#WWDC18

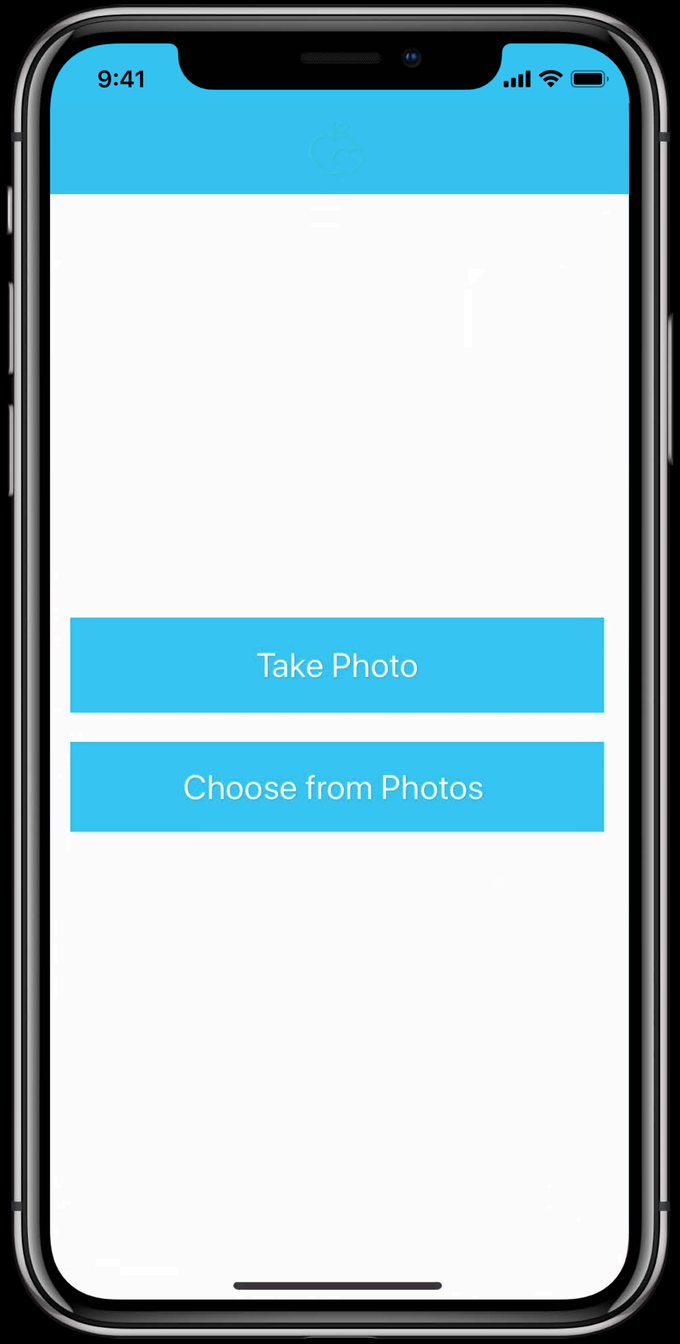
A Guide to Turi Create

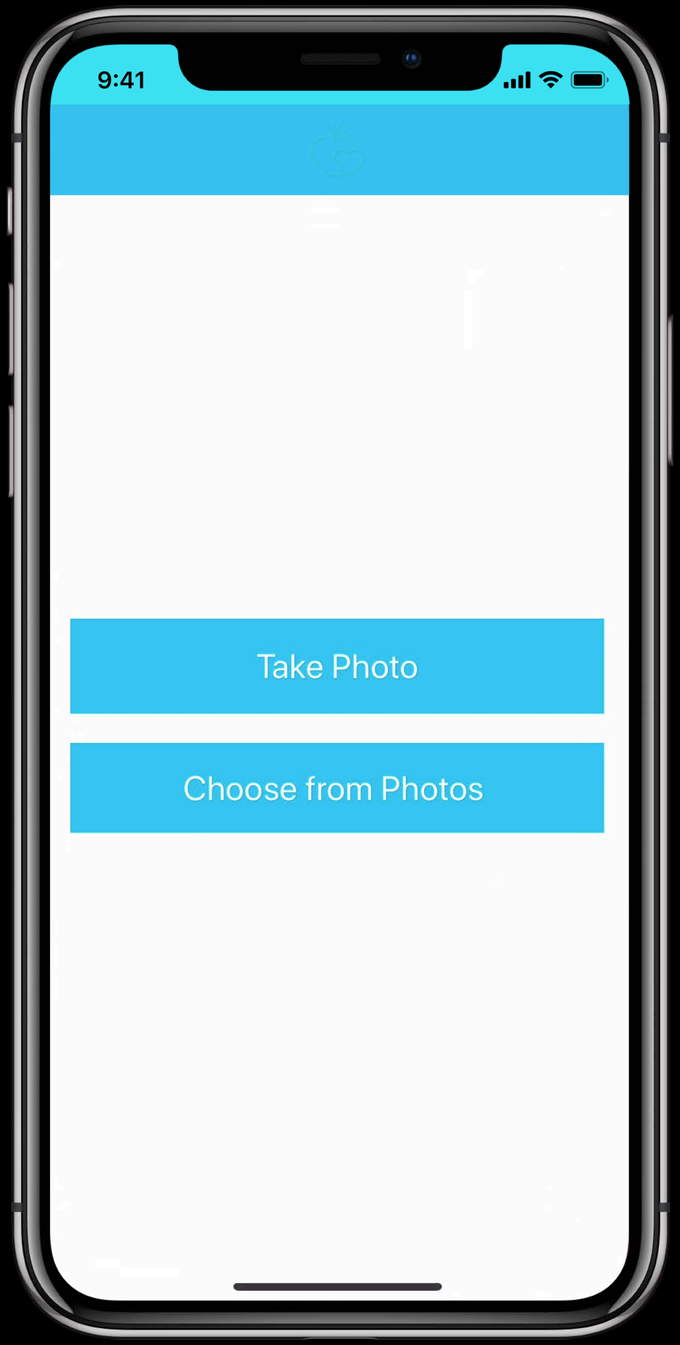
Task focused ML for your apps

Session 712

Aaron Franklin, Turi
Zach Nation, Turi

Create Core ML models for your intelligent apps.


9:41
Take Photo
Choose from Photos


9:41
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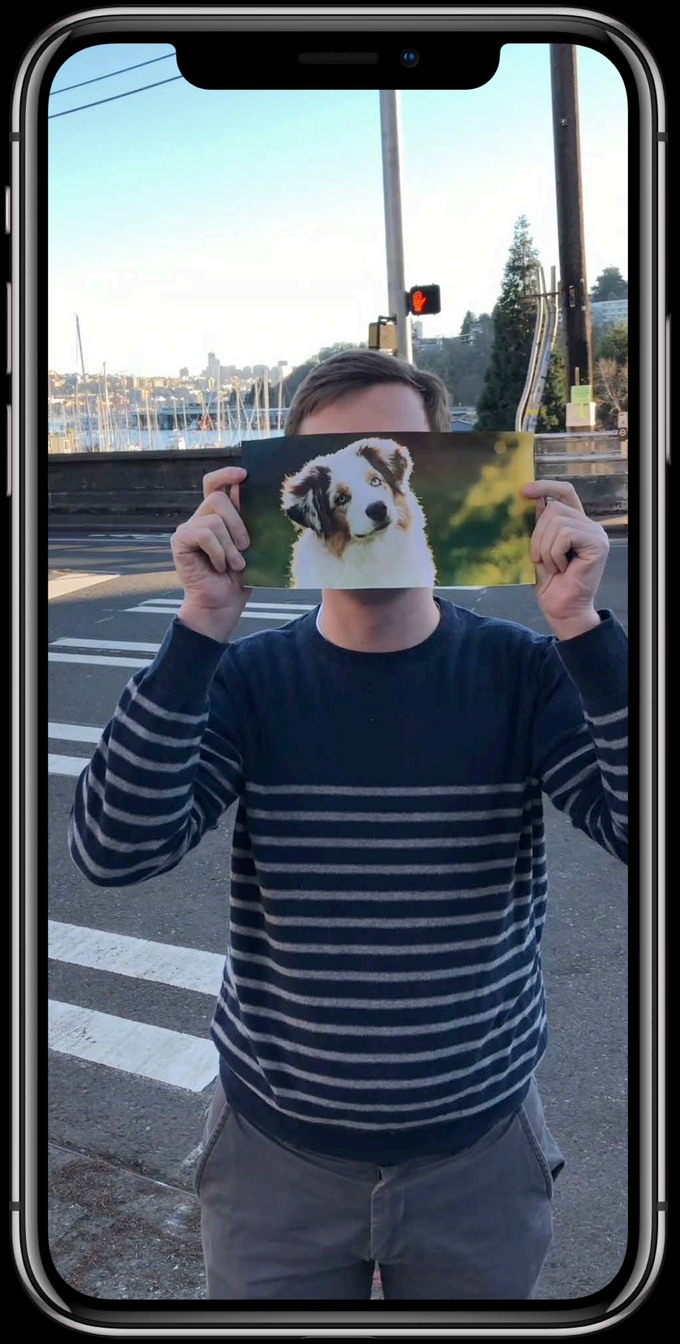
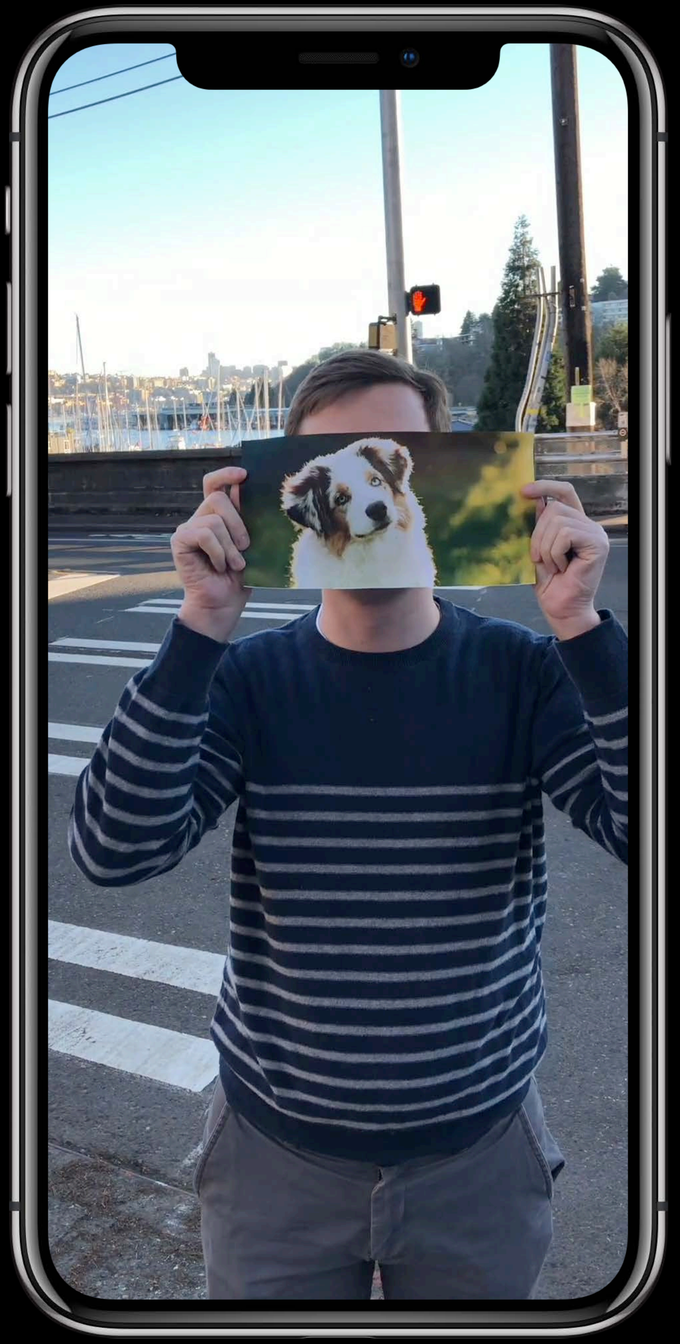
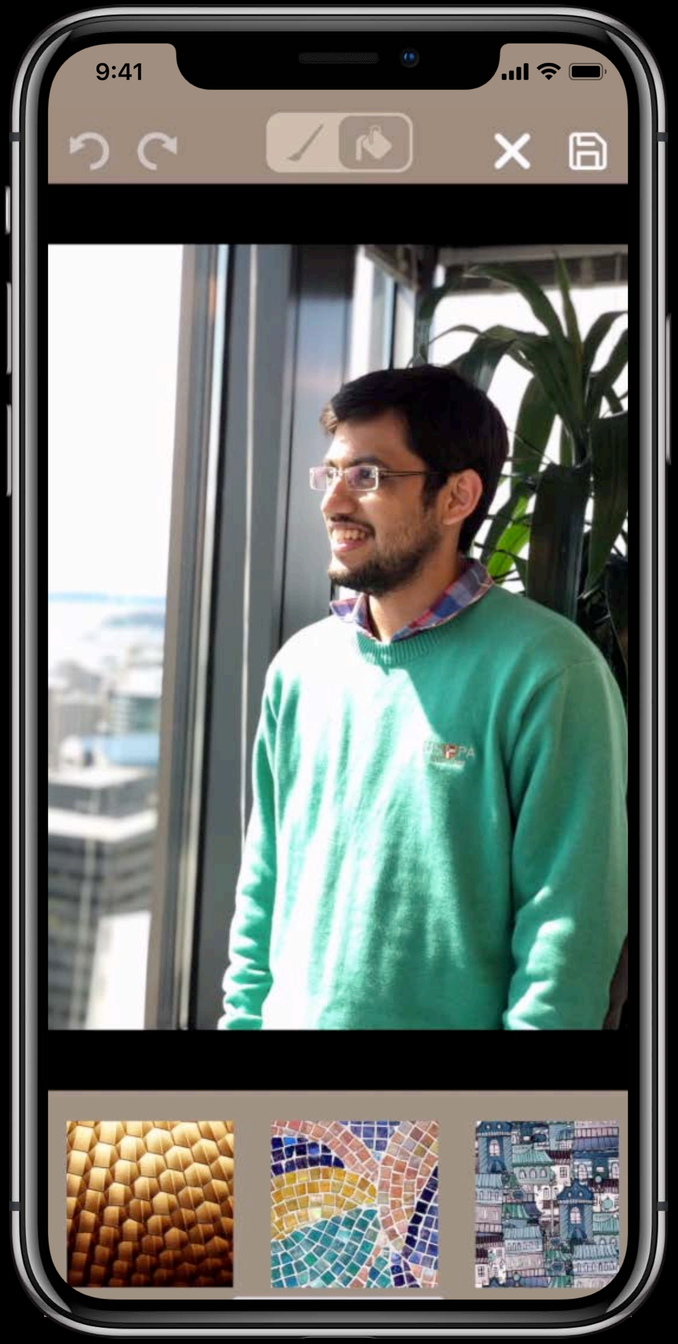
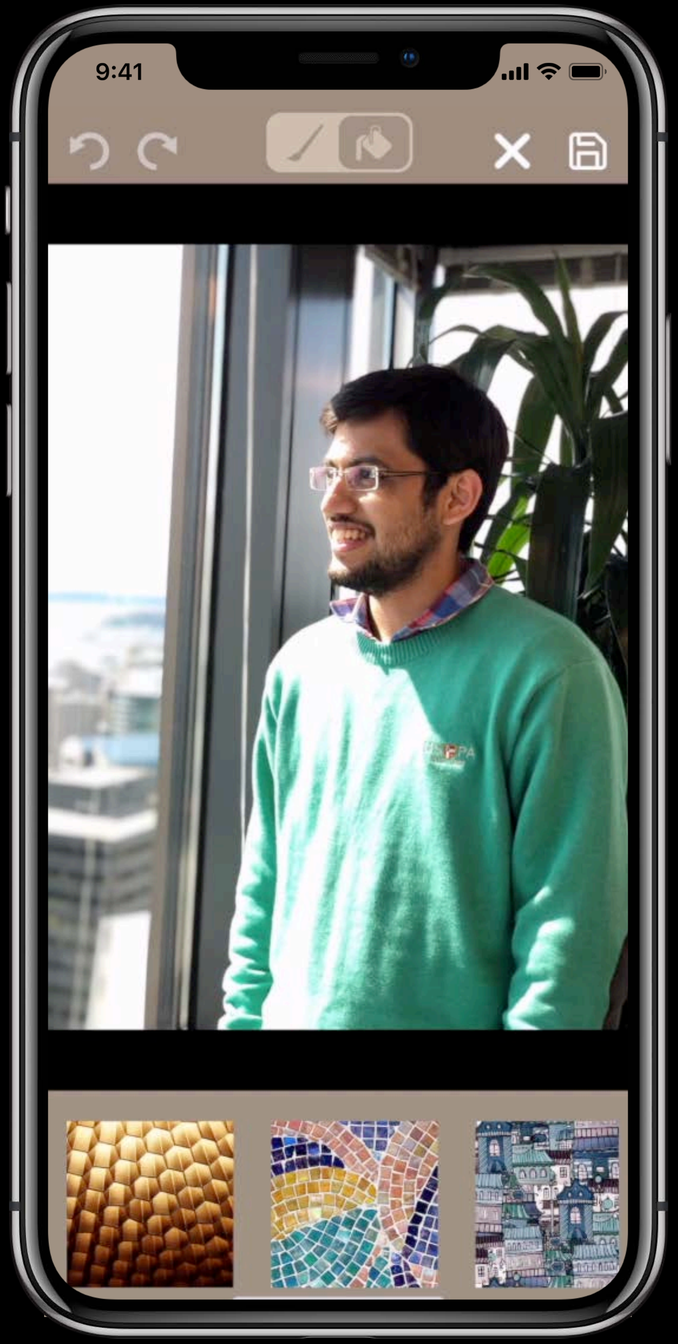
Choose from Photos



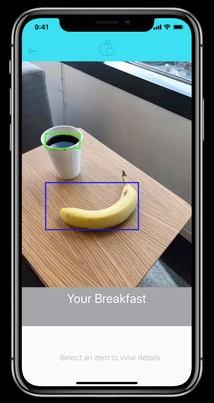



9:41
Eyes
Mouth
Hair
Clothes
Accessories


9:41


9:41

What Do These Apps Have in Common?



What Do These Apps Have in Common?

Use machine learning

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Use machine learning

Require very little data

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Model created with Turi Create, deployed with Core ML

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Follow a 5 step recipe

What Do These Apps Have in Common?

Use machine learning

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Model created with Turi Create, deployed with Core ML

Follow a 5 step recipe

Demo apps in the labs

What is Turi Create?

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Python library for creating Core ML models

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Easy to use, no need to be an ML expert

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Task focused APIs

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Cross platform (Mac, Linux)

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Task focused APIs

Cross platform (Mac, Linux)

Open source

Join the **community**

https://github.com/apple/turicreate

Get the newest **beta** release

Get the newest **beta** release

```
> pip install turicreate==5.0b1
```

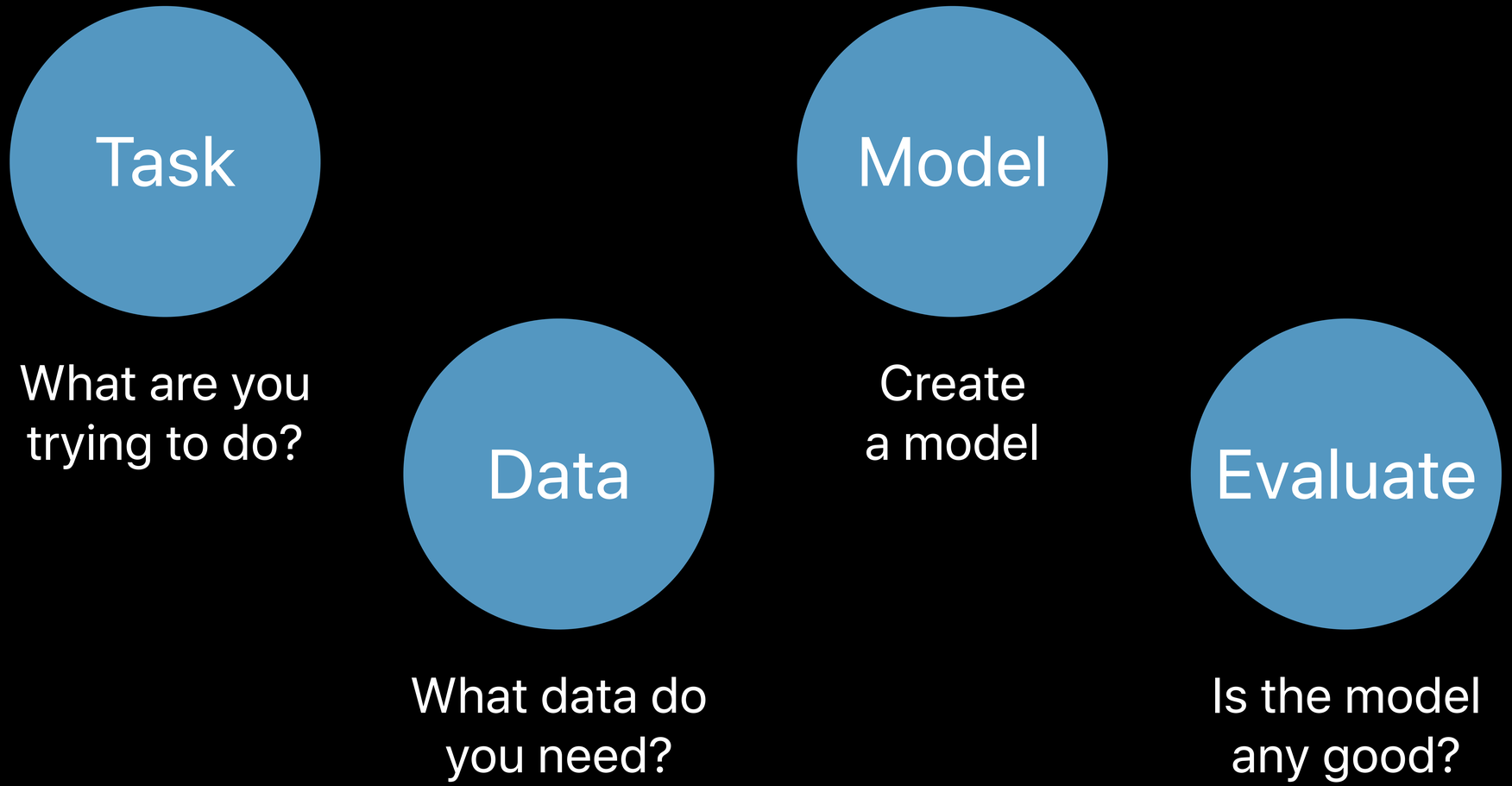
5 step recipe for creating Core ML models

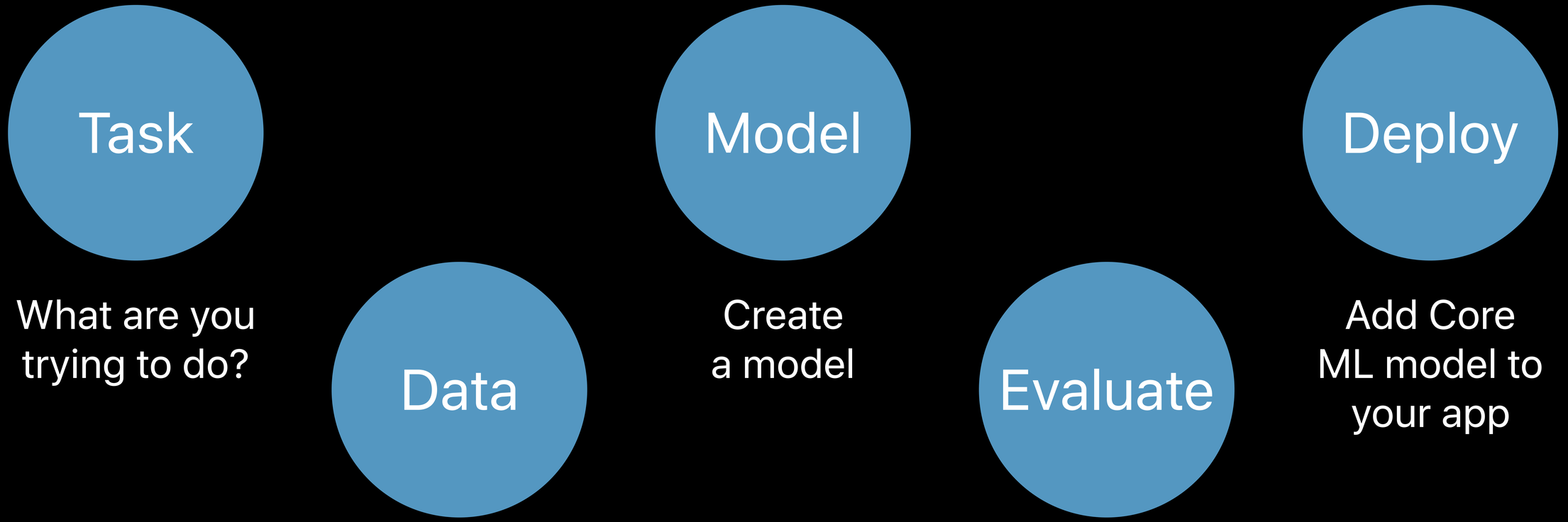
What are you trying to do?

What are you trying to do?

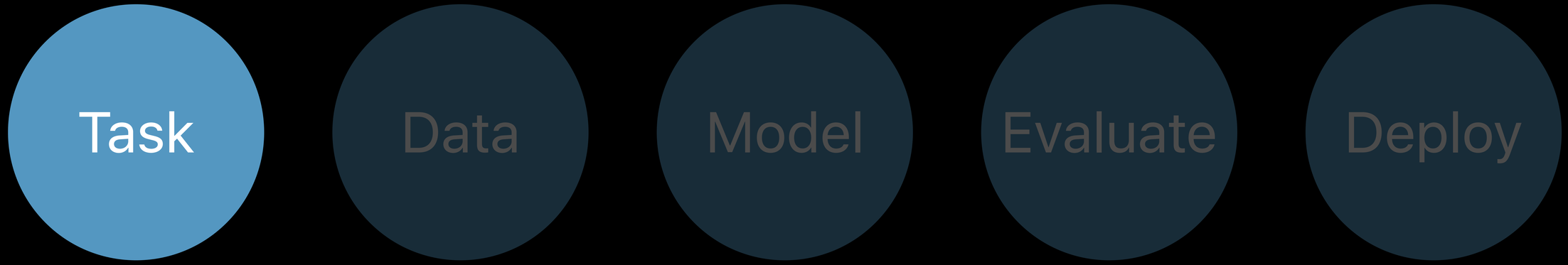
What data do you need?


Task
What are you trying to do?
Data
What data do you need?
Model
Create a model


Task
What are you trying to do?
Data
What data do you need?
Model
Create a model
Evaluate
Is the model any good?


Task
What are you trying to do?
Data
What data do you need?
Model
Create a model
Evaluate
Is the model any good?
Deploy
Add Core ML model to your app

Step 1: Task



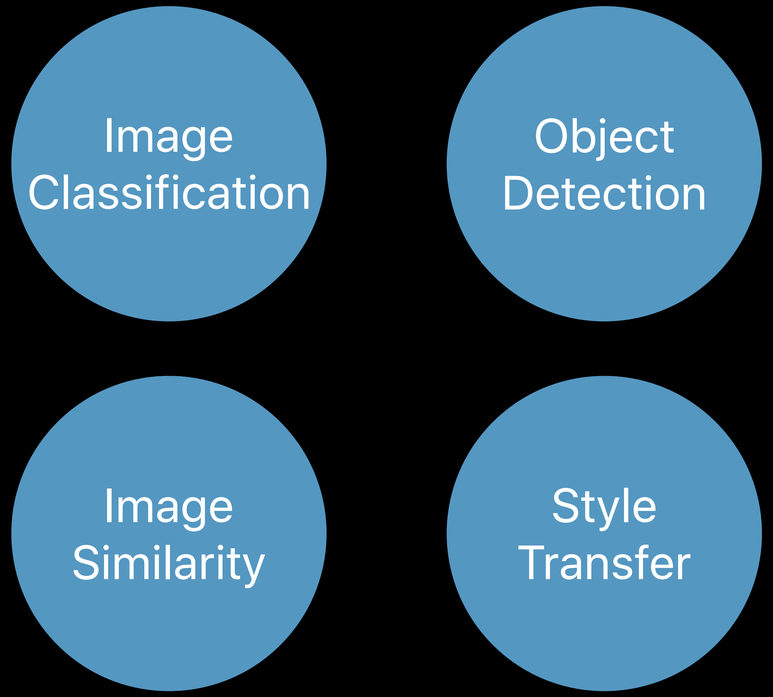


Image Classification
Object Detection
Image Similarity
Style Transfer

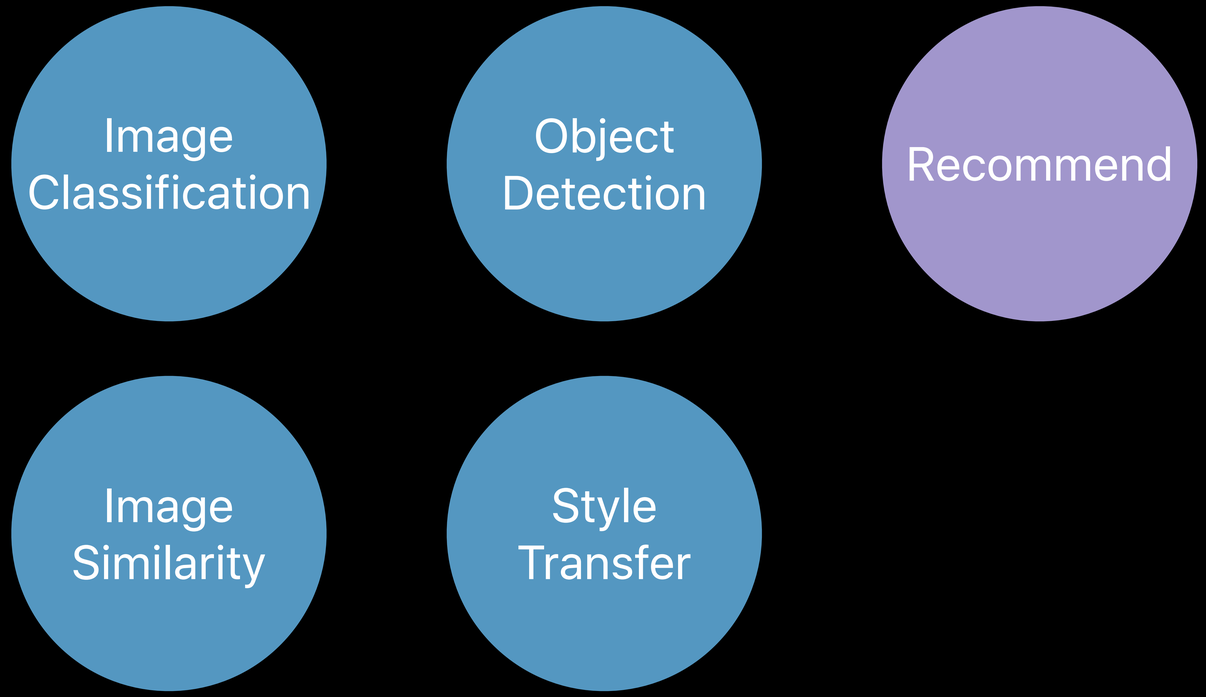


Image Classification
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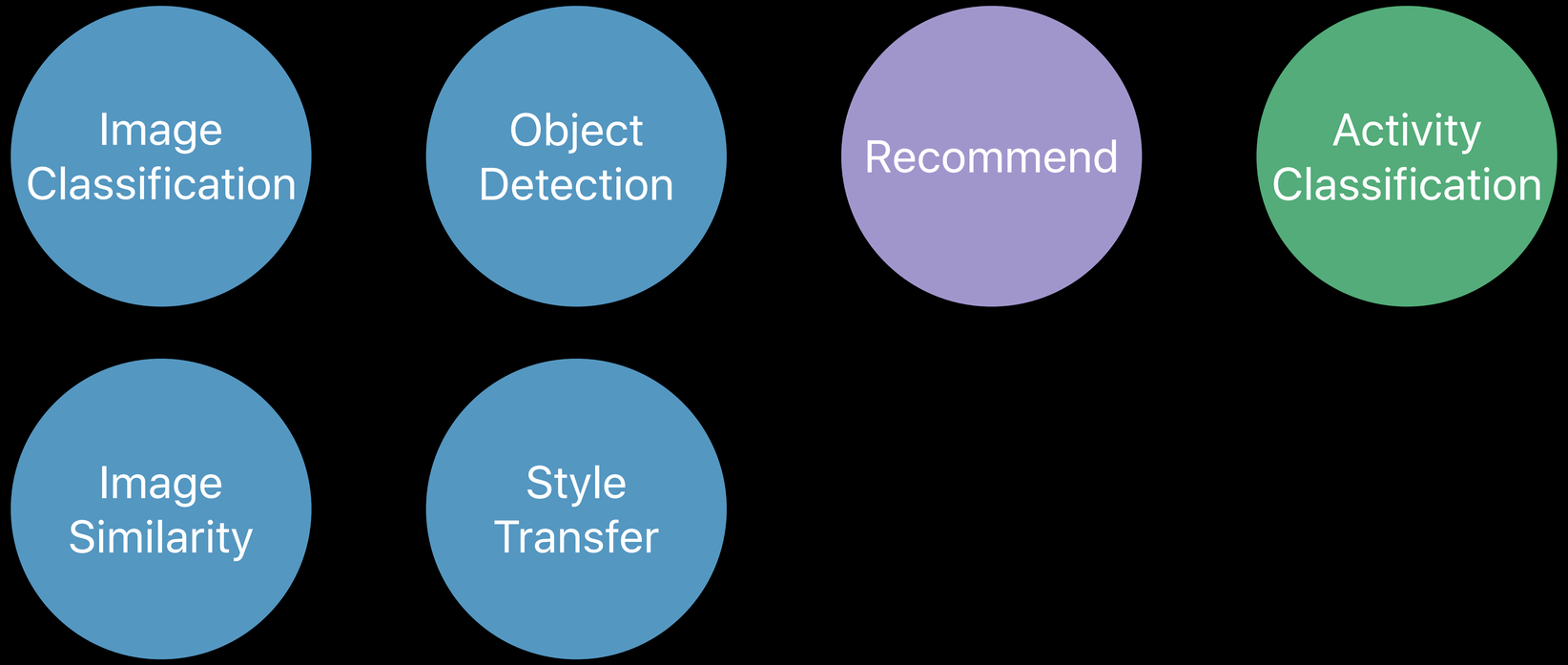


Image Classification
Object Detection
Recommend
Activity Classification
Image Similarity
Style Transfer

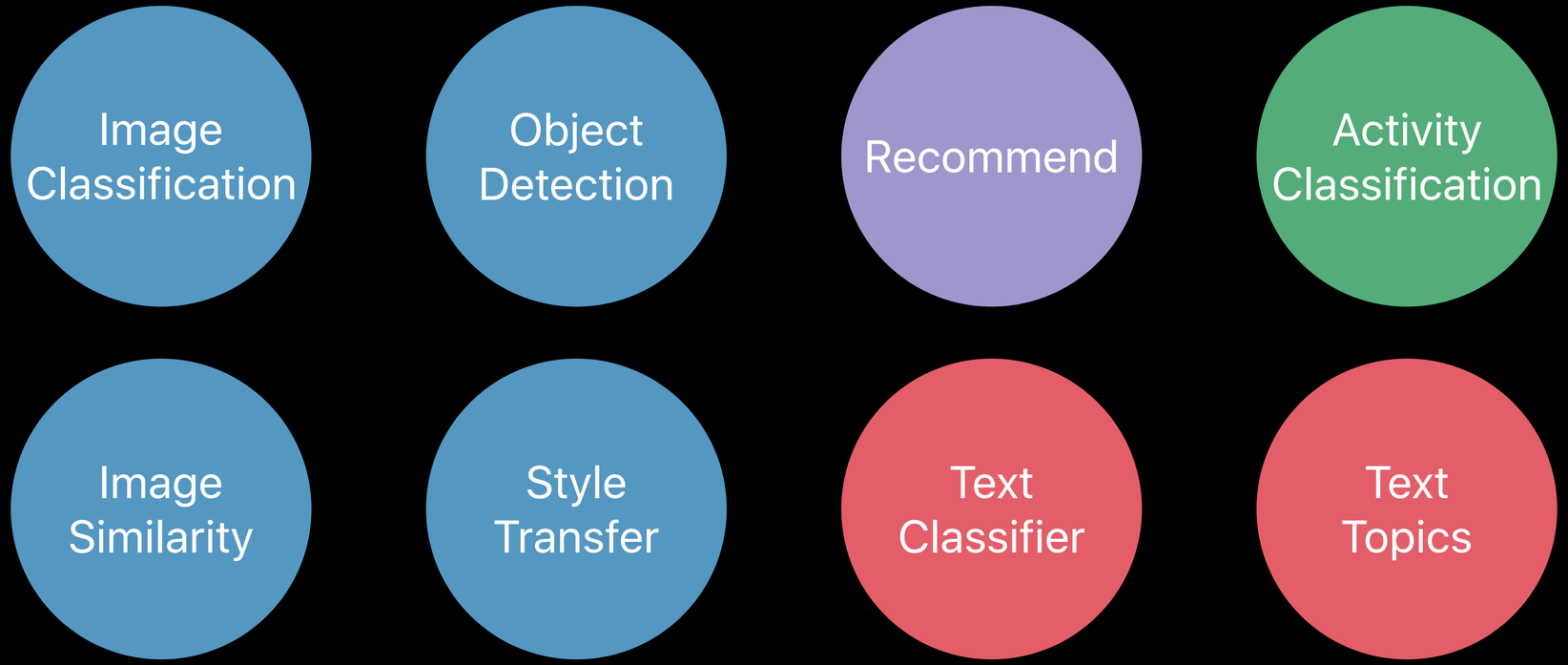


Image Classification
Object Detection
Recommend
Activity Classification
Image Similarity
Style Transfer
Text Classifier
Text Topics


Image Classification
Object Detection
Recommend
Activity Classification
Image Similarity
Style Transfer
Text Classifier
Text Topics
Classifiers
Regression
Clustering
Similarity

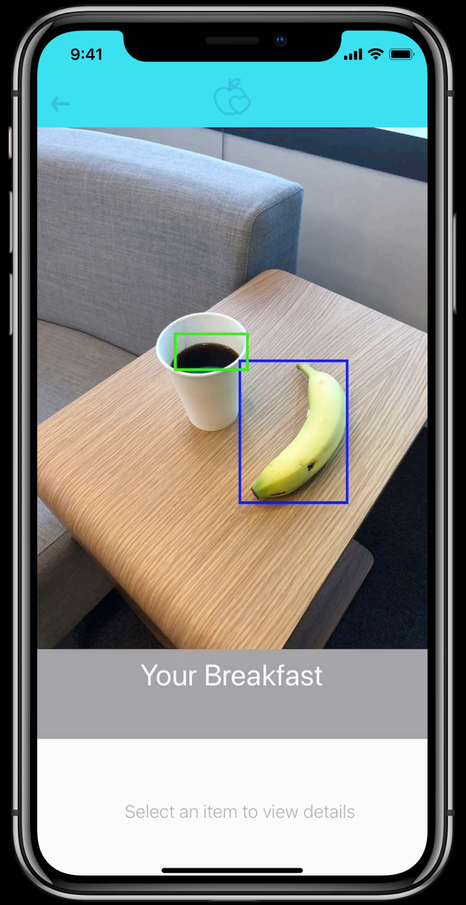
I want to...	Machine Learning Task
Label Images	Image Classification
Recognize objects within images	Object Detection
Find similar images	Image Similarity
Create stylized avatars / profile images	Style Transfer
Personalize choices for users	Recommender
Detect an activity using sensors	Activity Classification
Analyze sentiment of messages	Text Classifier
Predict a label	Classifiers
Predict numeric values	Regression
Group similar datapoints together	Clustering

Image Classification

Classify images into categories

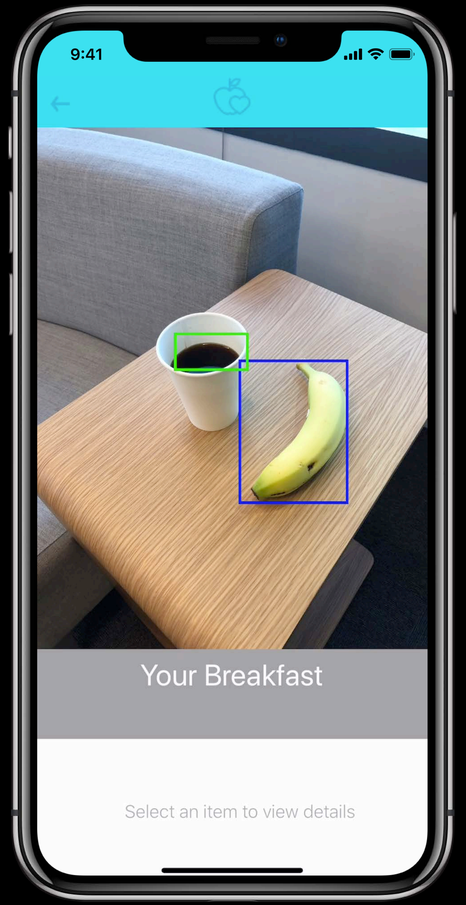
Object Detection

Detect objects in images



Object Detection

Detect objects in images



Style Transfer

Apply a visual style to images

Style Transfer

Apply a visual style to images

Activity Classification

Recognize gestures or motion

Activity Classification

Recognize gestures or motion

Recommenders

Personalize user preferences

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// Load data
data =  turicreate.SFrame(“data.sframe”)
train, test =  data.random_split(0.8)

// Create a model
model =  turicreate.object_detector.create(train, “labels”)

// Evaluate the model
metrics =  model.evaluate(test)

// Export for deployment
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import turicreate

// Load data
data =  turicreate.SFrame(“classifier_data.sframe”)
train, test =  data.random_split(0.8)

// Create a model
model =  turicreate.image_classifier.create(train, “labels”)

// Evaluate the model
metrics =  model.evaluate(test)

// Export for deployment
model.export_coreml(“MyModel.mlmodel”)
```

```
import turicreate

// Load data
data =  turicreate.SFrame(“sensor_data.sframe”)
train, test =  data.random_split(0.8)

// Create a model
model =  turicreate.activity_classifier.create(train, “labels”)

// Evaluate the model
metrics =  model.evaluate(test)

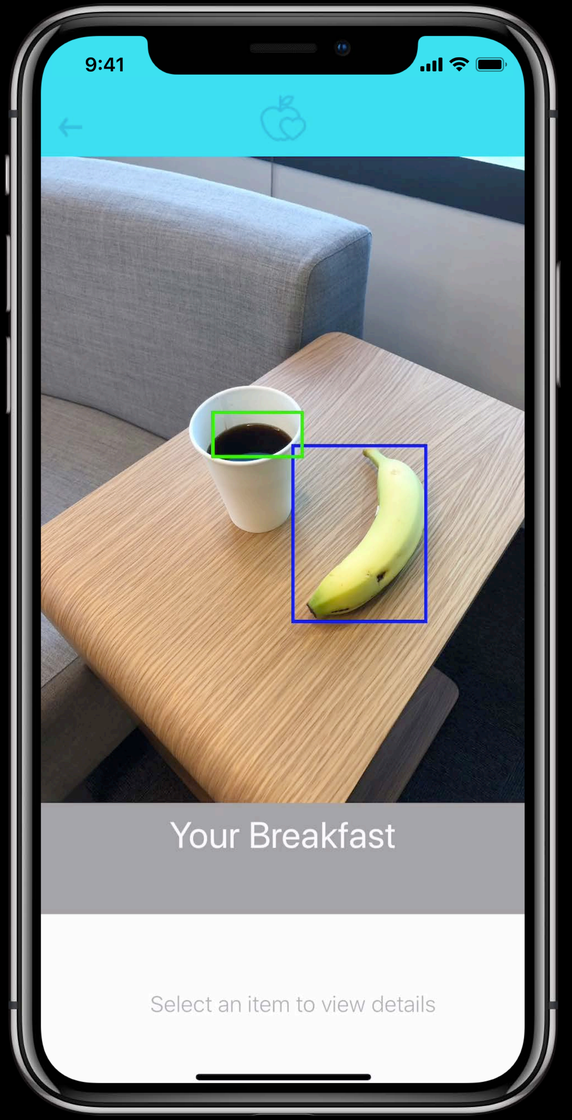
// Export for deployment
model.export_coreml(“MyModel.mlmodel”)
```

Sample App: Object Detection

Scenario: Calorie counting

Identify:

- Foods
- Where they occur



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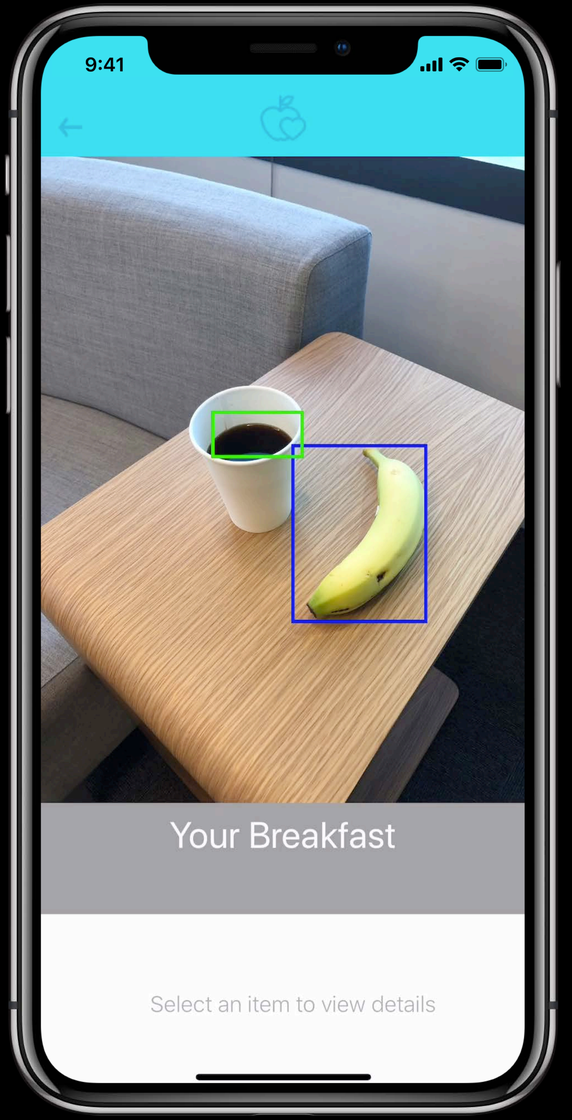
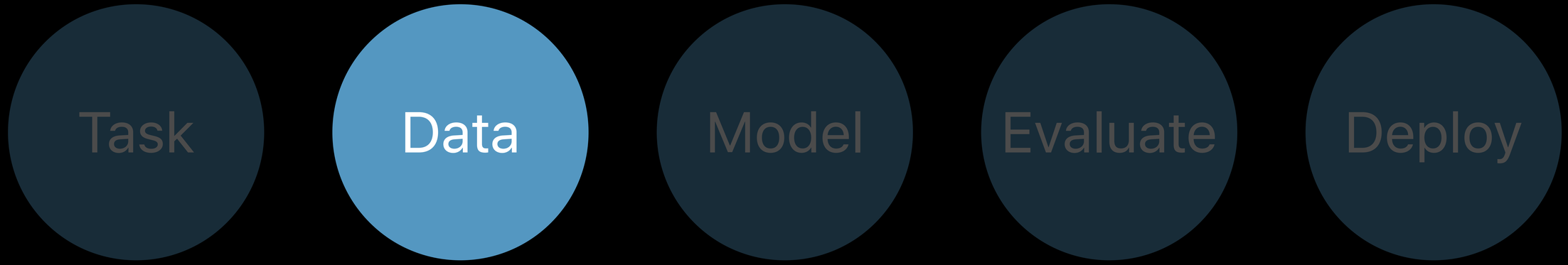
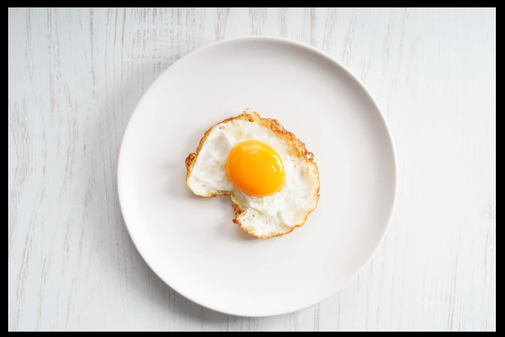


Step 2: Data



Images



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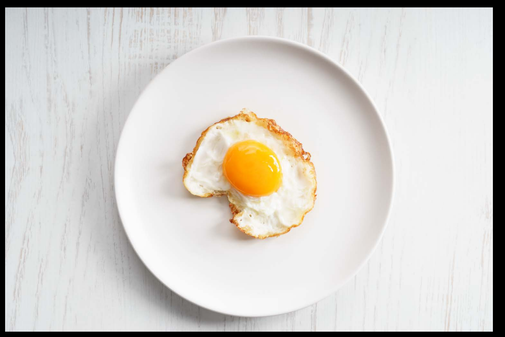
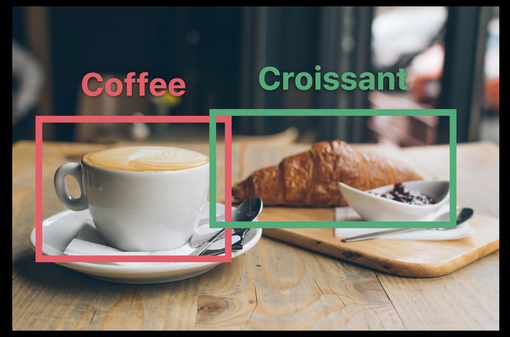
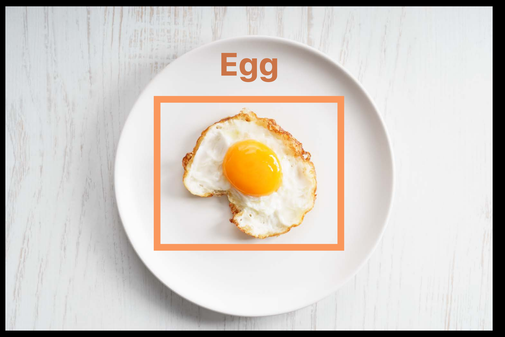
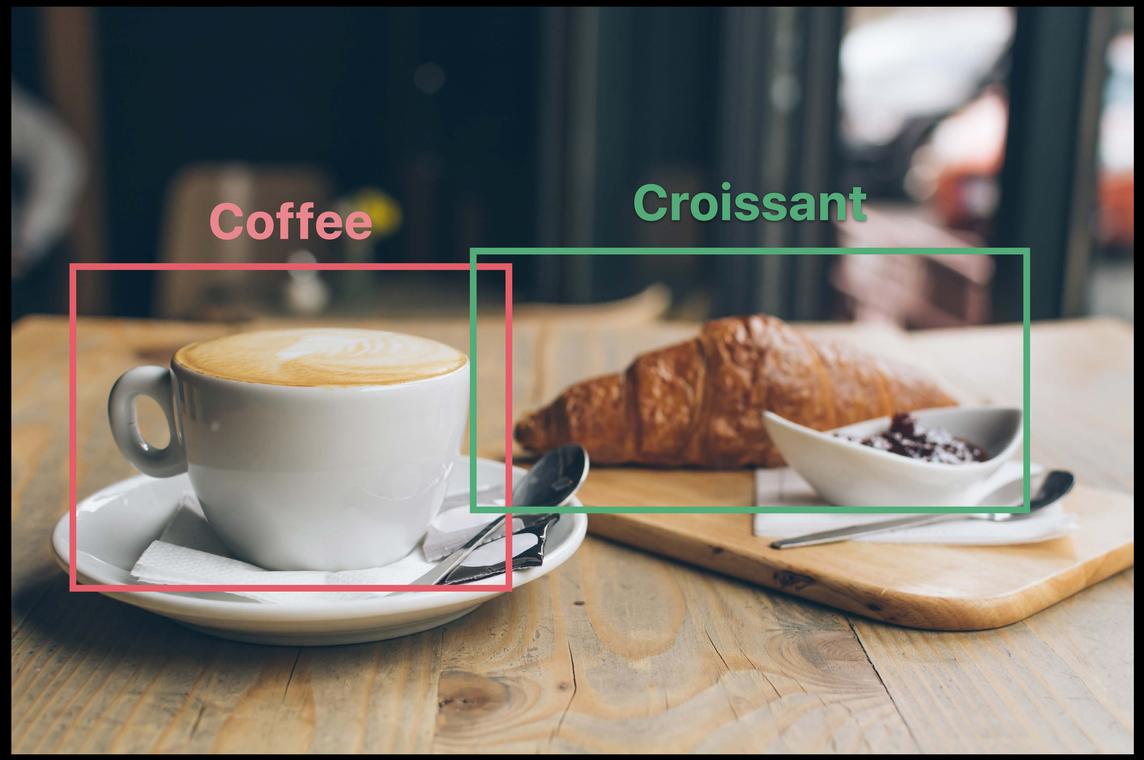


Annotations








```
[
  {
    "label"       : "coffee",
    "coordinates" : {
       "x"        : 387,
       "y"        : 660,
       "height"   : 550,
       "width"    : 814,
    }
  },
  {
    "label"       : "croissant",
    "coordinates" : {
       "x"        : 800,
       "y"        : 630,
       "height"   : 373,
       "width"    : 812,
    }
  }
]
```

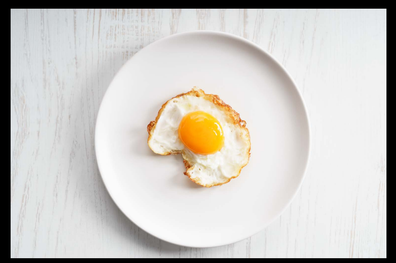
SFrame

Tabular data structure

image	annotation

	[{
	"label" : "coffee",
	"coordinates" : {
	"x" : 387,
	"y" : 660,
	"height" : 550,
	“width" : 814,
	}
	} ..

	[{
	"label" : “waffle",
	"coordinates" : {
	"x" : 261,
	"y" : 420,
	"height" : 500,
	“width" : 800,
	}
	} ..

	[{
	"label" : “egg",
	"coordinates" : {
	"x" : 381,
	"y" : 419,
	"height" : 431,
	“width" : 700,
	}
	} ..

What is an SFrame

What is an SFrame

Disk backed,
tabular data
structure

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Disk backed, tabular data structure

Common data manipulation tasks

What is an SFrame

Disk backed, tabular data structure

Common data manipulation tasks

Work with text, images, and json

What is an SFrame

Disk backed, tabular data structure

Common data manipulation tasks

Work with text, images, and json

Interactively explore and visualize data

```
import turicreate

// Load annotations & images
annotations =  turicreate.SFrame(“annotations.csv”)
images = turicreate.load_images(“training_images”)

// Interactive visualization & exploration
images.explore()

// Row-wise access
first_row = annotations[0]

// Column wise access
label_column = annotations[“labels”]

// Common operations
data = images.join(annotations)
data.save(“data.sframe”)
```

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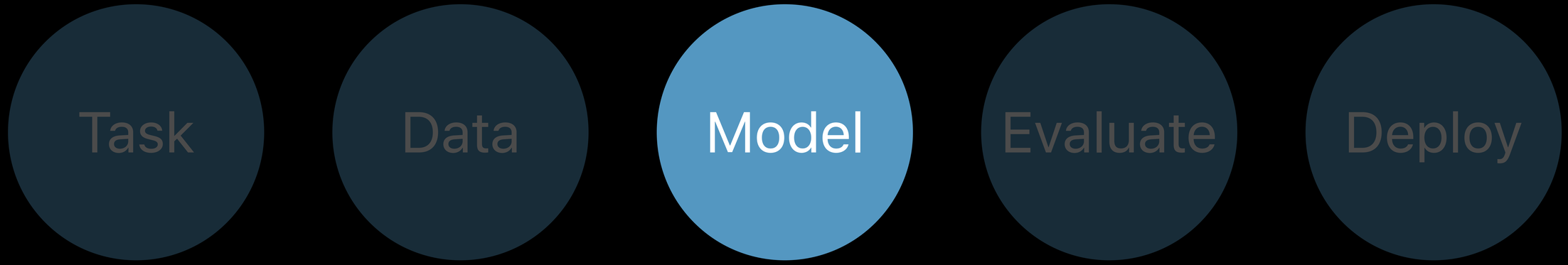
Step 3: Model



Model Creation Simplified

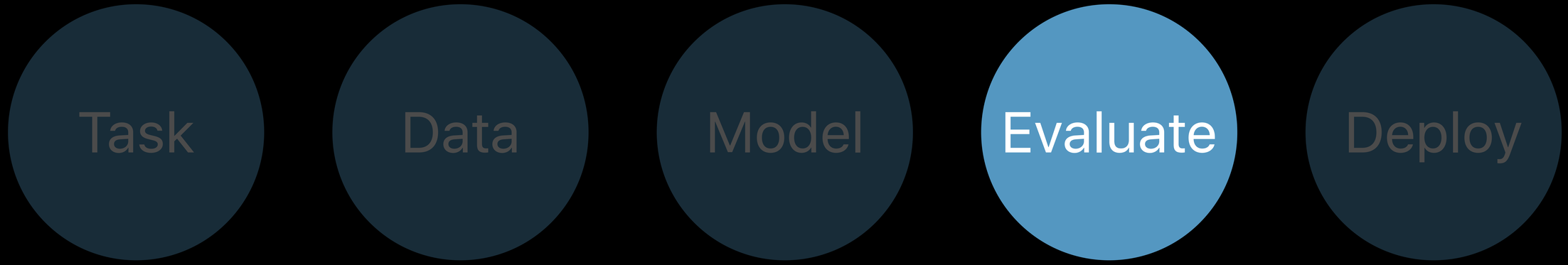
```
// Create a model
model =  turicreate.object_detector.create(train, “annotations”)
```

Model creation customized to task

State of the art

Small or large amounts of data

Step 4: Evaluate



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Evaluating Object Detectors

Did you get the label right?

Did you get the bounding box right?

Evaluation Metric

Need **correct labels** AND **at least 50%** overlap in boxes

Evaluation Metric

Overlap 10%

Need **correct labels** AND **at least 50%** overlap in boxes

Evaluation Metric

Overlap 10%

Overlap 99%

Need **correct labels** AND **at least 50%** overlap in boxes

Evaluation Metric

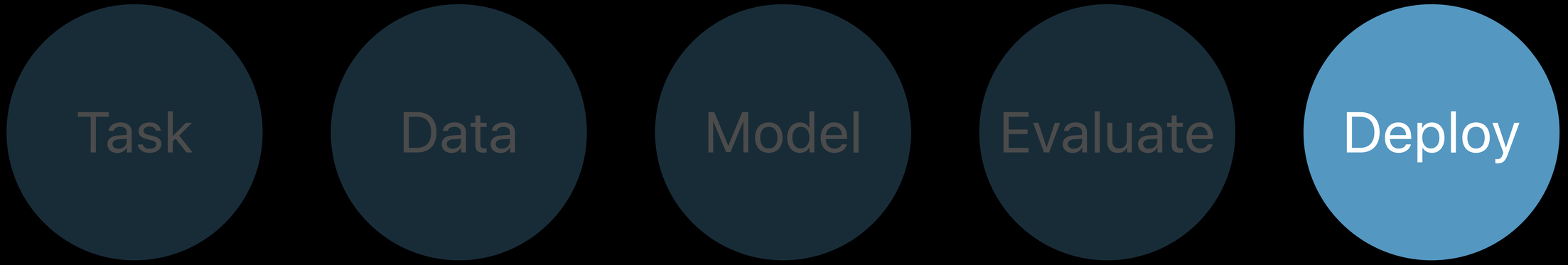
Overlap 10%

Overlap 70%

Overlap 99%

Need **correct labels** AND **at least 50%** overlap in boxes

Step 5: Deployment



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```
let mlModel = try MLModel(contentsOf: modelURL)
let visionModel = try VNCoreMLModel(for: mlModel)
let objectRecognition = VNCoreMLRequest(model: visionModel,
                                        completionHandler: { (request, error) in
    guard let results = request.results else { return }

    for case let foundObject as VNRecognizedObjectObservation in results {
        let bestLabel = foundObject.labels.first! // Label with highest confidence
        let objectBounds = foundObject.boundingBox

        // Use the computed values.
        print(bestLabel.identifier, bestLabel.confidence, objectBounds)
    }
})
```

NEW

Vision with Core ML Executive Ballroom Thursday 3:00PM

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Demo

Calorie counting

Zach Nation, Turi

Demo Recap

Demo Recap

Loaded images and annotations into the SFrame

Interactively explored data

Created a model

Evaluated quantitatively

Exported to Core ML

Exciting New features in 5.0

Turi Create 5.0

NEW

Turi Create 5.0

NEW

New Task

- Style Transfer

Turi Create 5.0

NEW

New Task

- Style Transfer

Performance

- Native GPU Acceleration on Macs

Turi Create 5.0

NEW

New Task

- Style Transfer

Performance

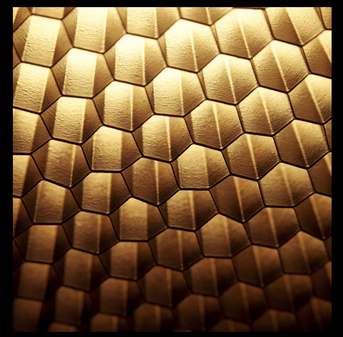
- Native GPU Acceleration on Macs

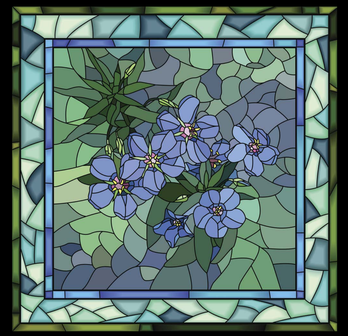
New Deployments

- Recommenders
- Vision Feature Print powered models

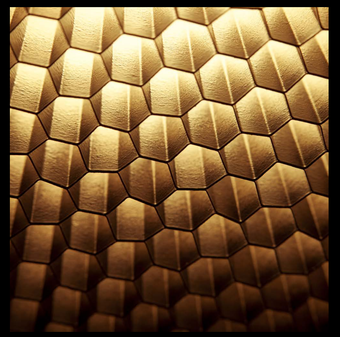
Style Transfer

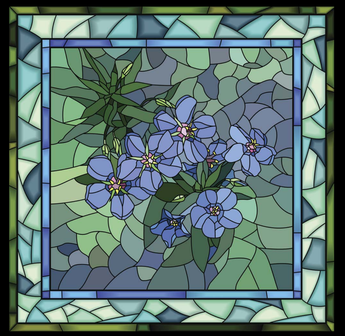
Style Transfer



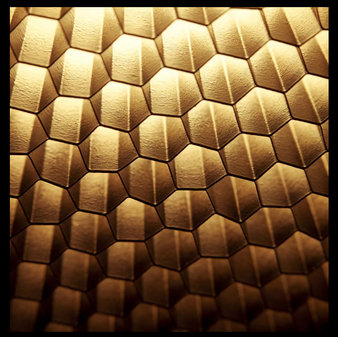


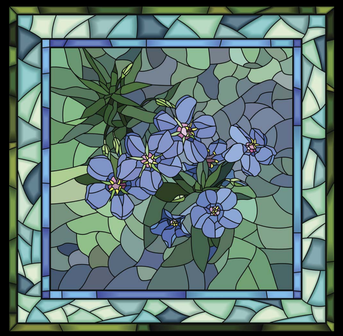
Style Transfer





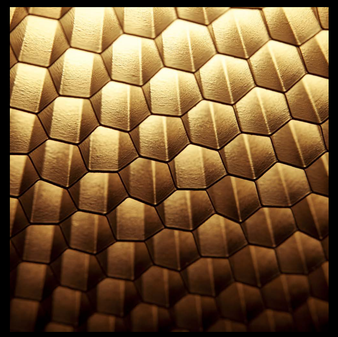
Style Transfer

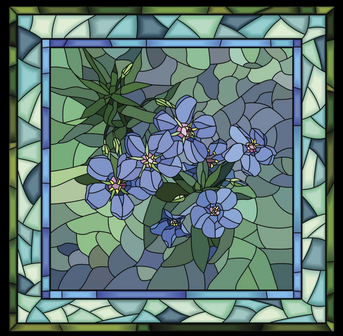




Style Transfer

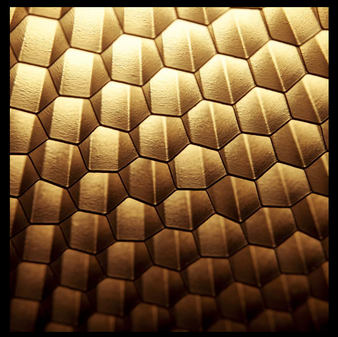


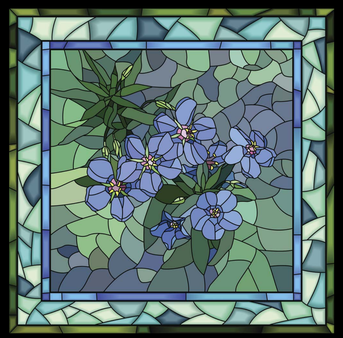



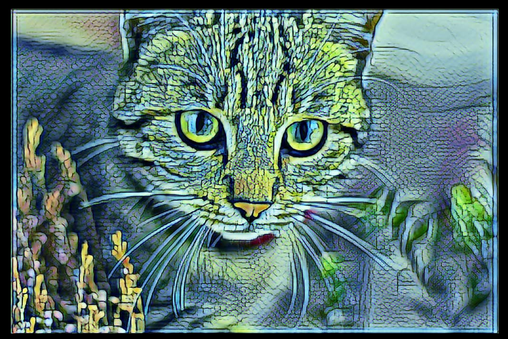
Style Transfer

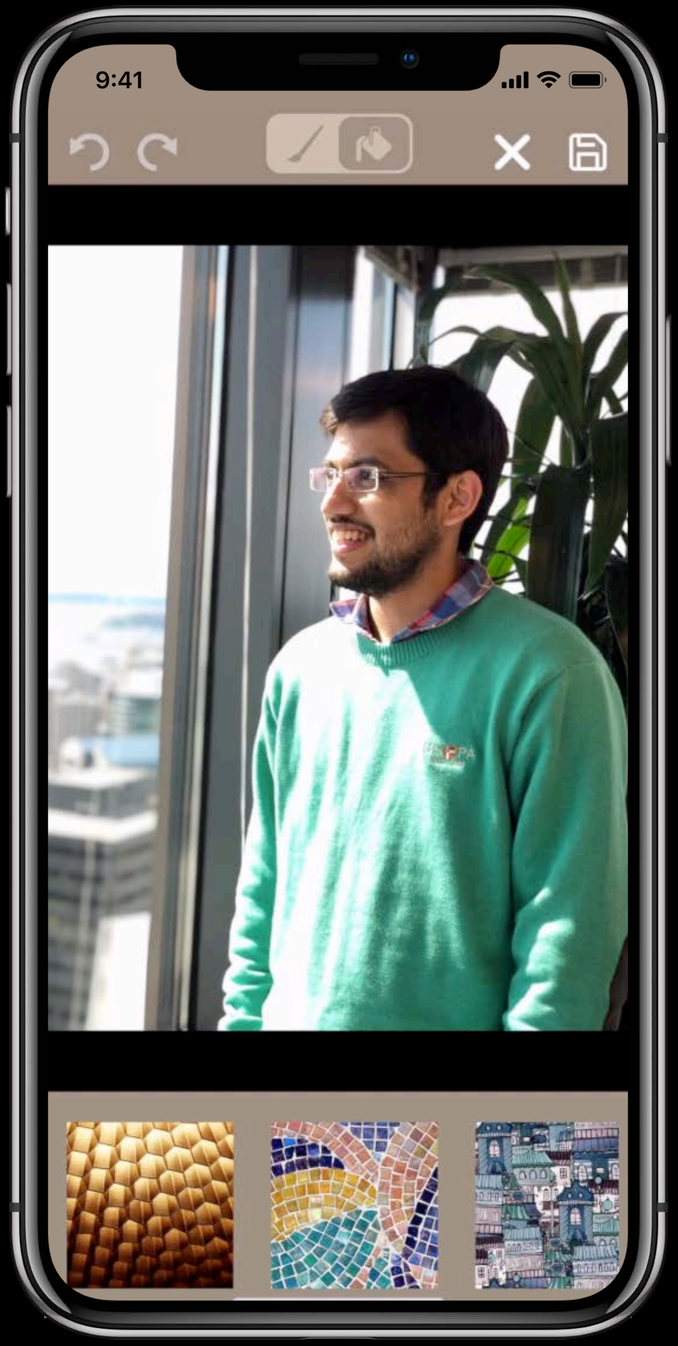


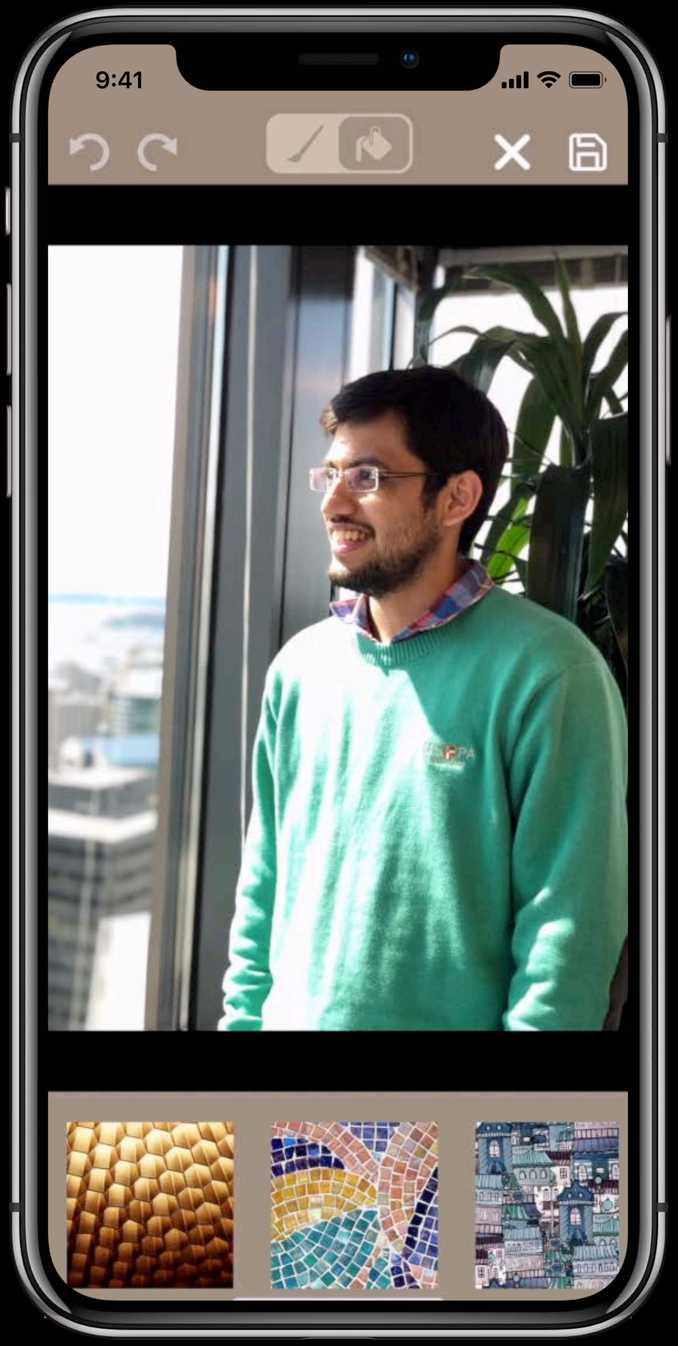







9:41


9:41

NEW

```
import turicreate

// Load data
content_images =  turicreate.load_images(“content/”)
style_images =  turicreate.load_images(“style/”)

// Create a model
model =  turicreate.style_transfer.create(content_images, style_images)

// Make predictions
stylized_images = model.stylize(content_images)

// Export for deployment
model.export_coreml(“MyStyles.mlmodel”)
```

Demo

Stylish filter creation app

Demo Recap

Loaded images into the SFrame

Created a model

Stylized images

Visualized predictions

Exported to Core ML

Mac GPU acceleration

12x

Image classifier

9x

Object detector

Metal for Accelerating Machine Learning	Hall 3	Thursday 4:00PM

Personalization

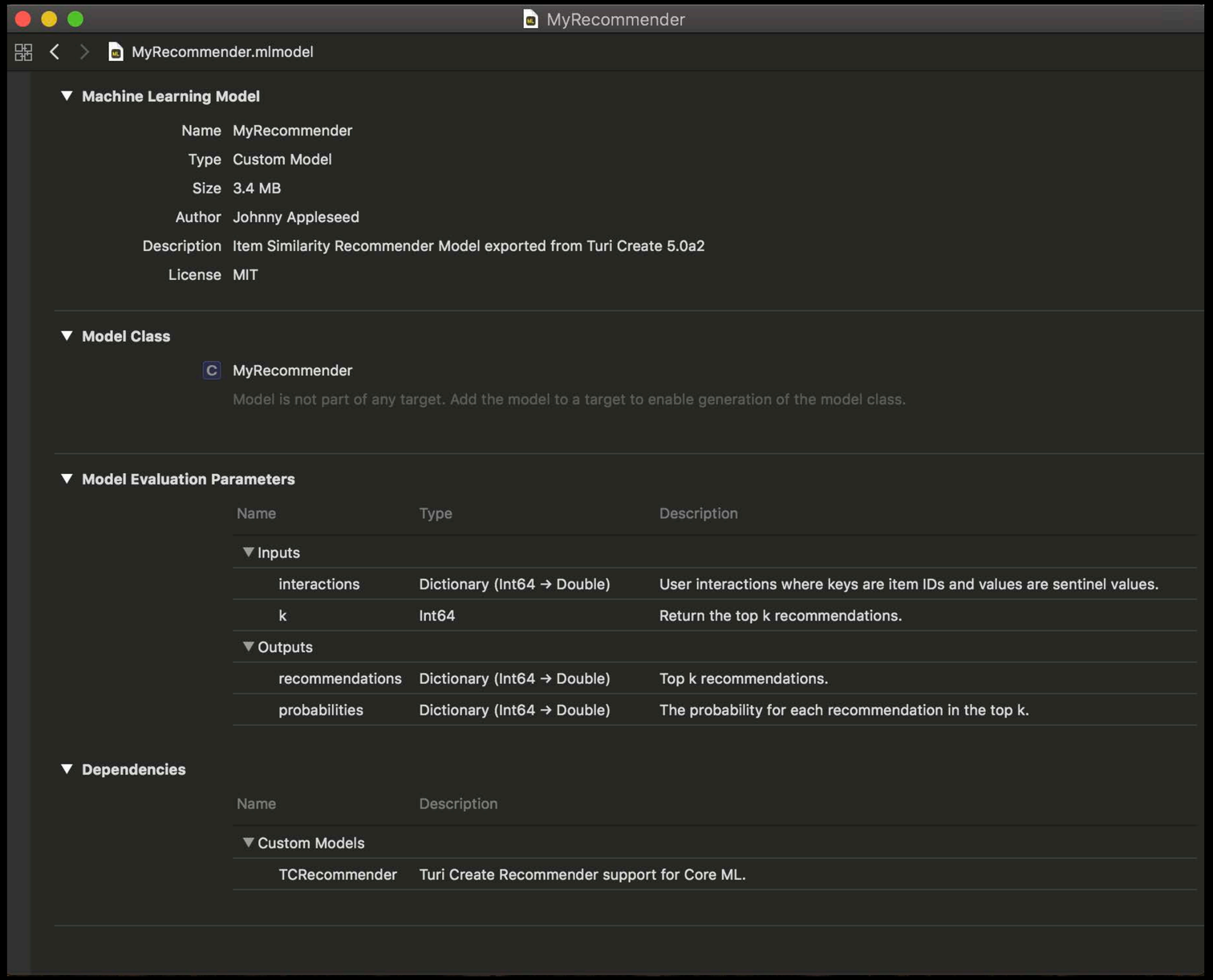
Task: Recommend items for users

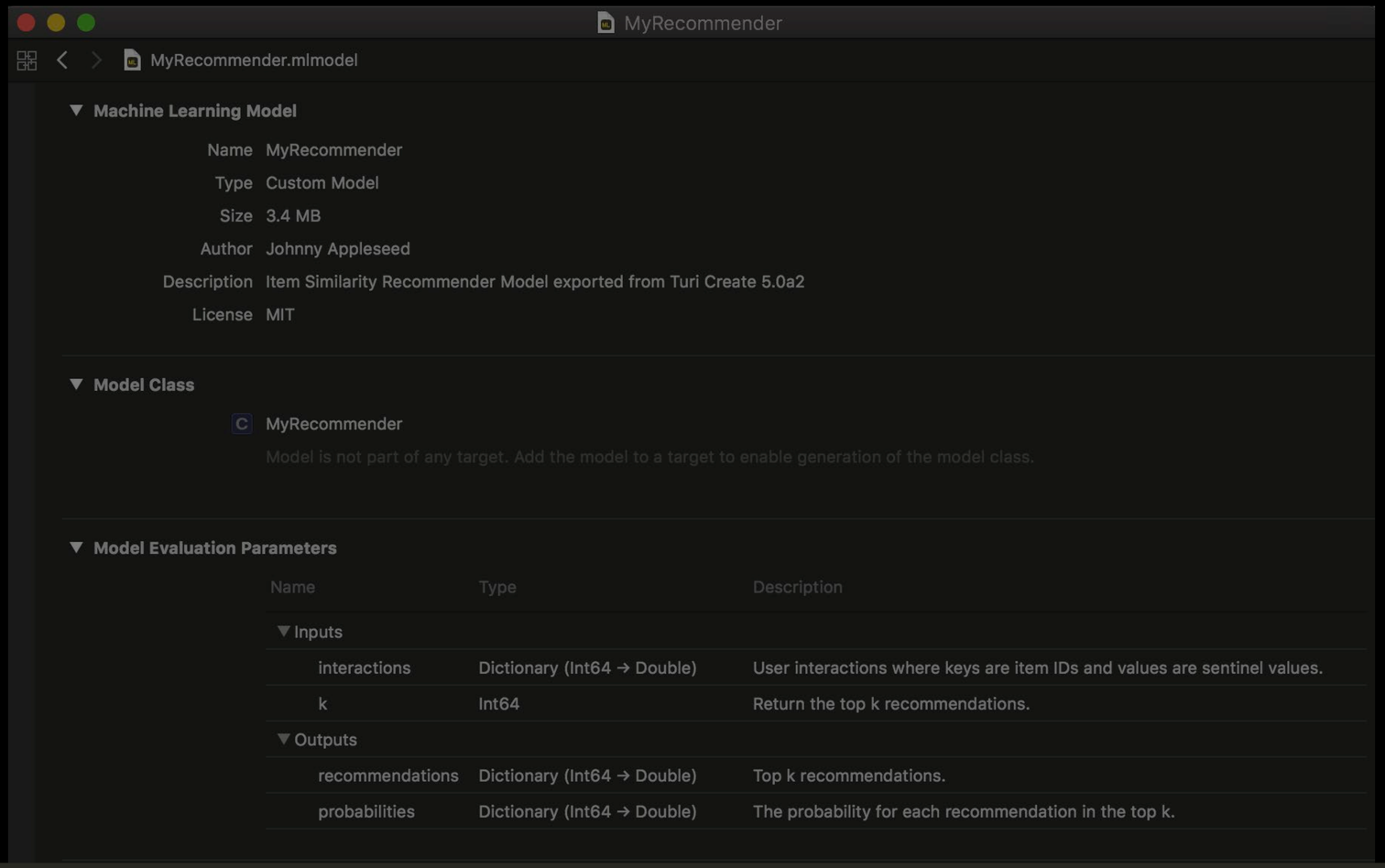
Data: Historical preferences

Deployment:

- Core ML custom models
- macOS 10.14, iOS 12

Top community feature request


MyRecommender
MyRecommender.mlmodel
Machine Learning Model
Name MyRecommender
Type Custom Model
Size 3.4 MB
Author Johnny Appleseed
Description Item Similarity Recommender Model exported from Turi Create 5.0a2
License MIT
Model Class
MyRecommender
Model is not part of any target. Add the model to a target to enable generation of the model class.
Model Evaluation Parameters
Name Type Description
Inputs
interactions Dictionary (Int64 → Double) User interactions where keys are item IDs and values are sentinel values.
k Int64 Return the top k recommendations.
Outputs
recommendations Dictionary (Int64 → Double) Top k recommendations.
probabilities Dictionary (Int64 → Double) The probability for each recommendation in the top k.
Dependencies
Name Description
Custom Models
TCRecommender Turi Create Recommender support for Core ML.


MyRecommender
MyRecommender.mlmodel
Machine Learning Model
Name MyRecommender
Type Custom Model
Size 3.4 MB
Author Johnny Appleseed
Description Item Similarity Recommender Model exported from Turi Create 5.0a2
License MIT
Model Class
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Model is not part of any target. Add the model to a target to enable generation of the model class.
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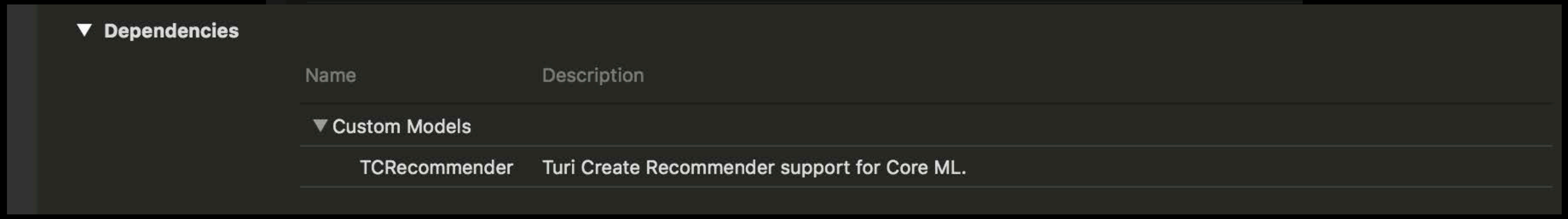

Dependencies
Name
Description
Custom Models
TCRecommender
Turi Create Recommender support for Core ML.

NEW

```
let model = MyRecommender()

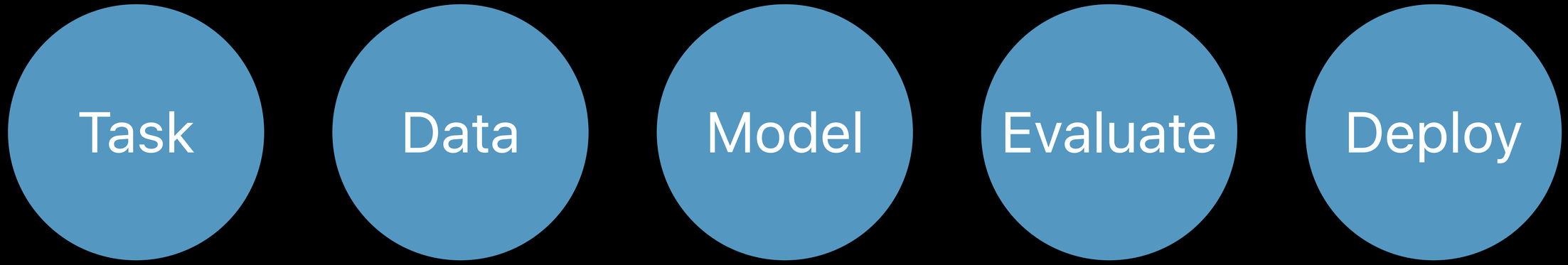
// Historical interactions
let input = [“BrownBeard”: 1.0,
         “BlackHandleBar”: 1.0,
          “BrownLongHair”: 1.0]

// Make predictions
let output = try model.prediction(interactions: input, k: 10)

// Consume predictions
let predictions = output.recommendations
let confidence  = output.probabilities
```

Recap

Create Core ML models for your intelligent apps



```
import turicreate

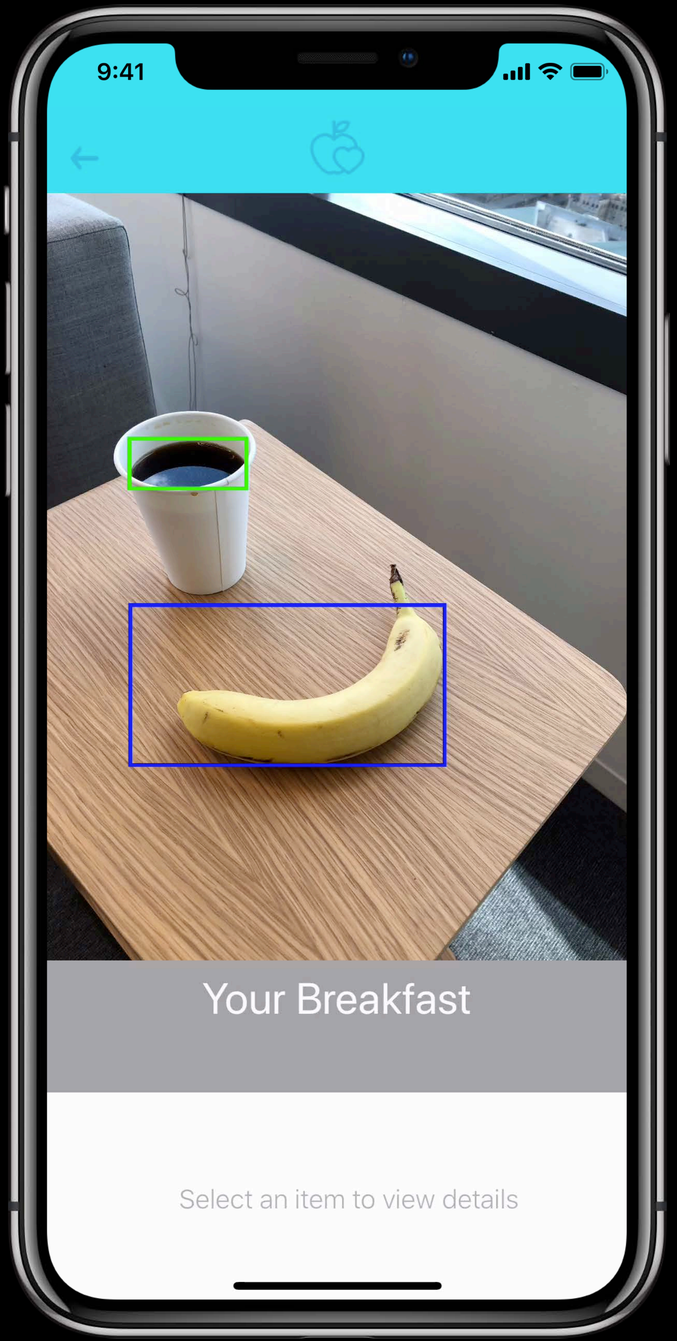
// Load data
data =  turicreate.SFrame(“data.sframe”)
train, test =  data.random_split(0.8)

// Create a model
model =  turicreate.object_detector.create(train, “annotations”)

// Evaluate the model
metrics =  model.evaluate(test)

// Export for deployment
model.export_coreml(“MyModel.mlmodel”)
```


Image Classification
Object Detection
Recommend
Activity Classification
Image Similarity
Style Transfer
Text Classifier
Text Topics
Classifiers
Regression
Clustering
Similarity


9:41
Your Breakfast
Select an item to view details


9:41

More Information

https://developer.apple.com/wwdc18/712


WWDC18