



LAMPIRAN

Lampiran 1. Hasil Prediksi dengan 5 Hidden Layer

<i>5 Hidden Layer</i>			
<i>Epoch maksimal 1000</i>			
Iterasi 1	Iterasi 2	Iterasi 3	Iterasi 4
Hasil Prediksi:	Hasil Prediksi:	Hasil Prediksi:	Hasil Prediksi:
0.2092	0.2136	0.2136	0.2146
0.6733	0.6628	0.6683	0.6703
0.6537	0.6471	0.6559	0.6563
0.5506	0.5497	0.5529	0.5527
0.2593	0.2651	0.2619	0.2618
0.6605	0.6556	0.6602	0.6612
0.1933	0.1916	0.1952	0.1967
0.541	0.5394	0.5403	0.5376
0.5362	0.537	0.532	0.5299
0.7995	0.7995	0.8044	0.8057
0.531	0.5298	0.5303	0.5279
0.147	0.1383	0.1412	0.148
0.3427	0.3455	0.3465	0.3418
0.8074	0.8109	0.8149	0.8132
0.4294	0.4315	0.4296	0.4277
0.6649	0.6607	0.666	0.6662
0.5897	0.5885	0.5883	0.5861
0.1451	0.1351	0.1355	0.1417
0.1877	0.185	0.1865	0.1884
0.6493	0.6468	0.6465	0.648
0.8026	0.8093	0.8038	0.8046
0.6042	0.6018	0.5966	0.6001
0.4274	0.4293	0.4301	0.4291
0.1538	0.1459	0.1487	0.153
0.7274	0.7271	0.7248	0.7268
0.1766	0.1722	0.1744	0.1773
0.6131	0.6114	0.6062	0.6098
0.2795	0.2828	0.2828	0.2807
0.8126	0.819	0.8149	0.8092
0.7471	0.7499	0.7419	0.7403
0.728	0.7267	0.7253	0.7259
0.4173	0.4213	0.415	0.4143
0.339	0.3446	0.3447	0.3403
0.2204	0.2194	0.2178	0.2206
0.556	0.5554	0.5547	0.553
0.6813	0.6752	0.6813	0.6822

0.4019	0.4035	0.404	0.403
0.7986	0.8008	0.8026	0.8011
0.749	0.7504	0.7521	0.7543
0.5171	0.5172	0.5183	0.519
0.7052	0.703	0.6996	0.7044
0.3384	0.3439	0.3419	0.3378
0.7485	0.7488	0.7503	0.7506
0.2569	0.2589	0.2586	0.2582
0.8173	0.8259	0.8163	0.8101
0.4952	0.4935	0.4942	0.4929
0.1773	0.1724	0.1742	0.1758
0.3988	0.4039	0.4018	0.4024
0.5666	0.5651	0.5699	0.5686
0.8381	0.8514	0.8517	0.8471
0.7455	0.7437	0.7511	0.7516
0.4887	0.488	0.4885	0.4885
0.3401	0.3445	0.3427	0.339
0.1484	0.1396	0.1414	0.1469
0.7415	0.7357	0.746	0.7486
0.311	0.3132	0.3143	0.3113
0.6857	0.6876	0.6804	0.6841
0.6623	0.6615	0.6553	0.6591
0.7434	0.7442	0.7425	0.7456
0.2627	0.266	0.2636	0.264
0.2787	0.2831	0.2786	0.2778
Nilai Error (MSE):	Nilai Error (MSE):	Nilai Error (MSE):	Nilai Error (MSE):
3.75E-04	2.91E-04	2.72E-04	3.39E-04

Lampiran 2. Coding ANN Backpropagation dengan 10 Hidden Layer

```
%input data
filename_input = 'Input ANN (Normalisasi).xlsx';
input_data = xlsread(filename_input);
filename_output = 'Target After Normalisasi.xlsx';
output_data = xlsread(filename_output);

% Inisialisasi parameter jaringan
input_neurons = size(input_data, 2);
hidden_neurons = 10; % Jumlah neuron pada lapisan tersembunyi
output_neurons = 1;
learning_rate = 0.1;
epochs = 1000;

% Inisialisasi bobot dan bias secara acak
hidden_weights = rand(input_neurons, hidden_neurons);
hidden_bias = rand(1, hidden_neurons);
output_weights = rand(hidden_neurons, output_neurons);
output_bias = rand(1, output_neurons);

% Training jaringan menggunakan metode backpropagation
for epoch = 1:epochs
    % Forward propagation
    hidden_layer_input = input_data * hidden_weights +
    repmat(hidden_bias, size(input_data, 1), 1);
    hidden_layer_output = 1 ./ (1 + exp(-hidden_layer_input)); %
    Fungsi aktivasi sigmoid biner

    output_layer_input = hidden_layer_output * output_weights +
    repmat(output_bias, size(input_data, 1), 1);
    predicted_output = 1 ./ (1 + exp(-output_layer_input)); %
    Fungsi aktivasi sigmoid biner

    % Menghitung error
    error = output_data - predicted_output;

    % Backpropagation
    d_predicted_output = error .* (predicted_output .* (1 -
    predicted_output));
    error_hidden_layer = d_predicted_output * output_weights';
    d_hidden_layer = error_hidden_layer .* (hidden_layer_output .*
    (1 - hidden_layer_output));

    % Update bobot dan bias
    output_weights = output_weights + hidden_layer_output' *
    d_predicted_output * learning_rate;
    output_bias = output_bias + sum(d_predicted_output) *
    learning_rate;
    hidden_weights = hidden_weights + input_data' * d_hidden_layer
    * learning_rate;
    hidden_bias = hidden_bias + sum(d_hidden_layer) *
    learning_rate;
    epoch=epoch+1;
end
```

```
% Prediksi menggunakan jaringan yang telah dilatih
hidden_layer_input = input_data * hidden_weights +
repmat(hidden_bias, size(input_data, 1), 1);
hidden_layer_output = 1 ./ (1 + exp(-hidden_layer_input));

output_layer_input = hidden_layer_output * output_weights +
repmat(output_bias, size(input_data, 1), 1);
predicted_output = 1 ./ (1 + exp(-output_layer_input));

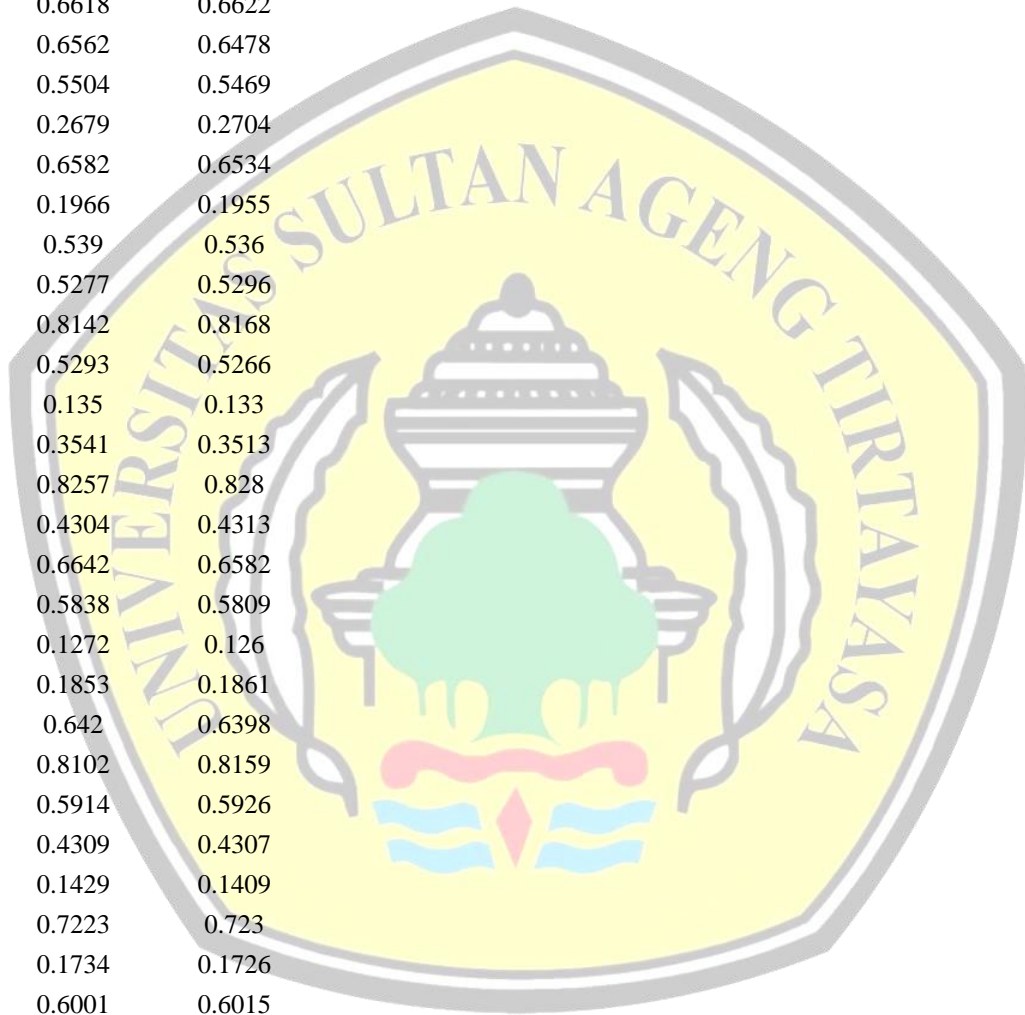
disp("Hasil Prediksi:");
disp(predicted_output);

%Menghitung nilai Error MSE hasil prediksi
MSE = sum((output_data - predicted_output).^2) /
numel(output_data);
disp("Nilai Error (MSE):");
disp(MSE);
```



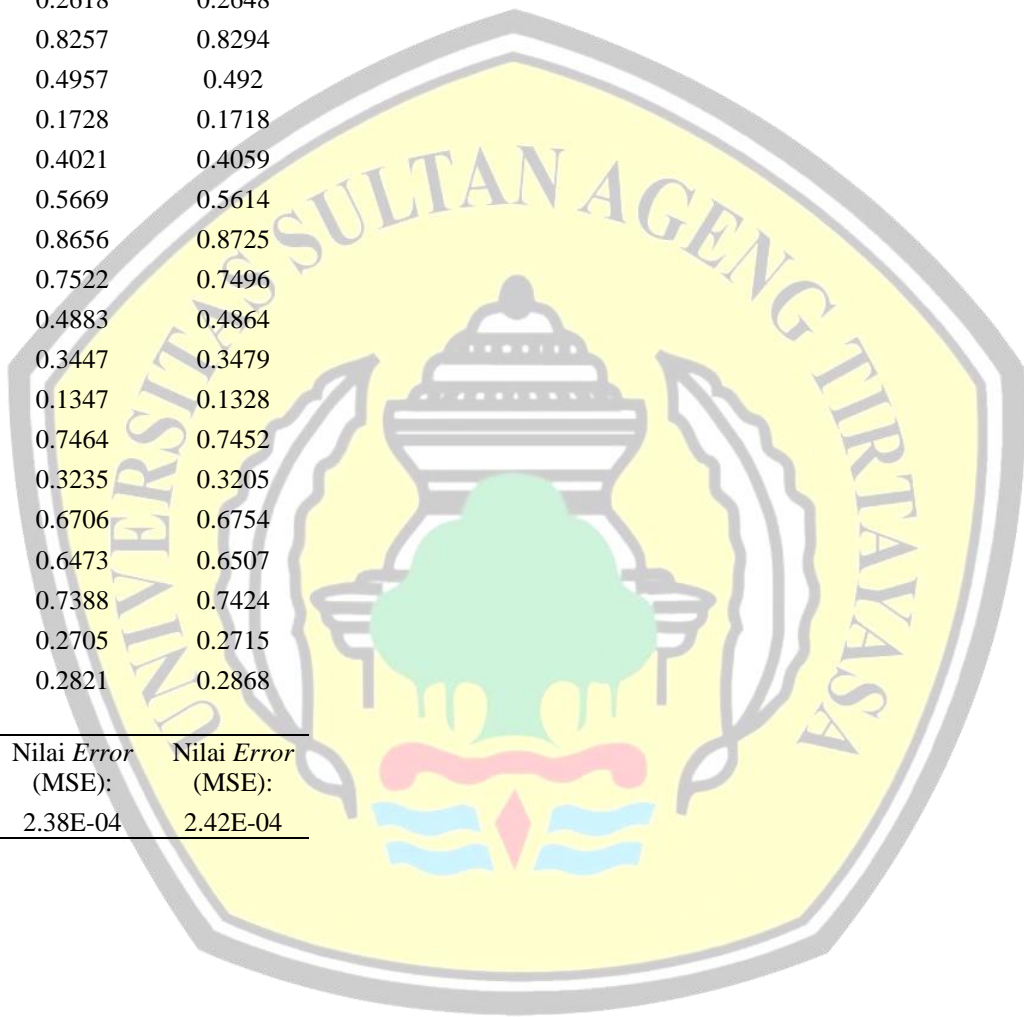
Lampiran 3. Hasil Prediksi dengan 10 *Hidden Layer*

10 <i>Hidden Layer</i>	
<i>Epoch</i> maksimum 1000	
Iterasi 1	Iterasi 2
Hasil Prediksi:	Hasil Prediksi:
0.2138	0.2181
0.6618	0.6622
0.6562	0.6478
0.5504	0.5469
0.2679	0.2704
0.6582	0.6534
0.1966	0.1955
0.539	0.536
0.5277	0.5296
0.8142	0.8168
0.5293	0.5266
0.135	0.133
0.3541	0.3513
0.8257	0.828
0.4304	0.4313
0.6642	0.6582
0.5838	0.5809
0.1272	0.126
0.1853	0.1861
0.642	0.6398
0.8102	0.8159
0.5914	0.5926
0.4309	0.4307
0.1429	0.1409
0.7223	0.723
0.1734	0.1726
0.6001	0.6015
0.2873	0.2891
0.8259	0.8276
0.7387	0.741
0.7249	0.7233
0.4124	0.4185
0.3496	0.35
0.2197	0.2233
0.5507	0.5489



0.6793	0.6754
0.4071	0.4067
0.8134	0.8142
0.7499	0.7514
0.515	0.5135
0.6961	0.6977
0.3456	0.3479
0.7497	0.7498
0.2618	0.2648
0.8257	0.8294
0.4957	0.492
0.1728	0.1718
0.4021	0.4059
0.5669	0.5614
0.8656	0.8725
0.7522	0.7496
0.4883	0.4864
0.3447	0.3479
0.1347	0.1328
0.7464	0.7452
0.3235	0.3205
0.6706	0.6754
0.6473	0.6507
0.7388	0.7424
0.2705	0.2715
0.2821	0.2868

Nilai <i>Error</i> (MSE):	Nilai <i>Error</i> (MSE):
2.38E-04	2.42E-04



Lampiran 4. Coding ANN Backpropagation dengan 15 Hidden Layer

```
%input data
filename_input = 'Input ANN (Normalisasi).xlsx';
input_data = xlsread(filename_input);
filename_output = 'Target After Normalisasi.xlsx';
output_data = xlsread(filename_output);

% Inisialisasi parameter jaringan
input_neurons = size(input_data, 2);
hidden_neurons = 15; % Jumlah neuron pada lapisan tersembunyi
output_neurons = 1;
learning_rate = 0.1;
epochs = 1000;

% Inisialisasi bobot dan bias secara acak
hidden_weights = rand(input_neurons, hidden_neurons);
hidden_bias = rand(1, hidden_neurons);
output_weights = rand(hidden_neurons, output_neurons);
output_bias = rand(1, output_neurons);

% Training jaringan menggunakan metode backpropagation
for epoch = 1:epochs
    % Forward propagation
    hidden_layer_input = input_data * hidden_weights +
repmat(hidden_bias, size(input_data, 1), 1);
    hidden_layer_output = 1 ./ (1 + exp(-hidden_layer_input)); %
Fungsi aktivasi sigmoid biner

    output_layer_input = hidden_layer_output * output_weights +
repmat(output_bias, size(input_data, 1), 1);
    predicted_output = 1 ./ (1 + exp(-output_layer_input)); %
Fungsi aktivasi sigmoid biner

    % Menghitung error
    error = output_data - predicted_output;

    % Backpropagation
    d_predicted_output = error .* (predicted_output .* (1 -
predicted_output));
    error_hidden_layer = d_predicted_output * output_weights';
    d_hidden_layer = error_hidden_layer .* (hidden_layer_output .*
(1 - hidden_layer_output));

    % Update bobot dan bias
    output_weights = output_weights + hidden_layer_output' *
d_predicted_output * learning_rate;
    output_bias = output_bias + sum(d_predicted_output) *
learning_rate;
    hidden_weights = hidden_weights + input_data' * d_hidden_layer
* learning_rate;
```



```

        hidden_bias = hidden_bias + sum(d_hidden_layer) *
learning_rate;
end

% Prediksi menggunakan jaringan yang telah dilatih
hidden_layer_input = input_data * hidden_weights +
repmat(hidden_bias, size(input_data, 1), 1);
hidden_layer_output = 1 ./ (1 + exp(-hidden_layer_input));

output_layer_input = hidden_layer_output * output_weights +
repmat(output_bias, size(input_data, 1), 1);
predicted_output = 1 ./ (1 + exp(-output_layer_input));

disp("Hasil Prediksi:");
disp(predicted_output);

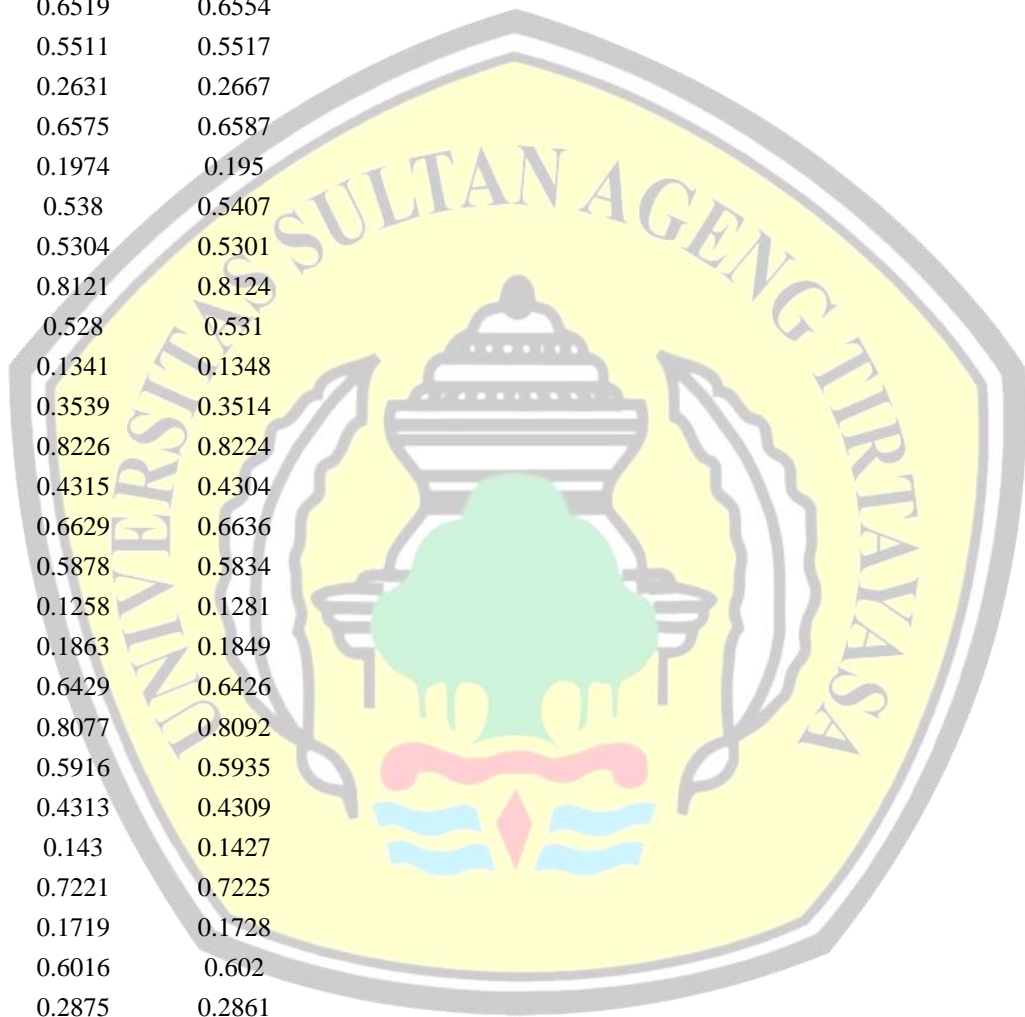
%Menghitung nilai Error MSE hasil prediksi
MSE = sum((output_data - predicted_output).^2) /
numel(output_data);
disp("Nilai Error (MSE):");
disp(MSE);

```



Lampiran 5. Hasil Prediksi dengan 15 Hidden Layer

15 Hidden Layer	
Epoch maksimum 1000	
Iterasi 1	Iterasi 2
Hasil Prediksi:	Hasil Prediksi:
0.2178	0.2133
0.6631	0.6683
0.6519	0.6554
0.5511	0.5517
0.2631	0.2667
0.6575	0.6587
0.1974	0.195
0.538	0.5407
0.5304	0.5301
0.8121	0.8124
0.528	0.531
0.1341	0.1348
0.3539	0.3514
0.8226	0.8224
0.4315	0.4304
0.6629	0.6636
0.5878	0.5834
0.1258	0.1281
0.1863	0.1849
0.6429	0.6426
0.8077	0.8092
0.5916	0.5935
0.4313	0.4309
0.143	0.1427
0.7221	0.7225
0.1719	0.1728
0.6016	0.602
0.2875	0.2861
0.8232	0.8217
0.7429	0.7382
0.7244	0.7242
0.4168	0.4133
0.3481	0.3491
0.2156	0.2199
0.5544	0.5509
0.6812	0.6807



0.4047	0.4071
0.808	0.8099
0.7497	0.7497
0.517	0.5154
0.6945	0.6977
0.3464	0.3451
0.7505	0.7491
0.2606	0.2613
0.8253	0.8224
0.4933	0.4958
0.1712	0.1722
0.3992	0.4043
0.5692	0.5663
0.8639	0.8618
0.7495	0.7507
0.4873	0.4888
0.3487	0.3438
0.1339	0.1349
0.7455	0.747
0.32	0.3207
0.6758	0.6721
0.6502	0.6494
0.7413	0.7402
0.2684	0.2683
0.2842	0.2812

Nilai <i>Error</i> (MSE):	Nilai <i>Error</i> (MSE):
1.98E-04	2.51E-04

