

Recommender Models in Create ML

Hoyt Koepke, Turi

9:41



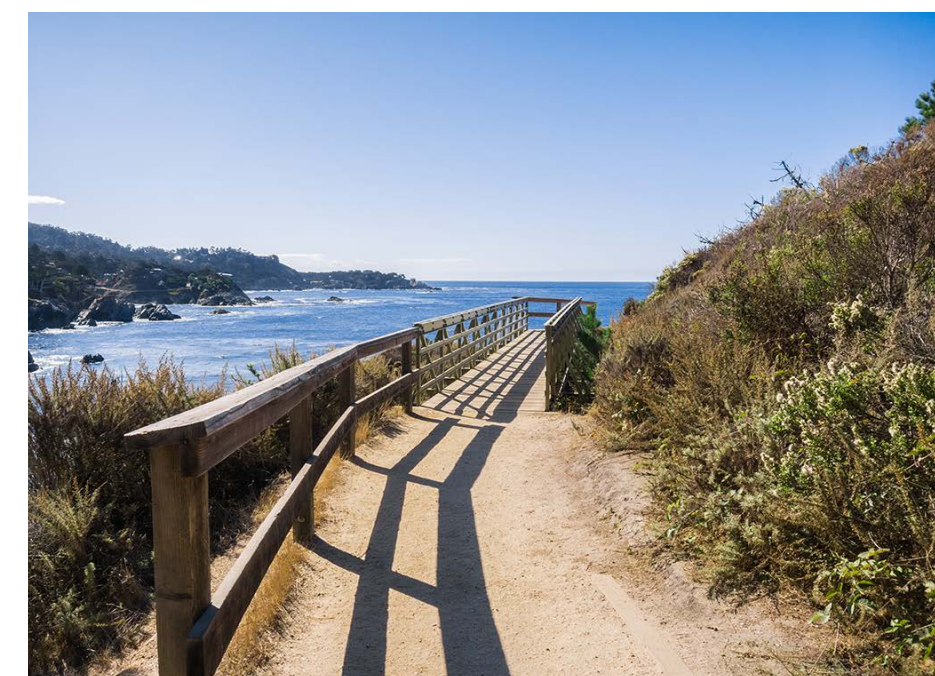
Hiking Journal



Hardtrail Mountain



Aspen Valley



Pleasant Cove



9:41



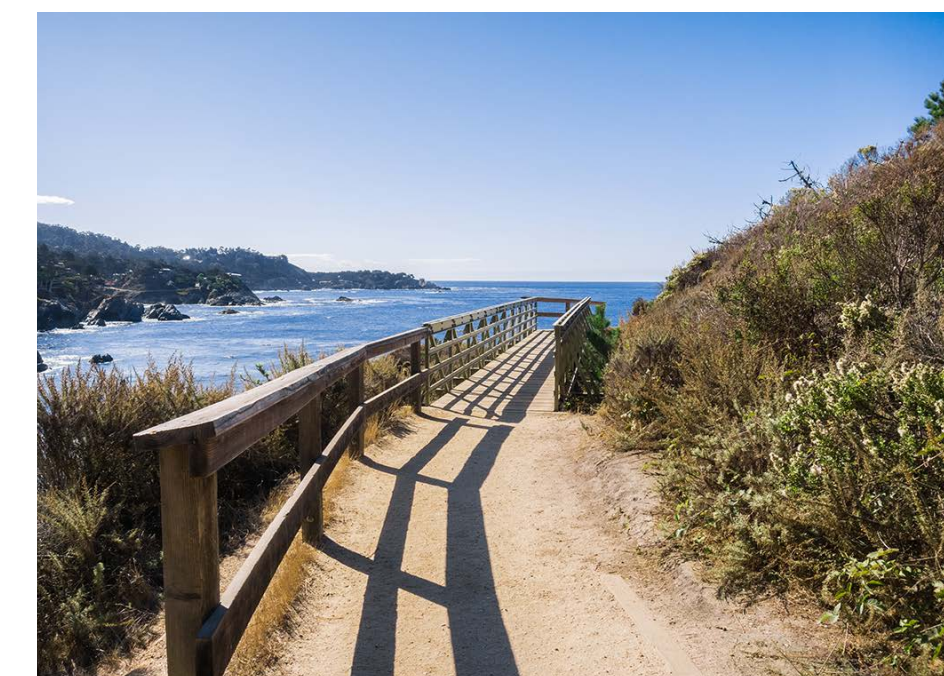
Hiking Journal



Hardtrail Mountain



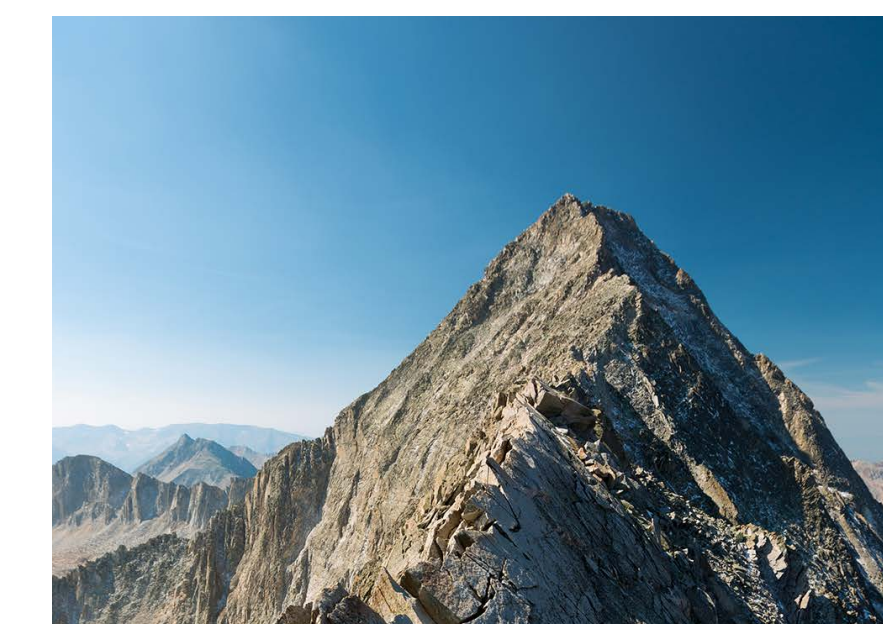
Aspen Valley



Pleasant Cove



For You:



Rocky Peak



Cactus Ridge

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Math Practice

Results:

$4 + 4 = 8$

Correct

$7 + 7 = 14$

Correct

$5 \times 3 = 15$

Correct

$6 \times 2 = 14$

Incorrect

Next Question:

$6 \times 5 = ?$

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Shopping List

- Chocolate Chips
- All-Purpose Flour
- Vanilla Extract
- Butter
-

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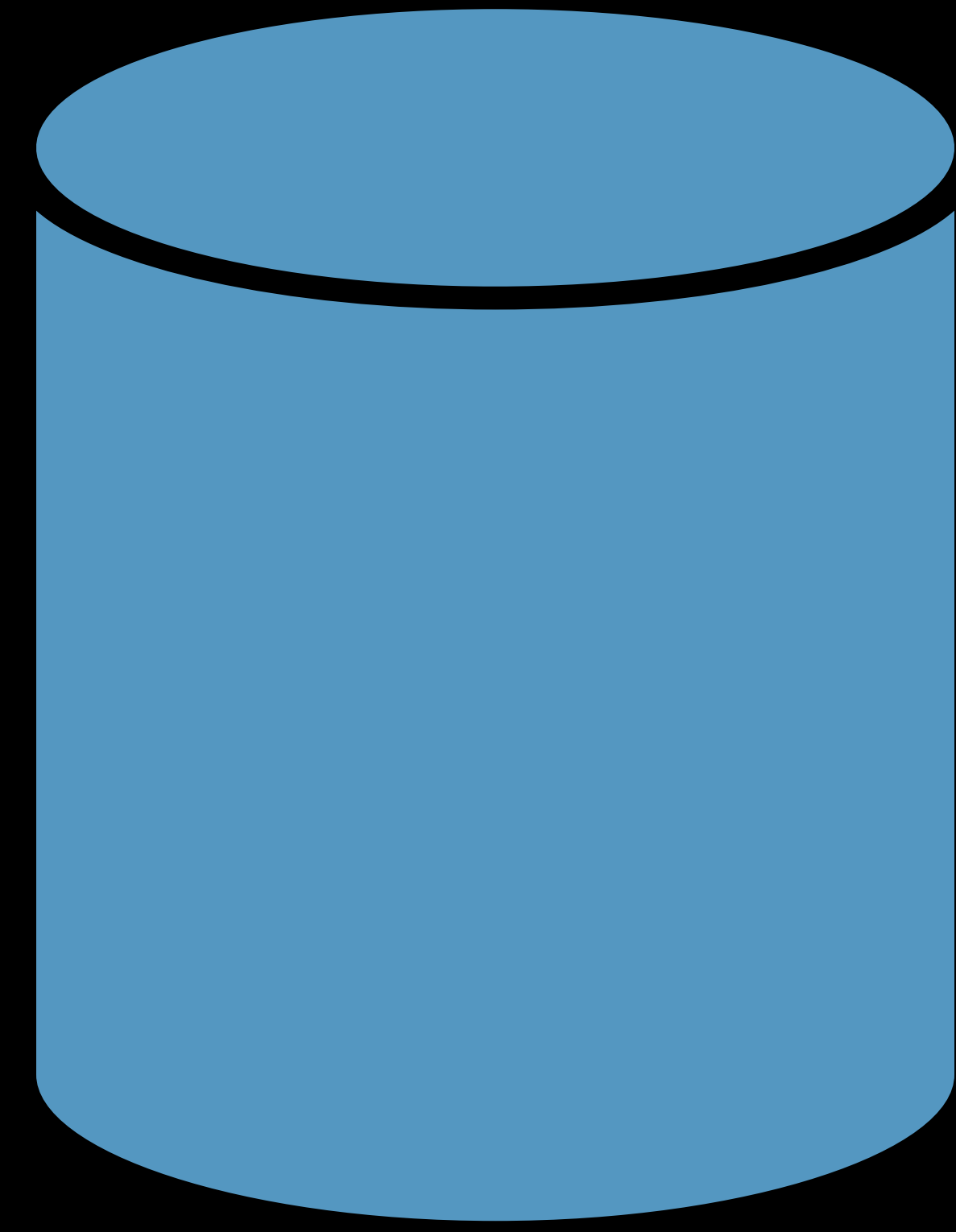


Shopping List

- Chocolate Chips
- All-Purpose Flour
- Vanilla Extract
- Butter
-

Did you forget something?

- Eggs [Add](#)
- Baking Powder [Add](#)
- Sugar [Add](#)



Data

Frannie's Famous Garlic Chicken

1/4 cup olive oil
8 cloves garlic, minced
1/4 cup Italian seasoning
1/4 cup grated Parmesan cheese
4 skinless, boneless chicken breasts

Homemade Wheat Bread

3 cups warm water
2 pkg. active dry yeast
1/3 cup honey
5 cups bread flour
3 Tbs. butter
1 Tbs. salt
3 1/2 cups water
2 Tbs. butter

Mom's Favorite Chocolate Chip Cookies

1 cup (2 sticks) unsalted butter, softened
3/4 cup light brown sugar
3/4 cup granulated sugar, fine
2 large eggs, room temperature
1 tsp vanilla extract
2 1/2 cups all-purpose flour
1 tsp baking soda
1/2 tsp salt
1 1/2 bag (18 oz.) bittersweet chocolate chips

Recipe	Ingredient
Bread	Flour
Bread	Water
Bread	Yeast
Cookies	Flour
Cookies	Sugar
Cookies	Chocolate chips
Garlic Chicken	Bread crumbs
Garlic Chicken	Garlic
Garlic Chicken	Chicken
...	...

Group Column

Recipe	Ingredient
Bread	Flour
Bread	Water
Bread	Yeast
Cookies	Flour
Cookies	Sugar
Cookies	Chocolate chips
Garlic Chicken	Bread crumbs
Garlic Chicken	Garlic
Garlic Chicken	Chicken
...	...

Group Column

Item Column

Recipe	Ingredient
Bread	Flour
Bread	Water
Bread	Yeast
Cookies	Flour
Cookies	Sugar
Cookies	Chocolate chips
Garlic Chicken	Bread crumbs
Garlic Chicken	Garlic
Garlic Chicken	Chicken
...	...

Session ID	Problem
0	$4 + 8$
0	$7 + 7$
1	$5 + 3$
1	8×9
1	$7 - 1$
2	$2^{(-1)}$
2	$(-1)^{(-1)}$
2	$(8 - 3) \times 4^2$
2	$223 / 100$
...	...

Group Column

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0	$4 + 8$
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...	...

Group Column

Item Column

Session ID

Problem

0

$4 + 8$

0

$7 + 7$

1

$5 + 3$

1

8×9

1

$7 - 1$

2

$2^{(-1)}$

2

$(-1)^{(-1)}$

2

$(8 - 3) \times 4^2$

2

$223 / 100$

...

...

Group Column

Item Column

Rating Column

Session ID

Problem

Correct

0

$4 + 8$

1

0

$7 + 7$

0

1

$5 + 3$

1

1

8×9

1

1

$7 - 1$

1

2

2^{-1}

0

2

$(-1)^{-1}$

0

2

$(8 - 3) \times 4^2$

1

2

$223 / 100$

0

...

...

...

Hiker	Trail	Rating
Tao	Granite Mountain	4
Tao	Ocean Views	5
Tao	Sandy Bluffs	2
Yuxin	Desert Basin	3
Yuxin	Hardtrail Mountain	5
Hoyt	Cactus Ridge	3
Hoyt	Sandy Bluffs	4
Hoyt	Hardtrail Mountain	3
Hoyt	Granite Mountain	5
...

Group Column

Hiker	Trail	Rating
Tao	Granite Mountain	4
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Hoyt	Hardtrail Mountain	3
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Hoyt	Sandy Bluffs	4
Hoyt	Hardtrail Mountain	3
Hoyt	Granite Mountain	5
...

Trail	Rating
Granite Mountain	4
Cactus Ridge	3
Rocky Peak	4
Aspen Valley	5

Trail	Rating
Granite Mountain	4
Cactus Ridge	3
Rocky Peak	4
Aspen Valley	5



Model

Trail	Rating
Granite Mountain	4
Cactus Ridge	3
Rocky Peak	4
Aspen Valley	5



Model



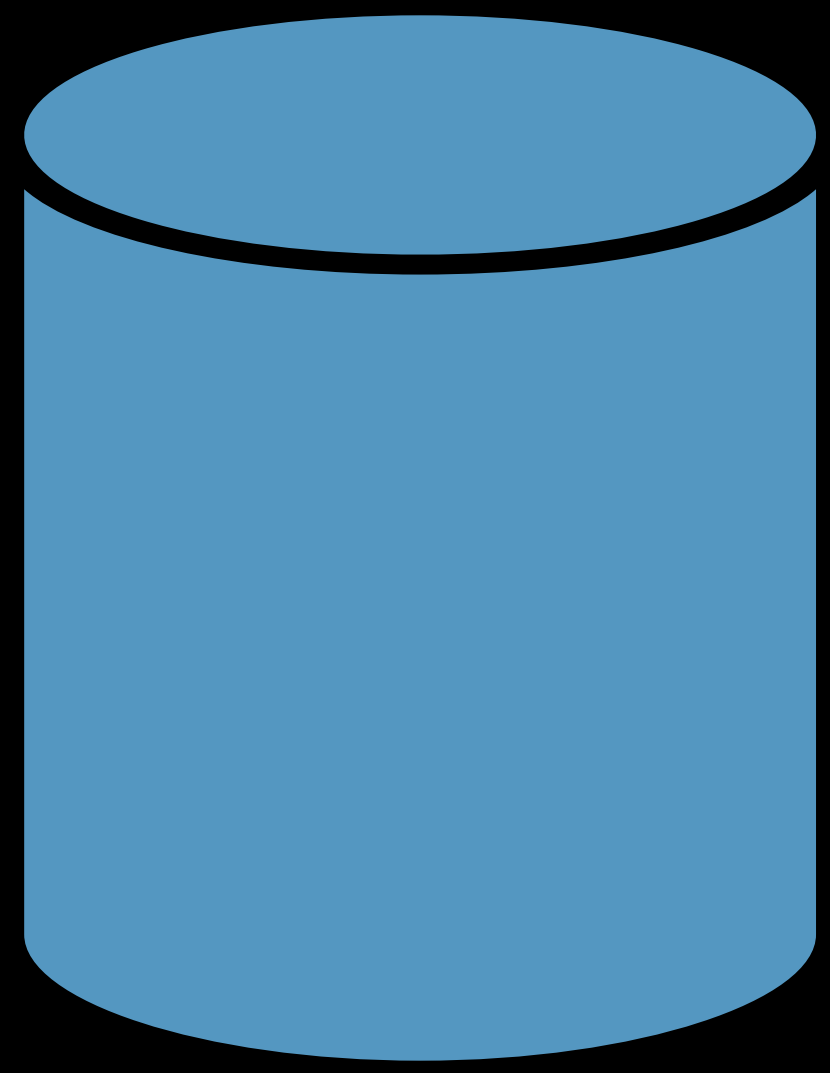
Recommendations



Demo

Hiking recommendations

Recommender in Three Steps

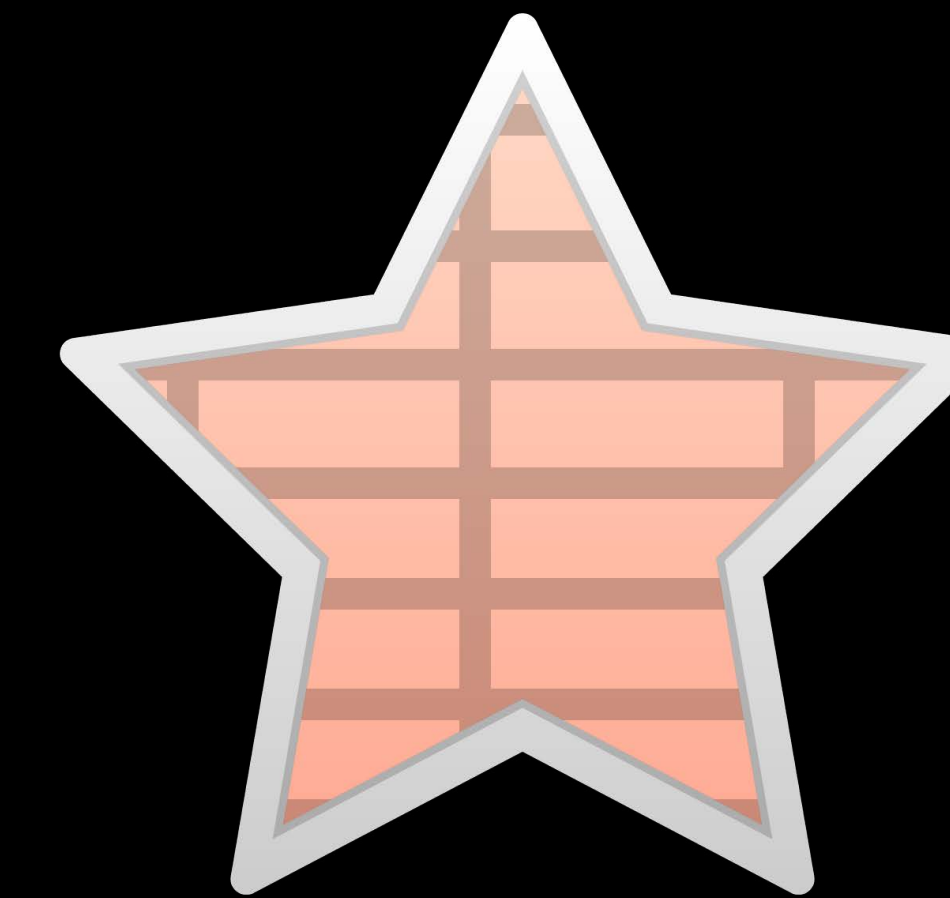


Data

Recommender in Three Steps



Data



Create ML

Recommender in Three Steps



Learning Item Relationships



Learning Item Relationships



Hikers give these similar ratings



Learning Item Relationships

Hikers give these different ratings



Hikers give these similar ratings

Learning Item Relationships

Hikers give these different ratings



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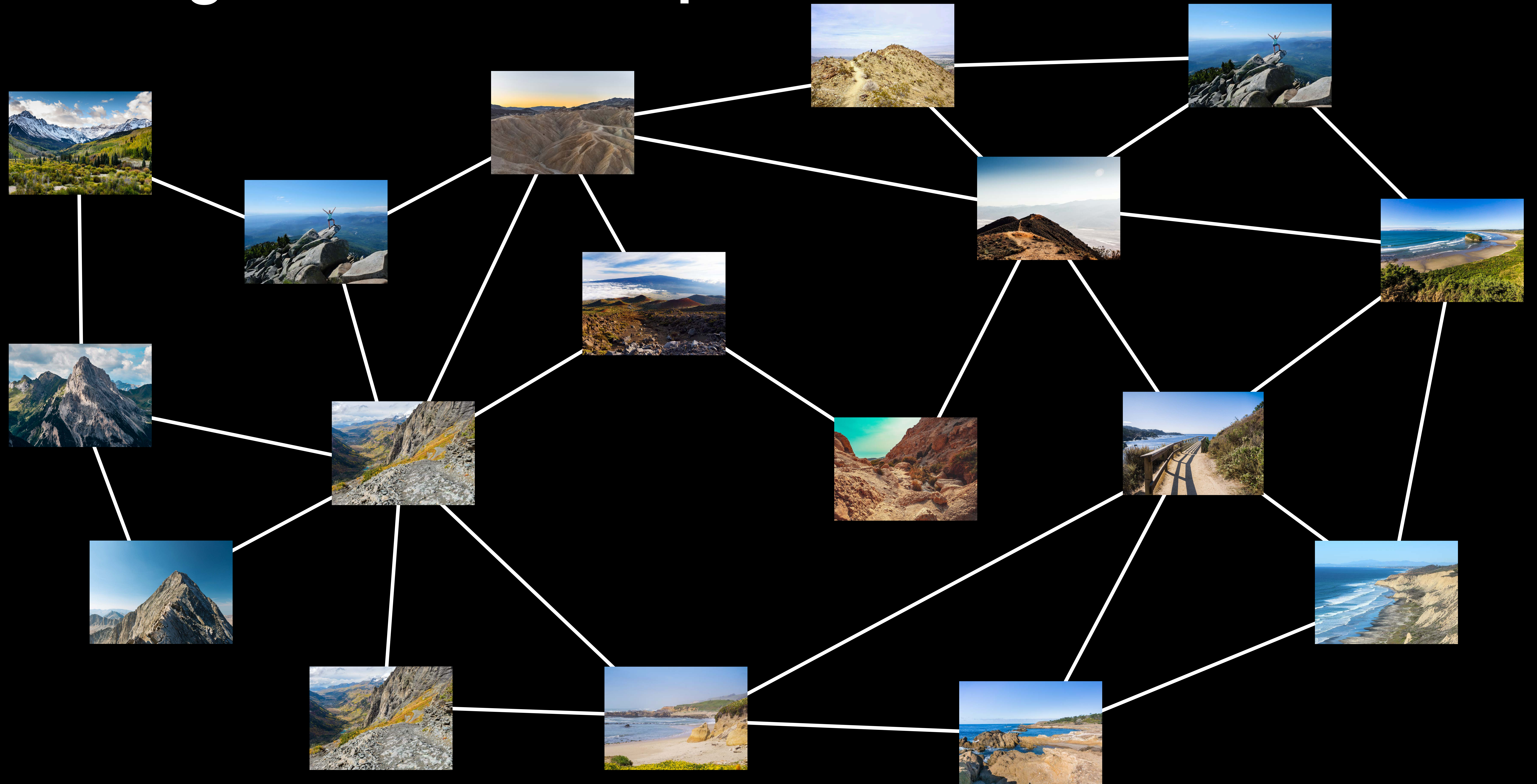


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Hikers give these similar ratings

Learning Item Relationships



Learning Item Relationships





Model

Choose a Template

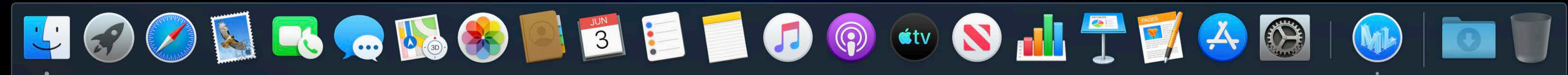
- All
- Image
- Sound
- Activity
- Text
- Table**

Table

 Regressor	 Classifier	 Recommender
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Recommender
A machine learning model that produces recommendations based on past behaviors.

Cancel Previous Next



```
// Load the hiking data
let trainingData = try MLDataTable(contentsOf: hikingTrainCSV)

// Train the recommender
let model = try MLRecommender(trainingData: trainingData,
                               userColumn: "Hiker ID",
                               itemColumn: "Trail ID",
                               ratingColumn: "Rating")

// Evaluate the model
let testingData = try MLDataTable(contentsOf: hikingTestCSV)
let metrics = model.evaluation(on: testingData)

// Write out the Core ML model
try model.write(to: writeToPath)
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```

```
// Track the items we want to query in the model.  
let hikes : [String : Double] = ["Granite Peak" : 5, "Wildflower Meadows" : 4]  
  
// Query for a set number of recommendations  
let input = HikingRouteRecommenderInput(items: hikes, k: 5)  
  
// Get results as sequence of recommended items  
let results = try model.prediction(input: input)
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Considerations

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Models are flexible

Considerations

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On-device, offline

Considerations

Models are flexible

On-device, offline

Privacy preserving

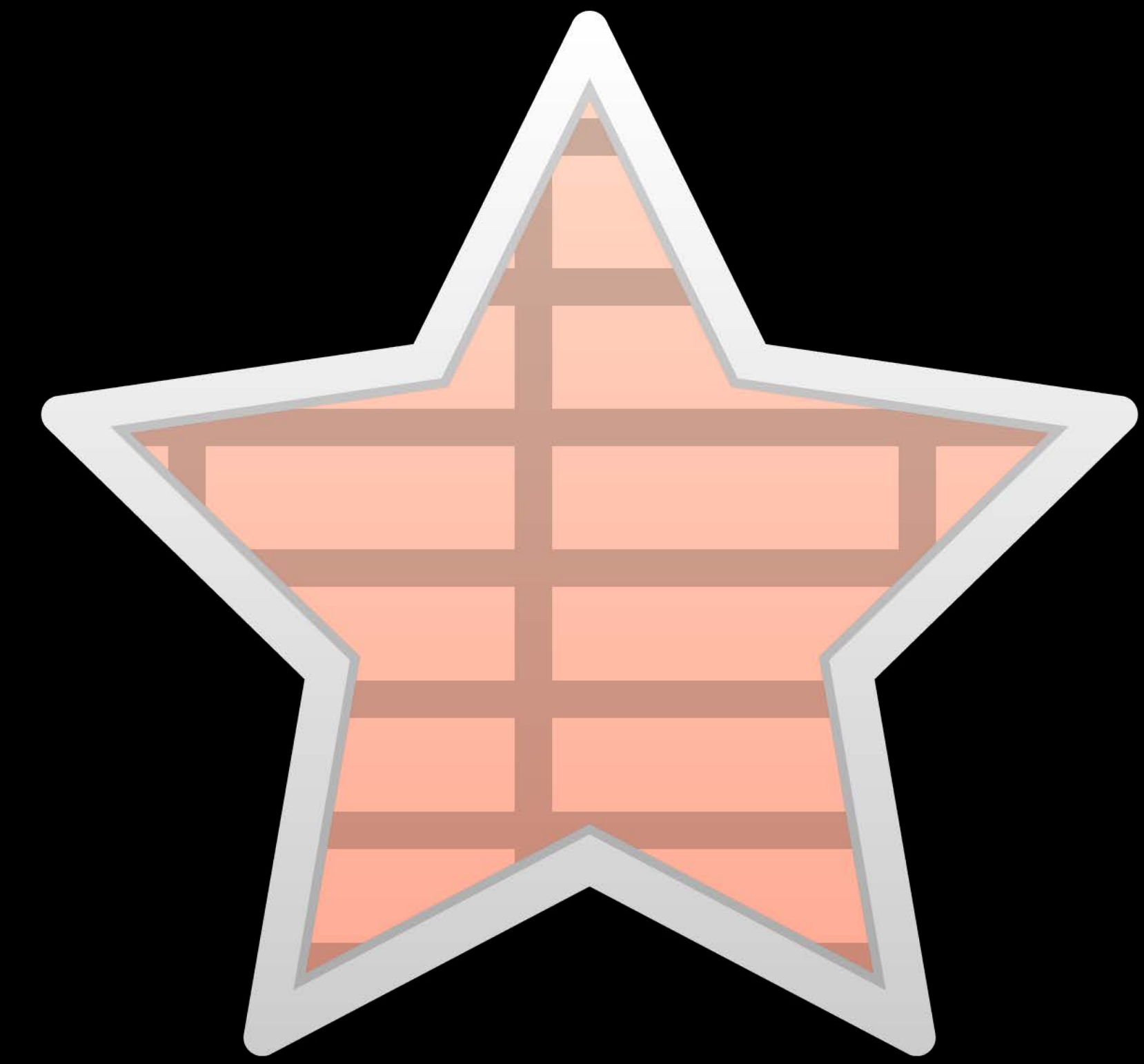
Summary



Text Classification



Activity Classification



Recommender

More Information

developer.apple.com/wwdc19/427

 WWDC19