SUPERVISOR'S ASSESSMENT OF FINAL WORK

I. IDENTIFICATION DATA

Title:	Construction of a Neural Networks model for translation of recorded sign language
Author´s name:	Tomas Ded
Type of assignment:	Bachelor Project
Faculty:	Faculty of Nuclear Sciences and Physical Engineering (FNSPE)
Department:	Department of Mathematics
Supervisor:	Nesrine Rabhi
Supervisor´s affiliation:	PhD

II. ASSESSMENT OF CRITERIA

Work assignment and topic motivation **demanding**

Assess how demanding the assigned topic is. Brief introductory word on motivation for choosing the topic.

Work Assignment and Topic Motivation:

The assigned task centers around the development of a Neural Network model for translating recorded sign language. This endeavor necessitates a thorough grasp of both machine learning methodologies and sign language principles. The primary objective is to construct a real-time Python application capable of accurately recognizing 49 American Sign Language (ASL) gestures. The workflow involves a series of steps, beginning with acquiring fundamental knowledge of sign language basics, gathering pertinent data for model construction, comprehending the intricacies of neural networks and other relevant models, constructing and refining an initial prototype, refining the model's performance through optimization, and ultimately expanding its capabilities to facilitate real-time translation.

Assessment of Topic Demand:

The assigned topic indeed involves considerable complexity, as it seamlessly intertwines two intricate fields: machine learning and sign language. The creation of a model capable of instantaneously translating sign language requires a deep comprehension of both the technical intricacies of machine learning algorithms and the subtle nuances inherent in sign language gestures. The endeavor mandates a judicious selection and fine-tuning of hyperparameters, meticulous preprocessing of the amassed data, and the establishment of a robust evaluation framework to ensure the precision and efficacy of the model. Furthermore, the incorporation of real-time translation introduces an added layer of intricacy, necessitating the seamless coordination of visual recognition and vocal output.

Motivation for Choosing the Topic:

The motivation driving the selection of this topic stems from the aspiration to bridge the communication divide between the hearing-impaired community and the broader society. Sign language stands as a crucial conduit of communication for individuals with hearing disabilities. However, the instantaneous translation of sign language into spoken language remains a technological hurdle. The chosen topic resonates with the pursuit of technological advancements geared towards fostering societal inclusivity and accessibility. By engaging in this project, we not only advance the realms of machine learning and computer vision but also contribute to a pragmatic solution that holds the potential to enhance the daily lives of those who rely on sign language for effective communication.

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Fulfilling the assignment **fulfilled with reservations**

Consider whether the work submitted meets the assignment topic. Comment, if necessary, on items of the assignment not fully answered, or mention whether the scope of the assignment has been broadened. If student failed to fully treat the assigned topic, try to assess the importance, impact and/or the reasons for failings.

Fulfilment of the Assignment:

After a careful assessment of the submitted work, it is evident that the student has made commendable progress in tackling the designated subject of developing a Neural Network model for translating recorded sign language. Nevertheless, there exist several aspects in which the work does not entirely meet the comprehensive expectations and requisites of the assignment. The student's efforts are notable, yet he has not reached the level of excellence.

Unaddressed Aspects:
1. Model Training and Epochs: The test graph indicates that loss stabilization occurred around epoch 20, while the student chose to employ a higher number of epochs, as mentioned earlier. This discrepancy raises questions about the student's reasoning for selecting a greater number of epochs and the potential risk of overfitting the model.

2. **Real-Time Accuracy:** The assertion of 100% real-time prediction accuracy lacks transparency as the methodology and calculations behind this claim are not adequately presented. This absence of explanation undermines the credibility of the result.

3. **Practical Application Issues:** Personal testing of the application exposed several limitations, including inconsistent recognition of signs, reliance on specific hand positions, and challenges in differentiating between left and right hands. These performance inconsistencies and limitations should have been more thoroughly addressed in the work.

4. **Library Usage and References:** The student did not provide comprehensive explanations for all the libraries used in the project, nor did he sufficiently reference the sources of these libraries. This omission weakens the overall transparency and reproducibility of the work.

5. **Voice Translation Implementation:** The integration of the "pyttsx3" library for voice translation was not fully justified, as the intention was to explore more robust alternatives for this task. The decision to use a simple library without elaboration on why it was chosen detracts from the completeness of the solution.

6. **Exploration of Tools:** The student's reluctance to explore advanced tools like Microsoft ML tools, which could potentially enhance the project, raises questions about their willingness to embrace new technologies and approaches that might contribute to a more sophisticated solution.

7. **Literature Review:** The student's approach to the literature review is focused primarily on aspects that do not pertain to real-time sign language translation. The lack of in-depth exploration of existing literature in the field of real-time sign language translation indicates a limited understanding of the research landscape.

Importance of Unaddressed Aspects:
The aforementioned shortcomings are important for several reasons. First, they impact the reliability of the results and conclusions presented in the work. Secondly, the real-world applicability of the model is undermined by the inconsistencies and limitations observed during personal testing. Additionally, the lack of

thorough explanations for library usage and the absence of a deeper exploration of relevant literature hinders the reader's ability to fully understand and contextualize the work.

In conclusion, while the student's efforts in constructing a Neural Network model for sign language translation are commendable, there are crucial aspects of the assignment that have not been fully addressed. These gaps have implications for the credibility, reliability, and practical applicability of the work, and they warrant further attention and refinement in order to fulfill the potential of the assigned topic.

Student´s effort and independent approach to the topic solution **average**

Assess whether student displayed constant effort while investigating the problem, whether they regularly consulted the issues and whether they attended consultations well prepared. Assess student´s creativity and independence.

Student's Effort and Independent Approach to the Topic Solution:

The student showcased a praiseworthy degree of effort and involvement during the course of investigating the assigned problem. Consistent consultations were upheld, and the student displayed a receptive attitude toward the guidance provided. However, there were instances where the student's autonomy and innovative approach could have been more prominent in their methodology. It's notable that certain recommendations, particularly concerning model evaluation, or textual aspects in the thesis, were not consistently incorporated, which could have further enhanced the work's quality.

Consultations and Guidance:
The student consistently sought consultation when confronted with challenges, underscoring their commitment to resolving issues and seeking direction. He displayed an openness to advice and recommendations, incorporating suggested changes into their work. This responsiveness to feedback underscores a readiness to learn and adapt.

Listening to Advice:
However, it is worth noting that the student did not fully embrace all pieces of advice provided. There were instances where recommendations for modifying the thesis were not heeded, leading to certain elements remaining unchanged.

Creativity and Independence:
While the student's dedication is evident in their approach, there are areas that suggest potential for increased creativity and independence. Notably, within the thesis, the student retained certain elements despite receiving recommendations for modifications. An illustrative example is the assertion of achieving 100% real-time accuracy, which lacks comprehensive context or substantiating evidence.

The confusion matrix reveals a limited representation of signs and exhibits exceptionally perfect outcomes after epoch 50, leading to suspicions regarding potential training issues. The absence of a comprehensive range of signs in the confusion matrix hampers a holistic understanding of the model's performance.

The student's assertion that their work should "serve as a teaching tool and pioneer in real-time sign language translation" appears overly ambitious based on the achieved results. The application, in its current state, remains basic and lacks the sophistication necessary to function as a reliable teaching tool. This overestimation of the project's capabilities raises concerns about the alignment of ambitions with the demonstrated outcomes.

Testing and Model Evaluation:
One aspect that warranted more comprehensive treatment was the testing of the model with a new individual. This step holds paramount importance for gauging the model's real-world performance and its ability to accommodate diverse sign language styles. A detailed account of the testing procedure, encompassing the selection of metrics and the presentation of results, would have offered greater insight into the model's practical applicability. Unfortunately, the process lacks clarity regarding the specific background and lighting conditions utilized for this new individual's testing, as well as the methodology employed to incorporate and assess the model's performance with the new dataset.

Library Usage and Results Explanation:
The utilization of the text-to-speech library "pyttsx3" for voice translation, though mentioned, lacked elaboration on its selection or implementation. Further details, such as why this specific library was chosen and how it was integrated, would have contributed to the transparency and reproducibility of the project.

Real-Time Accuracy Claims:
The claim of achieving 100% real-time prediction accuracy and subsequent mention of 91.8% accuracy under challenging conditions were presented without a comprehensive explanation. The sources of these percentages and the thorough evaluation under various conditions were not clearly outlined. A more detailed description of the evaluation process and the factors affecting these accuracy rates would have enhanced the credibility of the results.

In conclusion, the student demonstrated consistent effort and responsiveness in approaching the assigned problem. While consultations were effectively utilized, opportunities for greater independence, particularly in terms of addressing recommendations, and for increased creativity in exploring model limitations were present. Further transparency in describing testing processes, library usage, and result explanations would contribute to a more comprehensive and rigorous research presentation.

Professional standard **average**

Give your opinion on the professional standard of the work, application of course knowledge, references, and data from student´s practice.

Professional Standard, Application of Course Knowledge, References, and Data from Student's Practice:

The professional standard of the submitted work reflects a dedicated effort to address the assigned task. The student's demonstrated application of course knowledge, incorporation of references, and integration of practical data contributes to the overall quality of the work, although there are areas that could benefit from further refinement.

Professional Standard:
The work exhibits a commendable degree of professionalism, evident in the structured approach to problem-solving, adherence to academic guidelines, and the utilization of relevant terminology. The coherent organization of chapters and clear articulation of concepts contribute to a polished final product.

Application of Course Knowledge:
The application of course knowledge is evident throughout the work. The student displays a solid understanding of machine learning concepts, especially Neural Networks. They demonstrate their comprehension of essential techniques like model training, evaluation metrics, and data preprocessing. This application of foundational knowledge provides a robust foundation for investigating real-time sign language translation.

However, there are indications that the student's grasp of certain Neural Network concepts, particularly related to model evaluation, may not be complete. This suspicion arises from some questionable results observed in the work. It's important to further scrutinize the accuracy and reliability of the outcomes, especially when evaluating model performance.

References:
References are appropriately utilized to contextualize the work within the existing research landscape. The student draws upon relevant literature to support their arguments and methodologies, contributing to the work's academic rigor. However, there is room for improvement in terms of providing more comprehensive citations and attributions for the libraries used in the project, enhancing the overall transparency of the research process.

Data from Student's Practice:
The integration of data from the student's practice, particularly personal testing of the application, adds practical relevance to the work. The student's firsthand experience in evaluating the model's performance offers valuable insights into its strengths and limitations. However, this aspect could be further enriched by detailing the methodology, metrics, and conditions under which the testing was conducted.

Room for Improvement:
While the work demonstrates professionalism and a solid application of course knowledge, there are areas for improvement. Providing more thorough explanations of library usage, such as the "pyttsx3" library, would enhance the clarity and reproducibility of the project. Additionally, greater transparency in explaining the origin of claims, such as the 100% real-time accuracy, and elaborating on the evaluation process would strengthen the credibility of the results.

In conclusion, the work displays a commendable professional standard and adept application of course knowledge. The incorporation of references and practical data from the student's own testing enriches the overall quality of the work. By refining aspects related to library usage explanation, result origin clarification, and evaluation transparency, the work can achieve an even higher level of professionalism and rigor.

Level of formality and of the language used	**excellent**
Assess the use of scientific formalism, the typography and language of the work.	
The student work, strikes a balance between scientific formalism and language clarity. It effectively communicates complex concepts, though there is potential for enhancement in typography and language coherence. Striving for consistent typography and employing a clear, accessible language style would result in a more refined presentation that aligns with the standards of academic writing.	

Choice of references, citation correctness	**average**
Give your opinion on student´s effort in utilizing references in their investigation. Characterize the choice of references and say whether all relevant sources were utilized. Verify whether all resource facts were properly distinguished from student´s own findings and results, whether there was no breach of citation ethics, and whether all reference citations are complete and agree with the citation usage and standards.	
The student's engagement with references is notable, as he draws upon relevant literature to contextualize their work and support their arguments. By incorporating external sources, the student showcases a willingness to ground their investigation within the broader academic discourse. However, while references have been utilized, there is room for improvement in terms of the depth and variety of sources consulted.	

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Further comments and assessment *Give your opinion on the quality of the main results obtained in the work, e.g. on the level of quality of theoretical results, or the applicability of the engineering and programming outputs of the solutions obtained, on publication activity, experimental skills, etc.*
In conclusion, the main results obtained in the work reflect a commendable engagement with machine learning concepts and the creation of a functional Python application for recognizing ASL gestures. While the theoretical foundation is solid, opportunities for enhancing depth and nuance exist. Practical applicability can be improved by addressing limitations in the application's recognition capabilities. The student's engagement with publication activity and experimental skills is encouraging, although more comprehensive exploration and detailed reporting of experiments would enhance the overall research quality. By addressing these aspects, the work has the potential to achieve a higher level of excellence and contribute meaningfully to the field of real-time sign language translation.

III. OVERALL ASSESSMENT AND SUGGESTED GRADE

Summarize all aspects of the work most influential for the overall assessment. If adequate, write questions to be answered by student during the defence of their work before the board.

Suggested grade: **C - good.**

Date: 22.8.2023

Signature: