

cyt^omine

a **web platform** for **collaborative analysis**
of **multi-gigapixel images**
with **machine learning**

Raphaël MAREE – Renaud HOYOUX – Grégoire VINCKE



Wallonie



FEDER



G I G A



Université
de Liège

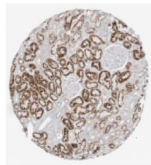
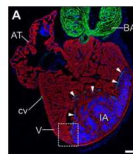
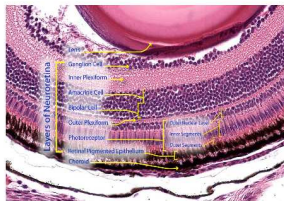
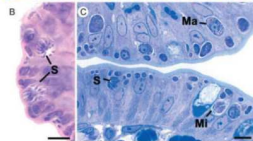
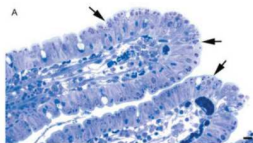
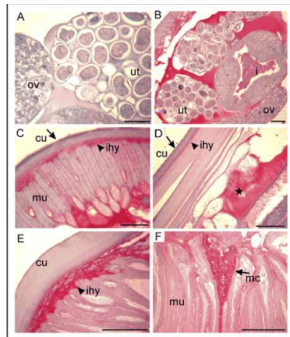
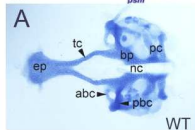
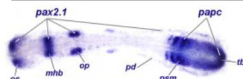
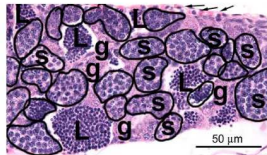
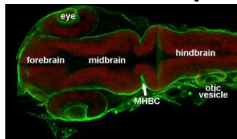
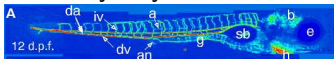


FOSDEM'16

Brussels / 30 & 31 January 2016

Biomedical research and routine pathology

Heavily rely on **semantic annotation** & **quantification** of tissue slides








Scientists and pathologist's daily work



Scientists and pathologist's daily work

Slide quantifications (annotations?)
are usually

- Performed **manually**     
- Performed within tissue **subregions**
in **small** sample **groups**
- Created by **isolated experts**
- Stored **locally** (generally no backups)
- **Proprietary** formats

Hardly repeatable

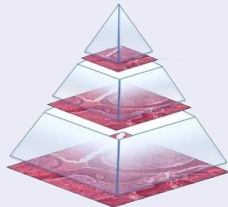
Digital histology and pathology



Digital histology and pathology

Multi-gigapixel images


- 15 x 15 mm
- $\approx 0,20\mu m/px$
- 100K x 100K pixels
- +100Mb \rightarrow +100Gb
- pyramidal structure



Digital histology and pathology



Slide quantifications and annotations could be

- Performed **automatically** 
- Performed in **entire** sample in **large groups**
- Shared between **experts**
- Stored on a **cloud**
- In **Open** formats

Easily repeatable

2010 : start of **cyt@mine** project

Sign in to Cytomine

Remember me

Sign In

Forgot your [username](#) or your [password](#) ?






2010 : start of **cyt@mine** project

Sign in to Cytomine

Remember me

Forgot your [username](#) or your [password](#) ?

Authentication

Roles, permissions, LDAP

SHORTCUTS »

Go to project »

Go to image »

STATISTICS »

3 PROJECTS <i>Now</i>	266 IMAGES <i>Now</i>	0 ANNOTATIONS <i>Now</i>	0 REVIEWED <i>Now</i>	PROJECTS »
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LAST OPENED IMAGES »

<p>TN201190 ISH-BR... 2015-11-19 16h10</p>	<p>015-TS_13C09246... 2015-11-19 16h10</p>	<p>PGP POUMON PBS... 2015-11-19 16h07</p>
--	--	---

LAST OPENED PROJECTS »

<p>ULG-GENEHUM-BREAST-BRCA1-RNASCOPE 2015-11-19 16h10</p>	<p>ULB-ANAPATH-THYROID-FNAB 2015-11-19 16h10</p>	<p>ULG-LBTD-PGP 2015-11-19 16h03</p>
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YOUR ACTIVITY »

No Data Available.

[VIEW ALL »](#)

Filters

Name

Images

56 - 124



Annotations

171 - 400



Discipline

All

Ontology

All

Reset filters

New project

ULG-LBTD-PGP

Name : ULG-LBTD-PGP

Discipline : HISTOLOGY

Ontology : ULG-LBTD-TISSUS

Number of images : 56

Number of user annotations : 171

Number of job annotations : 11225

Number of validated annotations : 9364

Info Open

ULG-GENEHUM-BR...

Name : ULG-GENEHUM-BREAST-BRCA1-RNASCOPE

Discipline : IMMUNOHISTOCHEM...

Ontology : ULG-GENEHUM-BRE...

Number of images : 125

Number of user annotations : 40118

Number of job annotations : 1141816

Number of validated annotations : 116

Info Open

ULB-ANAPATH-THY...

Name : ULB-ANAPATH-THYROID-FNAB

Discipline : CYTOLOGY

Ontology : ULB-ANAPATH-THY...

Number of images : 85

Number of user annotations : 6347

Number of job annotations : 1912733

Number of validated annotations : 961

Info Open

Upload

Important notes !

The maximum file size (per file) for uploads is **100 GB**

Only image files (**JP(E)G, PNG, BMP, TIF, TIFF, JP2K, SVS, SVS J2K, SCN, NDPI, VMS, MRXS, VSI, DICOM**) are allowed

VMS and MRXS **must be zipped** (the VMS/MRXS/VSI file and their nested files). One zip per image.

A Zip file containing multiple image is allowed (except for VMS and MRXS)

You can **drag & drop** files from your desktop on the 'Add files...' button with Google Chrome, Mozilla Firefox and Apple Safari.

You are also able to link images with project manually after upload is done.

Storage

gvincke storage

Project

 Link automatically uploaded file with selected project

ULG-GENEHUM-BREAST-BRCA1-RNASCOPE

Files

Add files...

+ Start upload

Cancel upload

Hide selected

Storage

Refresh

25

reco

Direct upload

Several file formats supported

Preview

Filename

Status

Action

No data available in table

Showing 0 to 0 of 0 entries









+ Add new image

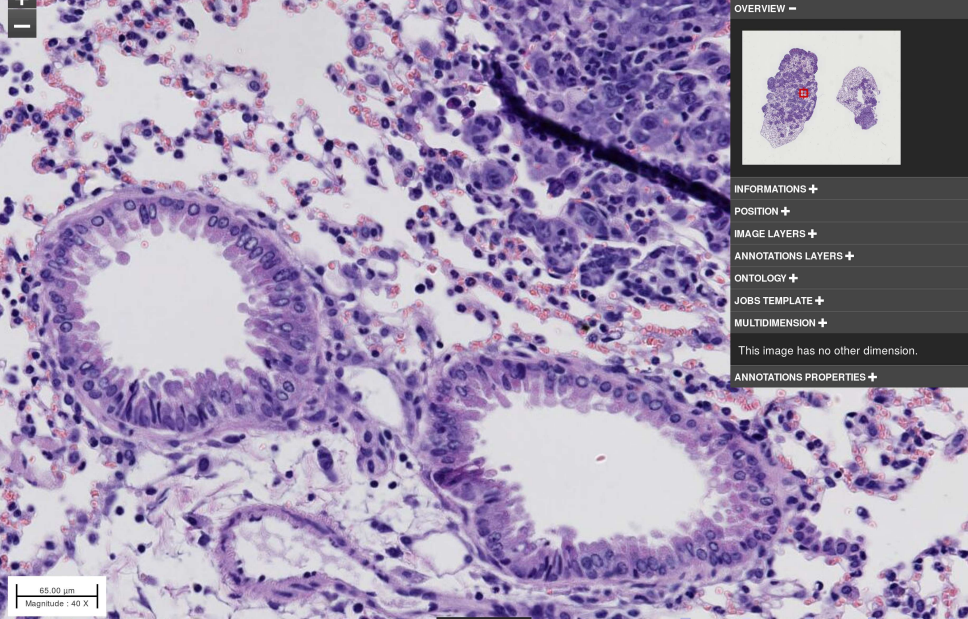
Refresh

10

records per page

Search:

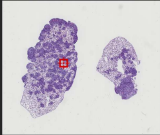
ID	Preview	Name	Width (px)	Height (px)	Magnitude	Resolution (μm/pixe)	User an.	Algo an.	Valid an.	Vendor	Created	Status	Action
7889452		PGP POUMON PBS 3 21 - 2012-08-08 11.07.24.jp2	34816	29440	40 X	0.650	13	614	100	Undefined	2012-10-18 10h50	In review	Explore
7889358		PGP POUMON PGP7 11 - 2012-08-07 12.07.00.jp2	36864	28416	40 X	0.650	3	130	119	Undefined	2012-10-18 10h50	In review	Explore
7889229		PGP POUMON PGP7 41 - 2012-08-07 12.13.50.jp2	36864	28416	40 X	0.650	1	142	142	Undefined	2012-10-18 10h50	In review	Explore
7889190		PGP POUMON PGP7 21 - 2012-08-07 12.09.19.jp2	34816	28928	40 X	0.650	6	122	124	Undefined	2012-10-18 10h50	Reviewed	Explore
7889180		PGP POUMON PGP7 31 - 2012-08-07 12.11.34.jp2	36864	26624	40 X	0.650	7	271	213	Undefined	2012-10-18 10h49	Reviewed	Explore
7889170		PGP POUMON	38912	32256	40 X	0.650	4	169	151	Undefined	2012-10-18 10h49	Reviewed	Explore



65.00 µm
Magnitude : 40 X

HIDE TOOLS

OVERVIEW -



INFORMATIONS +

POSITION +

IMAGE LAYERS +

ANNOTATIONS LAYERS +

ONTOLOGY +

JOB TEMPLATE +

MULTIDIMENSION +

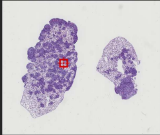
This image has no other dimension.

ANNOTATIONS PROPERTIES +



HIDE TOOLS

OVERVIEW -



INFORMATIONS +

POSITION +

IMAGE LAYERS +

ANNOTATIONS LAYERS +

ONTOLOGY +

JOB TEMPLATE +

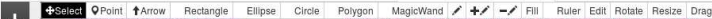
MULTIDIMENSION +

This image has no other dimension.

ANNOTATIONS PROPERTIES +

Rich web application
OpenStreetMap-like **visualization** (tiles)
No extra software to install

65.00 µm
Magnitude : 40 X



CURRENT SELECTION +

Area : 0 pixels²

Perimeter : 0 pixels

User : Vincke Grégoire (gvincke)

✖ You cannot edit this annotation.

Comment (0)

ANNOTATION PREVIEW +



SIMILARITIES +

PROPERTIES +

DESCRIPTION -

Petite description

See full text or s

Rich web application

Collaborative and semantic annotation
of regions of interest

HIDE TOOLS

OVERVIEW +

INFORMATIONS +

POSITION +

IMAGE LAYERS +

ANNOTATIONS LAYERS -

Add



- Potter Harry (hpotter) (2)
- Vincke Grégoire (gvincke) (16)
- Hagrid Rubeus (rhagid) (1)

Opacity

ONTOLOGY -

HISTOLOGIE DU DRAGON

- Ejection du feu
 - Muscles pyro-ejecteur (0) Show:
 - Pyroducte (0) Show:
- Production du feu
 - Glande pyrogène (0) Show:

Show annotations without terms:

Show all Hide all

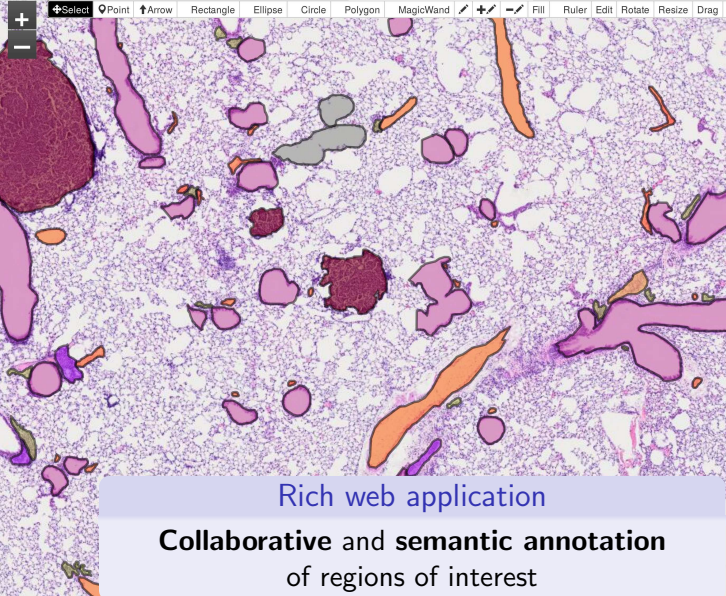
JOBS TEMPLATE +

MULTIDIMENSION +

ANNOTATIONS PROPERTIES -



Label



TD LB (lbtid) Add

- Vincke Grégoire (gvincke)
- Rocks Natacha (nrocks) (238)

Opacity

ONTOLOGY

ULG-LBTD-TISSUS

- Artefact (0) Show:
- Background (0) Show:
- Bronche (0) Show:
- Bronche - incidence de coupe
- Cartilage (0) Show:
- Cellules graisseuses (0) Show:
- Cellules nécrotiques (0) Show:
- Coupe (0) Show:
- Espaces aériens (0) Show:
- Foyer d'inflammation (0) Show:
- Globule rouge (0) Show:
- Mitose (0) Show:
- Muscle (0) Show:
- NotAdeno (0) Show:
- Poumon (0) Show:
- Poumon non insufflé (0) Show:
- Unknown (0) Show:
- Zone floue (0) Show:

Marquage

Tumeurs

Vaisseaux

Show annotations without terms:

Show all Hide all

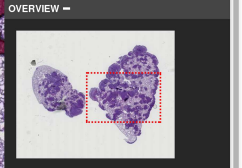
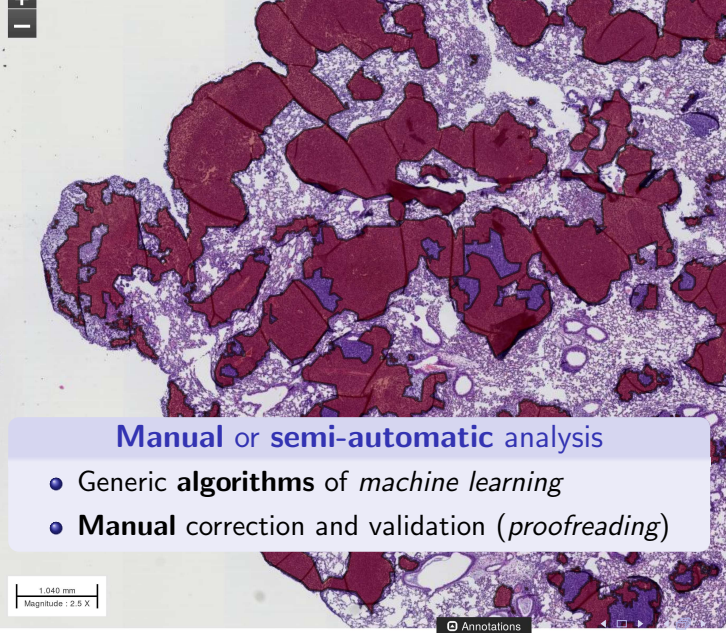
JOBS TEMPLATE +

MULTIDIMENSION +

Rich web application

Collaborative and semantic annotation

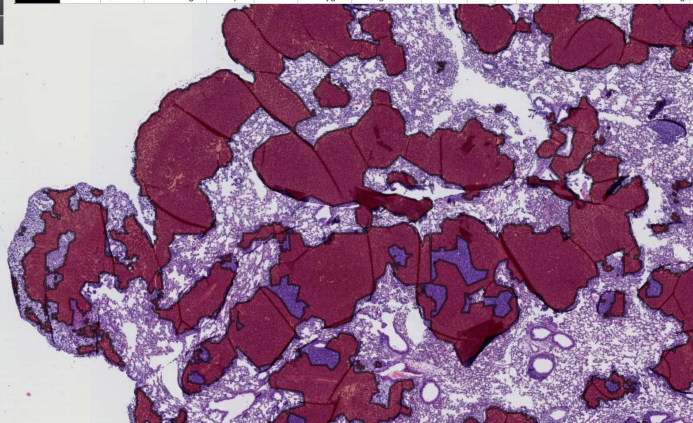
of regions of interest



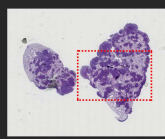
Manual or semi-automatic analysis

- Generic **algorithms** of *machine learning*
- **Manual** correction and validation (*proofreading*)

1.040 mm
Magnitude : 2.5 X



HIDE TOOLS OVERVIEW



INFORMATIONS POSITION IMAGE LAYERS ANNOTATIONS LAYERS

Marée Raphaël (rmaree) Add [checked] Vincke Grégoire (gvincke) [checked] PyxitSegmentationModelBuilder_ 2012-11-30 10h41 (348) See job details...

Opacity [slider]

ONTOLOGY - ULG-LBTD-TISSUS
Artefact (0) Show: [checked]
Background (0) Show: [checked]
Bronche (0) Show: [checked]
Bronche - incidence de coupe [checked]
Cartilage (0) Show: [checked]
Cellules grassieuses (0) Show [checked]
Cellules nécrotiques (0) Show [checked]

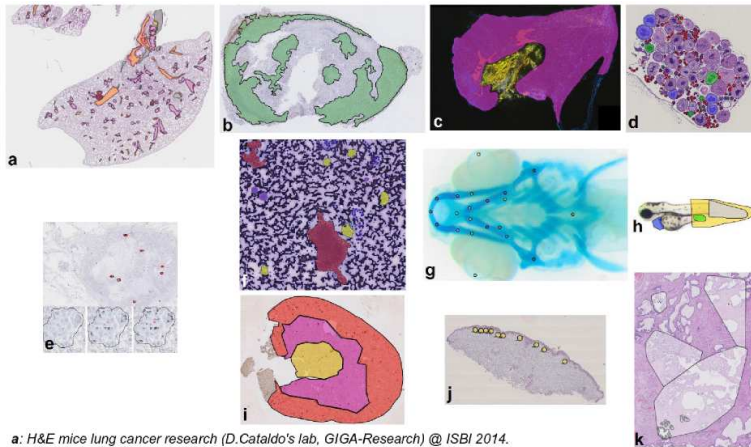
But also

- Search similar annotations
- Sharing of images and annotations (URL, email)
- Live broadcasting

Magnitude : 2.5 X

Annotations

cyt@mine-based research

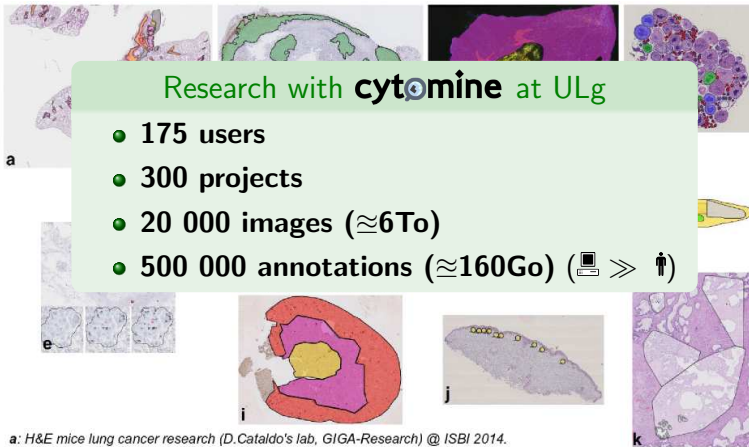


- a:** H&E mice lung cancer research (D.Cataldo's lab, GIGA-Research) @ ISBI 2014.
b: IHC mice lung cancer research (P. Martinive's lab, GIGA-Research) @ OncoTarget 2015.
c: Immunofluorescent mouse ear sponge assays in tumor angiogenesis. @ J. Pathol. 2015.
d: H&E Chondrostoma nasus sexual maturation research (Gennotte's lab, CEFRA).
e: *in situ* hybridization assays in human breast cancer research (C.Josse's lab, GIGA-Research) @ Submitted...
f: Human thyroid cytology (I. Salmon's lab, ULB Anatomical Pathology Department).
g: Danio rerio embryo development (M. Muller's lab, GIGA-Research) @ PLOS ONE 2015.
h: Danio rerio toxicology research (M.Muller's lab, GIGA-Research) @ PLOS ONE 2015.
i: IHC renal ischemia/reperfusion research (F.Jouret's lab, GIGA-Research) @ Am J Transl Res. 2015.
j: IHC in melanoma microenvironment research (P.Quatresooz's lab, GIGA-Research).
k: H&E in human breast cancer research (R. Longuespée, GIGA-Research).

cyt@mine-based research

Research with cyt@mine at ULg

- 175 users
- 300 projects
- 20 000 images ($\approx 6\text{To}$)
- 500 000 annotations ($\approx 160\text{Go}$) (🖨️ \gg 👤)



- a: H&E mice lung cancer research (D.Cataldo's lab, GIGA-Research) @ ISBI 2014.
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cyt@mine-based research

Research with cyt@mine at ULg

- 175 users
- 300 projects
- 20 000 images ($\approx 6\text{To}$)
- 500 000 annotations ($\approx 160\text{Go}$) (🖨️ \gg 👤)

Teaching with cyt@mine at l'ULg

- 4 000 users
- 50 projects
- 2 000 images ($\approx 2\text{To}$)
- 200 000 annotations ($\approx 30\text{Go}$) (🖨️ \ll 👤)

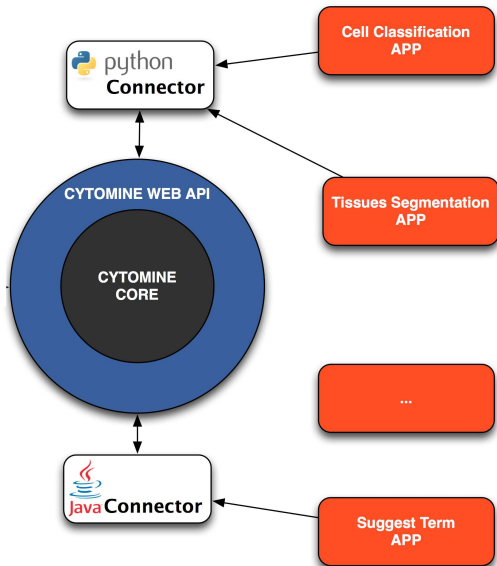
a: H&E mi
b: IHC mic
c: Immunc
d: H&E Cr
e: In situ h
f: Human i
g: Danio r
h: Danio re

i: IHC renal ischemia/réperfusion research (F.Jouret's lab, GIGA-Research) @ Am J Transl Res. 2015.

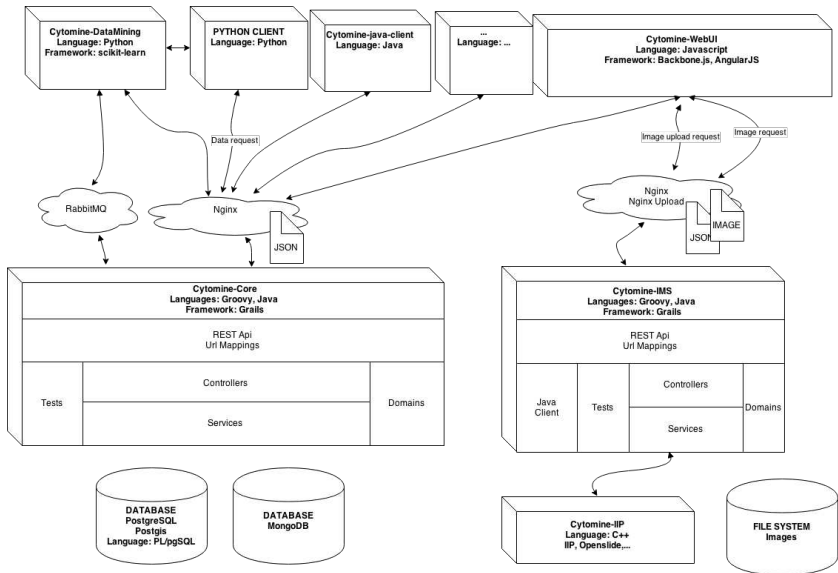
j: IHC in melanoma microenvironment research (P.Quatresooz's lab, GIGA-Research).

k: H&E in human breast cancer research (R. Longuespée, GIGA-Research).

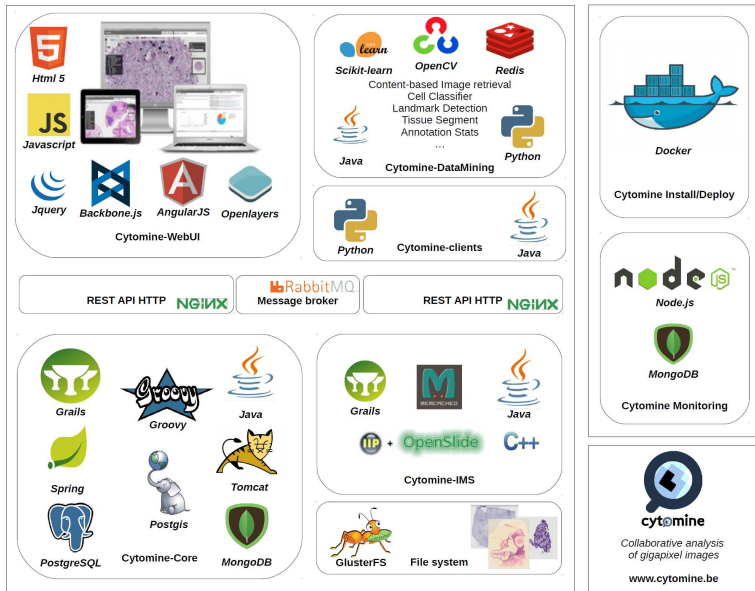
General architecture



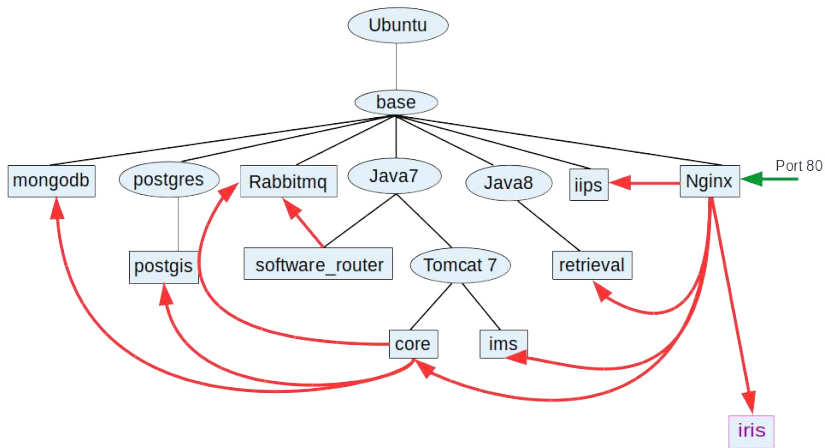
Detailed architecture



Included softwares and libraries



Docker architecture



Minimal setups

	Minimal Some users at the same time and some data	Recommand More users at the same time and more data	
CPU	8 core 64 bits	16 core 64 bits	Cytomine is a set of multithread servers/tools. If you want to support more users, you need to have more core.
MEMORY	8	16	If you want to store a lot of data or if you have a lot of users, you will need a larger amount of memory.
Disk	HDD 100GO	HDD with more than 2TO	On average, 1 image = 1GO and data for 1 image = 50MB (annotations, activities,...). If you plan to store 1000 images => 1To + 50GO <div style="border: 1px solid red; padding: 5px; margin-top: 10px;">! This does not include backup space!</div>
OS	Ubuntu / CentOS	Ubuntu	Docker needs to be installed Port 80 needs to be opened (by default, it's open) You need to have root (sudo) access to the server.
DNS		1 domain	

Several kinds of setups

	Server 1	Server 2	Server 3	Server 4	Server 5	Server 6	Server 7
1 server	All						
2 servers	Core PostgreSQL MongoDB Retrieval	IMS IIP					
3 servers	Core PostgreSQL MongoDB	IMS IIP	Retrieval				
4 servers	Core	IMS IIP	Retrieval	PostgreSQL MongoDB			
5 servers	Core	IMS IIP	Retrieval	PostgreSQL	MongoDB		
6 servers	Core	IMS 1 IIP 1	IMS 2 IIP 2	Retrieval	PostgreSQL	MongoDB	
>= 7 servers	Core	IMS 1 IIP 1	...	IMS N IIP N	Retrieval	PostgreSQL	MongoDB



[DOC] Main

Pages

Blog

SPACE SHORTCUTS

JIRA reports

JIRA reports

CHILD PAGES

Pages

[DOC] Cytomine main document...

Cytomine 20150712

Cytomine overview

JIRA reports

Pages

[DOC] Cytomine main documentation

Created by Loic Rollus, last modified by Raphaël Marée on Jan 19, 2016

Tools



Welcome to the Cytomine main documentation.

It is recommended to start by reading the main [Cytomine overview page](#) for a short introduction on Cytomine main concepts.

Then the documentation is organized in four main sections below for administrators/operators, developers, data/computer scientists, and end-users.

For testing the Cytomine platform, you can either:

1. Install a Cytomine instance at our own site, or
2. Access our demo instance available here: <http://demo.cytomine.be/> (see [Cytomine User Guide](#) for usernames/passwords or [request a personal account](#)).

Operations



Documentation for **administrators/operators**:

- [How to install a Cytomine server](#)

Developments



Documentation for **software developers**:

- [How to install a Cytomine](#)

Data & algorithms



Documentation for **data/computer scientists**:

- [How to install the Cytomine Data](#)

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IFRES : Grégoire Vincke, Dominique Verpoorten.

Histologie : Pascale Quatresooz, Valérie Defaweux, le groupe MorphoTIC.

CRIFA : Brigitte Denis, Céline Snoeck.

Students : Julien Confetti, Pierre Ansen, Olivier Caubo, Antoine Deblire.

Other collaborators :

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University of Namur : Patsy Renard, Eric Depiereux.

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SMASH (2012-2014) n°1217606

HISTOWEB (2014-2017) n°1318185

More information on : <http://cytomine.be>

info@cytomine.be

[@cytomine](#)