1. Linear OSCR Curves

Depending on the application, different false positive values are of importance. In the main paper, we focus more on the low FPR regions since these are of more importance when a human needs to look into the positive cases and, hence, large numbers of false positives involve labor cost. When false positives are not of utmost importance, e.g., when handled by an automated system in low-security applications, the focus will be more on having high correct classification rate. Therefore, in Fig. 1 we provide the OSCR plots according to figure 2 of the main paper, but this time with linear FPR axis. These plots highlight even more that the Entropic Open-Set (EOS) and the SoftMax with Background class (BG) approaches fail when known and unknown classes are very similar, as provided in $P_2$ and $P_3$.

2. Results Sorted by Protocol

Fig. 2 displays the same results as shown in Figure 2 of the main paper, but here we compare the results of the different protocols. This shows that the definition of our protocols follows our intuition. We can see that protocol $P_1$ is easy in open-set, but difficult in closed-set operation, especially when looking to the performance of BG and EOS, which are designed for open-set classification. On the opposite, protocol $P_3$ achieves higher closed-set recognition performance (at FPR = 1) while dropping much faster for lower FPR values. Protocol $P_2$ is difficult both in closed- and open-set evaluation, but open-set performance does not drop that drastically as in $P_3$, especially considering the unknown test data in the second row. Due to its relatively small size, $P_2$ is optimal for hyperparameter optimization and hyperparameters should be able to be transferred to the other two protocols – unless the algorithm is critical w.r.t. hyperparameters. We leave hyperparameter optimization to future work.

3. Detailed Results

In Tab. 1 we include detailed numbers of the values seen in figures 2 and 3 of the main paper. We also include the cases where we use our confidence metric to select the best epoch of training. When comparing Tab. 1(a) with Tab. 1(b) it can be seen that the selection of the best algorithm based on the confidence score provides better CCR values for BG in protocols $P_1$ and $P_2$, and better or comparable numbers for EOS across all protocols. The advantage of $S$ is not that expressed since $S$ does not take into consideration negative samples and, thus, the confidence for unknown $\gamma^-$ gets very low in Tab. 1(a). When using our validation metric, training stops early and does not provide a good overall, i.e., closed-set performance. Therefore, we propose to use our novel evaluation metric for training open-set classifiers, but not for closed-set classifiers such as $S$.

4. Detailed List of Classes

For reproducibility, we also provide the list of classes (ImageNet identifier and class name) that we used in our three protocols in Tables 2, 3 and 4. For known and negative classes, we used the samples of the original training partition for training and validation, and the samples from the validation partition for testing – since the test set labels of ILSVRC2012 are still not publicly available.
Figure 1: **Linear OSCR Curves.** OSCR curves in linear scale for negative data (top row) and unknown data (bottom row) of the test set for each protocol.

Figure 2: **Comparison of Protocols.** OSCR curves are split by algorithm to allow a comparison across protocols. Results are shown for negative data (top row) and unknown data (bottom row).
Table 1: **Classification Results.** Correct Classification Rates (CCR) are provided at some False Positive Rates (FPR) in the test set. The best CCR values are in bold. $\gamma^+$ is calculated using known and $\gamma^-$ using unknown classes.

(a) Using Last Epoch

| Epoch | Confidence | CCR at FPR of: |   |   |   |   |
|-------|------------|----------------|---|---|---|---|
|       | $\gamma^+$ | $\gamma^-$     | 1e-3 | 1e-2 | 1e-1 | 1 |
| $P_1$ - S | 120 | **0.665** | 0.470 | 0.077 | 0.326 | 0.549 | 0.678 |
| $P_1$ - BG | 120 | 0.650 | 0.520 | 0.146 | 0.342 | 0.519 | 0.663 |
| $P_1$ - EOS | 120 | 0.663 | **0.846** | **0.195** | **0.409** | **0.667** | **0.684** |
| $P_2$ - S | 120 | **0.665** | 0.341 | — | 0.189 | 0.443 | **0.683** |
| $P_2$ - BG | 120 | 0.598 | 0.480 | — | 0.111 | 0.339 | 0.616 |
| $P_2$ - EOS | 120 | 0.592 | **0.708** | — | **0.233** | **0.476** | 0.664 |
| $P_3$ - S | 120 | **0.767** | 0.240 | — | — | 0.540 | **0.777** |
| $P_3$ - BG | 120 | 0.753 | 0.344 | — | 0.241 | 0.543 | 0.764 |
| $P_3$ - EOS | 120 | 0.684 | **0.687** | — | **0.298** | **0.568** | 0.763 |

(b) Using Best Epoch

| Epoch | Confidence | CCR at FPR of: |   |   |   |   |
|-------|------------|----------------|---|---|---|---|
|       | $\gamma^+$ | $\gamma^-$     | 1e-3 | 1e-2 | 1e-1 | 1 |
| $P_1$ - S | 20 | 0.584 | **0.906** | 0.270 | 0.543 | 0.664 | 0.667 |
| $P_1$ - BG | 99 | 0.660 | 0.628 | 0.167 | 0.420 | 0.572 | 0.673 |
| $P_1$ - EOS | 105 | **0.672** | 0.877 | **0.283** | **0.535** | **0.683** | **0.694** |
| $P_2$ - S | 39 | 0.603 | 0.528 | **0.031** | 0.134 | 0.384 | 0.659 |
| $P_2$ - BG | 113 | **0.638** | 0.491 | — | 0.156 | 0.368 | 0.658 |
| $P_2$ - EOS | 101 | 0.599 | **0.694** | — | **0.223** | **0.473** | **0.666** |
| $P_3$ - S | 15 | 0.677 | 0.527 | **0.083** | 0.239 | 0.509 | 0.745 |
| $P_3$ - BG | 115 | **0.747** | 0.379 | — | 0.243 | 0.539 | 0.761 |
| $P_3$ - EOS | 114 | 0.696 | **0.688** | — | **0.266** | **0.585** | **0.772** |
Table 2: PROTOCOL 1 CLASSES: List of super-classes and leaf nodes of Protocol P1.

| Id     | Name               | Id     | Name               | Id     | Name               |
|--------|--------------------|--------|--------------------|--------|--------------------|
| n02084071 | dog                | n02113333 | fox               | n07555863 | food               |
| n02085620 | Chihuahua          | n02119022 | red fox           | n0764084  | French loaf        |
| n02087036 | Maltese dog        | n02119789 | kit fox           | n07695725 | bagel              |
| n02086079 | Pekinese           | n02120679 | Arctic fox        | n07695742 | pretzel            |
| n02086240 | Shih-Tzu           | n02120505 | grey fox          | n07714571 | head cabbage       |
| n02086910 | Blenheim spaniel   | n02115335 | wild dog          | n07714990 | broccoli           |
| n02086646 | Japanese spaniel   | n02119789 | dingo             | n07715103 | cauliflower        |
| n02085620 | Japanese spaniel   | n02115335 | dingo             | n07715103 | cauliflower        |
| n02086079 | Pekinese           | n02120679 | Arctic fox        | n07695742 | pretzel            |
| n02086240 | Shih-Tzu           | n02120505 | grey fox          | n07714571 | head cabbage       |
| n02086910 | Blenheim spaniel   | n02115335 | wild dog          | n07714990 | broccoli           |
| n02086646 | Japanese spaniel   | n02119789 | dingo             | n07715103 | cauliflower        |

Continued on next page
## Protocol 1 Classes: List of super-classes and leaf nodes of Protocol $P_1$.

| Known | Negative | Unknown |
|-------|----------|---------|
| Id    | Name     | Id      | Name          | Id      | Name                  |
| n02104365 | schipperke | n02493783 | spider monkey | n03180011 | desktop computer      |
| n02105056 | groenendael | n02494079 | squirrel monkey | n03196217 | digital clock         |
| n02105162 | malinois   | n02497673 | Madagascar cat | n03197337 | digital watch         |
| n02105251 | briard     | n02500267 | indri         | n03208938 | disk brake            |
| n02105412 | kelpie     |         |               | n03218960 | drum                   |
| n02105505 | komondor   |         |               | n03271574 | electric fan           |
| n02105641 | Old English sheepdog | n02500267 |         | n03272010 | electric guitar        |
| n02105855 | Shetland sheepdog |         |               | n03372929 | flute                  |
| n02106030 | collie     |         |               | n03394916 | French horn            |
| n02106166 | Border collie |         |               | n03425413 | gas pump               |
| n02106382 | Bouvier des Flandres |         |               | n03447721 | gong                   |
| n02106550 | Rottweiler |         |               | n03452741 | grand piano            |
| n02106662 | German shepherd |         |               | n03467068 | guillotine             |
| n02107142 | Doberman   |         |               | n03476684 | hair slide             |
| n02107312 | miniature pinscher |         |               | n03485407 | hand-held computer     |
| n02107574 | Greater Swiss Mounta |         |               | n03492542 | harp                   |
| n02107683 | Bernese mountain dog |         |               | n03494278 | harmonica              |
| n02107908 | Appenzeller |         |               | n03495258 | harp                   |
| n02108000 | EntleBucher |         |               | n03496892 | harvester              |
| n02108089 | boxer      |         |               | n03532672 | hook                   |
| n02108422 | bull mastiff |         |               | n03541443 | hourglass              |
| n02108551 | Tibetan mastiff |         |               | n03590841 | jack-o'-lantern        |
| n02108915 | French bulldog |         |               | n03602732 | knot                   |
| n02109047 | Great Dane |         |               | n03624804 | laptop                 |
| n02109525 | Saint Bernard |         |               | n03666591 | lighter                |
| n02109961 | Eskimo dog  |         |               | n03691459 | loudspeaker            |
| n02110063 | malamute    |         |               | n03695252 | loupe                  |
| n02110185 | Siberian husky |         |               | n03706229 | magnetic compass       |
| n02110341 | dalmatian   |         |               | n03720891 | maraca                 |
| n02110627 | affenpinscher |         |               | n03721384 | marimba                |
| n02110806 | basenji     |         |               | n03733131 | maypole                |
| n02110958 | pug         |         |               | n03759954 | microphone             |
| n02111129 | Leonberg    |         |               | n03773504 | missile                |
| n02111277 | Newfoundland |         |               | n03793489 | mouse                  |
| n02111500 | Great Pyrenees |         |               | n03794056 | mousetrap              |
| n02111889 | Sanyoyed    |         |               | n03803284 | muzzle                 |
| n02112018 | Pomeranian  |         |               | n03804744 | nail                   |
| n02112137 | chow        |         |               | n03814639 | neck brace             |
| n02112350 | keeshond    |         |               | n03832673 | notebook               |
| n02112706 | Brabancon griffon |         |               | n03838899 | oboe                   |
| n02113023 | Pembroke    |         |               | n03840681 | ocarina                |
| n02113186 | Cardigan    |         |               | n03841143 | odometer               |
| n02113624 | toy poodle  |         |               | n03845555 | oil filter             |
| n02113712 | miniature poodle |         |               | n03850465 | organ                  |
| n02113799 | standard poodle |         |               | n03886863 | oxygen mask            |
| n02113978 | Mexican hairless |         |               | n03874293 | paddlwheel             |
|         |            |         |               | n03875599 | padlock                |
|         |            |         |               | n03884397 | panpipe                |
|         |            |         |               | n03891332 | parking meter          |
|         |            |         |               | n03929660 | pick                   |
|         |            |         |               | n03933933 | pier                   |
|         |            |         |               | n03944341 | pinwheel               |
|         |            |         |               | n03952509 | potter's wheel         |
|         |            |         |               | n03995372 | power drill            |
|         |            |         |               | n04008614 | projectile             |
|         |            |         |               | n04009552 | projector              |
|         |            |         |               | n04040759 | radiator               |
|         |            |         |               | n04044716 | radio telescope        |
|         |            |         |               | n04067472 | reel                   |
|         |            |         |               | n04074963 | remote control          |
|         |            |         |               | n04086273 | revolver               |
|         |            |         |               | n04090263 | rifle                  |
|         |            |         |               | n04118776 | rule                   |
|         |            |         |               | n04127249 | safety pin             |
|         |            |         |               | n04140765 | sax                    |
|         |            |         |               | n04141975 | scale                  |
|         |            |         |               | n04152593 | screen                 |
|         |            |         |               | n04153571 | screw                  |
|         |            |         |               | n04228054 | ski                    |
|         |            |         |               | n04238763 | slide rule             |
|         |            |         |               | n04243546 | slot                   |
|         |            |         |               | n04251144 | snorkel                |

Continued on next page
**Protocol 1 Classes:** List of super-classes and leaf nodes of Protocol $P_1$.

| Known | Negative | Unknown |
|-------|----------|---------|
| Id    | Name     | Id      | Name     | Id      | Name   |
|       |          | n04258138 | solar dish | n04265275 | space heater |
|       |          | n04275548 | spider web | n04286575 | spotlight |
|       |          | n04311174 | steel drum | n04317175 | stethoscope |
|       |          | n04328186 | stopwatch | n04339267 | stove |
|       |          | n04332243 | strainer | n04355338 | sundial |
|       |          | n04355933 | sunglass | n04356056 | sunglasses |
|       |          | n04372370 | switch | n04376876 | syringe |
|       |          | n04428191 | thresher | n04456115 | torch |
|       |          | n04485082 | tripod | n04487394 | trombone |
|       |          | n04505470 | typewriter keyboard | n04515003 | upright |
|       |          | n04525305 | vending machine | n04536866 | violin |
|       |          | n04548280 | wall clock | n04579432 | whistle |
|       |          | n04592741 | wing | n06359193 | web site |

End of table Protocol 1
Table 3: PROTOCOL 2 CLASSES: List of super-classes and leaf nodes of Protocol $P_2$.

| Known | Negative | Unknown |
|-------|----------|---------|
| Id    | Name     | Id      | Name    | Id      | Name    |
| n02087394 | Rhodesian ridgeback | n02086051 | Airedale | n0208374 | toy dog |
| n02088094 | Afghan hound | n0208177 | cairn | n0208536 | Naijese dog |
| n02088238 | basset | n02086284 | Australian terrier | n02086079 | Pekinese |
| n02088364 | beagle | n02096437 | Dandie Dinmont | n02086240 | Shih-Tzu |
| n0208466 | bloodhound | n02096585 | Boston bull | n02086646 | Blenheim spaniel |
| n02088322 | bluetick | n02097047 | miniature schnauzer | n02086910 | papillon |
| n02089078 | black-and-tan coonho | n02097130 | giant schnauzer | n02087046 | toy terrier |
| n02089867 | Walker hound | n02097209 | standard schnauzer | n02118333 | fox |
| n02089973 | English foxhound | n02097298 | Scotch terrier | n02119022 | red fox |
| n02090379 | redbone | n02097474 | Tibetan terrier | n02119759 | kit fox |
| n02090622 | borzoi | n02097568 | silky terrier | n02120079 | Arctic fox |
| n02090721 | Irish wolfhound | n02098105 | soft-coated wheaten | n02120505 | grey fox |
| n02091244 | Ibizan hound | n02098286 | West Highland white terrier | n02115355 | wild dog |
| n02091467 | Norwegian elkhound | n02098413 | Lhasa | n02115641 | dingo |
| n02091635 | otterhound | n02099267 | flat-coated retriever | n02115913 | dhole |
| n02091831 | Saluki | n02099429 | curly-coated retriever | n02116738 | African hunting dog |
| n02092002 | Scottish deerhound | n02099601 | golden retriever | n02111467 | red wolf |
| n02092339 | Weimaraner | n02099712 | Labrador retriever | n02114367 | timber wolf |
| n02093256 | Staffordshire bullterrier | n02099849 | Chesapeake Bay retriever | n02114548 | white wolf |
| n02093428 | American Staffordshire terrier | n02100236 | German short-haired pointer | n02114712 | red wolf |
| n02093647 | Bedlington terrier | n02100583 | vizsla | n02114855 | coyote |
| n02093859 | Kerry blue terrier | n02100877 | Irish setter | n02120997 | feline |
| n02093991 | Irish terrier | n02101006 | Gordon setter | n02125311 | cougar |
| n02094114 | Norfolk terrier | n02101388 | Brittanay spaniel | n02127052 | lynx |
| n02094258 | Norwich terrier | n02101556 | clumber | n02128757 | snow leopard |
| n02094433 | Yorkshire terrier | n02102040 | English springer | n02128925 | jaguar |
| n02095514 | Wire-haired fox terrier | n02102117 | Welsh springer spaniel | n02129165 | lion |
| n02095570 | Lakeland terrier | n02102318 | cocker spaniel | n02129604 | tiger |
| n02095889 | Sealyham terrier | n02102480 | Sussex spaniel | n02130308 | cheetah |
| n02102973 | Irish water spaniel | n02109365 | bear | n02112316 | brown bear |
| n02130308 | | n02133161 | American black bear | n02134084 | ice bear |
| n02134418 | | n02134418 | sloth bear | n02241326 | musteline mammal |
| n02135482 | | n02135482 | | n02241382 | | |
| n02242845 | | n02242845 | | n02243111 | | |
| n02243384 | | n02243384 | | n02244819 | | |
| n02245715 | | n02245715 | | n02247366 | | |
| n02230806 | | n02230806 | | n02230806 | | |

End of table Protocol 2
Table 4: PROTOCOL 3 CLASSES: List of super-classes and leaf nodes of Protocol $P_3$. 

| Known | Negative | Unknown |
|-------|----------|---------|
| Id    | Name     | Id      | Name     | Id    | Name     |
| n02084071 | dog      | n02084071 | dog      | n02084071 | dog      |
| n02085620 | Chihuahua | n02085620 | Maltese dog | n02085620 | Maltese dog |
| n02085936 | Shih-Tzu | n02085936 | toy terrier | n02085936 | toy terrier |
| n02086910 | papillon | n02086910 | beagle | n02086910 | beagle |
| n02087394 | Rhodesian ridgeback | n02087394 | bluetick | n02087394 | bluetick |
| n02088288 | bassett | n02088288 | redbone | n02088288 | redbone |
| n02084846 | bloodhound | n02084846 | Irish wolfhound | n02084846 | Irish wolfhound |
| n02089078 | black-and-tan coonhound | n02089078 | Saluki | n02089078 | Saluki |
| n02089973 | English foxhound | n02089973 | Weimaraner | n02089973 | Weimaraner |
| n02090622 | borzoi | n02090622 | Border terrier | n02090622 | Border terrier |
| n02091244 | Ibizan hound | n02091244 | Otterhound | n02091244 | Otterhound |
| n02091635 | otterhound | n02091635 | pembroke | n02091635 | pembroke |
| n02092002 | Papillon | n02092002 | Bluetick | n02092002 | Bluetick |
| n02092339 | Staffordshire bull terrier | n02092339 | Bull terrier | n02092339 | Bull terrier |
| n02092458 | Norfolk terrier | n02092458 | Curly-coated retriever | n02092458 | Curly-coated retriever |
| n02093428 | American Staffordshire terrier | n02093428 | American Staffordshire terrier | n02093428 | American Staffordshire terrier |
| n02093647 | Bloodhound | n02093647 | Bloodhound | n02093647 | Bloodhound |
| n02093991 | Irish terrier | n02093991 | Irish terrier | n02093991 | Irish terrier |
| n02094433 | Yorkshire terrier | n02094433 | Yorkshire terrier | n02094433 | Yorkshire terrier |
| n02095570 | Lakeland terrier | n02095570 | Lakeland terrier | n02095570 | Lakeland terrier |
| n02095889 | Sealyham terrier | n02095889 | Sealyham terrier | n02095889 | Sealyham terrier |
| n02096051 | Airedale | n02096051 | Airedale | n02096051 | Airedale |
| n02096294 | Australian terrier | n02096294 | Australian terrier | n02096294 | Australian terrier |
| n02096585 | Boston bull | n02096585 | Boston bull | n02096585 | Boston bull |
| n02097130 | giant schnauzer | n02097130 | giant schnauzer | n02097130 | giant schnauzer |
| n02097298 | Scotch terrier | n02097298 | Scotch terrier | n02097298 | Scotch terrier |
| n02097658 | silky terrier | n02097658 | silky terrier | n02097658 | silky terrier |
| n02098266 | West Highland white terrier | n02098266 | West Highland white terrier | n02098266 | West Highland white terrier |
| n02099443 | English springer spaniel | n02099443 | English springer spaniel | n02099443 | English springer spaniel |
| n02099601 | Chesapeake Bay retriever | n02099601 | Chesapeake Bay retriever | n02099601 | Chesapeake Bay retriever |
| n02099849 | Chesapeake Bay retriever | n02099849 | Chesapeake Bay retriever | n02099849 | Chesapeake Bay retriever |
| n02100583 | vizsla | n02100583 | vizsla | n02100583 | vizsla |
| n02100877 | Irish setter | n02100877 | Irish setter | n02100877 | Irish setter |
| n02101388 | Brittany spaniel | n02101388 | Brittany spaniel | n02101388 | Brittany spaniel |
| n02102040 | English springer spaniel | n02102040 | English springer spaniel | n02102040 | English springer spaniel |
| n02102318 | cocker spaniel | n02102318 | cocker spaniel | n02102318 | cocker spaniel |
| n02102973 | Irish water spaniel | n02102973 | Irish water spaniel | n02102973 | Irish water spaniel |
| n02104365 | schipperke | n02104365 | schipperke | n02104365 | schipperke |
| n02105412 | kelpie | n02105412 | kelpie | n02105412 | kelpie |
| n02105641 | Old English sheepdog | n02105641 | Old English sheepdog | n02105641 | Old English sheepdog |
| n02106030 | collie | n02106030 | collie | n02106030 | collie |
| n02106382 | Bouvier des Flandres | n02106382 | Bouvier des Flandres | n02106382 | Bouvier des Flandres |
| n02106662 | German shepherd | n02106662 | German shepherd | n02106662 | German shepherd |
| n02107312 | miniature pinscher | n02107312 | miniature pinscher | n02107312 | miniature pinscher |
| n02107683 | Bernese mountain dog | n02107683 | Bernese mountain dog | n02107683 | Bernese mountain dog |
| n02108004 | EntleBucher | n02108004 | EntleBucher | n02108004 | EntleBucher |
| n02108442 | bull mastiff | n02108442 | bull mastiff | n02108442 | bull mastiff |
| n02108915 | French bulldog | n02108915 | French bulldog | n02108915 | French bulldog |
| n02109525 | Saint Bernard | n02109525 | Saint Bernard | n02109525 | Saint Bernard |
| n02110063 | malamute | n02110063 | malamute | n02110063 | malamute |
| n02110806 | basenji | n02110806 | basenji | n02110806 | basenji |
| n02111219 | Leonberg | n02111219 | Leonberg | n02111219 | Leonberg |
| n02112018 | Russian bear | n02112018 | Russian bear | n02112018 | Russian bear |
| n02112350 | keeshond | n02112350 | keeshond | n02112350 | keeshond |
| n02113023 | Pembroke | n02113023 | Pembroke | n02113023 | Pembroke |
| n02113624 | toy poodle | n02113624 | toy poodle | n02113624 | toy poodle |
| n02113799 | standard poodle | n02113799 | standard poodle | n02113799 | standard poodle |
| n02159955 | insect | n02159955 | insect | n02159955 | insect |

Continued on next page
## Protocol 3 Classes: List of super-classes and leaf nodes of Protocol $P_3$.

| Id     | Name               | Id     | Name               | Id     | Name               |
|--------|--------------------|--------|--------------------|--------|--------------------|
| n01824575 | coucal             | n03179701 | desk               | n01687978 | agama              |
| n01829413 | hornbill           | n03376595 | folding chair      | n01688243 | frilled lizard     |
| n01843065 | jacamar            | n03742115 | medicine chest     | n01698911 | alligator lizard   |
| n01847000 | drake              | n04380533 | table lamp         | n01692333 | Gila monster       |
| n01855672 | geese              | n04447861 | toilet seat        | n01693334 | green lizard       |
| n02002556 | white stork        | n02512053 | fish               | n01694178 | African chameleon  |
| n02006656 | spoolbill          | n01443337 | goldfish           | n01695060 | Komodo dragon      |
| n02009229 | little blue heron  | n01496331 | electric ray       | n01697457 | African crocodile  |
| n02011460 | bittern            | n02514041 | barracouta         | n01698640 | American alligator |
| n02013706 | limpin             | n02607072 | anemone fish       | n01704323 | triceratops        |
| n02018207 | American coot      | n02614379 | gar                | n01728572 | thunder snake      |
| n02025239 | ruddy turnstone    | n01444992 | monkey             | n01728920 | ringneck snake     |
| n02028035 | redshank           | n02486261 | patas              | n01729322 | hognose snake      |
| n02037110 | oystercatcher      | n02488702 | colobus            | n01729977 | green snake        |
| n02056570 | king penguin       | n02490219 | marmoset           | n01734418 | king snake         |
| n02159955 | insect             | n02493793 | spider monkey      | n01735189 | garter snake       |
| n02165105 | tiger beetle       | n02514031 | night snake        | n01737021 | water snake        |
| n02167151 | ground beetle      | n02514033 | beach wagon        | n01739381 | vine snake         |
| n02169497 | leaf beetle        | n02514035 | limousine          | n01740131 | night               |
| n02174001 | rhinoceros beetle  | n03777568 | Model T            | n01742172 | boa constrictor    |
| n02190166 | fly                | n03777569 | car                | n01744401 | rock python        |
| n02229544 | ant                | n02120997 | lynx               | n01748264 | Indian cobra       |
| n02233388 | cricket            | n02129165 | lion               | n01749939 | green mamba        |
| n02256656 | cockroach          | n02330308 | cheetah            | n01751748 | sea snake          |
| n02263436 | lacewing           | n02486261 | truck              | n01753488 | horned vipers      |
| n02288853 | danaelfly          | n02488702 | garbage truck      | n01755581 | diamondback        |
| n02277742 | ringlet            | n13134947 | tov truck          | n01756291 | sidewinder         |
| n02280649 | cabbage butterfly  | n13179895 | reapseed           | n02667093 | abaya              |
| n02281787 | lycaenid           | n13278882 | buckeye            | n02669723 | academic gown       |
| n02958343 | furniture          | n13299868 | fungus             | n02730930 | apron              |
| n02971124 | barber chair       | n13299881 | agaric             | n02807133 | bathing cap        |
| n02870880 | bookcase           | n13052670 | hen-of-the-woods   | n02817516 | bear skin          |
| n03018349 | china cabinet      | n02858304 | boat               | n02837789 | bikini             |
| n03131574 | crib               | n03443933 | fireboat           | n02865351 | bolo tie           |
| n03201208 | dining table       | n04612504 | yawl               | n02869837 | bonnet             |
| n03373140 | file               | n03082979 | computer           | n02883205 | bow tie            |
| n03388549 | four-poster        | n03485407 | hand-held computer | n02892767 | brassiere          |
| n03891251 | park bench         | n06359193 | web site           | n02963159 | cardigan           |
| n04344873 | studio couch       | n03051540 | fruit              | n03065060 | Christmas stocking |
| n04429376 | throne             | n03124170 | clothing           | n03127747 | crash helmet       |
| n04550184 | wardrobe           | n03188531 | diaper             | n03188531 | diaper             |
| n04550184 | fish               | n0325584 | feather boa        | n03373051 | football helmet    |
| n04550184 | furniture          | n03379051 | golf                | n03404251 | fur coat           |
| n04550184 | fish               | n03459230 | gown               | n03545800 | horseshoe          |
| n04550184 | fish               | n03594734 | jean               | n03594734 | jean               |
| n04550184 | furniture          | n03595614 | jersey             | n03595614 | jersey             |
| n04550184 | fish               | n03617480 | kimono             | n03617480 | kimono             |
| n04550184 | fish               | n03623198 | knee pad            | n03623198 | knee pad            |
| n04550184 | fish               | n03630383 | lab coat            | n03630383 | lab coat            |
| n04550184 | fish               | n03706307 | mailot             | n03706307 | mailot             |
| n04550184 | fish               | n03763968 | military uniform    | n03763968 | military uniform    |
| n04550184 | fish               | n03775071 | miniskirt           | n03775071 | miniskirt           |
| n04550184 | fish               | n03787032 | mortarboard        | n03787032 | mortarboard        |
| n04550184 | fish               | n03866082 | overskirt           | n03866082 | overskirt           |
| n04550184 | fish               | n03977472 | pajama             | n03977472 | pajama             |
| n04550184 | fish               | n04136333 | sarong             | n04136333 | sarong             |
| n04550184 | fish               | n04162706 | seat belt          | n04162706 | seat belt          |
| n04550184 | fish               | n04209133 | shower cap         | n04209133 | shower cap         |
| n04550184 | fish               | n04254777 | sock               | n04254777 | sock               |
| n04550184 | fish               | n04295630 | sombrero           | n04295630 | sombrero           |
| n04550184 | fish               | n04325704 | stole              | n04325704 | stole              |
| n04550184 | fish               | n04350905 | suit               | n04350905 | suit               |
| n04550184 | fish               | n04370456 | sweater            | n04370456 | sweater            |
| n04550184 | fish               | n04371430 | swimming trunks    | n04371430 | swimming trunks    |

Continued on next page
## Protocol 3 Classes: List of super-classes and leaf nodes of Protocol $P_3$.

| Id        | Name              | Id        | Name          | Id        | Name           |
|-----------|-------------------|-----------|---------------|-----------|----------------|
| n03796401 | moving van        | n04479046 | trench coat   | n02428753 | aircraft       |
| n03977966 | police van        | n04532106 | vestment      | n02428760 | airliner       |
| n04467665 | trailer truck     | n04584207 | wig           | n02423021 | balloon        |
| n013134947 | fruit            | n04591157 | Windsor tie   |           |                |
| n07742313 | Granny Smith     |           |               |           |                |
| n012144580 | corn             | n024389026 | sorrel        |           |                |
| n012620546 | hip              | n02391049  | zebra         |           |                |
| n013133613 | ear              | n02395406  | hog           |           |                |
| n12992868 | fungus            | n02396427  | wild boar     |           |                |
| n12985857 | coral fungus      | n02397096  | warthog       |           |                |
| n13037406 | gyromitra         | n02398521  | hippopotamus  |           |                |
| n13044778 | earthstar         | n02403003  | ox            |           |                |
| n13054560 | bolete            | n02408429  | water buffalo |           |                |
| n02858304 | boat              | n02410509  | bison         |           |                |
| n02951358 | canoe             | n02412080  | ram           |           |                |
| n03447447 | gondola           | n02415577  | bighorn       |           |                |
| n04273569 | speedboat         | n02417914  | ibex          |           |                |
| n03082979 | computer          | n02422106  | hartebeest    |           |                |
| n03180011 | desktop computer  | n02422699  | impala        |           |                |
| n03642806 | laptop            | n02423022  | gazelle       |           |                |
| n04238763 | slide rule        | n02437312  | Arabian camel |           |                |
|           |                   | n02437616  | llama         |           |                |
| n07707451 | vegetable         | n07714571  | head cabbage  |           |                |
|           |                   | n07714990  | broccoli      |           |                |
|           |                   | n07715103  | cauliflower   |           |                |
|           |                   | n07716358  | zucchini      |           |                |
|           |                   | n07716906  | spaghetti squash |       |                |
|           |                   | n07717410  | acorn squash  |           |                |
|           |                   | n07717556  | butternut squash |     |                |
|           |                   | n07718472  | cucumber      |           |                |
|           |                   | n07718747  | artichoke     |           |                |
|           |                   | n07720875  | bell pepper   |           |                |
|           |                   | n07730033  | cardoon       |           |                |
|           |                   | n07734744  | mushroom      |           |                |
| n02686568 | aircraft          | n02690373  | airliner      |           |                |
|           |                   | n02692877  | airship       |           |                |
|           |                   | n02782953  | balloon       |           |                |

End of table Protocol 3