

Isomorphe und homomorphe semiotische Grenzen und Ränder

1. Im Anschluß an die drei Vorgängerstudien zur topologischen Semiotik und ihrer zentralen Begriffe der semiotischen Nachbarschaft, linker (involvativer) und rechter (suppletiver) Ränder, von Grenzen und sog. Grenzrändern (vgl. Toth 2013a, b) soll im folgenden eine Darstellungsweise geboten werden, die es ermöglicht, für jedes Paar aus den 10 Peirce-Benseschen Zeichenklassen aufgrund der Nachbarschaften für $\Delta_{i,j} = \{1, 2, 3\}$ die isomorphen sowie homomorphen Grenzen, Ränder und Grenzränder auf einfache Weise festzustellen. Dieser "Service-Artikel" dient natürlich dazu, einerseits die bereits in den Vorgängerstudien formulierten und vorerst noch unbewiesenen Sätze der topologischen und algebraischen Semiotik ihren Beweisen entgegenzuführen und andererseits die Aufdeckung weiterer Sätze und Lemmata zu ermöglichen.

$$2.1. \Delta_{i,j} = 1$$

$$2.1.1.$$

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.2)) = (1.1, 1.2)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.1) = \{(3.2), (3.3), (2.2), (2.3), (1.2), (1.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.2) = (1.1)$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.2) = \{(3.2), (3.3), (2.2), (2.3), (1.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.1) = (1.2)$$

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.2) = (1.1)$$

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.2) = \emptyset.$$

2.1.2.

$$G((3.1, 2.1, 1.2), (3.1, 2.1, 1.3)) = (1.2, 1.3)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.2) = (1.1)$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.2) = \{(3.2), (3.3), (2.2), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.3) = \{(1.1), (1.2)\}$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.3) = \{(3.2), (3.3), (2.2), (2.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.2), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.2) = \emptyset$$

$$G((3.1, 2.1, 1.2), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.2) = (1.3)$$

$$G((3.1, 2.1, 1.2), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.3) = (1.2)$$

$$G((3.1, 2.1, 1.2), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.3) = \emptyset.$$

2.1.3.

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.2)) = ((2.1, 2.2), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.3) = \{(1.1), (1.2)\}$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.3) = \{(3.2), (3.3), (2.2), (2.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.2) = \{(1.1), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.2) = \{(3.2), (3.3), (2.3), (1.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.3) = (1.2)$$

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.3) = (2.2)$$

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.2) = (2.1)$$

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.2) = (1.3).$$

2.1.4.

$$G((3.1, 2.2, 1.2), (3.1, 2.2, 1.3)) = (2.2, (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.2) = \{(1.1), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.2) = \{(3.2), (3.3), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.3) = \{(1.1), (1.2), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.3) = \{(3.2), (3.3), (2.3)\}$$

Grenzränder

$$G((3.1, 2.2, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.2) = \emptyset$$

$$G((3.1, 2.2, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.2) = (1.3)$$

$$G((3.1, 2.2, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.3) = (1.2)$$

$$G((3.1, 2.2, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.3) = \emptyset.$$

2.1.5.

$$G((3.1, 2.2, 1.3), (3.1, 2.3, 1.3)) = ((2.2, 2.3), 1.3)$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.3) = \{(1.1), (1.2), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.3) = \{(3.2), (3.3), (2.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.3, 1.3) = \{(1.1), (1.2), (2.2), (2.3)\}$$

$$\mathcal{R}_\rho(3.1, 2.3, 1.3) = \{(3.2), (3.3)\}$$

Grenzränder

$$G((3.1, 2.2, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.3) = \emptyset$$

$$G((3.1, 2.2, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.3) = (2.3)$$

$$G((3.1, 2.2, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.3, 1.3) = (2.2, 2.3)$$

$$G((3.1, 2.2, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.3, 1.3) = \emptyset.$$

2.1.6.

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.2)) = ((3.1, 3.2), (2.2, 2.3), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.1, 2.3, 1.3) = \{(1.1), (1.2), (2.2), (2.3)\}$$

$$\mathcal{R}_\rho(3.1, 2.3, 1.3) = \{(3.2), (3.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.2) = \{(1.1), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.2) = \{(3.3), (2.3), (1.3)\}$$

Grenzränder

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.3, 1.3) = (2.2, 2.3, 1.2)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.3, 1.3) = (3.2)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.2) = (3.1)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.2) = (2.3, 1.3).$$

2.1.7.

$$G((3.2, 2.2, 1.2), (3.2, 2.2, 1.3)) = (1.2, 1.3)$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.2) = \{(1.1), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.2) = \{(3.3), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.3) = \{(1.1), (1.2), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.3) = \{(3.3), (2.3)\}$$

Grenzränder

$$G((3.2, 2.2, 1.2), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.2) = \emptyset$$

$$G((3.2, 2.2, 1.2), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.2) = (1.3)$$

$$G((3.2, 2.2, 1.2), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.3) = (1.2)$$

$$G((3.2, 2.2, 1.2), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.3) = \emptyset.$$

2.1.8.

$$G((3.2, 2.2, 1.3), (3.2, 2.3, 1.3)) = (2.2, 2.3)$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.3) = \{(1.1), (1.2), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.3) = \{(3.3), (2.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.3, 1.3) = (3.3)$$

Grenzränder

$$G((3.2, 2.2, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.3) = \emptyset$$

$$G((3.2, 2.2, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.3) = (2.3)$$

$$G((3.2, 2.2, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.3, 1.3) = (2.2)$$

$$G((3.2, 2.2, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.3, 1.3) = \emptyset.$$

2.1.9.

$$G((3.2, 2.3, 1.3), (3.3, 2.3, 1.3)) = (3.2, 3.3)$$

$$\mathcal{R}_\lambda(3.2, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.3, 1.3) = (3.3)$$

$$\mathcal{R}_\lambda(3.3, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1), (3.2)\}$$

$$\mathcal{R}_\rho(3.3, 2.3, 1.3) = \emptyset$$

Grenzränder

$$G((3.2, 2.3, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.3, 1.3) = \emptyset$$

$$G((3.2, 2.3, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.3, 1.3) = (3.3)$$

$$G((3.2, 2.3, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.3, 2.3, 1.3) = (3.2)$$

$$G((3.2, 2.3, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.3, 2.3, 1.3) = \emptyset.$$

2.2. $\Delta_{ij} = 2$

2.2.1.

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.3)) = (1.1, 1.3)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.1) = \{(3.2), (3.3), (2.2), (2.3), (1.2), (1.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.3) = \{(1.1), (1.2)\}$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.3) = \{(3.2), (3.3), (2.2), (2.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.1) = (1.3)$$

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.3) = (1.1)$$

$$G((3.1, 2.1, 1.1), (3.1, 2.1, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.3) = \emptyset.$$

2.2.2.

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.2)) = (2.1, 2.2)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.2) = (1.1)$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.2) = \{(3.2), (3.3), (2.2), (2.3), (1.3)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.2) = \{(3.2), (3.3), (2.3), (1.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.2) = \emptyset$$

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.2) = (2.2)$$

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.2) = (2.1)$$

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.2) = \emptyset.$$

2.2.3.

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.3)) = (2.1, 2.2)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.3) = \{(1.1), (1.2)\}$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.3) = \{(3.2), (3.3), (2.2), (2.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.3) = \{(1.1), (1.2), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.3) = \{(3.2), (3.3), (2.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.3) = \emptyset$$

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.3) = (2.2)$$

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.3) = (2.1)$$

$$G((3.1, 2.1, 1.3), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.3) = \emptyset.$$

2.2.4.

$$G((3.1, 2.2, 1.2), (3.1, 2.3, 1.3)) = ((2.2, 2.3), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.2) = \{(1.1), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.2) = \{(3.2), (3.3), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.3, 1.3) = \{(1.1), (1.2), (2.2), (2.3)\}$$

$$\mathcal{R}_\rho(3.1, 2.3, 1.3) = \{(3.2), (3.3)\}$$

Grenzränder

$$G((3.1, 2.2, 1.2), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.2) = \emptyset$$

$$G((3.1, 2.2, 1.2), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.2) = (1.3, 2.3)$$

$$G((3.1, 2.2, 1.2), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.3, 1.3) = (1.2, 2.2)$$

$$G((3.1, 2.2, 1.2), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.3, 1.3) = \emptyset.$$

2.2.5.

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.2)) = ((3.1, 3.2), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.3) = \{(1.1), (1.2), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.3) = \{(3.2), (3.3), (2.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.2) = \{(1.1), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.2) = \{(3.3), (2.3), (1.3)\}$$

Grenzränder

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.3) = (1.2)$$

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.3) = (3.2)$$

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.2) = (3.1)$$

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.2) = (1.3)$$

2.2.6.

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.3)) = ((3.1, 3.2), (2.2, 2.3))$$

$$\mathcal{R}_\lambda(3.1, 2.3, 1.3) = \{(1.1), (1.2), (2.2), (2.3)\}$$

$$\mathcal{R}_\rho(3.1, 2.3, 1.3) = \{(3.2), (3.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.3) = \{(1.1), (1.2), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.3) = \{(3.3), (2.3)\}$$

Grenzränder

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.3, 1.3) = (2.2)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.3, 1.3) = (3.2)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.3) = (3.1)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.3) = (2.3)$$

2.2.7.

$$G((3.2, 2.2, 1.2), (3.2, 2.3, 1.3)) = ((2.2, 2.3), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.2) = \{(1.1), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.2) = \{(3.3), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.3, 1.3) = (3.3)$$

Grenzränder

$$G((3.2, 2.2, 1.2), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.2) = \emptyset$$

$$G((3.2, 2.2, 1.2), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.2) = (2.3, 1.3)$$

$$G((3.2, 2.2, 1.2), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.3, 1.3) = (2.2, 1.2)$$

$$G((3.2, 2.2, 1.2), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.3, 1.3) = \emptyset.$$

2.2.8.

$$G((3.2, 2.2, 1.3), (3.3, 2.3, 1.3)) = ((3.2, 3.3), (2.2, 2.3))$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.3) = \{(1.1), (1.2), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.3) = \{(3.3), (2.3)\}$$

$$\mathcal{R}_\lambda(3.3, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1), (3.2)\}$$

Grenzränder

$$G((3.2, 2.2, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.3) = \emptyset$$

$$G((3.2, 2.2, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.3) = (2.3, 3.3)$$

$$G((3.2, 2.2, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.3, 2.3, 1.3) = (2.2, 3.2)$$

$$G((3.2, 2.2, 1.3), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.3, 2.3, 1.3) = \emptyset.$$

2.2.9.

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.1)) = ((3.1, 3.2), (2.1, 2.3), (1.1, 1.3))$$

$$\mathcal{R}_\lambda(3.2, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.3, 1.3) = (3.3)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.1) = \{(3.2), (3.3), (2.2), (2.3), (1.2), (1.3)\}$$

Grenzränder

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\lambda(3.2, 2.3, 1.3) = (1.1, 2.1, 3.1)$$

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\rho(3.2, 2.3, 1.3) = \emptyset$$

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.1) = \emptyset.$$

2.3. $\Delta_{ij} = 3$

2.3.1.

$$G((3.1, 2.1, 1.1), (3.1, 2.2, 1.2)) = ((2.1, 2.2), (1.1, 1.2))$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.1) = \{(3.2), (3.3), (2.2), (2.3), (1.2), (1.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.2) = \{(1.1), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.2) = \{(3.2), (3.3), (2.3), (1.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.1), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$G((3.1, 2.1, 1.1), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.1) = (1.2, 2.2)$$

$$G((3.1, 2.1, 1.1), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.2) = (1.1, 2.1)$$

$$G((3.1, 2.1, 1.1), (3.1, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.2) = \emptyset.$$

2.3.2.

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.3)) = ((2.1, 2.2), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.2) = (1.1)$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.2) = \{(3.2), (3.3), (2.2), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.3) = \{(1.1), (1.2), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.3) = \{(3.2), (3.3), (2.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.2) = \emptyset$$

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.2) = (1.3, 2.2)$$

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.3) = (1.2, 2.1)$$

$$G((3.1, 2.1, 1.2), (3.1, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.3) = \emptyset.$$

2.3.3.

$$G((3.1, 2.1, 1.3), (3.1, 2.3, 1.3)) = (2.1, 2.3)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.3) = \{(1.1), (1.2)\}$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.3) = \{(3.2), (3.3), (2.2), (2.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.3, 1.3) = \{(1.1), (1.2), (2.2), (2.3)\}$$

$$\mathcal{R}_\rho(3.1, 2.3, 1.3) = \{(3.2), (3.3)\}$$

Grenzränder

$$G((3.1, 2.1, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.3) = \emptyset$$

$$G((3.1, 2.1, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.3) = (2.3)$$

$$G((3.1, 2.1, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.3, 1.3) = (2.1)$$

$$G((3.1, 2.1, 1.3), (3.1, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.3, 1.3) = \emptyset.$$

2.3.4.

$$G((3.1, 2.2, 1.2), (3.2, 2.2, 1.2)) = (3.1, 3.2)$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.2) = \{(1.1), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.2) = \{(3.2), (3.3), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.2) = \{(1.1), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.2) = \{(3.3), (2.3), (1.3)\}$$

Grenzränder

$$G((3.1, 2.2, 1.2), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.2) = \emptyset$$

$$G((3.1, 2.2, 1.2), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.2) = (3.2)$$

$$G((3.1, 2.2, 1.2), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.2) = (3.1)$$

$$G((3.1, 2.2, 1.2), (3.2, 2.2, 1.2)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.2) = \emptyset.$$

2.3.5.

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.3)) = (3.1, 3.2)$$

$$\mathcal{R}_\lambda(3.1, 2.2, 1.3) = \{(1.1), (1.2), (2.1)\}$$

$$\mathcal{R}_\rho(3.1, 2.2, 1.3) = \{(3.2), (3.3), (2.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.3) = \{(1.1), (1.2), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.3) = \{(3.3), (2.3)\}$$

Grenzränder

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.2, 1.3) = \emptyset$$

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.2, 1.3) = (3.2)$$

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.3) = (3.1)$$

$$G((3.1, 2.2, 1.3), (3.2, 2.2, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.3) = \emptyset.$$

2.3.6.

$$G((3.1, 2.3, 1.3), (3.2, 2.3, 1.3)) = (3.1, 3.2)$$

$$\mathcal{R}_\lambda(3.1, 2.3, 1.3) = \{(1.1), (1.2), (2.2), (2.3)\}$$

$$\mathcal{R}_\rho(3.1, 2.3, 1.3) = \{(3.2), (3.3)\}$$

$$\mathcal{R}_\lambda(3.2, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.3, 1.3) = (3.3)$$

Grenzränder

$$G((3.1, 2.3, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.1, 2.3, 1.3) = \emptyset$$

$$G((3.1, 2.3, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.1, 2.3, 1.3) = (3.2)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.3, 1.3) = (3.1)$$

$$G((3.1, 2.3, 1.3), (3.2, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.3, 1.3) = \emptyset.$$

2.3.7.

$$G((3.2, 2.2, 1.2), (3.3, 2.3, 1.3)) = ((3.2, 3.3), (2.2, 2.3), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.2) = \{(1.1), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.2) = \{(3.3), (2.3), (1.3)\}$$

$$\mathcal{R}_\lambda(3.3, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1), (3.2)\}$$

$$\mathcal{R}_\rho(3.3, 2.3, 1.3) = \emptyset$$

Grenzränder

$$G((3.2, 2.2, 1.2), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.2) = \emptyset$$

$$G((3.2, 2.2, 1.2), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.2) = (1.3, 2.3, 3.3)$$

$$G((3.2, 2.2, 1.2), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\lambda(3.3, 2.3, 1.3) = (1.2, 2.2, 3.2)$$

$$G((3.2, 2.2, 1.2), (3.3, 2.3, 1.3)) \cap \mathcal{R}_\rho(3.3, 2.3, 1.3) = \emptyset.$$

2.3.8.

$$G((3.2, 2.2, 1.3), (3.1, 2.1, 1.1)) = ((3.1, 3.2), (2.1, 2.2), (1.1, 1.3))$$

$$\mathcal{R}_\lambda(3.2, 2.2, 1.3) = \{(1.1), (1.2), (2.1), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.2, 1.3) = \{(3.3), (2.3)\}$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.1) = \{(3.2), (3.3), (2.2), (2.3), (1.2), (1.3)\}$$

Grenzränder

$$G((3.2, 2.2, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\lambda(3.2, 2.2, 1.3) = (1.1, 2.1, 3.1)$$

$$G((3.2, 2.2, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\rho(3.2, 2.2, 1.3) = \emptyset$$

$$G((3.2, 2.2, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.1) = \emptyset$$

$$G((3.2, 2.2, 1.3), (3.1, 2.1, 1.1)) \cap \mathcal{R}_\rho(3.1, 2.1, 1.1) = (1.3, 2.2, 3.2).$$

2.3.9.

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.2)) = ((3.1, 3.2), (2.1, 2.3), (1.2, 1.3))$$

$$\mathcal{R}_\lambda(3.2, 2.3, 1.3) = \{(1.1), (1.2), (2.1), (2.2), (3.1)\}$$

$$\mathcal{R}_\rho(3.2, 2.3, 1.3) = (3.3)$$

$$\mathcal{R}_\lambda(3.1, 2.1, 1.2) = (1.1)$$

$$\mathcal{R}_\rho(3.1, 2.1, 1.2) = \{(3.2), (3.3), (2.2), (2.3), (1.3)\}$$

Grenzränder

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.2)) \cap \mathcal{R}_\lambda(3.2, 2.3, 1.3) = (1.2, 2.1, 3.1)$$

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.2)) \cap \mathcal{R}_\rho(3.2, 2.3, 1.3) = \emptyset$$

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.2)) \cap \mathcal{R}_\lambda(3.1, 2.1, 1.2) = \emptyset$$

$$G((3.2, 2.3, 1.3), (3.1, 2.1, 1.2)) \cap \mathcal{R}_p(3.1, 2.1, 1.2) = (1.3, 2.3, 3.2).$$

Literatur

Toth, Alfred, Semiotische Grenzen und Ränder. In: Electronic Journal for Mathematical Semiotics, 2013a

Toth, Alfred, Zur Topologie semiotischer Grenzen und Ränder I-II. In: Electronic Journal for Mathematical Semiotics, 2013b

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