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(1942-2016)

Title
The Tale of Transjunctions

Archive-Number / Categories
2_57 / K11, K08

Publication Date
2010

Keywords
TOPICS: Steps towards logical transjunctions – Günther's truth tables – Gunther's "akward formula" – Reformulation of the "akward formula" – Günther's morphogrammatic interpretation of the "akward formula" – ndexed negations – Comparison of global and local – Term interpretation of tableaux – Matrix interpretation – The Abacus of Universal Logics – Memristic speculations (matrix, functorial) – Catching Transjunctions: http://www.vordenker.de/rk/rk_Catching-Transjunctions_2010.pdf

Disciplines
Cybernetics, Artificial Intelligence and Robotics, Systems Architecture and Theory and Algorithms, Theory of Science, Philosophy of Science

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http://www.thinkartlab.com/pkl/archive/GUNTHER-BOOK/GUNTHER.htm
A history of polycontextural logic has been sketched at: Place-valued Logics around Cybernetic Ontology, the BCL and AFOSR
http://works.bepress.com/thinkartlab/16/
or at:
http://www.scribd.com/doc/18543421/Placevalued-logics-aroundCyberneticOntology-the-BCL-and-AFOSR
This paper complements the theoretical paper: "Catching Transjunctions. Steps towards an emulation of polycontextural transjunctions in memristic systems." at:
http://memristors.memristics.com/Transjunctions/Catching Transjunctions.pdf

Citation Information / How to cite
Rudolf Kaehr: "The Tale of Transjunctions", www.vordenker.de (Sommer Edition, 2017) J. Paul (Ed.),
URL: http://www.vordenker.de/rk/rk_Tale-of-Transjunctions_2010.pdf

The Tale of Transjunctions

Some historical steps in the explanation and implementation of transcontextural operations

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Abstract

Transjunctions had been introduced in the early 60s by the philosopher and cybernetician Gotthard Gunther at the Biological Computer Laboratory (BCL) Urbana at Illinois in his historical research report *"Cybernetic Ontology and Transjunctional Operators"*. (http://www.thinkartlab.com/pkl/archive/GUNTHER-BOOK/GUNTHER.htm)
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1. History of transjunctions

1.1. Steps towards logical transjunctions

Gunther's truth table (Gunther)
morphogrammatic interpretation (Gunther)
Indexed interpretation (Kaehr)
Tableaux interpretation (Kaehr)
term interpretation (Bashford)
categorical interpretation (Pfalzgraf)
functorial interpretation (Kaehr)
memristic interpretatin (Kaehr)

1.1.1. Gunther's truth tables

Table for transjunction, conjunction and disjunction.

$(\oplus\wedge\vee)$	1	2	3
1	**1**	**3**	**1**
2	**3**	**2**	**3**
3	**1**	**3**	**3**

$(\oplus\oplus\oplus)$	1	2	3
1	**1**	**3**	**2**
2	**3**	**2**	**1**
3	**2**	**1**	**3**

$$X \oplus\oplus\oplus Y := (X \vee\vee\wedge Y) \vee\vee\wedge N_1 N_2 (X \wedge\wedge\vee Y)$$
$$X \oplus\oplus\oplus Y := (X \wedge\wedge\vee Y) \wedge\wedge\vee N_2 N_1 (X \vee\vee\wedge Y)$$

1.1.2. Gunther's "akward formula"

$$(p \wedge\wedge\vee q) = N_1 (N_1 p \vee\vee\vee N_1 q) \wedge\wedge\wedge N_2 (N_2\ p \vee\vee\vee N_2 q) \quad : ok$$
$$(p \vee\vee\wedge q) = N_1 (N_1 p \wedge\wedge\wedge N_1 q) \vee\vee\vee N_2 (N_2\ p \wedge\wedge\wedge N_2 q) \quad : ok$$
$$(p \oplus\ominus\oplus q) = (p \wedge\wedge\vee q) \wedge\wedge\vee N_2 N_1 (p \vee\vee\wedge p) \quad : ok$$

$$(p \oplus\ominus\oplus q) = [N_1 (N_1 p \vee\vee\vee N_1 q) \wedge\wedge\wedge N_2 (N_2\ p \vee\vee\vee N_2 q)] \wedge\wedge\vee [N_2 N_1\ (N_1 (N_1 p \wedge\wedge\wedge N_1 q) \vee\vee\vee N_2 (N_2\ p \wedge\wedge\wedge N_2 q))] \quad : ok$$

$$(p \oplus\oplus\oplus\, q) =$$

$$\underbrace{[N_1(N_1p \vee\vee\vee N_1q) \wedge\wedge\wedge N_2(N_2\ p \vee\vee\vee N_2q)]}_{(p)}\ \underbrace{\langle N_1(N_1p \vee\vee\vee N_1q) \wedge\wedge\wedge N_2(N_2\ p \vee\vee\vee N_2q)\rangle}_{(p\wedge\wedge\vee\, q)}\ \underbrace{[N_2N_1\ (N_1(N_1p \wedge\wedge\wedge N_1q) \vee\vee\vee N_2(N_2\ p \wedge\wedge\wedge N_2q))]}_{(q)}$$

But this formula is an abbreviation only. It can not be considered as a well-formed formula. For strange reasons, this fact was never mentioned in the literature.

1.1.3. Reformulation of the “akward formula"

Transjunction in monoform disjunctions only.

$$(p \oplus\oplus\oplus\, q) ---$$

$$N_5\left\langle\begin{array}{l}
N_5\left\langle N_1\left(\begin{array}{l}
N_1[N_5[N_5[N_1(N_1p \vee\vee\vee N_1q)] \vee\vee\vee N_5[N_2(N_2\ p \vee\vee\vee N_2q)]]] \\
\vee\vee\vee \\
\langle N_2N_1(N_1[N_5[N_1([N_5(N_1p)] \vee\vee\vee [N_5(N_1q)])]\ \vee\vee\vee N_5[N_2([N_5(N_2p)] \vee\vee\vee [N_5(N_2q)])]])\rangle
\end{array}\right)\right\rangle \\
\vee\vee\vee \\
N_5\left\langle N_2\left(\begin{array}{l}
N_2\ [N_5[N_5[N_1(N_1p \vee\vee\vee N_1q)] \vee\vee\vee N_5[N_2(N_2\ p \vee\vee\vee N_2q)]]] \\
\vee\vee\vee \\
\langle N_2N_1(N_1[N_5[N_1([N_5(N_1p)] \vee\vee\vee [N_5(N_1q)])]\ \vee\vee\vee N_5[N_2([N_5(N_2p)] \vee\vee\vee [N_5(N_2q)])]])\rangle
\end{array}\right)\right\rangle
\end{array}\right\rangle$$

$$(p \oplus\oplus\oplus\, q) ---$$

$$\left\langle\begin{array}{l}
N_1\left(\begin{array}{l}
N_1[N_5[N_5[N_1(N_1p \vee\vee\vee N_1q)] \vee\vee\vee N_5[N_2(N_2\ p \vee\vee\vee N_2q)]]] \\
\vee\vee\vee \\
\langle N_2N_1(N_1[N_5[N_1([N_5(N_1p)] \vee\vee\vee [N_5(N_1q)])]\ \vee\vee\vee N_5[N_2([N_5(N_2p)] \vee\vee\vee [N_5(N_2q)])]])\rangle
\end{array}\right) \\
\wedge\wedge\wedge \\
N_2\left(\begin{array}{l}
N_2\ [N_5[N_5[N_1(N_1p \vee\vee\vee N_1q)] \vee\vee\vee N_5[N_2(N_2\ p \vee\vee\vee N_2q)]]] \\
\vee\vee\vee \\
\langle N_2N_1(N_1[N_5[N_1([N_5(N_1p)] \vee\vee\vee [N_5(N_1q)])]\ \vee\vee\vee N_5[N_2([N_5(N_2p)] \vee\vee\vee [N_5(N_2q)])]])\rangle
\end{array}\right)
\end{array}\right\rangle$$

$$(p \oplus\oplus\oplus\ q) === \left\langle\begin{array}{l}
N_1\left(\begin{array}{l}
N_1[N_1(N_1p \vee\vee\vee N_1q) \wedge\wedge\wedge N_2(N_2\ p \vee\vee\vee N_2q)] \\
\vee\vee\vee \\
\langle N_2N_1(N_1[\ N_1(N_1p \wedge\wedge\wedge N_1q) \vee\vee\vee N_2(N_2\ p \wedge\wedge\wedge N_2q)])\rangle
\end{array}\right) \\
\wedge\wedge\wedge \\
N_2\left(\begin{array}{l}
N_2\ [N_1(N_1p \vee\vee\vee N_1q) \wedge\wedge\wedge N_2(N_2\ p \vee\vee\vee N_2q)] \\
\vee\vee\vee \\
\langle N_2N_1(N_2[N_1(N_1p \wedge\wedge\wedge N_1q) \vee\vee\vee N_2(N_2\ p \wedge\wedge\wedge N_2q)])\rangle
\end{array}\right)
\end{array}\right\rangle$$

7. Monoform transjunction in negation plus implication and disjunction, bracket cascads.

$$p \oplus\oplus\oplus q := N_5 \left\langle \begin{array}{l} \left\langle \begin{array}{l} \left\langle N_5 \left\langle N_5 \left[\begin{array}{l} \left(\left(N_5 \left(p \supset\supset\supset q\right) \supset\supset\supset N_5 \left(N_2 \left(q \supset\supset\supset p\right)\right)\right)\right) \\ \supset\supset\supset \\ N_5 \left(N_2 \left(q \supset\supset\supset p\right)\right) \end{array}\right] \supset\supset\supset p \right\rangle\right\rangle \\ \supset\supset\supset \\ \left\langle N_5 \left\langle N_2 \left[N_5 \left[\begin{array}{l} N_5 \left(p \supset\supset\supset q\right) \supset\supset\supset N_5 \left(N_2 \left(q \supset\supset\supset p\right)\right) \\ \supset\supset\supset \\ N_5 \left(N_2 \left(q \supset\supset\supset p\right)\right) \end{array}\right]\right]\right\rangle\right\rangle \end{array}\right\rangle \\ \supset\supset\supset \\ \left\langle N_5 \left\langle N_2 \left[N_5 \left[\begin{array}{l} N_5 \left(p \supset\supset\supset q\right) \supset\supset\supset N_5 \left(N_2 \left(q \supset\supset\supset p\right)\right) \\ \supset\supset\supset \\ N_5 \left(N_2 \left(q \supset\supset\supset p\right)\right) \end{array}\right]\right]\right\rangle\right\rangle \end{array}\right\rangle$$

1.1.4. Gunther's morphogrammatic interpretation of the "akward formula"

"The precise meaning of such a statement is simple that the behavioral properties of the system in question display a logical structure that includes rejection values. And the individual morphograms which come into play will indicate precisely which of the three described varieties of subjective behavior we are referring to.
The introduction of the fifteen morphograms as the basic logical units of a trans-classic system of logic has far-reaching consequences. Such units would have hardly more than decorative significance unless there exists a specific operator able to handle them and to transform one morphogram directly into another. Negation is not capable of doing this as long as we adhere to the classic concept of negation. It is traditionally a reversible exchange relation between two values. It follows that by negating values we only change the value occupancy of a morphogram, not the morphogram itself; no matter how many negations are used, the abstract pattern of value occupancy remains always the same." (Gunther, 1962)

"By using the Formulas (14) and (15) we may, of course, reduce the awkward Formula (16) to the very simple formula:

[13,13,13] = ([1,1,4]) [1,1,4] (N2.1 [4,4,1]) (17)

and

[13,13,13] = ([4,4,1]) [4,4,1] (N1.2 [1,1,4]) (18)" Gunther

He was not happy with the "awkward formula" (16), and used his *discomfort* to motivate a decision towards a morphogrammatic formulation of DeMorgan based on the new operator *reflector* in a mixed system of logic and morphogrammatics.

$$\left(p \oplus\oplus\oplus q\right) === N_2 \left\langle\left(N_R R^2 R\left[\vee \vee \vee\right]\right)\left[\vee \vee \vee\right]\left(N_{1.2} R^1\left[\vee \vee \vee\right]\right)\right\rangle$$

$$\left(p \oplus\oplus\oplus q\right) === N_1 \left\langle\left(N_R R^1 R\left[\wedge \wedge \wedge\right]\right)\left[\wedge \wedge \wedge\right]\left(N_{2.1} R^2\left[\wedge \wedge \wedge\right]\right)\right\rangle$$

1.1.5. Indexed interpretation

Matrix representation

of (oto)			*of (taa)*		
$T_{1,3}$	T_1	T_3	$T_{1,3}$	$F_{2,3}$	F_3
T_1	$f_{1,2}$	$T_{1,3}$	$F_{2,3}$	$f_{1,2}$	F_2
T_3	$T_{1,3}$	$F_{2,3}$	F_3	F_2	$F_{2,3}$

T1,3 : truth value true for systems 1 an3

f1: value false for system 1 (= f1)
f2: value true for system 2 (= t2)

F2,3: values false for systems 2, 3

t: transjunction
o: disjunction
a: conjunction
(this terminology (o, a, t, i, j) holds for the ML implementation)

1.1.6. Indexed negations

$$\frac{t_1\left(\neg_1\ X^{(3)}\right)}{f_1\ X^{(3)}} \qquad \frac{t_2\left(\neg_1\ X^{(3)}\right)}{t_3\ X^{(3)}} \qquad \frac{t_3\left(\neg_1\ X^{(3)}\right)}{t_2\ X^{(3)}}$$

$$\frac{f_1\left(\neg_1\ X^{(3)}\right)}{t_1\ X^{(3)}} \qquad \frac{f_2\left(\neg_1\ X^{(3)}\right)}{f_3\ X^{(3)}} \qquad \frac{f_3\left(\neg_1\ X^{(3)}\right)}{f_2\ X^{(3)}}$$

1.1.7. Comparison of global and local

Comparison between local and global tableaux

$$\frac{t_1\ X \wedge\wedge\wedge Y}{\begin{array}{c} t_1\ X \\ t_1\ Y \end{array}} \qquad \frac{f_1\ X \wedge\wedge\wedge Y}{f_1\ X \mid f_1\ Y} \qquad \frac{t_2\ X \wedge\wedge\wedge Y}{\begin{array}{c} t_2\ X \\ t_2\ Y \end{array}} \qquad \frac{f_2\ X \wedge\wedge\wedge Y}{f_2\ X \mid f_2\ Y}$$

$$\frac{t_3\ X \wedge\wedge\wedge Y}{\begin{array}{c} t_3\ X \\ t_3\ Y \end{array}} \qquad \frac{f_3\ X \wedge\wedge\wedge Y}{f_3\ X \mid f_3\ Y} \qquad \begin{array}{l} t_1, t_3 \longrightarrow T \\ f_1, t_2 \longrightarrow F \\ f_2, f_3 \longrightarrow \mathbb{F} \end{array}$$

$$\frac{T\ X \wedge\wedge\wedge Y}{\begin{array}{c} T\ X \\ T\ Y \end{array}} \qquad \frac{F\ X \wedge\wedge\wedge Y}{\begin{array}{c|c|c} F\ X & T\ X & F\ X \\ T\ Y & F\ Y & F\ Y \end{array}} \qquad \frac{\mathbb{F}\ X \wedge\wedge\wedge Y}{\mathbb{F}\ X \mid \mathbb{F}\ Y}$$

$$\frac{t_{1,3}\ X \diamond\diamond\diamond Y}{\begin{array}{c|c|c} t_{1,3}\ X & t_2\ X & f_2\ X \\ t_{1,3}\ Y & f_2\ Y & t_2\ Y \end{array}} \qquad \frac{f_1/t_2\ X \diamond\diamond\diamond Y}{\begin{array}{c|c|c} f_1/t_2\ X & t_3\ X & f_3\ X \\ f_1/t_2\ Y & f_3\ Y & t_3\ Y \end{array}} \qquad \frac{f_{2,3}\ X \diamond\diamond\diamond Y}{\begin{array}{c|c|c} t_1\ X & f_1\ X & f_{2,3}\ X \\ f_1\ Y & t_1\ Y & f_{2,3}\ Y \end{array}}$$

$$\frac{T\ X \diamond\diamond\diamond Y}{\begin{array}{c|c|c} T\ X & F\ X & \mathbb{F}\ X \\ T\ Y & \mathbb{F}\ Y & F\ Y \end{array}} \qquad \frac{F\ X \diamond\diamond\diamond Y}{\begin{array}{c|c|c} F\ X & T\ X & \mathbb{F}\ X \\ F\ Y & \mathbb{F}\ Y & T\ Y \end{array}} \qquad \frac{\mathbb{F}\ X \diamond\diamond\diamond Y}{\begin{array}{c|c|c} T\ X & F\ X & \mathbb{F}\ X \\ F\ Y & T\ Y & \mathbb{F}\ Y \end{array}}$$

1.1.8. Pfalzgraf's fibre bundle approach

2.2.5 Tranjunctions

Modeling the local bivariate operation as a map ($\Theta : L_i \times L_i \to E$) a distribution of the input pairs $(x_i, y_i) \in L_i \times L_i$ over the maximally four subsystems ($L_\alpha, L_\beta, L_\gamma, L_\delta$) is possible (see Figure 2-14) [PFA96].

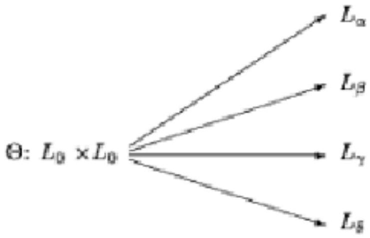
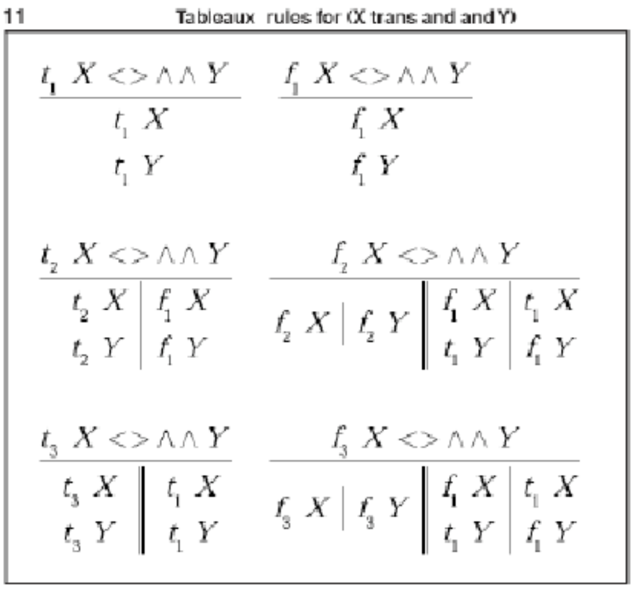


Figure 2-14: Transjunction

Considering the truth values, there are obviously four possible input pairs ($\Omega_i \times \Omega_i = \{(T_i, T_i), (T_i, F_i), (F_i, T_i), (F_i, F_i)\}$). Taken a classic truth-value matrix of a disjunction, we obtain: $\Theta(T_i, T_i) = T_\alpha$, $\Theta(T_i, F_i) = T_\beta$, $\Theta(F_i, T_i) = T_\gamma$, $\Theta(F_i, F_i) = F_\delta$. This way, the transjunction is used to spread images over subsystems (see [PFA04]).

1.1.9. Tableaux interpretation



1.1.10. Term interpretation of tableaux (Bashford)

3.8 Term rules for junction and transjunctions

Term Rules

$$R_0: \quad \frac{t_1 \; et \; (t_2 \; or \; t_3)}{(t_1 \; et \; t_2) \; or \; (t_1 \; et \; t_3)}$$

$$\frac{(t_1 \; or \; t_2) \; et \; t_3}{(t_1 \; et \; t_3) \; or \; (t_2 \; et \; t_3)}$$

$R1:$

$$\frac{(t \; simul \; ta) \odot (t' \; simul \; t'a)}{(t \odot t') \; simul \; (ta \odot t'a)}$$

$R2:$

$$\frac{t \; et \; (t' \; simul \; t'a)}{(t \; et \; t') \; simul \; ta}$$

$$\frac{(t \; simul \; ta) \; et \; t'}{(t \; et \; t') \; simul \; ta}$$

$R3:$

$$\frac{(\{t\} \; simul \; ta) \; or \; (\{t'\} \; simul \; ta')}{(t \; or \; t') \; simul \; (ta \; or \; t'a)}$$

$R4:$

$$\frac{\{t\} \; or \; (\{t'\} \; simul \; t'a)}{(t \; or \; t') \; simul \; t'a}$$

$$\frac{(\{t\} \; simul \; ta) \; or \; \{t'\}}{(t \; or \; t') \; simul \; ta}$$

$R5:$

$$\frac{(t \; simul \; ta) \; simul \; t'a}{t \; simul \; (ta \; et \; t'a)}$$

1.1.11. Matrix interpretation

Pattern: [bif, id, id] for transjunction

$[\oplus \vee \wedge]$	S_1^1	S_2^1	S_3^1	S_1^2	S_2^2	S_3^2	S_1^3	S_2^3	S_3^3
1	○	–	–	–	–	–	○	–	○
2	–	–	–	□	–	–	□	–	–
3	–	–	–	–	–	–	–	–	○
4	–	–	–	□	–	–	□	–	–
5	△	–	–	△	△	–	–	–	–
6	–	–	–	–	△	–	–	–	–
7	–	–	–	–	–	–	–	–	○
8	–	–	–	–	△	–	–	–	–
9	–	–	–	–	□	–	–	–	□

$[\oplus \vee \wedge]$	$O1$	$O2$	$O3$
$M1$	$[trans]_1$	$[trans]_1$	$[trans]_1$
$M2$	$\varnothing$	$[or]_2$	$\varnothing$
$M3$	$\varnothing$	$\varnothing$	$[and]_3$

$[\oplus \vee \wedge]$	1	2	3
1	○	□	□
2	□	△	△
3	□	△	□

The Abacus of Universal Logics
http://works.bepress.com/thinkartlab/17/

1.1.12. Contextural programming

$$samba^{(3)}\ (bif\ ,\ id,\ id)$$

$$\begin{bmatrix} thematize\ (\ trans,\ \mathbf{or},\ or\ ) \\ \begin{bmatrix} lambda\ (a^{(3)}\ b^{(3)}) \\ \begin{bmatrix} define\ trans^1 \\ \begin{bmatrix} lambda\ (\ a\ b\ ) \\ elect_1 \\ \quad (\ if\ \ a\ a\ a) \\ \quad (\ if\ \ b\ b\ b) \end{bmatrix} \begin{bmatrix} lambda\ (\ a\ b\ ) \\ elect_2 \\ \quad (\ if\ \ b\ a\ b) \\ \quad (\ if\ \ b\ b\ a) \end{bmatrix} \begin{bmatrix} lambda\ (\ a\ b\ ) \\ elect_3 \\ \quad (\ if\ \ b\ a\ b) \\ \quad (\ if\ \ b\ b\ a) \end{bmatrix} \end{bmatrix} \\ \begin{array}{ccc} \varnothing & \begin{bmatrix} define\ or^2 \\ \begin{bmatrix} lambda\ (\ a\ b\ ) \\ \quad (\ if\ a\ a\ b) \\ elect_1 \\ \quad (if\ \ b\ a\ b\ ) \end{bmatrix} \end{bmatrix} & \varnothing \\ \varnothing & \varnothing & \begin{bmatrix} define\ or^3 \\ \begin{bmatrix} lambda\ (\ a\ b\ ) \\ \quad (\ if\ a\ a\ b) \\ elect_1 \\ \quad (if\ \ b\ a\ b\ ) \end{bmatrix} \end{bmatrix} \end{array} \end{bmatrix} \end{bmatrix}$$

1.1.13. Functorial interpretation

$$\left(X <> \wedge \wedge Y\right) - \text{scheme}: \begin{bmatrix} <>_{1.1} & <>_{2.1} & <>_{3.1} \\ - & \wedge_{2.2} & - \\ - & - & \wedge_{3.3} \end{bmatrix}$$

$$\left(\begin{matrix} \left(\begin{matrix} [A]_1 \circ_{1.1} [B]_1 \\ \amalg_{1.2.0} \\ \left([A]_2 \circ_{2.2} [B]_2\right) \diamond_{2.1} \left([A]_1 \circ_{2.1} [B]_1\right) \end{matrix}\right) \\ \amalg_{1.2.3} \\ \left([A]_3 \circ_{3.3} [B]_3\right) \diamond_{3.1} \left([A]_1 \circ_{3.1} [B]_1\right) \end{matrix}\right) =$$

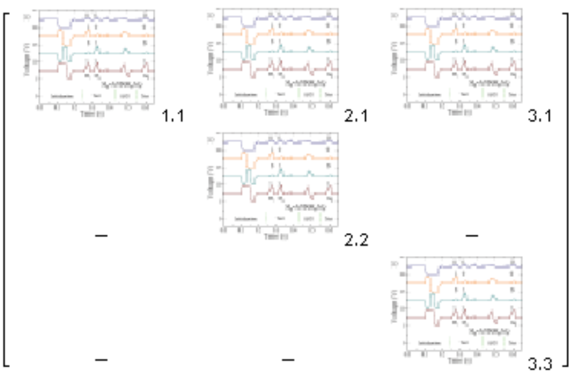
$$\left(\begin{matrix} \left(\begin{matrix} [A]_1 \\ \amalg_{1.2.0} \\ [A]_2 \diamond_{2.1} [A]_1 \end{matrix}\right) \\ \amalg_{1.2.3} \\ [A]_3 \diamond_{3.1} [A]_1 \end{matrix}\right) \begin{bmatrix} \circ_{1.1} & -- \\ \circ_{2.1} \circ_{2.2} & - \\ \square & \\ \circ_{3.1} - & \circ_{3.3} \end{bmatrix} \left(\begin{matrix} \left(\begin{matrix} [B]_1 \\ \amalg_{1.2.0} \\ [B]_2 \diamond_{2.1} [B]_1 \end{matrix}\right) \\ \amalg_{1.2.3} \\ [B]_3 \diamond_{3.1} [B]_1 \end{matrix}\right)$$

$$\left(\begin{matrix} \left(\begin{matrix} [A]_1 \oplus_{1.1} [B]_1 \\ \amalg_{1.2.0} \\ \left([A]_2 \circ_{2.2} [B]_2\right) \diamond_{2.1} \left([A]_1 \ominus_{2.1} [B]_1\right) \end{matrix}\right) \\ \amalg_{1.2.3} \\ \left([A]_3 \circ_{3.3} [B]_3\right) \diamond_{3.1} \left([A]_1 \ominus_{3.1} [B]_1\right) \end{matrix}\right) = \left(\begin{matrix} \left(\begin{matrix} \left([A]_1 \ominus_{1.1} [B]_1\right) \diamond_{2.1} \left(\left([A]_1 \ominus_{2.1} [B]_1\right) \diamond_{3.1} \left([A]_1 \ominus_{3.1} [B]_1\right)\right) \\ \amalg_{1.2.0} \\ \left([A]_2 \circ_{2.2} [B]_2\right) \end{matrix}\right) \\ \amalg_{1.2.3} \\ \left([A]_3 \circ_{3.3} [B]_3\right) \end{matrix}\right)$$

1.1.14. Memristic speculations (matrix, functorial)

$$\left(X <> \wedge \wedge Y\right) - \text{scheme}: \begin{bmatrix} <>_{1.1} & <>_{2.1} & <>_{3.1} \\ - & \wedge_{2.2} & - \\ - & - & \wedge_{3.3} \end{bmatrix}$$

$\text{Mod}_{\text{elect}}\left(X <> \wedge \wedge Y\right) =$



1.1.15. Morphic abstraction

Pattern: [bif, id, id] for transjunction

[⊕ ∨ ∧]	S_1^1	S_2^1	S_3^1	S_1^2	S_2^2	S_3^2	S_1^3	S_2^3	S_3^3
1	○	–	–	–	–	–	○	–	○
2	–	–	–	□	–	–	□	–	–
3	–	–	–	–	–	–	–	–	○
4	–	–	–	□	–	–	□	–	–
5	△	–	–	△	△	–	–	–	–
6	–	–	–	–	△	–	–	–	–
7	–	–	–	–	–	–	–	–	○
8	–	–	–	–	△	–	–	–	–
9	–	–	–	–	□	–	–	–	□

[⊕ ∨ ∧]	$O1$	$O2$	$O3$
$M1$	$[trans]_1$	$[trans]_1$	$[trans]_1$
$M2$	∅	$[or]_2$	∅
$M3$	∅	∅	$[and]_3$

[⊕ ∨ ∧]	1	2	3
1	○	□	□
2	□	△	△
3	□	△	□

[⊕ ∨ ⊕]	S_1^1	S_2^1	S_3^1	S_1^2	S_2^2	S_3^2	S_1^3	S_2^3	S_3^3
1	○	–	○	–	–	–	○	–	○
2	–	–	–	□	–	–	□	–	–
3	–	–	△	–	–	△	–	–	–
4	–	–	–	□	–	–	□	–	–
5	△	–	–	△	△	–	–	–	–
6	–	–	–	–	△	–	–	–	–
7	–	–	△	–	–	△	–	–	–
8	–	–	–	–	△	–	–	–	–
9	–	–	–	–	□	□	–	–	□

[⊕ ⊕ ⊕]	S_1^1	S_2^1	S_3^1	S_1^2	S_2^2	S_3^2	S_1^3	S_2^3	S_3^3
1	○	–	○	–	–	–	○	–	○
2	–	–	–	□	–	–	□	–	–
3	–	–	△	–	–	△	–	–	–
4	–	–	–	□	–	–	□	–	–
5	△	–	–	△	△	–	–	△	–
6	–	○	–	–	–	–	–	○	–
7	–	–	△	–	–	△	–	–	–
8	–	○	–	–	–	–	–	○	–
9	–	□	–	–	□	□	–	–	□

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Scheme of morphogrammatic transjunction (⊕)

⊕	S_1^1	S_2	S_3	S_1^2	S_2	S_3	S_1^3	S_2	S_3
1	○	–	–	–	–	–	○	–	–
2	–	–	–	□	–	–	□	–	–
3	–	–	–	□	–	–	□	–	–
4	△	–	–	△	–	–	–	–	–

<==>

⊕	S_1^1	S_1^2	S_1^3
1	○	–	○
2	–	□	□
3	–	□	□
4	△	△	–

<==>

⊕	$S_1^{1.2.3}$
1	$○_{1.3}$
2	$□_{2.3}$
3	$□_{2.3}$
4	$△_{1.2}$

1.1.16. Interchangeability for morphic transjunctions

Transjunction as bifurcation

⊕ = bifurcation "bif".

$$\text{bif}_1([[MG_{1.1}], [MG_{2.2}], [MG_{3.3}]]) = [[\oplus_{1.1}], [MG_{2.2}], [MG_{3.3}]]$$

$$[S_1^1] = [\circ - - \triangle], \quad [S_1^2] = [- \square \square \triangle], \quad [S_1^3] = [\circ \square \square -]$$

$$\text{dom}([S_1^1]) = \text{dom}([S_1^3]) = \text{dom}([S_3^3])$$

$$\text{cod}([S_1^1]) = \text{cod}([S_1^2]) = \text{dom}([S_2^2])$$

$$\text{cod}([S_2^2]) = \text{cod}([S_3^3])$$

$$[\oplus_{1.1}\ MG_{2.2}\ MG_{3.3}] : [\text{bif}, \text{id}, \text{id}]$$

$$\left(\begin{pmatrix} [\oplus_{1.1}] \\ \amalg_{1.2.0} \\ [MG_{2.2}] \\ \amalg_{1.2.3} \\ [MG_{3.3}] \end{pmatrix}\right) = \left(\begin{pmatrix} [S_1^1] \diamond_{2.1} [S_1^2] \diamond_{3.1} [S_1^3] \end{pmatrix} \atop {\amalg_{1.2.0} \atop {[MG_{2.2}] \atop {\amalg_{1.2.3} \atop [MG_{3.3}]}}}\right)$$

$$[\oplus\oplus\ MG_{3.3}] : [\text{bif}, \text{bif}, \text{id}]$$

$$\left(\begin{pmatrix} [\oplus_{1.1}] \\ \amalg_{1.2.0} \\ [\oplus_{2.2}] \end{pmatrix} \atop {\amalg_{1.2.3} \atop [MG_{3.3}]}\right) = \left(\begin{pmatrix} [S_1^1] \diamond_{1.2} [S_1^2] \diamond_{1.3} [S_1^3] \\ \amalg_{1.2.0} \\ [S_2^1] \diamond_{2.1} [S_2^2] \diamond_{2.3} [S_2^3] \end{pmatrix} \atop {\amalg_{1.2.3} \atop [MG_{3.3}]}\right)$$

$$[\oplus\oplus\oplus] : [\text{bif}, \text{bif}, \text{bif}]$$

$$\left(\begin{pmatrix} [\oplus_{1.1}] \\ \amalg_{1.2.0} \\ [\oplus_{2.2}] \end{pmatrix} \atop {\amalg_{1.2.3} \atop [\oplus_{3.3}]}\right) = \left(\begin{pmatrix} [S_1^1] \diamond_{1.2} [S_1^2] \diamond_{1.3} [S_1^3] \\ \amalg_{1.2.0} \\ [S_2^1] \diamond_{2.1} [S_2^2] \diamond_{2.3} [S_2^3] \end{pmatrix} \atop {\amalg_{1.2.3} \atop [S_3^1] \diamond_{3.1} [S_3^2] \diamond_{3.2} [S_3^3]}\right)$$

2. Catching Transjunctions

Steps towards an emulation of polycontextural transjunctions in memristic systems http://memristors.memristics.com/Transjunctions/Catching Transjunctions.pdf