

# What's New in Core Motion

Session 705

Anil Kandangath Engineer

Gabrielle Badie Engineer



# ① Core Motion on Apple Watch

① Core Motion on Apple Watch

② Pedometer

① Core Motion on Apple Watch

② Pedometer

③ Altimeter

① Core Motion on Apple Watch

② Pedometer

③ Altimeter

④ Motion awareness

# Past Sessions

On Apple Developer

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Motion Tracking with the Core Motion Framework

WWDC14

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Understanding Core Motion

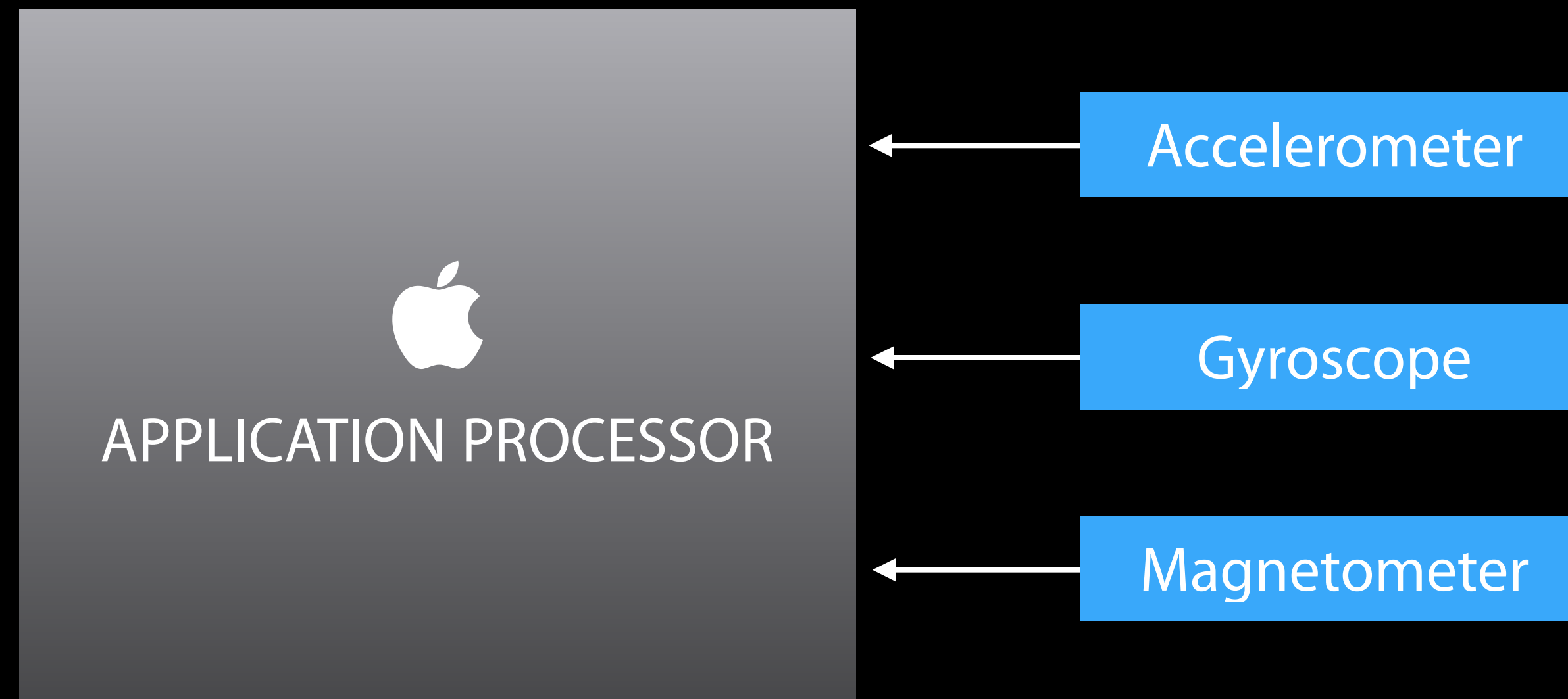
WWDC12

---

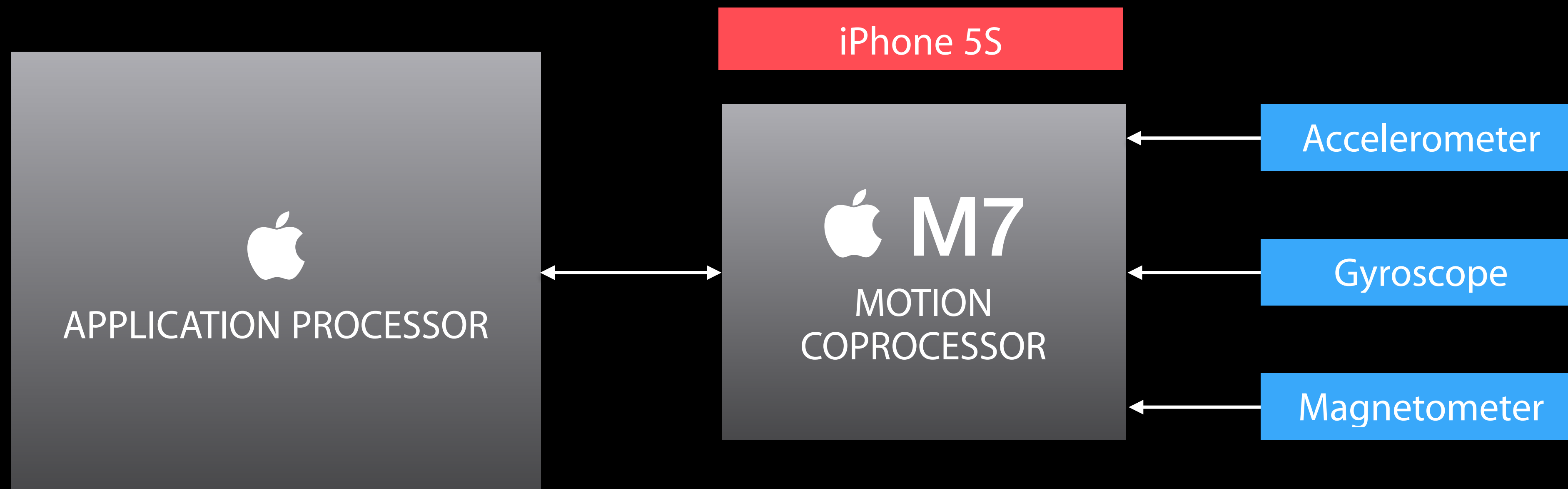
# Motion Sensing



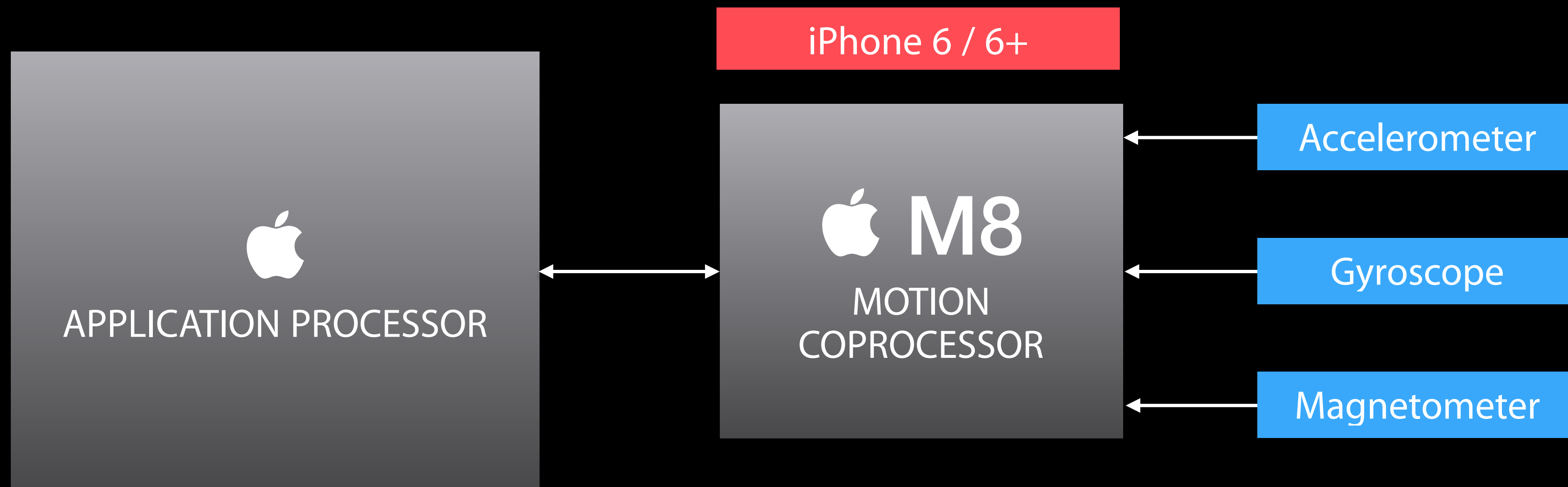
# Motion Sensing



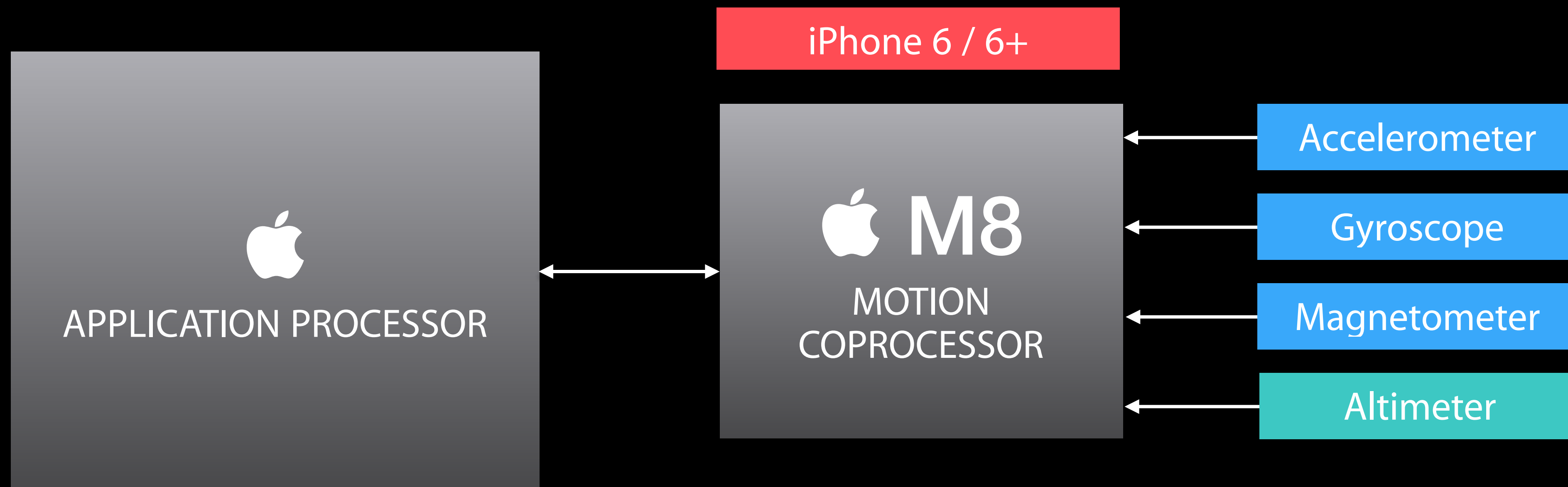
# Motion Sensing



# Motion Sensing



# Motion Sensing



# Motion Sensing

Accelerometer

Gyroscope

Magnetometer

Altimeter

# Motion Sensing



# Motion Sensing

Accelerometer

Gyroscope

Magnetometer

Altimeter



Sensor Data  
Device Motion

Motion Activity  
Pedometer

Raw Pressure  
Altitude Changes

# Motion Sensing

Accelerometer

Gyroscope

Magnetometer

Altimeter



Sensor Data  
Device Motion  
Motion Activity  
Pedometer

Raw Pressure  
Altitude Changes

Flights of Stairs



# Motion Sensing

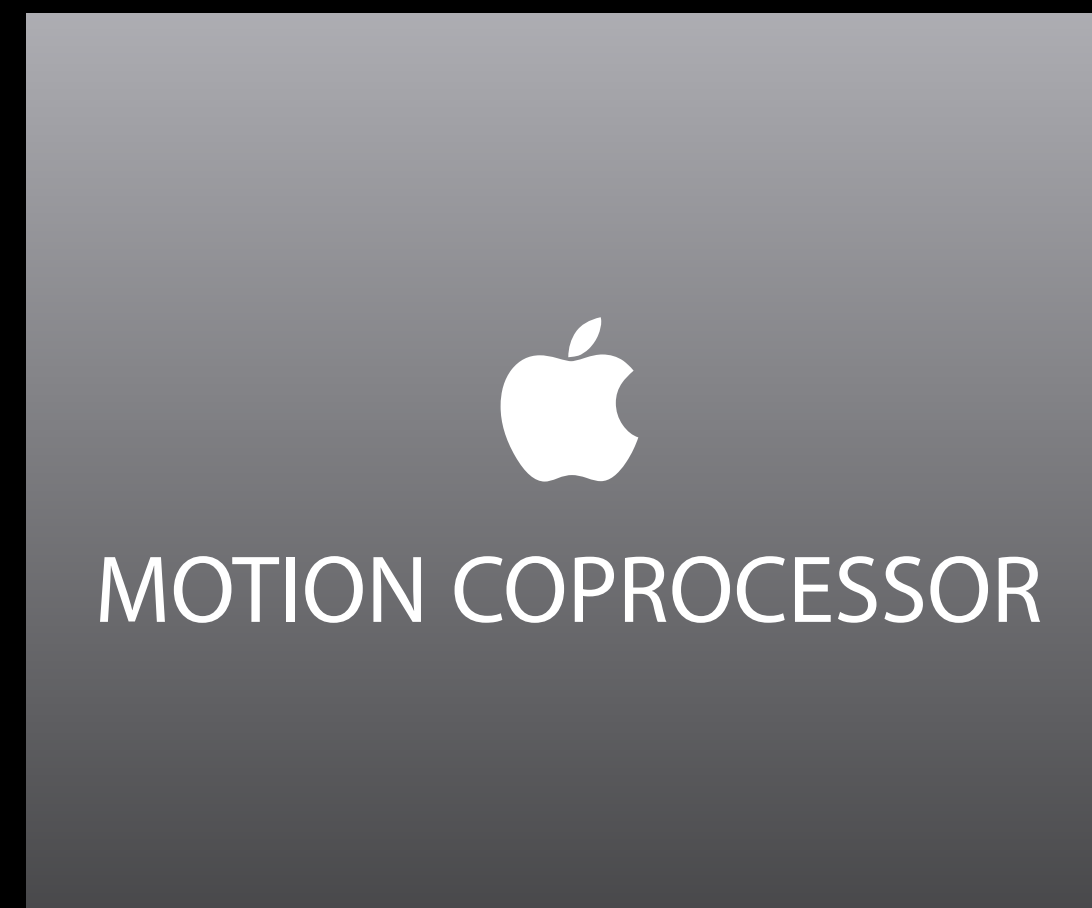


Apple Watch

# Apple Watch

Motion sensing

2

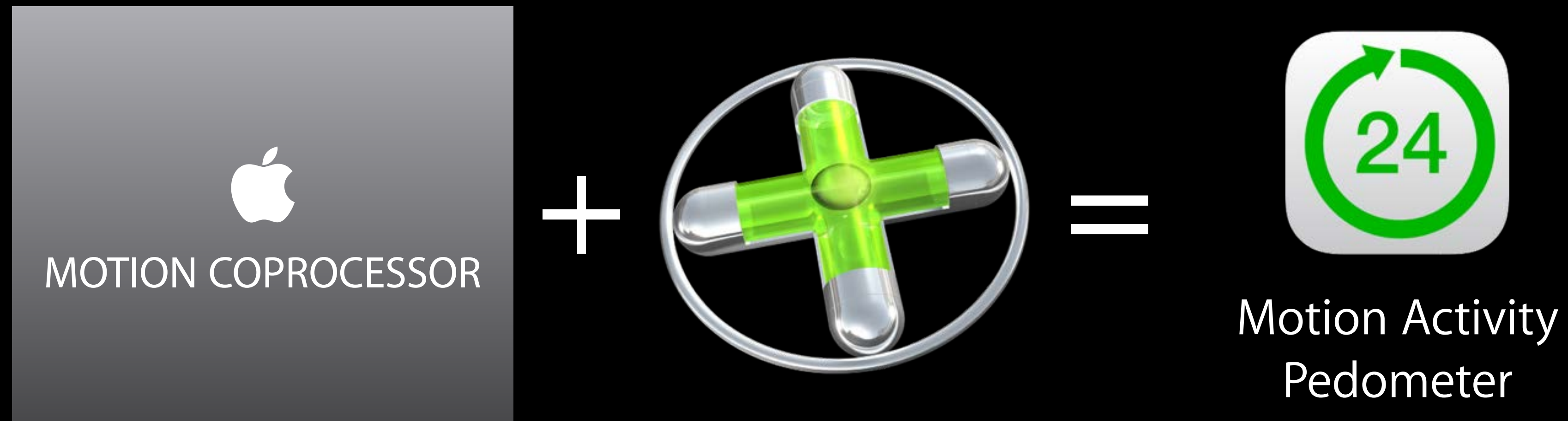


+



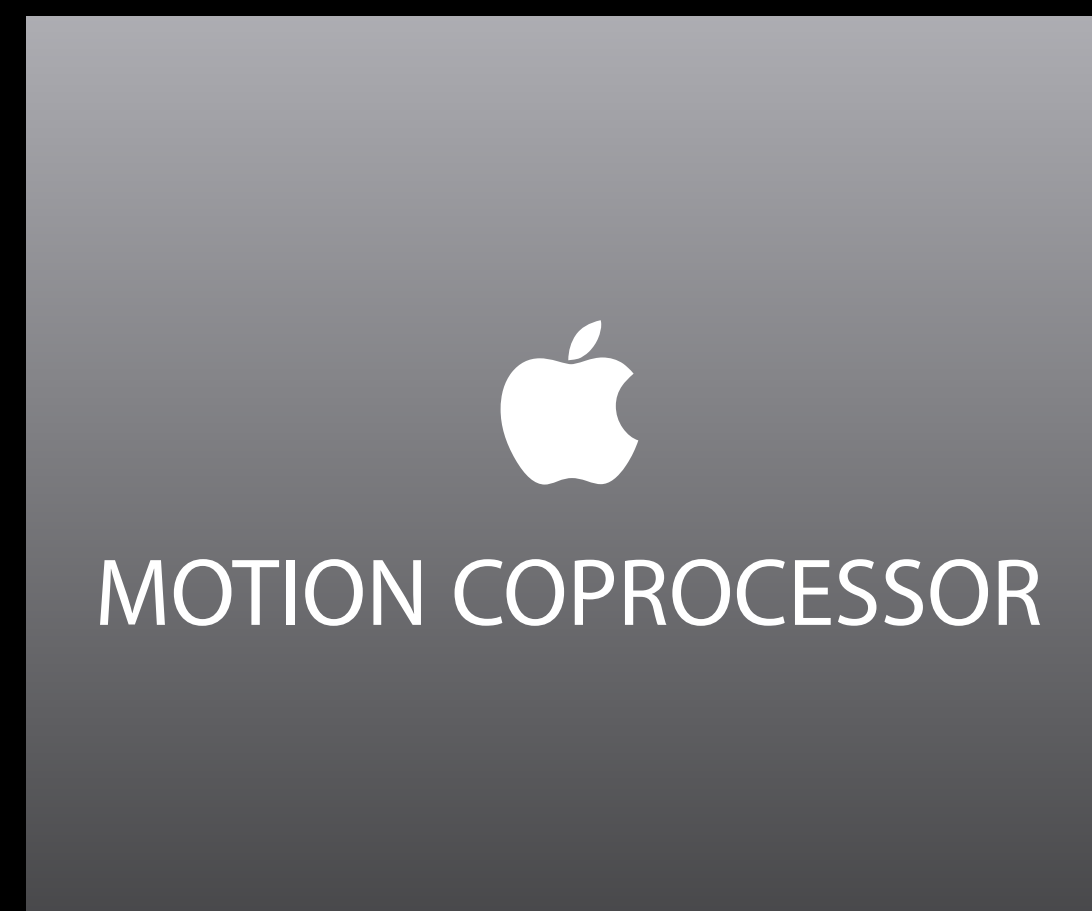
# Apple Watch

## Motion sensing



# Apple Watch

## Motion sensing



+



=



Motion Activity  
Pedometer



Motion Activity  
Pedometer  
Sensor Data

# Apple Watch

Motion sensing



# Apple Watch

## Motion sensing



Most Core Motion APIs are available on watchOS

Core Motion APIs behave similarly on iOS and watchOS

# Apple Watch

## Motion sensing



Most Core Motion APIs are available on watchOS

Core Motion APIs behave similarly on iOS and watchOS

	iOS	watchOS
Raw Sensors	✓	✓ (Accelerometer)
Device Motion	✓	
Pedometer	✓	✓
Motion Activity	✓	✓



# Apple Watch Motion Activity



# Apple Watch Motion Activity

2



# Apple Watch Motion Activity

## States

Activity	iPhone 5S	iPhone 6/6+	Apple Watch
Walking	✓	✓	✓
Running	✓	✓	✓
Cycling		✓	✓
Automotive	✓	✓	
Stationary	✓	✓	✓

# Apple Watch Accelerometer

2

Available through **CMAccelerometer**



# Apple Watch Accelerometer

2

Available through **CMAccelerometer**

Challenges



# Apple Watch Accelerometer

2

Available through **CMAccelerometer**

## Challenges

- Limited processing time



# Apple Watch Accelerometer

2

Available through **CMAccelerometer**

## Challenges

- Limited processing time
- Screen may turn off due to user motion



# Apple Watch Accelerometer

2

Available through **CMAccelerometer**

## Challenges

- Limited processing time
- Screen may turn off due to user motion

## Best Practices





# Apple Watch Accelerometer

Available through **CMAccelerometer**

## Challenges

- Limited processing time
- Screen may turn off due to user motion

## Best Practices

- Expect data only when app is on screen



# Apple Watch Accelerometer

2

Available through **CMAccelerometer**

## Challenges

- Limited processing time
- Screen may turn off due to user motion

## Best Practices

- Expect data only when app is on screen
- Be prepared for task to be suspended



# Apple Watch Accelerometer

2

Available through **CMAccelerometer**

## Challenges

- Limited processing time
- Screen may turn off due to user motion

## Best Practices

- Expect data only when app is on screen
- Be prepared for task to be suspended

[NSProcessInfo.h](#)

```
performExpiringActivityWithReason(_:,usingBlock:)
```



# Historical Accelerometer

# Historical Accelerometer



# Historical Accelerometer



Collect continuous data for long durations

# Historical Accelerometer



Collect continuous data for long durations

Even when app is not running

# Historical Accelerometer



Collect continuous data for long durations

Even when app is not running

Enable custom data analysis



# Apple Watch Historical Accelerometer



CMSSensorRecorder

# Apple Watch Historical Accelerometer



## `CMSSensorRecorder`

Apps can initiate historical data recording

# Apple Watch Historical Accelerometer



## **CMSensorRecorder**

Apps can initiate historical data recording

Accelerometer recorded at 50Hz

# Apple Watch Historical Accelerometer



## **CMSSensorRecorder**

Apps can initiate historical data recording

Accelerometer recorded at 50Hz

Data can be queried up to three days

# Apple Watch Historical Accelerometer

Start recording



# Apple Watch Historical Accelerometer

2

Start recording

**CMSensorRecorder**

```
recordAccelerometerFor(duration:)
```

Start Recording

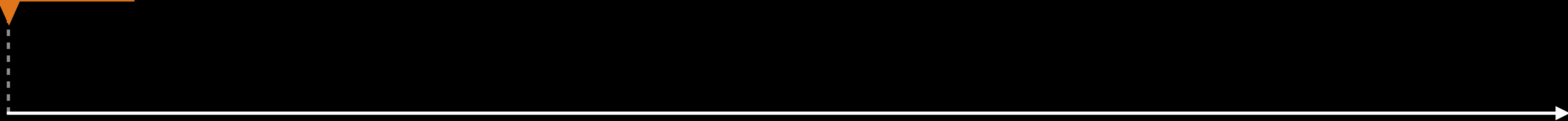


# Apple Watch Historical Accelerometer

Access data



Start Recording



# Apple Watch Historical Accelerometer

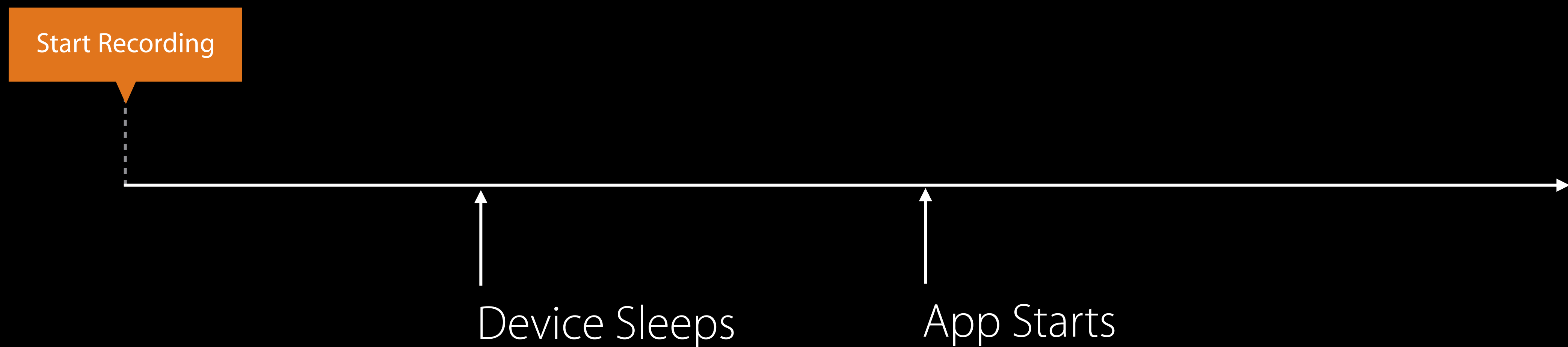
Access data





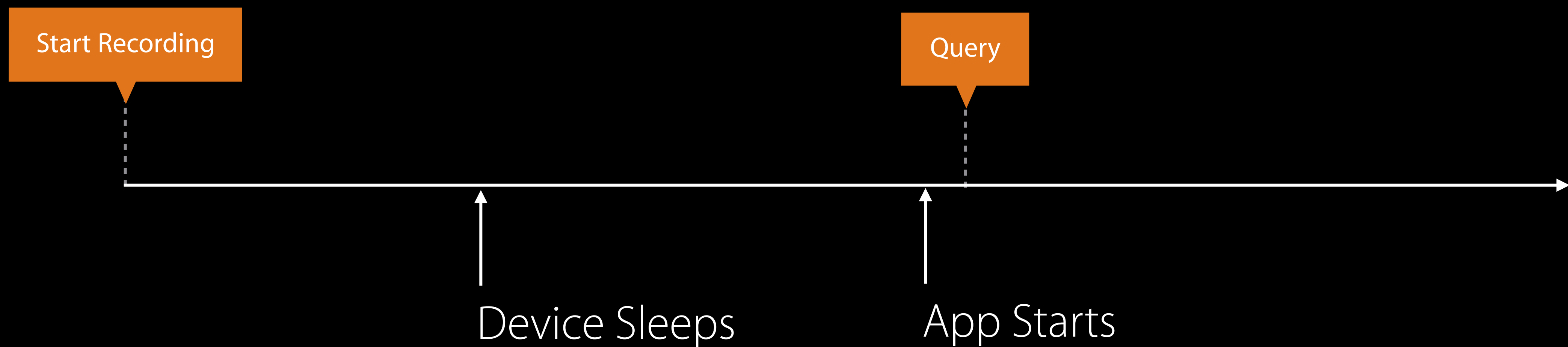
# Apple Watch Historical Accelerometer

Access data



# Apple Watch Historical Accelerometer

Access data

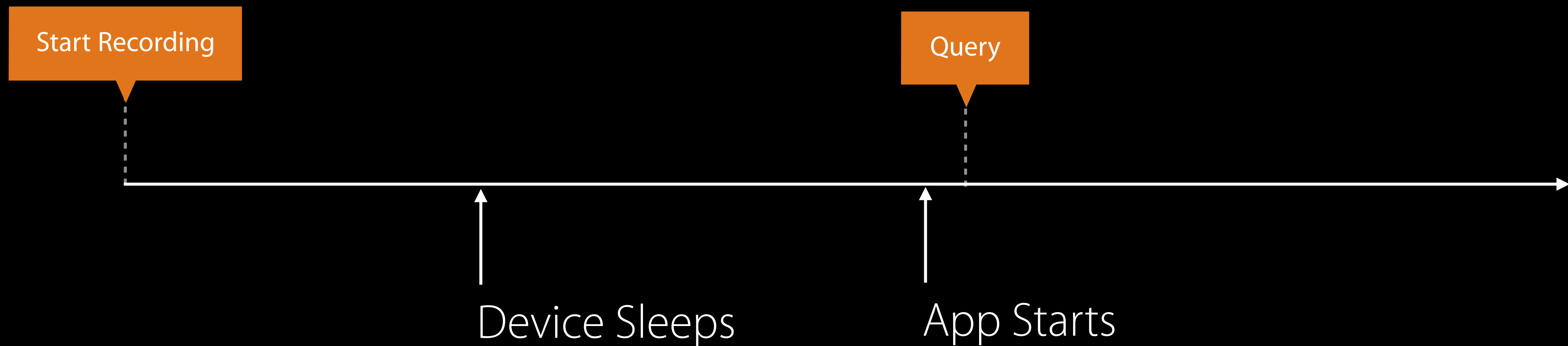


# Apple Watch Historical Accelerometer

Access data

**CMSSensorRecorder**

```
accelerometerDataFrom(_:, to:) -> CMSensorDataList
```

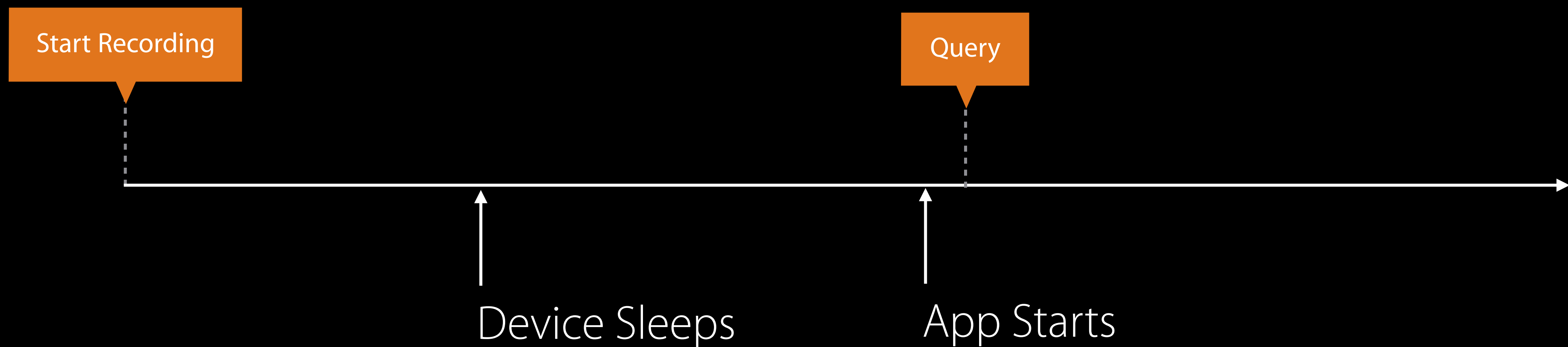


# Apple Watch Historical Accelerometer

Access data

**CMSSensorRecorder**

```
accelerometerDataFrom(_:, to:) -> CMSensorDataList
```

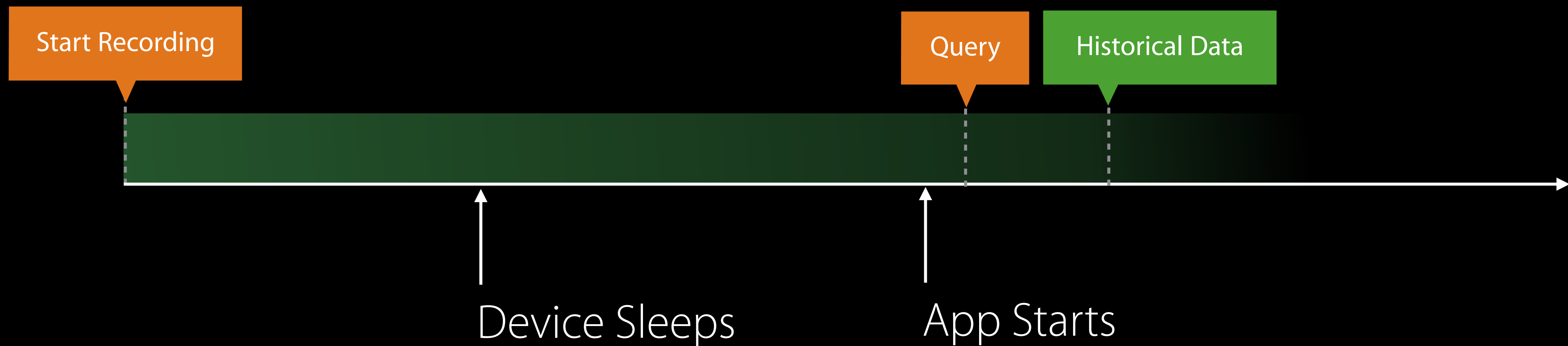


# Apple Watch Historical Accelerometer

Access data

**CMSSensorRecorder**

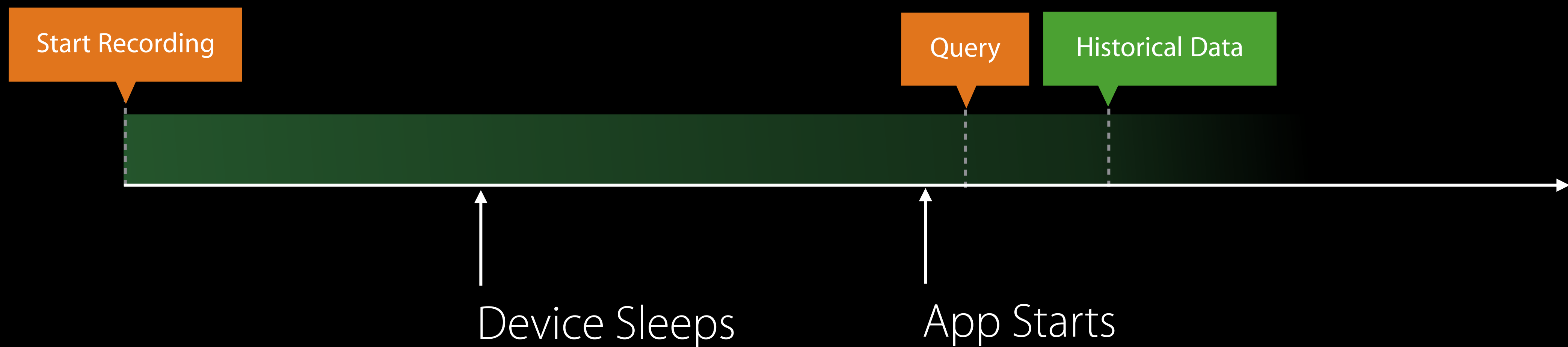
```
accelerometerDataFrom(_:, to:) -> CMSensorDataList
```



# Apple Watch CMSensorRecorder

Access data

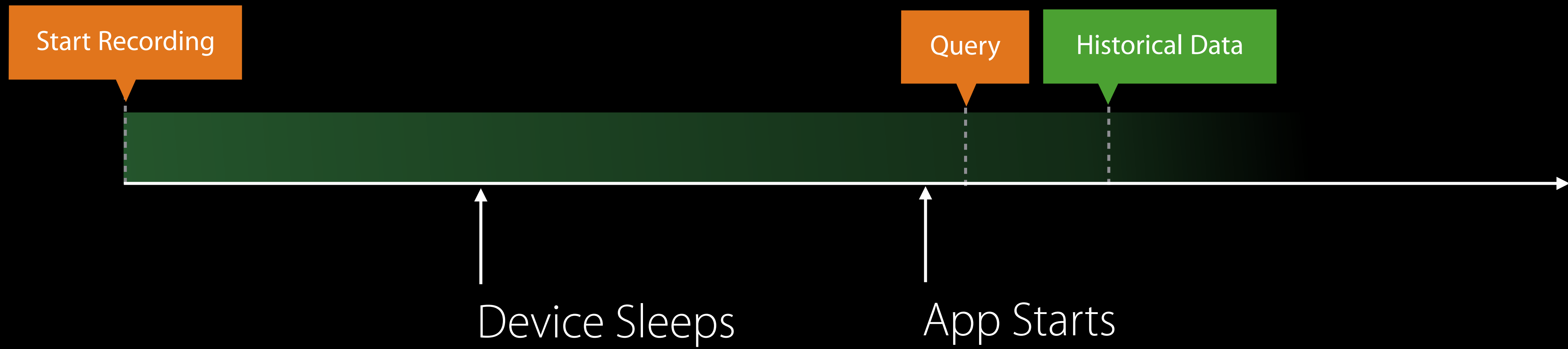
CMSensorRecorder



# Apple Watch CMSensorRecorder

Access data

CMSensorRecorder



# Apple Watch CMSensorRecorder

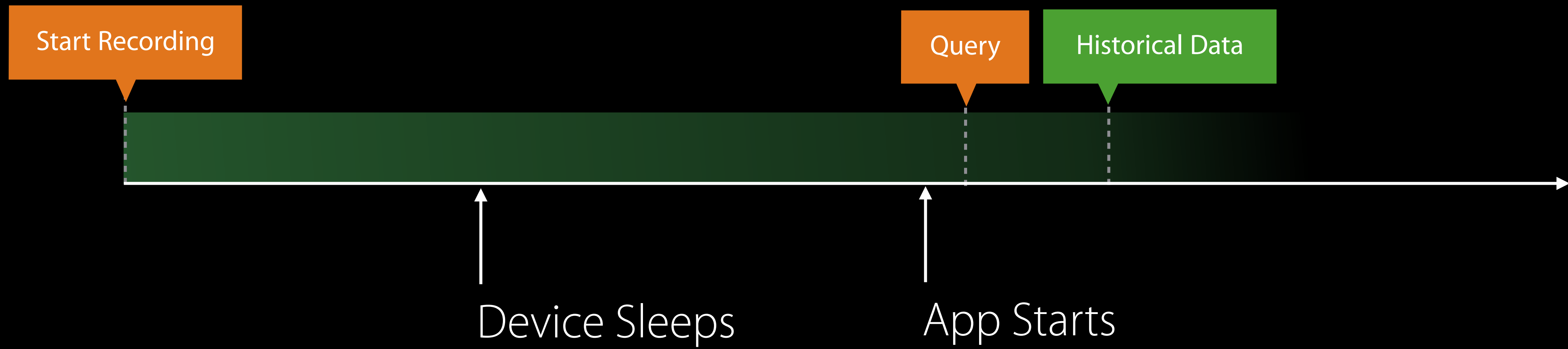
Access data

## CMSensorRecorder



NSProcessInfo.h

```
performExpiringActivityWithReason(_:, usingBlock:)
```





# Apple Watch CMSensorRecorder

CMRecordedAccelerometerData



## CMRecordedAccelerometerData

---

startDate

---

timestamp

---

acceleration

---

# CMSensorRecorder

2



# CMSensorRecorder

Consider power and performance



# CMSensorRecorder

Consider power and performance  
Large data dumps will take time to process



# CMSensorRecorder

2

Consider power and performance

Large data dumps will take time to process

Best Practices



# CMSensorRecorder

Consider power and performance

Large data dumps will take time to process

## Best Practices

- Record/Query minimum duration required



# CMSensorRecorder

Consider power and performance

Large data dumps will take time to process

## Best Practices

- Record/Query minimum duration required
- Know your sensor rate requirements



# CMSensorRecorder

Consider power and performance

Large data dumps will take time to process

## Best Practices

- Record/Query minimum duration required
- Know your sensor rate requirements
- Decimate data to reduce processing time





# Apple Watch Summary



Motion Activity, Pedometer, and Accelerometer

Historical Accelerometer

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Introducing WatchKit for watchOS 2

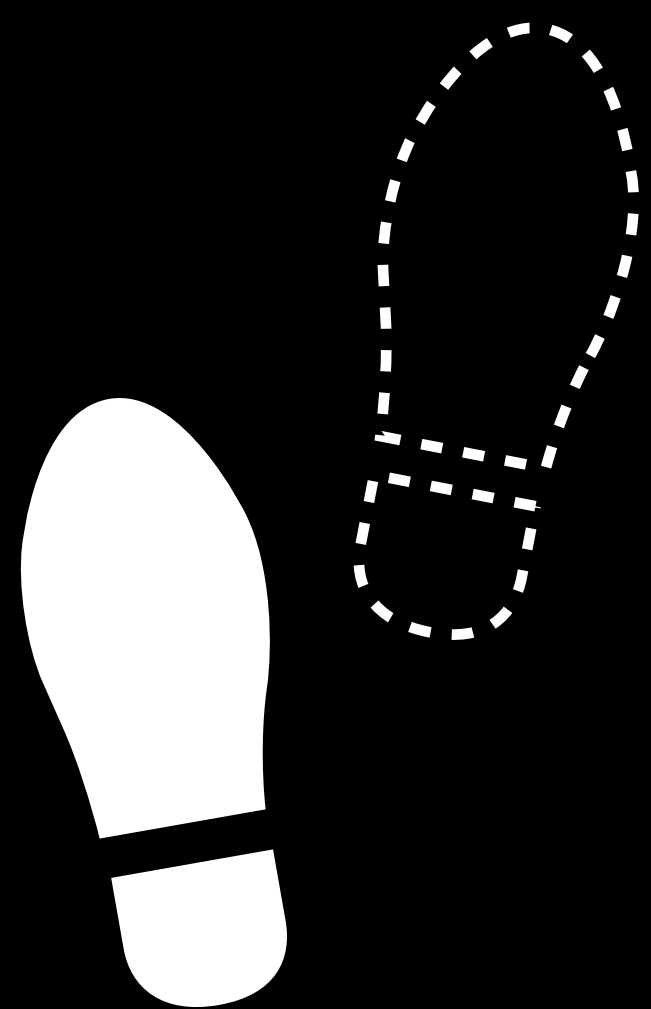
Presidio

Tuesday 10:00AM

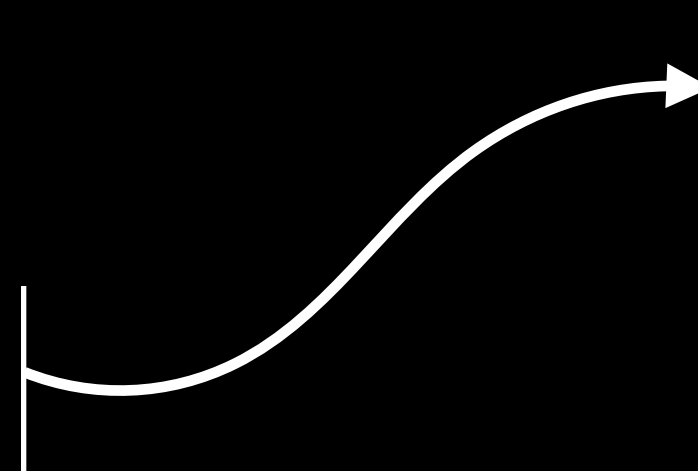
---

Pedometer

# Pedometer



Steps



Distance

# Steps and Distance

Recap

**CMPPedometerData**

---

numberOfSteps

---

distance

---

# Steps and Distance

Recap

Consistent performance

**CMPPedometerData**

---

numberOfSteps

---

distance

---

# Steps and Distance

## Recap

Consistent performance

- Across body locations

**CMPPedometerData**

---

numberOfSteps

---

distance

---

# Steps and Distance

## Recap

Consistent performance

- Across body locations
- For varying pace

**CMPPedometerData**

---

numberOfSteps

---

distance

---

# Steps and Distance

## Recap

Consistent performance

- Across body locations
- For varying pace

Adapts to user over time

**CMPPedometerData**

---

numberOfSteps

---

distance

---



# Steps and Distance

## Recap

Consistent performance

- Across body locations
- For varying pace

Adapts to user over time

Uses GPS when available

**CMPPedometerData**

---

numberOfSteps

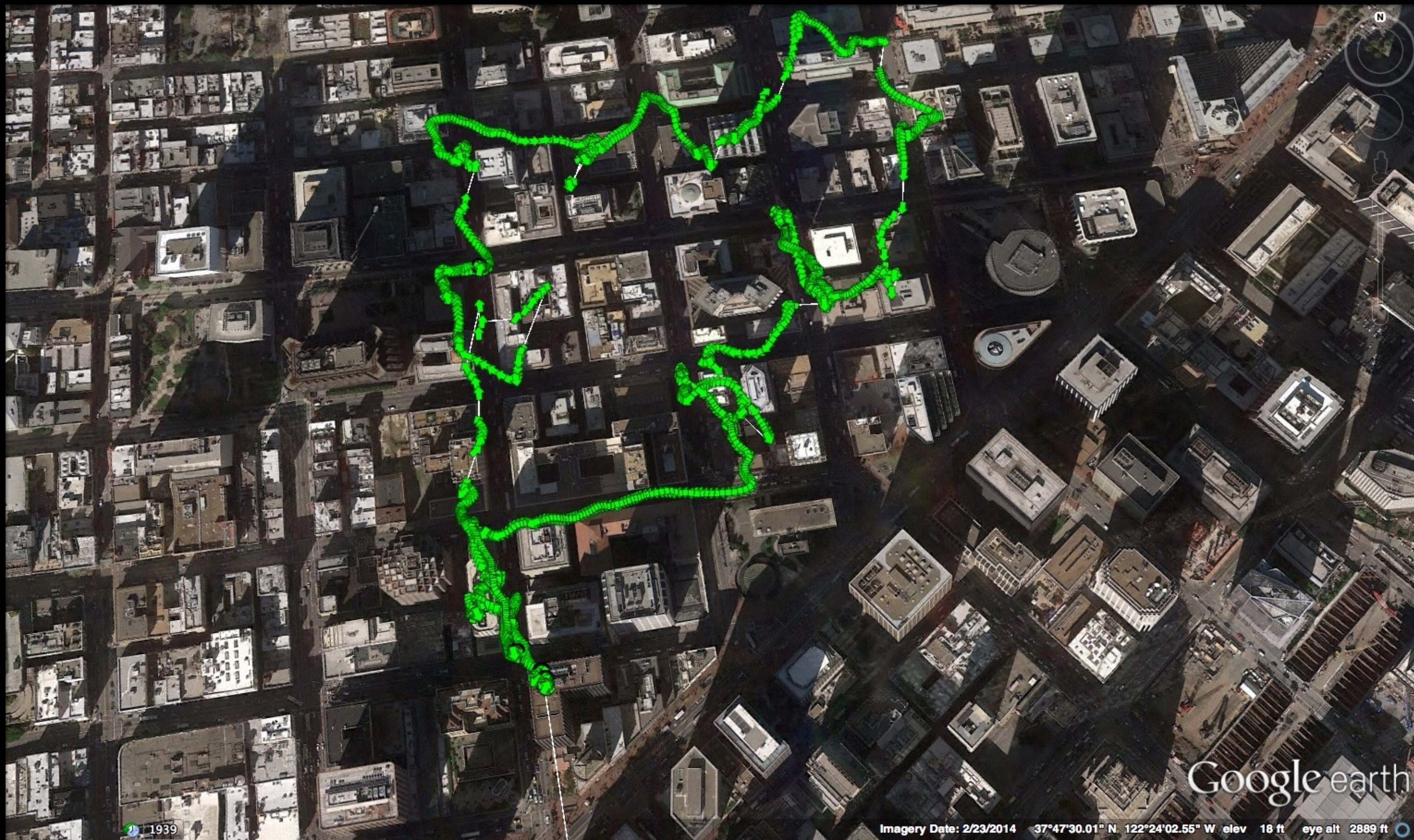
---

distance

---

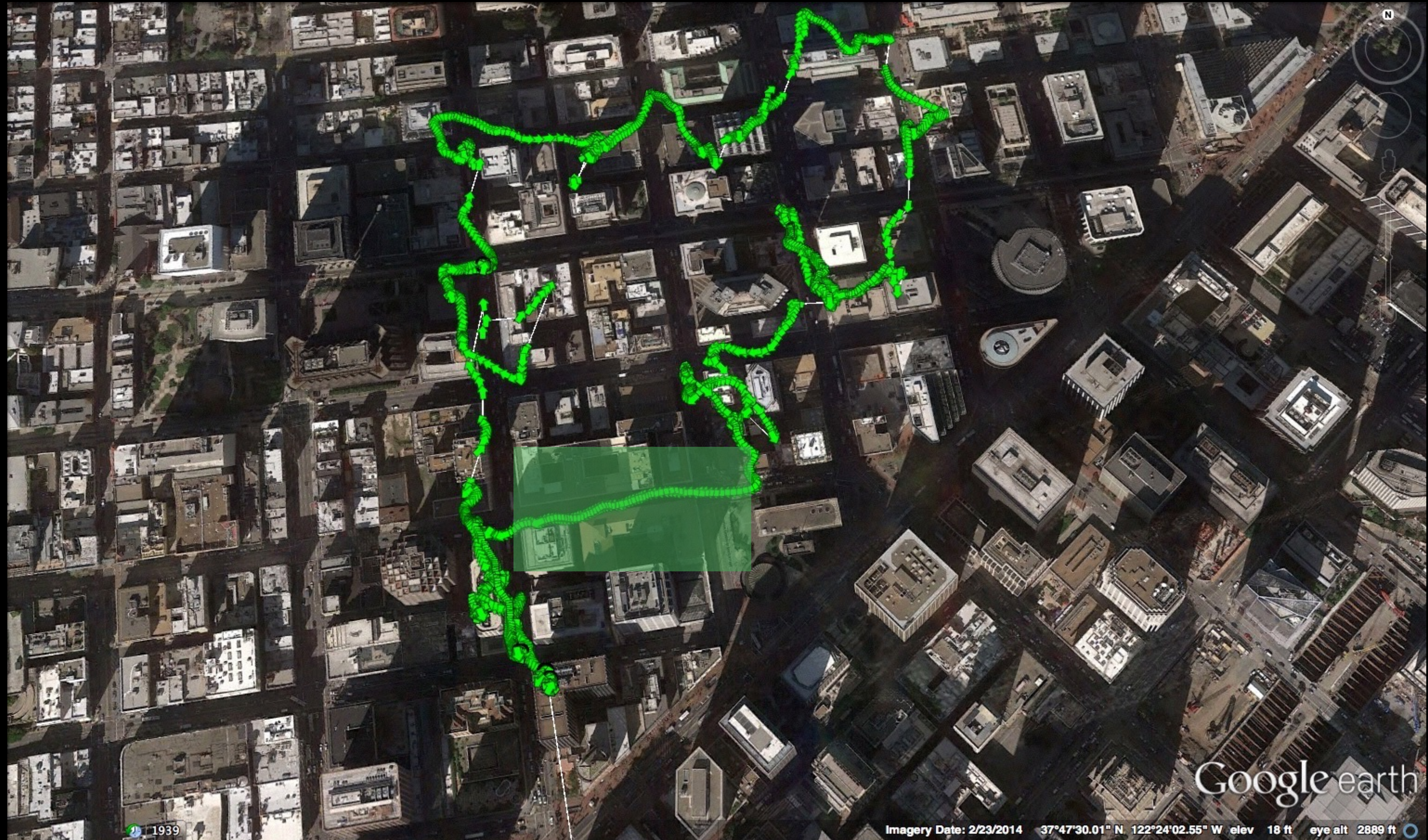
# Steps and Distance

## GPS-Fusion



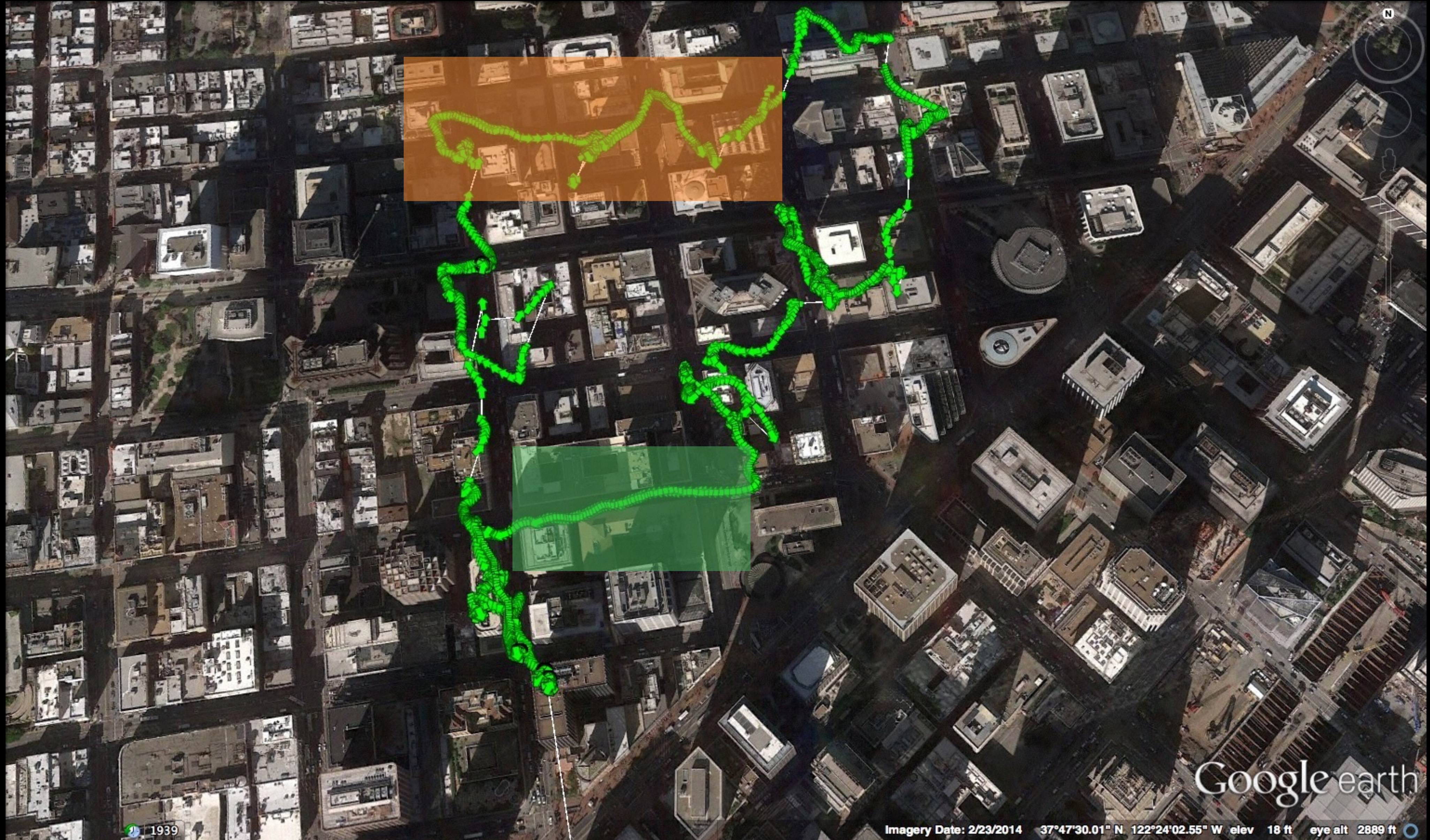
# Steps and Distance

## GPS-Fusion

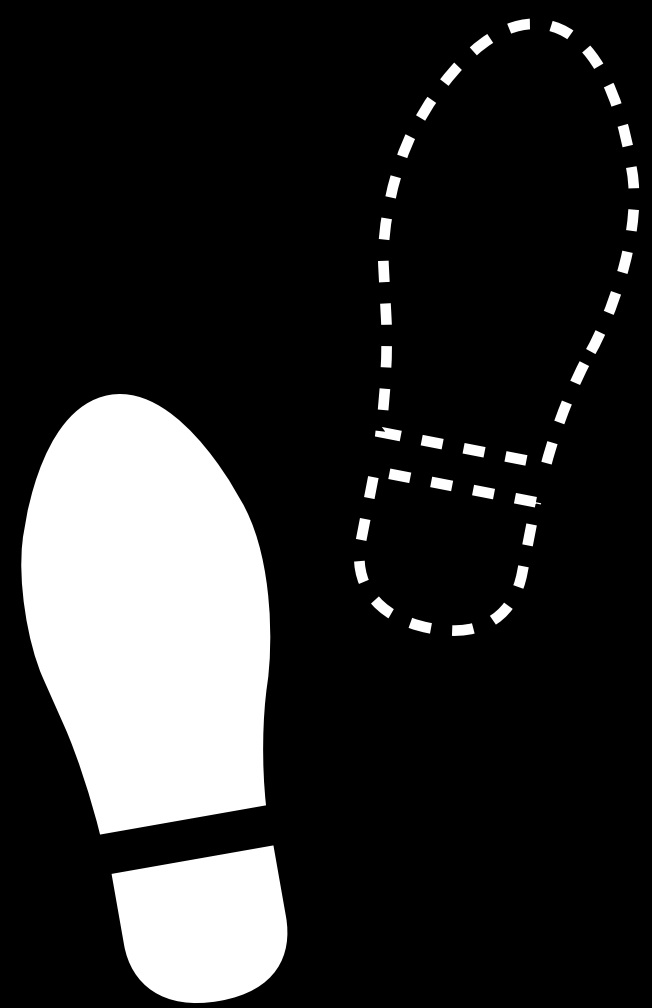


# Steps and Distance

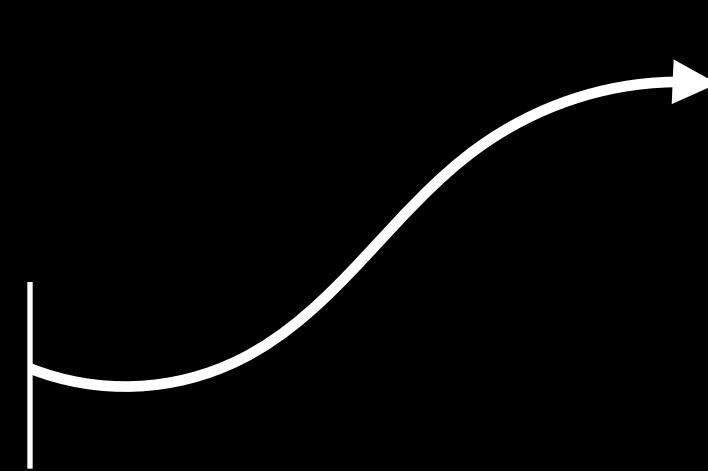
## GPS-Fusion



# Pedometer

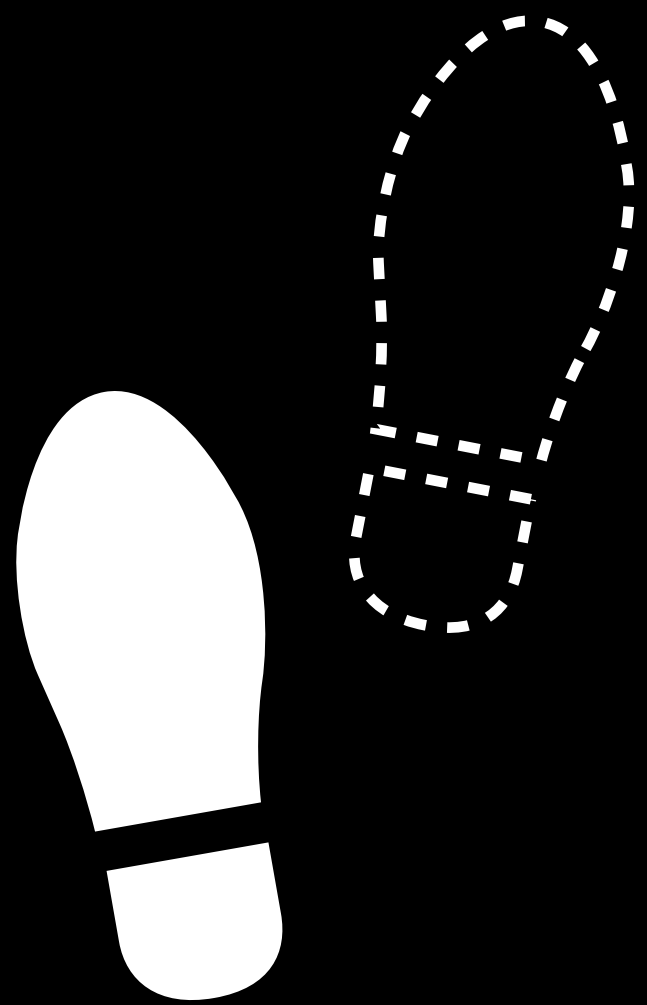


Steps

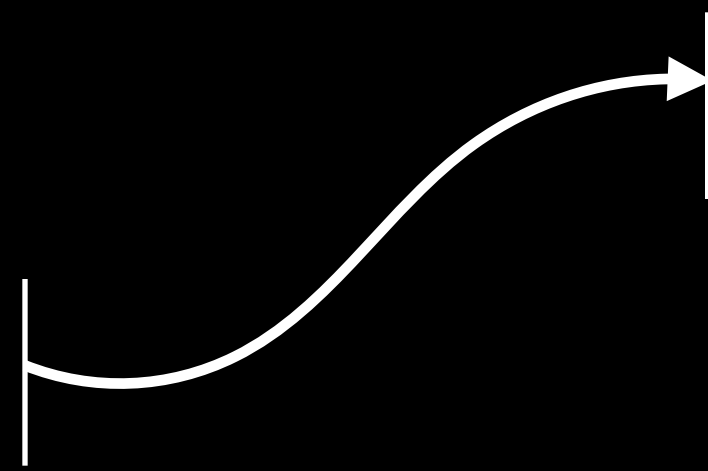


Distance

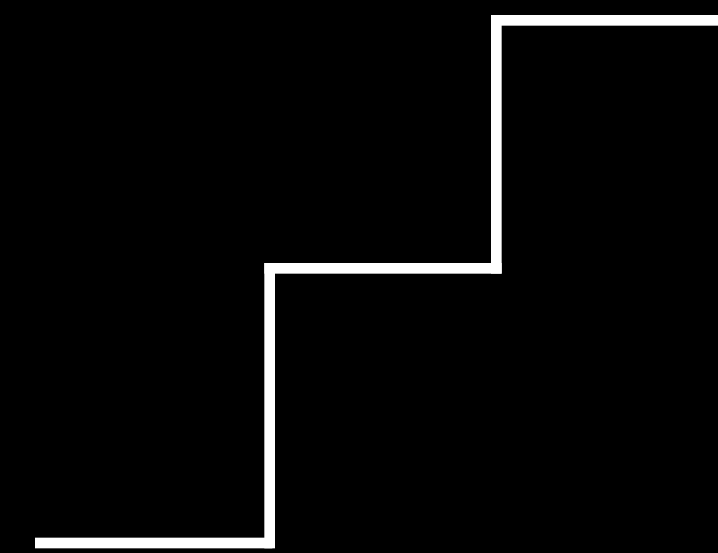
# Pedometer



Steps



Distance



Floor Counting

# Floor Counting

## CMPedometerData

---

numberOfSteps

---

distance

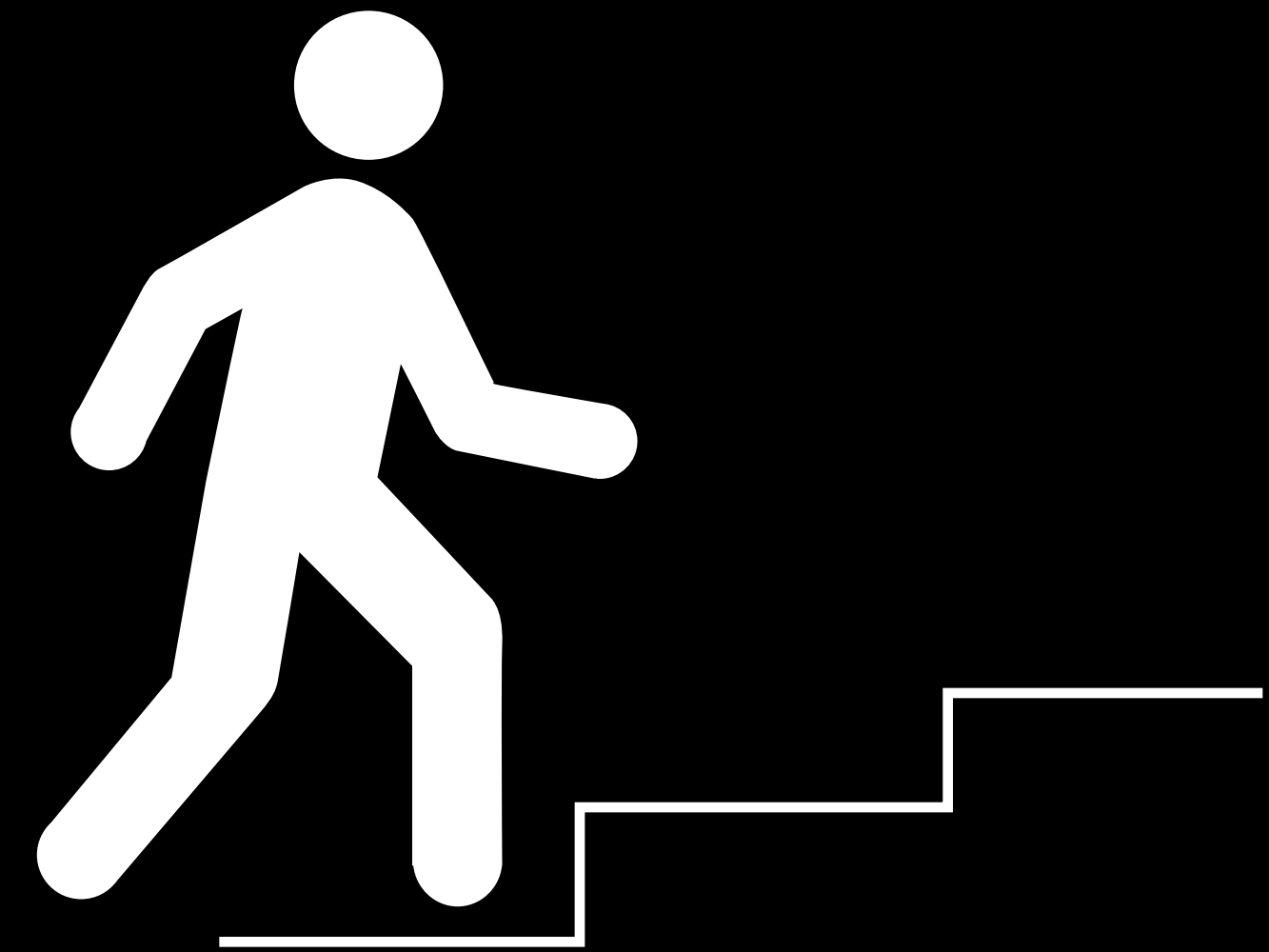
---

floorsAscended

---

floorsDescended

---



# Floor Counting

## CMPedometerData

---

numberOfSteps

---

distance

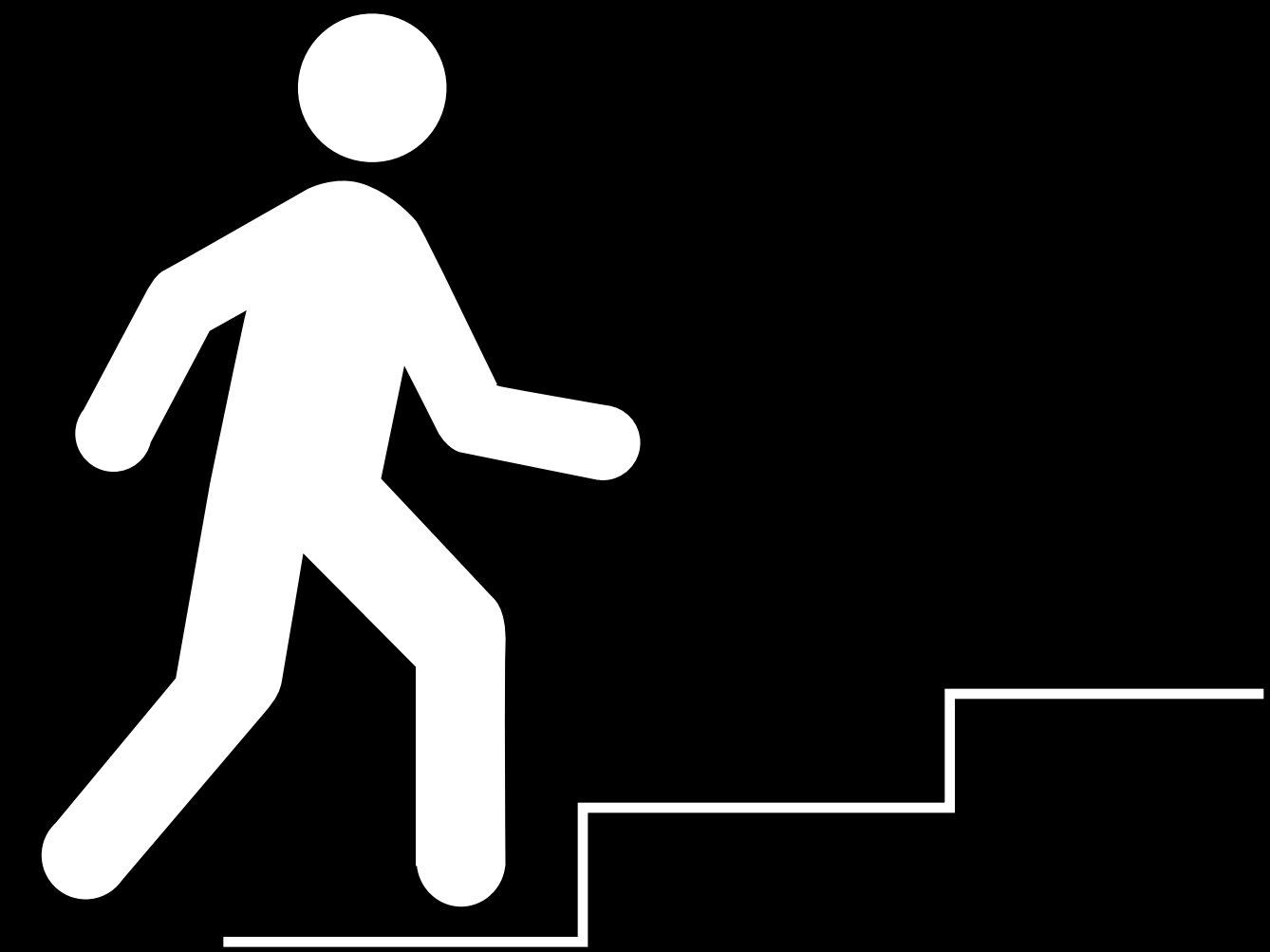
---

floorsAscended

---

floorsDescended

---



Earn your floors



# Floor Counting

# Floor Counting

Requirements

# Floor Counting

## Requirements

- Minimum ascend rate

# Floor Counting

## Requirements

- Minimum ascend rate
- Steps

# Floor Counting

## Requirements

- Minimum ascend rate
- Steps

## Implications

# Floor Counting

## Requirements

- Minimum ascend rate
- Steps

## Implications

- May award floors for steep hills

# Floor Counting

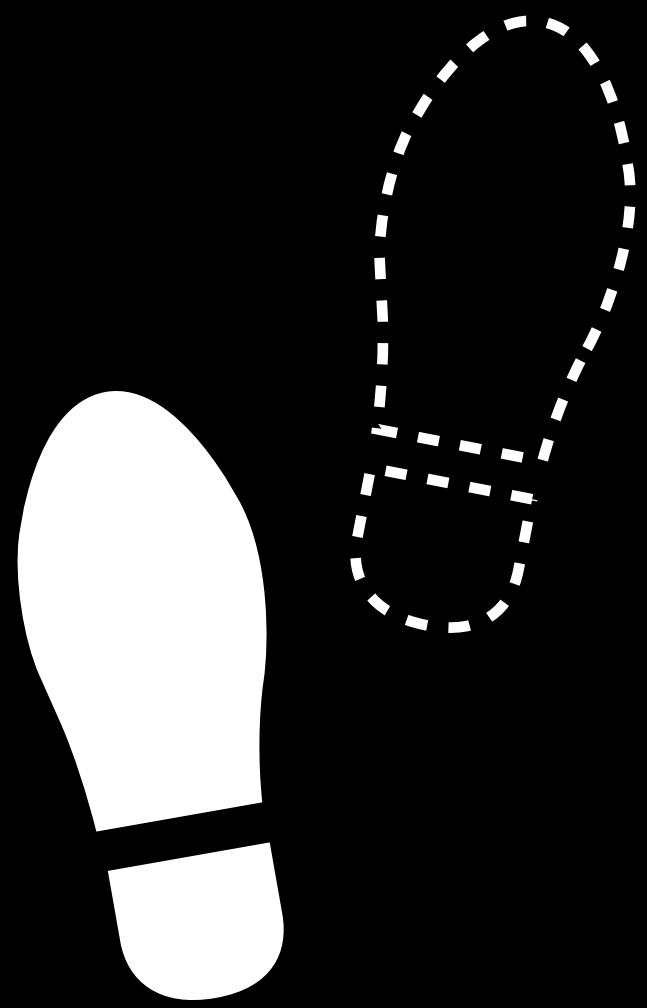
## Requirements

- Minimum ascend rate
- Steps

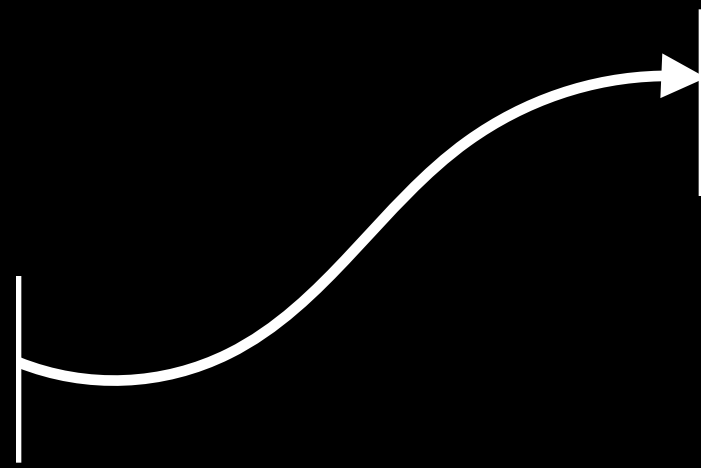
## Implications

- May award floors for steep hills
- Will not award floors for elevators/escalators

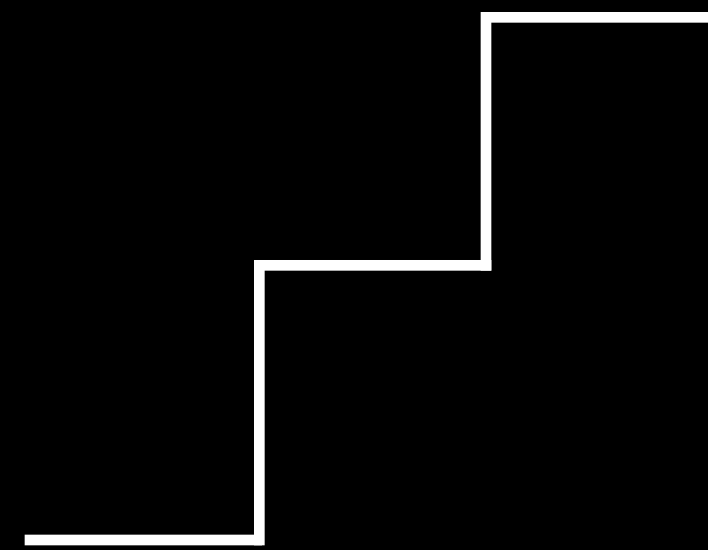
# Pedometer



Steps



Distance

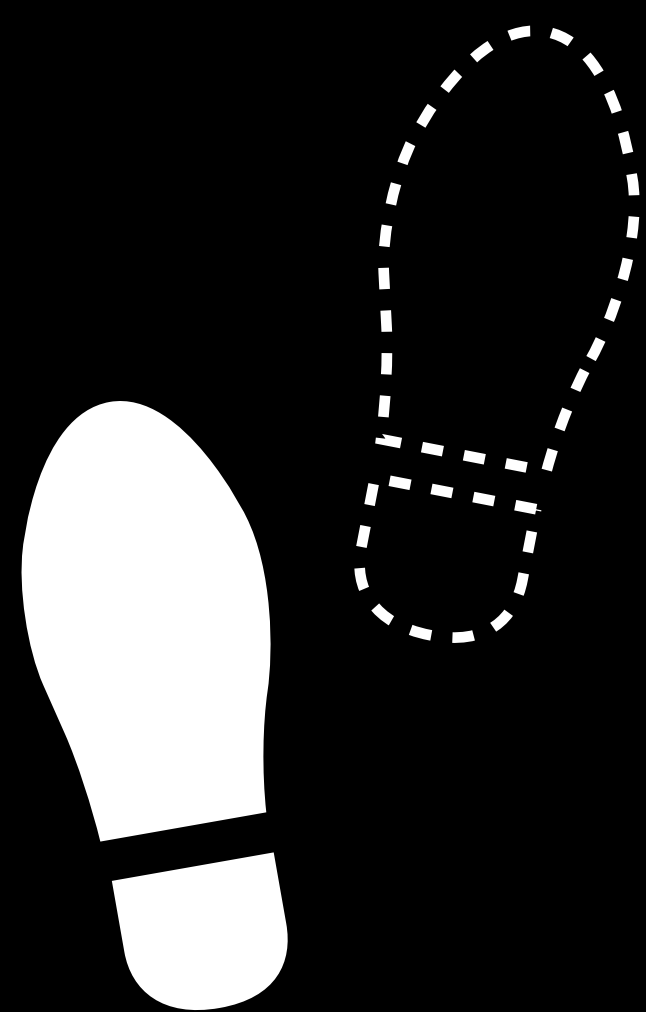


Floor Counting

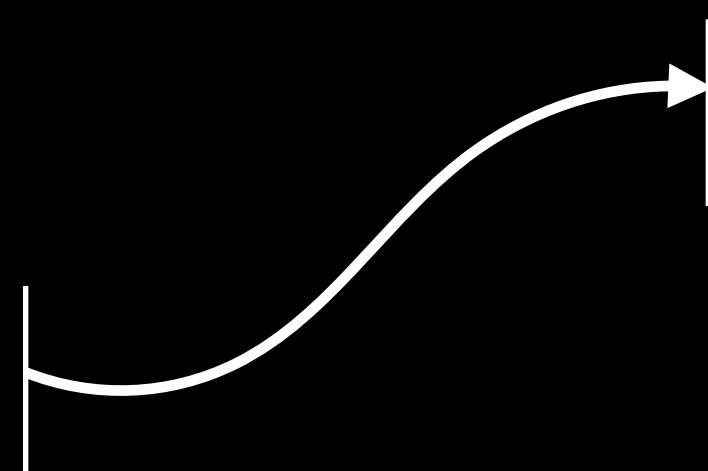


# Pedometer

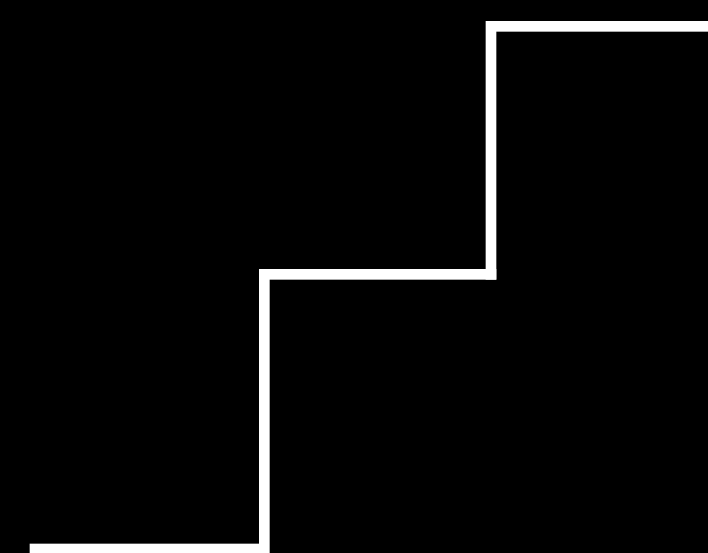
NEW



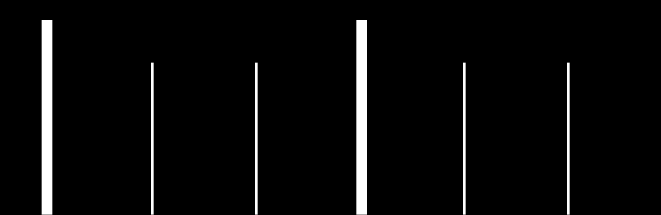
Steps



Distance



Floor Counting



Pace

# Pace

NEW

# Pace

NEW

## CMPPedometerData

---

numberOfSteps

---

distance

---

floorsAscended

---

floorsDescended

---

currentPace

---

# Pace

NEW

## CMPPedometerData

---

numberOfSteps

---

distance

---

floorsAscended

---

floorsDescended

---

currentPace

---

Instantaneous Pace

# Pace

NEW

## CMPPedometerData

---

numberOfSteps

---

distance

---

floorsAscended

---

floorsDescended

---

currentPace

---

Instantaneous Pace

Provided in time/distance units (s/m)

# Pace

NEW

## CMPPedometerData

numberOfSteps

distance

floorsAscended

floorsDescended

currentPace

Instantaneous Pace

Provided in time/distance units (s/m)



# Pace

NEW

## CMPPedometerData

---

numberOfSteps

---

distance

---

floorsAscended

---

floorsDescended

---

currentPace

---

Instantaneous Pace

Provided in time/distance units (s/m)

Available for live pedometer updates



# Pace Challenges





Pace

Challenges

Smoothness

NEW

Pace

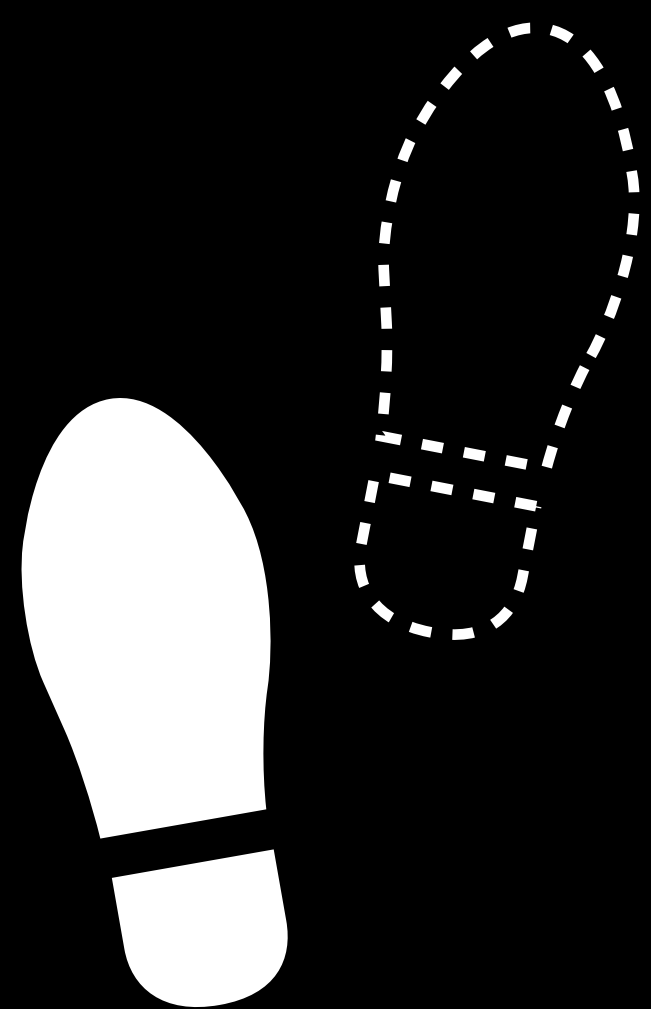
Challenges

Smoothness

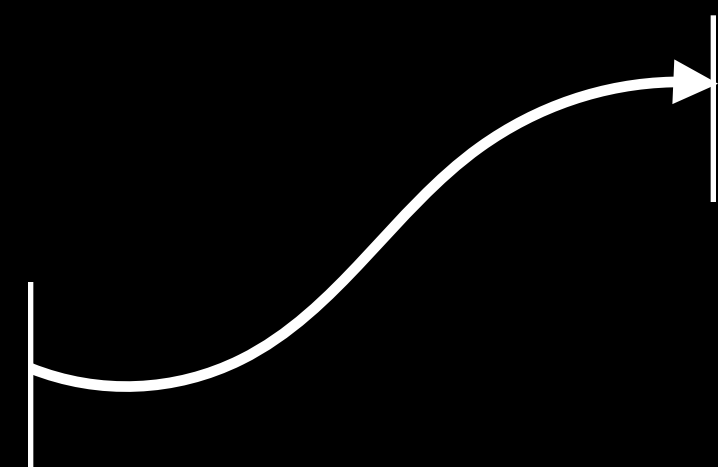
Responsiveness

NEW

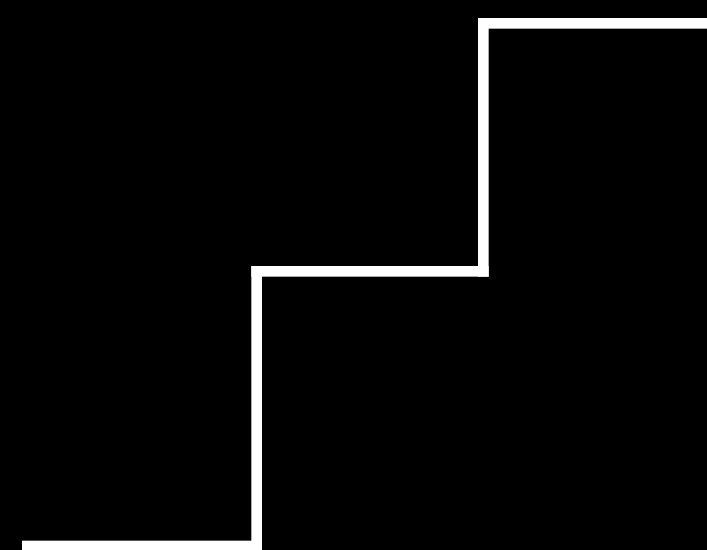
# Pedometer



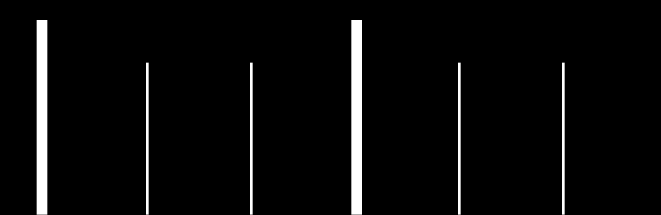
Steps



Distance



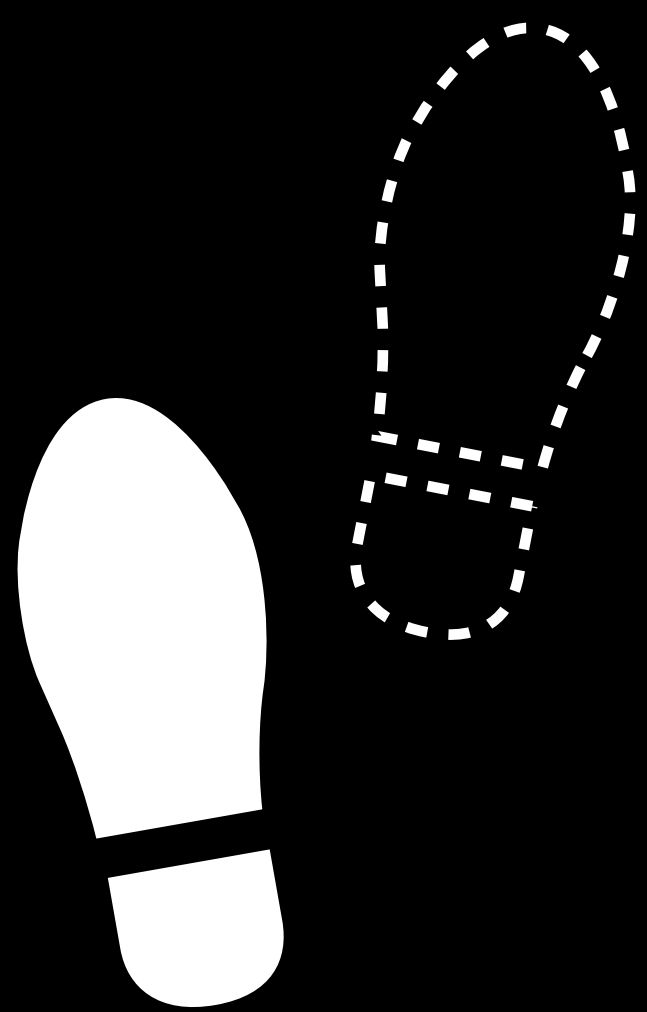
Floor Counting



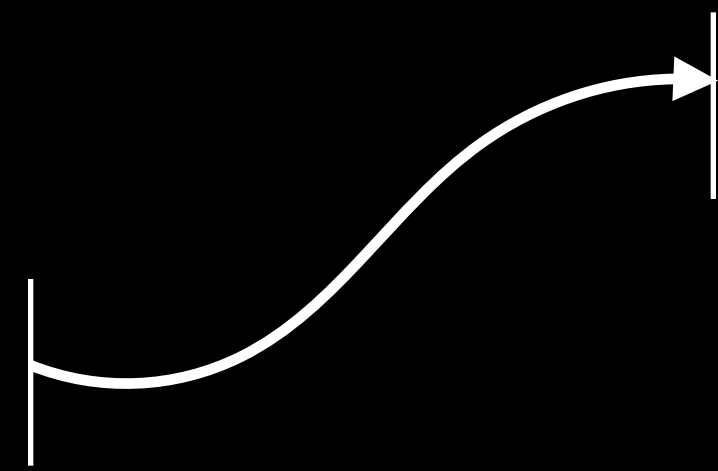
Pace

# Pedometer

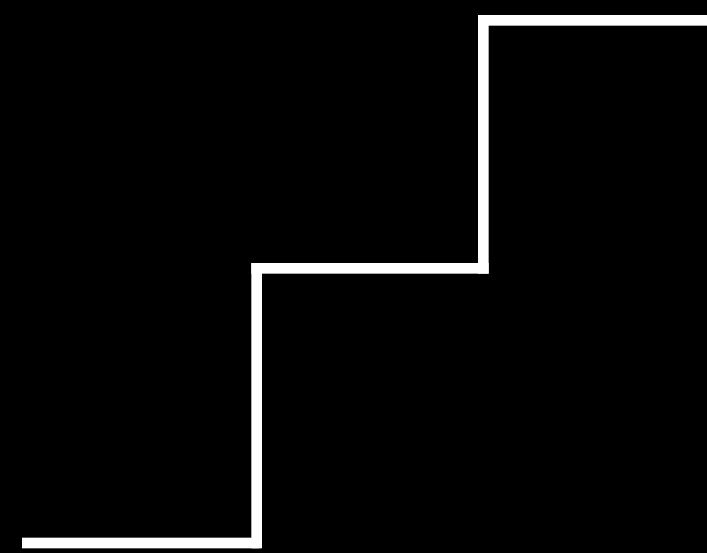
NEW



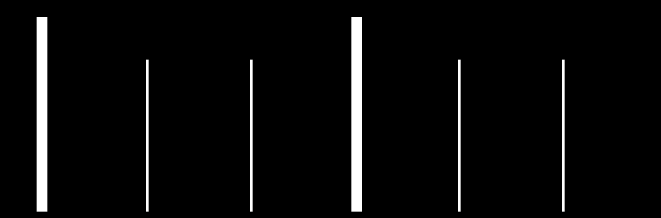
Steps



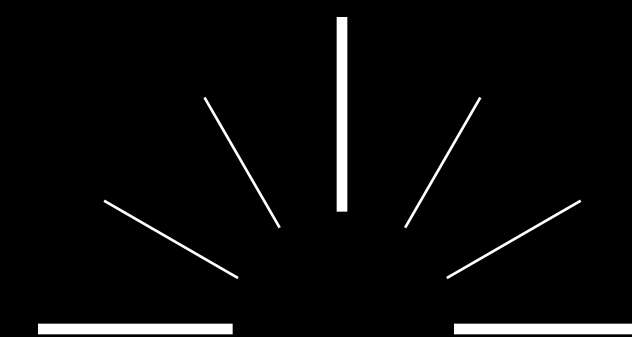
Distance



Floor Counting



Pace



Cadence

# Cadence

NEW

## CMPedometerData

---

numberOfSteps

---

distance

---

floorsAscended

---

floorsDescended

---

currentPace

---

cadence

---

# Cadence

NEW

Rate of steps taken

## CMPPedometerData

---

numberOfSteps

---

distance

---

floorsAscended

---

floorsDescended

---

currentPace

---

cadence

---

# Pedometer

## Availability

	iPhone 5S	iPhone 6/6+	Apple Watch
Steps	✓	✓	✓
Distance	✓	✓	✓
Floor Counting	✓	✓	
Pace		✓	✓
Cadence		✓	

Pressure



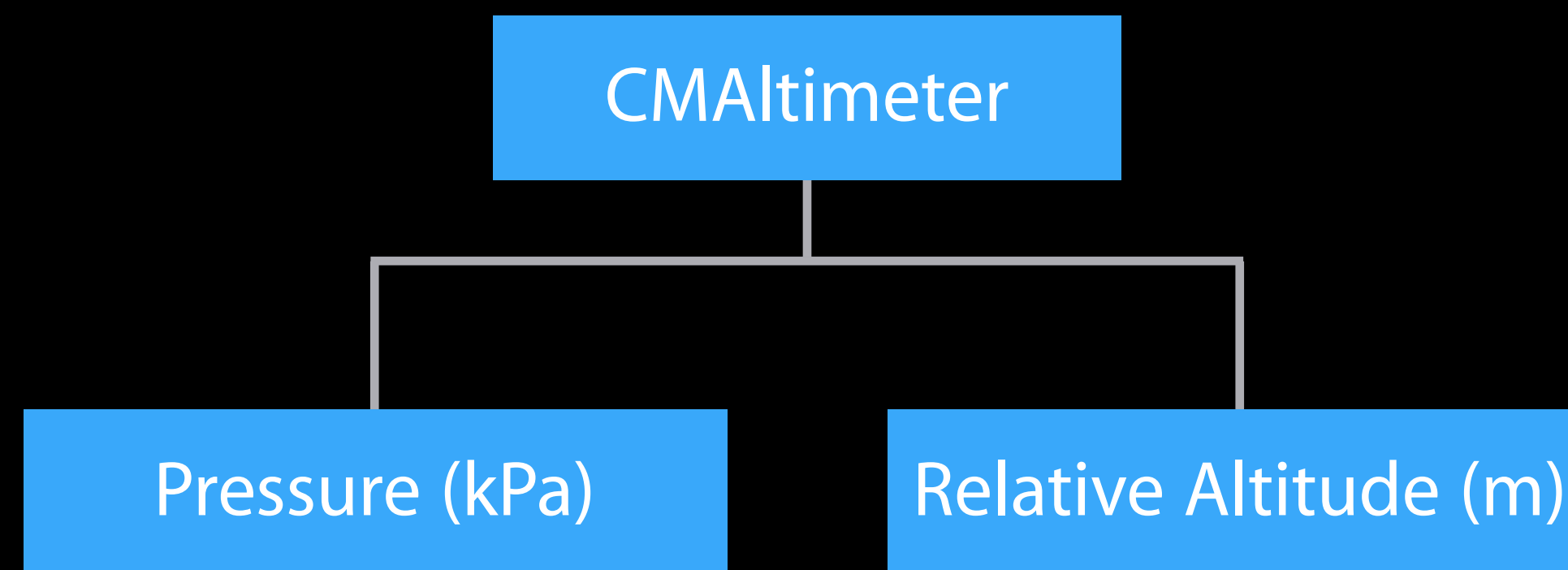
# Pressure

Using this sensor

CMAltimeter

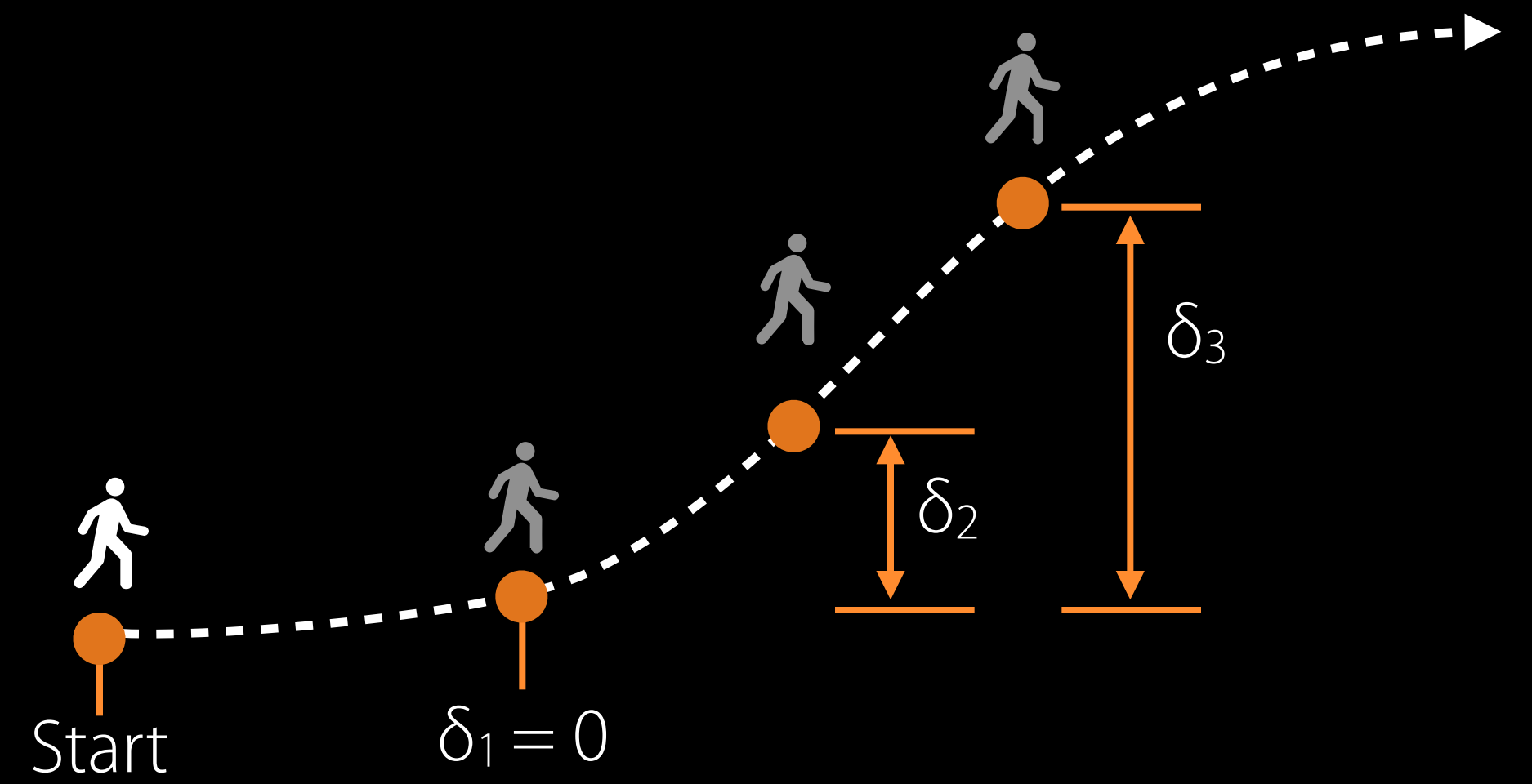
# Pressure

Using this sensor



# Pressure

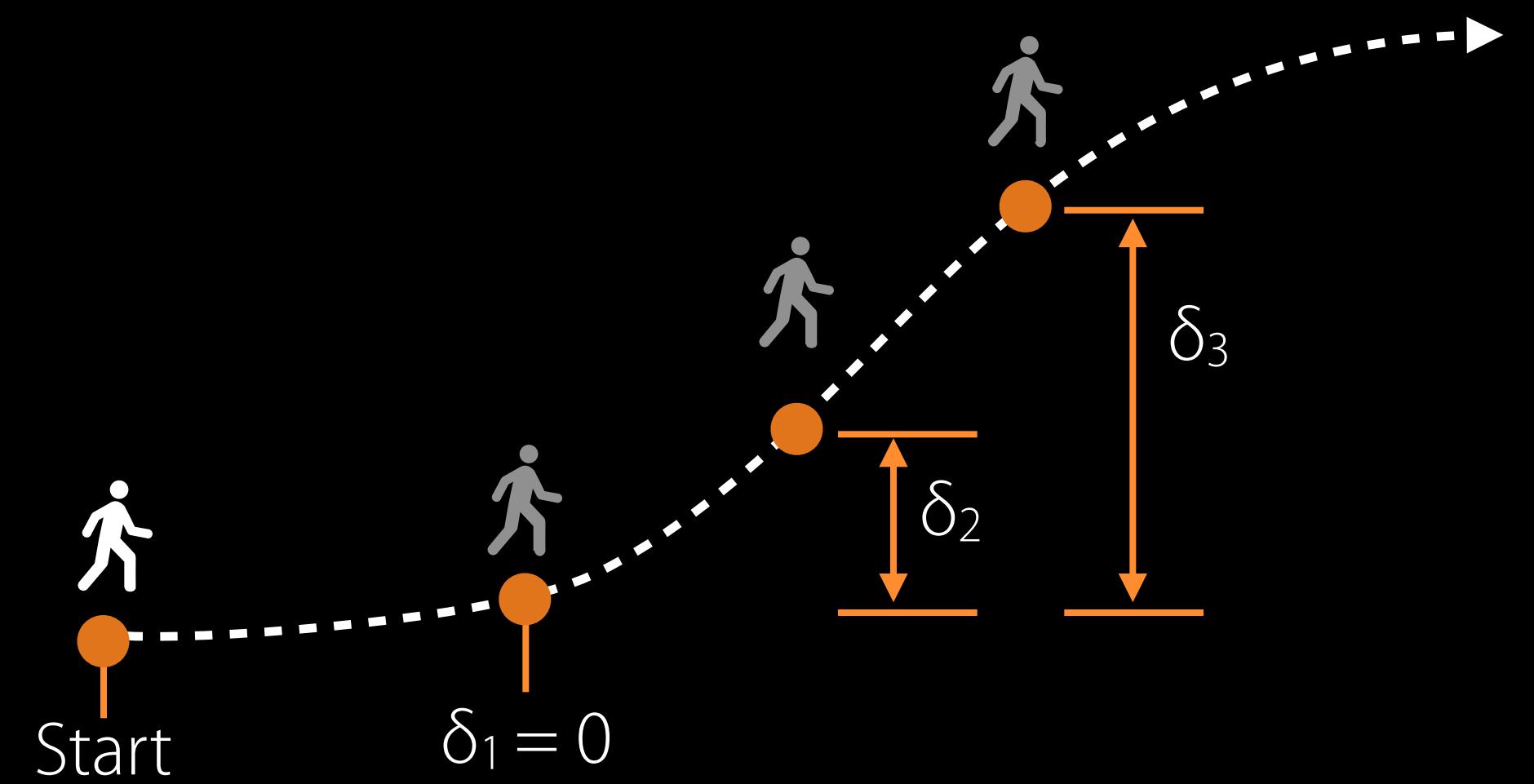
## Relative Altitude



# Pressure

Relative Altitude

Relative to first altitude sample

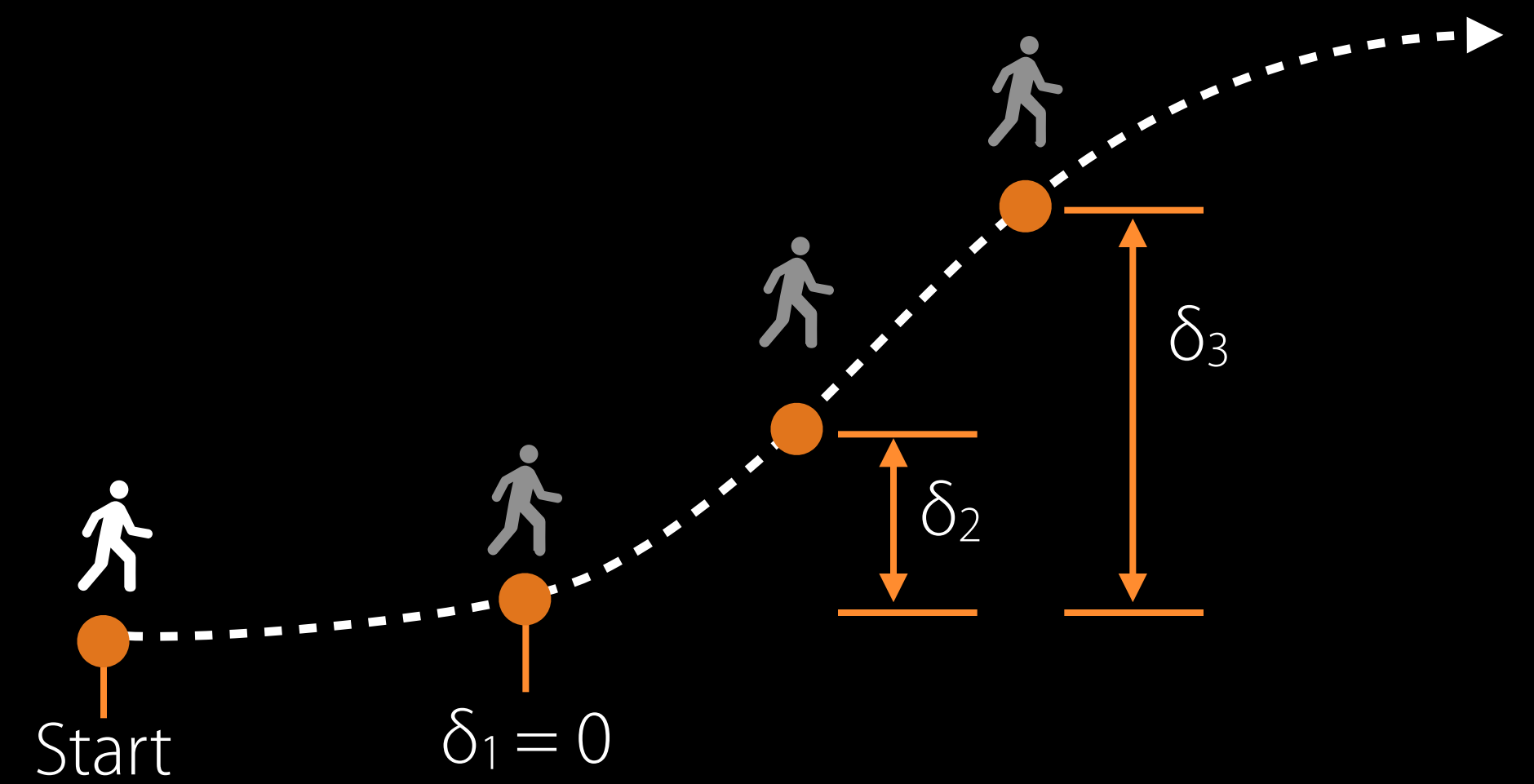


# Pressure

## Relative Altitude

Relative to first altitude sample

First sample reports zero altitude



# Relative Altitude

Usage

# Relative Altitude

Usage

Use for floor-scale changes, not body-scale

# Relative Altitude

Usage

Use for floor-scale changes, not body-scale

Challenging Situations



# Relative Altitude

## Usage

Use for floor-scale changes, not body-scale

## Challenging Situations

- Weather changes over long durations

# Relative Altitude

## Usage

Use for floor-scale changes, not body-scale

## Challenging Situations

- Weather changes over long durations
- Rigid sealed cases

# Relative Altitude

API

CMAltimeter

```
startRelativeAltitudeUpdatesToQueue(_:, withHandler:)
```

# Relative Altitude

API

CMAltimeter

```
startRelativeAltitudeUpdatesToQueue(_:, withHandler:)
```



CMAltitudeData

---

pressure

---

relativeAltitude

---

# Relative Altitude

API

CMAltimeter

```
startRelativeAltitudeUpdatesToQueue(_:, withHandler:)
```



CMAltimeterData

pressure

relativeAltitude

Request

Altimeter Data

# Relative Altitude

API

CMAltimeter

```
startRelativeAltitudeUpdatesToQueue(_:, withHandler:)
```



CMAltimeterData

pressure

relativeAltitude



# Relative Altitude

API

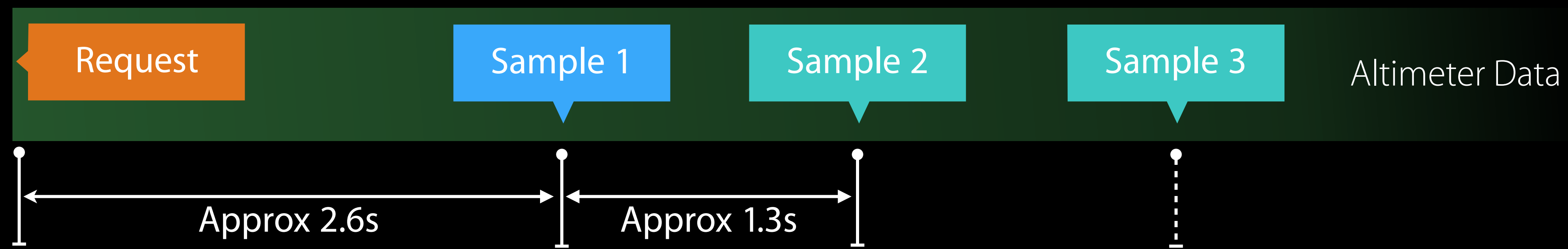
CMAltimeter

```
startRelativeAltitudeUpdatesToQueue(_:, withHandler:)
```

↓  
CMAltimeterData

pressure

relativeAltitude



# Summary



# Summary

Access to Apple Watch accelerometer data

# Summary

Access to Apple Watch accelerometer data

Historical accelerometer data

# Summary

Access to Apple Watch accelerometer data

Historical accelerometer data

GPS-fusion in Pedometer

# Summary

Access to Apple Watch accelerometer data

Historical accelerometer data

GPS-fusion in Pedometer

Pace and Cadence

# Motion Awareness

Gabrielle Badie  
Engineer

# Sample App Concept

Music player

# Sample App Concept

Music player



Detect

# Sample App Concept

Music player



Detect



Engage



# Sample App Concept

Music player



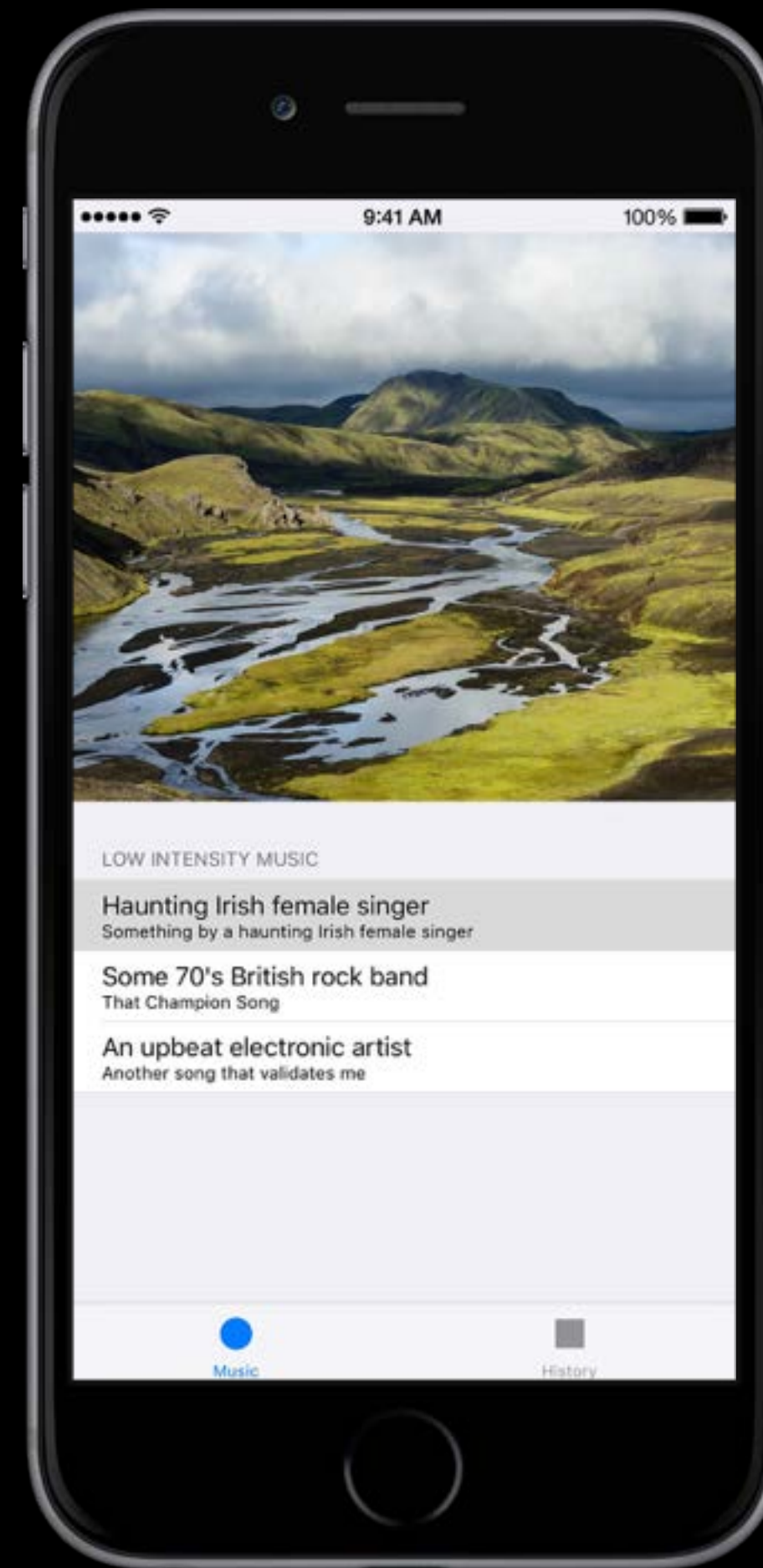
Detect



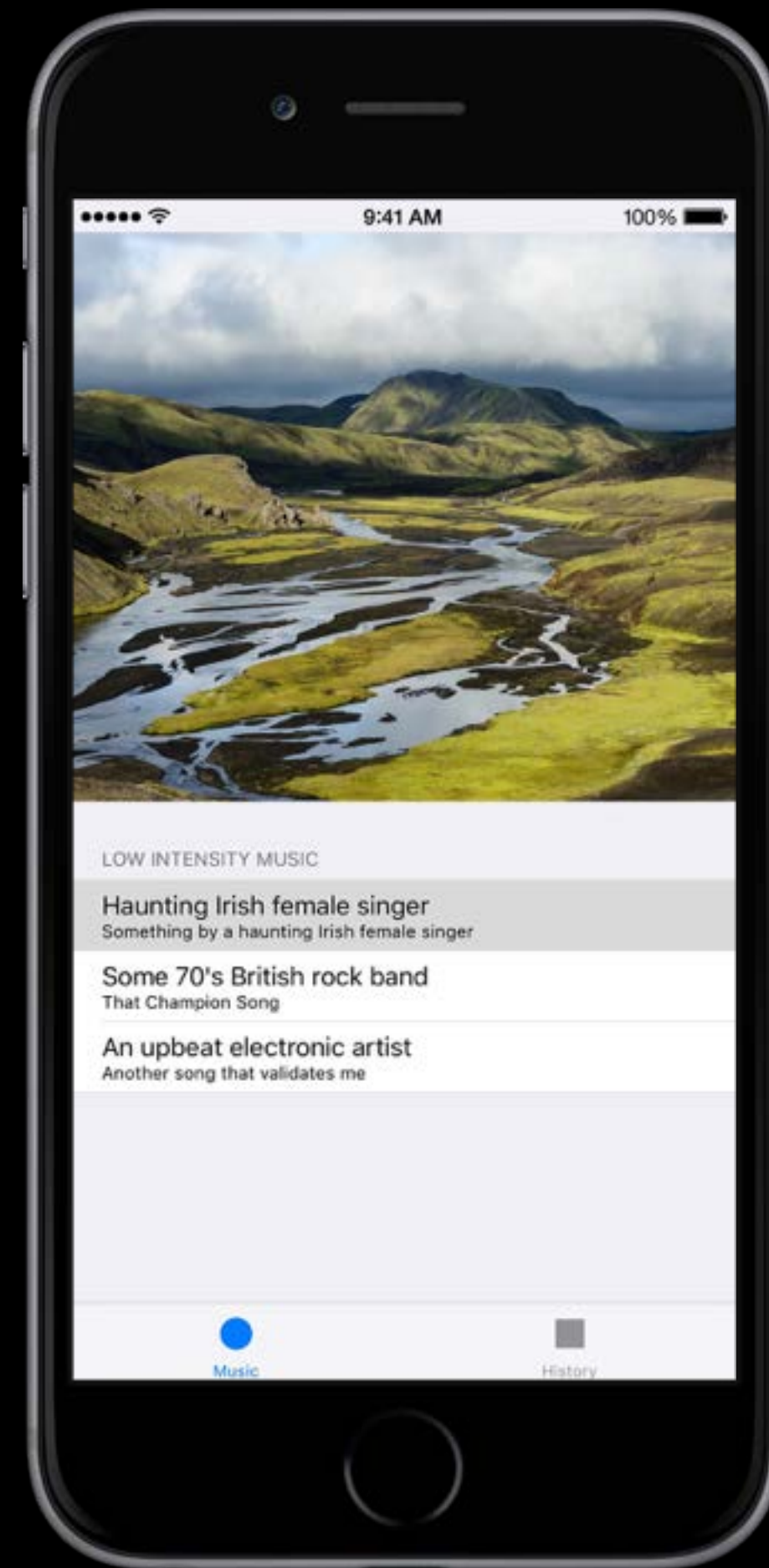
Engage



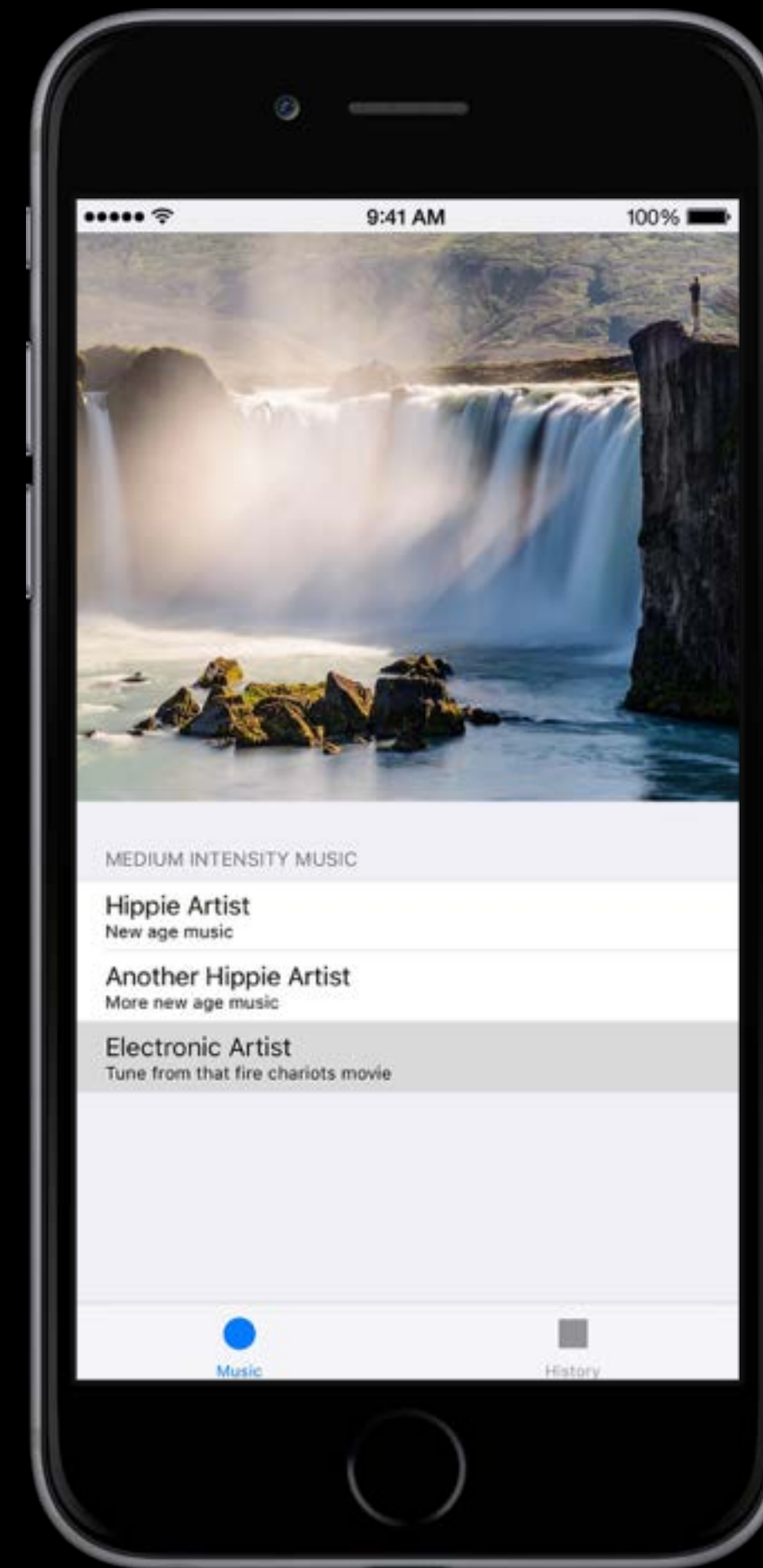
Reflect



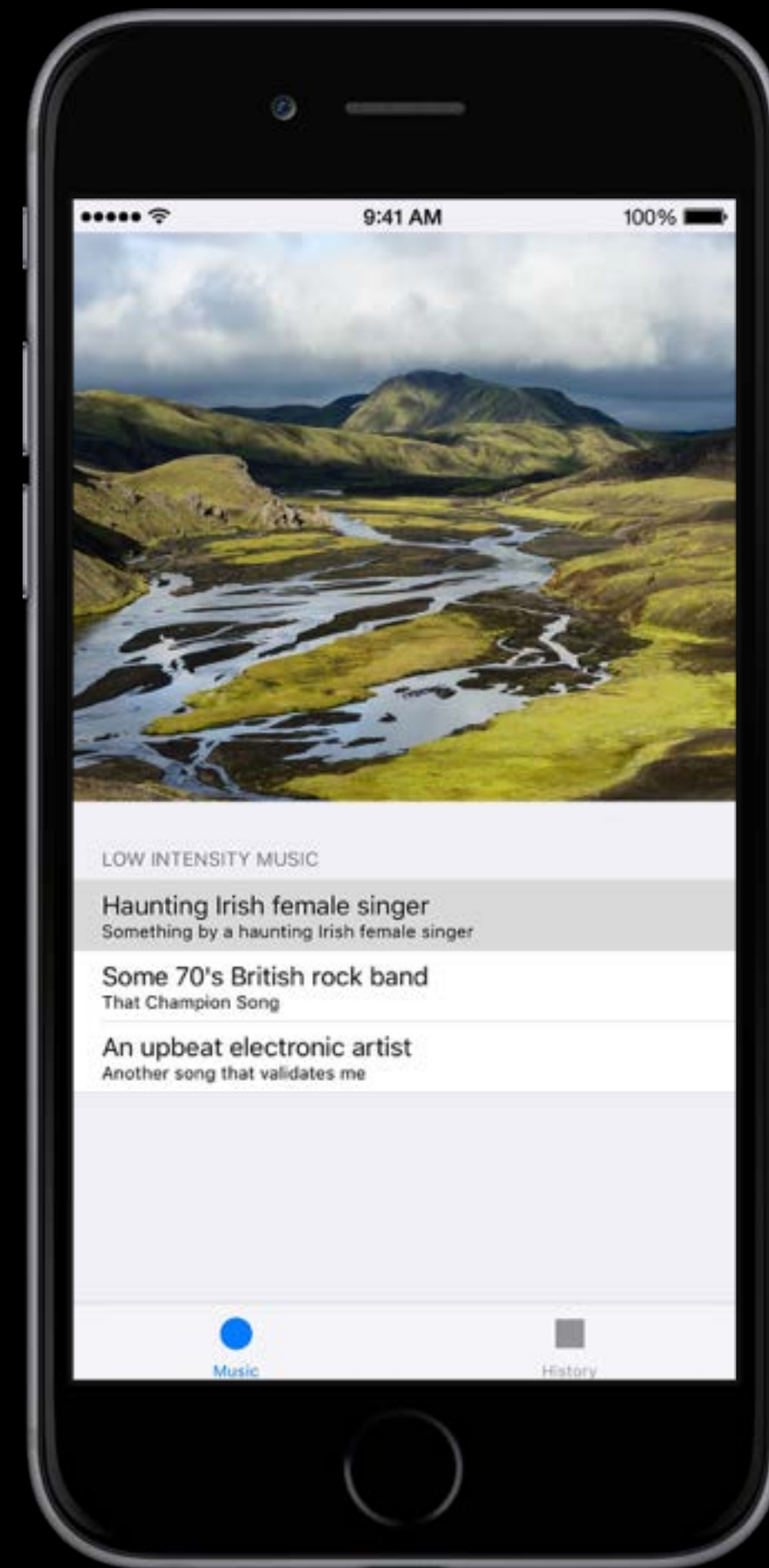
Start Up



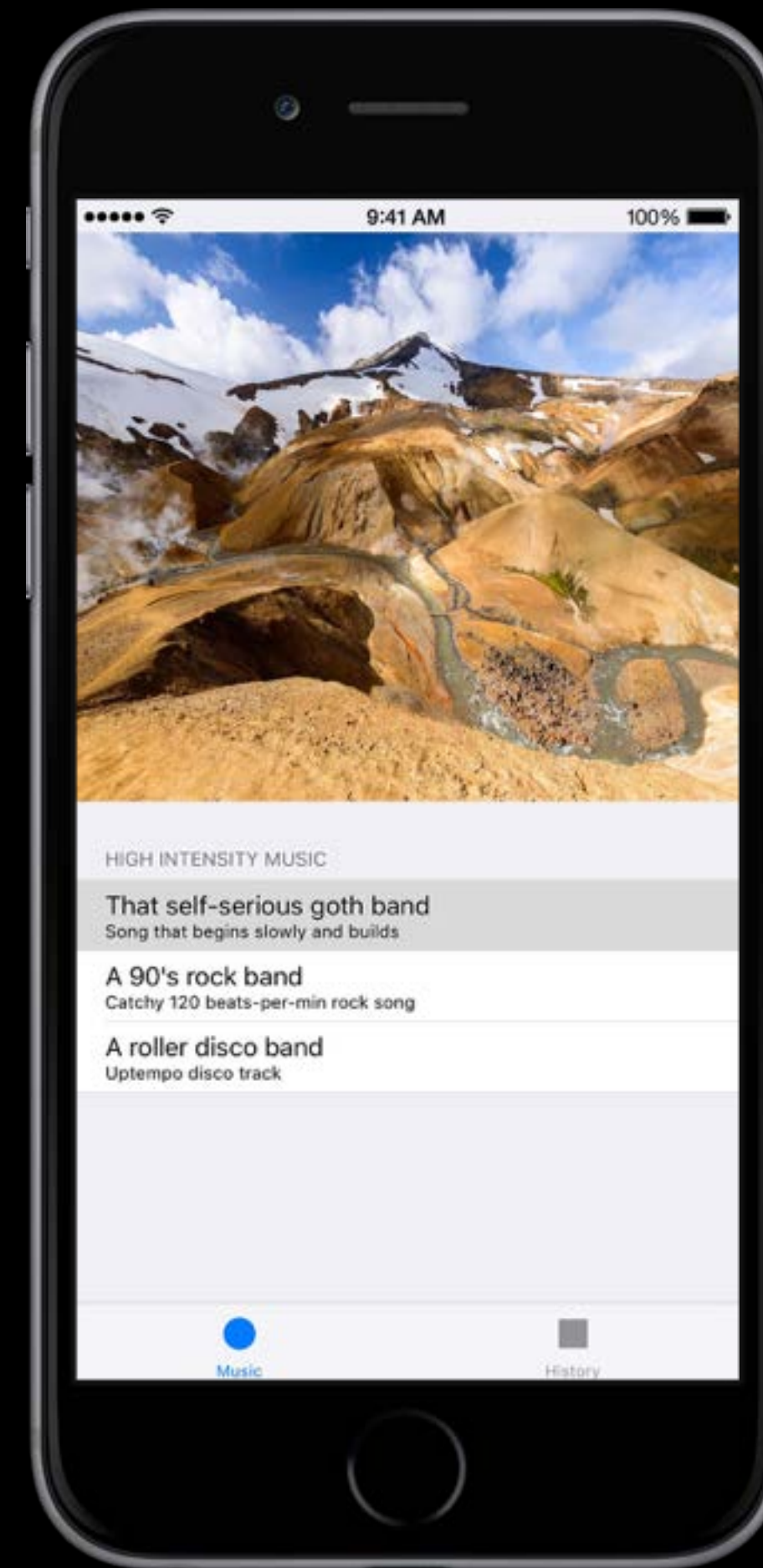
Start Up



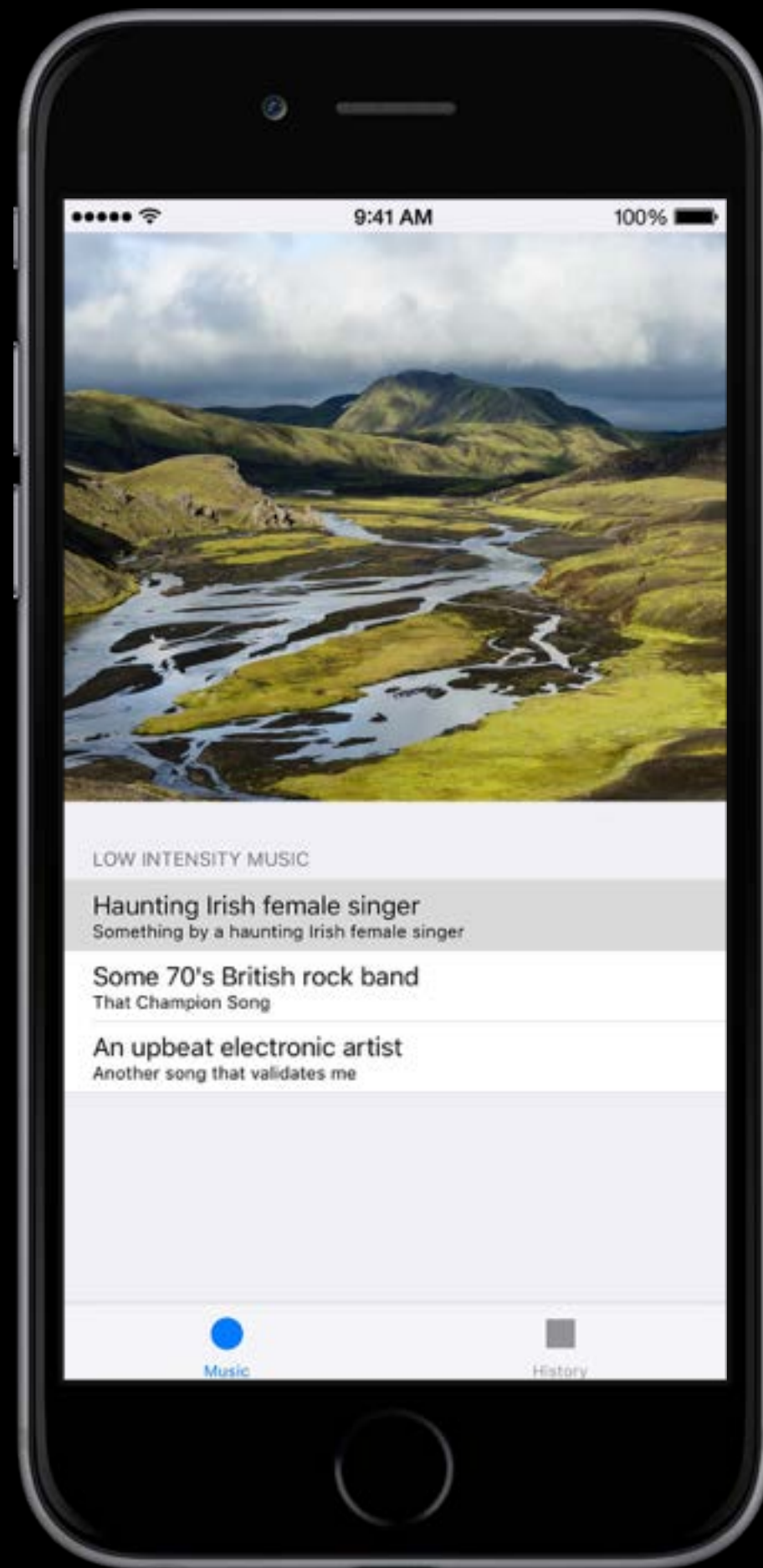
Work Out



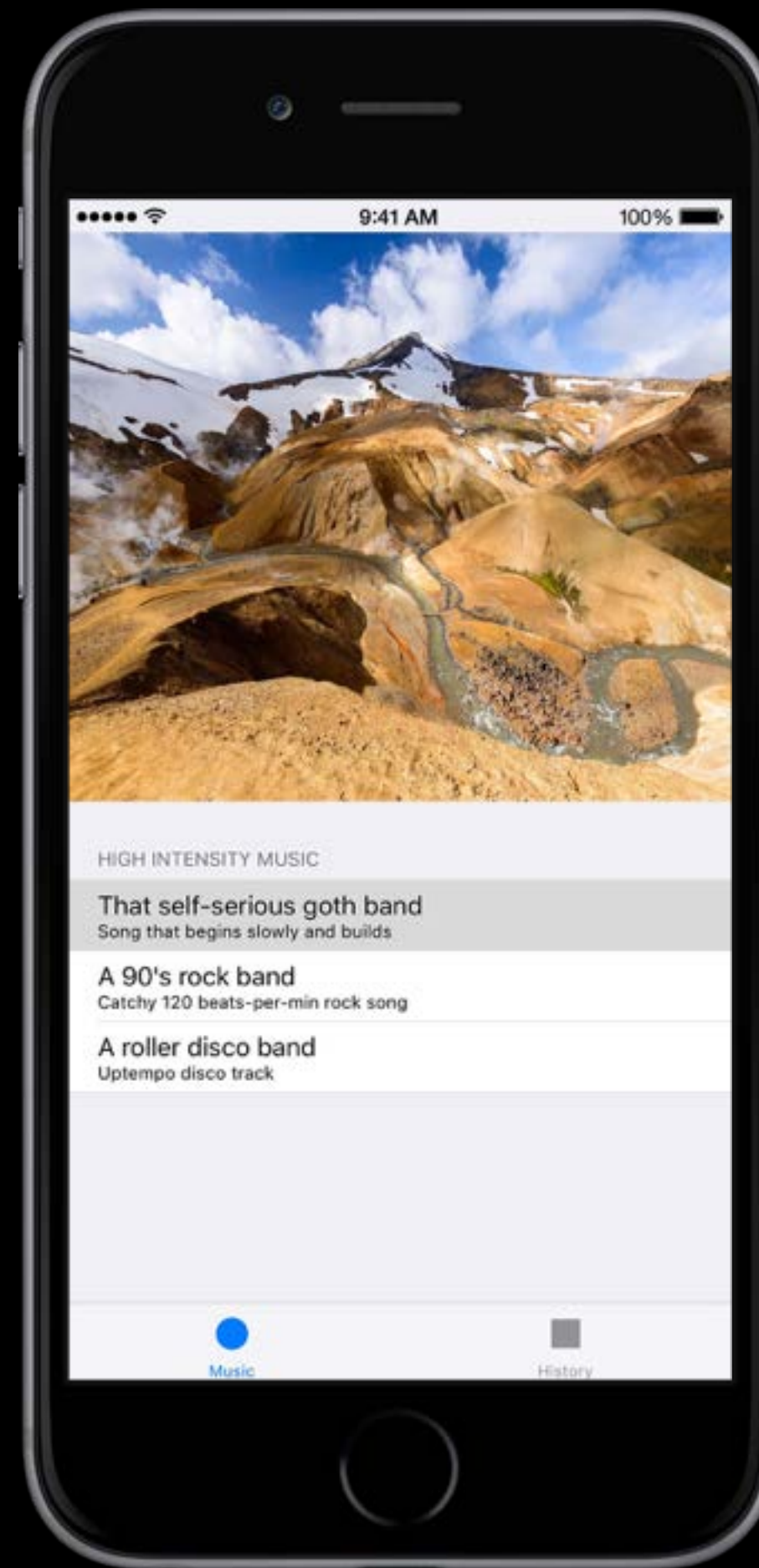
Start Up



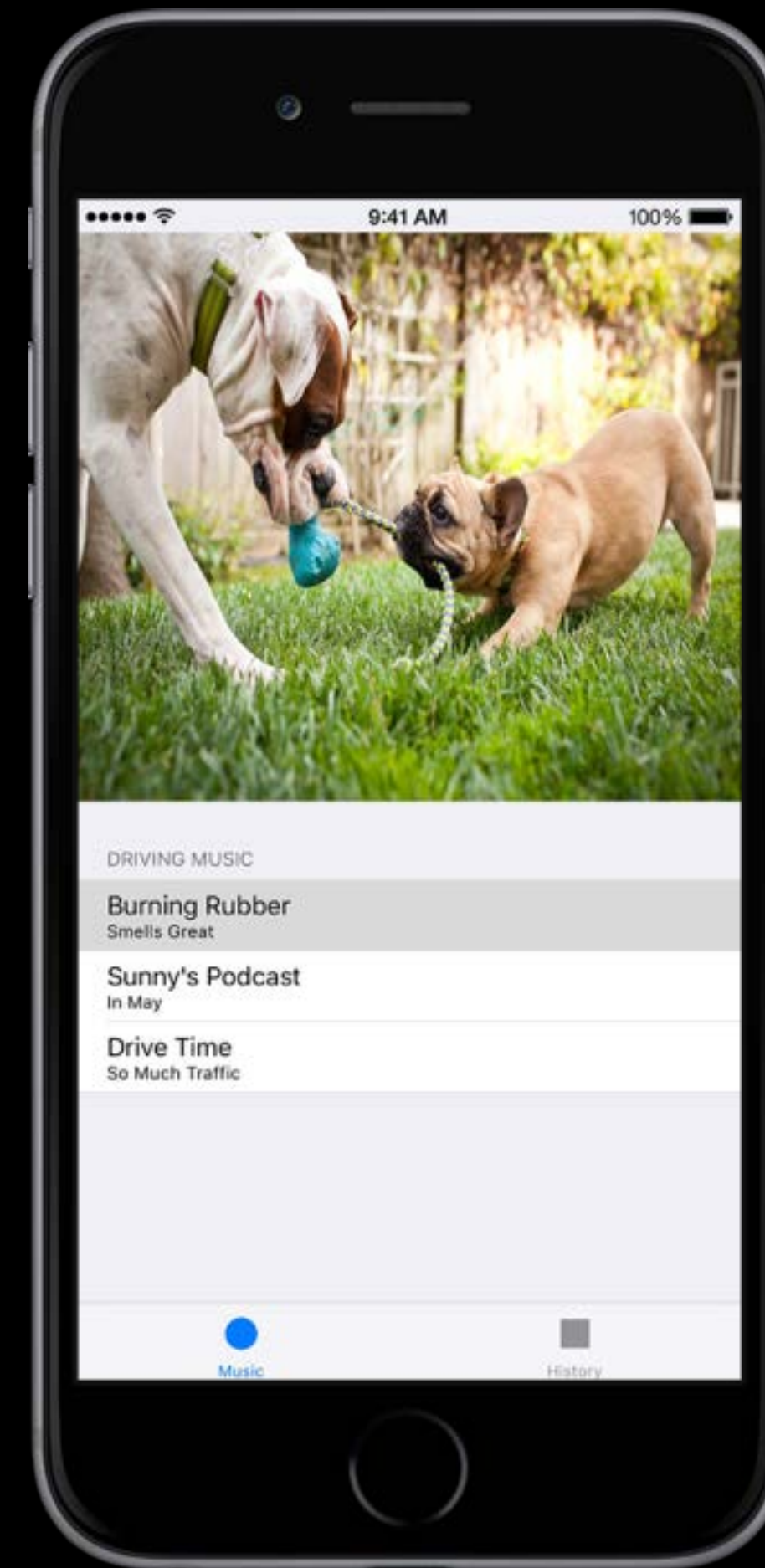
Work Out  
Follow Along



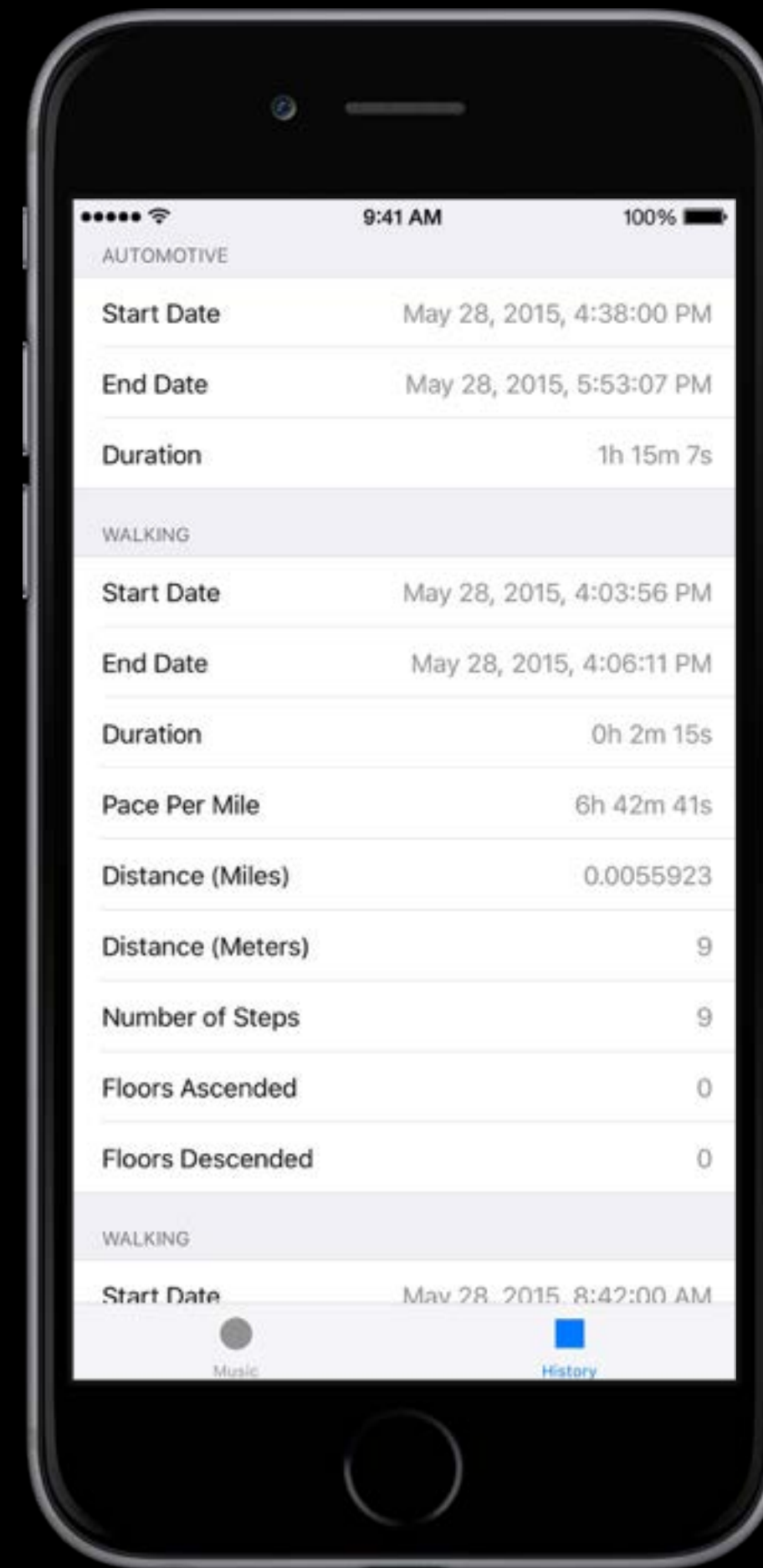
Start Up



Work Out  
Follow Along



Drive



Reflect

# Detect



# Detect

Activity updates

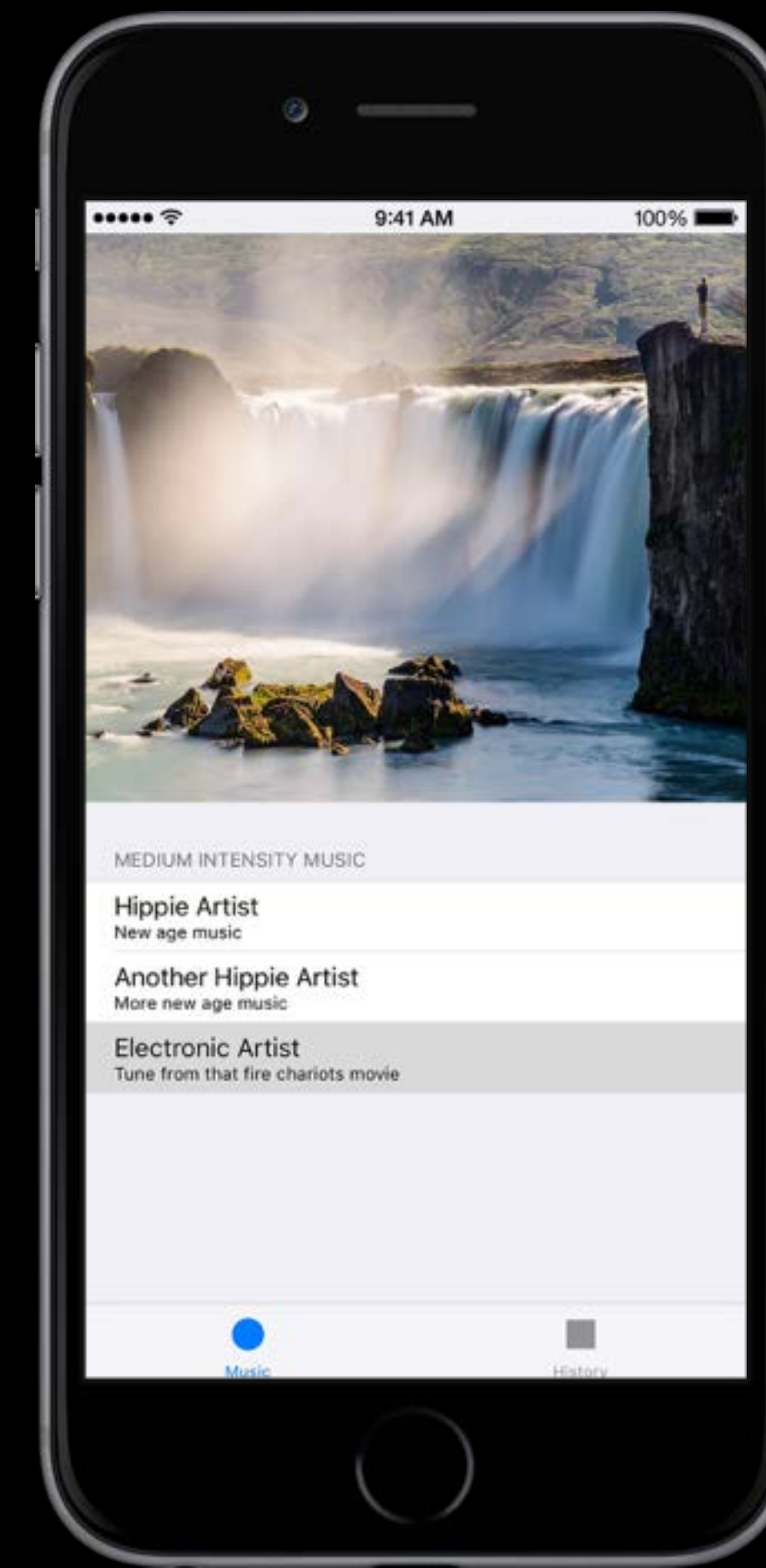
Pedometer updates





# Engage

Walking and running

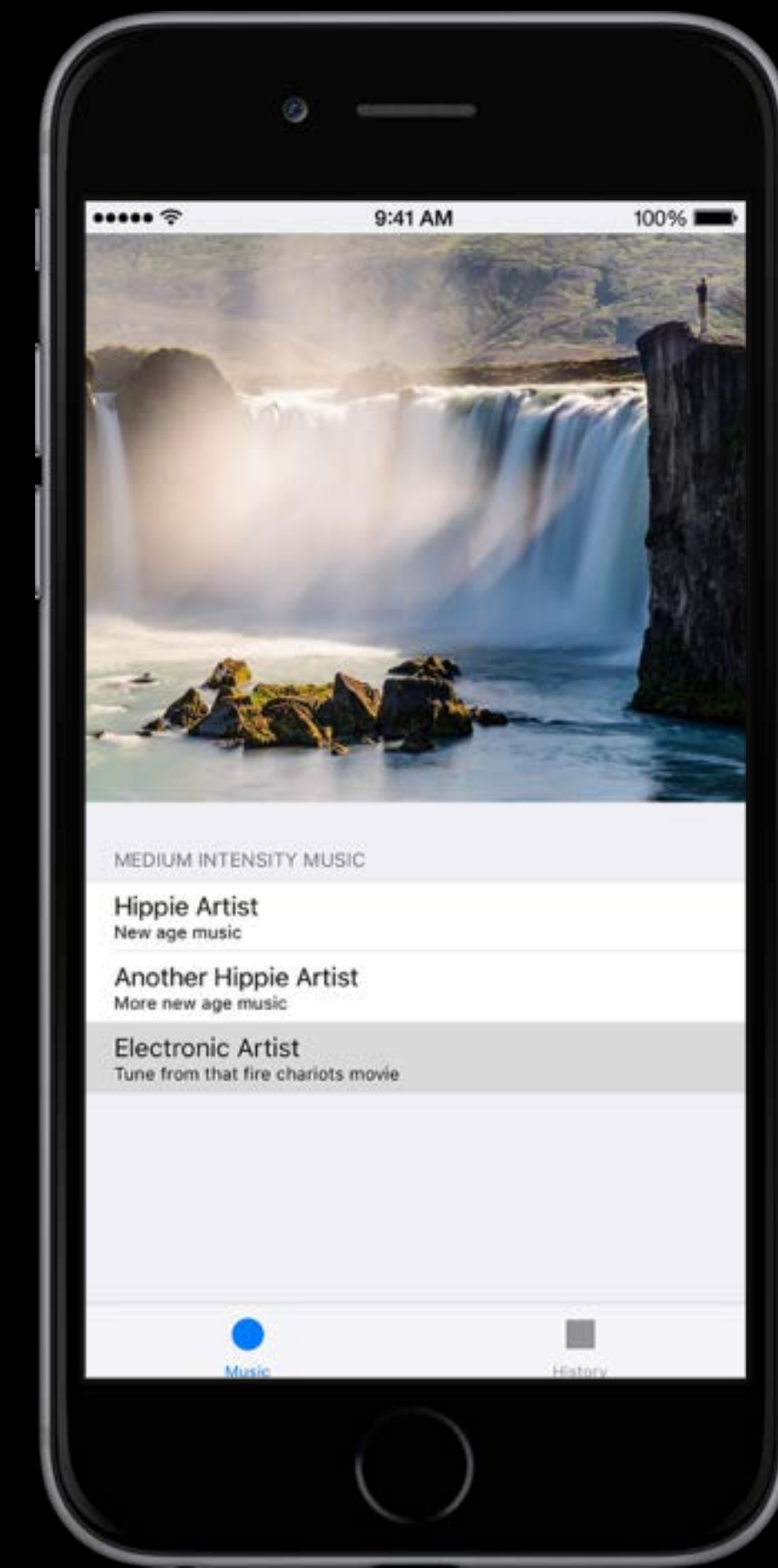


# Engage

Walking and running

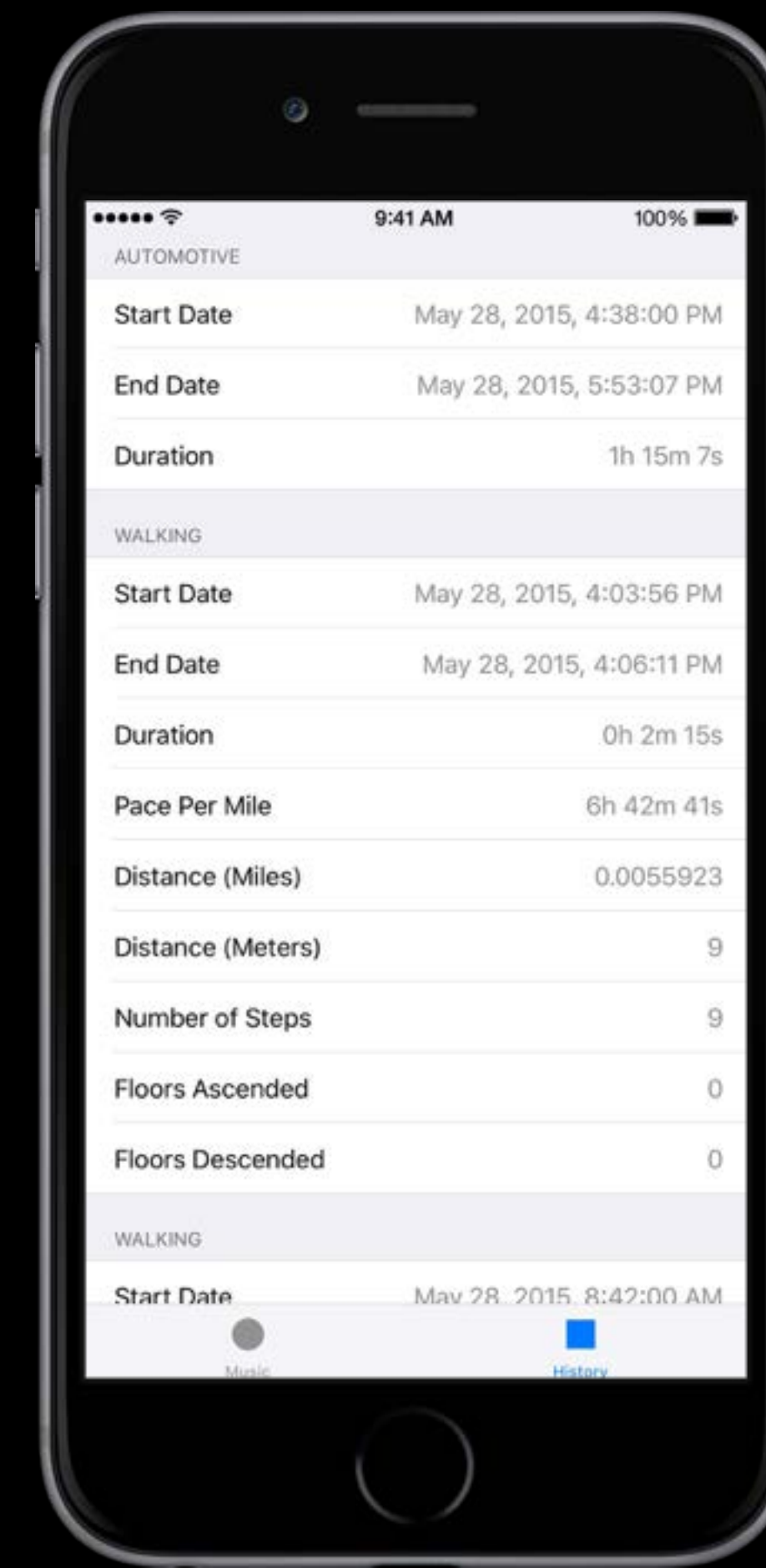
Pace and Cadence changes (Pedometer)

Altitude updates



# Reflect

Context and summary

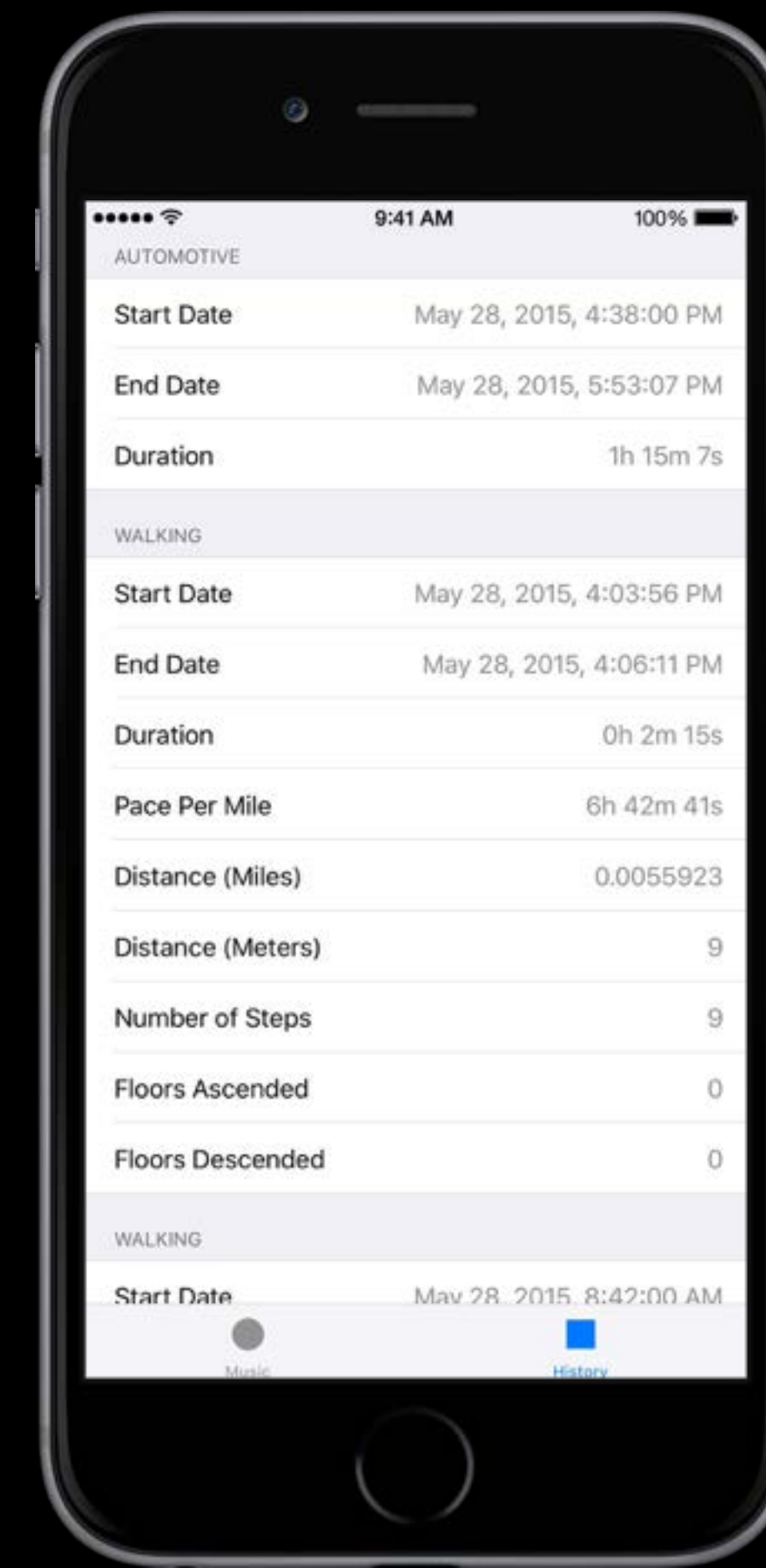


# Reflect

Context and summary

Historical Activity query

Historical Pedometer query



*Demo*

Music Motion

# More Information

## Technical Support

Apple Developer Forums

<http://developer.apple.com/forums>

## General Inquiries

Craig Keithley, Technologies Evangelist

[keithley@apple.com](mailto:keithley@apple.com)

# Related Sessions

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What's New in HealthKit

Pacific Heights

Tuesday 11:00AM

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What's New in Cocoa Touch

Presidio

Tuesday 2:30PM

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What's New in Core Location

Pacific Heights

Thursday 1:30PM

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# Labs

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Core Motion Lab

Frameworks Lab A

Tuesday 4:30PM

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