# YOLO Model Comparison

## Performance Comparison

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model Version | Precision | Recall | mAP@50 | mAP@50-95 |
| YOLOv5 | 0.36321 | 0.29375 | 0.27527 | 0.10979 |
| YOLOv8 | 0.39189 | 0.32703 | 0.30174 | 0.13399 |
| YOLOv9 | 0.36804 | 0.34132 | 0.30875 | 0.1399 |
| YOLOv11 | 0.43098 | 0.30092 | 0.30819 | 0.14381 |

## Training Loss Comparison

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| --- | --- | --- | --- |
| Model Version | Box Loss | Class Loss | DFL Loss |
| YOLOv5 | 1.49627 | 0.97016 | 1.06157 |
| YOLOv8 | 0.8935 | 0.52603 | 0.99198 |
| YOLOv9 | 1.05822 | 0.61511 | 1.12335 |
| YOLOv11 | 1.06712 | 0.63631 | 1.02607 |

## Validation Loss Comparison

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| --- | --- | --- | --- |
| Model Version | Box Loss | Class Loss | DFL Loss |
| YOLOv5 | 2.49573 | 2.23867 | 1.57431 |
| YOLOv8 | 1.97681 | 2.01803 | 1.65983 |
| YOLOv9 | 2.44268 | 2.55416 | 2.24973 |
| YOLOv11 | 1.86944 | 1.62179 | 1.44827 |

## Learning Rate Comparison

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| --- | --- | --- | --- |
| Model Version | LR PG0 | LR PG1 | LR PG2 |
| YOLOv5 | 0.000398 | 0.000398 | 0.000398 |
| YOLOv8 | 3.31733e-05 | 3.31733e-05 | 3.31733e-05 |
| YOLOv9 | 3.31733e-05 | 3.31733e-05 | 3.31733e-05 |
| YOLOv11 | 3.31733e-05 | 3.31733e-05 | 3.31733e-05 |

## Training Time Comparison

|  |  |
| --- | --- |
| Model Version | Training Time (Seconds) |
| YOLOv5 | 931.654 |
| YOLOv8 | 3116.82 |
| YOLOv9 | 3019.8 |
| YOLOv11 | 2265.86 |