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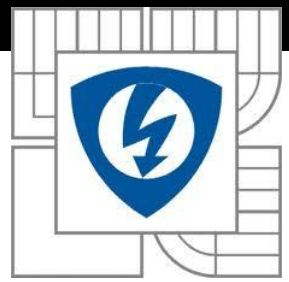

Evolutionary Evolved Image Object Detection

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Brno University of Technology (BUT), CZECH REPUBLIC
European Union

Motivation

- Training of image object detectors often require
  - 1) domain knowledge
  - 2) engineering and image processing knowledge

- (Semi)automatic object detection can save 1) computational time and resources, 2) improve accuracy

⇒WE ARE LOOKING FOR PARTNERS TO COLLABORATE ON THIS PROJECT,

⇒MANY ALGORITHMS CAN FIND UTILIZATION IN OTHER FILEDS OF RESEARCH (multidisciplinary)

Outline

- About Data-Mining Research Group
- Grammar Driven Genetic Programming
- Image-Mining

- Open-source software
  - Image-Mining extension for RapidMiner
  - Grammar driven Genetic Programming

Two examples:

- Planned Future Work

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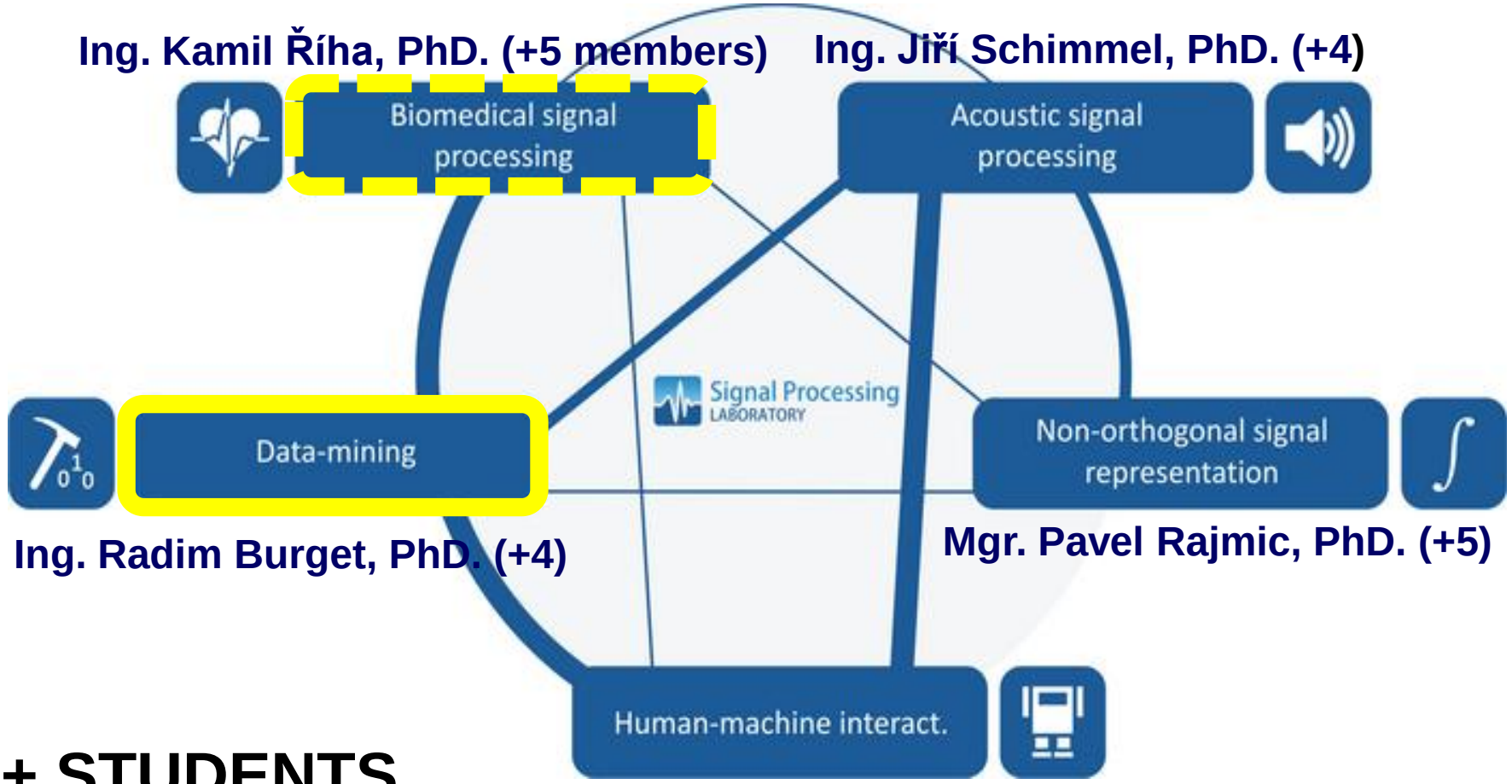
Data-Mining Research Group

Signal processing laboratory

Czech Republic

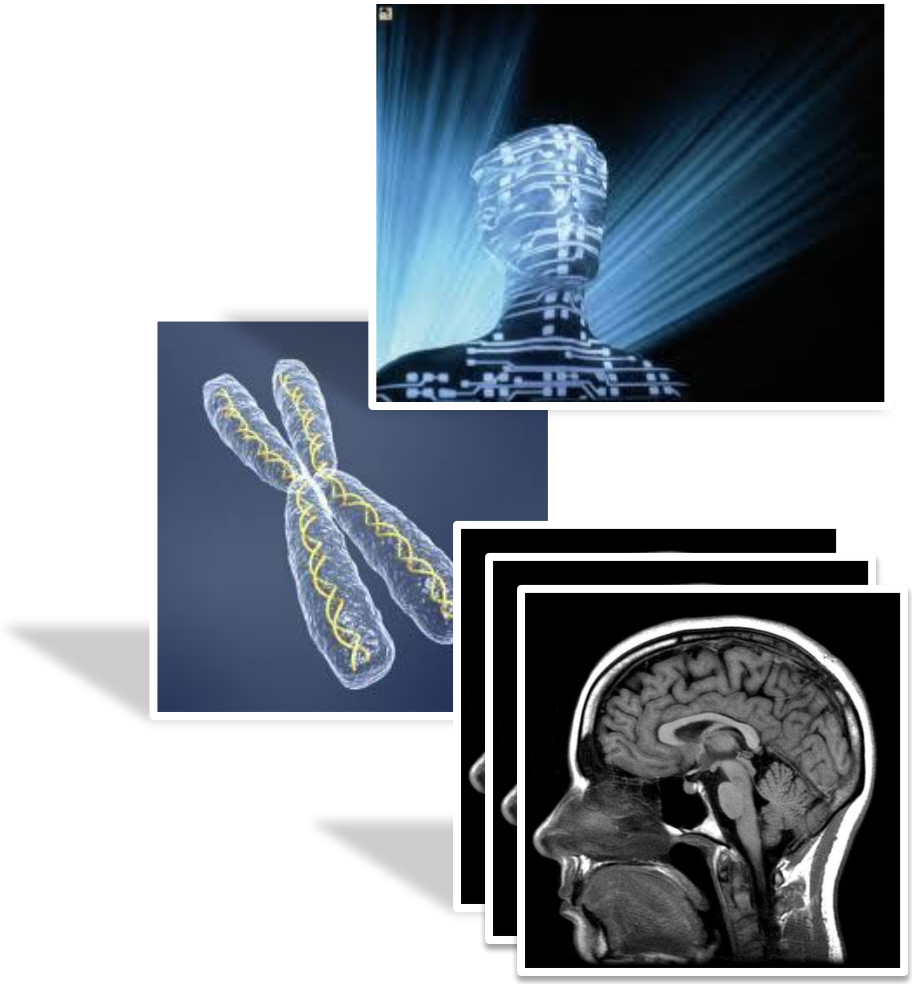
European Union

Signal Processing Laboratory SPLab

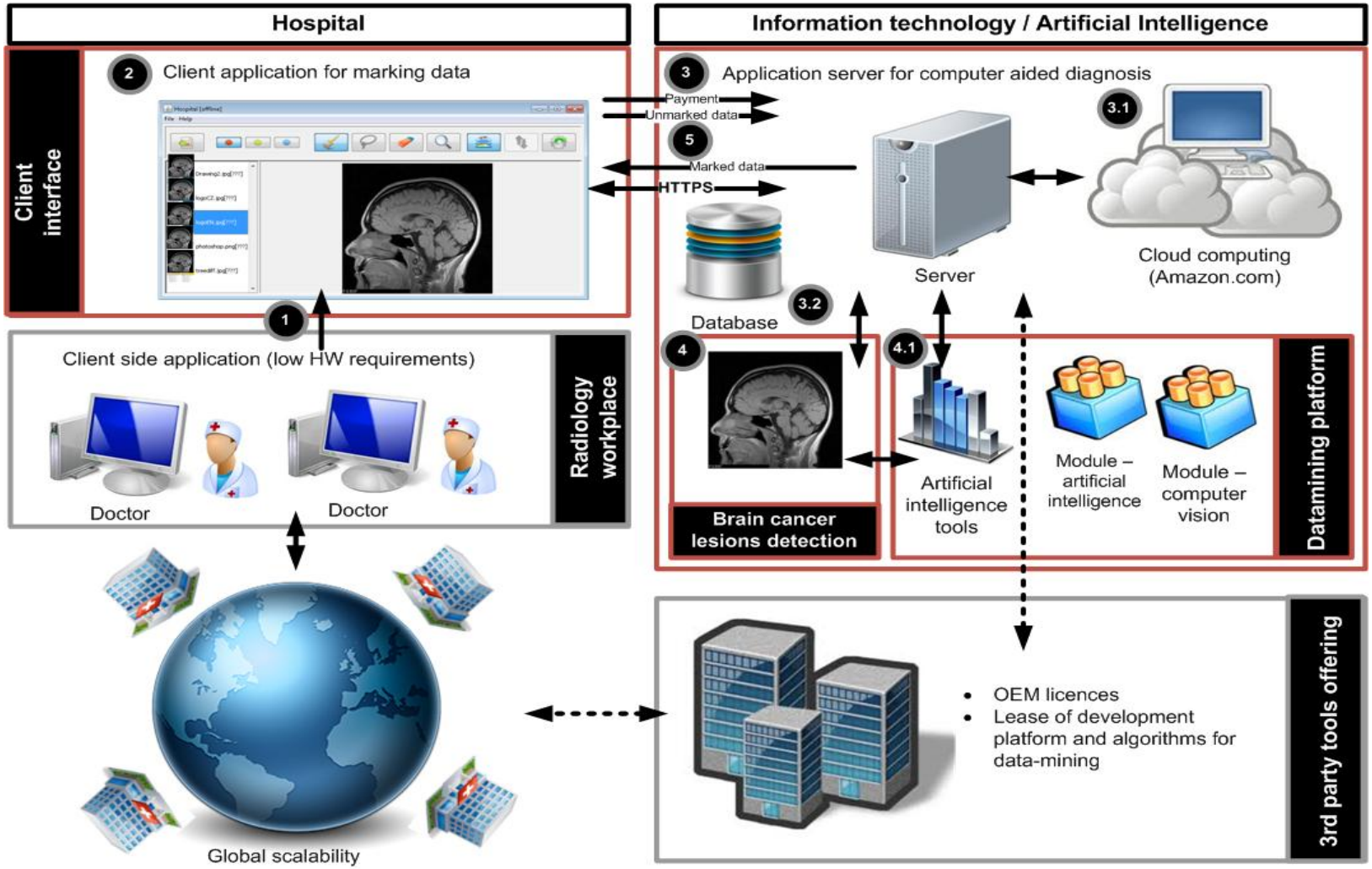


Data-Mining Research Group

- Data mining
  - Image mining
  - Genetic Programming (Grammar driven)
  - Biomedical processing



Computer Aided Diagnosis System



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Grammar Driven Genetic Programming

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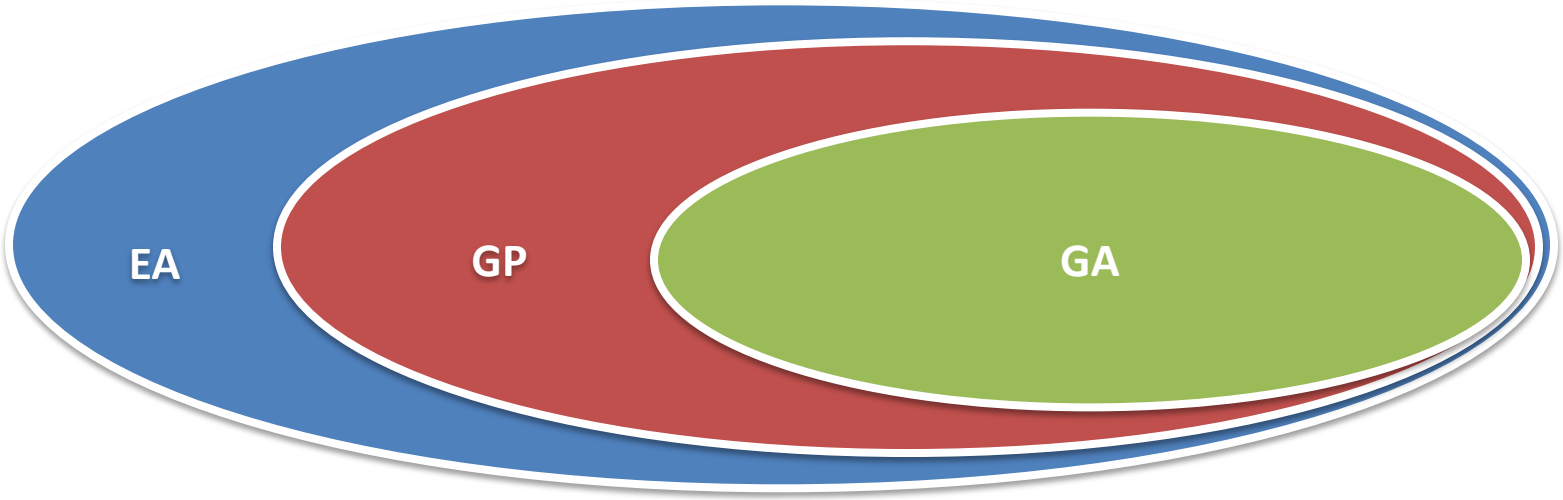
What is Genetic Programming

- Evolutionary algorithm-based methodology inspired by biological evolution to find computer programs



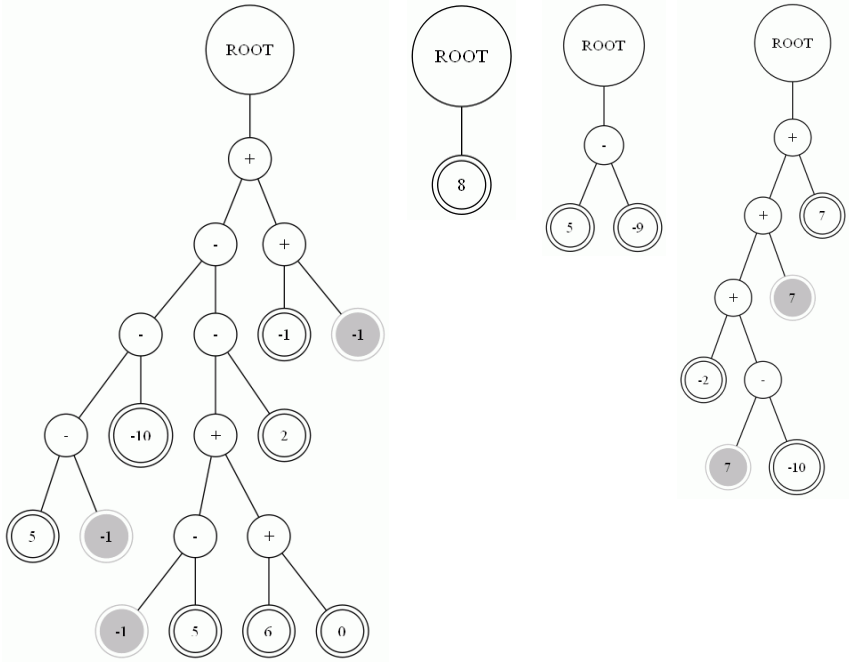
Program structure

1. A] Linear B] Tree or B] Acyclic graphs

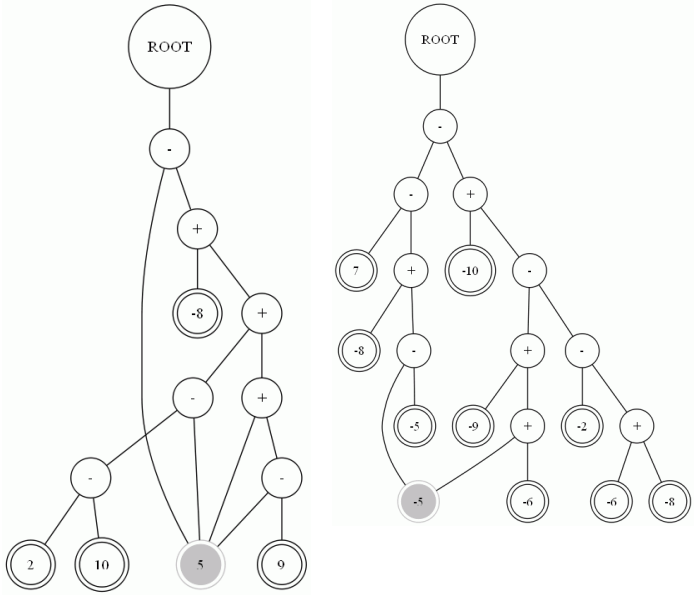
A]

88	12	88	12	139	30	88	12	88	12	139	30	1	40

B]

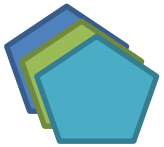


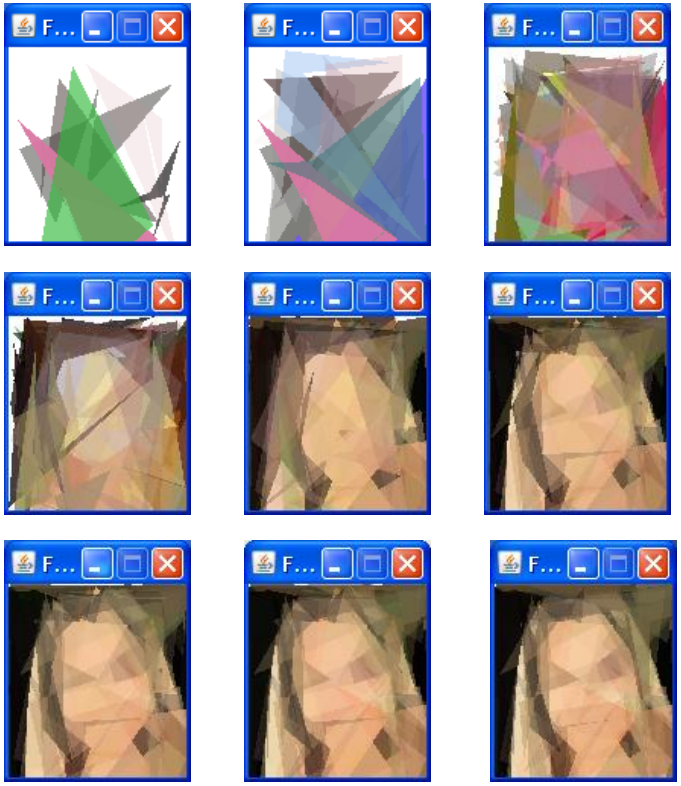
C]

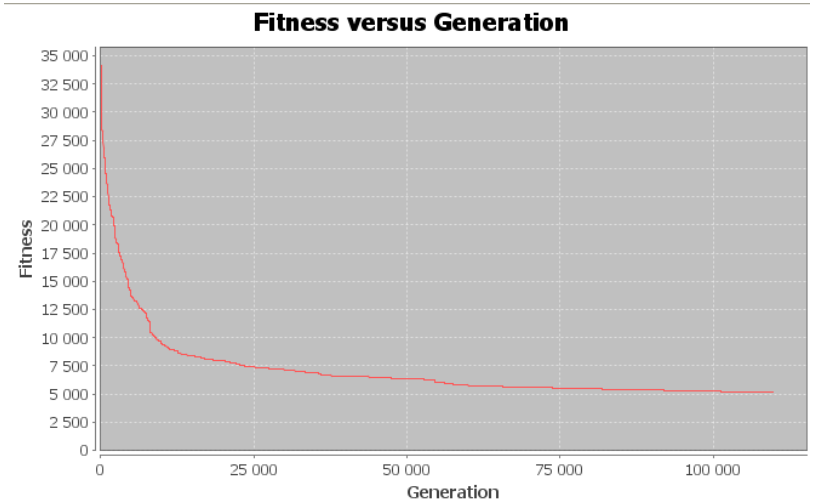


Example

- Example: Draw picture with use of 50 polygons







POLYGON 1													
X1	Y1	X2	Y2	X3	Y3	X4	Y4	X5	Y5	Color RED	Color GREEN	Color BLUE	Transparency
88	12	88	12	139	30	88	12	88	12	139	30	1	40

POLYGON 2													
X1	Y1	X2	Y2	X3	Y3	X4	Y4	X5	Y5	Color RED	Color GREEN	Color BLUE	Transparency
88	12	88	12	139	30	88	12	88	12	139	30	1	40

...

POLYGON 50													
X1	Y1	X2	Y2	X3	Y3	X4	Y4	X5	Y5	Color RED	Color GREEN	Color BLUE	Transparency
88	12	88	12	139	30	88	12	88	12	139	30	1	40

Problems of GP

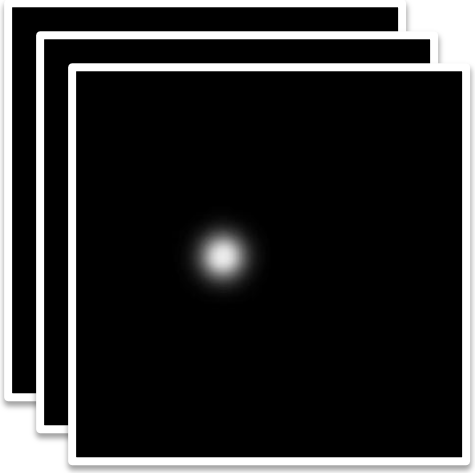
- Can reveal hidden patterns and hidden information

- Time-consuming
- Risk of overfittinng

- **Grammar Driven Genetic Programming**
  - Context-free grammar

- high chance of success when applied to complex problems

Example - Image processing



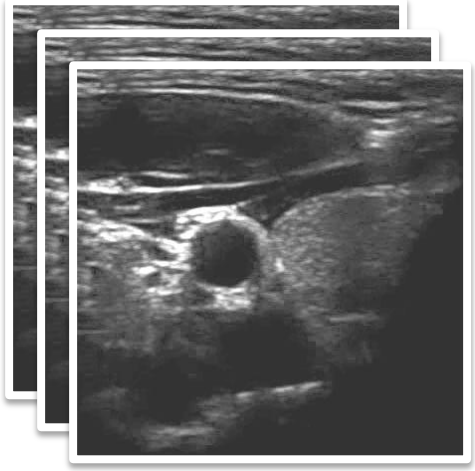


Image operators,
semantic gramatic

GP

New image filter

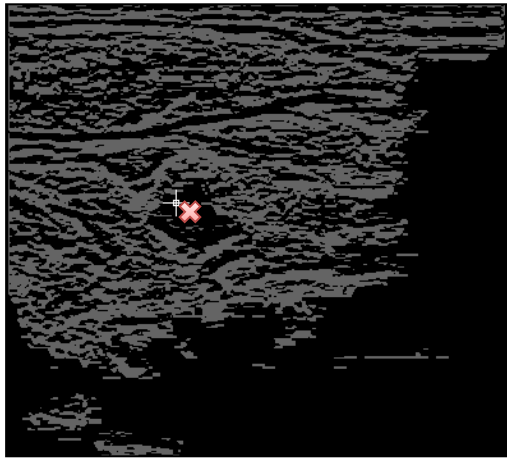
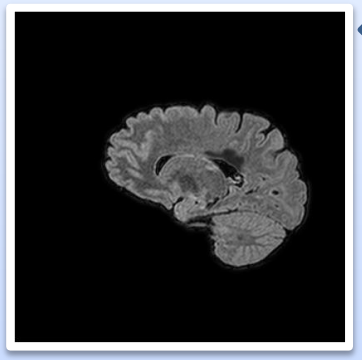
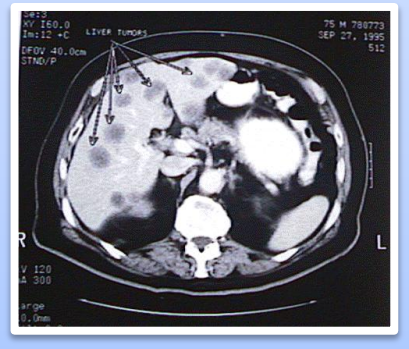


Image filter
invention machine

Traditional concept

Limited training set





...

Domain expert

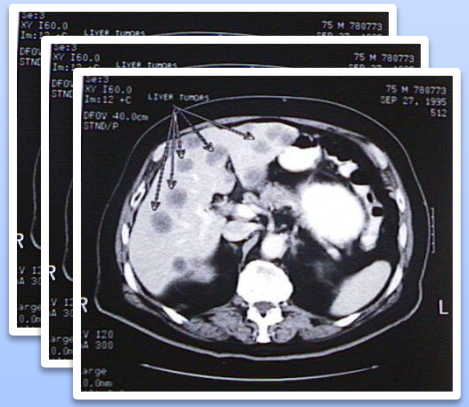
Labeling

Labeled

Image vision expert

Training detectors

Large data set



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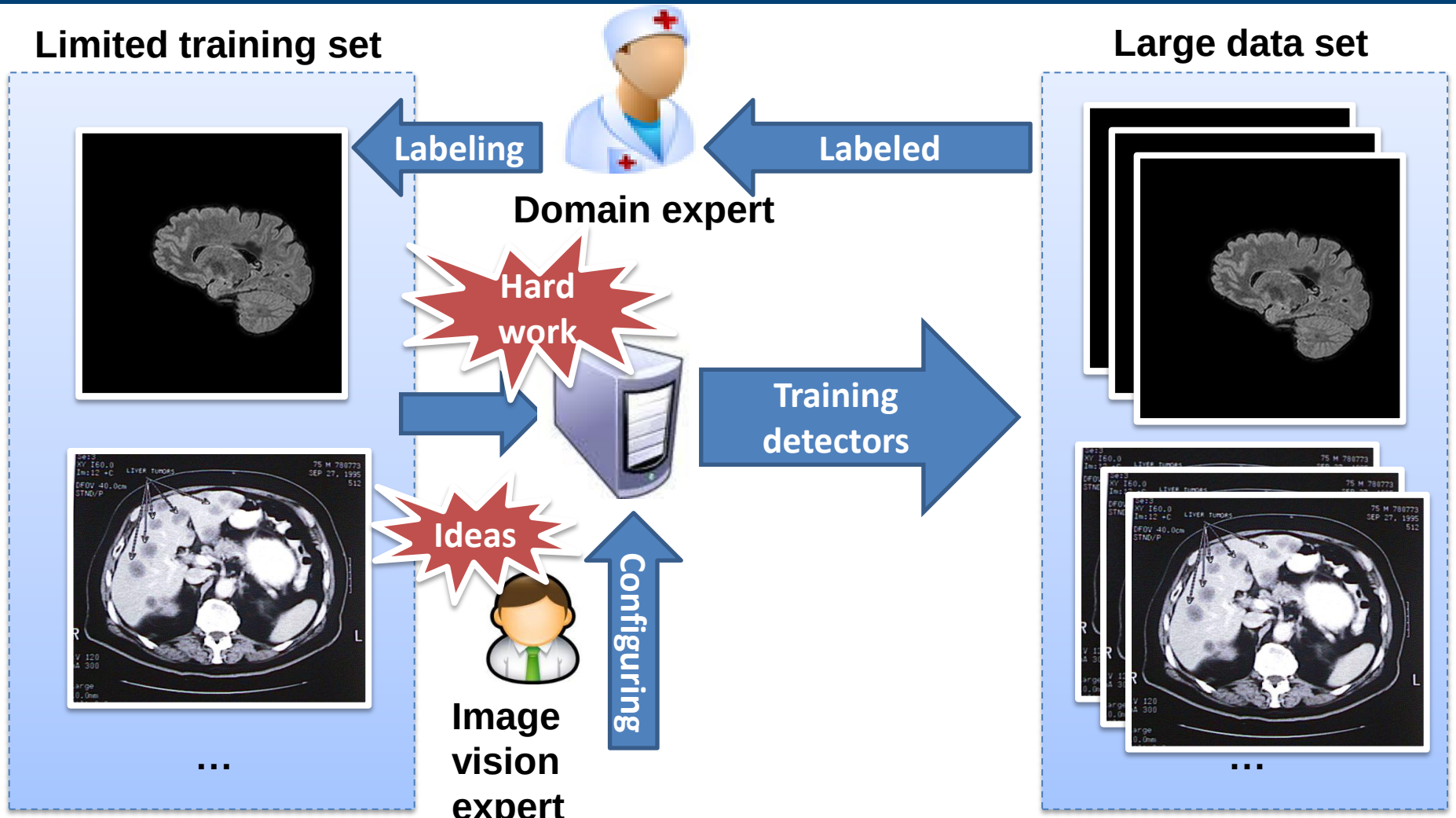
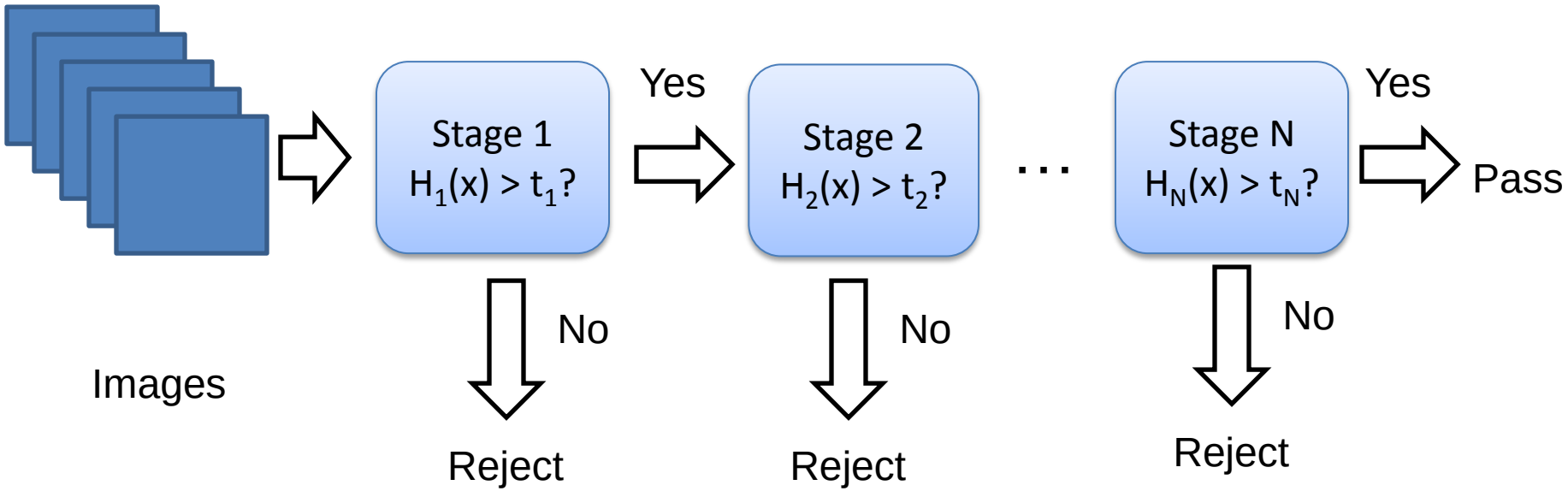
GP-concept


Limited training set
Large data set
Labeling
Labeled
Domain expert
Hard work
Training detectors
Ideas
Configuring
Image vision expert
...
...

Viola-Jones Object Detection



1. Ada-Boost
2. Rearanging opearators order using evolution

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Image Mining

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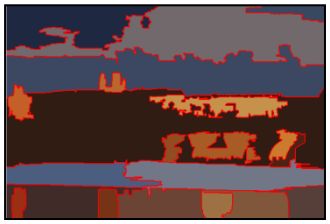
Feature Extraction Levels



?

- Global level features
- Segment level features
- Local level features
- Similarity to other image features

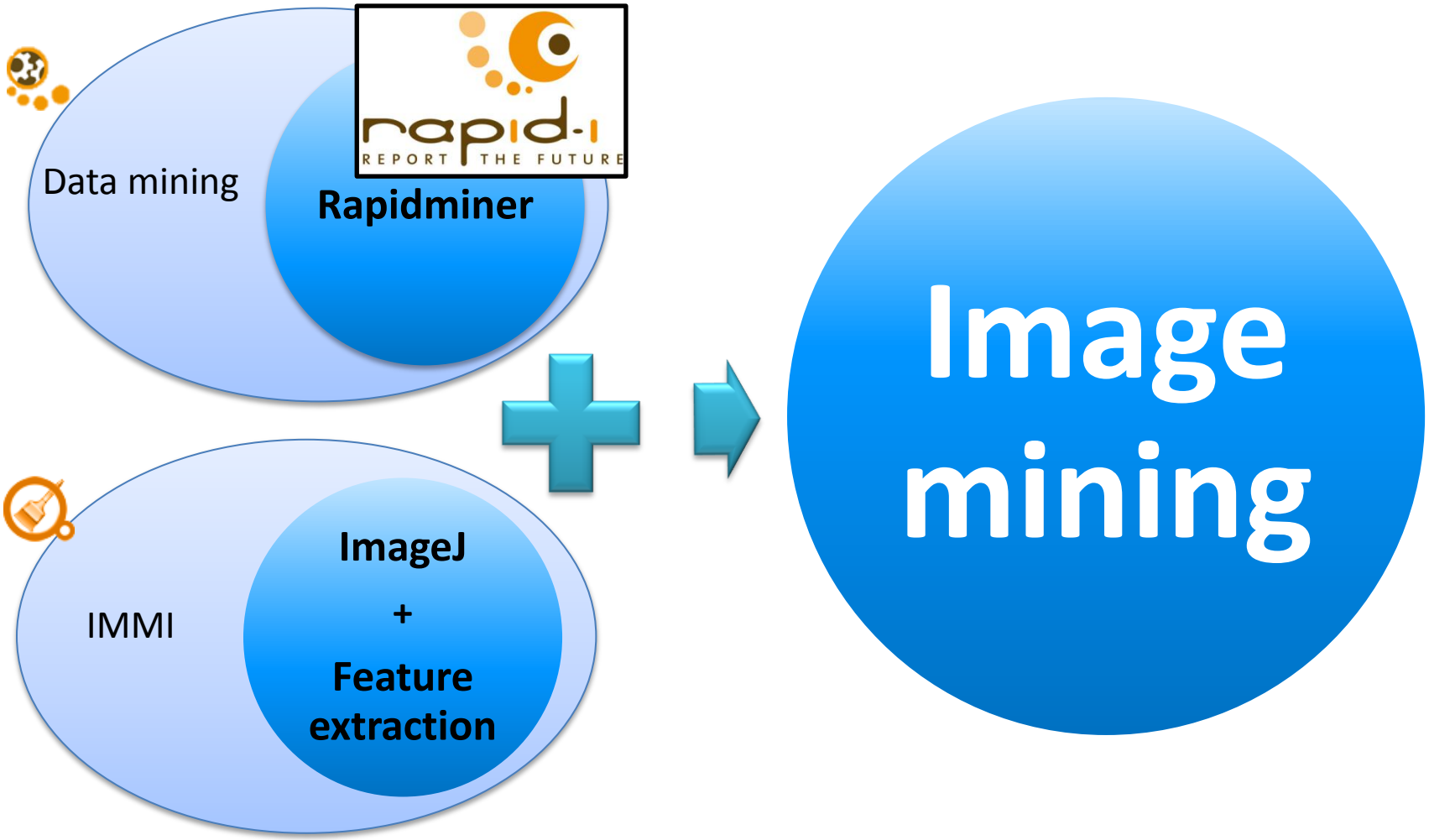
Features		
Mean value	105,675	153,269
Standard deviation	31,555	20,117
Skewness	-0,219	-0,053
Peak	-1,350	-0,269
BDIP	1,386	6,120
BVLC	0,137	3,017
…	…	…

Data

RAPID MINER

Knowledge ☺

Image mining



Tool for Image Processing and Mining

rapid-i
REPORT THE FUTURE

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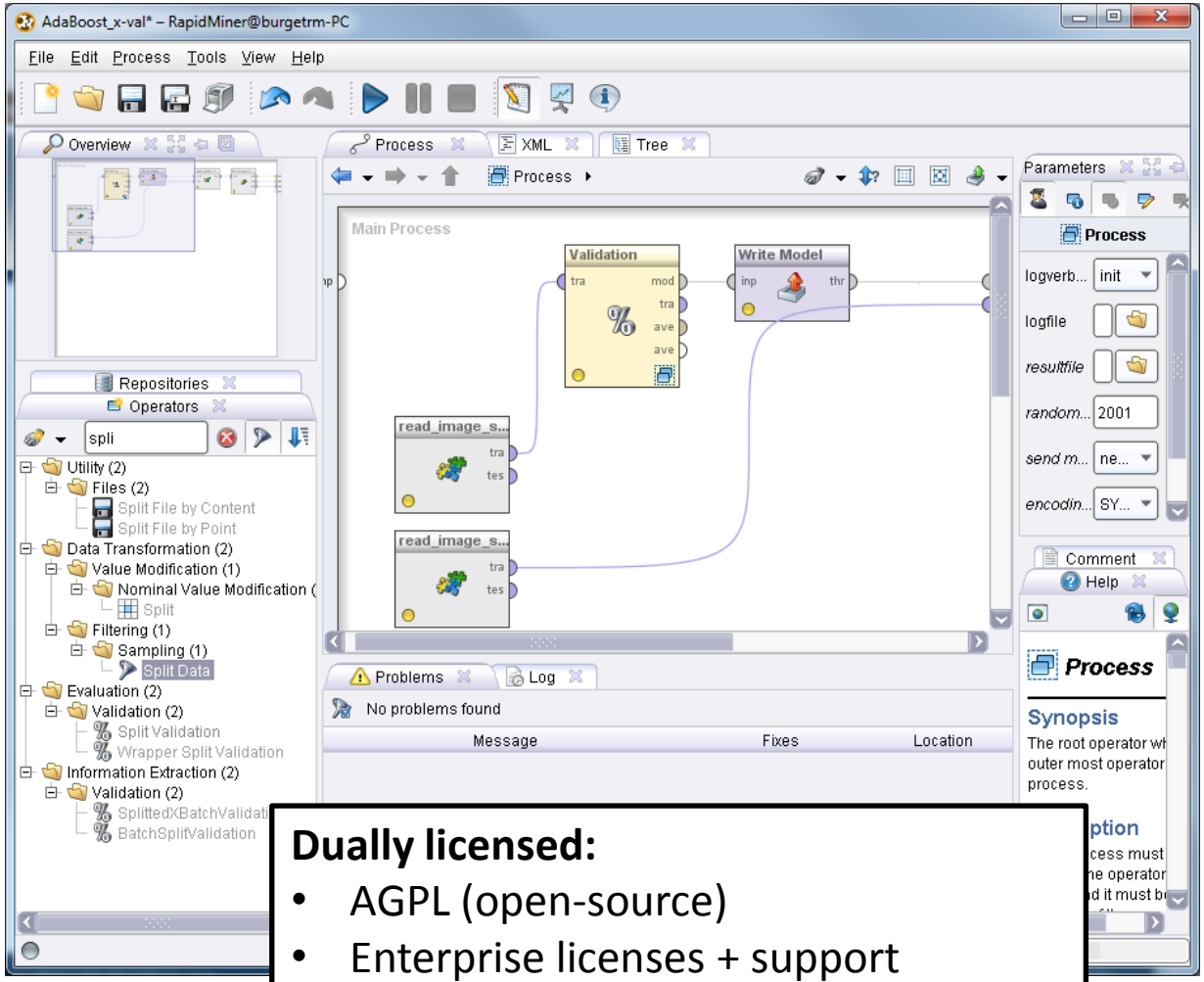
Image Mining

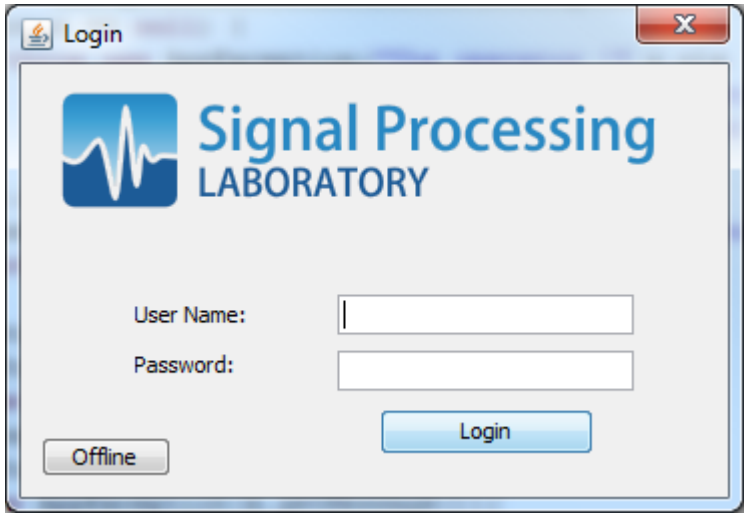
ImageJ
Image Processing and Analysis in Java

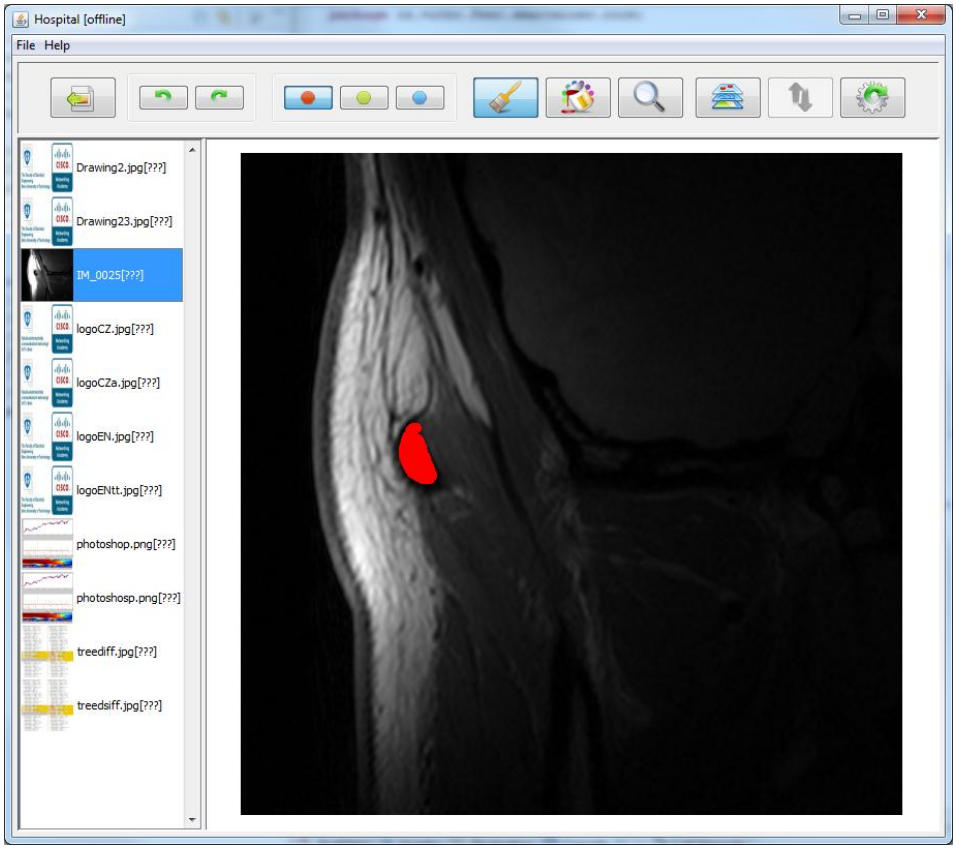


Dually licensed:

- AGPL (open-source)
- Enterprise licenses + support

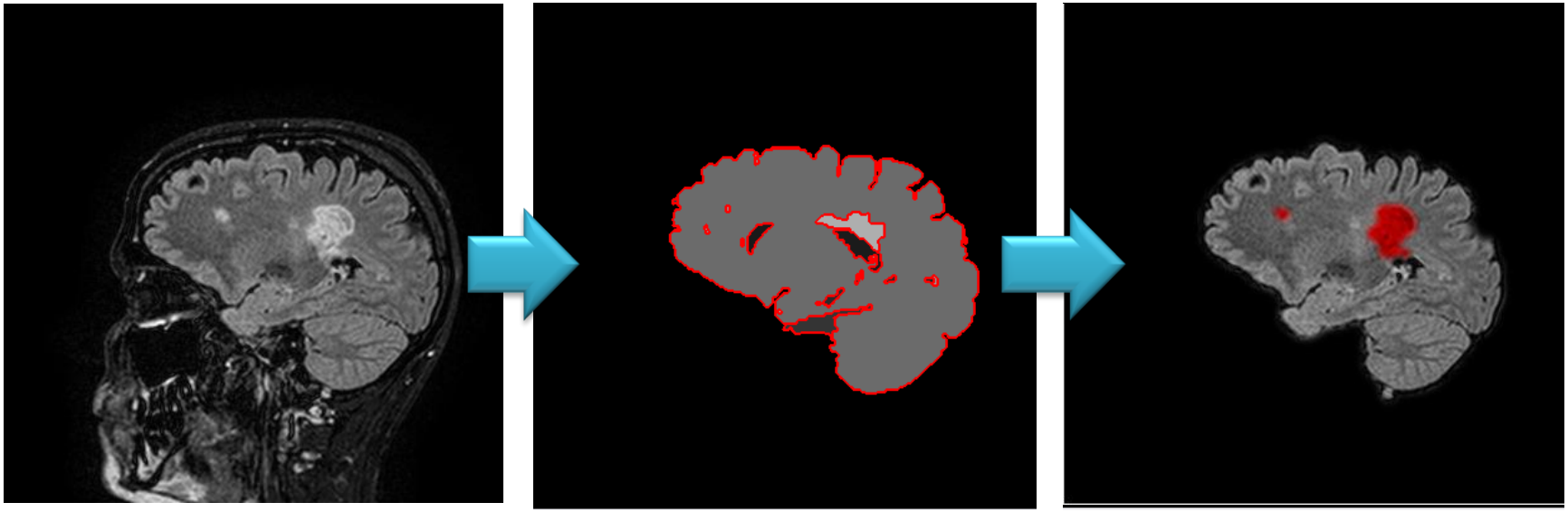
GUI Tools for Domain Experts





Example – Brain Leasion Detection

Segments selection according to ontology base



Original

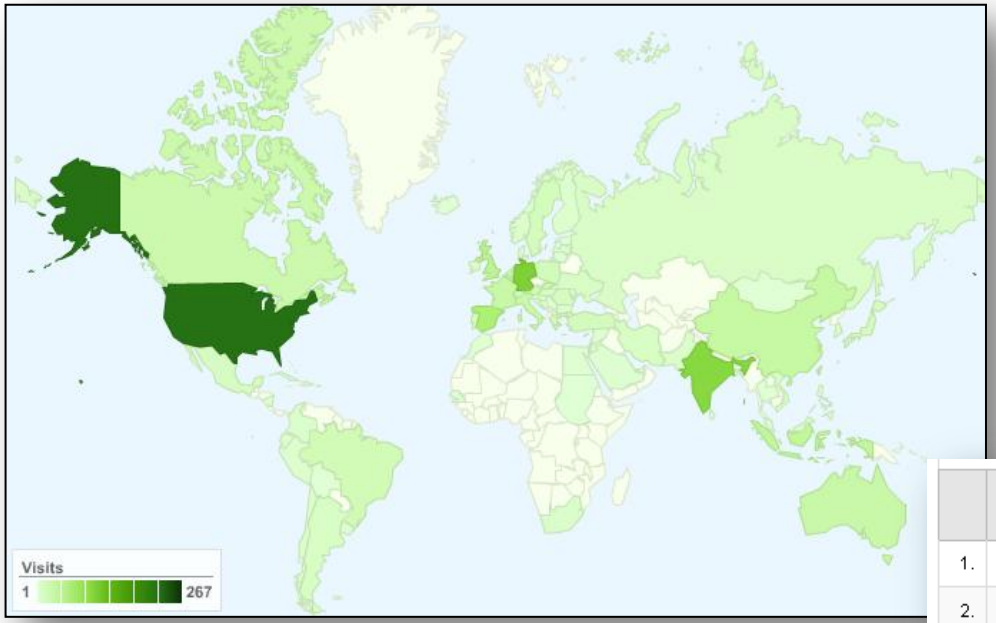
Segmentation & Selection

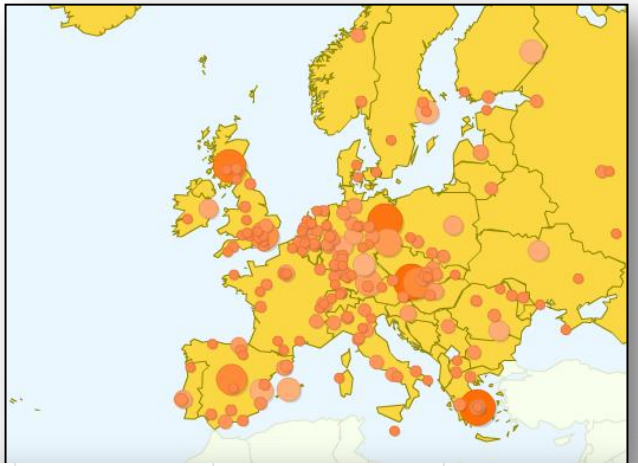
Identified disease

Ontology base

Statistics

Download statistics





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2.	Germany	128	5.50	00:07:06	77.34%
3.	India	119	4.96	00:06:33	82.35%
4.	Spain	76	4.99	00:05:15	60.53%
5.	United Kingdom	52	4.23	00:05:56	86.54%
6.	Indonesia	44	4.34	00:09:36	52.27%
7.	Belgium	40	6.28	00:05:47	55.00%
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10.	France	35	4.20	00:05:18	82.86%

Period:
01/2011 – 10/2011
European Union
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Funding – selected projects

- Média—informatics system for support of advanced multimedia services, MPO, FR—TI2/679, GiTy, a.s. 2010-2013, 667 000 EUR

Research and development system for product processes optimization, MPO FR-TI1/444, 2009 – 2013, 649 000 EUR

- The Research of Algorithms for Processing of Digital Images and Image Sequences, MSM, ME10123, 2010 – 2012, 100 000 EUR

Planned Future Work

- GP - Improvement in grammar definition
- Improved 3D reconstruction of brain tumor
- Brain cancer segmentation

Thank you for your attention

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