Intro to Deep Learning and Transfer learning

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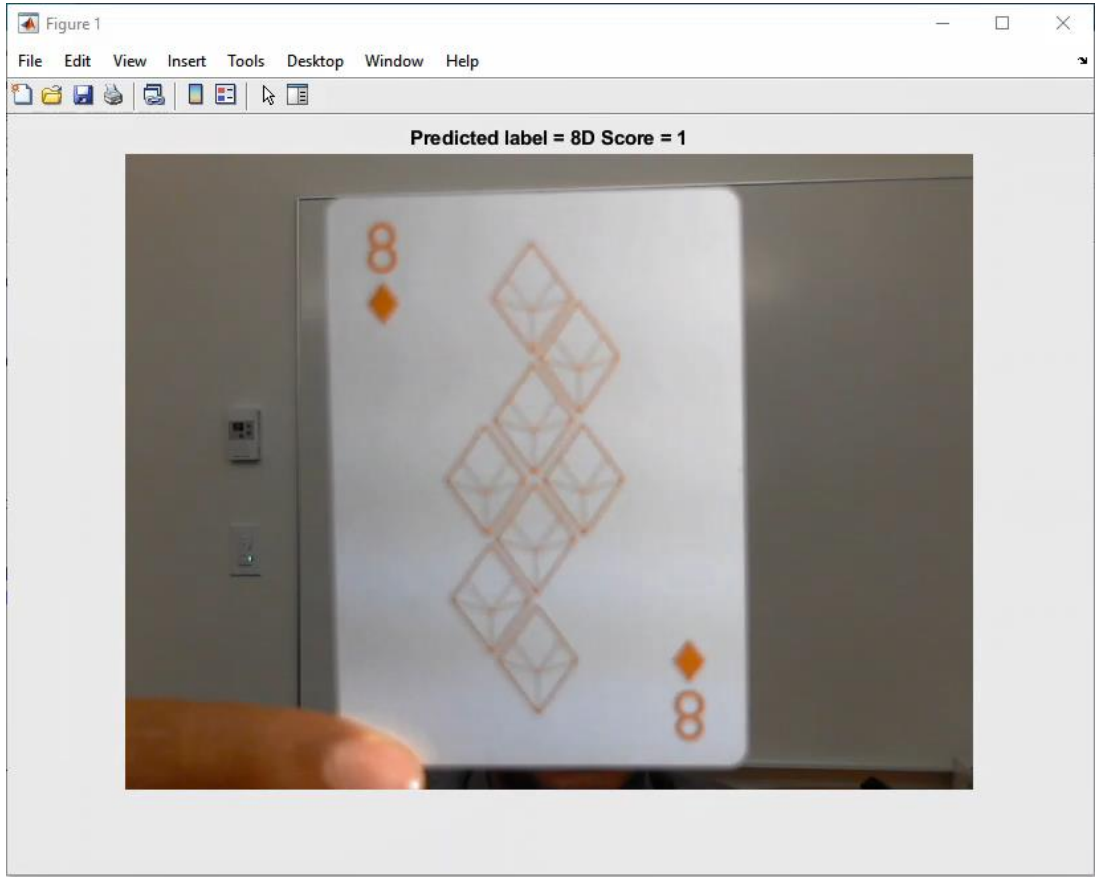
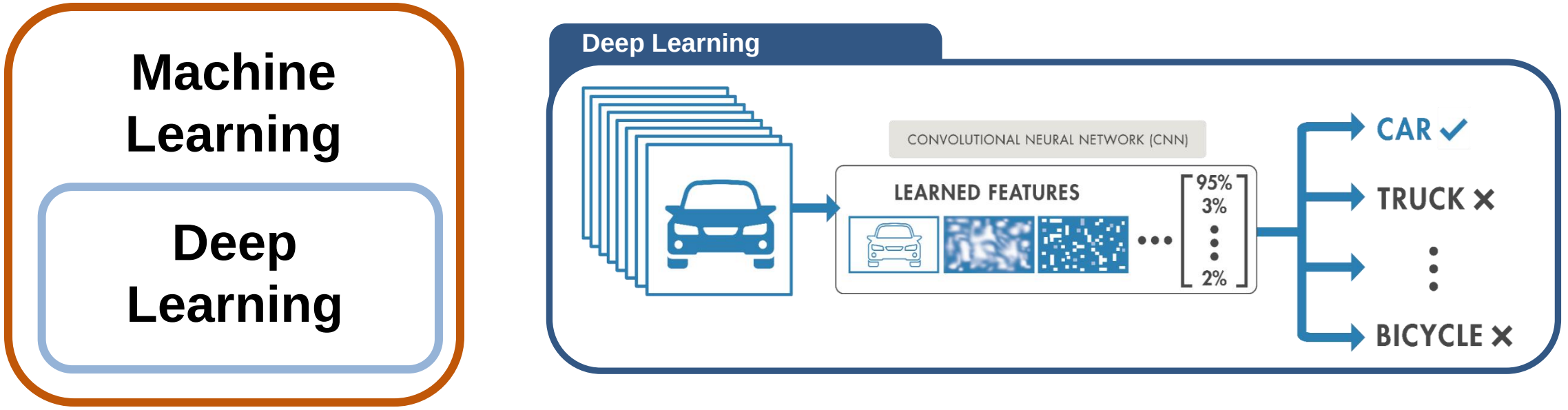
Agenda

- Intro to deep learning and transfer learning
- Demo: Using transfer learning to identify poker cards
- Additional resources



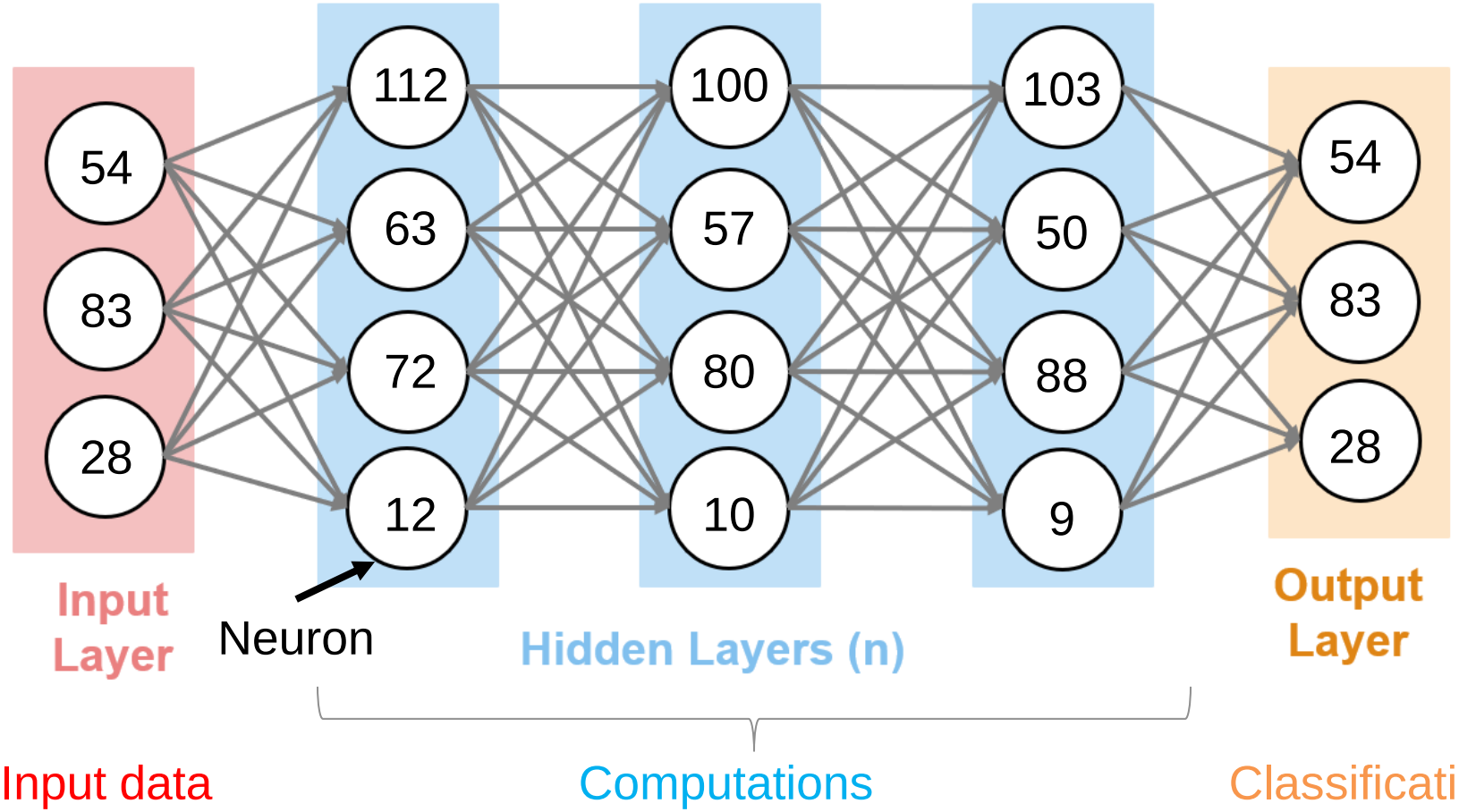
What is Deep Learning?

- Subset of machine learning (ML) with automatic feature extraction
  - Learns features and tasks directly from data
- Implemented using a neural network architecture
  - Deep refers to the numerous number of layers in the network
- Accuracy can surpass traditional ML Algorithms



Deep Learning Models are Neural networks

- Neural networks are a set of neurons that perform computations on input data to predict what the input object is

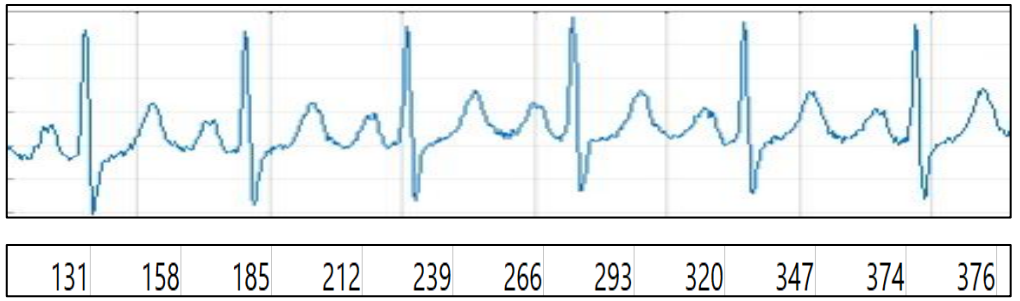


How can a neural network perform computations on an image or audio file?

Deep Learning Networks Take in Numeric Data

199	206	208	201	188	178	165	164	180
202	205	202	188	176	169	178	186	183
203	206	189	178	181	183	182	154	87
203	192	184	186	177	167	153	181	192
191	182	176	166	153	141	136	180	227
166	165	154	154	138	137	169	170	211
158	150	145	183	144	156	158	154	179
143	51	98	144	129	130	143	178	123
107	50	33	95	152	173	192	159	87
104	100	84	120	132	172	131	64	94
119	101	97	81	90	109	87	106	111
127	122	110	97	108	120	133	131	134
111	117	108	119	131	143	146	141	156
126	122	113	119	139	142	155	161	151
129	126	130	111	103	130	149	149	156
138	128	136	144	136	129	134	122	145
154	133	134	141	168	150	126	127	151

Images are a numeric matrix



Signals are numeric vectors

The Bird Flies = [0 13 5 6]

The Leaf Is Brown = [13 3 11 2]

Text is processed as numeric vectors

Deep Learning Workflow

PREPARE DATA

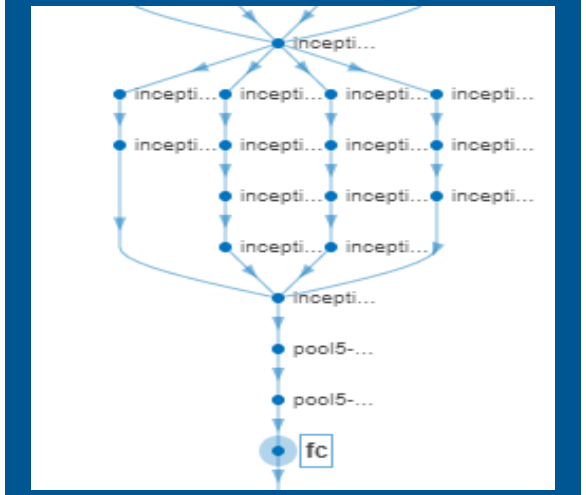
Label: Dog
Size: 524x640

Label: Lion
Size: 444x205

Label: Cat
Size: 3338x2592

The data must be labeled and preprocessed to give accurate results

BUILD & TRAIN MODEL



Build a neural network that learns from your dataset

DEPLOY SYSTEM

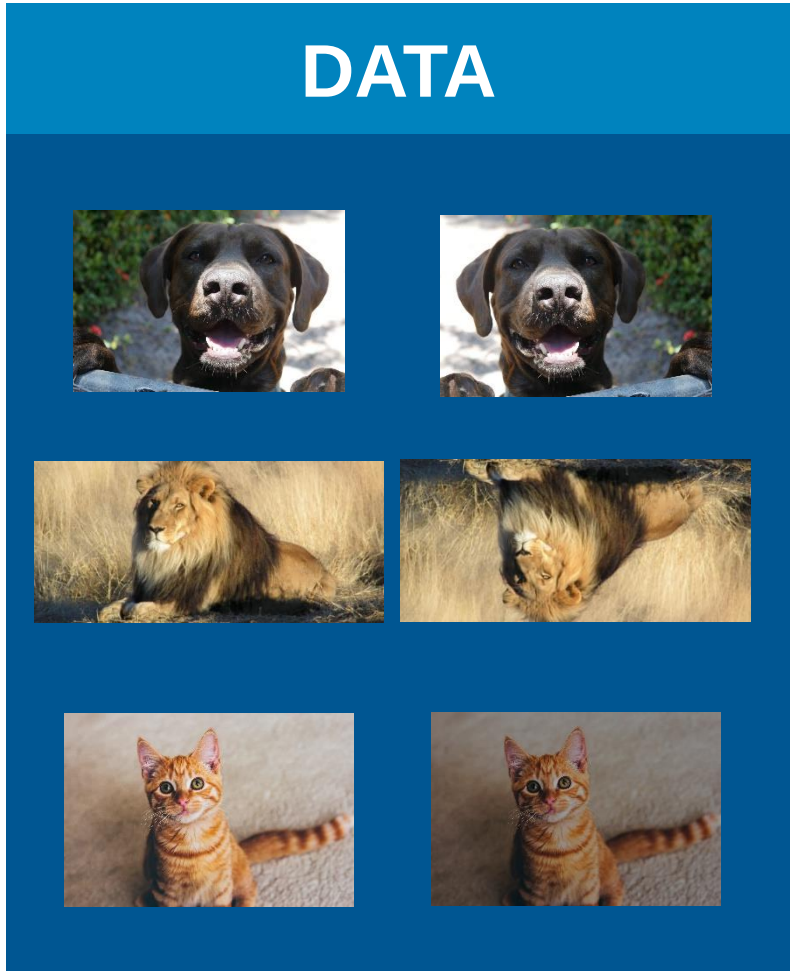
Integrate your trained model onto embedded hardware or cloud

Preparing Data

- Labeling data
- Resizing Images

Preparing Data

- Labeling data
- Resizing Images
- Modifying images for robust network



Preparing Data

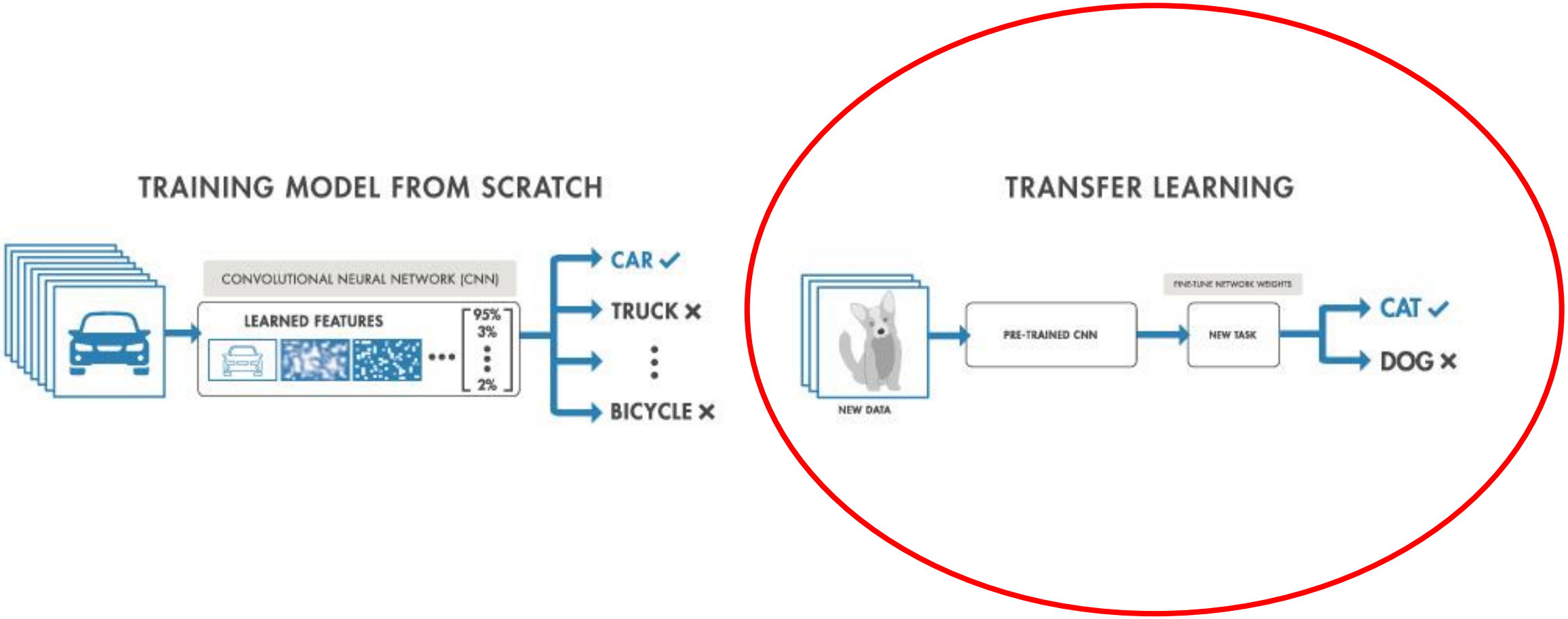
- Labeling data
- Resizing Images
- Modifying images for robust network
- Splitting training/validation set

Training Set: 60%

Validation Set: 40%

*70% training and 30% validation is most common

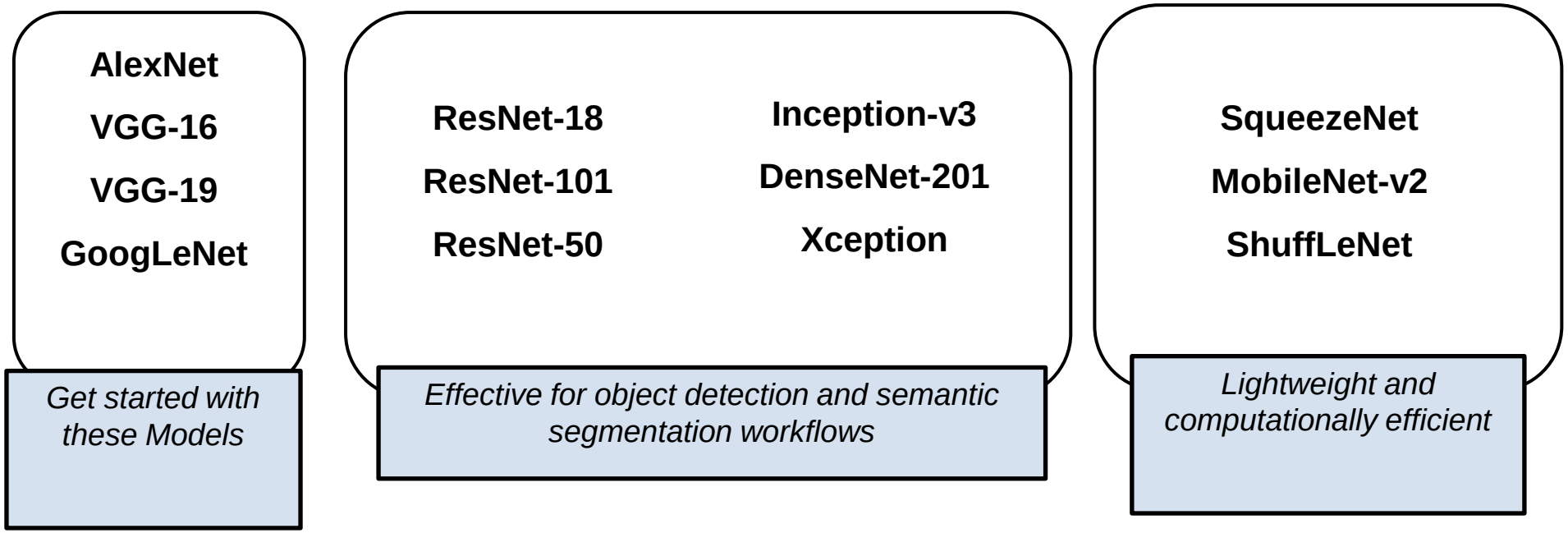
Building a neural network



Pretrained Neural Networks

- Pretrained neural networks are networks that have been designed and trained
- These networks can be used to classify data just by loading it
- GoogLeNet for example can be used to classify 1000 object categories, such as keyboard, mouse, pencil, and many animals
- Using these networks can save time and leverage the accuracy achieved in these models

Example pretrained network



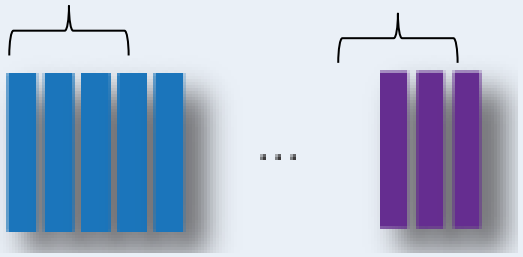
Full list of models available HERE

Transfer Learning Workflow

Load pretrained network

Early layers that learned low-level features (edges, blobs, colors)

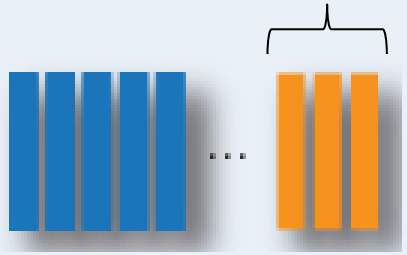
Last layers that learned task specific features



1 million images
1000s classes

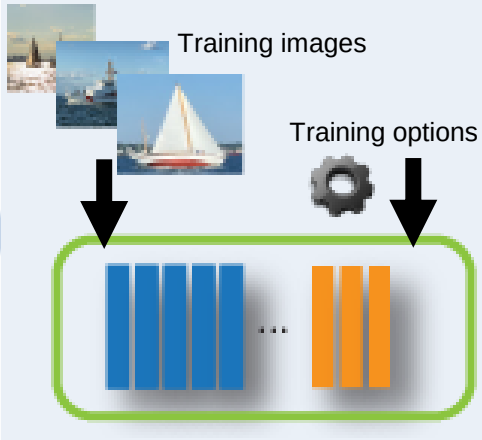
Replace final layers

New layers to learn features specific to your data



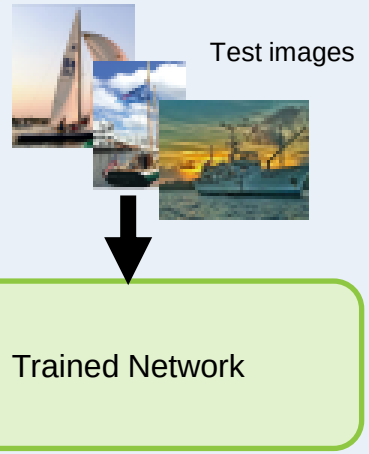
Fewer classes
Learn faster

Train network



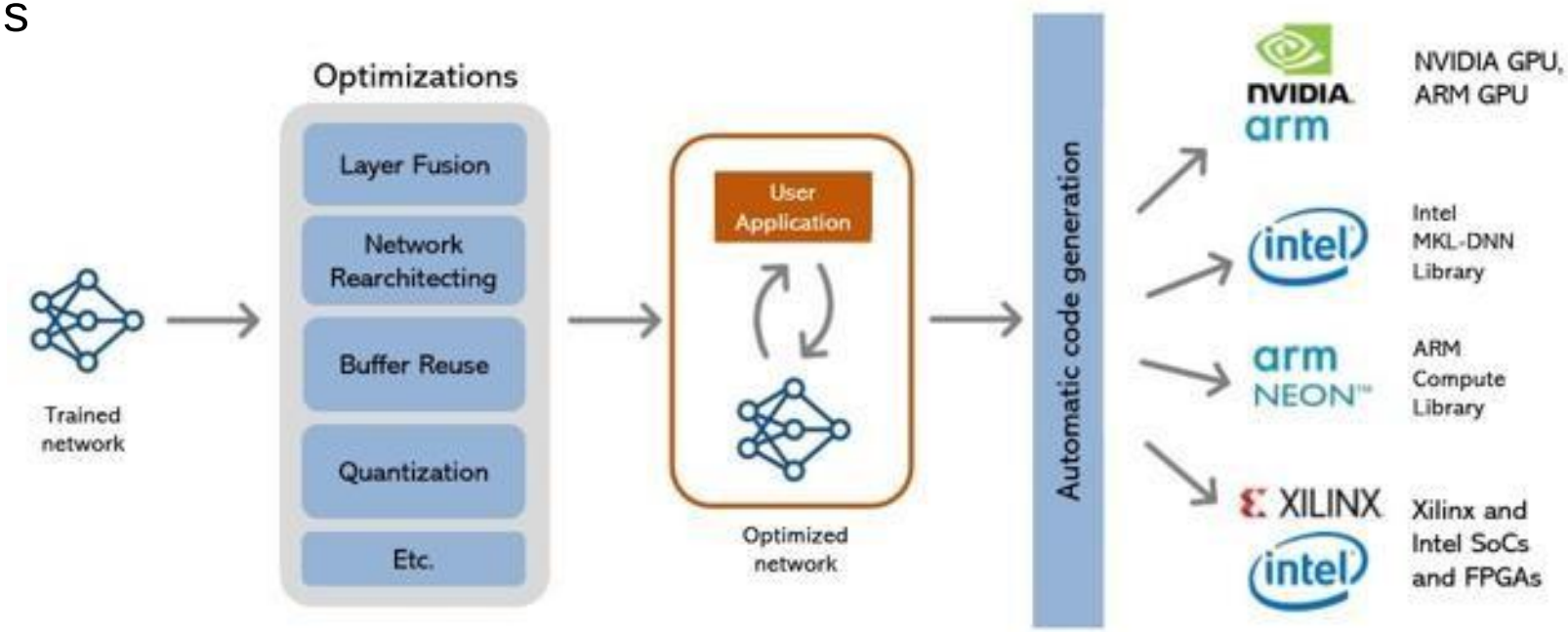
100s images
10s classes

Predict and assess network accuracy



Deploying neural networks

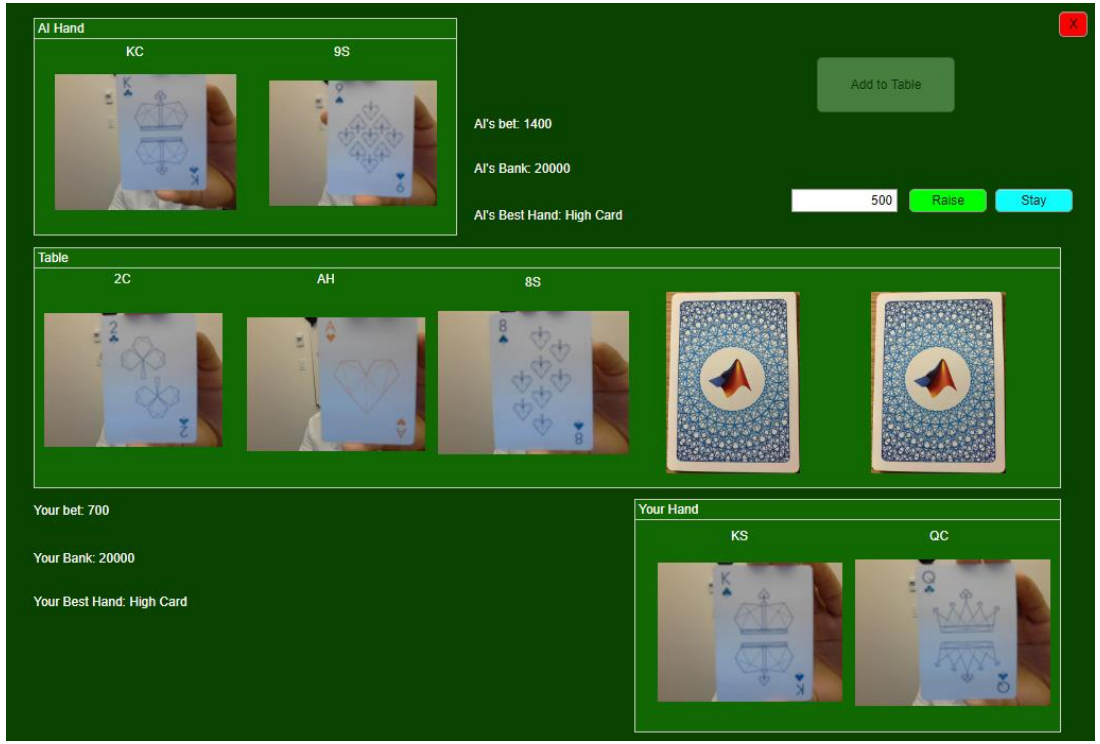
- Use MATLAB to deploy the trained model to:
  - GPUs and CPUs
  - Embedded devices (e.g. NVIDIA or Raspberry Pi)
  - Standalone applications
  - Web Apps



Demo – Deep Learning Poker Player

Goal:

- Generate playing card picture data from webcam
- Use transfer learning to train a model to correctly identify the cards
- Integrate model into app to make a poker game



Demo Takeaways

- Use a webcam to save picture data
- Pre-process image data for a robust neural network
- Load a pretrained Neural Network and replace layers for desired application
- Modify the training options before training the network
- Test and use the trained network to classify new data