AI & GAN IN SCIENTIFIC RESEARCH

Daochen Shi, Solution Architect

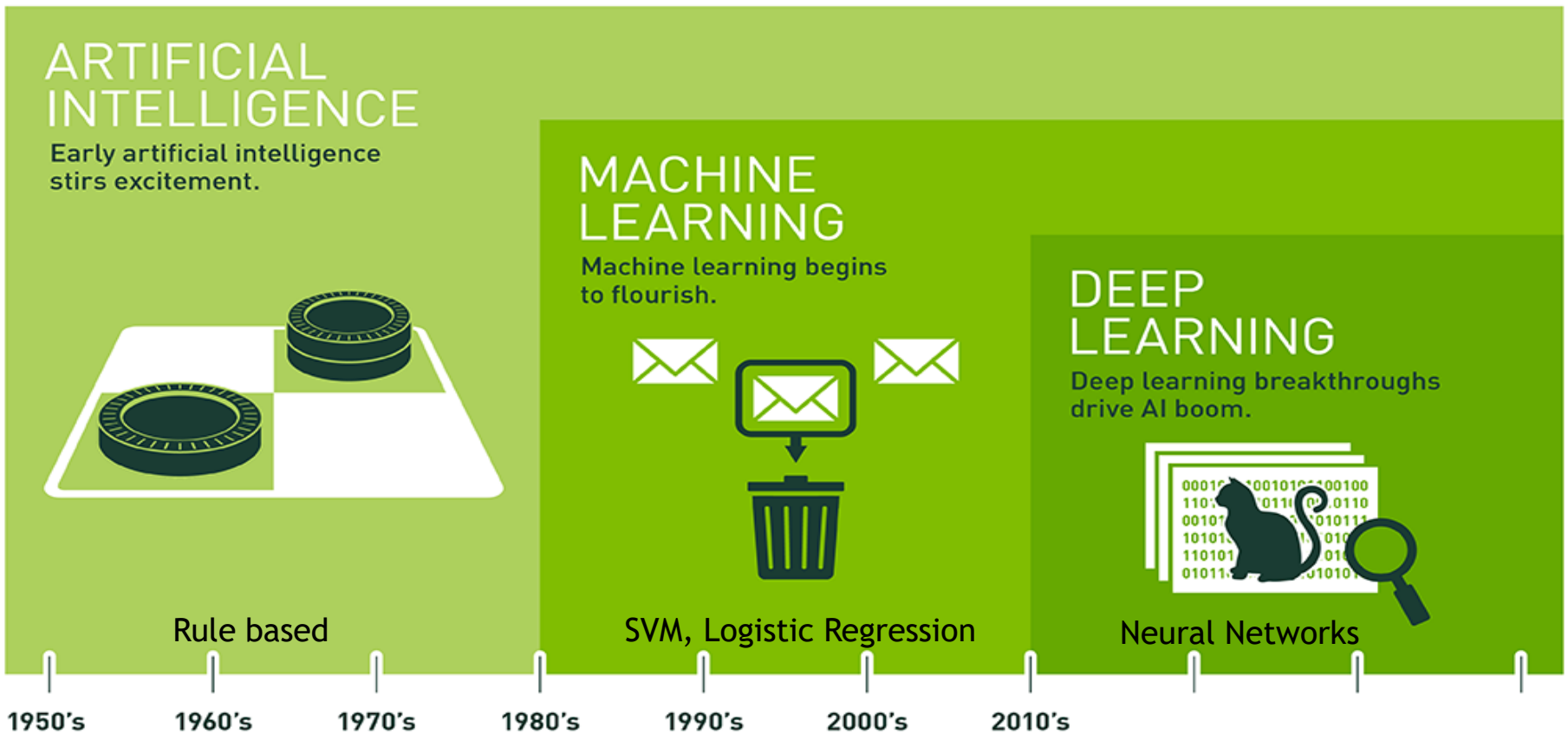
CONTENT SLIDE

What and why deep learning (DL)

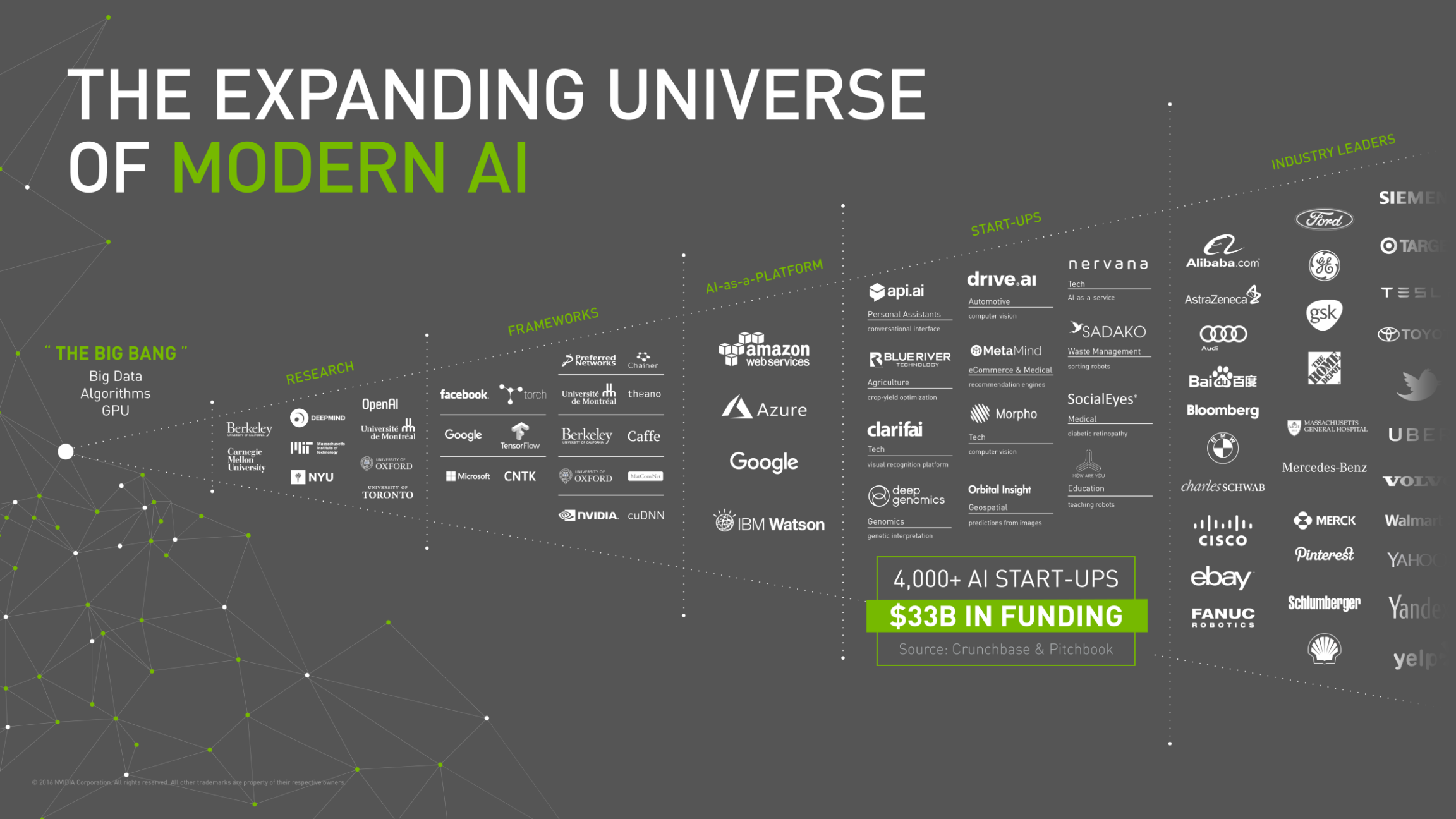
Deep neural networks models (DNN)

Applications Depolyment

DEFINITIONS



THE EXPANDING UNIVERSE OF MODERN AI



A NEW COMPUTING MODEL

Algorithms that learn from examples

MACHINE LEARNING

TRADITIONAL APPROACH

Requires domain experts
Time-consuming experimentation
Custom algorithms
Not scalable to new problems

Car
Vehicle
Coupe

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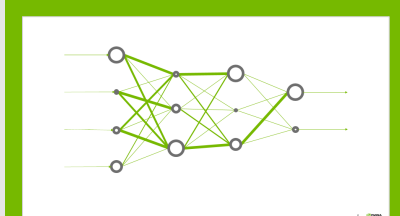
DEEP LEARNING



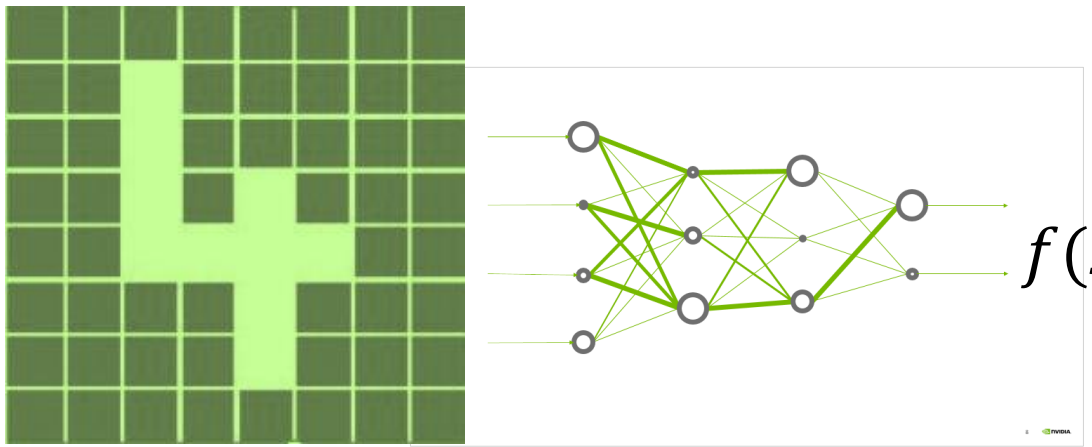
DEEP NEURAL NETWORKS

Learn from data
Easily to extend
Accelerated with GPUs

Car
Vehicle
Coupe

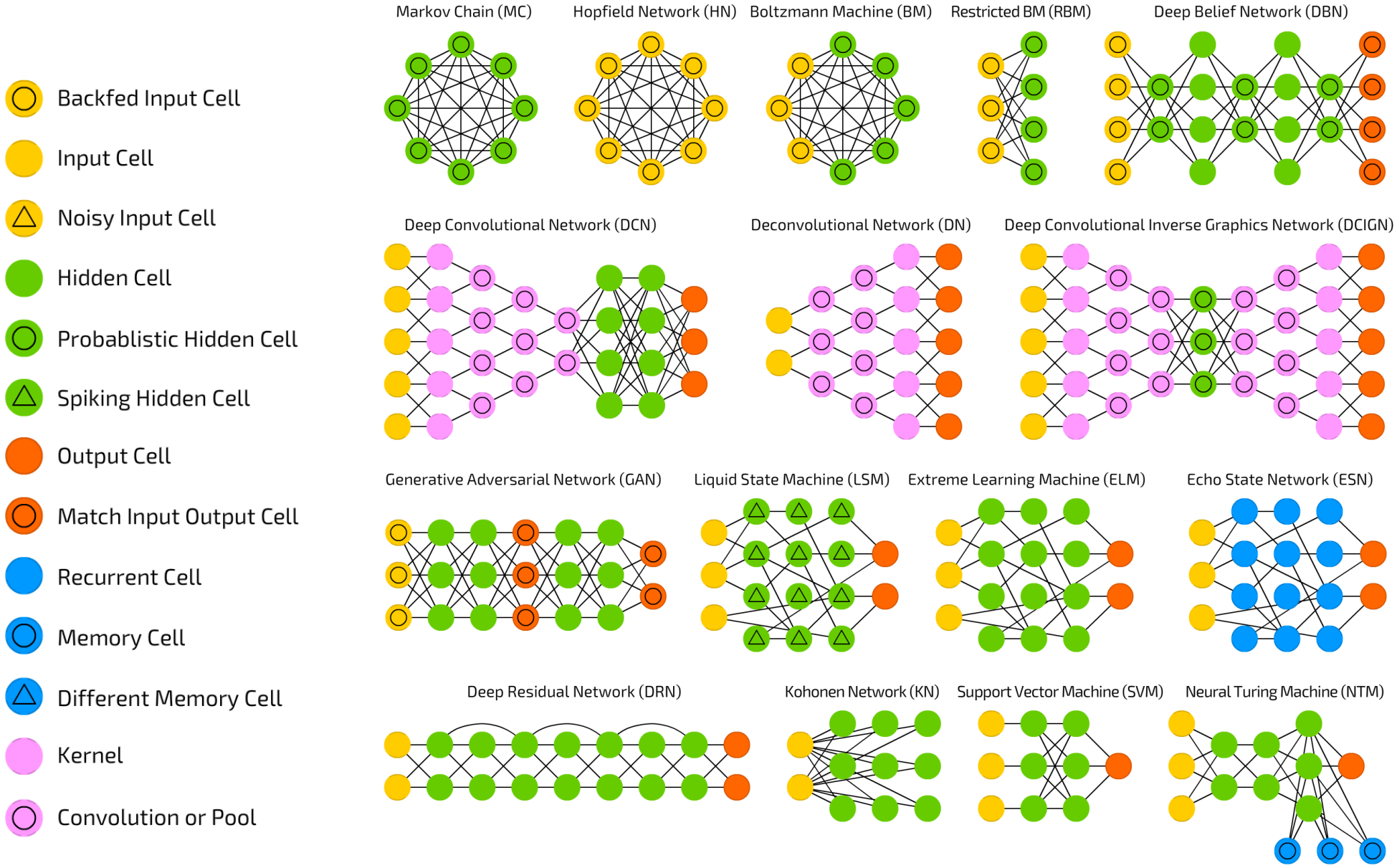
THEORY BEHIND

$$\forall\, x \xrightarrow{Neural\ Network} \forall\, f(x)$$



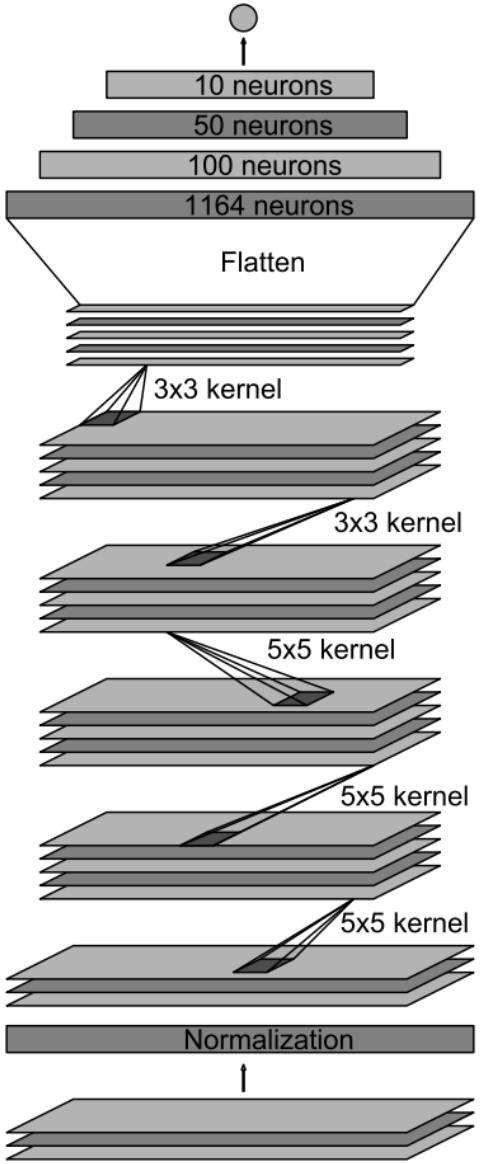
x

$$f(x) = \begin{cases} 1, if\ the\ picture\ is\ "4" \\ 0, otherwise \end{cases}$$


Backfed Input Cell
Input Cell
Noisy Input Cell
Hidden Cell
Probablistic Hidden Cell
Spiking Hidden Cell
Output Cell
Match Input Output Cell
Recurrent Cell
Memory Cell
Different Memory Cell
Kernel
Convolution or Pool
Markov Chain (MC)
Hopfield Network (HN)
Boltzmann Machine (BM)
Restricted BM (RBM)
Deep Belief Network (DBN)
Deep Convolutional Network (DCN)
Deconvolutional Network (DN)
Deep Convolutional Inverse Graphics Network (DCIGN)
Generative Adversarial Network (GAN)
Liquid State Machine (LSM)
Extreme Learning Machine (ELM)
Echo State Network (ESN)
Deep Residual Network (DRN)
Kohonen Network (KN)
Support Vector Machine (SVM)
Neural Turing Machine (NTM)

NETWORK MODELS

CNN



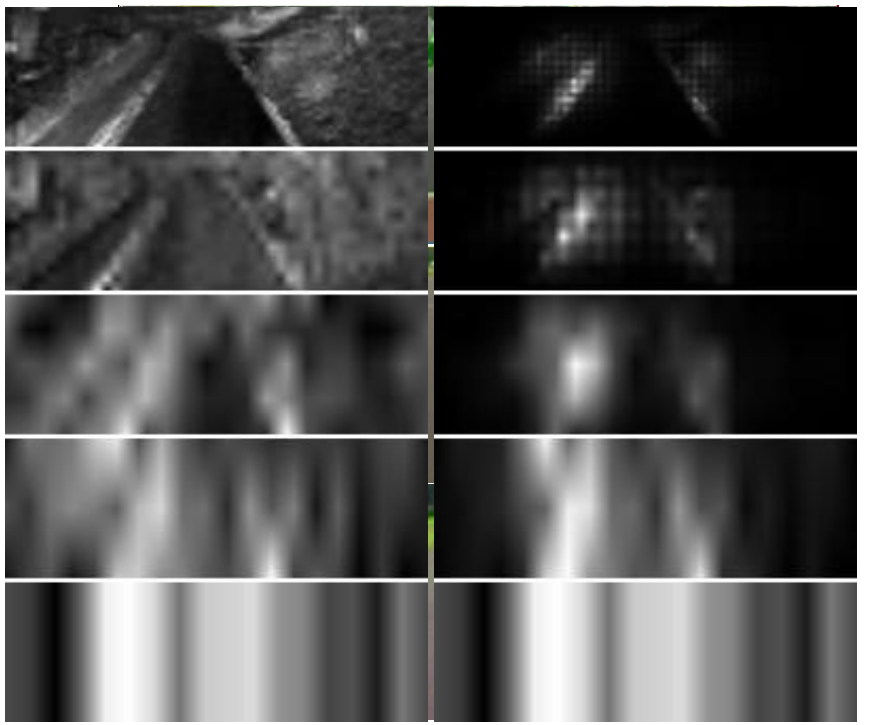
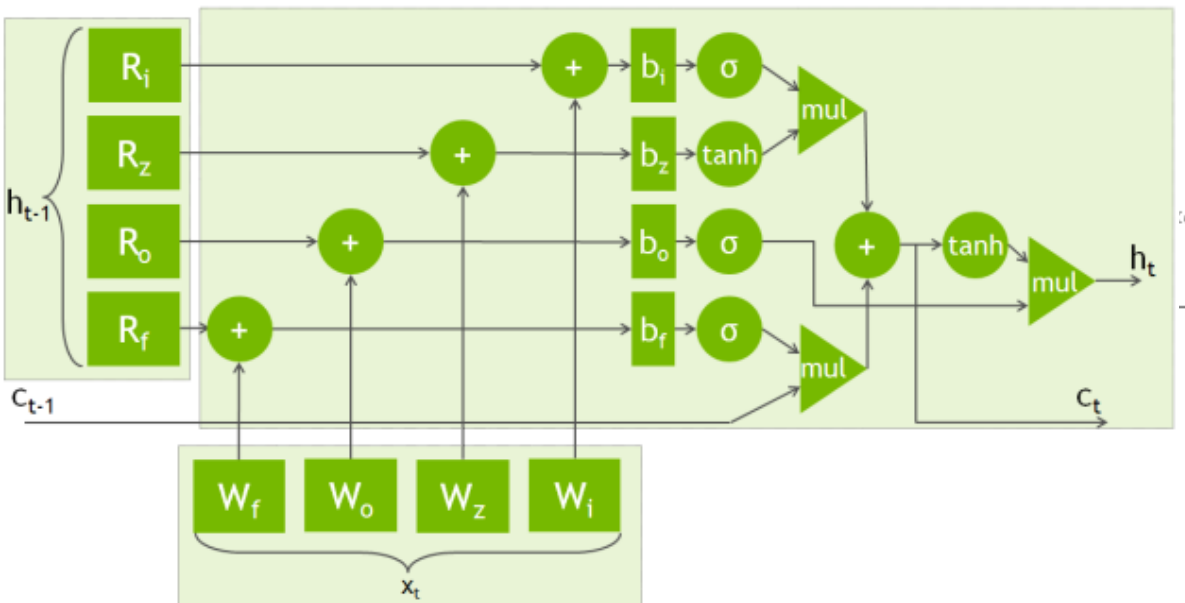


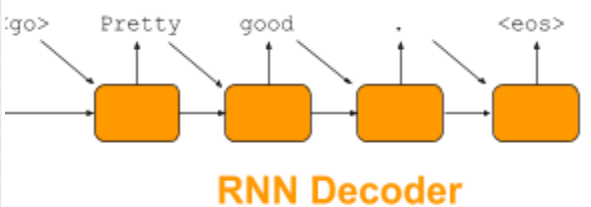
Figure 1: PilotNet architecture.

Bojarski, Mariusz, et al. "Explaining how a deep neural network trained with end-to-end learning steers a car."

NETWORK MODELS

RNN



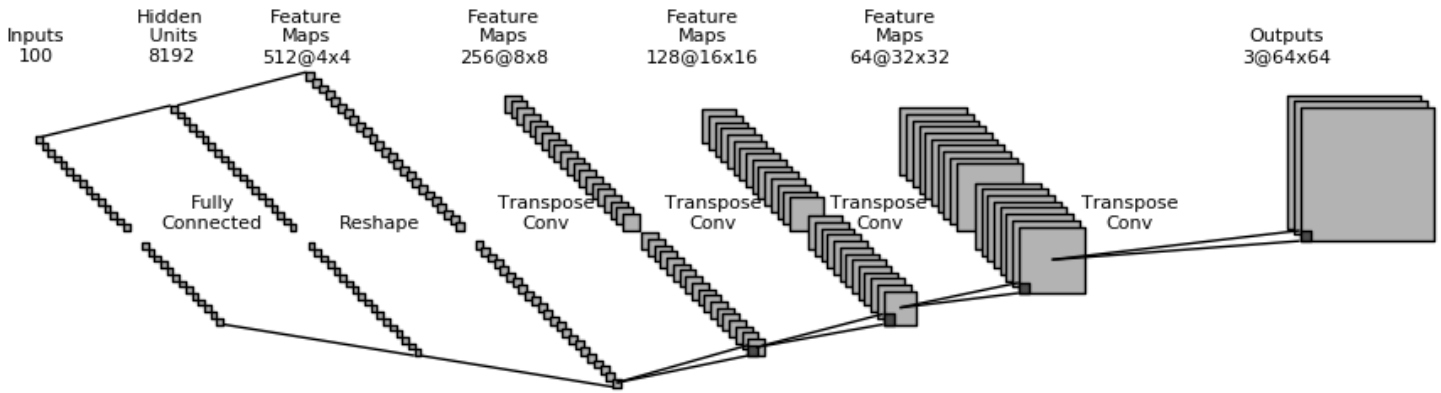


Cho, Kyunghyun, et al. “Learning phrase representations using RNN encoder-decoder for statistical machine translation.”

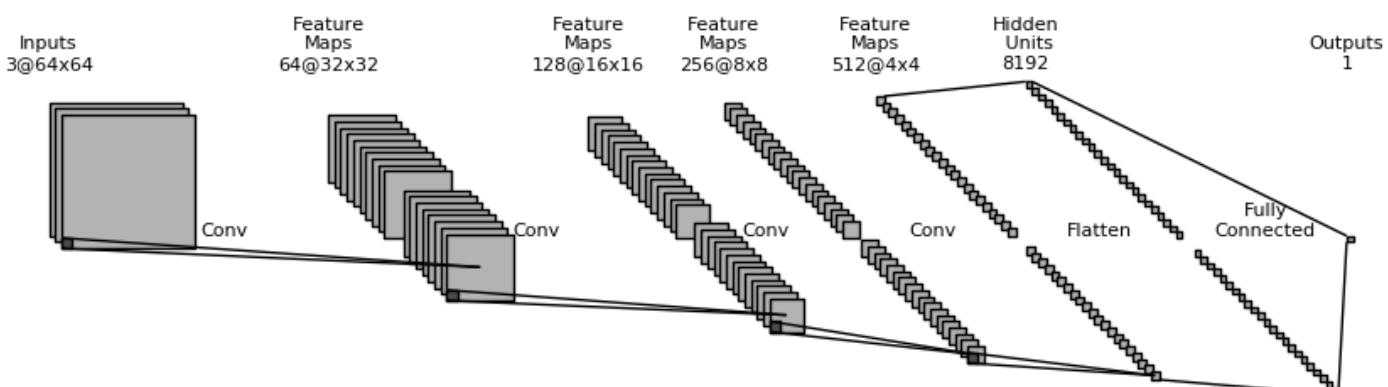
NETWORK MODELS

GAN: Network topology

Generator



Discriminator



Radford (2015). Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks.

REAL FACE?

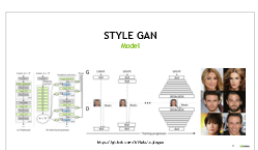
StyleGAN

https://github.com/NVlabs/stylegan

VIDEO DEMO

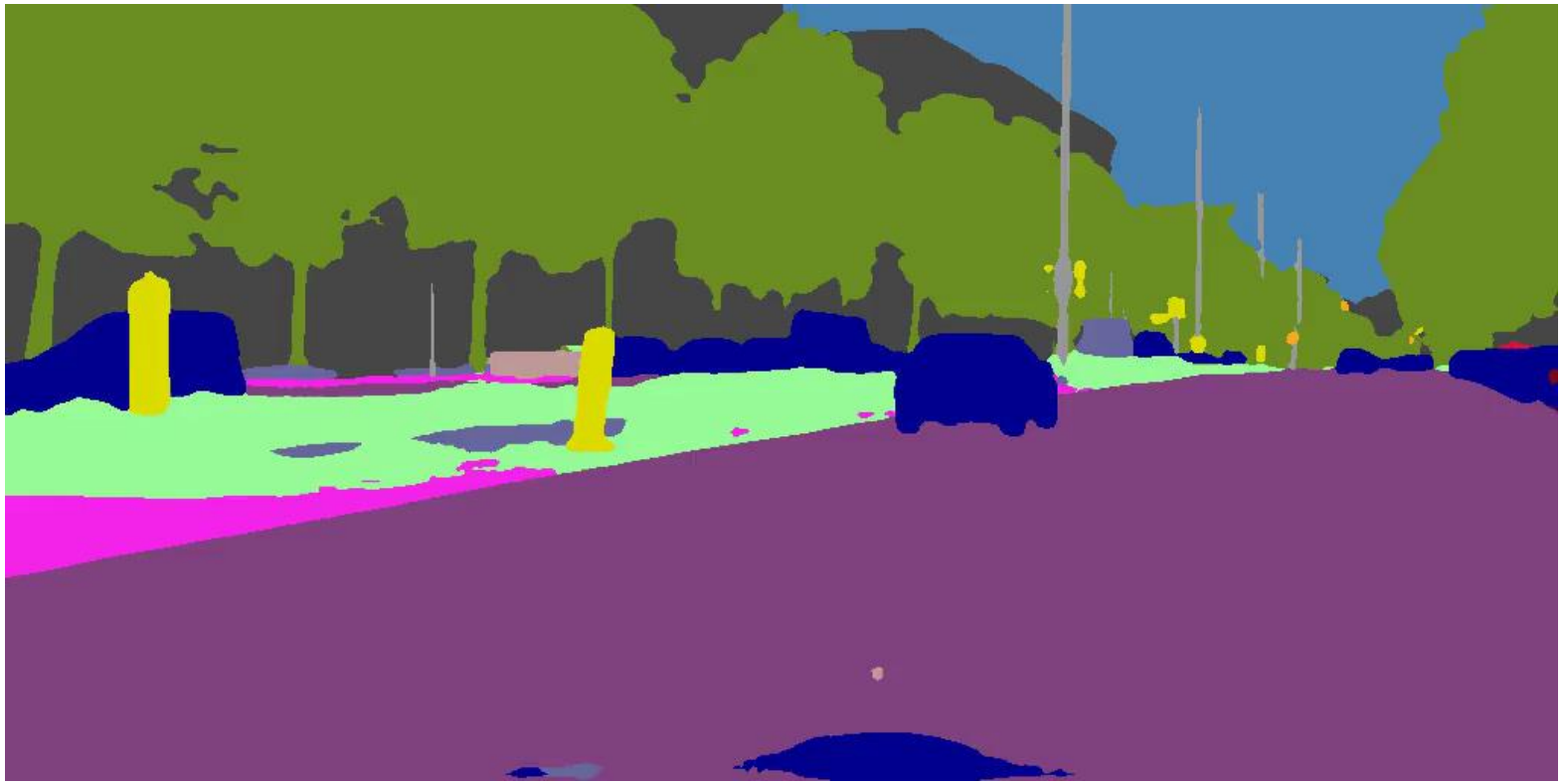
StyleGAN https://github.com/NVlabs/stylegan

Our generator thinks of an image as a collection of “styles”, where each style controls the effects at a particular scale



ENVIRONMENT SIMULATION

vid2vidHD



Wang, Ting-Chun, et al. "High-resolution image synthesis and semantic manipulation with conditional gans." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2018.

ENVIRONMENT SIMULATION

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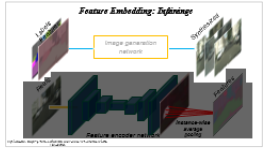

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WHAT PROBLEM ARE YOU SOLVING?

Defining the AI/DL Task

INPUTS	BUSINESS QUESTION	AI/DL TASK	EXAMPLE OUTPUTS		
			HEALTHCARE	RETAIL	FINANCE
Text Data, Images, Video, Audio	**Is "it" present or not?**	Detection	Cancer Detection	Targeted ads	Cybersecurity
	What type of thing is "it"?	Classification	Image Classification	Basket Analysis	Credit Scoring
	To what extent is "it" present?	Segmentation	Tumor Size/Shape Analysis	Build 360° Customer View	Credit Risk Analysis
	What is the likely outcome?	Prediction	Survivability Prediction	Sentiment & behavior recognition	Fraud Detection
	What will likely satisfy the objective?	Recommendations	Therapy Recommendation	Recommendation Engine	Algorithmic Trading

DEEP LEARNING APPLICATION DEVELOPMENT

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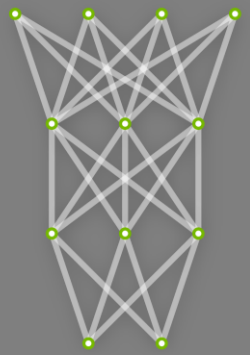
Untrained
Neural Network
Model



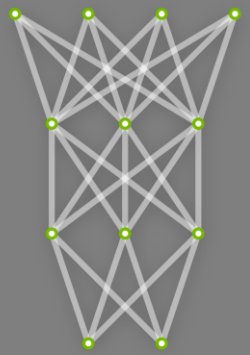
TRAINING
DATASET

DEEP LEARNING APPLICATION DEVELOPMENT

TRAINING

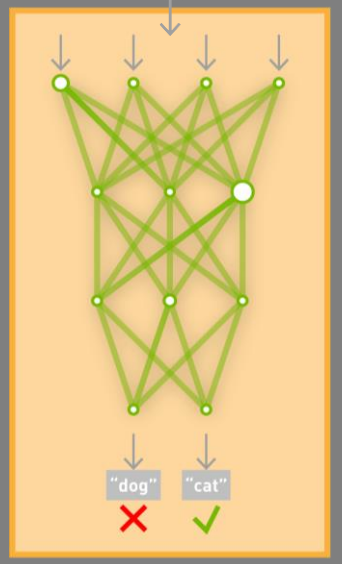
Learning a new capability
from existing data

Untrained
Neural Network
Model



Deep Learning
Framework

TRAINING
DATASET



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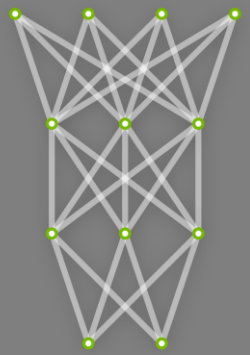

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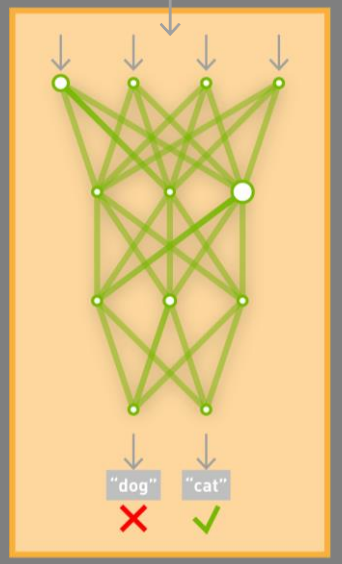
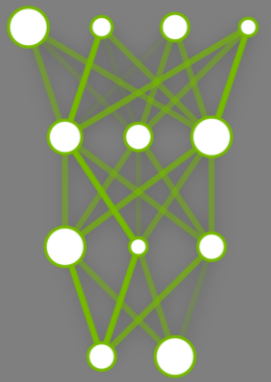


Trained Model
New Capability



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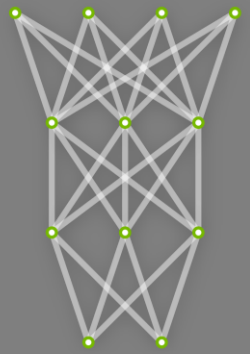

Deep Learning
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TRAINING
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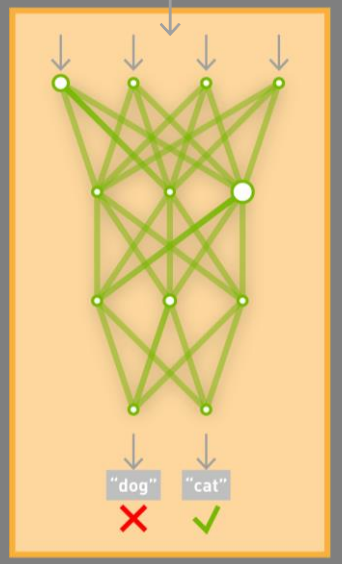

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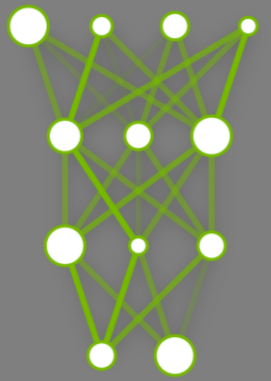

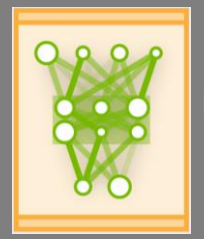

Trained Model
TensorRT: Optimized
for Performance

DEEP LEARNING APPLICATION DEVELOPMENT

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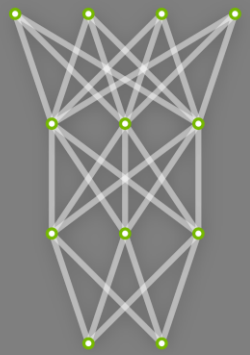

Deep Learning
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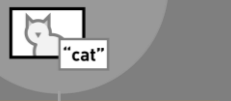

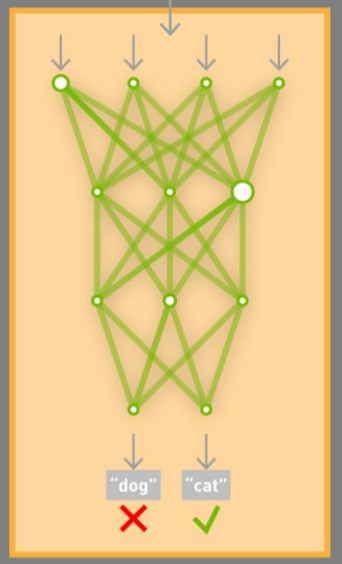

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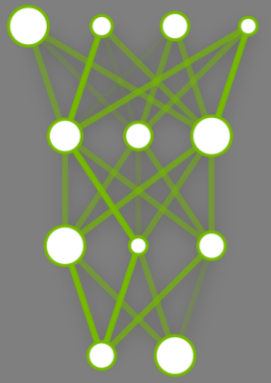
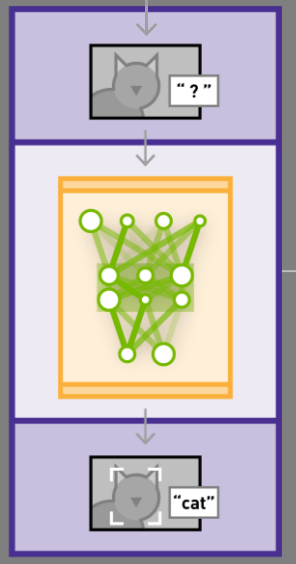


INFERENCE
Applying this capability
to new data

NEW
DATA

App or Service
Featuring Capability



Trained Model
TensorRT: Optimized
for Performance


NVIDIA