



Sterocarpus ludovicicus

Spironala stehlosa

Camassia quamash

Calyptocum portulatum

Erythronium grandiflorum

Asarum caudatum

Sarcodes sanguinea

Simbilosa argorea

CALIFORNIA WILDFLOWER FIELD GUIDE & NEW SPECIES NAME GENERATOR*

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 CS230: FALL [HTTPS://YOUTU.BE/EXJZVIK4MKO](https://youtu.be/EXJZVIK4MKO)

PREDICTING: Only 1% of the estimated 2 billion species living on Earth have been classified, leaving a staggering 99% of new species to be discovered and named. The purpose of this project is to encourage an interest in nature & conservation by creating tools to:

- 1) accurately identify California wildflower species from images &
- 2) generate new realistic scientific (Latin) names from wildflower images for newly discovered species.

DATA: For wildflower identification:
 • Oxford's "102 common flower categories", plus 32 added categories of California wildflowers cross-validated w/ California Native Plant Society website.

For generating new species names:
 • A collection of 6101 species of North American wildflowers from www.WildflowerSearch.org. This averaged only about two image per species, but many for each genus (first word in species name).

FEATURES: RGB images scaled & padded to size requirements of each classic model. AlexNet and VGG-16 take inputs of 227x227x3 and 224x224x3 images, respectively & are normalized with the ImageNet mean. The inception V3 model requires inputs of 299x299x3 to create encoding vectors of size 2048 to feed into an RNN with LSTM units.

MODELS: For wildflower identification: **AlexNet** with pretrained ImageNet weights had the last 3 fully-connected layers finetuned with flower data. **VGG-16** with pretrained ImageNet weights had its last fully-connected layer trained for 10 epochs, then all layers further finetuned at a lower learning rate for another 10 epochs to speed convergence.

For generating scientific names: Google's **Show & Tell Model** (Inception V3 + RNN w/ LSTM units) developed to generate captions was used with modified inputs. Pretrained COCO weights for the Inception model were frozen during training of the vector-to-sequence RNN. Specifically, caption words were replaced with letters of each wildflower species' scientific name, then a beam search algorithm generated new two-word Latin names *letter by letter*.

	Train/Dev/Test Size	Epochs	Performance Metric	Train Perform	Dev Perform	Test Perform
AlexNet (Dev/Test only Wildflower Data)	11,463 408	25	Accuracy	0.95	0.92	0.91
AlexNet (Dev/Test Common + Wildflower Categories)	9,428 1,424 1,430	50	Accuracy	1.0	0.88	0.90
VGG-16 (Dev/Test Common + Wildflower Categories)	9,428 1,424 1,430	10 + 10	Accuracy	0.73	0.59	0.58
Show & Tell Model Inception V3 + RNN	19,495 2,436 2,436	100	Recall of Genus (first word)	0.30	0.16	0.16

RESULTS: AlexNet produced results approaching the state of the art on the Oxford dataset (94%) for classification. The Show & Tell model generated new plausible Latin names, where the first word (or genus) of a prediction was accurate 16% for the dev & test sets (for beam size = 1), but less than 0.5% for the second.

DISCUSSION: For new name generation, the dataset was selected to represent a wide range of species names, not to identify species. Many values of beam size were tested, and bs = 1 (greedy search) generated the most unique Latin sounding names. The Bleu Score proved meaningless when calculated for letters of generated and actual names. A less than ideal performance metric was adopted, similar to that used for generating classical Chinese poetry from images: *recall of key concepts*, in this case the genus (or first word) of the species.

FUTURE: 1) To generate more unique names, add an additional term to the loss function penalizing generation of existing names. 2) Incorporate more clean images by using YOLO 9000 cropping.

Selected References:
 Vinyals, Oriol & Toshev, Alexander & Bengio, Samy & Erhan, Dumitru (2016). Show and Tell: Lessons learned from the 2015 MSCOCO Image Captioning Challenge. IEEE Transactions on Pattern Analysis and Machine Intelligence. 39.
 Xu, Linli & Jiang, Liang & Qin, Chuan & Wang, Zhe & Du, Dongfang. (2018). How Images Inspire Poems: Generating Classical Chinese Poetry from Images with Memory Networks.

*Generated names above: Sterocarpus ludovicicus, Spironala stehlosa, Calyptocum portulatum, Simbilosa argorea. All others are actual scientific names for species identified by the project's deep learning models.

