NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

增强现实,虚拟现实, 元宇宙 – AR VR and Metaverse

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Agenda

20 April 技术创新 - Technology Innovation -Construction

12th May 人工智能和机器学习 - AI and machine learning

2nd June科学研究论文Scientific Research Paper – IMRAD

9th June 增强现实,虚拟现实, 元宇宙 – AR VR and Metaverse

Video

【虚拟现实与增强现实在元宇宙中的应用】
https://www.bilibili.com/video/BV1ED421E793/?share_source=copy_web

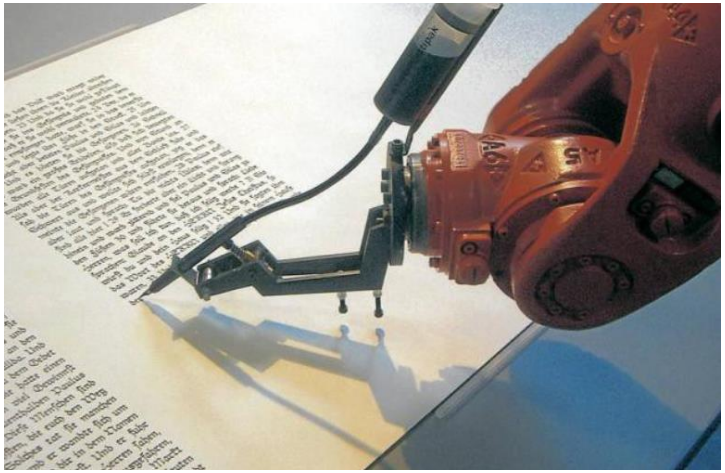
【算力时代 | VR、AR、MR你分得清吗？“元宇宙”属于哪一挂？划个重点，秒懂！】
https://www.bilibili.com/video/BV1J3411c7HS/?share_source=copy_web

【元宇宙入门丨如何设计虚拟和增强现实外网课程丨1.3 AR、VR、MR的区别】
https://www.bilibili.com/video/BV1aP4y137AS/?share_source=copy_web

1. How do users experience the integration of AR and VR within the Metaverse, and what are their emotional responses to immersive environments?
2. In what ways can AR and VR contribute to the sense of presence and social interaction within the Metaverse?
3. How do individuals' perceptions of reality shift after prolonged exposure to AR and VR environments?
4. What are the ethical implications of creating and experiencing highly realistic avatars within the Metaverse?
5. How do AR and VR affect the learning and educational outcomes in virtual spaces?
6. What are the potential risks and benefits of conducting therapy using AR and VR in the Metaverse?
7. How do different cultural backgrounds influence the way users interact with and perceive the Metaverse?
8. What are the barriers to widespread adoption of AR and VR technologies in everyday life and in the Metaverse?
9. How do users navigate issues of privacy and data security within AR, VR, and Metaverse platforms?
10. How do AR and VR in the Metaverse influence the development of digital economies and the nature of work?

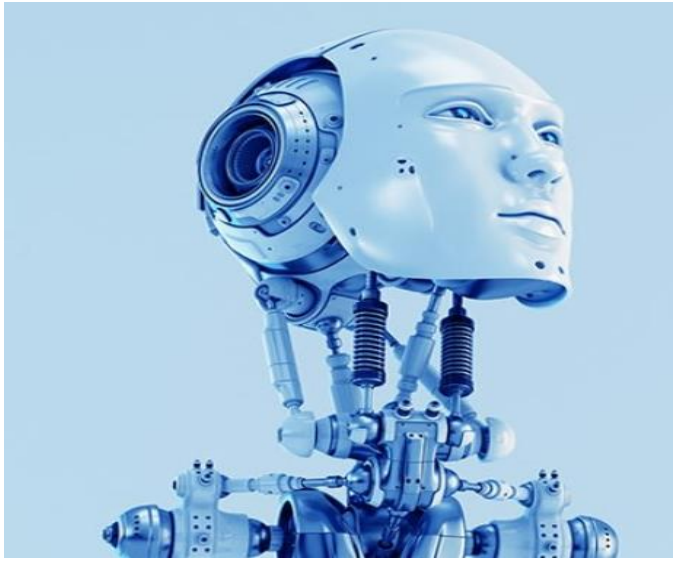
1. 用户如何体验在元宇宙中融合AR和VR，并且他们对沉浸式环境有何情感反应？
2. AR和VR如何有助于元宇宙中的存在感和社交互动？
3. 长时间暴露于AR和VR环境后，个人对现实的感知如何改变？
4. 在元宇宙中创建和体验高度真实化的虚拟人物有哪些伦理影响？
5. AR和VR如何影响虚拟空间中的学习和教育成果？
6. 在元宇宙中使用AR和VR进行治疗的潜在风险和益处是什么？
7. 不同的文化背景如何影响用户与元宇宙的互动和感知？
8. 在日常生活和元宇宙中广泛采用AR和VR技术的障碍是什么？
9. 用户如何在AR、VR和元宇宙平台上处理隐私和数据安全问题？
10. AR和VR在元宇宙中如何影响数字经济的发展和工作性质？

Will machine replace human



Evolution

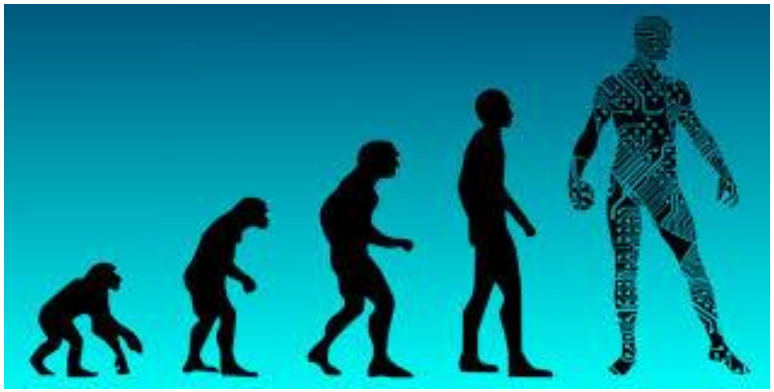
- Steam Engine
- Car
- Computer
- Internet
- AI?



Evolution: Red flag traffic laws

Secondly, one of such persons, while any locomotive is in motion, shall precede such locomotive on foot by not less than sixty yards, and shall carry a red flag constantly displayed.

AR, VR and AI
03 August 2019



https://youtu.be/Iigd1f5tMjU

https://www.youtube.com/watch?v=lZfnsvIqsfg&feature=youtu.be

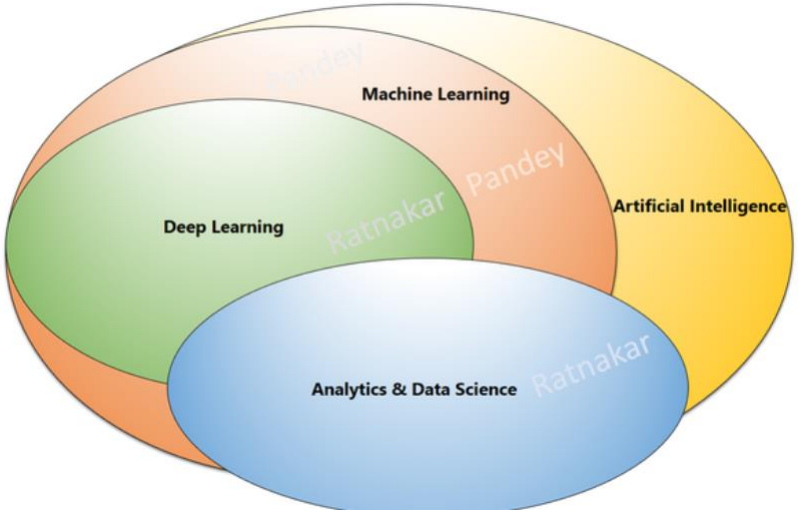
Introduction to AR, VR and AI

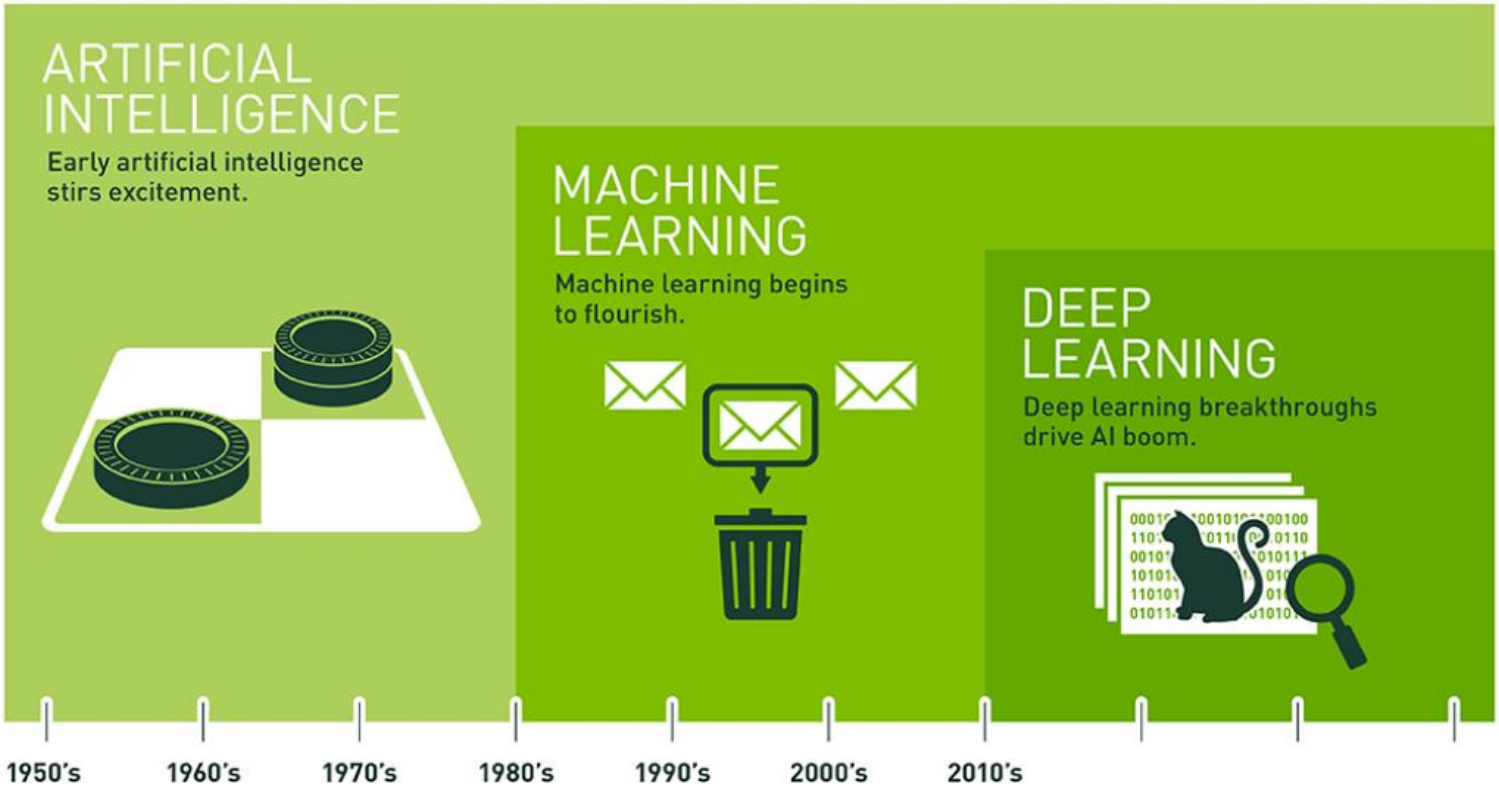
1. AI
2. Overview of AR and VR
3. Industry uses of AR and VR
4. Commonly used Hardware and Software
5. AR, VR and AI integration
6. Intro to Unreal Engine

1. Artificial Intelligence

Data Analyst, Data Science, AI

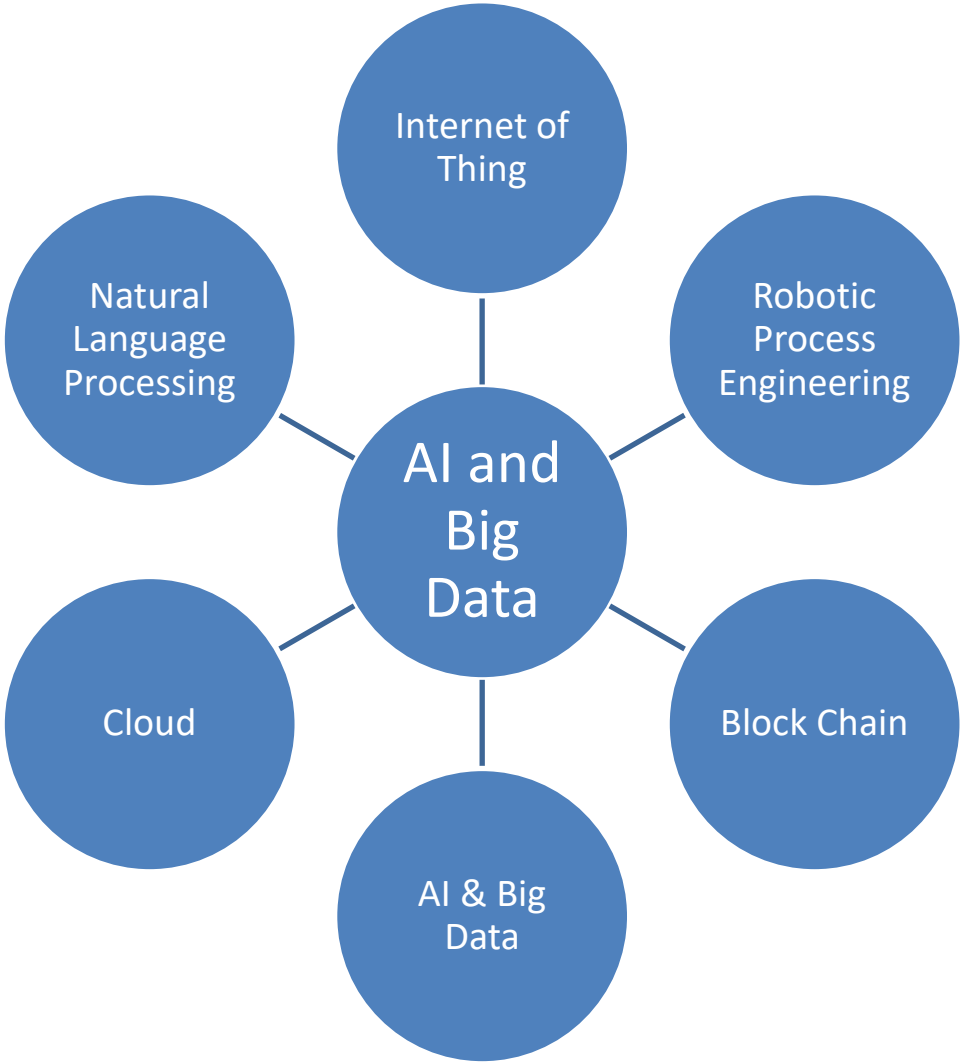
- Data Analyst – Use Model
- Data Science – Create Model
- AI – Automated DA and DS using Machine





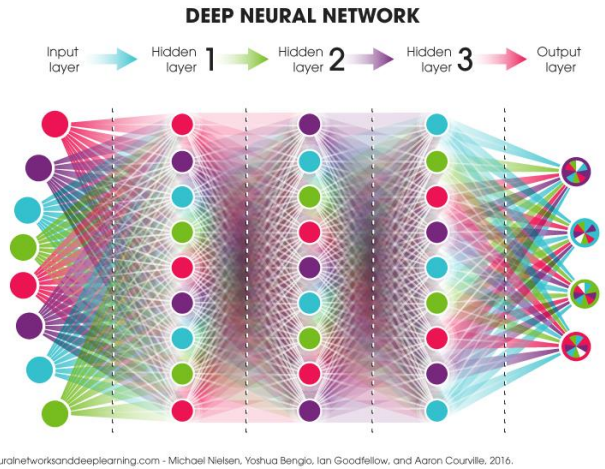
https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

AI and Big Data



AI: Neural Network

- Started in 1943 by Warren and Walter
- NN : Modelled on the human brain
- Hundreds of variants (RNN, LSTM, CNN, MLP….)
- Applications: Handwriting, face, speech recognition



Source: https://blog.ttro.com/wp-content/uploads/2017/01/TB010-Deep-Neural-Network.jpg

Brains and Traditional Computers

Brain

- 200 billion neurons, 32 trillion synapses
- Processing speed: 100 Hz
- Parallel
- Inputs are approximately summed

Computer

- 1 billion bytes RAM but trillions of bytes on disk
- Processing speed: 10^9 Hz
- Serial
- Activation Function : Sum

2018: Deep Learning, Big Data, Distributed Computation

- Deep Learning (LSTM by TensorFlow)
- Big Data (Hadoop)
- Large Distributed Computation (Spark)

27th June 2019

A humanoid robot working side by side with employees at a factory in Japan. A report by UK-based research firm Oxford Economics says about one in three robots worldwide is in China, which accounts for around one-fifth of the world's total stock. But Japan – formerly the world leader in automation – has reduced its active stock of robots by around 100,000 units since 2000, it says. PHOTO: REUTERS

Robots to wipe out 20m jobs by 2030: Study

Lead author says Singapore, with a supportive regulatory structure, is well-placed to benefit from new robotics

Chong Koh Ping
Technology Correspondent

Up to 20 million manufacturing jobs will be lost globally to robots by 2030, a new study has found.

And the displacement of jobs will not be evenly spread around the world, or within countries, according to the study published yesterday by Oxford Economics, a UK-based research firm.

Lower-skilled regions are much more vulnerable to the job losses, it said after surveying seven economies – the United States, Germany, Britain, France, Japan, South Korea and Australia.

Since 2000, some 1.7 million manufacturing jobs have been lost to robots, including around 400,000 in Europe, 260,000 in the US, and 550,000 in China.

The study noted that the rate at which robots were replacing jobs had been rising steadily, with the global stock of industrial robots more than doubling since 2010.

"The robotics revolution is rapidly accelerating... The result will transform what robots can do over coming decades – and their ability to take over tasks that humans do now," said Mr James Lambert, associate director at Oxford Economics and a lead author of the study. He added: "The number of robots is also set to multiply rapidly. We expect the number in use to reach 20 million by 2030 – about 10 times the number now."

20m
Number of robots expected to be in use by 2030 – about 10 times the number now.

1.7m
Number of manufacturing jobs that have already been lost to robots since 2000, including around 400,000 in Europe, 260,000 in the US, and 550,000 in China.

14m
Number of industrial robots in use in China by 2030, dwarfing the rest of the world's stock of them.

The study noted the centre of gravity in the world's robot stock has shifted towards new manufacturers, mainly in China, Korea, and Taiwan but also to India, Brazil and Poland. About one in three robots worldwide is in China, which accounts for around one-fifth of the world's total stock, up from just 0.1 per cent in 2000. By 2030, China could have as many as 14 million industrial robots, dwarfing the rest of the world's stock of them.

In contrast, the combined robot inventory of the US and Europe has fallen to under 40 per cent of the global share from its peak of close to 50 per cent in 2009.

And Japan – formerly the world leader in automation – has reduced its active stock of robots by around 100,000 units since 2000.

The study predicted that the use of robots in services industries would accelerate sharply in the next five years. This would particularly affect the logistics sector but should spread to other industries, including healthcare and retail.

"The implications are huge. We will see a significant boost to productivity and economic growth and some new types of job we can't even yet foresee," said Mr Lambert.

The report predicted that a 30 per cent rise in robot installations above its baseline forecast for 2030 would add US$4.9 trillion (S$6.6 trillion) to the global economy that year, equivalent to an economy greater than the projected size of Germany's in that year.

"But at the same time business models will be disrupted or upturned and millions of existing workers will be displaced – and the impact will affect lower-skilled and poorer economies... most," he cautioned. "Governments, policymakers, business and individuals need to think hard now about this wave of tech-driven change and we all need to prepare for what amounts to a new industrial revolution."

When asked about the impact of robots in Singapore, Mr Lambert said it was well positioned to benefit from this new generation of robotics as it has a modern and upgradeable infrastructure, a supportive regulatory framework and a strong investment environment.

"Those workers in Singapore that are displaced by technology will have to adapt their skills to the evolving demands of the future economy but the government already has put in place schemes to help to retrain workers displaced by technology," he said.

"Singapore also has an ageing population (more so than most) and restraints on inward migration, so robots may be particularly helpful in keeping the economy growing."

kohping@sph.com.sg

Man or machine: Who's really driving your portfolio? Feb 23 2019

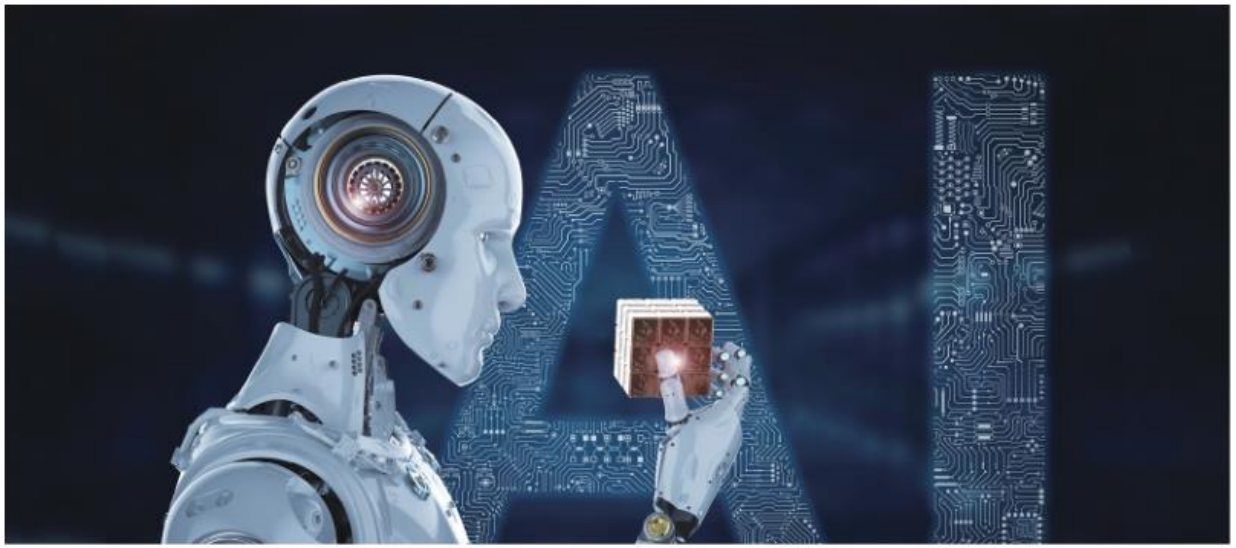
MARK AINSWORTH

For the asset management industry, IA (Intelligence Augmentation) is a much more relevant area of science than AI. It enables the extraction of insights that few others can even identify. PHOTO: REUTERS

ARTIFICIAL intelligence (AI) is a hot topic. Innovations in this area are creating intrigue as to whether machines will replace human beings as portfolio managers. "Robo-advisers" already exist, providing basic financial advice using algorithms that are calculated from the questions being asked.

https://www.businesstimes.com.sg/executive-money/man-or-machine-whos-really-driving-your-portfolio

AI, the future of investment management? CFA Institute July 2018



CFA Institute recently co-hosted a conference with CFA Society Beijing, which was also livestreamed around China, to discuss and, dare I say, speculate on the impact of artificial intelligence (AI) on our industry. As you can imagine, this sparked some lively debate and the consensus was that although the investment management business is not going away any time soon, AI will have a profound impact on the way we invest in the future.

https://www.asiaasset.com/aam/2018-07/201807-ai.aspx

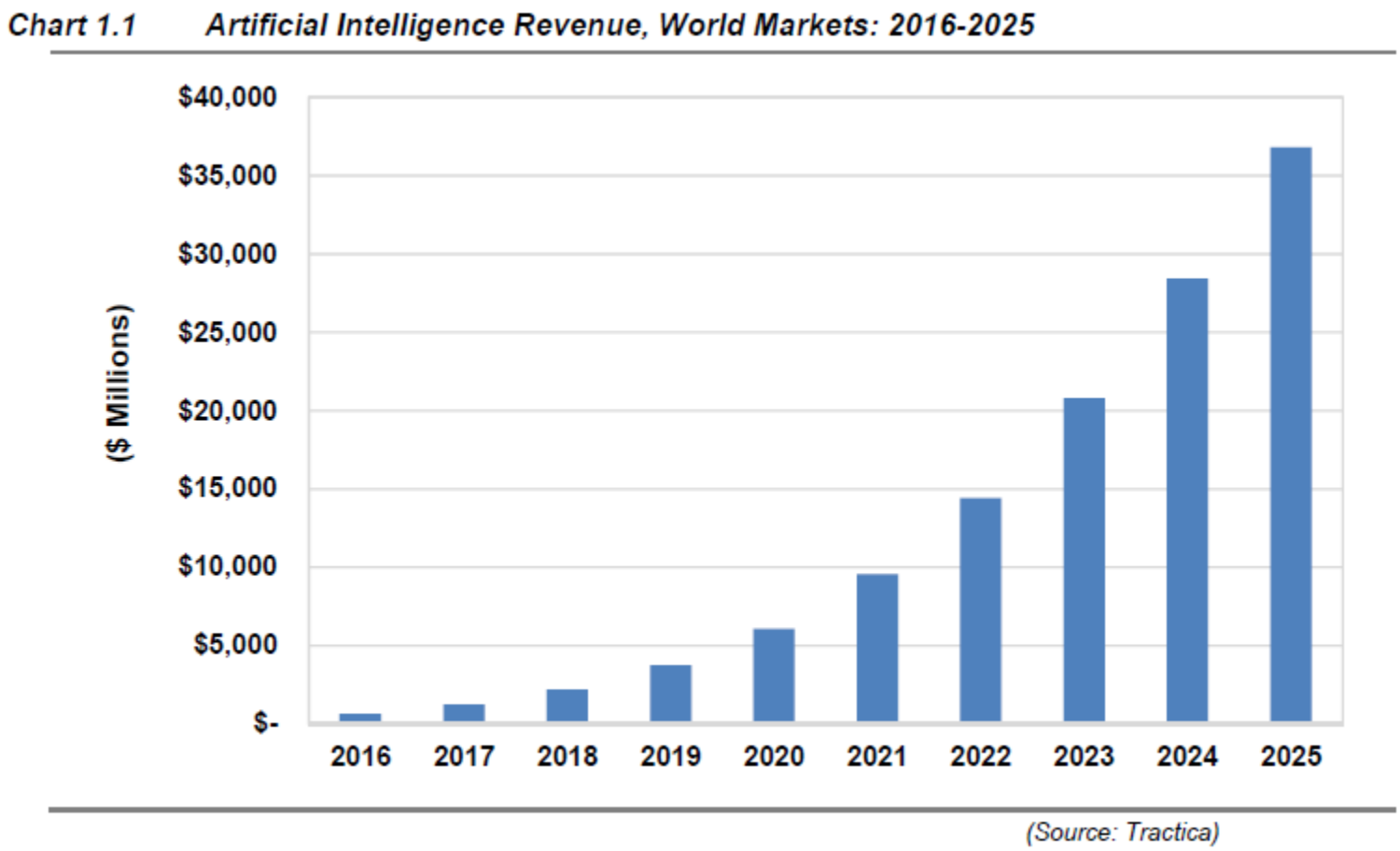
EY, Deloitte And PwC Embrace Artificial Intelligence For Tax And Accounting

Adelyn Zhou Contributor ⓘ

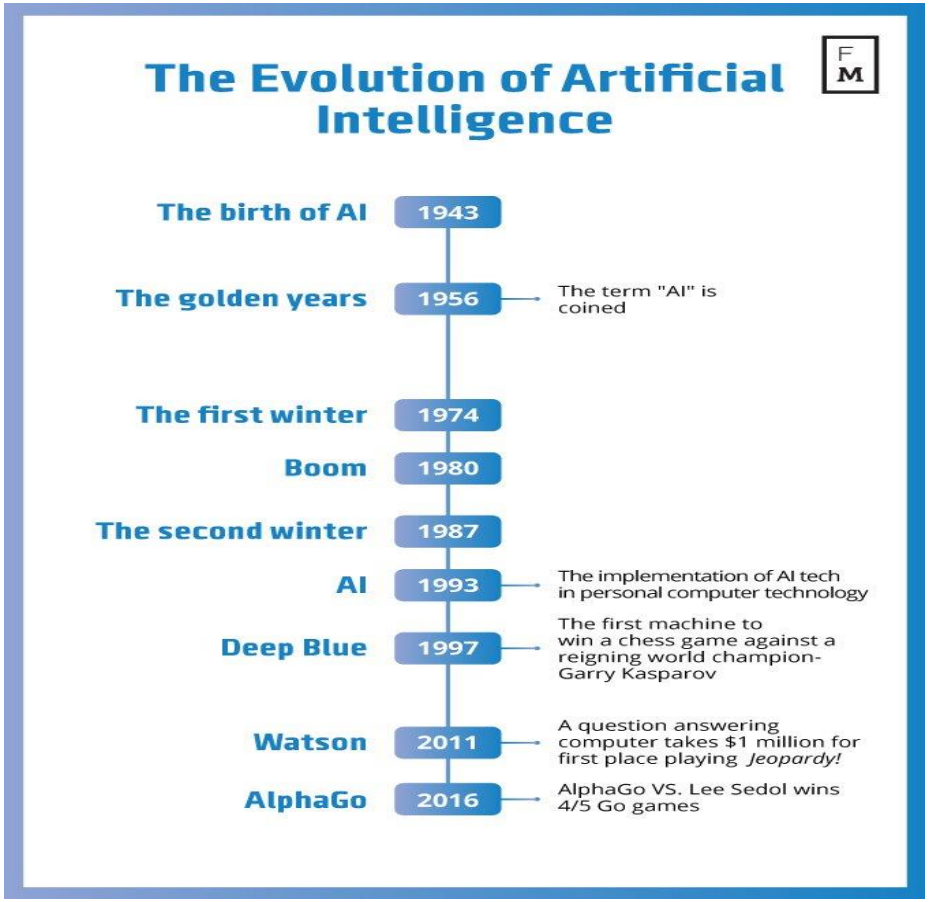
TWEET THIS

- Using NLP to extract information and a human-in-the-loop to validate the results, the AI system is three times more consistent and twice as efficient as previous humans-only teams.
- At Deloitte, what once took four to five months to complete is now done in a week

AI Market Size



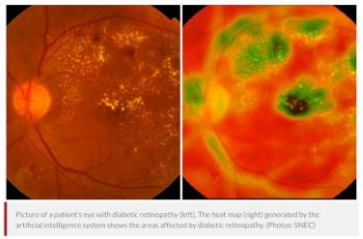
Evolution in AI



Source: https://davidlecea.wordpress.com/2016/11/10/robots-on-the-rise-how-ai-can-change-the-financial-world/

Singapore AI: Detect Eye Conditions

- In a world first, Singapore-developed artificial intelligence system detects 3 major eye conditions
- Singapore National Eye Centre (SNEC), Singapore Eye Research Institute (SERI) and National University of Singapore (NUS) School of Computing.
- Deep Learning System (DLS)
- 5 million images next 5 years
- 30 co-investigators
- 500,000 retinal images
- 180,000 out of 600,000 Singaporeans with diabetes have diabetic retinopathy – lead to blindness.

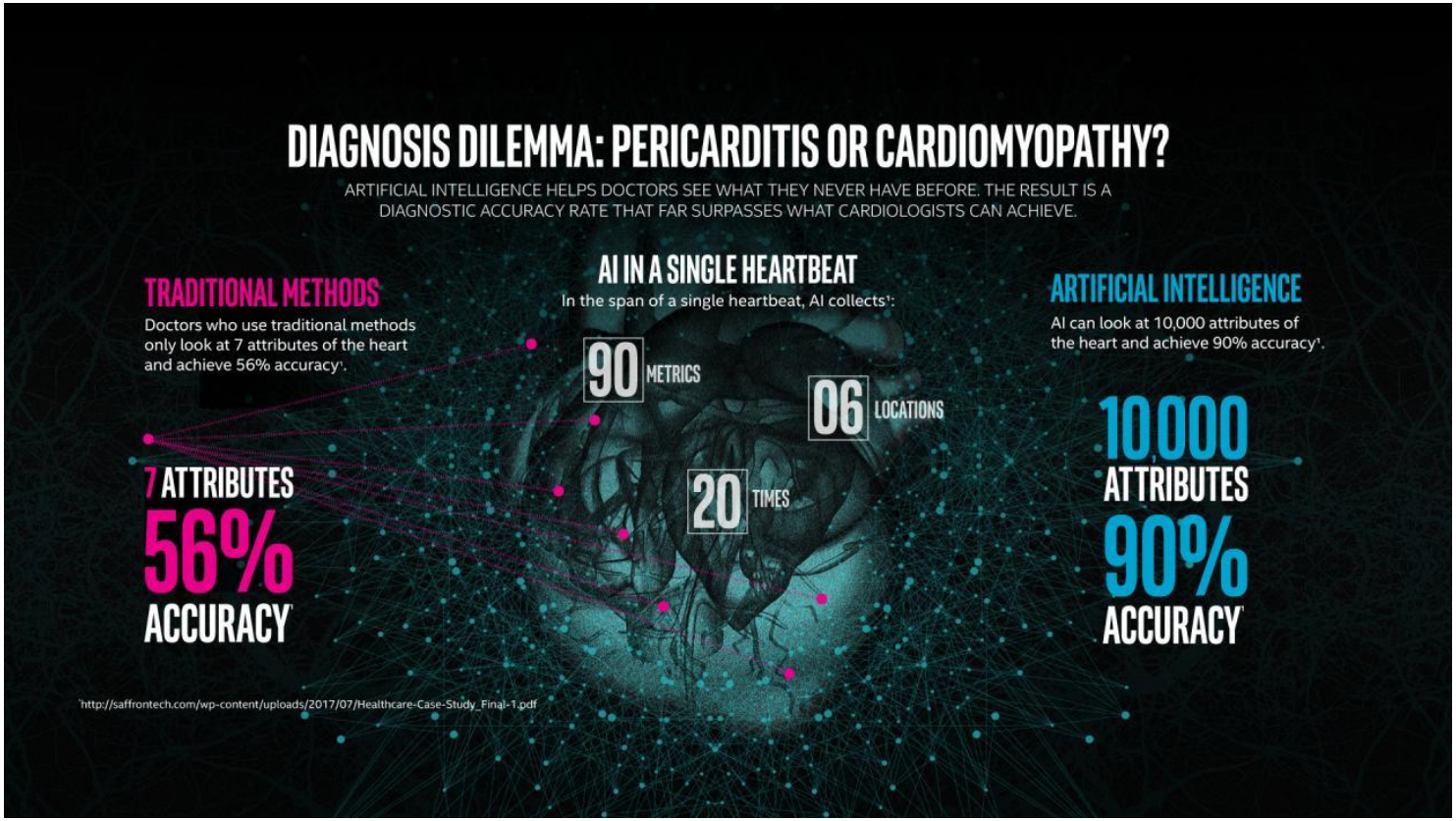


Picture of a patient's eye with diabetic retinopathy (left). The heat map (right) generated by the artificial intelligence system shows the areas affected by diabetic retinopathy. (Photos: SNEC)

Source: https://www.ihis.com.sg/Latest_News/News_Article/Pages/In-a-world-first-Singapore-developed-artificial-intelligence-system-detects-3-major-eye-conditions.aspx

- https://www.channelnewsasia.com/news/singapore/in-a-world-first-singapore-developed-artificial-intelligence-9498742

Cardiologist vs AI



Source: https://www.intel.com/content/www/us/en/healthcare-it/article/improved-diagnosis.html

Big Four embraces AI for Tax and Accounting

Natural Language Processing (NLP)	**Document Review**	•Review high volumes of contracts •Deloitte: Half a year → < 1 month
Machine Learning	**Anomaly Detection**	•Identify fraudulent invoices for clients •EY: Fraud detection system with 97% accuracy has been rolled out to over 50 companies
Natural Language Generation (NLG)	**Producing Reports**	•NLG: creation of text by computers •Deloitte: use NLG to create detailed narrative reports of individual tax returns. Its tax professionals rely on these reports to provide more targeted financial advice to clients during consultations.

Mining giant BHP goes digital in race for survival

At BHP's Integrated Remote Operations Centre in Perth, banks of monitors flicker with real-time video and tracking data from far-off autonomous equipment at the company's mining sites. (Courtesy of BHP)

https://asia.nikkei.com/Business/Company-in-focus/Mining-giant-BHP-goes-digital-in-race-for-survival

Block Chain in Commodity Trading 14 Feb 2019

Blockchain Could Be Used to Fix Sugar Trading Problems

Home » News » Blockchain Could Be Used to Fix Sugar Trading Pr…

Priyeshu Garg February 14, 2019

Sugar traders are looking to fix industry woes by implementing blockchain technology, following the steps of agricultural merchants who have already used the tech to help streamline trading and shipping transactions, Bloomberg reported on February 14, 2019.

https://unblock.net/blockchain-could-be-used-to-fix-sugar-trading-problems/

TO Logistic : How a logistics company in Toronto cut business costs by 80% + saved space by 60% + saved time by 75%

"The digitization of TO Logistics' storage process required skilled planning, delivery, implementation and training. 360 Business Ventures designed the digital transformation pathway for TO Logistics and worked with the various stakeholders on its successful implementation."

-Controller at TO Logistics

The Result

60% SAVED SPACE

75% SAVED TIME

80% SAVED COST

https://www.360businessventures.com/case-study-logistics/

https://logisticsviewpoints.com/2018/04/09/recent-supply-chain-case-studies/

Campbell Soup's Ability to Greatly Improve their Forecasting - August 15, 2017 - **76 percent** forecast accuracy

https://logisticsviewpoints.com/2017/08/15/campbells-demand-management-benchmarking/

AI fake face website launched

19 February 2019 Share

https://www.bbc.com/news/technology-47296481

CNN World » U.S. | Africa | Americas | Asia | Australia | China | Europe | Middle East | India | UK International Edition +

Police used facial recognition to identify the Capital Gazette shooter. Here's how it works

By Dakin Andone, CNN

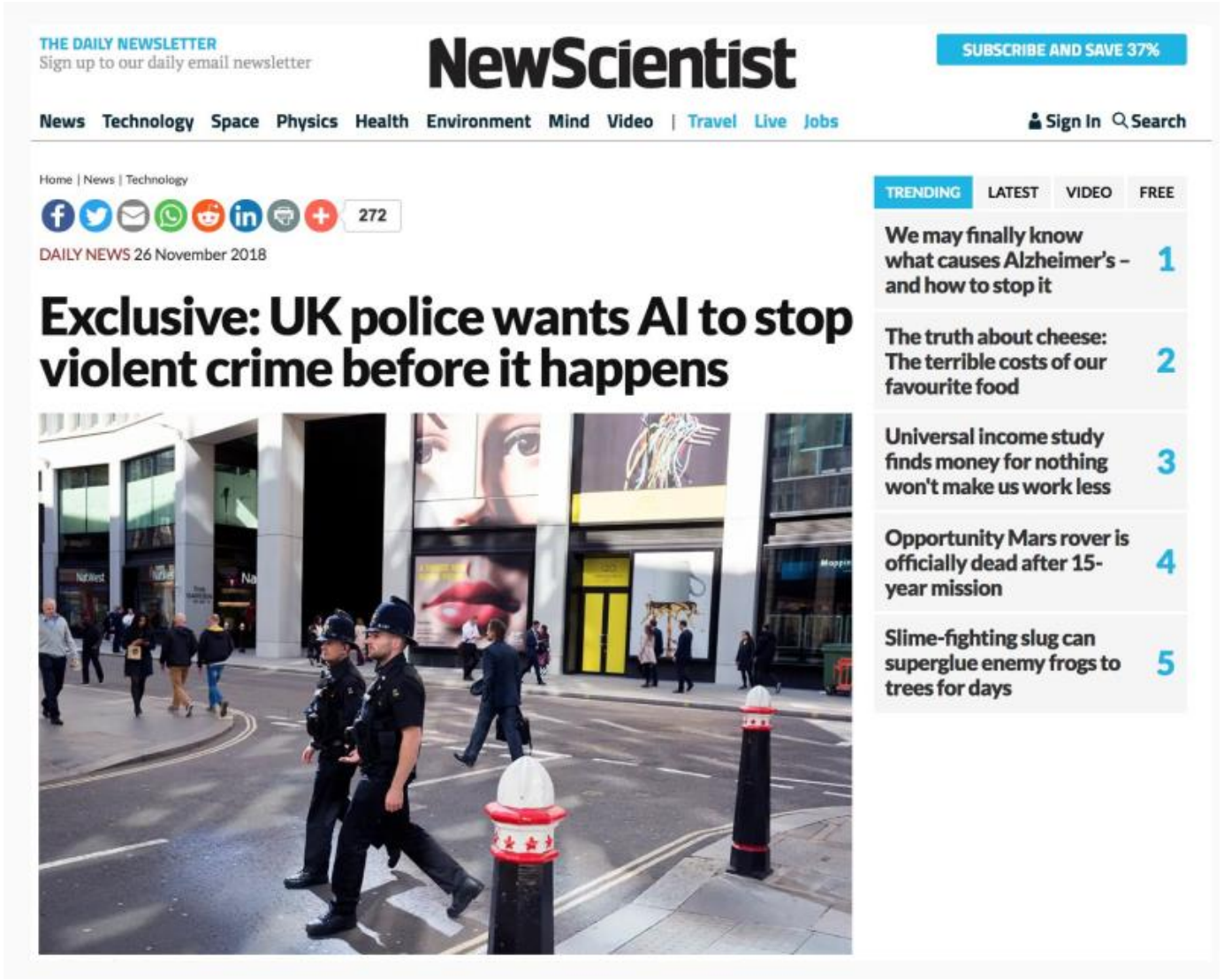
Updated 2222 GMT (0622 HKT) June 29, 2018

This airport commits to facial recognition tech 00:53

News & buzz

Montana residents who spoke Spanish and were asked for ID are...

Tiger discovered by a weed smoker in Houston moves to its new...



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DAILY NEWS 26 November 2018

Exclusive: UK police wants AI to stop violent crime before it happens

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1 We may finally know what causes Alzheimer's – and how to stop it

2 The truth about cheese: The terrible costs of our favourite food

3 Universal income study finds money for nothing won't make us work less

4 Opportunity Mars rover is officially dead after 15-year mission

5 Slime-fighting slug can superglue enemy frogs to trees for days

IBM

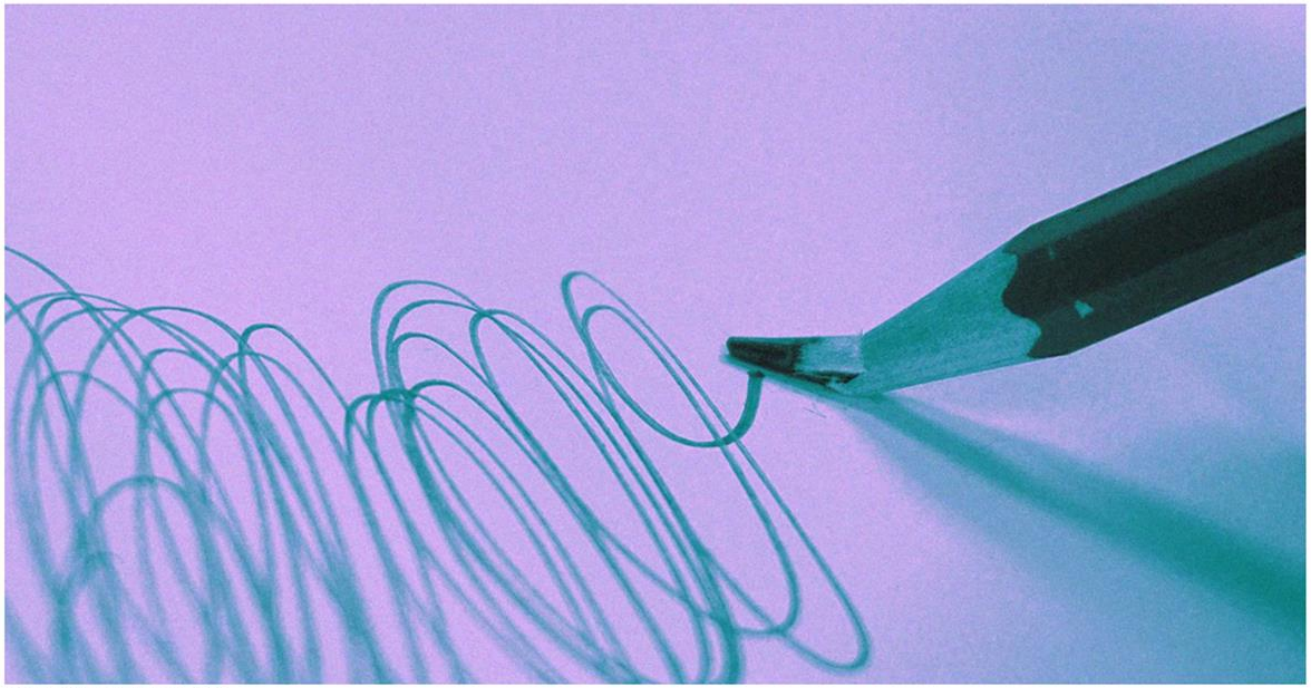
AI is even discovering new spices for our meals

By Ryan Daws
Editor of AI News. A gadget lover, music purveyor, and ex-host of a consumer technology show.

Posted on February 5, 2019

SAVING LIVES

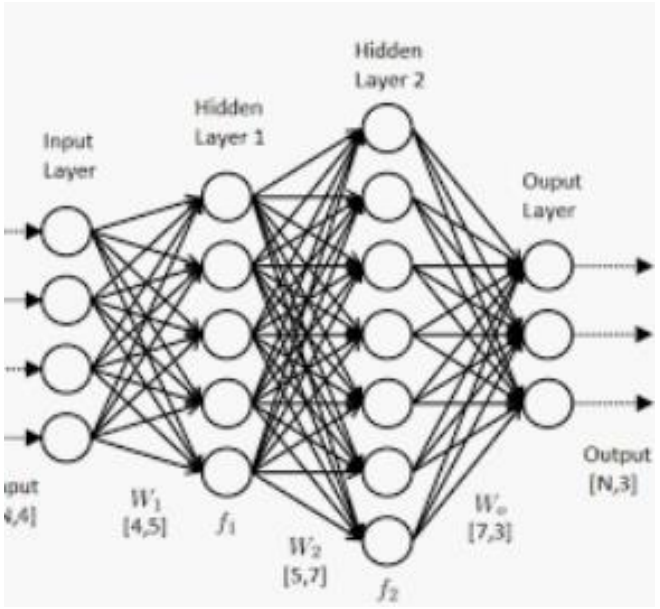
A JAPANESE CITY IS USING AI TO PREVENT YOUTH SUICIDES



AXXL/TAG HARTMAN-SIMKINS

Artificial Intelligent

- Predictive – Campbell to Predict Order
- Student's Project – Predicting Commodity Price, Predicting Bankruptcy Risk

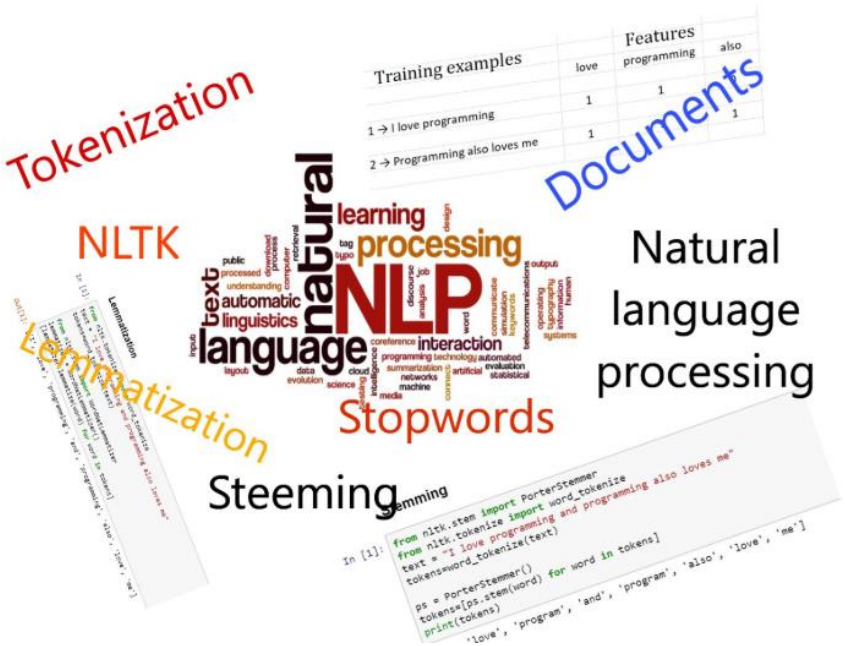


Cloud Computing

- Amazon Work Space – Host AI application

Natural Language Processing (NLP)

- Student's Project
  - Web Scrapping - Know Your Client
  - Medical Chatbot



Robotic Process Automation (RPA)

- Student's Project – Automate Hotel Processes Using UI Path

Software Used

TELEGRAM

Natural Language Analysis with Python NLTK

GOOGLE NEWS CORPUS

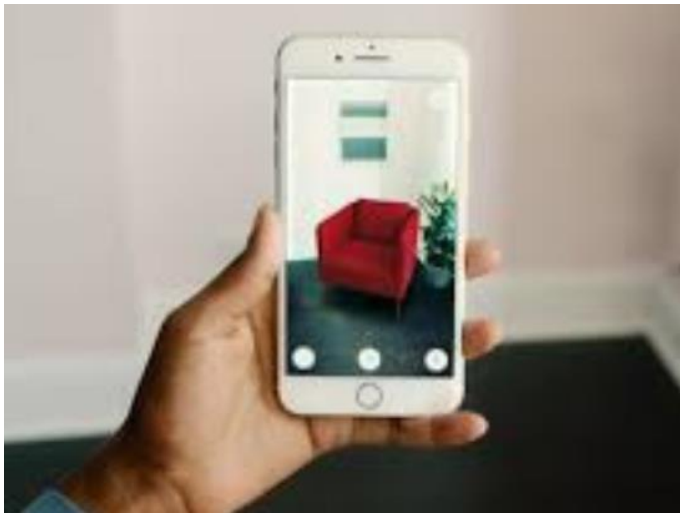
2. AR/VR


WOW


sensorama
3-D MOVIES
STEREO SOUND
VIBRATIONS
AROMAS
WIND

What is Augmented Reality (AR)?

- **Real-time** direct or indirect view of our physical world, **overlaid** with computer generated information and graphics
- **Combines** virtual and real objects together and creates an **interactive** experience

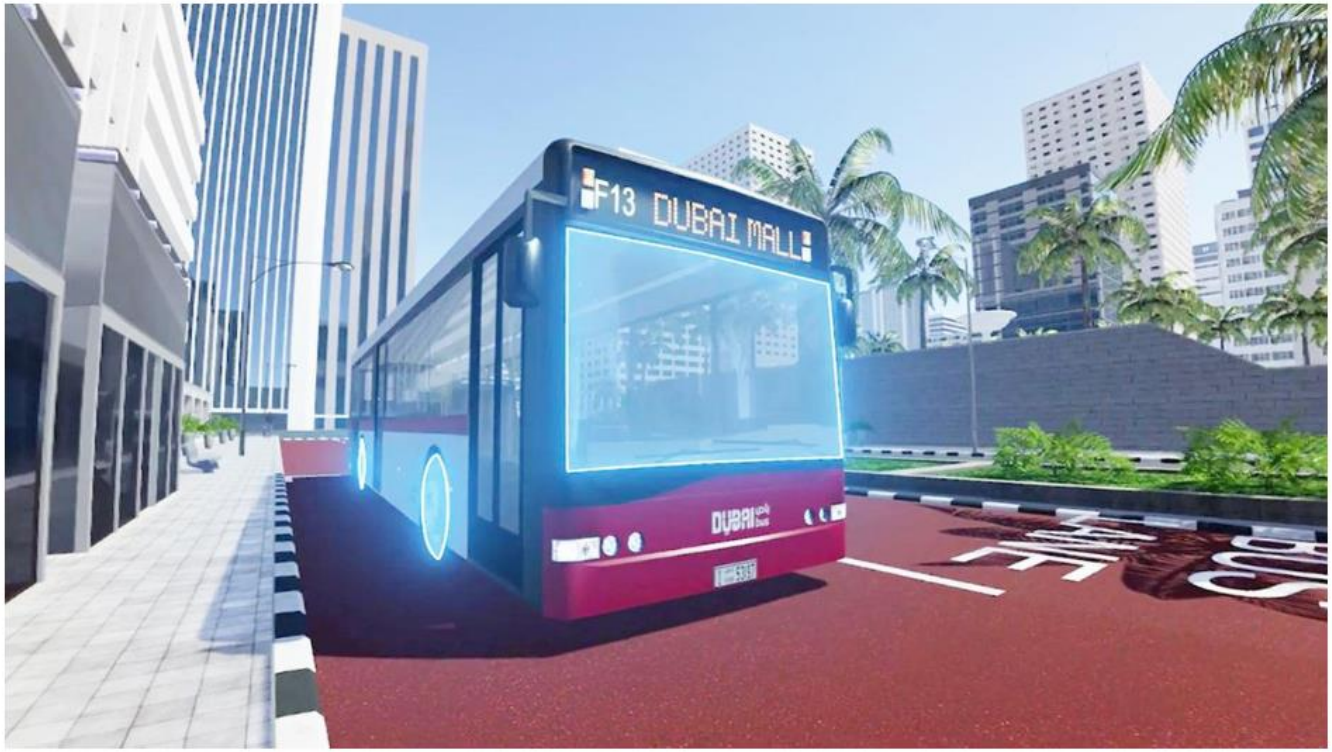


Patrick Ryan
July 31, 2019

SHARE

Dubai bus drivers to receive virtual-reality training

► Dubai's Roads and Transport Authority is turning to technology to improve safety standards



Dubai bus drivers will soon be receiving special virtual reality training.

https://www.thenational.ae/uae/dubai-bus-drivers-to-receive-virtual-reality-training-1.892929

Virtual reality will reshape your entertainment experience in the next five years

Game developers are learning how to use virtual reality (VR) and immersive technology to engage their audiences.

by Cheryl Kahla — 2019-07-29 15:13 in Technology

Image via Pixabay/RawPixel

Google Custom Search

https://www.thesouthafrican.com/tech/virtual-reality-reshape-entertainment-experience-next-five-years/

07.31.2019 | Fourth Industrial Revolution

Augmented reality will change concerts forever

By: Rachelle Dragani

U2, Maroon 5 and Eminem are shattering the fourth wall.

https://www.verizon.com/about/our-company/fourth-industrial-revolution/augmented-reality-will-change-concerts-forever

Facebook Augmented Reality device to let you type with your mind

The researchers hope to reach a real-time decoding speed of 100 words per minute

Published: July 31, 2019 17:42
IANS

Image Credit: Pexels

https://gulfnews.com/technology/media/facebook-augmented-reality-device-to-let-you-type-with-your-mind-1.1564580786366

Apple is hosting augmented reality art walking tours in major cities

Lucas Matney @lucasmtny / 1 day ago

Comment

https://techcrunch.com/2019/07/30/apple-is-hosting-augmented-reality-art-walking-tours-in-major-cities/

Other News

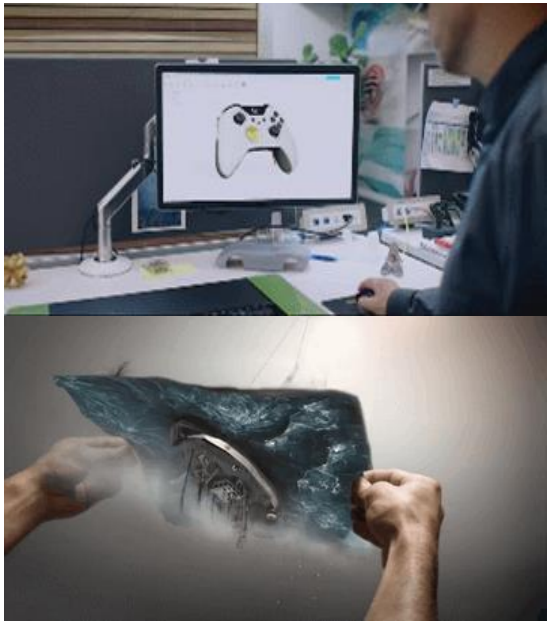
- https://www.roadtovr.com/apple-ar-vr-job-listings-new-products/
- https://www.businessnewsdaily.com/9245-augmented-reality-for-business.html
- https://www.livemint.com/technology/tech-news/ar-vr-games-motivate-players-to-sweat-it-out-in-the-real-world-1564669560594.html
- https://venturebeat.com/2019/07/16/ar-vr-early-stage-valuations-soften-leading-to-investment-and-merger-opportunities/

Augmented Reality Check: Why Businesses are Embracing AR in 2018

AR, VR games motivate players to sweat it out in the real world

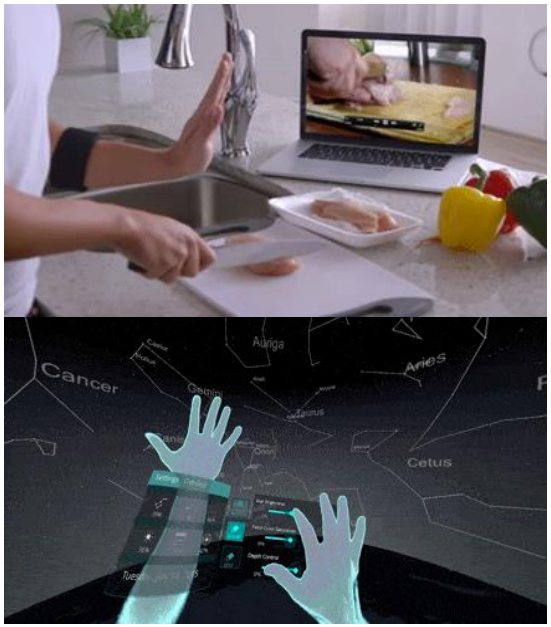
2 min read . Updated: 01 Aug 2019, 08:36 PM IST

AR/VR early stage valuations soften, leading to investment and acquisition opportunities

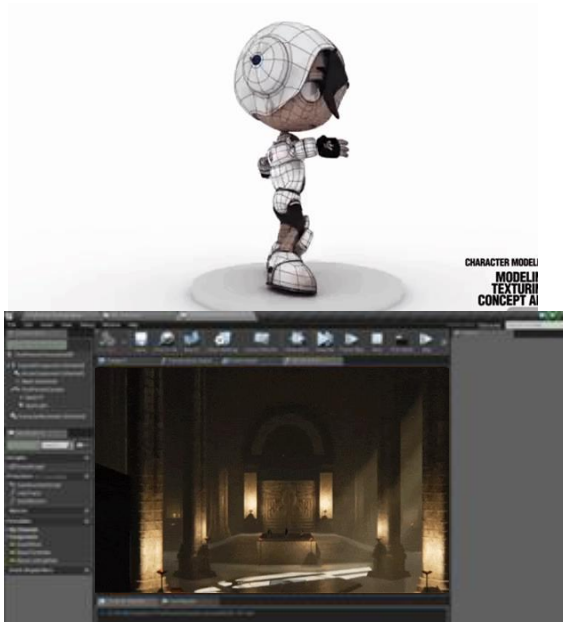


Augmented
Reality

Virtual
Reality



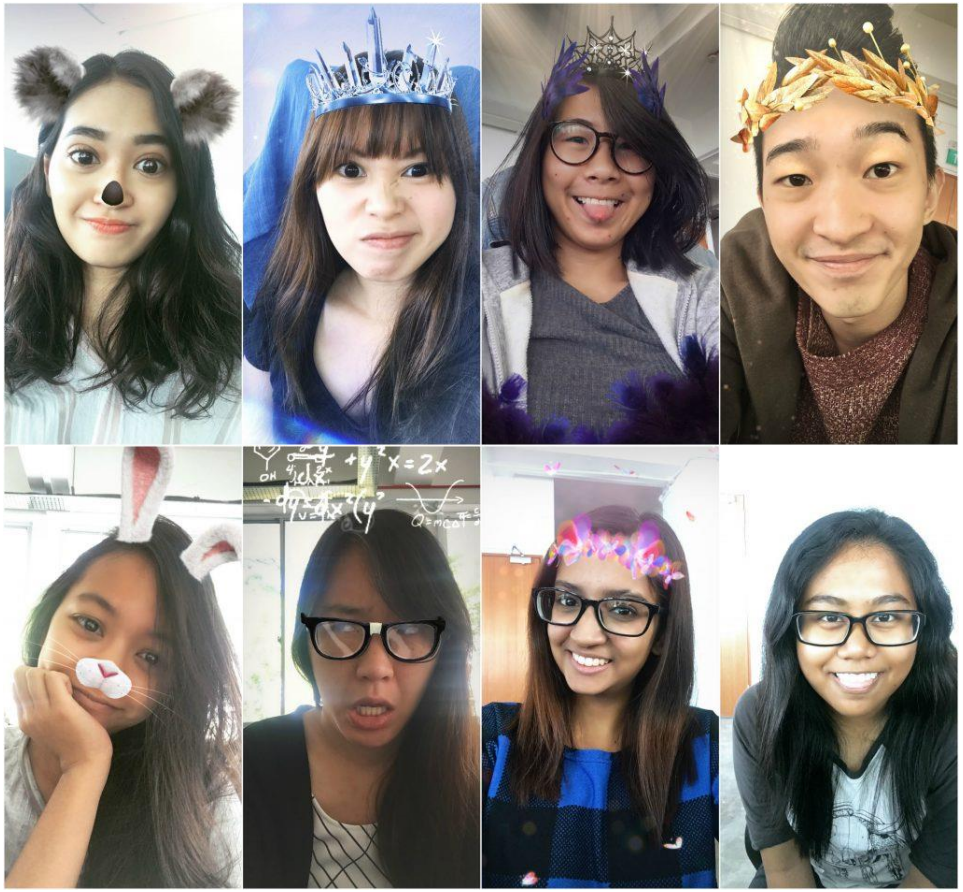
Hardware



Software

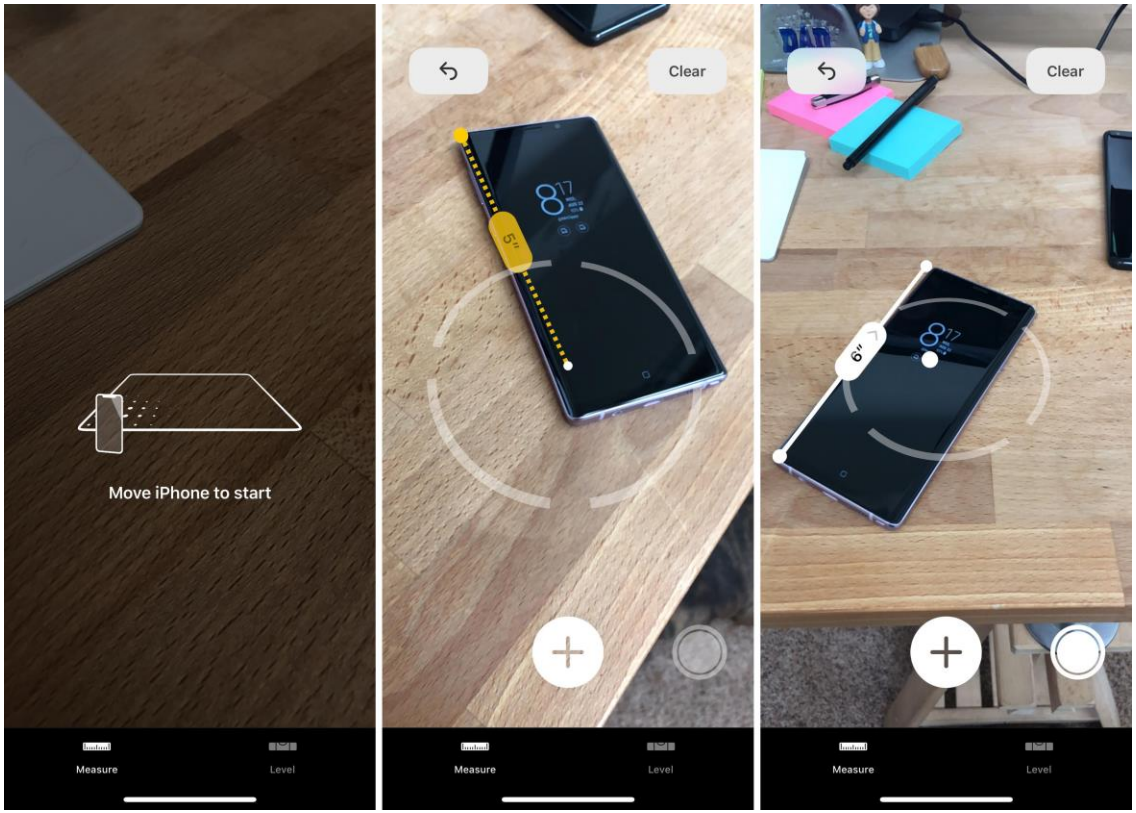
Popular AR Applications

1. Instagram Stories Filters

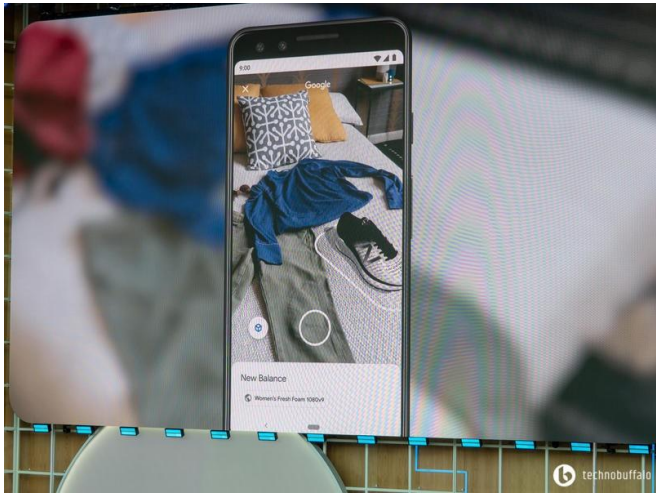


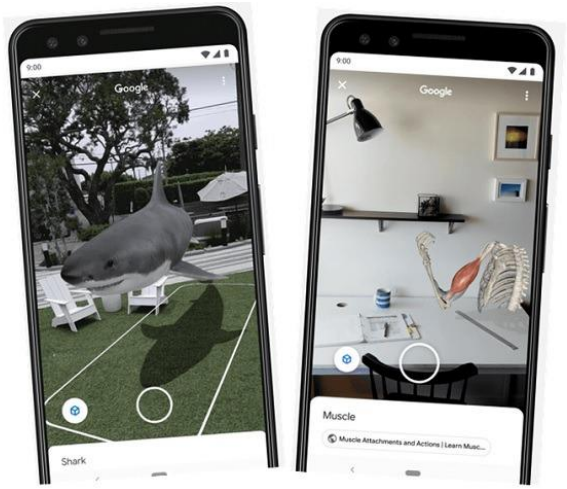
2. Pokémon Go

3. iOS Measure App



4. Google Search





What is Virtual Reality (VR)?

- **Three-dimensional, computer generated environment** which can be explored and interacted with by a person using input devices
- Users becomes part of this virtual world or is immersed within this environment and whilst there, is able to **manipulate objects or perform a series of actions**.

Current VR Applications

- Resident Evil 7 VR
- Tilt Brush
- Kraken Unleashed Roller Coaster

1. Resident Evil 7 VR

https://youtu.be/fcLl-DZGLZ8

2. Tilt Brush

https://youtu.be/TckqNdrdbgk

3. Kraken Unleashed Roller Coaster

https://youtu.be/5K950lBpi6A

Industries' Usage of AR & VR

- Healthcare
- Architecture
- Entertainment
- Sports
- Business
- Education
- Military
- Media
- Rehabilitation
- Arts

Healthcare

https://youtu.be/4p7MUzSeCWU

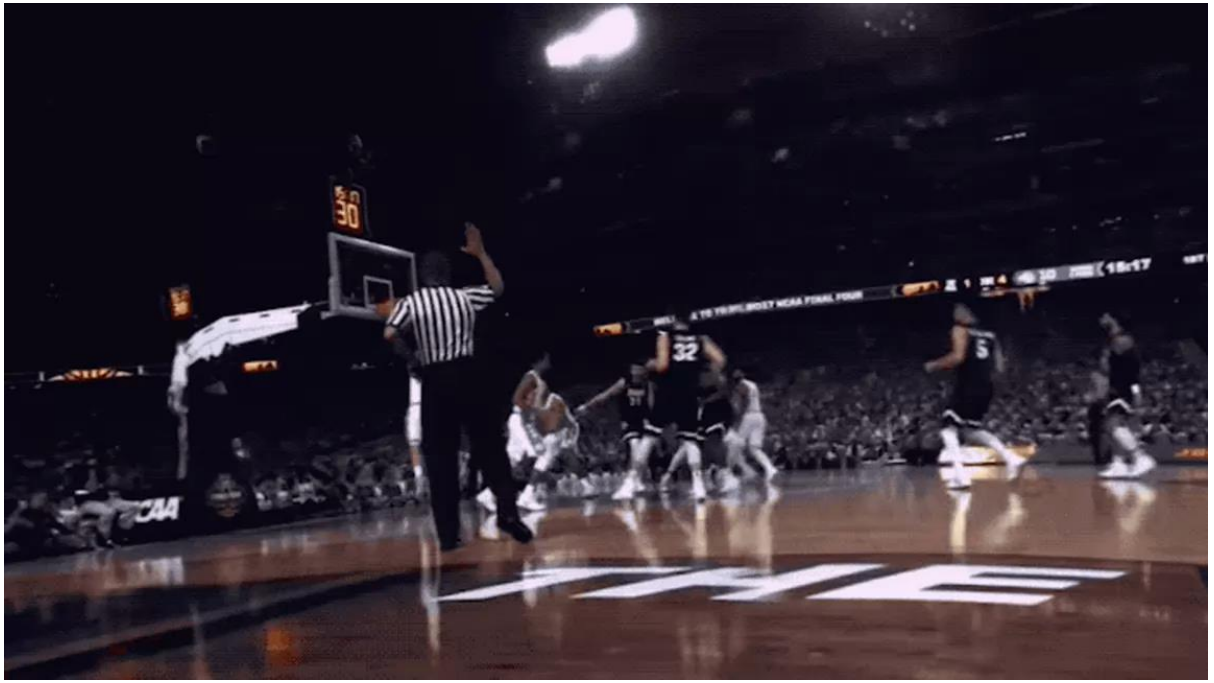
Architecture

https://youtu.be/xpjhsOneeQQ

Entertainment

https://www.youtube.com/watch?v=HAY1ioIl0Ec

Sports



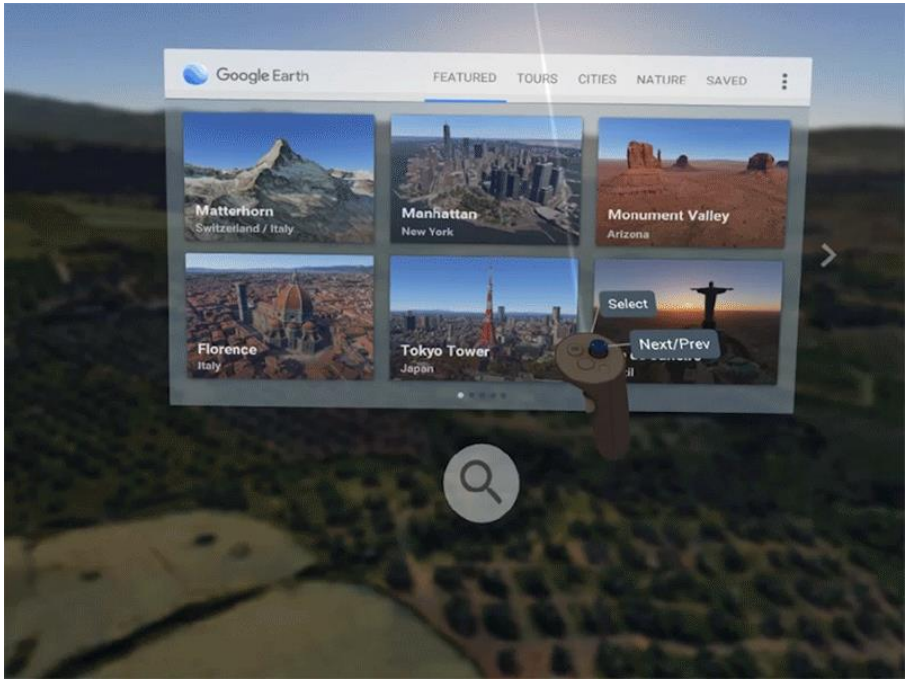
Arts

https://youtu.be/tTJb6-9pvsQ

Business

https://youtu.be/RxhecVUtyHA

Education & Training



https://www.youtube.com/watch?v=SCrkZOx5Q1M

Military

https://youtu.be/bgCLB7AktL8

Media

https://youtu.be/mclPB06sCYY

Some hardware that are used

Virtual Reality

- HTC Vive

- Oculus Rift

- Valve Index

Some hardware that are used

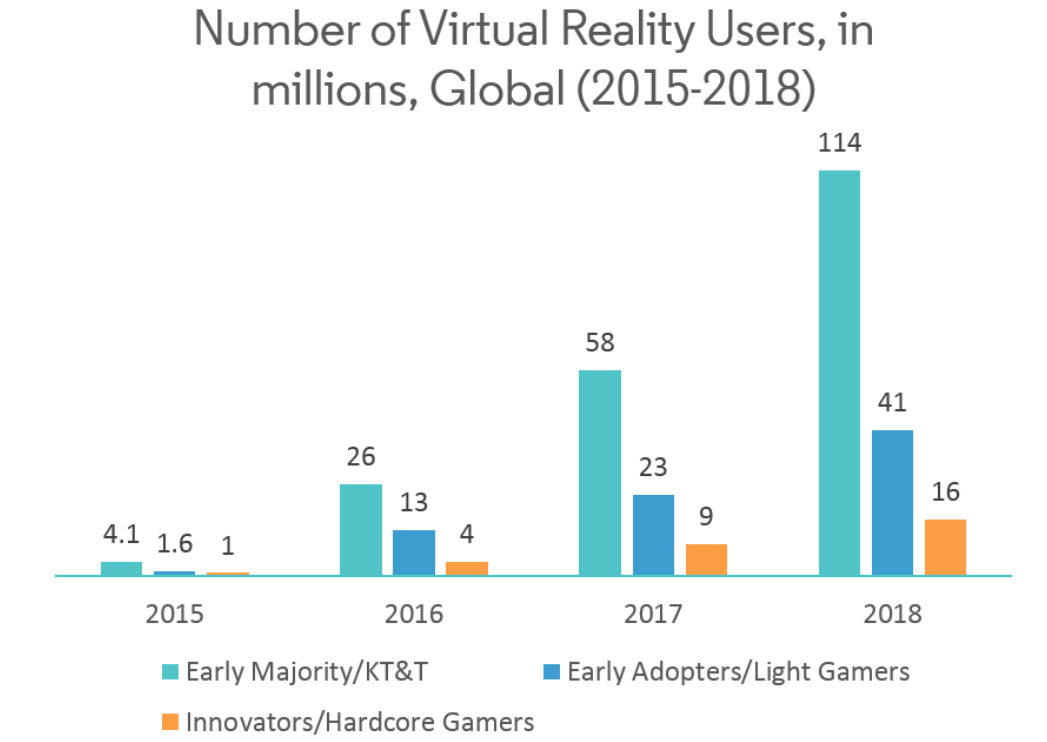
Augmented Reality

- Microsoft HoloLens

- Google Glass

- Your phone

Market Trends



Source: KZero

Market Trends

Integration of AI with AR and VR

1. Physical Environment Mapping
2. Precise Depth Perception
3. Relevant Threat Warnings
4. Simulation & Training
5. Rendering Optimization
6. Unbounded Social Events
7. Character Modelling

Physical Environment Mapping

- Mapping entire environments in real time while blending the results with a virtual world.
- Allows a fully immersive VR and AR experiences with real world buildings and structures
- Creates opportunities such as AR shopping

Precise Depth Perception

- Besides mapping stationary structures, AI could soon map constantly moving environments, such as internal organs
- Only AI can handle the vast number of calculations needed to achieve instant, precise and accurate adjustments for the required actions
  - e.g. Surgery

Relevant Threat Warnings

- Make complex decisions for the military, through learning from archived simulations and strategies

- Able to highlight clear and relevant danger

Relevant Threat Warnings

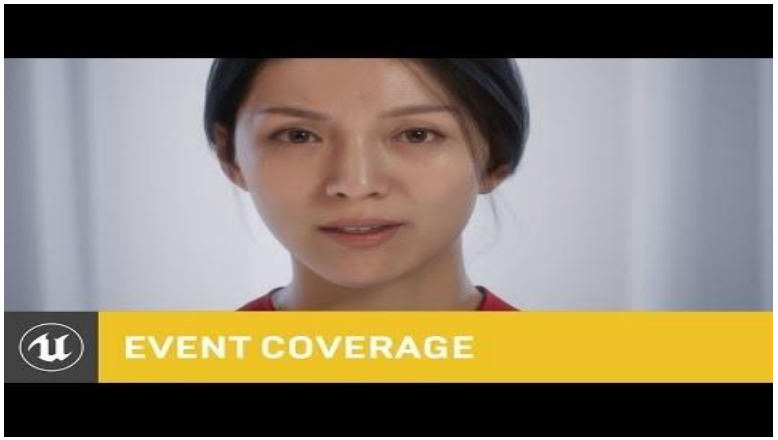
Civilian can also use the same system, where it highlights danger such as oncoming cars or see round corners and give advance warnings before they're even in danger.

Customized Simulation & Training

- Improve simulated training
  - Incorporating more data points
  - Comparing and contrasting different techniques
  - Personalizing education
- Has the potential to make education easily accessible for every student, giving all a chance to learn

Character Modelling

- Coupled with deep learning to create realistic character models, realistic characters can be produced easily and readily, in theory.



Appendix A:
Quick look at Unreal Engine 4

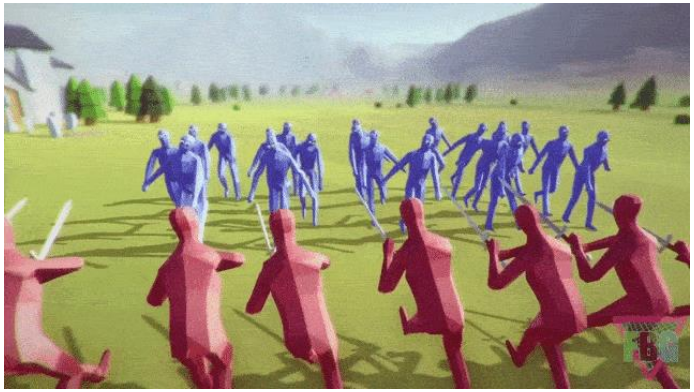
What is Unreal Engine 4?

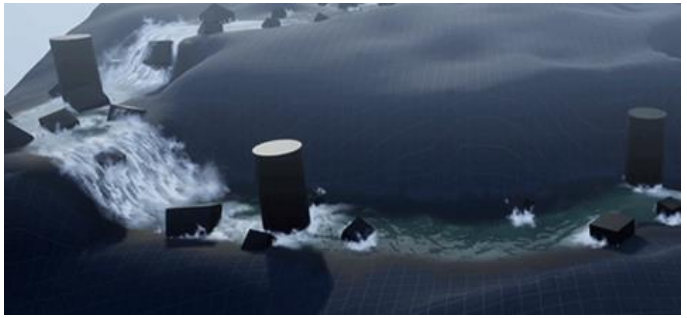
UE4 = A Game Engine

What do game engines do?

Graphics Renderer

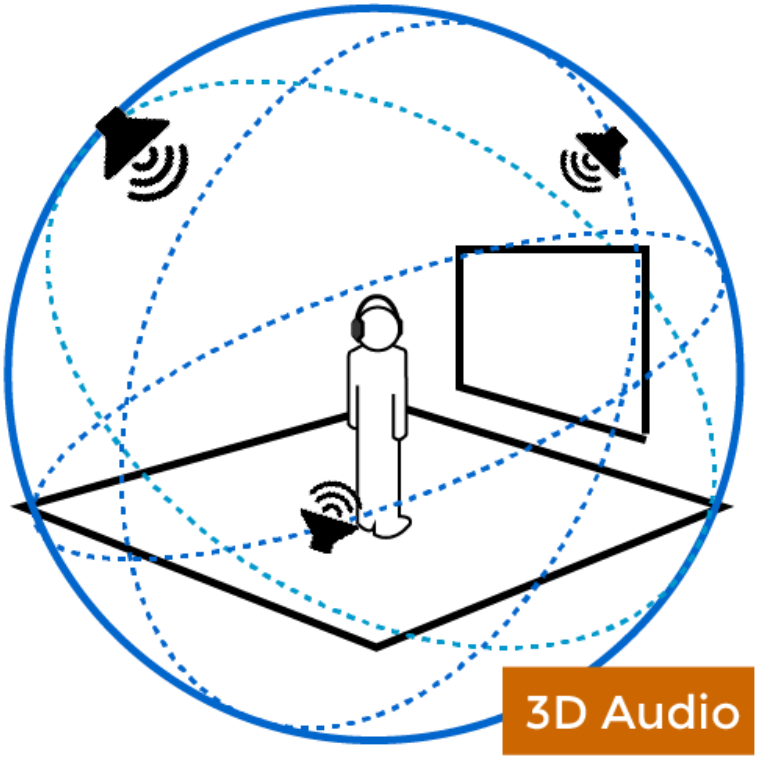
Simulation





Logic

Audio

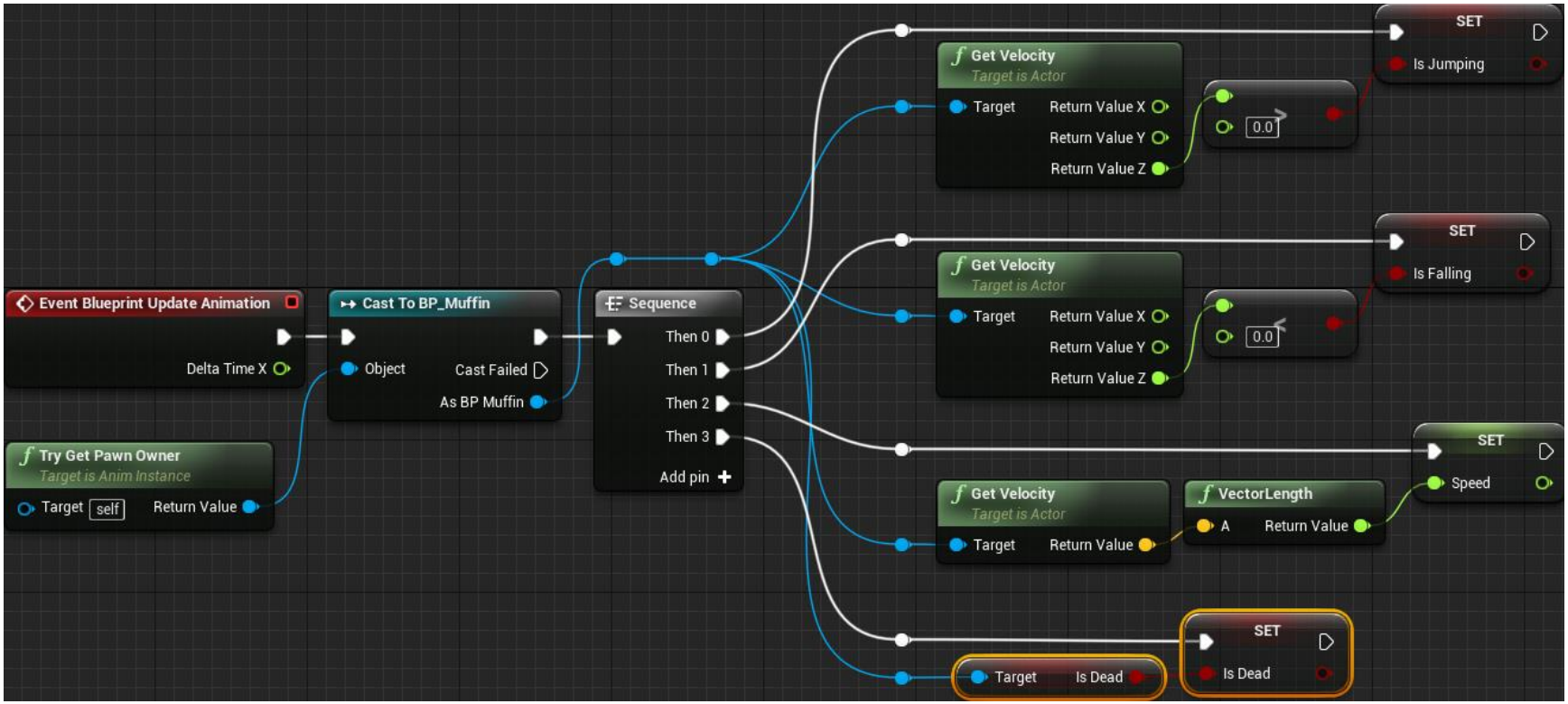


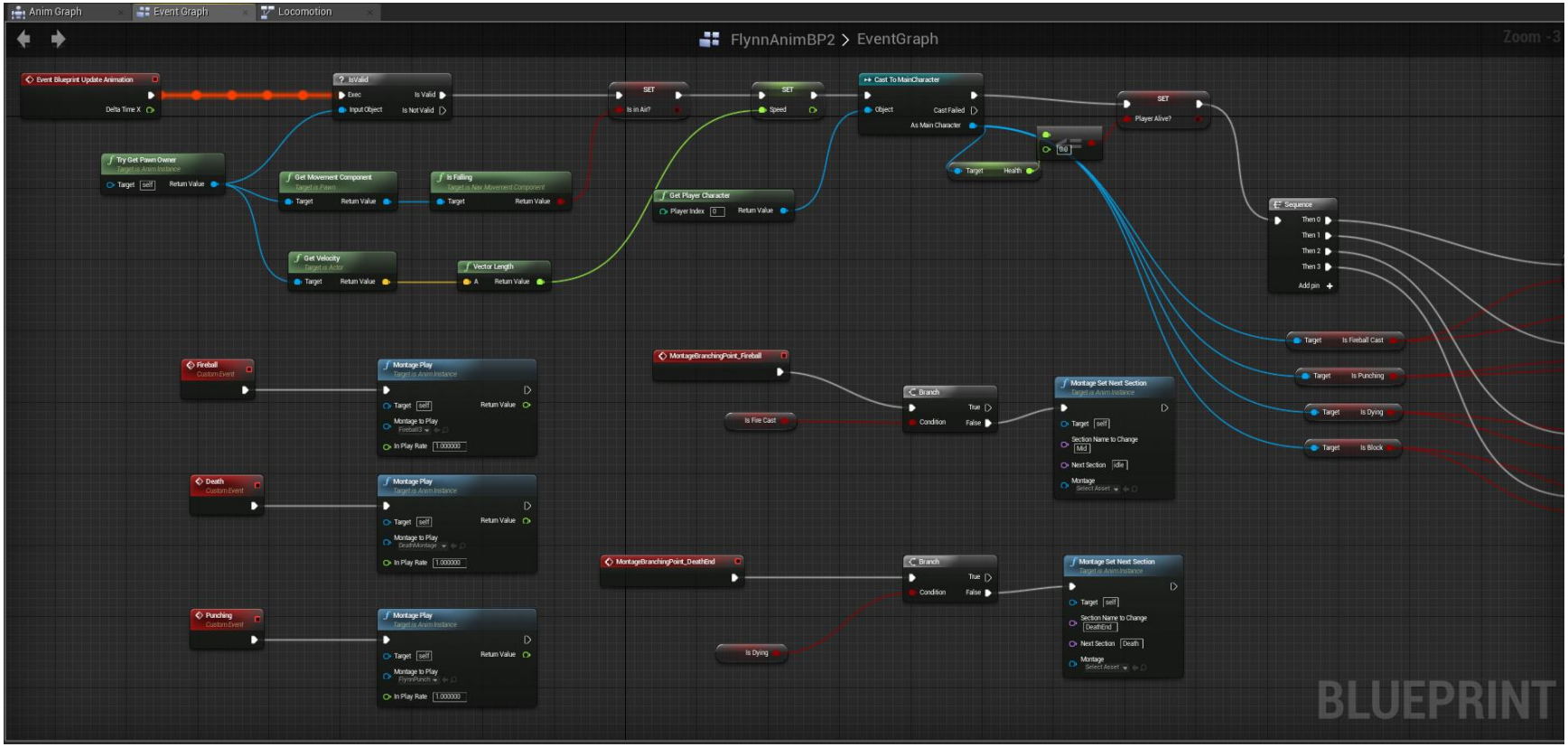
Platforms Deployment

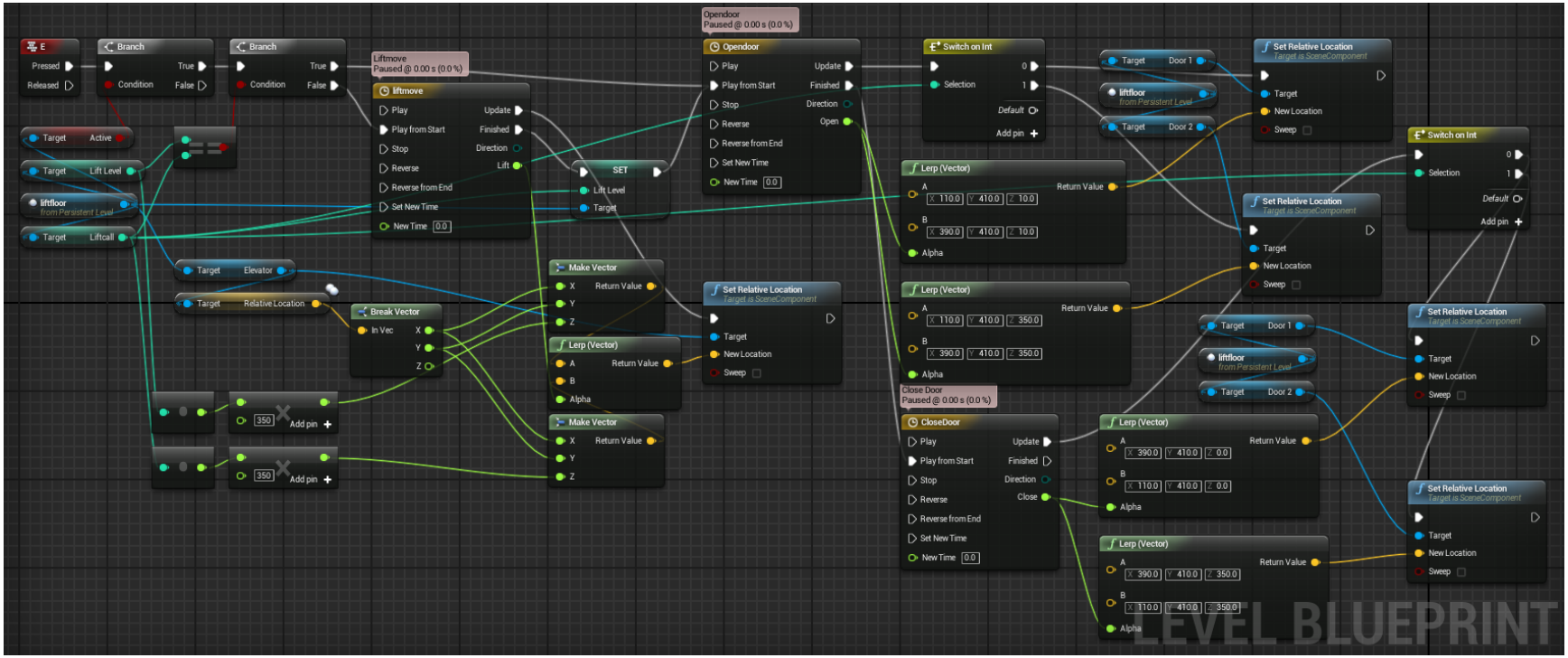
Logic behind UE4 ➡ Blueprints

Blueprints

- Scripting system based on the concept of using a **node-based interface**
- Used to define object-oriented (OO) classes or objects in the engine


Event Blueprint Update Animation
Delta Time X
Cast To BP_Muffin
Object
Cast Failed
As BP Muffin
Sequence
Then 0
Then 1
Then 2
Then 3
Add pin
Try Get Pawn Owner
Target is Anim Instance
Target self
Return Value
Get Velocity
Target is Actor
Target
Return Value X
Return Value Y
Return Value Z
0.0
SET
Is Jumping
Get Velocity
Target is Actor
Target
Return Value X
Return Value Y
Return Value Z
0.0
SET
Is Falling
Get Velocity
Target is Actor
Target
Return Value
VectorLength
A
Return Value
SET
Speed
Target
Is Dead
SET
Is Dead


Anim Graph
Event Graph
Locomotion
FlynnAnimBP2 > EventGraph
Zoom -3
Event Blueprint Update Animation
Delta Time X
IsValid
Exec
Input Object
Is Valid
Is Not Valid
SET
Is in Air?
SET
Speed
Cast To MainCharacter
Object
Cast Failed
As Main Character
SET
Player Alive?
Try Get Pawn Owner
Target is Anim Instance
Target
self
Return Value
Get Movement Component
Target is Pawn
Is Falling
Target is Nav Movement Component
Get Player Character
Player Index
Get Velocity
Target is Actor
Vector Length
A
Sequence
Then 0
Then 1
Then 2
Then 3
Add pin
Target
Health
Target
Is Fireball Cast
Target
Is Punching
Target
Is Dying
Target
Is Block
Fireball
Custom Event
Montage Play
Target is Anim Instance
Montage to Play
In Play Rate
1.000000
MontageBranchingPoint_Fireball
Is Fire Cast
Branch
Condition
True
False
Montage Set Next Section
Section Name to Change
Mid
Next Section
idle
Montage
Death
Custom Event
DeathMontage
MontageBranchingPoint_DeathEnd
Is Dying
DeathEnd
Death
Punching
Custom Event
FlynnPunch
BLUEPRINT


E
Pressed
Released
Branch
Condition
True
False
Branch
Condition
True
False
Liftmove
Paused @ 0.00 s (0.0 %)
liftmove
Play
Play from Start
Stop
Reverse
Reverse from End
Set New Time
New Time
Update
Finished
Direction
Lift
Target
Active
Target
Lift Level
liftfloor
from Persistent Level
Target
Liftcall
Target
Elevator
Target
Relative Location
Break Vector
In Vec
X
Y
Z
350
Add pin
350
Add pin
SET
Lift Level
Target
Make Vector
X
Y
Z
Return Value
Lerp (Vector)
A
B
Alpha
Return Value
Make Vector
X
Y
Z
Return Value
Set Relative Location
Target is SceneComponent
Target
New Location
Sweep
Opendoor
Paused @ 0.00 s (0.0 %)
Opendoor
Play
Play from Start
Stop
Reverse
Reverse from End
Set New Time
New Time
Update
Finished
Direction
Open
Switch on Int
Selection
0
1
Default
Add pin
Lerp (Vector)
A
X 110.0 Y 410.0 Z 10.0
B
X 390.0 Y 410.0 Z 10.0
Alpha
Return Value
Lerp (Vector)
A
X 110.0 Y 410.0 Z 350.0
B
X 390.0 Y 410.0 Z 350.0
Alpha
Return Value
Close Door
Paused @ 0.00 s (0.0 %)
CloseDoor
Play
Play from Start
Stop
Reverse
Reverse from End
Set New Time
New Time
Update
Finished
Direction
Close
Target
Door 1
liftfloor
from Persistent Level
Target
Door 2
Set Relative Location
Target is SceneComponent
Target
New Location
Sweep
Lerp (Vector)
A
X 390.0 Y 410.0 Z 0.0
B
X 110.0 Y 410.0 Z 0.0
Alpha
Return Value
Lerp (Vector)
A
X 390.0 Y 410.0 Z 350.0
B
X 110.0 Y 410.0 Z 350.0
Alpha
Return Value
Switch on Int
Selection
0
1
Default
Add pin
Set Relative Location
Target is SceneComponent
Target
New Location
Sweep
Target
Door 1
liftfloor
from Persistent Level
Target
Door 2
Set Relative Location
Target is SceneComponent
Target
New Location
Sweep
Set Relative Location
Target is SceneComponent
Target
New Location
Sweep
LEVEL BLUEPRINT

How do blueprints works?

- Basically, Blueprints are **visually scripted additions** to your project.

- It works by connecting **Nodes, Events, Functions, and Variables** with *Wires*

How do blueprints works?

- Blueprints work by using graphs of Nodes for various purposes that are **specific** to each instance of the Blueprint in order to implement behavior and other functionality.

- It is possible to create **complex interactive** elements from blueprints

Blueprint Classes

- Usually ideal for making interactive assets like:
  - Doors
  - Switches
  - Collectible items
  - Destructible scenery
  - Etc..

Blueprint Classes

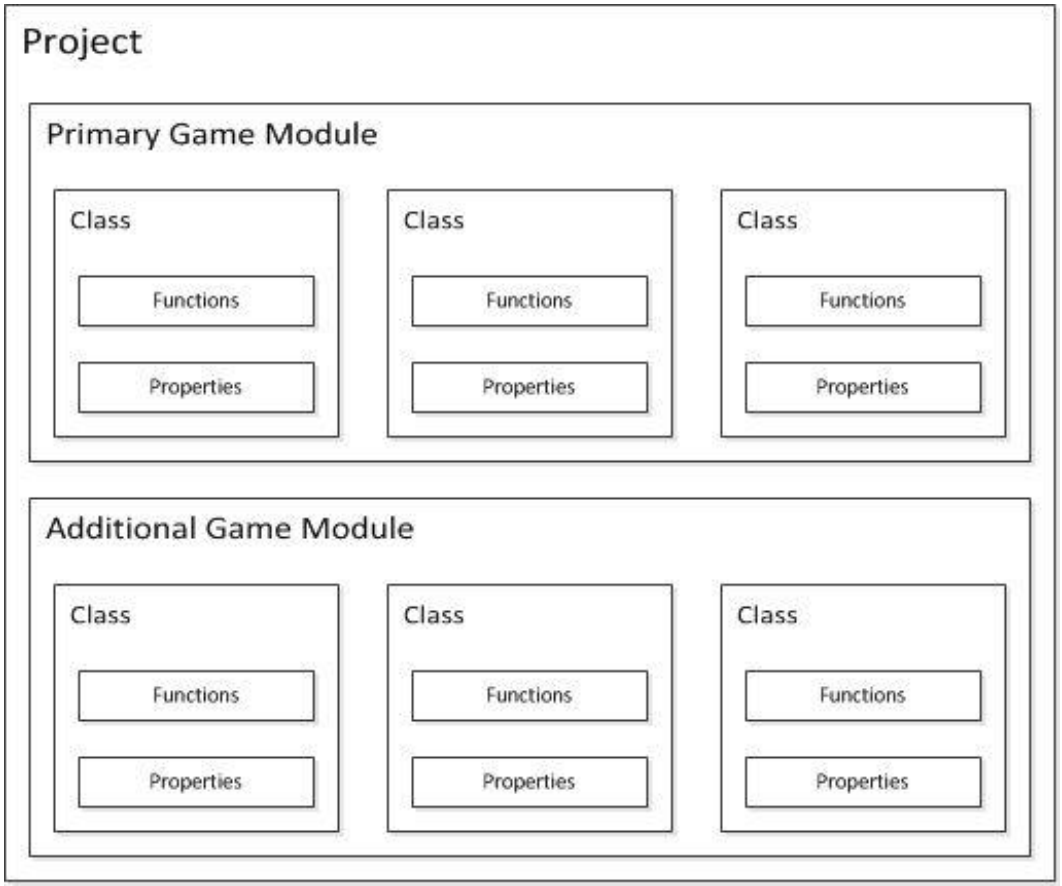
- Ideally, each interactive assets has their own separate Blueprints

- Contains the necessary script to **respond** to events such as:
  - Making them animate
  - Play sound effects
  - Change their materials

Blueprint Classes

- Blueprint classes are **self-contained**
  - Thus, they can be constructed in such a way that you can drop them into a level and they will simply work, with minimal setup required.

- This also means that editing a Blueprint that is in use throughout a project will **update every instance of it**.


Project
Primary Game Module
Class
Functions
Properties
Class
Functions
Properties
Class
Functions
Properties
Additional Game Module
Class
Functions
Properties
Class
Functions
Properties
Class
Functions
Properties

Construction Scripts

- A type of graph within Blueprint Classes that executes when that Actor is placed or updated in the editor, but not during gameplay.

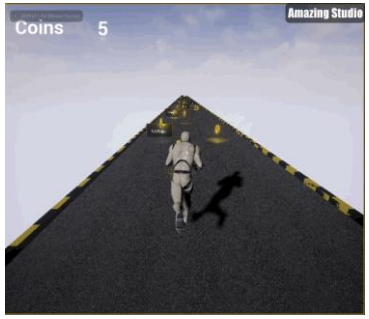
- It is useful for creating easily customizable props that allow environment artists to work faster, such as a light fixture that automatically updates its material to match the color and brightness of its point light component, or a Blueprint that randomly scatters foliage meshes over an area.

Pawns

- A type of Blueprint Class that allows users to put together every element you need for a playable character in the Blueprint graph.
  - Manipulate camera behavior
  - Set up input events for mouse, controller, and touch screens
  - Create an Animation Blueprint asset for handling skeletal mesh animations.

Pawns

- Blueprint also comes with a character component that you can edit such as:
  - Moving around
  - Jumping
  - Swimming
  - Falling built-in



- You can edit and add values and input in accordance with how you want your character to be controlled.

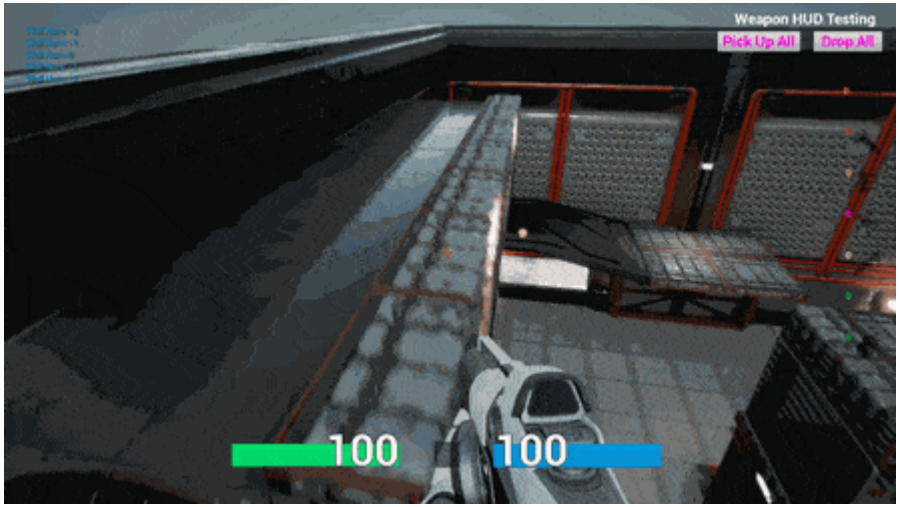
Creating a HUD

- Blueprint script can be used to create a game's HUD (Heads Up Display) as well

- Similar to Blueprint Classes, it can contain event sequences and variables but is assigned to your project's **GameMode** asset instead of being added directly to a level.

Creating a HUD

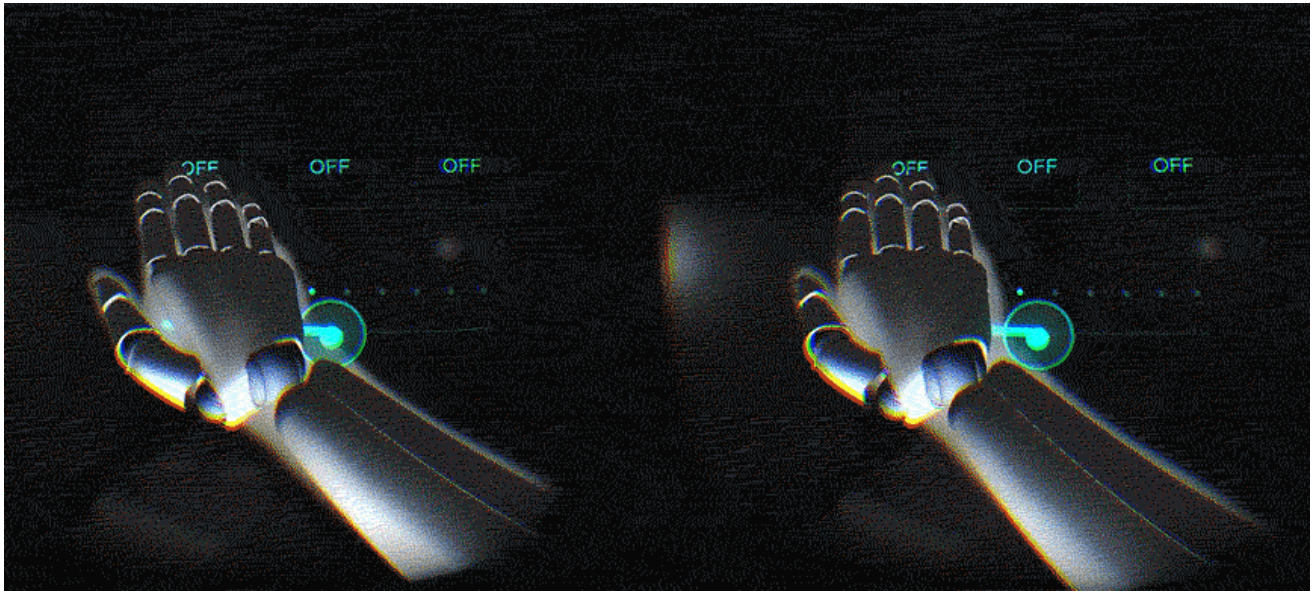
- HUDs can be set up to read variables from other Blueprints and use them such as:
  - To display a health bar
  - Update a score value
  - Display objective markers
  - Etc..


Weapon HUD Testing
Pick Up All
Drop All
100
100

Creating a HUD

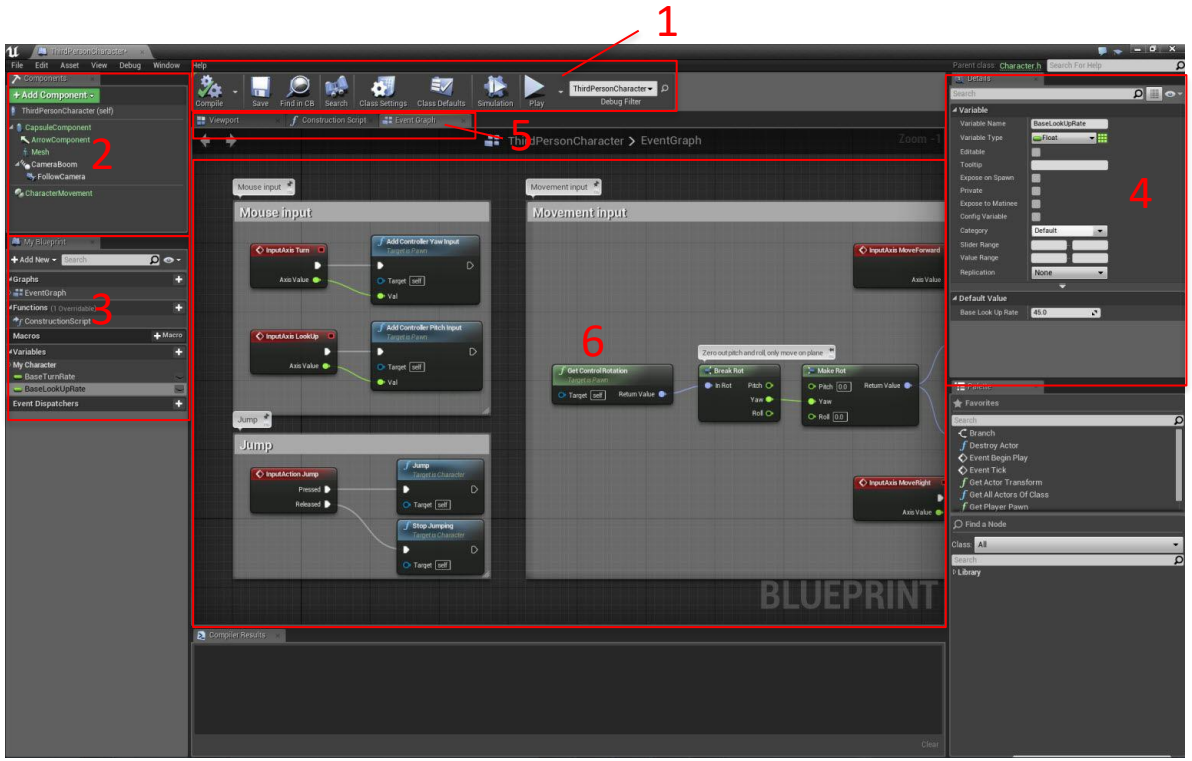
- It is also possible to use the HUD to add hit-boxes for elements like buttons that can be clicked on or, in the case of mobile or Virtual Reality, can respond to touch input.


Portal List
tap to search
Altspace
ClimbingDemo
Convrge
3D


OFF
OFF
OFF
OFF
OFF
OFF

Blueprints - Interface

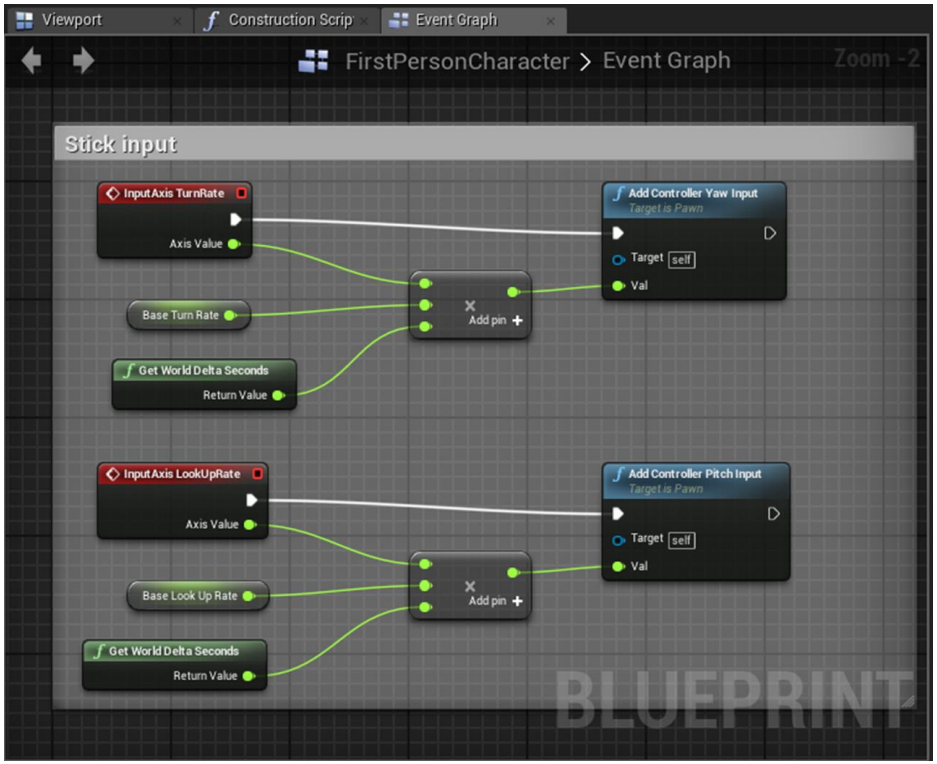
1. Toolbar
2. Components panel
3. My Blueprint panel
4. Details panel
5. Viewport
6. Event Graph



Blueprints – Event Graph

This is where the gameplay logic that determines a Blueprint class's behaviour during gameplay appears.

The Event Graph contains events and actions represented by a node graph.

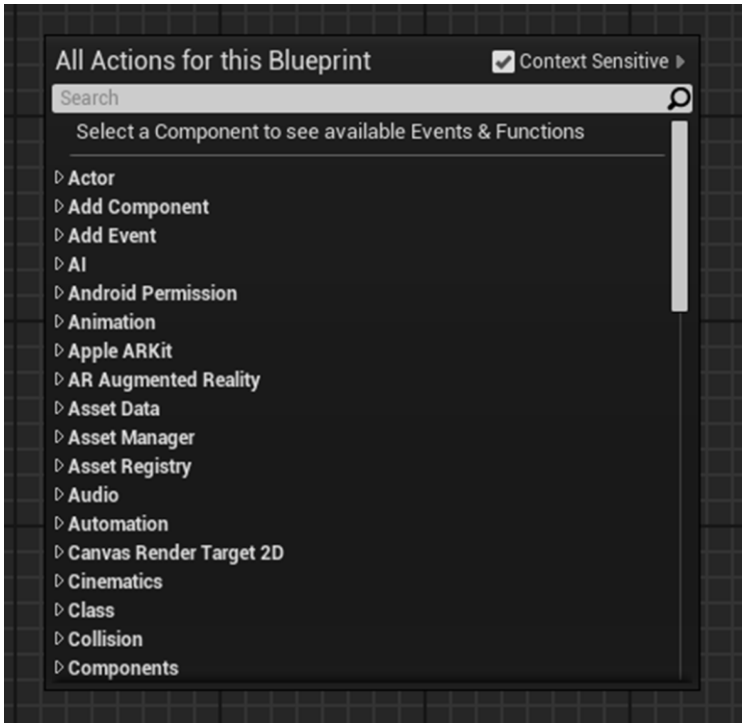


Blueprints – Context Menu

Clicked within the event graph, this menu is used to add nodes within.

Some of the nodes represented are:

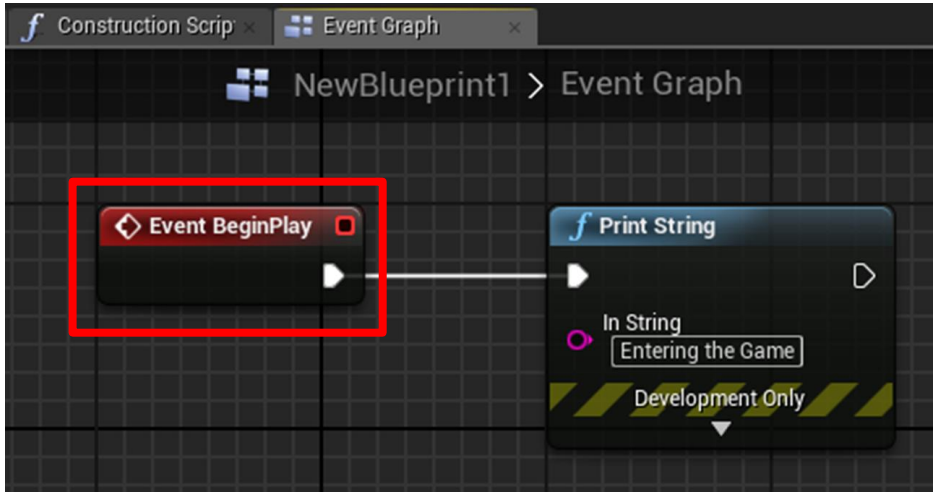
- Variables
- Operators
- Functions
- Events



Blueprints – Events

Events allow Blueprints to perform a series of actions in response to certain events that occur within the game.

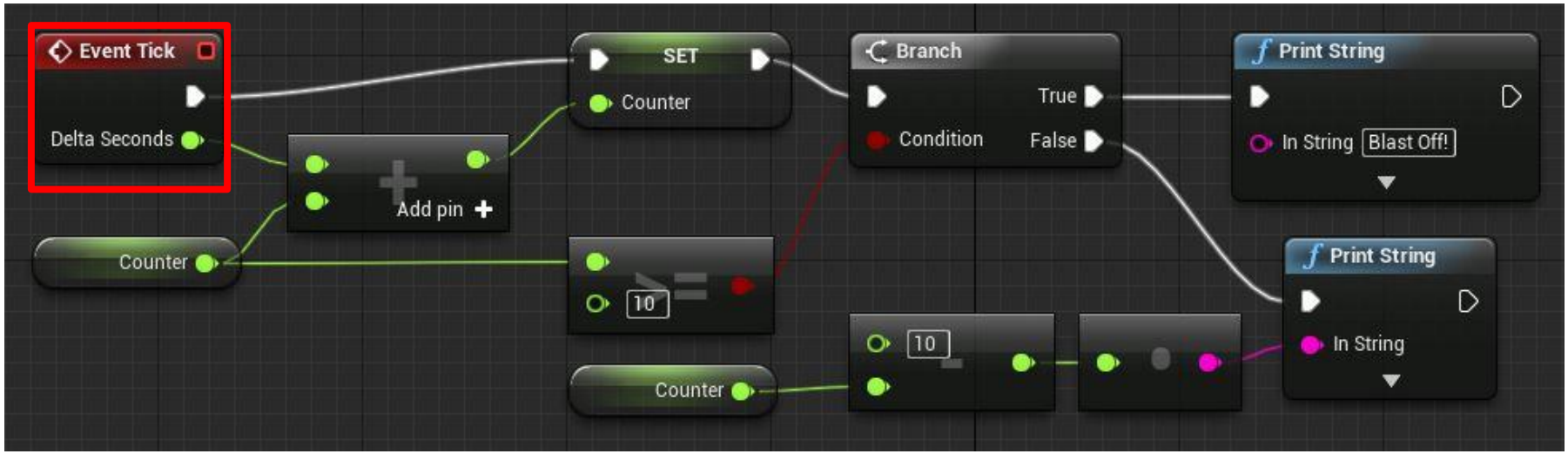
An example is the ***BeginPlay*** event, where it is triggered when the game starts for an Actor spawns within, which then triggers any other connected event or function components.



Blueprints – Events

Another example is the ***Tick*** event, where it is called every frame of the game.

For example, in a game that is running at 60 frames per second, the Tick event is called 60 times in a second.



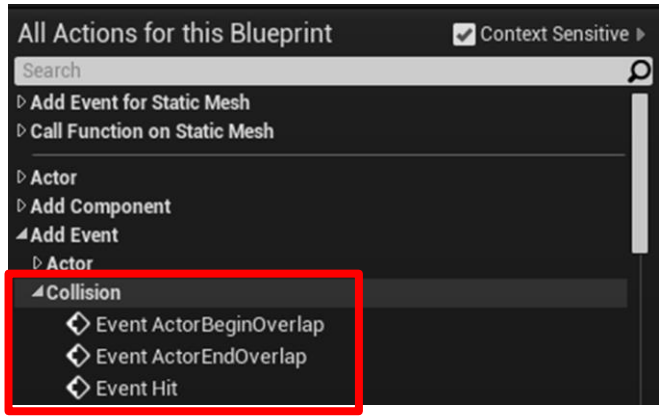
Blueprints – Events

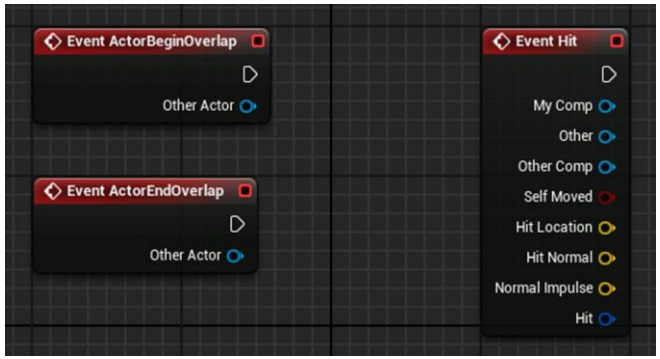
Collision events are triggered when two Actors collide or overlap.

Event ActorBeginOverlap will execute when two Actors start overlapping.

Event ActorEndOverlap will execute when two Actors stop overlapping.

Event Hit will execute if the **Simulation Generates Hit Events** property of one of the Actors in the collision is set to "**true**".





Blueprints – Events

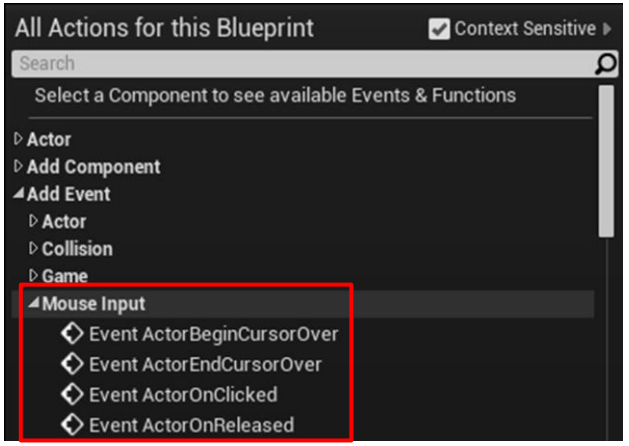
There are some events related to **mouse interaction** with an Actor.

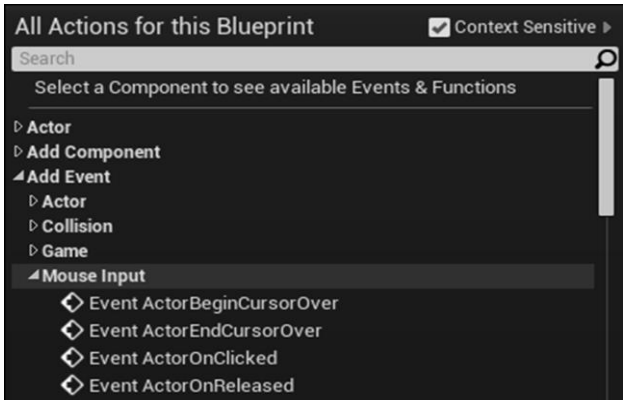
Event ActorBeginCursorOver is activated when the mouse cursor moves over the Actor.

Event ActorEndCursorOver is activated when the mouse cursor moves off the Actor.

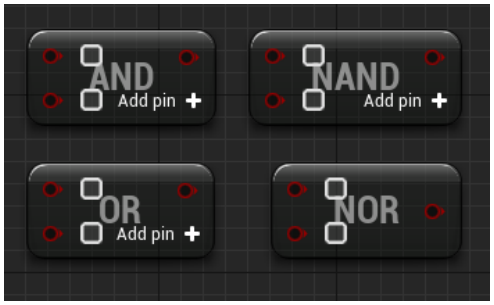
Event ActorOnClicked is activated when the mouse clicks on the Actor.

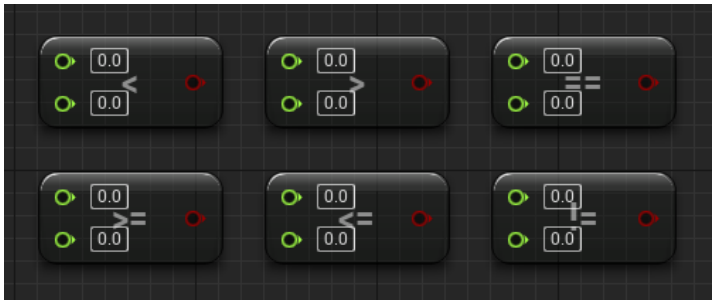
Event ActorOnReleased is activated when the mouse button is released and the mouse cursor is still over the Actor.

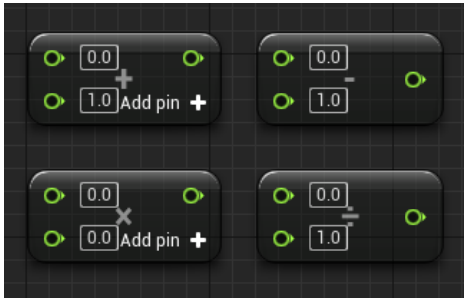




Blueprints – Operators



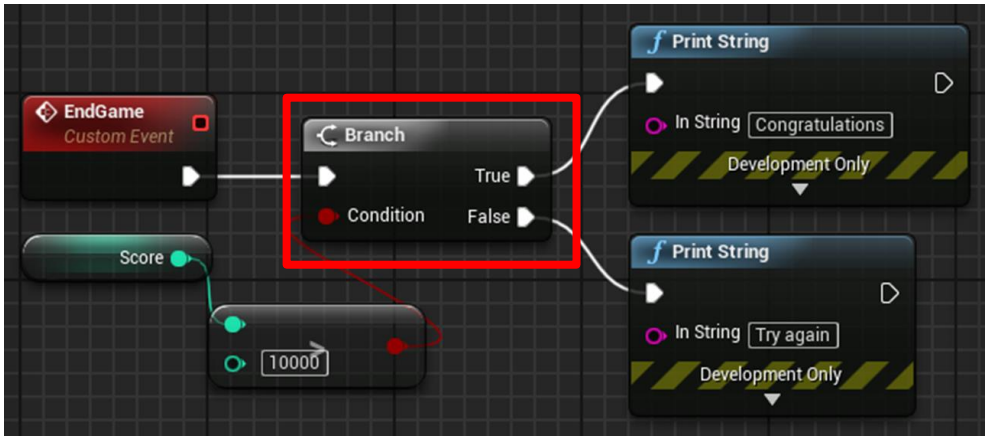




Blueprints - Functions

The ***Branch*** node directs the flow of execution of a Blueprint based on the value of the Boolean input “Condition”, which can be **“true”** or **“false”**.

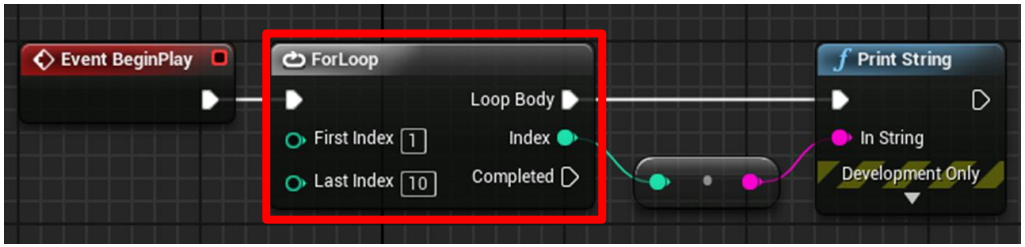
This works the same as an if-else function within coding languages



Blueprints - Functions

The ***ForLoop*** node performs the set of actions that are associated with the output pin Loop Body for each index.

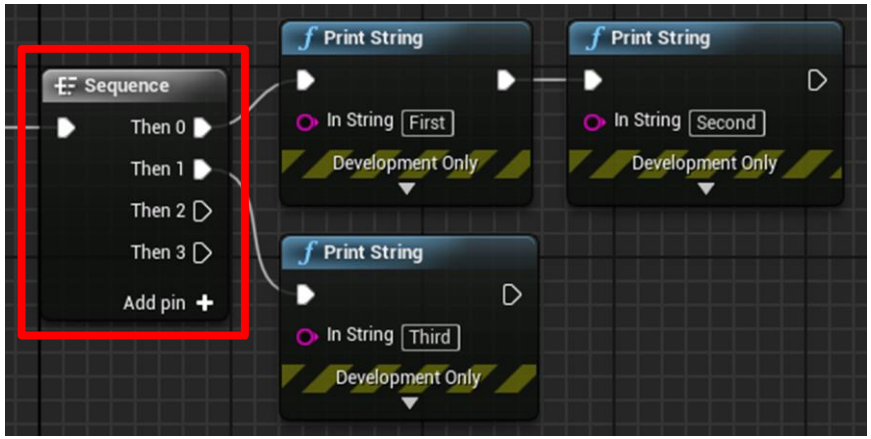
When the ***ForLoop*** node completes its execution, the output pin Complete is triggered.

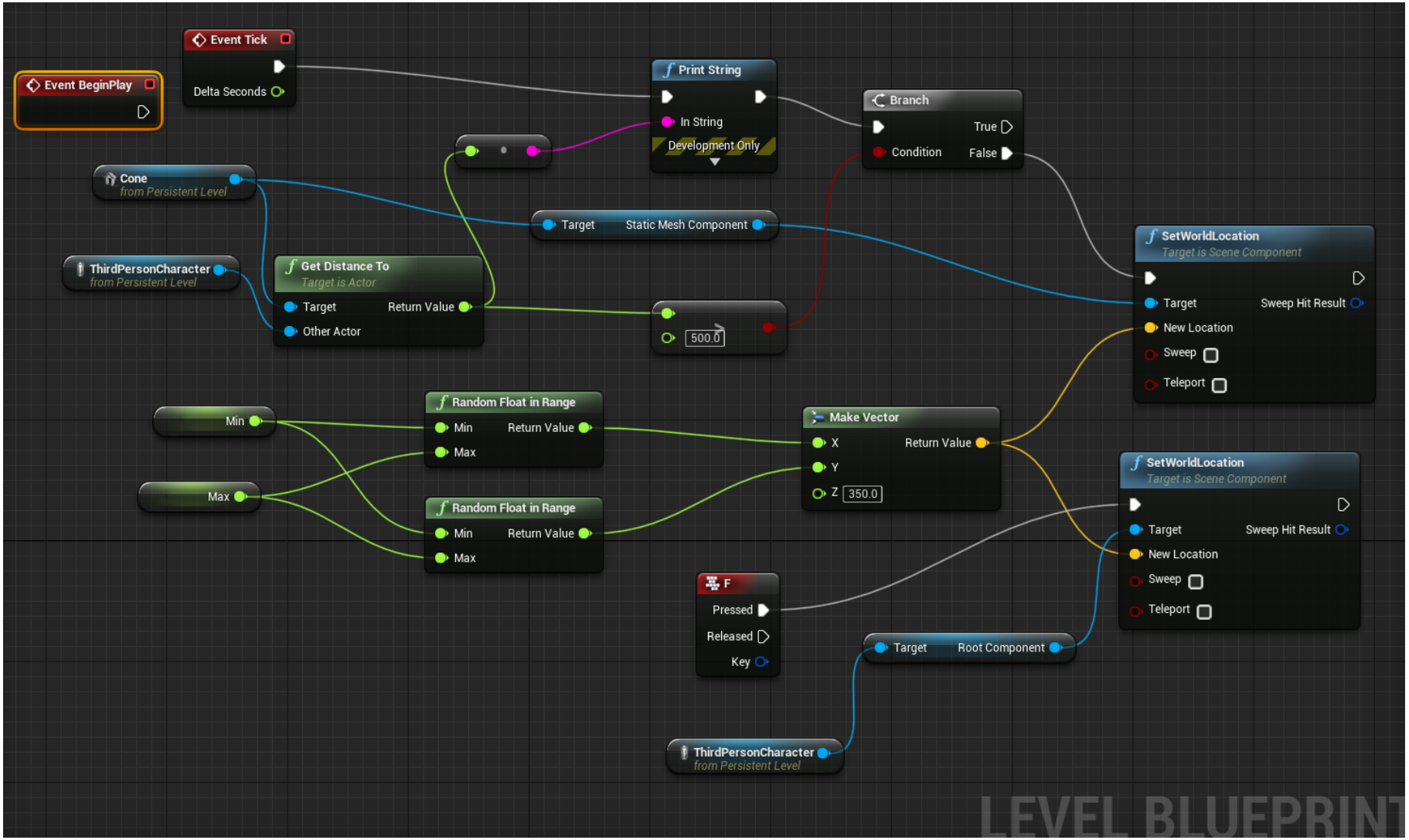


Blueprints - Functions

A ***Sequence*** node can be used to help organize other Blueprint actions.

When triggered, it executes all the nodes connected to the output pins in sequential order—that is, it executes all the actions of pin **“Then 0”**, then all the actions of pin **“Then 1”**, and so on.




Event Tick
Delta Seconds
Event BeginPlay
Print String
In String
Development Only
Branch
True
Condition
False
Cone
from Persistent Level
Target
Static Mesh Component
ThirdPersonCharacter
from Persistent Level
Get Distance To
Target is Actor
Target
Return Value
Other Actor
500.0
SetWorldLocation
Target is Scene Component
Target
Sweep Hit Result
New Location
Sweep
Teleport
Min
Max
Random Float in Range
Min
Return Value
Max
Make Vector
X
Return Value
Y
Z
350.0
F
Pressed
Released
Key
Target
Root Component
ThirdPersonCharacter
from Persistent Level
LEVEL BLUEPRINT

Blueprints

Affects features within Unreal Engine 4 such as:

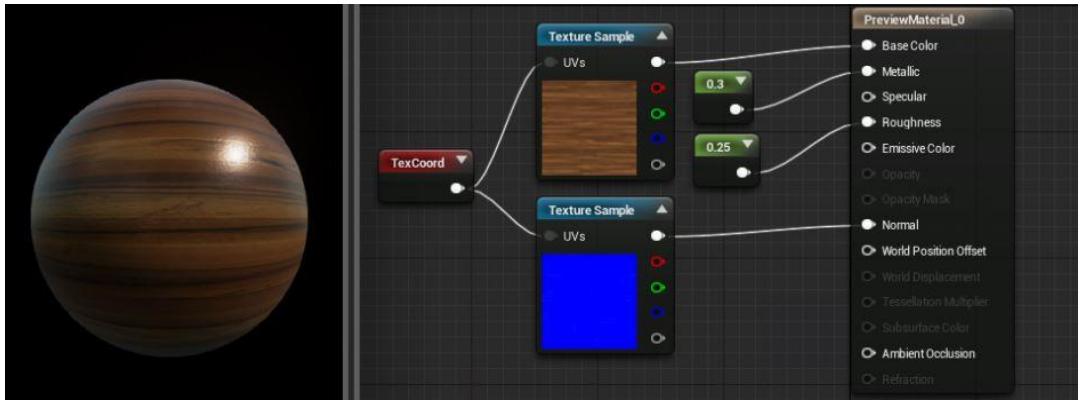
- Materials
- Geometry Animations & Interactions
- AI

Materials

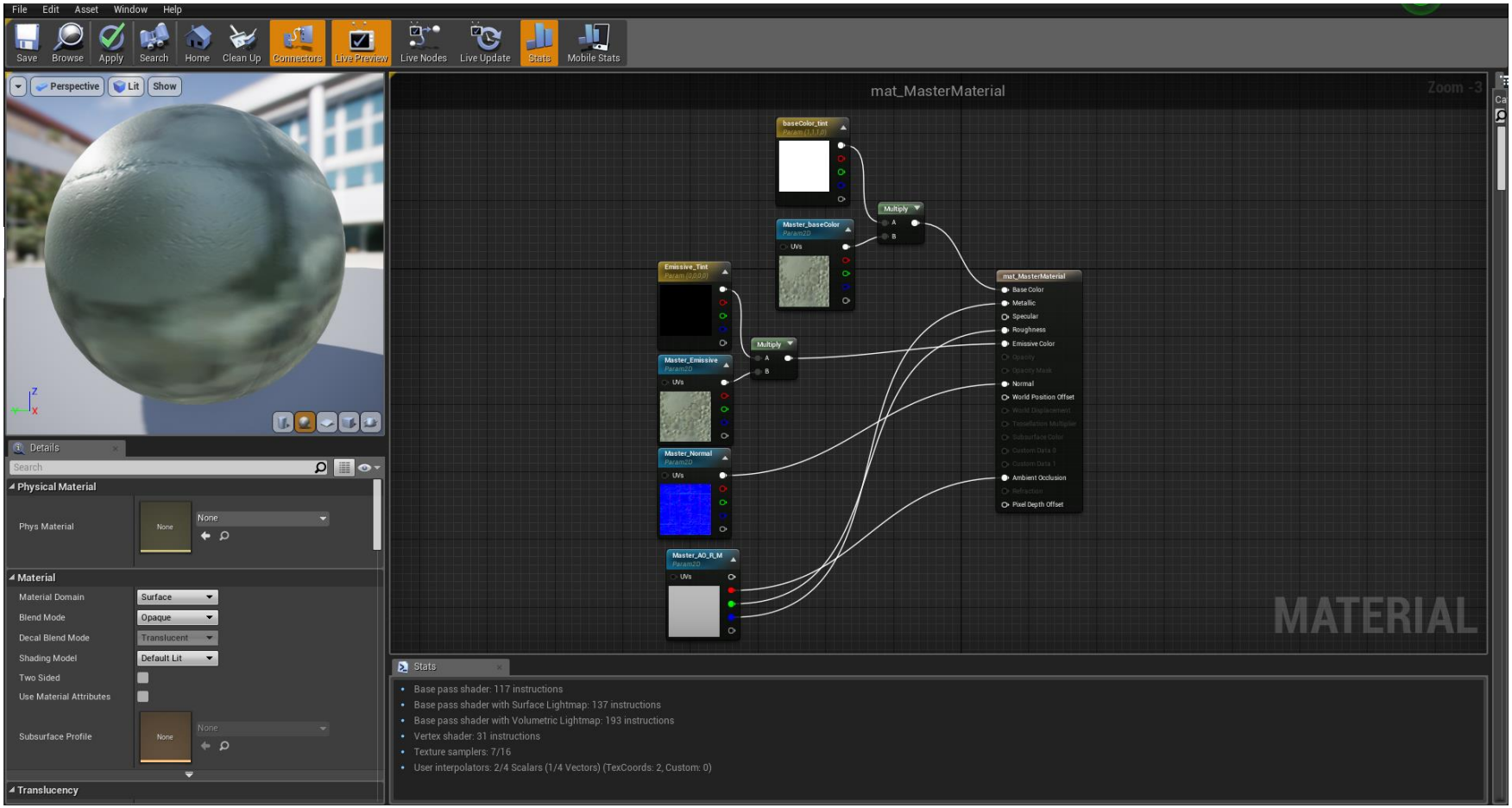
Materials

- Constructed not through code, but via a network of visual scripting nodes (called Material Expressions) within the Material Editor.

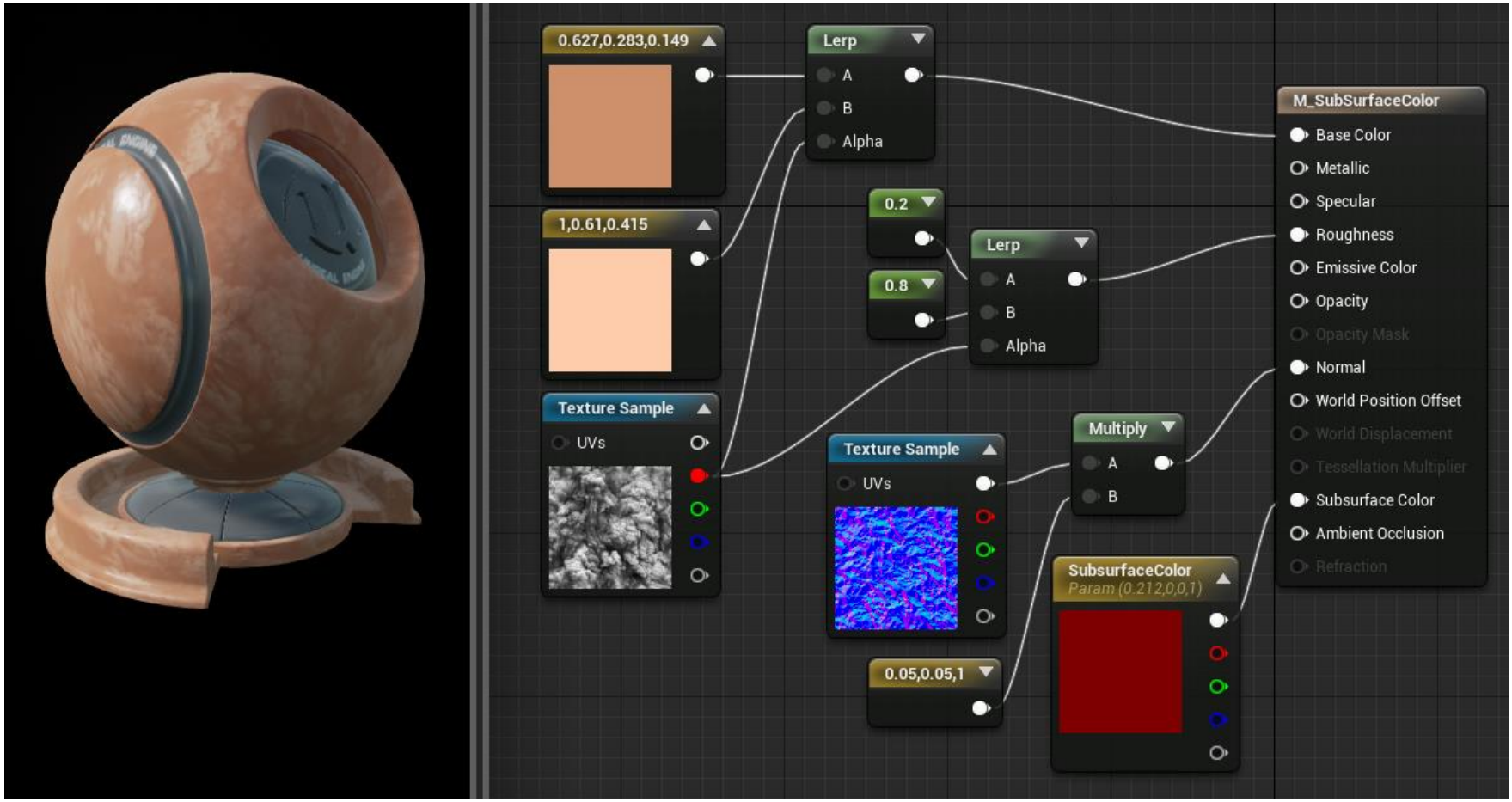
- Each node contains a snippet of **HLSL code**, designated to perform a specific task. This means that as you construct a Material, you are creating HLSL code through visual scripting.



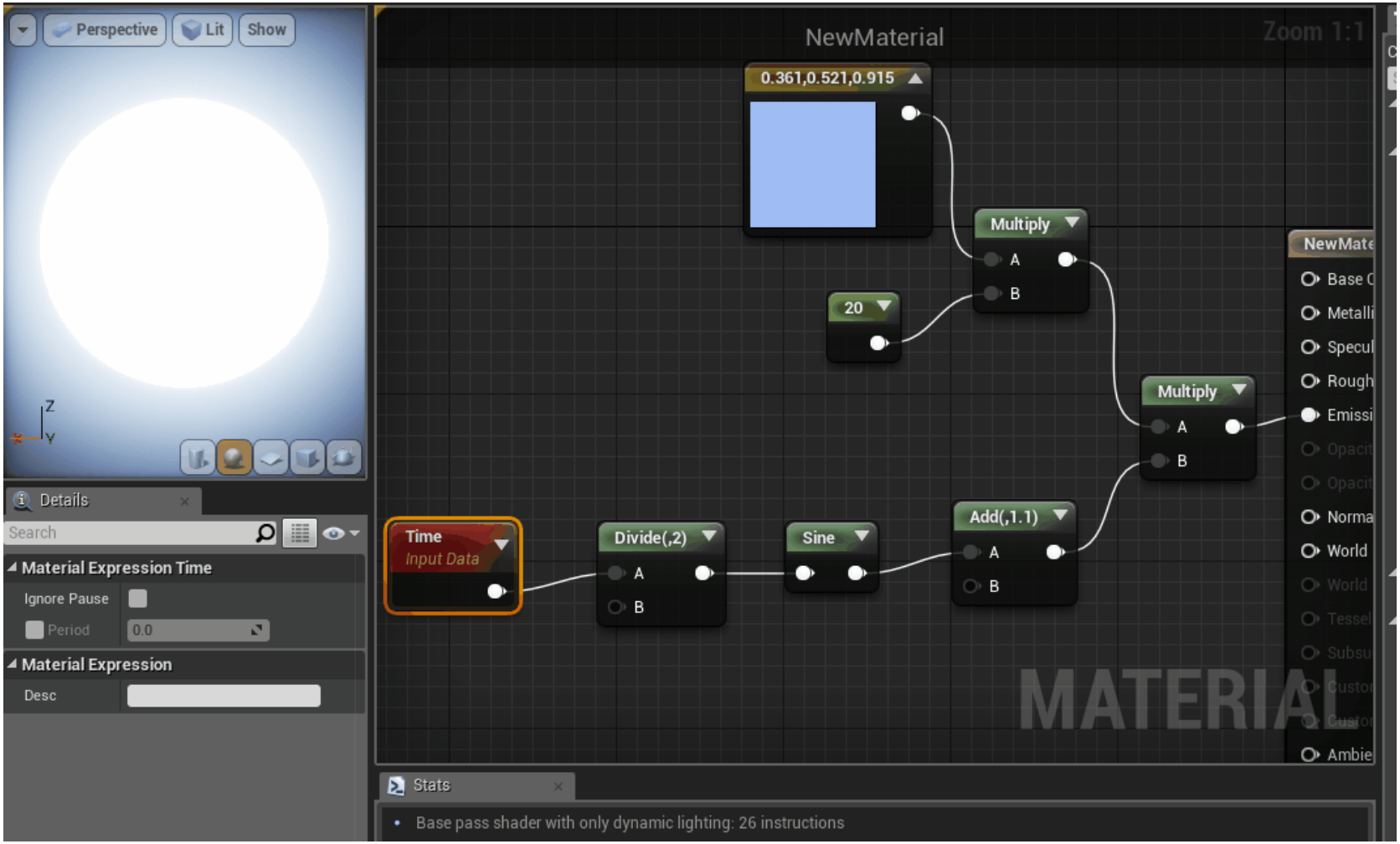
Materials Example 1



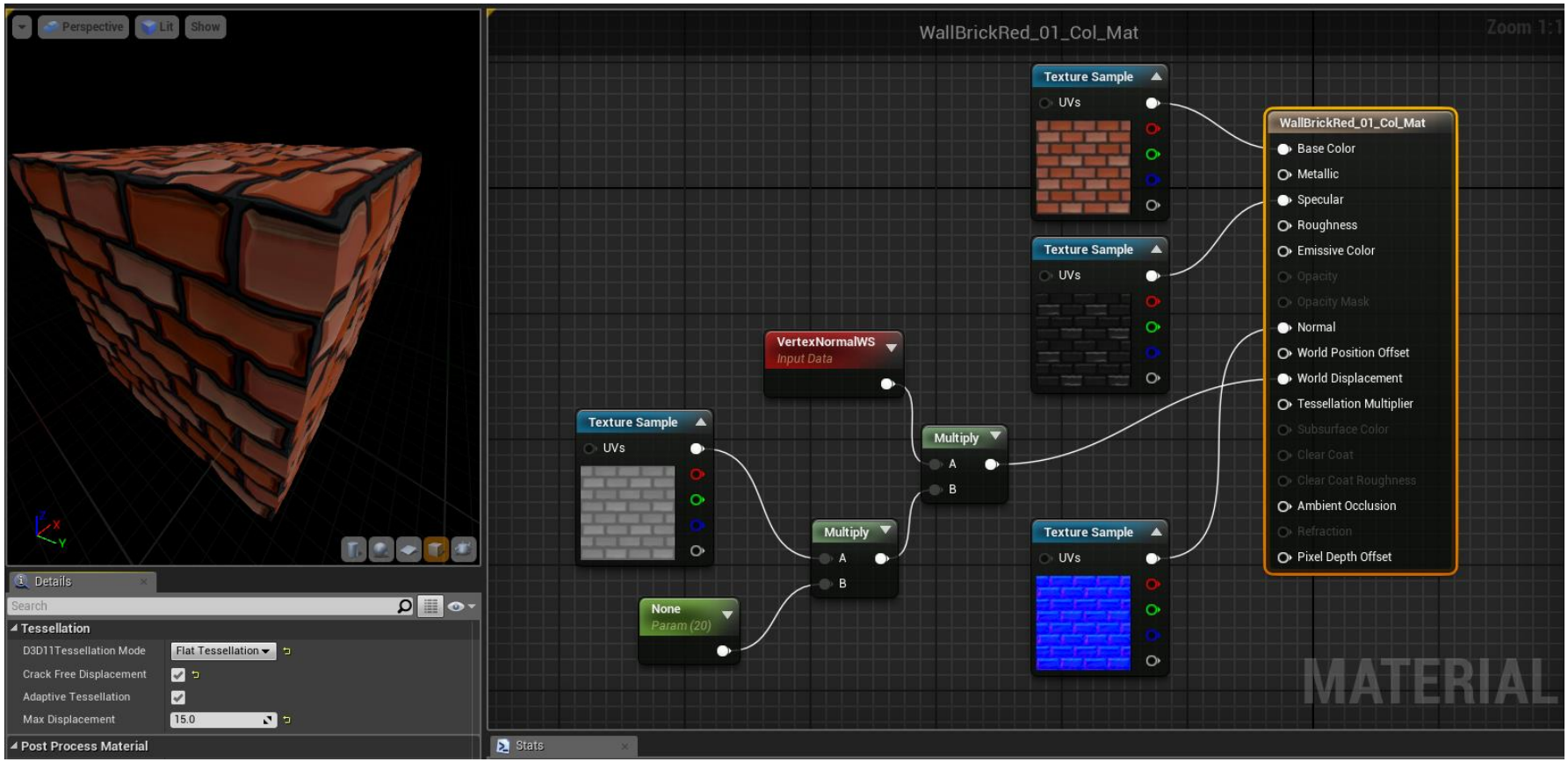
Materials Example 2



Materials Example 3

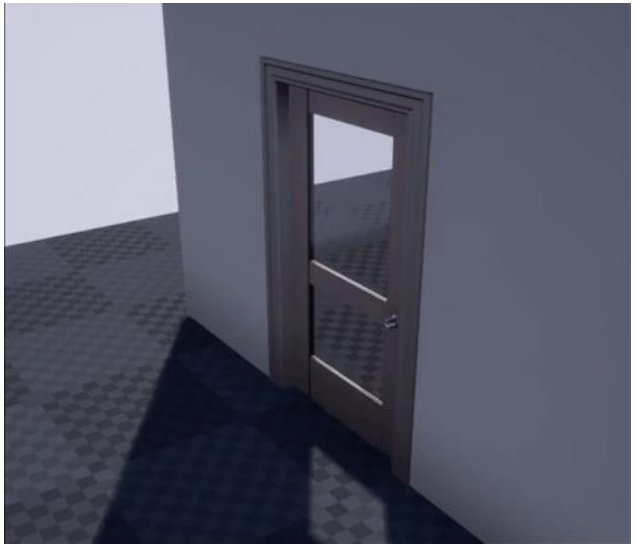


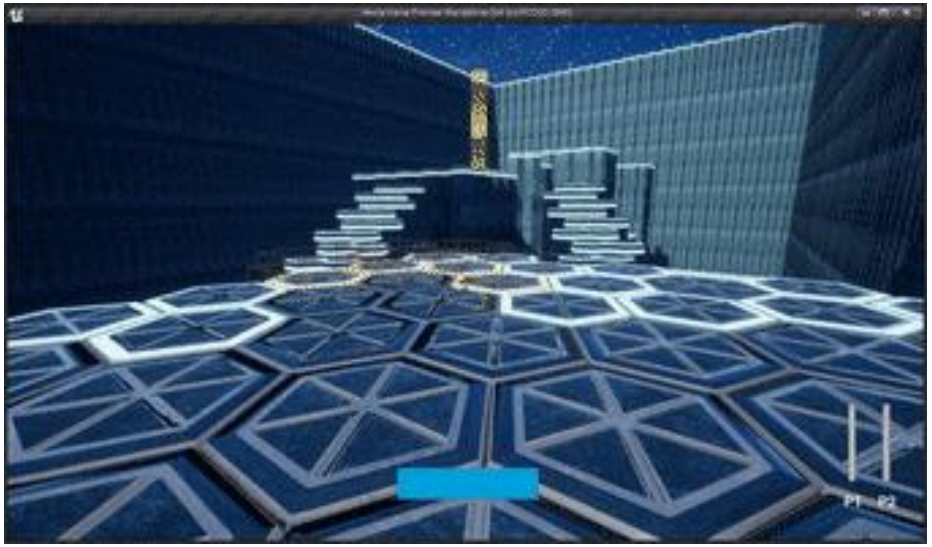
Materials Example 4



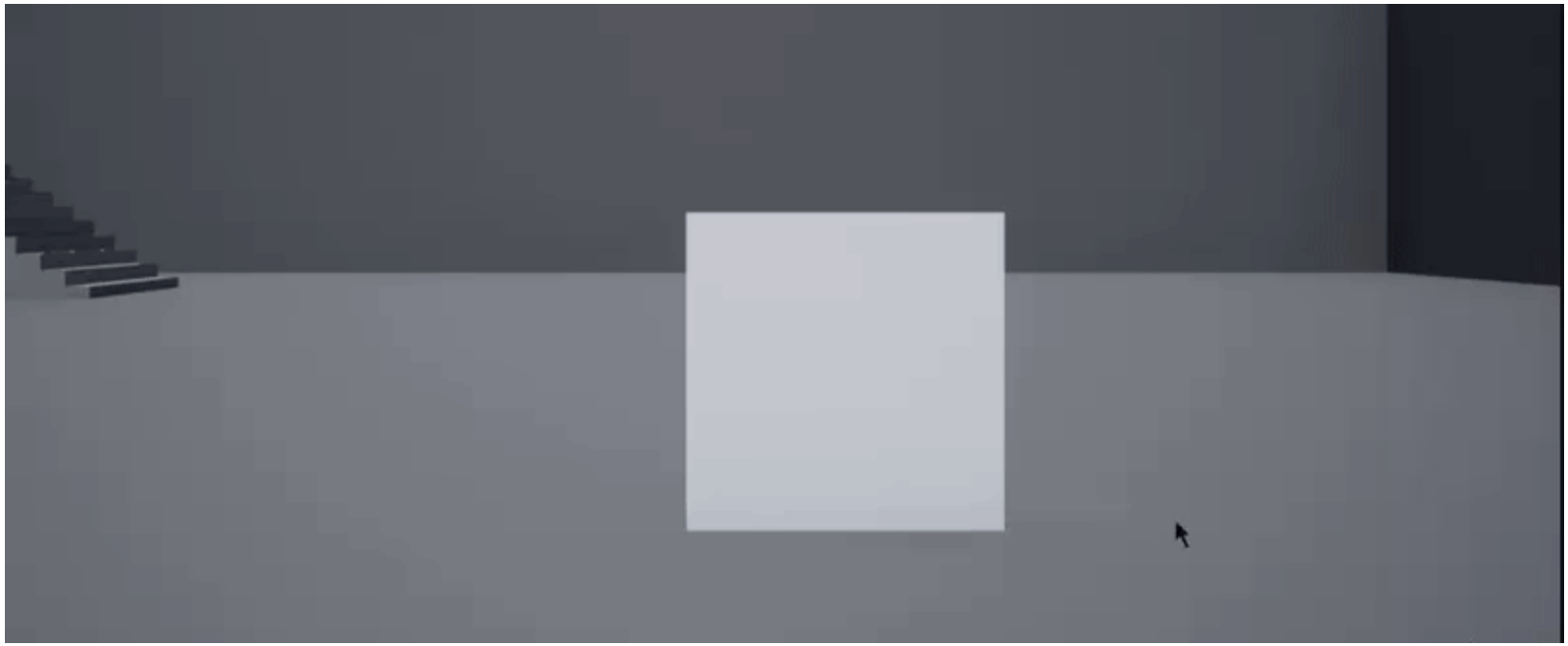
Geometry Animations & Interactions

Examples

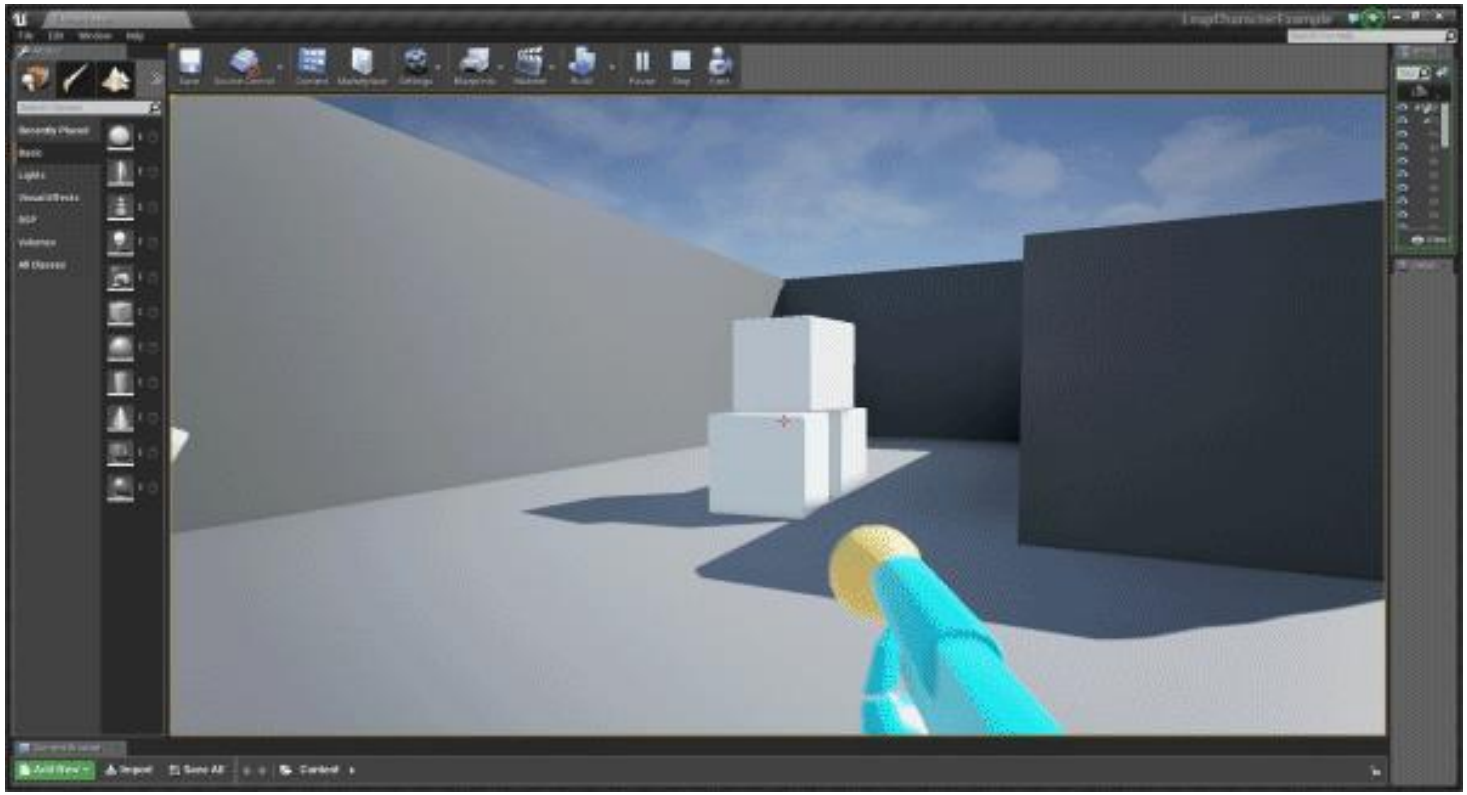




Examples

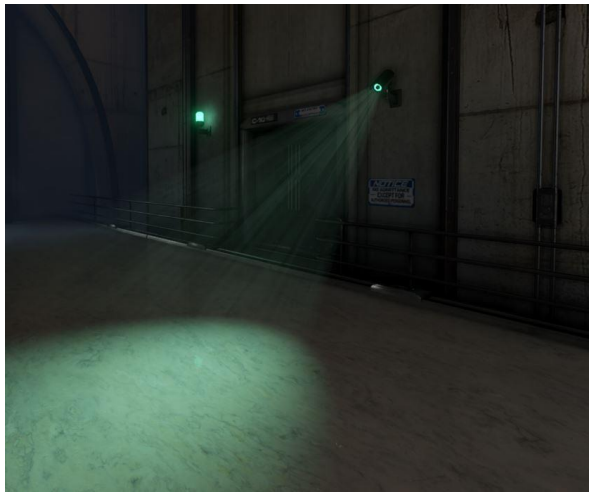


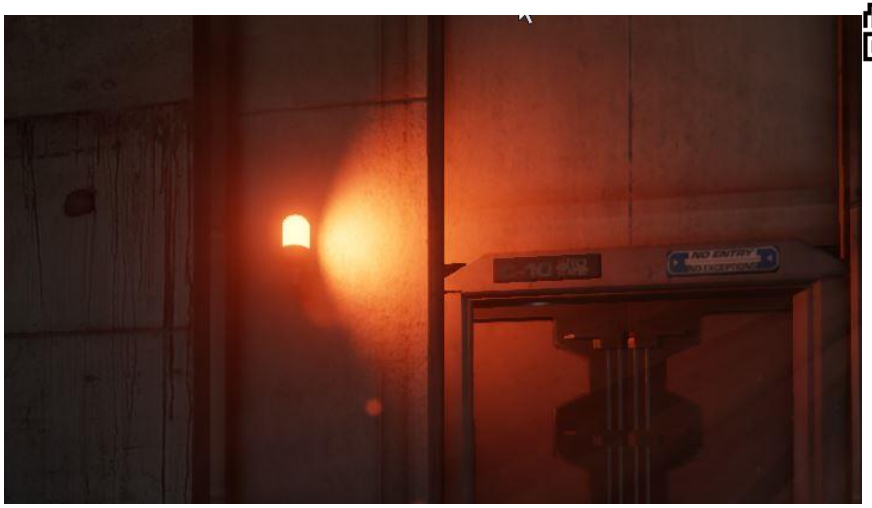
Examples



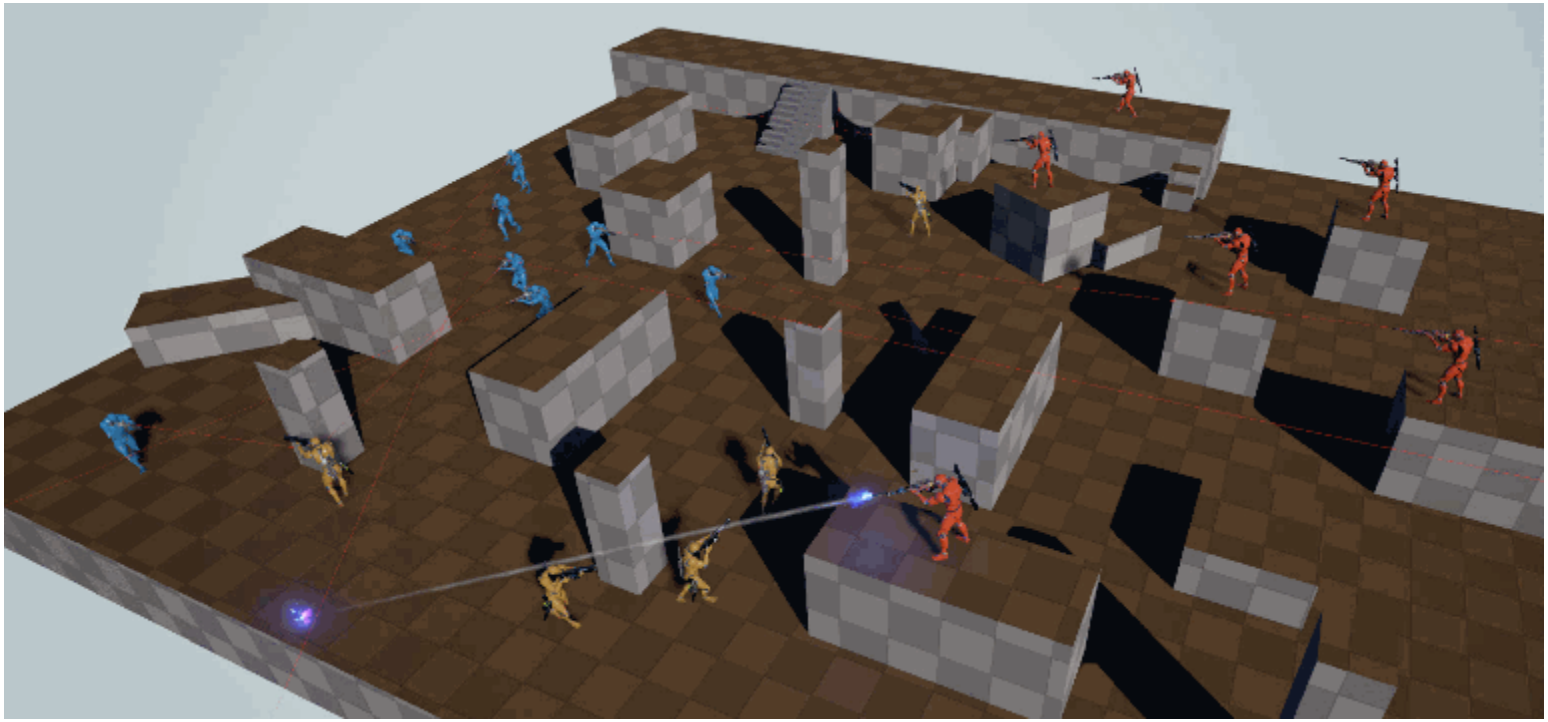
AI

Examples

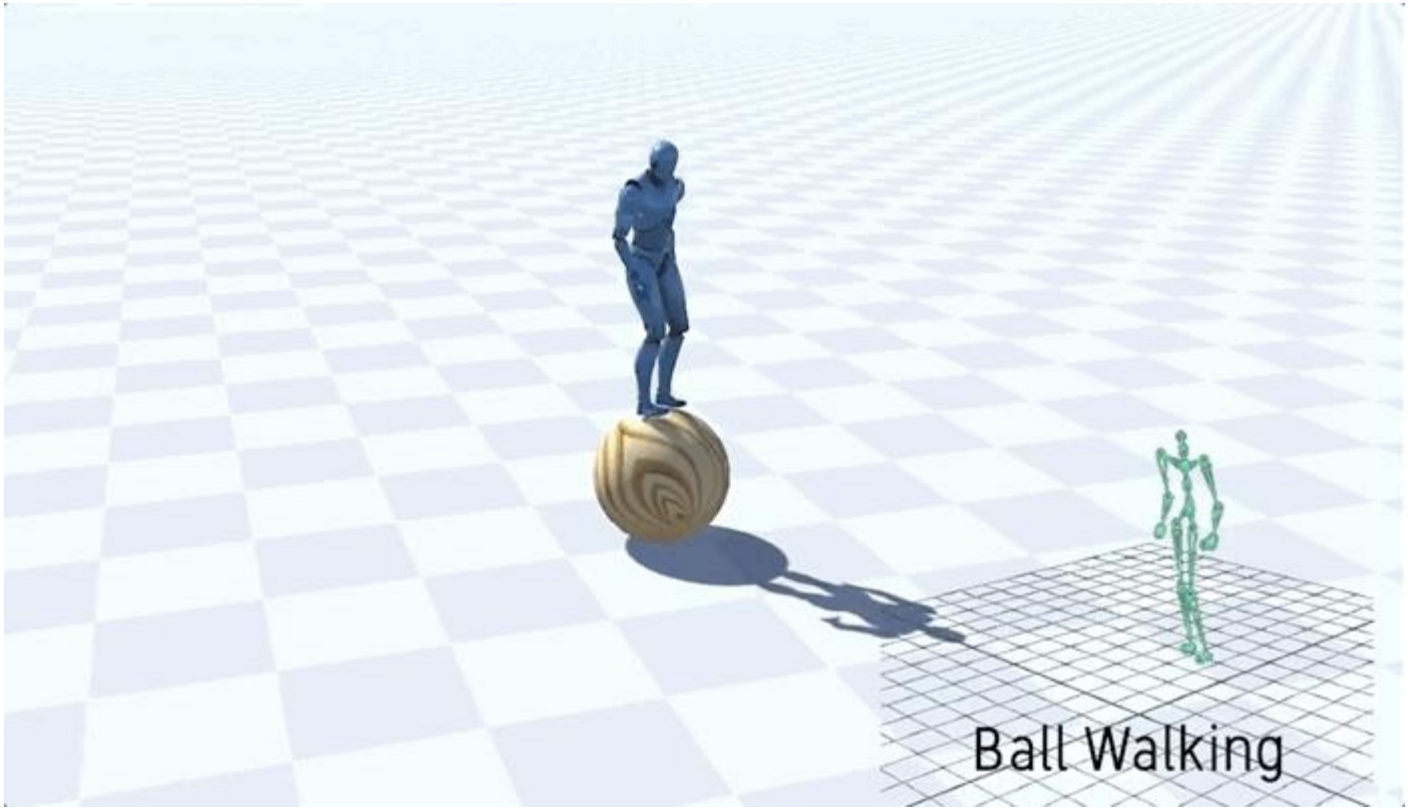




Examples



Examples




UNREAL
ENGINE

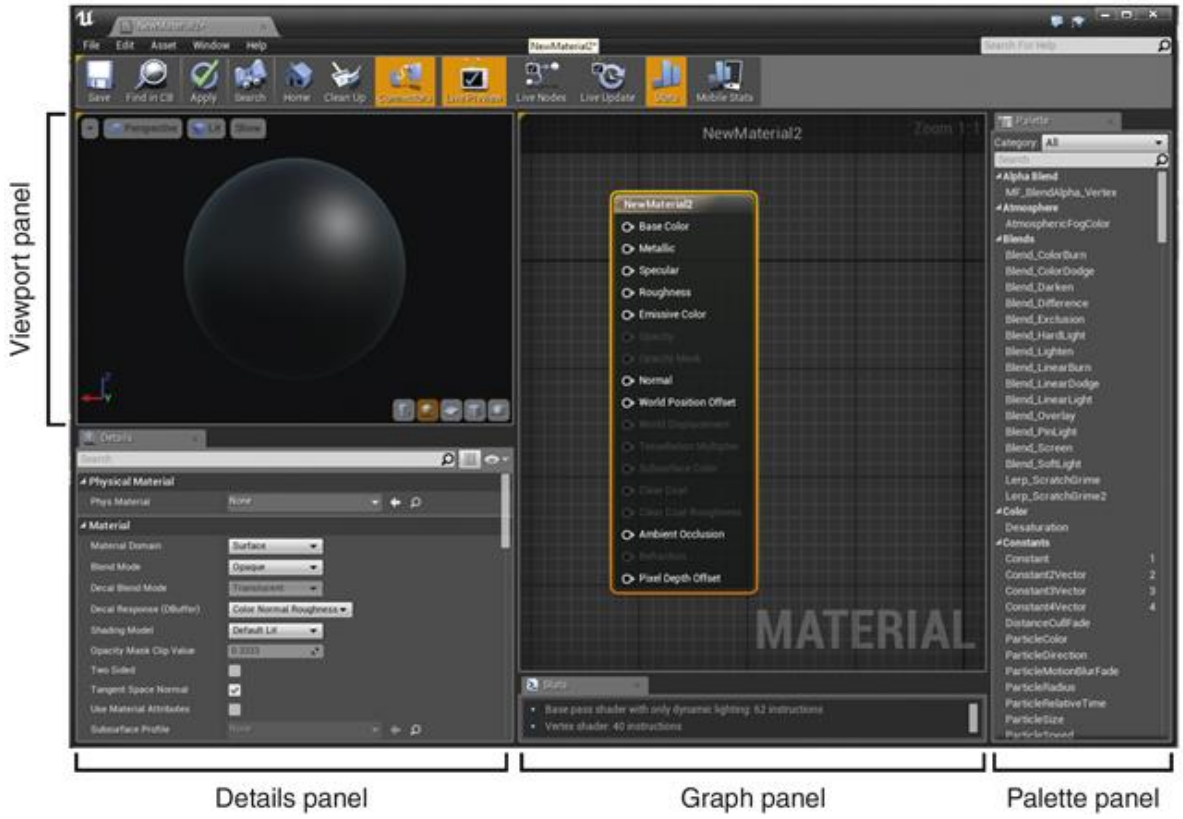
Appendix B: Legends

Blueprint Class Legend

Class Type	Description
Actor	An Actor is an object that can be placed or spawned in the world.
Pawn	A Pawn is an Actor that can be "possessed" and receive input from a Controller.
Character	A Character is a Pawn that includes the ability to walk, run, jump, and more.
PlayerController	A Player Controller is an Actor responsible for controlling a Pawn used by the player.
Game Mode	A Game Mode defines the game being played, its rules, scoring, and other faces of the game type.

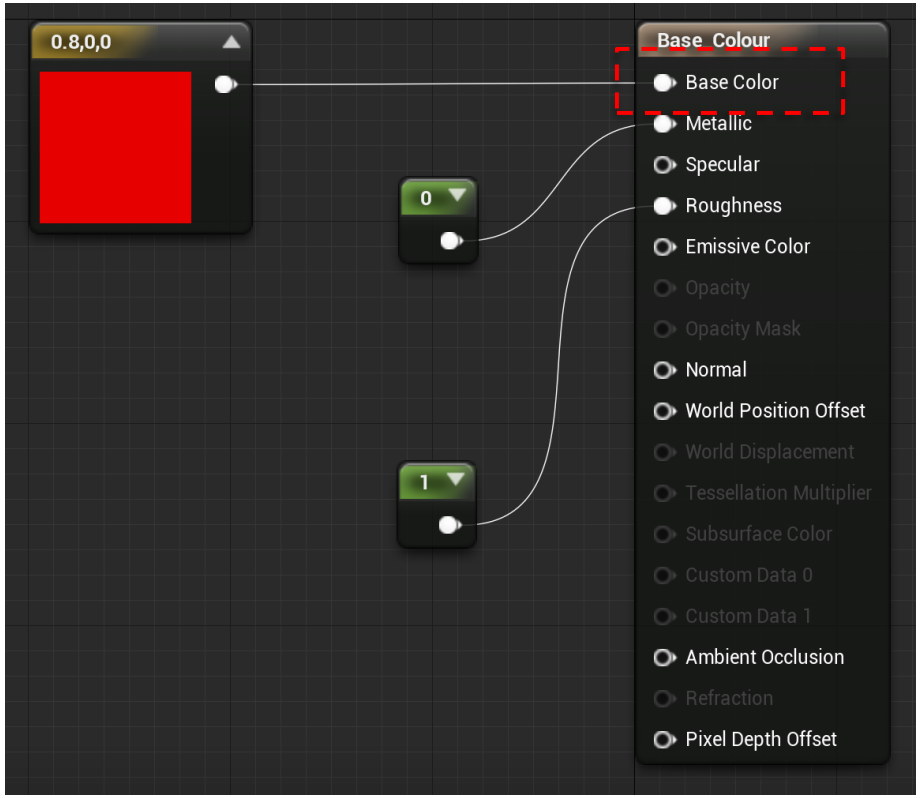
Appendix C: Materials Editor

Materials Editor



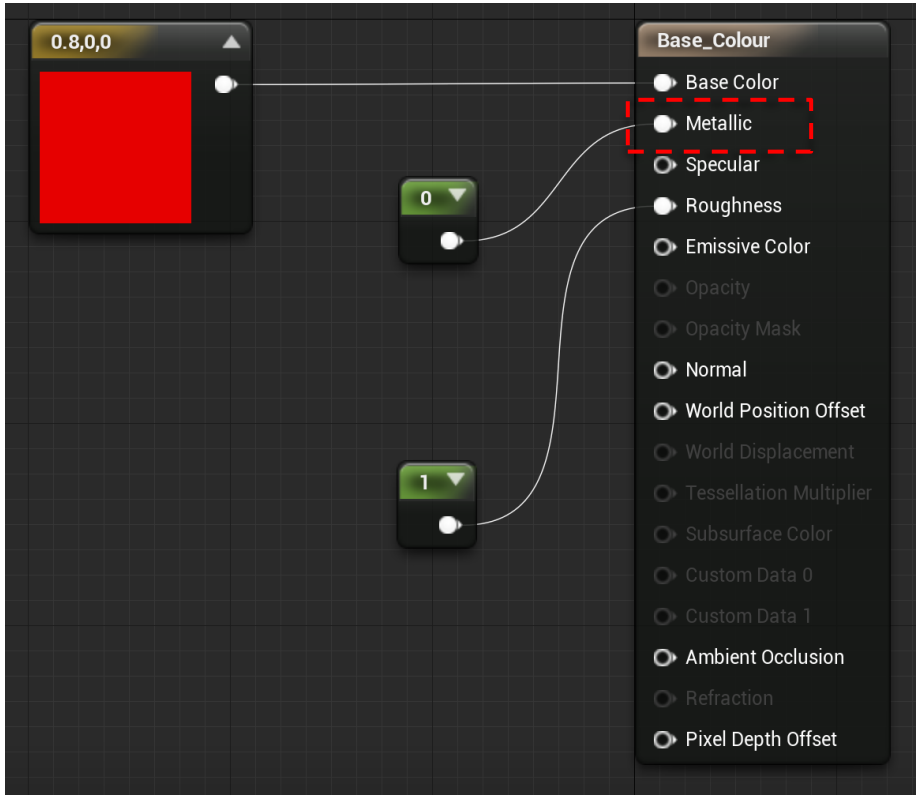
Base Material Node - Base Colour

- It is the main colour of the surface in a Material
- Has no shadow or lighting detail.



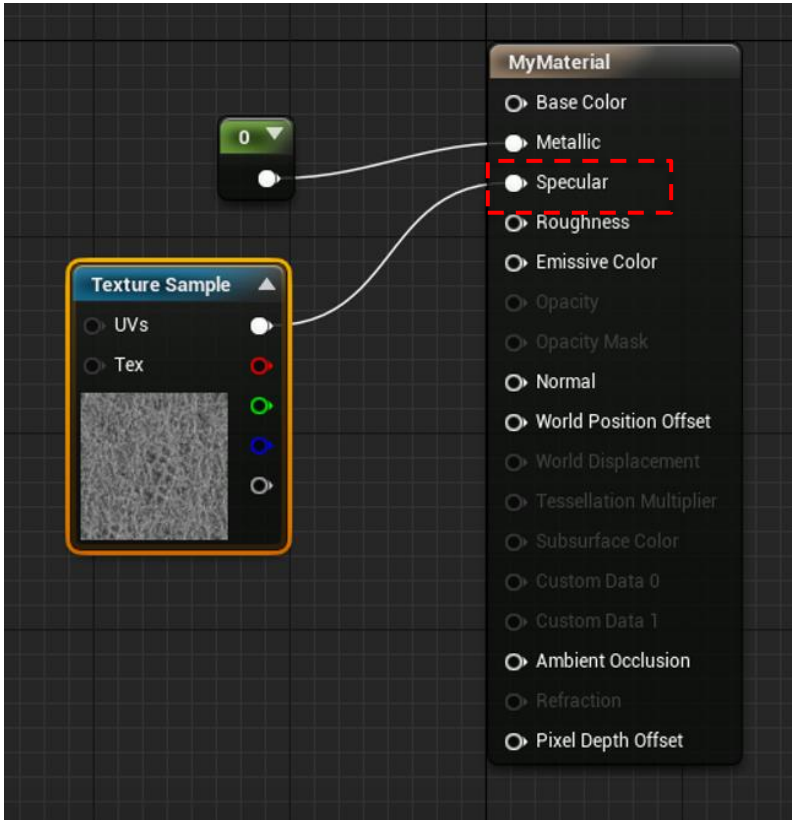
Base Material Node - Metallic

- Determines if the Material looks like a metal.
- 0 / black = not metallic
- 1 / white = fully metallic.
- Affects the reflective properties of the surface.



Base Material Node - Specular

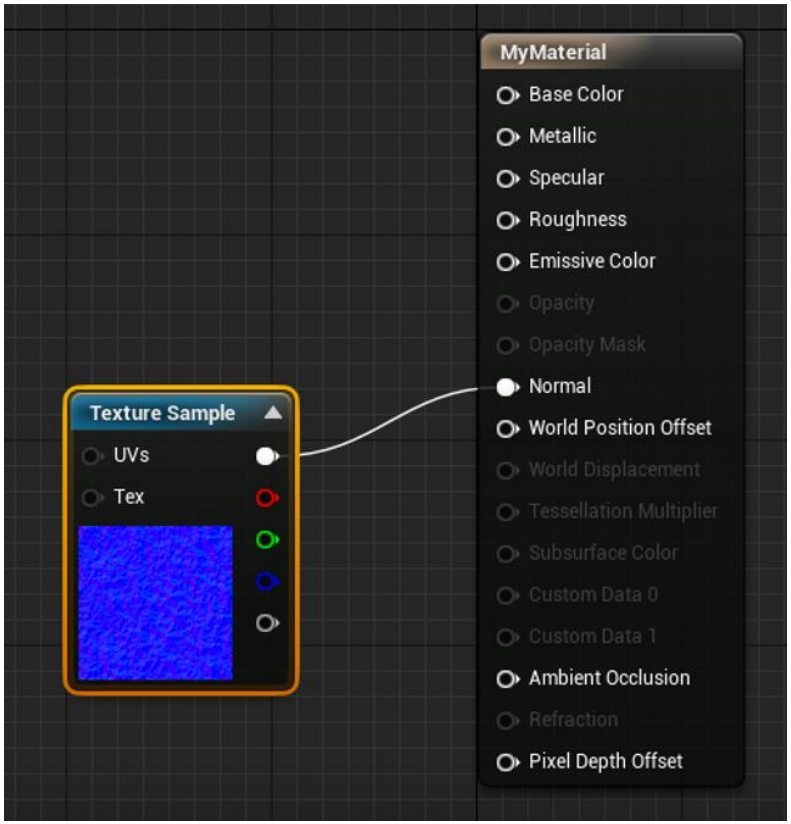
- Determines the overall reflectivity of a surface
- 0 = does not reflect anything
- 1 = reflects everything
- Specular input does not affect metallic Materials.



Base Material Node - Normal

Controls the direction in which light should react with a surface.

Normal maps add high-definition surface detail and shape to a Material by modifying the underlying surface's world normal direction.



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Thank You