Women in Data Hackathon - Team 4
Damaged Aircraft Fuselage Dimensioning (Maintenance)

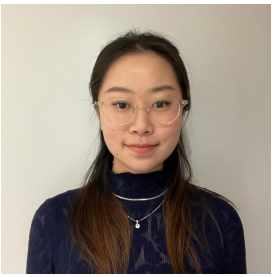
Nov 14 & 15, 2022

Agenda

1. Intro: Team 4 – ACT App

Emma Rousseau

Megan Chang



Kristen Chen

Zohreh Hajabedi

Pat Duong

Laila Nouasri

2. Problem Statement

CURRENT STATE	WHY IS THIS IMPORTANT
Technicians **manually measure damage** to aircraft exterior surfaces using rulers and an optical micrometer/digital microscopes/laser displacement sensor and measure to the closest ⅛”	The size of the damage determines the **amount of work** required for the repair, but also if the aircraft is good to continue flying until a permanent repair can be made.

Problem Statement

- *How to use Augmented Reality to help optimize the review and measurement of damaged aircraft exteriors.*

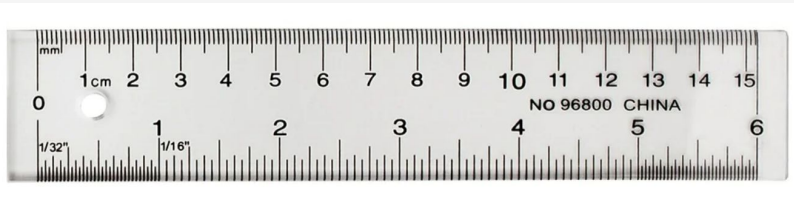
3. Current State: What is the current process?

Process length - 1 to 1.5 hours

Determine location of the damage (FR & STR)

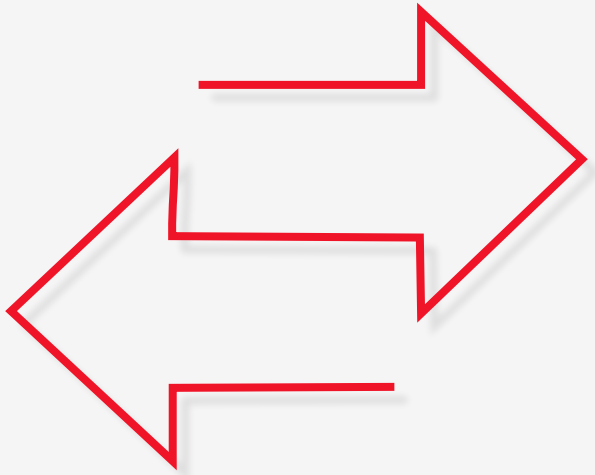
Identify damaged area with Bingo stickers

Capture dimensions manually with depth gage



4. Goal & Scope

App to **automatically** identify and capture the **dimensions of a damaged surface** area of an aircraft.



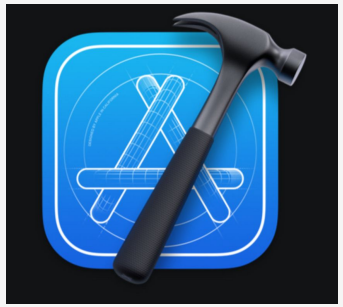
REQUEST

Non-invasive measurement process

Increased accuracy (0.00003”)

Shorter time for damage assessment

5. Solution (Methodology)



XCode as our Integrated Development Environment

ARKit for object detection and overlay

Swift UI for User Interface (iOS app)

5. Solution Continued... (Timeline)

Future State

1

APP PROTOTYPE (PROOF OF CONCEPT)

Develop distance measuring AR app

2

EXPAND PROTOTYPE

Add depth measurement, and increase accuracy

3

USER ACCEPTANCE TESTING

Get potential end users to test the app

4

INTEGRATE WITH MAINTENANCE SYSTEMS

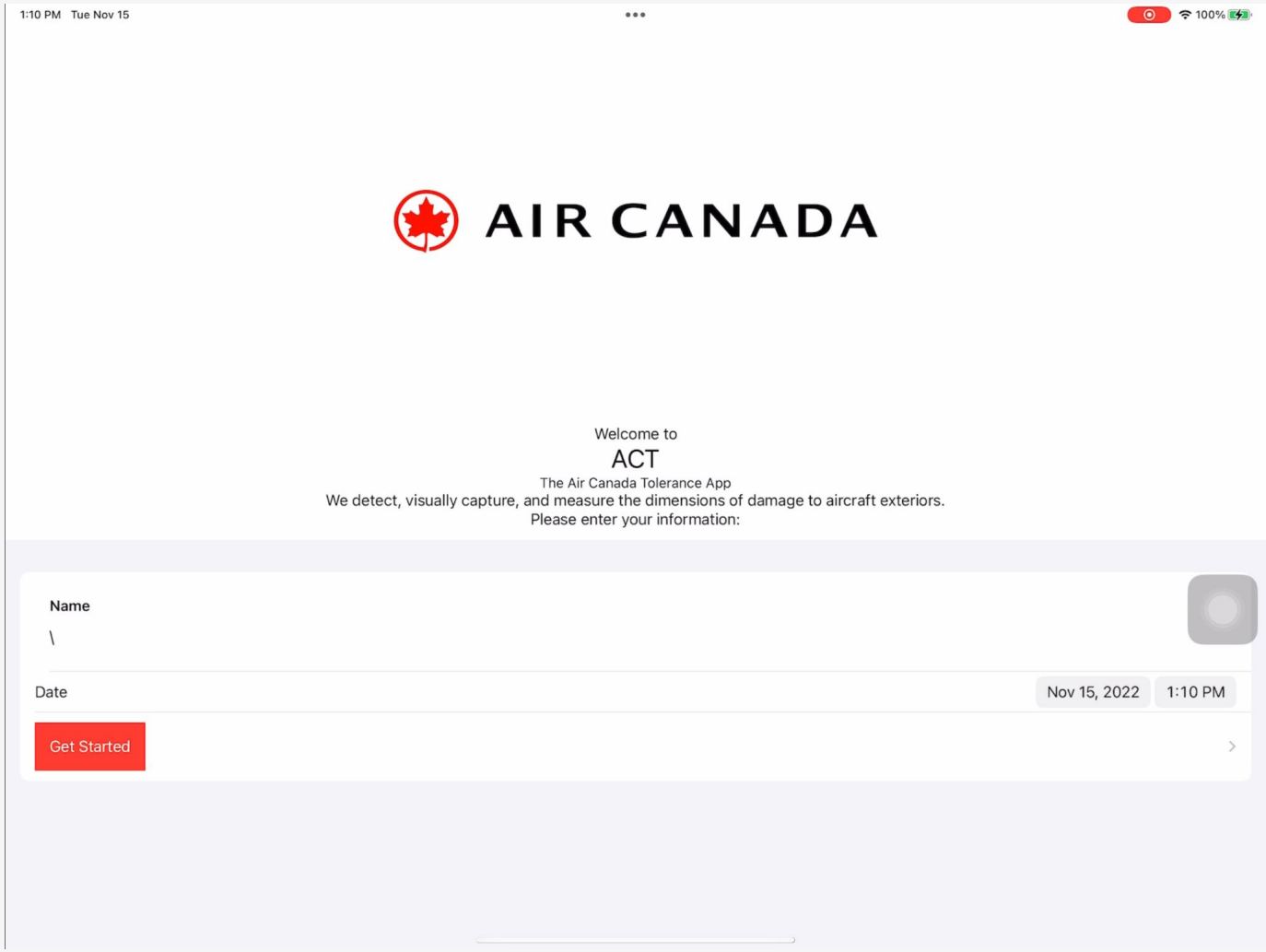
Saving tagged information to a database

5

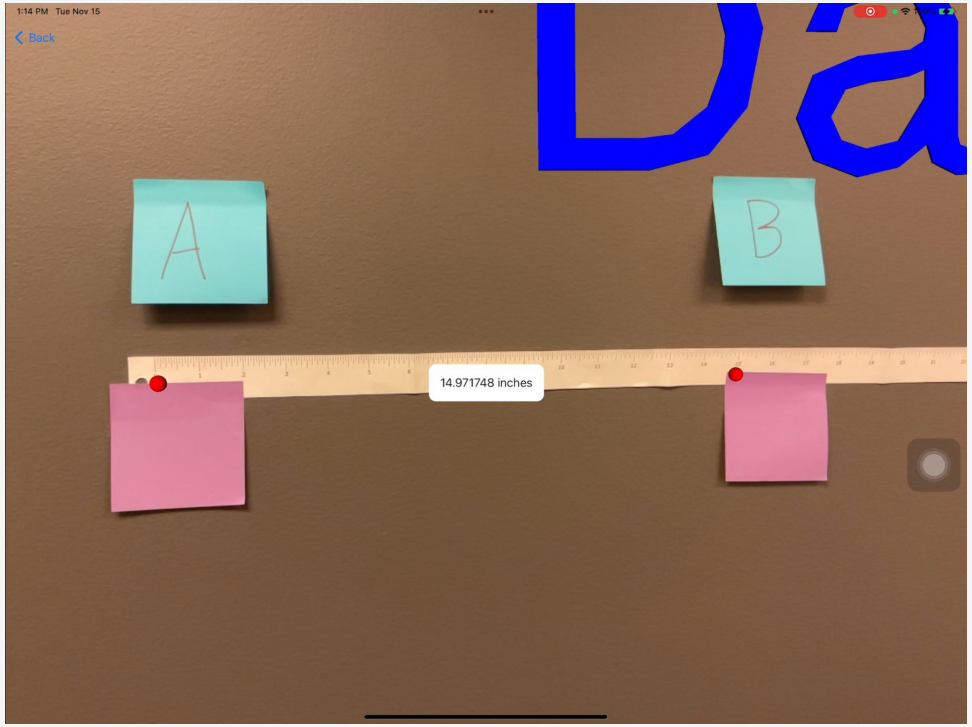
FUTURE TECHNOLOGIES

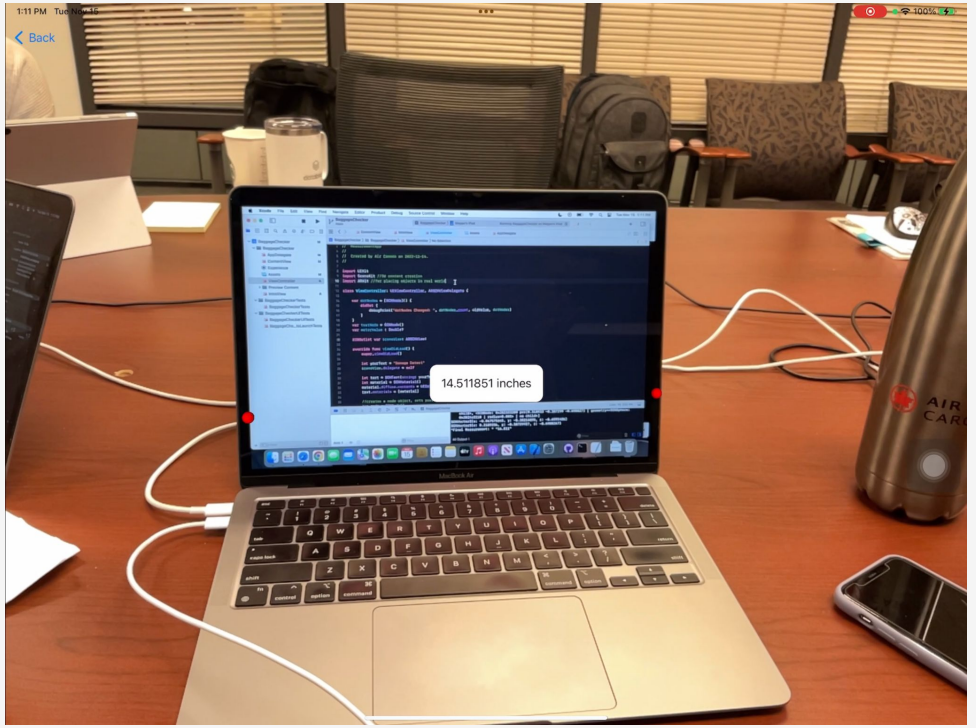
Machine Learning for object detection or other technologies

6. Demo (Landing Screen)



6. Demo Continued… (Measurement)





7. Future State - Ideas For Future Related Topics

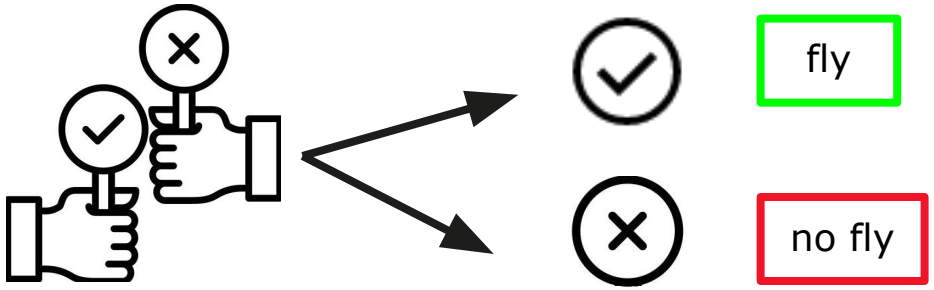
An AI-based decision support system to decide on flying after damage is detected

According to SMEs, determining whether an aircraft can fly despite of the damage or if it should be left on the ground is one of their most challenging processes. Depending on availability of historical data, a decision support AI-based system can be designed to assist the experts in establishing the best course of action for the damaged aircrafts.

CASE SPECIFICATION

Damage image:
damage length: x inch
damage width: y inch
damage depth: z inch
damage severity level: L1

DECISION SUPPORT SYSTEM

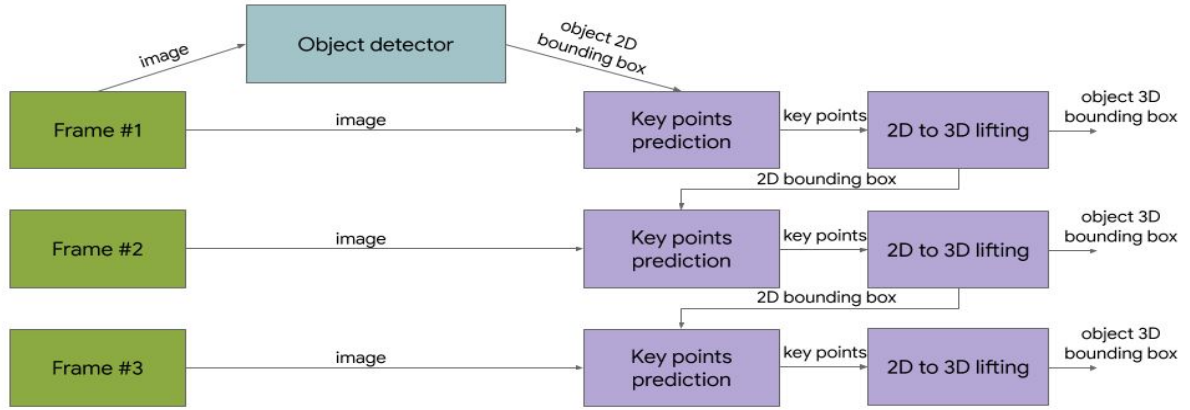


7. Future State -Ideas For Future Related Topics

Leveraging Machine Learning based algorithms and libraries for Object Detection

MediaPipe Objectron

- **Framework** for building machine learning pipelines for video, image and audio processing
- Published by **Google**
- Cross-platform framework that works in **Desktop/Server, Android, iOS**
- Consists of set of **real-time 3D object detection models** designed for mobile devices
- It can **predict** objects' 3D **bounding boxes**



- The Objectron dataset is a collection of short, object-centric video clips, which are accompanied by AR session metadata
- The data also contain manually annotated 3D bounding boxes for each object, which describe the object's position, orientation, and dimensions

Objectron - V7 Open Datasets (v7labs.com)
https://google.github.io/mediapipe/solutions/objectron
https://www.v7labs.com/open-datasets/objectron

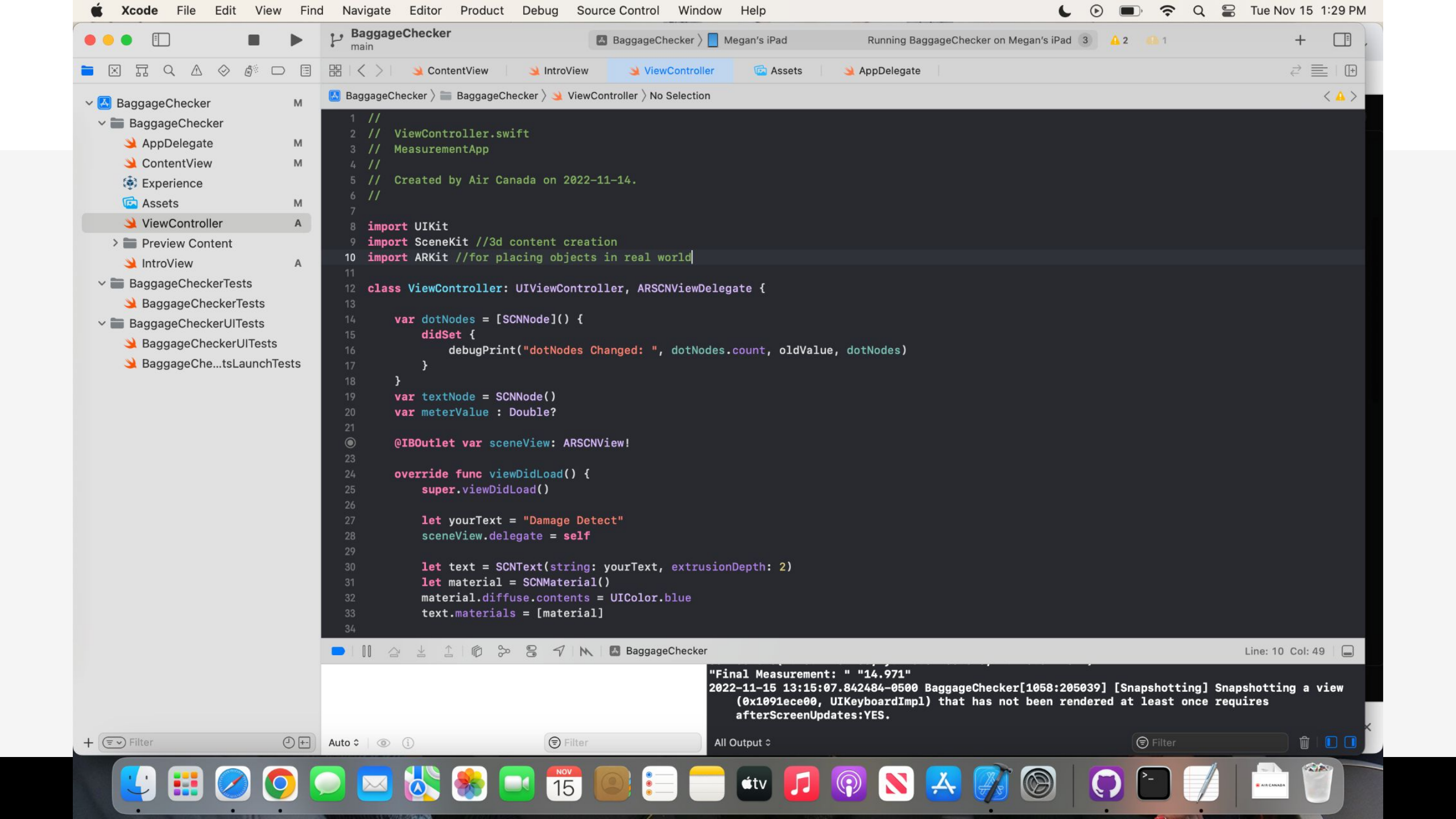
Thank You

- SME - Mingfang Wu
- SME - Annie Bellmare
- Organizer - Ankei Yau
- Organizer - Raphaelle De Gagne
- Organizer - Keith Dugas
- Apple Developer - François Tiffreau

Merci
Thank you

aircanada.com

Appendix A: Code Snapshots


Xcode File Edit View Find Navigate Editor Product Debug Source Control Window Help
Tue Nov 15 1:29 PM
BaggageChecker
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BaggageChecker 〉 Megan's iPad
Running BaggageChecker on Megan's iPad 3
ContentView
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1 //
2 // ViewController.swift
3 // MeasurementApp
4 //
5 // Created by Air Canada on 2022-11-14.
6 //
7
8 import UIKit
9 import SceneKit //3d content creation
10 import ARKit //for placing objects in real world
11
12 class ViewController: UIViewController, ARSCNViewDelegate {
13
14 var dotNodes = [SCNNode]() {
15 didSet {
16 debugPrint("dotNodes Changed: ", dotNodes.count, oldValue, dotNodes)
17 }
18 }
19 var textNode = SCNNode()
20 var meterValue : Double?
21
22 @IBOutlet var sceneView: ARSCNView!
23
24 override func viewDidLoad() {
25 super.viewDidLoad()
26
27 let yourText = "Damage Detect"
28 sceneView.delegate = self
29
30 let text = SCNText(string: yourText, extrusionDepth: 2)
31 let material = SCNMaterial()
32 material.diffuse.contents = UIColor.blue
33 text.materials = [material]
34
BaggageChecker
Line: 10 Col: 49
"Final Measurement: " "14.971"
2022-11-15 13:15:07.842484-0500 BaggageChecker[1058:205039] [Snapshotting] Snapshotting a view (0x1091ece00, UIKeyboardImpl) that has not been rendered at least once requires afterScreenUpdates:YES.
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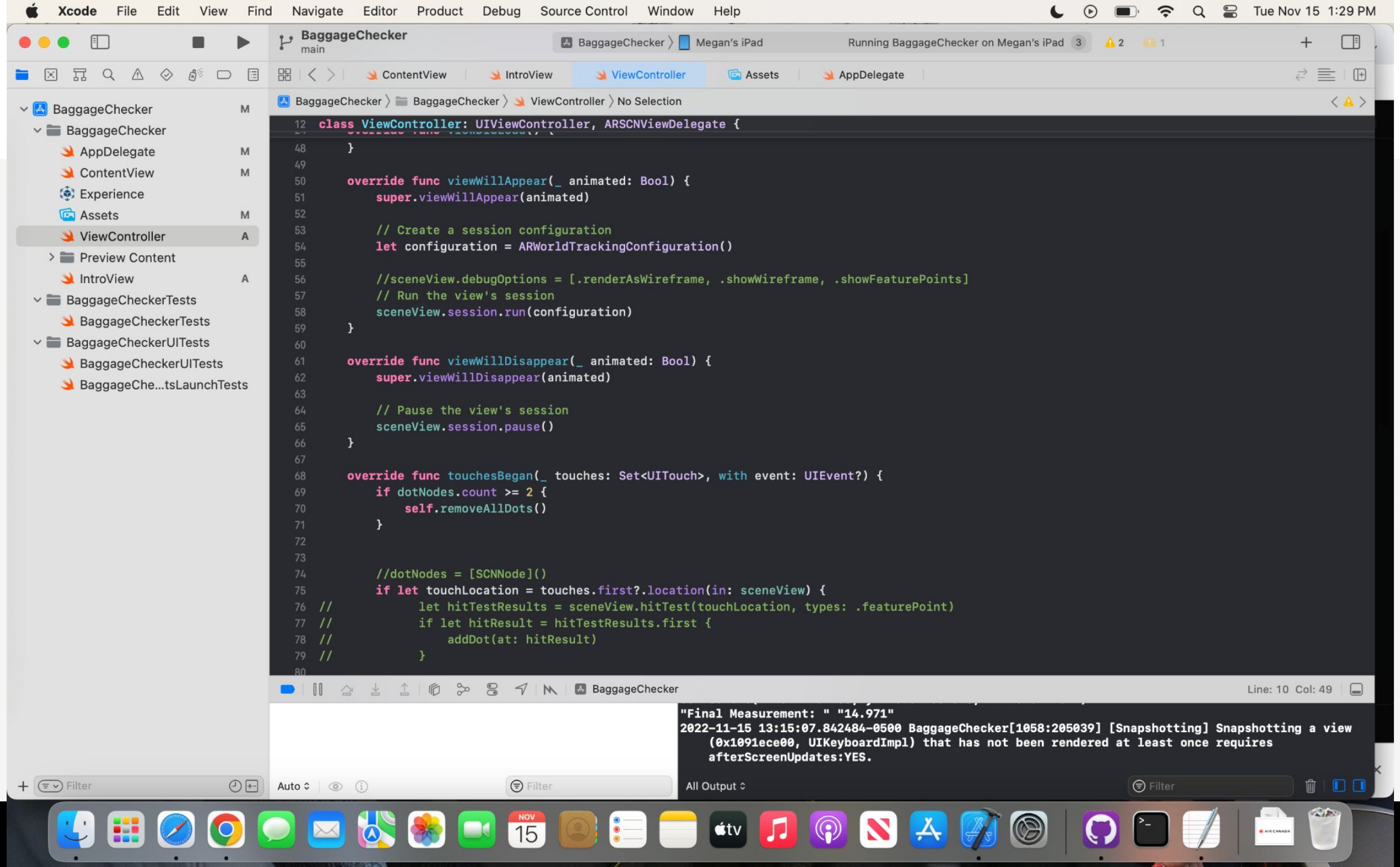
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12 class ViewController: UIViewController, ARSCNViewDelegate {
48 }
49
50 override func viewWillAppear(_ animated: Bool) {
51 super.viewWillAppear(animated)
52
53 // Create a session configuration
54 let configuration = ARWorldTrackingConfiguration()
55
56 //sceneView.debugOptions = [.renderAsWireframe, .showWireframe, .showFeaturePoints]
57 // Run the view's session
58 sceneView.session.run(configuration)
59 }
60
61 override func viewWillDisappear(_ animated: Bool) {
62 super.viewWillDisappear(animated)
63
64 // Pause the view's session
65 sceneView.session.pause()
66 }
67
68 override func touchesBegan(_ touches: Set<UITouch>, with event: UIEvent?) {
69 if dotNodes.count >= 2 {
70 self.removeAllDots()
71 }
72
73
74 //dotNodes = [SCNNode]()
75 if let touchLocation = touches.first?.location(in: sceneView) {
76 // let hitTestResults = sceneView.hitTest(touchLocation, types: .featurePoint)
77 // if let hitResult = hitTestResults.first {
78 // addDot(at: hitResult)
79 // }
80
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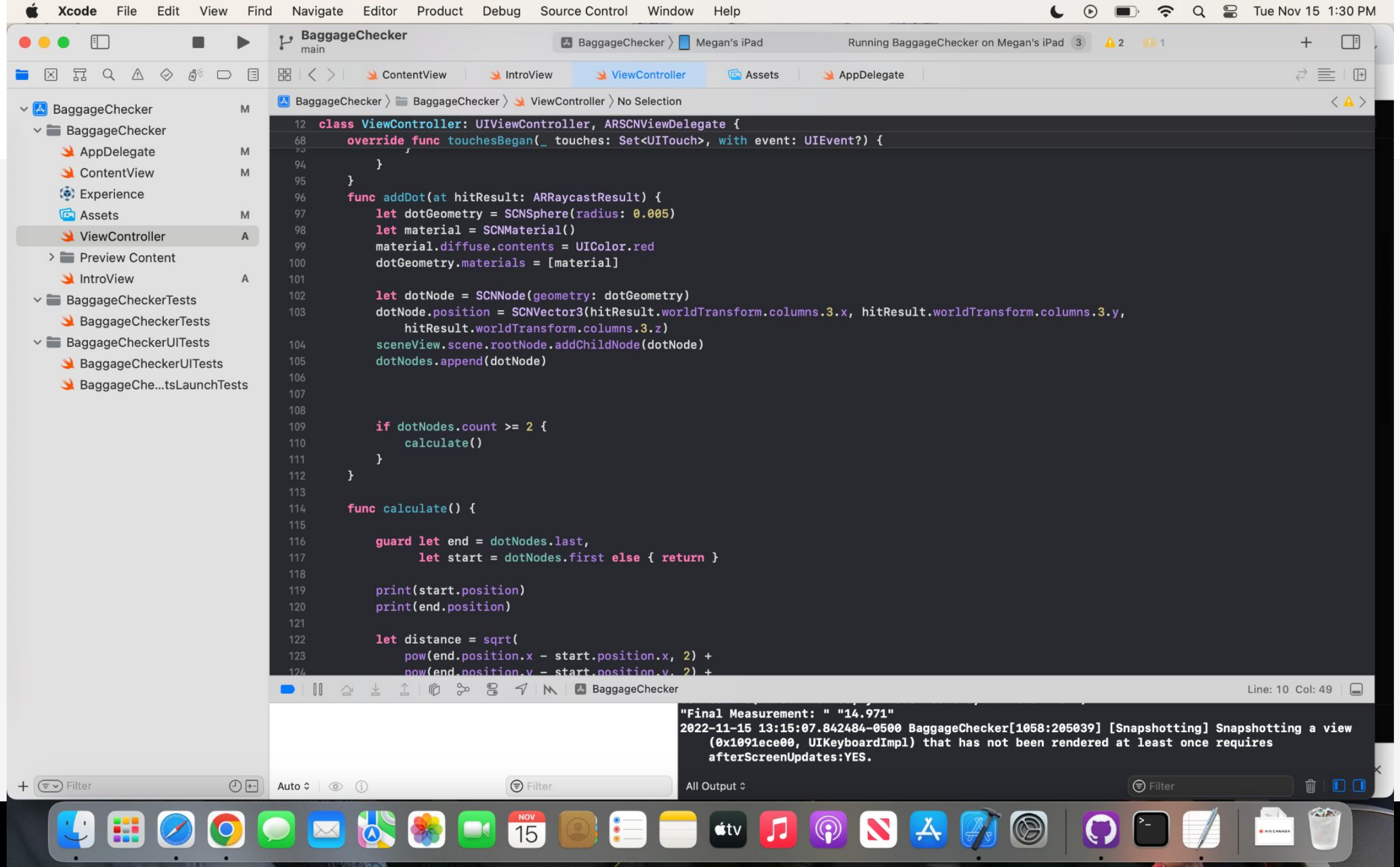
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ContentView
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12 class ViewController: UIViewController, ARSCNViewDelegate {
68 override func touchesBegan(_ touches: Set<UITouch>, with event: UIEvent?) {
94 }
95 }
96 func addDot(at hitResult: ARRaycastResult) {
97 let dotGeometry = SCNSphere(radius: 0.005)
98 let material = SCNMaterial()
99 material.diffuse.contents = UIColor.red
100 dotGeometry.materials = [material]
101
102 let dotNode = SCNNode(geometry: dotGeometry)
103 dotNode.position = SCNVector3(hitResult.worldTransform.columns.3.x, hitResult.worldTransform.columns.3.y,
hitResult.worldTransform.columns.3.z)
104 sceneView.scene.rootNode.addChildNode(dotNode)
105 dotNodes.append(dotNode)
106
107
108
109 if dotNodes.count >= 2 {
110 calculate()
111 }
112 }
113
114 func calculate() {
115
116 guard let end = dotNodes.last,
117 let start = dotNodes.first else { return }
118
119 print(start.position)
120 print(end.position)
121
122 let distance = sqrt(
123 pow(end.position.x - start.position.x, 2) +
124 pow(end.position.y - start.position.y, 2) +
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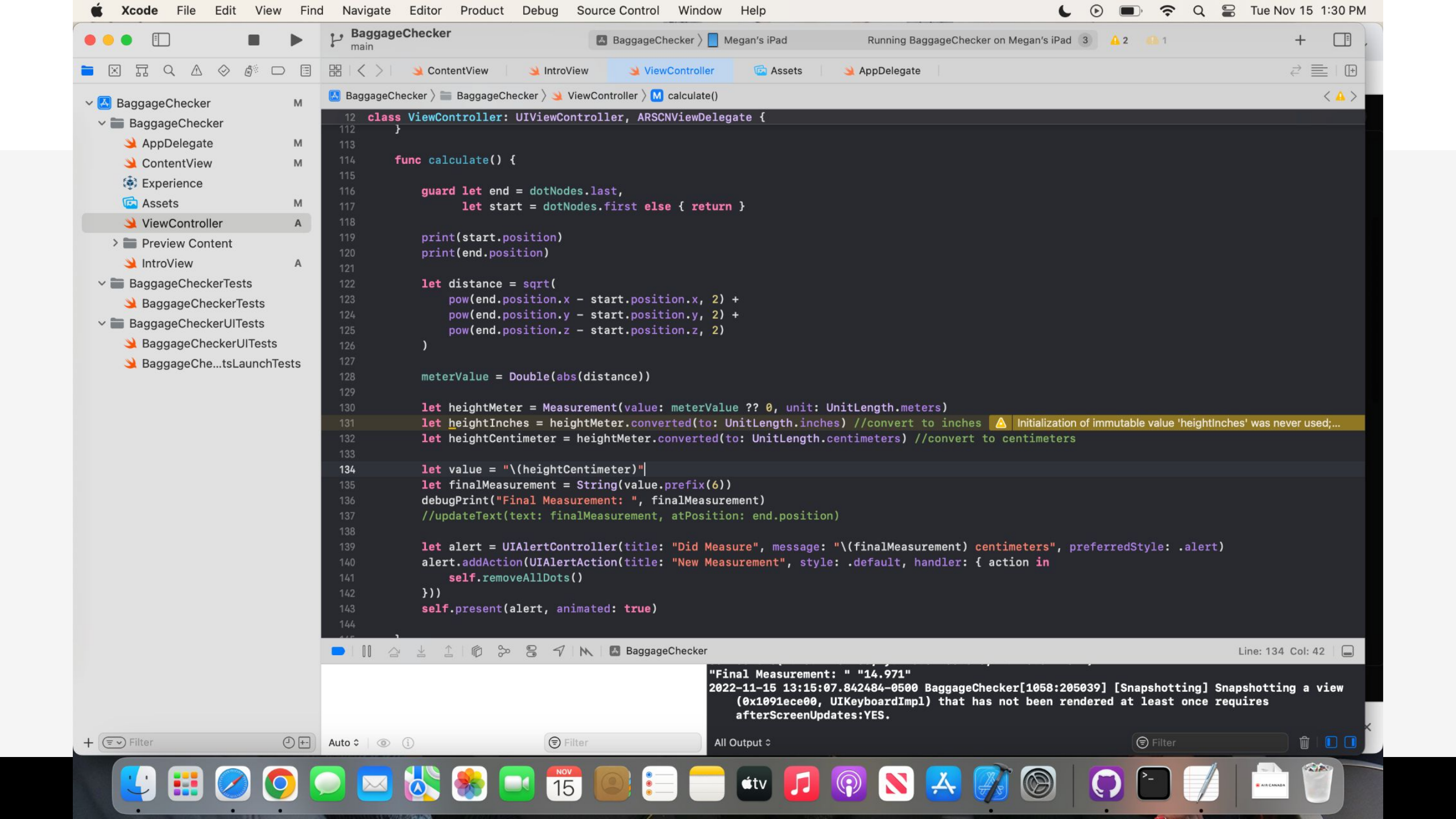
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119 print(start.position)
120 print(end.position)
121
122 let distance = sqrt(
123 pow(end.position.x - start.position.x, 2) +
124 pow(end.position.y - start.position.y, 2) +
125 pow(end.position.z - start.position.z, 2)
126)
127
128 meterValue = Double(abs(distance))
129
130 let heightMeter = Measurement(value: meterValue ?? 0, unit: UnitLength.meters)
131 let heightInches = heightMeter.converted(to: UnitLength.inches) //convert to inches
Initialization of immutable value 'heightInches' was never used;...
132 let heightCentimeter = heightMeter.converted(to: UnitLength.centimeters) //convert to centimeters
133
134 let value = "\(heightCentimeter)"
135 let finalMeasurement = String(value.prefix(6))
136 debugPrint("Final Measurement: ", finalMeasurement)
137 //updateText(text: finalMeasurement, atPosition: end.position)
138
139 let alert = UIAlertController(title: "Did Measure", message: "\(finalMeasurement) centimeters", preferredStyle: .alert)
140 alert.addAction(UIAlertAction(title: "New Measurement", style: .default, handler: { action in
141 self.removeAllDots()
142 }))
143 self.present(alert, animated: true)
144
BaggageChecker
Line: 134 Col: 42
"Final Measurement: " "14.971"
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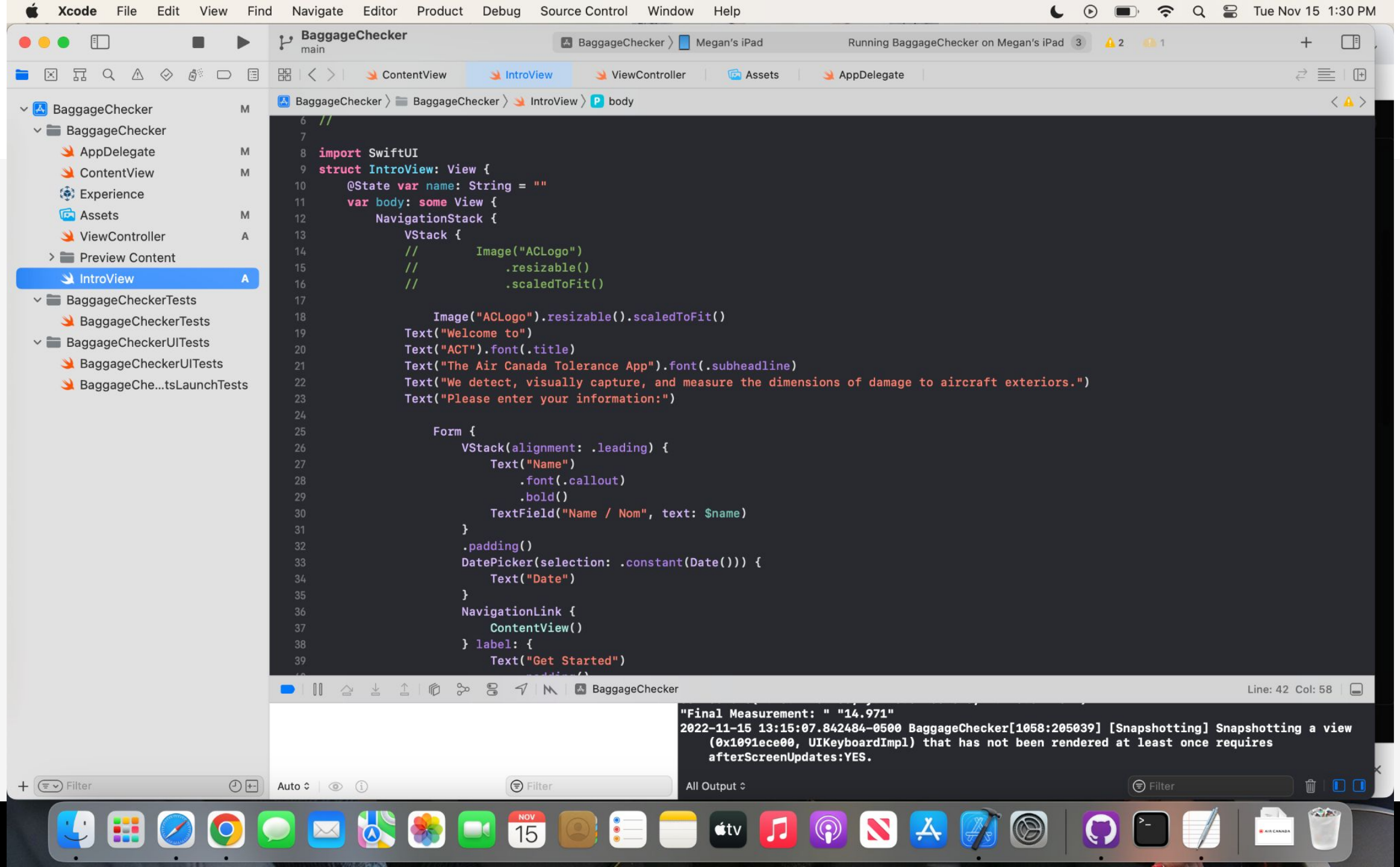
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ContentView M
Experience
Assets M
ViewController A
Preview Content
IntroView A
BaggageCheckerTests
BaggageCheckerTests
BaggageCheckerUITests
BaggageCheckerUITests
BaggageChe...tsLaunchTests
//
import SwiftUI
struct IntroView: View {
@State var name: String = ""
var body: some View {
NavigationStack {
VStack {
// Image("ACLogo")
// .resizable()
// .scaledToFit()
Image("ACLogo").resizable().scaledToFit()
Text("Welcome to")
Text("ACT").font(.title)
Text("The Air Canada Tolerance App").font(.subheadline)
Text("We detect, visually capture, and measure the dimensions of damage to aircraft exteriors.")
Text("Please enter your information:")
Form {
VStack(alignment: .leading) {
Text("Name")
.font(.callout)
.bold()
TextField("Name / Nom", text: $name)
}
.padding()
DatePicker(selection: .constant(Date())) {
Text("Date")
}
NavigationLink {
ContentView()
} label: {
Text("Get Started")
BaggageChecker
Line: 42 Col: 58
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