Monthly Commentary
BMO Global Innovators Fund

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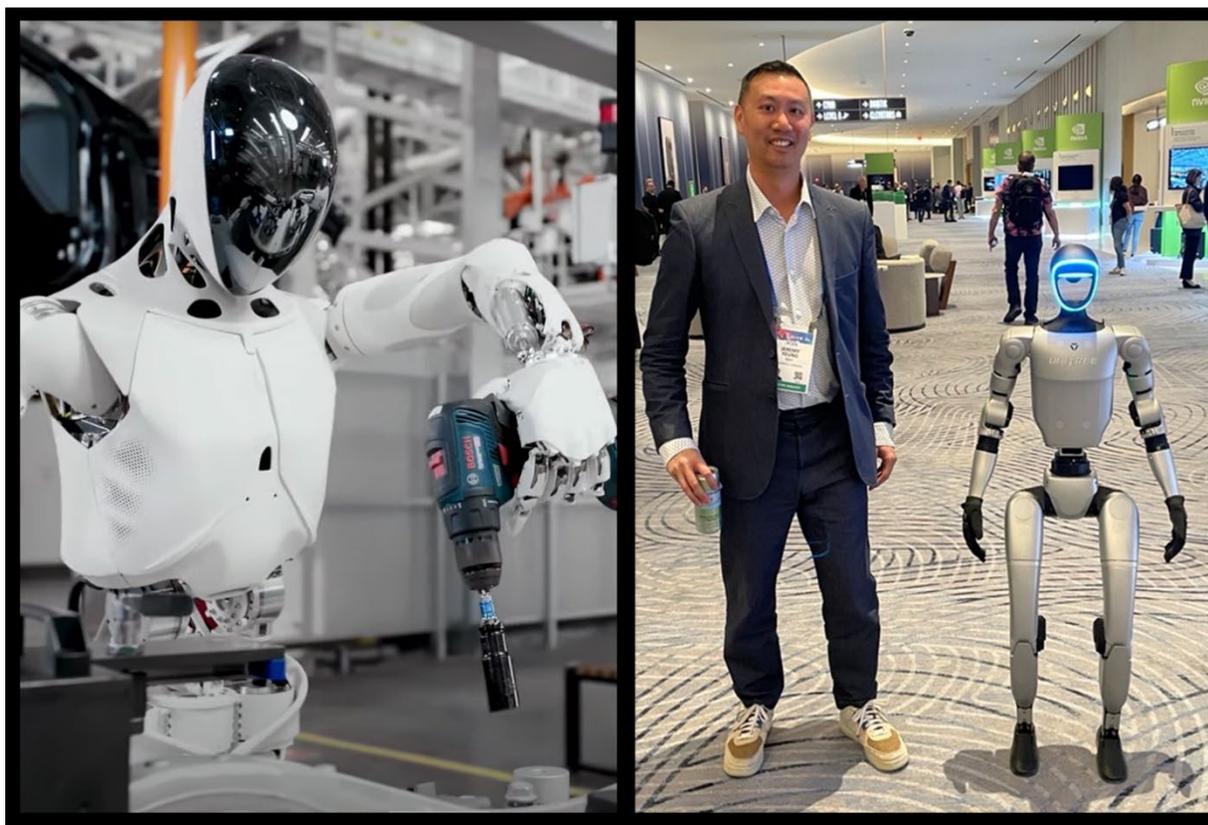Director & Portfolio Manager
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Figure 1- Images from The Consumer Electronic Show (CES) 2025. Source: Nvidia, Jeremy Yeung, BMO GAM, All logos and trademarks of other companies are the property of those respective companies.

The Red Carpet of Innovation

We are very excited about up-and-coming innovative products slated for release in 2025 and we highlight a few of these in this monthly.

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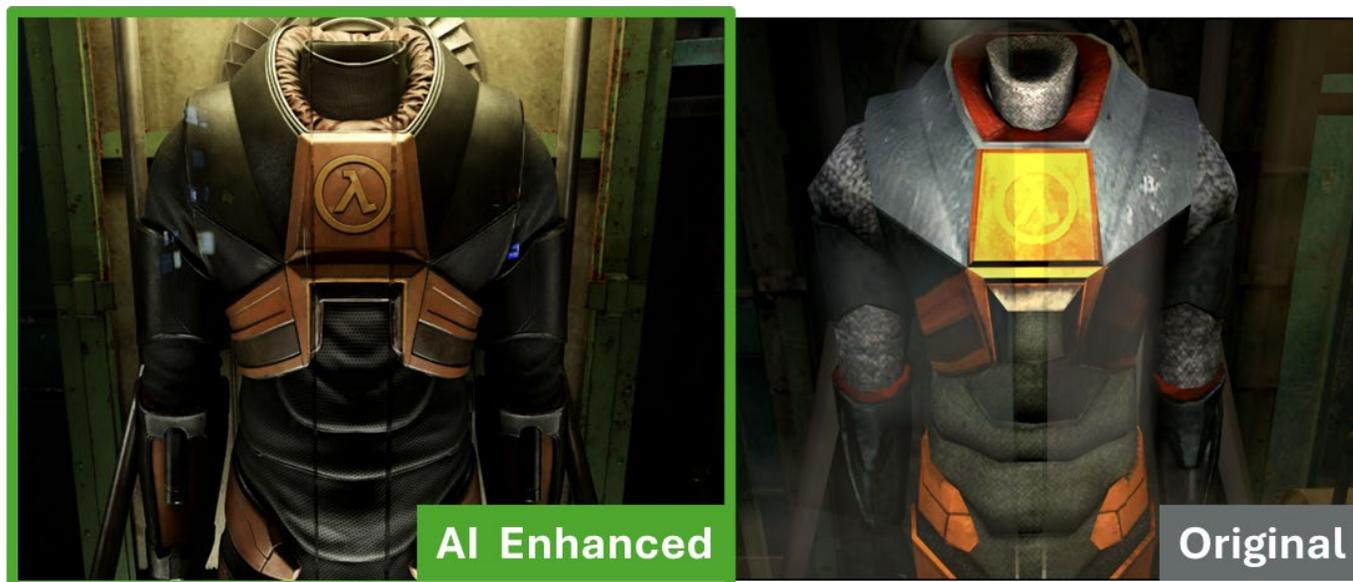
Enhancing Gaming with AI Rendering

Figure 2 - Half-Life 2 RTX Remix with NVIDIA's new groundbreaking Neural Shaders running on the RTX 5090. Source: NVIDIA, February 2025.

There are two interesting advancements in gaming thanks to developments in AI-based technology. The first is the ability to take an old game and use AI to make it look like a new game with minimal product development and reprogramming. The second development centers around advances in AI-based ray tracing, which takes a computationally intensive process and makes it faster producing rich visuals in real time. Both technologies complement each other – an older game can be given a new look that incorporates ray tracing to give it an outstanding makeover when run in a new environment. We outline each innovation below.

Old School Games get a New Remix

When a game called Half-Life 2 was released in 2004, it amazed audiences with its 3D realism and gameplay. This old-school legend has been given a new modern makeover thanks to NVIDIA's RTX Remix.

RTX Remix is an open software platform that allows non-programmers (people who want to modify a game without reprogramming it aka "modders") to recreate a classic game into a stunning remaster of that game using AI-generated, photo-realistic scenery and characters. Within the application, game modders can capture in-game assets such as characters, clothing, walls, and furniture and automatically enhance them by changing materials and adding high-resolution details automatically with generative AI tools. For example, the AI can automatically assess the composition of a knight's armor and incorporate these properties (e.g. gold, silver, wood, stone, etc.) into their proper respective materials so they look and act more realistically when exposed to an ambient light source.

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This dramatic transformation can be seen in **Figure 2 – Half-Life 2 RTX Remix** where the character's new armor is composed of materials and textures that properly reflect light. Many older games did not factor every light source due to computational complexity. Remix can identify these light sources and add them as active elements to the scene increasing the ambiance and realism of the modified game.

This platform leverages NVIDIA's new Omniverse software providing several collaborative tools. It not only improves existing game objects such as transforming objects into a more interesting highly detailed, high-definition shapes, but Omniverse gives game designers the added benefit of being able to see their proposed changes in real-time and as they would appear within the game. Objects can also easily be modified in every part of the game with one simple change. Once the new game is recoded, larger changes in environmental lighting can instantly be changed for the entire game to create a new lighting effect, mood, or ambiance. Details about the platform and videos from the Half Life Remix project are available at hl2rtx.com.

Real-Time Realism

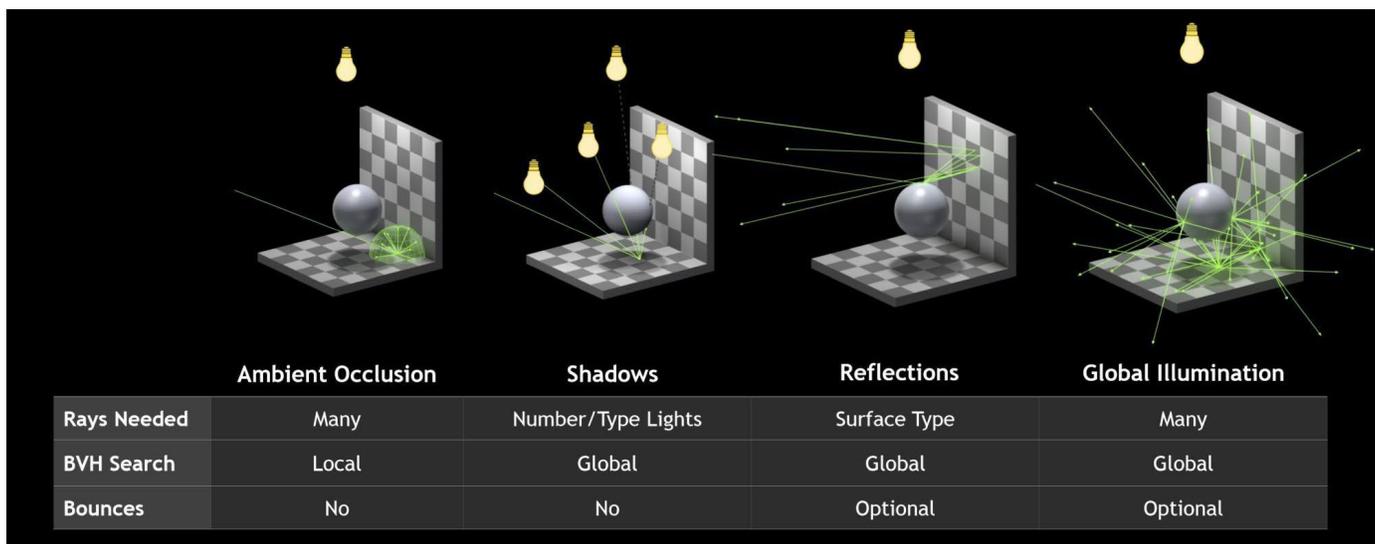|	Ambient Occlusion	Shadows	Reflections	Global Illumination
Rays Needed	Many	Number/Type Lights	Surface Type	Many
BVH Search	Local	Global	Global	Global
Bounces	No	No	Optional	Optional

Figure 3- Ray Tracing Examples Source: NVIDIA, February 2025.

The second interesting development is on the ray tracing side. Ray tracing, which is a graphics technique that generates very realistic scenes by simulating how lights bounce off surfaces (see **Figure 3**), provides beautiful and accurately lit scenes but is very compute intensive, expensive, and slow. As such, it has traditionally been used to render Pixar-like CGI movies offline and not in real-time video games despite numerous attempts over the years by the industry to develop software and graphics cards to support this feature[1].

One novel approach to solving this problem would be to take a small sample of a ray traced scene, which would look grainy and noisy, and then try to predict what the scene should look like if fully rendered. But if the ray tracing is not done properly and is too slow, the image can look worse than if not done at all.

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[1] DirectX, Microsoft's game engine, has supported ray tracing features since 2018 (DirectX 12).

NVIDIA's latest product offering (Deep Learning Super Sampling[2] – DLSS 4[3]) has solved this problem. They have developed a new version of ray tracing that uses AI to infer what the scene should look like rather than compute every step. It works by drawing a few light rays as you play and then guesses what the other parts of the picture should look like based on what it has learned. It can also go beyond the current image and try to predict potential frames that were not rendered. This can dramatically speed up future frames if the predicted frames properly guess what is to come e.g. which way the player will move.

In situations where it would have been impossible to ray trace the whole scene in real time, this technique can be highly performant. As NVIDIA CEO Jensen Huang said when he showcased this feature at CES[4], we now only need to compute 2 million pixels of a scene and the AI can predict the rest (31M = 94%) rendering at a much higher speeds than what was previously possible at that high resolution.

Overall this can boost frame rates by up to 8 times faster than traditional rendering. This enables a high-definition resolution (4K) game to run at an amazing 240 frames-per-second (FPS) while being fully ray-traced on NVIDIA's new high-end GeForce RTX 5090 graphics card. Additional features include better detail, stability of objects in motion, smoother frame transitions, and a more efficient use of memory on the card.

The industry is providing technical support to hundreds of games and applications with popular games showing huge improvements in performance as seen in the chart below, **Figure 4** - Performance Improvements using DLSS 4 (light green) vs not using DLSS (grey) - Source: NVIDIA.
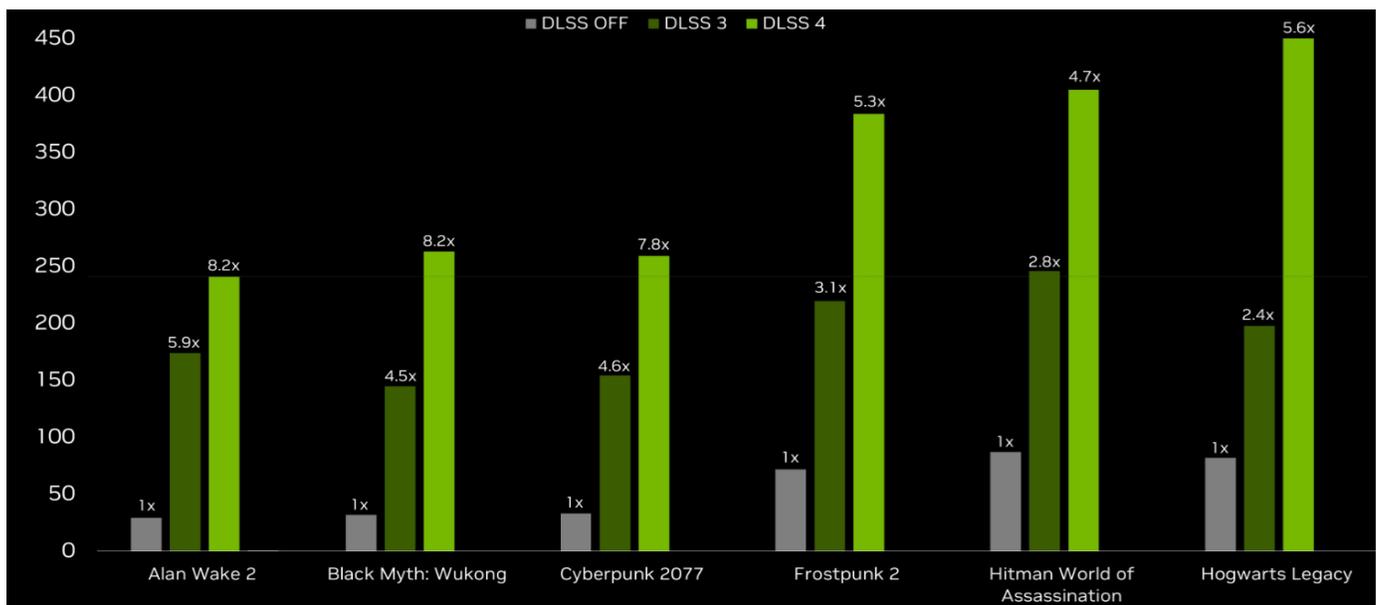

Figure 4 - Performance Improvements using DLSS 4 (light green) vs not using DLSS (grey) - Source: NVIDIA, February 2025.

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[2] Deep Learning Super Sampling (DLSS) is an image upscaling technology developed by Nvidia and exclusive to Nvidia graphics cards for real-time use in select video games. DLSS uses deep learning to upscale lower-resolution images to a higher-resolution for display on higher-resolution computer monitors.

[3] NVIDIA DLSS 4 Introduces Multi Frame Generation & Enhancements For All DLSS Technologies | GeForce News | NVIDIA

[4] CES (Consumer Electronics Show) is an annual trade show organized by the Consumer Technology Association (CTA). Held in January at the Las Vegas Convention Center in Winchester, Nevada, United States, the event typically hosts presentations of new products and technologies in the consumer electronics industry.

Figure 5 – High-resolution flight simulator images drawn at 2x speeds using ray tracing without visual degradation – Source: NVIDIA, February 2025.

THE AI TRANSITION - FROM DIGITAL TO PHYSICAL

Figure 6 - Realistic real-time simulation of a modern traffic scene used to train autonomous vehicles - Source: NVIDIA CES 2025

" The ChatGPT moment for robotics is just around the corner"
– Jensen Huang, CEO of NVIDIA, CES 2025

Automation in the physical world, e.g. automobiles, factory automation, humanoid robots, has proven to be a more challenging task than digital AI e.g. language models (ChatGPT) and image/video generation.

There are several reasons for this:

1) Digital information is easily accessed, understood, and described (e.g. this is a picture of a dog). Physical information is largely unavailable in usable formats and requires a "digital twin" to be created[5].

2) If a digital model generates an erroneous response, you will see bad text or an artifact in an image. If a 900-pound industrial robot is programmed incorrectly, it could damage or destroy your physical facilities.

3) We generally do not know how to instruct robots to perform a task under variant conditions. For example, we may need several instructions to pick up a beverage container depending on what it is e.g. grab a wine glass by the stem, a coffee mug by the handle, etc. Instructions can also dramatically change depending on the context of the situation and require real-time feedback loops e.g. adjust the glass to stop it from spilling.

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[5] A digital twin is a virtual (digital) representation of an object or system designed to reflect a physical object accurately ... and is updated from real-time data and uses simulation, machine learning, and reasoning to help make decisions. (Source: Whatls a Digital Twin? | IBM)

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Understandably, physical AI has lagged digital AI due to these constraints and difficulties. However we always believed that advances in the digital realm would eventually benefit physical AI problems and accelerate advancements in this space. It appears that this time has come. Jensen Huang, CEO of NVIDIA, at CES 2025 stated that "The ChatGPT moment for robotics is just around the corner". What did he mean?

We spent extensive time with NVIDIA engineers at CES (see cover image) to get a better understanding of the breakthroughs in physical AI training that should accelerate applications just as ChatGPT accelerated AI language models.

Engineers are using techniques and tricks they previously used to train ChatGPT to now train physical AI systems. Instead of text-based tokens (the machine equivalent of words), they are training these systems using action-based tokens. Instead of deriving an understanding of language by reading text, they are deriving an understanding of our world (geospatial, gravity, physics, friction, etc.) using video as an input. NVIDIA's Cosmos[6] took 20 million hours of video of physically dynamic actions – movements, walking, etc. – to teach the AI about our world and its physical properties. Omniverse is the complement to Cosmos. Whereas Cosmos generates the ground truth of the physics of our world, Omniverse lets an AI explore a physical world in a digital simulation and easily adjust the world for outside scenarios (e.g. snow or construction for a self-driving car). It can create new synthetic data based on these scenarios to supplement the training of the AI without the need of a physical equivalent.

We believe that the training of physical AI will become much easier, faster and more accurate with these new software tools, unlocking huge cognitive intelligence gains in robotics, manufacturing, and automotive applications. As NVIDIA's CEO said in his keynote, manufacturing is a multi-trillion-dollar footprint, factories are to become software defined, and digital robots such as Kion will need a digital simulation before physical deployment.

AI ecosystem benefits do not end at training. Once trained, physical AI devices will need their own local computer to be able to use the AI in real-time (inference). This will create a new market for a "third computer" that powers this local machine intelligence in additional to digital "factories" where industrial applications will be trained.

Developments of the latest autonomous, electrical, and infotainment features of the automotive supply chain are becoming a regular showcase at CES[4]. We had an opportunity to talk to Valeo, a leading global automotive supplier, at the Consumer Electronic Show (CES). They are an excellent example of this trend toward the "third computer" and software-defined automobile. Next generation cars have been called a "server on wheels" to emphasize the enormous amount of compute required to pilot autonomous driving vehicles.

We are still in the early phases of adoption but AI-based, real-world simulation systems such as Cosmos and Omniverse should accelerate AI deployment in physical systems and provide better results and safety outcomes.

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[6] NVIDIA Cosmos is a cloud-based platform that helps developers build and deploy AI for robots and autonomous vehicles, using "world foundation models" to generate synthetic training data. NVIDIA unveiled Cosmos at the 2025 CES conference in Las Vegas, alongside several other product launches.

Deep Interest in Chinese AI post DeepSeek

For the past two years, China was considered a laggard in terms of developing and deploying AI models, through no fault of its own but rather due to lack of access to the latest AI-based compute infrastructure. As we wrote in our last monthly, "A Deep Dive on Deep Seek", this narrative has completely changed given the incredible results generated from the Chinese-developed AI DeepSeek model.

This surge in new artificial intelligence (AI) tools from China has instigated a frenzy in the country's stock market, dramatically boosting tech company valuations. Leading the charge is Alibaba Group Holding Ltd., whose latest AI model promises to rival DeepSeek's R1 while utilizing significantly less data. This rollout, along with new offerings from Tencent and Kuaishou Technology, has spurred investor confidence, with Alibaba's stock recently jumping in Hong Kong and propelling a Chinese tech index to its highest level since 2021. The recent advancements underscore Alibaba's rising influence in AI, as the company aims to keep pace with or surpass competitors like OpenAI. By pledging to invest a substantial sum in AI infrastructure over the coming years, Alibaba signals its determination to leverage AI as a key growth driver. This has benefited our exposures to China-based technology investments.

Despite lingering questions about the long-term profitability of these technologies, Chinese commitments to AI research and infrastructure, as demonstrated by DeepSeek's successful launch of a highly efficient AI model, have generated enthusiasm among Chinese investors as seen by the recent strong performance of their domestic AI companies.

These developments follow a pro-AI position announced by the Chinese government during the National People's Congress, reinforcing investor optimism in the domestic AI sector's growth prospects. China's ambition to be a technological frontrunner is mirrored in the nation's legislative and economic initiatives, signaling substantial governmental support for AI and innovation. During the National People's Congress, discussions centered on expanding AI applications and supporting entrepreneurship through financial initiatives like a massive state-backed startup guidance fund. This enthusiasm for AI was further emphasized by regional leaders advocating for investments in related sectors such as smart manufacturing and connected vehicles. As a result, there is a growing re-investment in the tech sector, previously hindered by regulatory crackdowns, which is now experiencing renewed vigor under a more supportive political climate.

Fund Codes & Fees – BMO Global Innovators Fund

Series	Fund Code/Ticker	MER (%) *
Advisor FE / US$ FE	BM099164 / BM079164 (USD)	1.93
T6 FE	BM034269	2.01
Series F / US$	BM095164 / BM040164 (USD)	1.01
Series F6	BM036164	1.03
ETF - BMO Global Innovators Fund Active ETF Series	BGIN	1.05

*Annual Management Expense Ratios (MERs) are as of March 31, 2024.

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