An interactive demonstration of counterfactual truth conditions[*]

Proposal for a Bachelor Thesis (v0.5, 3 August 2022)

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Problem: Representation of directed weighted graph-edges

display numbers -> adds a lot of clutter

create a hierarchy of different arrows, representing a handful of differently weighted edges -> cannot find good looking design using only one arrow property, when multiple properties are modulated the hierarchy becomes unclear

scale thickness of arrows -> hard to gauge whose arrows value is higher in comparison, also ugly

position small fuel/energy icon aside arrows -> adds some clutter, hard to position neatly

only display numbers, when hovering over arrows -> users need to think forward to solve the levels and having to hover over arrows all the time is tedious

Replace edges with linear paths of arrows, with the number of arrows equaling the weight of the edge -> creates hard layout problems, adds a lot of clutter

Place big stars or planets along arrows, with their number equaling the edge weight (indicating stops on the journey) -> hard to distinguish stars from background stars, users have to tediously count stars, stars may be distracting clutter

Add crossections to the arrow, like on a ruler -> doesnt look good, spacing of crosssections becomes inconsistent (feels weird)

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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

Add flowing animation from source to destination (speed, number of flyers) -> edgeweights should be discernible from a still image, speed is hard to gauge

Problem: UI-Design Learnings

Everything a user needs needs to know has to be readily visible

UI-Sprite Borders have to be slim to look nice

UI should be clear even in a still image

Problem: Learnings from Alpha-Testing

Multiple Choice Fragebogen?

Problem: The Joys of Phaser

Containers cannot be nested -> as such a lot of the ui-hierarchy had to be flattened and be built less modular (couldnt leverage relative positioning and property-inheritance as much)

Bitmapmasks produced weird darkened areas in areas with alpha of the masked sprite -> needed to convert all bitmapmasks to geometrymasks

rexUI a plugin developed for UI was time-consuming to use (searching docs all the time) and didnt offer enough flexibility to design original UI elements (Clipping mask of ScrollablePanel was forcably set to a rectangle ???)

Couldnt define level data in json format, since browser may not write files

tweens were a delight to use (are very powerful)

Definitions

0.1 Counterfactual formulas

$Atoms = \{x, y, ...\}$
$\Phi = \{\varphi, \psi, ...\}$
$\varphi, \psi ::= \bot \mid x \mid \neg\varphi \mid \Box\varphi \mid \Diamond\varphi \mid \varphi \lor \psi \mid \varphi \land \psi \mid \varphi \mathbin{\Box\!\!\rightarrow} \psi \mid \varphi \mathbin{\Diamond\!\!\rightarrow} \psi$

0.2 Worlds

$W = \{w, v, ...\}$

0.3 Facts

$F : W \rightarrow 2^{Atoms}$

0.4 Similarity relation

$\leadsto : W \times \mathbb{R} \times W$

0.5 Accessible worlds

$W_w = \{w' \mid w \overset{r}{\leadsto} w'\}$

0.6 Truth conditions of counterfactual logic

$w \vDash \bot$ is always false.

$w \vDash \top$ is always true.

$w \vDash x$ iff $x \in V(w)$.

$w \vDash \neg\varphi$ iff $w \nvDash \varphi$.

$w \vDash \varphi \vee \psi$ iff ($w \vDash \varphi$ or $w \vDash \psi$)

$w \vDash \varphi \wedge \psi$ iff ($w \vDash \varphi$ and $w \vDash \psi$)

$w \vDash \Box\varphi$ iff for every world w', for which an r with $w \overset{r}{\leadsto} w'$ exists, $w' \vDash \varphi$ holds true.

$w \vDash \Diamond\varphi$ iff a world w' and an r exist, such that $w \overset{r}{\leadsto} w'$ and $w' \vDash \varphi$ hold true.

$w \vDash \varphi \mathbin{\Box\!\!\rightarrow} \psi$, if no world w' and r exist, such that $w' \vDash \varphi$ and $w \overset{r}{\leadsto} w'$.

$w \vDash \varphi \mathbin{\Box\!\!\rightarrow} \psi$, if a world w' and an r exist, such that $w' \vDash \varphi$ and $w \overset{r}{\leadsto} w'$ and for each world $w*$, for which a $r* \leq r$ exists, such that $w \overset{r*}{\leadsto} w*$, $w* \vDash \psi \vee \neg\varphi$ holds true.

$w \vDash \varphi \mathbin{\Diamond\!\!\rightarrow} \psi$, iff a world w' and an r exist, such that $w \overset{r}{\leadsto} w'$ and $w' \vDash \varphi$ hold and for each world w'', for which an r'' exists, such that $w \overset{r''}{\leadsto} w''$ and $w'' \vDash \varphi$ hold true, a world $w*$ and an $r*$ exist, such that $r* \leq r''$ and $w \overset{r''}{\leadsto} w''$ and $w'' \vDash \varphi \wedge \psi$.

0.7 Similarity graph

$$G = (V, E, F), \text{ such that } V \subseteq W \text{ and } E \subseteq \leadsto \tag{1}$$

Rules of the semantic game

$$(\bot, w)_a \quad \text{Attacker wins} \tag{2}$$

$$(\top, w)_a \quad \text{Defender wins} \tag{3}$$

$$(\neg\bot, w)_a \rightarrow (\top, w)_a \tag{4}$$

$$(\neg\top, w)_a \rightarrow (\bot, w)_a \tag{5}$$

$$(x, w)_a \xrightarrow{x \in F(w)} (\top, w)_{d/a} \tag{6}$$

$$(x, w)_a \xrightarrow{x \notin F(w)} (\bot, w)_{d/a} \tag{7}$$

$$(\neg x, w)_a \xrightarrow{x \in F(w)} (\neg\top, w)_{d/a} \tag{8}$$

$$(\neg x, w)_a \xrightarrow{x \notin F(w)} (\neg\bot, w)_{d/a} \tag{9}$$

$$(\neg\neg\varphi, w)_a \rightarrow (\varphi, w)_{d/a} \tag{10}$$

$$(\varphi \vee \psi, w)_d \rightarrow (\varphi, w)_{d/a} \tag{11}$$

$$(\varphi \vee \psi, w)_d \rightarrow (\psi, w)_{d/a} \tag{12}$$

$$(\neg(\varphi \vee \psi), w)_a \rightarrow (\neg\varphi, w)_{d/a} \tag{13}$$

$$(\neg(\varphi \vee \psi), w)_a \rightarrow (\neg\psi, w)_{d/a} \tag{14}$$

$$(\varphi \wedge \psi, w)_a \rightarrow (\varphi, w)_{d/a} \tag{15}$$

$$(\varphi \wedge \psi, w)_a \rightarrow (\psi, w)_{d/a} \tag{16}$$

$$(\neg(\varphi \wedge \psi), w)_d \rightarrow (\neg\varphi, w)_{d/a} \tag{17}$$

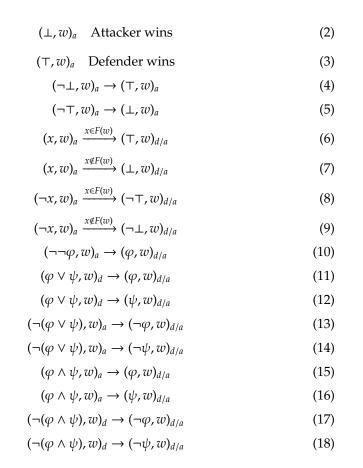$$(\neg(\varphi \wedge \psi), w)_d \rightarrow (\neg\psi, w)_{d/a} \tag{18}$$

Fig. 1: rules of the propositional logic

$$(\Box\varphi, w)_a \xrightarrow{[w \overset{r}{\leadsto} w']} (\varphi, w')_{d/a} \tag{19}$$

$$(\Box\varphi, w)_a \rightarrow (\top, w')_{d/a} \tag{20}$$

$$(\neg\Box\varphi, w)_d \xrightarrow{[w \overset{r}{\leadsto} w']} (\neg\varphi, w')_{d/a} \tag{21}$$

$$(\neg\Box\varphi, w)_d \rightarrow (\neg\top, w')_{d/a} \tag{22}$$

$$(\Diamond\varphi, w)_d \xrightarrow{[w \overset{r}{\leadsto} w']} (\varphi, w')_{d/a} \tag{23}$$

$$(\Diamond\varphi, w)_d \rightarrow (\bot, w')_{d/a} \tag{24}$$

$$(\neg\Diamond\varphi, w)_a \xrightarrow{[w \overset{r}{\leadsto} w']} (\neg\varphi, w')_{d/a} \tag{25}$$

$$(\neg\Diamond\varphi, w)_a \rightarrow (\neg\bot, w')_{d/a} \tag{26}$$

$$(\varphi \,\Box\!\!\rightarrow \psi, w)_d \rightarrow (vac, \varphi, w)_a \tag{27}$$

$$(vac, \varphi, w)_a \xrightarrow{[w \overset{r}{\leadsto} w']} (\neg\varphi, w')_{d/a} \tag{28}$$

$$(\varphi \,\Box\!\!\rightarrow \psi, w)_d \xrightarrow{[w \overset{r}{\leadsto} w']} (cf, \varphi, \psi, w, w', r)_a \tag{29}$$

$$(cf, \varphi, \psi, w, w', r)_a \rightarrow (\varphi, w')_{d/a} \tag{30}$$

$$(cf, \varphi, \psi, w, w', r)_a \xrightarrow{[w \overset{r^*}{\leadsto} w^*, r^* \le r]} (\neg\varphi \vee \psi, w^*)_d \tag{31}$$

$$(\neg(\varphi \,\Box\!\!\rightarrow \psi), w)_a \rightarrow (vac, \varphi, w)_d \tag{32}$$

$$(vac, \varphi, w)_d \xrightarrow{[w \overset{r}{\leadsto} w']} (\varphi, w')_{d/a} \tag{33}$$

$$(\neg(\varphi \,\Box\!\!\rightarrow \psi), w)_a \xrightarrow{[w \overset{r}{\leadsto} w']} (cf, \varphi, \psi, w, w', r)_d \tag{34}$$

$$(cf, \varphi, \psi, w, w', r)_d \rightarrow (\neg\varphi, w')_{d/a} \tag{35}$$

$$(cf, \varphi, \psi, w, w', r)_d \xrightarrow{[w \overset{r^*}{\leadsto} w^*, r^* \le r]} (\neg(\neg\varphi \vee \psi), w^*)_a \tag{36}$$

Fig. 2: rules of the modal operators