

Supervisor's statement of a final thesis

Czech Technical University in Prague

Faculty of Information Technology

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Supervisor: RNDr. Jiří Kroc, Ph.D.
Thesis title: Identification of Pre-Arrhythmogenic Features in ECG and Other Data Using Machine Learning
Branch of the study: Knowledge Engineering

Date: 22. 5. 2017

<p><i>Evaluation criterion:</i></p> <p>1. Difficulty and other comments on the assignment</p> <p><i>Criteria description:</i> Characterize this final thesis in detail and its relationships to previous or current projects. Comment what is difficult about this thesis (in case of a more difficult thesis, you may overlook some shortcomings that you would not in case of an easy assignment, and on the contrary, with an easy assignment those shortcomings should be evaluated more strictly.)</p> <p><i>Comments:</i> This thesis solved problems that are well beyond of the current edge of achieved knowledge in the field of cardiology and especially in the prediction of deadly arrhythmias. It is an extraordinarily difficult subject that shifted current knowledge and sooner or later will lead to the development of clinical and personal devices guarding lives of seriously diseased people.</p>	<p><i>The evaluation scale: 1 to 5.</i></p> <p>1 = extremely challenging assignment, 2 = rather difficult assignment, 3 = assignment of average difficulty, 4 = easier, but still sufficient assignment, 5 = insufficient assignment</p>
<p><i>Evaluation criterion:</i></p> <p>2. Fulfilment of the assignment</p> <p><i>Criteria description:</i> Assess whether the thesis meets the assignment statement. In Comments indicate parts of the assignment that have not been fulfilled, completely or partially, or extensions of the thesis beyond the original assignment. If the assignment was not completely fulfilled, try to assess the importance, impact, and possibly also the reason of the insufficiencies.</p> <p><i>Comments:</i> The research carried out in the thesis is done perfectly. Research provided in the thesis is at the level of a Ph.D. student. From my point of view, it would be sufficient to achieve Ph.D. title after just one year of such work!</p>	<p><i>The evaluation scale: 1 to 4.</i></p> <p>1 = assignment fulfilled, 2 = assignment fulfilled with minor objections, 3 = assignment fulfilled with major objections, 4 = assignment not fulfilled</p>
<p><i>Evaluation criterion:</i></p> <p>3. Size of the main written part</p> <p><i>Criteria description:</i> Evaluate the adequacy of the extent of the final thesis, considering its content and the size of the written part, i.e. that all parts of the thesis are rich on information and the text does not contain unnecessary parts.</p> <p><i>Comments:</i> The text is self-consistent and well balanced. What should be explained is explained clearly with many links to the further literature.</p>	<p><i>The evaluation scale: 1 to 4.</i></p> <p>1 = meets the criteria, 2 = meets the criteria with minor objections, 3 = meets the criteria with major objections, 4 = does not meet the criteria</p>
<p><i>Evaluation criterion:</i></p> <p>4. Factual and logical level of the thesis</p> <p><i>Criteria description:</i> Assess whether the thesis is correct as to the facts or if there are factual errors and inaccuracies. Evaluate further the logical structure of the thesis, links among the chapters, and the comprehensibility of the text for a reader.</p> <p><i>Comments:</i> The text is for MT very readable and comprehensive. It allows everybody to 'jump in' the subject very quickly and easy. There are no objections from my side.</p>	<p><i>The evaluation scale: 0 to 100 points (grade A to F).</i></p> <p>97 (A)</p>
<p><i>Evaluation criterion:</i></p> <p>5. Formal level of the thesis</p> <p><i>Criteria description:</i> Assess the correctness of formalisms used in the thesis, the typographical and linguistic aspects, see Dean's Directive No. 14/2015, Article 3.</p> <p><i>Comments:</i> This is the weakest point of the thesis. The student worked on research so intensively that he 'forget' to start to write down thesis on time. It was necessary to stop him from doing excellent research and focus his attention on writing down his thesis. Unluckily quite a lot of results are not included in the thesis. Because he did not manage to put them there all but those most relevant are already included. The result of this situation is a small number of formal mistakes in the thesis, which do not degrade the level of achieved results. The work is so good that I do recommend him for Ph.D. studies.</p>	<p><i>The evaluation scale: 0 to 100 points (grade A to F).</i></p> <p>90 (A)</p>

<i>Evaluation criterion:</i>	<i>The evaluation scale: 0 to 100 points (grade A to F).</i>
6. Bibliography	100 (A)
<i>Criteria description:</i> Evaluate the student's activity in acquisition and use of studying materials in his thesis. Characterize the choice of the sources. Discuss whether the student used all relevant sources, or whether he tried to solve problems that were already solved. Verify that all elements taken from other sources are properly differentiated from his own results and contributions. Comment if there was a possible violation of the citation ethics and if the bibliographical references are complete and in compliance with citation standards.	
<i>Comments:</i> It is comprehensive, well balanced and enables an easy start for newcomers! The student was very pro-active in search of sources.	
<i>Evaluation criterion:</i>	<i>The evaluation scale: 0 to 100 points (grade A to F).</i>
7. Evaluation of results, publication outputs and awards	100 (A)
<i>Criteria description:</i> Comment on the achieved level of major results of the thesis and indicate whether the main results of the thesis extend published state-of-the-art results and/or bring completely new findings. Assess the quality and functionality of hardware or software solutions. Alternatively, evaluate whether the software or source code that was not created by the student himself was used in accordance with the license terms and copyright. Comment on possible publication output or awards related to the thesis.	
<i>Comments:</i> His results are beyond what is the current state-of-the-art at the field of arrhythmia prediction. Sensitivity 93% (99%), specificity 93% (99%), and AUC 93% (99%) are well beyond of what achieved so far (the first values are a bit more reliable than those in brackets; see thesis for details). Results will be published in a journal with IF >= 4. I do recommend the student for an award for extraordinary achievements.	
<i>Evaluation criterion:</i>	<i>No evaluation scale.</i>
8. Applicability of the results	
<i>Criteria description:</i> Indicate the potential of using the results of the thesis in practice.	
<i>Comments:</i> These results serve to the prediction of deadly Torsades des Points arrhythmias. Once they reach patients at hospitals or at homes, they will literally save lives of millions of people living in danger of occurrence of deadly arrhythmias. So far, there is no prediction tool that is capable of predicting arrhythmias one hour before their onset with so high accuracy. Nevertheless, it will take some time before this research reach patients.	
<i>Evaluation criterion:</i>	<i>The evaluation scale: 1 to 5.</i>
9. Activity and self-reliance of the student	9a: 1 = excellent activity, 2 = very good activity, 3 = average activity, 4 = weaker, but still sufficient activity, 5 = insufficient activity 9b: 1 = excellent self-reliance, 2 = very good self-reliance, 3 = average self-reliance, 4 = weaker, but still sufficient self-reliance, 5 = insufficient self-reliance.
<i>Criteria description:</i> Review student's activity while working on this final thesis, student's punctuality when meeting the deadlines and consulting continuously and also, student's preparedness for these consultations. Furthermore, review student's independency.	
<i>Comments:</i> He independently searched for possible strategies that were subsequently used to tackle the solved problem. From the other side, he quickly understands what I did propose as best ways to improve achieved results. We were truly cooperating on the subject. Neither of us two can solve the problem so fast and effectively without the other. He was very proactive in ML techniques and did his job independently with our weekly consultations. We were together reaching goals very efficiently without substantial loss of time due to any communication blocks. He only needed to explain cardiology to the certain extent, after it, he was able to work independently according to the goal of the work. The goals and achieved results were checked on a regular basis; usually once per week.	
<i>Evaluation criterion:</i>	<i>The evaluation scale: 0 to 100 points (grade A to F).</i>
10. The overall evaluation	100 (A)
<i>Criteria description:</i> Summarize the parts of the thesis that had major impact on your evaluation. The overall evaluation does not have to be the arithmetic mean or any other formula with the values from the previous evaluation criteria 1 to 9.	
<i>Comments:</i> Excellent piece of research work. The true cooperation. He achieved all results efficiently and fast. During each research occur errors and mistakes; they were localized fast and efficiently removed. He is capable of continuing in research in Ph.D. studies! I do recommend him to continue in doing research.	

Signature of the supervisor: