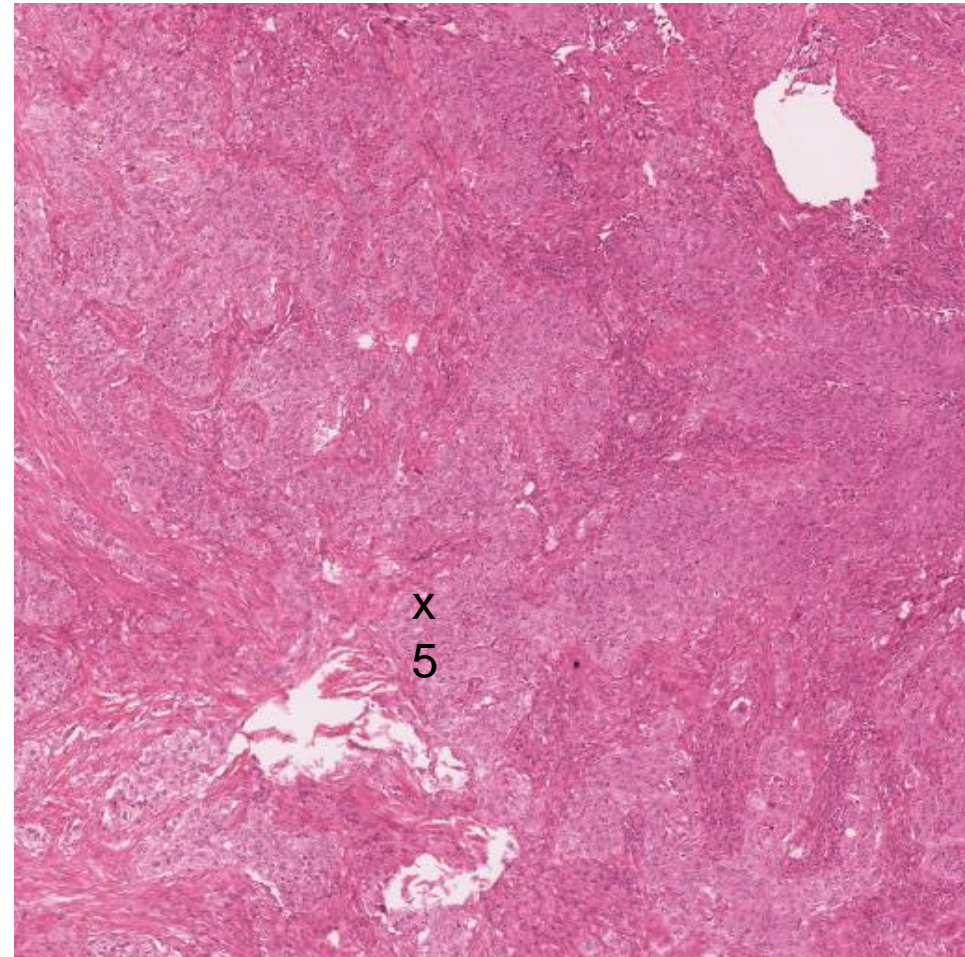
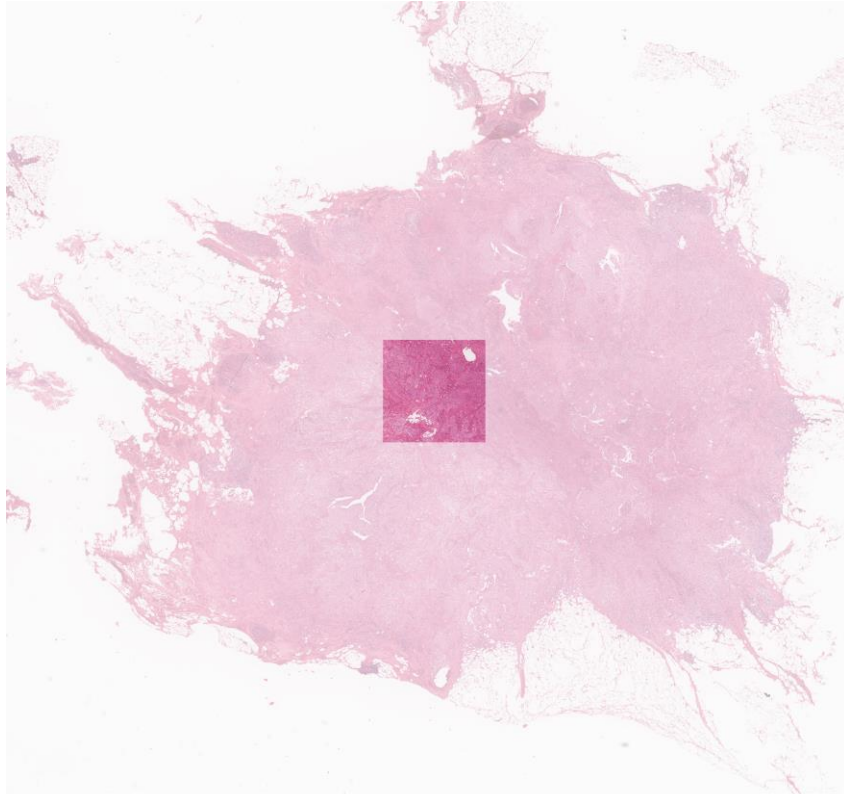
	Items	Value
1	Total tumor cells number:	2576
2	Total tumor cells area:	309390
3	Total RNA objects number:	1895
4	Total RNA objects area:	14455
5	The number of tumor cells with RNAs:	1062
6	The number of RNA objects inside nuclei:	1365

**Zoom:**

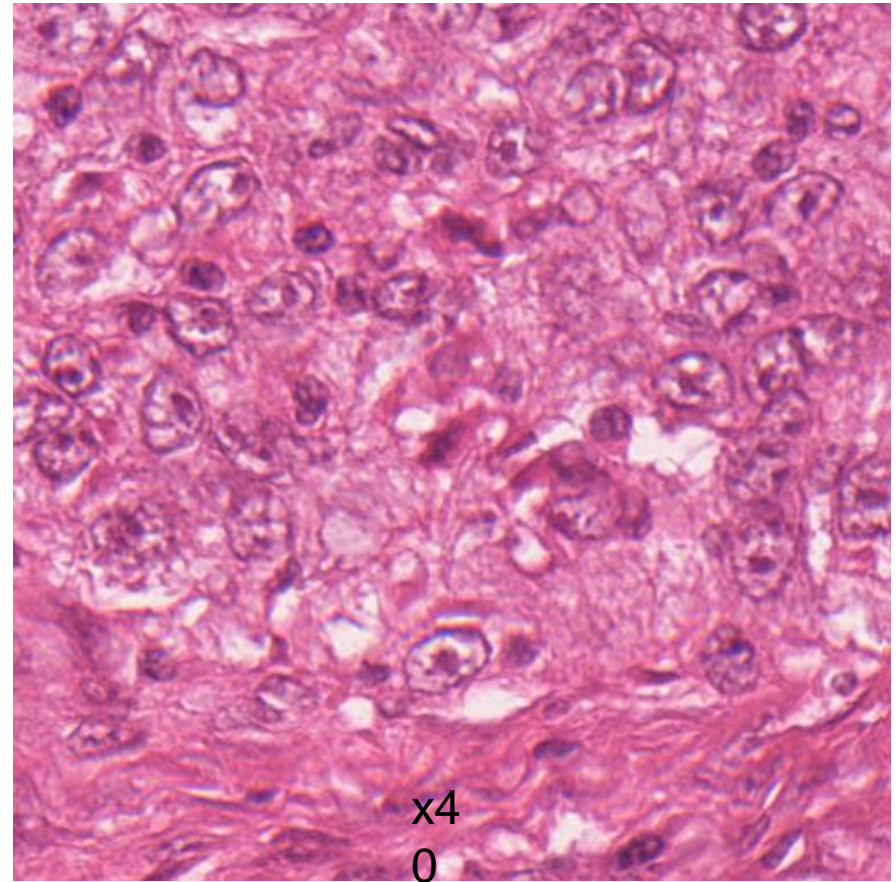
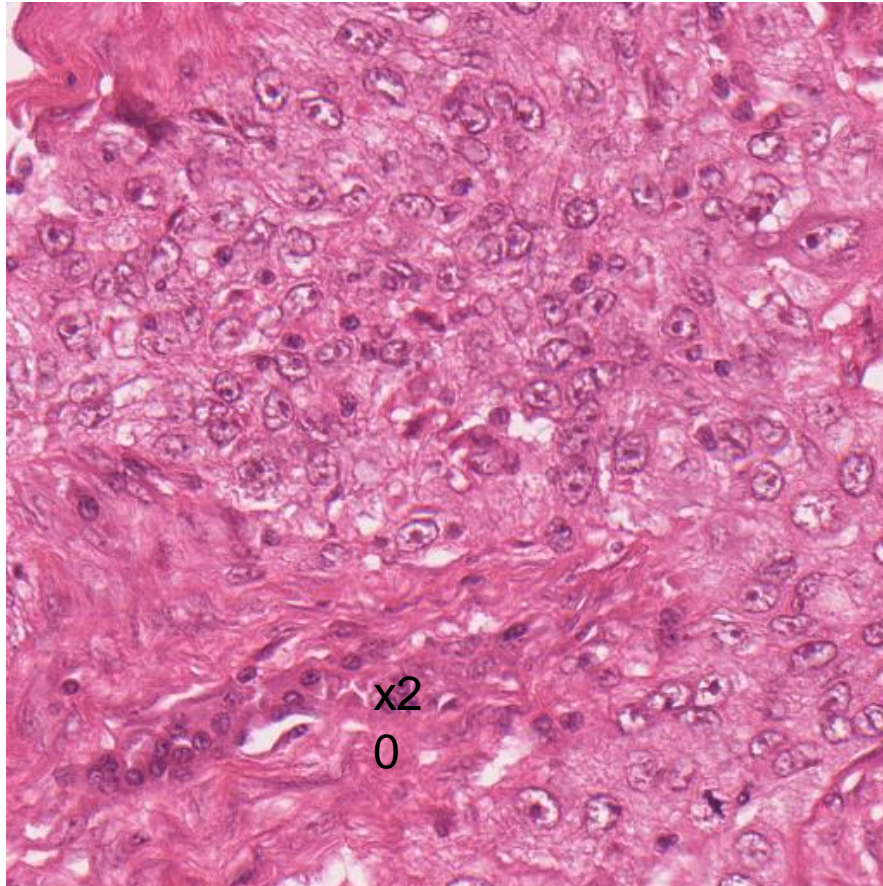
# Présentation de l'histopathologie



# Présentation de l'histopathologie



# Présentation de l'histopathologie



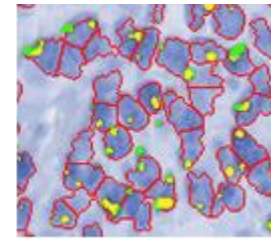
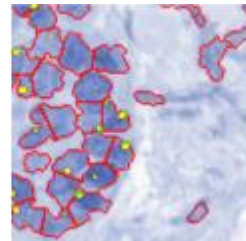
De nombreux acteurs : Owkin par exemple en France, historiquement Tribvn aussi (voir [tissuepathology.org](http://tissuepathology.org)), PathAI aux USA

Problématique de l'échange de données de santé

De nombreux software : QuPath (libre), VisioPharm

Digital Pathology As a Service ?

*(red: boundaries between nuclei,  
yellow: mRNA inside nuclei  
green: mRNA inside cytoplasm)*

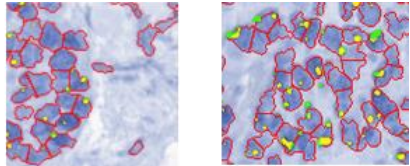


## DPaaS : un but commun






## Digital Pathology As a Service ?



(red: boundaries between nuclei,  
yellow: mRNA inside nuclei  
green: mRNA inside cytoplasm)



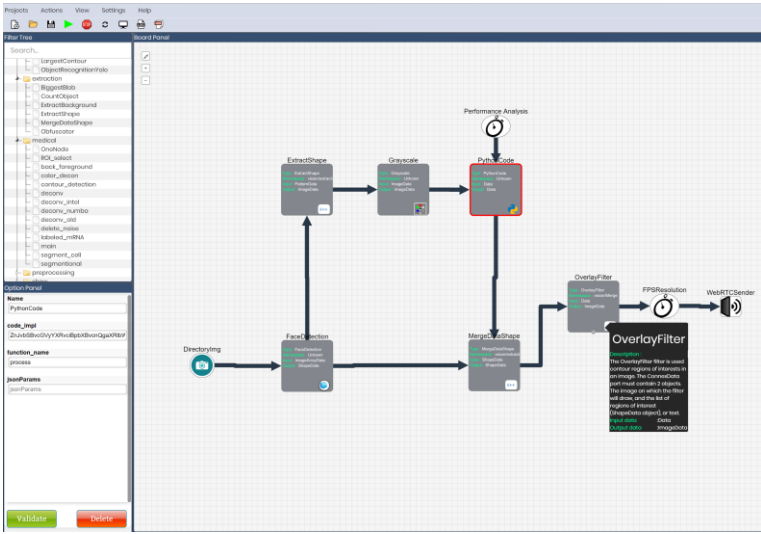
### Welcome into the WebHIPE Model studio !

Please inform the HIPE service address first

Service url

expected version

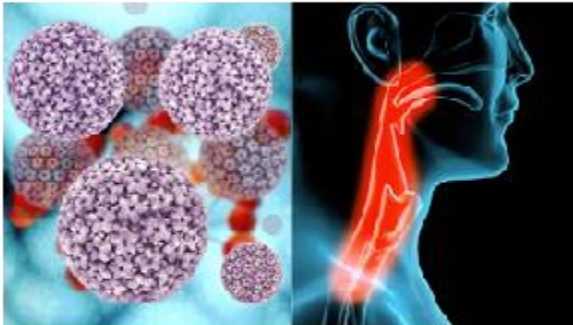
Validation



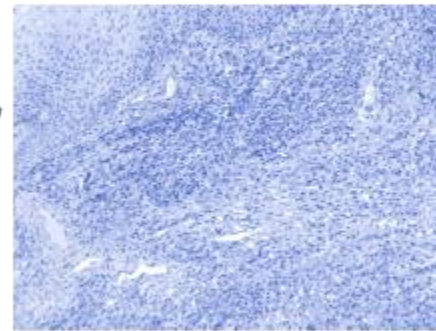
# Sujets de collaboration

Projet 1 : HPV related Head and Neck cancer – HEGP –  
collaboration avec Prof. Cécile Badoual

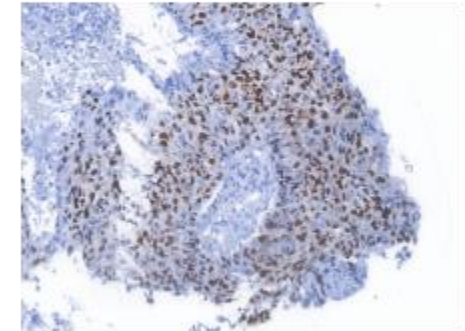
Alcohol and tobacco



Incident of head and neck cancer  
World: 500 000/year  
US: 38 500/year  
France: 16 000/year  
Mostly, squamous cell carcinoma



Higher risk diseases from  
human papilloma virus  
(HPV)



Less risk diseases from  
human papilloma virus (HPV)

# Sujets de collaboration

Projet 1 : HPV related Head and Neck cancer – HEGP –  
collaboration avec Prof. Cécile Badoual

RNAscope + Hematoxylin + Vectra

mRNA as  
brownish

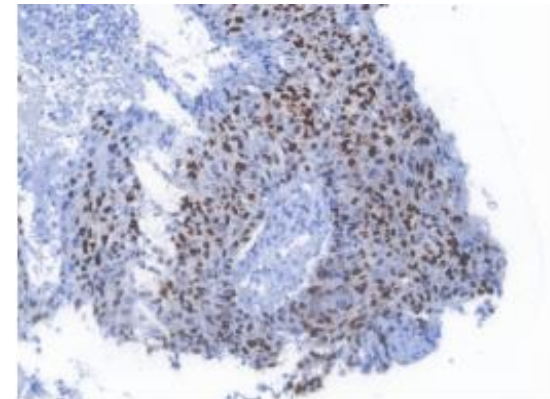
Nuclei as bluish



Staining technique



Digital slides



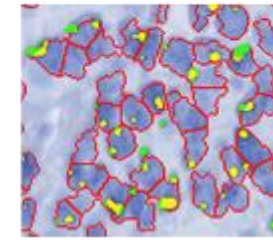
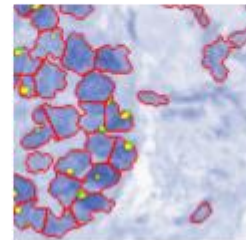
Sample of mucosa in range of 200  
patients

## Projet 1 : HPV related Head and Neck cancer – HEGP – collaboration avec Prof. Cécile Badoual



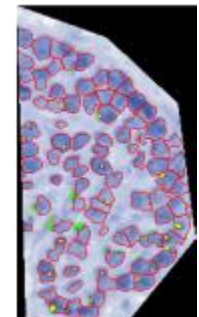
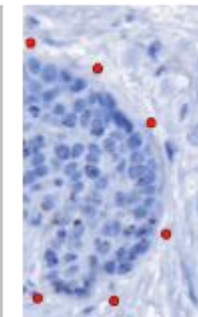
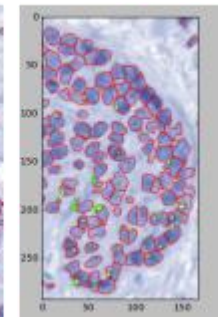
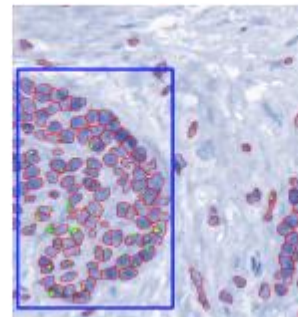
### a). Fusion of nuclei and mRNA

*(red: boundaries between nuclei,  
yellow: mRNA inside nuclei  
green: mRNA inside cytoplasm)*

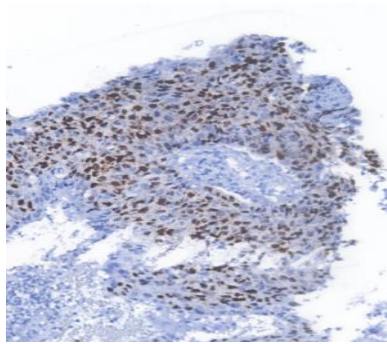


### b). Selection of region of interest

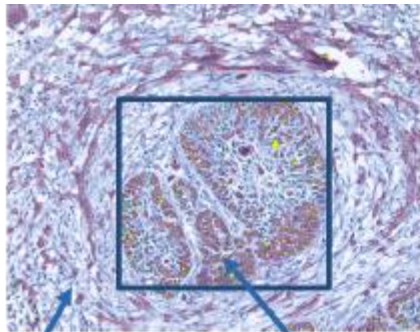
1. by rectangle
2. by polygon



# Sujets de collaboration



X4  
—→  
0

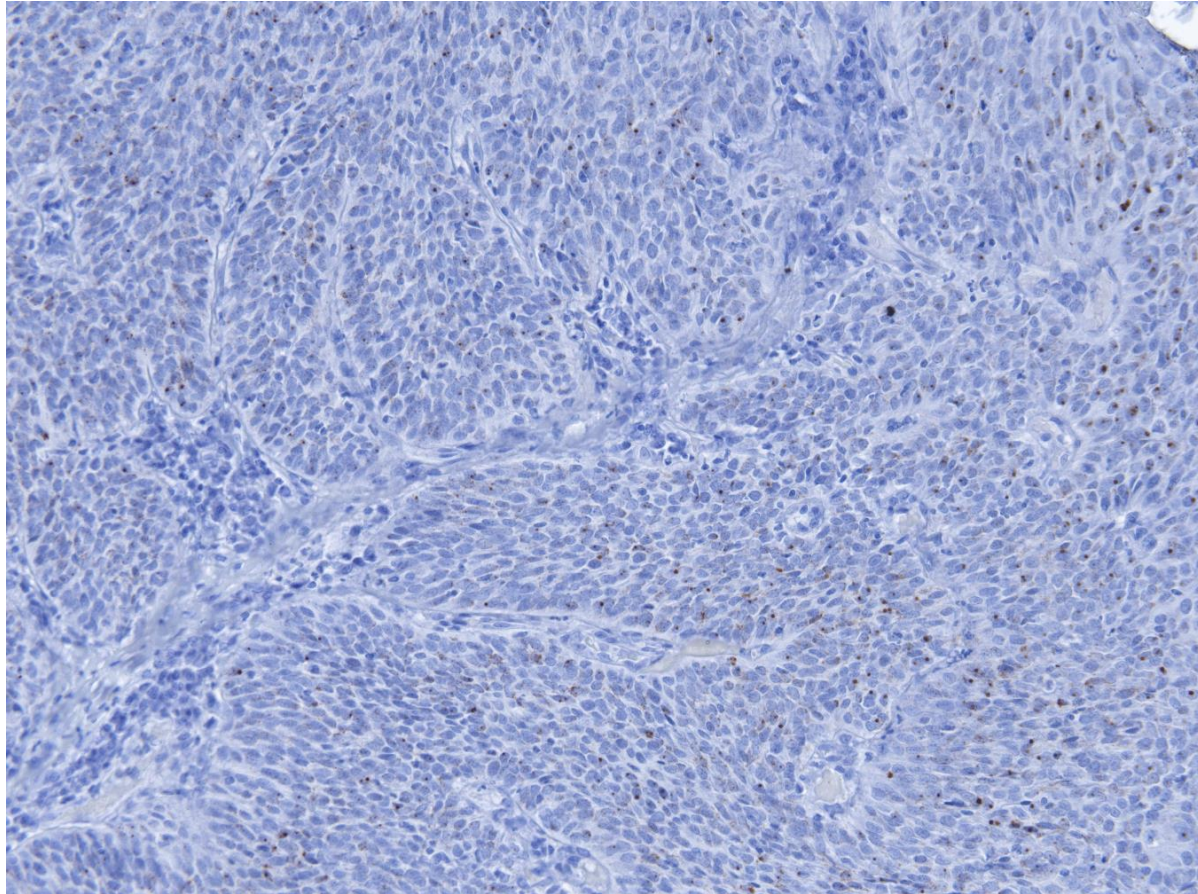


Stroma

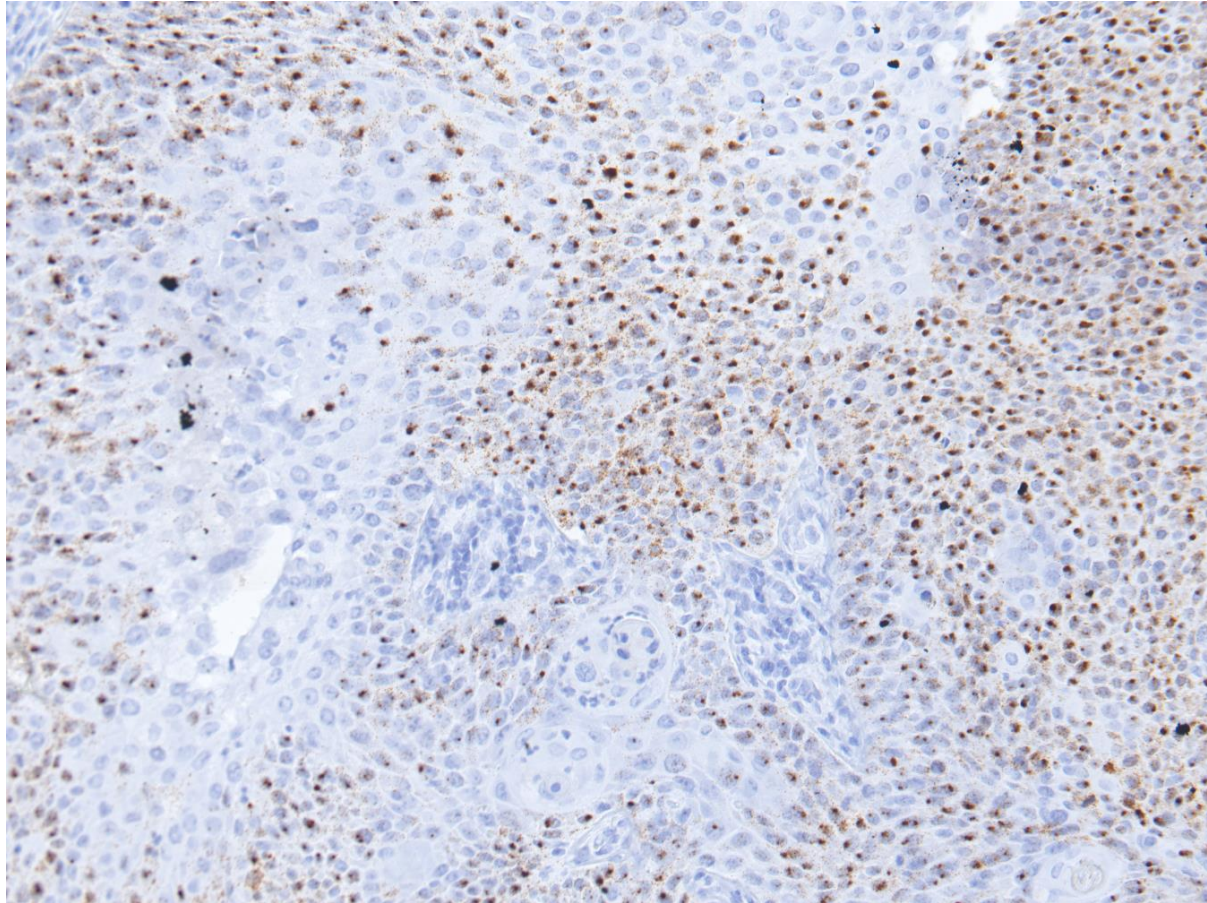
Cancer cells

	In the whole image	In the ROI
Nuclei with mRNA (percentage)	25.90%	67.06%
Ground truth (positivity strength)	++	

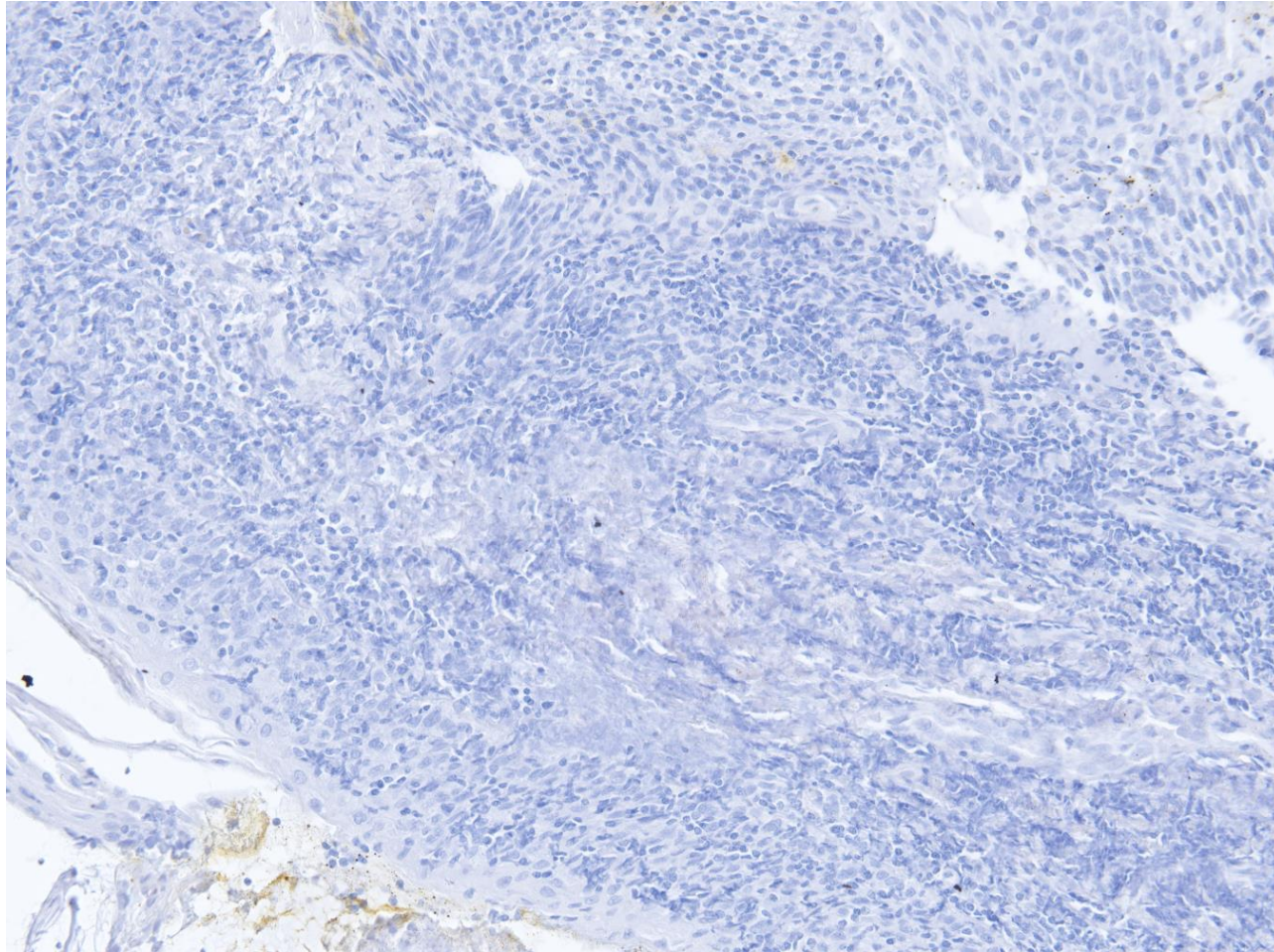
# Sujets de collaboration



# Sujets de collaboration



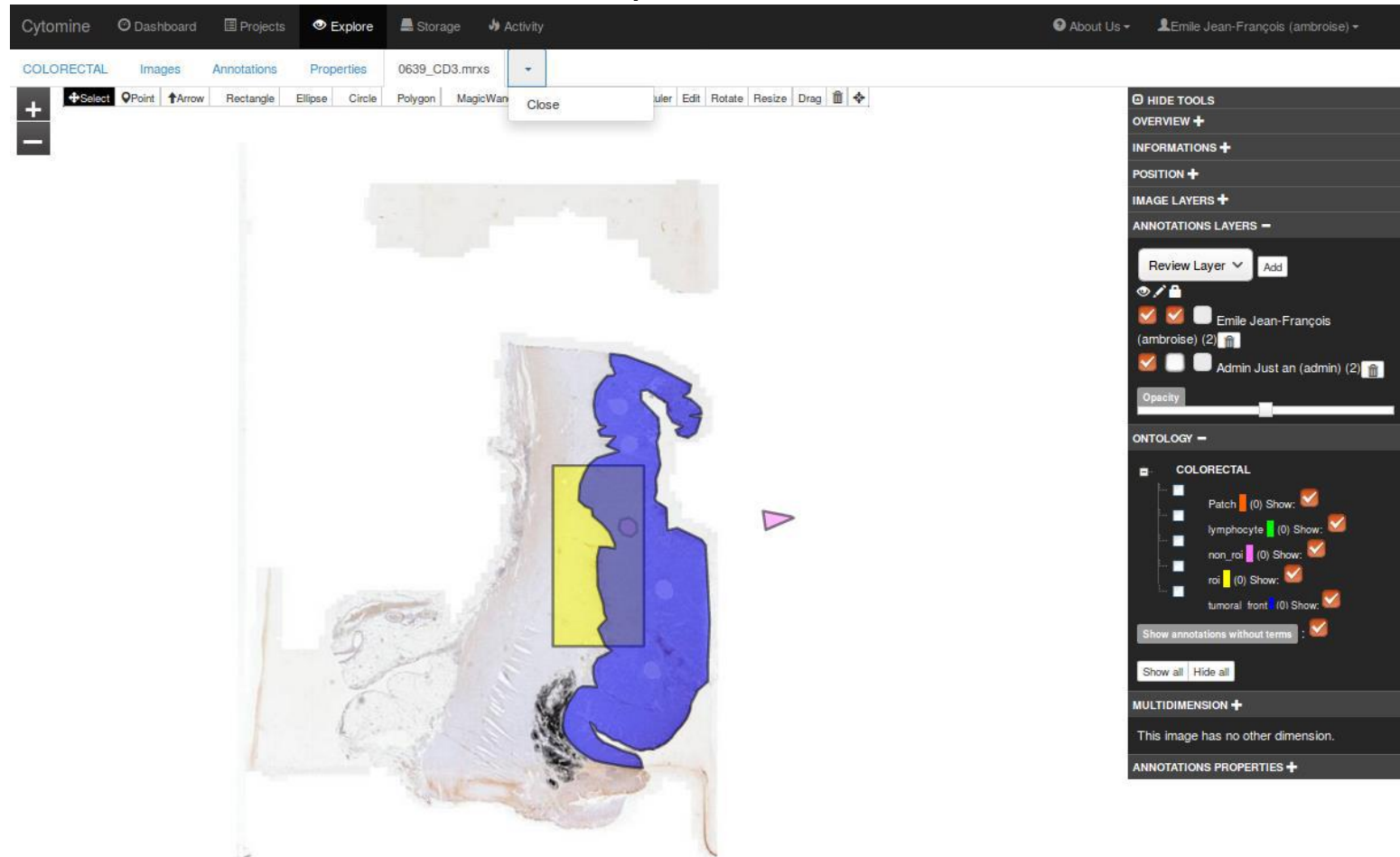
# Sujets de collaboration





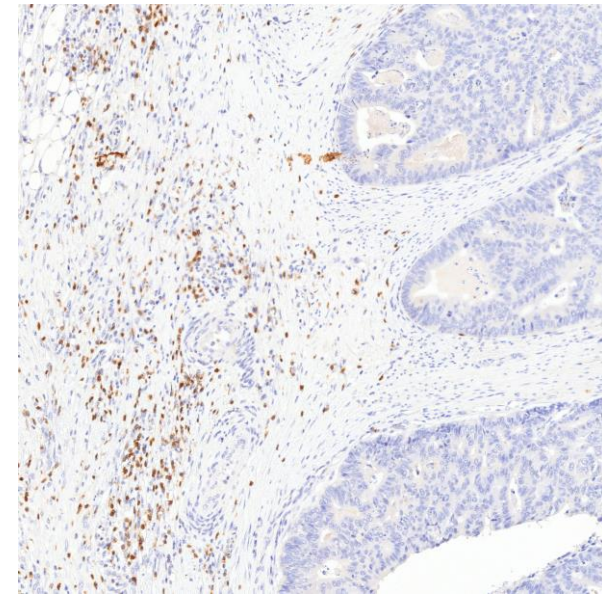
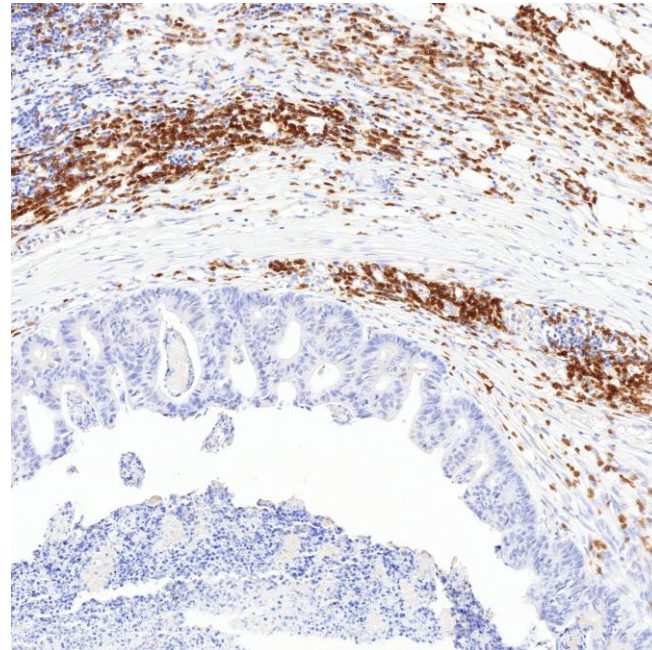
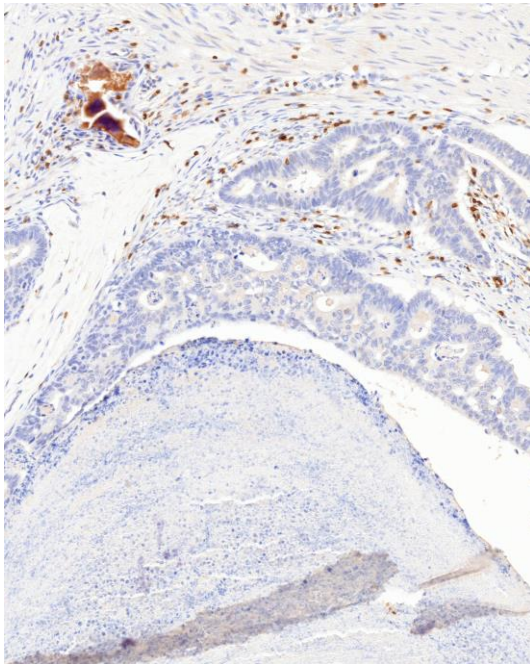
# Sujets de collaboration

## Projet 2 : Colorectal Cancer - Collaboration with PUPH JF. Emile – Hôpital Ambroise Paré.

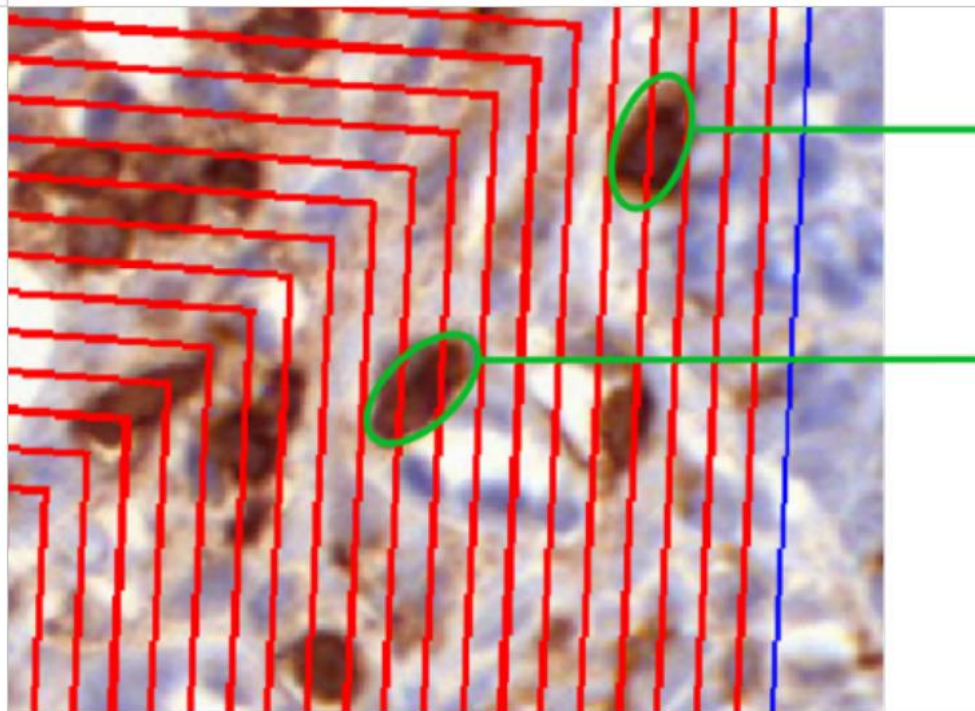


# Sujets de collaboration

Projet 2 : Colorectal Cancer -  
Collaboration with PUPH JF. Emile – Hôpital Ambroise Paré.

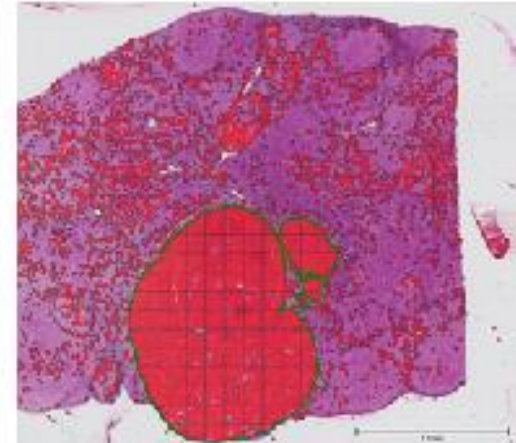
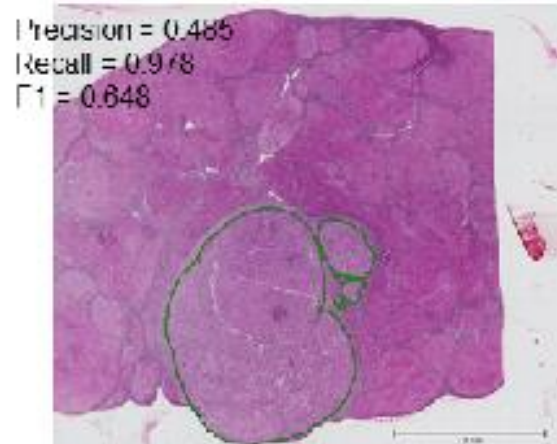
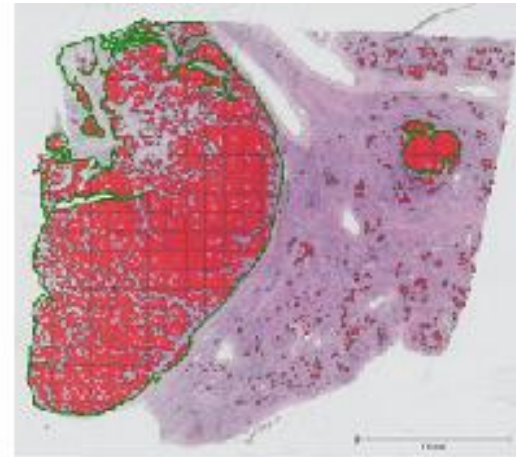
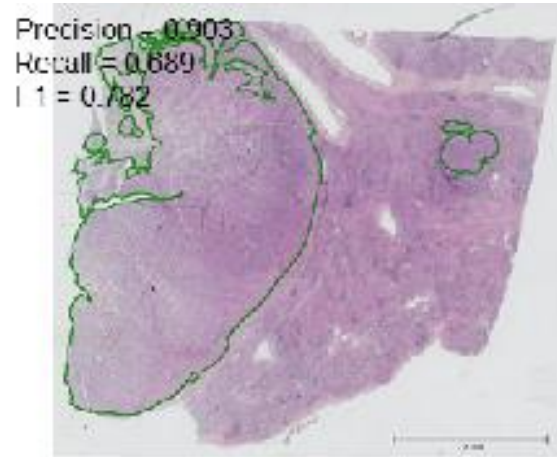


Projet 2 : Colorectal Cancer -  
Collaboration with PUPH JF. Emile – Hôpital Ambroise Paré.



# Sujets de collaboration

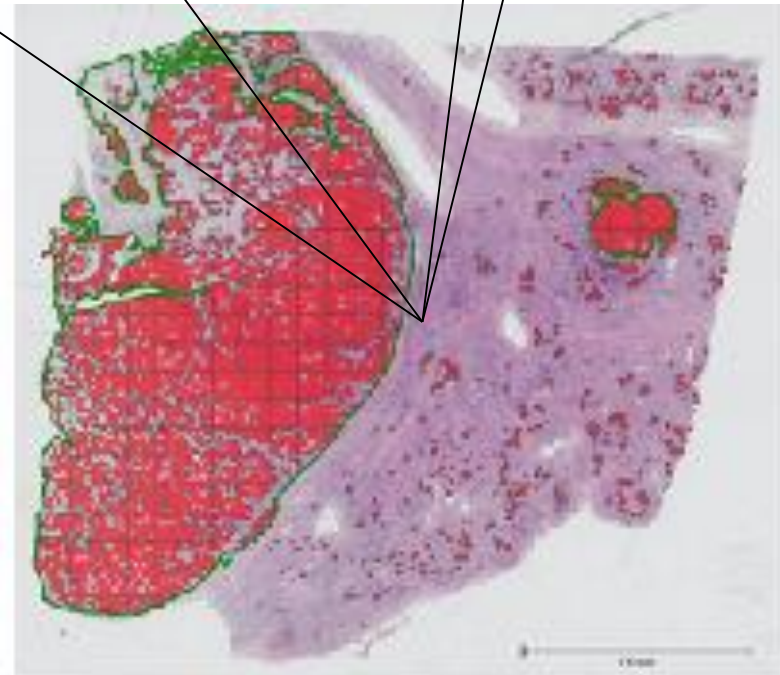
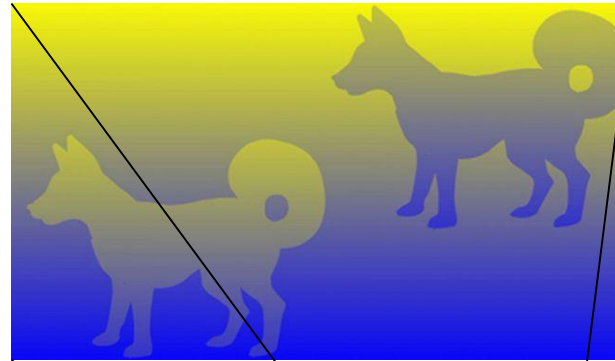
Projet 3 : Cancer Hépatique –  
Collaboration avec Julien Calderaro et Christophe Klein –  
Hôpital Henri Mondor et Platerforme d'imagerie des Cordeliers (P5-P6-P7)



# Sujets de collaboration

## Problématiques communes

- analyse de la couleur
- détermination des zones d'intérêt
- analyse de grand volume de données
- reporting pour prise de décision médicale



Nécessité de passer à l'échelle : SaaS pour des besoins spécifiques en histopathologie numérique

Avec en visée les applications d'immuno-thérapie sous la forme d'assistance au diagnostic in vitro

En utilisant l'HPC en particulier concernant les images de lames entières (Whole Slide Image-based analysis)

ANEO et partenaires ALDWIN

**HIPE**  
HIERARCHIC IMAGE  
PROCESSING ENGINE

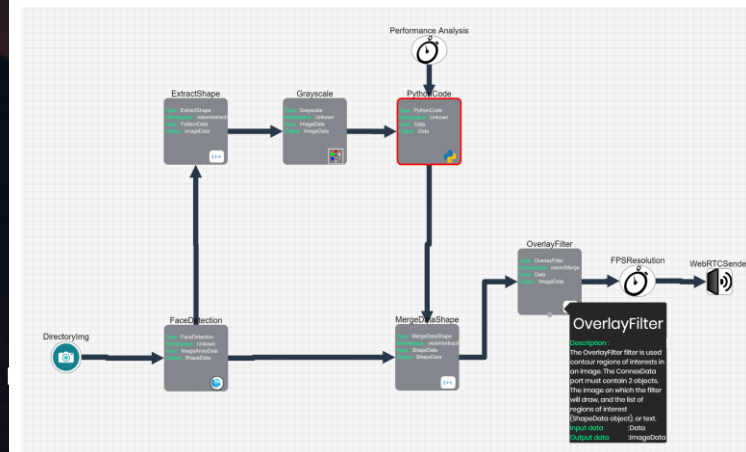
C'EST QUOI HIPE ? TÉLÉCHARGER UTILISER ACCOMPAGNEMENT CONTACTEZ L'ÉQUIPE aneo

**STRUCTURER ET RÉDUIRE LE TEMPS DE DÉVELOPPEMENT EN VISION ARTIFICIELLE**

HIPE est une application SaaS pensée pour faciliter la conception et le design de briques d'analyse temps-réels visuelle et de simulation numérique intensive.

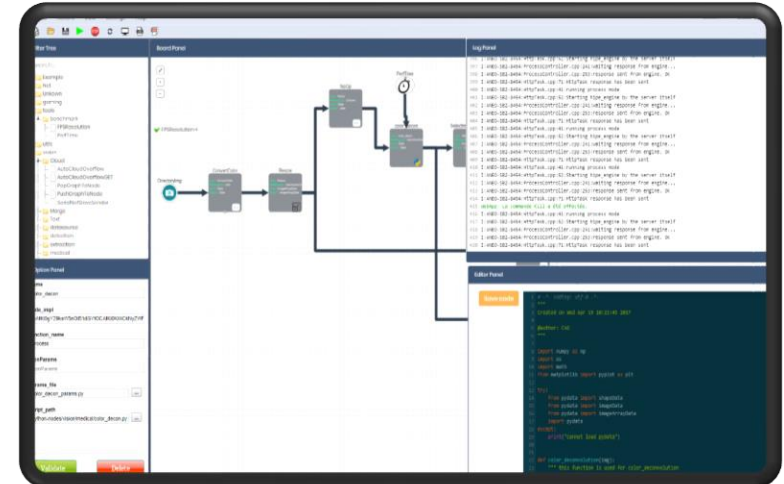
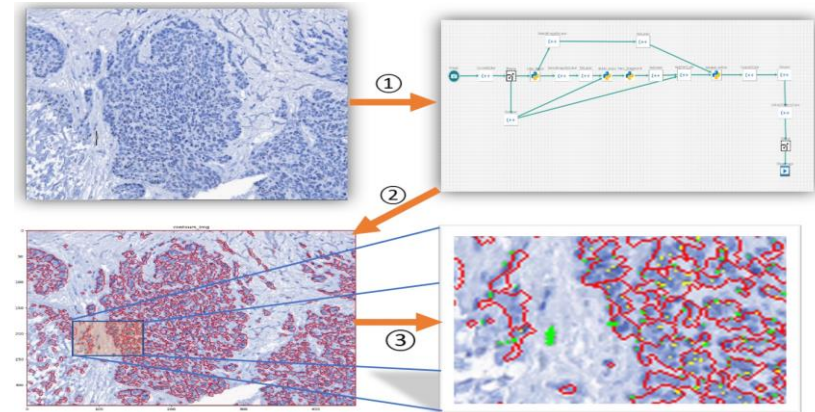
Cet outil est à destination des développeurs, chercheurs et administrateurs, et permet de une meilleure compréhension entre tous les membres de l'équipe.

A digital pathology toolbox  
aaS

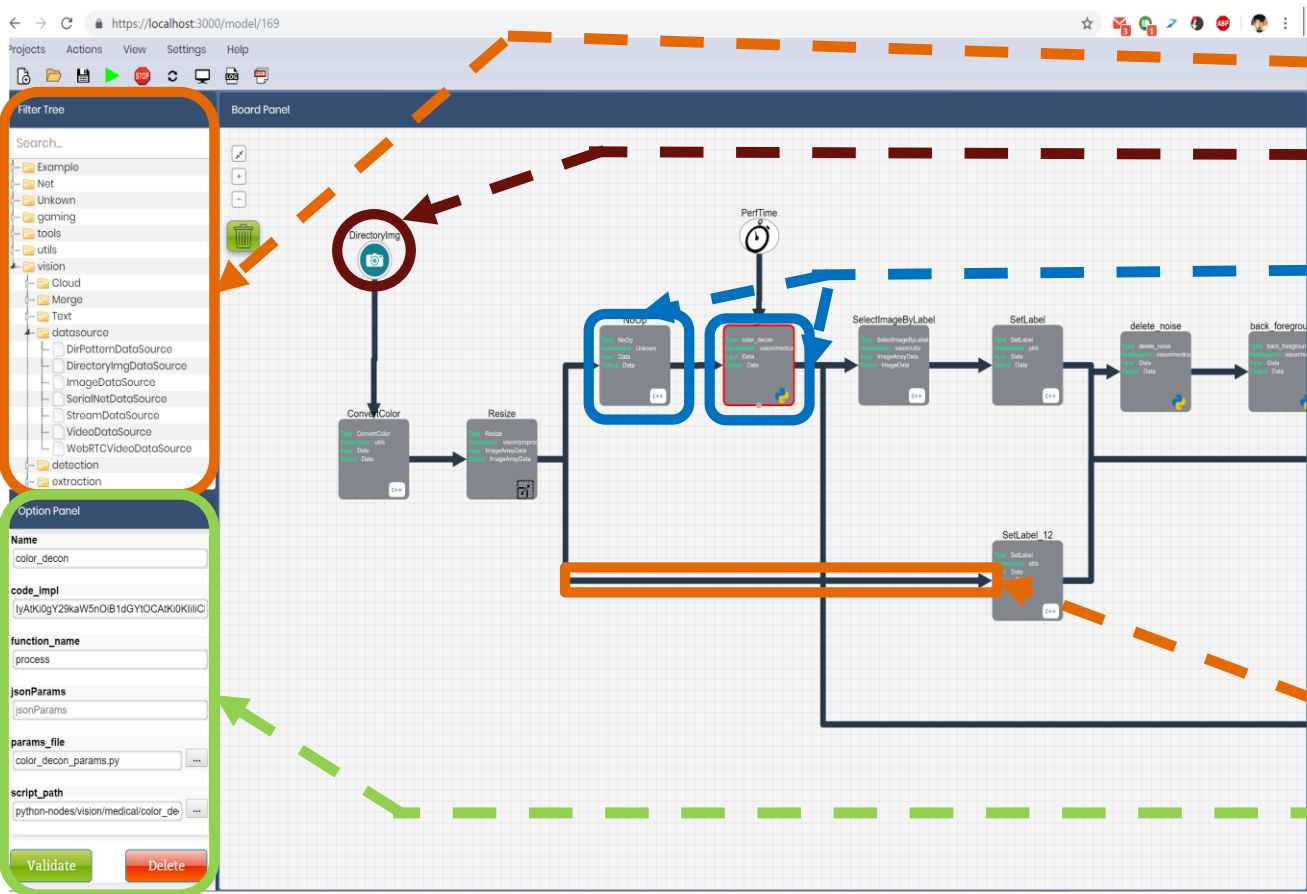


## Framework HIPE : C'est quoi ?

- Hierarchic Image processing Engine
- Un environnement de développement pour concevoir des chaînes d'algorithmes de traitement d'images et de vidéo
- Permettre au plus grand nombre d'accéder aux traitements d'images
- Permet de concevoir des algorithmes de workflow en utilisant plusieurs langages de programmation.
- Recalibrer les algorithmes sans développement supplémentaire
- Aide à la collaboration en matière de développement et de connaissances.



# Composer avec HIPE



Algorithms & tools boxes

Input Video source

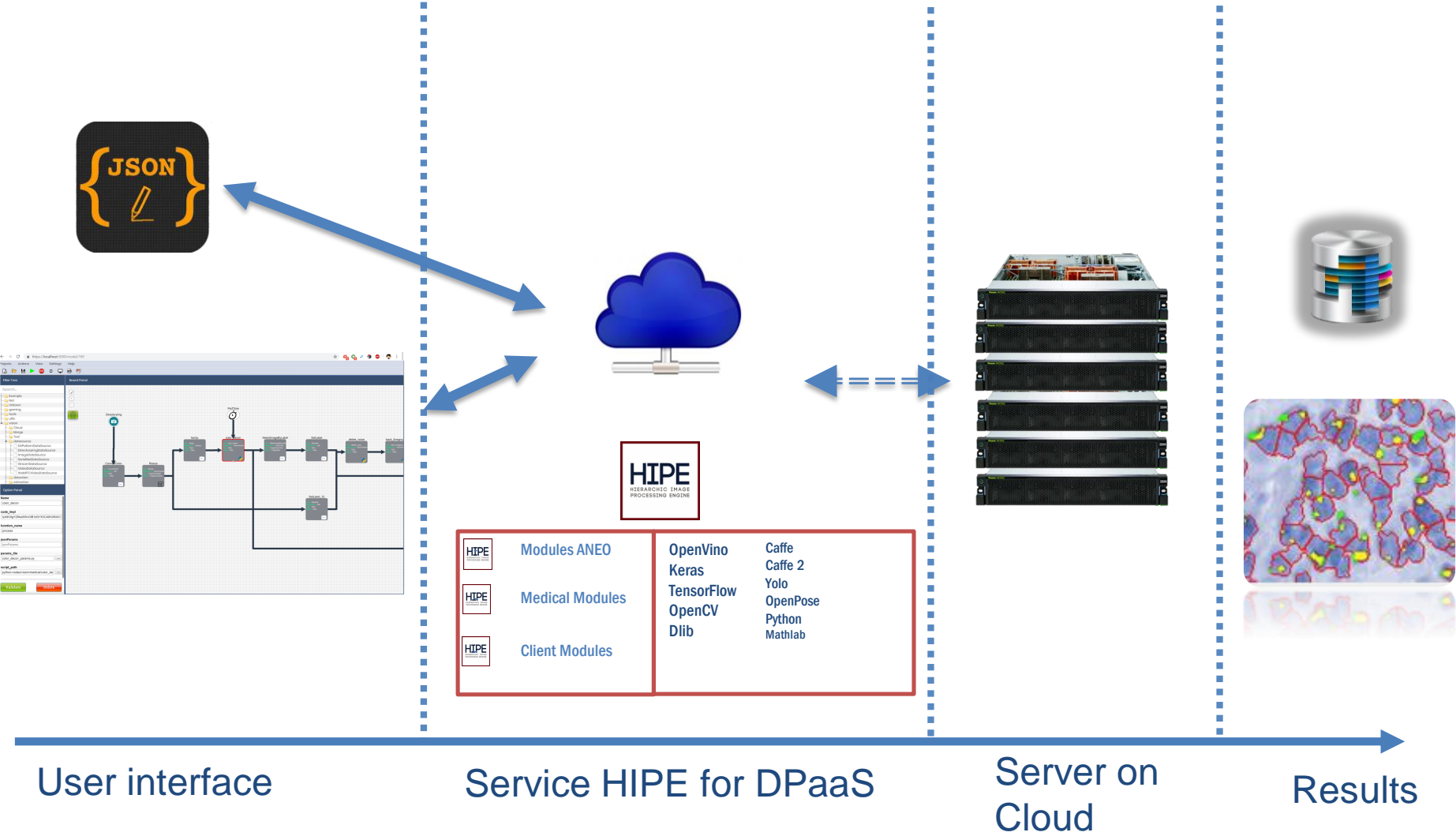
C++, Matlab or Python node

Direct acyclic data transition

Parameters for each node



# Accessible à distance



# MERCI

Une démonstration de HIPE est en ligne :

Outils pour le Digital Pathology As a Service

[https://youtu.be/o9t8hMlz8\\_o](https://youtu.be/o9t8hMlz8_o)

<http://www.aneu.eu/hipe>

[http://lipade.mi.parisdescartes.fr/?page\\_id=248](http://lipade.mi.parisdescartes.fr/?page_id=248)

Nicolas LOMENIE

Damien DUBUC

# Q & R