

# Bachelor Thesis Review

Faculty of Mathematics and Physics, Charles University

**Thesis author** Ekaterina Nikonova  
**Thesis title** Angry Birds Artificial Player  
**Year submitted** 2018  
**Study program** Computer Science  
**Study branch** General Computer Science

**Review author** Filip Matzner Reviewer  
**Department** Katedra softwaru a výuky informatiky

## Overall

good    OK    poor    insufficient

Assignment difficulty	X			
Assignment fulfilled	X			
Total size <i>... text and code, overall workload</i>	X			

The goal of this thesis is to implement an artificial agent for Angry Birds video game. The agent should be able to compete with human players. The thesis is written in the form of a diary. It starts with a simple approach, describes its pros and cons and iterates to more advanced solutions. The most advanced approach presented are Dueling Deep Q-networks.

The author of the thesis has proven to be able to learn and understand state-of-the art methods of reinforcement learning and deep neural networks. Furthermore, she was able to implement and successfully apply the methods in practice. All the set out goals were fulfilled and I definitely recommend the work for defense. The results of the thesis were published, presented and well received by the audience of AIBirds.org (Angry Birds AI Competition).

My questions/notes for the author are:

- By "Flatten layers" the author probably means "Dense layers" or "Fully connected layers".
- When visualizing learning curves, it is better to visualize not only the error on the training data, but also the error on the validation data. Otherwise it is not clear whether the network overfits or truly improves.
- The work contains a lot of claims like "By looking at the figure, the agent X is clearly better than agent Y". However, I was often unable to see the difference. Some numerical results and statistics to substantiate the claims would significantly improve their value.
- $\epsilon$  greedy policy is not defined prior to its first appearance.
- What is the motivation of  $C(s, a)$  in update equation in section 5.5 page 40?
- Scaling the input image to 84x84 seems to be a bit drastical, I can hardly recognize the original image with my "human eyes". Has the author tried larger input size? In older Atari games, graphical elements were trivial and recognizable even in such a low resolution, thus it did not pose a problem.
- What kind of image normalization was used? And was it necessary (since the network uses ReLU activations, there is no need to have the input in range e.g. [0,1])?
- Has the author considered some kind of regularization? E.g. random mutation of the shot angle, random shift of the input image, or softmax distribution on the output layer? Or some kind of weight decay? Regularization techniques could help with the mentioned problem that some networks behaved strangely and started shooting randomly after many hours of training.

## Thesis Text

good    OK    poor    insufficient

Form <i>... language, typography, references</i>		X		
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Structure	<i>... context, goals, analysis, design, evaluation, level of detail</i>	X			
Problem analysis		X			
Developer documentation		X			
User Documentation		X			
<p>Even though the thesis is primarily a theoretical research project, it offers both user and developer documentation. The documentation contains diagrams and application screenshots and provides a good starting point for new contributors. The user documentation even contains a "Troubleshooting" section for which I give the author a big plus. The text is nicely interleaved by screenshots.</p> <p>The work contains rather large number of wrong prepositions and articles, especially in its second half. I also recommend to the author reading a brief tutorial on scientific writing, e.g. correct term is "in Figure 5.1", not "on the Figure 5.1". The work unintentionally contains some humorous philosophical expressions, such as "AI lost to humanity" instead of "AI lost to humans", or "respectfully" instead of "respectively". Nonetheless, the text is fluent and well understandable. The bibliography list is, however, confusingly indented and the records do not have a consistent form.</p>					

### Thesis Code

good    OK    poor    insufficient

Design	<i>... architecture, algorithms, data structures, used technologies</i>		X		
Implementation	<i>... naming conventions, formatting, comments, testing</i>	X			
Stability		X			
<p>It should be noted that agent integration was a challenging task. The game itself runs in a web browser, the agent communicates with the game through a Java API and the neural network is constructed in Python.</p> <p>The code is publicly available on GitHub including the text of the thesis and user and developer documentation.</p>					

**Overall grade**    Excellent  
**Award level thesis**    Yes

Date

Signature