**MSBA 503 Take-Home Assignment**

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GitHub Link to Take Home Assignment is below.

[willkilday/MSBA503\_TakeHome: take home assignment](https://github.com/willkilday/MSBA503_TakeHome/tree/main)

**PART A**

**(i)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Image** | **Model** | **Inference Time** | **Objects Detected** | **Objects Assigned** | **Highest Probability (%)** |
| 1 - Bear | YOLO | 1263.3 | 1 | Bear | 0.96 |
| 1 - Bear | RCNN | 19358.41 | 1 | Bear | 1.00 |
| 1 - Bear | SSD | 3648.14 | 1 | Giraffe | 1.00 |
| 2 - Tetras | YOLO | 1253.9 | 19 | Birds | 0.87 |
| 2 - Tetras | RCNN | 12317.47 | 6 | Birds | 0.87 |
| 2 - Tetras | SSD | 1907.11 | 2 | Bear, Hot Dog | 0.59 |
| 3 - Jets | YOLO | 1513.0 | 9 | airplane | 0.95 |
| 3 - Jets | RCNN | 10470.99 | 9 | airplane | 1.00 |
| 3 - Jets | SSD | 2337.41 | 9 | bus, dog | 0.80 |
| 4 – Highway System | YOLO | 685.4 | 0 | None | None |
| 4 – Highway System | RCNN | 5432.77 | 5 | Car, Broccoli, bench | 0.94 |
| 4 – Highway System | SSD | 836.75 | 0 | None | None |
| 5 - Shrimp | YOLO | 4221.0 | 2 | Orange, Carrot | 0.36 |
| 5 - Shrimp | RCNN | 16289.51 | 5 | Broccoli, Carrot | 0.92 |
| 5 - Shrimp | SSD | 1877.06 | 1 | Dog | 0.86 |
| 6 - Motorcycle | RCNN | 14122.29 | 3 | Motorcycle, Car | 1.00 |
| 6 - Motorcycle | YOLO | 3784.3 | 3 | Motorcycle, car | 0.96 |
| 6 - Motorcycle | SSD | 2252.64 | 2 | Airplane, motorcycle | 1.00 |
| 7 – Jimmy Page | RCNN | 11858.27 | 3 | Person, Skateboard | 0.99 |
| 7 – Jimmy Page | YOLO | 2196.2 | 1 | Person | 0.89 |
| 7 – Jimmy Page | SSD | 2916.84 | 2 | Bicycle, cup | 0.95 |
| 8 – Tomatoes | RCNN | 3402.70 | 11 | apples, oranges | 0.91 |
| 8 – Tomatoes | YOLO | 909.9 | 19 | apples, oranges | 0.87 |
| 8 – Tomatoes | SSD | 832.00 | 2 | Pizza | 0.53 |
| 9 - Greyhound | RCNN | 4922.07 | 1 | Dog | 0.98 |
| 9 - Greyhound | YOLO | 628.2 | 1 | Dog | 0.96 |
| 9 - Greyhound | SSD | 757.56 | 1 | Sheep | 0.92 |

|  |  |  |
| --- | --- | --- |
|  | **Average Inference Time (ms)** | **Average Highest Probability (%)** |
| RCNN | 10,908.28 | 0.96 |
| YOLO | 1,828.36 | 0.76 |
| SSD | 1,929.50 | 0.74 |

These two tables show the varying performance across the three object detection models, RCNN, YOLO, and SSD (Single Shot MultiBox Detector). While RCNN was the slowest with an average inference time of 10,908.28 ms, it showed the highest accuracy with an average highest probability of 96%. In contrast, YOLO and SSD offered around 6x faster processing times at 1,828.36 ms and 1,929.50 ms respectively, but with lower accuracy, as reflected by their average highest probabilities of 0.76 and 0.74. Specifically SSD had a poor identification accuracy, never actually identifying the object correctly showing the trade off between speed and accuracy when selecting a model.

**(ii)**

|  |  |
| --- | --- |
| **Image** | **Identification and Probabilties (%)** |
| 1 – Bear (Brown Bear) | brown\_bear 0.117  sloth\_bear 0.004  Sussex\_spaniel 0.002  black-footed\_ferret 0.002  hyena 0.002 |
| 2 – Fish (Tetras) | envelope 0.130  traffic\_light 0.122  street\_sign 0.056  carton 0.0379  crossword\_puzzle 0.017 |
| 3 – Jets (Fighter Jets + Bomber) | warplane 0.443  wing 0.095  airliner 0.010  starfish 0.004  aircraft\_carrier 0.003 |
| 4 – Highway System | vault 0.251  greenhouse 0.063  church 0.042  dome 0.019  coil 0.0151 |
| 5 – Shrimp | crayfish 0.198  isopod 0.032  spiny\_lobster 0.030  American\_lobster 0.021  centipede 0.020 |
| 6 – Motorcycle (Sport Bike) | crash\_helmet 0.186  motor\_scooter 0.080  disk\_brake 0.043  moped 0.020  car\_wheel 0.010 |
| 7 – Musician (Jimmy Page with Electric Guitar) | electric\_guitar 0.200  stage 0.065  microphone 0.037  acoustic\_guitar 0.026  sax 0.011038390919566154 |
| 8 – Tomato Plant with tomatoes | cucumber 0.069  orange 0.050  grocery\_store 0.044  hip 0.0262  crate 0.014 |
| 9 – Greyhound Dog (large whippet) | whippet 0.270  Scottish\_deerhound 0.029  Saluki 0.027  Irish\_wolfhound 0.021  Ibizan\_hound 0.013 |

Part B used pre-trained deep learning model with ResNet50 and the database ImageNet to help correctly identify objects from Part A but with better detail. Despite correctly recognizing several subjects, such as a brown bear and fighter jets, the model occasionally misidentified or assigned low-confidence predictions to the images that weren’t as simple and more congested (highway system, tomato plants). Still, Part B’s model is a great improvement than Part A in identification, with bear becoming brown bear, airplane becoming warplane, shrimp actually being identified, Jimmy Page becoming electric guitar, and dog becoming the actual breed, whippet.