Animal Adoptability Analysis

Predict animal adoption speed from pet profiles

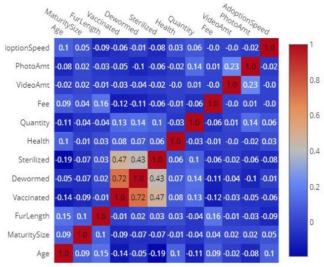
Hermann Qiu (hq2128), Xu Zhao (pglory), Chun Kit Chan (cckit)
Department of Computer Science, Stanford University

Motivation

- Inspired by a recent kaggle challenge to predict pet adoption speed from pet profiles. The long-term goal of the project is to guide shelters and rescues on improving their pet profiles' appeal, reducing animal suffering and euthanization.
- The input is the pet profile, including structured data columns and image data; The output is the adoption speed categorized from 0 to 4 (0 being the fastest and 4 being the slowest).
- We use pre-trained ResNet to extract image features, concatenate with structured features at certain stage, and feed the combined vectors to another network.

Dataset

- 14993 pet profiles with labels from 0 to 4 indicating the adoption speed (the smaller, the faster the pet is adopted).
- Structured data: 24 columns, including numerical feature, nominal feature and ordinal feature (11 out of 24 are shown on the right).
- Image data: 58311 pet images
  One pet profile can have more than one photo, and one photo can include multiple pets.

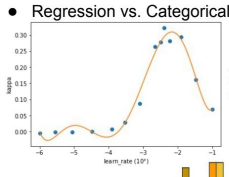


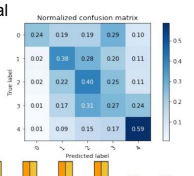
Feature Engineering

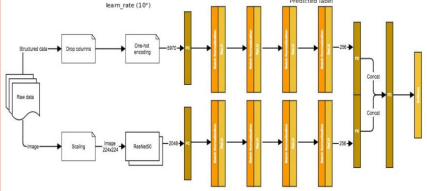
- Structured data:
  - Keep numerical features as what they are (age, Adoption Fee, Number of photos, etc)
  - convert nominal data and ordinal data into One-Hot Vectors
  - In this way, every sample has a feature vector size of 5970 derived from structured data
- Image data:
  - Pick and scale the first image for every sample profile, for those that don't have a image, we will insert a dummy black image. Preprocessed into uniform 224*224*3 array.
  - Transfer learning: use ResNet50 to process the images
- Structured data + Image data:
  - In a simple saying, at certain stage of the network, we will merge two set of feature data together into one

Models, Results, Discussion

- Transfer Learning (image): Freeze/unfreeze certain layers, concatenate the last few layers
- Image Augmentation
- Variation of dense layers/number of units
- When to merge structured and image feature: Early merge vs. Late merge
- Loss Function: MSE vs. Cross-Entropy Loss vs. QWKappa Loss
- Hyperparameters search
- Regression vs. Categorical







Data Used	Network	Loss Function	Accuracy - Dev	QW-Kappa - Dev
Structure Data	*1- layer NN*	*Cross-entropy*	*30.40%*	**N/A*
		MSE	*27.00%*	**N/A*
Image Data	*Pre-trained ResNet + 2-layer NN*	*Cross-entropy*	*33.9%*	**N/A*
		MSE	*25.90%*	**N/A*
Structure Data	*6- layer NN*	*Cross-entropy*	*32.13%*	*24.56%*
		QW-Kappa Loss	*39.00%*	*42.00%*
Structure Data + Image Data	*Step1:Pre-trained ResNet for image feature extraction, then feed into 2-layer NN; Step2: Feed structure data to a 6-layer NN; Step3: Concatenate the results from 1 and 2, then run through softmax layer*	*Cross-entropy*	*40.40%*	*38.98%*
		QW-Kappa Loss	***43.60%***	***48.01%***

Error Analysis

- Rescuer Effect: Star rescuer vs single pet rescuer.
- Quantity effect: each profile can include multiple pets
- Information in description not able to use yet - personality, reason for relinquishment.
- Profile quality: Low quality→Low prediction.

Compare with other teams

- Current Kaggle Public Leaderboard top 0.4920 vs. Our highest of *0.4801*

Future Work and Citations

- Clean up description text data, translate non-English sentences into English, and extract important information like 'reason for pet relinquishment' -- "*Break the 0.5*"
- Enrich the infrastructure and improve the running efficiency, to allow more users seamless feeding in their own data to see the results

[1] Liwei Wang, Yin Li, Jing Huang, Svetlana Lazebnik (2018). "Learning Two-Branch Neural Networks for Image-Text Matching Tasks"
[2] Classifying e-commerce products based on images and text.
[3] Adopter-dog interactions at the shelter: Behavioral and contextual predictors of adoption
Please find the full list in the final report.

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kaggle

Link to Video:
https://youtu.be/QP6BnCuSXSk