Medical classification

Medical compound figure separation and multi-label classification task

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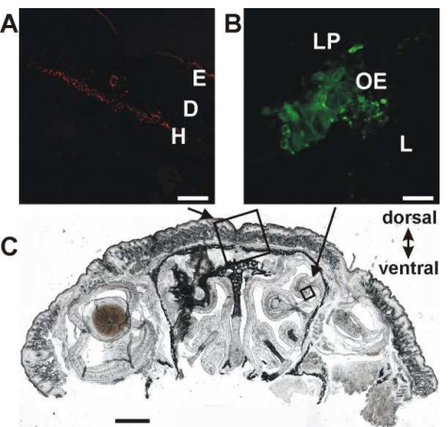
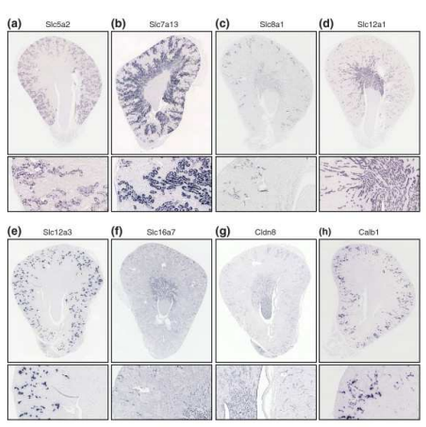
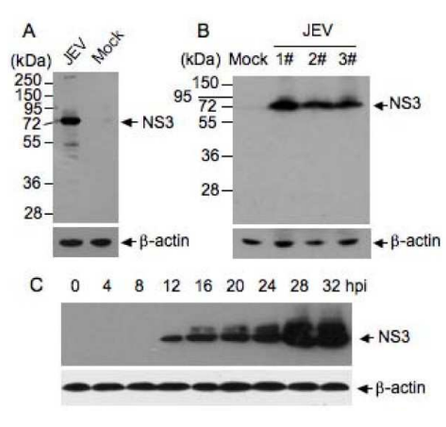
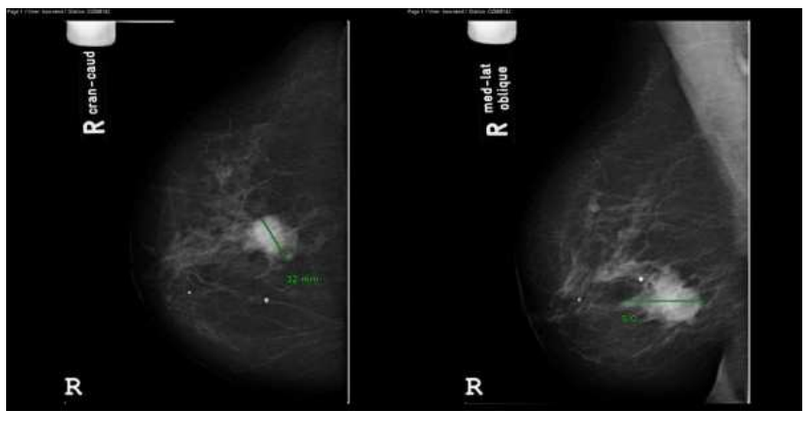
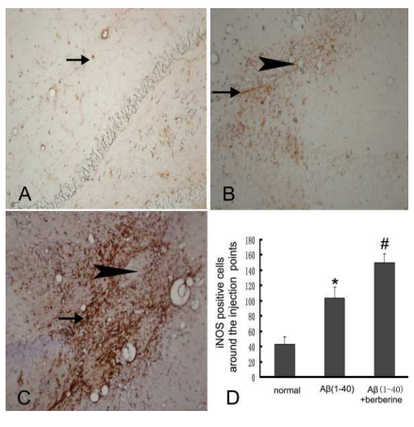






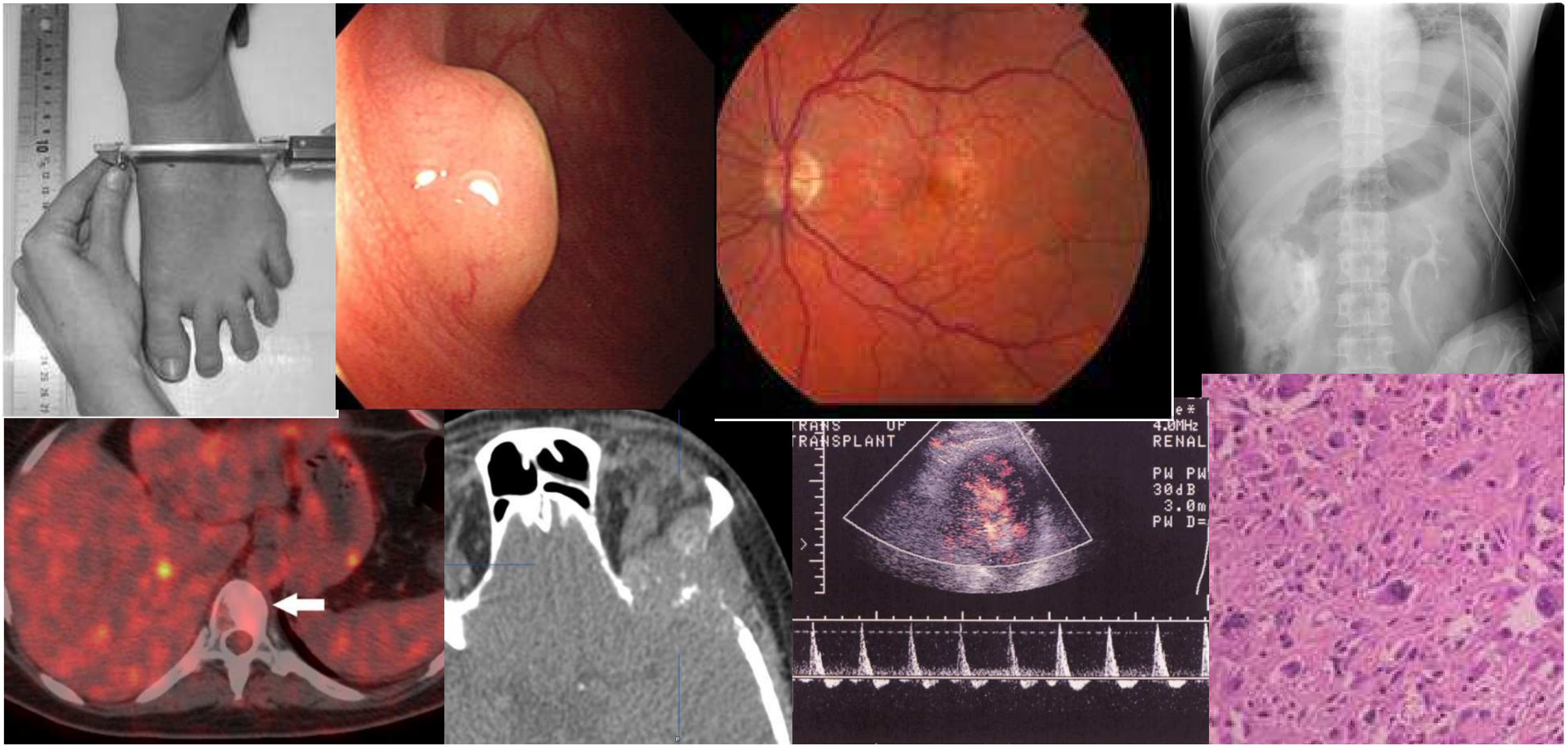




ImageCLEF 2015

- Four tasks offered:
  - image annotation
  - medical classification
  - medical clustering
  - liver CT annotation

Medical images



Medical images

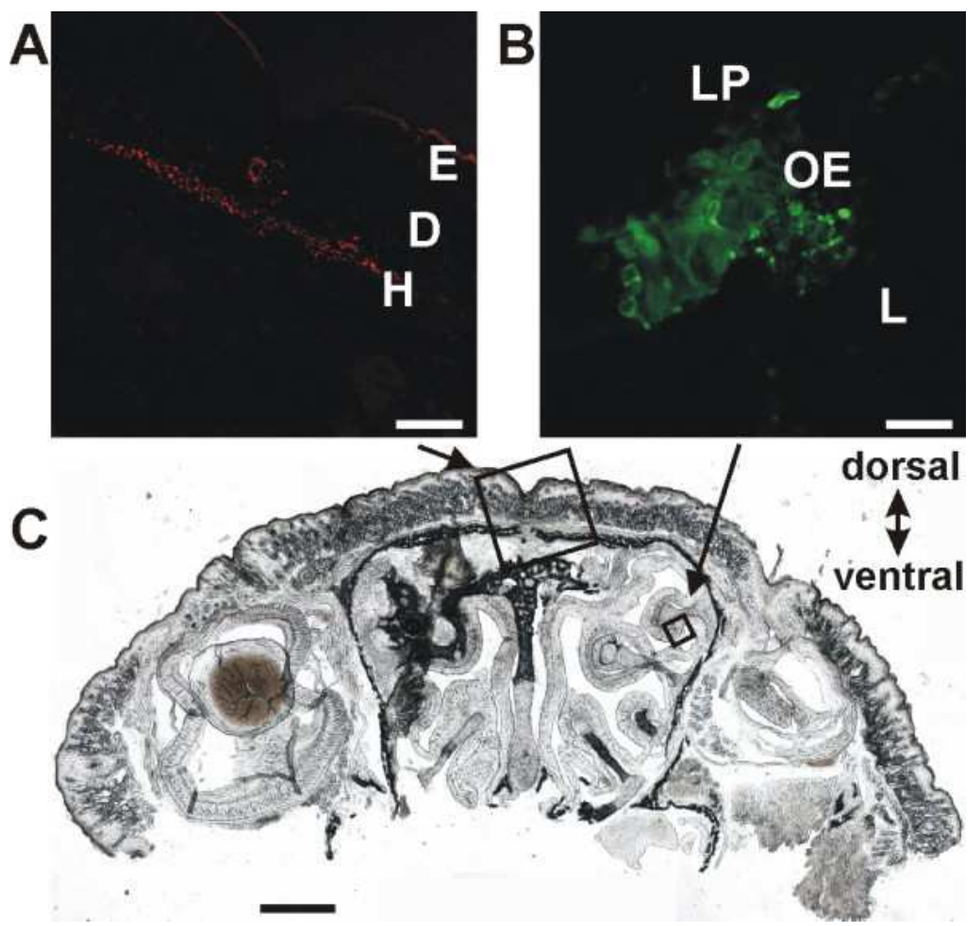
- Provided crucial information
  - Diagnosis, treatment planning…
- Produced in hospitals in ever-increasing numbers
- 30% of the global digital storage
- Made available via biomedical publications

Search for relevant information

A woman in her mid-30s presented with dyspnea and hemoptysis. CT scan revealed a cystic mass in the right lower lobe. Before she received treatment, she developed right arm weakness and aphasia. She was treated, but four years later suffered another stroke. Follow-up CT scan showed multiple new cystic lesions.

Compound figures

- ~40% of the figures in PubMed Central
- CBIR systems should distingue subfigures



Past editions

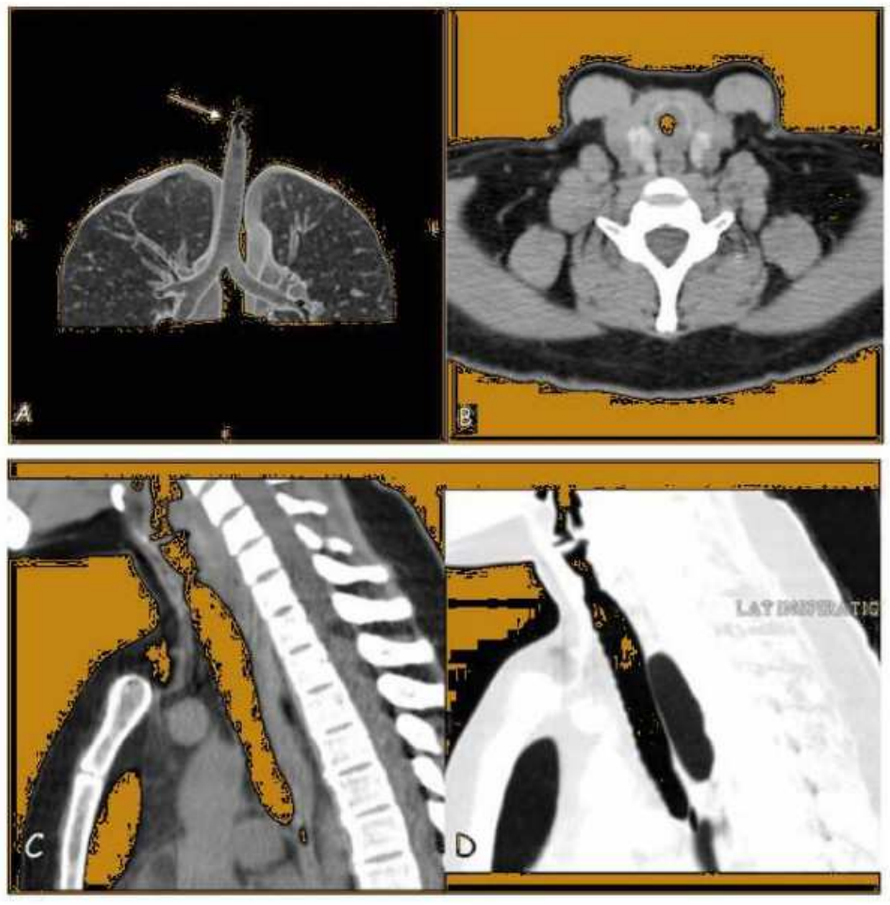
- 11th ImageCLEFmed edition
- Figure classification subtask since 2010
- Compound figure separation subtask in 2013

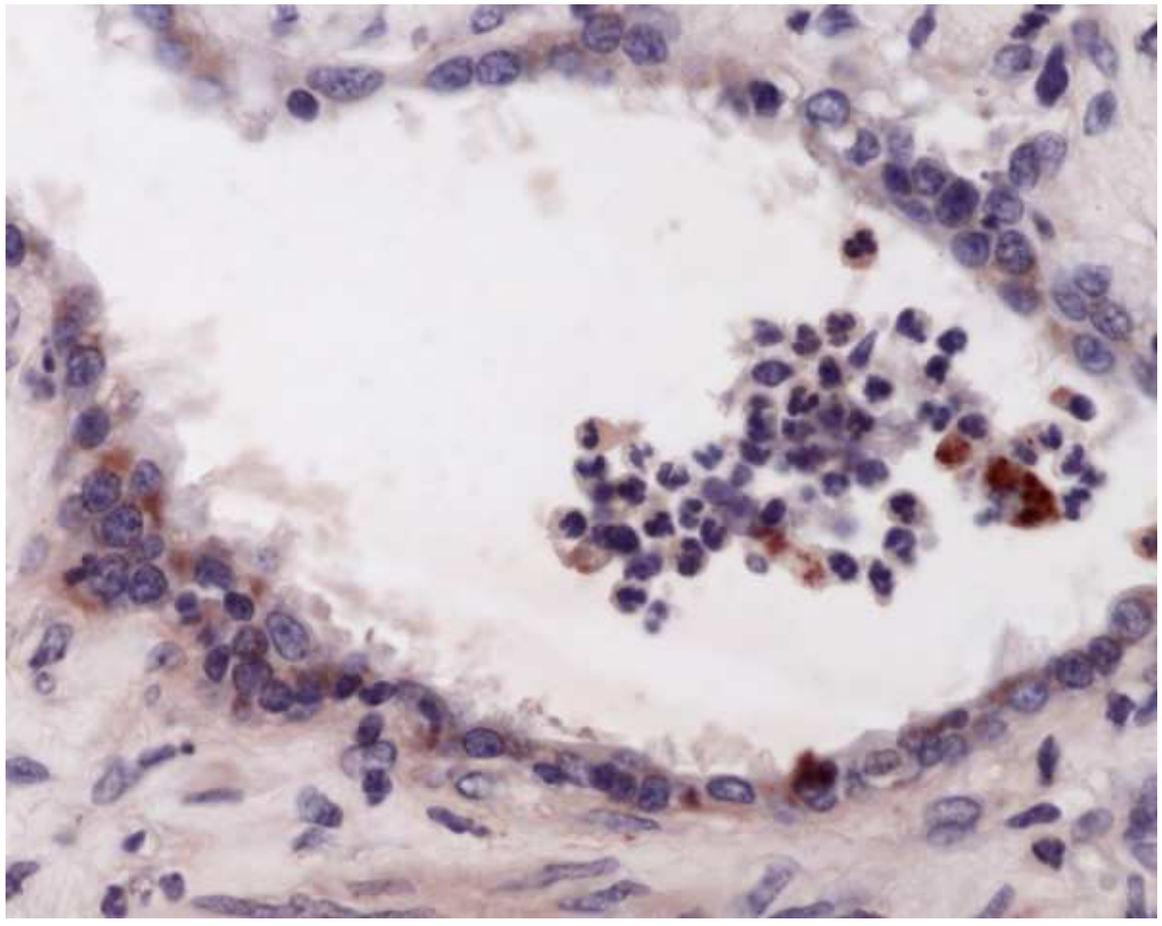
2015 Subtasks

- Compound figure detection
- Compound figure separation
- Multi-label classification
- Subfigure classification

Compound figure detection

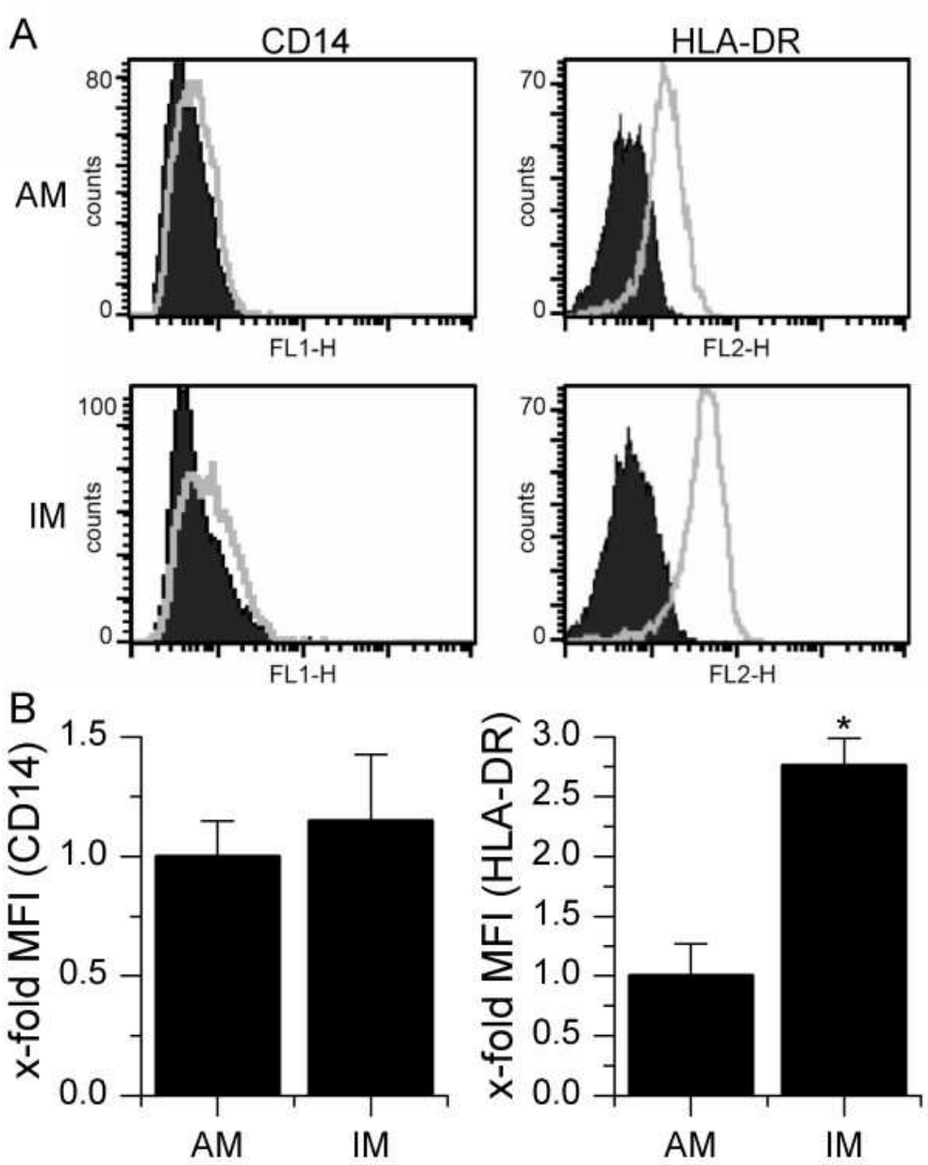
- To identify if a figure is compound or not

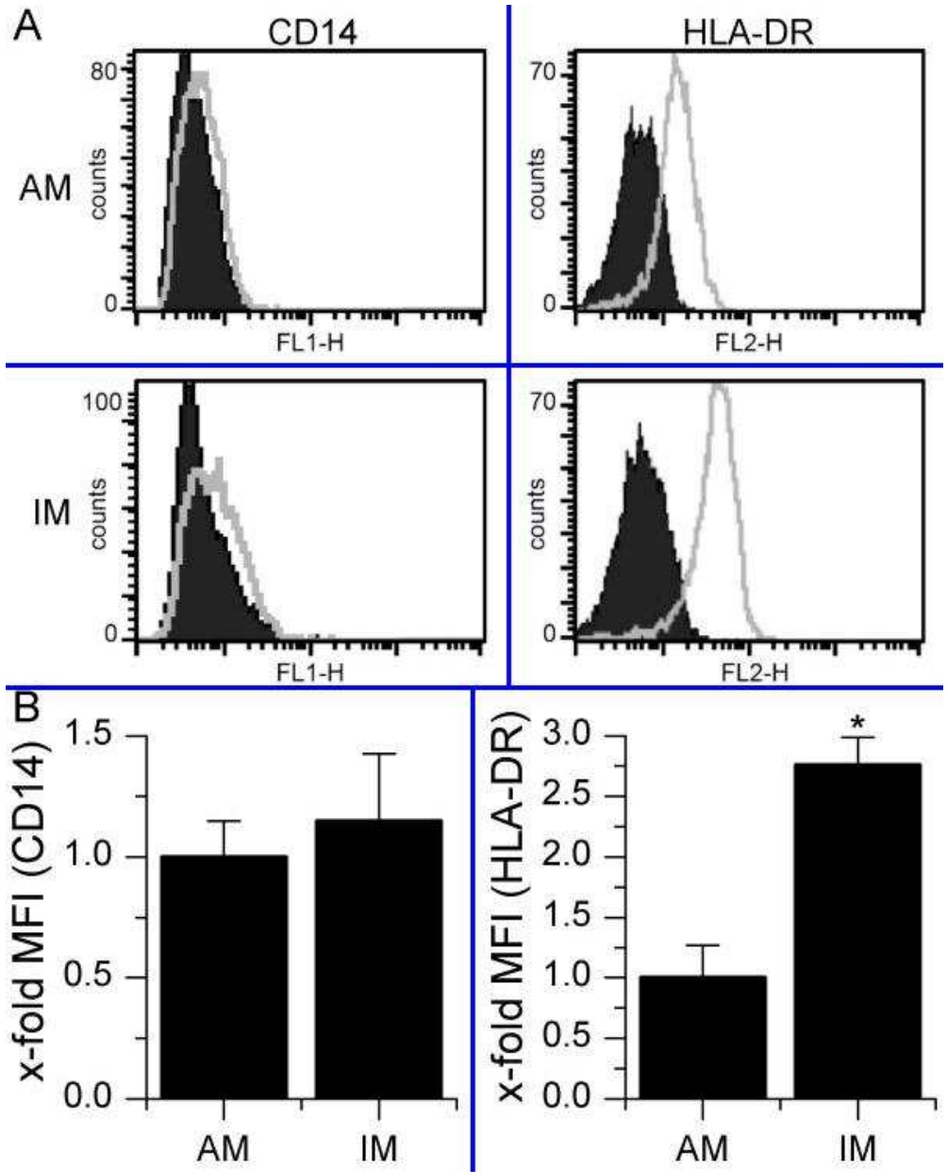




Compound figure separation

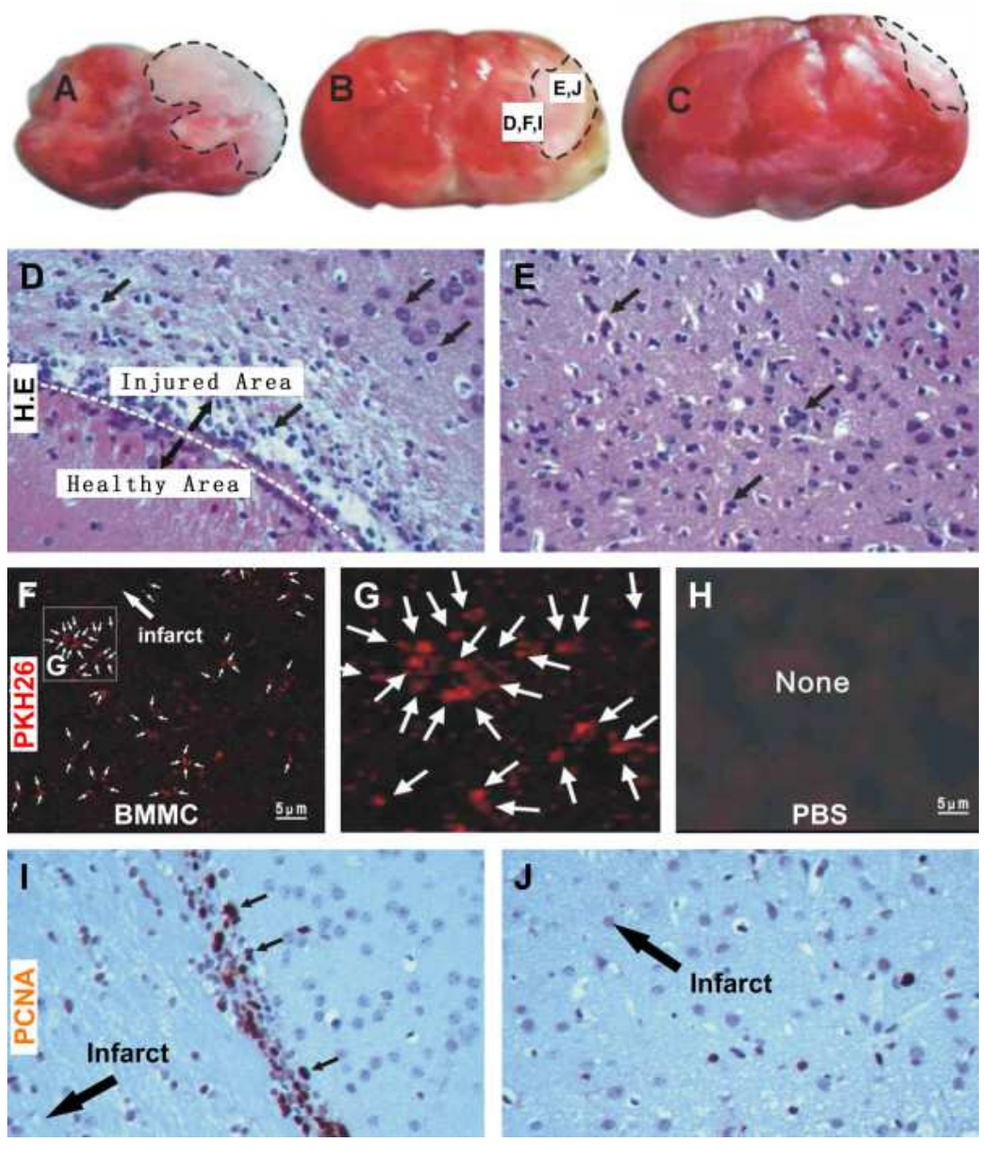
- To separate the compound figures into subfigures



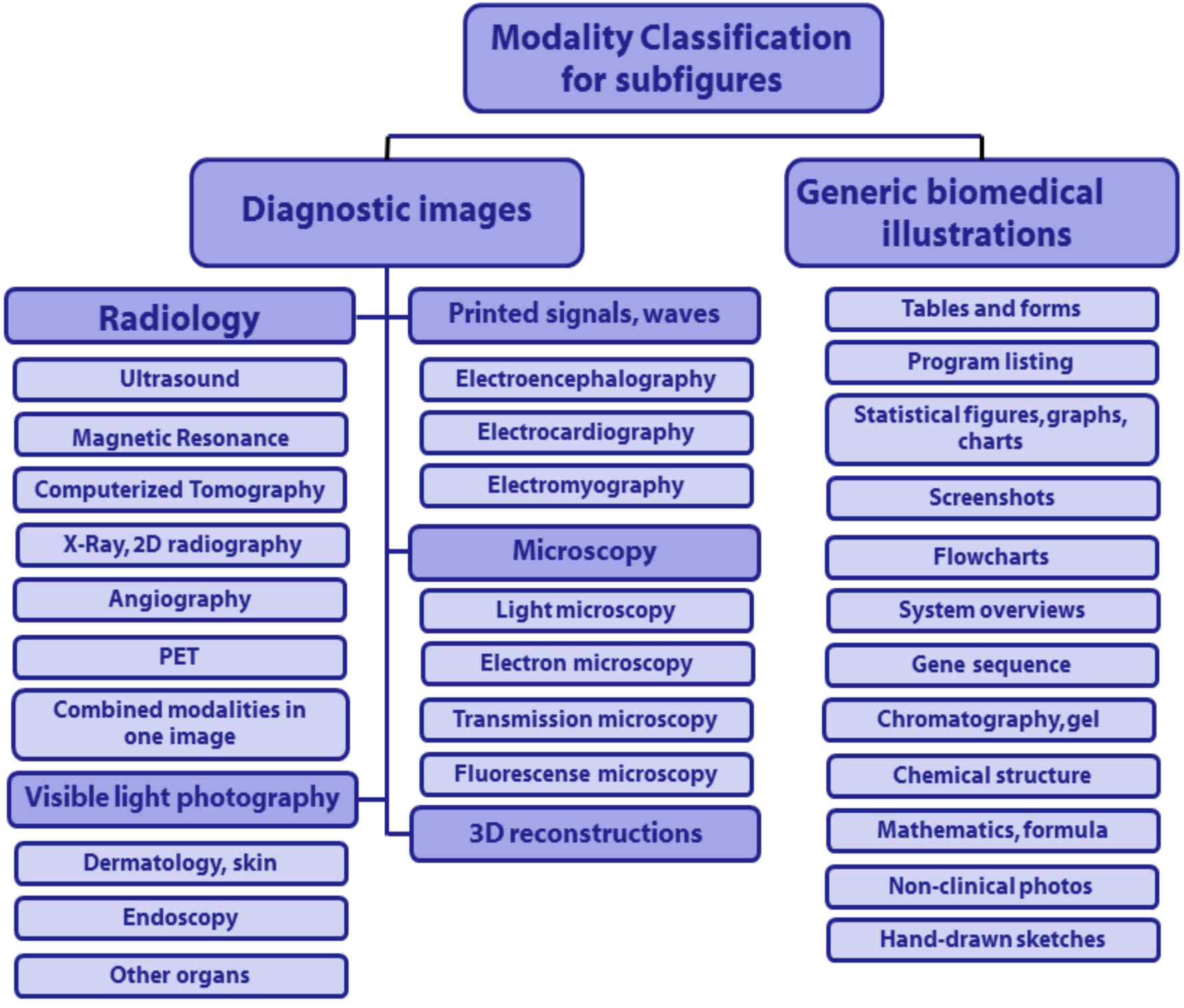


Multi-label classification

- To label compound figures with each of the modalities of the subfigures

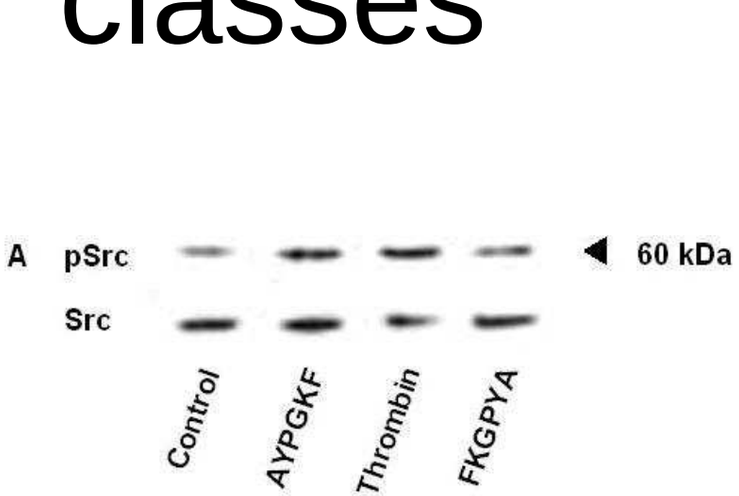


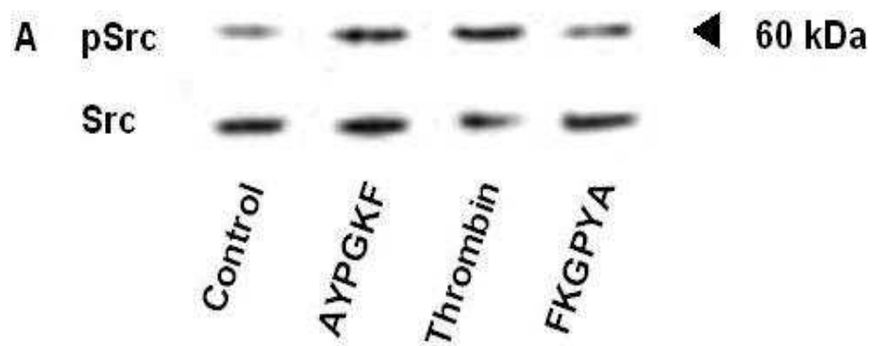
Hierarchy

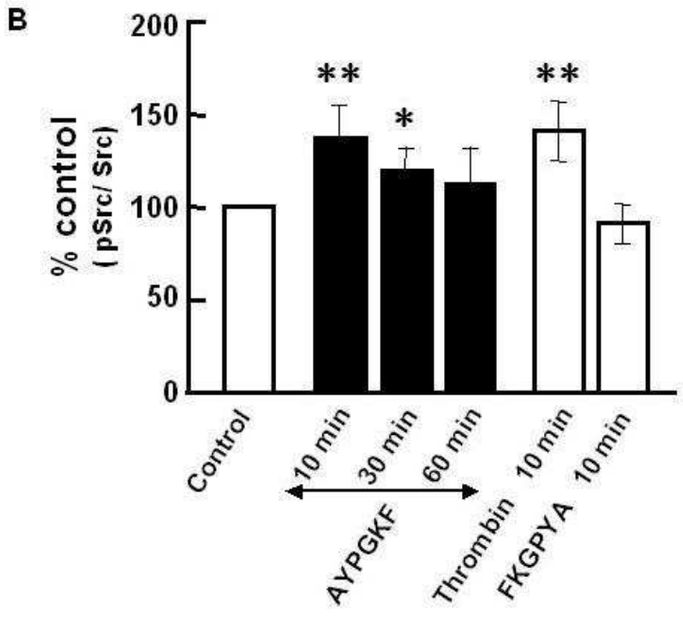

Modality Classification for subfigures
Diagnostic images
Generic biomedical illustrations
Radiology
Printed signals, waves
Ultrasound
Magnetic Resonance
Computerized Tomography
X-Ray, 2D radiography
Angiography
PET
Combined modalities in one image
Visible light photography
Dermatology, skin
Endoscopy
Other organs
Electroencephalography
Electrocardiography
Electromyography
Microscopy
Light microscopy
Electron microscopy
Transmission microscopy
Fluorescense microscopy
3D reconstructions
Tables and forms
Program listing
Statistical figures, graphs, charts
Screenshots
Flowcharts
System overviews
Gene sequence
Chromatography, gel
Chemical structure
Mathematics, formula
Non-clinical photos
Hand-drawn sketches

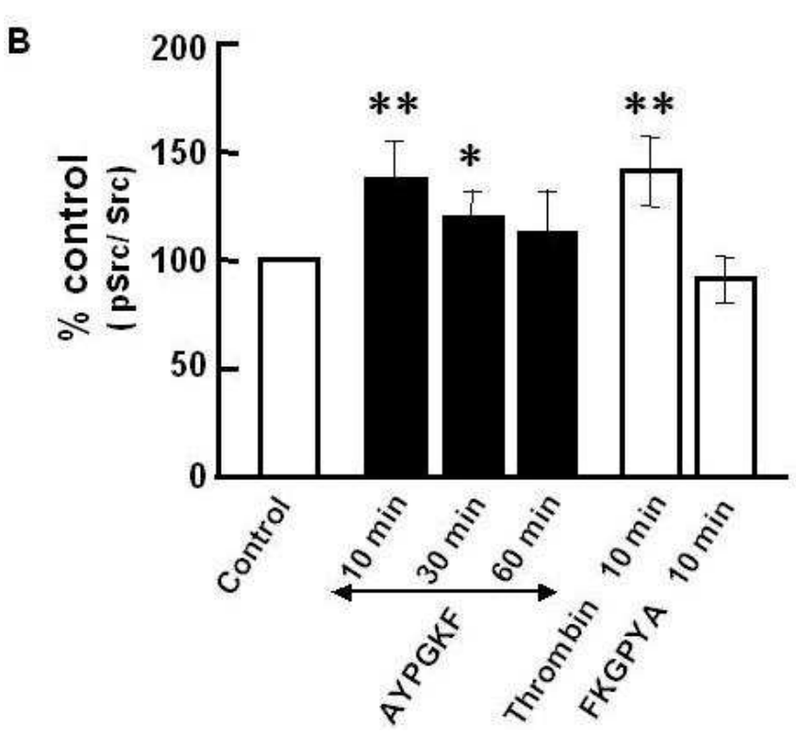
Subfigure classification

- To classify subfigures into the 30 classes









Datasets

- ImageCLEFmed 2015
  - 20,867 figures
  - distributed in training and test sets
- Subset of PubMed Central
  - over 1.7 million images of over 650,000 articles (2014)

Dataset by subtasks

- Compound figure detection
  - full dataset: 20,867 figures
- Compound figure separation
  - subset containing 6,784
- Multi-label classification
  - subset containing 1,568
- Subfigure classification
  - 6,776 subfigures

Compound figures and subfigures

- 1,568 figures are:
  - multi-labeled
  - separated into subfigures
- Figure ID:
  - “1297-9686-42-10-3”
- Subfigures IDs:
  - “1297-9686-42-10-3-1”,“1297-9686-42-10-3-2”,…, “1297-9686-42-10-3-4”

GT generation

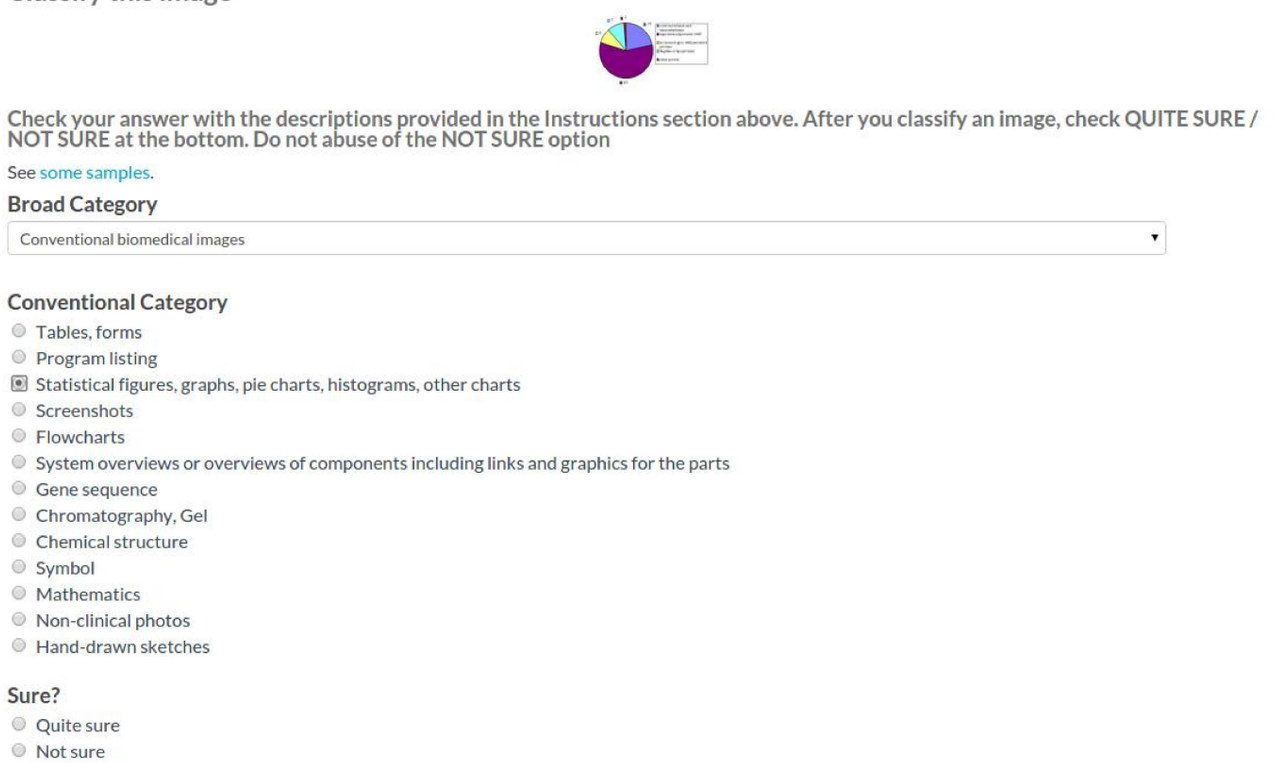
- Iterative process:

  1) Automatic data generation

  2) Crowdsourcing data verification and labeled

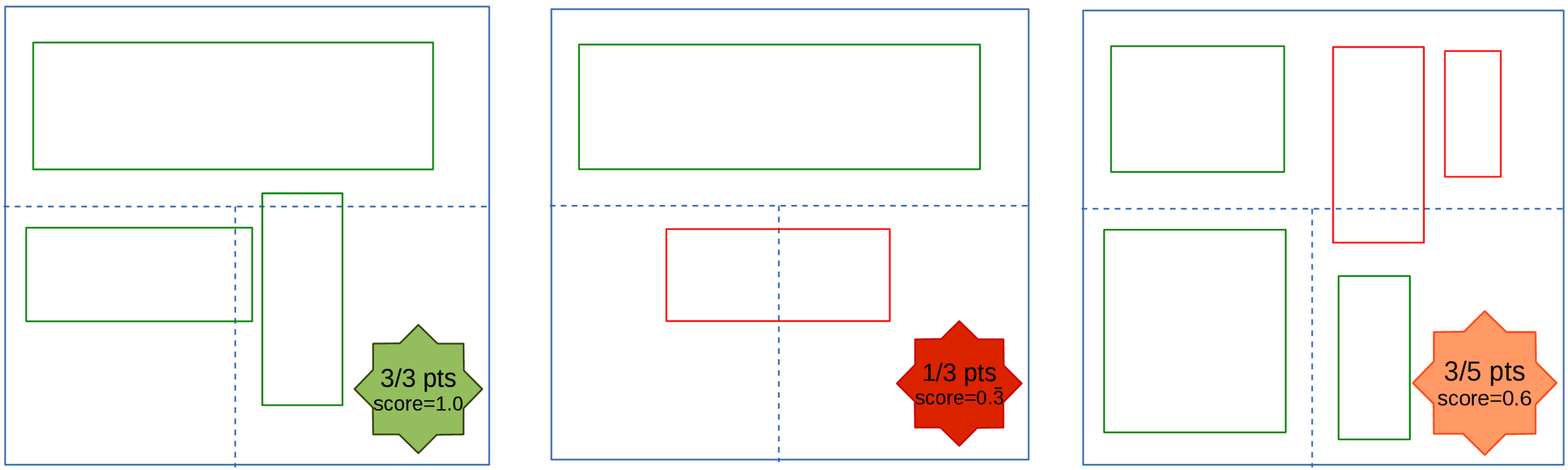
CrowdFlower

3) Manual correction



Evaluation

- Compound figure separation
  - Same method than in 2013



Evaluation

- Compound figure detection
  - Accuracy
- Multi-label classification
  - Hamming loss
- Subfigure classification
  - Accuracy

Participation

- Over 70 groups registered
- 8 groups from 4 continents submitted results
- 40 runs submitted

Results: compound figure detection

- Multimodal approached achieves better results
- Border or peak region detection and connected component analysis are used

Group	Run type	Accuracy
FHDO BCSG	mixed	85.39
FHDO BCSG	mixed	83.88
FHDO BCSG	mixed	80.07
FHDO BCSG	mixed	78.32
FHDO BCSG	textual	78.34
CIS UDEL	visual	82.82
FHDO BCSG	visual	72.51

Results: compound figure separation

- NLM manually selects “stitched” figures or with gap
- AAUITEC applies line detection
- Only visual techniques are applied

Group	Run type	Accuracy
NLM	visual	84.64
NLM	visual	79.85
AAUITEC	visual	49.40
AAUITEC	visual	35.48
AAUITEC	visual	30.22

Results: multi-label classification

- No standard multi-label techniques
- Only visual techniques are applied

Group	Hamming Loss
MindLAB	0.0500
IIS	0.0671
MindLAB	0.0674
IIS	0.0674
IIS	0.0675
IIS	0.0678
IIS	0.0680
IIS	0.0696
IIS	0.0700
IIS	0.0710
IIS	0.0785
IIS	0.0817

Results: subfigure classification

- Multimodal approached achieves better results

Group	Run type	Accuracy
FHDO BCSG	mixed	67.60
FHDO BCSG	mixed	67.24
FHDO BCSG	mixed	66.48
FHDO BCSG	mixed	66.44
FHDO BCSG	mixed	65.99
FHDO BCSG	mixed	64.34
FHDO BCSG	textual	60.91
FHDO BCSG	visual	60.91
CMTECH	visual	52.98
CMTECH	visual	48.61
BMET	visual	45.63
BMET	visual	45.00
BMET	visual	44.34
BMET	visual	43.62
BMET	visual	37.56
BMET	visual	37.56

Main tendencies

- Little use of textual information
- Border detection commonly used
- New approached for multi-label classification
- More participants in the subfigure classification task

Conclusions

- Participants present a variety of techniques
- Multimodal approaches achieve better results
- Optimization is needed to improve results
- More “stitched” figures are needed in the provided database

Thank you for your attention!!!

Questions?

http://imageclef.org/2015/medical

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