





Introduction to Omniverse

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AGENDA

- Introduction to Nvidia Omniverse
Modern Collaboration Workflows & Universal Scene Description (USD)

- Five Foundational Components (Demo)
Nucleus, Connect, Kit, Simulation, RTX Renderer

- Building the Digital Twin (Hands-On)
Visualizing weather prediction on Omniverse

- Unified Industrial Digitalization
Digital twin development & Synthetic data generation

- Extension & Omni.UI (Hands-On)
Building an extension to visualize weather prediction using FourCastNet

- Getting started
Download & Resources

Unified Industrial Digitalization

Digital twin development & Synthetic data generation



NVIDIA Omniverse

Cloud Native Platform for Connecting, Building and Operating Industrial Metaverse Applications



AI Avatars



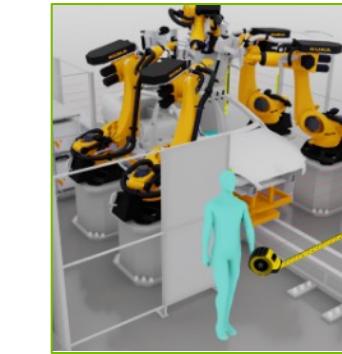
3D Design



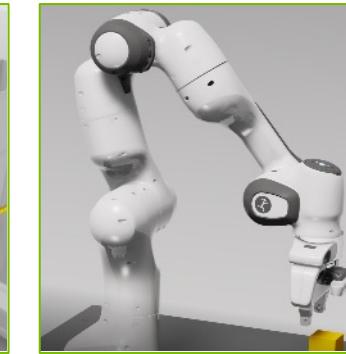
Autonomous
Vehicles



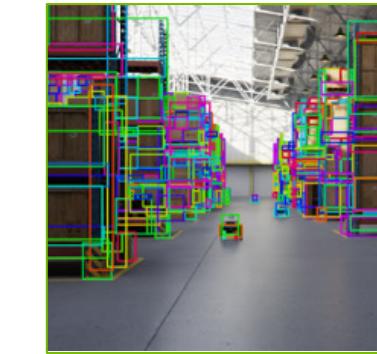
Scientific
Digital Twin



Industrial
Digital Twin



Robotics



Synthetic Data
Generation

Audio2Face

USD Composer

DRIVE Sim

Isaac Sim

Replicator

USD-GDN
Publisher

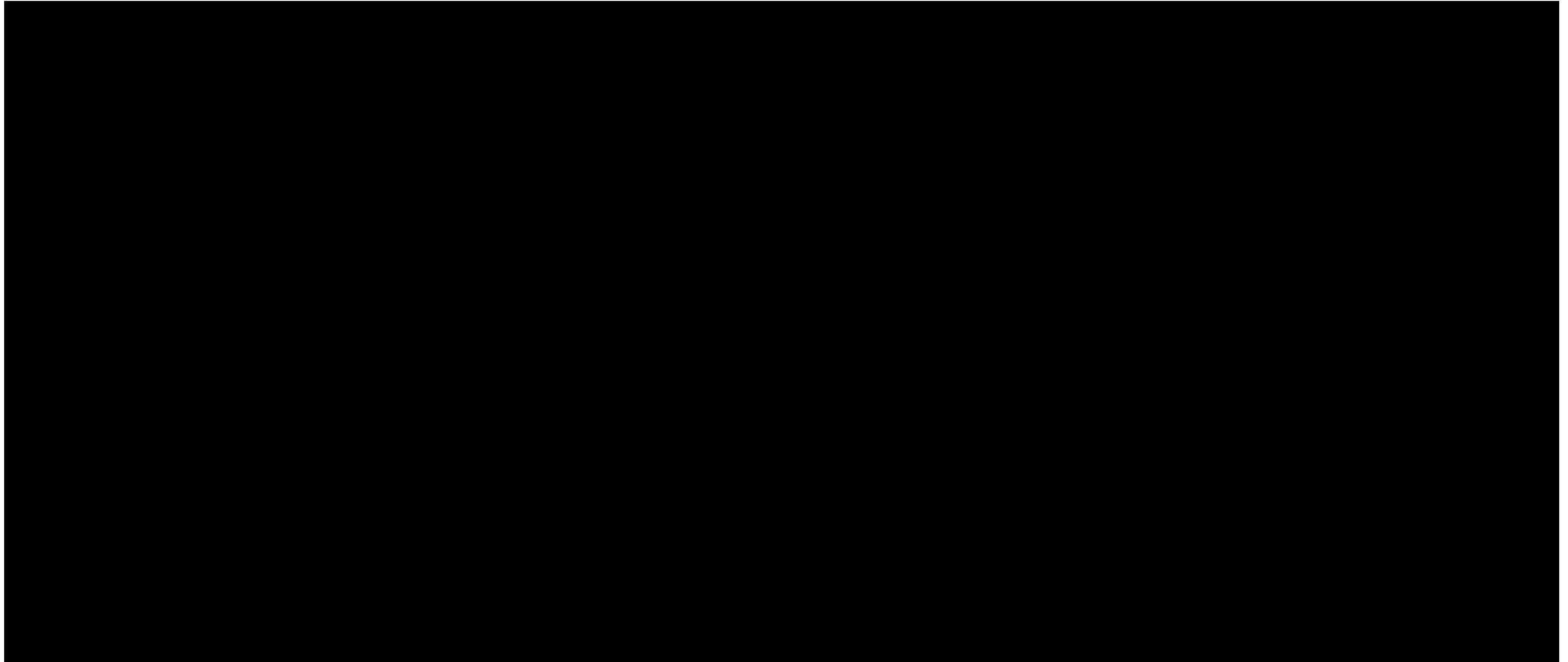


NVIDIA Omniverse



Before Industrial Digital Twin

Designing a System



The Founder 'Speedy System' Featurette (2017)



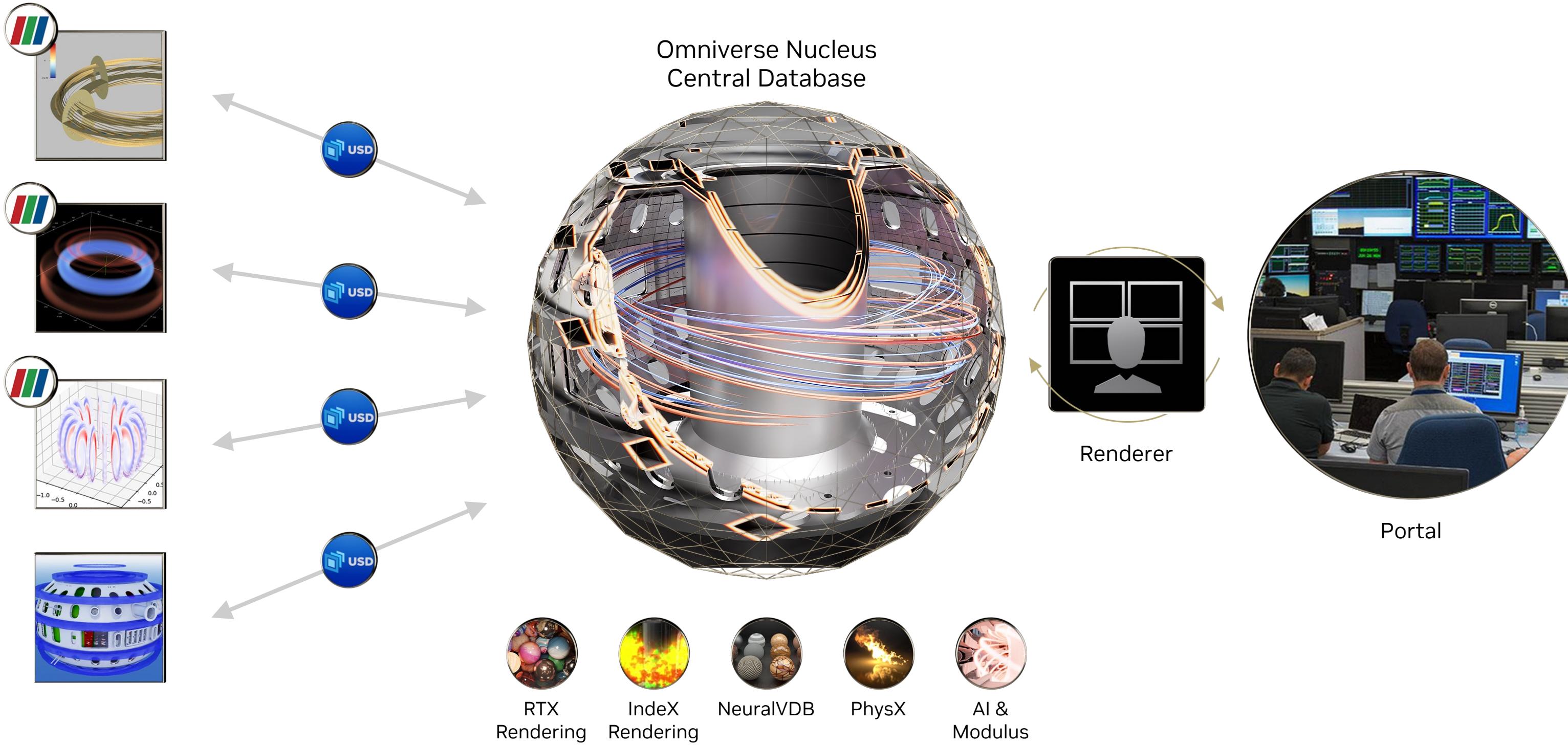
"With Omniverse and AI, we set up new factories faster and more efficiently"

"It all starts with planning - a complex process in which we need to connect many tools, datasets and specialists around the world. Traditionally we are limited as data is managed separately in a variety of systems and tools. Today we are developing custom Omniverse applications to connect our existing tools, know-how, and teams in a unified view."

Dr Milan Nedeljković, Member of the Board of Management of BMW AG

NVIDIA Omniverse for Scientific Computing

Connecting Complex HPC 3D and Simulation Workflows



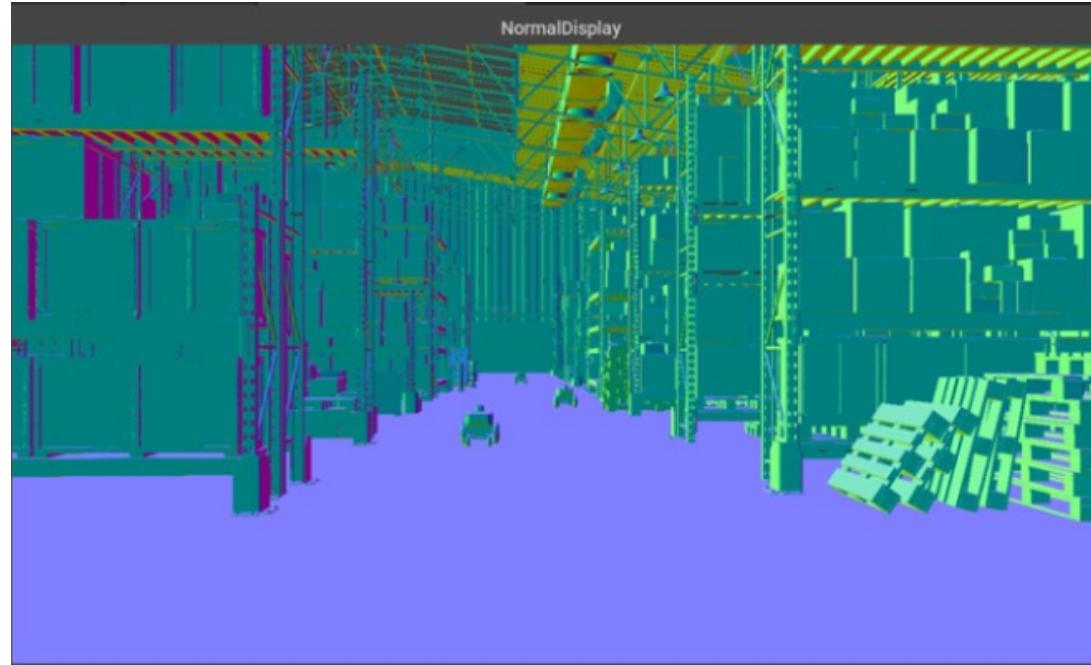
最佳化建築、工程、營造與營運工作流程



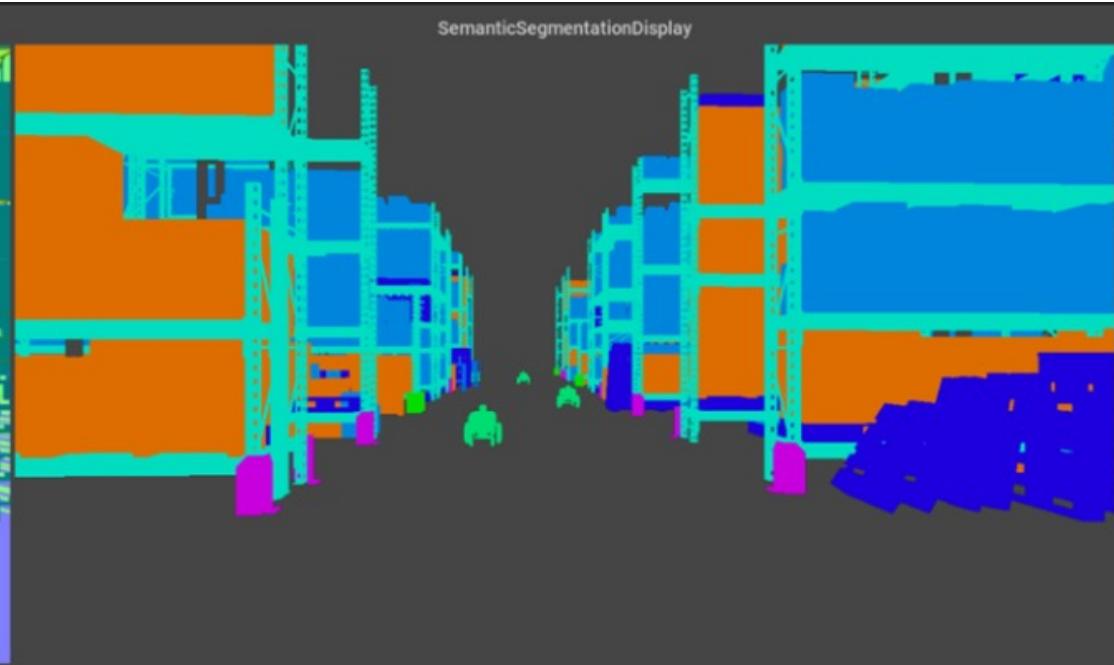
合成資料生成 (Synthetic Data Generation)

使用 Omniverse Replicator 在倉庫場景中加強感測器標註

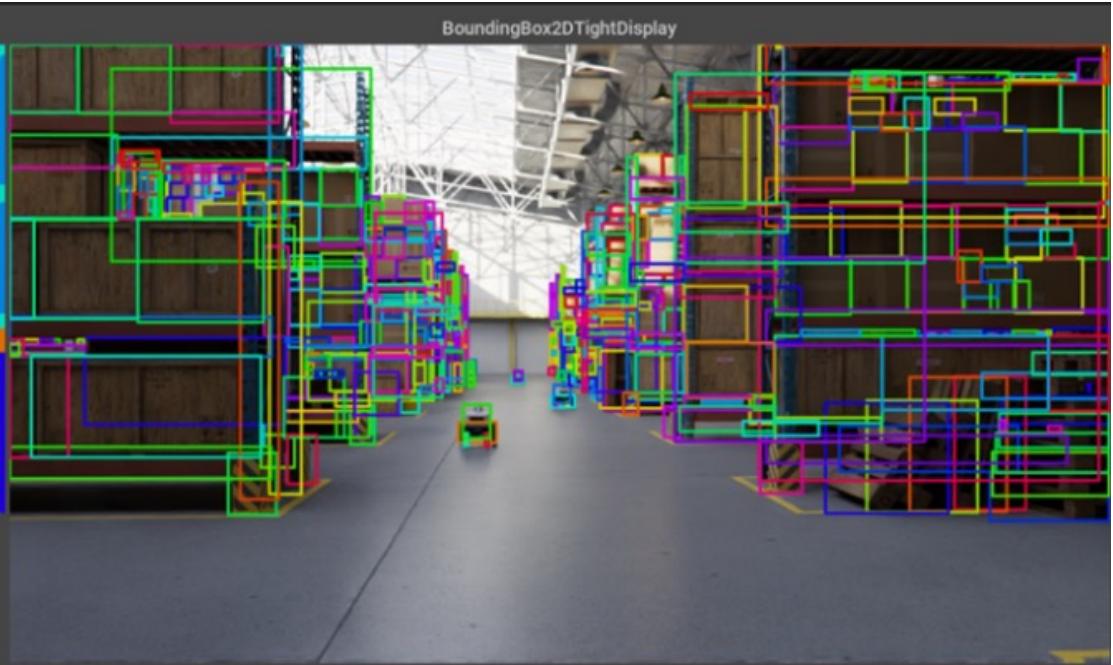
Normal Display



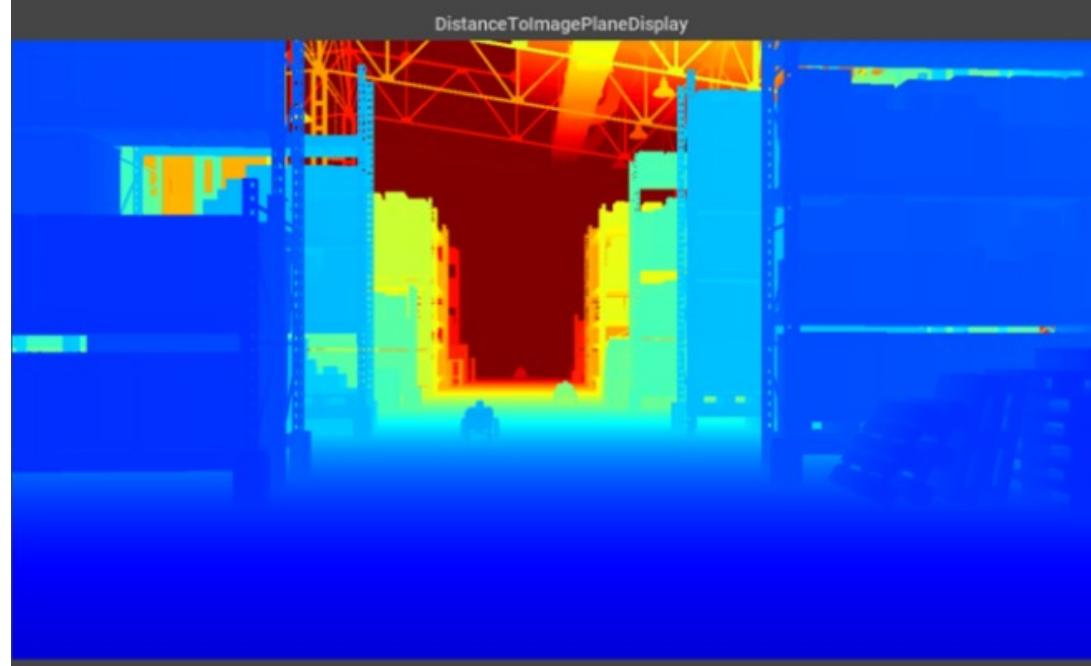
Semantic Segmentation Display



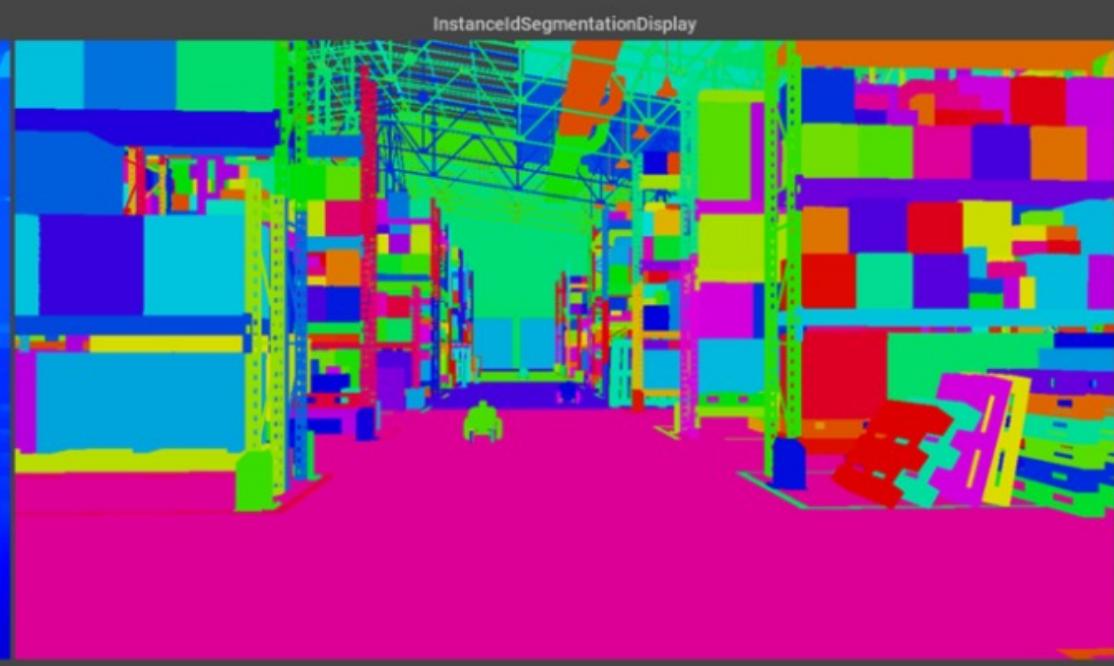
Bounding Box2D Tight Display



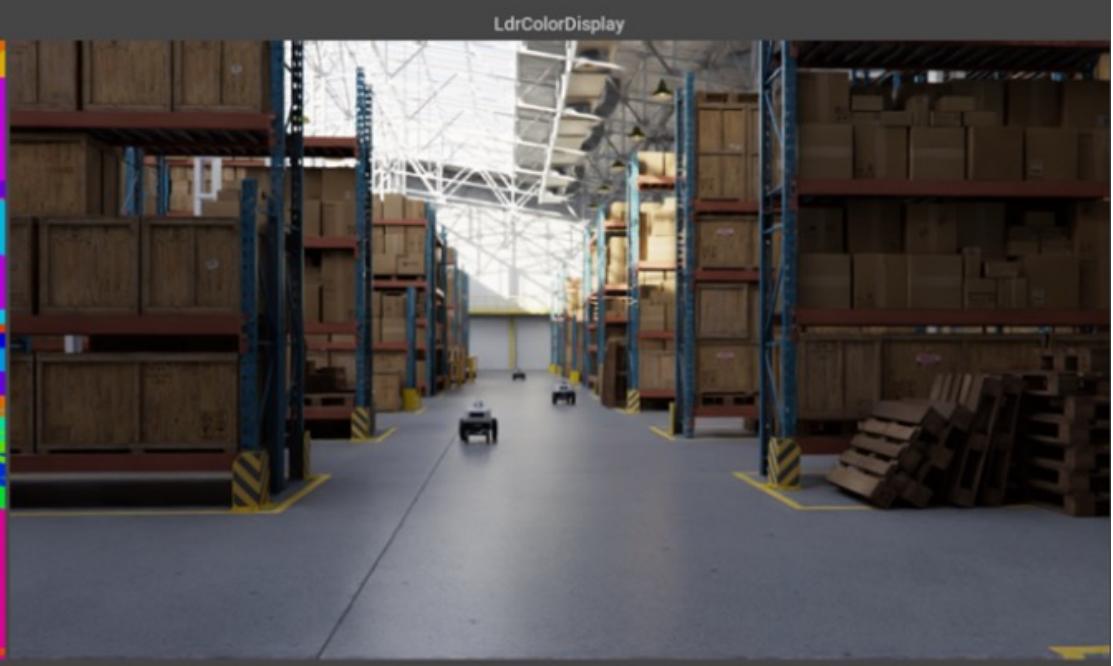
Distance ToImage Display



InstanceIdSegmentation Display



LdrColorDisplay



Distance ToImage Display

InstanceIdSegmentation Display

Ldr Color Display

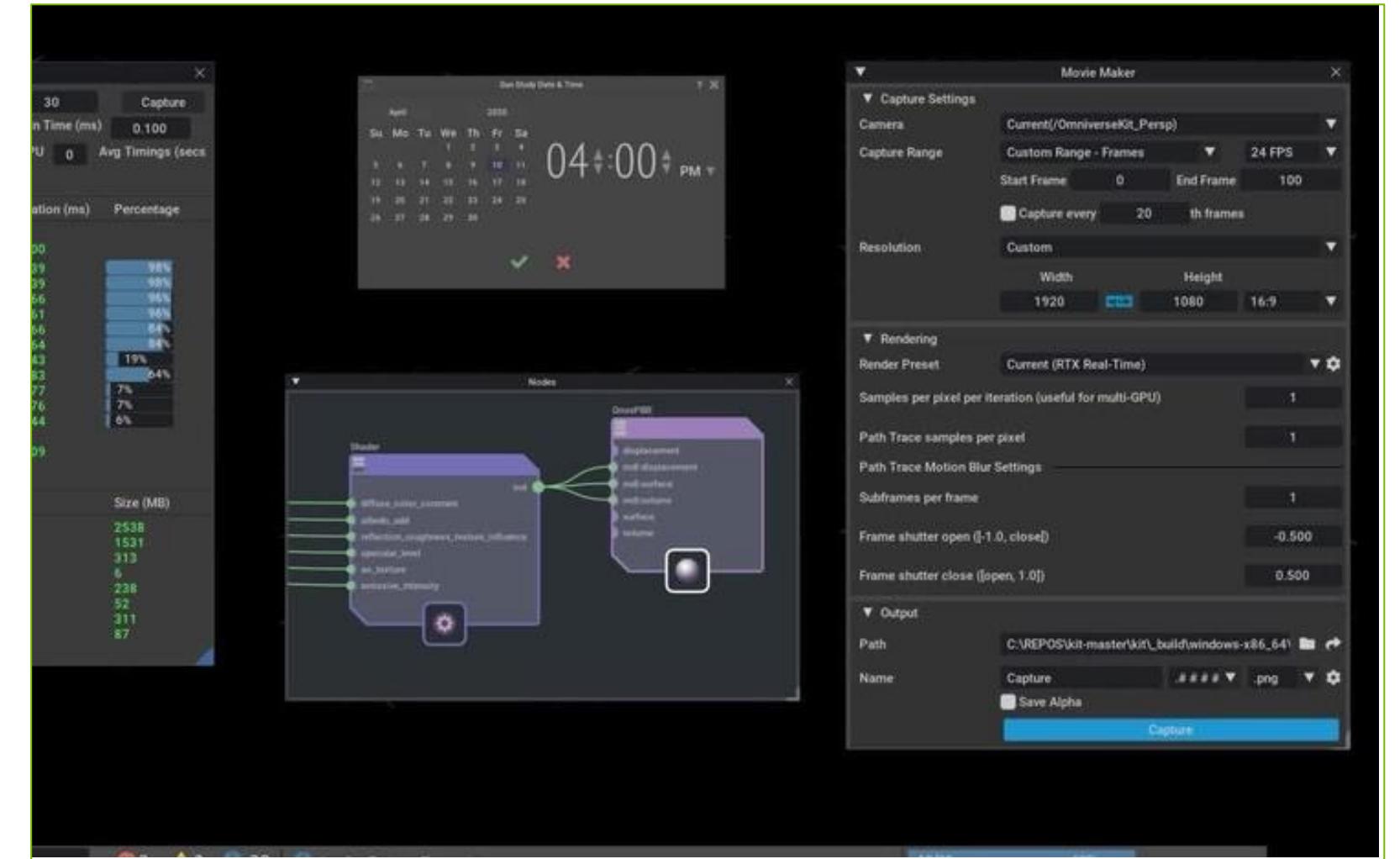
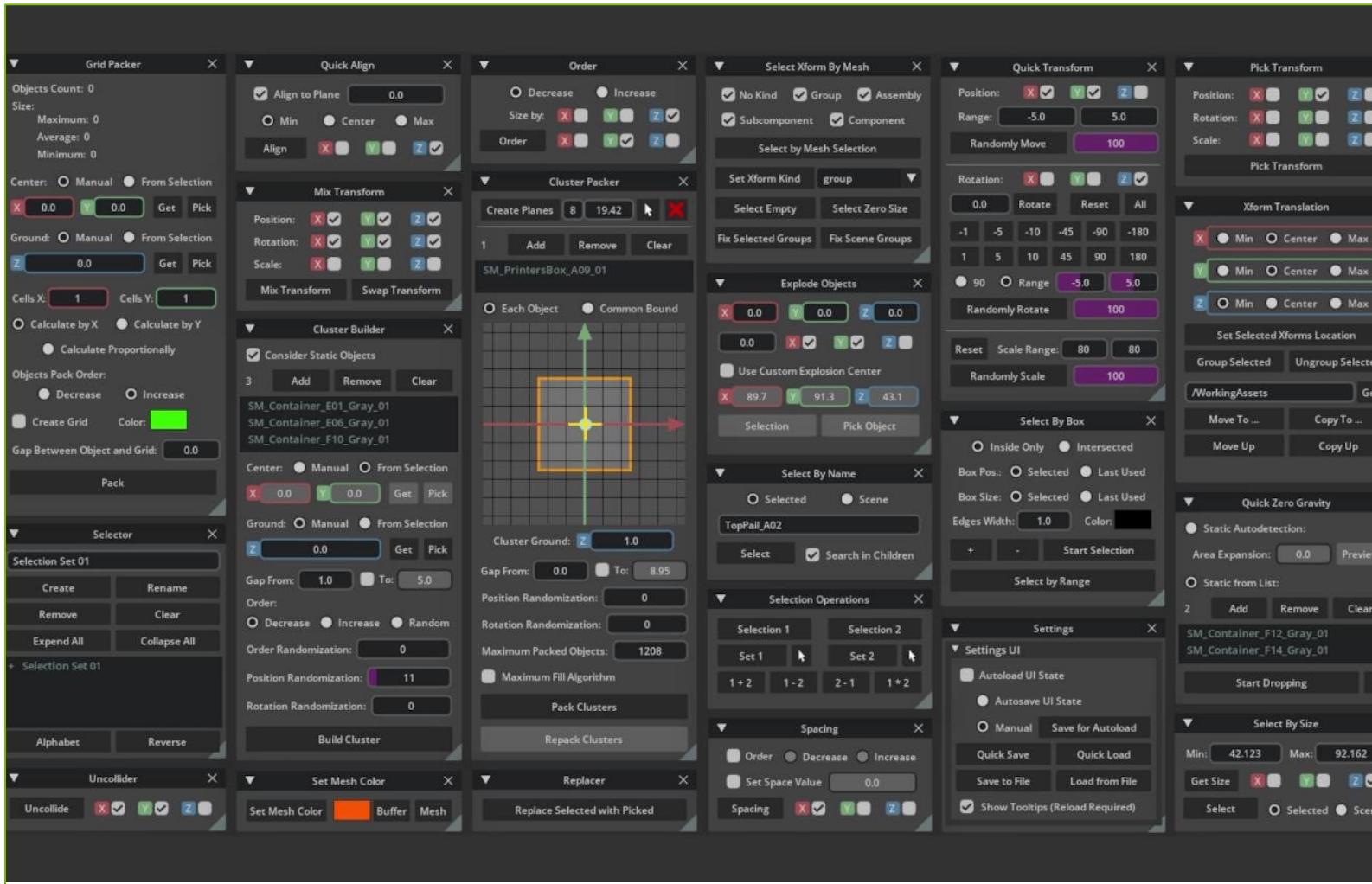
Extension & Omni.UI (Hands-On)

Building an extension to visualize weather prediction using FourCastNet



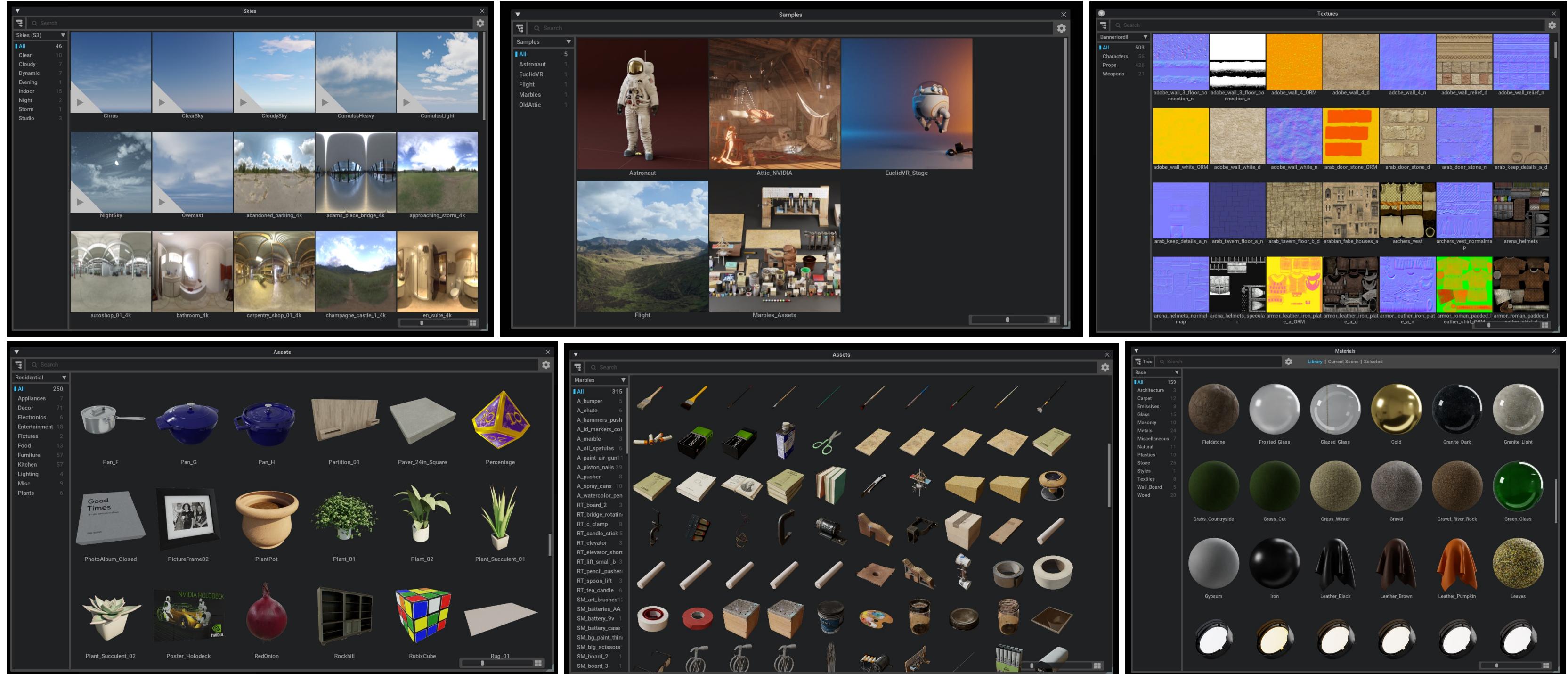
Custom Extensions

Omniverse is a development platform for building tools



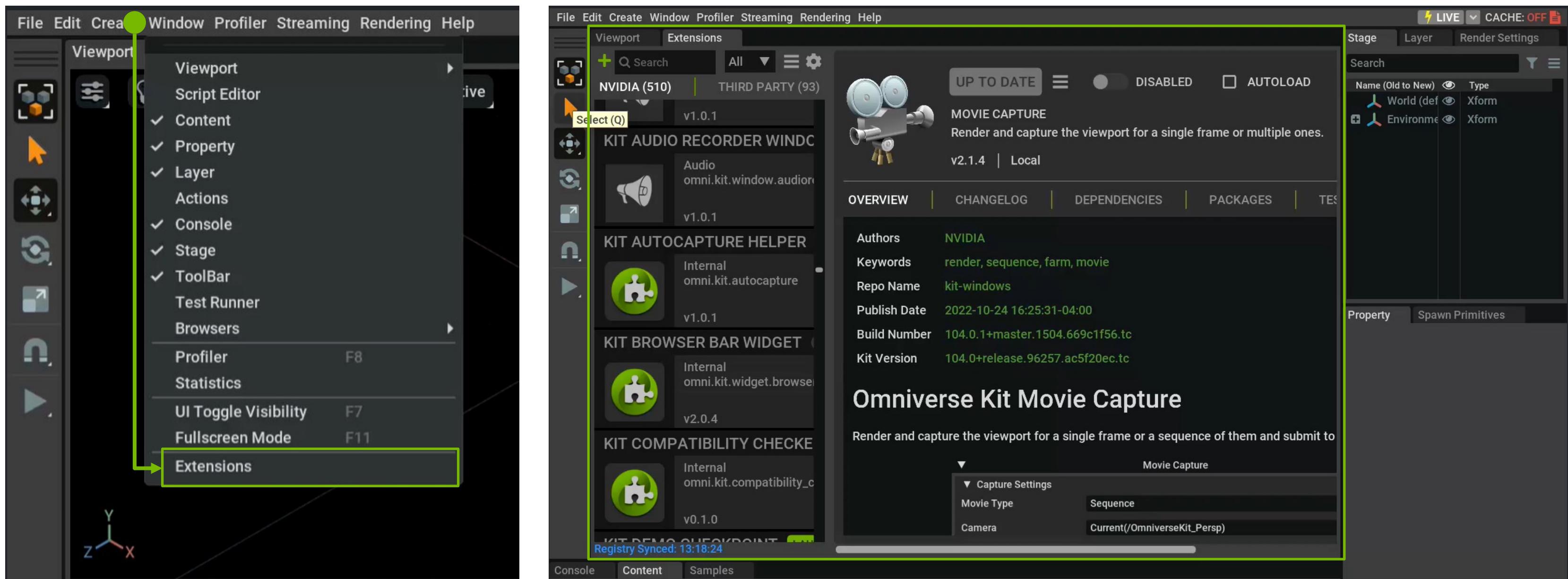
Extensions

Browser extension for creating any browser

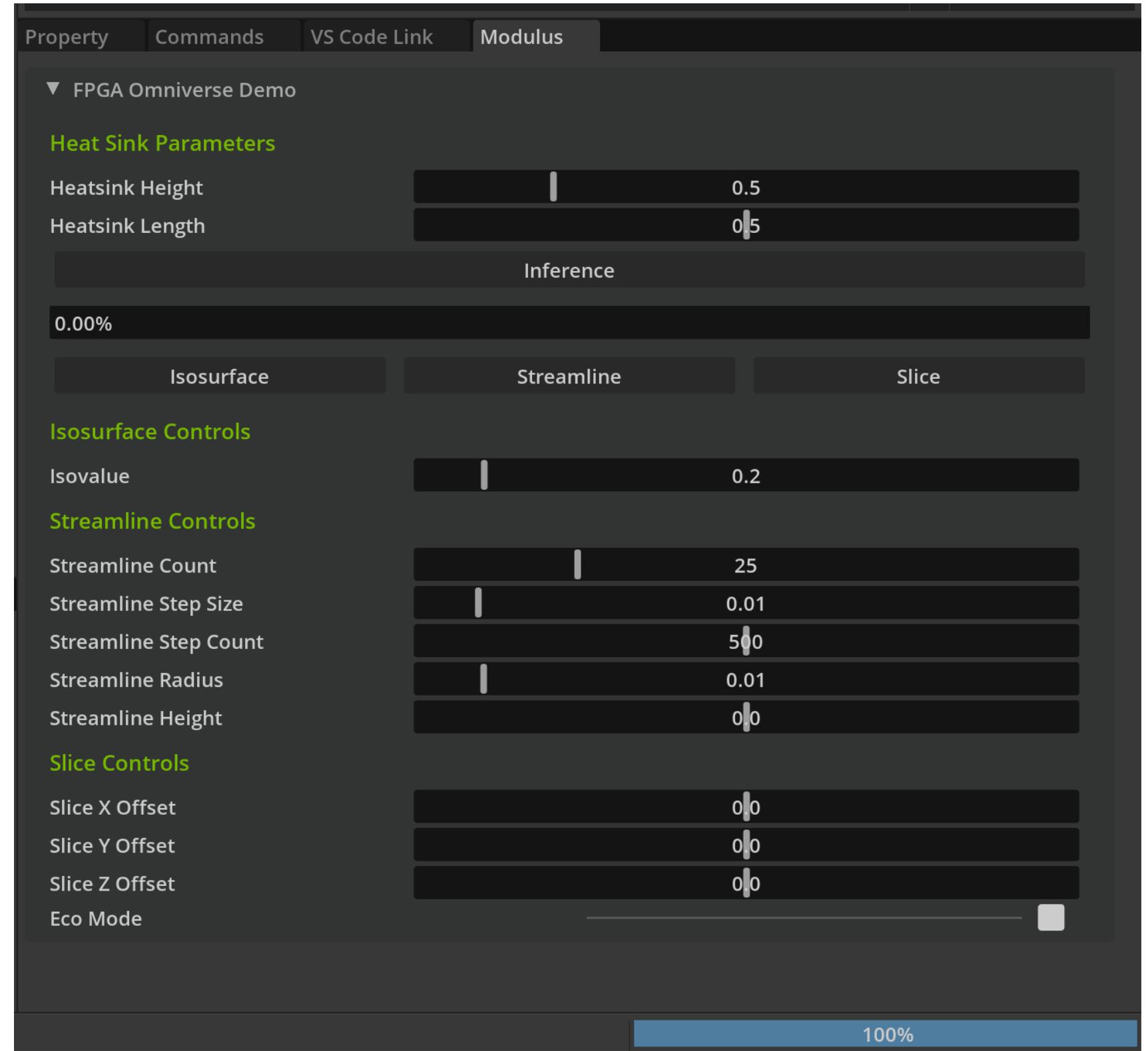
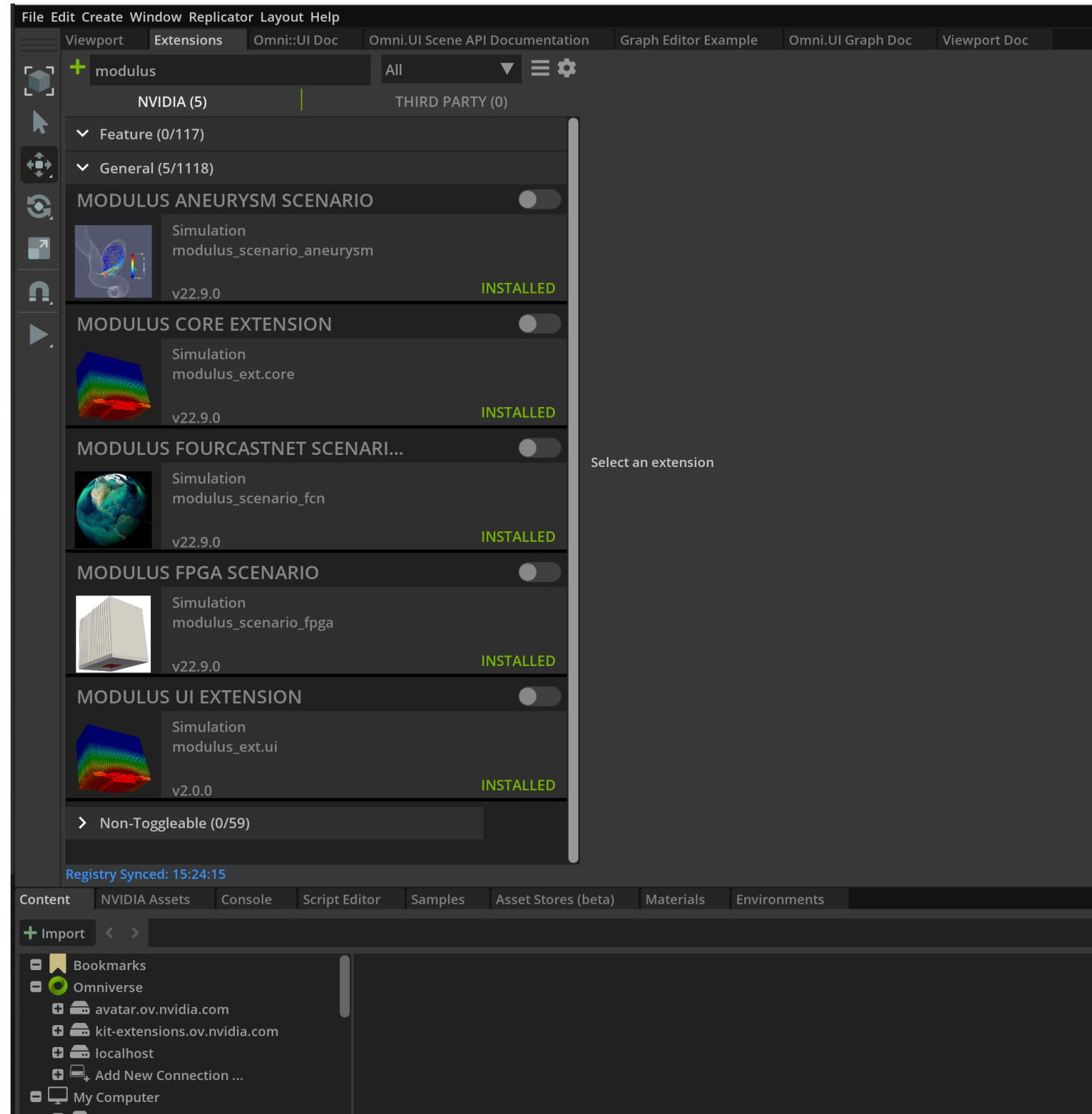


擴充套件管理 (Extension Manager)

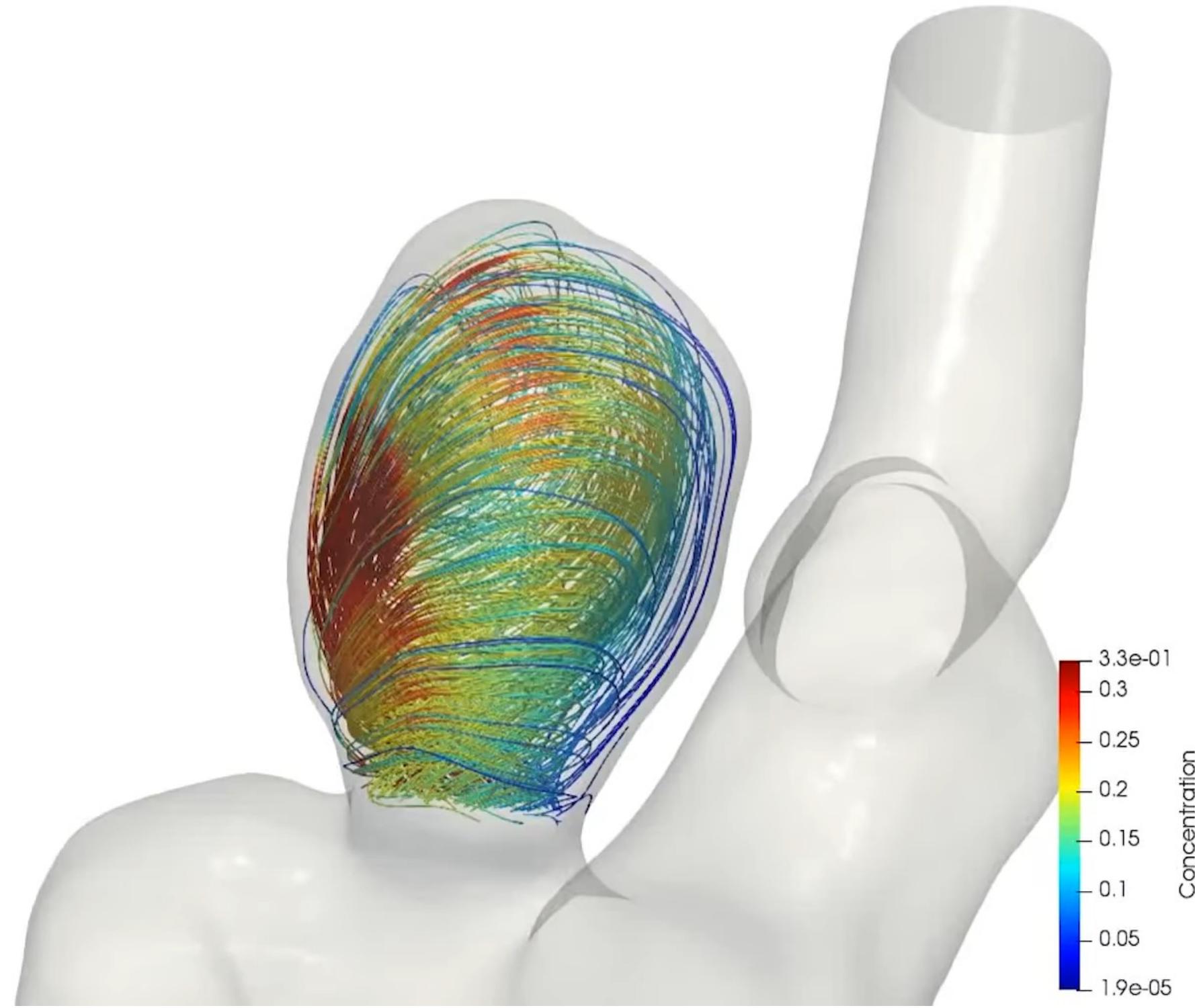
NVIDIA提供了數百個由NVIDIA開發的擴充套件給開發者免費使用，開發者可以自由的去編輯、修改、或是整合到自己的擴充套件或是應用程式中。不需要從0開始，即可快速完成開發流程。



Modulus Extension

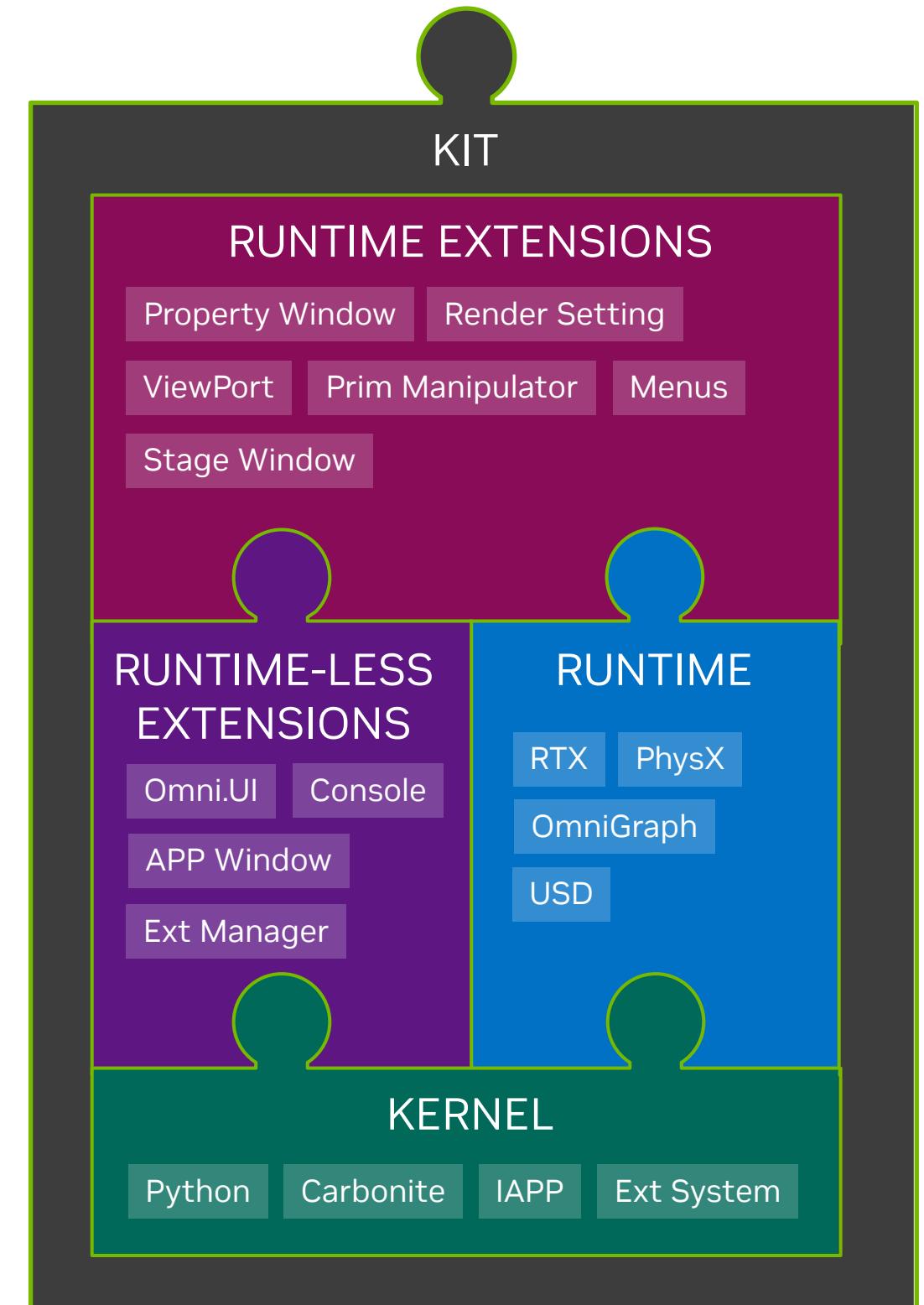


Modulus Extension



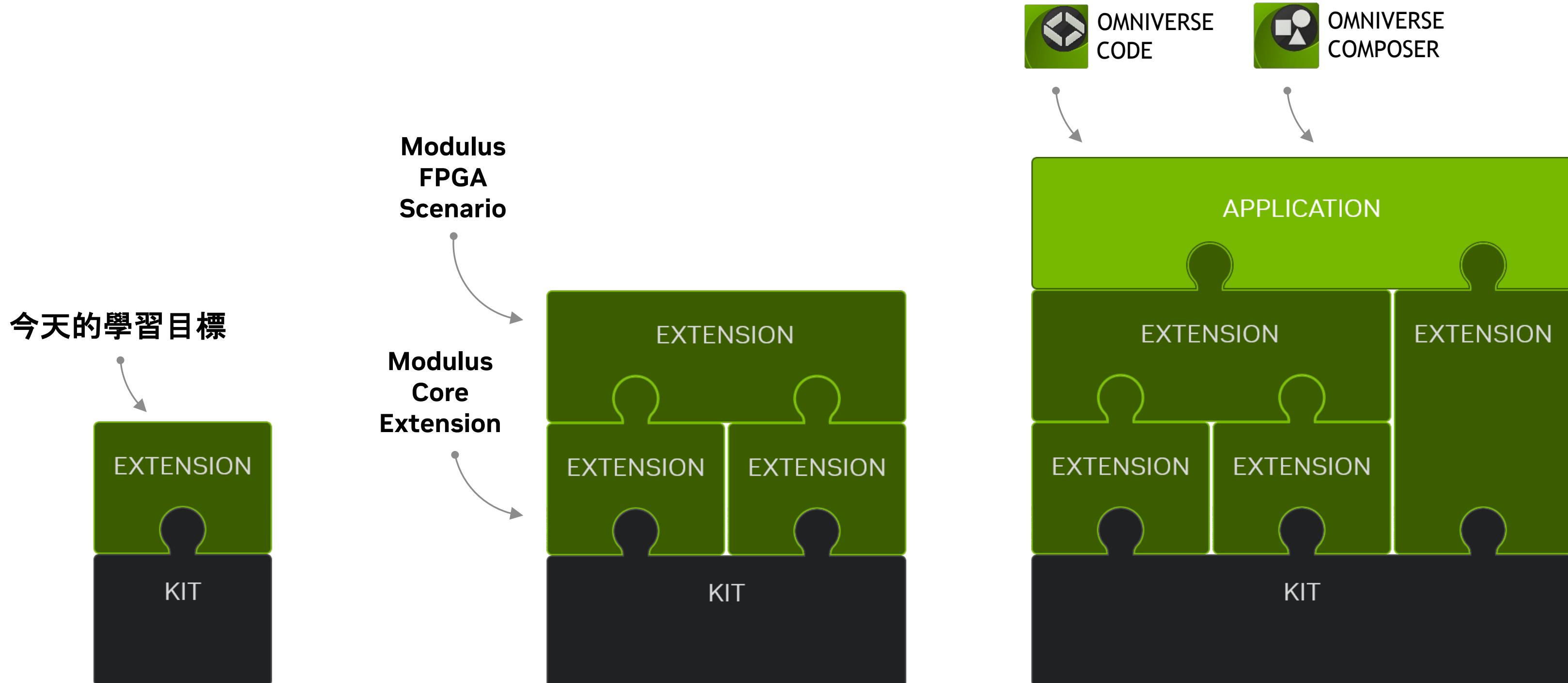
Kit Technology Stack

Kit is a modular stack of Runtimes and Extensions



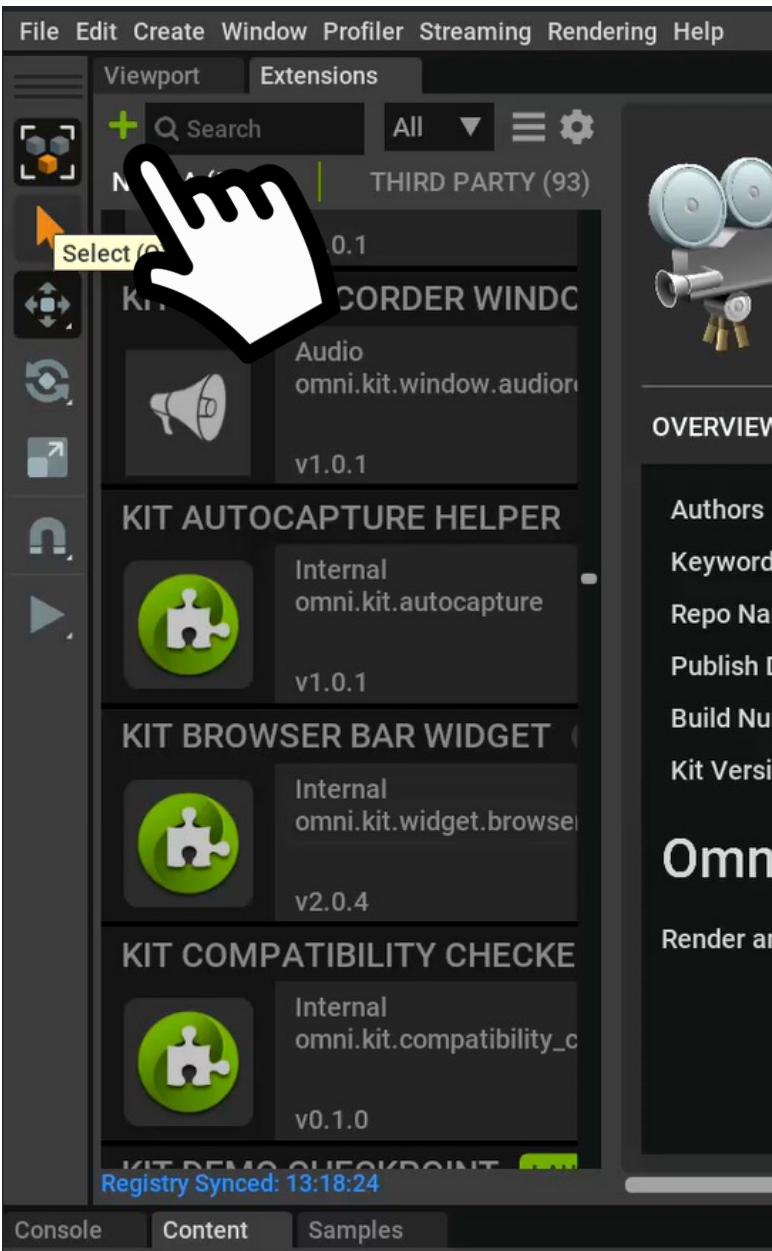
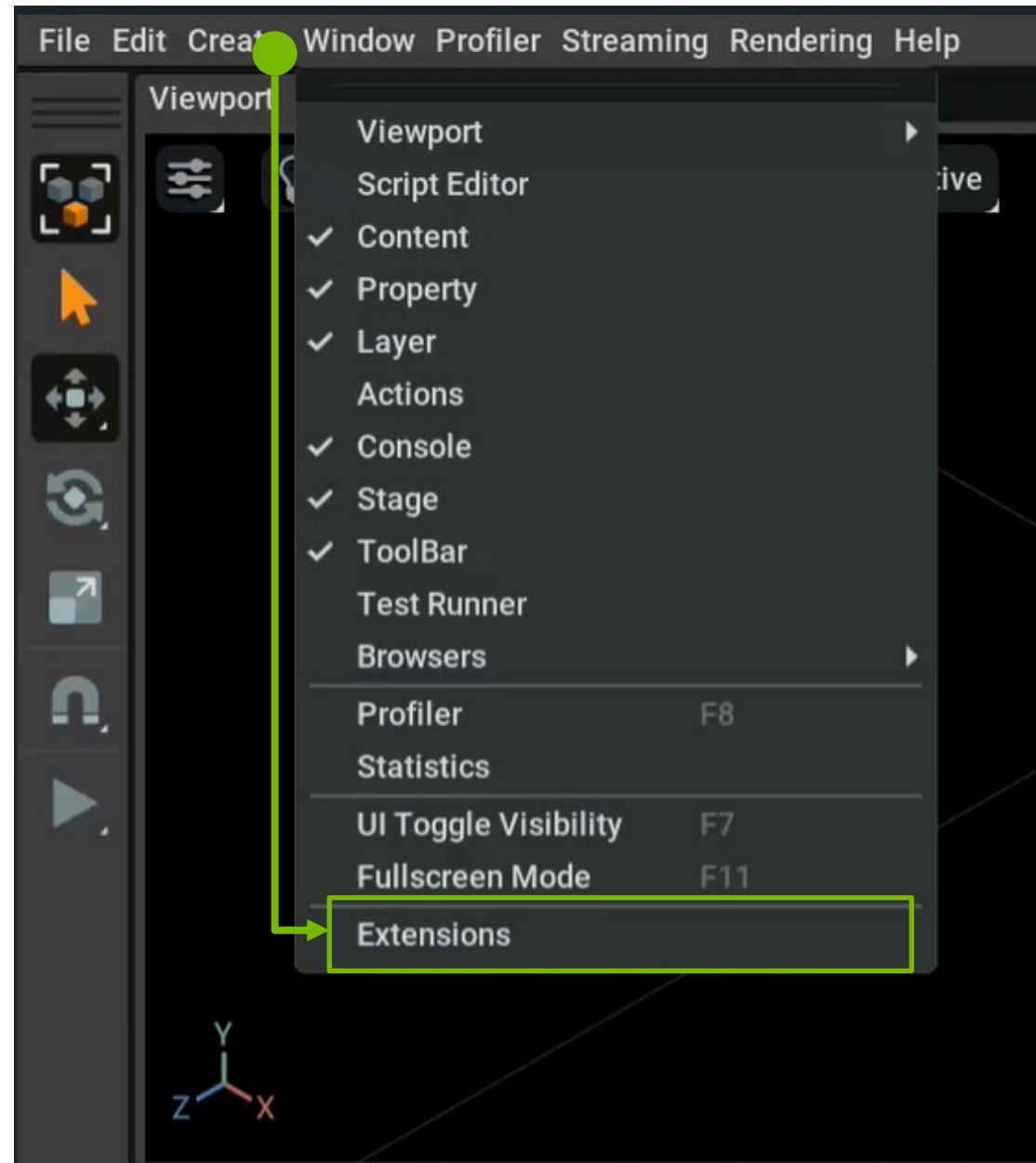
Extreme Modularity with Kit

Solutions are stacks of Extensions



Hands-On (5分鐘)

新增一個Extension

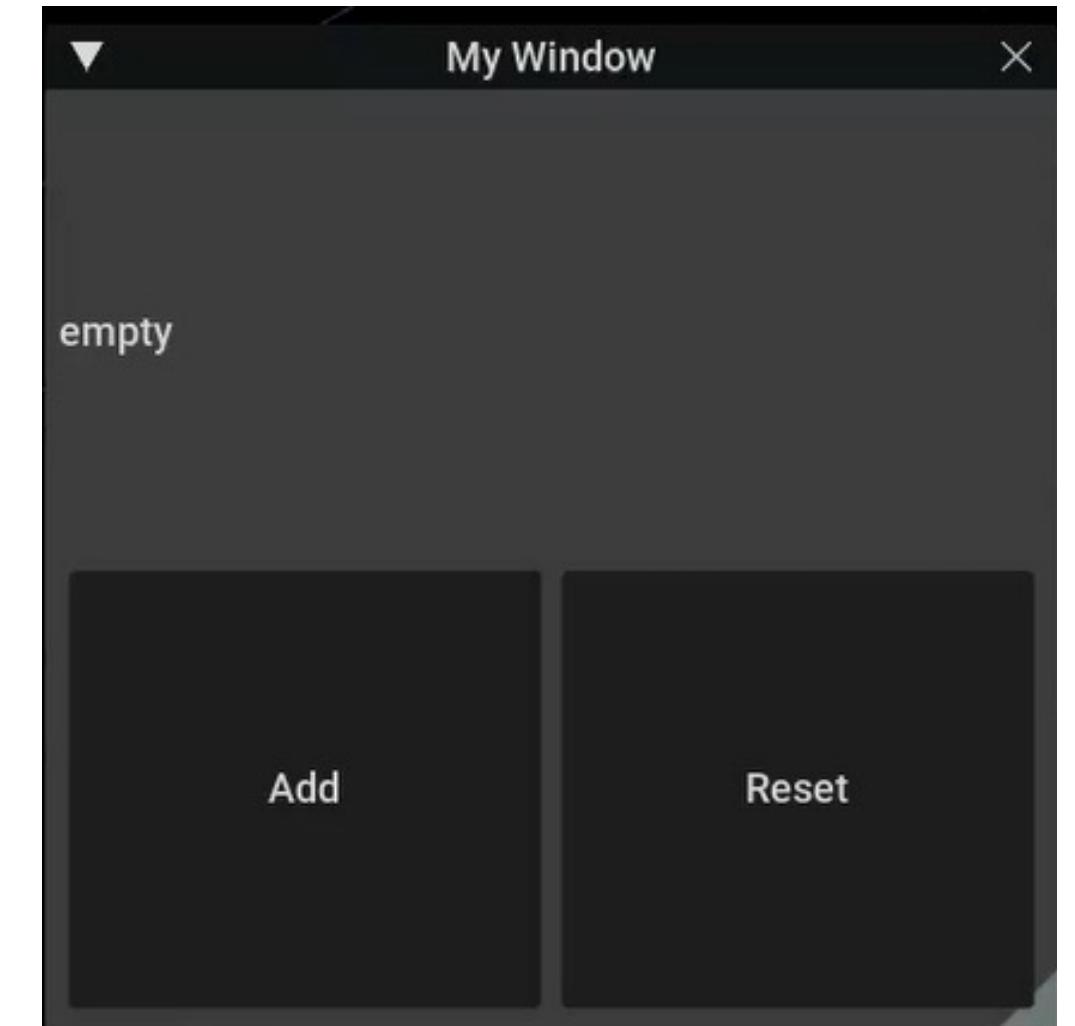


- 選「New Extension Project Template」
- 選「/workspace/python/source_code/extension」
- Project Name: omniverse-project-navier-stokes
- ext_id: omniverse-project-navier-stokes
- 回到JupyterLab開啟extension.py檔案，路徑如下：
source_code -> extension ->
omniverse-project-navier-stokes -> exts ->
omniverse.extension.navierstokes -> omniverse ->
extension -> navierstokes -> extension.py

omni.ui

Building the User Interface

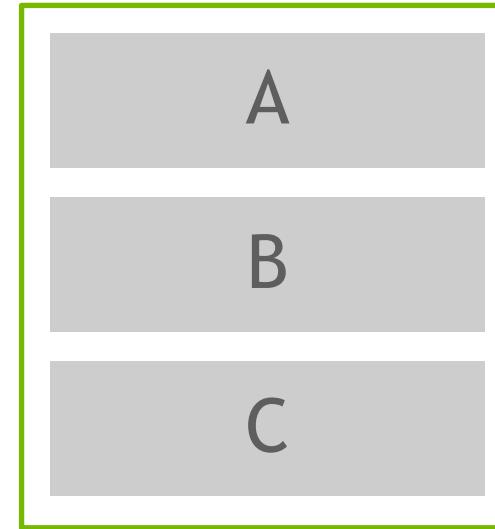
```
class OmniverseExtensionNavierstokesExtension(omni.ext.IExt):  
  
    def on_startup(self, ext_id):  
        print("[omniverse.extension.navierstokes] ... startup")  
  
        self._window = ui.Window("My Window", width=300, height=300)  
        with self._window.frame:  
            with ui.VStack():  
                label = ui.Label("empty")  
  
                with ui.HStack():  
                    ui.Button("Add")  
                    ui.Button("Reset")  
  
    def on_shutdown(self):  
        print("[omniverse.extension.navierstokes] ... shutdown")
```



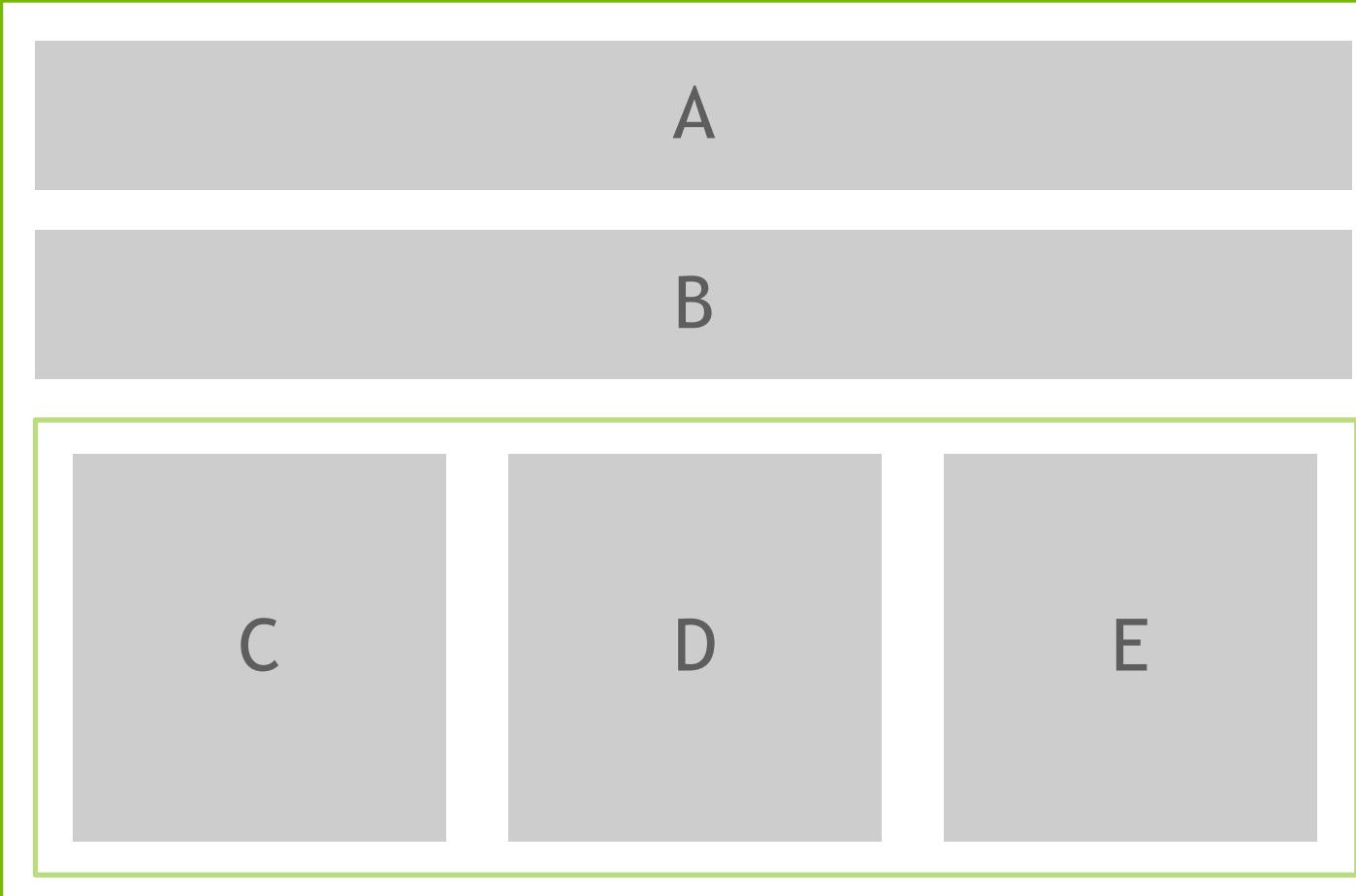
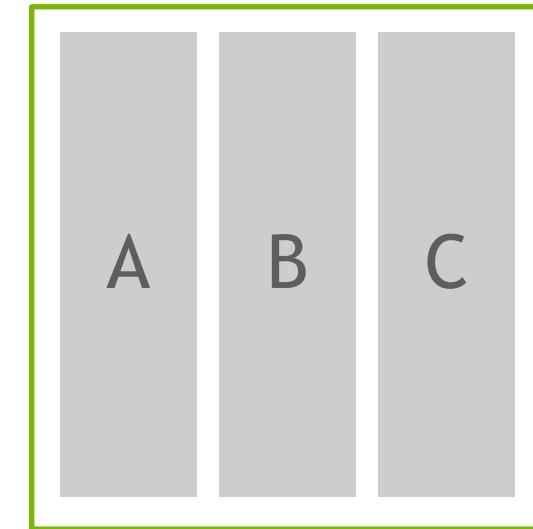
omni.ui

ui.HStack() & ui.Vstack()

```
with ui.VStack():  
    ui.Button("A")  
    ui.Button("B")  
    ui.Button("C")
```



```
with ui.HStack():  
    ui.Button("A")  
    ui.Button("B")  
    ui.Button("C")
```

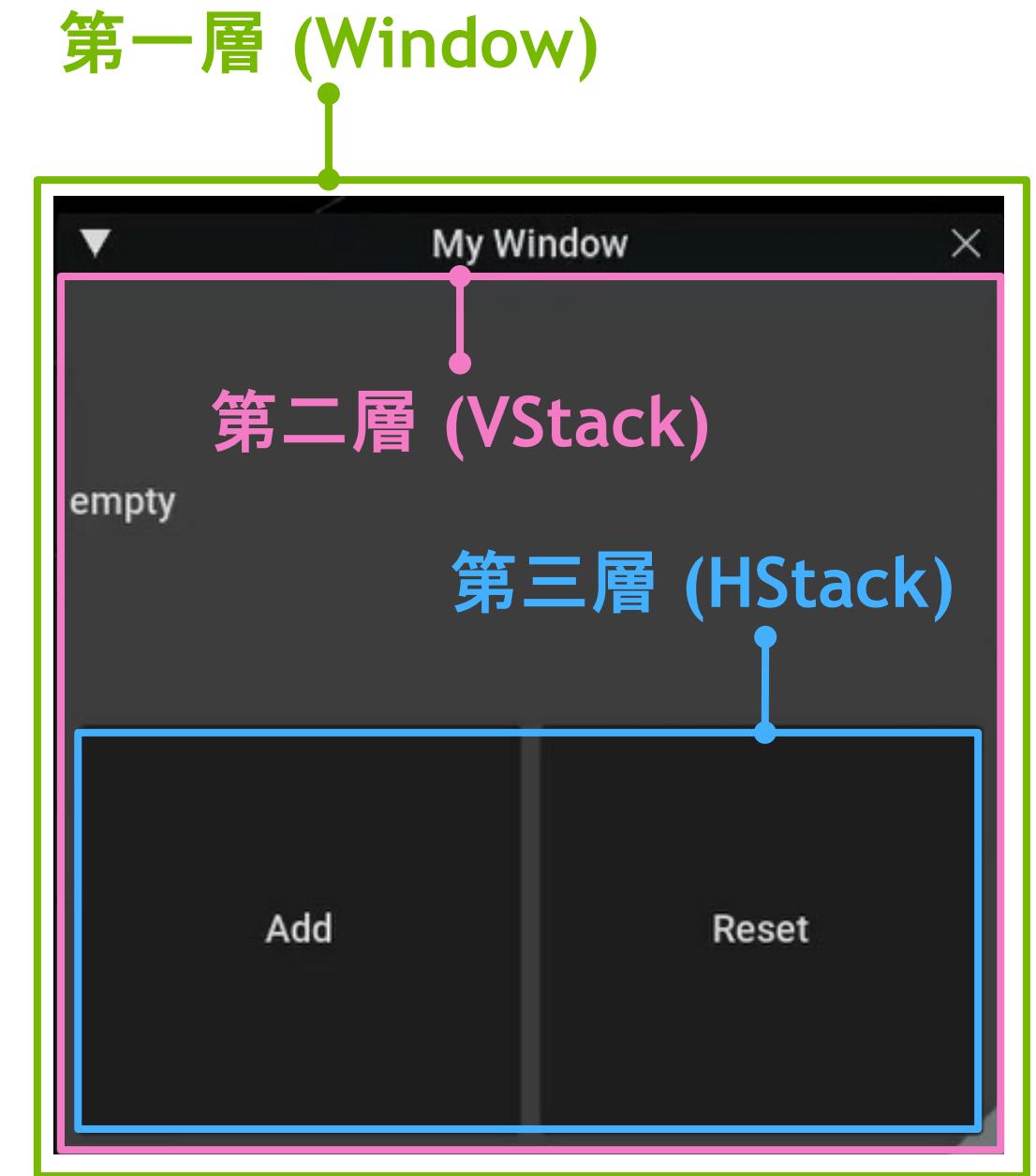


```
# A 2-Layer UI structure  
with ui.VStack():  
    ui.Button("A")  
    ui.Button("B")  
with ui.HStack():  
    ui.Button("C")  
    ui.Button("D")  
    ui.Button("E")
```

omni.ui

Building the User Interface

```
class OmniverseExtensionNavierstokesExtension(omni.ext.IExt):  
  
    def on_startup(self, ext_id):  
        print("[omniverse.extension.navierstokes] ... startup")  
  
        self._window = ui.Window("My Window", width=300, height=300)  
        with self._window.frame:  
            with ui.VStack():  
                label = ui.Label("empty")  
  
                with ui.HStack():  
                    ui.Button("Add")  
                    ui.Button("Reset")  
  
    def on_shutdown(self):  
        print("[omniverse.extension.navierstokes] ... shutdown")
```



omni.ui

More Components

Label

```
"Button": {"stack_direction"}  
"Button.Image": {"alignment"}  
"Button.Label": {"alignment"}  
padding  
margin  
Button.spacing
```

TOP_TO_BOTTOM ▾

CENTER ▾

CENTER ▾

0.0

0.0

0.0

FloatSlider

Mode	Value
Default	0.0
Min/Max	0.0
Hard Min/Max	1.0
With Style	0.0
Transparent bg	0.0
different slider color	0.0
Field & Slider	12.0
Filled Mode Slider	0.5

Drags connected to the color model

0.36886

```
with ui.HStack(spacing=SPACING):  
    color_model = ui.ColorWidget(0.125, 0.25, 0.5, width=0, height=0)  
    for item in color_model.get_item_children():  
        component = color_model.get_item_value_model(item)  
        ui.FloatDrag(component)
```

ComboBox connected to the color model.

0.36886

Current

R:0.000 G:0.000 B:0.000 A:1.000

H:0.000 S:0.000 V:0.000 A:1.000

#000000FF

omni.ext

Adding functions to your UI

```
def on_startup(self, ext_id):
    print("[omniverse.extension.navierstokes] omniverse extension navierstokes startup")

    self._count = 0

    self._window = ui.Window("My Window", width=300, height=300)
    with self._window.frame:
        with ui.VStack():
            label = ui.Label("")

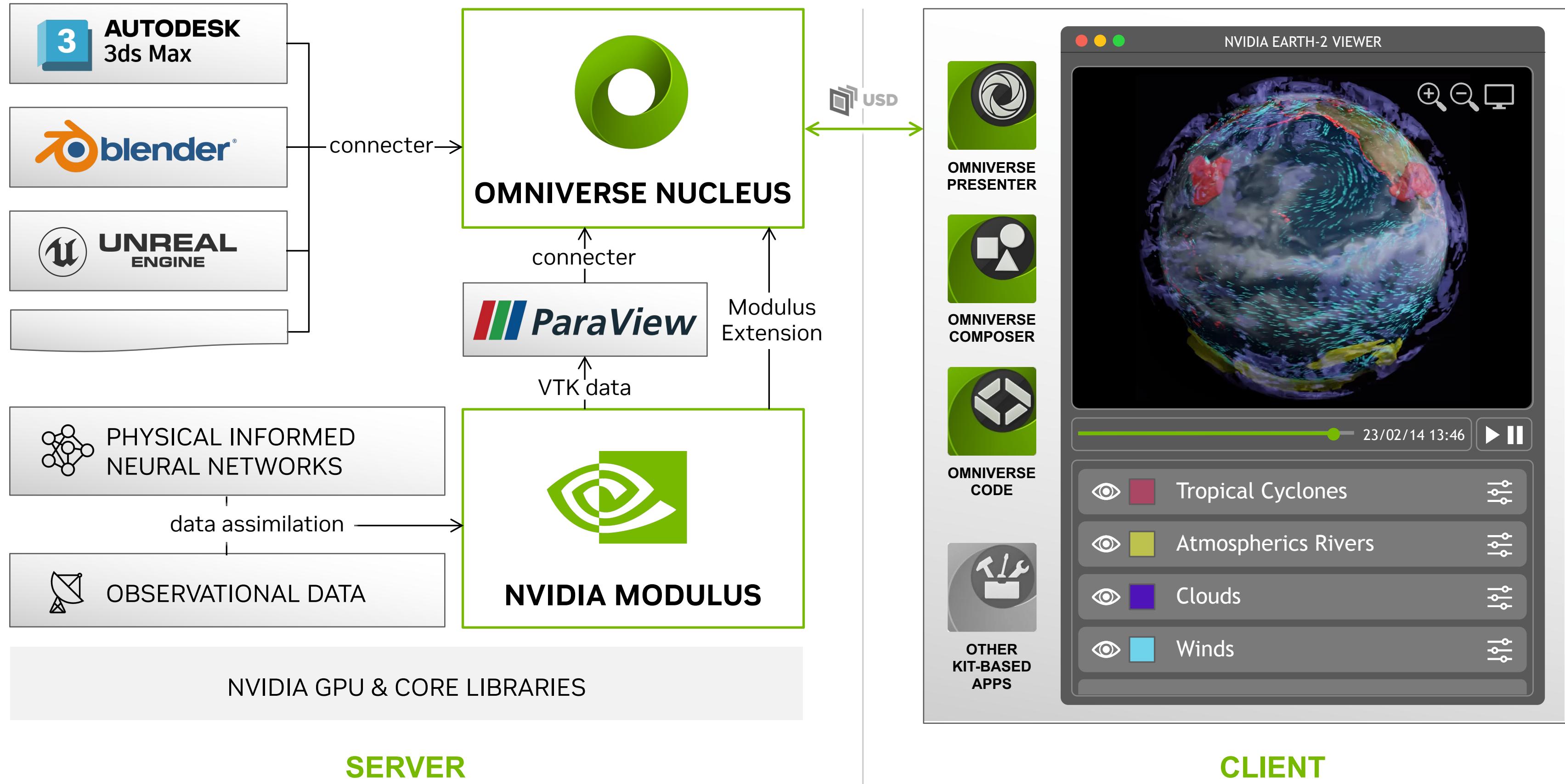
            def on_click():
                self._count += 1
                label.text = f"count: {self._count}"

            def on_reset():
                self._count = 0
                label.text = "empty"

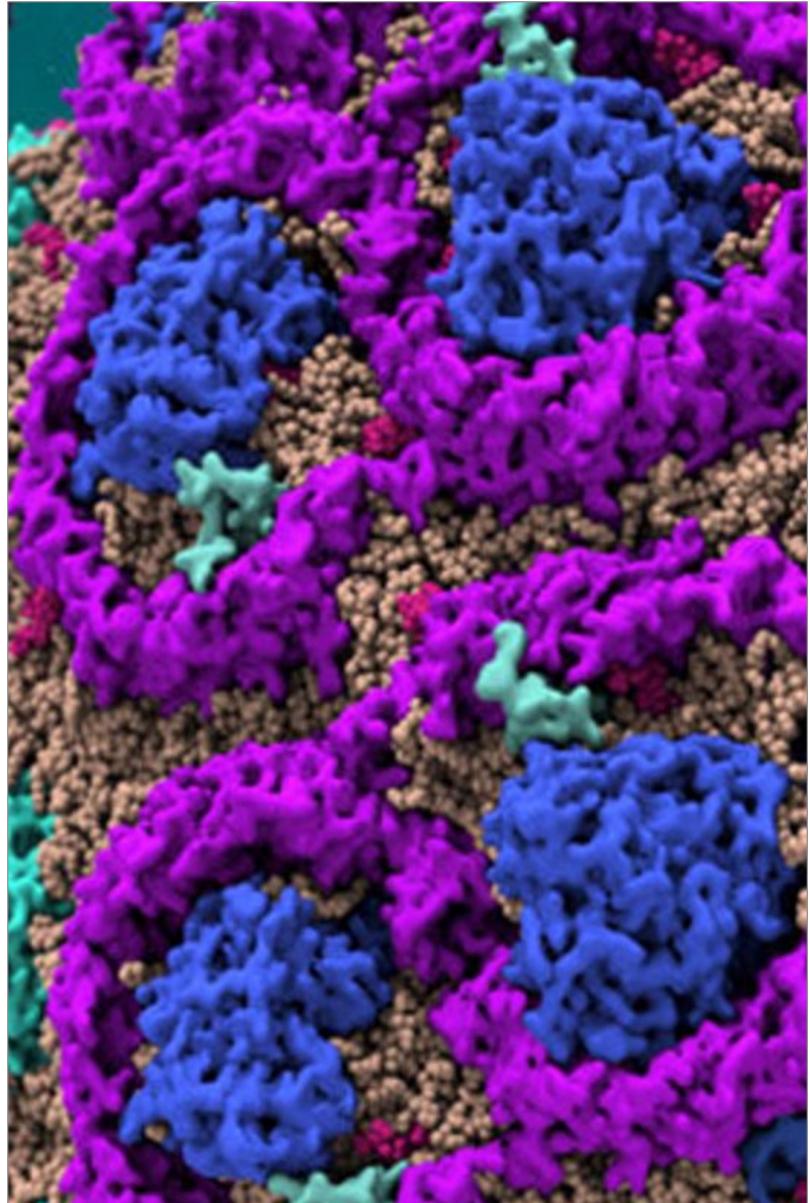
            on_reset()

            with ui.HStack():
                ui.Button("Add", clicked_fn=on_click)
                ui.Button("Reset", clicked_fn=on_reset)
```

EARTH-2 Reference Framework



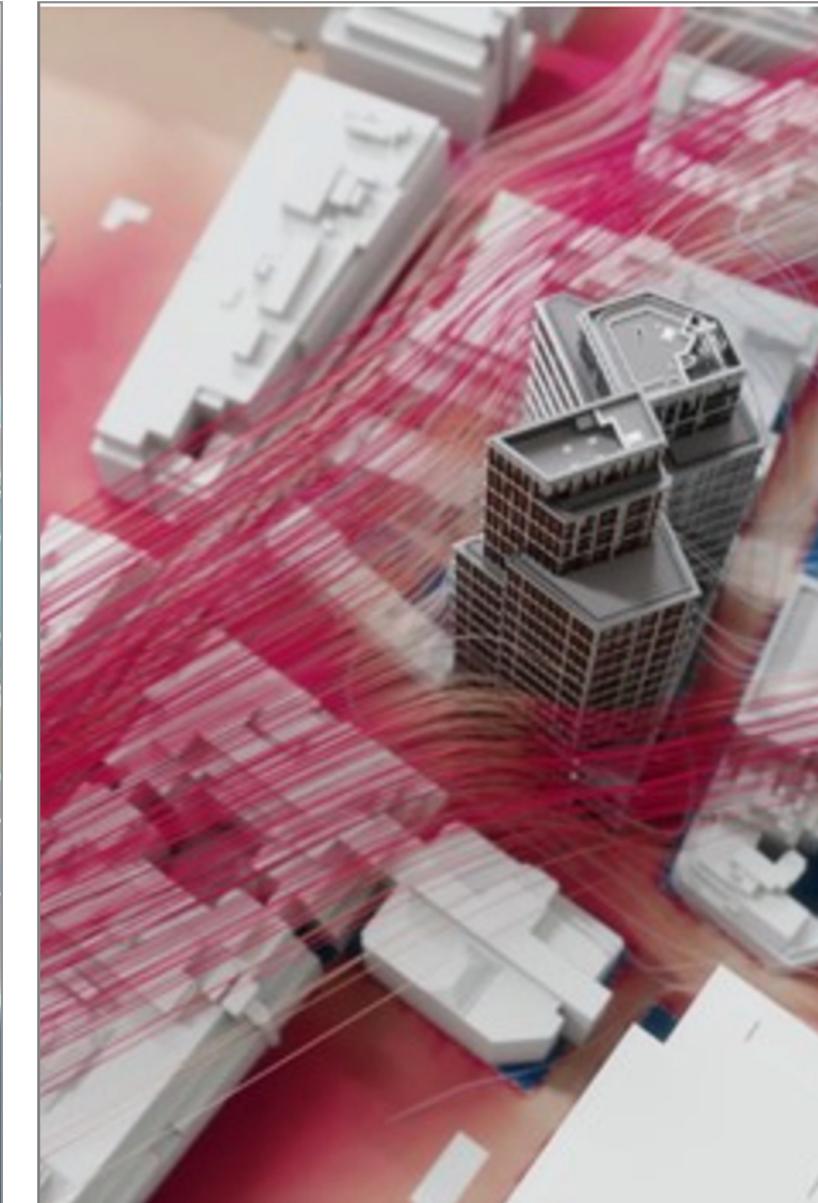
Digital Twins Can be Built at Every Scale



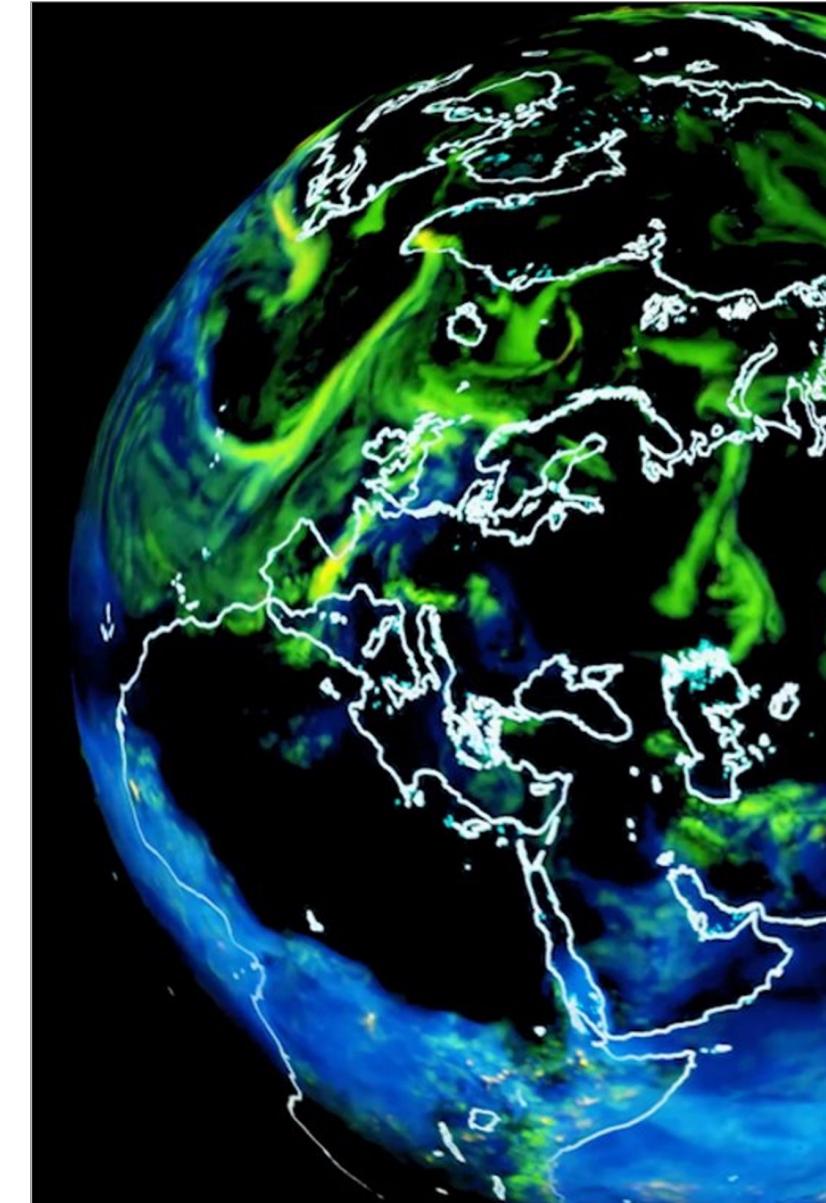
MOLECULAR



INDUSTRIAL



CITY

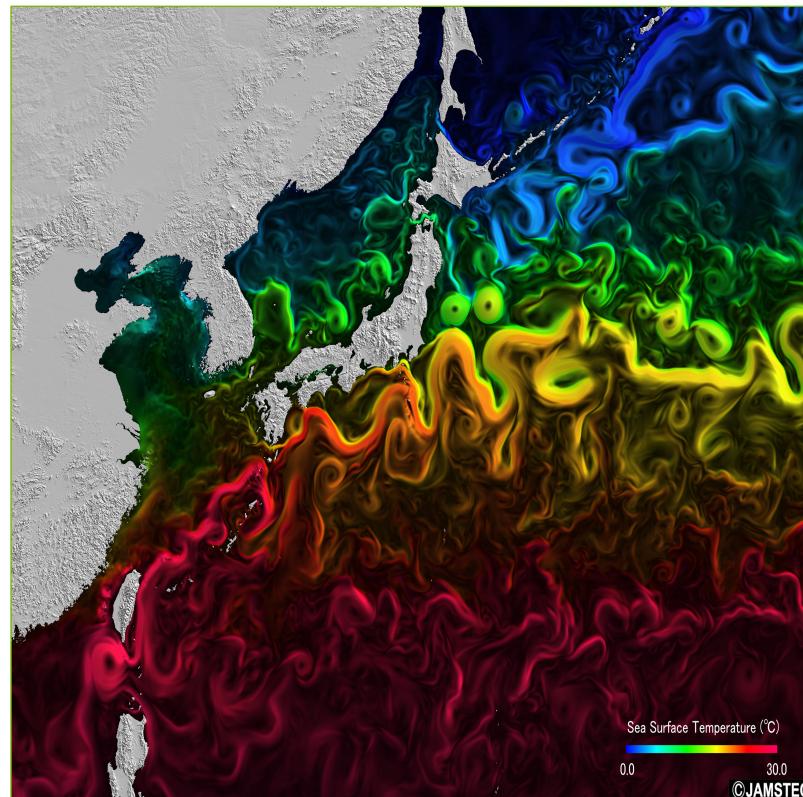


PLANETARY

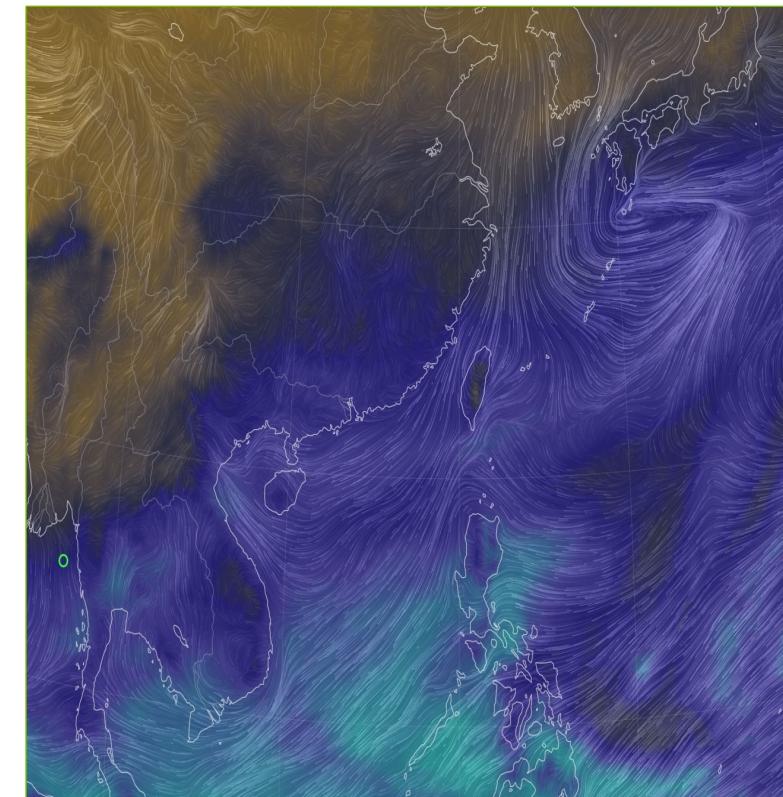
Model Coupling to Answer What-If Questions

Coupling fast data-driven models together enables us to explore their interactions

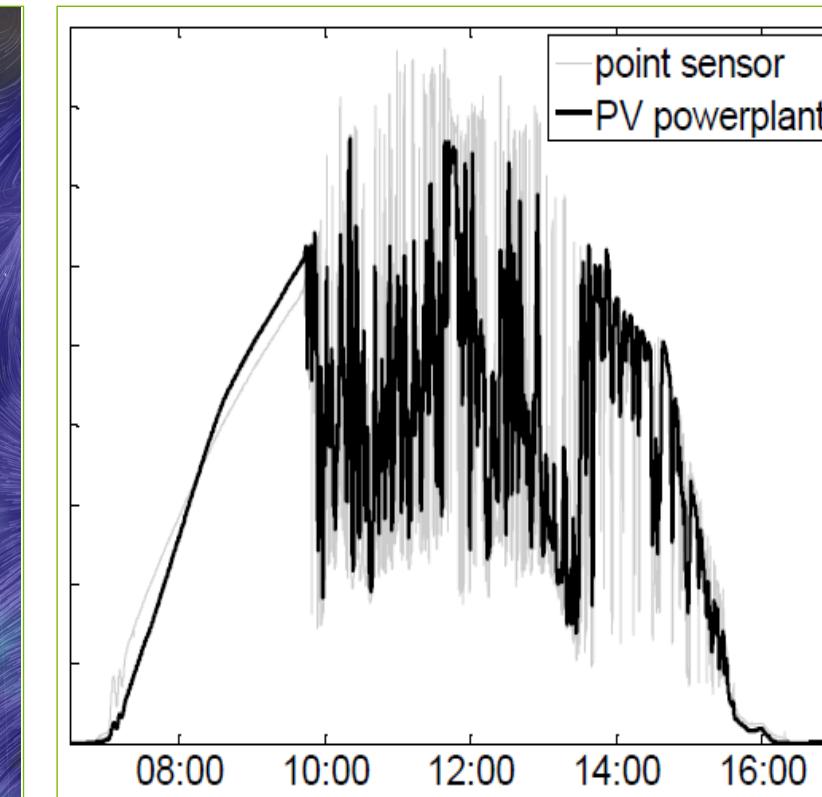
Climate Twin



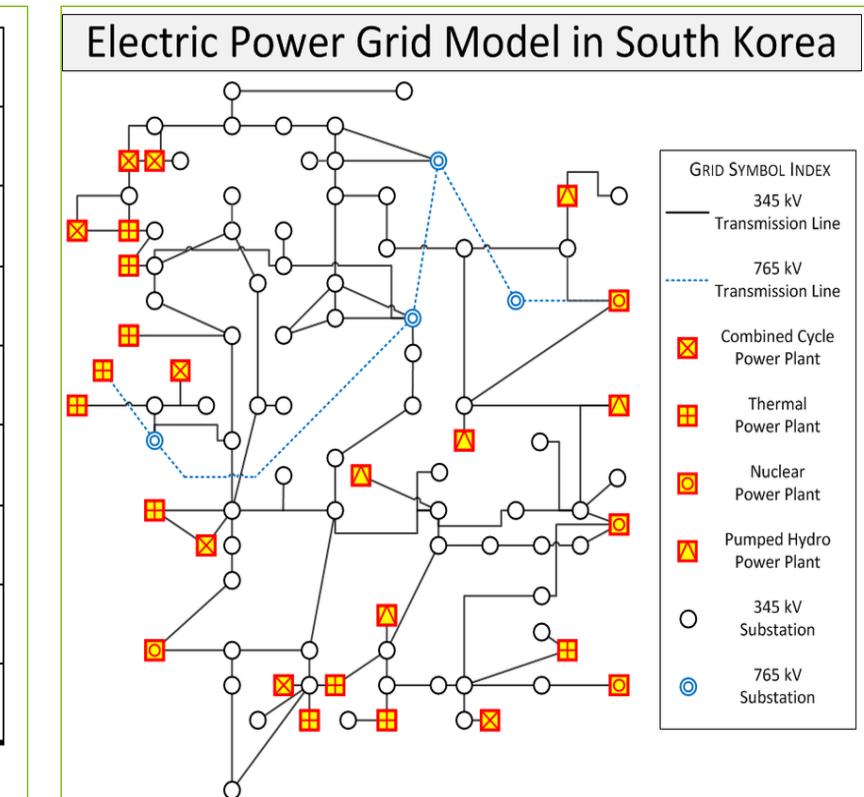
Weather Twin



Powerplant Twin



Electric Grid Model



<http://www.jamstec.go.jp/gallery/e/simulation/weather/002.html>

https://earth.nullschool.net/#current/wind/surface/level/overlay=total_precipitable_water/orthographic=-64.71,19.12,2322

<https://www.esig.energy/wiki-main-page/simulating-solar-power-plant-variability-a-review-of-current-methods/>

https://www.researchgate.net/figure/Overall-configuration-of-electric-power-grid-modelling_fig2_311217737

Simple Visualization

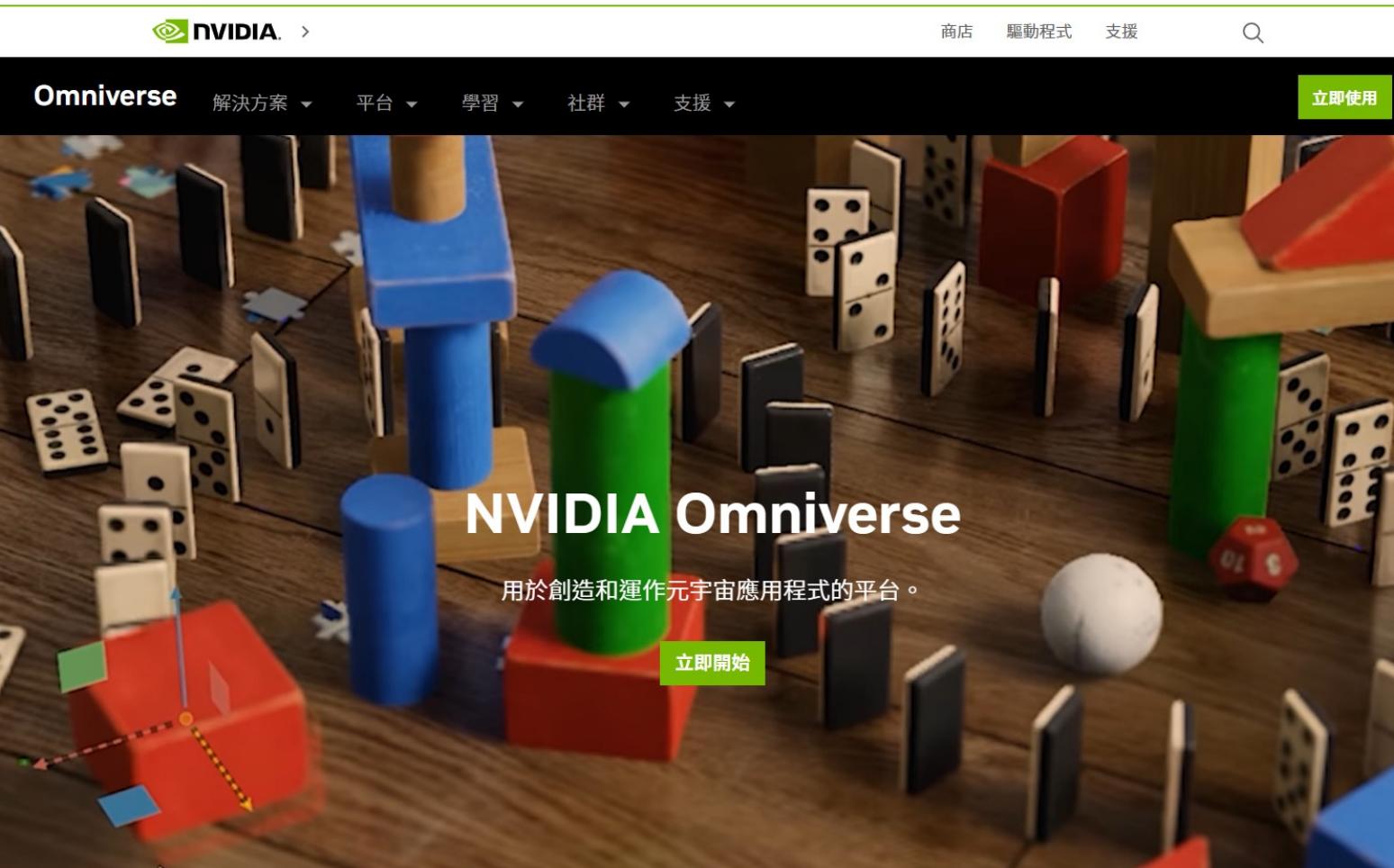


Get Started

Download & Installation for non-Enterprise customers

1. 到Omniverse官網點擊立即開始

<https://www.nvidia.com/zh-tw/omniverse/>



2. 選擇標準版，並點擊「免費下載」

註冊Nvidia開發者帳號即可免費使用

NVIDIA Omniverse 授權選擇		
標準版	企業版	
個人使用、本地部署		團隊使用、本地部署
特色	免費下載	免費試用
不限次數，可連接至業界領先的 3D 設計、CAD 工具及生態圈	✓	✓
可存取樣本應用程式，例如 Omniverse USD Composer 和 USD Presenter	✓	✓
能夠檢視、修改、並使用超過 500 個預先建立的擴充功能，並以 Python 原始碼形式，進而提供開發和構建自訂義解決方案的能力	✓	✓
2 個以上使用者的多人協作	✓	✓
將 Omniverse Nucleus 協作能力擴展至資料中心或雲端的能力	✓	✓

學習資源

Want to learn more?

Omniverse Document

The screenshot shows the homepage of the NVIDIA Omniverse Documentation. It features a large banner with the text "OMNIVERSE DOCUMENTATION" and "Start Developing in Omniverse Today". Below the banner, there's a "Read our Developer Guide" button. The main content area is divided into two sections: "GET STARTED" and "DEVELOP ON OMNIVERSE". Under "GET STARTED", there are links to "Platform Overview", "Launcher", "Install Guide", and "Omniverse Enterprise". Under "DEVELOP ON OMNIVERSE", there are links to "Omniverse Developer Guide", "Materials and Rendering", "Omniverse Utilities", "Omniverse Services", and "Omniverse Workflows". Each link includes a small thumbnail image and a brief description.

<https://docs.omniverse.nvidia.com/>

NVIDIA Deep Learning Institute

The screenshot shows the "All Self-Paced Courses" page of the NVIDIA Deep Learning Institute. The top navigation bar includes "Deep Learning Institute", "Self Paced Courses", "Instructor-Led Workshops", and "...". Below the navigation, there are tabs for "All Courses", "Free Courses", "Benefits", "Partners", and "Resources". The main content area is titled "All Self-Paced Courses" and features a "Share Graphics and Simulation Courses" button. There are three course cards displayed: "Synthetic Data Generation for Training Computer Vision Models" (Fundamentals, NEW), "Develop, Customize, and Publish in Omniverse With Extensions" (Graphics, NEW), and "Introduction to Robotic Simulations in Isaac Sim" (Graphics, NEW). Each card includes a thumbnail, a brief description, and a "View Course >" button.

<https://www.nvidia.com/en-us/training/online/> <https://www.youtube.com/@NVIDIAOmniverse>

Omniverse YouTube

The screenshot shows the NVIDIA Omniverse YouTube channel page. The channel has 1.89 million subscribers and 536 videos. The main content area features a video thumbnail for "NVIDIA Omniverse Foundational Technology Montage - SIGGRAPH 2023". Below the video, there are several other video thumbnails with titles like "NVIDIA Omniverse at GTC Spring 2023", "GTC 2023 Keynote with NVIDIA CEO Jensen Huang", "BMW Group Celebrates Opening the World's First...", and "Easily Scale and Unify Industrial Digitalization With...". Each thumbnail includes a play button and a timestamp.



Kit Solutions

Presenter, Composer, and Code



Start Workflows with Omniverse Foundation Applications

Fully Customizable and Extensible “Template” Applications



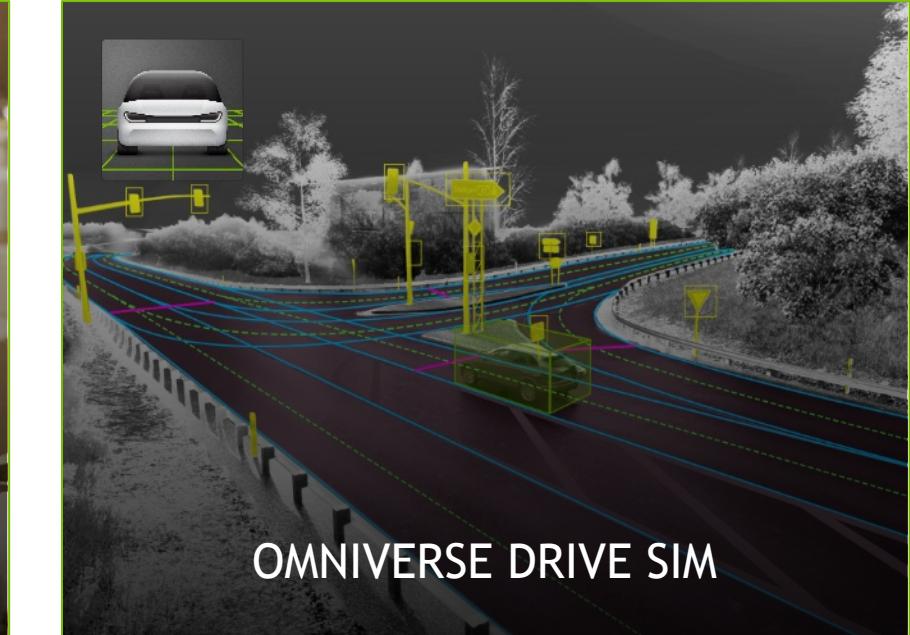
OMNIVERSE AUDIO2FACE



OMNIVERSE CODE



OMNIVERSE COMPOSER



OMNIVERSE DRIVE SIM



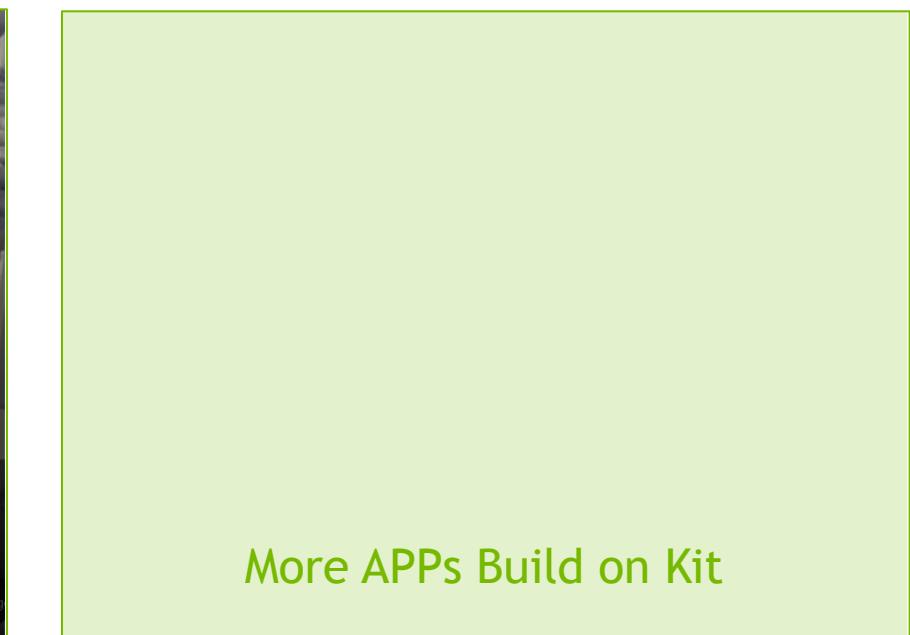
OMNIVERSE ISSAC SIM



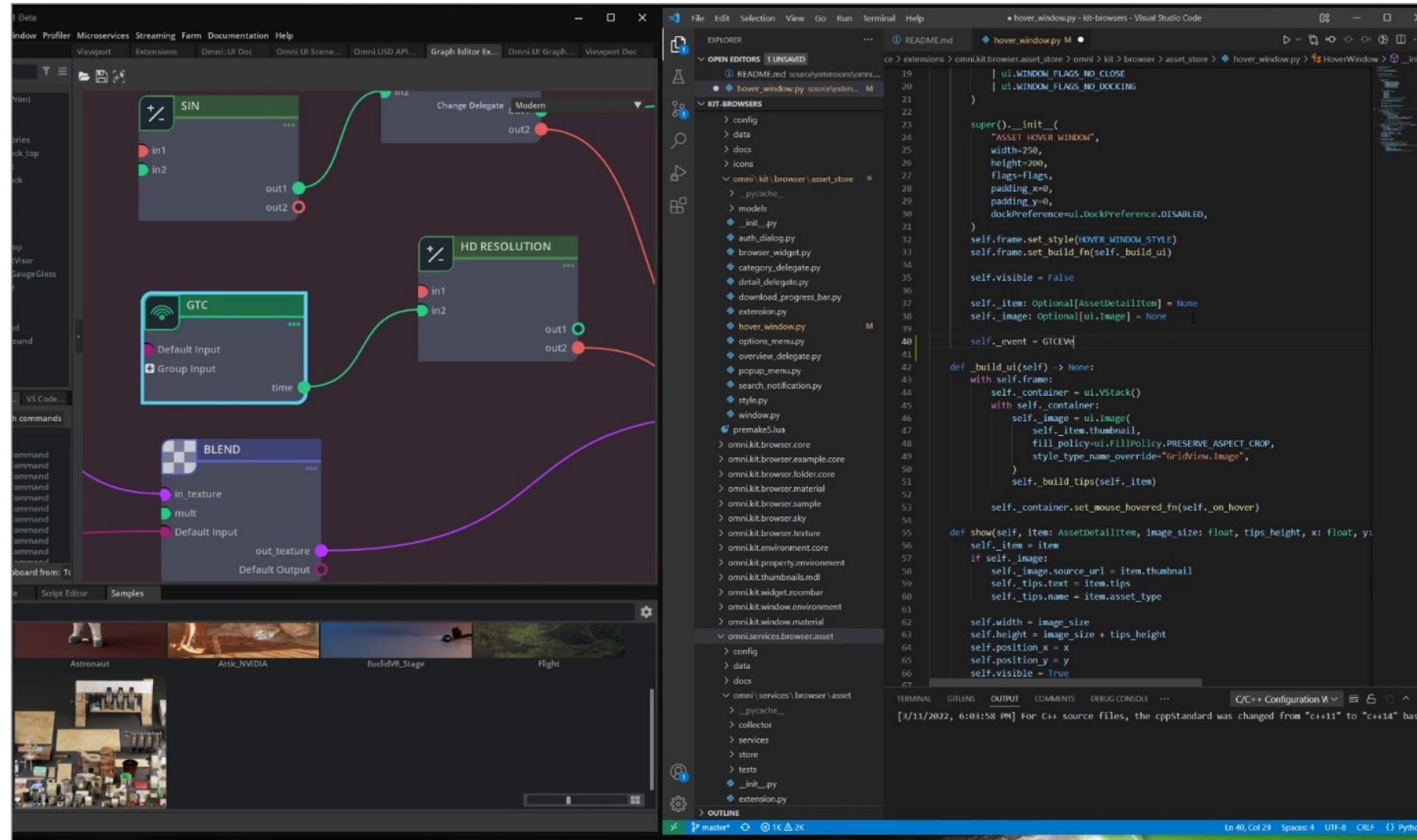
OMNIVERSE MACHINIMA



OMNIVERSE PRESENTER



More APPs Build on Kit



**OMNIVERSE
CODE**

Omniverse Code

Integrated Development Environment (IDE) to build Omniverse extensions, apps, microservices

- Simple to learn and use – easy user interface, interactive documentation, sample templates, and ‘Hello World’ exercises
- Helps developers and power users achieve maximum output with minimal code – free to use any of the 300+ NVIDIA-built Omniverse Extensions in their projects, so no need to start from scratch
- Easily package and publish to a private or public registry
- Includes Omniverse Kit runtime

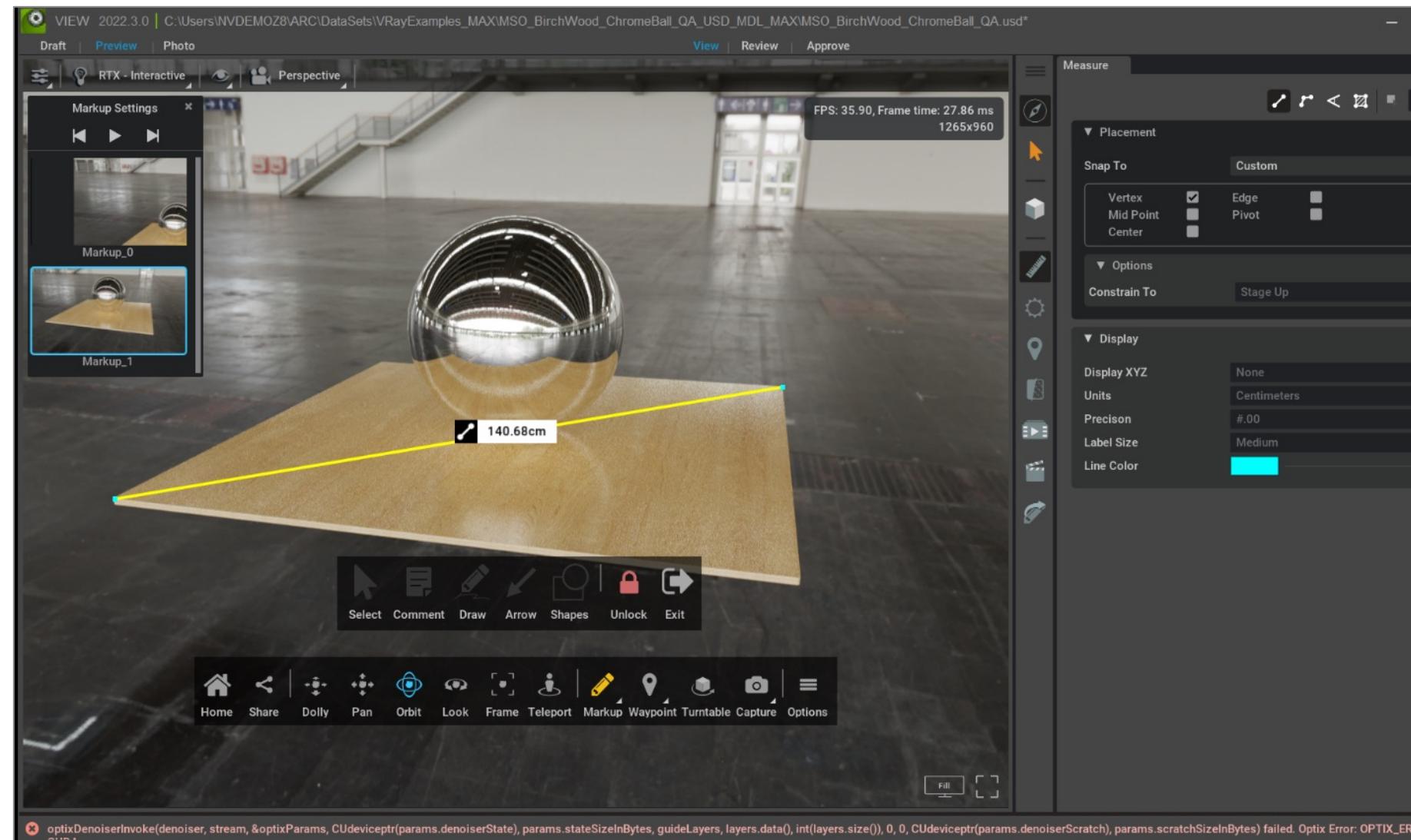


OMNIVERSE
COMPOSER

- Simplify world building with intuitive layout tools and physics
- Breathtaking photorealism with physically-accurate materials, and real time ray and path traced rendering
- Advanced simulation capabilities with NVIDIA PhysX 5, Flow, and Blast integration

Omniverse USD Composer (formerly Create)

Advanced USD Scene Composition, Lighting, Rendering



OMNIVERSE
PRESENTER

Omniverse USD Presenter (formerly View)

Immersive, true-to-reality visualization for reviews & approvals

- Simple to use tools for project reviews including camera waypoints, annotations, measure, and markup
- Ability to make minor environment or material iterations and edits to present multiple options
- Quick toggling between real-time ray traced and ultra-high-fidelity path-traced mode allows teams to visualize interactively