

# Posudek bakalářské práce

Matematicko-fyzikální fakulta Univerzity Karlovy

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**Název práce** Artificial Intelligence for the Card Game Durak  
**Rok odevzdání** 2023  
**Studijní program** Informatika  
**Specializace** Artificial Intelligence

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**Pracoviště** KSVI

**Role** Oponent

Prosím vyplňte hodnocení křížkem u každého kritéria. Hodnocení *OK* označuje práci, která kritérium vhodným způsobem splňuje. Hodnocení *lepší* a *horší* označují splnění nad a pod rámec obvyklý pro bakalářskou práci, hodnocení *nevyhovuje* označuje práci, která by neměla být obhájena. Hodnocení v případě potřeby doplňte komentářem. Komentář prosím doplňte všude, kde je hodnocení jiné než *OK*.

<b>K celé práci</b>	lepší	OK	horší	nevyhovuje
Obtížnost zadání	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Splnění zadání	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rozsah práce ... <i>textová i implementační část, zohlednění náročnosti</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Komentář Overall the student presents a complete and thorough fulfillment of the assignment. The implementation includes multiple simple, rule-based agents and two out of three proposed agents with higher implementation difficulty. They are individually analyzed and then compared against each other. The work also contains a comparison between their behavior in an open- and closed-world scenario.				
Questions: How do you think your agents would perform in a multi-agent scenario? Tables 5.1 and 5.2 contains range values. Are these multiple tournaments started with different seeds?				

**Textová část práce**

lepší OK horší nevyhovuje

Formální úprava ... jazyková úroveň, typografická úroveň, citace	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Struktura textu ... kontext, cíle, analýza, návrh, vyhodnocení, úroveň detailu	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Analýza	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Vývojová dokumentace	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Uživatelská dokumentace	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Komentář** The thesis is well structured and reads in a continuous flow. All topics are introduced on time and the build-up of knowledge is balanced well using cross-references and avoiding conceptual repetition. I am missing a dedicated background chapter that would provide the mathematical and algorithmical foundation and in turn would prove the student's understanding thereof.

The formal level of English is grammatically correct with only minor mistakes at times. Textual repetitions is however apparent (within a paragraph or verbatim sentence copies) which can be exhausting to the reader (eg. 2.1-2.3, 4.5, 5.1 vs 5.2). It starts out concise in the introduction and then leaves a rather rushed impression towards the results section. The figures could be placed closer to the text they are referenced in to reduce the amount of jumping the reader has to do. This could be achieved by making them smaller or combining them into less, but full-page figures.

The analysis is overall complete and covers the most expected aspects in the evaluation. The statistical methodology could be improved with significance tests, denser sampling of the parameter space and increased search boundaries (it is always arbitrarily capped to ~100ms).

I have some concern with the chosen strategy for finding the hyperparameters of MCTS and minimax in the closed-world scenario. Given the premise that the more samples the better, I would have liked to see the analysis start with a high sample count (or budget), find the other parameters for that, and then choose a lower sample count such that the winrate doesn't decrease too much. In the presented methodology, the potential of the two method's optima is not explored, because the analysis already starts with a fixed low sample count (budget) (10 samples / ~6 cards = <2 experiments per card). This is visible from the high variance eg. in Fig. 5.6 / 5.8 oscillating around the 50% chance mark.

The usage of "significanct" in Section 5.3 is overstated given the little 100 samples and a variance of +- 3-7%. A t-test would have been required here to support these claims.

The development and user documentation are excellent.

**Writing tips:**

- Put more variation into your sentence beginnings and structure. Structures like "It is important to ..." and "It should be noted ..." occurred quite a lot.
- You did a good job in explaining the game concepts with examples (eg 1.9). Consider visualizing them even further using a flow diagram or a comic-strip where each image would show one move. Experiments in 2.3 would also benefit from a visual presentation of the numbers.
- The function name in Fig. 4.7 should probably be "EvaluateWeakness"
- In Fig 5.2 leave some space between the subplots, the y-axis label is confusing.
- In 5.2.1 there is a copy-paste mistake of depth 9 vs the newly selected depth 3.

**Implementační část práce**

lepší OK horší nevyhovuje

Kvalita návrhu ... <i>architektura, struktury a algoritmy, použité technologie</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kvalita zpracování ... <i>jmenné konvence, formátování, komentáře, testování</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stabilita implementace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<p>Komentář The provided source code is well structured into modules, has decently named functions and variables and a consistent formatting. I was able to navigate and understand the code well with the description provided in the thesis. I like that it is a self-contained implementation without external dependencies (apart from the C# runtime). A test suite that is verifying the implementation is unfortunately missing. Limited by not being provided with pre-compiled binaries I was unable to run and verify the stability of the implementation.</p>				

**Celkové hodnocení** Výborně (spíše horší)**Práci navrhuji na zvláštní ocenění** Choose an item.**Datum** 31. ledna 2023**Podpis**