



I. IDENTIFICATION DATA

Thesis title:	Efficient MDP Algorithms in POMDPs.jl
Author's name:	Tomáš Omasta
Type of thesis:	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Niklas Heim
Reviewer's department:	Department of Computer Science

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
The original assigned project was of regular difficulty, with possible extensions of increased difficulty. By his own choice, the student tackled the most challenging interpretation of the assignment, researching and implementing finite horizon methods for partially observable domain, instead of keeping with fully observable domains only.	

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>	
The student satisfied the assignment, achieving all the goals fully and in most cases going above the assigned objectives.	

Activity and independence when creating final thesis	A - excellent.
<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 has shown high degree of independence in his work on the thesis. He worked diligently and independently to achieve the goals of this work, showing good progress between the frequent meetings. The student was proactive, willing to ask many questions when something was unclear and was also able to get good advice from external researchers as well, such as the authors of the POMDPs.jl package. The student has also shown to be a skillful developer in his contributions to the POMDPs.jl framework, communicating with the maintainers and iterating on his code.	

Technical level	B - very good.
<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 appears to be technically sound.	
The student's code is an important and useful contribution to the <i>POMDPs.jl</i> project, providing efficient solvers to a specific class of finite horizon problems.	
In the theoretical part of the thesis, I would also like to commend the student for a novel approach to explaining the finite horizon MDP and POMDP theory. This approach has unfortunately led some oversimplifications. Together with the dense style, this creates some confusing or misleading paragraphs and sentences in the theory section, such as on page 6, second paragraph: "We evaluate the policy with a reward, which the agent receives for following the policy's mappings. In our context, the best quality is the maximal one."	
However, overall, the whole thesis shows good level of student's understanding of the technical aspects of this work. The student also clearly lays out his contribution.	

Formal level and language level, scope of thesis	B - very good.
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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, with good structure into chapters, sections, and paragraphs.

The student shows a good command of the English language. He is mostly clear and understandable in his sentences. There are occasional Bohemisms in the text (e.g. on page 2, sentence "...we also implement the ... algorithm on which foundation build many heuristics ...") and some typos (e.g. missing full stop at the end of the 1st paragraph of Section 2.1, page 5) but these never hinder the understandability of the text.

That said, students written style is very concise but often to the detriment of understandability. Some sentences are too convoluted or not specific enough to convey a clear message. Particularly in the theoretical Part I this makes for a heavy reading. This section would greatly benefit from more accessible explanations and examples. However, this part takes up 23 pages of the thesis already and such extensions would undoubtedly increase the length of the thesis significantly.

The formalism used in the thesis is consistent.

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?

The student provides enough references for this kind of thesis and seems to correctly reference all the prior work used in the thesis.

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 student has proactively focused on the most challenging interpretation of the assignment, implementing not only MDP solvers, but also significantly more challenging POMDP solvers. This makes this thesis long at almost 60 pages.

However, due to this scope creep, some sections lack the depth they would otherwise in my opinion deserve. This is the case of the evaluation section, where choice of the benchmarks could have been wider. The MDP algorithms are evaluated on two grid-world derivatives while the POMDP algorithms are evaluated on two variants of the hallway problem. It would have been nice to have more varied domains to evaluate the speedup of the implemented techniques. However, this is in the realm of "nice to have" things and not a significant weakness of the thesis.

The main impact of this work is the code contributed to the POMDPs.jl library, which is well integrated with the rest of the framework and provides very efficient solution methods to a wide range of finite horizon problems.

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

This is an excellent thesis on a challenging subject that has led to numerous useful contributions to the POMDPs.jl library. The thesis has a few minor weaknesses in the form of hard to understand and sometimes confusing theoretical section and in the limited number of benchmarking experiments but is otherwise sound on all levels.

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

Date: **2.6.2021**

Signature: Jan Mrkos