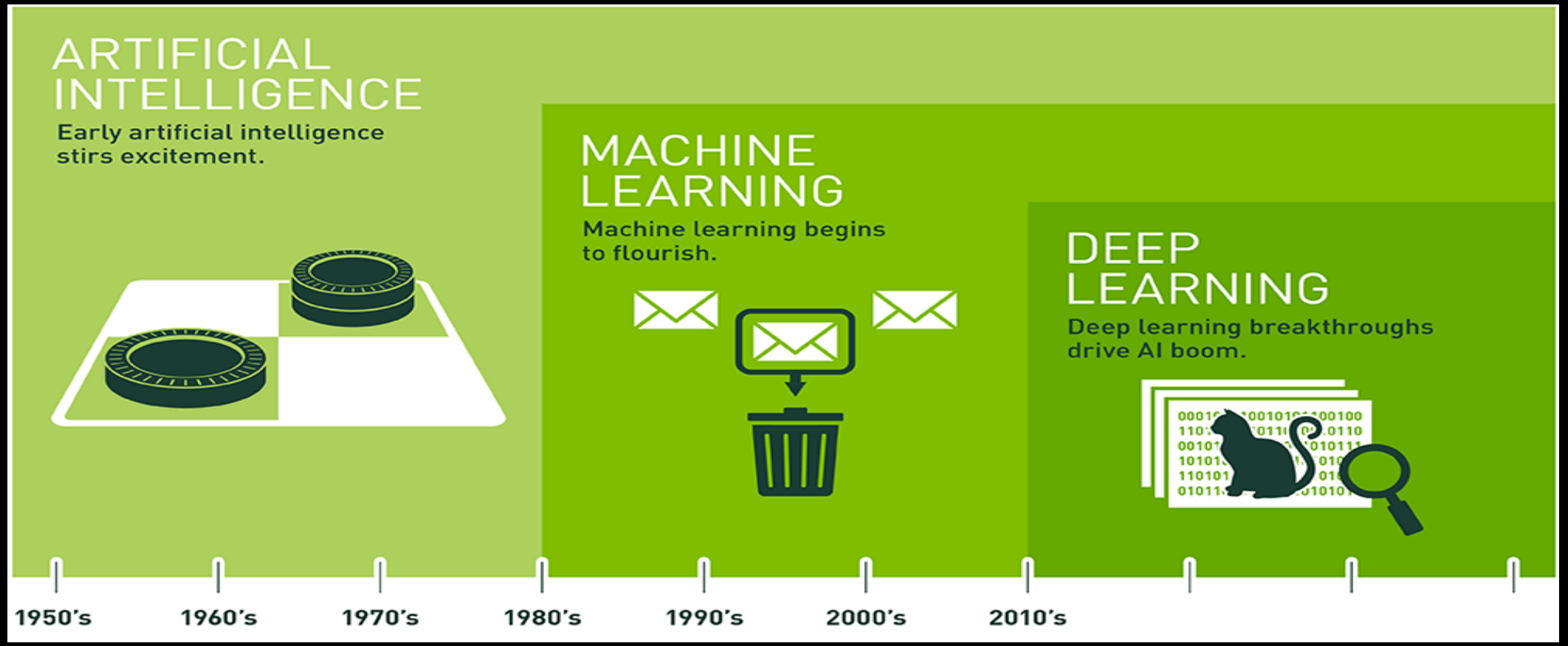
Was ist „Deep Learning“? Welche Dimensionen hat dies für das autonome Fahren?

Joerg Krall, Sr. Business Development Manager Automotive EMEA

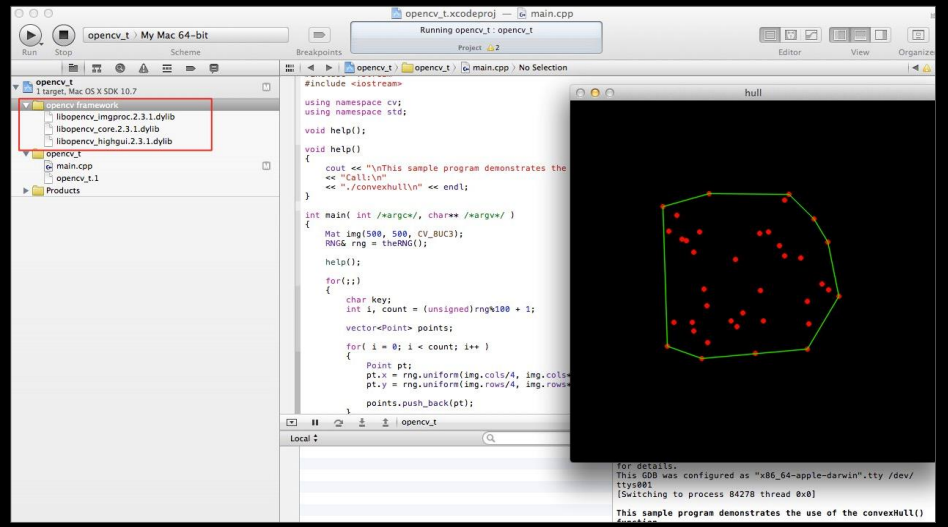
July 4, 2018

NVIDIA.

Definitions



A NEW computing model



Traditional Computer Vision

Domain experts design feature detectors

Quality = patchwork of algorithms

Need CV **experts and time**

Deep Learning Object Detection

DNN learn features from large data

Quality = data & training method

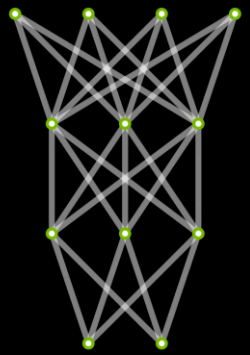
Needs lots of **data and compute**

NVIDIA

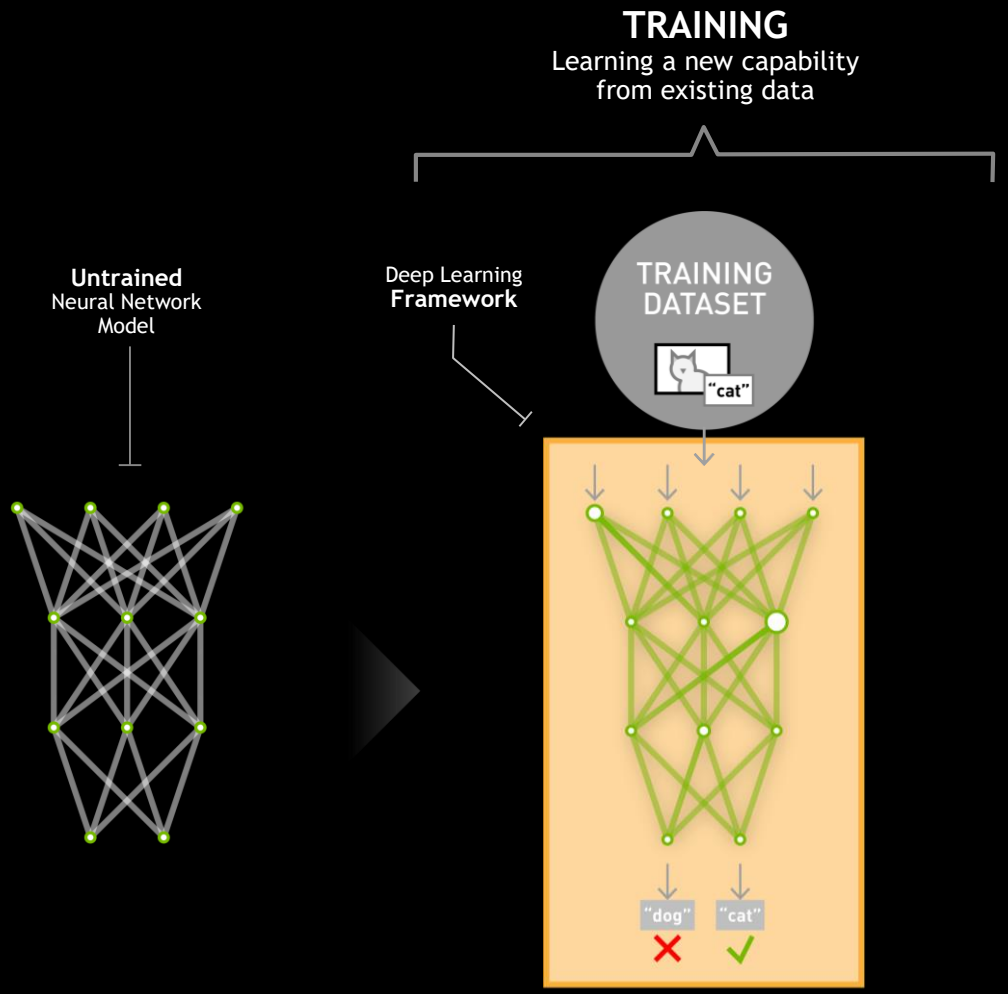
DEEP LEARNING Application Development

DEEP LEARNING Application Development

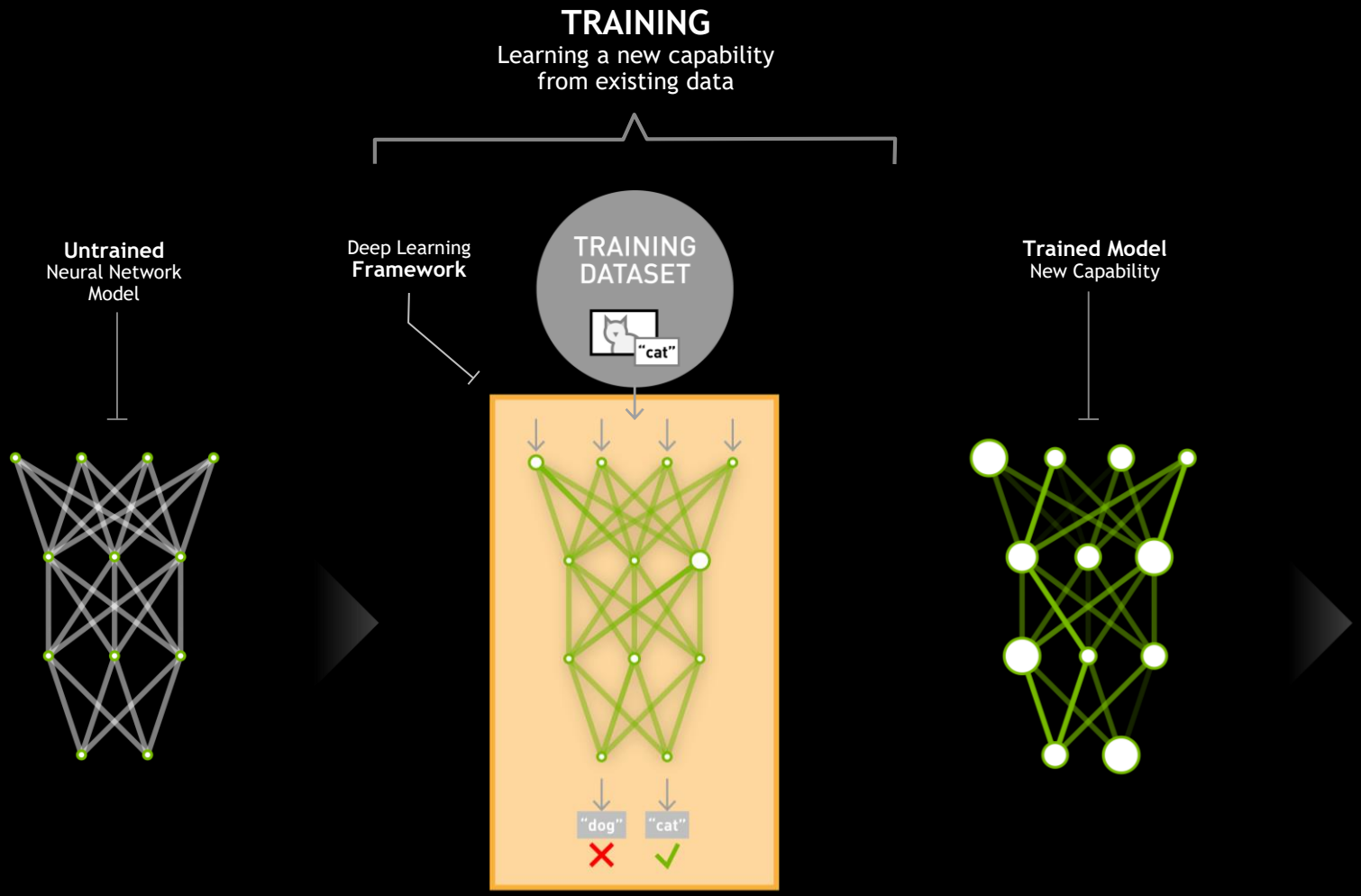
Untrained
Neural Network
Model



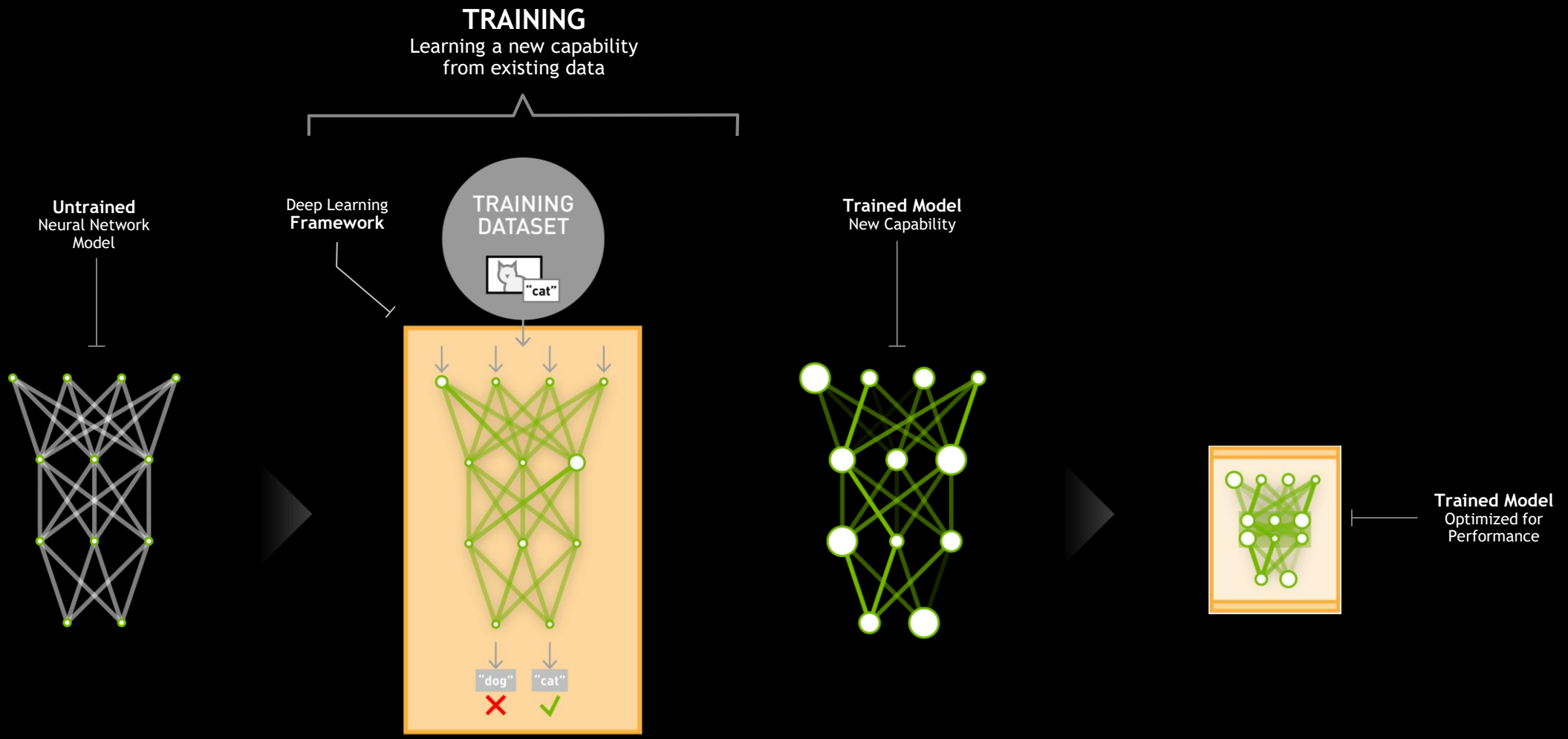
DEEP LEARNING Application Development



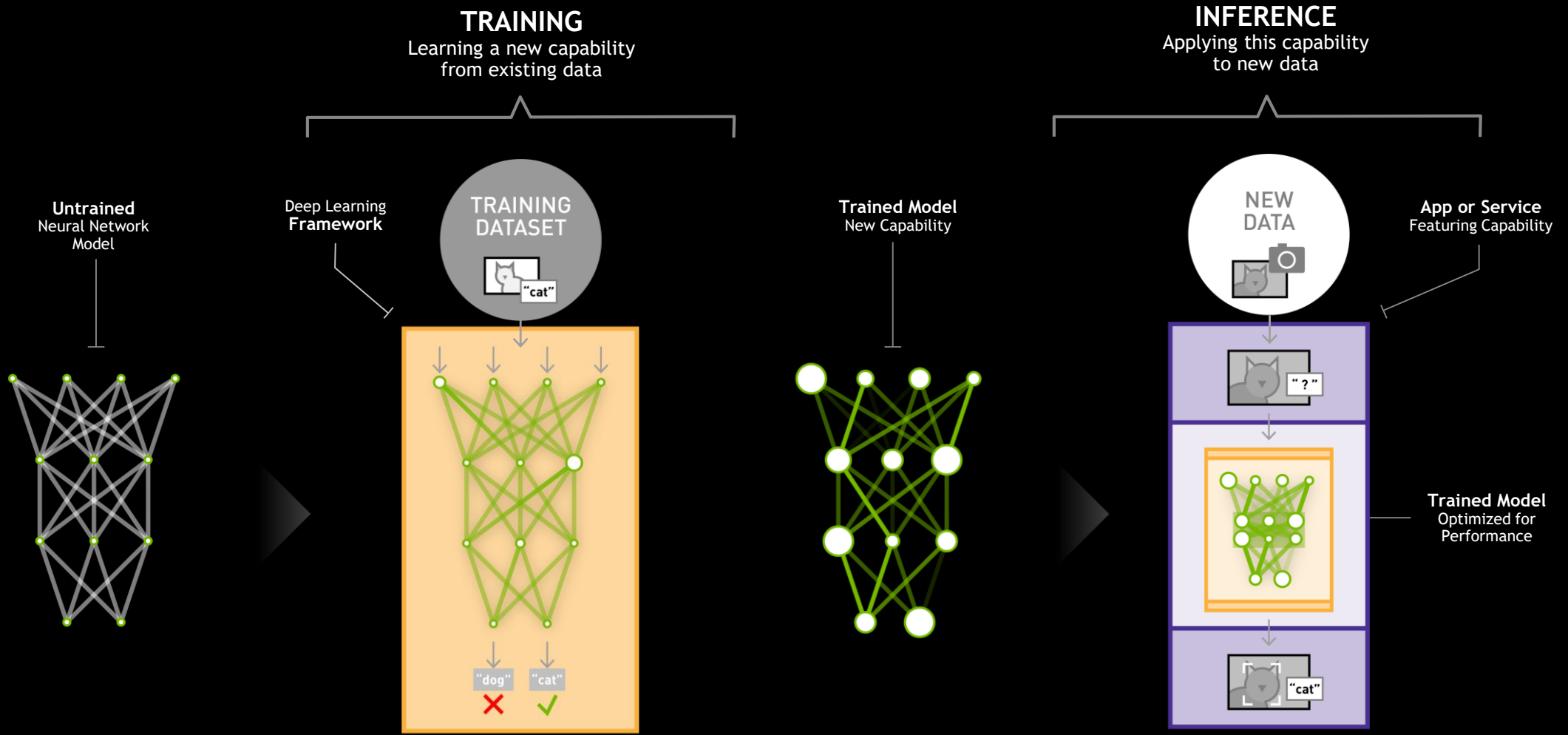
DEEP LEARNING Application Development



DEEP LEARNING Application Development



DEEP LEARNING Application Development

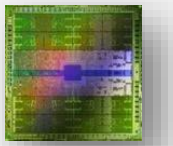


NVIDIA

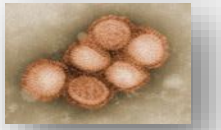
TEN YEARS OF GPU COMPUTING

2006 — CUDA Launched
NVIDIA CUDA

2008 — World's First GPU Top500 System


2010 — Fermi: World's First HPC GPU


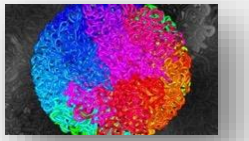
Oak Ridge Deploys World's Fastest Supercomputer w/ GPUs

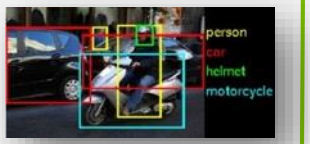

2012 — Discovered How H1N1 Mutates to Resist Drugs


AlexNet beats expert code by huge margin using GPUs
IMAGENET

World's First Atomic Model of HIV Capsid


2014 — Stanford Builds AI Machine using GPUs


World's First 3-D Mapping of Human Genome


Google Outperforms Humans in ImageNet


2016 — GPU-Trained AI Machine Beats World Champion in Go

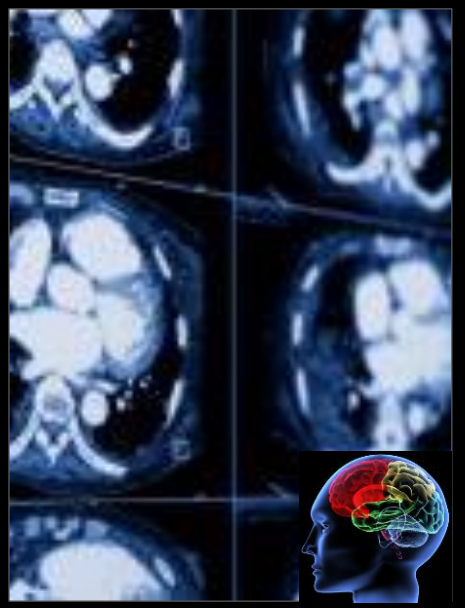

NVIDIA

Deep Learning Is Sweeping Across Industries

INTERNET SERVICES

Image/Video classification
Speech recognition
Natural language processing

MEDICINE



Cancer cell detection
Diabetic grading
Drug discovery

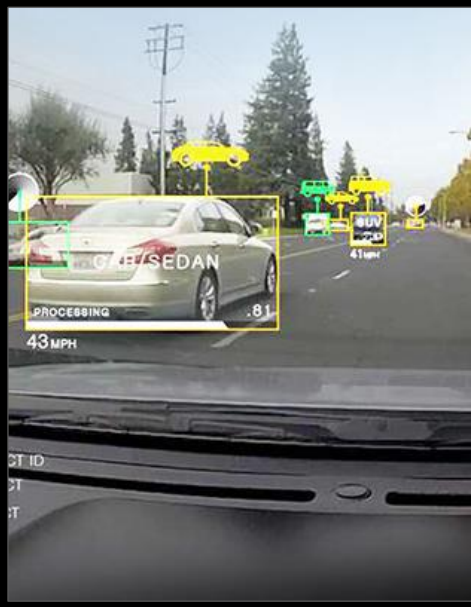
MEDIA & ENTERTAINMENT

Video captioning
Content based search
Real time translation

SECURITY & DEFENSE

Face recognition
Video surveillance
Cyber security

AUTONOMOUS MACHINES



Pedestrian detection
Lane tracking
Recognize traffic

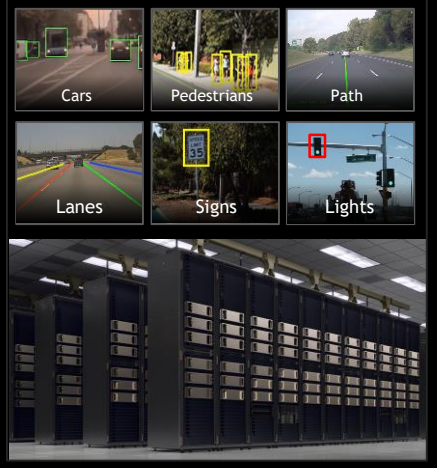
news.developer.nvidia.com/

NVIDIA

END-TO-END SYSTEM FOR AV

COLLECT DATA

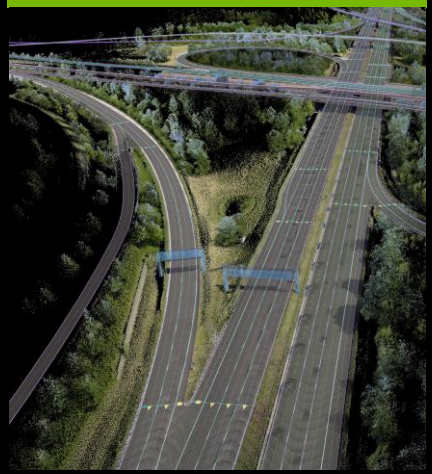
TRAIN MODELS



SIMULATE

RE-SIMULATE

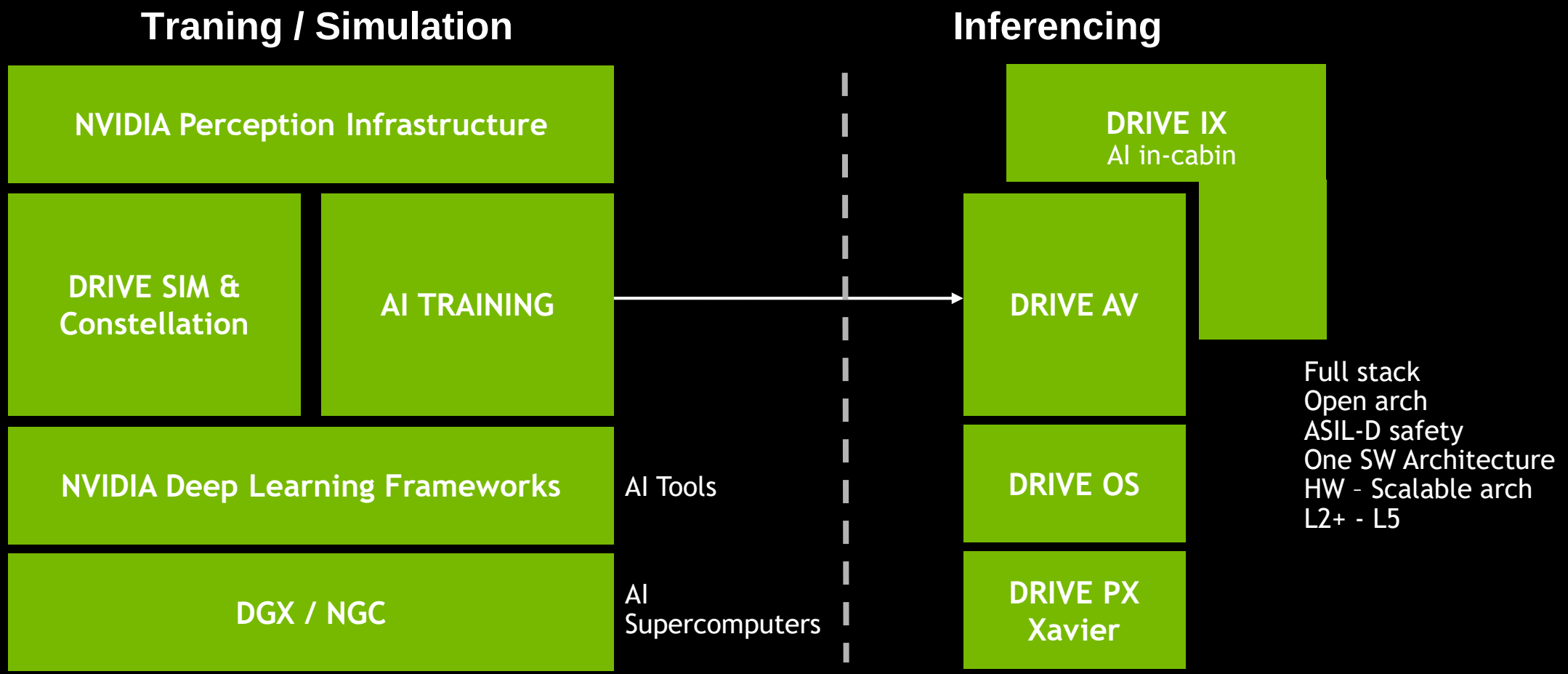
MAPPING



Sources: NVIDIA, RAND Corporation

NVIDIA

NVIDIA end to end drive platform



NVIDIA PERCEPTION INFRASTRUCTURE

LARGE-SCALE DEEP LEARNING MODEL DEVELOPMENT

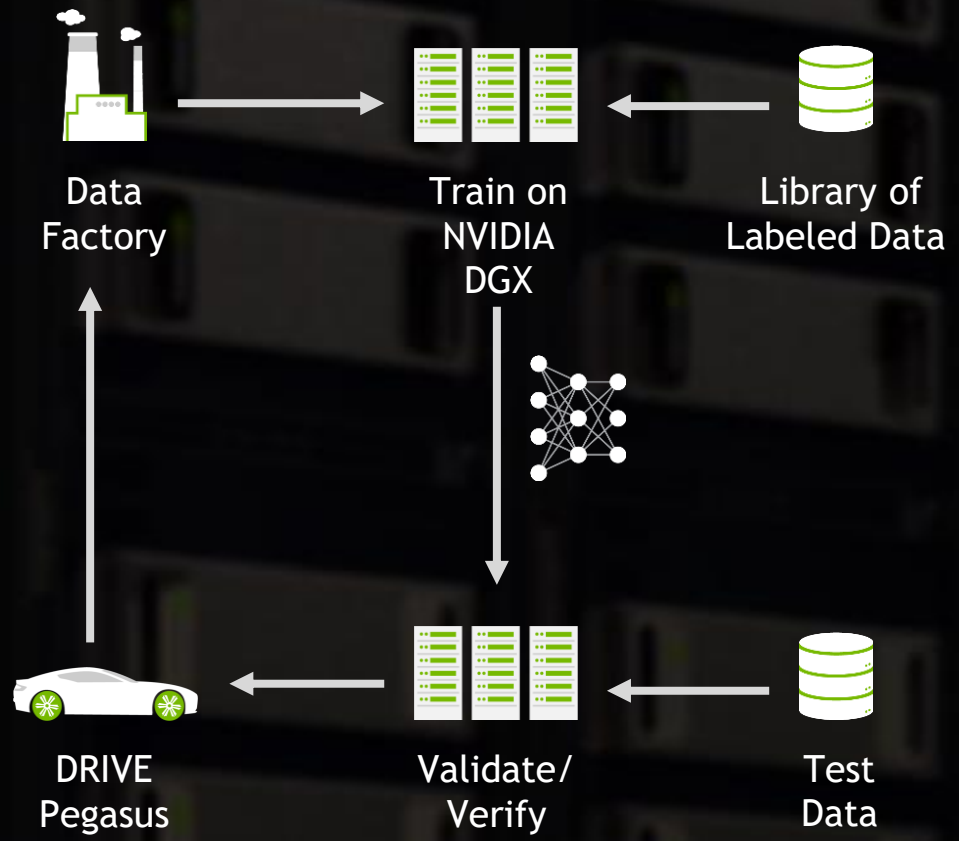
Workflow, Tools, Supercomputing Infrastructure

Data Ingest, Labeling, Training, Validation, Adaptation

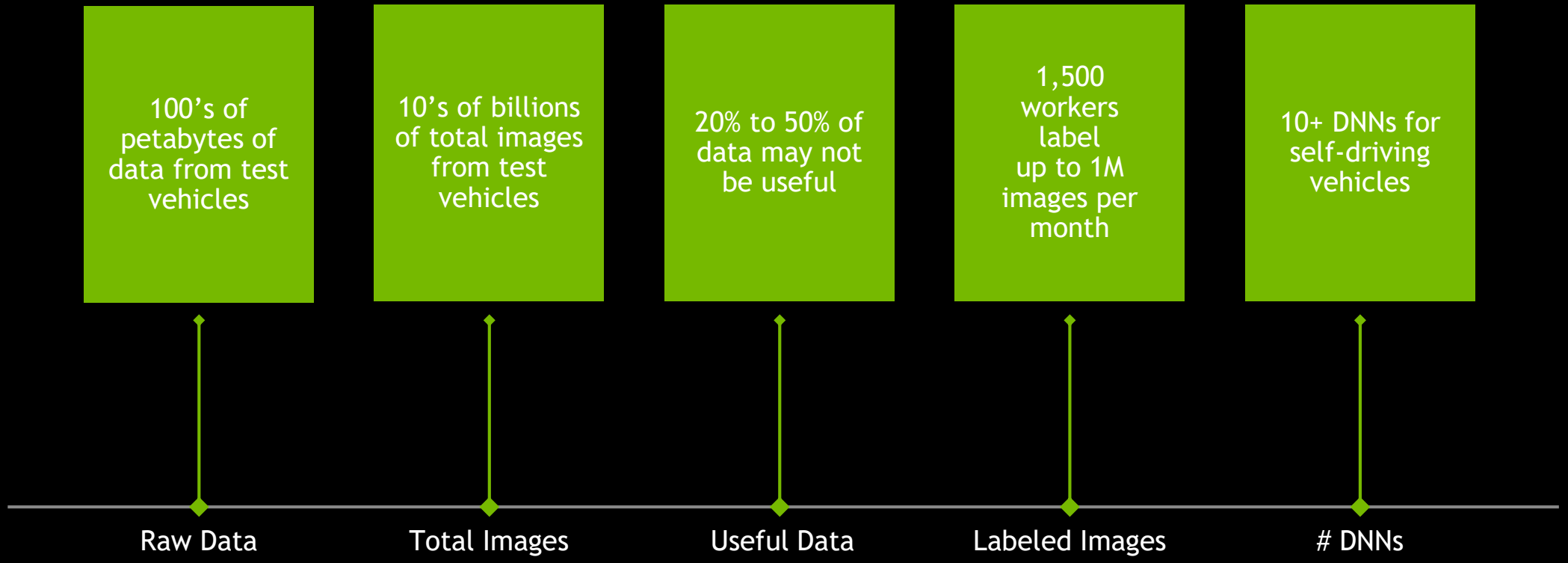
Automation, Best Model Discovery, Traceability, Reproducibility

Purpose-built for Safety Standards of Automotive

"Data is the new source code"



DATA COLLECTION AND LABELING FOR AI



Source: Data from test fleets of 50-100 cars

NVIDIA

DATA GENERATION FROM ONE SURVEY CAR

DATA COLLECTED	TOTAL IMAGES	LABELED IMAGES
2 petabytes per car / year	1 billion images / year	3 million images / year

Source: NVIDIA's Self-Driving Cars - BB8

AI FOR SELF-DRIVING WORKFLOW

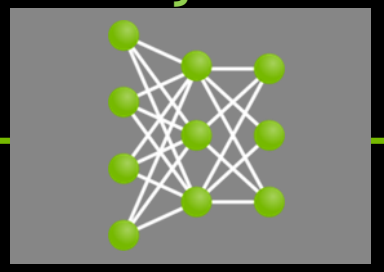
Get Data

Labeled Data

Train & Test

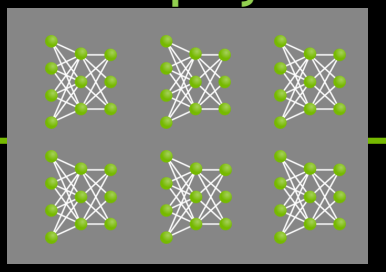
Trained Model

Adjust



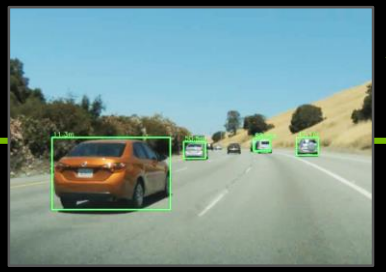
Fine Tune Model

Deploy



Export Model

Test & Validate



Inference at Edge

DNN Development
Exploration
Development
Model Selection

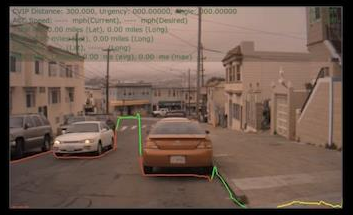
Simulate

Re-Simulate

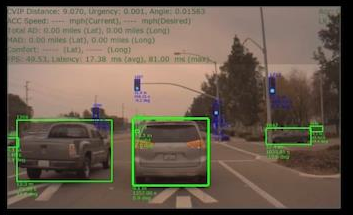
NVIDIA

AI FOR SELF-DRIVING

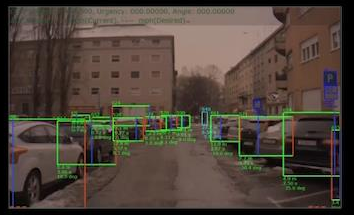
Perception



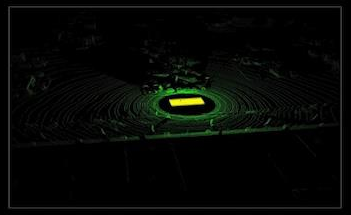
Free Space Perception



Distance Perception

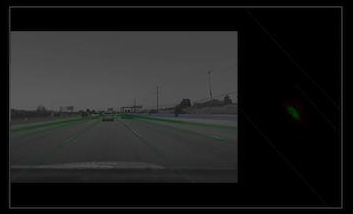


Weather



LIDAR Perception

Camera-based Mapping



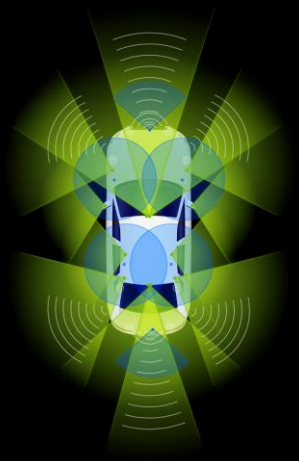
Camera Localization to HD Map

LIDAR Localization to HD Map

Path Perception

Scene Perception

AI OUTSIDE AND INSIDE THE VEHICLE



Exterior Driver Recognition

Automatic Personalization

Device usage detection

Cyclist Alert

Distracted Driver Alert

Driver/Passenger Recognition

Customer Application

DRIVE AV
Object, Freespace, Path / Lane, Path Planning, Wait, Map, Sign, Lights, Road Markings, Surround

DRIVE IX
Gaze, Eye Openness, Head Pose, Gestures, Emotions
Facial Recognition, Voice Recognition & Lip Reading

DRIVE OS

NVIDIA

COMPUTATIONAL SCALE REQUIRED

3 million labeled images
1 DGX-1 trains 300k labeled images on 1 DNN in 1 day
10 DNNs required for self-driving
10 parallel experiments at all times
100 DGX-1 to start serious DL Training for Autonoumus Driving

NVIDIA GPU PLATFORM SAVES MONEY

Enable Deep Learning Training at Scale

$1.25M in servers

=

10x TCO

1/8 THE COST

10X LESS SPACE

20X LESS POWER

140 Skylake Gold CPU Servers

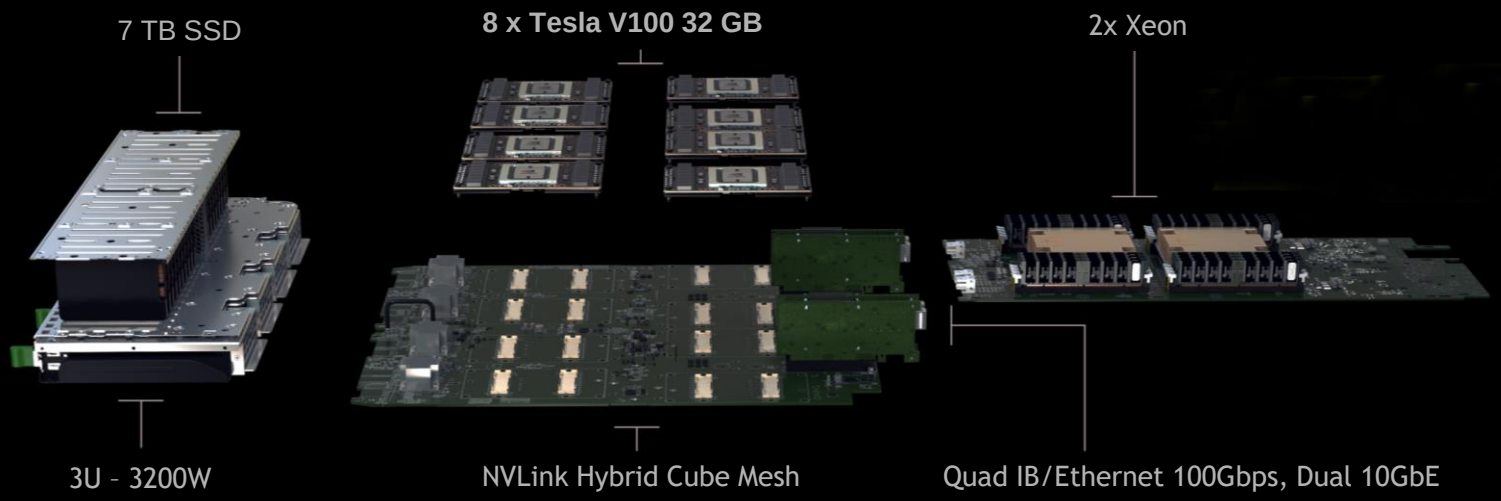
One DGX-1

NVIDIA

NVIDIA ® DGX-1™

nvidia DGX-1 with volta

Highest Performance, Fully Integrated HW System



1 PetaFLOPS | 8x Tesla V100 32GB | 300 Gb/s NVLink Hybrid Cube Mesh

2x Xeon | 7 TB RAID 0 | Quad IB/Ethernet 100Gbps, Dual 10GbE | 3U — 3500W

NVIDIA

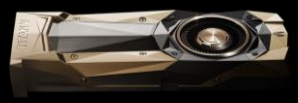
End-to-end product family

TRAINING

FULLY INTERGRATED DL SUPERCOMPUTER

DGX & DGX Station

DESKTOP



GV 100

DATA CENTER

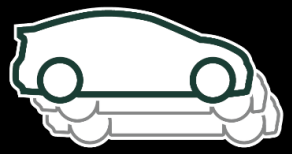
Tesla V100

INFERENCE

DATA CENTER

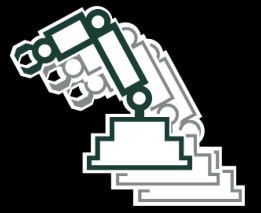
V100

AUTOMOTIVE



Drive PX2

EMBEDDED



Jetson TX2

NVIDIA

SIMULATION
THE PATH TO BILLIONS OF MILES

World drives trillions of miles each year.

U.S. has 770 accidents per billion miles.

A fleet of 20 test cars cover 1 million miles per year.

NVIDIA DRIVE SIM AND CONSTELLATION

AV VALIDATION SYSTEM

- Virtual Reality AV Simulator
- Same Architecture as DRIVE Computer
- Simulate Rare and Difficult Conditions, Recreate Scenarios, Run Regression Tests, Drive Billions of Virtual Miles
- 10,000 Constellations Drive 3B Miles per Year

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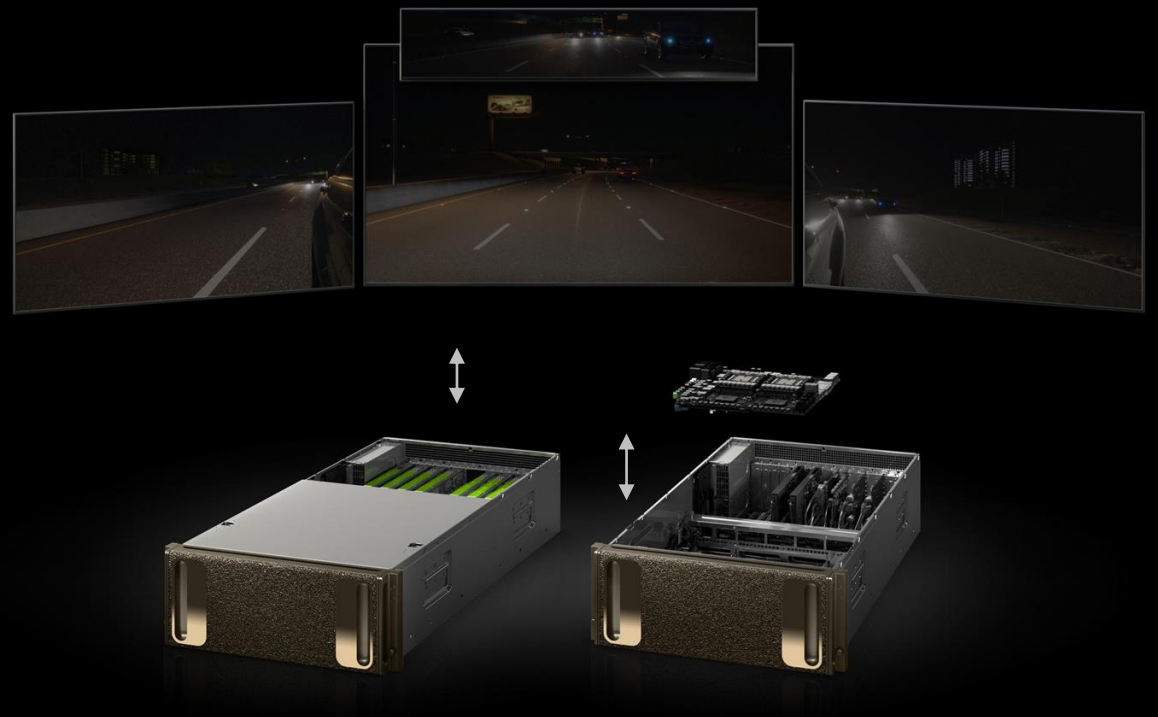

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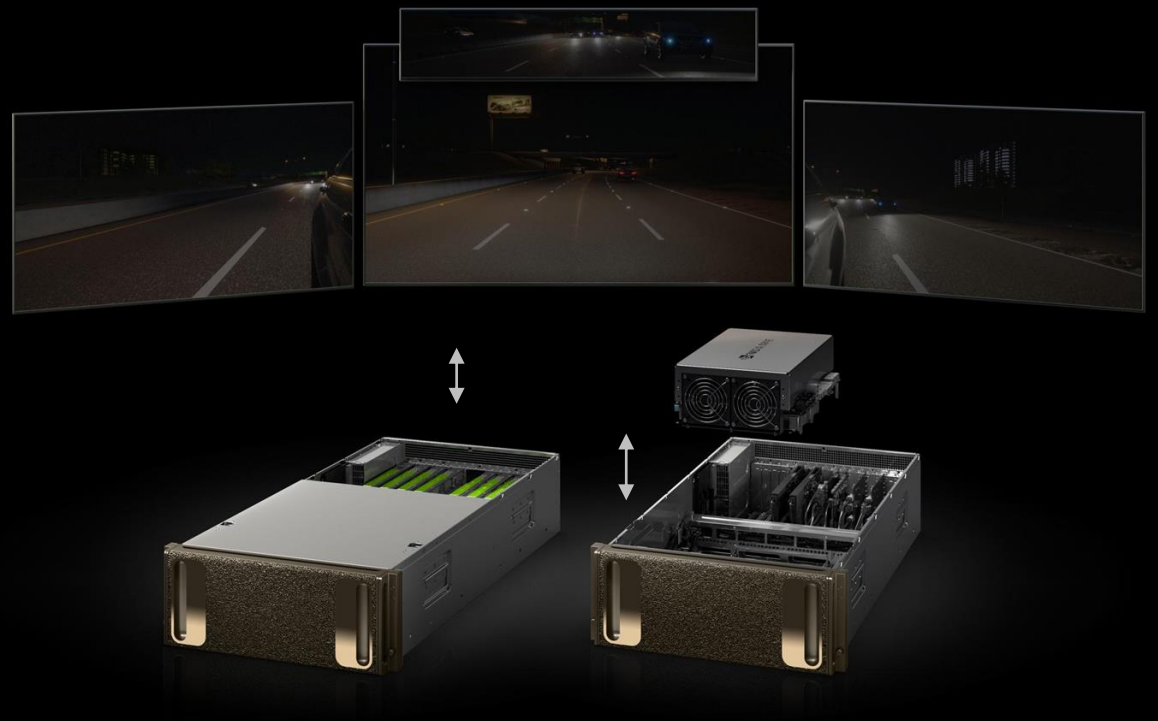

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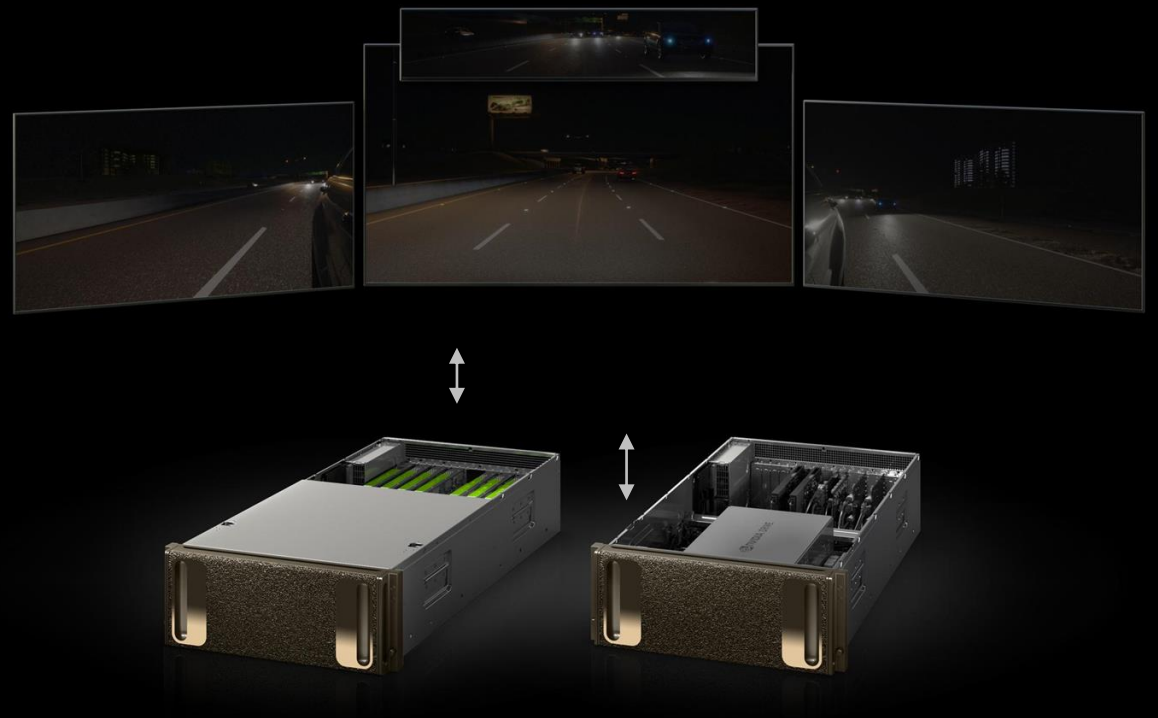
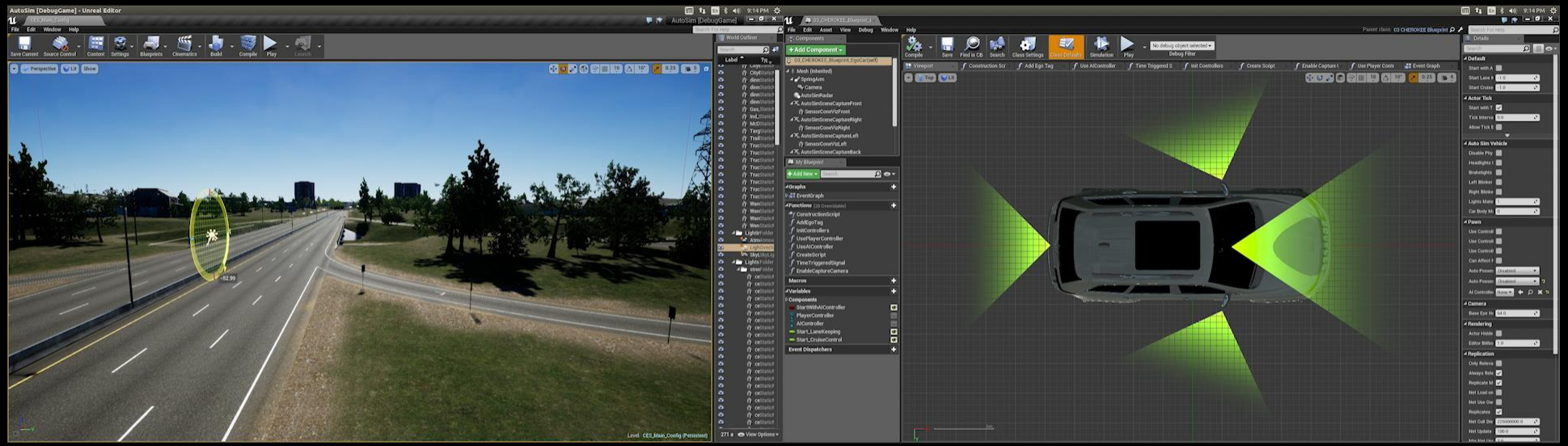


MULTI-SENSOR SIMULATION

MULTI-SENSOR SIMULATION



Setting Up The Environment

NVIDIA Think Session

“AV Datasets & MultiGPU Training to the Rescue”

Explore your AI/DNN development plan and data center infrastructure

Develop customized AI infrastructure roadmap

Leverage NVIDIA Deep Learning Institute

THANK YOU