

# Multi-disciplinary modality classification for medical images

Viktor Gál<sup>1</sup>, Illés Solt<sup>2</sup>

<sup>1</sup>Dept. of Applied Mathematics and  
Computer Science  
Ghent University  
Belgium

<sup>2</sup>Dept. of Telecommunication and  
Media Informatics  
Budapest University of Technology  
Hungary

# Intro

- one of the **newbie** groups
- 5 submitted **mixed** runs
- **86.03** accuracy  $\rightarrow$  2<sup>nd</sup> rank
- we're **open-source**

# Methods

## Early fusion

- multi-modal features: visual, textual and more
- using Weka's SMO (SVM with polynomial kernel)

## Late fusion

- separate classifiers for visual and textual features
- combining our system with the organizer's predictions

## Hierarchical classification

- based on the given ImageCLEFmed modality taxonomy



# Features

## Textual

#

- caption text → bag of relevant words → regular expressions 118

## Visual

- SIFT → bag of “visual words” → *tf-idf* weighting 939
- colours in HSV space → histogram binning 36
- orthogonal axis recognition 2
- skin detection 1

## Other

- EXIF meta-data 2
- Radiopaedia body system annotations → transfer learning 17
- PubMed Central article → MeSH terms 264

# Features

## Textual

#

- caption text → bag of relevant words → regular expressions 118

## Visual

- SIFT → bag of “visual words” → *tf-idf* weighting 939
- colours in HSV space → histogram binning 36
- orthogonal axis recognition 2
- skin detection 1

## Other

- EXIF meta-data 2
- Radiopaedia body system annotations → transfer learning 17
- PubMed Central article → MeSH terms 264

# Features

## Textual

#

- caption text → bag of relevant words → regular expressions 118

## Visual

- SIFT → bag of “visual words” → *tf-idf* weighting 939
- colours in HSV space → histogram binning 36
- orthogonal axis recognition 2
- skin detection 1

## Other

- EXIF meta-data 2
- Radiopaedia body system annotations → transfer learning 17
- PubMed Central article → MeSH terms 264

# Results

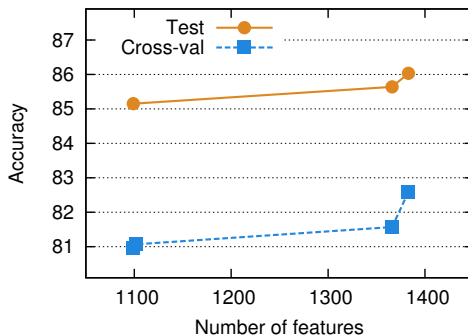
Run	Test	Cross-val
BoVW+Regex+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$	85.15	80.97
BoVW+Regex+MeSH+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$ + $f_{lines}$	85.64	81.57
BoVW+Regex+MeSH+RP+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$ + $f_{lines}$	<b>86.03</b>	82.59
Sys    BoVW+Regex+MeSH+RP+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$ + $f_{lines}$ + $f_{CEDD}$	74.12	
XEROX	86.91	

Features: textual, visual, other

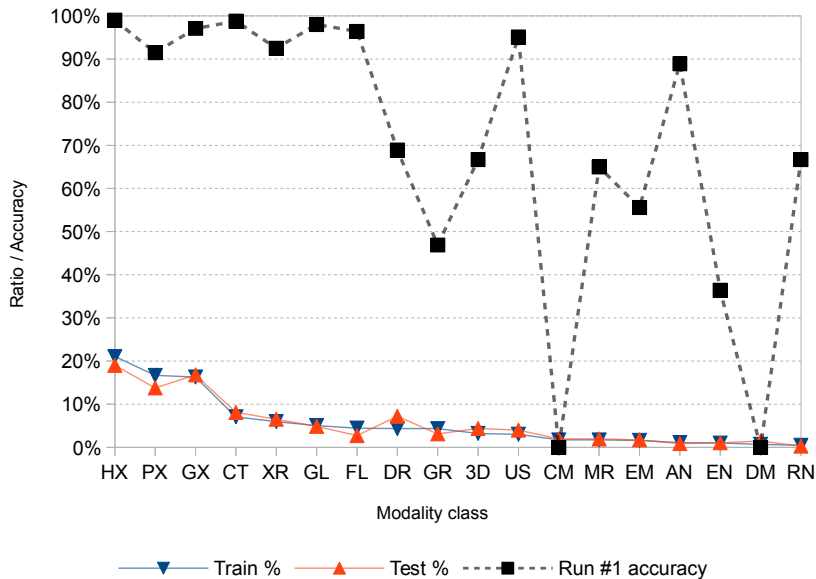
# Results

Run	Test	Cross-val
BoVW+Regex+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$	85.15	80.97
BoVW+Regex+MeSH+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$ + $f_{lines}$	85.64	81.57
BoVW+Regex+MeSH+RP+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$ + $f_{lines}$	<b>86.03</b>	82.59
Sys    BoVW+Regex+MeSH+RP+ $f_{hist}$ + $f_{skin}$ + $f_{mean}$ + $f_{lines}$ + $f_{CEDD}$	74.12	
XEROX	86.91	

Features: textual, visual, other



## Best run



Source code available at  
[github.com/illes/imageclef-med](https://github.com/illes/imageclef-med)



## Resources

- Radiopaedia <http://radiopaedia.org/>
- Weka <http://www.cs.waikato.ac.nz/ml/weka>

	Modality class	Train	Test	#1	#2	#3	#4	#5
3D	3D render	3.2	4.4	66.7	71.1	<b>73.3</b>	66.7	57.8
AN	Angiography	1.1	0.9	<b>88.9</b>	77.8	77.8	66.7	88.8
CM	Compound figure	1.7	2.0	0.0	<b>5.0</b>	5.0	5.0	5.0
CT	Computed tomography	7.1	8.1	<b>98.8</b>	97.6	95.2	91.6	89.2
DM	Dermatology	0.7	1.5	0.0	0.0	0.0	6.7	<b>13.3</b>
DR	Drawing	4.4	7.2	68.9	66.2	<b>70.3</b>	27.0	24.3
EM	Electronmicroscope	1.6	1.8	<b>55.6</b>	<b>55.6</b>	<b>55.6</b>	<b>55.6</b>	<b>55.6</b>
EN	Endoscope	1.0	1.1	<b>36.4</b>	36.4	27.3	36.4	27.3
FL	Fluorescence	4.5	2.7	96.4	96.4	<b>100</b>	<b>100</b>	<b>100</b>
GL	Gel	5.1	4.9	98.0	98.0	<b>100</b>	82.0	80.0
GR	Gross pathology	4.4	3.1	<b>46.9</b>	40.6	34.4	34.4	34.4
GX	Graphics	16.3	16.8	<b>97.1</b>	96.5	94.8	97.1	96.5
HX	Histopathology	21.1	19.0	<b>99.0</b>	99.0	99.0	95.4	95.9
MR	MRI	1.7	2.0	65.0	70.0	<b>75.0</b>	60.0	50.0
PX	Photo	16.7	13.8	<b>91.5</b>	90.1	88.7	73.8	66.7
RN	Retiongraph	0.5	0.3	<b>66.7</b>	66.7	66.7	0.0	33.3
US	Ultrasound	3.0	4.0	<b>95.1</b>	95.1	90.2	85.4	78.0
XR	X-ray	6.0	6.5	92.5	<b>94.0</b>	94.0	82.1	71.6