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
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 **distinguish** subfigures
Past editions

• 11\textsuperscript{th} 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
- Radiology
  - Ultrasound
  - Magnetic Resonance
  - Computerized Tomography
  - X-Ray, 2D radiography
  - Angiography
  - PET
  - Combined modalities in one image
- Visible light photography
  - Dermatology, skin
  - Endoscopy
  - Other organs
- Microscopy
  - Light microscopy
  - Electron microscopy
  - Transmission microscopy
  - Fluorescence microscopy
- Printed signals, waves
  - Electroencephalography
  - Electrocardiography
  - Electromyography

Generic biomedical illustrations
- 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
  3) Manual correction
Evaluation

• Compound figure separation
  – Same method than in 2013

![Diagram showing compound figure separation with scores 3/3 pts, score=1.0; 1/3 pts, score=0.3; 3/5 pts, score=0.6]
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

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<th>Run type</th>
<th>Accuracy</th>
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Results: compound figure separation

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

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Results: multi-label classification

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

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Results: subfigure classification

- Multimodal approach achieves better results

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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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