MACHINE LEARNING
Games and Beyond

Calvin Lin, NVIDIA
ARTIFICIAL INTELLIGENCE
Early artificial intelligence stirs excitement.

MACHINE LEARNING
Machine learning begins to flourish.

DEEP LEARNING
Deep learning breakthroughs drive AI boom.
THE MACHINE LEARNING ERA IS HERE

And it is transforming every industry... including Game Development
OVERVIEW

- NVIDIA Volta: An Architecture for Machine Learning
- NVIDIA GameWorks Materials & Textures
- Project Isaac & Holodeck
NVIDIA VOLTA
An Architecture for Machine Learning
NVIDIA VOLTA GPU: KEY FEATURES

- Tensor Cores for deep learning
- 2nd generation NVIDIA NVLink
- HBM2 memory
- Cooperative groups
- Volta-optimized software
**TENSOR CORES**
An Exponential Leap in Performance

Equipped with **640** Tensor Cores
120T Tensor FLOPS
Over a 5X over NVIDIA Pascal™ architecture.
TESLA V100 vs. TESLA P100
2ND GEN NVLINK
Scalability for Rapid Time-to-Solution

High-speed interconnect technology
2X throughput over previous gen
Enable large scale parallel computing
HBM2 MEMORY
Faster, Higher Efficiency

16GB HBM2 memory
900 GB/sec peak bandwidth
COOPERATIVE GROUPS
New programming model in CUDA 9

Independent thread scheduling
New way for organizing groups of communicating threads
VOLTA-OPTIMIZED SOFTWARE

GPU-Accelerated Frameworks and Applications

NVIDIA Deep Learning SDK libraries:

cuDNN, cuBLAS, NCCL, TensorRT
NVIDIA GameWorks Materials & Textures
Game Content Creation by Machine Learning
What is Machine Learning to Game Development?

**Content Creation**
Better game assets with less effort

**Game AI**
Bots are smarter and more fun

**User Interface**
Innovative ways to interact
NVIDIA’s Goal for Game Content Creation

- Accelerate content creation
- Remove the mundane/repetitive
- Increase asset quality/realism
- Promote creativity

**GAMEWORKS RESEARCH**
300 world-class engineers at the intersection of art and science

**GAMEWORKS LIBRARY**
Visual & physical simulation SDKs
Technology, algorithms, engines, libraries

**DEVELOPER TOOLS**
IDE-integrated and standalone
Debuggers, profilers and utilities
GameWorks: Materials & Textures

Set of tools targeting the game industry using machine learning

Tools in the initial release:

- Photo To Material: 2shot
- Super-resolution
- Texture Multiplier

GameWorks Materials & Textures beta
https://gwmt.nvidia.com
Using CNN to generate PBR materials

Two input photos:
- Flash image (with flash)
- Guide image (without flash)
Photo to Material: 2Shot

- Using CNN to generate PBR materials
- Two input photos:
  - Flash image (with flash)
  - Guide image (without flash)
Texture Multiplier

Example texture in, new textures out

Limitless images generated
Super-Resolution

Amplify the image by 2x or 4x using deep learning method

Far better quality than image filtering
Super-Resolution Convolutional Auto-Encoder

- LR image
- Mapping
- Convolutional operators
- Mapping in the feature space
- Mapping
- HR image
Project Isaac & Holodeck
Machine Learning Beyond Games
Hockey Demo

Training: real world vs. virtual world

Real robot:
Power plug task
**ISAAC**
Training robots in the virtual world, downloading to the real world

The faster, safer, cheaper way to train robots

Faster - rapid domain adaptation

Safer - train scenarios difficult to do in real world

Cheaper - cost saving regression test and labelling
The Robotic Simulator

1. The processor of NVIDIA Jetson TX
2. The software stack for perceive, localize, plan and take action
3. Isaac Lab - a real world simulator
4. A collection of reference platforms like drones and submersibles
Isaac Lab
Training in the virtual world

DNN / Compute platform
OpenAI Gym
Ease transition from training to inference

Rendering
Customized UE4
Camera, lidar, radar sensing and segmentation

Physical Simulation
PhysX
Hardware-accelerated simulation in the cloud
Jetson Reference Platform
Downloading to the real world

Transfer training result to real world
Quick iteration on tuning final products

Open-sourced robotic platforms
Various drones, submersibles, wheeled robots for developers to create & test prototypes
Koenigsegg Regera Demo

Holodeck makes it easy to import render enormous models.

The Koenigsegg Regera supercar contains 50 million polygons.

http://www.nvidia.com/object/nvidia-project-holodeck-notify-me.html
Holodeck
Photorealistic, Collaborative VR

Sight, sound and haptics
Headset & gloves

Models and physics
Built on UE4 and utilizing GameWorks, VRWorks and DesignWorks

Interaction and collaboration
Machine learning for posture recognition
WRAP-UP: GAMES AND BEYOND
THANK YOU!