**Analisis MSE, R-squared, dan Normalitas Residual**

1. Model: MLPRegressor
2. Hyper parameter tuning:

* Jumlah neurons
* Kedalaman
* Optimizer (adam, lbfgs, sgd)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Neurons | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| 8 | 0, 0004680 | 0, 0004627 | -0, 000381 | -0, 000021 |
| 16 | 0, 0005242 | 0, 0005205 | -0, 120457 | -0, 121287 |
| 32 | 0, 0004697 | 0, 0004657 | -0, 004013 | -0, 004013 |
| 64 | 0, 0004693 | 0, 0004651 | -0, 003270 | -0, 001805 |
| 128 | 0, 0004771 | 0, 0004730 | -0, 019951 | -0, 018883 |
| 256 | 0, 0005139 | 0, 0005104 | -0, 098530 | -0, 099491 |

Paling optimal = 8 neurons:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Kedalaman | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| 3 | 0, 0004680 | 0, 0004627 | -0, 000381 | -0, 000021 |
| 5 | 0, 0004690 | 0, 0004647 | -0, 002622 | -0, 001037 |
| 7 | 0, 0004654 | 0, 0004612 | 0, 0051490 | 0, 0064402 |
| 9 | 0, 0004672 | 0, 0004635 | 0, 0014014 | 0, 0016008 |
| 11 | 0, 0004679 | 0, 0004642 | -0, 0001017 | -0, 000473 |

Paling optimal = 8 neurons + 7 depth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Optimizer | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| adam | 0, 0004654 | 0, 0004612 | 0, 0051490 | 0, 0064402 |
| sgd | 0, 0004631 | 0, 0004605 | 0, 0075641 | 0, 0080226 |
| lbfgs | 0, 0004657 | 0, 0004620 | 0, 0045909 | 0, 0048534 |

Paling optimal = 8 neurons + 7 depth + sgd (tp banyak outlier)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Learing rate | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| constant | 0, 0004631 | 0, 0004605 | 0, 0075641 | 0, 0080226 |
| invscaling | 0, 0004643 | 0, 0004605 | 0, 0075634 | 0, 0080272 |
| adaptive | 0, 0004643 | 0, 0004605 | 0, 0075793 | 0, 0081083 |

Paling optimal = 8 neurons + 7 depth + sgd + adaptive

STEP PAPER:

1. Pendahuluan (Introduction)

-EDM

-increasing university standards

-giving more attention to student who hanve small GPA predicted

-predicting GPA is regression problem

-solving with MLP Regressor

1. Penelitian Terkait (Related Work)
2. Implementasi (Implementation)

- metode

- dataset

- distribusi dataset yg diolah model, perlu optimasi dengan hyper parameter tuning

- neurons tuning (tampilkan tabel hasil percobaan)

- depth tuning (tampilkan tabel hasil perocbaan)

- optimizer tuning (tampilkan tabel hasil percobaan)

- learning rate tuning (tampilkan tabel hasil percobaan dan gambar distribusi normalitas residual

- implementasi dalam web apps menggunakan streamlit (tampilkan halaman prediksi, ada 2 gambar)

1. Kesimpulan (Conclusion)

REV

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Neurons | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| 8 | 0, 1017338 | 0, 1158513 | 0, 1884257 | 0, 0882128 |
| 16 | 0, 0935056 | 0, 0893567 | 0, 2540654 | 0, 2975205 |
| 32 | 0, 0960541 | 0, 0872938 | 0, 2337430 | 0, 3129691 |
| 64 | 0, 0934673 | 0, 0873010 | 0, 2542705 | 0, 3129126 |
| 128 | 0, 1008586 | 0, 0944057 | 0, 1954074 | 0, 2569966 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Kedalaman | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| 3 | 0, 0934673 | 0, 0873010 | 0, 2542705 | 0, 3129126 |
| 5 | 0, 0941192 | 0, 0819453 | 0, 2491703 | 0, 3550639 |
| 7 | 0, 0929088 | 0, 1210244 | 0, 2588268 | 0, 0047498 |
| 9 | 0, 0966011 | 0, 0942628 | 0, 2293710 | 0, 2589165 |
| 11 | 0, 0938161 | 0, 0844815 | 0, 2515884 | 0, 3351029 |

Semakin dalam, model semakin tidak stabil. Yang dipakai adalah 64 neurons with 3 depth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Optimizer | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| adam | 0, 0934673 | 0, 0873010 | 0, 2542705 | 0, 3129126 |
| sgd | 0, 0925673 | 0, 0844448 | 0, 2615505 | 0, 3353622 |
| lbfgs | 0, 0929823 | 0, 1098250 | 0, 2582396 | 0, 1356414 |

Paling optimal adalah 64 + 3 + sgd. Sgd membuat MSE model turun dan R-squared naik dengan stabil.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Learing rate | MSE (Validation) | MSE (Testing) | R-squared (Val) | R-squared (Test) |
| constant | 0, 0925673 | 0, 0844448 | 0, 2615505 | 0, 3353622 |
| invscaling | 0, 2384611 | 0, 2381294 | -0, 9023066 | -0, 8741546 |
| adaptive | 0, 0925673 | 0, 0844448 | 0, 2615505 | 0, 3353622 |

Optimal:

* 64 + 3 + sgd + constant
* 64 + 3 + sgd + adaptive