

# TRADITIONAL FEATURE ENGINEERING AND DEEP LEARNING APPROACHES AT MEDICAL CLASSIFICATION TASK OF IMAGECLEF 2016

Biomedical Computer Science Group (BCSG)

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# INTRODUCTION

- BCSG participated at ImageCLEF 2015 Medical Classification Task
  - Task 1 – Compound Figure Detection Task (6 Runs)
  - Task 4 – Subfigure Classification Task (8 Runs)

Pelka O, Friedrich CM.

**Modality prediction of biomedical literature images using multimodal feature representation.**

GMS Medizinische Informatik, Biometrie und Epidemiologie. 2016; 12(1):Doc05.  
DOI: 10.3205/mibe000167

- Participation at ImageCLEF 2016 Medical Task:
  - Task 4 – Subfigure Classification Task (10 Runs)

# SUBFIGURE CLASSIFICATION HIERARCHY OVERVIEW

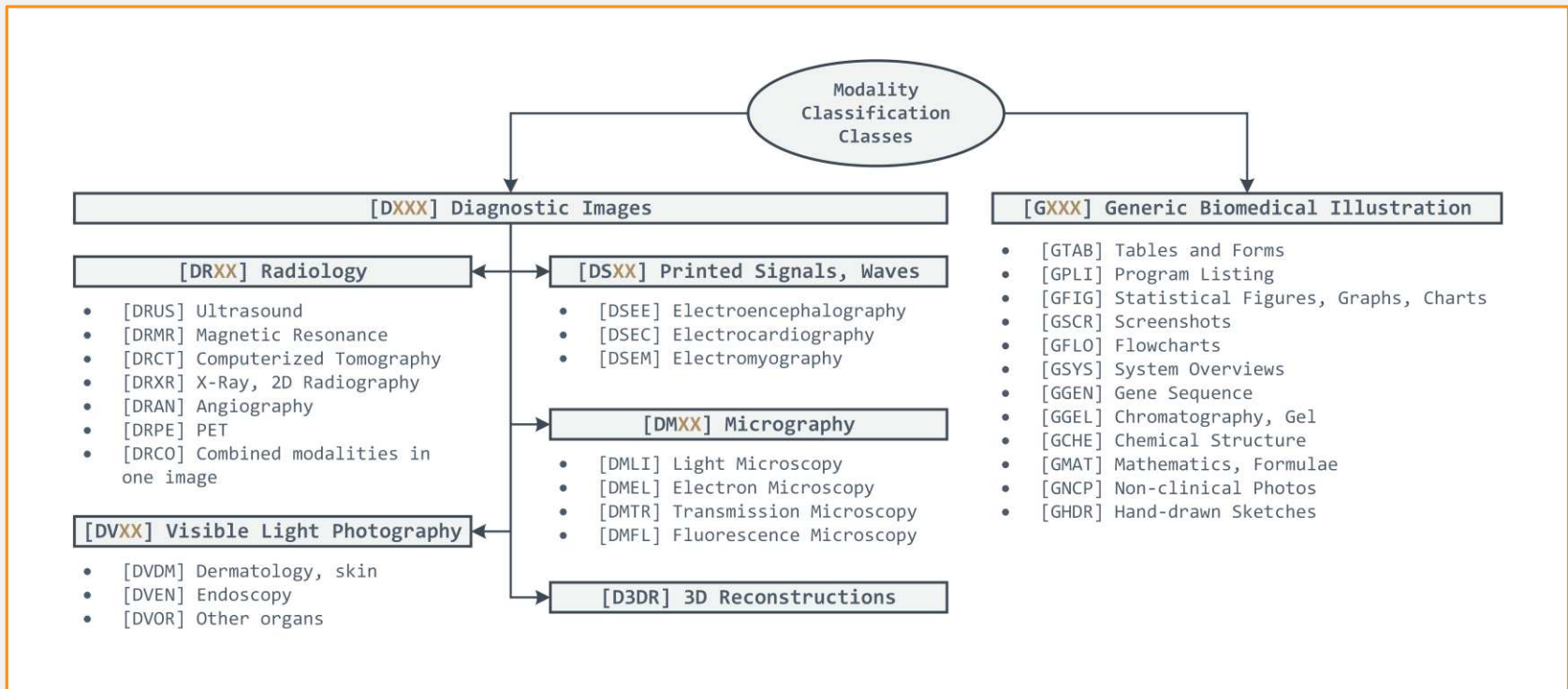
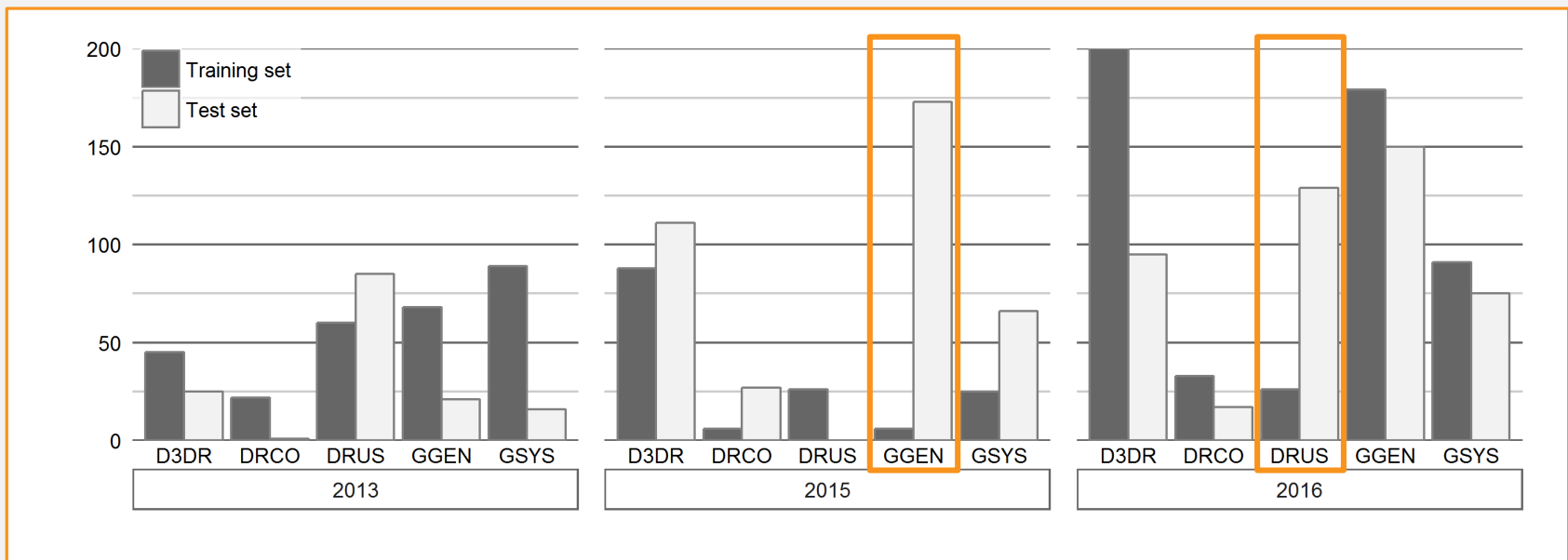


Figure derived from [1]

# SUBFIGURE CLASSIFICATION CLASS IMBALANCES



# SUBFIGURE CLASSIFICATION CLASS IMBALANCES

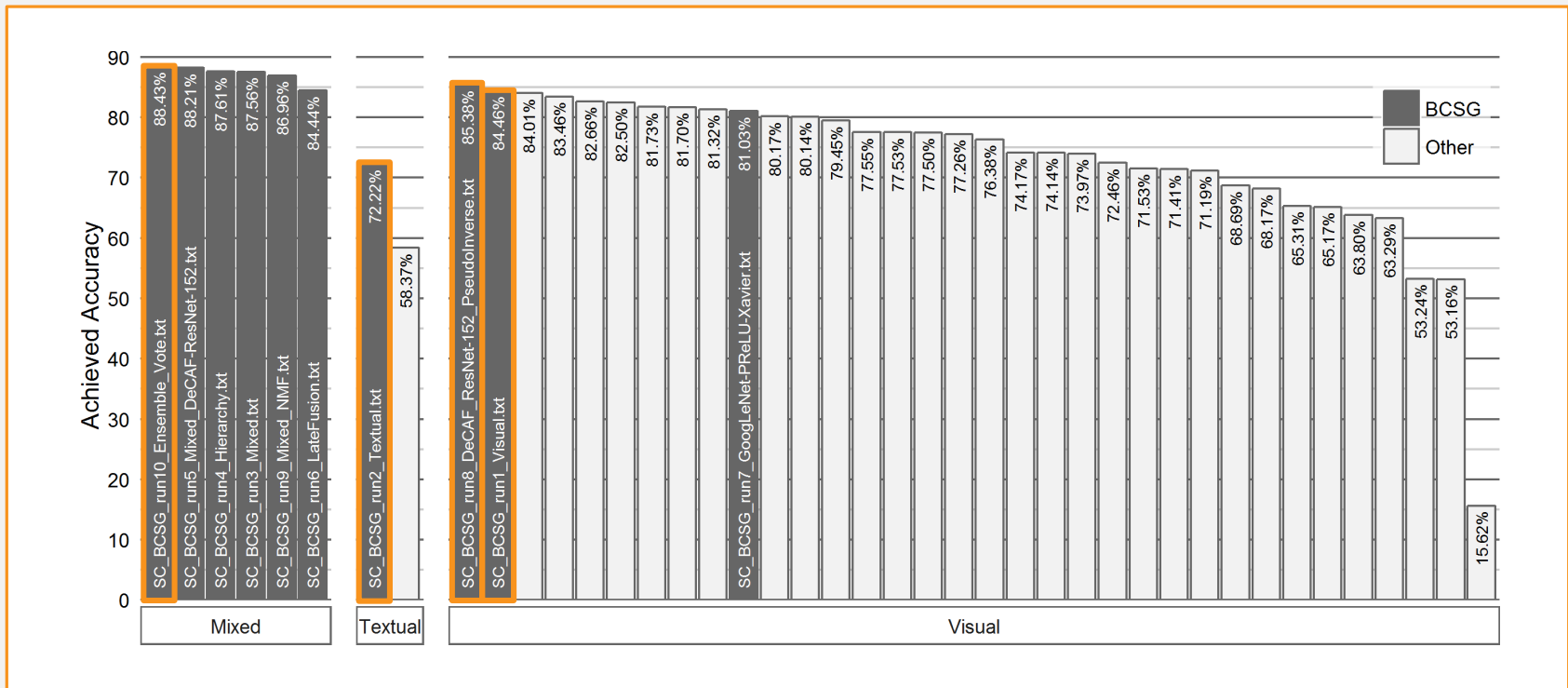
- Subfigure Classification 2016
  - Training set: Subfigure Classification 2015 training + test set = **6776 images**
  - Test set: **4166 images**
- Overall class distribution is very skewed
  - Class *GFIG* is with 2954 training images (about 44%) very dominant
  - Five classes cover more than 76% of all training images
  - Class *DSEM* has 5 training images and *GPLI* only one single training image
- Enhanced with dataset from ImageCLEF 2013 without COMP category
  - Dataset is not as skewed as in 2015/2016
  - Additional training set images: **3412 images**
  - Total number of training images: **10140 images**

## SUBFIGURE CLASSIFICATION EVALUATION STRATEGY

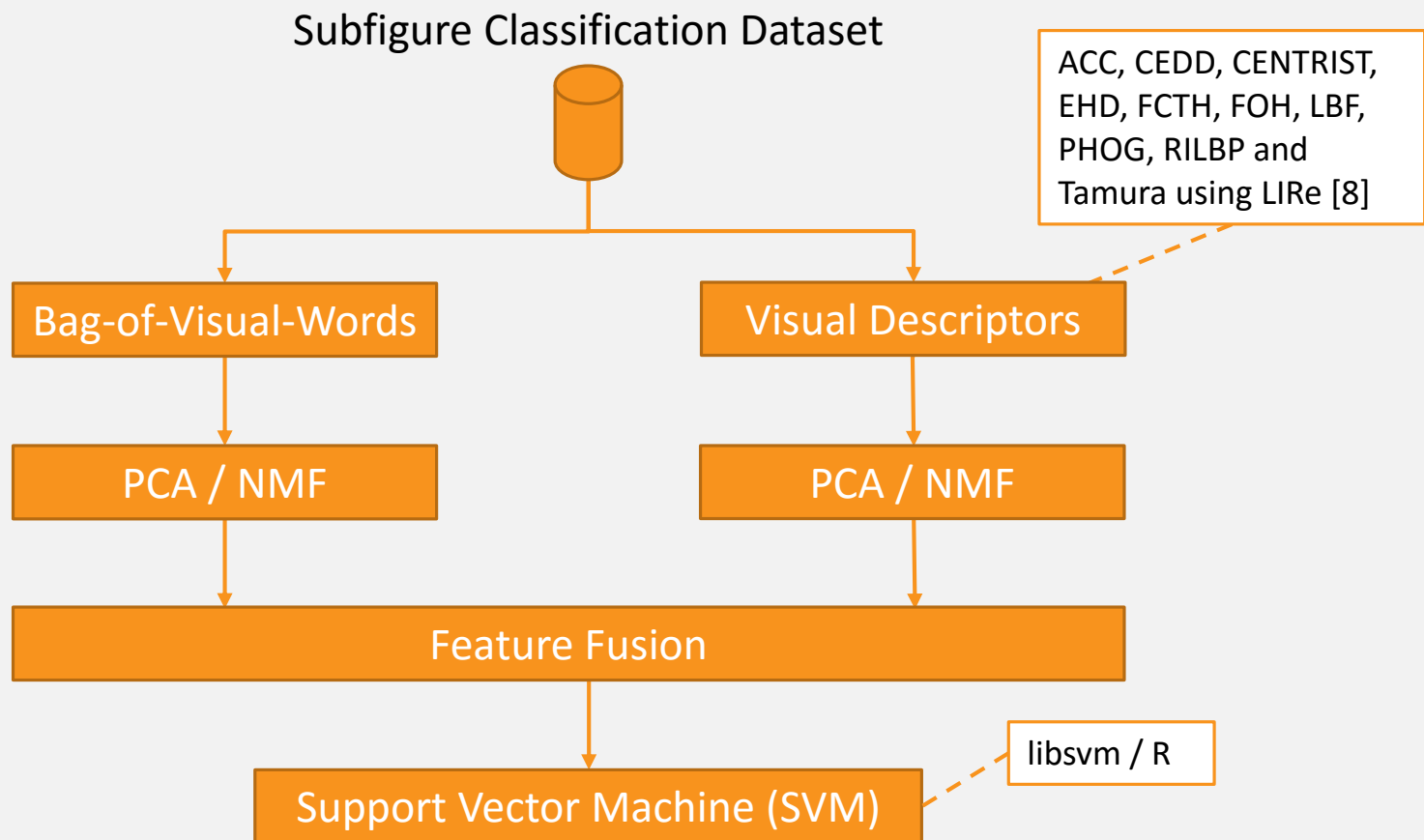
- Adjusted evaluation strategy based on the findings of class imbalances
- Bootstrapping samples validation sets with a similar class distribution
- ImageCLEF 2015 test set used as one validation set
- Model evaluation based on a modified .632 Estimator [2]

$$Err = 0.368 \cdot Err_{val} + 0.632 \cdot \overline{Err}_{boot}$$

# OFFICIAL EVALUATION

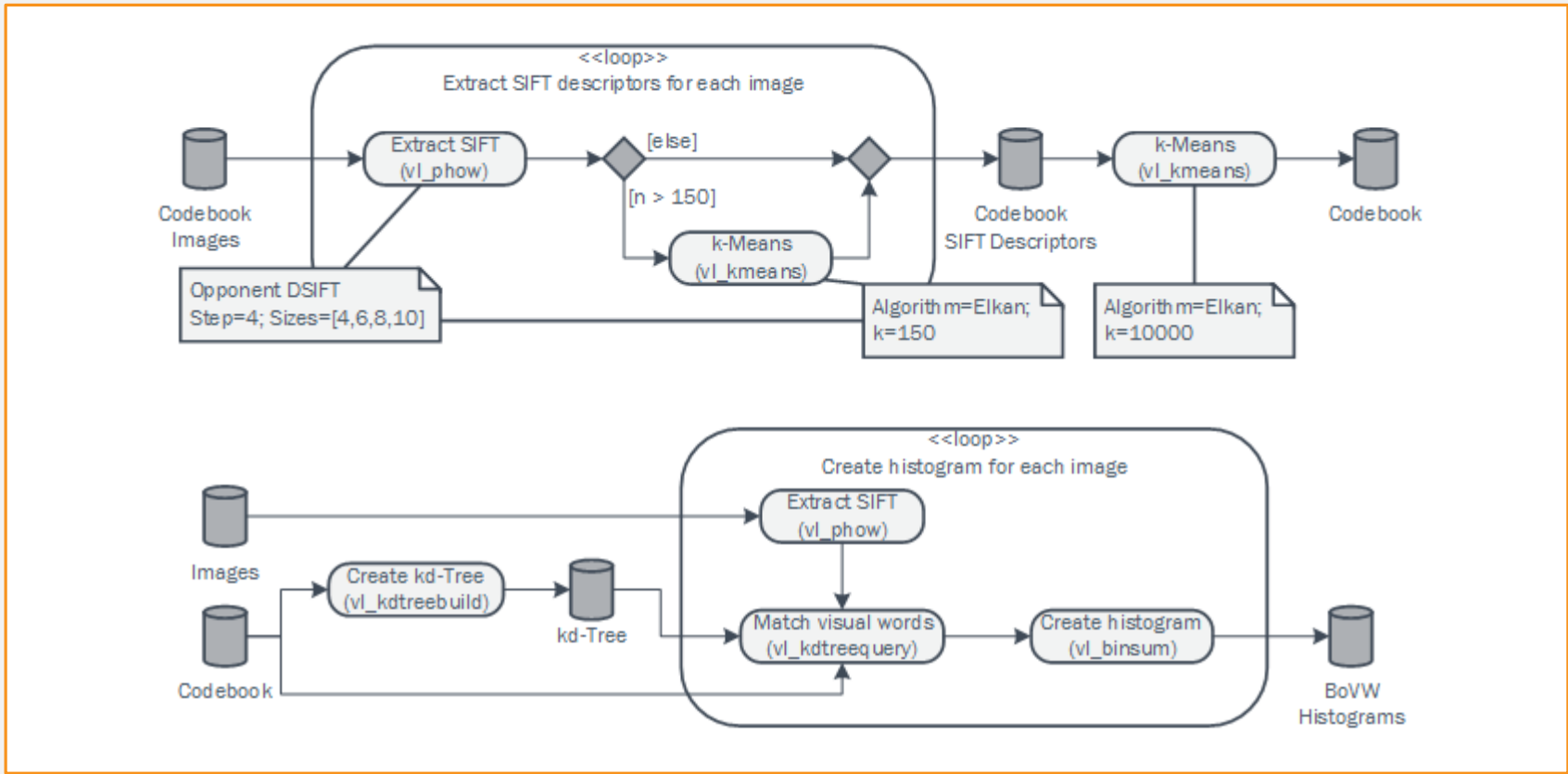


RUN 1 (TYPE: VISUAL)  
VISUAL (84.46%)



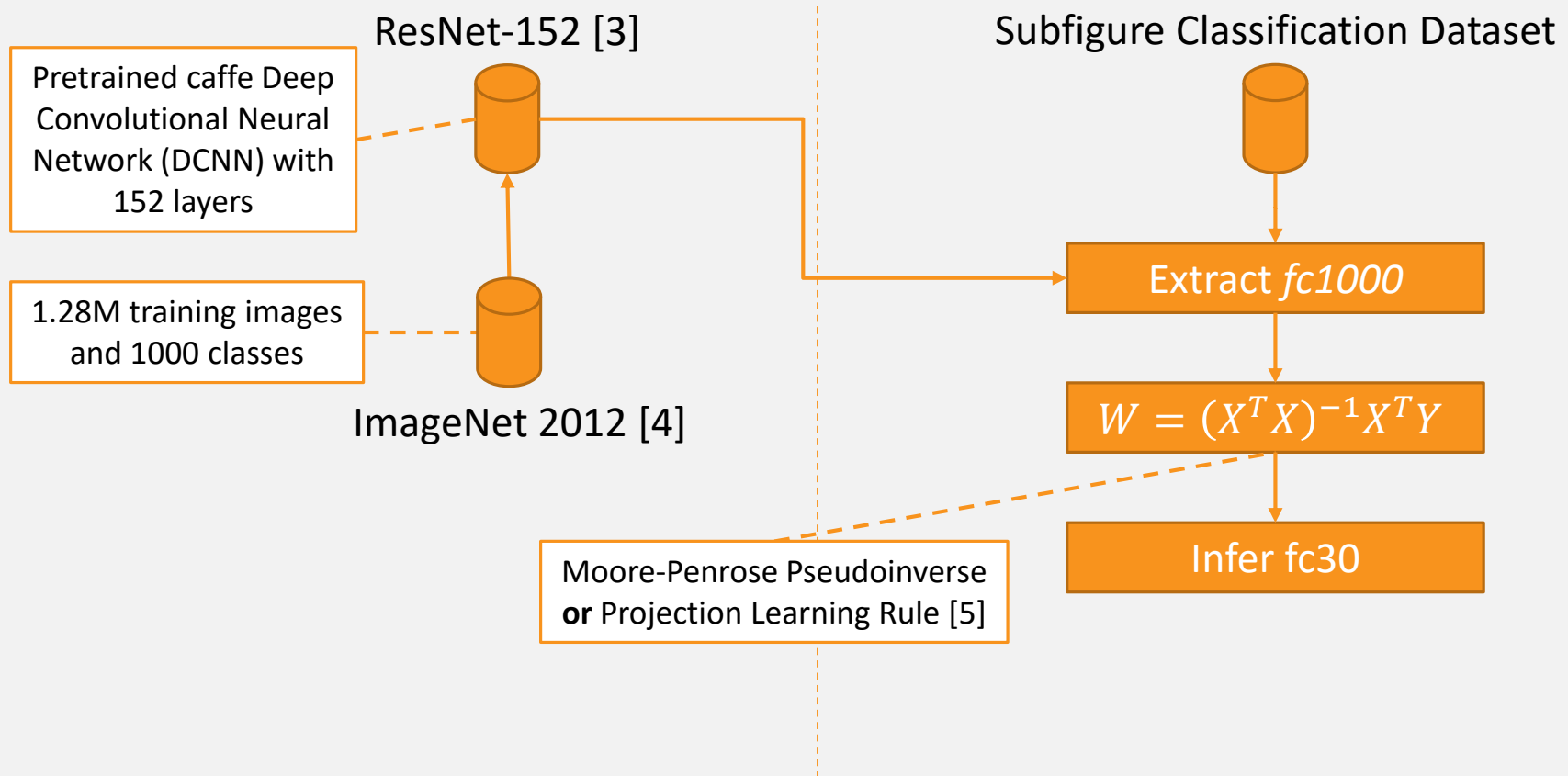


# BAG-OF-VISUAL-WORDS



# RUN 8 (TYPE: VISUAL)

## RESNET-152 PSEUDOINVERSE (85.38%)



# TRANSFER LEARNING

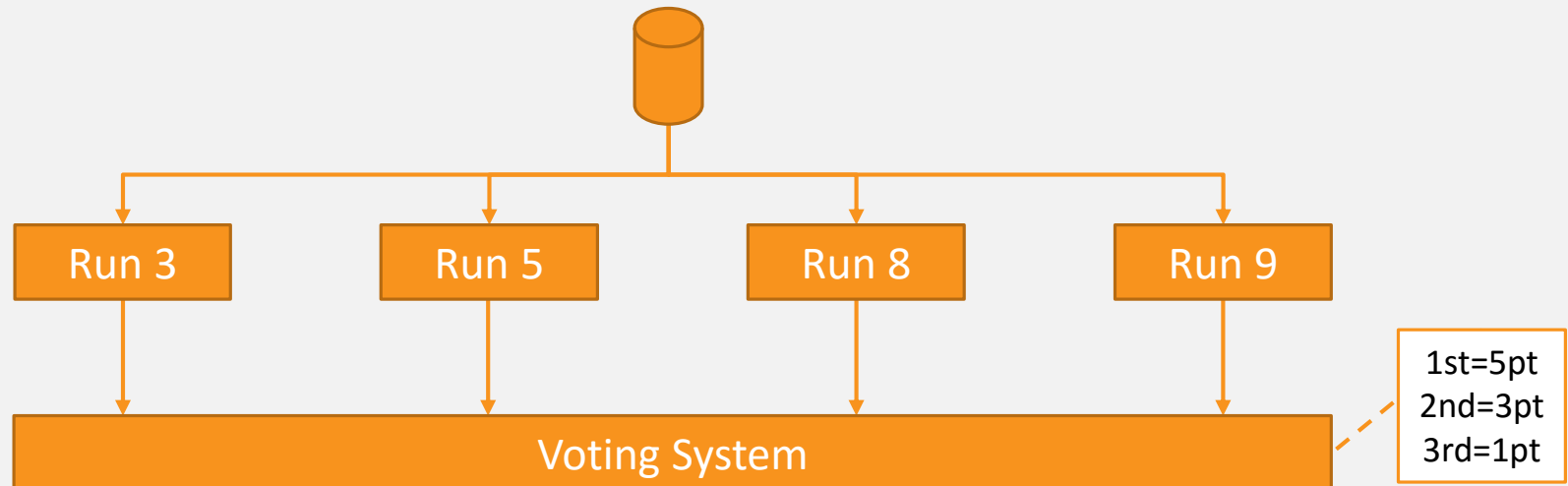
- Might be interesting if dataset is too small to train a generalizable DCNN [6]
- Pre-trained DCNNs can be used from...
  - the same domain but different dataset
  - a different domain
- Usage scenarios
  - Feature extraction (e.g. DeCAF [7] in run 5: 88.21%)
  - Fine-tuning with a new output layer, but fixed network weights (e.g. in run 8 with 85.38%)
  - Fine-tuning the complete network with reduced learning rate

## RUN 2 (TYPE: TEXTUAL) TEXTUAL (72.22%)

- Two Bag-of-Words (BoW) models
  - Subfigure Captions
  - Paper full texts
- Text processing in R using the package tm
  - Stop word deletion, Porter's stemming, ...
- Okapi BM25 [9] term weighting
- Information gain vocabulary ranking
- Principal Component Analysis (PCA) for feature reduction
- Fusion of both BoW as input for libsvm

RUN 10 (TYPE: MIXED)  
ENSEMBLE (88.43%)

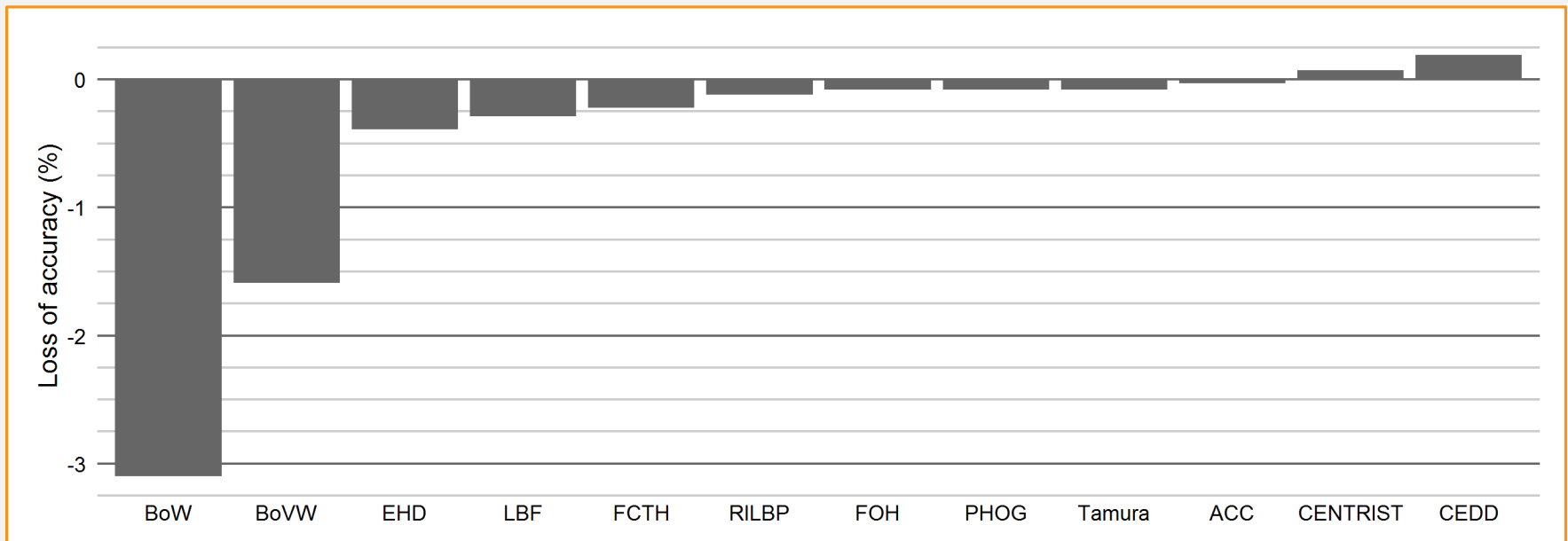
### Subfigure Classification Dataset



- Run 3/5/9: Support Vector Machines with RBF-Kernel
- Run 8: Trained linear neuron layer using Projection Learning Rule [5]
- Non-calibrated classifier outputs cannot be combined directly
- Overall best submitted run

# EX-POST EVALUATIONS

- Findings based on run 3
  - PCA computation on combined training and test set reduced accuracy by 0.33%
  - Training without ImageCLEF 2013 images reduced accuracy by 2.9%
  - Bag-of-Words and Bag-of-Visual-Words were the strongest features



# CONCLUSIONS

- Transfer learning from a different domain was surprisingly strong
- Dataset is still too small for training DCNNs effectively
- Textual features are independent and give a significant boost

# REFERENCES

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# THANK YOU FOR YOUR ATTENTION

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Do you have any questions?

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