Create Neural Network in Excel

1. Prepare training data for NN
    a. Identify what are inputs and output
    b. How many inputs and output?
    c. How many patterns?
    d. Perform data scaling into [0,1], [-1,1], etc
2. Define NN Configuration
    a. How many Slabs?
    b. How many Hidden neurons on each slab?
    c. Define transfer function, example tanh=1/exp(-x))
    d. Initiate weight and bias values
    e. Insert formula for each hidden neurons
    f. Insert formula for output neurons
    g. Insert formula for error^2 and MSE
3. Run Solver add-in
    a. Criteria can be minimize MSE or maximize R^2
    b. Insert Graph for output and predicted output
4. Post processing data
    a. Revert scale of predicted output
    b. Record final values of weight and bias
5. Deploy Trained Net
    a. Convert formula relation between input and output into C or MQ4 code
    b. Create dll file using C compiler or MT4
    c. Create MT4 indicator based on trained net.

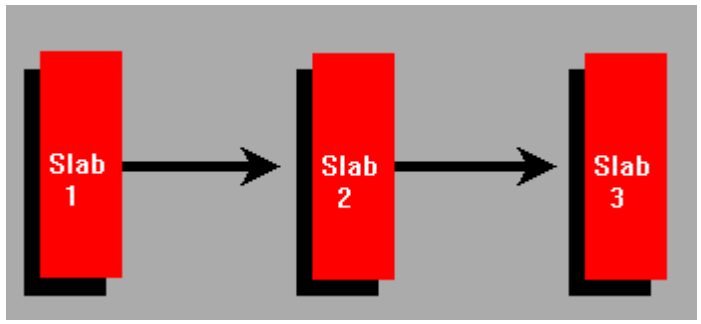
Example

1. We have time series data (Mackey Glass) that consist of 4 inputs and 1 input, 700 patterns
2. Scale input and output data become [0, 1]

	A	B	C	D	E	F	G	H	I	J	K	L
1	Input				Output		Scaled Input				Scaled Output	
2	X	X1	X2	X3	X4		X	X1	X2	X3	X4	
3	1.056	1.042	1.026	1.007	0.983		0.731791	0.719794	0.706084	0.689803	0.669237	
4	1.042	1.026	1.007	0.983	0.954		0.719794	0.706084	0.689803	0.669237	0.644387	
5	1.026	1.007	0.983	0.954	0.921		0.706084	0.689803	0.669237	0.644387	0.61611	
6	1.007	0.983	0.954	0.921	0.885		0.689803	0.669237	0.644387	0.61611	0.585261	
7	0.983	0.954	0.921	0.885	0.848		0.669237	0.644387	0.61611	0.585261	0.553556	
8	0.954	0.921	0.885	0.848	0.811		0.644387	0.61611	0.585261	0.553556	0.521851	
9	0.921	0.885	0.848	0.811	0.774		0.61611	0.585261	0.553556	0.521851	0.490146	
10	0.885	0.848	0.811	0.774	0.74		0.585261	0.553556	0.521851	0.490146	0.461011	
687	1.069	1.05	1.022	0.984	0.939		0.742931	0.72665	0.702656	0.670094	0.631534	
688	1.05	1.022	0.984	0.939	0.889		0.72665	0.702656	0.670094	0.631534	0.588689	
689	1.022	0.984	0.939	0.889	0.837		0.702656	0.670094	0.631534	0.588689	0.54413	
690	0.984	0.939	0.889	0.837	0.785		0.670094	0.631534	0.588689	0.54413	0.499572	
691	0.939	0.889	0.837	0.785	0.734		0.631534	0.588689	0.54413	0.499572	0.45587	
692	0.889	0.837	0.785	0.734	0.686		0.588689	0.54413	0.499572	0.45587	0.414739	
693	0.837	0.785	0.734	0.686	0.64		0.54413	0.499572	0.45587	0.414739	0.375321	
694	0.785	0.734	0.686	0.64	0.597		0.499572	0.45587	0.414739	0.375321	0.338475	
695	0.734	0.686	0.64	0.597	0.558		0.45587	0.414739	0.375321	0.338475	0.305056	
696	0.686	0.64	0.597	0.558	0.521		0.414739	0.375321	0.338475	0.305056	0.27335	
697	0.64	0.597	0.558	0.521	0.486		0.375321	0.338475	0.305056	0.27335	0.243359	
698	0.597	0.558	0.521	0.486	0.453		0.338475	0.305056	0.27335	0.243359	0.215081	
699	0.558	0.521	0.486	0.453	0.422		0.305056	0.27335	0.243359	0.215081	0.188518	
700	0.521	0.486	0.453	0.422	0.394		0.27335	0.243359	0.215081	0.188518	0.164524	
701	0.486	0.453	0.422	0.394	0.369		0.243359	0.215081	0.188518	0.164524	0.143102	
702	0.453	0.422	0.394	0.369	0.348		0.215081	0.188518	0.164524	0.143102	0.125107	
703												
704	1.369	1.369	1.369	1.369	1.369		1	1	1	1	1	Max
705	0.202	0.202	0.202	0.202	0.202		0	0	0	0	0	Min

Input-Output and Scaled Data

3. Define NN configuration
    a. NN is backpropagation, 3 slabs
    b. 4 inputs in Slab 1
    c. 29 hidden neurons in Slab 2
    d. There are 29 weight for each input, 29 bias, then we have 29 x 4 weight to connect Slab 1 to Slab 2
    e. There are 29 weight and one bias to connect Slab 2 to Slab 3



Net Configuration

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1				Slab 1					Slab 2						
2		Weight Layer 1			bias layer1				h(1,1)	h(1,2)	h(1,3)	h(1,4)	h(1,5)	h(1,6)	h(1,7)
3		w(1,1)	0.782117086		b(1,1)	-1.57525			0.48118	0.964832	0.726541	0.779528	0.757684	0.965078	0.895592
4		w(1,2)	-0.898731175		b(1,2)	-0.16502			0.470858	0.962248	0.741011	0.785834	0.767798	0.9689084	0.901848
5		w(1,3)	0.548921197		b(1,3)	2.838758			0.458387	0.958901	0.757865	0.793352	0.779535	0.9729731	0.908986
6		w(1,4)	1.720635994		b(1,4)	2.348646			0.444385	0.954522	0.775195	0.80148	0.791969	0.97689	0.91633
7		w(2,1)	1.546278259		b(1,5)	2.922041			0.429048	0.948824	0.792131	0.809831	0.804777	0.9805152	0.923494
8		w(2,2)	1.189589068		b(1,6)	7.296467			0.41308	0.94166	0.807522	0.817888	0.81719	0.9836567	0.930019
9		w(2,3)	1.188502401		b(1,7)	4.096209			0.397092	0.93298	0.821163	0.825424	0.828896	0.9862977	0.935817
10		w(2,4)	0.942053356		b(1,8)	-0.13454			0.381029	0.922758	0.833813	0.83262	0.840144	0.9885441	0.941096
11		w(3,1)	-0.182782125		b(1,9)	-3.57004			0.366092	0.911215	0.843947	0.838845	0.849812	0.99028	0.945398
12		w(3,2)	2.433265677		b(1,10)	-1.54823			0.352402	0.898563	0.852521	0.84432	0.858383	0.9916682	0.94906
13		w(3,3)	0.318748894		b(1,11)	-0.81743			0.339633	0.883104	0.83986	0.849143	0.866004	0.992783	0.952141
14		w(3,4)	-5.370185142		b(1,12)	-0.28956			0.328487	0.87141	0.865815	0.853246	0.872411	0.9936451	0.95468
15		w(4,1)	0.00450119		b(1,13)	0.388408			0.318583	0.857719	0.870764	0.856751	0.87792	0.9943298	0.956782
16		w(4,2)	0.762504492		b(1,14)	1.244239			0.309708	0.844378	0.875274	0.859908	0.882824	0.9948943	0.958642
17		w(4,3)	-0.260966512		b(1,15)	-4.99274			0.301416	0.831423	0.879831	0.862973	0.88743	0.9953851	0.96042
18		w(4,4)	-2.107278091		b(1,16)	-3.23323			0.292836	0.818428	0.885586	0.866527	0.892437	0.9958734	0.962477
19		w(5,1)	-0.859891771		b(1,17)	1.720265			0.283726	0.80467	0.892107	0.870536	0.897695	0.996346	0.964716
108		w(27,2)	-0.221661944						0.361898	0.870516	0.78985	0.82294	0.838661	0.9890972	0.931846
109		w(27,3)	0.301774614						0.38302	0.886684	0.758652	0.80933	0.821337	0.9858241	0.920426
110		w(27,4)	-1.408788993						0.406982	0.905363	0.727896	0.795414	0.80207	0.9813631	0.907976
111		w(28,1)	-1.058299693						0.430977	0.923104	0.701348	0.782618	0.782862	0.975896	0.895823
112		w(28,2)	1.973592565						0.454237	0.938147	0.678835	0.771208	0.763977	0.9694197	0.884411
113		w(28,3)	-0.080263247						0.475816	0.949916	0.659889	0.761205	0.746074	0.962157	0.873986
114		w(28,4)	-4.2036788						0.494659	0.958726	0.645151	0.752903	0.730272	0.9546925	0.865086
115		w(29,1)	1.58044394						0.511539	0.965275	0.631243	0.745331	0.715253	0.9466978	0.856581
116		w(29,2)	0.385174697						0.526795	0.970176	0.617978	0.738289	0.701209	0.9383766	0.848483
117		w(29,3)	1.896724856						0.540402	0.973924	0.604741	0.731488	0.687958	0.9297016	0.840331
118		w(29,4)	5.601993745						0.553087	0.976921	0.591578	0.724862	0.675198	0.9205704	0.832205

	AU	AV	AW	AX	AY	AZ	BA	BB
1								
2	h(1,25)	h(1,26)	h(1,27)	h(1,28)	h(1,29)		bias output Layer	
3	0.304021	0.197959	0.504606	0.774517	0.98382		b(2,1)	2.877455
4	0.296298	0.189209	0.51409	0.787076	0.980873			
5	0.286921	0.179006	0.525276	0.801529	0.976597			
6	0.277465	0.168042	0.538129	0.816586	0.97046			
7	0.268869	0.156807	0.552766	0.831746	0.961709			
8	0.262017	0.146003	0.568555	0.846095	0.949655			
9	0.256884	0.135927	0.585035	0.859261	0.933571			
10	0.25259	0.126459	0.601929	0.871587	0.912469			
11	0.250369	0.118327	0.617912	0.881953	0.886803			
12	0.249227	0.111181	0.633264	0.890869	0.856597			
13	0.248949	0.105005	0.647512	0.898655	0.822701			
14	0.249296	0.099781	0.660258	0.905058	0.786878			
15	0.250132	0.095361	0.671681	0.910466	0.750379			
16	0.250677	0.09147	0.681923	0.915204	0.713938			
17	0.250363	0.087853	0.691227	0.91961	0.677356			
18	0.247684	0.083944	0.700371	0.924354	0.637714			
19	0.243311	0.079788	0.709391	0.929315	0.59374			
108	0.345199	0.128051	0.647281	0.867666	0.854766			
109	0.369452	0.143661	0.62987	0.847682	0.896352			
110	0.386595	0.161091	0.608003	0.824845	0.930632			
111	0.39544	0.178703	0.583837	0.801646	0.954565			
112	0.39801	0.19576	0.558744	0.778534	0.97004			
113	0.396915	0.211687	0.534584	0.756344	0.979663			
114	0.393202	0.225709	0.512802	0.736573	0.985557			
115	0.39012	0.238821	0.49298	0.717683	0.989354			
116	0.388013	0.250983	0.475618	0.699738	0.991875			
117	0.387528	0.262707	0.460193	0.682691	0.993635			
118	0.387914	0.27403	0.446266	0.666076	0.994917			

Net Config | Mackey Glass Solver | Mackey Glass NS2 GH | Mackey Glass NS2

Network Configuration

Input: X, X1, X2, X3

Slab 2 Calculation:

Weight data:

w(1,1), w(1,2), w(1,3), w(1,4) for hidden neuron (1,1)
w(2,1), w(2,2), w(2,3), w(2,4) for hidden neuron (1,2)
……..
w(1,1), w(1,2), w(1,3), w(1,4) for hidden neuron (1,29)

Bias:

b(1,1) for hidden neuron (1,1)
b(1,2) for hidden neuron (1,2)
……
b(1,29) for hidden neuron (1,9)

Excel Formula:

Hidden Neuron(1,1) = 1/(1+(EXP(-(X*w(1,1) + X1*w(1,2)+X2*w(1,3)+X3*w(1,4)+b(1,1))
Hidden Neuron(1,2) = 1/(1+(EXP(-(X*w(2,1) + X1*w(2,2)+X2*w(2,3)+X3*w(2,4)+b(1,2))
…….
Hidden Neuron(1,29) = 1/(1+(EXP(-(X*w(29,1) + X1*w(29,2)+X2*w(29,3)+X3*w(29,4)+b(1,29))

Slab 3 Calculation

Weight data:

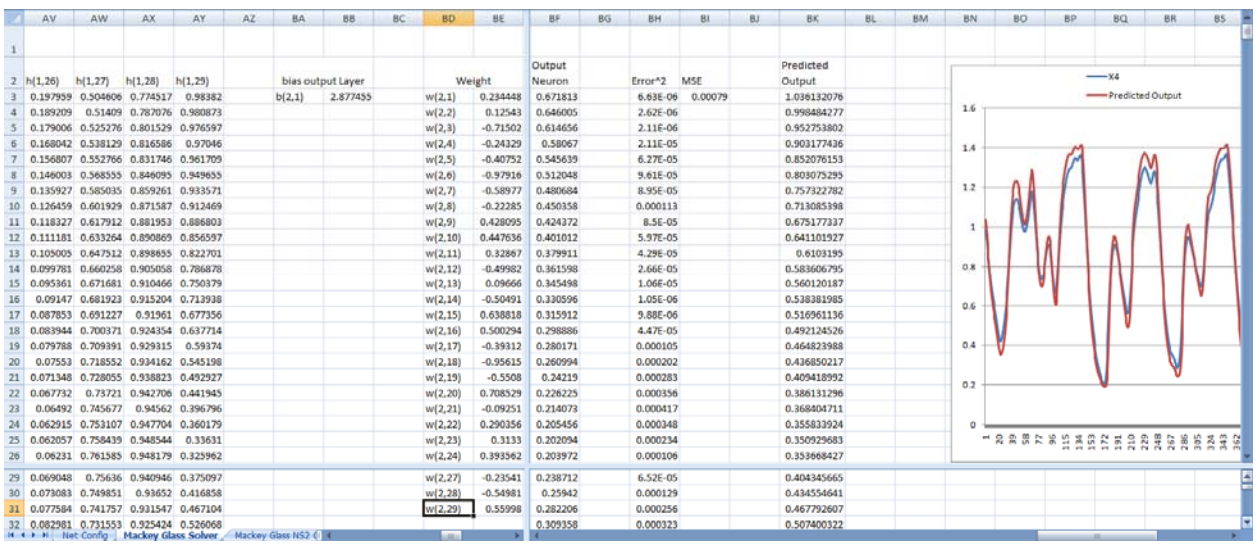
w(2,1), w(2,2), w(2,3), w(2,4) , w(2,5)…., w(2,29)

Bias:

b(2,1)

Excel Formula:

Output Neuron = 1/(1+(EXP(-(h(1,1)*w(2,1) + h(1,2)*w(1,2)+h(1,3)*w(1,3)+ …. h(1,29)*w(29,4)+b(2,1))



AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK
h(1,26)	h(1,27)	h(1,28)	h(1,29)		bias output Layer			Weight		Output Neuron		Error^2	MSE		Predicted Output
0.197959	0.504606	0.774517	0.98382		b(2,1)	2.877455		w(2,1)	0.234448	0.671813		6.63E-06	0.00079		1.036132076
0.189209	0.51409	0.787076	0.980873					w(2,2)	0.12543	0.646005		2.62E-06			0.998484277
0.179006	0.525276	0.801529	0.976597					w(2,3)	-0.71502	0.614656		2.11E-06			0.952753802
0.168042	0.538129	0.816586	0.97046					w(2,4)	-0.24329	0.58067		2.11E-05			0.903177436
0.156807	0.552766	0.831746	0.961709					w(2,5)	-0.40752	0.545639		6.27E-05			0.852076153
0.146003	0.568555	0.846095	0.949655					w(2,6)	-0.97916	0.512048		9.61E-05			0.803075295
0.135927	0.585035	0.859261	0.933571					w(2,7)	-0.58977	0.480684		8.95E-05			0.757322782
0.126459	0.601929	0.871587	0.912469					w(2,8)	-0.22285	0.450358		0.000113			0.713085398
0.118327	0.617912	0.881953	0.886803					w(2,9)	0.428095	0.424372		8.5E-05			0.675177337
0.111181	0.633264	0.890869	0.856597					w(2,10)	0.447636	0.401012		5.97E-05			0.641101927
0.105005	0.647512	0.898655	0.822701					w(2,11)	0.32867	0.379911		4.29E-05			0.6103195
0.099781	0.660258	0.905058	0.786878					w(2,12)	-0.49982	0.361598		2.66E-05			0.583606795
0.095361	0.671681	0.910466	0.750379					w(2,13)	0.09666	0.345498		1.06E-05			0.560120187
0.09147	0.681923	0.915204	0.712938					w(2,14)	-0.50491	0.330596		1.05E-06			0.538381985
0.087853	0.691227	0.91961	0.677356					w(2,15)	0.638818	0.315912		9.88E-06			0.516961136
0.083944	0.700371	0.924354	0.637714					w(2,16)	0.500294	0.298886		4.47E-05			0.492124526
0.079788	0.709391	0.929315	0.59374					w(2,17)	-0.39312	0.280171		0.000105			0.464823988
0.07553	0.718552	0.934162	0.545198					w(2,18)	-0.95615	0.260994		0.000202			0.436850217
0.071348	0.728055	0.938823	0.492927					w(2,19)	-0.5508	0.24219		0.000283			0.409418992
0.067732	0.73721	0.942706	0.441945					w(2,20)	0.708529	0.226225		0.000356			0.386131296
0.06492	0.745677	0.94562	0.396796					w(2,21)	-0.09251	0.214073		0.000417			0.368404711
0.062915	0.753107	0.947704	0.360179					w(2,22)	0.290356	0.205456		0.000348			0.355833924
0.062057	0.758439	0.948544	0.33631					w(2,23)	0.3133	0.202094		0.000234			0.350929683
0.06231	0.761585	0.948179	0.325962					w(2,24)	0.393362	0.203972		0.000106			0.353668427
0.069048	0.75636	0.940946	0.375097					w(2,27)	-0.23541	0.238712		6.52E-05			0.404345665
0.073083	0.749851	0.93652	0.416858					w(2,28)	-0.54981	0.25942		0.000129			0.434554641
0.077584	0.741757	0.931547	0.467104					w(2,29)	0.55998	0.282206		0.000256			0.467792607
0.082981	0.731553	0.925424	0.526068							0.309358		0.000323			0.507400322

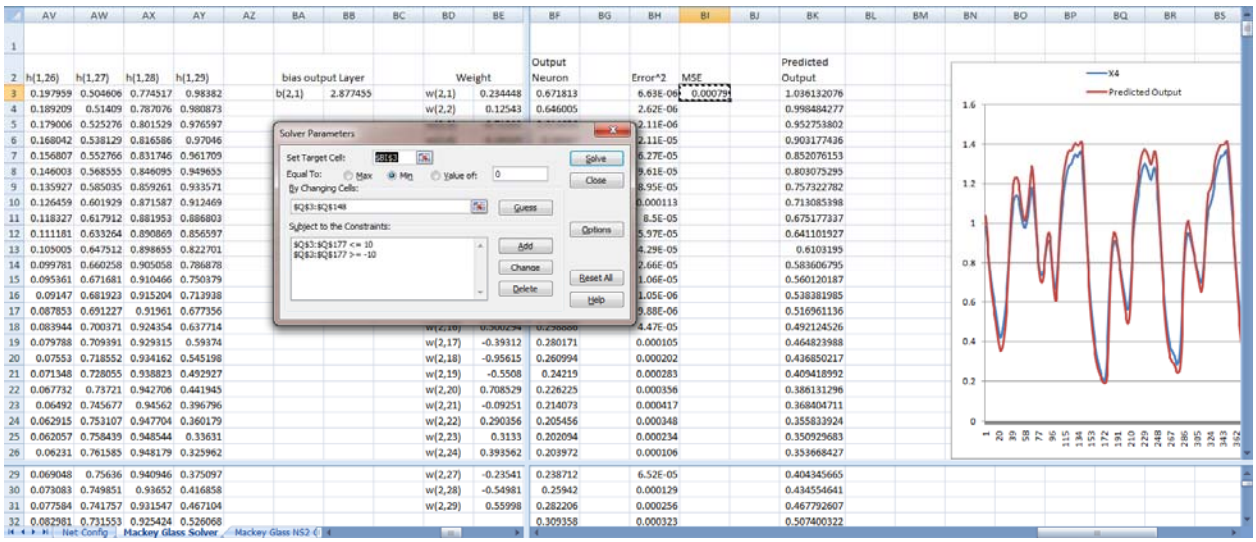
Calculate Error^2, MSE

Formula:

Error^2 = (output prediction – X4)^2

MSE= Average(Error^2)

Run Solver add-in



Adjustable Cells: all weight and bias data

Criteria: Minimize MSE

Display Chart predicted and desired output