Plankton Image Recognition

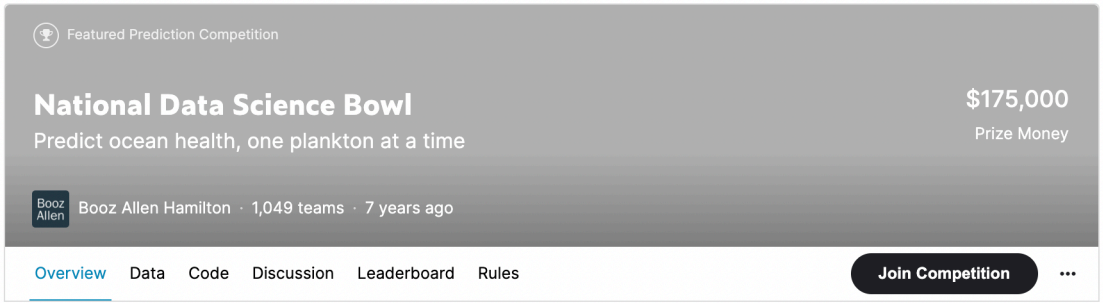
Group 11
M102040016李翊瑄　M102040010許育禎

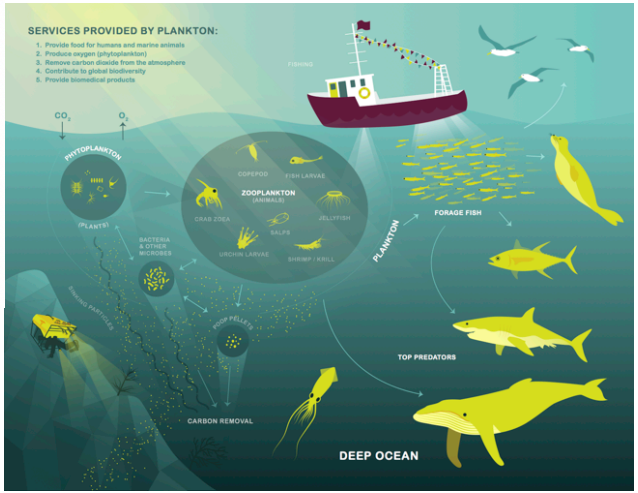
Content

1

Introduction

Introduction -- Kaggle Competition





"Identify images of 121 species of plankton,

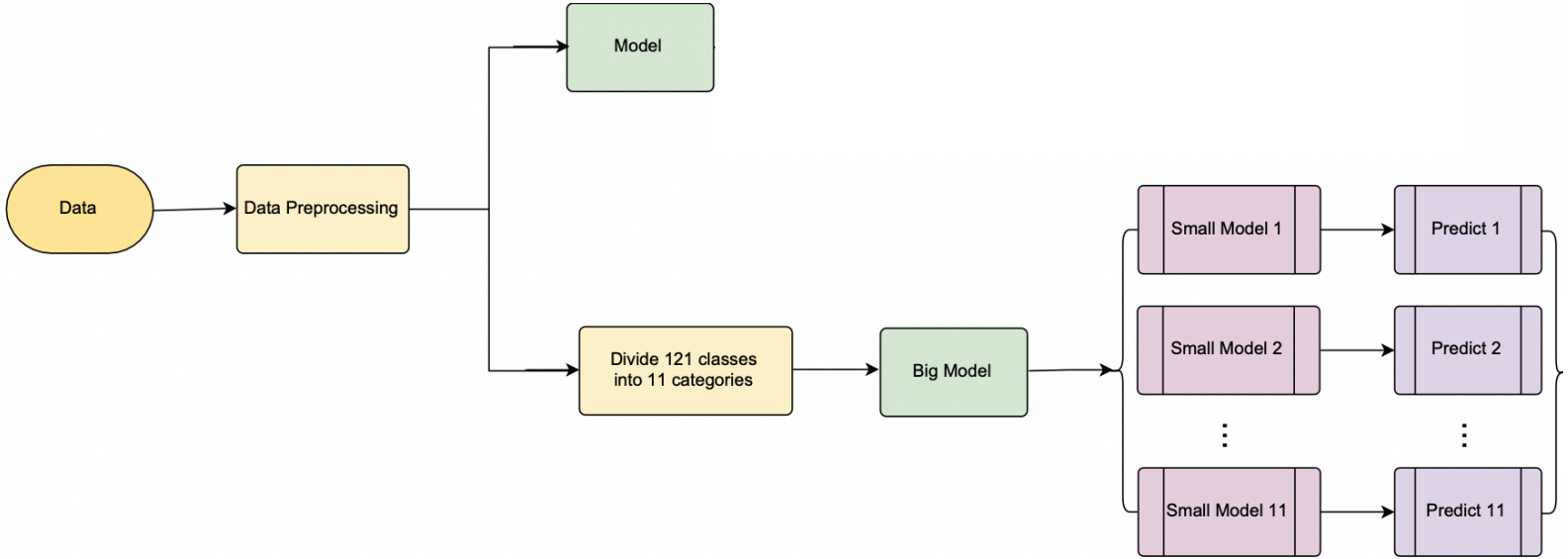
and calculate the probability of each species."

Evaluation

Image	Class 1	Class 2	.....	Class 121
Image1.jpg	0.01	0.03	.....	0.09
Image2.jpg	0.05	-0.01	.....	0.02

$$logloss = -\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{M} y_{ij}\log(p_{ij}),$$

Flow Chart


Model
Data
Data Preprocessing
Divide 121 classes into 11 categories
Big Model
Small Model 1
Predict 1
Small Model 2
Predict 2
Small Model 11
Predict 11

2

Data Preprocessing and Splitting

Data Preprocessing and Splitting

- The datasets is monochromic image -> change 1 layer to 3 layer
- Enhance the edges with `ImageFilter.EDGE_ENHANCE_MORE` in PIL package
- Resize to (256,256)

- Split Training set (n=24322) and
  Val set(n = 6014) with 80/20 principal,
  Test set(n=130400)

Before

After

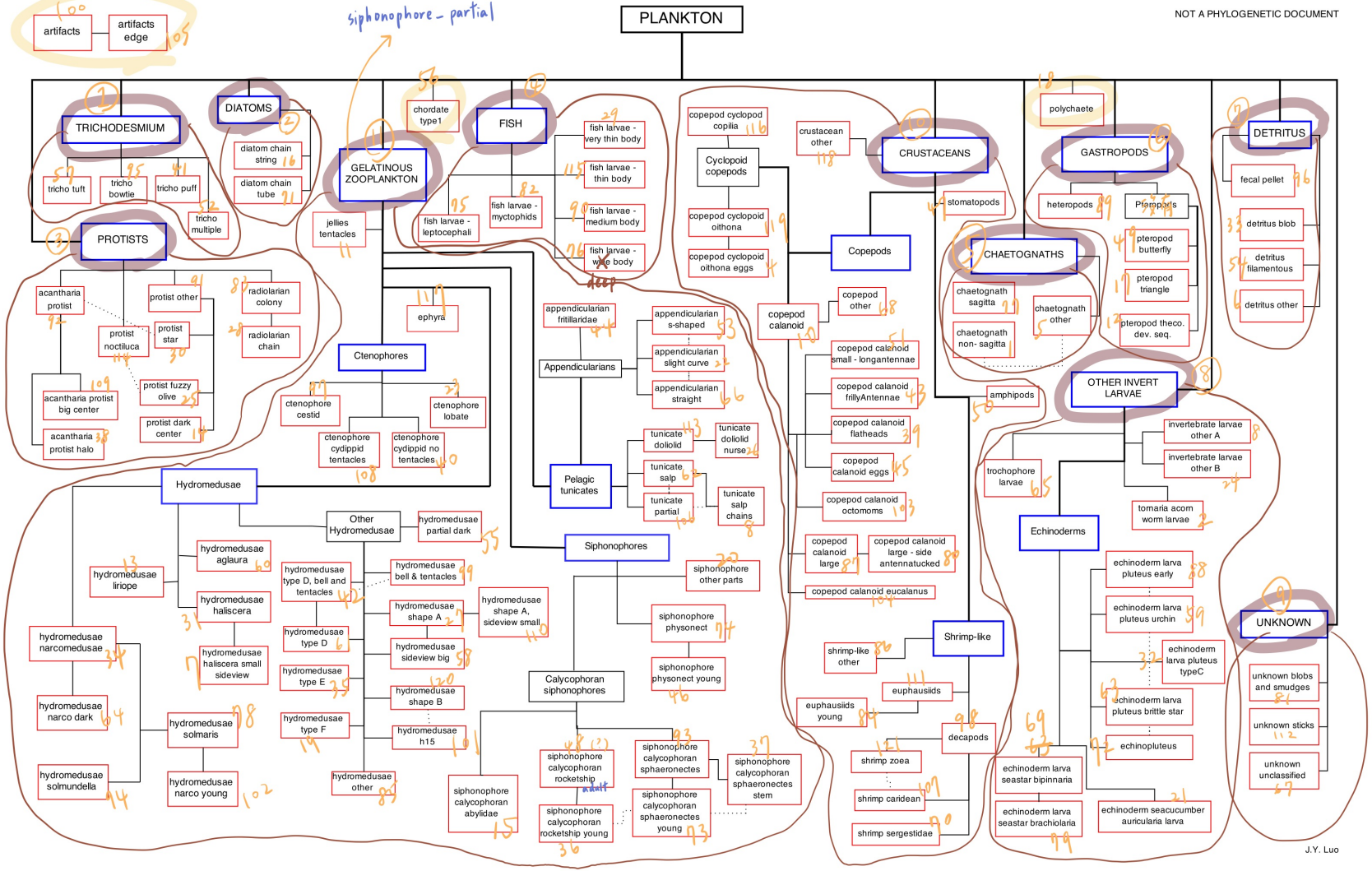
3

Models

Model

Model	Optimizer	Learning Rate	Best Accuracy
CNN-1	SGD (momentum = 0.9)	10^-2	0.55
CNN-2	Adam (betas=(0.9, 0.999))	10^-5	0.65
CNN-2	SGD (momentum = 0.8)	10^-4	0.51
ResNet34 (pretrained = False)	SGD (momentum = 0.9)	10^-2	0.63
ResNet152 (pretrained = False)	SGD (momentum = 0.9)	10^-2	0.68

Kaggle Score: 10.88


artifacts
artifacts edge
PLANKTON
NOT A PHYLOGENETIC DOCUMENT
siphonophore - partial
TRICHODESMIUM
tricho tuft
tricho bowtie
tricho puff
tricho multiple
DIATOMS
diatom chain string
diatom chain tube
GELATINOUS ZOOPLANKTON
jellies tentacles
chordate type1
FISH
fish larvae - leptocephali
fish larvae - myctophids
fish larvae - very thin body
fish larvae - thin body
fish larvae - medium body
fish larvae - wide body
deep
PROTISTS
acantharia protist
protist other
radiolarian colony
protist noctiluca
protist star
radiolarian chain
protist fuzzy olive
acantharia protist big center
protist dark center
acantharia protist halo
ephyra
Ctenophores
ctenophore cestid
ctenophore lobate
ctenophore cydippid tentacles
ctenophore cydippid no tentacles
Hydromedusae
Other Hydromedusae
hydromedusae partial dark
hydromedusae liriope
hydromedusae aglaura
hydromedusae haliscera
hydromedusae haliscera small sideview
hydromedusae narcomedusae
hydromedusae narco dark
hydromedusae solmundella
hydromedusae solmaris
hydromedusae narco young
hydromedusae type D, bell and tentacles
hydromedusae type D
hydromedusae type E
hydromedusae type F
hydromedusae bell & tentacles
hydromedusae shape A
hydromedusae sideview big
hydromedusae shape B
hydromedusae h15
hydromedusae other
hydromedusae shape A, sideview small
siphonophore calycophoran abylidae
Appendicularians
appendicularian fritillaridae
appendicularian s-shaped
appendicularian slight curve
appendicularian straight
Pelagic tunicates
tunicate doliolid
tunicate doliolid nurse
tunicate salp
tunicate partial
tunicate salp chains
Siphonophores
siphonophore other parts
siphonophore physonect
siphonophore physonect young
Calycophoran siphonophores
siphonophore calycophoran rocketship
siphonophore calycophoran rocketship young
siphonophore calycophoran sphaeronectes
siphonophore calycophoran sphaeronectes young
siphonophore calycophoran sphaeronectes stem
copepod cyclopod copilia
Cyclopoid copepods
copepod cyclopoid oithona
copepod cyclopoid oithona eggs
crustacean other
CRUSTACEANS
Copepods
copepod calanoid
copepod other
copepod calanoid small - longantennae
copepod calanoid frillyAntennae
copepod calanoid flatheads
copepod calanoid eggs
copepod calanoid octomoms
copepod calanoid large
copepod calanoid large - side antennatucked
copepod calanoid eucalanus
Shrimp-like
shrimp-like other
euphausiids
euphausiids young
decapods
shrimp zoea
shrimp caridean
shrimp sergestidae
stomatopods
amphipods
polychaete
GASTROPODS
heteropods
Pteropods
pteropod butterfly
pteropod triangle
pteropod theco. dev. seq.
CHAETOGNATHS
chaetognath sagitta
chaetognath other
chaetognath non- sagitta
OTHER INVERT LARVAE
trochophore larvae
invertebrate larvae other A
invertebrate larvae other B
tornaria acorn worm larvae
Echinoderms
echinoderm larva pluteus early
echinoderm larva pluteus urchin
echinoderm larva pluteus typeC
echinoderm larva pluteus brittle star
echinopluteus
echinoderm larva seastar bipinnaria
echinoderm larva seastar brachiolaria
echinoderm seacucumber auricularia larva
DETRITUS
fecal pellet
detritus blob
detritus filamentous
detritus other
UNKNOWN
unknown blobs and smudges
unknown sticks
unknown unclassified
J.Y. Luo

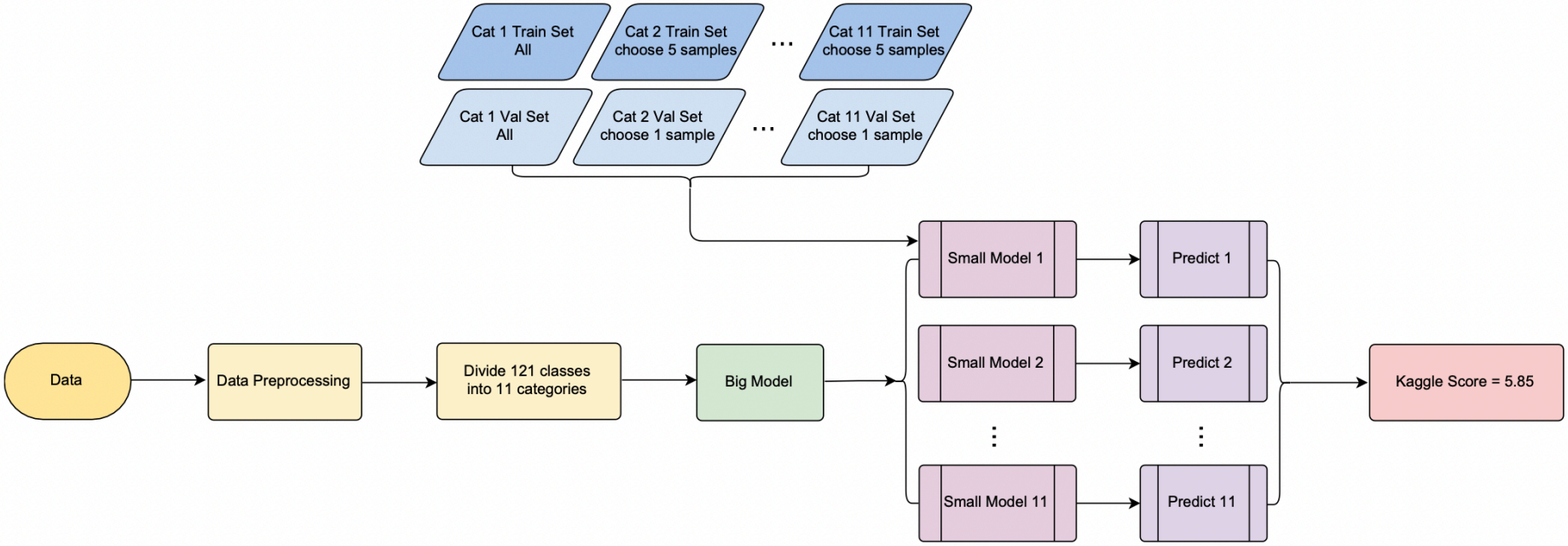
Big Model -> Small Model

Big Model

Split all Classes to 11 Categories in train set and validation set.

file_path	images_category	label	label_11	label2
protist_star_90.jpg	protist_star	30	protists	3
protist_star_78.jpg	protist_star	30	protists	3
⋮	⋮	⋮	⋮	⋮
artifacts_399.jpg	artifacts	100	unknown	9
artifacts_197.jpg	artifacts	100	unknown	9
⋮	⋮	⋮	⋮	⋮
hydromedusae_other_117.jpg	hydromedusae_other	85	gelatinous_zooplankton	11
hydromedusae_other_115.jpg	hydromedusae_other	85	gelatinous_zooplankton	11
⋮	⋮	⋮	⋮	⋮
copepod_calanoid_1097.jpg	copepod_calanoid	10	crustaceans	10
copepod_calanoid_639.jpg	copepod_calanoid	10	crustaceans	10

Big Model -> Small Model -- Flow Chart



Big Model -> Small Model

Take 1st small model for example:

Train Set

Get all training images in 1st Category, and randomly pick up 5 images in the rest of classes

Validation Set

Get all validation images in 1st Category, and randomly pick up 1 image in the rest of classes

Test Set

All test images predicted as 1st Category

Comparison

Model	Kaggle Score
Model (ResNet152)	10.88
Big Model -> Small Model (ResNet152) -> (ResNet152)	5.85

Depends on the accuracy of big model

New Findings in Small Model Training

- Val Acc < Training Acc in the beginning of the training
- Sometimes accuracy improves, but log loss does not

```
==================== Epoch 1 ====================
Train Acc: 0.452481 Train Loss: 2.765803
  Val Acc: 0.565217   Val Loss: 1.276544
==================== Epoch 2 ====================
Train Acc: 0.524806 Train Loss: 2.040130
  Val Acc: 0.668116   Val Loss: 1.064313
==================== Epoch 3 ====================
Train Acc: 0.528093 Train Loss: 1.902031
  Val Acc: 0.475362   Val Loss: 1.413311
==================== Epoch 4 ====================
Train Acc: 0.525403 Train Loss: 1.815078
  Val Acc: 0.626087   Val Loss: 0.998090
```

```
==================== Epoch 20 ====================
Train Acc: 0.633592 Train Loss: 1.212397
  Val Acc: 0.614493   Val Loss: 1.036882
==================== Epoch 21 ====================
Train Acc: 0.637179 Train Loss: 1.223277
  Val Acc: 0.668116   Val Loss: 1.235346
```

```
==================== Epoch 24 ====================
Train Acc: 0.663479 Train Loss: 1.126488
  Val Acc: 0.591304   Val Loss: 1.582351
==================== Epoch 25 ====================
Train Acc: 0.661088 Train Loss: 1.119432
  Val Acc: 0.550725   Val Loss: 1.416806
```

5

Insight and Future Work

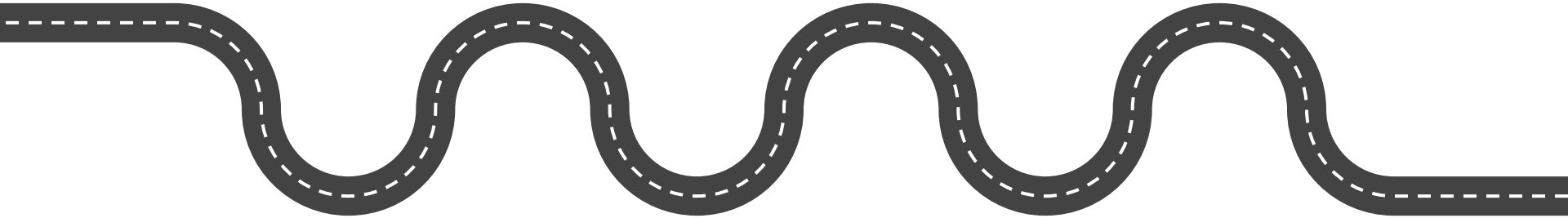
Insight and Future Work

Whether plankton unrelated to other species be included in the category of unknown species

2

Apply Semi-supervised Learning method.

4

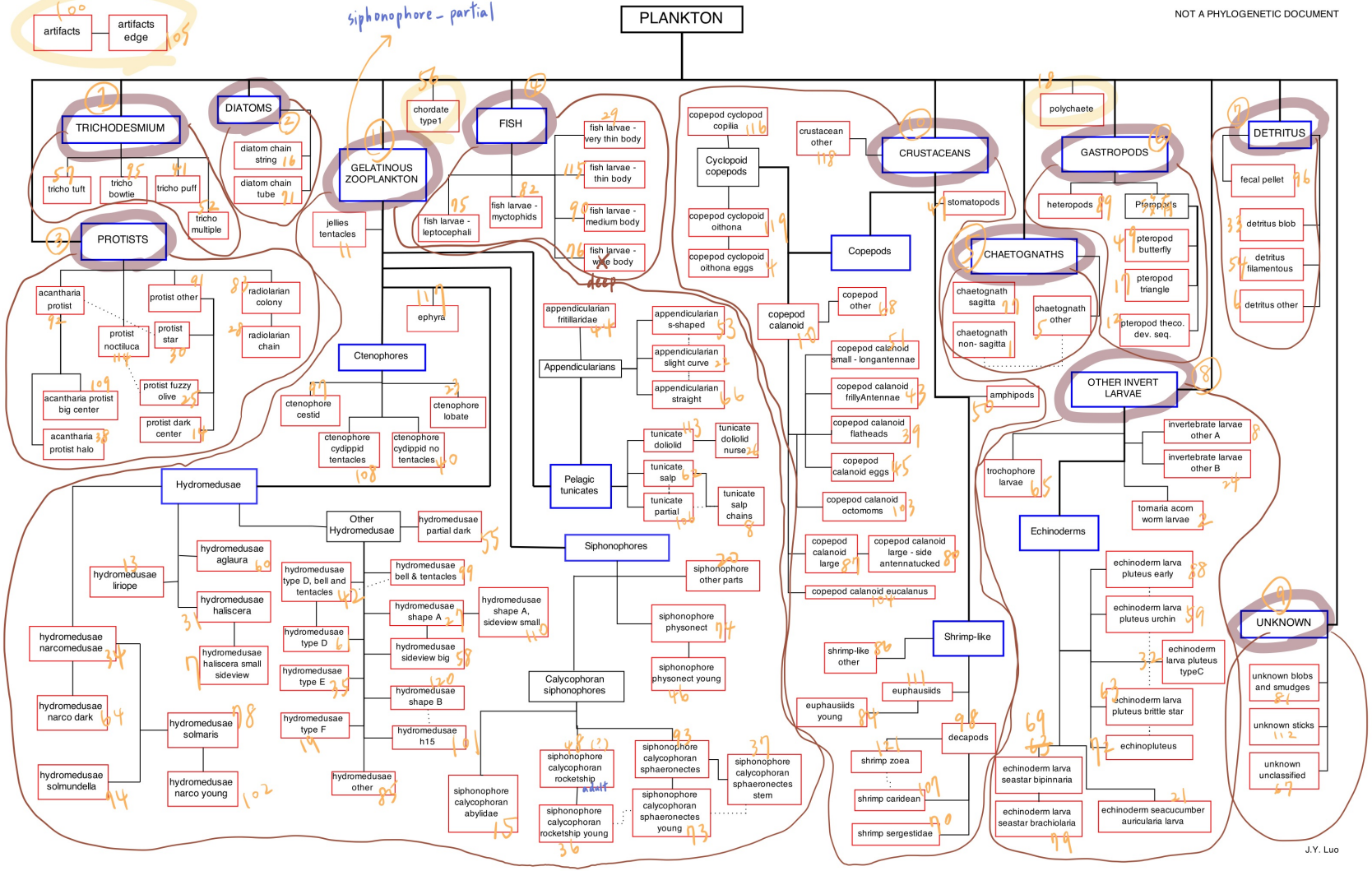


1

After being divided into 11 categories, the amount of data in each category is unbalanced.
Categories with too many species can be subdivided.

3

The way to form a new training set and validation set.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siphonophore calycophoran abylidae
siphonophore calycophoran sphaeronectes
siphonophore calycophoran sphaeronectes young
siphonophore calycophoran sphaeronectes stem
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euphausiids
euphausiids young
decapods
shrimp zoea
shrimp caridean
shrimp sergestidae
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THANKS!