



# FishSnap



Saving and mapping the Ocean one fish at a time  
through Fishial Recognition Technology



# The Secret Origin

We decided to enter an ecological global sustainability Ocean oriented hackathon

<http://fishackathon.hackernest.com/>

We needed to choose a challenge

#5: Marketplace - Fish Identification

*A key challenge in fisheries management is accurate identification of fish species.*

*The current methods for identifying fish are time-consuming, expensive, and reliant on unreliable human expertise.*

This was an opportunity to get into CoreML.

# What was the challenge

Neither of us knew  
Core ML



# Tonight we'd like to present

How we signed up and went into a hackathon

With no knowledge of what we needed to know

With no app

Ended with an App in the App Store

And won!



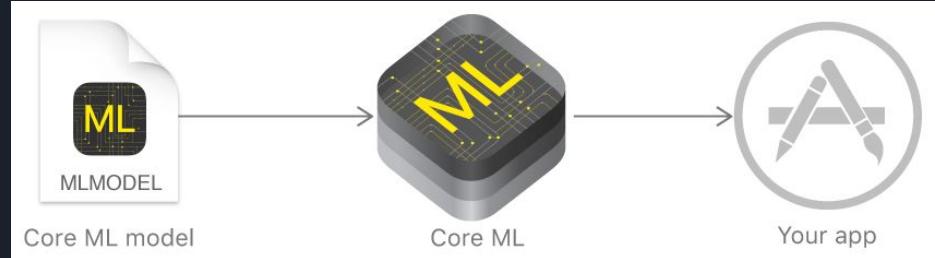
# How do we do it?

With a two man team we break the challenge into two parts

1. The Neural Network Model
2. The CoreML based Camera Vision App



# What is Core ML?



Core ML is a framework introduced by Apple

in iOS 11 to

Integrate **trained** machine learning models

into your app.

# What are these models?

A **trained model** is the result of applying  
a **machine learning algorithm** to a set of  
training data.

The model makes predictions based on new input data.



# I need an example

Canonical example is **Real Estate**:



A model that's been trained on a region's historical house prices

that may be able to **predict** a new house's price

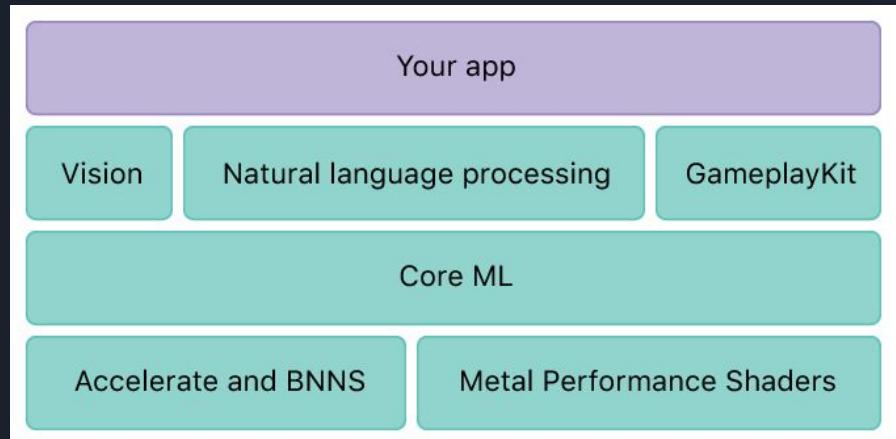
when given the number of bedrooms and bathrooms.

This is a different model of programming that gets better with more data.

# Couple of more things about Core ML

Core ML is optimized for **on-device** performance

Core ML supports **Vision** for image analysis



# How do we learn this?

By building apps of course

Built two apps before the hackathon



# First App



How do

1. Getting
2. Integrat
3. Convinc



# Where does one get a Hot Dog Image Recognition Model?

Apple of course

Apple provides several popular, open source models

They are already in the Core ML model format

For Not Hot Dog - I used Inception v3

<https://developer.apple.com/machine-learning/>



# What do you do with this MLMModel file?

Drag the model into Xcode

Xcode builds a Swift Wrapper Class file

You can then access the Model say from your VC

See <https://github.com/duliodenis/hotdog>

```
import CoreML
```

```
import Vision
```





Does it work?

Let's see





That's great - but ...

How do I convert a pre-trained models

Apple has [CoreML Tools](#)

Use Python 2.7

PIP create a Virtual Environment

\$ [pip install -U coremltools](#)



# Convert a Caffe Model into MLModel

Write a Python conversion script

To convert some Caffe Model to an MLModel

Caffe is a Deep Learning  
Framework from  
Berkeley



# Second App

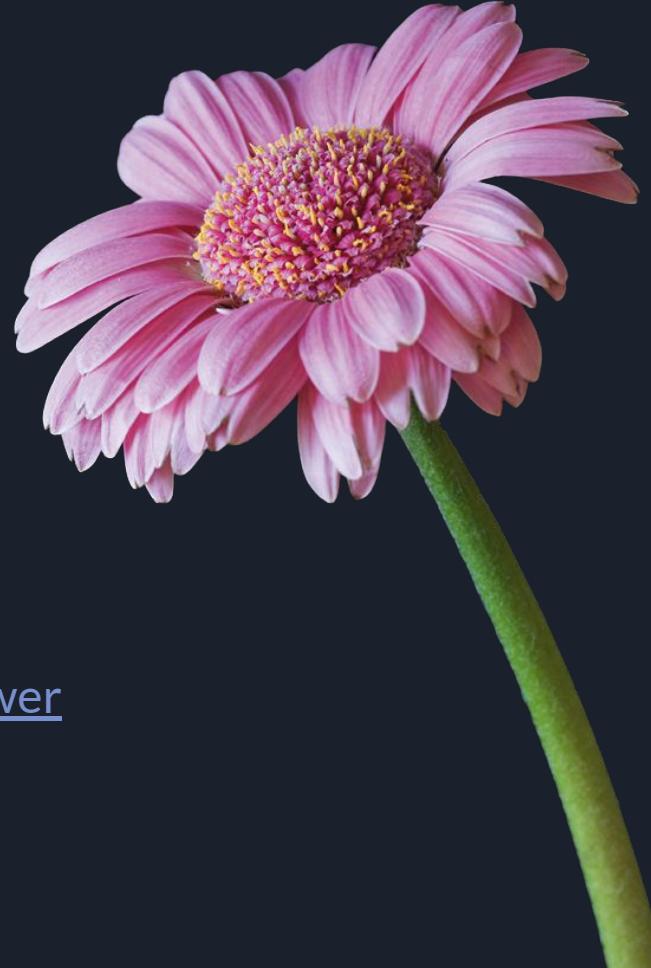
Pick some Caffe based pretrained model

Convert and integrate into an iOS App

Oxford [102 Flower Classifications](#) Model

Caffe Model [on Github](#)

See <https://github.com/duliodenis/flowerpower>



# Conversion Script

([documentation](#))

13 lines (9 sloc) | 281 Bytes

```
1 import coremltools
2
3 caffe_model = ('oxford102.caffemodel', 'deploy.prototxt')
4 labels = 'flower-labels.txt'
5
6 coreml_model = coremltools.converters.caffe.convert(
7     caffe_model,
8     class_labels=labels,
9     image_input_names='data'
10 )
11
12 coreml_model.save('FlowerClassifier.mlmodel')
```



# Does it work?

Made some refinements from Hot Dog

Cross check Wikipedia

Get a description

Get Image

Let's see



Meanwhile ....





In parallel we were learning to make a model

A database of fish images and names

Train a model with the images

Produce a Caffe Model from the training

Convert the Caffe Model to MLModel

and drop in to ~~Flower Power~~

FishSnap



# How do we learn to train a model?

Using the same technique as on the iOS side

Started by training a model using a practice dataset

- a. We started with food - used a dataset called 101 food
- b. <https://www.kaggle.com/dansbecker/food-101>

Once this was done then we could move to the final stage of creating our own dataset with 480 fish and training a brand new model



## Exploring 101food (train\_db) images

Show all images or filter by class **apple pie** baby back ribs baklava beef carpaccio beef tartare beet salad beignets bibimbap bread pudding breakfast burrito

bruschetta caesar salad cannoli caprese salad carrot cake ceviche cheese plate cheesecake chicken curry chicken quesadilla chicken wings chocolate cake chocolate mousse churros clam chowder club sandwich crab cakes creme brulee croque madame cup cakes deviled eggs donuts dumplings edamame eggs benedict escargots falafel filet mignon fish and chips foie gras french fries french onion soup french toast fried calamari fried rice frozen yogurt garlic bread gnocchi greek salad grilled cheese sandwich grilled salmon guacamole gyoza hamburger hot and sour soup hot dog huevos rancheros hummus ice cream lasagna lobster bisque lobster roll sandwich macaroni and cheese macarons miso soup mussels nachos omelette onion rings oysters pad thai paella pancakes panna cotta peking duck pho pizza pork chop poutine prime rib pulled pork sandwich ramen ravioli red velvet cake risotto samosa sashimi scallops seaweed salad shrimp and grits spaghetti bolognese spaghetti carbonara spring rolls steak strawberry shortcake sushi tacos takoyaki tiramisu tuna tartare waffles

Items per page: 10 - 25 - 50 - 100

« 0 1 2 3 4 5 ... 29 »

**29 PAGES OF APPLE  
PIES**



apple pie



apple pie



apple pie



apple pie



DB Entries  
75750

800

700

600

500

400

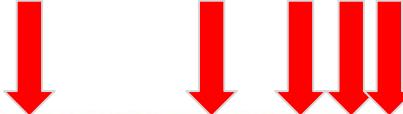
300

200

100

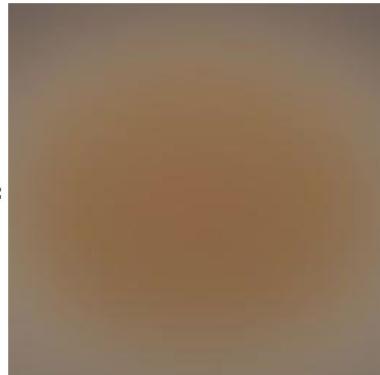
0

Image Count



Type of food

Category



Explore the db

## Exploring 480fish (train\_db) images

Show all images or filter by class: [Istiophorus platypterus](#) acanthaluteres brownii acanthaluteres spilomelanurus acanthaluteres vittiger acanthistius cinctus acanthopagrus australis acanthopagrus berda acanthopagrus latus achoerodus gouldii achoerodus viridis acreichthys tomentosus aesopia cornuta aethaloperca roga alectis ciliaris alectis indica alepes kleinii aluterus monoceros aluterus scriptus amanses scopas anampsae caeruleopunctatus anampsae elegans anampsae femininus anampsae geographicus anampsae lennardi anampsae melanurus anampsae meleagrides anampsae neoguinaicus anampsae twistii anodontostoma chacunda anyperodon leucogrammicus aphereus furca aphereus rutilans aprion virescens argyrops spinifer aserragodes melanostictus attractoscion aequidens atule mate auxis rochei auxis hazard bathylagichthys greyae beryx decadactylus bodianus anthiope bodianus axillaris bodianus bilunulatus bodianus bimaculatus bodianus diana bodianus loxozonus bodianus mesothorax bodianus perdito bodianus unimaculatus bodianus vulpinus bothus manucus bothus myriaster bothus pantherinus brachaluteres jacksonianus brachirius orientalis caesioperca lepidopterus cantherhines dumerili cantherhines fronticinctus cantherhines pardalis cantheschenia grandisquamis caprodon longimanus caprodon schlegelii carangoides caeruleopinnatus carangoides chrysophrys carangoides equula carangoides ferdau carangoides fulvoguttatus carangoides hedlandensis carangoides malabaricus carangoides orthogrammus carangoides plagiotaenia caranx ignobilis caranx lugubris caranx melampygus caranx sexfasciatus carcharhinus albimarginatus carcharhinus amblyrhynchos carcharhinus falciformis carcharhinus galapagensis carcharhinus limbatus carcharhinus melanopterus carcharhinus obscurus carcharhinus plumbeus carcharhinus sorrah centroberyx affinis centrogenys vaigiensis centrosyncyrus coelolepis cephalopholis argus cephalopholis boenak cephalopholis cyanostigma cephalopholis formosa cephalopholis igarashiensis cephalopholis leopardus cephalopholis micropion cephalopholis miniata cephalopholis sexmaculata cephalopholis sonneratii cephalopholis spiloparaea chascanopsetta lugubris cheilinus chlorourus cheilinus fasciatus cheilinus oxycephalus cheilinus trilobatus cheilinus undulatus cheilio inermis cheilodactylus ephippium cheilodactylus fuscus cheilodactylus spectabilis cheilodactylus vestitus chelidonichthys kumu chirocentrus dorab chirocentrus nudus choerodon anchorago choerodon cauteroma choerodon cyanodus choerodon fasciatus choerodon graphicus choerodon jordani choerodon rubescens choerodon schoenleinii choerodon venustus choerodon vitta choerodon zamboanga chromeleptes altivelis cirrhitabrus bathyphilus cirrhitabrus condei cirrhitabrus cyanopleura cirrhitabrus exquisitus cirrhitabrus laboutei cirrhitabrus punctatus cirrhitabrus scottorum cirrhitabrus temminckii coris aygula coris batuensis coris bulbifrons coris caudimacula coris dorsomacula coris gaimard coris picta coris pictoides coris sandeyeri crenimugil crenilabis cymbacephalus nematophthalmus cymolutes praetextatus cymolutes torquatus cynoglossus puncticeps cyttopsis rosea dactylophora nigricans decapterus macrosoma decapterus russelli diproctacanthus xanthurus dotalabrus aurantiacus elagatis bipinnulata epibulus insidiator epinephelus areolatus epinephelus bleekeri epinephelus chlorostigma epinephelus coeruleopunctatus epinephelus coioides epinephelus corallicola epinephelus cyanopodus epinephelus epistictus epinephelus fasciatus epinephelus fuscoguttatus epinephelus hexagonatus epinephelus howlandi epinephelus lanceolatus epinephelus latifasciatus epinephelus macropilos epinephelus maculatus epinephelus melanostigma epinephelus merra epinephelus morrhua epinephelus multinotatus epinephelus ongus epinephelus polyphekadion epinephelus quoyanus epinephelus radiatus epinephelus retouti epinephelus rivulatus epinephelus sexfasciatus epinephelus spilotoceps epinephelus tauvina epinephelus undulatostriatus etelis carbunculus etelis coruscans eubalichthys cyanoura eubalichthys mosaicus eupetrichthys angustipes euthynnis affinis evistias acutirostris gempylus serpens gnathanodon speciosus gnathodentex aureolineatus gracila albomarginata gymnocranius microdon gymnocranius audleyi gymnocranius euanus gymnocranius grandoculis gymnocranius microdon gymnosarda unicolor halichoeres argus halichoeres biocellatus halichoeres chloropterus halichoeres chrysus halichoeres hartzfeldii halichoeres hortulanus halichoeres leucurus halichoeres margaritaceus halichoeres marginatus halichoeres melanochir halichoeres melanurus halichoeres melasma pomus halichoeres miniatus halichoeres nebulosus halichoeres nigrescens halichoeres scapularis halichoeres trimaculatus harriotta raleighana hemigymnus fasciatus hemigymnus melapterus hemiramphus far herklotsichthys quadrimaculatus hologrammosus annulatus hologrammosus dolatus hyporhamphus affinis hyporhamphus dussumieri inegocia japonica johni borneensis katsuwonus pelamis labrichthys unilineatus labroides bicolor labroides dimidiatus labroides pectoralis labropsis australis labropsis manchaei labropsis xanthoneura latridopsis forsteri lepidocybium flavobrunneum leptojulis cyanopleura letothrinus amboinensis letothrinus atkinsoni

### DB Entries

1446

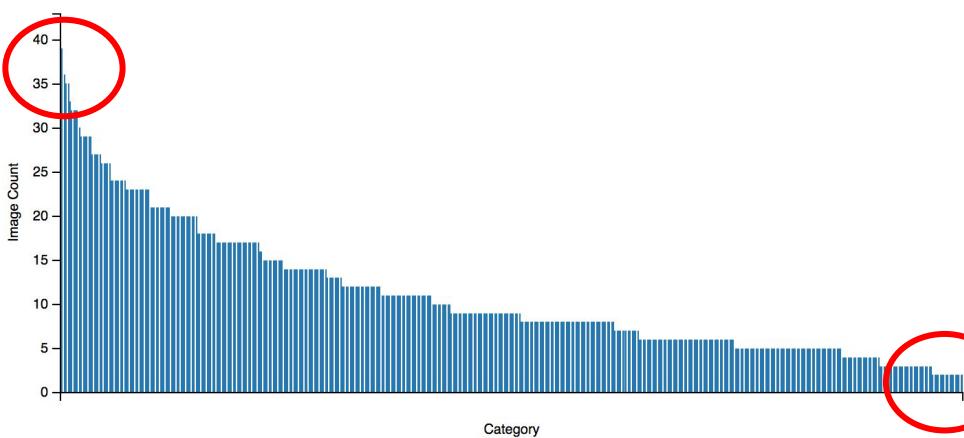
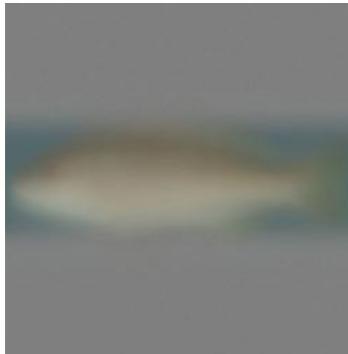


Image Mean:

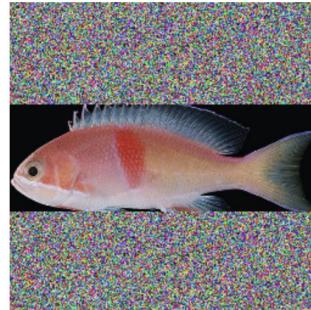


[Explore the db](#)

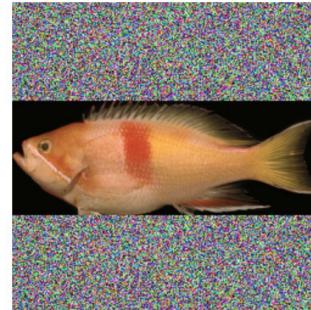
pseudanthias bicolor pseudanthias cooperi pseudanthias dispar pseudanthias fasciatus pseudanthias huchtii pseudanthias hypselosoma pseudanthias lori pseudanthias luzonensis pseudanthias pictilis pseudanthias pleurotaenia **pseudanthias rubrizonatus** pseudanthias sheni pseudanthias smithvanizi pseudanthias squamipinnis pseudanthias tuka pseudanthias ventralis pseudocaranx dentex pseudocararias kamoharai pseudocheilinus evanidus pseudocheilinus hexataenia pseudocheilinus ocellatus pseudocheilinus octotaenia pseudodax moluccanus pseudojuloides cerasinus pseudolabrus biserialis pseudolabrus guentheri pseudolabrus luculentus pseudorhombus argus pseudorhombus arius pseudorhombus elevatus pteragogus cryptus pteragogus enneacanthus pteragogus flagellifer rastrelliger kanagurta retropinna semoni rhabdosargus sarba rhinodon typus rhizoprionodon acutus ruvettus pretiosus samaris cristatus samariscus triocellatus sarda orientalis sardinella albella sardinella gibbosa sardinops sagax scaevius mili scolopsis affinis scolopsis bilineata scolopsis lineata scolopsis margaritifer scolopsis monogramma scolopsis trilineata scolopsis vosmeri scolopsis xenochrous scomberoides commersonnianus scomberoides lysan scomberomorus commerson selar crumenophthalmus selaroides leptolepis seriola dumerili seriola hippus seriola rivoliana seriolina nigrofasciata serranocirrhitus latus sillago ciliata sillago sihama soleichthys heterorhinos sphraena barracuda sphraena forsteri sphraena jello sphraena obtusa stegostoma fasciatum stethojulis bandanensis stethojulis interrupta stethojulis strigiventer stethojulis trilineata stolephorus waitei suezichthys arquatus suezichthys cyanolaemus suezichthys gracilis symphorichthys spilurus symphorus nematophorus thalassoma amblycephalum thalassoma hardwicke thalassoma jansenii thalassoma lunare thalassoma lutescens thalassoma nigrofasciatum thalassoma purpureum thalassoma quinquevittatum thalassoma trilobatum thyrsa baelama thyrsa hamiltonii thunnus alalunga thunnus albacares thysanophrys celebica thysanophrys chitonae trachichthys australis trachinotus bailloni trachinotus blochii trachinotus botla trachypoma macracanthus triaenodon obesus uraspis secunda valamugil cunnesius valamugil engeli valamugil seheli variola albimarginata variola louti wattssia mossambica wetmorella albofasciata wetmorella nigropinnata xiphocheilus typus zenarchopterus dispar zeus faber

Items per page: 10 - 25 - 50 - 100

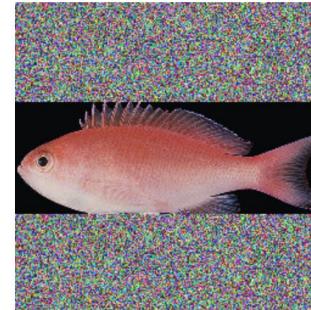
« 0



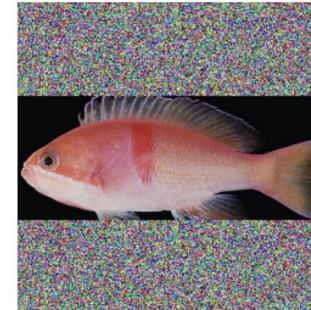
pseudanthias rubrizonatus



pseudanthias rubrizonatus



pseudanthias rubrizonatus



pseudanthias rubrizonatus



Now we were ready to make our fish dataset

101food

Imdb

Delete

**Submitted:** Feb 07, 12:16:43 AM

**Status:** Done after 43 minutes, 18 seconds

480fish

Imdb

Delete

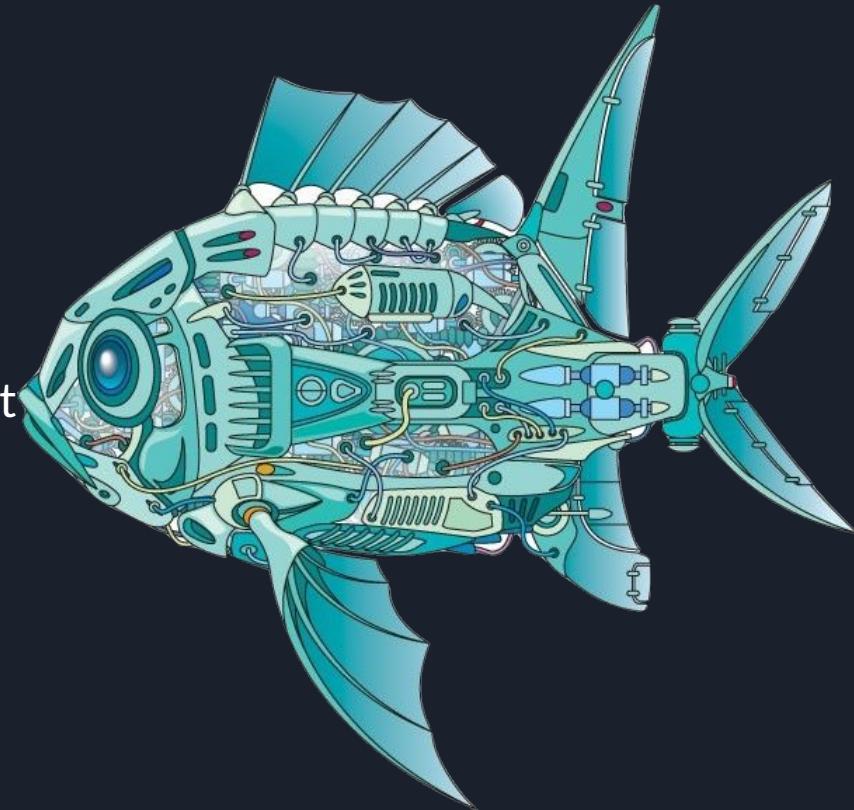
**Submitted:** Feb 10, 02:47:10 AM

**Status:** Done after 26 seconds

# Making a larger dataset

Fishbase.org has the single largest database of fish on the Internet

(that we know of)



Postman

New Import Runner + Filter History Collections Clear all

Builder Team Library SYNC OFF No Environment

GET https://fishbase.ropensci.org/species

Params Send Save Cookies Code

Authorization Headers Body Pre-request Script Tests

TYPE Inherit auth from parent

The authorization header will be automatically generated when you send the request. [Learn more about authorization](#)

This request is not inheriting any authorization helper at the moment. Save it in a collection to use the parent's authorization helper.

Body Cookies Headers (11) Test Results Status: 200 OK Time: 396 ms Size: 21.09 KB

Pretty Raw Previous JSON

```
1 {  
2   "count": 33754,  
3   "returned": 10,  
4   "data": [  
5     {  
6       "SpecCode": 64588,  
7       "Genus": "Aapticheilichthys",  
8       "Species": "websteri",  
9       "SpeciesRefNo": 78622,  
10      "Author": "(Huber, 2007)",  
11      "FBname": null,  
12      "PicPreferredName": "Prweb_u0.jpg",  
13      "PicPreferredNameM": null,  
14      "PicPreferredNameF": null,  
15      "PicPreferredNameJ": null,  
16      "FamCode": 216,  
17      "SubFamily": "Pseudechidinae"  
]
```



# What did we build? // *What is FishSnap?*



A mobile image recognition app that

- uses the device camera to capture an image
- identify it through vision and ML frameworks

We used a custom fish category dataset as a pre-trained model for Core ML to classify what type of fish is in the photo.

# What impact will this have?

Allows smaller/poorly-funded fishers to quickly

- assess the nature/value of their catch and to
  - track fish locations by the scans.





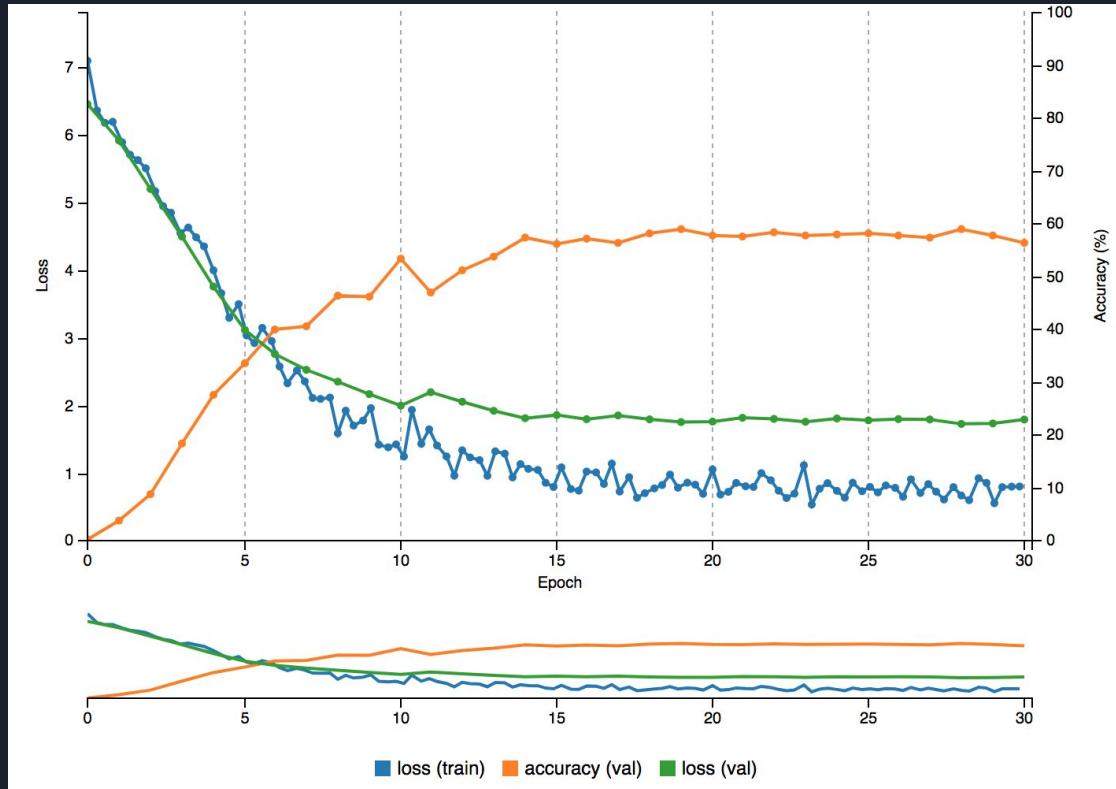
# Why is the data important?

Two reasons

- This data collection will both facilitate aquatic marine studies
- and further improve the machine learning of the image recognition.



# Machine Learning you say?





Would you like to sea it?

DEMO IT!



A friend from the coral reefs and lagoons in  
the Indo-Pacific region



*Novaculichthys Taenourus*



# The Sailfin Snapper from the Great Barrier Reef

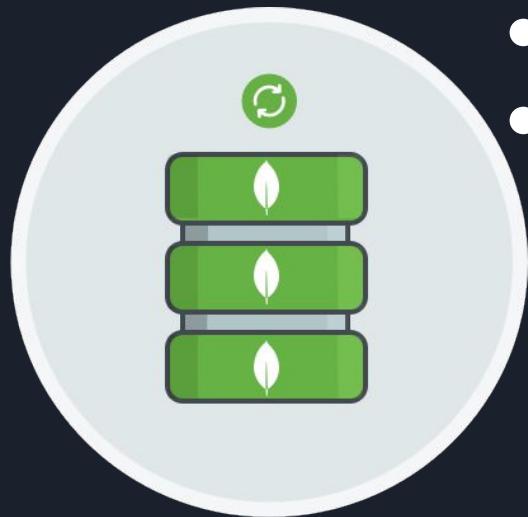


*Symphorichthys Spilurus*



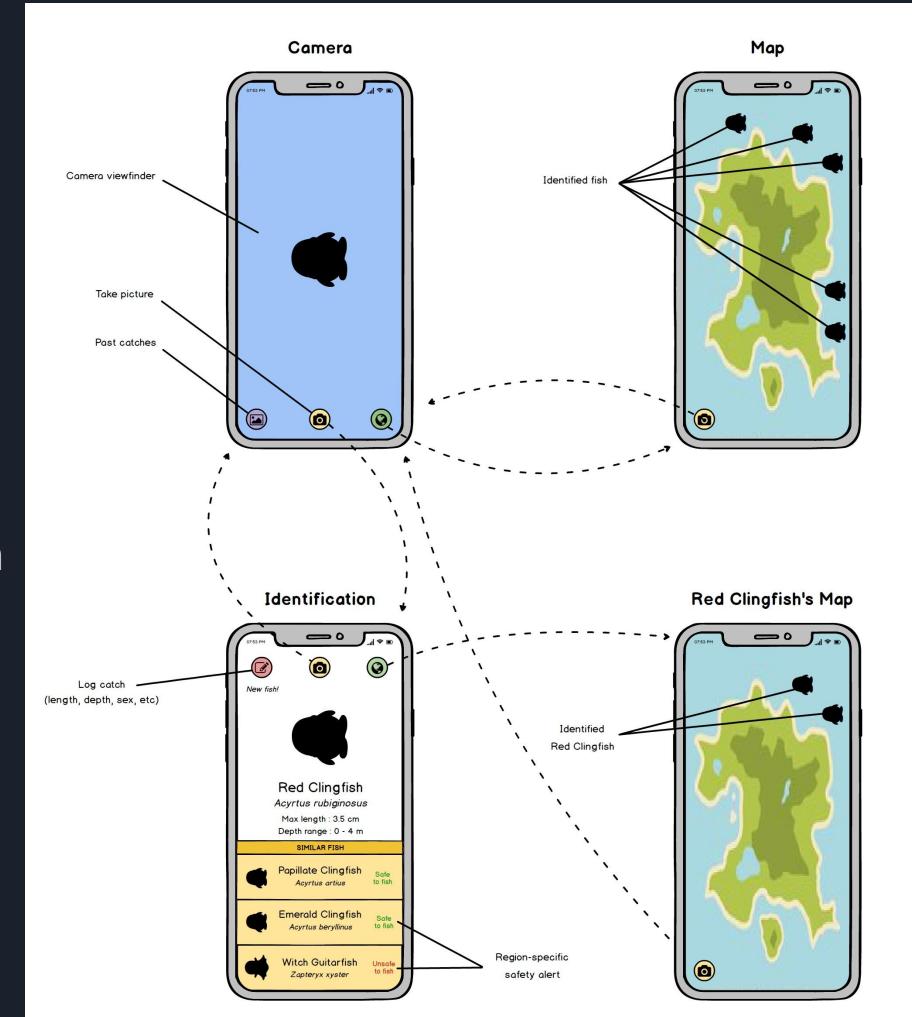
## Where do we go from here?

- Add 33K additional species from Fishbase.org
- Add BaaS to collect images to a centralized file store
- Social Feature
- Mapping UI of the verified catches



# Design for 2.0

- Integration of MapViews
- Region specific messaging Upon identification
- Catch Log to capture length
- ARKit for the ruler



# For More on Core ML

Check the following WWDC 2017 Sessions:

Part 1: (30 min)

[Session 703: Introducing Core ML](#)

Part 2: (40 min)

[Session 710: Core ML in Depth](#)





Stay in touch

Visit us at

<http://fishsnap.us>



<http://fishsnap.us/deck/fishsnap-cocoaheads.pdf>