How to Create an Augmented Reality Experience

MAY 31, 2022

Content

- XR Prototyping Tools
- XR Toolkits
- Top SDKs for AR
- Get Started with AR in Unity

Review

Typical AR Experiences

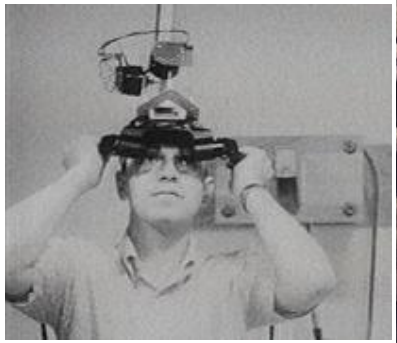
- Web based AR
  - Flash, HTML 5 based AR
  - Marketing, education
- Outdoor Mobile AR
  - GPS, compass tracking
  - Viewing Points of Interest in real world
  - Eg: Layar, Wikitude
- Handheld AR
  - Vision based tracking
  - Marketing, gaming
- Location Based Experiences
  - HMD, fixed screens
  - Museum, point of sale, advertising

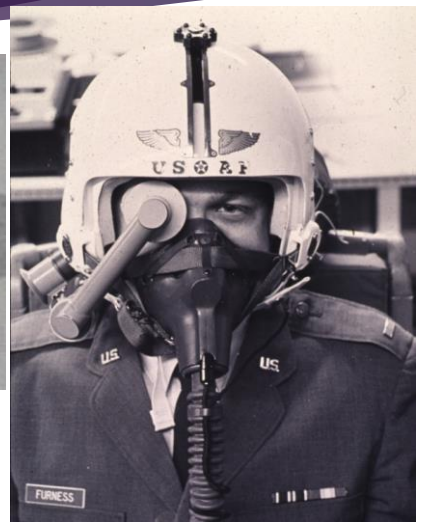
What You Need

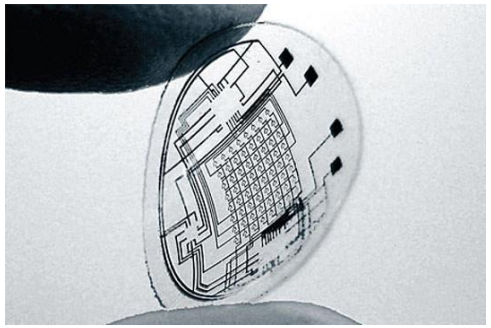
- Smart Device
  - AR Glasses
  - Smart Phone (Android /iOS)
- Authoring Tools/SDK
  - Native SDK
  - Unity/Unreal game engine
  - Non programming tools
- Content
  - 3D models, videos, images, sounds …

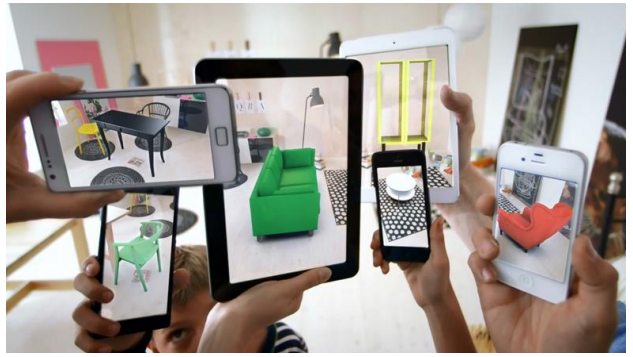
AR Display Technology

- Past
  - Bulky Head Mounted Display
- Current
  - Handheld, lightweight head mounted display
- Future
  - Wide FOV see through
  - Retinal displays
  - Contact lens









AR Display

Vuzix M100

Vuzix M400

Vuzix Wrap 1200

Epson BT200

Google Glass

Lumus DK40

Recon Jet

Eyerysight Raptor

Microsoft HoloLens

DAQRI

HRBox

Magic Leap One

AR Display（国内）

Angleyes G7F

MAD GAZE VADER

ThinkReality A3

INMO AIR

HiAR G200

OPPO AR Glass

Shadow Creator

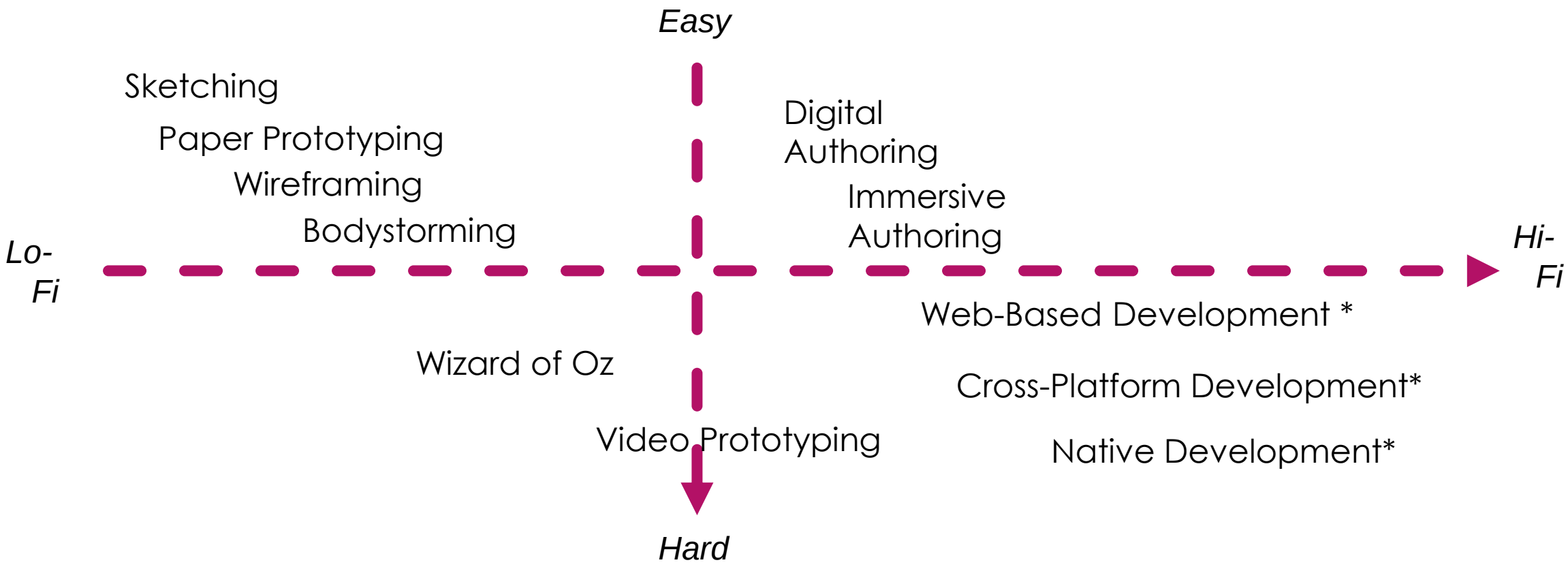
Nreal Light

VR Display

XR Prototyping Tools

- **Low Fidelity (Concept, visual design)**
  - Sketching
  - Photoshop
  - PowerPoint
  - Video
- **High Fidelity (Interaction, experience design)**
  - Interactive sketching
  - Desktop & on-device authoring
  - Immersive authoring & visual scripting
  - XR development toolkits

XR Prototyping Techniques



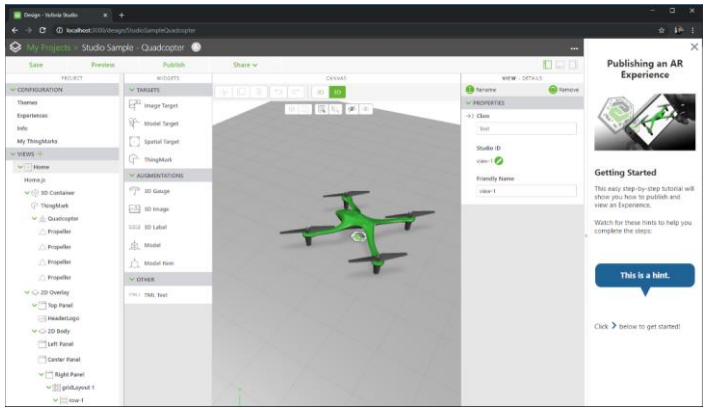
** Requires scripting and 3D programming skills*

Digital Authoring Tools for AR

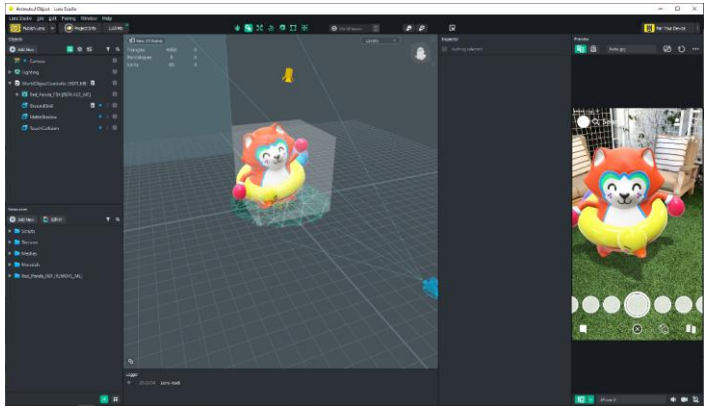
- Support visual authoring of marker-based and/or marker-less AR apps
- Provide default markers and support for custom markers
- Typically enable AR previews through emulator but need to deploy to AR device for testing

Digital Authoring Tools for AR

- Vuforia Studio
- Lens Studio
- Zapworks Studio
- Snap LensStudio



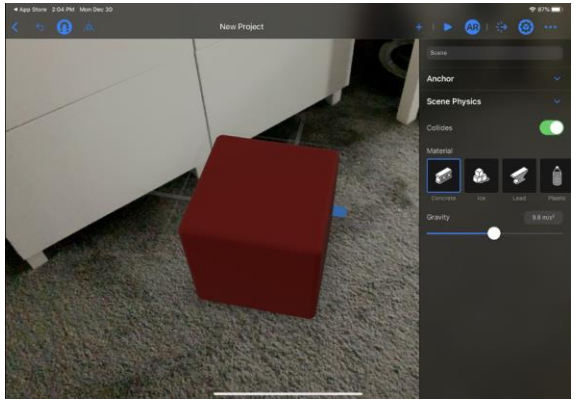
Vuforia Studio



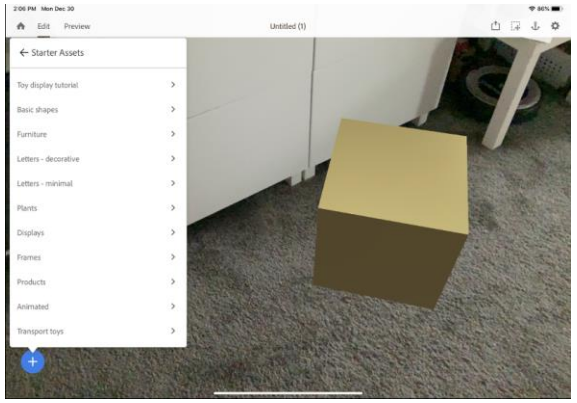
Lens Studio

Immersive Authoring Tools for AR

- Enable visual authoring of 3D content in AR
- Make it possible to edit while previewing AR experience in the environment
- Provide basic support for interactive behaviors
- Sometimes support export to WebXR



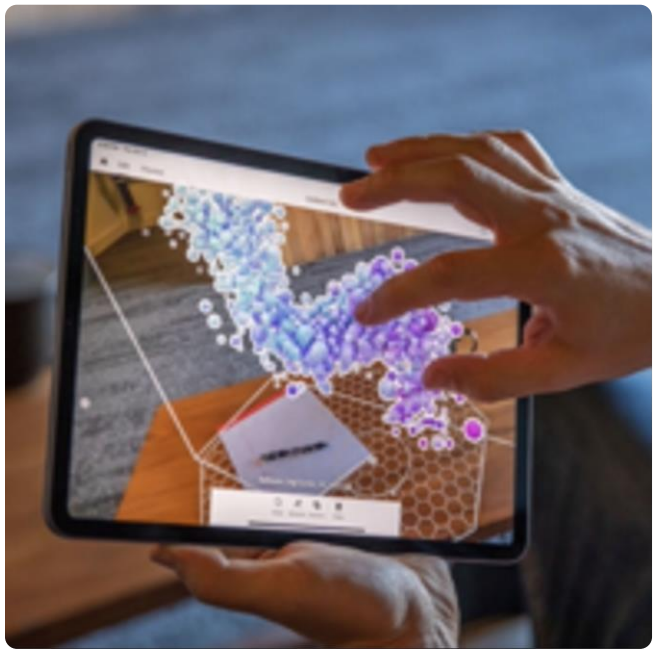
Apple Reality Composer

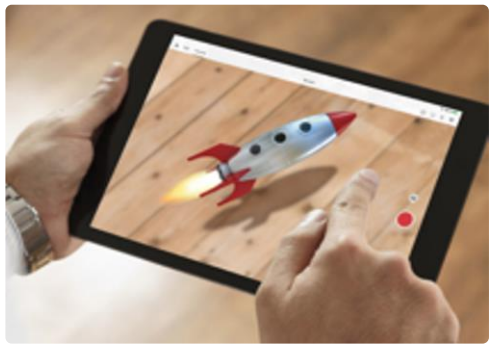


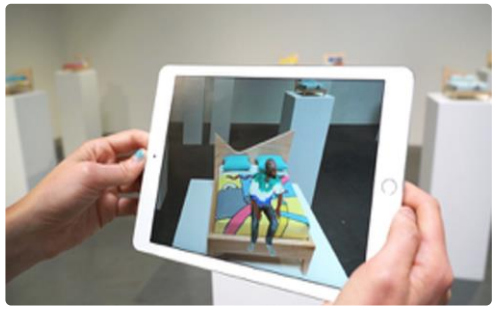
Adobe Aero

Adobe Aero

- Create AR on mobile devices
- Touch based interaction and authoring
- Only iOS support for now



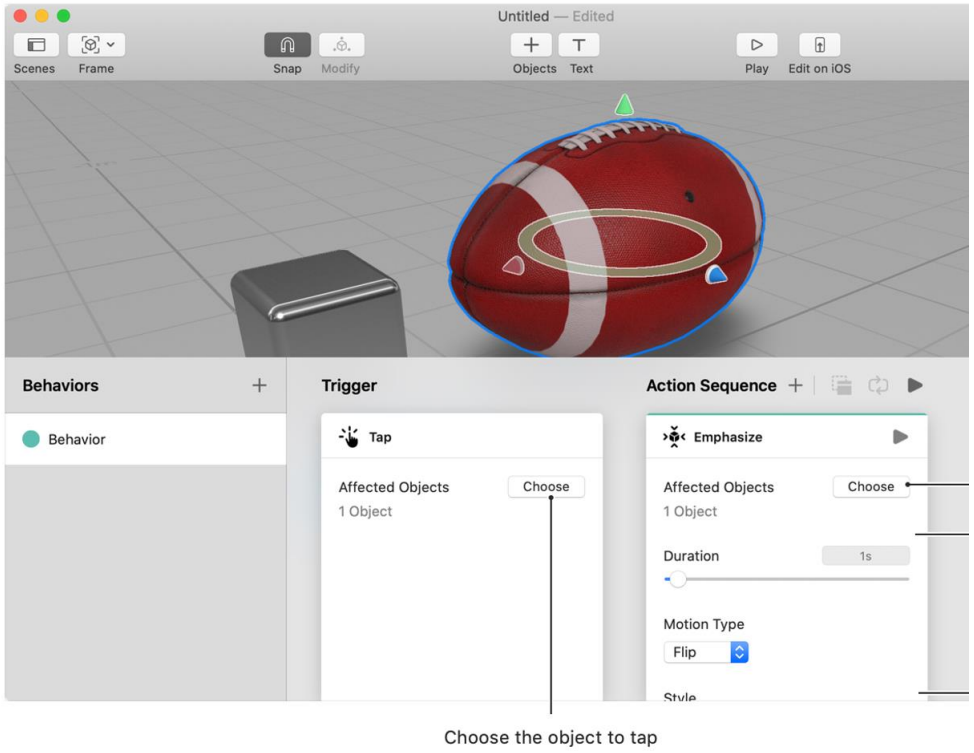




https://www.adobe.com/nz/products/aero.html

Apple Reality Composer

- Rapidly create 3D scenes and AR experiences
  - Creation on device (iPhone, iPad)
  - Drag and drop interface
  - Loading 2D/3D content
  - Simple interactivity – trigger/action
- Anchor content in real world (AR view)
  - Planes (vertical, horizontal), faces, images



XR Tools Landscape

- Digital & Immersive Authoring: Good for storyboarding but limited support for interactions
  - Proto.io, Tour Creator, …
  - Tilt Brush, Blocks, Quill, …
- Web-Based Development: Good for basic XR apps but often interactions feel unfinished
  - THREE.js, Babylon.js, …
  - A-Frame, AR.js
- Cross-Platform Development: Good for full-fledged XR apps but usually high learning curve
  - Unity + SDKs
  - Unreal SDKs
- Native Development: Good for full-fledged XR apps but limited to a particular platform
  - Cardboard/Oculus/Vive/ … SDK
  - Vuforia/ARCore/ARKit/… SDK

XR Toolkits

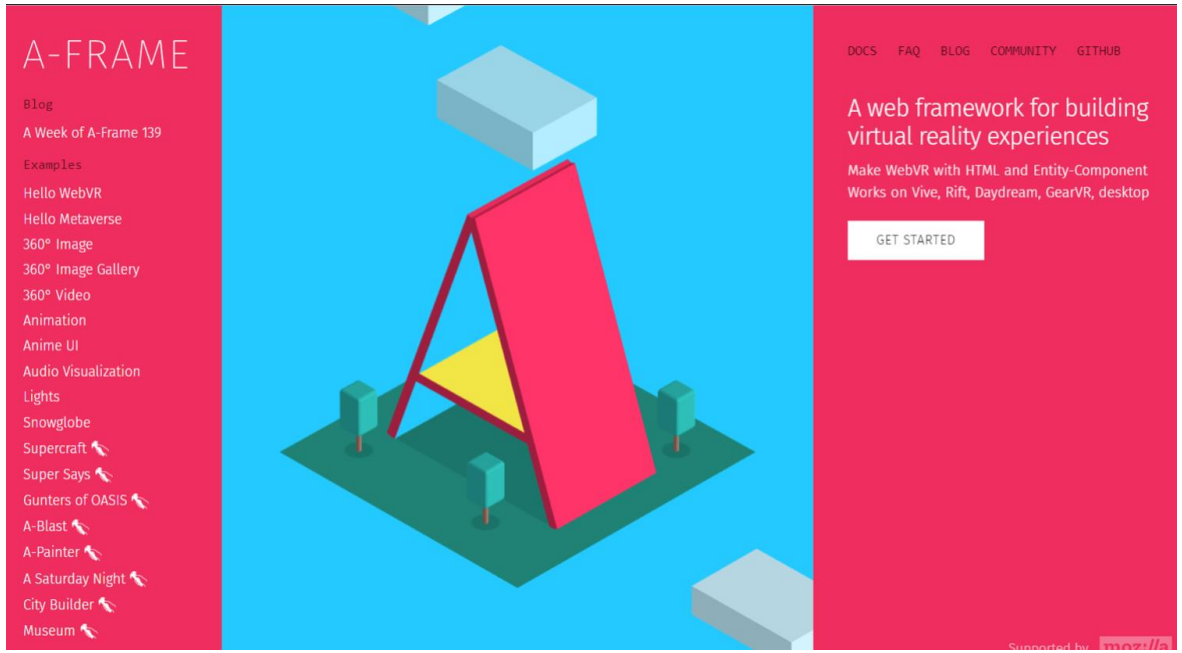
A-Frame
AR.js
SteamVR
MRTK
Vuforia
AR Foundation
XR Interaction

Cardboard	Oculus	VIVE	WMR

WebCam	ARCore	ARKit	HoloLens

WebXR: A-Frame

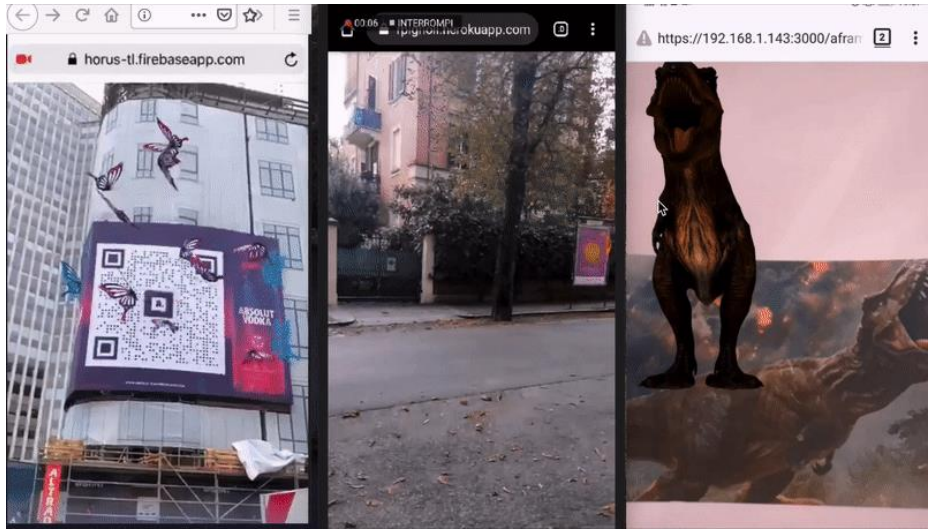
- Based on Three.js and WebGL
- New HTML tags for 3D scenes
- A-Frame Inspector(not editor)
- Asset management(image, video, audio & 3D models)
- ECS architecture with many open-source components
- Cross-platform XR



AR.js – WebXR Tracking

- Web based AR tracking library
  - **Marker tracking**: ARToolkit markers
  - **Image tracking**: Natural feature tracking
  - **Location tracking**: GPS and compass
- Key Features
  - **Very fast:** It runs efficiently even on phones
  - **Web-based** : It is a pure web solution, so no installation required.
    - Full javascript based on three.js + A-Frame + jsartoolkit5
  - **Open Source** : It is completely open source and free of charge!
  - **Standards** : It works on any phone with webGL and webRTC

See https://ar-js-org.github.io/AR.js-Docs/



AR.js Demo

- Image Tracking Example

https://ar-js-org.github.io/AR.js-Docs/#tutorials

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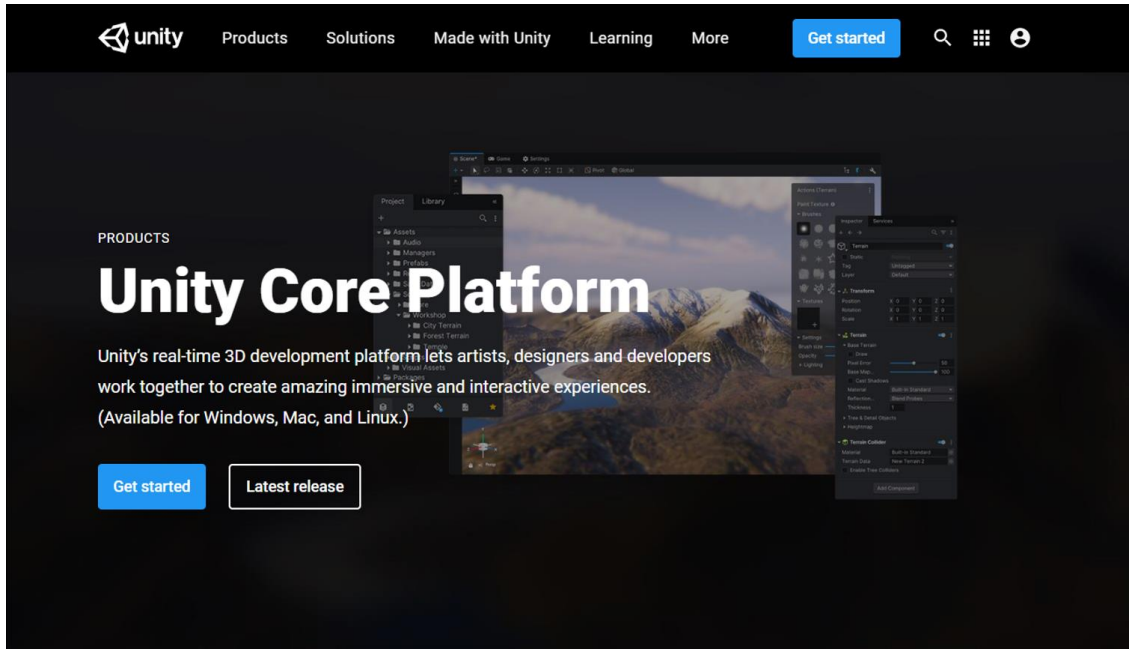
Unity

- Started out as game engine
- Has integrated support for many types of XR apps
- Powerful scene editor
- Asset management & store
- Basically, all XR device vendors provide Unity SDKs



Vuforia

- Highly optimized computer vision tracking
- Multiple types of tracking
  - Image tracking, object tracking, model tracking, area tracking, etc.
- Interaction features
  - Virtual buttons, occlusion, visual effects,
- Multi-platform
  - Mobile AR, AR headsets

See https://www.vuforia.com/

AR Foundation

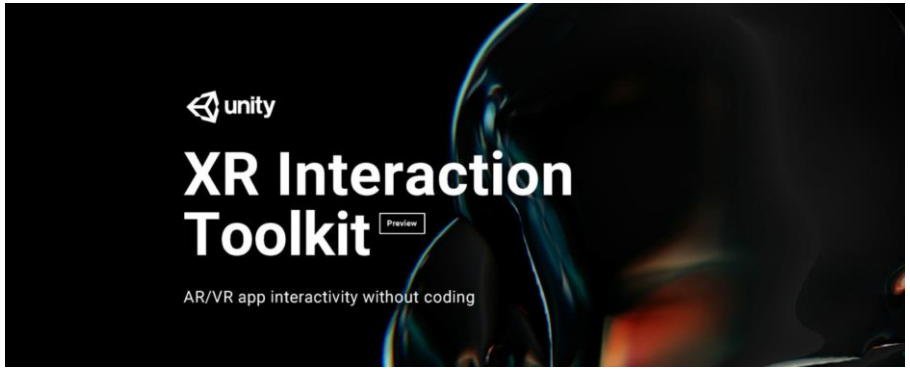
- A unified Framework for AR
  - Multi-platform API
  - Includes core features from ARKit, ARCore, Magic Leap, and HoloLens
  - Set of behaviours and API with following features
    - Tracking, light estimation, occlusion, meshing , video pass-through, etc.
- Integrates with Unity MARS

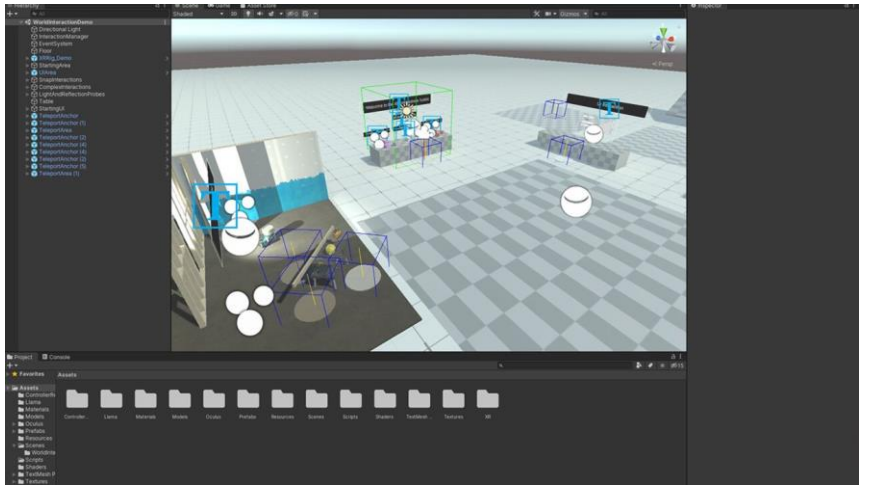
See https://unity.com/unity/features/arfoundation

Unity XR Interaction Toolkit(Preview package)

- Easy way to add interactivity to AR/VR experience
  - Object interactions
  - UI interactions
  - Locomotion
- Enabling common interactions without writing code
  - AR gesture, object placement, annotations

https://docs.unity3d.com/Packages/com.unity.xr.interaction.toolkit@1.0/

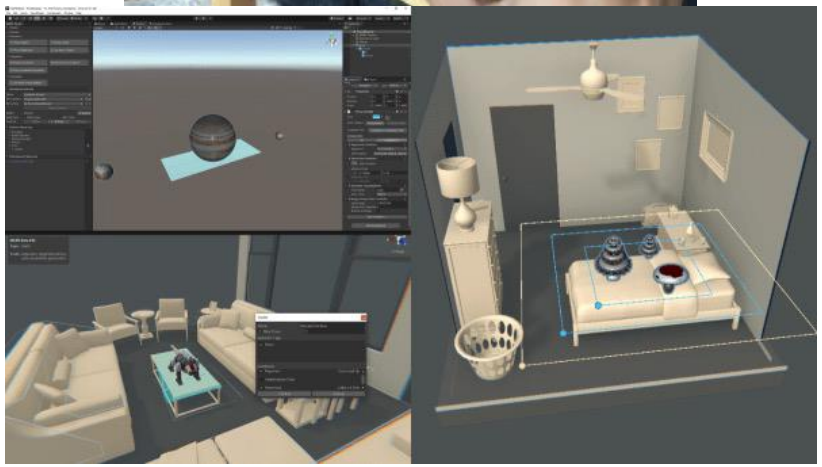




Unity MARS

- Features
  - Visually author AR apps (WYSIWYG)
  - Test apps in Unity editor
  - Develop apps that can interact with real world
  - Intelligent real-world recognition
- Multi-platform development
  - Based on ARFoundation
  - ARKit, ARCore, Magic Leap and Hololens

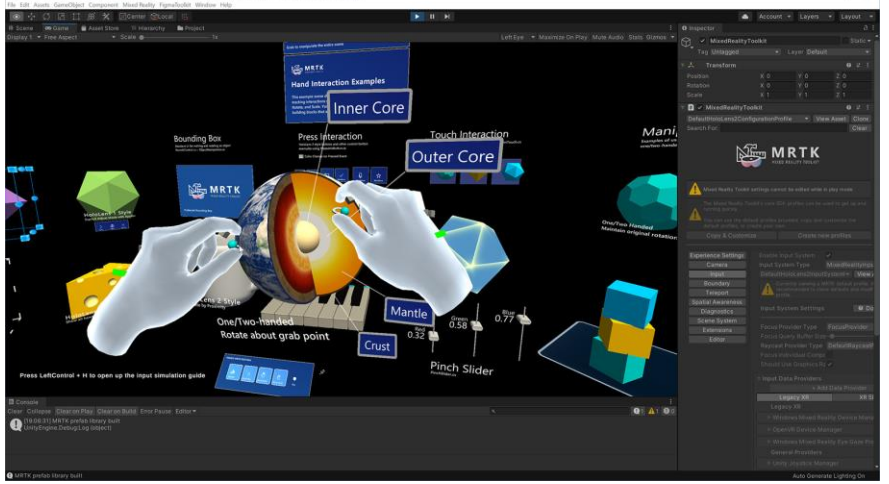
See unity.com/mars



Mixed Reality ToolKit (MRTK)

- Open-Source Mixed Reality ToolKit
  - Set of Unity modules/Unreal plugin
- Interaction Models
  - Controllers, gesture, gaze, voice, etc.
- UX elements
  - Foundational elements
    - Material, text, light, etc.
  - Controls and behaviours
    - Button, menu, slider, etc.
- Tutorials, documentation, guidelines

See https://github.com/microsoft/MixedRealityToolkit-Unity



Top SDKs for AR

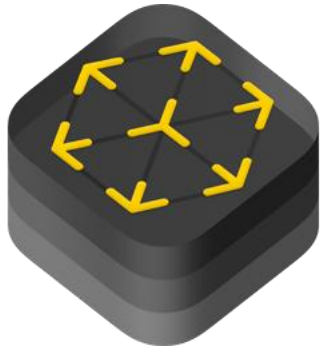
- ARKit
  https://developer.apple.com/documentation/arkit
- ARCore
  https://developers.google.com/ar
- PTC Vuforia
  https://www.ptc.com/en/products/augmented-reality/vuforia
- Witkitude
  https://www.wikitude.com/
- Maxst (KOR)
  https://developer.maxst.com/?lang=en

Top SDKs for AR

- DeepAR
  https://www.deepar.ai/
- EasyAR
  https://www.easyar.com/
- Xzimg
  https://www.xzimg.com/
- Kudan
  https://www.kudan.io/
- ARToolKit
  https://github.com/artoolkit/artoolkit5

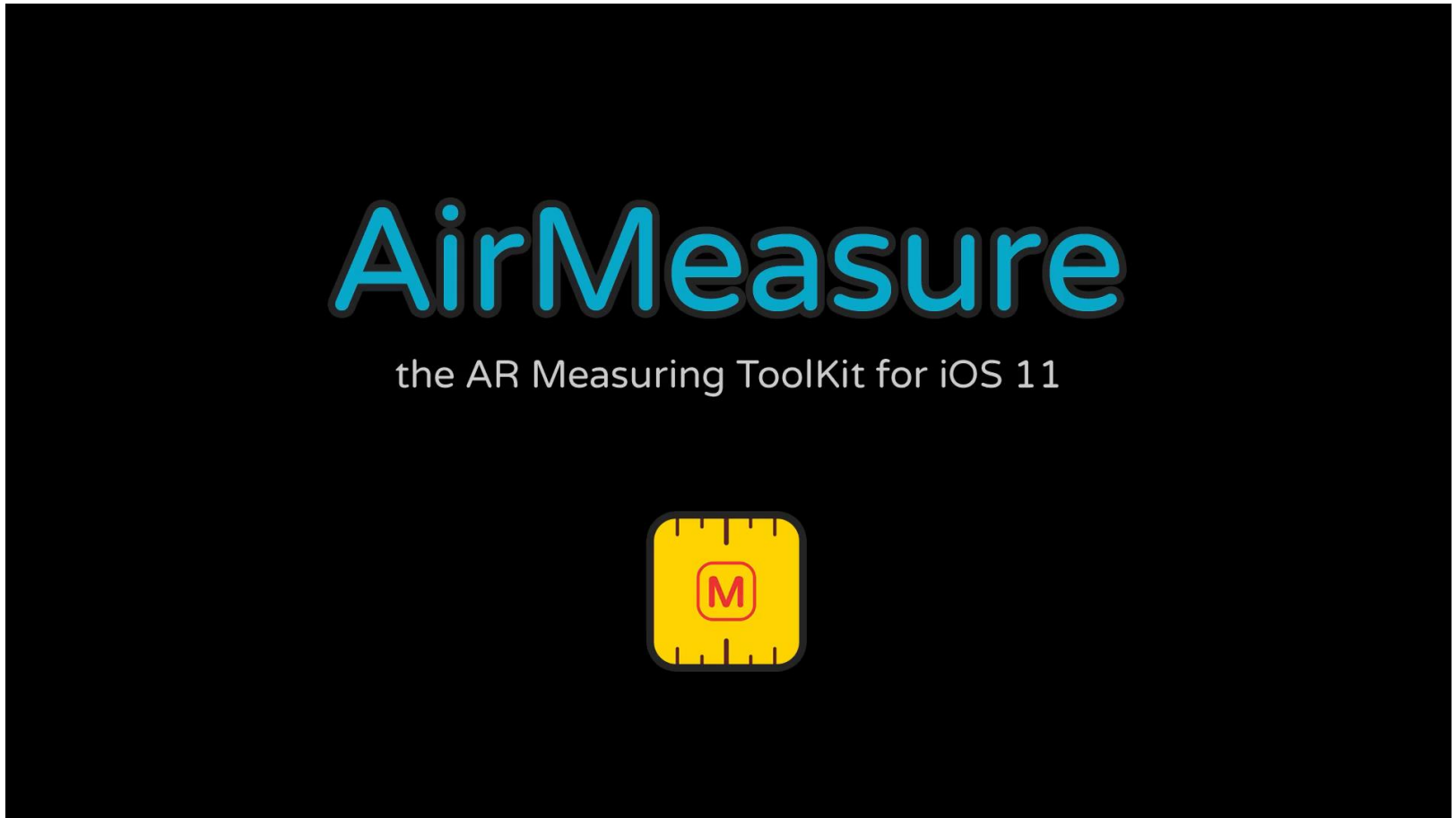
ARKit

- Current ARKit 5 (2021)
- Supported platforms: iOS 14/15 and above
- Pricing: free/$99 USD annual developer program for distribution.
- Key Features:
  - Depth API
  - Scene Geometry
  - Instant AR
  - People Occlusion
  - Motion Capture
  - Simultaneous front back camera



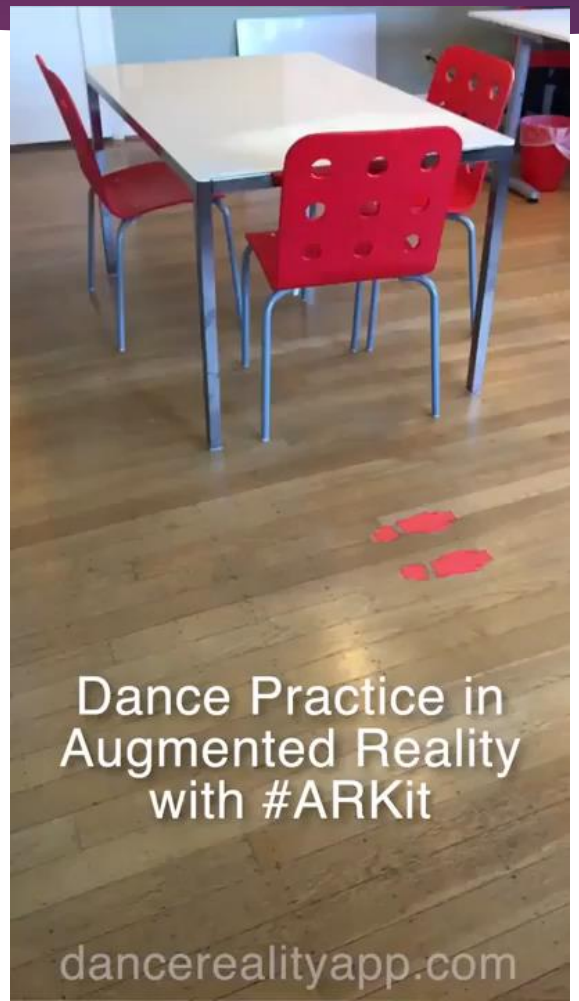
ARKit

- Examples:
  - AirMeasure (2017)



ARKit

- Examples:
  - Dance Reality (2017)



ARKit

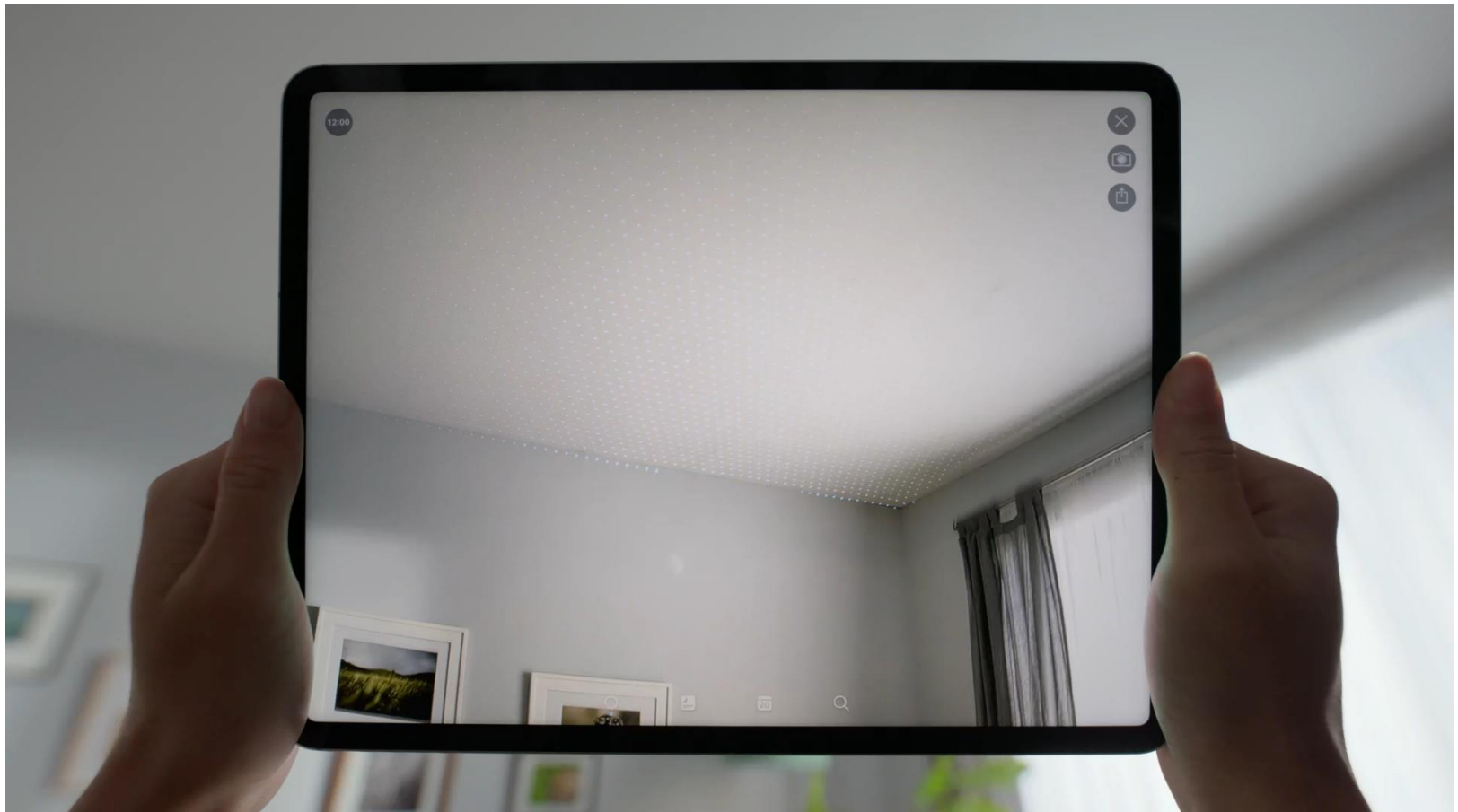
- Examples:
  - WiTag (2017)

ARKit

- Examples:
  - Solarscene (2017)

ARKit

- Examples:
  - Skyguid (2021)

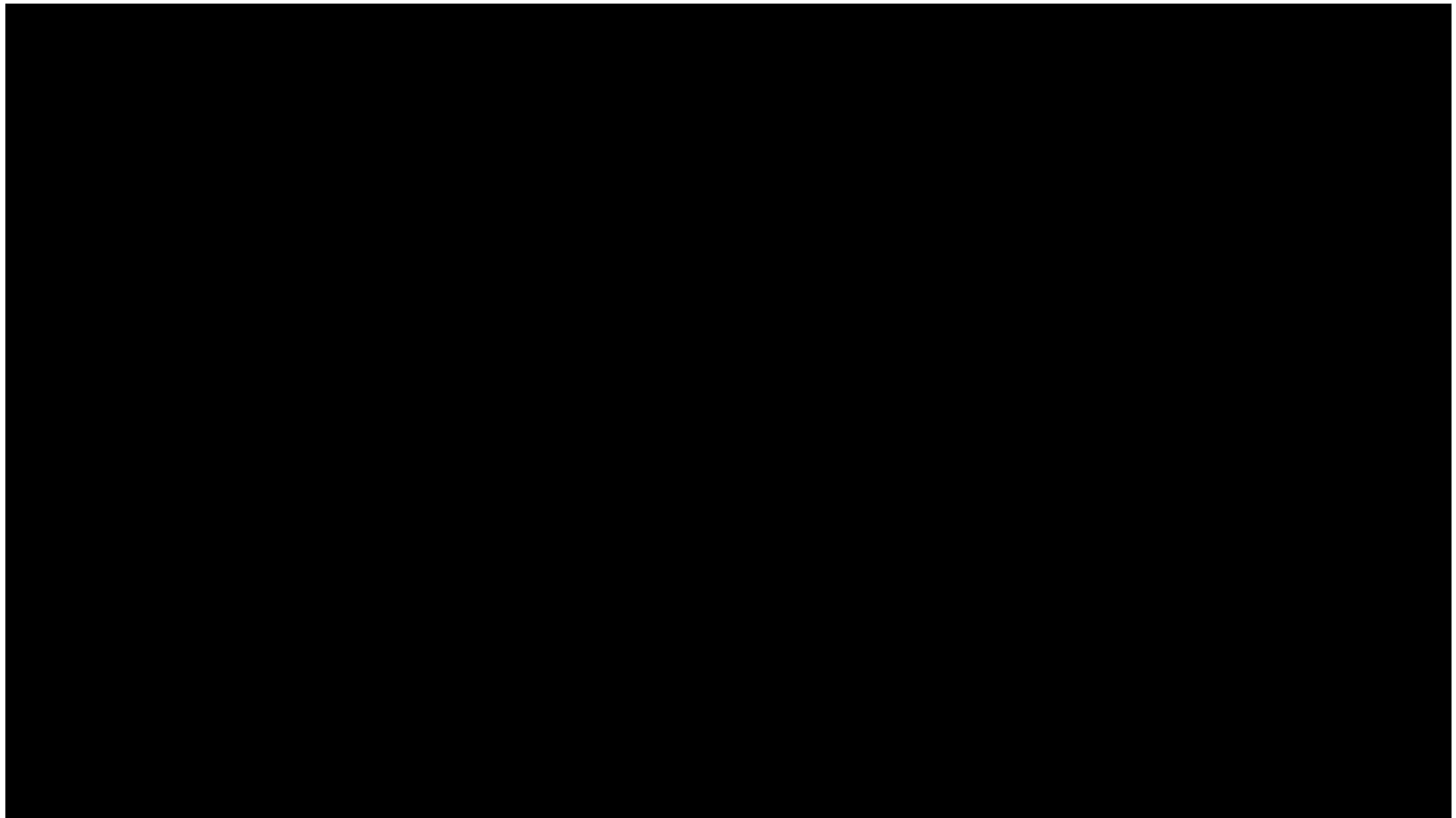


RealityKit

- Current RealityKit 2 (2021)
- Key features:
  - Object capture
  - Custom shaders
  - Custom systems
  - Dynamic assets
  - Character controller
  - …

RealityKit

- Examples:

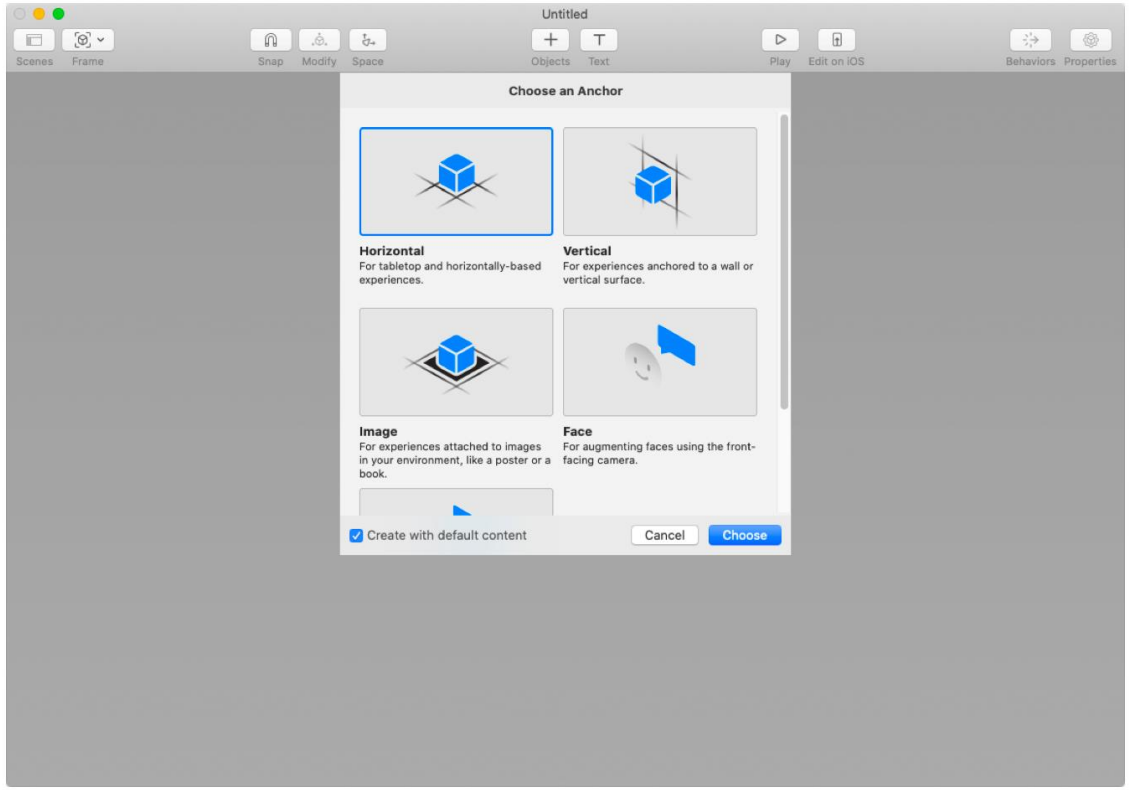


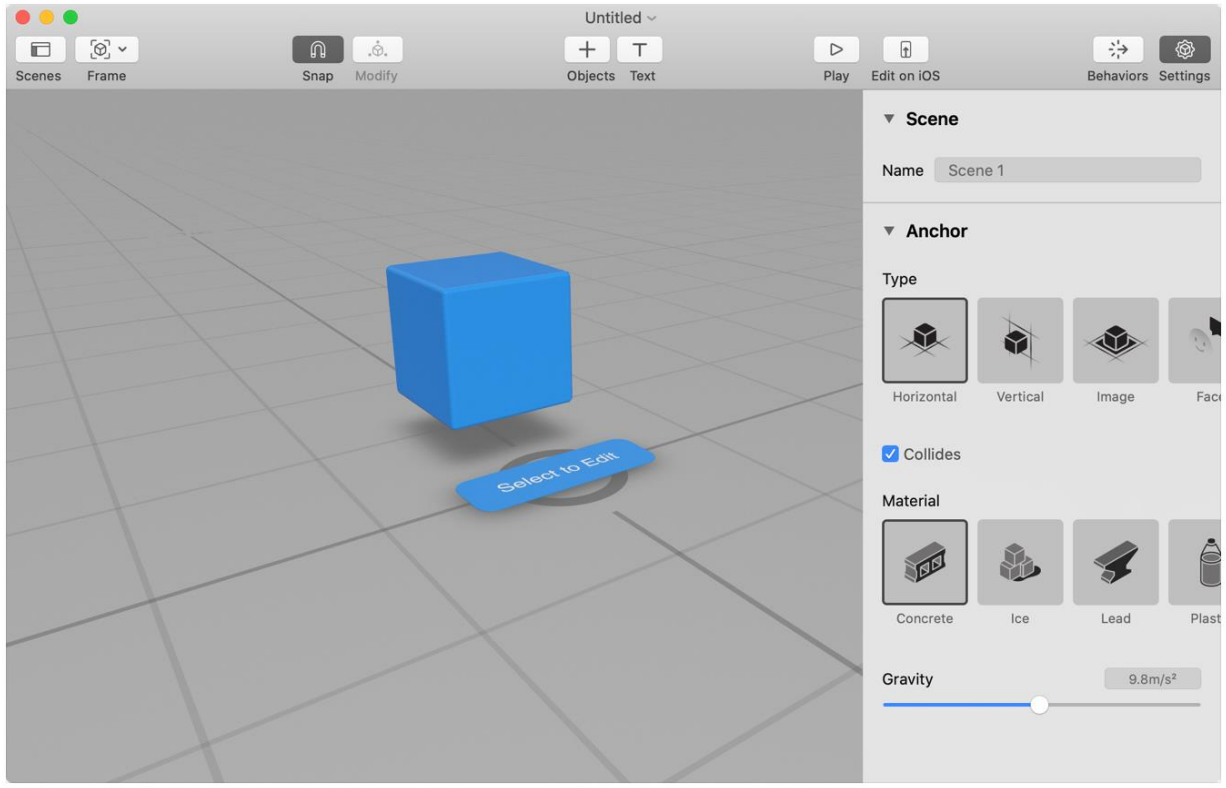
Reality Composer

- Reality Composer is a code-less AR scene editor. Its essentially like Powerpoint in AR; you can import assets and animate them, trigger events with input, do basic image recognition, etc. Its built on top of ARKit and possibly the other APIs mentioned here.
- https://developer.apple.com/documentation/realitykit/creating_3d_content_with_reality_composer

Reality Composer

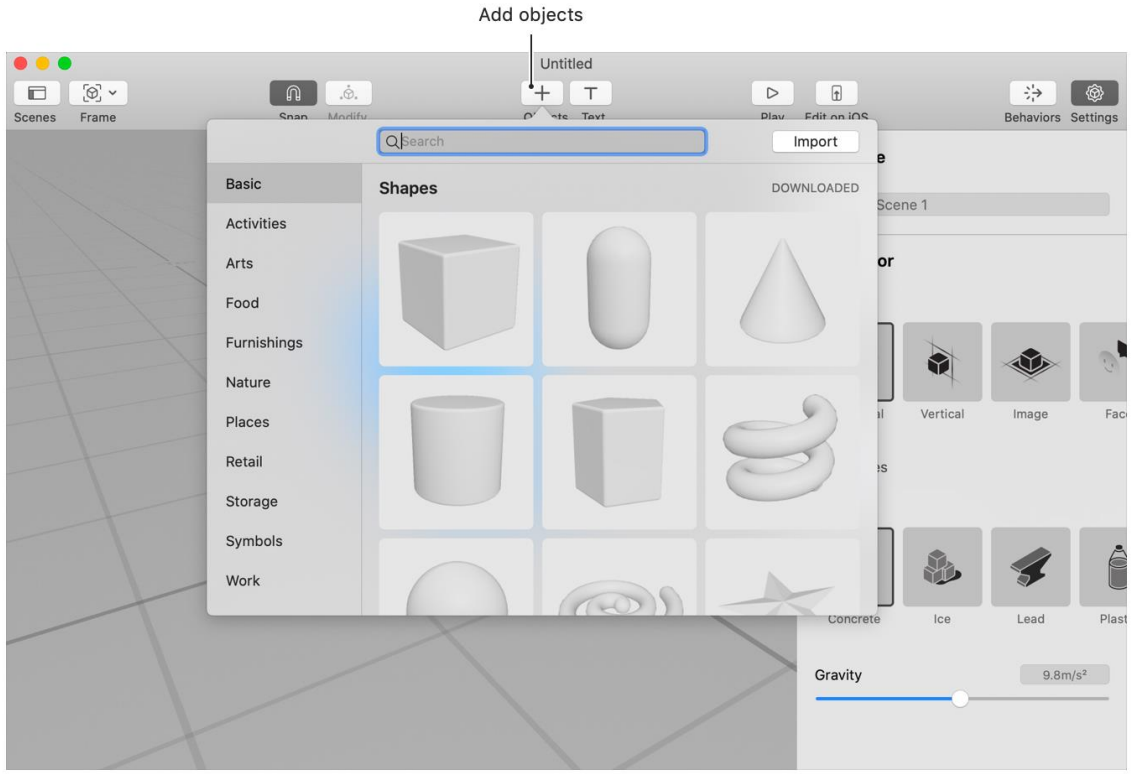
- Anchor Your Composition to Something in the Real World

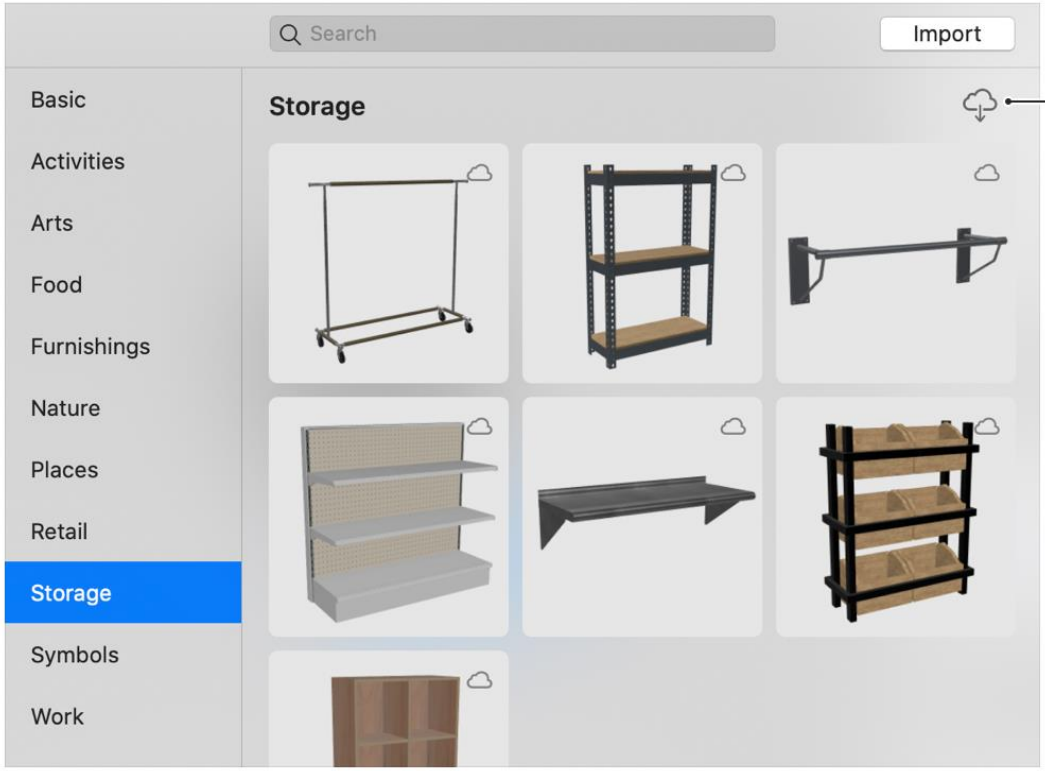




Reality Composer

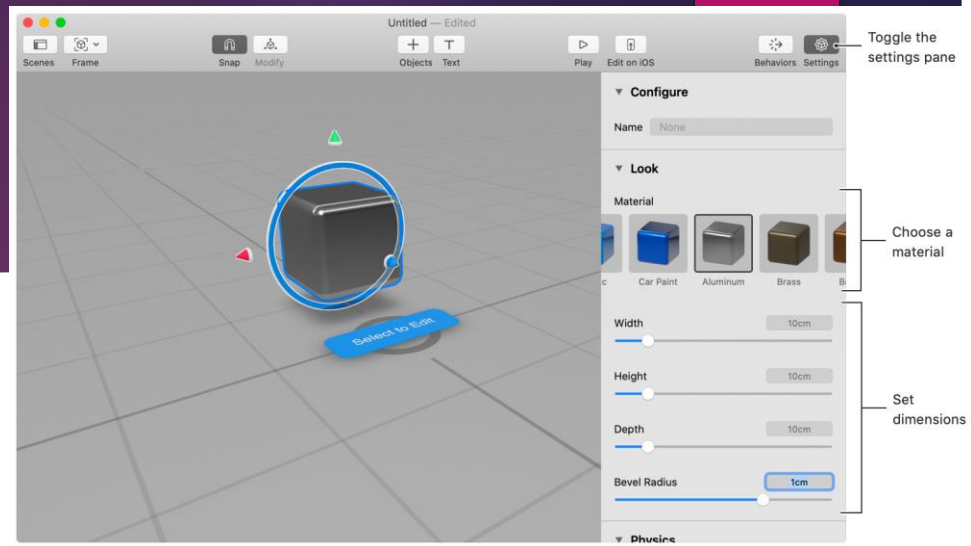
- Add Content to Your Composition

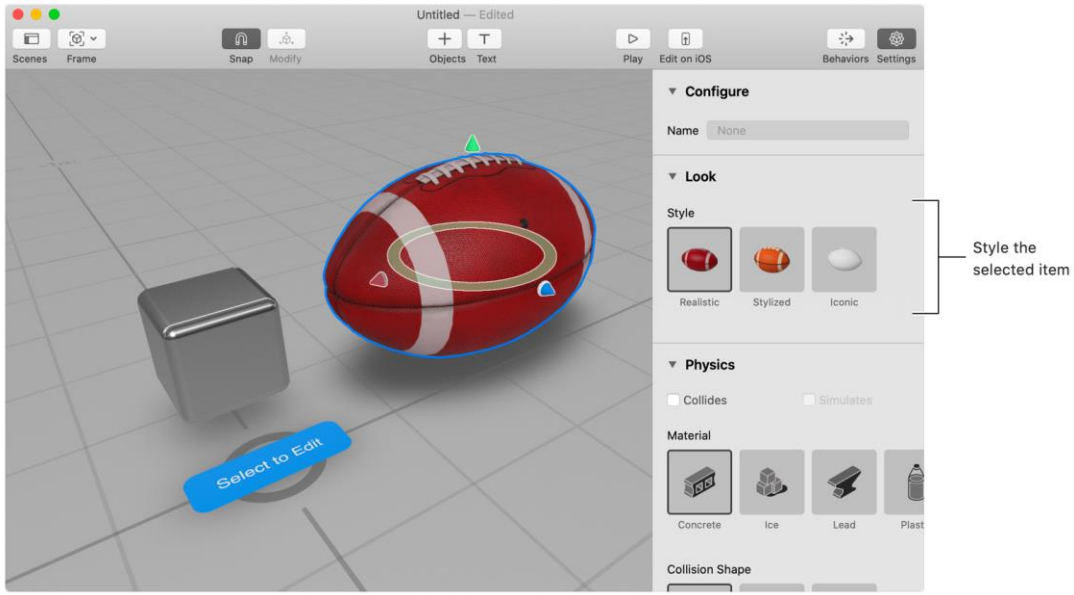


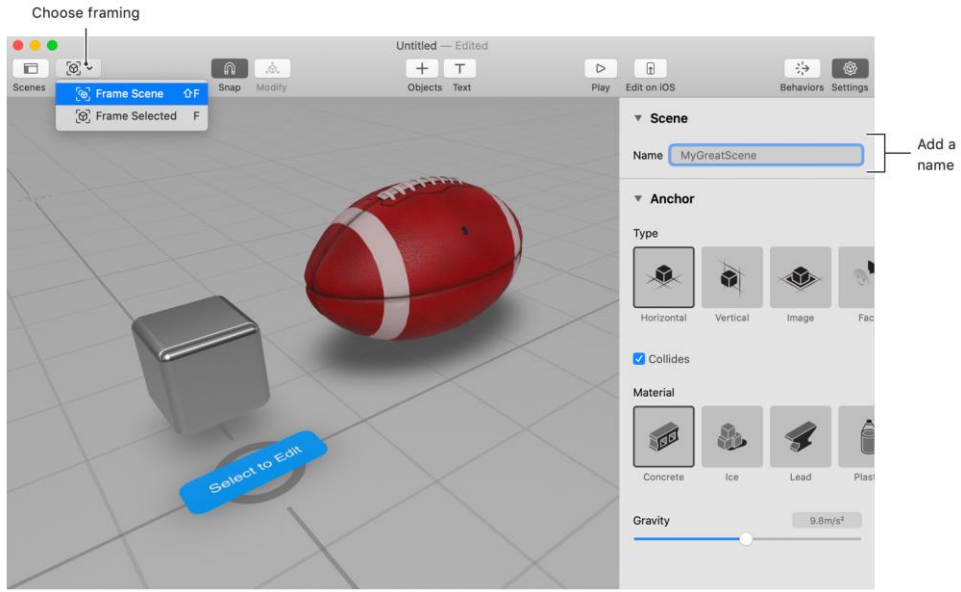


Reality Composer

- Configure an object

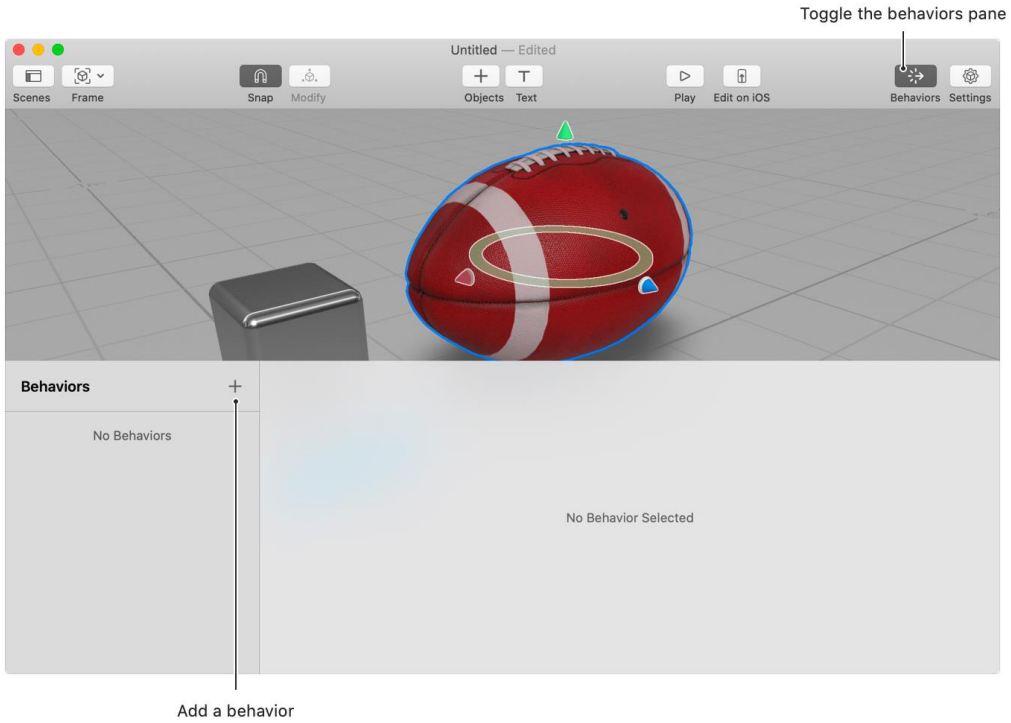


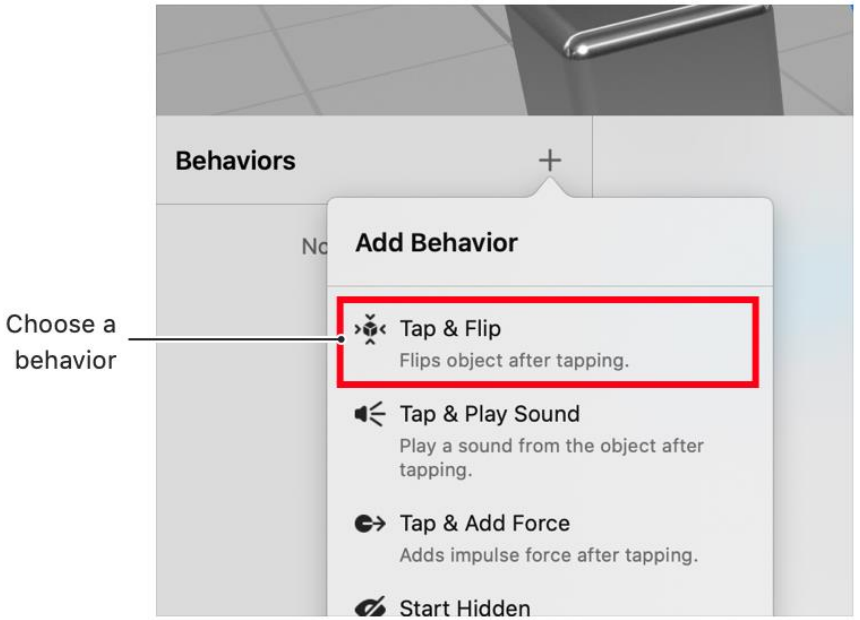




Reality Composer

- Trigger Movement and Sound with Behaviours





Reality Composer

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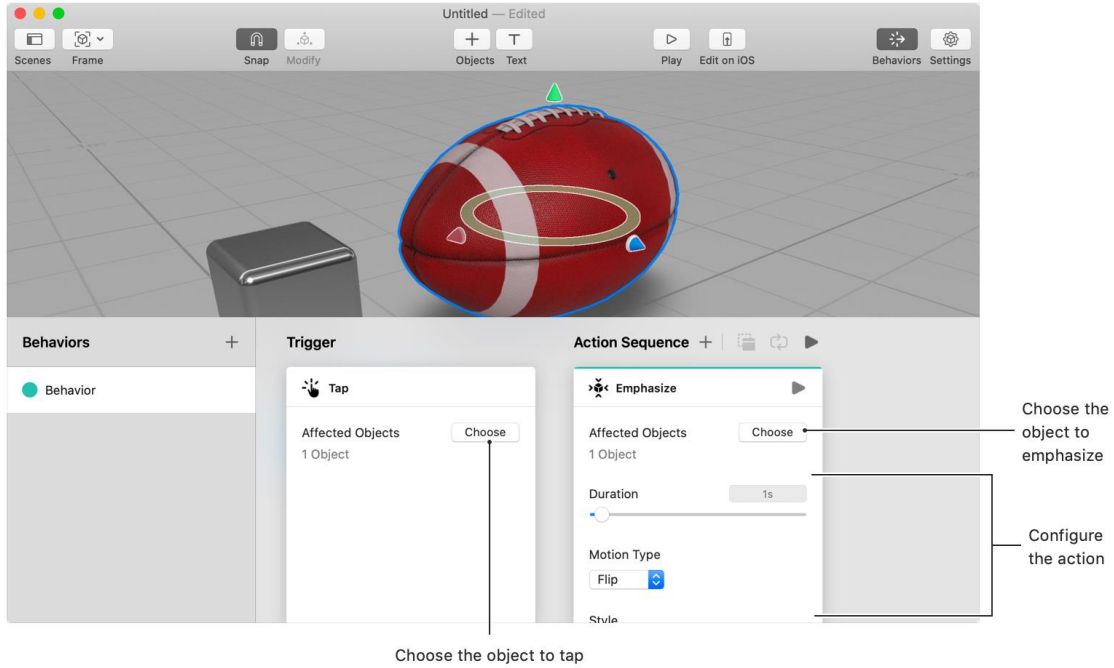
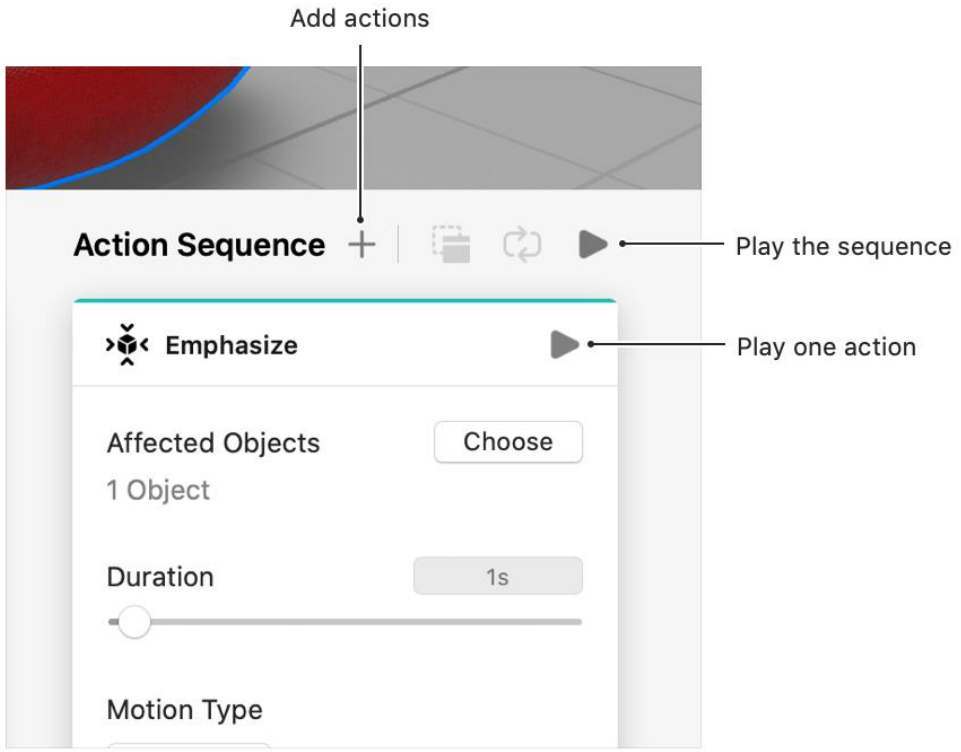
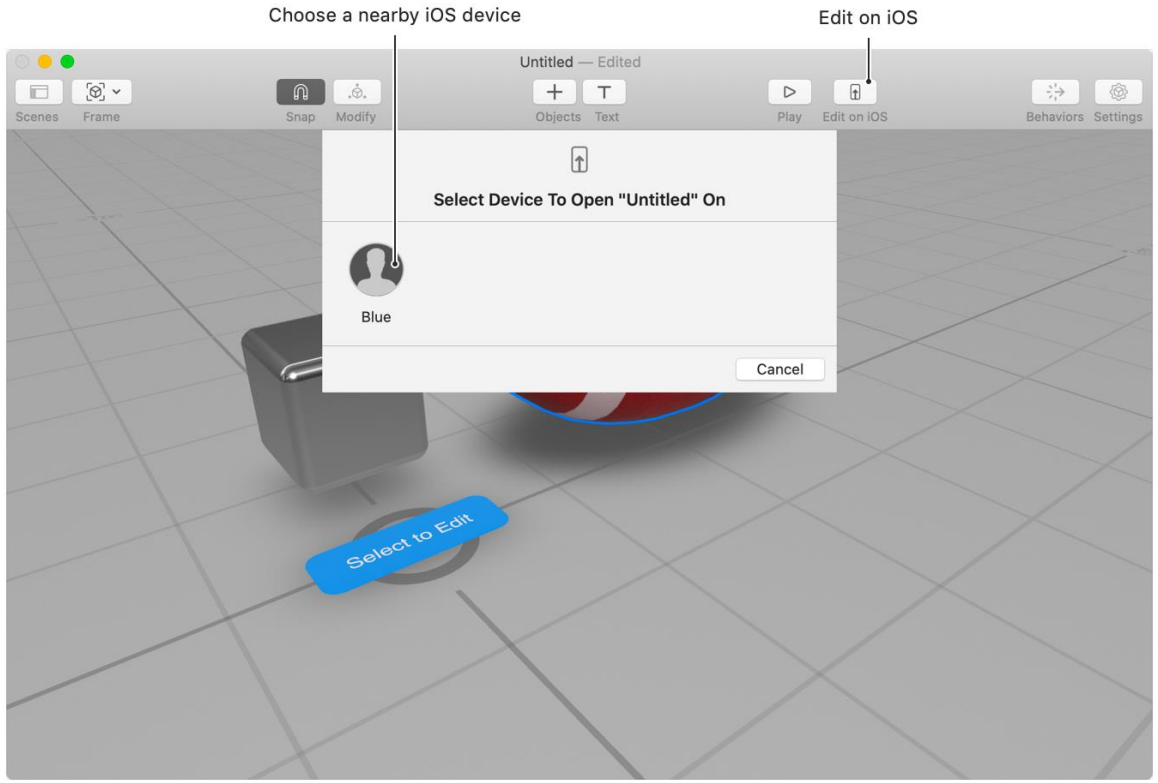




Reality Composer

- See Your Content in the Real World

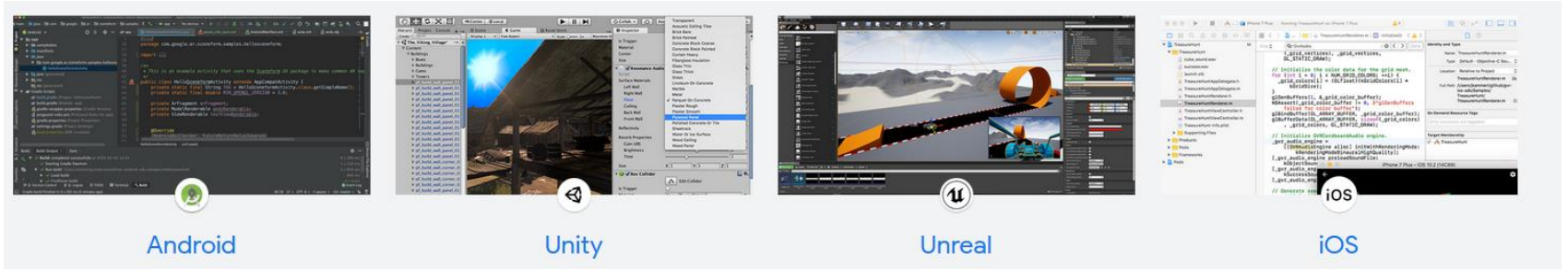


ARKit vs RealityKit vs Reality Composer

- ARKit is a software SDK that essentially provides and processes sensor data necessary for AR experiences to work.
- RealityKit is a higher level SDK that provides some game engine functionality for AR apps (input, multiplayer, audio, etc)
- Reality Composer is a code-less AR scene editor. Its essentially like Powerpoint in AR; you can import assets and animate them, trigger events with input, do basic image recognition, etc. Its built on top of ARKit and possibly the other APIs mentioned here.

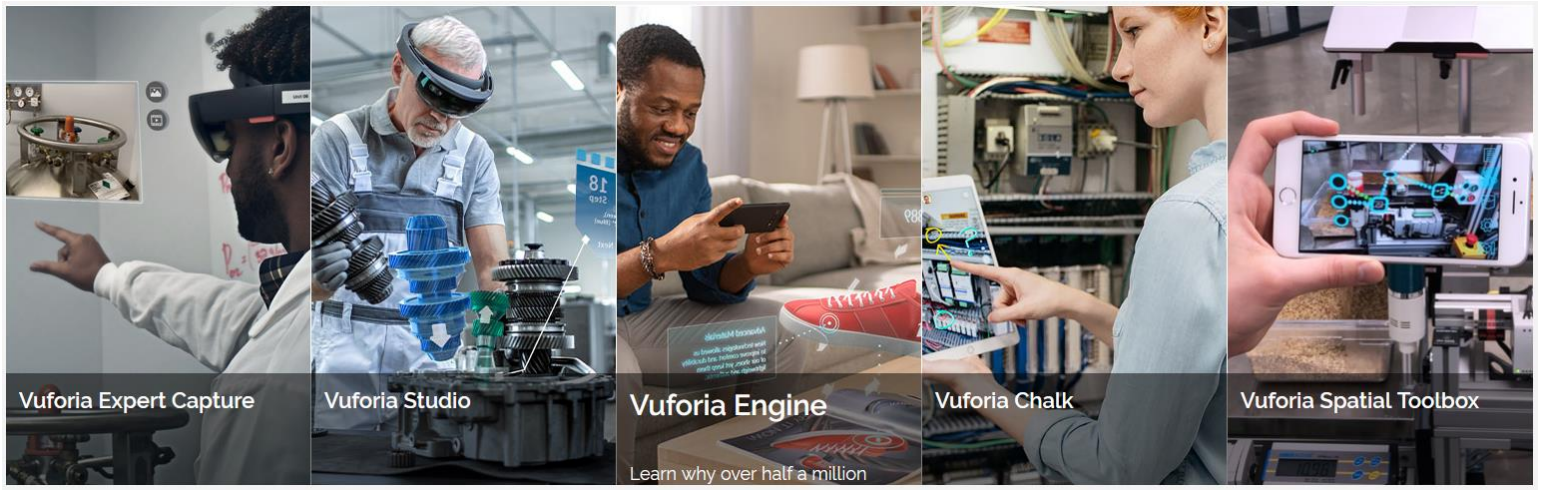
ARCore

- Supported platforms: Android 7.0 and Higher, iOS 11 or higher
- Pricing: free/$25 USD one-time registration fee.
- Examples:
  - Measure App,
  - Just a Line,
  - AR Stickers,
  - Molecatch,
  - Stack Tower,
  - Beer Pong.



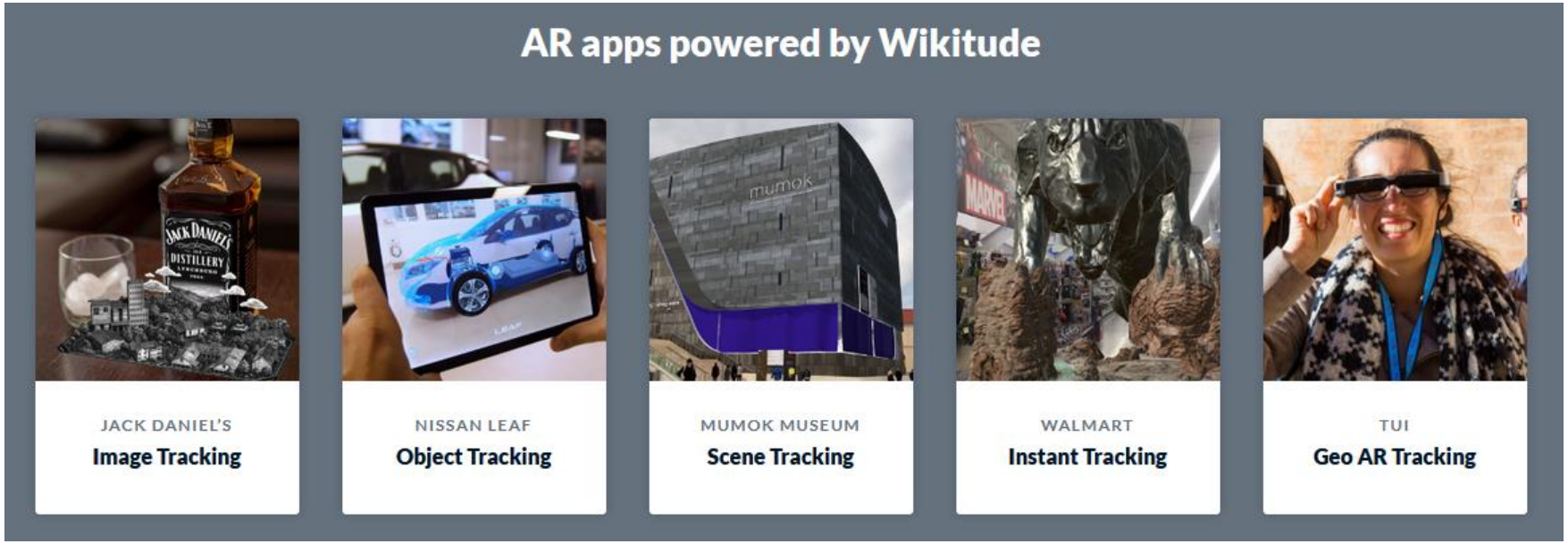
PTC Vuforia

- Supported platforms: Android, iOS, UWP and Unity Editor
- Pricing: tier-based starting at $99/month.
- Examples:
  - Ask Mercedes
  - LEGO Nexo Knights
  - Fujitsu



Wikitude

- Supported platforms: Android, iOS, Windows for tablets, smart glasses (Epson Moverio, Vuzix M100, ODG R-7).
- Pricing: free + tier-based.
- Examples:



Maxst

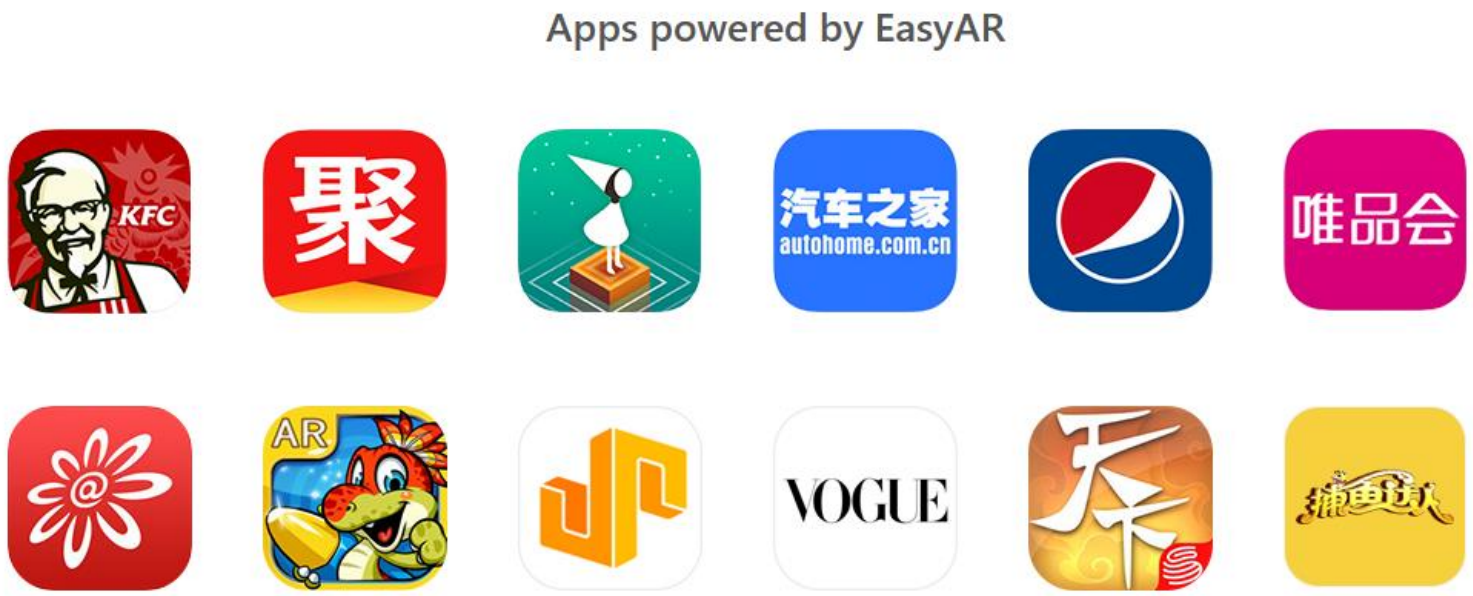
- Supported platforms: Android, iOS, Windows, Mac OS, Unity
- Pricing: tier-based starting at $50/month.
- Examples:
  - Canada AR,
  - Volvo AR Stories,
  - AR Money

DeepAR

- Supported platforms: PC, Android, iOS, Windows, WebGL
- Pricing: Flexible plans – pay as you grow.

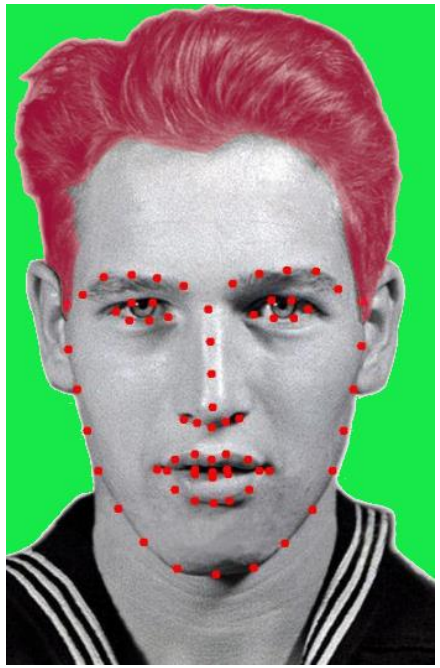
EasyAR

- Supported platforms: Android, iOS, UWP, Windows, Mac and Unity Editor
- Pricing: free.
- Examples:



Xzimg

- Supported platforms: Android, iOS, Windows
- Pricing: Free trial version for non-commercial use/2200 Euro for unlimited number of apps.



Kudan

- Supported platforms: Android, iOS, Unity.
- Pricing: free and commercial licences.

ARToolKit

- Supported platforms: Android, iOS, Windows, Mac OS, Linux
- Pricing: Free

Note: ARToolKit5 available on github (ARToolKit6 owns by DAQRI)

Augmented Reality Tools Comparison

	ARKit	ARCore	PTC Vuforia	Wikitude	Maxst	DeepAR	EasyAR	Xzimg
Maximum distance capture, m	1.5/5	1.0/3	1.2/3.7	2.4/5	0.5/0.9	0.7/5	0.9/2.7	0.5/1
Recognition stability of immovable marker	9	9	10	6	7	8	7	4
Recognition stability of movable marker	7	6	6	6	2	7	3	3
Minimum angle recognition	30	50	30	10	50	35	35	45
Minimum visibility for recognition overlapped marker, %	50	75	20	100	50	10	10	25
2D recognition	+	+	+	+	+	+	+	+
3D recognition	+	+	+	+	+	–	–	+
Geo-location	+	+	–	+	–	–	–	–
Cloud recognition	+	+	+	+	–	–	–	–
SLAM (Simultaneous Localization and Mapping)	+	+	+	+	+	–	–	–
Rating	7.5	7.7	7.7	8	5.2	4.7	4.4	3.1

国内AR技术平台

- 视+AR （http://www.sightp.com/ ）
- 百度AR （https://ar.baidu.com/home#/）
- 腾讯AR （https://tar.qq.com/）
- QQ-AR （https://ar.qq.com/#/ ）
- 阿里巴巴AR平台
- 网易AR （https://ar.163.com ）
- 京东AR （https://ar.jd.com/ ）
- 亮风台（https://www.hiscene.com/ ）

AR产品开发流程


准备阶段
注册登录→
了解平台→
选择合作或开发模式
→选择内容开发类型
制作开发阶段
权限申请→
账号认证→
模板选择→
编辑基本信息
（设置AR识别图、封面图）
编辑AR内容
（引导页配图、背景音乐、活动页面URL）
修改完善阶段
扫描识别图，预览AR项目→
提交审核→
查看项目详情，修改完善

AR Foundation Requirement

- Developer
  - Unity Editor with iOS/Android Platform support
  - AR Foundation & ARCore / ARKit packages
  - Mac OS X (for iOS)
  - Android/iOS device for testing on device
- End User
  - Android 7.0 or Higher
  - iOS 11.0 or higher
  - iPhone X or newer for face tracking

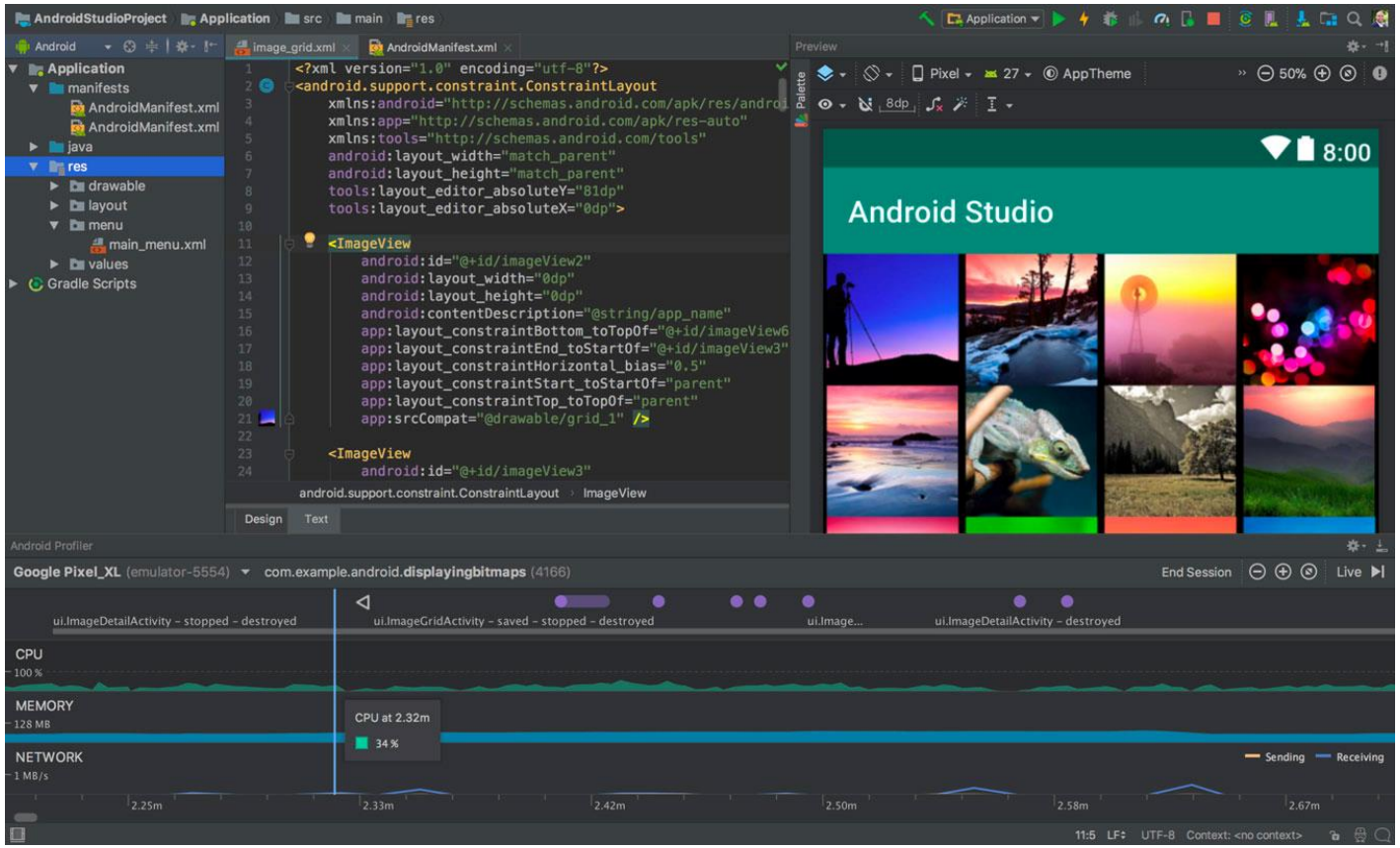
Installation

- ARCore SDKs:

SDK	Release Notes	Download SDK	GitHub repo
ARCore SDK for Android	Android release notes	`arcore-android-sdk-1.24.0.zip`	arcore-android-sdk
ARCore SDK for iOS	iOS release notes	`arcore-ios-sdk-1.24.0.zip`	arcore-ios-sdk
ARCore SDK for Unity	Unity release notes	`arcore-unity-sdk-1.24.0.unitypackage`	arcore-unity-sdk
ARCore Extensions for AR Foundation	ARCore Extensions for AR Foundation release notes	`arcore-unity-extensions-1.24.0.tgz`	arcore-unity-extensions
ARCore SDK for Unreal	Unreal release notes	`arcore-unreal-sdk-1.7.0.zip`	arcore-unreal-sdk

Installation

- ARCore
  - Android
    - Android studio



Installation

- ARKit
  - Xcode

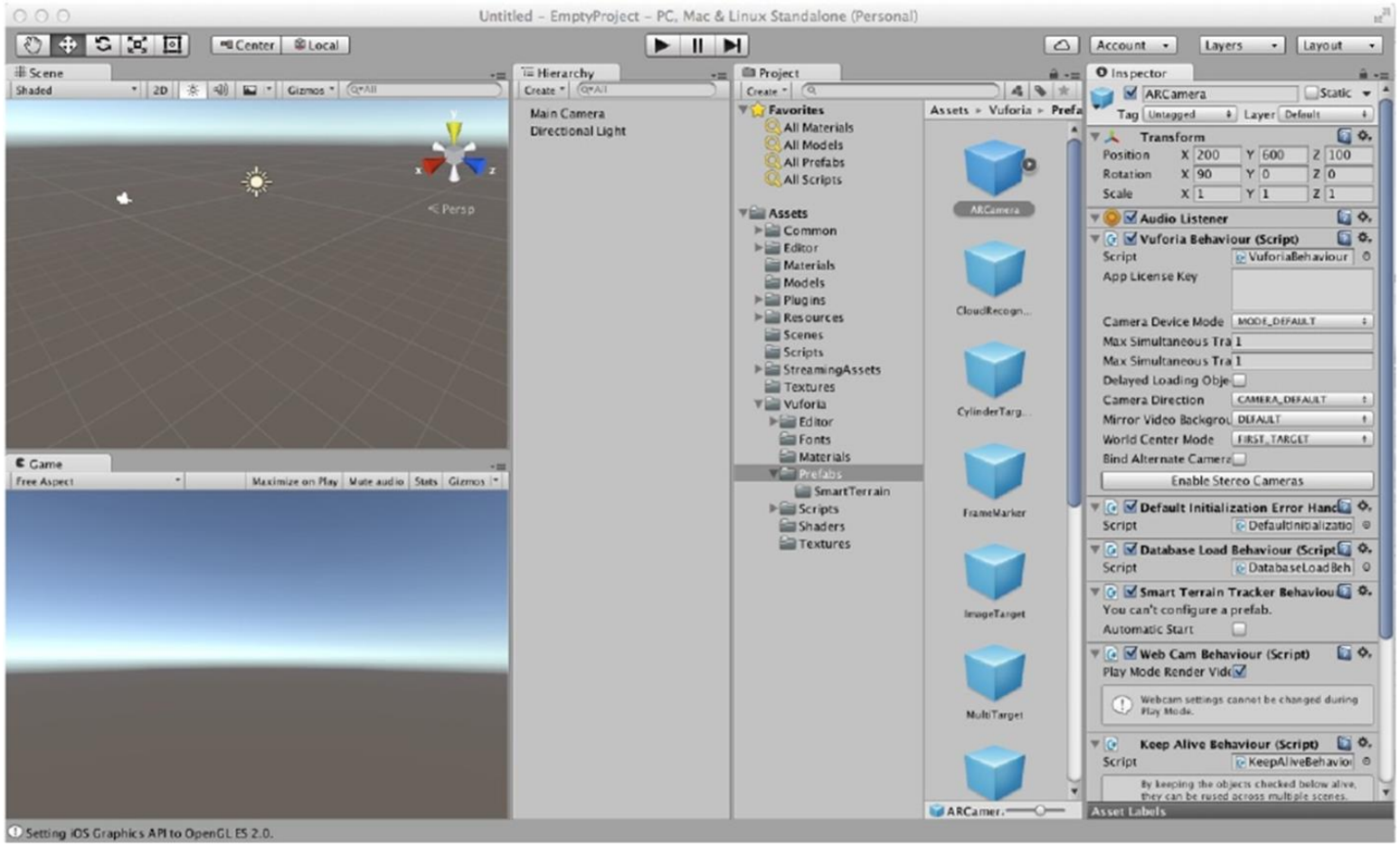
Installation

- Unity

Unity Interface

- Toolbar, Scene, Hierarchy, Project, Inspector

Customizable Interface

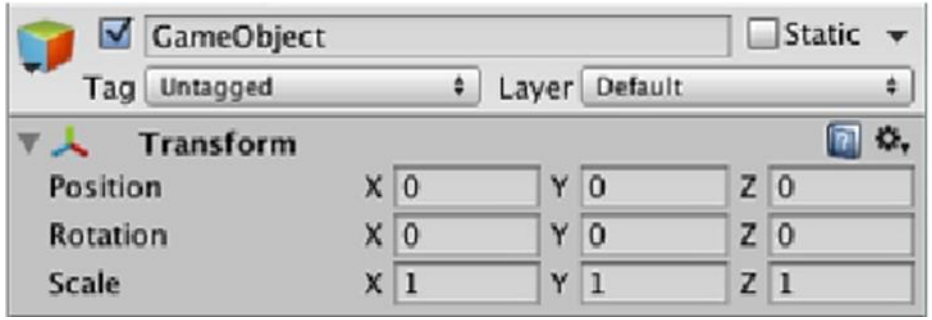


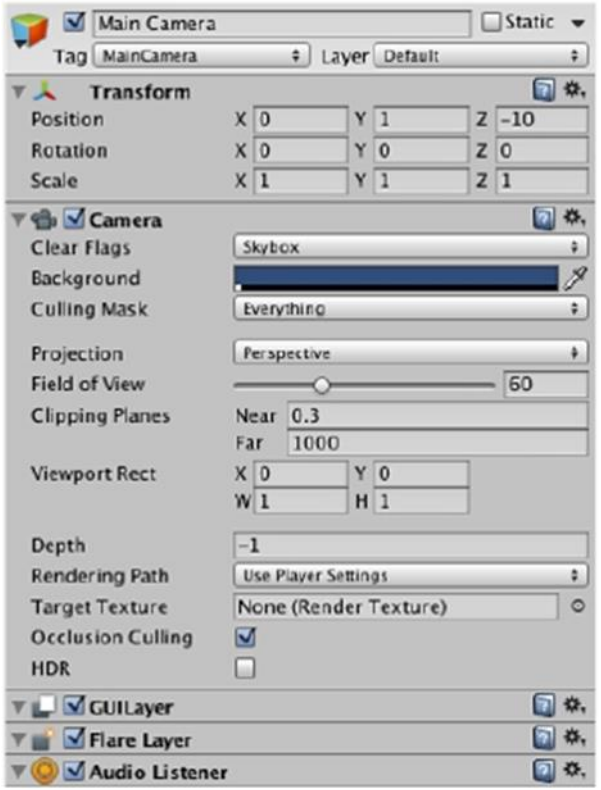
Building Scenes

- Use GameObjects:
  - Containers that hold different components
    - Eg 3D model, texture, animation
- Use Inspector
  - View and edit object properties and other settings
- Use Scene View
  - Position objects, camera, lights, other GameObjects etc
- Scripting
  - Adding interaction, user input, events, etc

GameObjects

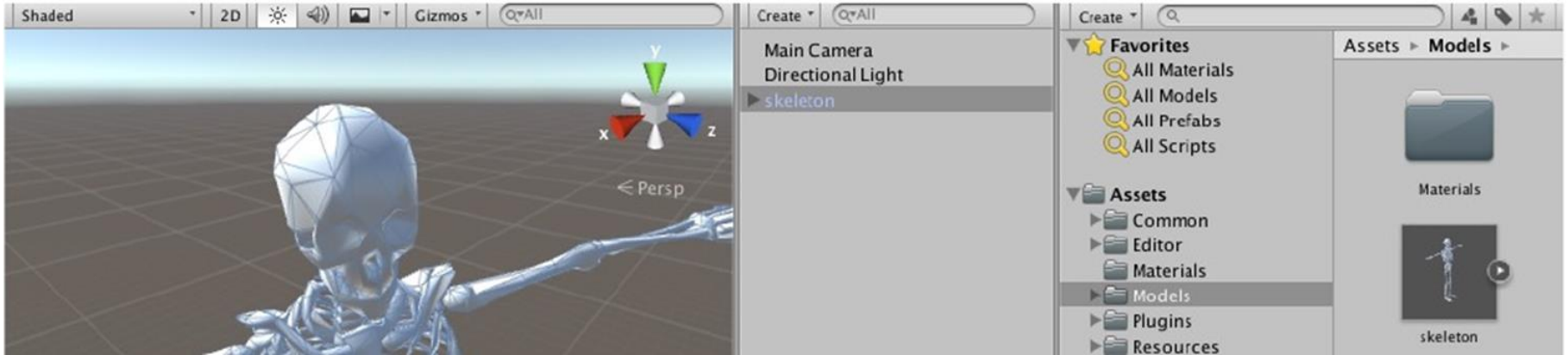
- Every object in Scene is a GameObject
- GameObjects contain Components
  - Eg Transform Component, Camera Component





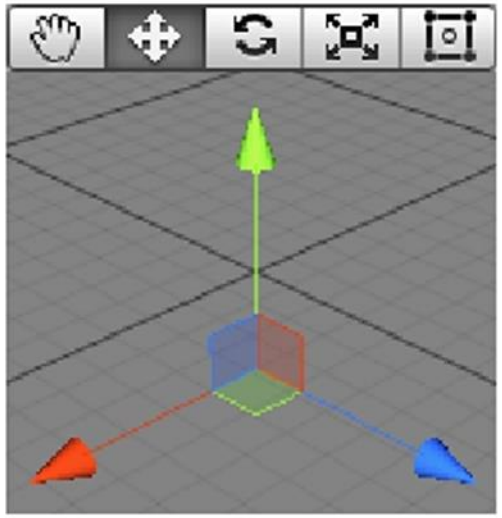
Adding 3D Content

- Create 3D asset using modeling package, or download
  - Fbx, Obj file format for 3D models
- Add file to Assets folder in Project
- When project opened 3D model added to Project View
- Drag mesh from Project View into Hierarchy or Scene View
  - Creates a game object

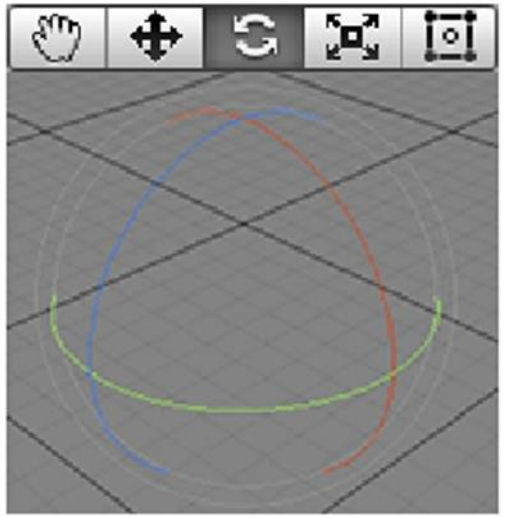


Positioning/Scaling Objects

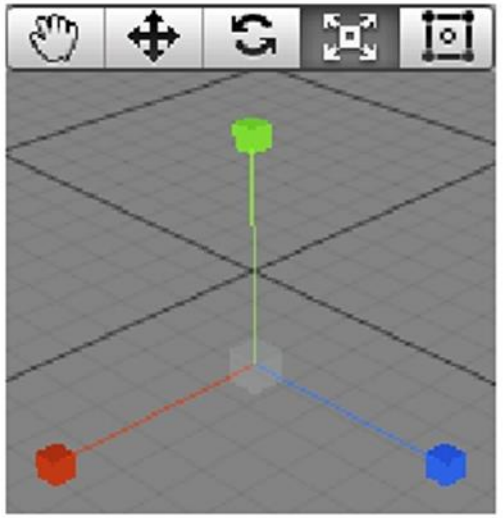
- Click on object and choose transform



Translate (W)



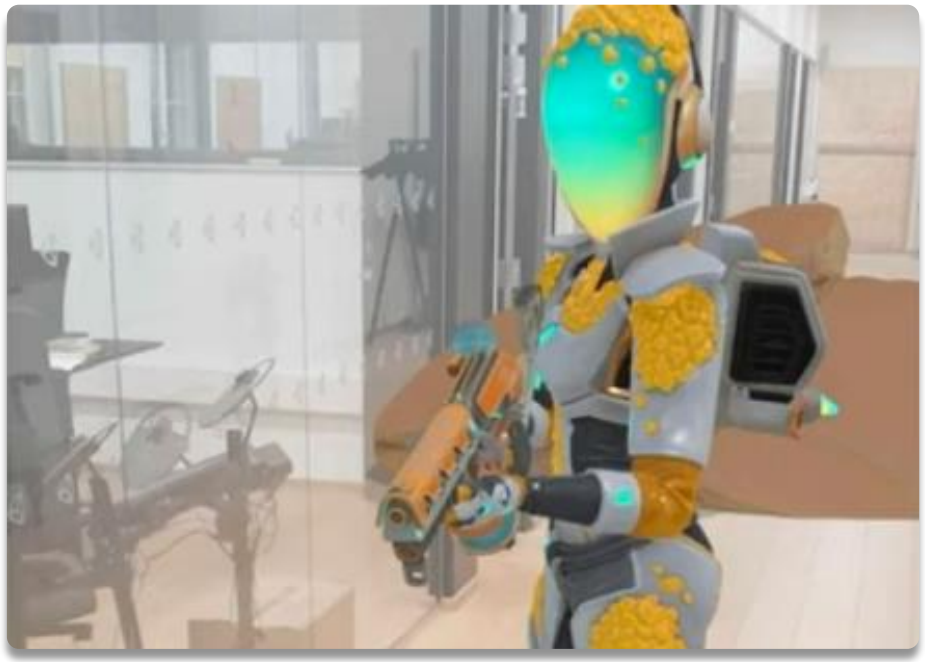
Rotate (E)



Scale (R)

AR Foundation Overview

AR Foundation



- Preview Version 1.5 – Unity 2018.4
- Verified Version 2.1 – Unity 2019.3
- Verified Version 3.0 – Unity 2020.1
- Preview Version 4.2.0 – Unity 2020.3

Preview vs Verified packages

- **Verified Package**

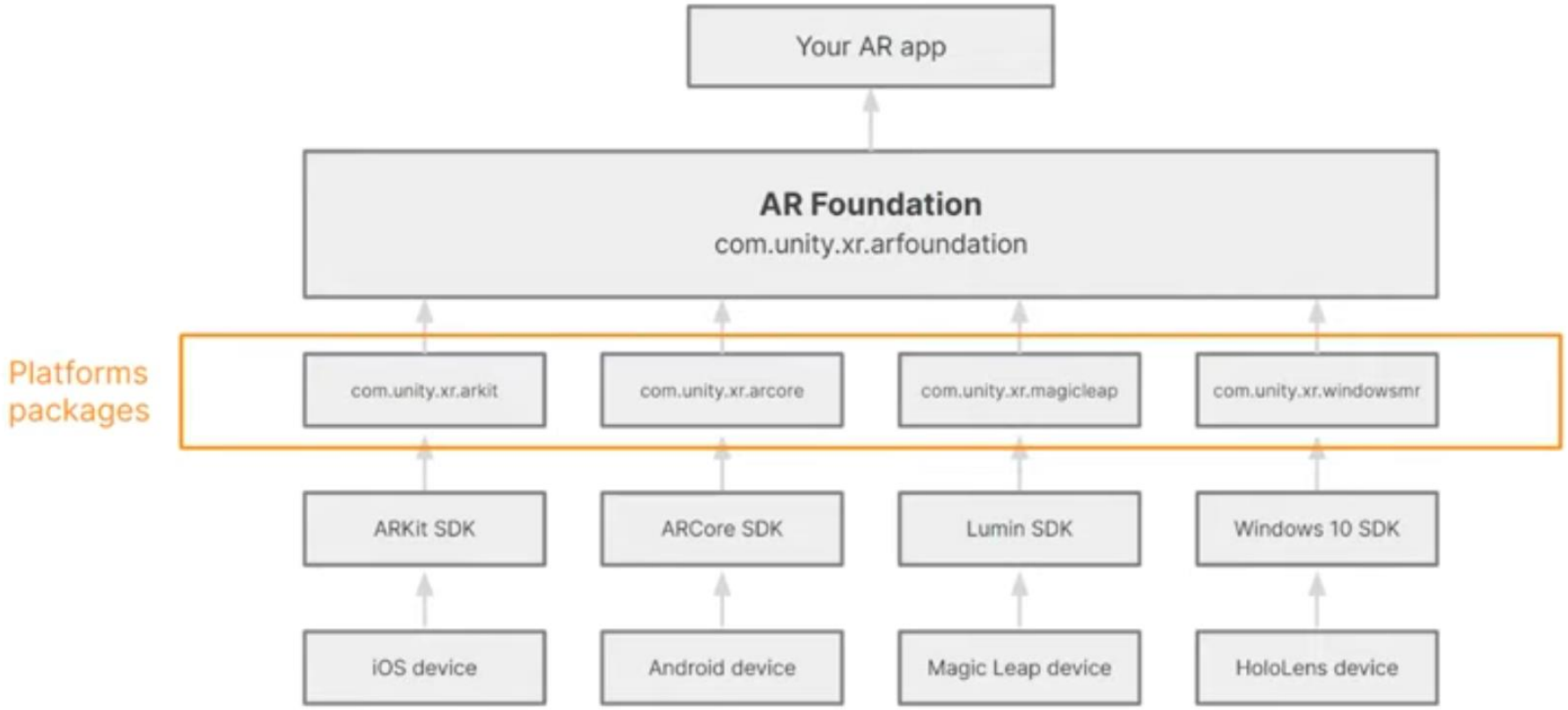
The package has undergone rigorous testing and has been verified to work safely with this specific version of Unity, and all other packages verified for the same version.

- **Preview Package**

Preview packages have not yet been verified to be safe to use with the current version of Unity, so you should only use them for testing and to provide feedback.

Some package are neither verified nor preview packages. In AR Foundation's case, this is because a package was verified in a newer version of Unity but is compatible with earlier versions of Unity.

“Build once, deploy anywhere”



Feature Support Per Platform

	ARCore	ARKit	Magic Leap	HoloLens
Device tracking	✓	✓	✓	✓
Plane tracking	✓	✓	✓	
Point clouds	✓	✓		
Anchors	✓	✓	✓	✓
Light estimation	✓	✓		
Environment probes	✓	✓		
Face tracking	✓	✓		
2D Image tracking	✓	✓	✓	
3D Object tracking		✓		
Meshing		✓	✓	✓
2D & 3D body tracking		✓		
Collaborative participants		✓		
Human segmentation		✓		
Raycast	✓	✓	✓	
Pass-through video	✓	✓		
Session management	✓	✓	✓	✓
Occlusion	✓	✓		

Supported Platform Packages

Package Name	Version
ARCore XR Plug-in	4.2
ARKit XR Plug-in	4.2
ARKit Face Tracking	4.2
Magic Leap XR Plug-in	6.0
Windows XR Plug-in	5.0

Getting started

- Downloaded the packages
- Configure the platform settings
- Configure XR management
- Modifying a scene to use AR
- Adding AR features

Useful links

- AR Foundation Samples
  https://github.com/Unity-Technologies/arfoundation-samples
- AR Foundation Demos
  https://github.com/Unity-Technologies/arfoundation-demos