Automating the Modelling of Transformative Artificial Intelligence Risks

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# Preface

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# Abstract

# Outline(s): Table of Contents

# 1. Introduction

10% of Grade: ~ 14% of text ~ 4200 words ~ 10 pages  
  
- introduces and motivates the core question or problem  
- provides context for discussion (places issue within a larger debate or sphere of relevance)  
- states precise thesis or position the author will argue for  
- provides roadmap indicating structure and key content points of the essay

## 1.1 Abstract

[x] introduces and motivates the core question or problem

## 1.2 Motivation: Problem Statement

AIs are (on the path to) getting smarter than humans  
 Humanities (de-centralized) collective information processing, sense-making AND coordination/cooperation is falling behind  
 BUT new technology/AI also enables new modes/methods of collective information processing  
 therefore this thesis/AMTAIR aspires to be an epistemic tool that enables/empowers humanity (collectively)

## 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

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

AMTAIR is a new epistemic tool/framework that enables/empowers humanities collective information processing, comprehension and thereby enables the necessary coordination ... (to compete with AIs?)

[ ] 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

#### 1.10.1.1 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

# 2. Context

### 20% of Grade: ~ 29% of text ~ 8700 words ~ 20 pages  
  
- demonstrates understanding of all relevant core concepts  
  
- explains why the question/thesis/problem is relevant in student’s own words (supported by quotations)  
  
- 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 with the course material as well as the research question/thesis/problem

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

#### 2.2.2.1 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

#### 2.4.1.1 Research Design Overview

#### 2.4.1.2 Formalizing World Models from AI Safety Literature

#### 2.4.1.3 Directed Acyclic Graphs: Structure and Semantics

#### 2.4.1.4 Quantification Approaches for Probabilistic Judgments

#### 2.4.1.5 Inference Techniques for Complex Networks

#### 2.4.1.6 Integration with Prediction Markets and Forecasting Platforms

## 2.5 Practical Real World Examples

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

#### 2.5.0.1 Kialo

#### 2.5.0.2 BayeServer

#### 2.5.0.3 BayesNet — Extended Example

### 2.5.1 Rain/Sprinkler/Lawn DAG

#### 2.5.1.1 Code + documentation

|  |
| --- |
| [AMTAIR Automation Pipeline from CITATION](https://github.com/VJMeyer/submission)  Figure 2.1: AMTAIR Automation Pipeline from CITATION |

Testing crossreferencing grapics [Figure 8.1](#fig-automation_pipeline).

# 3. AMTAIR

### 20% of Grade: ~ 29% of text ~ 8700 words ~ 20 pages  
  
- 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 concepts within the debate  
- claim/argument is original or insightful, possibly even presents an original contribution to the debate

## 3.1 Own Carlsmith Model Implementation — Explanation

## 3.2 Own Implementation: Good example from a published paper

## 3.3 Implementation

#### 3.3.0.1 System Architecture and Data Flow

#### 3.3.0.2 Automated Extraction Pipeline

#### 3.3.0.3 Network Construction and Visualization

#### 3.3.0.4 Probabilistic Inference Engine

#### 3.3.0.5 Prediction Market Integration Module

#### 3.3.0.6 Policy Evaluation Interface

## 3.4 Results: From Theory to Application

#### 3.4.0.1 Extraction Quality Assessment

#### 3.4.0.2 Computational Performance Analysis

#### 3.4.0.3 Case Study: The Carlsmith Model Formalized

#### 3.4.0.4 Comparative Analysis of AI Governance Worldviews

#### 3.4.0.5 Policy Impact Evaluation: Proof of Concept

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# 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.

# 5. Discussion

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

# 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

#### 6.4.0.1 Red-Teaming Results: Identifying Failure Modes

#### 6.4.0.2 Enhancing Epistemic Security in AI Governance

#### 6.4.0.3 Scaling Challenges and Opportunities

#### 6.4.0.4 Integration with Existing Governance Frameworks

#### 6.4.0.5 Known Unknowns and Deep Uncertainties

# 7. Conclusion

## 7.1 The Current State of Things & How to Continue

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

#### 7.3.8.1 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?

#### 7.3.8.2 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

Table 1: Table name

Table 2: Table name

Table 3: Table name

* Figure 1.1: The coordination crisis in AI governance - visualization of fragmentation
* Figure 2.1: The Carlsmith model - DAG representation
* Figure 3.1: Research design overview - workflow diagram
* Figure 3.2: From natural language to BayesDown - transformation process
* Figure 4.1: ARPA system architecture - component diagram
* Figure 4.2: Visualization of Rain-Sprinkler-Grass\_Wet Bayesian network - screenshot
* Figure 5.1: Extraction quality metrics - comparative chart
* Figure 5.2: Comparative analysis of AI governance worldviews - network visualization
* Table 2.1: Comparison of approaches to AI risk modeling
* Table 3.1: Probabilistic translation guide for qualitative expressions
* Table 4.1: System component responsibilities and interactions
* Table 5.1: Policy impact evaluation results - summary metrics

## 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)

# 8. Quarto Syntax

## Figures

|  |
| --- |
| [AMTAIR Automation Pipeline from Bucknall and Dori-Hacohen (2022)](https://github.com/VJMeyer/submission)  Figure 8.1: AMTAIR Automation Pipeline from Bucknall and Dori-Hacohen (2022) |

Testing crossreferencing grapics [Figure 8.1](#fig-automation_pipeline).

|  |
| --- |
| Figure 8.2: Caption/Title 2 |

Testing crossreferencing grapics [Figure 8.2](#fig-testgraphic2).

## Citations

Soares and Fallenstein (2014)

(Soares and Fallenstein 2014) and (Knuth 1984)

Blah Blah (see Knuth 1984, 33–35; also Growiec 2024, chap. 1)

Blah Blah (Knuth 1984, 33–35, 38–39 and passim)

Blah Blah (Growiec 2024; Knuth 1984).

Growiec says blah (2024)

## 8.1 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 “Suggested Citations (e.g. carlsmith 2024 on …)” and/or claims which require a citation (e.g. claim x should be backed-up by a ciation from the literature)

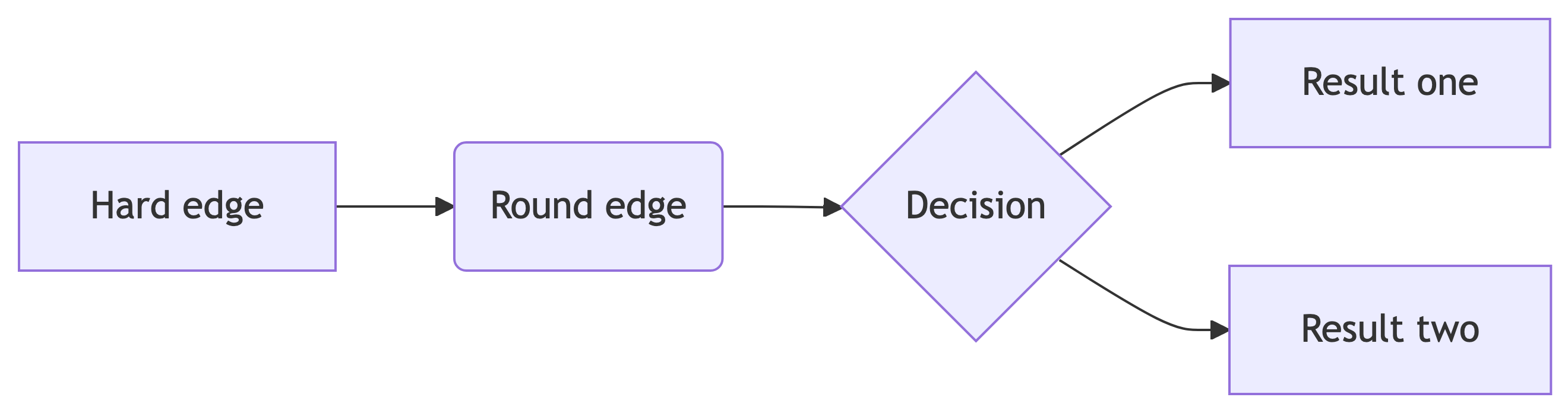
Here is an inline note.[[1]](#footnote-154)

Here is a footnote reference,[[2]](#footnote-155)

Here’s some raw inline HTML:

page 1

page 2



Testing crossreferencing grapics [Figure 8.1](#fig-automation_pipeline).

# Bibliography (References)

Bucknall, Benjamin S., and Shiri Dori-Hacohen. 2022. “Current and Near-Term AI as a Potential Existential Risk Factor.” In *Proceedings of the 2022 AAAI/ACM Conference on AI, Ethics, and Society*, 119–29. Oxford United Kingdom: ACM. <https://doi.org/10.1145/3514094.3534146>.

Growiec, Jakub. 2024. “Existential Risk from Transformative AI: An Economic Perspective.” *Technological and Economic Development of Economy*, 1–27.

Knuth, Donald E. 1984. “Literate Programming.” *Computer Journal* 27 (2): 97–111. <https://doi.org/10.1093/comjnl/27.2.97>.

Soares, Nate, and Benja Fallenstein. 2014. “Aligning Superintelligence with Human Interests: A Technical Research Agenda.”

# 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

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# Appendix B — appendixA

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1. Inlines notes are easier to write, since you don’t have to pick an identifier and move down to type the note. [↑](#footnote-ref-154)
2. Here is the footnote. [↑](#footnote-ref-155)