REVIEWER'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**Applying Deep Learning Algorithms for Classification of Images**
Author's name:	**Ahmed Mohamed Alaa Toubar**
Type of thesis:	bachelor
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Instrumentation and Control Engineering
Thesis reviewer:	Ing. Cyril Oswald, Ph.D.
Reviewer's department:	Department of Instrumentation and Control Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	**extraordinarily challenging**

Evaluation of thesis difficulty of assignment.

The point of the assignment is to collect the dataset from the Internet usable for the deep learning image recognition techniques and then train the appropriate deep neural network on them. The assignment is challenging even on master level for the students of the Faculty of Mechanical Engineering. Therefore, I consider the assignment of the bachelor thesis as extraordinary challenging.

Satisfaction of assignment	**fulfilled with minor objections**

Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.

Student fulfill the assignment in all points. At point three of assignment, "review the different deep learning libraries", student mention Tensorflow and Keras, where Keras is implemented in Tensorflow as higher-level API. There are much more libraries for deep neural networks implementation and student didn't mention any of them.

Method of conception	**correct**

Assess that student has chosen correct approach or solution methods.

Student's task was to collect a dataset of labeled images and use deep learning approach to classify the images by correct labels. The method that uses web scrapping for dataset collection and pre-trained deep CNN in combination with supervised transfer learning to retrain the pre-trained network is correct.

Technical level	**E - sufficient.**

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

Student try to conduct deep research of deep neural network concept. However, the artificial neural networks are undoubtably the complex mathematical problem but there are just two equations in the thesis. The evaluation of results in one small table at the end of thesis is insufficient.

Formal and language level, scope of thesis	**E - sufficient.**

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

The language level is good despite occasional typos.
The formal level of the thesis is very poor. There are no sections numbering, the figures numbering is broken and there are seven figures without any caption. Moreover, equations are referred as figures. Because of these shortcomings, the thesis is very confusing.

Selection of sources, citation correctness	**E - sufficient.**

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

In text citations are correct. The selection of literature sources is good. But most of images used in the work are taken from external sources without any reference in figure caption. This, in my opinion, grossly violates the citation conventions.

Additional commentary and evaluation
Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

The formal level of the thesis is poor. Although the deep neural networks are complex mathematical problem, only two equations related to one subset of this area were presented by the student in his work. Student violates the citation conventions in his work. In some sections of the theoretical part it is obvious that the student is confused about the concepts from the field of the artificial intelligence and the neural networks. For example, in section called Deep Learning Concepts and Algorithms student claims "Deep learning was created in an attempt to mimic the complex human brain … And so, deep learning algorithms are structured upon the understanding of the basic building block of the human brain; the neuron.". That's true for the Artificial Neural Networks (ANN), the deep learning is just one of advanced approaches of ANN construction and optimization, that emerged from the nowadays technical possibilities.

Despite these shortcomings, considering the assignment is very difficult for the bachelor thesis, student demonstrated his ability to solve this extraordinary challenging task and I suggest to evaluate this thesis with classification grade E (sufficient) if the student answer following questions during the thesis defense:

1. *Can you introduce and describe at least three more libraries for the deep neural network implementation?*
2. *In the practical part, you use pre-trained VGG16 convolutional neural network (CNN) model. The VGG16 CNN architecture is very extensive and very computationally demanding. Moreover, there are different architectures (e.g. ResNet or Inception) that are less computationally demanding and more successful in image classification tasks. Why you decided to use VGG16?*
3. *You use the multi-layer perceptron network with two hidden layers to demonstrate the deep learning concept. Are you sure that the MLP with two hidden layers is the deep neural network?*
4. *You mention that it is possible to completely confuse the trained CNN by adding the noise to the input image. Is it true for any noise, or it is some specially prepared noise that are designed with knowledge of the CNN model?*
5. *You mention that you checked your dataset if the images contain some noise or not. Which noise you look for and how you did it?*

I evaluate handed thesis with classification grade **E - sufficient.**

Date: **18.6.2019**   Signature: