

# An interactive demonstration of counterfactual truth conditions\*

Proposal for a Bachelor Thesis (v0.2, 19 Juni 2022)

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## Problem: An approachable showcase of counterfactuals

*Counterfactuals* are in essence conditional statements carrying information about the relationship of a false *antecedent* and a *consequent*. Their truth value answers the question: “If it were the case that A, would it then be the case that B?”. *Counterfactual thought*—that is the thought of alternate outcomes—[Byr16] is common for humans to engage in and is consequently subject to a great volume of philosophical and mathematical discourse.

Considering the amount of information available and the various propositions on how to mathematically model counterfactuals, gaining an understanding of the nuances of counterfactual truth conditions tends to be a difficult endeavour for any layman. I propose to remedy this issue by implementing a computer game based on a semantic game of counterfactuals.

## Approach: A computer game on counterfactuals

As part of my research I will try to find a didactically suitable semantic game for the evaluation of counterfactuals. More precisely I am looking to find a way to express *Lewis’s formulation of counterfactual truth conditions* [Lew73] by way of a semantic game about proving counterfactual sentences.

I hope to create a software solution, that is intuitive and easy to use. The user is meant to be able to learn about counterfactuals, with little prior knowledge or time investment. Hence a minimalistic and functional user interface has to be developed.

For the purposes of visual clarity, usability and simplicity the application will provide finite selections of exemplar worlds as stand-ins for potentially infinite sets of accessible worlds and visualize them as nodes of a graph as shown in figure 1.

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\*Further title proposals: (B) Creating an educational computer game about counterfactuals in terms of a centered system of spheres (C) Implementing a computer game illustrating the truth conditions of counterfactuals as variably strict conditionals

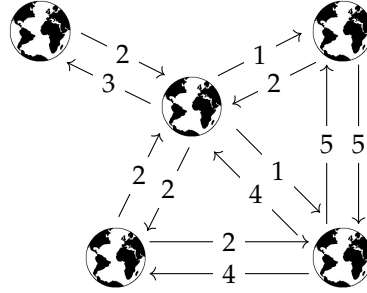


Fig. 1: similarity graph of exemplar worlds

Additionally i will determine an appropriate visual representation of counterfactual sentences from amongst various possibilities such as natural language, logical expressions and logical expression trees. While natural language is the most intuitive representation, it lacks the unambiguity of logical constructs and may create long unreadable sentences. Logical expressions, however, tend to be difficult to read and comprehend for laymen as well. Here are some examples of the same counterfactual statement expressed in different ways in (1), (2) and figure 2.

“If Alexander the Great had not died at the age of 32 and attacked europe, the Romans would have defeated him” (1)

$$(\neg\varphi_1 \wedge \varphi_2) \Box \rightarrow \psi \quad (2)$$

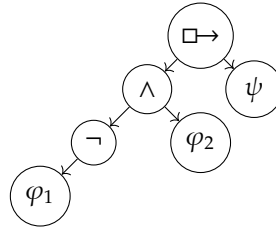


Fig. 2: counterfactual sentence as a logical expression tree

It would also be desirable to find a way to convey the notions of *realism about possible worlds* and *comparative similarity* between worlds, which are essential to Lewis’s model.

In order to deliver an easily accessible software solution I intend to make use of the Phaser 3 Framework for Typescript to develop a web-application. Phaser 3 is well suited for this task because it is a lightweight framework, that fits the scope of the project and allows for distribution of the software with a small barrier to entry.

## Schedule

In accordance with StuPO Bachelor Informatik 2015, the elaboration of the thesis is scheduled over a period of 20 weeks:

- 3 weeks Familiarization with theory & Game design.
- 1 week Implementation of a semantic game engine. (Output: Software)
- 3 weeks Implementation of the user interface. (Output: Counterfactual representation, Graph representation, Menu)
- 2 weeks Creation of levels or levelgenerator. (Output: Software)
- 2 weeks Testing & QA.
- 6 weeks Write thesis. (Output: Thesis)
- 3 weeks Puffer

## Thesis Outline (Sketch)

1. Introduction
  - (a) Problem description
  - (b) Context / related work
  - (c) Overview
2. Formulation of the semantic game of counterfactuals
  - (a) Definitions (worlds, facts at worlds, graph of worlds)
  - (b) Game rules
3. Implementation
  - (a) Design decisions (visual representation of cfs, finite graph / exemplar worlds)
  - (b) Discussion of the framework
  - (c) Concrete implementation of the semantic game engine
  - (d) Evaluation of the implementation
4. Conclusion
  - (a) Summary
  - (b) Outlook

## References

- [Byr16] Ruth M.J. Byrne. Counterfactual thought. *Annual Review of Psychology*, 67(1):135–157, 2016. PMID: 26393873. arXiv:<https://doi.org/10.1146/annurev-psych-122414-033249>, doi:10.1146/annurev-psych-122414-033249.
- [Lew73] David K. Lewis. *Counterfactuals*. Basil Blackwell, Oxford, 1973.
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