



Technische Universität Berlin

Chair of Agent Technologies in Business Applications and Telecommunications

Master's Thesis

Reinforcement Learning based Strategic Bidding for a Virtual Power Plant in the Frequency Containment Reserve Market

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Hereby I declare that I wrote this thesis myself with the help of no more than the mentioned literature and auxiliary means.

Berlin, DD.MM.YYYY

.....
Firstname, Lastname(s)

Zusammenfassung

Tipps zum Schreiben dieses Abschnitts finden Sie unter [4]

Abstract

The abstract should be 1-2 paragraphs. It should include:

- a statement about the problem that was addressed in the thesis,
- a specification of the solution approach taken,
- a summary of the key findings.

For additional recommendations see [4].

Acknowledgments

For recommendations on writing your Acknowledgments see [5].

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List of Abbreviations

DAI Labor Distributed Artificial Intelligence Laboratory

List of Algorithms

1	Splitting a Session[3].	7
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1 Introduction

... should include the following:

- motivation (why is this problem interesting? offer examples),
- research challenge (what is the obstacle to be overcome?),
- novelty (was this problem already solved?),
- anticipated impact (how does solving this problem impact our world?).

This chapter should include the following sections.

1.1 Motivation

This section should

- answer the question - why is this problem interesting?
- offer examples illustrating the problem.

1.2 Research Challenge

This section should answer the question -

- what is the obstacle to be overcome?

1.3 Novelty

This section should answer the question -

- was this problem already solved?

1.4 Anticipated Impact

This section should answer the question -

- how does solving this problem impact our world?

Conclude this subsection with an image describing 'the big picture'. How does your solution fit into a larger environment? You may also add another image with the overall structure of your component.

'Figure ?? shows Component X as part of ...'

The 'structure' or 'outline' section gives a brief introduction into the main chapters of your work. Write 2-5 lines about each chapter. Usually diploma thesis are separated into 6-8 main chapters.

This example thesis is separated into 7 chapters.

Chapter 2 is usually termed 'Related Work', 'State of the Art' or 'Fundamentals'. Here you will describe relevant technologies and standards related to your topic. What did other scientists propose regarding your topic? This chapter makes about 20-30 percent of the complete thesis.

Chapter ?? analyzes the requirements for your component. This chapter will have 5-10 pages.

Chapter 9 is usually termed 'Concept', 'Design' or 'Model'. Here you describe your approach, give a high-level description to the architectural structure and to the single components that your solution consists of. Use structured images and UML diagrams for explanation. This chapter will have a volume of 20-30 percent of your thesis.

Chapter ?? describes the implementation part of your work. Don't explain every code detail but emphasize important aspects of your implementation. This chapter will have a volume of 15-20 percent of your thesis.

Chapter ?? is usually termed 'Evaluation' or 'Validation'. How did you test it? In which environment? How does it scale? Measurements, tests, screenshots. This chapter will have a volume of 10-15 percent of your thesis.

Chapter ?? summarizes the thesis, describes the problems that occurred and gives an outlook about future work. Should have about 4-6 pages.

2 Scientific Background

... should include the following:

- definitions / technical terms,
- theoretical foundations / principles,
- descriptions of algorithms, hardware, software, and/or systems employed.

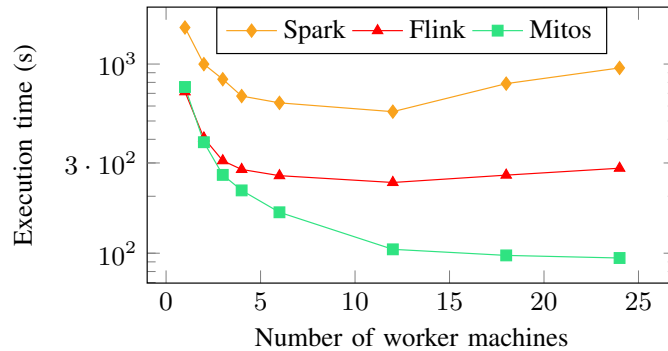


Figure 1: Strong scaling for Visit Count[1].

Suggestion: Figures could be inserted in pdf form to avoid pixelation when the image is magnified.

This section is intended to give an introduction about relevant terms, technologies and standards in the field of X. You do not have to explain common technologies such as HTML or XML.

3 Research Problem

... should include the following:

- a succinct, precise, and unambiguous statement of the research problem or question to be solved,
- goals and subproblems that will be explored, including the scope of the thesis (i.e., what is in and out of scope).

Area (Million sq. miles)	Calling Code
0.29	56
0.3	90
3.8	1
0.5	51
600	9800
Pearson = 1.0	Spearman's = 0.1

Table 1: Correlation in the existence of outlier[2].

4 State of the Art

... should include the following:

- state-of-the-art solutions to the problem,
- related work and a differentiation of your contributions to the related work.

5 Requirements

6 Solution

... should include the following:

- research methodology (e.g., prototype and experiments, case study, literature survey, theoretical analysis),
- derivations and descriptions of algorithms, hardware, software, and/or systems developed.

Algorithm 1: Splitting a Session[3].

Parameters:

e : Tuple to be inserted.
 $te(e)$: Event-time of e .

$S \leftarrow$ slice that covers $te(e)$;

if S starts at $te(e)$ **then**

//Slice before S must be fixed.
change the type of the slice before S to combined;
add e to S ;

else

// S does not start at $te(e)$.
change $tend(S)$ to $te(e)$ (excluding $te(e)$ from S);
change type of S to flexible;
add slice in $[te(e), \text{former } tend(S)]$ with former type of S .
add e to the new slice.

end

7 Concept

8 Implementation

... should include the following:

- research methodology (e.g., prototype and experiments, case study, literature survey, theoretical analysis),
- derivations and descriptions of algorithms, hardware, software, and/or systems developed.

Algorithm 2: Splitting a Session[3].

Parameters:

e : Tuple to be inserted.
 $te(e)$: Event-time of e .

$S \leftarrow$ slice that covers $te(e)$;

if S starts at $te(e)$ **then**

//Slice before S must be fixed.
change the type of the slice before S to combined;
add e to S ;

else

// S does not start at $te(e)$.
change $tend(S)$ to $te(e)$ (excluding $te(e)$ from S);
change type of S to flexible;
add slice in $[te(e), \text{former } tend(S)]$ with former type of S .
add e to the new slice.

end

9 Experimental and Analytical Evaluation

9.1 Experimental Setup

... should include the following:

- define experimental data and workload(s),
- discussion about the selection and interpretation of the evaluation metrics,
- discussion about the computing environment, including hardware, software, tools.

5.X Design and an Interpretation of the Results (For each Experiment Class X)

... should include the following:

- which experiments will be conducted and why?
- for each experiment, what are objectives, baselines, and expected results?
- description and an interpretation of the experimental results,
- explanation for any anomalies or any unexpected behavior.

10 Conclusion and Outlook

... should include the following:

- problem restated and a brief summary of the methodology,
- student contributions (e.g., survey, open-source software, journal publication),
- a brief summary of the findings and results,
- limitations and generalizability of the findings and results.
- lessons learned,
- recommendations for future research.

Bibliography

- [1] Gévay, G.E., Rabl, T., Breß, S., Madai-Tahy, L., Quiané-Ruiz, J.A., Markl, V.: Efficient control flow in dataflow systems: When ease-of-use meets high performance (2021), https://www.researchgate.net/publication/349768477_Efficient_Control_Flow_in_Dataflow_Systems_When_Ease-of-Use_Meets_High_Performance, to be published
- [2] Mahdi Esmailoghli, Jorge-Arnulfo Quiané-Ruiz, Z.A.: Cocoa: Correlation coefficient-aware data augmentation (2021)
- [3] Traub, J., Grulich, P.M., Cuéllar, A.R., Bress, S., Katsifodimos, A., Rabl, T., Markl, V.: Scotty: General and efficient open-source window aggregation for stream processing systems (2020), https://www.redaktion.tu-berlin.de/fileadmin/fg131/Publikation/Papers/Traub_TODS-21-Scotty_preprint.pdf
- [4] Wallwork, A.: English for writing research papers, chap. Abstracts, pp. 177–245. Springer International Publishing Switzerland (2011)
- [5] Wallwork, A.: English for writing research papers, p. 306. Springer International Publishing Switzerland (2011)

Appendix A. Further Details on the Solution Approach

Appendix B. Extended Version of the Experimental Results