FIU-UM at TRECVID 2017: Rectified Linear Score Normalization and Weighted Integration for Ad-hoc Video Search

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Submission Details

- Class: M (Manually-assisted runs)
- Training type: D (IACC & non-IACC non-TRECVID data)
- Team ID: FIU-UM (Florida International University - University of Miami)
- Year: 2017

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Outline

- Introduction
- The Proposed Framework
- Experimental Results
- Conclusion and Future Work

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1

Introduction

Introduction

TRECVID 2017

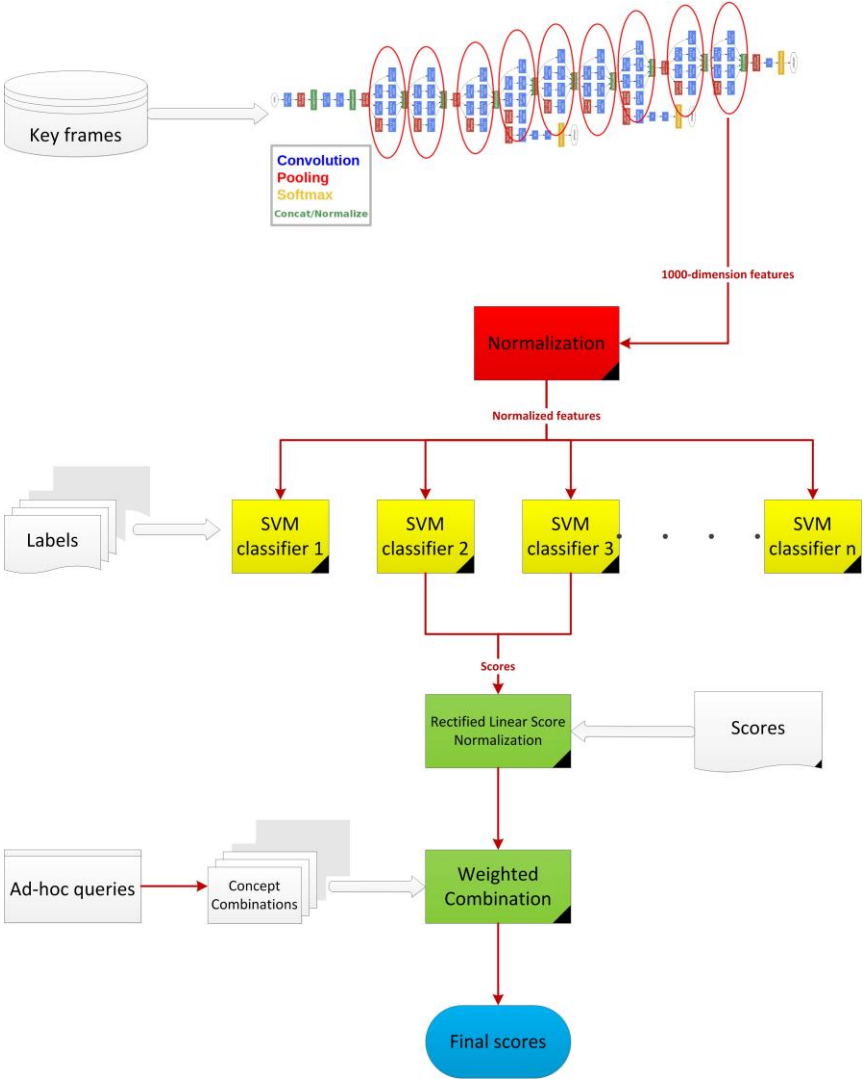
- Year 2015: Semantic indexing (SIN)
- Year 2016: Ad-hoc video search (AVS)
- Year 2017: Same training and testing datasets, different topics

- Test collection: IACC.3
- 346 concepts
- 30 Ad-hoc queries
- Submit a maximum of 1k possible shots from the test collection for each query

2

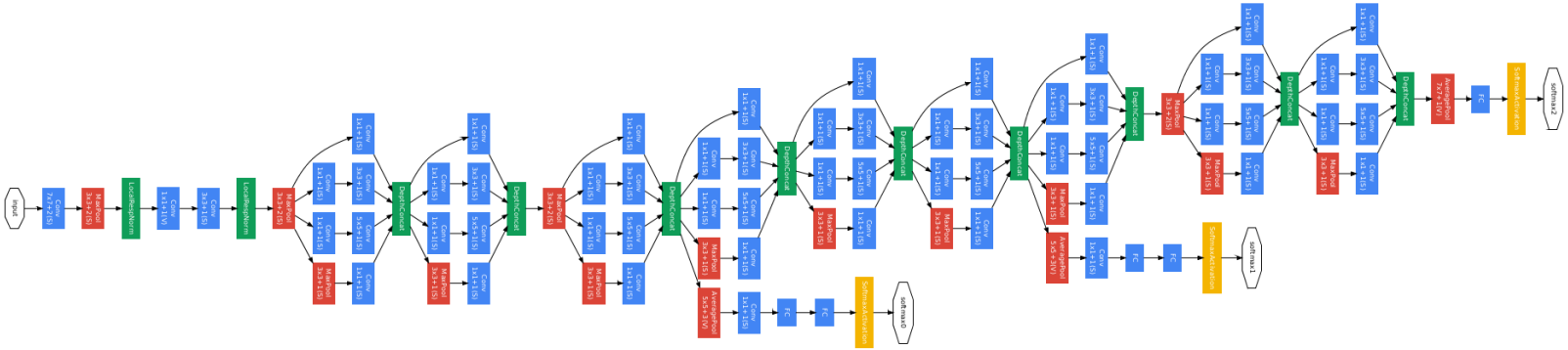
The Proposed Framework

Framework


Key frames
Convolution
Pooling
Softmax
Concat/Normalize
1000-dimension features
Normalization
Normalized features
Labels
SVM classifier 1
SVM classifier 2
SVM classifier 3
SVM classifier n
Scores
Rectified Linear Score Normalization
Scores
Ad-hoc queries
Concept Combinations
Weighted Combination
Final scores

CNN Feature Extraction

- Last Pooling Layer
- Feature: ImageNet-1000



Classification

- Support Vector Machine (SVM)
- Linear kernels
- Positive weight / Negative weight: 1:1

Rectified Linear Score Normalization

- How to eliminate the effect of “bad” scores of a concept in an Ad-hoc query before the score fusion

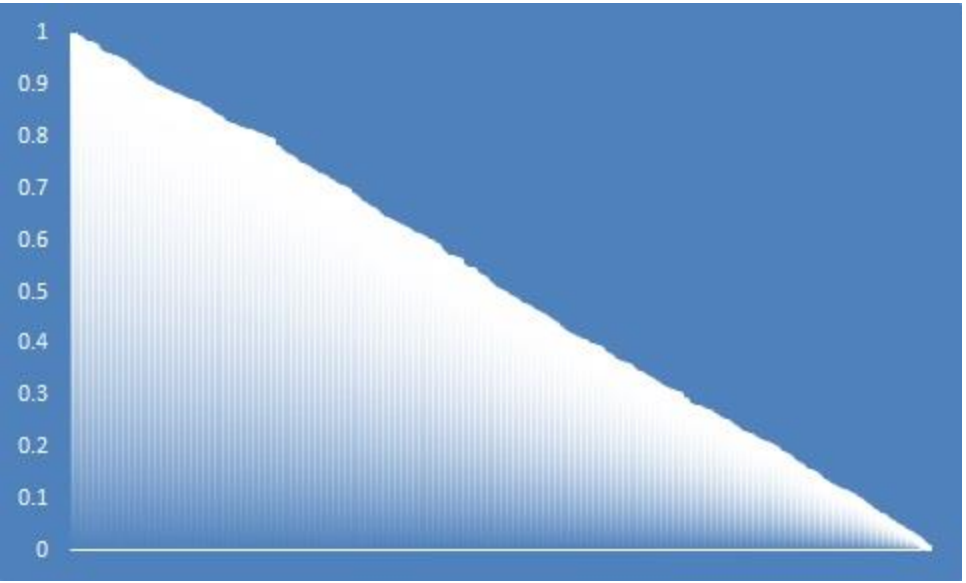
- Two thresholds:
  - threshold_high
  - threshold_low

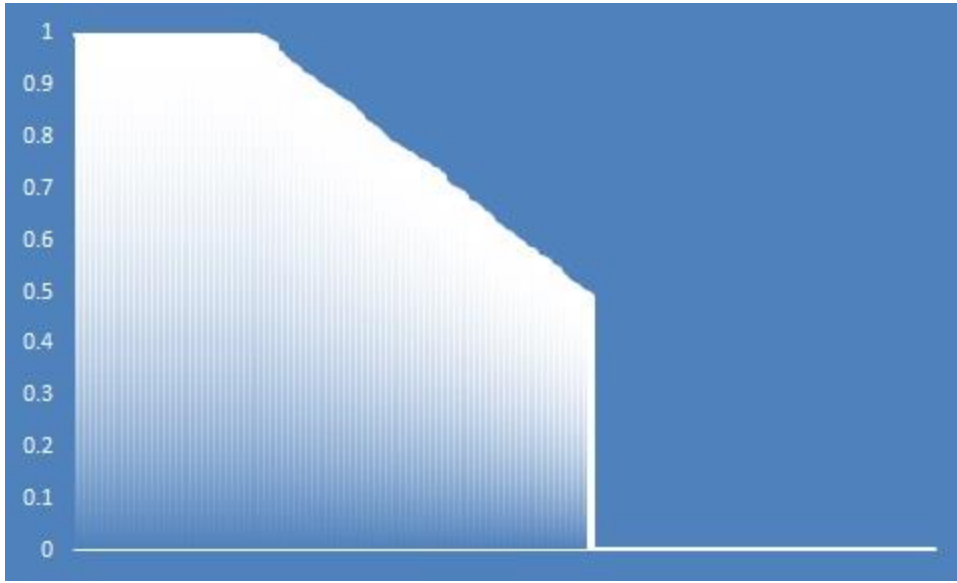
Rectified Linear Score Normalization

Algorithm 1 The proposed rectified linear score normalization algorithm.

for all scores **do**
  if $score \geq threshold_{high}$ **then**
    $score_{normed} = 1;$
  else if $score \leq threshold_{low}$ **then**
    $score_{normed} = 0;$
  else
    $score_{normed} = \frac{score}{threshold_{high}}.$
  end if
end for

Rectified Linear Score Normalization





Query Formulation and Score Combination

- More concepts:
  - A pretrained ImageNet model: ImageNet1000
- Score fusion:
  - Weighted geometric mean

$$score_{query} = \prod_{i}^{N} (score_{concept_i})^{weight_i}$$

3

Experimental Results

Data

- Model training: using TRECVID 2010-2012 training videos as the training data
- Model evaluation: using TRECVID 2013-2015 training videos as the testing data to evaluate the framework and tune the parameters of the models
- Model testing: using TRECVID 2010-2015 training videos as the TRECVID 2017 training data, and TRECVID 2017 testing videos as the testing data to generate the ranking results for the submission

Evaluation

- Mean extended inferred average precision (mean xinfAP)
  - allows the sampling density to vary so that it can be 100% in the top strata. This is the most important one for average precision

- As in the past years, other detailed measures based on recall and precision are generated and given by the sample eval software provided by the TRECVID team

Four Runs Submitted

- 1: CNN features + Linear SVM
- 2: CNN features + Linear SVM + Scores from other groups
- 3: CNN features + Linear SVM + Rectified Linear Score Normalization
- 4: CNN features + Linear SVM + Scores from other groups + Rectified Linear Score

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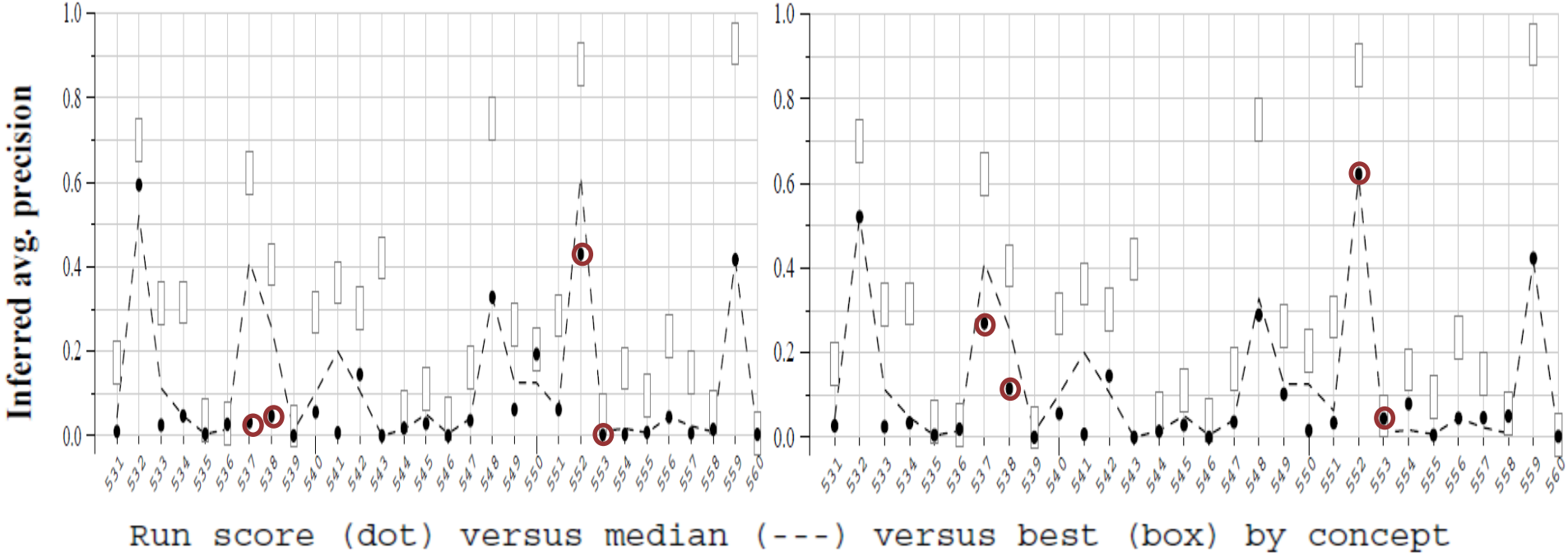
Performance

Framework	# of inferred true shots returned	Mean xinfAP values
M_D_FIU_UM.17_1	3608	0.088
M_D_FIU_UM.17_2	4731	0.147
M_D_FIU_UM.17_3	4125	0.102
M_D_FIU_UM.17_4	4623	0.145

Performance

Run1

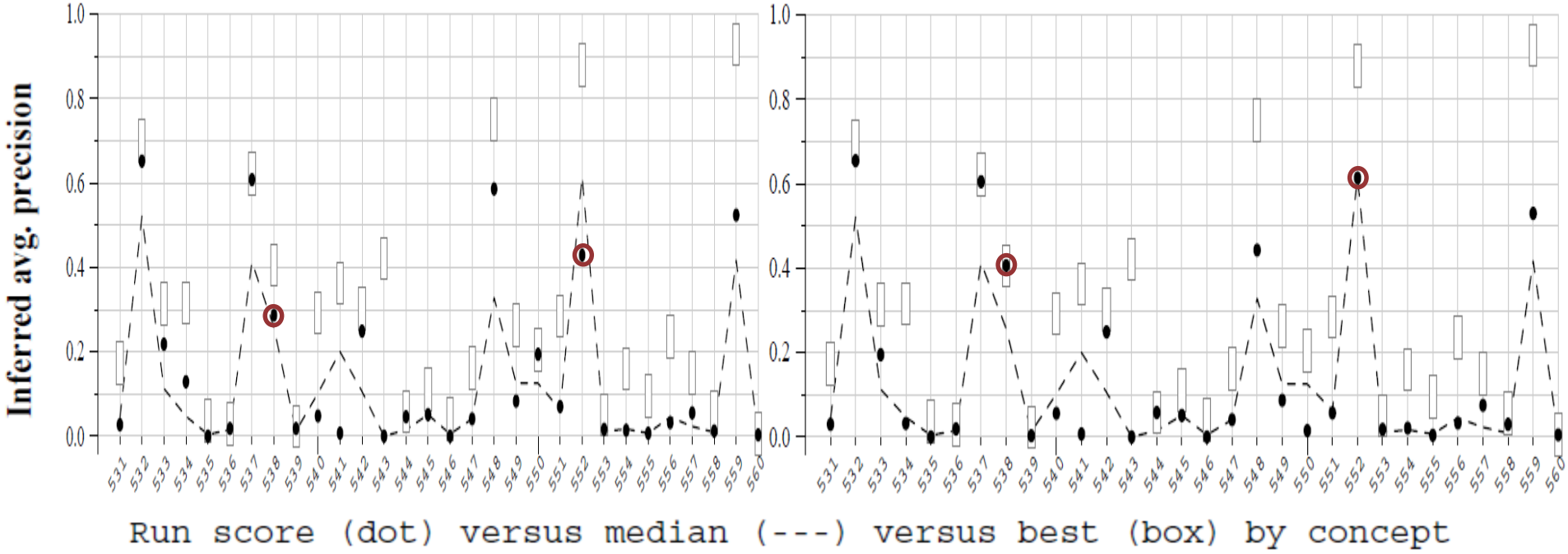
Run3



Performance

Run2

Run4



4

Conclusion and Future Work

Conclusion and Future Work

- In our framework, only global features are currently utilized => the object-level features can also be explored by R-CNN (Regional CNN)
- Non-linear SVM classifiers need to be adopted to address the data imbalance issue
- More advanced CNN structures can be integrated and scores from them can be fused
- Temporal correlations can be considered to reach a better performance
- More training data should be collected by a general purpose search engine like Google using the query definition to further improve the retrieval accuracy

THANKS!

Any questions?

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