Assignment 4

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1. In Figure 1 an overview of the reified network can be seen, the different layers denoted by different colors. The blue arrows represent upwards connections while the red arrows represent downwards connections.

   In Table 1 the corresponding legend for all states can be found.

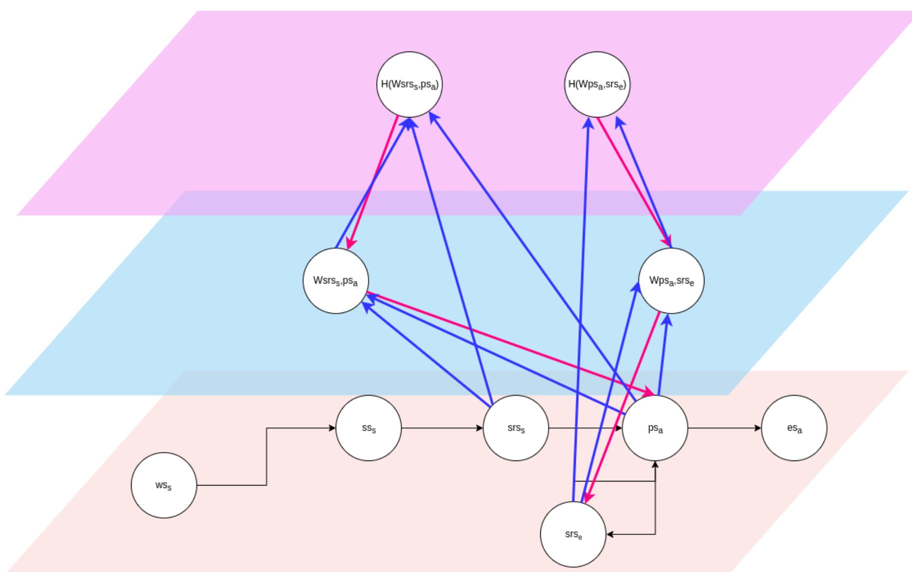


Figure 1: Overview of the reified network architecture for plasticity and meta plasticity, each color denoting another level.

2. The role matrices for connectivity, aggregation and timing are shown in Figure 2, 3 and 4 respectively.

3. We use a real world example to explain the behavior of the scenarios (as inspired by Nimat). When we see an ice cream stand, stimulus s (srs_s), we prepare for a buying/eating the ice cream, action a (ps_a). Thereafter we predict the reaction of buying/eating the ice cream, effect e (srs_e), which

State nr	**State name**	**Explanation**	**Level**
X_1	ws_s	Stimulus state	Base
X_2	ss_s	Sensor state for stimulus s	Base
X_3	srs_s	Sensory representation for stimulus s	Base
X_4	ps_a	Preparation state for action a	Base
X_5	srs_e	Prediction of response effect	Base
X_6	es_a	Execution of action a	Base
X_7	W_{sr_s,ps_a}	Reified representation state for connection weight $\omega(sr_s, ps_a)$	First reification
X_8	W_{ps_a,srs_e}	Reified representation state for connection weight $\omega(ps_a, srs_e)$	First reification
X_9	$H(W_{sr_s,ps_a})$	Reified representation state for speed factor $\eta_{W_{srs_s,ps_a}}$ for reified representation state W_{srs_s,ps_a}	Second reification
X_{10}	$H(W_{ps_a,srs_e})$	Reified representation state for speed factor $\eta_{W_{ps_a,srs_e}}$ for reified representation state W_{ps_a,srs_e}	Second reification

Table 1: Legend for Figure 1.

m_b	**base connectivity**	**1**	**2**	**3**
X_1	ws_s	1		
X_2	ss_s	1		
X_3	srs_s	2		
X_4	ps_a	3	5	
X_5	srs_e	4		
X_6	es_a	5		
X_7	W_{sr_s,ps_a}	3	4	7
X_8	W_{ps_a,srs_e}	4	5	8
X_9	$H(W_{sr_s,ps_a})$	3	4	7
X_{10}	$H(W_{ps_a,srs_e})$	4	5	8

(a) Base connectivity matrix m_b.

m_b	**connection weights**	**1**	**2**	**3**
X_1	ws_s	1		
X_2	ss_s	1		
X_3	srs_s	1		
X_4	ps_a	X_7	1	
X_5	srs_e	X_8	1	
X_6	es_a	1		
X_7	W_{sr_s,ps_a}	1	1	1
X_8	W_{ps_a,srs_e}	1	1	1
X_9	$H(W_{sr_s,ps_a})$	1	1	1
X_{10}	$H(W_{ps_a,srs_e})$	1	1	1

(b) Connection weight matrix m_{cwv}.

Figure 2: Connectivity role matrices.

might be a positive one so eventually we will actual execution action a (es_a).

For first order adaptive learning with a constant speed, the weight between srs_s and ps_a will grow over time and will be modelled by W_{srs_s,ps_a}. The same applies to the weight between ps_a and srs_e, which is modelled by W_{ps_a,srs_e}. Both weights will increase at a constant rate over time.

For second order apative learning both these weights will not increase at a constant rate but instead are affected by two other states being $H(W_{srs_s,ps_a})$ and $H(W_{ps_a,srs_e})$.

In modelling our scenario X_1 should have a constant value of 1 over time. The weight states will also have a initial value of higher than 0 being 0.1. The speed states for the weights will have a value of 0.5 while other states start at 0 initially.

4. In Figure 5 we see the response rates for both scenarios in a graph. The result is in accordance to the expectation we had. In the first scenario we

m_{cfw}	**combination function weights**	**hebian**	**alogistic**	**id**
X_1	ws_s			1
X_2	ss_s			1
X_3	srs_s		1	
X_4	ps_a		1	
X_5	srs_e		1	
X_6	es_a		1	
X_7	W_{sr_s,ps_a}	1		
X_8	W_{ps_a,srs_e}	1		
X_9	$H(W_{srs,psa})$		1	
X_{10}	$H(W_{psa,srse})$		1	

(a) Combination function weights matrix m_{cfw}.

m_{cfp}	**combination function parameters**	**hebian**		**alogistic**		**id**	
X_1	ws_s						
X_2	ss_s						
X_3	srs_s			5	0.2		
X_4	ps_a			5	0.2		
X_5	srs_e			5	0.2		
X_6	es_a			5	0.2		
X_7	$W_{srs,psa}$	0.9					
X_8	$W_{psa,srse}$	0.9					
X_9	$H(W_{srs,psa})$			5	0.2		
X_{10}	$H(W_{psa,srse})$			5	0.2		

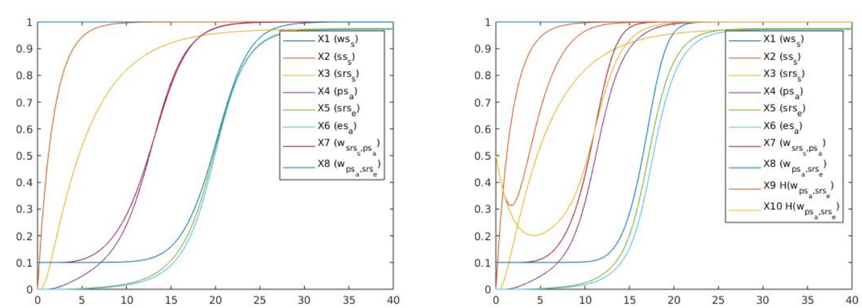
(b) Combination function parameters matrix m_{cfpv}.

Figure 3: Aggregation role matrices.

can see that as the weight states increase, the states with downward connections will grow faster. For the second scenario we that the downward connected states are even reaches 1 faster.

m_s	**speed factors**	1
X_1	ws_s	0.5
X_2	ss_s	0.5
X_3	srs_s	0.5
X_4	ps_a	0.5
X_5	srs_e	0.5
X_6	es_a	0.5
X_7	W_{srs_s,ps_a}	X9
X_8	W_{ps_a,srs_e}	X10
X_9	$H(W_{srs_s,ps_a})$	0.5
X_{10}	$H(W_{ps_a,srs_e})$	0.5

Figure 4: Speed role matrices



(a) First order with constant learning speed. (b) Second order with adaptive learning speed.

Figure 5: Responses rate for scenario.