Pet Disease Prediction Using Deep Learning Approach

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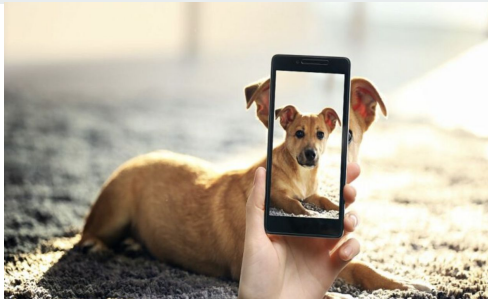
Problem statement & Analysis

- Our project aims to develop a pet disease prediction model based on deep learning making people learn about the health conditions of their pets given given their behaviors and symptoms
  - There has been a constant quest to comprehend the well-being of our animals
  - Our pets cannot verbally communicate with us and demonstrate their health status
    - The demand for veterinary medicine has been raised to understand pets' health conditions
- Machine learning / deep learning provides a promising approach to making people learn about the health conditions of their pets with plenty of data collected through various sources [1,2].

1. Hwang, S., Shin, H. K., Park, J. M., Kwon, B., & Kang, M. G. (2022). Classification of dog skin diseases using deep learning with images captured from multispectral imaging devices. *Molecular & Cellular Toxicology*, *18*(3), 299-309.
2. Debes, C., Wowra, J., Manzoor, S. et al. Predicting health outcomes in dogs using insurance claims data. Sci Rep 13, 9122 (2023). https://doi.org/10.1038/s41598-023-36023-5
Image source: https://www.forbes.com/sites/joanverdon/2022/09/12/pet-insurer-creates-platform-that-predicts-your-dogs-medical-future/?sh=1d929c571d6d

Use-case scenario

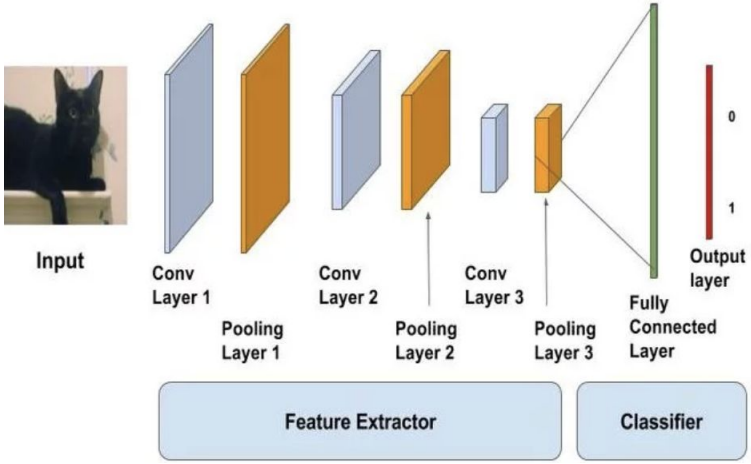


- Users who have a dog may notice their dog has some discomfort, which requires a diagnosis from hospitals
  - Some of the common disease in dogs are quire severe and need immediate action
- Our model will predict what kind of disease the dog has and provide proper recommendations for users to take further actions
  - Cases such as skin diseases can be cured at home with minor therapy
  - Users can just take a picture of the dogs' skin and summit it to our proposed model

Image source: https://www.zooplus.co.uk/magazine/dog/dog-adoption/10-tips-for-taking-the-perfect-photo-of-your-dog

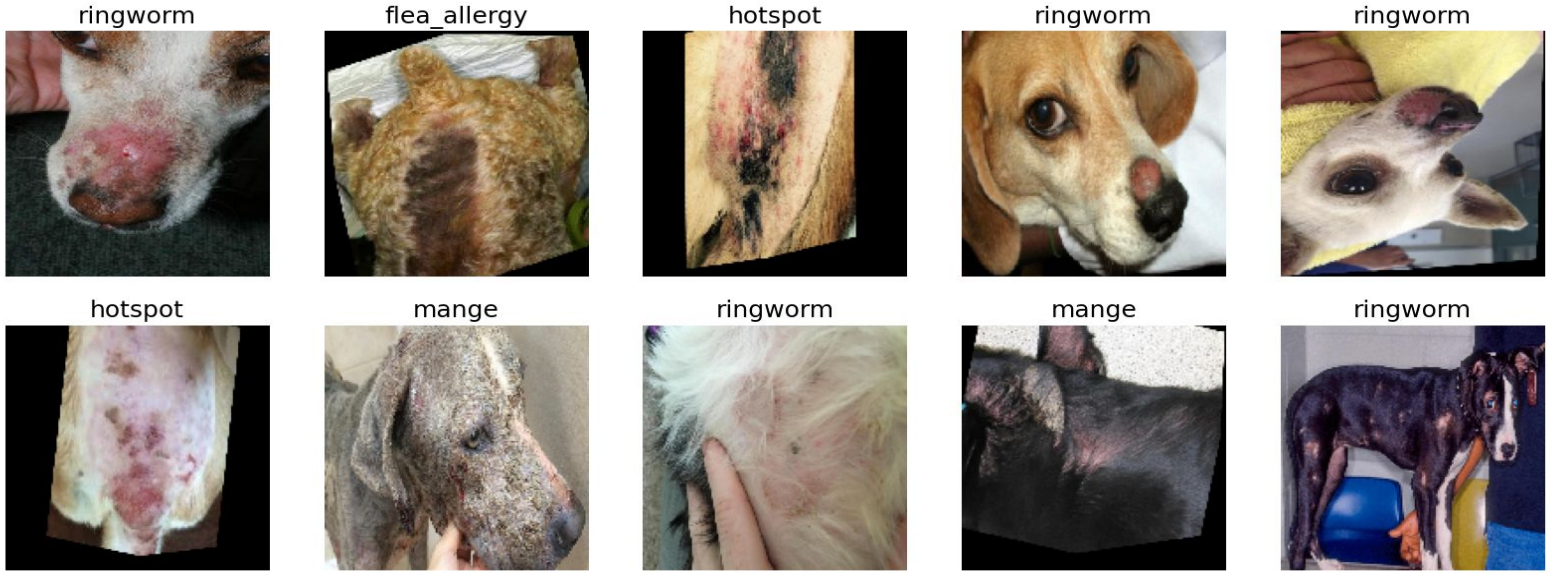
AI algorithm & Model

- Deep Learning
  - Convolutional neural network (CNN), a regularized type of feed-forward neural network learning feature engineering by itself via filters optimization
    - Convolutional layers
    - Pool layers
    - Fully connected layers
    - Receptive fields
    - Weights
- Common applications using CNN
  - Image and video recognition
  - Image classification
  - Recommender system
  - Natural language processing



Experiment setting

- We use two datasets: image classification & tabular data classification
  - Image: Skin disease for dogs containing 1119 images from 4 types of diseases
    - Data can be found at: https://github.com/1zuu/Doggy-Disease-Detection/data

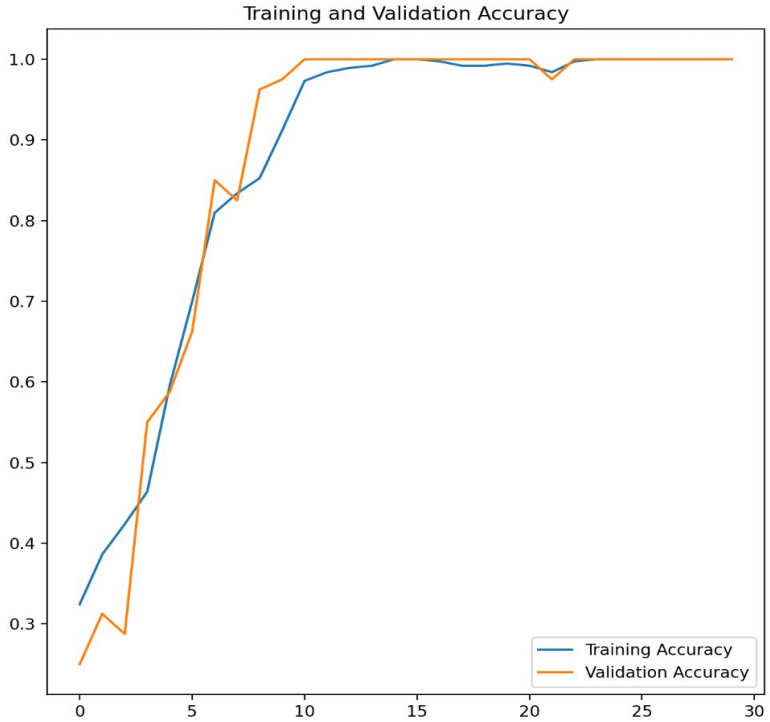


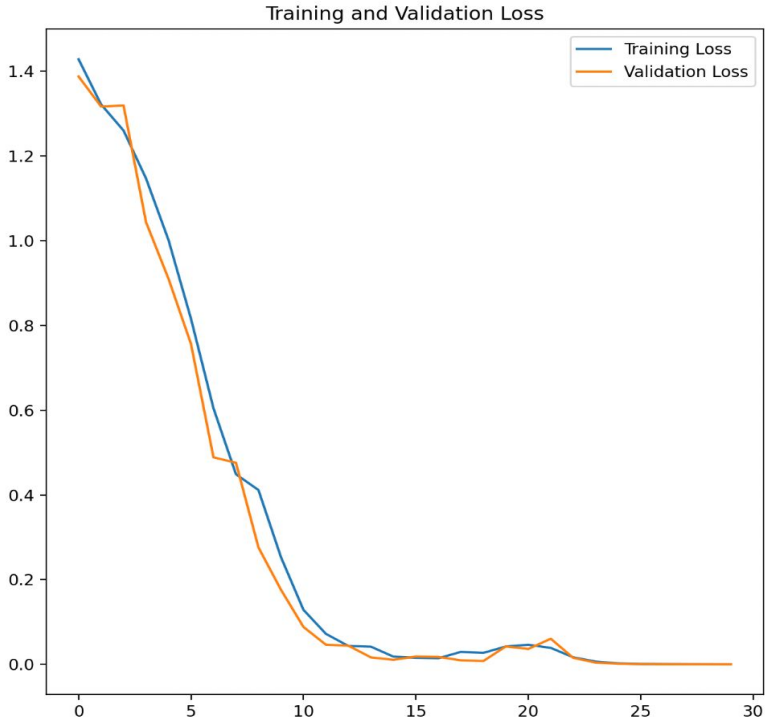
Experiment setting

- We use two datasets: image classification & tabular data classification
  - Tabular data: Dog disease containing 24000 entities with 17 symptoms and 12 diseases
    - Data can be found at: https://github.com/OPet-OnlineDiagnosisforYourPet-sDisease/MachineLearning/blob/main/dataset/dogSkinDisease.zip.

Disease	Symptom_1	Symptom_2	Symptom_3	Symptom_4	Symptom_5	Symptom_6	Symptom_7	Symptom_8
Tick fever	Fever	Nasal Discharge	Lameness	Lethargy	Increased drinking and urination	Neurological Disorders	NaN	NaN
Tick fever	Fever	Lameness	Swollen Lymph nodes	Vomiting	Neurological Disorders	NaN	NaN	NaN
Tick fever	Fever	Nasal Discharge	Lethargy	Swollen Lymph nodes	NaN	NaN	NaN	NaN
Tick fever	Fever	Nasal Discharge	Lameness	Vomiting	Neurological Disorders	NaN	NaN	NaN

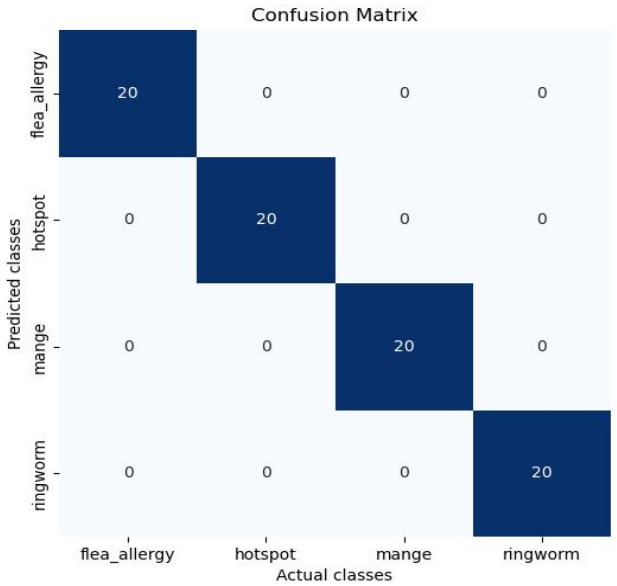
Results & Demonstration (Skin disease prediction)



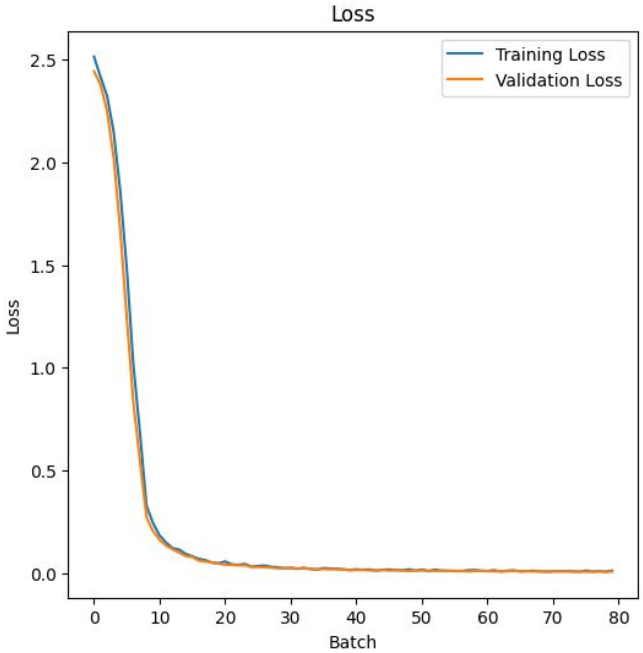


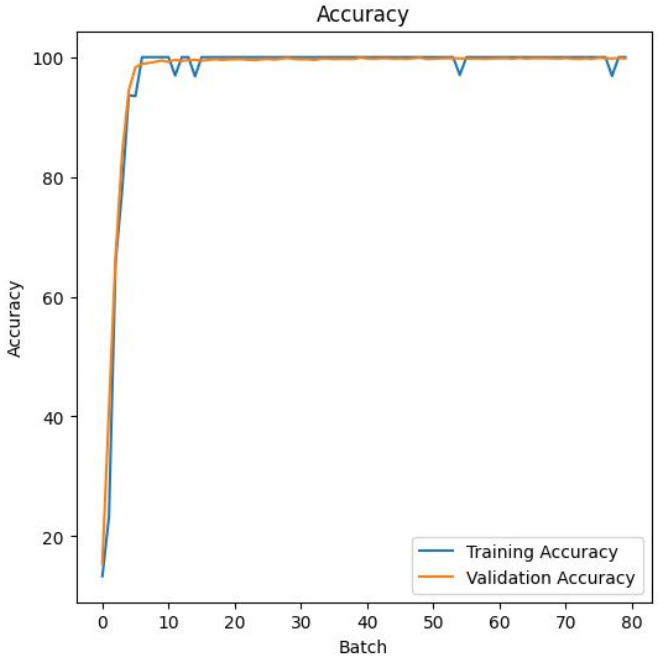
Results & Demonstration (Skin disease prediction)

	precision	recall	f1-score	support
flea_allergy	1.00	1.00	1.00	20
hotspot	1.00	1.00	1.00	20
mange	1.00	1.00	1.00	20
ringworm	1.00	1.00	1.00	20



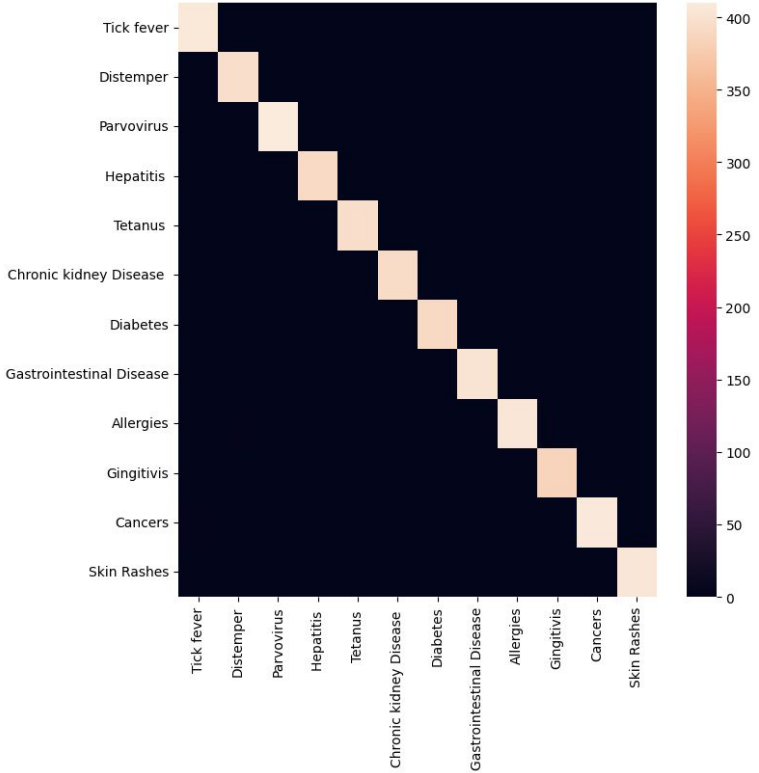
Results & Demonstration (Dog symptoms model)





Results & Demonstration (Dog symptoms model)

	precision	recall	f1-score	support
Tick fever	0.992665	0.995098	0.993880	408.0
Distemper	0.982630	0.997481	0.990000	397.0
Parvovirus	1.000000	0.997567	0.998782	411.0
Hepatitis	0.994924	0.997455	0.996188	393.0
Tetanus	1.000000	0.997487	0.998742	398.0
Chronic kidney Disease	1.000000	0.994937	0.997462	395.0
Diabetes	0.997442	1.000000	0.998720	390.0
Gastrointestinal Disease	1.000000	0.995037	0.997512	403.0
Allergies	1.000000	0.995074	0.997531	406.0
Gingitivis	1.000000	1.000000	1.000000	385.0
Cancers	0.995110	0.992683	0.993895	410.0
Skin Rashes	1.000000	1.000000	1.000000	404.0
macro avg	0.996898	0.996902	0.996893	4800.0
weighted avg	0.996899	0.996875	0.996880	4800.0



Lesson learned

- From this project, we learned
  - The importance of data preprocessing in deep learning including tasks such as cleansing, normalization, data augmentation, and handling imbalanced datasets
    - We initially had a hard time training the CNN model for image classification without preprocessing the images
  - More Insights into different neural network architectures for image classification and the significance of layers extending the knowledge we learned from lecture
  - Experiment with hyperparameter tuning to optimize the performance of our models like learning rate and batch_size
- We also learned how to implement the techniques and algorithms we learned in lecture into real-world applications

Q & A