

I. IDENTIFICATION DATA

Thesis title:	Selection of Representative Landmark Images
Author's name:	Pavel Gramovich
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Filip Sroubek
Reviewer's department:	Czech Academy of Sciences, UTIA

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
The problem of selecting representative images is actively studied in the literature. The scale of the assignment, which includes comparison of different approaches on huge datasets, makes the project particularly challenging.	

Fulfilment of assignment	fulfilled
<i>How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.</i>	
All the assigned tasks – review existing work, define a dataset for evaluation and comparison, propose and implement a method, and perform evaluation - have been fulfilled.	

Methodology	outstanding
<i>Comment on the correctness of the approach and/or the solution methods.</i>	
The proposed methodology is sound inspired by state-of-the-art methods. Different local features and their aggregation was tested. Outlier detection methods were evaluated. Two clustering methods and three representative selection methods were compared. Thorough evaluation was carried out on a publicly available dataset while adopting well-established evaluation criteria.	

Technical level	B - very good.
<i>Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?</i>	
<p>The thesis in general is technically sound. There are only a few parts where statements are not clear and/or a more detailed explanation would be helpful:</p> <p>Sec. 4.2.2 – I would welcome more detailed explanation of calculating TF-IDF vectors for MediaEval dataset.</p> <p>Sec. 4.2.6 – Mean normalization is a projection to a unit ball drawn around the centroid. This does not solve the problem of similar descriptors. It amplifies noise and might not improve the quality of diversification. However, I can imagine that it helps to keep parameters (thresholds) fixed in clustering and representative selection algorithms.</p> <p>Sec 5.1.3 – It is not explained how the combination of different outlier detection methods was done.</p> <p>Sec 5.3.1 Clustering algorithm choice – What type of the representative selection was used?</p> <p>Sec 5.3.4 Descriptor comparison – The term “top size” is used but not explained. In the next section and from Fig. 5.8(a) one deduces that it is the number of output images the algorithm returns.</p> <p>Sec 5.3.5 – It would be informative to analyze, which ground-truth classes were never picked as representatives. This might help to understand the reason of this failure.</p> <p>Sec 5.4 Working time analysis – The outlier detection is an important step in the overall pipeline and very likely not fast. Its working time should be also considered.</p>	

Formal and language level, scope of thesis	A - excellent.
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Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?

The thesis is well written and organized in a logical way. I have found only a few errors. Some of them are listed below.

Misleading or incorrect statements:

Page 8 - "This step repeats until the required number of images is ~~not~~ reached."

Page 9 - "The image with the highest rank was chosen as images with high ranks are likely to be relevant."

Page 9 - "If β inf, ..."

Page 10 - "...are either do not..."

Page 20, Sec. 4.2.4 - is the equation for the residual vector correct?

Page 23, "...at least on core point..."

Page 23, denoting density and distance with the same letter "d" is misleading.

Selection of sources, citation correctness

A - excellent.

Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?

References to earlier work on the topic are adequate and the bibliographic citations meet the standards. The student's contribution is clearly stated.

Additional commentary and evaluation (optional)

Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

The thesis has shown that the problem of selecting representative landmark images is still not well understood. Relatively simple steps proposed in the thesis outperform state-of-the-art methods, which could encourage the student and others to carry out valuable future work in this area.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.

To conclude, Mr. Pavel Gramovich has mastered all the problems related to the assigned project, in particular feature aggregation, outlier detection and clustering. He has demonstrated excellent working skills in implementing the proposed methods, conducting experiments and writing the thesis.

In addition to comments mentioned above, the student might try to answer the following two questions during the defense:

- Instability of the system to small changes in the input set of images is alarming. Is inadequacy of the tested clustering algorithms the only reason? For example, could the problem be in the choice of local features?
- Apart from classification CNNs (ResNet) as generators of local features, have you considered using other approaches? For example, what about applying image synthesis CNNs, such as variational autoencoder, and use the output of the encoder part as a feature vector?

The grade that I award for the thesis is **A - excellent.**

Date: **31.8.2020**

Signature: