Workflow Languages for Convolutional Neural Networks

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Introduction

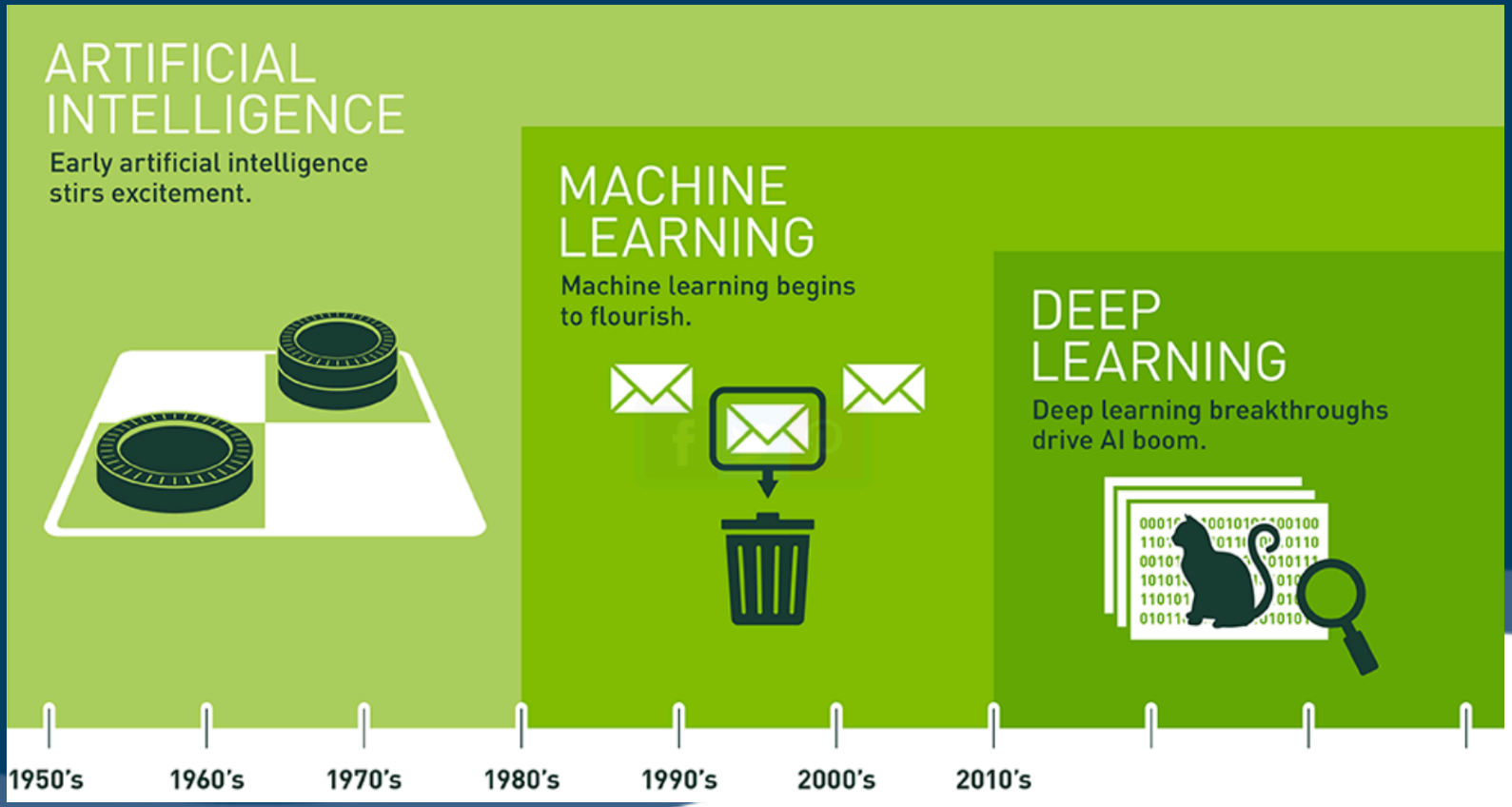
- Complexity:
  - Programming knowledge
  - Deep Learning
- Optimizing Deep Learning experience
- Analysis:
  - Data Augmentation code
- Pathologists

Objectives

- Identify CNN commonalities
- Workflow Language with parameters
- No programming expertise required

- No viable model ensured:
  - Parameters used influence model viability
  - Data preprocessing
  - Insight in CNN's still required

Machine Learning vs. Deep Learning



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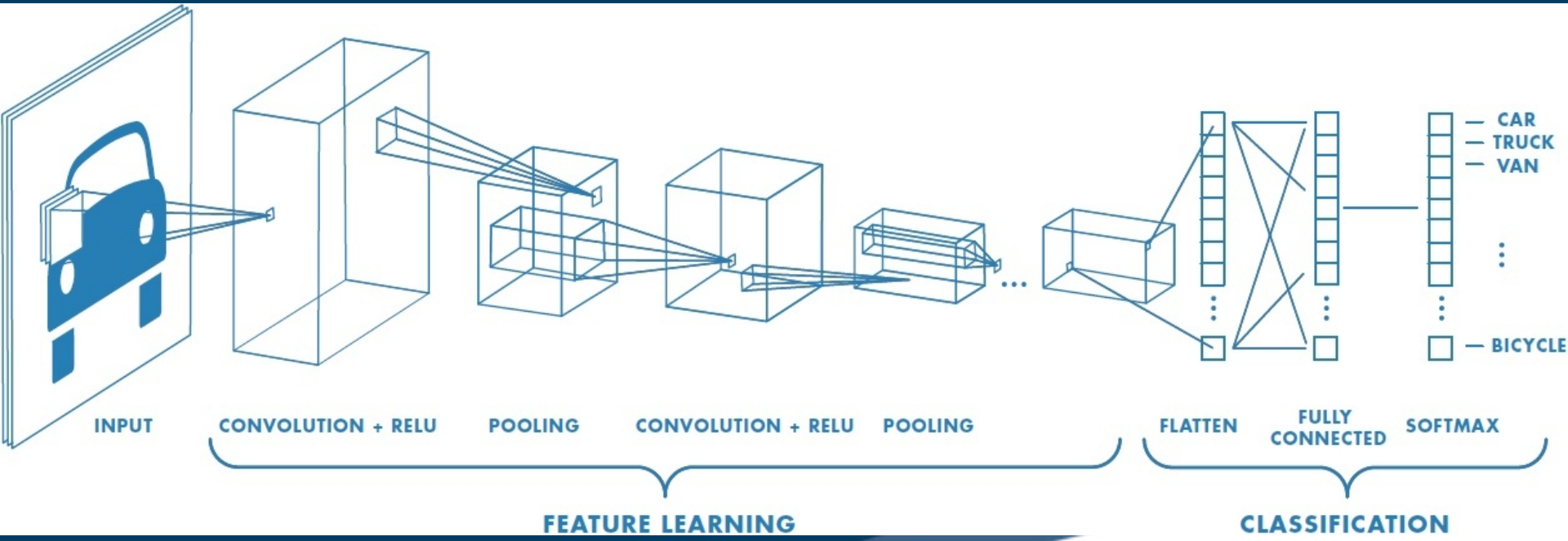
Convolutional Neural Network



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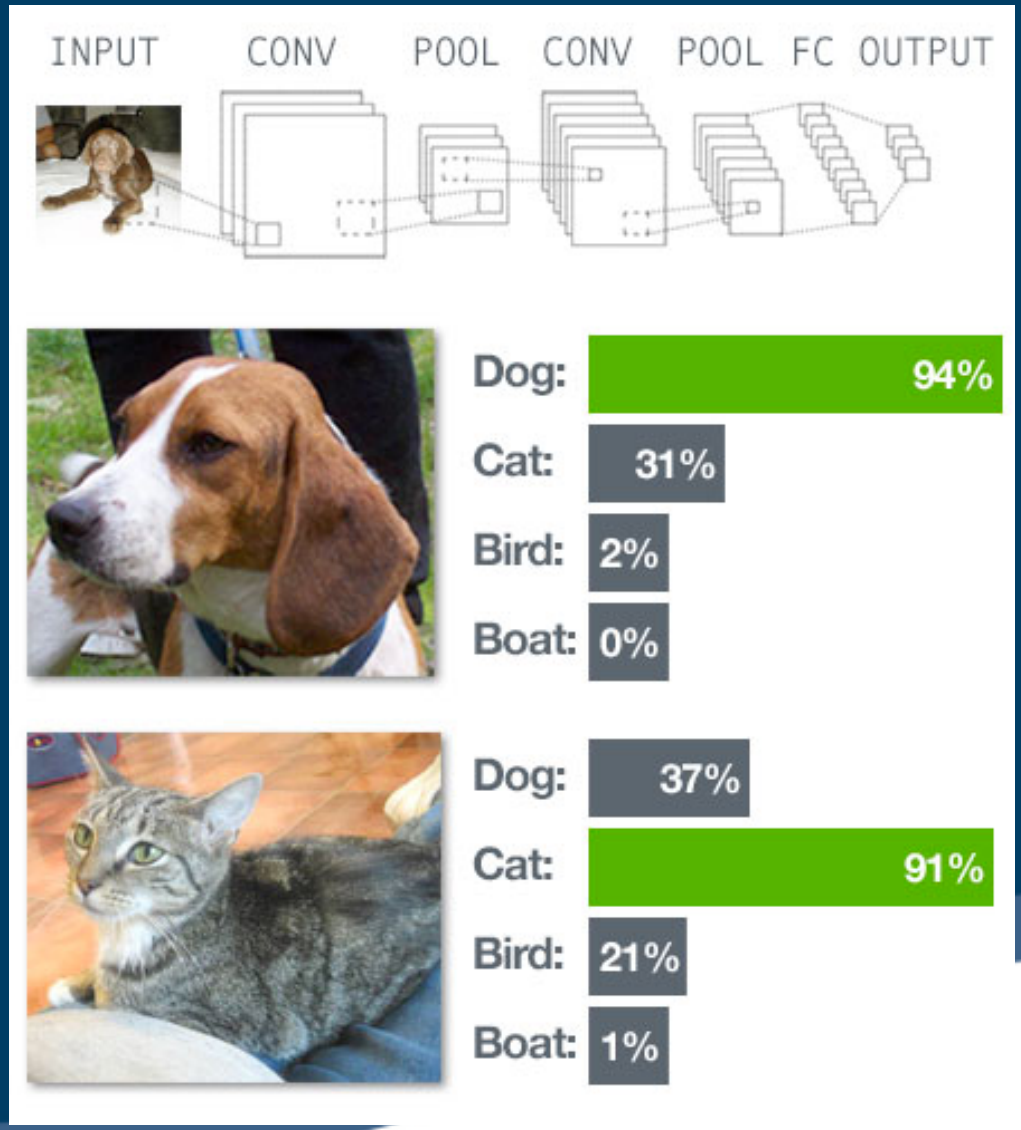
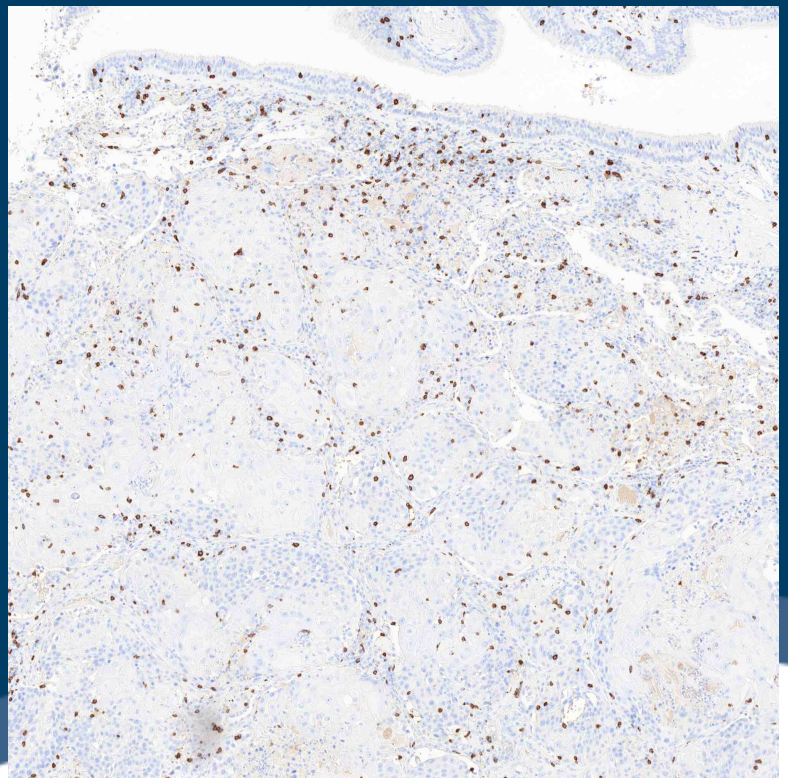

INPUT
CONV
POOL
CONV
POOL
FC
OUTPUT
Dog: 94%
Cat: 31%
Bird: 2%
Boat: 0%
Dog: 37%
Cat: 91%
Bird: 21%
Boat: 1%

Data

- Images
- Labeled → Supervised Learning
- Specific folder hierarchy



Data Augmentation: Required Folder Hierarchy

- /data/
  - Dogs/
    - Dog.1.png
    - Dog.2.png
    - …
  - Cats/
    - Cat.1.png
    - Cat.2.png
    - …

Data Augmentation: Required Folder Hierarchy

- Collecting data → Not automatable
- Renaming files → Automatable

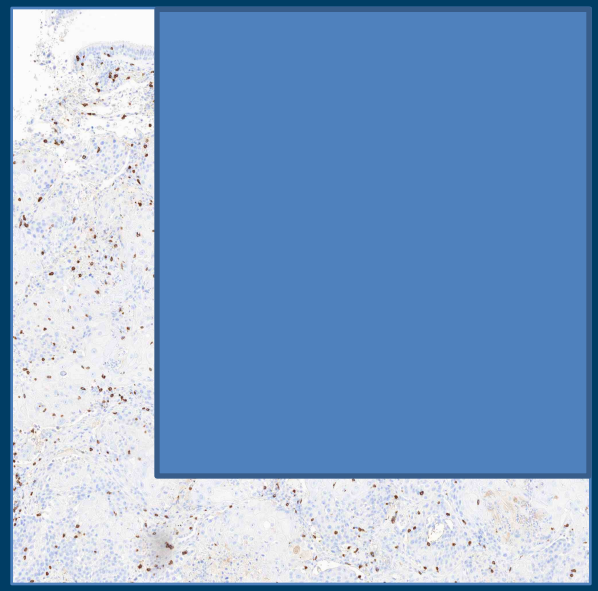
Data Augmentation: Expanding the dataset size

- Eg: 2000x2000 images
  - Take 1700x1700
  - Shift 10 pixels width/height
  - …
- 900 images from one image (30x30)

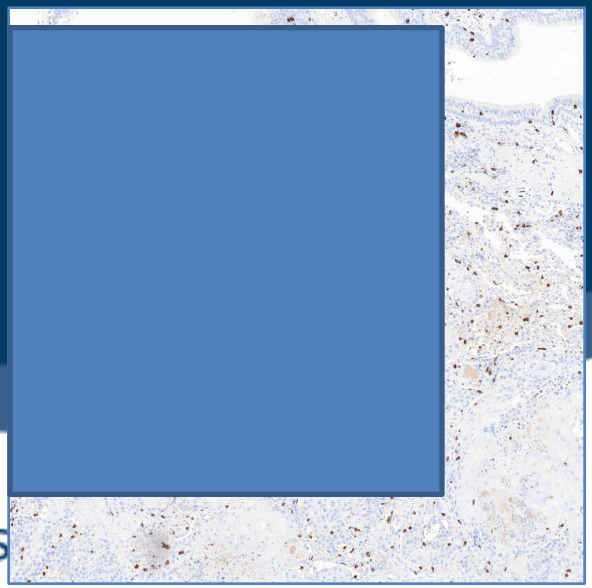
1

2

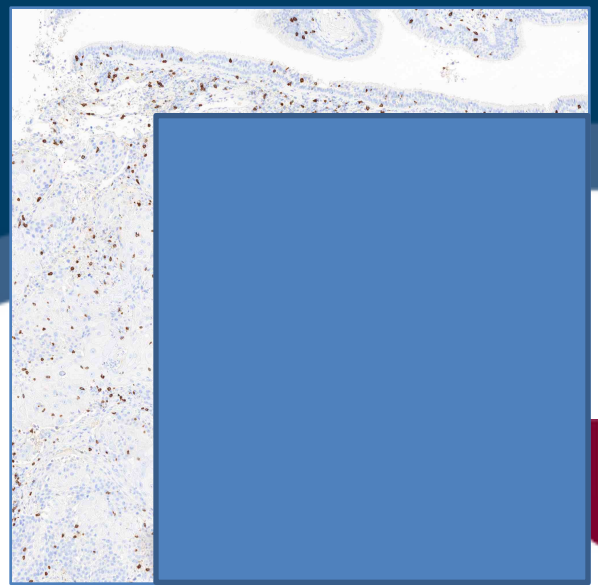
30



31



900



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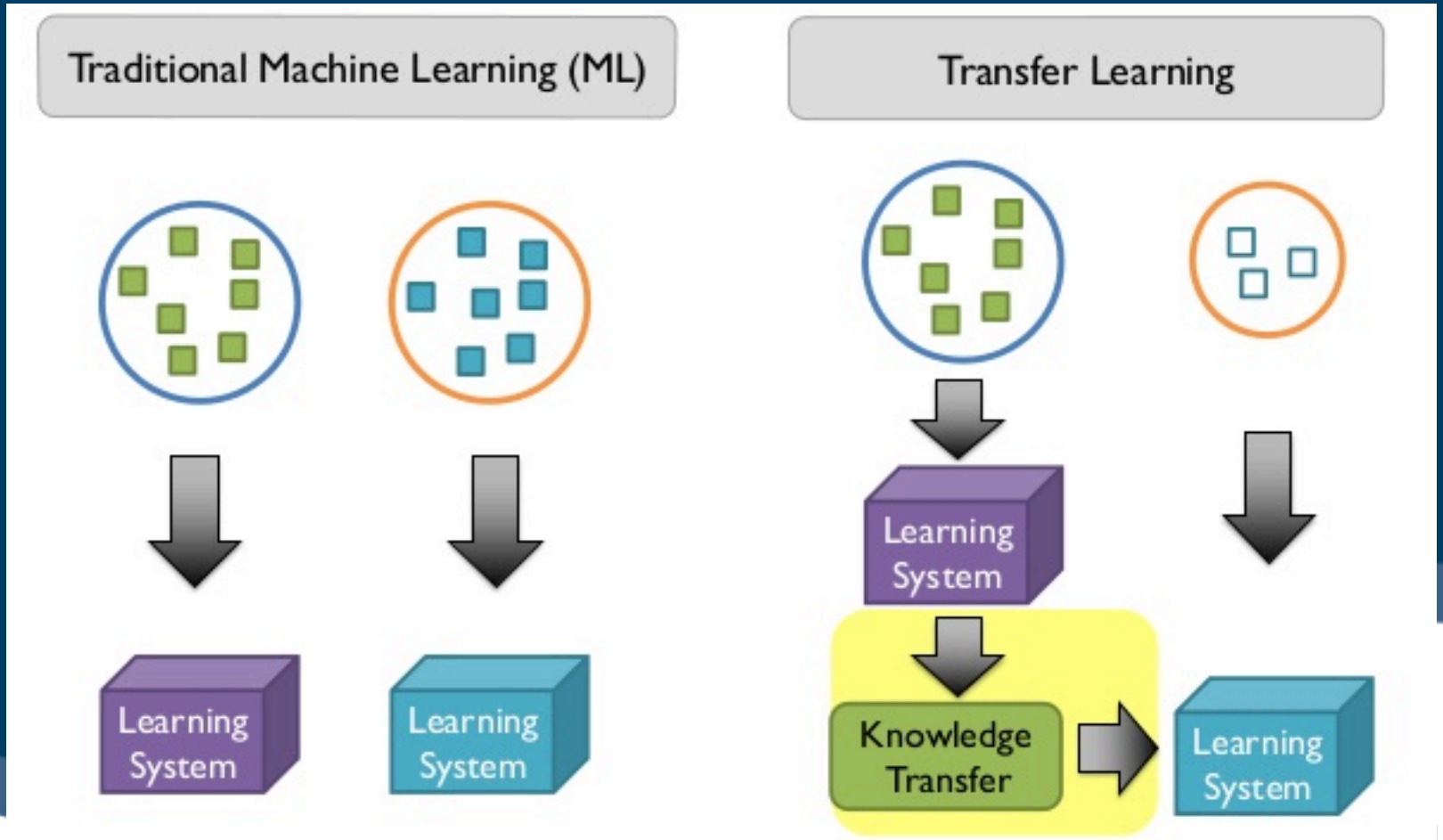
Transfer Learning & Fine Tuning



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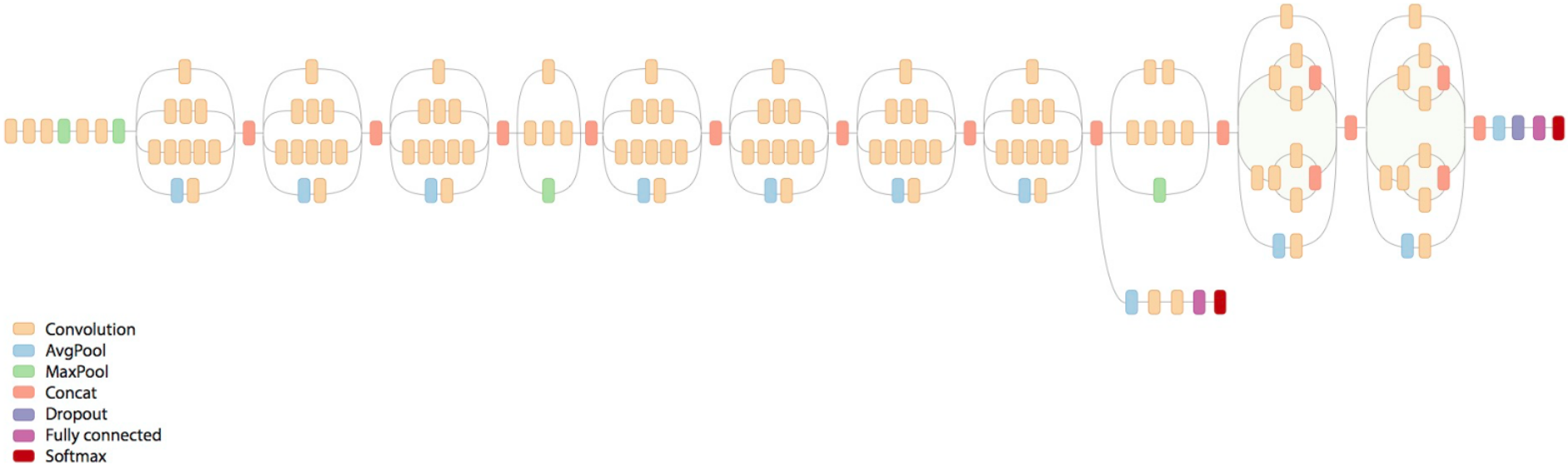
InceptionV3



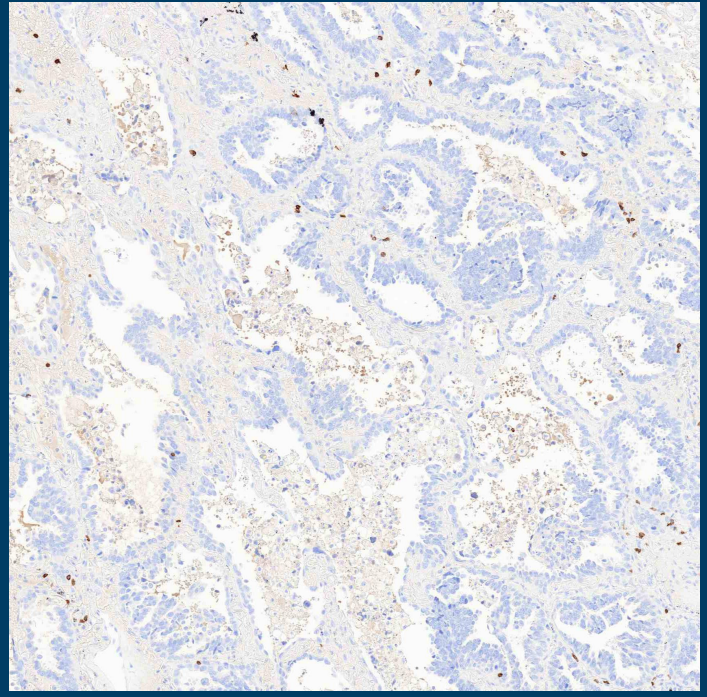
Bron: https://research.googleblog.com/2016/03/train-your-own-image-classifier-with.html

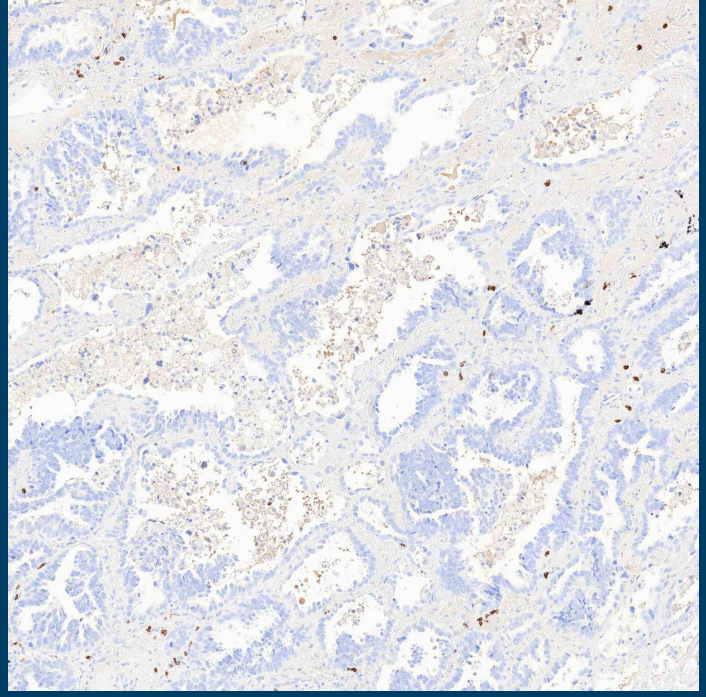
Data Augmentation: Expanding the dataset size

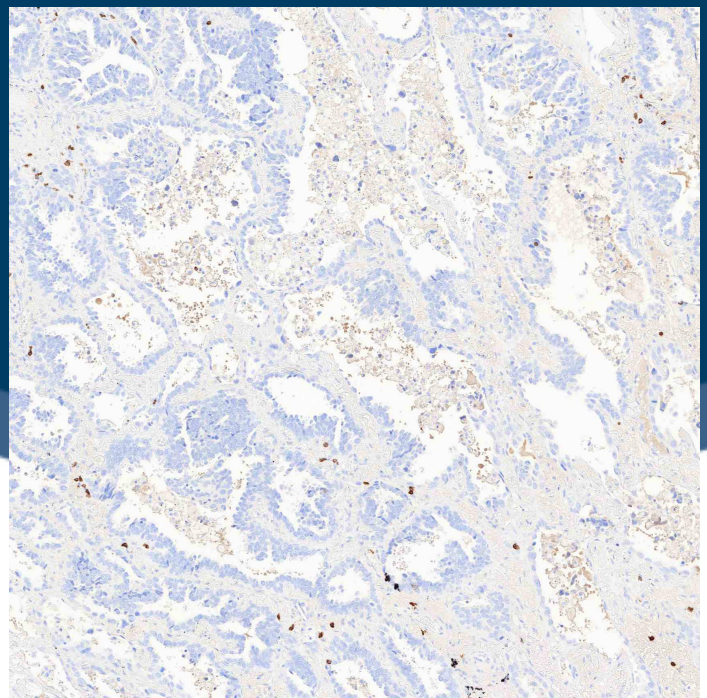
- Eg: 2000x2000 images
  - Take 1700x1700
  - Shift 10 pixels width/height
  - …
- 900 images from one image (30x30)
- InceptionV3 takes inputsize 299
  - Min width/height shift: 1700/299 < 6 pixels

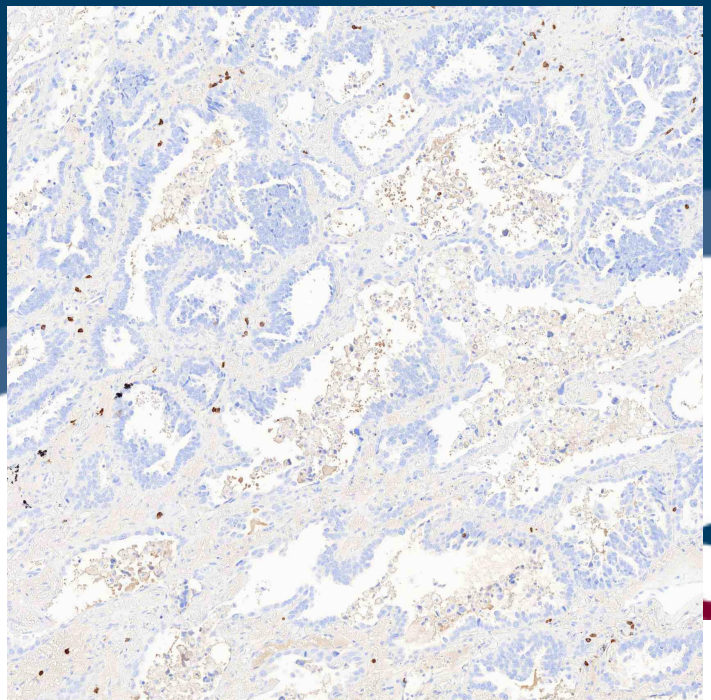
Data Augmentation: Expanding the dataset size

- Rotate 90 degrees:
  - 0
  - 90
  - 180
  - 270
- X4 images



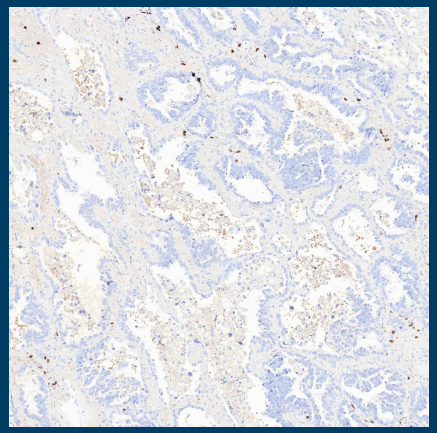
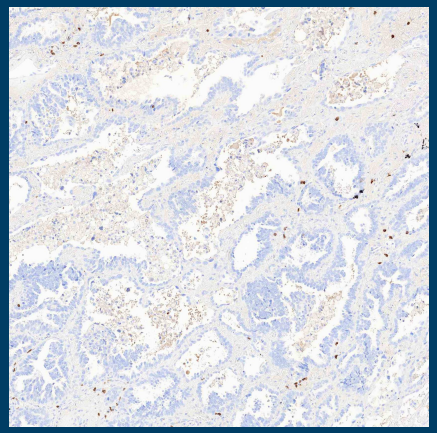
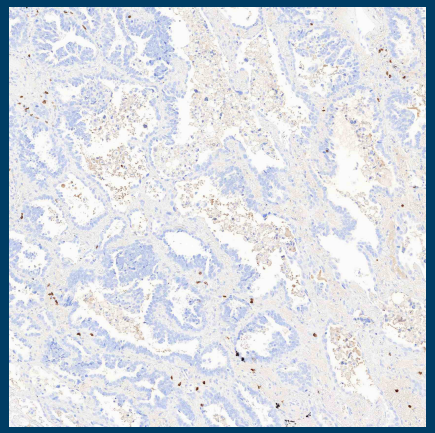
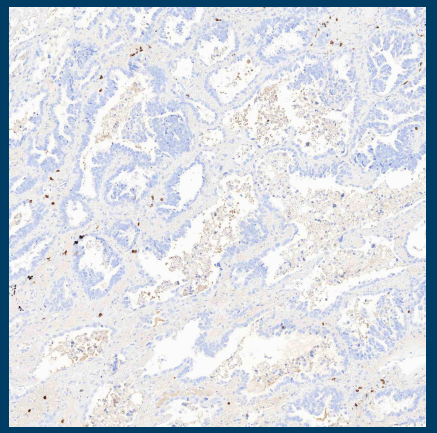
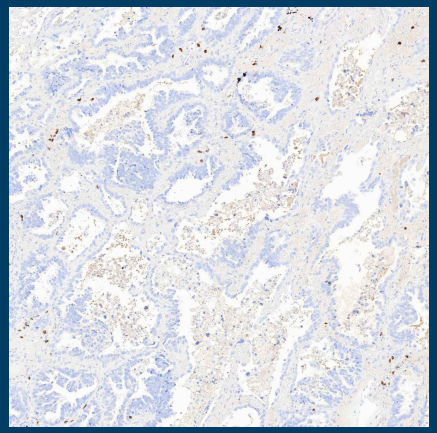
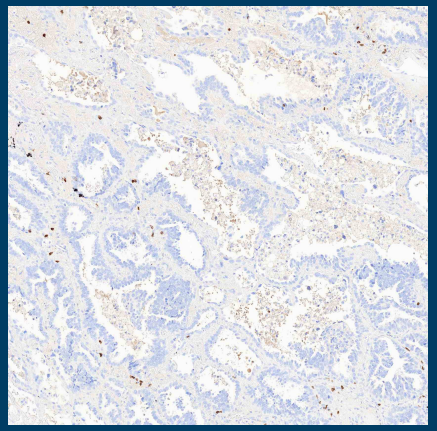
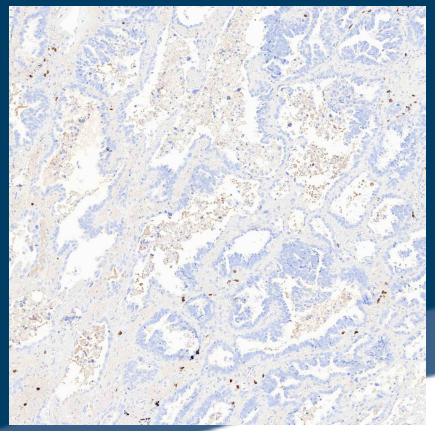
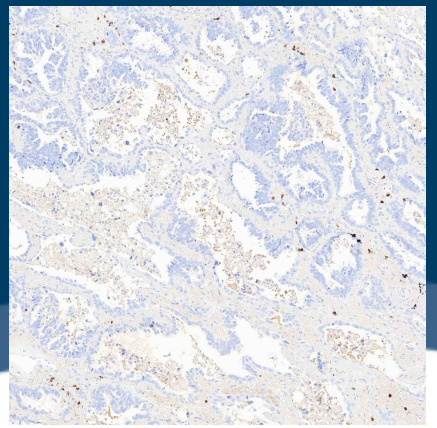






Data Augmentation: Expanding the dataset size

- Flip Vertically
- X2 images

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Future Perspectives

- Color correction

Training, Validation and Testing set

- 60% Training
- 20% Validation
- 20% Testing

- Specific resulting folder hierarchy

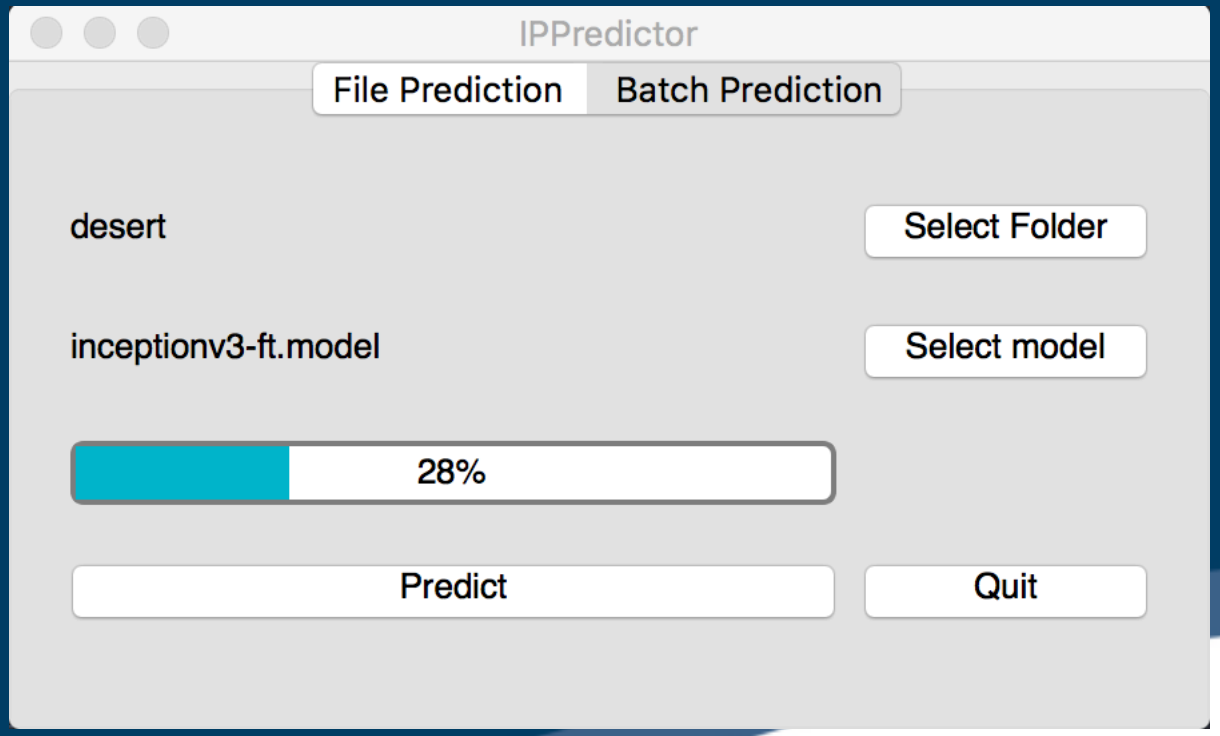
Training, Validation and Testing set

- /augmented_data/
  - Train_dir/
    - Dogs/
    - Cats/
  - Val_dir/
    - Dogs/
    - Cats/
  - Test_dir/
    - Dogs/
    - Cats/

Model generation

- Amount of epochs
- Transfer learning optimizers
- Optimizer learning rates
- Directory of:
  - Training data
  - Validation data
  - Model prediction plots

Gui



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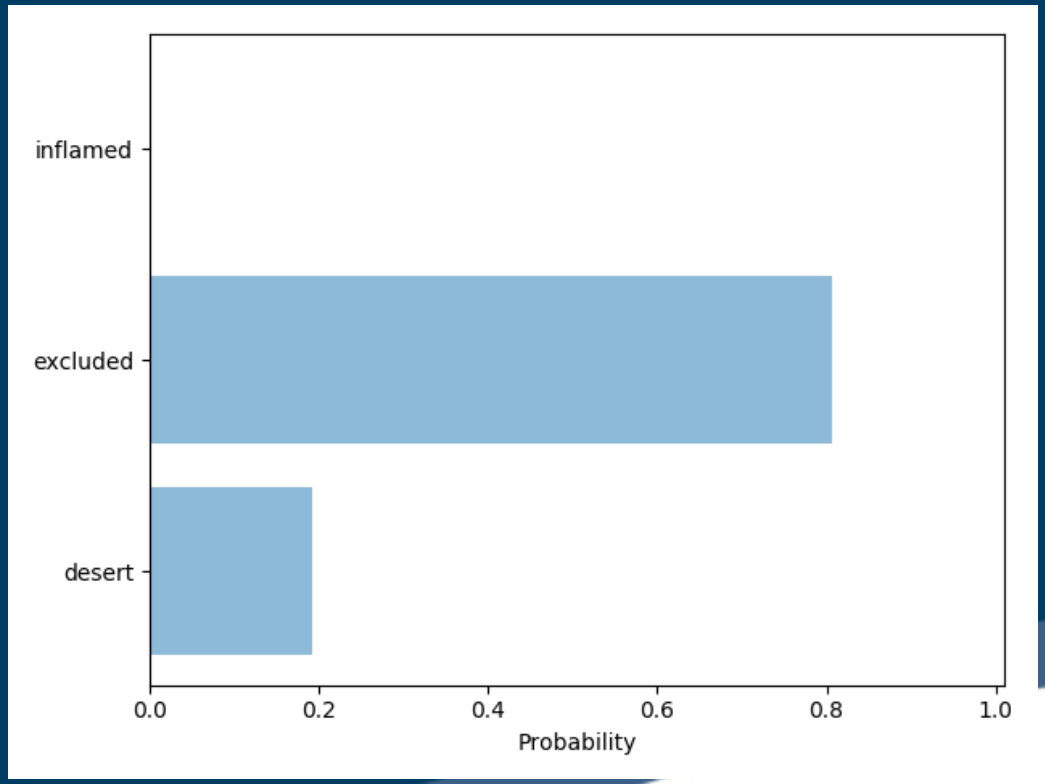

inflamed
excluded
desert
0.0
0.2
0.4
0.6
0.8
1.0
Probability

Tools

- AToMPM: Domain-specific modeling tools
- metaDepth: Template coding
- Python
- Keras: High-level neural networks API (TensorFlow, Theano)

Risk Analysis: Usability

- Will the user know what to do with the VWL?
- Decent study with non-experts and potential users to decrease the risk drastically
- User testing for evaluation purposes

Risk Analysis: Ignorance

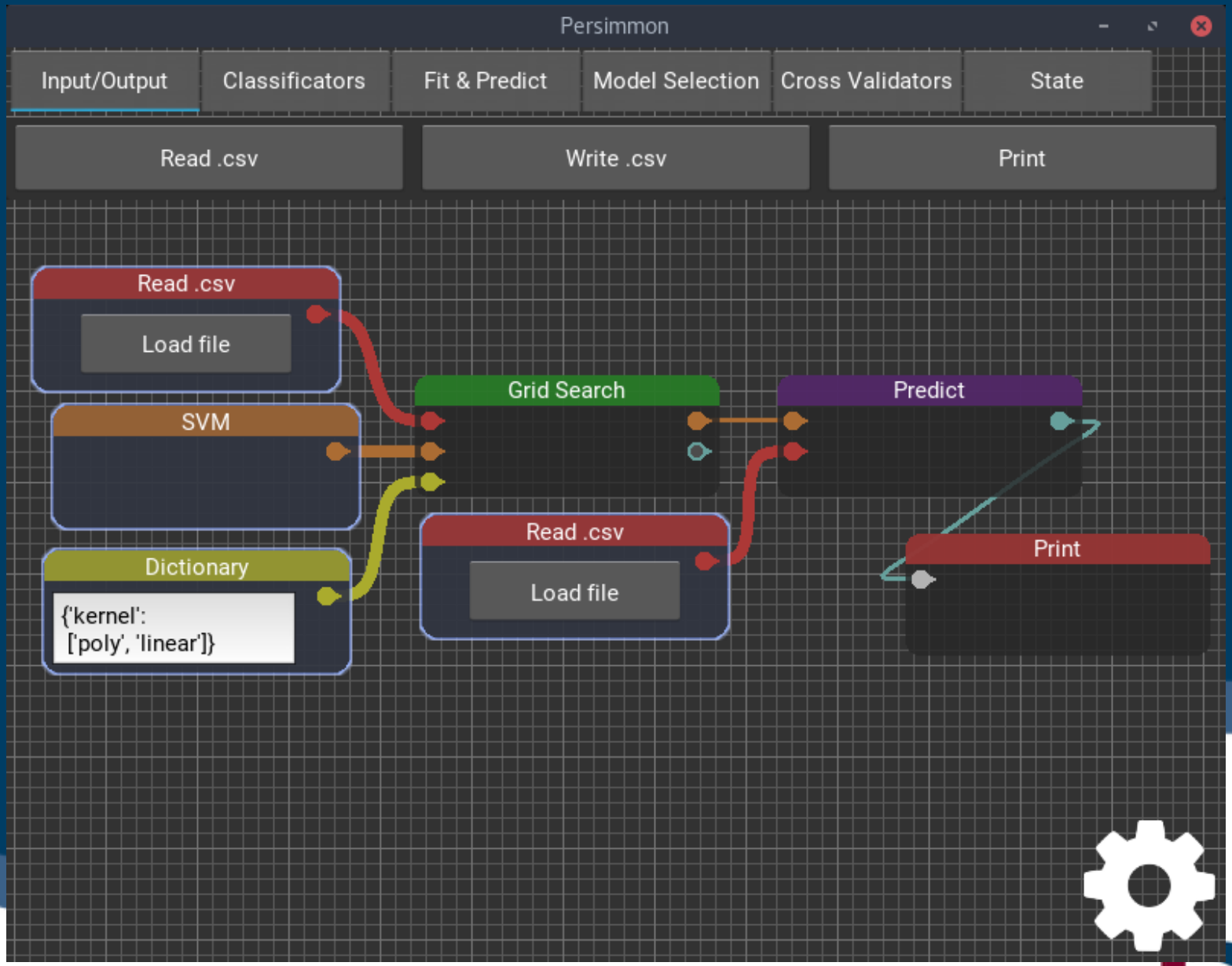
- People can’t relate
- It sounds like science-fiction for non-experts
- Skepticism

- Provide an easy to use, plug-and play tool
- Provide use cases, like my thesis

Related Work: Persimmon

- Drag and drop scikit-learn tool for Machine Learning.
- Aids with the lack of programming skills
- Aim to provide the user with feasibility study functionality

- No functionality for CNN’s


Persimmon
Input/Output
Classificators
Fit & Predict
Model Selection
Cross Validators
State
Read .csv
Write .csv
Print
Read .csv
Load file
SVM
Dictionary
{'kernel':
['poly', 'linear']}
Grid Search
Read .csv
Load file
Predict
Print

Conclusion

- Generate CNN’s
- No Programming skills required
- User experience is very important
- Model can be tweaked using parameters
- Learning about CNN’s is required