

## I. IDENTIFICATION DATA

<b>Thesis title:</b>	<b>Neural Arithmetic</b>
<b>Author's name:</b>	<b>Oleksii Shuhailo</b>
<b>Type of thesis :</b>	bachelor
<b>Faculty/Institute:</b>	Faculty of Electrical Engineering (FEE)
<b>Department:</b>	
<b>Thesis reviewer:</b>	Niklas Heim
<b>Reviewer's department:</b>	Artificial Intelligence Center

## II. EVALUATION OF INDIVIDUAL CRITERIA

<b>Assignment</b>	<b>challenging</b>
<i>How demanding was the assigned project?</i>	
The student had to learn to understand and use both feedforward and recurrent neural networks. Additionally, the field of neural arithmetic and its applications to extrapolation and equation discovery had to be explored which is a challenging task.	

<b>Fulfilment of assignment</b>	<b>fulfilled</b>
<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>	
The student fulfilled the assigned task. He successfully analyzed different arithmetic layers and their capabilities. The focus of the application to MNIST digits was removed during the thesis because we realized that more elementary aspects of neural arithmetic like extrapolation and regularization need to be addressed first. Image processing tasks and larger networks that use neural arithmetic layers as part of their architecture remain for another project.	

<b>Activity and independence when creating final thesis</b>	<b>C - good.</b>
<i>Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted and whether the student was well prepared for the consultations. Assess the student's ability to work independently.</i>	
The student attended regular consultations. The thesis had to be extended because he felt a lack of time during the students exam period. Preparation for meetings was sufficient and became better especially after the students exam period.	

<b>Technical level</b>	<b>D - satisfactory.</b>
<i>Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?</i>	
The thesis is technically sound but lacks a good presentation. Many explanations within the thesis could be more detailed. The lack of clarity is mostly due to the student's troubles with the English language, however, I saw improvements here towards the end of his project.	

<b>Formal level and language level, scope of thesis</b>	<b>D - satisfactory.</b>
<i>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?</i>	
Sometimes notation is not used entirely correctly and not all used symbols are perfectly well defined. The presentation of the thesis suffers from the students troubles with the English language.	

<b>Selection of sources, citation correctness</b>	<b>C - good.</b>
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*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?*

The student cites all prior work in neural arithmetic correctly. There could be more references to the basic theory of neural networks.

**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 provides a nice overview over which simple arithmetic tasks are currently possible to solve and where current layers still have problems. The language of the thesis is unfortunately taking away from its overall quality.

### 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.*

The grade that I award for the thesis is C - good.

Date: **23.08.2021**

Signature: