**Results for OCC Case Study**

# Set Up

## Duration

|  |  |  |  |
| --- | --- | --- | --- |
| Behaviour | Mean dur | Volume (min) | Window |
| Dog Data | | | |
| Multiclass | 2.57 | 971.79 | 1 |
| Walking | 4.76 | 109.88 | 4.5 |
| Shaking | 1.51 | 6.19 | 1.5 |
| Eating | 1.75 | 43.75 | 1.5 |
| Lying chest | 1.22 | 66.42 | 1 |
| Seal data | | | |
| Multiclass | 0.88 | 578.86 | 0.5 |
| Swimming | 1.04 | 122.55 | 1 |
| Scratch | 1.40 | 4.87 | 1 |
| Still | 0.75 | 70.50 | 0.5 |
| Chewing | 0.64 | 13.69 | 0.5 |

## Behavioural Clustering

Behavioural clusters for seal data were replicated from the 2016 paper. A similar grouping paradigm was used for the dog data.

|  |  |  |
| --- | --- | --- |
| Domestic Dogs | | |
| Activity | **“Other”** | **Generalised** |
| Eating | Eating | Feeding |
| Drinking | Other |
| Sniffing | Other |
| Shaking | Shaking | Grooming |
| Lying chest | Lying chest | Resting |
| Sitting | Other |
| Standing | Other |
| Carrying object | Other | Travelling |
| Galloping | Other |
| Jumping | Other |
| Packing | Other |
| Trotting | Other |
| Tugging | Other |
| Walking | Walking |

# Seal Data

## Hyperparameter Optimisation

Random initialisations = 5, iterations = 10, acq = "ucb", kappa = 2.576

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Behaviour | Window | ROUND | Kernel | Nu | Gamma | Trees | Features | PR\_AUC/F1 |
| swimming | 1 | 8 | radial | 0.091 | 0.0527 | 409.408 | 18.281 | 0.689 |
| scratch | 1 | 12 | polynomial | 0.056 | 0.0480 | 362.464 | 72.866 | 0.922 |
| still | 0.5 | 14 | radial | 0.100 | 0.100 | 100.000 | 75.000 | 0.774 |
| chewing | 0.5 | 8 | polynomial | 0.001 | 0.056 | 120.100 | 15.961 | 0.703 |
| All |  |  |  |  |  |  |  |  |
| Other | 1 | 15 | polynomial | 0.0988 | 0.001 | 500.00 | 10.00 | 0.827 |
| General | 1 | 6 | radial | 0.100 | 0.001 | 100.00 | 10.00 | 0.610 |

## Testing Optimal Model Performance

Scores for each model on the hold-out test set.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Metric | Swimming | Scratch | Still | Chewing |
| AUC | 0.565 | 0.499 | 0.617 | 0.6762 |
| PR-AUC | 0.529 | 0.518 | 0.411 | 0.736 |
| threshold | 0 | 0 | 0.05 | 0 |
| F1 | 0.670 | 0.194 | 0.531 | 0.630 |
| Precision | 0.534 | 0.5 | 0.454 | 0.545 |
| Recall | 0.899 | 0.12 | 0.639 | 0.746 |
| Accuracy | 0.557 | 0.5 | 0.435 | 0.562 |
| TP | 3168 | 24 | 731 | 792 |
| TN | 759 | 175 | 265 | 401 |
| FP | 2763 | 24 | 879 | 661 |
| FN | 354 | 175 | 413 | 270 |

With the specific scores of each class in the multiclass model displayed below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Seal, all Activity classes | | | | | | |
| Metric | **Macro** | **Swimming** | **Scratch** | **Still** | **Chewing** |  |
| F1 | 0.149 | 0.430 | 0.009 | 0.075 | NaN |  |
| Precision | 0.206 | 0.320 | 0.0454 | 0.0526 | 0.000 |
| Recall | 0.067 | 0.656 | 0.005 | 0.133 | 0.000 |
| Balanced Accuracy | 0.517 | 0.625 | 0.502 | 0.513 | 0.500 |
| Seal, Other class | | | | | | |
| Metric | **Macro** | **Swimming** | **Scratch** | **Still** | **Chewing** | **Other** |
| F1 | 0.822 | NaN | NaN | NaN | NaN | 0.822 |
| Precision | 0.698 | NA | NA | NA | NA | 0.700 |
| Recall | 0.2 | 0 | 0 | 0 | 0 | 1 |
| Balanced Accuracy | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Seal, cleaned and generalised classes | | | | | | |
| Metric | **Macro** | **Travelling** | **Grooming** | **Rest** | **Feeding** |  |
| F1 | 0.297 | 0.7627 | 0.0056 | 0.410 | 0.008 |  |
| Precision | 0.533 | 0.650 | 1.000 | 0.3887 | 0.09459 |
| Recall | 0.341 | 0.922 | 0.0028 | 0.433 | 0.004 |
| Balanced Accuracy | 0.568 | 0.6128 | 0.501 | 0.657 | 0.4987 |

# Dog Data

## Hyperparameter Optimisation

Random initialisations = 5, iterations = 10, acq = "ucb", kappa = 2.576

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Behaviour | Window | ROUND | Kernel | Nu | Gamma | Trees | Features | PR\_AUC/F1 |
| WALKING | 4.5 | 15 | radial | 0.009 | 0.035 | 418.756 | 46.472 | 0.684 |
| SHAKING | 1.5 | 11 | radial | 0.001 | 0.100 | 500.00 | 75.00 | 0.989 |
| LYING CHEST | 1 | 8 | radial | 0.100 | 0.100 | 100.00 | 67.409 | 0.725 |
| EATING | 1.5 | 3 | radial | 0.0436 | 0.0865 | 358.814 | 58.621 | 0.707 |
| All | 1 | 5 | radial | 0.0582 | 0.0436 | 245.314 | 40.893 | 0.629 |
| Other | 1 | 15 | radial | 0.0614 | 0.001 | 295.148 | 24.962 | 0.733 |
| General | 1 | 4 | radial | 0.0792 | 0.0750 | 167.885 | 21.380 | 0.917 |

## Testing Optimal Model Performance

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Metric | Walking | Shaking | Lying Chest | Eating |
| AUC | 0.7838 | 0.734 | 0.550 | 0.733 |
| PR-AUC | 0.7595 | 0.785 | 0.459 | 0.7254 |
| threshold | 0.03 | 0 | 0 | 0 |
| F1 | 0.7744 | 0 | 0.364 | 0.563 |
| Precision | 0.7124 | 0 | 0.4266 | 0.653 |
| Recall | 0.8482 | 0 | 0.3176 | 0.495 |
| Accuracy | 0.7529 | 0.5 | 0.445 | 0.616 |
| TP | 218 | 0 | 128 | 100 |
| TN | 169 | 29 | 231 | 149 |
| FP | 88 | 0 | 172 | 53 |
| FN | 39 | 29 | 275 | 102 |

With the specific scores of each class in the multiclass model displayed below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Dog, all Activity classes | | | | | | |
| Metric | **Macro** | **Walking** | **Shaking** | **Lying Chest** | **Eating** |  |
| F1 | 0.5027 | 0.7547 | 0.2429 | 0.1324 | 0.3516 |  |
| Precision | 0.3906 | 0.6541 | 0.1413 | 0.0879 | 0.355 |
| Recall | 0.4525 | 0.8919 | 0.8667 | 0.2686 | 0.3478 |
| Balanced Accuracy | 0.7100 | 0.9172 | 0.9275 | 0.5469 | 0.6629 |
| dog, Other class | | | | | | |
| Metric | **Macro** | **Walking** | **Shaking** | **Lying Chest** | **Eating** | **Other** |
| F1 | 0.6692 | 0.2663 | 0.8667 | NA | NA | 0.8747 |
| Precision | 0.6635 | 0.3054 | 0.8667 | NA | NA | 0.8185 |
| Recall | 0.4084 | 0.2362 | 0.8667 | 0 | 0 | 0.9392 |
| Balanced Accuracy | 0.6162 | 0.5853 | 0.9332 | 0.500 | 0.5000 | 0.5625 |
| dog, cleaned and generalised classes | | | | | | |
| Metric | **Macro** | **Travelling** | **Grooming** | **Rest** | **Feeding** |  |
| F1 | 0.8813 | 0.9337 | 0.7857 | 0.9089 | 0.8969 |  |
| Precision | 0.9008 | 0.9167 | 0.8461 | 0.8827 | 0.9575 |
| Recall | 0.8662 | 0.9514 | 0.7333 | 0.9367 | 0.8435 |
| Balanced Accuracy | 0.9169 | 0.9438 | 0.8664 | 0.9427 | 0.9144 |