Interactive Analytics Library

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Georgia Tech Visualization Lab

Interaction is data.

http://gtvalab.github.io/ial/

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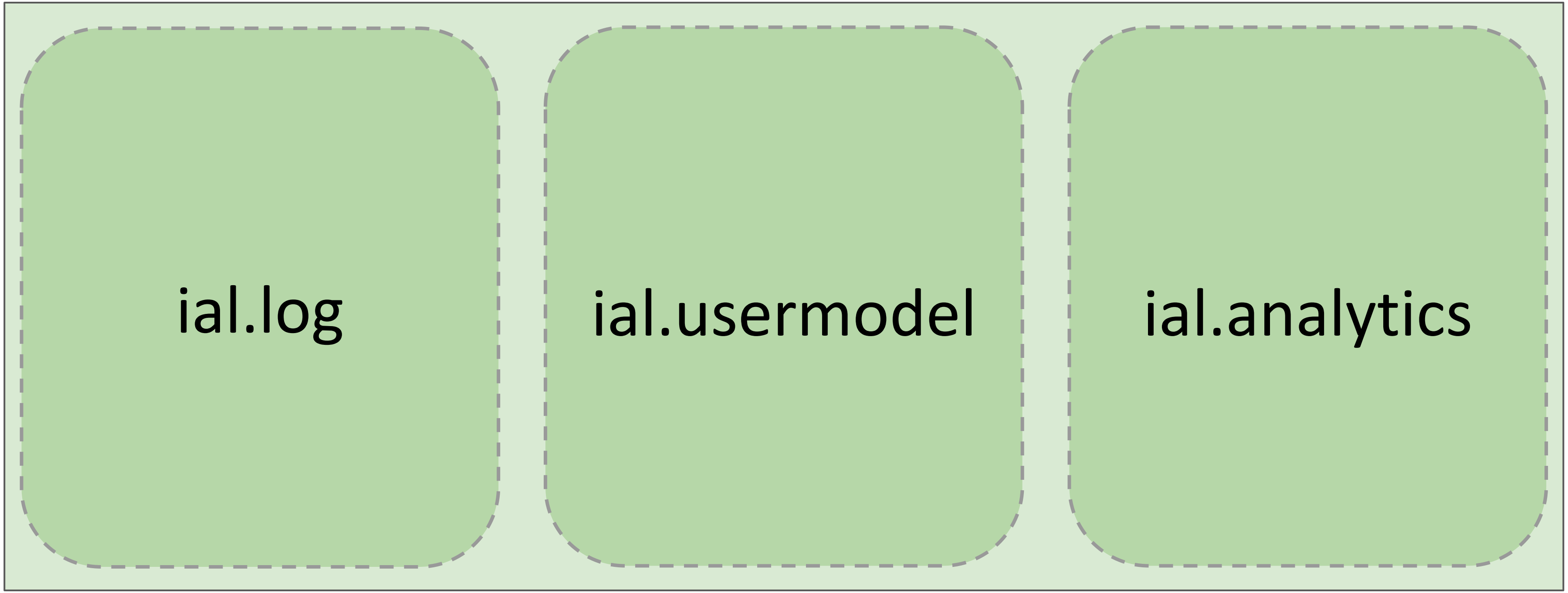
Motivation

- Interaction is data.
  - What can we tell about a user based on their interactions with data?
  - In the case of streaming data: when the user can’t examine all of the data, how can a system leverage the user’s goals, interests, etc.?

- Facilitate faster prototyping of web-based visual analytic applications
  - Written in javascript
  - Flexibility to export results for further customized analytic operations in R, python, etc.

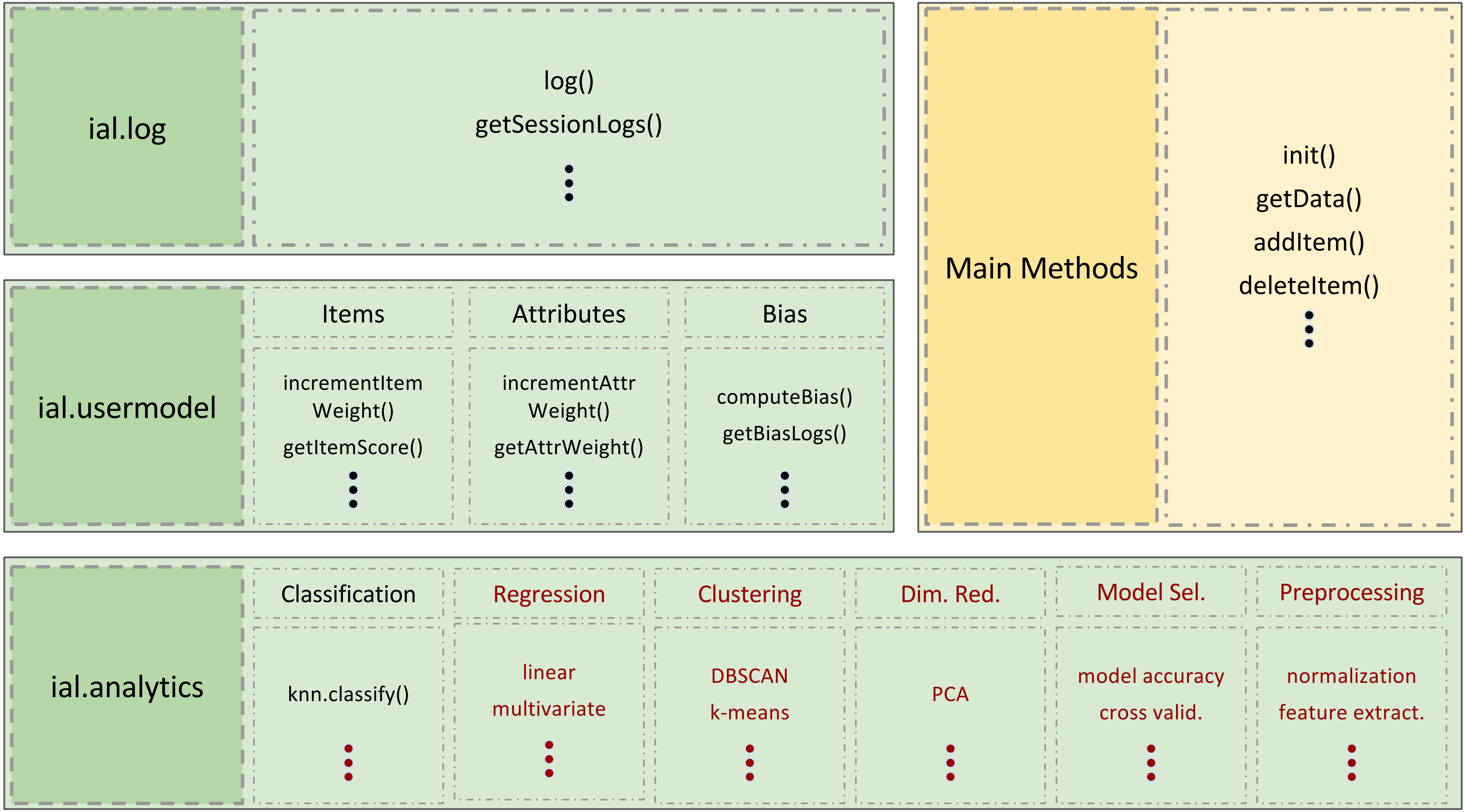
Design



ial.log

ial.usermodel

ial.analytics



ial.log

log()

getSessionLogs()

⋮

ial.usermodel

Items

incrementItem Weight()

getItemScore()

⋮

Attributes

incrementAttr Weight()

getAttrWeight()

⋮

Bias

computeBias()

getBiasLogs()

⋮

Main Methods

init()

getData()

addItem()

deleteItem()

⋮

ial.analytics

Classification

knn.classify()

⋮

Regression

linear

multivariate

⋮

Clustering

DBSCAN

k-means

⋮

Dim. Red.

PCA

⋮

Model Sel.

model accuracy

cross valid.

⋮

Preprocessing

normalization

feature extract.

⋮

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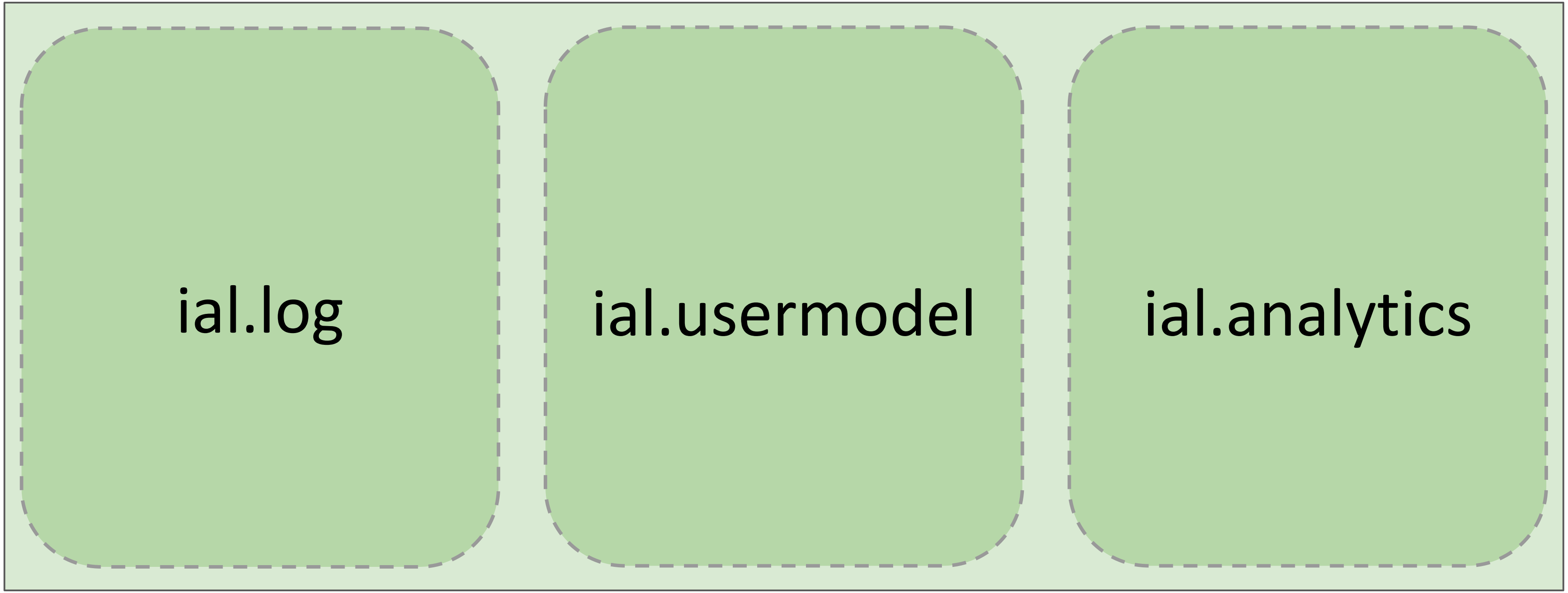
IAL TEST BED DEMO



ial.log

ial.usermodel

ial.analytics

http://gtvalab.github.io/ial/

ial.log

- What: create customized logs of a user’s interactions

- How: add a call to ial.log within event-handlers in JS

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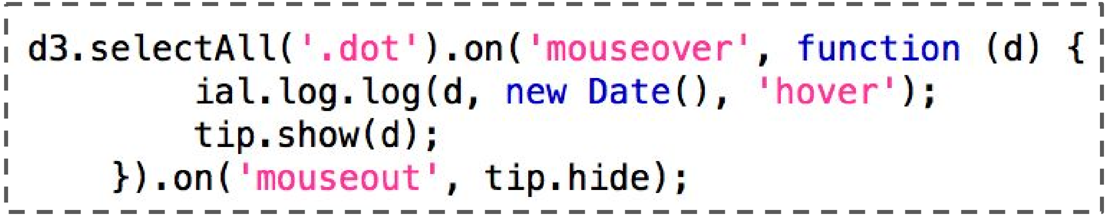
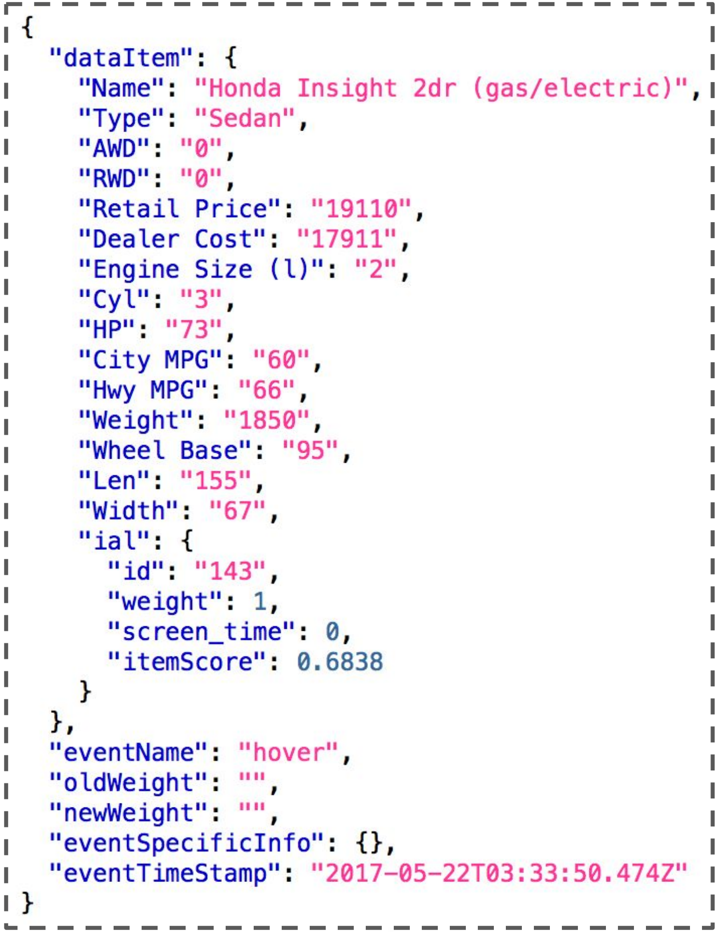
ial.log

Code JSON



```
d3.selectAll('.dot').on('mouseover', function (d) {
        ial.log.log(d, new Date(), 'hover');
        tip.show(d);
    }).on('mouseout', tip.hide);
```



```
{
  "dataItem": {
    "Name": "Honda Insight 2dr (gas/electric)",
    "Type": "Sedan",
    "AWD": "0",
    "RWD": "0",
    "Retail Price": "19110",
    "Dealer Cost": "17911",
    "Engine Size (l)": "2",
    "Cyl": "3",
    "HP": "73",
    "City MPG": "60",
    "Hwy MPG": "66",
    "Weight": "1850",
    "Wheel Base": "95",
    "Len": "155",
    "Width": "67",
    "ial": {
      "id": "143",
      "weight": 1,
      "screen_time": 0,
      "itemScore": 0.6838
    }
  },
  "eventName": "hover",
  "oldWeight": "",
  "newWeight": "",
  "eventSpecificInfo": {},
  "eventTimeStamp": "2017-05-22T03:33:50.474Z"
}
```

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ial.log

- Functions in ial.log:
  - ial.log.log()
  - ial.log.getSessionLogs()
  - ial.log.getItemLogs()
  - ial.log.getAttributeLogs()
  - ial.log.printSessionLogs()
  - ial.log.setMaxQueueSize()
  - ial.log.enqueue()
  - ial.log.dequeue()

ial.usermodel

- What: create a model of user’s interest based on user interactions
  - Represented as two weight vectors: items and attributes
  - Which data items are of interest? Which attributes are of interest?

- How: assigning weight to interactions and add a call to ial.usermodel within event-handlers in JS

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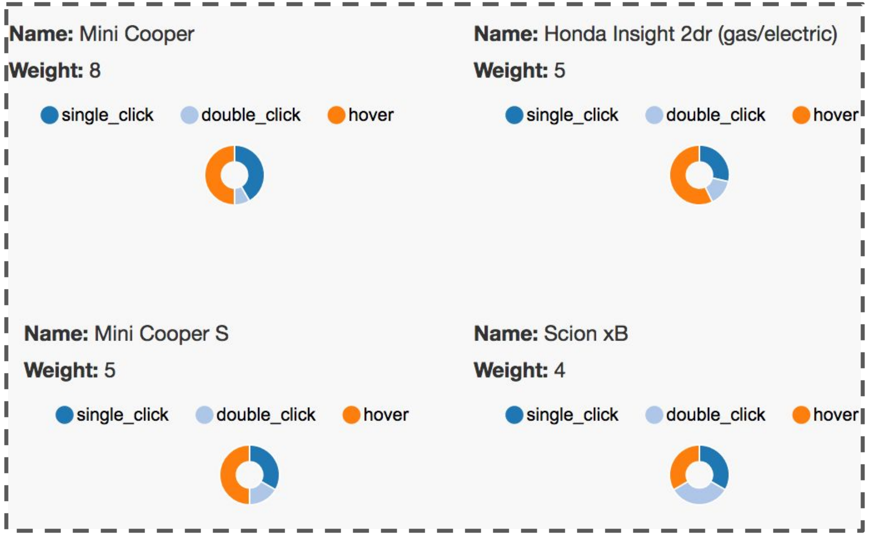
ial.usermodel: items



Name: Mini Cooper

Weight: 8

Name: Honda Insight 2dr (gas/electric)

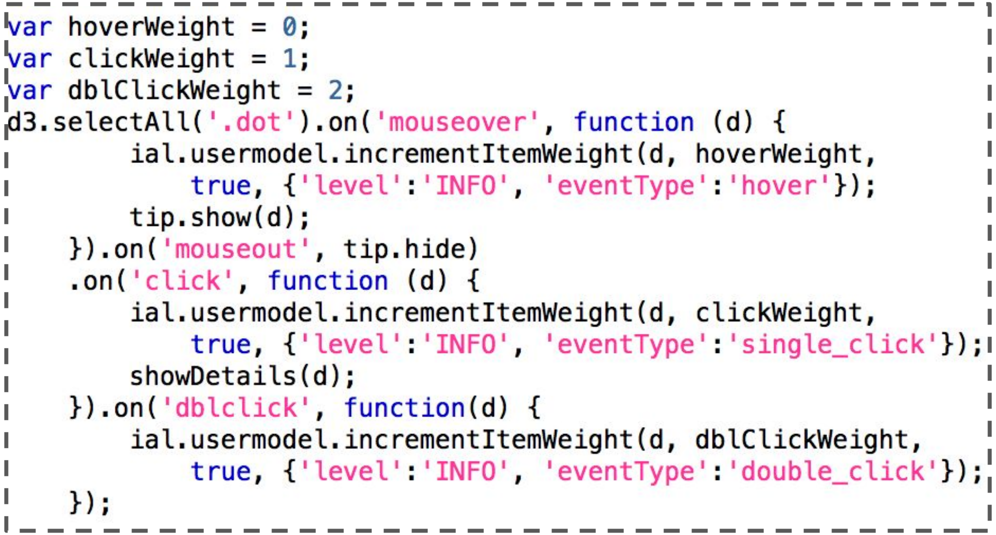
Weight: 5

Name: Mini Cooper S

Weight: 5

Name: Scion xB

Weight: 4



```
var hoverWeight = 0;
var clickWeight = 1;
var dblClickWeight = 2;
d3.selectAll('.dot').on('mouseover', function (d) {
        ial.usermodel.incrementItemWeight(d, hoverWeight,
            true, {'level':'INFO', 'eventType':'hover'});
        tip.show(d);
    }).on('mouseout', tip.hide)
    .on('click', function (d) {
        ial.usermodel.incrementItemWeight(d, clickWeight,
            true, {'level':'INFO', 'eventType':'single_click'});
        showDetails(d);
    }).on('dblclick', function(d) {
        ial.usermodel.incrementItemWeight(d, dblClickWeight,
            true, {'level':'INFO', 'eventType':'double_click'});
    });
```

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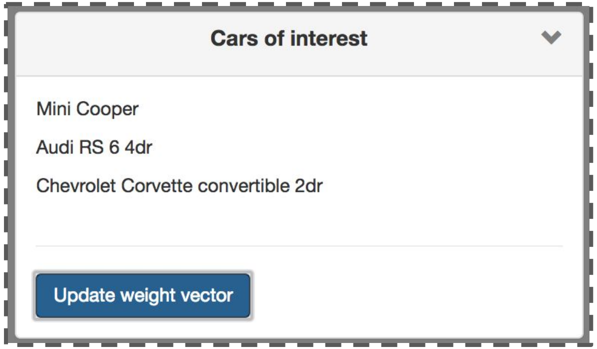
ial.usermodel: attributes

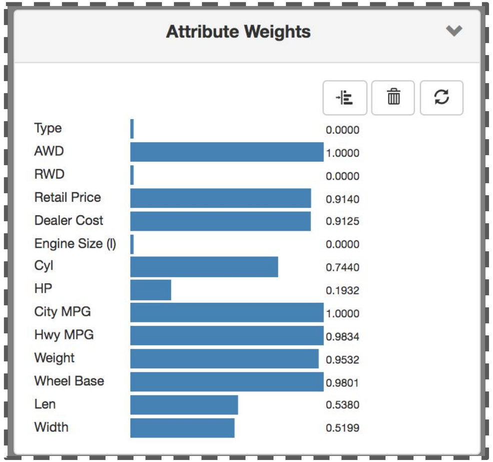


Cars of interest

Mini Cooper

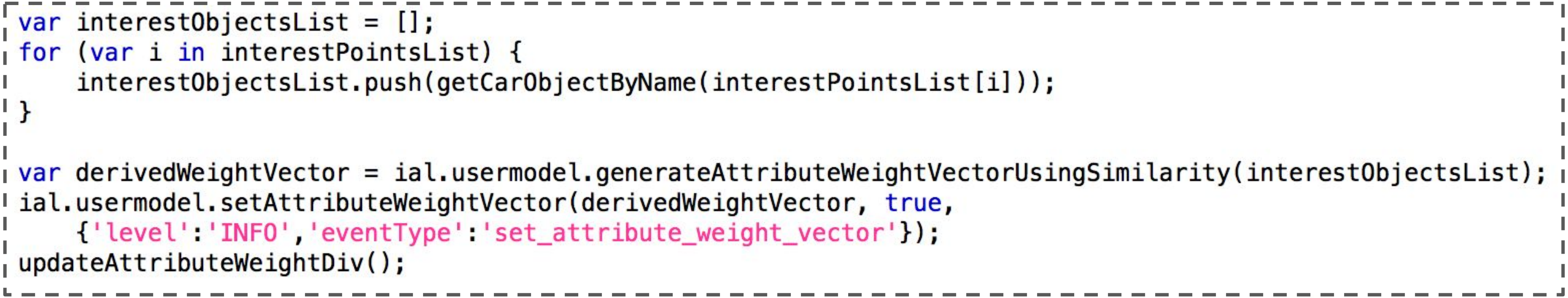
Audi RS 6 4dr

Chevrolet Corvette convertible 2dr



Attribute Weights

Type	0.0000
AWD	1.0000
RWD	0.0000
Retail Price	0.9140
Dealer Cost	0.9125
Engine Size (l)	0.0000
Cyl	0.7440
HP	0.1932
City MPG	1.0000
Hwy MPG	0.9834
Weight	0.9532
Wheel Base	0.9801
Len	0.5380
Width	0.5199



```
var interestObjectsList = [];
for (var i in interestPointsList) {
    interestObjectsList.push(getCarObjectByName(interestPointsList[i]));
}

var derivedWeightVector = ial.usermodel.generateAttributeWeightVectorUsingSimilarity(interestObjectsList);
ial.usermodel.setAttributeWeightVector(derivedWeightVector, true,
    {'level':'INFO','eventType':'set_attribute_weight_vector'});
updateAttributeWeightDiv();
```

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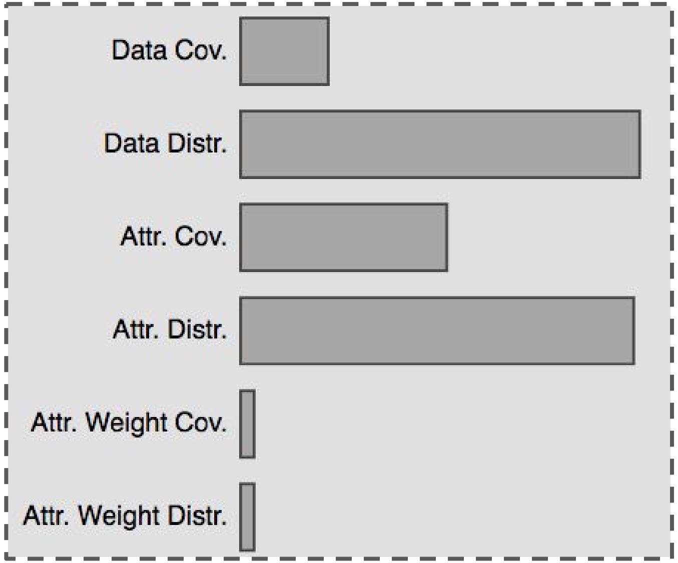
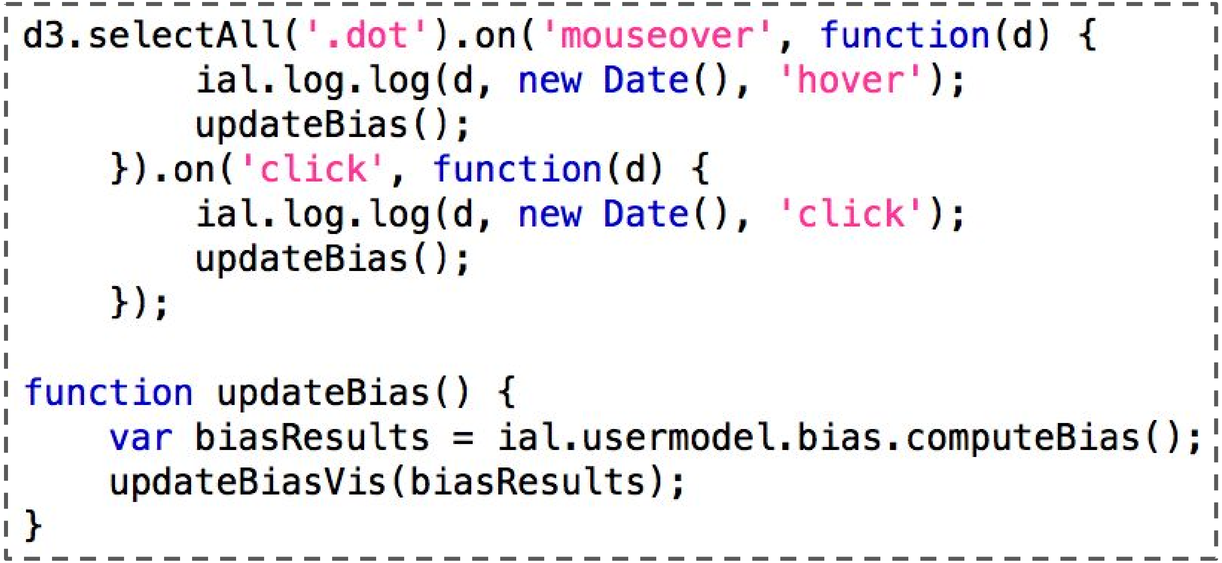
ial.usermodel: bias





```
d3.selectAll('.dot').on('mouseover', function(d) {
        ial.log.log(d, new Date(), 'hover');
        updateBias();
    }).on('click', function(d) {
        ial.log.log(d, new Date(), 'click');
        updateBias();
    });

function updateBias() {
    var biasResults = ial.usermodel.bias.computeBias();
    updateBiasVis(biasResults);
}
```

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ial.usermodel

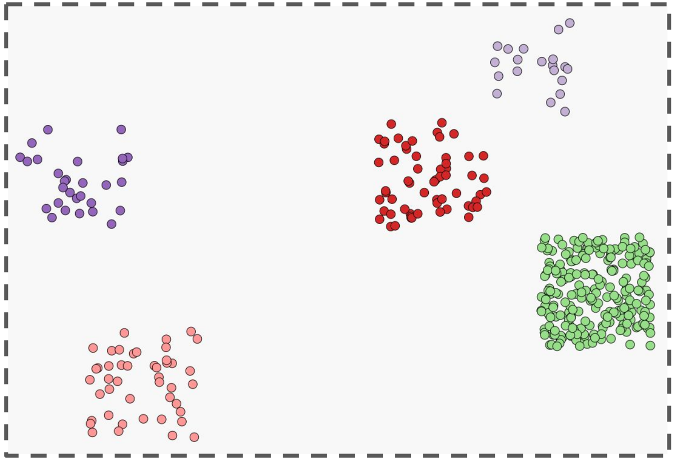
- Functions in ial.usermodel:
    - ial.usermodel.setItemWeight()
    - ial.usermodel.incrementItemWeight()
    - ial.usermodel.setAttributeWeight()
    - ial.usermodel.incrementAttributeWeight()
    - ial.usermodel.getItemScore()
    - ial.usermodel.getTopNPointsByInteractionWeights()
    - ial.usermodel.getTopNPointsByScores()
    - ial.usermodel.getNSimilarPoints()
    - ial.usermodel.getSimilarityScore()
    - ial.usermodel.generateAttributeWeightVectorUsingSimilarity()
    - ial.usermodel.generateAttributeWeightVectorUsingDifferences()

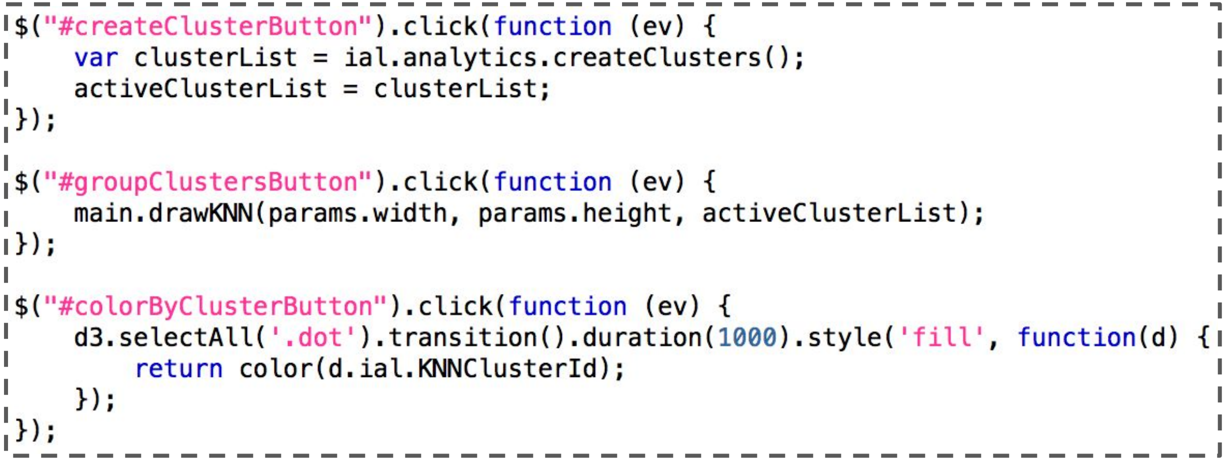
ial.analytics

- What: perform common analytic operations using data, logs, or user model
    - Can be unsupervised, or can be steered with user model to create adaptable interfaces

- How: add a call to ial.analytics

ial.analytics





```
$("#createClusterButton").click(function (ev) {
    var clusterList = ial.analytics.createClusters();
    activeClusterList = clusterList;
});

$("#groupClustersButton").click(function (ev) {
    main.drawKNN(params.width, params.height, activeClusterList);
});

$("#colorByClusterButton").click(function (ev) {
    d3.selectAll('.dot').transition().duration(1000).style('fill', function(d) {
        return color(d.ial.KNNClusterId);
    });
});
```

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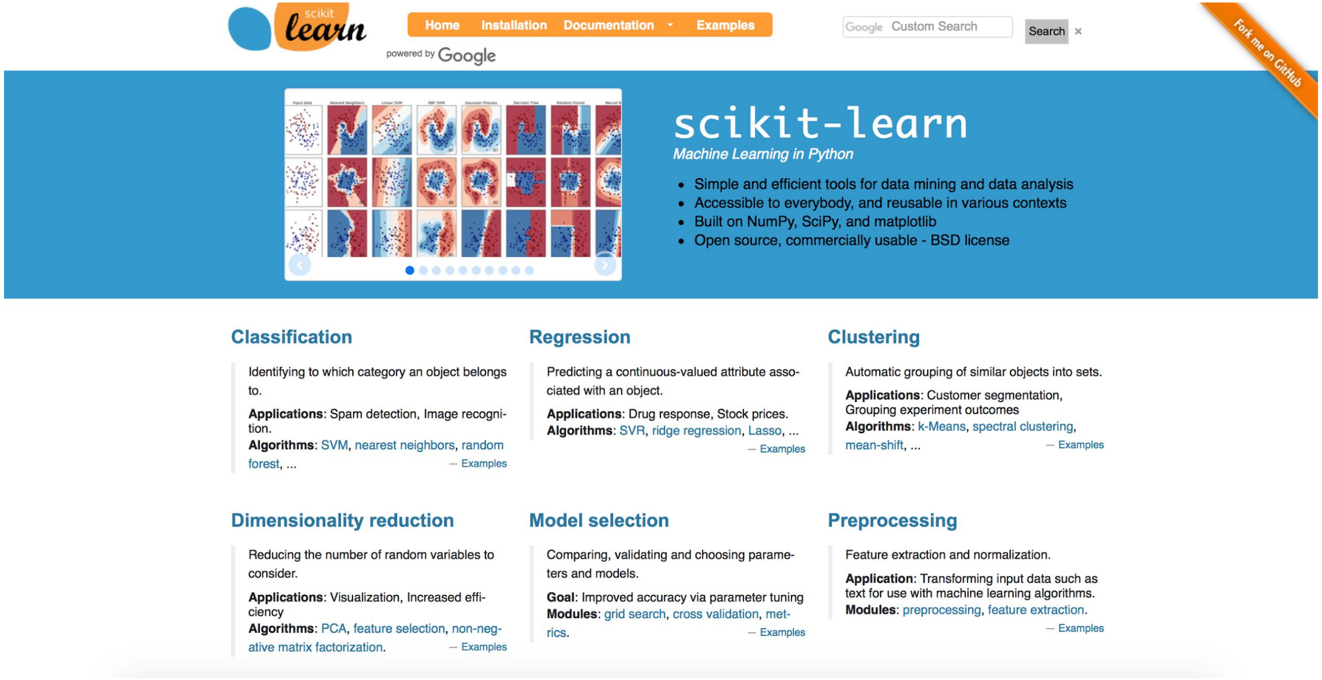
ial.analytics



scikit-learn

Machine Learning in Python

- Simple and efficient tools for data mining and data analysis
- Accessible to everybody, and reusable in various contexts
- Built on NumPy, SciPy, and matplotlib
- Open source, commercially usable - BSD license

Classification

Identifying to which category an object belongs to.

Applications: Spam detection, Image recognition.
Algorithms: SVM, nearest neighbors, random forest, ... — Examples

Regression

Predicting a continuous-valued attribute associated with an object.

Applications: Drug response, Stock prices.
Algorithms: SVR, ridge regression, Lasso, ... — Examples

Clustering

Automatic grouping of similar objects into sets.

Applications: Customer segmentation, Grouping experiment outcomes
Algorithms: k-Means, spectral clustering, mean-shift, ... — Examples

Dimensionality reduction

Reducing the number of random variables to consider.

Applications: Visualization, Increased efficiency
Algorithms: PCA, feature selection, non-negative matrix factorization. — Examples

Model selection

Comparing, validating and choosing parameters and models.

Goal: Improved accuracy via parameter tuning
Modules: grid search, cross validation, metrics. — Examples

Preprocessing

Feature extraction and normalization.

Application: Transforming input data such as text for use with machine learning algorithms.
Modules: preprocessing, feature extraction. — Examples

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ial.analytics

- Functions in ial.analytics:
  - ial.analytics.createClusters()
  - ial.analytics.classify()
  - ial.analytics.linearRegression()
  - ial.analytics.dbscan()
  - ial.analytics.pca()

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Using IAL

- Who can use it?
  - researchers
  - designers
  - etc.
- What to use it for?
  - logging
  - user modeling
  - analytic operations
- Applications?
  - analytic provenance from log analysis
  - recommendation systems
  - adaptive model steering
  - smart sampling of streaming data

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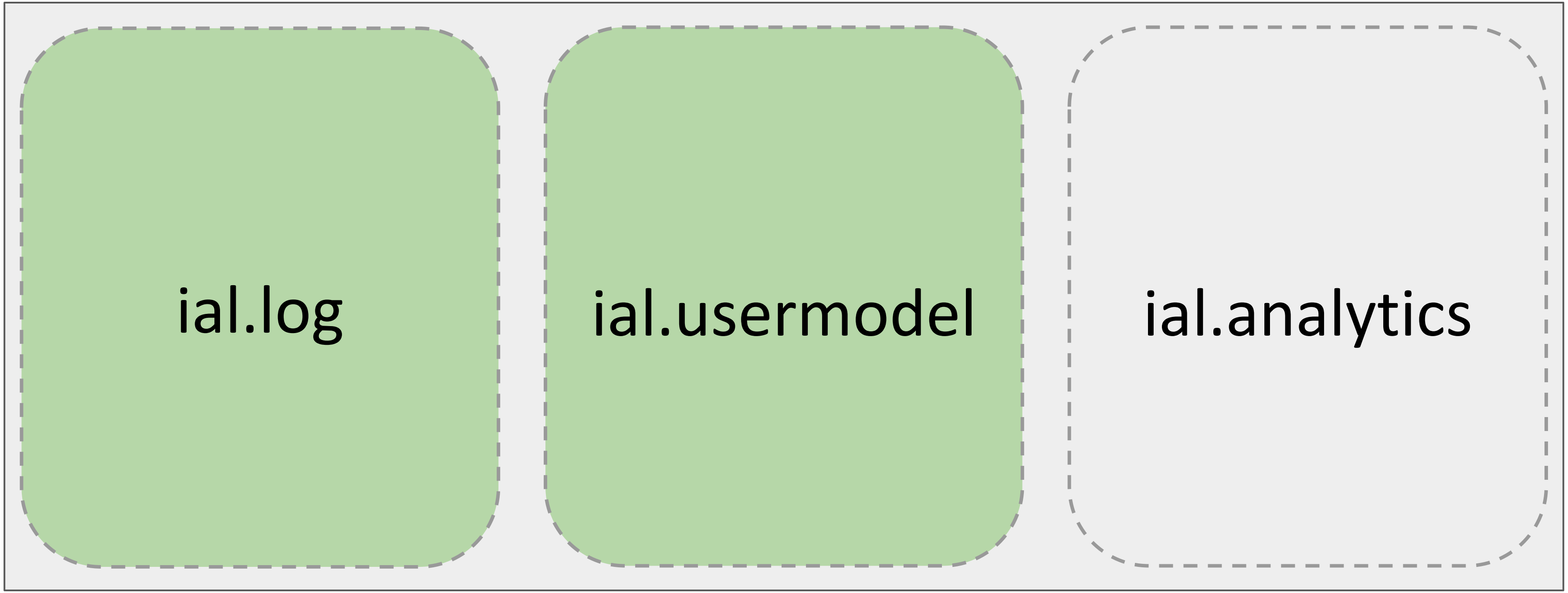
BIAS DEMO



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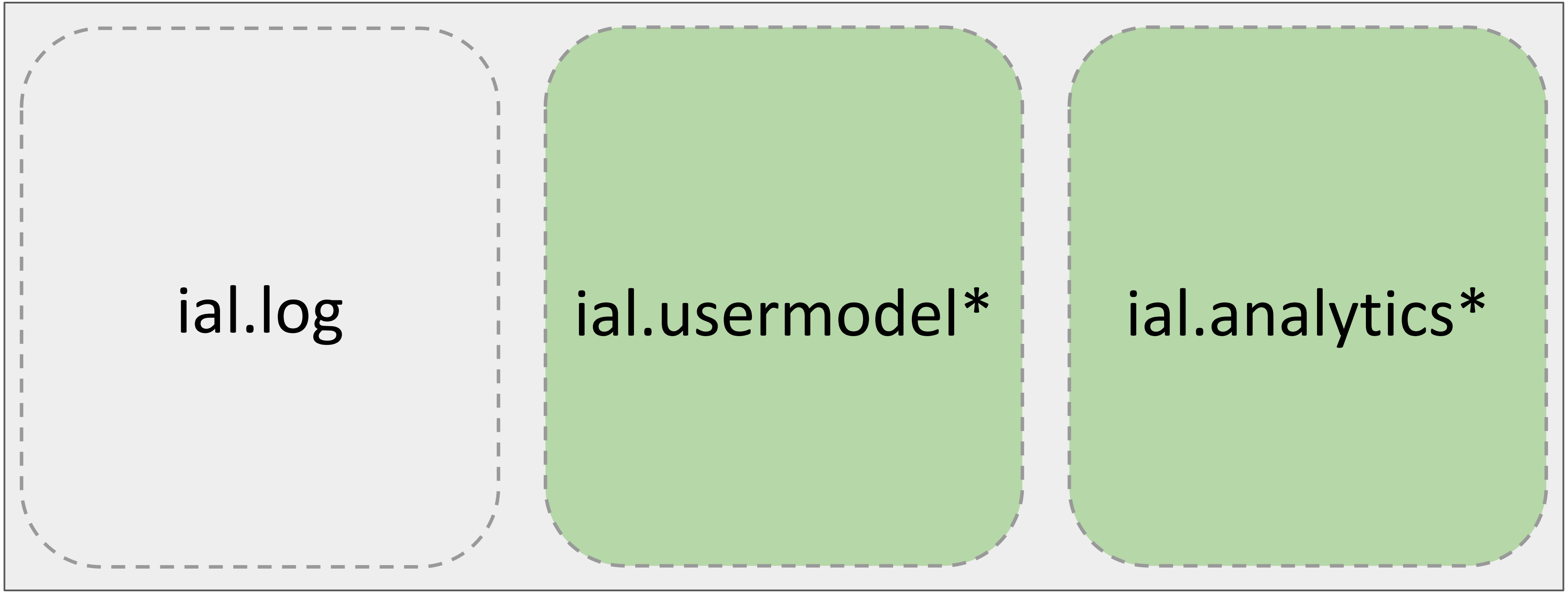
PODIUM DEMO



ial.log

ial.usermodel*

ial.analytics*

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Questions?

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