– P&E Master's Programme –
Chair of Philosophy, Computer Science & Artificial Intelligence

Automating the Modelling of Transformative Artificial Intelligence Risks

"*An Epistemic Framework for Leveraging Frontier AI Systems to Upscale Conditional Policy Assessments in Bayesian Networks on a Narrow Path towards Existencial Safety*"

A thesis submitted at the Department of Philosophy

for the degree of *Master of Arts in Philosophy & Economics*

Author:

Valentin Jakob Meyer
Valentin.meyer@uni-bayreuth.de
Matriculation Number: 1828610
Tel.: +49 (1573) 4512494
Pielmühler Straße 15
52066 Lappersdorf

Supervisor:

Dr. Timo Speith

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Contents

Preface

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Abstract

Outline(s): Table of Contents

Chapter 1

Introduction

```
10% of Grade:

-   introduces and motivates the core question or problem
-   provides context for discussion (places issue within a larger debate or sphere of
-   states precise thesis or position the author will argue for
-   provides roadmap indicating structure and key content points of the essay

\~ 14% of text \~ 4200 words
```

1.1 Abstract

- introduces and motivates the core question or problem

Testing crossreferencing grapics Figure 1.1.

1.2 Motivation: Problem Statement

1.3 Motivation: Research Question

- provides context for discussion (places issue within a larger debate or sphere of relevance)

1.4 Scope: Aim & Context of the Research

1.5 Significance of the Research: Theory of Change

- states precise thesis or position the author will argue for

Figure 1.1: Caption/Title 2

1.6 Thesis Statement & Position: (Aim of the Paper)

- provides roadmap indicating structure and key content points of the essay

1.7 Overview: Structure & Approach of the Paper (Roadmap — Theory of Change)

1.8 Table of Contents

1.9 Problem Statement — Motivation

Continued AI Progress:

- Rapid advancements in AI technology increase both potential benefits and risks.

Existential Risks (AI X-Risk):

- Advanced AI systems could pose significant threats if misaligned with human values.

Complexity Challenges:

- The intricate nature of AI systems complicates policy formulation and understanding.

Limitations of Current Approaches:

- MTAIR's Reliance on Human Labor:
  - Modeling Transformative AI Risks (MTAIR) is constrained by manual cognitive efforts.

- Need for Automation:
  - Scaling and automating risk modeling is essential to keep pace with AI developments.

Opportunity:

- Leveraging new technologies to enhance our ability to model and mitigate AI risks.

1.10 Aim of the Paper

1.10.1 Research Question & Scope

Can frontier AI technologies be utilized to automate the modeling of transformative AI risks, so as to allow for the prediction of policy impacts?

Frontier AI Technology: Today's most capable AI systems (e.g. GPT4 level LLMs)
Scaling Up: Automating the previously "manual" cognitive labor

Modeling: Formalizing the world views underlying arguments
Transformative AI: Level of AI capabilities defined by severe impact on the world
Safety & Governance Literature: Publications, reports etc. concerned with risks from AI

Automated Estimation: Non-manual (AI systems + scaffolding), quantified evaluations

Probability Distributions: Formal expressions of the expectations over future worlds
Conditional Trees of Possible Worlds: "If … then…" reasoning over ways things may play out
Forecasting Policy Impacts: Qualitative & quantitative evaluation of expected outcomes

1.10.2 Significance of the Research

1.11 Theory of Change — Approach & Structure of the Paper

Multiplicative Benefits:

- Automation × Live Prediction Market Integrations × Policy Impact Evaluations

Explanation:

Automation:

- Increases efficiency and scalability of risk modeling.

  Live Prediction Markets:

- Provides up-to-date, collective intelligence to inform models.

  Policy Impact Evaluations:

- Improves the accuracy and relevance of policy assessments.

Outcome:

- Enhanced ability to develop effective policies that mitigate AI risks.

Visual Aid:

- A diagram illustrating how each component amplifies the others, leading to greater overall impact.

1.11.1 The Coordination Crisis in AI Governance

1.11.2 1.2 Research Question and Scope

1.11.3 1.3 The Multiplicative Benefits Framework

1.11.4 1.4 From Theory to Practice: A Roadmap

1.12 Overview / Table of Contents

Chapter 2

Context

```
### 20% of Grade: {.unnumbered .unlisted}

- demonstrates understanding of all relevant core concepts

- explains why the question/thesis/problem is relevant in student’s own words (suppor

- situates it within the debate/course material

- reconstructs selected arguments and identifies relevant assumptions

- describes additional relevant material that has been consulted and integrates it wi

~ 29% of text ~ 8700 words
```

1. successively (chunk my chunk) introduce concepts/ideas — and 2. ground each with existing literature

2.1 Background Considerations

2.2 Literature, Concepts & Terminology

2.2.1 DAG / BayesNets

2.2.2 State of the art (MTAIR) — Explanation

Carlsmith Model (Analytica)

2.3 Theoretical Foundations

2.3.1 AI Existential Risk: The Carlsmith Model

2.3.2 The Epistemic Challenge of Policy Evaluation

2.3.3 Argument Mapping and Formal Representations

2.3.4 Bayesian Networks as Knowledge Representation

2.3.5 The MTAIR Framework: Achievements and Limitations

2.3.6 "A Narrow Path": Conditional Policy Proposals in Practice

2.3.7 (Intro) Example — Rain/Sprinkler/Lawn

/ Rain/Sprinkler/Lawn DAG / BayesNet — Extended Example

…

Own Position/Argument: AMTAIR … Own Rain/Sprinkler/Lawn DAG / BayesNet Implementation

2.4 Methodology

2.4.1 From World Models to Computational Representation

Research Design Overview

Formalizing World Models from AI Safety Literature

Directed Acyclic Graphs: Structure and Semantics

Quantification Approaches for Probabilistic Judgments

Inference Techniques for Complex Networks

Integration with Prediction Markets and Forecasting Platforms

2.5 Practical Real World Examples

MTAIR / Carlsmith Model (Analytica) — Explanation (— is motivation: should come first)

Kialo

Rain/Sprinkler/Lawn DAG

BayeServer

BayesNet — Extended Example

Code + documentation

Testing crossreferencing grapics Figure 2.1.

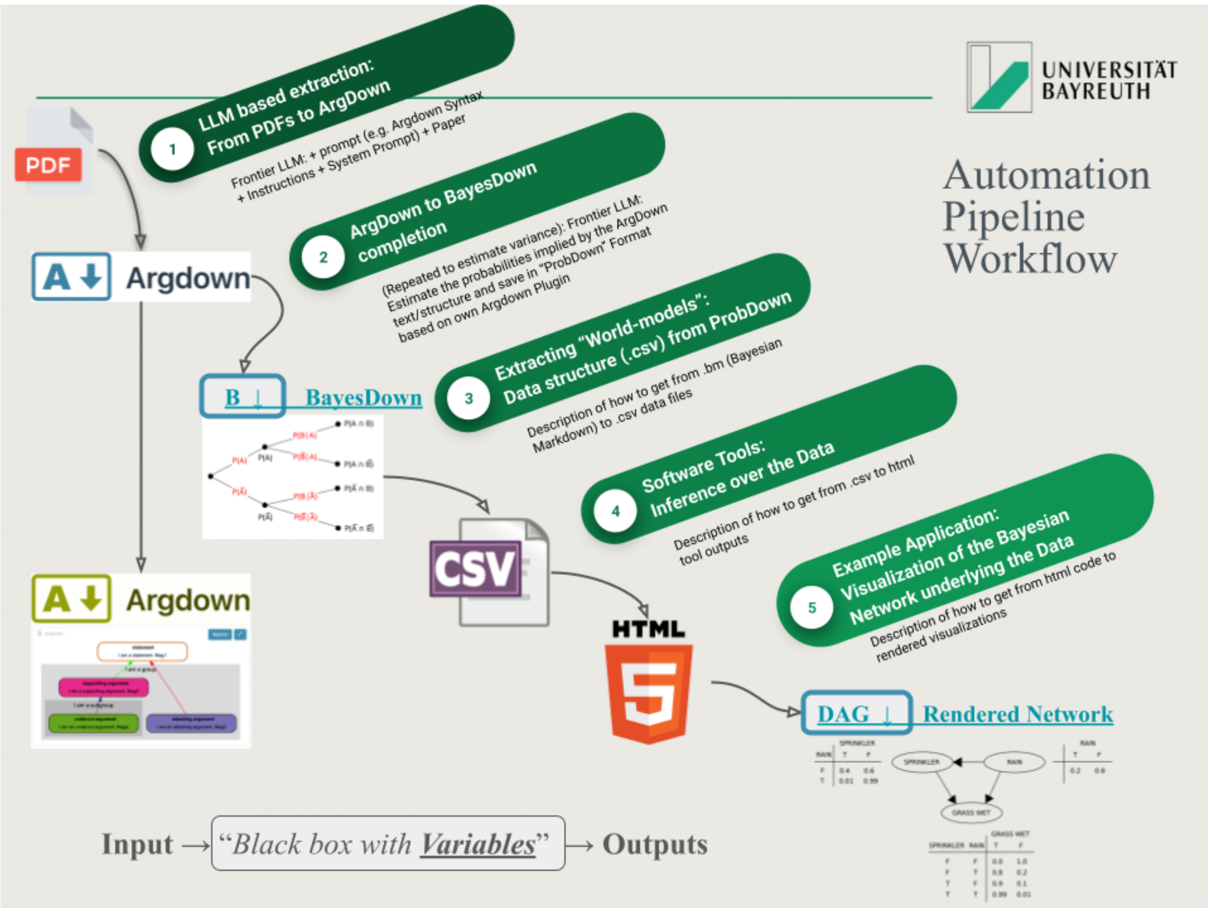


Figure 2.1: AMTAIR Automation Pipeline

Chapter 3

AMTAIR

```
### 20% of Grade: ~ 29% of text ~ 8700 words

- provides critical or constructive evaluation of positions introduced
- develops strong (plausible) argument in support of author's own position/thesis
- argument draws on relevant course material claim/argument
- demonstrate understanding of the course materials incl. key arguments and core conc
- claim/argument is original or insightful, possibly even presents an original contri
```

3.1 Own Carlsmith Model Implementation — Explanation

3.2 Own Implementation: Good example from a published paper

3.3 Implementation

System Architecture and Data Flow

Automated Extraction Pipeline

Network Construction and Visualization

Probabilistic Inference Engine

Prediction Market Integration Module

Policy Evaluation Interface

3.4 Results: From Theory to Application

Extraction Quality Assessment

Computational Performance Analysis

Case Study: The Carlsmith Model Formalized

Comparative Analysis of AI Governance Worldviews

Policy Impact Evaluation: Proof of Concept

TestText

Chapter 4

Insights & Findings

4.1 Automated Modeling Pipeline — From Academic Papers to Political Strategy

`Success of Automation:`

- Demonstrated feasibility of automated model extraction.

  Improved Forecasting:

- Enhanced accuracy with real-time data integration.

  Policy Analysis:

- Identified impactful policies through conditional forecasting.

  Scalability Achieved:

- Efficient processing of extensive data sets.

  Addressed Challenges:

- Overcame limitations of manual modeling.

4.2 Project Scaling — Workflow Pipeline & Automation

Scaling Opportunities:

- Horizontal: Incorporate more data sources.
- Vertical: Add detailed variables.

New Capabilities:

- Advanced analytics.
- Real-time data integration.

Requirements:

- Software Setup: Robust infrastructure.
- Financial: Funding for APIs and compute resources.

Impact:

- Broader, more comprehensive models.
- Enhanced policy analysis.

4.3 Computational Complexity — Computational Tractability

Challenges:

- High computational demands of complex models.

Solutions:

- Clustering Worldviews:
- Group similar perspectives to simplify models.
- Correlation Management:
- Adjust for variable interdependencies.
- Efficient Algorithms:
  Use optimized sampling methods like Monte Carlo.

Outcome:

- Achieved efficiency without sacrificing accuracy.

Link to Theory of Change:

- Scalability amplifies policy impact.

4.4 External Validation — Manual Extraction & Processing

`Purpose:`

- Assess accuracy of automated methods.
  Comparison:
- Automation Strengths:

- Speed, consistency.

- Human Strengths:

- Nuanced understanding.
  Findings:

- Automation excels in data handling.

- Human oversight enhances quality.
  Conclusion:

- Optimal results from combining AI with expert input.

Chapter 5

Discussion

10% of Grade: ~ 14% of text ~ 4200 words

- discusses a specific objection to student's own argument
- provides a convincing reply that bolsters or refines the main argument
- relates to or extends beyond materials/arguments covered in class

Chapter 6

Discussion — Exchange, Controversy & Influence

6.1 Challenges & Problems — Red Teaming Problems, Failures & Downsides

`Potential Failures:`

- Data Issues: Inaccurate or biased inputs.
- Model Limitations: Oversimplifications.
- Tech Risks: AI misinterpretations.
  Red Teaming:
- Stress-testing models to find weaknesses.
  Impact on Theory of Change:
- Identifying points of failure strengthens the approach.

6.2 Implications & Impact — Uptake, Feedback Loops, Uptake & Success – Green Teaming –

`Potential Outcomes:`

- First-Order: Reduced AI risks through better policies.
- Second-Order: Enhanced collaboration.
- Third-Order: Framework applied to other global risks.
  Feedback Loops:

- Continuous model improvement.

- Adaptive policy-making.
  Green Teaming:

- Strategies to maximize positive impacts.

6.3 Known Unknowns & Unknown Unknowns — Input Data Example: Modeling Author Worldviews from Bibliographies Instead of Individual Papers

`Potential Outcomes:`

- First-Order: Reduced AI risks through better policies.

- Second-Order: Enhanced collaboration.

- Third-Order: Framework applied to other global risks.
  Feedback Loops:

- Continuous model improvement.

- Adaptive policy-making.
  Green Teaming:

- Strategies to maximize positive impacts.

6.4 Discussion: Implications and Limitations

Red-Teaming Results: Identifying Failure Modes

Enhancing Epistemic Security in AI Governance

Scaling Challenges and Opportunities

Integration with Existing Governance Frameworks

Known Unknowns and Deep Uncertainties

Chapter 7

Conclusion

7.1 The Current State of Things & How to Continue

```
10% of Grade: ~ 14% of text ~ 4200 words

- summarizes thesis and line of argument
- outlines possible implications
- notes outstanding issues / limitations of discussion
- points to avenues for further research
- overall conclusion is in line with introduction
```

7.2 Summary — Key Takeaways & Findings

7.2.1 Assessing Policy Effects:

Evaluating how different policies alter P(Doom).

7.2.2 Conditional Probability:

Calculating P(Doom | Policy Alpha).

7.2.3 Methodology:

Update model parameters based on policy implementation.
Recompute probabilities accordingly.

7.2.4 Purpose:

Inform policymakers of potential policy effectiveness.
Prioritize interventions that significantly reduce risks.

7.3 Outlook — Outlook & Next Steps / Further Research

7.3.1 Scaling Up:

- Include more variables and data sources.

7.3.2 Collaboration:

- Partner with policymakers and researchers.

7.3.3 Technological Enhancements:

- Employ advanced AI techniques.

7.3.4 Potential Impact:

- Influence global AI governance.

7.3.5 Limitations of the Analysis

7.3.6 Policy Implications & Recommendations

7.3.7 Areas for Future Research

7.3.8 Open Questions — Central/Remaining Questions & Feedback

Questions:

- How can we improve automation accuracy?
- What challenges exist in policy implementation?
- How do we mitigate AI model biases?
- How can interdisciplinary efforts enhance outcomes?

Feedback:

- Invite thoughts, critiques, and suggestions.

7.3.9 Outlook — Outlook & Next Steps / Further Research

7.4 Conclusion: Toward an Adaptive AI Governance Framework

7.4.1 Key Contributions and Findings

7.4.2 Limitations of the Current Implementation

7.4.3 Policy Implications and Recommendations

7.4.4 Future Research Directions

7.4.5 Concluding Reflections

Frontmatter

Prefatory Apparatus: Illustrations and Terminology — Quick References

List of Tables

List of Graphics & Figures

List of Abbreviations

esp. especially
f., ff. following
incl. including
p., pp. page(s)
MAD Mutually Assured Destruction

- AI - Artificial Intelligence
- AGI - Artificial General Intelligence
- ARPA - AI Risk Pathway Analyzer
- DAG - Directed Acyclic Graph
- LLM - Large Language Model
- MTAIR - Modeling Transformative AI Risks
- P(Doom) - Probability of existential catastrophe from misaligned AI
- CPT - Conditional Probability Table

Glossary

- **Argument mapping**: A method for visually representing the structure of arguments
- **BayesDown**: An extension of ArgDown that incorporates probabilistic information
- **Bayesian network**: A probabilistic graphical model representing variables and their dependencies
- **Conditional probability**: The probability of an event given that another event has occurred
- **Directed Acyclic Graph (DAG)**: A graph with directed edges and no cycles
- **Existential risk**: Risk of permanent curtailment of humanity's potential
- **Power-seeking AI**: AI systems with instrumental incentives to acquire resources and power

- **Prediction market**: A market where participants trade contracts that resolve based on future events
- **d-separation**: A criterion for identifying conditional independence relationships in Bayesian networks
- **Monte Carlo sampling**: A computational technique using random sampling to obtain numerical results

Checklists

"Usual paper requirements"

- introduce all terminology
  - go through text, make sure all terms are defined, explained (and added to the list of Abbr.) when first mentioned
- readership is intelligent and interested but has no prior knowledge

(Format:) ~ Anything that makes it easier to understand

- short sentences
- paragraphs (one idea per paragraph)
- simplicity
- !limit use of passive voice!
- use active voice, even prefer I over we!
- minimise use of "zombi nouns" (don't turn verbs/adjectives to nouns!)
- "find words that can be cut"

– the paper can **focus** on **one aspect of the presentation**
– "open door policy" for (content) questions
~ demonstrate ability for novel research
– "solve research question with the tools accessible to you"
– "show something that has not been shown before / should be publishable in principle"
– new idea (or criticism) "in this field"
– Outline idea THEN reading with a purpose (answering concrete questions)

– "Only" confirm that nobody has published the exact same idea on the same topic

– pretty much determined by presentation & proposal but narrow down further (& choose supervisor?)

Quarto Features Incompatible with LaTeX (Below)

Bibliography (References)

Headings & Potential Headings

`verbatim code formatting for notes and ideas to be included (here)`

```
Also code blocks for more extensive notes and ideas to be included and checklists
- test 1.
- test 2.
- test 3.
2. second
3. third
```

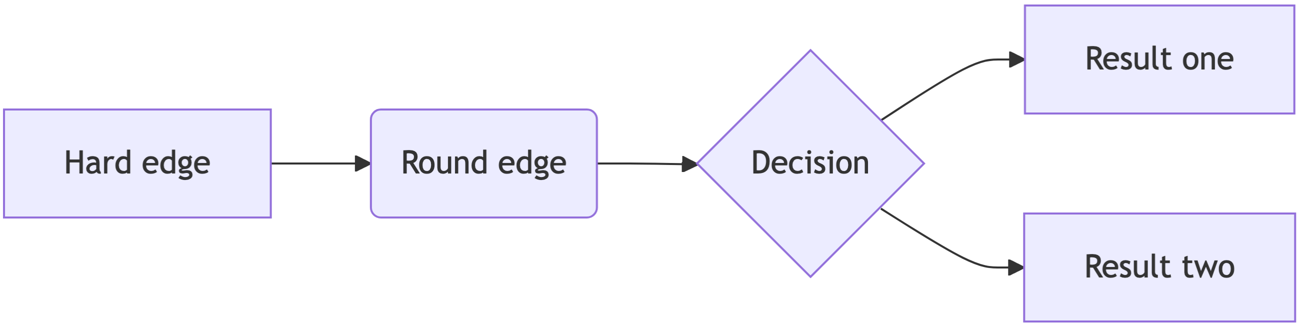
> Blockquote formatting for “Citations / Things to reference”

Here is an inline note.[1]
Here is a footnote reference,[2]
Here’s some raw inline HTML:
page 1

[1]Inlines notes are easier to write, since you don’t have to pick an identifier and move down to type the note.

[2]Here is the footnote.

page 2



Testing crossreferencing grapics Figure 2.1.

Citations

Adams [1]

[1] and [3]
Blah Blah [see 3, pp. 33–35, also 2, chap. 1]
Blah Blah [3, 33–35, 38-39 and passim]
Blah Blah [2, 3].
Wickham says blah [2]

[1] Ernest W Adams. “Four Probability-Preserving Properties of Inferences”. In: *Journal of Philosophical Logic* 25 (1996), pp. 1–24. ISSN: 0022-3611.

[2] Jakub Growiec. “Existential Risk from Transformative AI: An Economic Perspective”. In: *Technological and Economic Development of Economy* 30.6 (July 10, 2024), pp. 1682–1708. ISSN: 2029-4921, 2029-4913. DOI: `10.3846/tede.2024.21525`. URL: `https://journals.vilniustech.lt/index.php/TEDE/article/view/21525` (visited on 11/13/2024).

[3] Donald E. Knuth. “Literate Programming”. In: *Computer Journal* 27.2 (May 1984), pp. 97–111. ISSN: 0010-4620. DOI: `10.1093/comjnl/27.2.97`. URL: `https://doi.org/10.1093/comjnl/27.2.97`.

Appendix A

Appendices

A.1 Appendix A: Technical Implementation Details

A.2 Appendix B: Model Validation Procedures

A.3 Appendix C: Case Studies

A.4 Appendix D: Ethical Considerations

TestText

Appendix B

appendixA

testtext

List of Figures

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Science & Artificial Intelligence

Affidavit

Declaration of Academic Honesty

Hereby, I attest that I have composed and written the presented thesis

Automating the Modelling of Transformative Artificial Intelligence Risks

independently on my own, without the use of other than the stated aids and without any other resources than the ones indicated. All thoughts taken directly or indirectly from external sources are properly denoted as such.

This paper has neither been previously submitted in the same or a similar form to another authority nor has it been published yet.

Bayreuth on the
May 20, 2025

Valentin Meyer