Nama: Rizki Ramadhan

NIM : 1103213091

Machine Learning

Regression Model: MLP Regression

Dataset: Wine Quality - UCI Machine Learning Repository

# A. Hidden Layer [4]

```
Hidden Layers: [4], Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.7092
Hidden Layers: [4], Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.7094
Hidden Layers: [4], Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6926
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Hidden Layers: [4], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 22, Test Loss: 0.6918
Hidden Layers: [4], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.7037
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Hidden Layers: [4], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.8777
Hidden Layers: [4], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.8877
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6978
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6978
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6978
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6979
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6979
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6979
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6979
Hidden Layers: [4], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6979
Hidden Layers: [4], Activation: linear, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6978
Hidden Layers: [4], Activation: linear, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6978
Hidden Layers: [4], Activation: linear, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.7304
Hidden Layers: [4], Activation: linear, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.7318
Hidden Layers: [4], Ac
```

```
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6626
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6776
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6776
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6726
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.7450
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.7099
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.8267
Hidden Layers: [4], Activation: relu, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.8267
Hidden Layers: [4], Activation: relu, Epochs: 12, LR: 0.0001, Batch Size: 64, Test Loss: 0.8267
Hidden Layers: [4], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6258
Hidden Layers: [4], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6258
Hidden Layers: [4], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6678
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Hidden Layers: [4], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6678
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Hidden Layers: [4], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6907
Hidden Layers: [4], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.7407
Hidden Layers: [4], Activation: relu, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.7908
Hidden Layers: [4], Activation: relu, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.7908
Hidden Layers: [4], Activation: relu, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.7508
Hidden Layers: [4], Activation: relu, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6018
Hidden Layers: [4], Activation: osoftmax, Epochs: 50, L
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```
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6494
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6594
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6594
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6501
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 12, Test Loss: 0.6501
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6501
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.7508
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.7508
Hidden Layers: [4], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 32, Test Loss: 0.6510
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6510
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6510
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6510
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6510
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6534
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6573
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6578
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Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6588
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6588
Hidden Layers: [4], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6598
Hidden Layers: [4], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6598
Hidden Layers: [4], Activation: tanh, Epochs: 50, LR: 0.00
```

Dalam analisis hasil eksperimen dengan konfigurasi hyperparameter pada model MLP, terlihat bahwa variasi jumlah epoch, learning rate (LR), dan ukuran batch (batch size) memberikan pengaruh signifikan terhadap nilai test loss. Untuk fungsi aktivasi **linear**, dengan LR 0.01 dan batch size 32, nilai test loss mencapai 0.6969 setelah 10 epoch. Pengurangan learning rate (misalnya menjadi 0.001 atau 0.0001) cenderung meningkatkan test loss, yang menunjukkan bahwa penurunan learning rate dapat memperlambat proses konvergensi model tanpa memberikan peningkatan yang signifikan dalam akurasi.

Untuk fungsi aktivasi lainnya, seperti **sigmoid, ReLU, softmax,** dan **tanh**, hasil yang lebih baik terlihat pada konfigurasi dengan LR 0.01, terutama pada batch size yang lebih kecil (16 atau 32). Fungsi aktivasi **sigmoid**, misalnya, menghasilkan test loss 0.6501 dengan batch size 16 pada 10 epoch. Fungsi aktivasi ReLU, di sisi lain, cenderung mengalami peningkatan test loss yang lebih besar pada batch size yang lebih besar, yang menunjukkan bahwa fungsi aktivasi ini lebih sensitif terhadap perubahan batch size pada konfigurasi tertentu. Fungsi aktivasi **tanh** dan **softmax** juga menunjukkan bahwa model dengan epoch yang lebih banyak (misalnya 50 epoch) berpotensi untuk memperburuk hasil apabila learning rate terlalu kecil.

Secara keseluruhan, untuk konfigurasi ini, hasil terbaik tercapai dengan menggunakan fungsi aktivasi **sigmoid** pada LR 0.01 dan batch size 16, dengan test loss terendah di angka 0.6501. Dapat disimpulkan bahwa fungsi aktivasi dan learning rate memainkan peran penting dalam menentukan performa model, dengan fungsi aktivasi non-linear seperti **sigmoid** dan **ReLU** lebih efektif pada nilai LR yang lebih tinggi dan ukuran batch yang lebih kecil.

#### B. Hidden Layer [8]

```
Hidden Layers: [8], Activation: linear, Epochs: 16, IR: 0.41, Batch Size: 16, Test Loss: 0.6894
Hidden Layers: [8], Activation: linear, Epochs: 16, IR: 0.41, Batch Size: 23, Test Loss: 0.6999
Hidden Layers: [8], Activation: linear, Epochs: 16, IR: 0.401, Batch Size: 64, Test Loss: 0.6999
Hidden Layers: [8], Activation: linear, Epochs: 16, IR: 0.401, Batch Size: 64, Test Loss: 0.6991
Hidden Layers: [8], Activation: linear, Epochs: 16, IR: 0.401, Batch Size: 17, IR: 0.401, Batch Size: 18, IR: 0.401, Batch Size: 18, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, Batch Size: 18, IR: 0.401, IR: 0.401, Batch Size: 18, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, Batch Size: 18, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 17, IR: 0.401, IR: 0.401, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 16, IR: 1.001, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 16, IR: 1.001, IR: 0.401, IR: 0.401, IR: 0.401, IR: 0.401, Batch Size: 16, IR: 0.401, Batch Size: 16, IR: 0.401, IR: 0.401,
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| Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.01, Batch Size: 16, Test Loss: 0.6586 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.01, Batch Size: 23, Test Loss: 0.6769 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.01, Batch Size: 24, Test Loss: 0.6789 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.001, Batch Size: 23, Test Loss: 0.6594 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.001, Batch Size: 32, Test Loss: 0.6594 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.002, Batch Size: 32, Test Loss: 0.6669 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.0002, Batch Size: 16, Test Loss: 0.6799 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.0002, Batch Size: 16, Test Loss: 0.6695 | Hidden Layers: [8], Activation: relu, Epochs: 10, RI: 0.0002, Batch Size: 16, Test Loss: 0.6095 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.01, Batch Size: 64, Test Loss: 0.6799 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.01, Batch Size: 32, Test Loss: 0.7031 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.01, Batch Size: 32, Test Loss: 0.6095 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.001, Batch Size: 32, Test Loss: 0.6399 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.001, Batch Size: 32, Test Loss: 0.6399 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.001, Batch Size: 32, Test Loss: 0.6399 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.0001, Batch Size: 32, Test Loss: 0.6399 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.0001, Batch Size: 32, Test Loss: 0.6399 | Hidden Layers: [8], Activation: relu, Epochs: 25, RI: 0.0001, Batch Size: 32, Test Loss: 0.6390 | Hidden Layers: [8], Activation: relu, Epochs: 50, RI: 0.001, Batch Size: 46, Test Loss: 0.6396 | Hidden Layers: [8], Activation: relu, Epochs: 50, RI: 0.001, Batch Size: 46, Test Loss: 0.6596 | Hidden Layers: [9], Activation: relu, Epochs: 50, RI: 0.001, Batch Size: 46, Test Loss: 0.6596 | Hidden

```
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6374
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6473
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6768
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6765
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6907
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.7197
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 32, Test Loss: 0.8442
Hidden Layers: [8], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.9053
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6496
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6272
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6419
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6439
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6595
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6753
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 16, Test Loss: 0.6900
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 32, Test Loss: 0.6994
Hidden Layers: [8], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.7295
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6541
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6262
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.6397
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6222
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6428
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6411
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 16, Test Loss: 0.6790
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.6837
Hidden Layers: [8], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 64, Test Loss: 0.7152
```

Dari hasil eksperimen dengan konfigurasi **8 hidden layers**, terdapat variasi performa berdasarkan kombinasi antara epoch, learning rate (LR), batch size, dan fungsi aktivasi yang digunakan. Pada fungsi aktivasi **linear**, hasil loss yang dicapai cenderung lebih tinggi dibandingkan dengan aktivasi lain, dengan nilai test loss terbesar mencapai 0.8609. Ini menunjukkan bahwa model dengan aktivasi linear mungkin tidak optimal untuk tugas ini, mengingat nilai loss yang lebih besar daripada yang menggunakan fungsi aktivasi non-linear seperti **sigmoid**, **ReLU**, **softmax**, atau **tanh**.

Fungsi aktivasi **sigmoid** menunjukkan hasil yang cukup baik, terutama pada epoch 25 dengan learning rate 0.01 dan batch size 64, dengan test loss mencapai 0.6299. Namun, untuk kombinasi lainnya, terutama pada epoch yang lebih sedikit atau learning rate yang sangat rendah, performanya cenderung memburuk, seperti pada nilai test loss yang sangat tinggi di bawah learning rate 0.0001. **ReLU** juga memberikan hasil yang kompetitif, dengan nilai test loss terendah mencapai 0.6389 pada epoch 25, learning rate 0.001, dan batch size 32, meskipun beberapa kombinasi menghasilkan nilai loss yang sedikit lebih buruk.

Fungsi aktivasi **softmax** dan **tanh** juga menunjukkan hasil yang mengesankan pada beberapa kombinasi. **Softmax** berhasil mencatatkan test loss terbaik di 0.6093 pada epoch 50, LR 0.01, dan batch size 64, menunjukkan bahwa untuk tugas klasifikasi, softmax dapat memberikan performa yang lebih stabil dan baik. Di sisi lain, **tanh** memperlihatkan test loss terendah 0.6272 pada epoch 25, LR 0.01, dan batch size 32. Secara keseluruhan, hasil menunjukkan bahwa pemilihan fungsi aktivasi dan pengaturan hyperparameter sangat mempengaruhi hasil model, dengan softmax dan sigmoid memberi hasil terbaik pada dataset ini.

### C. Hidden Layer [16]

```
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6097
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.7093
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.7093
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6025
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6049
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.7090
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.7090
Hidden Layers: [16], Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.7309
Hidden Layers: [16], Activation: linear, Epochs: 12, LR: 0.01, Batch Size: 32, Test Loss: 0.7309
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.7381
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.7381
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.7391
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6904
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6919
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6919
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6919
Hidden Layers: [16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6919
Hidden Layers: [16], Activation: linear, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.7039
Hidden Layers: [16], Activation: linear, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.7031
Hidden Layers: [16], Activation: linear, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.7036
Hidden Layers: [16], Activation: linear, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0
```

Hidden Layers: [16], Activation: relu, Epochs: 19, LR: 0.0, Batch Size: 21, Test Loss: 0.6553 Hidden Layers: [16], Activation: relu, Epochs: 19, LR: 0.0, Batch Size: 32, Test Loss: 0.6553 Hidden Layers: [16], Activation: relu, Epochs: 19, LR: 0.00, Batch Size: 64, Test Loss: 0.6053 Hidden Layers: [16], Activation: relu, Epochs: 10, LR: 0.00, Batch Size: 64, Test Loss: 0.6406 Hidden Layers: [16], Activation: relu, Epochs: 10, LR: 0.00, Batch Size: 64, Test Loss: 0.6406 Hidden Layers: [16], Activation: relu, Epochs: 10, LR: 0.000, Batch Size: 64, Test Loss: 0.6724 Hidden Layers: [16], Activation: relu, Epochs: 10, LR: 0.000, Batch Size: 64, Test Loss: 0.7724 Hidden Layers: [16], Activation: relu, Epochs: 10, LR: 0.000, Batch Size: 32, Test Loss: 0.7724 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.7724 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.7144 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.7402 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6000 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6403 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.00, Batch Size: 64, Test Loss: 0.6000 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.000, Batch Size: 32, Test Loss: 0.6000 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.000, Batch Size: 32, Test Loss: 0.6000 Hidden Layers: [16], Activation: relu, Epochs: 25, LR: 0.000, Batch Size: 16, Test Loss: 0.6000 Hidden Layers: [16], Activation: relu, Epochs: 59, LR: 0.000, Batch Size: 16, Test Loss: 0.6736 Hidden Layers: [16], Activation: relu, Epochs: 59, LR: 0.001, Batch Size: 64, Test Loss: 0.6736 Hidden Layers: [16], Activation: relu, Epochs: 59, LR: 0.001, Batch Size: 64, Test Loss: 0.6000 Hidden Layers: [16], Activation: relu, Epochs: 59, LR: 0.001, Batch Size: 64, Test Loss: 0.6738 Hidden Layers: [16], Activation: softmax, E

```
Hidden Layers: [16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6371
 Hidden Layers: [16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6387
Hidden Layers: [16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6632
Hidden Layers: [16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6647
Hidden Layers: [16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6773
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Hidden Layers: [16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 32, Test Loss: 0.7199
Hidden Layers: [16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.8438
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6326
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6458
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6313
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6264
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6343
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6357
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.655/
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 32, Test Loss: 0.6941
Hidden Layers: [16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.7209
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6622
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6431
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.6162
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6181
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6108
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6286
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 16, Test Loss: 0.6705
 Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.6901
Hidden Layers: [16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 64, Test Loss: 0.6905
```

Dari hasil eksperimen menggunakan konfigurasi dengan jumlah hidden layer sebanyak 16, terlihat bahwa pemilihan fungsi aktivasi dan parameter lainnya memiliki pengaruh signifikan terhadap performa model. Secara umum, fungsi aktivasi **ReLU** menunjukkan hasil yang lebih baik pada beberapa kombinasi parameter, terutama pada **epochs 50** dan **learning rate 0.01**, yang menghasilkan **test loss** terendah sekitar 0.6087 dengan **batch size 16**. Ini menunjukkan bahwa **ReLU** cenderung memberikan hasil yang lebih optimal untuk model ini.

Sebaliknya, fungsi aktivasi **sigmoid** dan **softmax** cenderung menghasilkan **test loss** yang lebih tinggi, terutama dengan learning rate rendah seperti **0.0001**. Misalnya, pada sigmoid dengan epoch 50 dan batch size 64, **test loss** mencapai 0.7561, yang lebih buruk dibandingkan dengan **ReLU** di konfigurasi serupa. Fungsi aktivasi ini mungkin mengalami kesulitan dalam konvergensi pada learning rate yang sangat kecil, yang dapat memengaruhi kemampuan model untuk menemukan solusi yang lebih baik.

Secara keseluruhan, hasil yang diperoleh mengindikasikan bahwa kombinasi **fungsi aktivasi ReLU**, **learning rate 0.01**, dan **epoch 50** lebih optimal dalam konteks ini, memberikan performa terbaik dalam hal **test loss**. Untuk hasil yang lebih stabil, disarankan untuk menghindari penggunaan learning rate yang terlalu kecil atau epoch yang sangat pendek, karena hal tersebut cenderung menurunkan performa model.

#### D. Hidden Layer [4,8]

```
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6932
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.7123
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6962
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6963
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6963
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6943
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.6943
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.6870
Hidden Layers: (4, 8), Activation: linear, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.6870
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6770
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6770
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.7901
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.7001
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.7001
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.7001
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.7002
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.7002
Hidden Layers: (4, 8), Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.7002
Hidden Layers: (4, 8), Activation: linear, Epochs: 59, LR: 0.001, Batch Size: 64, Test Loss: 0.7002
Hidden Layers: (4, 8), Activation: linear, Epochs: 59, LR: 0.001, Batch Size: 64, Test Loss: 0.7004
Hidden Layers: (4, 8), Activation: linear, Epochs
```

[4, 8], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6727 [4, 8], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6757
[4, 8], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 26, Test Loss: 0.6854
[4, 8], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6860
[4, 8], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.7876
[4, 8], Activation: relu, Epochs: 10, LR: 0.0001, Batch Size: 27, Test Loss: 0.8876
[4, 8], Activation: relu, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.9118 Hidden Layers: [4, 8], Activation: relu, Epochs: 10, LN: 0.4801, Batch Size: 32, lest Loss: 0.8886Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6609
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6609
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6527
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6550
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 63, Test Loss: 0.6550
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6540
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6550
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6541
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.0510
Hidden Layers: [4, 8], Activation: relu, Epochs: 25, LR: 0.0001, Batch Size: 32, Test Loss: 0.0510
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6548
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6604
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6604
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6091
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6093
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6094
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6098
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6098
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6098
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6 Hidden Layers: [4, 8], Activation: relu, Epochs: 30, LH: 0.0001, Batch Size: 42, Let Loss: 0.6889
Hidden Layers: [4, 8], Activation: relu, Epochs: 50, LH: 0.001, Batch Size: 64, Test Loss: 0.7569
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.01, Batch Size: 15, Test Loss: 0.6571
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6432
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6572
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6567
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6567
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.7558
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.9247
Hidden Layers: [4, 8], Activation: softmax, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.9479
Hidden Layers: [4, 8], Activation: softmax, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6584
Hidden Layers: [4, 8], Activation: softmax, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6304
Hidden Layers: [4, 8], Activation: softmax, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6304
Hidden Layers: [4, 8], Activation: softmax, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6364
Hidden Layers: [4, 8], Activation: softmax, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6587
Hidden Layers: [4, 8], Activation: softmax, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6598
Hidden Layers: [4, 8], Activation: softmax, Epochs: 55, LR: 0.001, Batch Size: 32, Test Loss: 0.6598
Hidden Layers: [4, 8], Activation: softmax, Epochs: 55, LR: 0.001, Batch Size: 32, Test Loss: 0.6598
Hidden Layers: [4, 8], Activation: softmax, Epochs: 55, LR: 0.001, Batch Size: 32, Test Loss: 0.6598
Hidden Layers: [4, 8], Activation: softmax, Epochs: 55, LR: 0.001, Batch Size: 32, Test Loss: 0.6598 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6375 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6356 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.6293 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6507 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6407 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6528 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.8258 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.8288 Hidden Layers: [4, 8], Activation: softmax, Epochs: 50, LR: 0.0001, Batch Size: 64, Test Loss: 0.8887

```
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6493
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6700
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6661
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6803
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6835
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6888
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.7075
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 32, Test Loss: 0.7697
Hidden Layers: [4, 8], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.8993
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6274
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6345
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6478
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6318
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6604
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6669
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 16, Test Loss: 0.6862
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 32, Test Loss: 0.7061
Hidden Layers: [4, 8], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.7633
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6471
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6279
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.6293
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6607
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6459
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6397
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 16, Test Loss: 0.6858
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.6961
Hidden Layers: [4, 8], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 64, Test Loss: 0.7268
```

Untuk konfigurasi hidden layers dengan [4,8], hasil menunjukkan bahwa penggunaan aktivasi **linear, sigmoid, ReLU, softmax**, dan **tanh** memberikan variasi performa yang signifikan tergantung pada kombinasi epoch, learning rate (LR), dan batch size. Pada umumnya, konfigurasi dengan aktivasi **sigmoid** dan **softmax** menunjukkan performa yang lebih baik pada epoch yang lebih tinggi dan learning rate yang lebih besar. Contohnya, pada epoch 50 dengan LR 0.01, batch size 64, **softmax** menghasilkan loss terendah, yakni 0.6293, yang lebih baik dibandingkan kombinasi lainnya. Sebaliknya, penggunaan aktivasi **linear** dan **sigmoid** dengan learning rate sangat kecil (0.0001) cenderung meningkatkan loss secara signifikan, menunjukkan ketidakefektifan kombinasi tersebut.

Dalam hal batch size, ukuran yang lebih kecil seperti 16 sering memberikan hasil yang lebih stabil, tetapi dengan waktu pelatihan yang lebih lama. Batch size yang lebih besar, seperti 64, memperlihatkan peningkatan loss pada konfigurasi tertentu, terutama dengan learning rate kecil. Pada epoch yang lebih tinggi (misalnya 50), loss yang tercatat cenderung lebih rendah, mencerminkan konvergensi yang lebih baik pada model, meskipun ada variasi pada konfigurasi aktivasi dan learning rate. Aktivasi **ReLU** dan **tanh**, meskipun kadang memberikan loss yang lebih tinggi, tetap menunjukkan potensi dalam konfigurasi yang lebih optimal di epoch dan LR yang lebih besar.

Secara keseluruhan, konfigurasi terbaik tampaknya melibatkan kombinasi aktivasi **softmax** atau **sigmoid** dengan epoch yang lebih tinggi dan learning rate moderat (0.01). Kombinasi ini memberikan performa terbaik pada beberapa uji, dengan loss yang lebih rendah di sebagian besar batch size. Ini menunjukkan pentingnya pemilihan parameter yang tepat dalam mencapai hasil yang optimal, terutama dalam klasifikasi dengan menggunakan MLP.

#### E. Hidden Layer [8, 16]

```
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.01, Batch Size: 16, Test Loss: 0.6982
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.01, Batch Size: 32, Test Loss: 0.7085
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.01, Batch Size: 13, Test Loss: 0.7143
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.001, Batch Size: 32, Test Loss: 0.6982
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.001, Batch Size: 32, Test Loss: 0.6982
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.001, Batch Size: 64, Test Loss: 0.6981
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.0001, Batch Size: 16, Test Loss: 0.6982
Hidden Layers: [8, 16], Activation: Linear, Epochs: 10, RR: 0.0001, Batch Size: 64, Test Loss: 0.6982
Hidden Layers: [8, 16], Activation: Linear, Epochs: 22, RR: 0.01, Batch Size: 64, Test Loss: 0.6982
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.01, Batch Size: 64, Test Loss: 0.6984
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.01, Batch Size: 32, Test Loss: 0.6984
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.01, Batch Size: 32, Test Loss: 0.6984
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.001, Batch Size: 32, Test Loss: 0.6984
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.001, Batch Size: 32, Test Loss: 0.6984
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.001, Batch Size: 16, Test Loss: 0.6987
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.0001, Batch Size: 16, Test Loss: 0.6987
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.0001, Batch Size: 16, Test Loss: 0.6987
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.0001, Batch Size: 16, Test Loss: 0.6994
Hidden Layers: [8, 16], Activation: Linear, Epochs: 25, RR: 0.0001, Batch Size: 32, Test Loss: 0.6994
Hidden Layers: [8, 16], Activation: Linear, Epochs: 26, RR: 0.0001, Batch Size: 32, Test Loss: 0.6994
Hidden Layers: [8, 16], Ac
```

Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.01, Batch Size: 16, Text Loss: 0.6367
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.01, Batch Size: 24, Text Loss: 0.6295
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.01, Batch Size: 24, Text Loss: 0.6295
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.01, Batch Size: 16, Text Loss: 0.6347
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.001, Batch Size: 16, Text Loss: 0.6548
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.001, Batch Size: 26, Text Loss: 0.6559
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.001, Batch Size: 32, Text Loss: 0.6559
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.001, Batch Size: 32, Text Loss: 0.6559
Hidden Layers: [8, 16], Activation: relu, Epochs: 10, LB: 0.001, Batch Size: 32, Text Loss: 0.6259
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.01, Batch Size: 32, Text Loss: 0.6359
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.01, Batch Size: 32, Text Loss: 0.6351
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.01, Batch Size: 32, Text Loss: 0.6351
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.01, Batch Size: 32, Text Loss: 0.6351
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.001, Batch Size: 32, Text Loss: 0.6352
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.001, Batch Size: 32, Text Loss: 0.6352
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.001, Batch Size: 32, Text Loss: 0.6558
Hidden Layers: [8, 16], Activation: relu, Epochs: 25, LB: 0.001, Batch Size: 32, Text Loss: 0.6558
Hidden Layers: [8, 16], Activation: relu, Epochs: 50, LB: 0.001, Batch Size: 32, Text Loss: 0.6502
Hidden Layers: [8, 16], Activation: relu, Epochs: 50, LB: 0.001, Batch Size: 32, Text Loss: 0.6528
Hidden Layers: [8, 16], Activation: relu, Epochs: 50, LB: 0.001, Batch Size: 32, Text Loss: 0.6528
Hidden Layers: [8, 16], Activation: relu, Epochs: 50, LB: 0.001, Batch Siz

```
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6223
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6711
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6343
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6548
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6646
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6735
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.7011
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 32, Test Loss: 0.7285
Hidden Layers: [8, 16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.8347
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6379
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6208
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6139
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6245
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6472
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6508
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 16, Test Loss: 0.6800 Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 32, Test Loss: 0.6878
Hidden Layers: [8, 16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.7110
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6122
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6176
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.6230
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6271
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6273
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6476
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 16, Test Loss: 0.6767
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.6818
Hidden Layers: [8, 16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 64, Test Loss: 0.6862
```

Pada konfigurasi **hidden layer [8, 16]**, eksperimen dengan berbagai pengaturan hyperparameter menunjukkan hasil yang variatif, terutama dalam hal fungsi aktivasi. Ketika menggunakan **linear**, test loss menunjukkan hasil yang relatif lebih tinggi, berkisar antara 0.6860 hingga 0.8033 untuk berbagai kombinasi learning rate dan batch size. Hal ini mengindikasikan bahwa konfigurasi linear mungkin kurang optimal untuk dataset ini, dengan nilai test loss yang tidak cukup rendah, bahkan meskipun ada penambahan epoch.

Namun, saat menggunakan **sigmoid**, hasil test loss mengalami penurunan yang signifikan, terutama pada konfigurasi dengan learning rate yang lebih tinggi (0.01) dan batch size kecil (16 atau 32). Nilai test loss mencapai 0.6218 hingga 0.6573 pada epoch 50, menunjukkan kinerja yang lebih baik dibandingkan dengan linear. Penggunaan **ReLU** juga memberikan hasil yang baik, dengan nilai test loss antara 0.6170 hingga 0.6607 pada epoch yang lebih panjang, yang menunjukkan bahwa **ReLU** lebih efektif dalam menangani masalah ini.

Pada konfigurasi **softmax**, meskipun memberikan hasil yang relatif baik pada batch size lebih kecil dan learning rate yang lebih besar, nilai test loss tidak dapat bersaing dengan hasil dari aktivasi sigmoid atau **ReLU**, terutama pada epoch yang lebih panjang. Test loss berkisar antara 0.6044 hingga 0.9131 pada epoch 50, yang menunjukkan bahwa softmax mungkin tidak ideal dalam konfigurasi ini. Demikian pula, dengan **tanh**, hasilnya tidak jauh lebih baik dari softmax, dengan test loss berada di kisaran 0.6223 hingga 0.8347. Secara keseluruhan, **sigmoid dan ReLU** tampaknya memberikan performa terbaik pada tugas ini, dengan sigmoid cenderung menunjukkan hasil yang lebih stabil pada beberapa konfigurasi hyperparameter.

## F. Hidden Layer [16,32]

```
Hidden Layers: [16, 32], Activation: Jinnar, Epochs: 10, UR: 0.01, Batch Size: 16, Test Loss: 0.7065
Hidden Layers: [16, 32], Activation: Jinnar, Epochs: 10, UR: 0.01, Batch Size: 21, Test Loss: 0.7088
Hidden Layers: [16, 32], Activation: Jinnar, Epochs: 10, UR: 0.01, Batch Size: 16, Test Loss: 0.7164
Hidden Layers: [16, 32], Activation: Jinnar, Epochs: 10, UR: 0.001, Batch Size: 16, Test Loss: 0.6989
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 10, UR: 0.001, Batch Size: 22, Test Loss: 0.6982
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 10, UR: 0.001, Batch Size: 32, Test Loss: 0.6982
Hidden Layers: [18, 32], Activation: Linnar, Epochs: 10, UR: 0.001, Batch Size: 32, Test Loss: 0.6983
Hidden Layers: [18, 32], Activation: Linnar, Epochs: 10, UR: 0.001, Batch Size: 32, Test Loss: 0.7085
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 19, UR: 0.001, Batch Size: 32, Test Loss: 0.7468
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.01, Batch Size: 32, Test Loss: 0.7087
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.01, Batch Size: 32, Test Loss: 0.7087
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.01, Batch Size: 32, Test Loss: 0.7087
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.01, Batch Size: 32, Test Loss: 0.7087
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.01, Batch Size: 64, Test Loss: 0.7081
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.001, Batch Size: 64, Test Loss: 0.6912
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.001, Batch Size: 64, Test Loss: 0.6912
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.001, Batch Size: 64, Test Loss: 0.7081
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 25, UR: 0.001, Batch Size: 64, Test Loss: 0.7081
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 50, UR: 0.001, Batch Size: 64, Test Loss: 0.7087
Hidden Layers: [16, 32], Activation: Linnar, Epochs: 50, UR: 0.001, Batch Size: 64, Test Loss: 0.7089
Hidden Layers:
```

| Hidden Layers: [16, 32], Activation: relu, Epochs: 19, LR: 0.01, Batch Size: 16, Test Loss: 0.6282 | Hidden Layers: [16, 32], Activation: relu, Epochs: 19, LR: 0.01, Batch Size: 22, Test Loss: 0.6031 | Hidden Layers: [16, 32], Activation: relu, Epochs: 19, LR: 0.01, Batch Size: 64, Test Loss: 0.6032 | Hidden Layers: [16, 32], Activation: relu, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6023 | Hidden Layers: [16, 32], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6226 | Hidden Layers: [16, 33], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6275 | Hidden Layers: [16, 32], Activation: relu, Epochs: 10, LR: 0.0001, Batch Size: 16, Fest Loss: 0.6375 | Hidden Layers: [16, 32], Activation: relu, Epochs: 19, LR: 0.0001, Batch Size: 16, Fest Loss: 0.6402 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6712 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6514 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6514 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6514 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6514 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6514 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6413 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6413 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6413 | Hidden Layers: [16, 32], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6601 | Hidden Layers: [16, 32], Activation: relu, Epochs: 26, LR: 0.001, Batch Size: 32, Test Loss: 0.6601 | Hidden Layers: [16, 32], Activation: relu, Epochs: 26, LR: 0.001, Batch Size: 32, Test Loss: 0.6601 | Hidden Layer

```
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6549
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6278
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6554
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6515
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6717
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.6929
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 32, Test Loss: 0.7011
Hidden Layers: [16, 32], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.7329
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6248
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6166
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6165
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6342
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6427
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6175
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 16, Test Loss: 0.6782
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 32, Test Loss: 0.6873
Hidden Layers: [16, 32], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.7061
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6097
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6011
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.6114
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.5995
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6254
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6142
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 16, Test Loss: 0.6641
Hidden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.6607
 didden Layers: [16, 32], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 64, Test Loss: 0.696
```

Untuk konfigurasi Hidden Layer [16, 32] dengan fungsi aktivasi yang berbeda, hasil evaluasi menunjukkan variasi yang cukup besar dalam nilai test loss, tergantung pada kombinasi hyperparameter yang digunakan. Dengan fungsi aktivasi **linear**, test loss menunjukkan nilai yang lebih tinggi, terutama pada pengaturan epoch yang lebih banyak dan learning rate yang lebih kecil, seperti pada epoch 50 dan learning rate 0.0001 yang menghasilkan test loss 0.6915. Namun, ketika menggunakan fungsi aktivasi **sigmoid**, **ReLU**, dan **softmax**, hasilnya menunjukkan kinerja yang lebih baik, terutama pada epoch yang lebih tinggi dengan learning rate yang lebih besar.

Konfigurasi dengan fungsi aktivasi **sigmoid** menunjukkan test loss yang lebih rendah pada epoch 10 dan 25, dengan learning rate 0.01, seperti pada kombinasi batch size 16 yang menghasilkan test loss 0.6242. Fungsi **ReLU** juga memberikan hasil yang cukup baik, dengan test loss yang lebih rendah pada kombinasi epoch 25 dan batch size 64, yang mencapai 0.5902. Meskipun fungsi aktivasi **softmax** dan **tanh** menunjukkan hasil yang lebih bervariasi, **softmax** cenderung menghasilkan nilai test loss yang lebih tinggi pada epoch dan learning rate yang lebih rendah, sedangkan **tanh** memberikan nilai test loss yang relatif stabil meskipun sedikit lebih tinggi pada beberapa pengaturan.

Secara keseluruhan, fungsi aktivasi **ReLU** dan **sigmoid** menunjukkan kinerja terbaik di antara semua pengaturan, dengan test loss yang lebih rendah pada berbagai kombinasi hyperparameter, terutama ketika batch size lebih besar dan epoch yang lebih tinggi digunakan. Meskipun ada beberapa fluktuasi pada beberapa kombinasi, seperti pada learning rate rendah, hasil ini menunjukkan pentingnya pemilihan fungsi aktivasi yang tepat dalam membangun model MLP untuk optimasi hasil yang lebih baik.

#### G. Hidden Layer [4, 8, 16]

```
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.01, Batch Size: 16, Test Loss: 0.6893
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.01, Batch Size: 32, Test Loss: 0.7187
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.01, Batch Size: 32, Test Loss: 0.7187
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.01, Batch Size: 14, Test Loss: 0.6938
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.001, Batch Size: 12, Test Loss: 0.6938
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.001, Batch Size: 22, Test Loss: 0.6948
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.001, Batch Size: 22, Test Loss: 0.7499
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.0001, Batch Size: 22, Test Loss: 0.7499
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 19, LR: 0.0001, Batch Size: 22, Test Loss: 0.7122
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 22, Test Loss: 0.7122
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 22, Test Loss: 0.7122
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 22, Test Loss: 0.7027
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 22, Test Loss: 0.7027
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.01, Batch Size: 22, Test Loss: 0.6934
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6934
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6934
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6934
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 59, LR: 0.001, Batch Size: 64, Test Loss: 0.6934
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 59, LR: 0.001, Batch Size: 64, Test Loss: 0.6936
Midden Layers: [4, 8, 16], Activation: linear, Epochs: 59, LR: 0.001, Batch S
```

Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6988 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6513 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6517 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6559 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6559 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6559 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6559 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 10, LR: 0.001, Batch Size: 12, Test Loss: 0.6563 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6567 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 22, Test Loss: 0.6567 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 23, Test Loss: 0.6567 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6567 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6568 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6568 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6578 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6578 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6571 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6571 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6571 Hidden Layers: [4, 8, 16], Activation: relu, Epochs: 59, LR: 0.01, Batch Size: 16, Test Loss: 0.6501 Hidden Layers:

```
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 16, Test Loss: 0.6376
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 32, Test Loss: 0.6413
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.01, Batch Size: 64, Test Loss: 0.6753
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 16, Test Loss: 0.6657
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 32, Test Loss: 0.6830
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.001, Batch Size: 64, Test Loss: 0.6826
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 16, Test Loss: 0.7013
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 32, Test Loss: 0.7590
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 10, LR: 0.0001, Batch Size: 64, Test Loss: 0.8031
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 16, Test Loss: 0.6328
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 32, Test Loss: 0.6362
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.01, Batch Size: 64, Test Loss: 0.6385
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 16, Test Loss: 0.6502
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 32, Test Loss: 0.6591
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.001, Batch Size: 64, Test Loss: 0.6716
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 16, Test Loss: 0.6924
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 32, Test Loss: 0.6936
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 25, LR: 0.0001, Batch Size: 64, Test Loss: 0.7525
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 16, Test Loss: 0.6334
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 32, Test Loss: 0.6311
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.01, Batch Size: 64, Test Loss: 0.6165
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 16, Test Loss: 0.6364
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 32, Test Loss: 0.6447
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.001, Batch Size: 64, Test Loss: 0.6674
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 16, Test Loss: 0.6907
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 32, Test Loss: 0.6925
Hidden Layers: [4, 8, 16], Activation: tanh, Epochs: 50, LR: 0.0001, Batch Size: 64, Test Loss: 0.6997
```

Dari hasil eksperimen dengan jumlah hidden layers [4, 8, 16] pada berbagai kombinasi fungsi aktivasi, epoch, learning rate, dan batch size, dapat disimpulkan bahwa konfigurasi dengan fungsi aktivasi **softmax** memberikan performa yang paling stabil. Pada epoch 50, learning rate 0.01, dan batch size 16, model menghasilkan test loss yang paling rendah, yaitu **0.6259**, menunjukkan bahwa pengaturan ini cenderung lebih efektif dalam mengoptimalkan model.

Sebaliknya, fungsi aktivasi **sigmoid** dan **tanh** menunjukkan performa yang lebih buruk dibandingkan dengan softmax, terutama pada learning rate yang lebih kecil (0.0001). Hal ini terlihat jelas dengan test loss yang lebih tinggi pada kombinasi seperti **0.9391** (sigmoid, epoch 10, lr 0.0001) dan **0.6376** (tanh, epoch 10, lr 0.01). Fungsi aktivasi sigmoid, dalam hal ini, tampaknya tidak cukup optimal untuk dataset ini, sedangkan tanh cenderung memberikan sedikit perbaikan dibandingkan sigmoid.

Secara umum, **ReLU** juga menunjukkan performa yang baik, terutama pada epoch lebih panjang (25-50) dengan test loss sekitar **0.6321** hingga **0.6563** untuk berbagai kombinasi. Namun, kombinasi dengan learning rate yang lebih rendah, seperti **0.0001**, menghasilkan test loss yang lebih buruk, mencapai sekitar **0.8595** pada epoch 10. Fungsi aktivasi **linear** menunjukkan hasil yang lebih variatif, dengan beberapa konfigurasi memberikan test loss yang cukup tinggi, seperti pada epoch 25 dengan learning rate 0.0001 yang menghasilkan **0.8171**.