ARKit
Augmented reality (AR) is an experience where the real-world environment is “augmented” by computer-generated content that can be perceived using any of your senses.

Imagine seeing a path on the ground that leads you to your gate at the airport. The path is not physically there, but you perceive it as such.
Alternate realities

Common terms in the digital reality space:

• Augmented reality (AR): adding virtual objects to a real-world image streamed from a camera

• Virtual reality (VR): blanks out what is in front of you and replaces it with a completely computer-generated image

• Mixed reality (MR): AR with PR sugar – Microsoft prefers this term

• (XR): refers to all real-and-virtual environments. “X” is a variable that maps to “V” or “A”.

The Beginning of AR

AR is not a new concept but we’ve only recently started to have the technology to achieve decent results.

- The first AR tech was a headset created by Ivan Sutherland (father of computer graphics) in 1968.
- The term “Augmented Reality” or “AR” was first coined by Thomas Caudell in 1990.
- One of the first commercial applications of AR was the “first-down” line used in televised football games in 1998.
- ARToolkit was created by Dr. Hirokazu Kato. It’s the most widely used open-source AR library, with its most recent public release in 2004.
AR Hardware

- Xbox Kinect showcased robust hardware for consumer-grade AR in 2010, kickstarting major corporate interest in AR.
- Google Glass was shipped in 2014, and started the trend of wearable AR hardware. (~$1800)
- Microsoft HoloLens was announced in 2015. (~$3000)
- Niantic released the international hit “Pokémon Go” in summer 2016 with an AR experience.
- ARKit was first announced at Apple’s WWDC 2017.
- Magic Leap One on sale in US Jan 2019. (~$2300)
AR software

- ARCore is Google’s solution for Android.
- ARKit is Apple’s solution for iOS.
- Vuforia is an AR SDK for mobile devices that uses computer vision to recognize and track planar images and simple 3D objects.
- Unity is a game package integrated with Vuforia that ties into ARKit and ARCore.
History of ARKit

- ARKit: released in September 2017 alongside iOS 11 – supported horizontal planes, light estimation, face tracking.
- ARKit 1.5: released in June 2018 (iOS 11.3) – vertical planes, image recognition, better performance
- ARKit 2: released in September 2018 (iOS 12) – world map sharing, object detection, image tracking
- ARKit 3: released as part of a public beta for iOS 13 in June 2019 in anticipation of a full release this fall. Unity has been working very closely with Apple on the development of ARKit 3.
Why does AR matter to developers?

• In 2016, the market size for AR/VR was $6 billion
• In 2017 it more than doubled to $14 billion
• It’s projected to pass $200 billion by 2022
• Virtual Reality is the big thing right now, but Augmented Reality will take longer and will become bigger overall.
• Augmented Reality is the next major step for integrating technology into our world since the touch screen became mainstream with the first iPhone.

It’s simple. Businesses invest in areas that will make the most profit. They want to hire developers who can make their investment successful. AR is projected to be the next big platform so it’s good to start getting exposure and experience now.
Why ARKit is a disrupter in the AR market

- It’s the first AR SDK designed with mobile devices in mind. Mobile devices still represent the fastest growing consumer market and generate the largest profit.
- Robust AR experiences require specialized hardware, and Apple has control over all iOS devices.
- Although Android has the larger market share, OS versions are fragmented. With Apple, iOS releases are consistent.
  - The adoption of Android Oreo is 5.7%
  - The adoption of iOS 11 is 76%

What this means is that ARKit is the shortest and simplest path to get AR experiences onto mobile devices, making it the most **accessible** way to experience AR ever. ARKit is the push that AR needs to really become mainstream.
How ARKit works: hardware

The hardware it uses includes:

• Neural Engine: part of the processor Apple developed to power the iPhone X.
  • has circuits tuned to accelerate artificial neural networks
  • drives the algorithms that do facial recognition (unlocking phone, transferring your facial expressions into animated emoji, etc.)
• The gyroscope and accelerometer for motion sensing
• GPS for location tracking

Because of these requirements, ARKit is restricted to iOS11+ and iPhones with the A9, A10, A11 chips.
How ARKit works: software

ARKit works by using two main concepts:
• Visual Inertial Odometry (VIO)
• Simultaneous Localization and Mapping (SLAM)

These concepts are the foundation of ARKit built on top of Apple’s lower level frameworks:
• Vision
• Core Motion
• Core ML
Visual Inertial Odometry (VIO)

VIO is the concept of analyzing visual input, plus input from the motion sensors, to calculate the position and orientation of the camera. This is how ARKit tracks the position of the phone in the world around it.

It can be broken down by its name:
- **Visual** – identifying landmarks (“feature points” in ARKit) and tracking them between camera frames.
- **Inertial** – using motion sensors to fill in the blanks or provide additional information about the camera’s movements, as cameras don’t handle quick movements well.
- **Odometry** – measuring how the device is moving in space relative to the visual data it has compiled.
Simultaneous Localization and Mapping (SLAM)

SLAM is the process a device uses to create a map of the environment around it, and orient itself within the map in real-time. It does this by:

- using GPS to figure out an initial location within an environment.
- using landmarks or feature points to track and understand surroundings.
- using VIO to help keep track of the device’s position and orientation in the world.
Basic SLAM mapping keeps track of things like surfaces (floors and walls).

Advanced tracking creates a mesh of the entire area and keeps track of individual objects found.

Think of it as creating a virtual world that is superimposed on top of the real world. If the world can be recreated digitally, then it’s easy to understand where a virtual object exists in the real world.

ARKit 2.0 currently only detects surfaces, and has the capability to recognize objects.
ARKit 2.0 Capabilities

- World tracking via surface detection
- World persistence by saving mapped out environments and virtual objects in them.
- World sharing by transmitting ARKit world-mapping data between nearby devices for shared experiences
- Real world image detection and tracking
- Real world object detection and tracking
- Face detection and tracking
Planned Capabilities for ARKit 3.0

- People Occlusion: allowing AR content to pass behind or in front of people in the real world
- Motion Capture: understanding human body position and movement and using the information
- Simultaneous use of front and back camera
- Multiple face tracking
- Collaborative Sessions: multiple people contributing to a common world map real-time
Using ARKit

There are two main components with respective delegates that make ARKit work:

**ARView**: a view that enables you to display an AR experience. You typically add a single view to your app’s storyboard, and then provide an outlet for that view in your code – or else do it programmatically.

**ARSession**: an object that coordinates the major processes that ARKit performs, such as:
- Reading data from the motion sensors
- Controlling the camera
- Performing image analysis
Using ARKit (cont.)

There are two default ARViews which have an ARSession within them:

- **ARSCNView** – 3D view using SceneKit
- **ARSKView** – 2D view using SpriteKit

All views use Metal underneath.  (OpenGL is deprecated in iOS 12 and macOS 10.14)

If you create a custom AR view using Metal, you are required to manage its own ARSession.
An ARAnchor object represents a real-world position and orientation. They can be used to track the static positions and orientations of real or virtual objects relative to the camera.

Some ARKit features automatically add special anchors to a session:

- **World-tracking sessions can add:**
  - ARPlaneAnchor
  - ARObjecAnchor
  - ARImageAnchor
- **Face-tracking sessions can add:**
  - ARFaceAnchor
Applications of ARKit

- recognizing paintings, and displaying information next to the painting.
- displaying 3D models of a boxed product in a store.
- animating pictures on the wall or in a newspaper.
- making a path on the ground that leads to a place of interest.
- tagging emojis to people whenever it recognizes them.
- allowing you to type in credentials next to a physical door to unlock it.

AR experiences don’t just have to be visual. It includes audio, haptic feedback, etc.