

Contribution Title

Miklós F. Hatwagner

Abstract Each chapter should be preceded by an abstract (no more than 200 words) that summarizes the content. The abstract will appear *online* at www.SpringerLink.com and be available with unrestricted access. This allows unregistered users to read the abstract as a teaser for the complete chapter.

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1 The birth of Fuzzy Cognitive Maps

Cognitive Maps (CM) are used in political analysis and decision making in international relations, foreign policy for a long time. The method was suggested by Robert Axelrod in his book [1] in the late '70s. According to Bart Kosko's description in [2], these maps are signed digraphs. Graphs, as algebraic structures have two components: nodes and edges. In CM, nodes represent variable concepts (eg. social instability) and the causal connections among these concepts are characterized by edges. The edges have a direction and a sign. If concept A causally increases concept B , it is represented by an edge from A to B with positive sign. On the other hand, if A reduces the value of B , the edge has a negative sign. Kosko illustrated CM with an example based on Henry Kissinger's essay "Starting Out in the Direction of Middle East Peace" published in *Los Angeles Times* in 1982 (see Fig. 1). Besides the graph, he also composed the adjacency matrix (Fig. 2) of the model. Only three different values can be found in this matrix, representing the causal relationship among concepts. If $w_{ij} = w(C_i, C_j)$ is 1, concept C_1 causally increases the value of C_2 (positive edges). On the contrary, if C_1 causally decreases the value

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of C_2 , it is represented by -1 (negative edges), and the value 0 indicates the lack of causal connection.

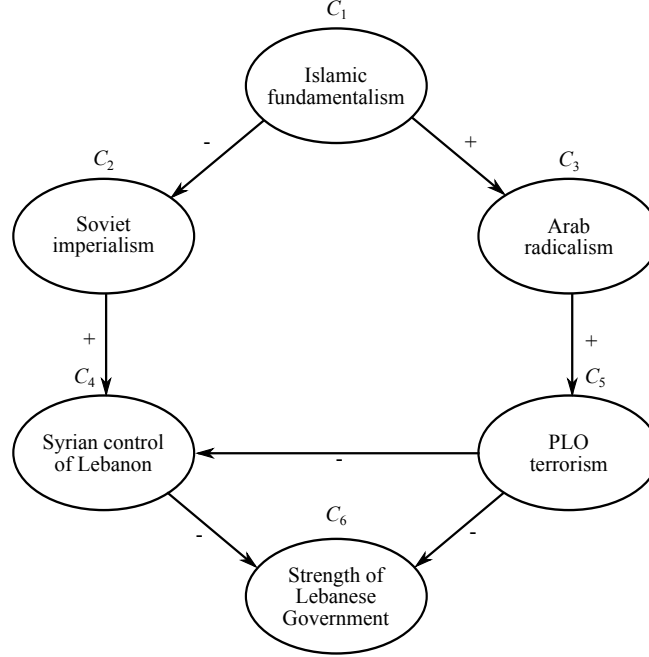


Fig. 1 The Cognitive Map drawn by Kosko based on Kissinger's essay.

Fig. 2 The adjacency matrix of the CM based on Kissinger's essay.

$$\begin{matrix}
 & C_1 & C_2 & C_3 & C_4 & C_5 & C_6 \\
 \begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \end{matrix} & \begin{pmatrix} 0 & -1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & -1 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
 \end{matrix}$$

It became quickly evident that the structure of a Cognitive Map imply too much limitations. The degree of causality, the levels of the causal effects (sometimes—often, little—much, etc.) cannot be expressed with the existing tool, and needs further development. Kosko introduced the Fuzzy Cognitive Map (FCM) [2], where the edges may have several causality values and he also developed a fuzzy causal algebra for propagating causality in it.

2 Section Heading

Instead of simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Further on please use the \LaTeX automatism for all your cross-references and citations.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

Use the standard `equation` environment to typeset your equations, e.g.

$$a \times b = c, \quad (1)$$

however, for multiline equations we recommend to use the `eqnarray` environment¹.

$$|\nabla U_\alpha^\mu(y)| \leq \frac{1}{d-\alpha} \int \left| \nabla \frac{1}{|\xi-y|^{d-\alpha}} \right| d\mu(\xi) = \int \frac{1}{|\xi-y|^{d-\alpha+1}} d\mu(\xi) \quad (2)$$

$$= (d-\alpha+1) \int_{d(y)}^{\infty} \frac{\mu(B(y,r))}{r^{d-\alpha+2}} dr \leq (d-\alpha+1) \int_{d(y)}^{\infty} \frac{r^{d-\alpha}}{r^{d-\alpha+2}} dr \quad (3)$$

2.1 Subsection Heading

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Please do not use quotation marks when quoting texts! Simply use the `quotation` environment – it will automatically be rendered in line with the preferred layout.

2.1.1 Subsubsection Heading

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Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

¹ In physics texts please activate the class option `vecphys` to depict your vectors in *boldface-italic* type - as is customary for a wide range of physical subjects

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Paragraph Heading

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Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

For typesetting numbered lists we recommend to use the `enumerate` environment – it will automatically rendered in line with the preferred layout.

1. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.
 - a. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.
 - b. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.
2. Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development.

Subparagraph Heading

In order to avoid simply listing headings of different levels we recommend to let every heading be followed by at least a short passage of text. Use the \LaTeX automatism for all your cross-references and citations as has already been described in Sect. 2, see also Fig. 4.

For unnumbered list we recommend to use the `itemize` environment – it will automatically be rendered in line with the preferred layout.

- Livelihood and survival mobility are oftentimes coutcomes of uneven socioeconomic development, cf. Table 1.

Fig. 3 If the width of the figure is less than 7.8 cm use the `sidecaption` command to flush the caption on the left side of the page. If the figure is positioned at the top of the page, align the sidecaption with the top of the figure – to achieve this you simply need to use the optional argument `[t]` with the `sidecaption` command

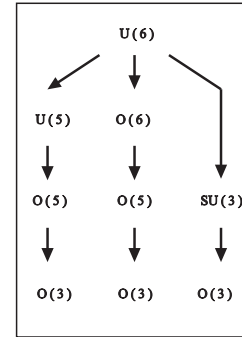


Fig. 4 If the width of the figure is less than 7.8 cm use the `sidecaption` command to flush the caption on the left side of the page. If the figure is positioned at the top of the page, align the sidecaption with the top of the figure – to achieve this you simply need to use the optional argument `[t]` with the `sidecaption` command

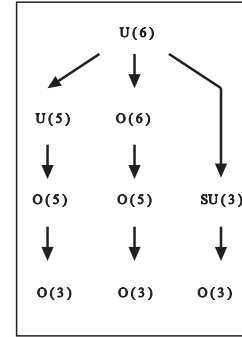


Table 1 Please write your table caption here

Classes	Subclass	Length	Action Mechanism
Translation	mRNA ^a	22 (19–25)	Translation repression, mRNA cleavage
Translation	mRNA cleavage	21	mRNA cleavage
Translation	mRNA	21–22	mRNA cleavage
Translation	mRNA	24–26	Histone and DNA Modification

^a Table foot note (with superscript)

- Livelihood and survival mobility are oftentimes coutcomes of uneven socioe-
conomic development.
- Livelihood and survival mobility are oftentimes coutcomes of uneven socioe-
conomic development.
- Livelihood and survival mobility are oftentimes coutcomes of uneven socioeco-
nomic development.

Run-in Heading Boldface Version Use the \LaTeX automatism for all your cross-
references and citations as has already been described in Sect. 2.

Run-in Heading Boldface and Italic Version Use the \LaTeX automatism for all
your cross-references and citations as has already been described in Sect. 2.

Run-in Heading Displayed Version

Use the \LaTeX automatism for all your cross-references and citations as has already
been described in Sect. 2.

3 Section Heading

Instead of simply listing headings of different levels we recommend to let every
heading be followed by at least a short passage of text. Further on please use the

L^AT_EX automatism for all your cross-references and citations as has already been described in Sect. 2.

Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

If you want to list definitions or the like we recommend to use the enhanced `description` environment – it will automatically rendered in line with the preferred layout.

- Type 1 That addresses central themes pertaining to migration, health, and disease. In Sect. 1, Wilson discusses the role of human migration in infectious disease distributions and patterns.
- Type 2 That addresses central themes pertaining to migration, health, and disease. In Sect. 2.1, Wilson discusses the role of human migration in infectious disease distributions and patterns.

3.1 Subsection Heading

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Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

If you want to emphasize complete paragraphs of texts we recommend to use the newly defined class option `graybox` and the newly defined environment `svgraybox`. This will produce a 15 percent screened box 'behind' your text.

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3.1.1 Subsubsection Heading

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Please note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

Theorem 1 *Theorem text goes here.*

Definition 1 Definition text goes here.

Proof Proof text goes here. □

Paragraph Heading

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Note that the first line of text that follows a heading is not indented, whereas the first lines of all subsequent paragraphs are.

Theorem 2 *Theorem text goes here.*

Definition 2 Definition text goes here.

Proof Proof text goes here. □

Trailer Head

If you want to emphasize complete paragraphs of texts in an Trailer Head we recommend to use

```
\begin{trailer}{Trailer Head}
...
\end{trailer}
```

? Questions

If you want to emphasize complete paragraphs of texts in an Questions we recommend to use

```
\begin{question}{Questions}
...
\end{question}
```

> Important

If you want to emphasize complete paragraphs of texts in an **Important** we recommend to use

```
\begin{important}{Important}  
...  
\end{important}
```

! Attention

If you want to emphasize complete paragraphs of texts in an **Attention** we recommend to use

```
\begin{warning}{Attention}  
...  
\end{warning}
```

Program Code

If you want to emphasize complete paragraphs of texts in an **Program Code** we recommend to use

```
\begin{programcode}{Program Code}  
\begin{verbatim}...\end{verbatim}  
\end{programcode}
```

Tips

If you want to emphasize complete paragraphs of texts in an **Tips** we recommend to use

```
\begin{tips}{Tips}  
...  
\end{tips}
```

Overview

If you want to emphasize complete paragraphs of texts in an Overview we recommend to use

```
\begin{overview}{Overview}
...
\end{overview}
```

Background Information

If you want to emphasize complete paragraphs of texts in an Background Information we recommend to use

```
\begin{backgroundinformation}{Background Information}
...
\end{backgroundinformation}
```

Legal Text

If you want to emphasize complete paragraphs of texts in an Legal Text we recommend to use

```
\begin{legaltext}{Legal Text}
...
\end{legaltext}
```

Acknowledgements If you want to include acknowledgments of assistance and the like at the end of an individual chapter please use the `acknowledgement` environment – it will automatically be rendered in line with the preferred layout.

Appendix

When placed at the end of a chapter or contribution (as opposed to at the end of the book), the numbering of tables, figures, and equations in the appendix section continues on from that in the main text. Hence please *do not* use the `appendix` command when writing an appendix at the end of your chapter or contribution. If there is only one the appendix is designated “Appendix”, or “Appendix 1”, or “Appendix 2”, etc. if there is more than one.

$$a \times b = c \tag{4}$$

References

1. Robert Axelrod. *Structure of decision: The cognitive maps of political elites*. Princeton university press, Princeton, NJ, 1976.
2. B. Kosko. Fuzzy cognitive maps. *Int. J. Man-Machine Studies*, 24:65–75, 1986.