

# SparkCognition Darwin Python SDK Guide

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## About this guide

This guide describes using the Darwin™ SDK to access and use the Darwin API in automated model building. It is intended for data scientists, software engineers and analysts who want to use the Darwin API to interact with Darwin to create and train models, test the generated models, monitor jobs and perform analysis. The SDK also provides some convenience functions. Note that throughout this document, long key and token values are truncated, indicated by ellipses (...).

## Expectation

This document assumes experience of the data scientist or software engineer that is commensurate with data science techniques and associated programming tasks.

## Darwin overview

Darwin is a SparkCognition™ tool that automates model building processes to solve specific problems. This tool enhances data scientist potential because it automates various tasks that are often manually performed. These tasks include data cleaning, latent relationship extraction, and optimal model determination. Darwin promotes rapid and accurate feature generation through both automated windowing and risk generation. Darwin quickly creates highly-accurate, dynamic models using both supervised and unsupervised learning methods.

The general workflow for simple modeling includes:

- Upload training data
- Create model
- Upload test data
- Test the model
- Download result artifact

**Note:** Darwin expects all uploaded ingestion files to be in a *rectangular* format. This means a flat file with features that span columns and data samples that span rows. Plan your data file so it fits this expectation to help prevent errors.

See the [SDK example](#) for a modeling example.

For additional information on Darwin, contact your local SparkCognition partner for access to the white paper titled: *Darwin - A Neurogenesis Platform*.

## Accessing the API

This document describes the python SDK and explains how to access the Darwin API and its functionality. Additional methods to access the Darwin API include:

- through the `https://darwin-api.sparkcognition.com/v1` end point
- optionally, through user created `curl` commands

For additional information on the Darwin API, contact your local SparkCognition partner for access to see the *SparkCognition Darwin API User Guide*.

### Notes:

- An *API key* is necessary to use the Darwin SDK.  
Contact SparkCognition or your IT manager for an appropriate key.
- All methods return a 2-tuple, for example:

```
(True, <context-dependent-return-object> )  
(False, <some-helpful-message> )
```

## Darwin SDK interface

### Setup Darwin SDK

Perform the following to download and setup the Darwin SDK:

1. Install Python 3.5 or greater. Alternatively, install *Miniconda*, from <https://conda.io/miniconda.html>.
2. Create a directory to receive the git repository clone.
3. Change (*cd*) into the new directory.
4. Clone the *darwin-sdk* repository:

```
git clone https://github.com/sparkcognition/darwin-sdk
```

5. Change into the new root directory of the *darwin-sdk* cloned darwin-sdk project:

```
cd <NewCloneRootDirectory>
```

**Note:** By default this is the *master* trunk.

6. Ensure code is from master trunk:

```
git pull
```

7. Setup the SDK:

```
python setup.py install
```

The SDK defaults to using the production URL: <https://darwin-api.sparkcognition.com/v1/>

### Connect to the Darwin interface

1. Obtain an api key.

To use the Darwin SDK, an api key is required. A key can be obtained from SparkCognition support or your IT manager. An *api\_key* is a long string, for example:

```
'RsJ74ZS5AvwznbHh0AfVSgrchhS9KxACDy3jefaQnxb9f6QTSDBFmhnGa0cOIWtNAIFRAG9ToOTpi0mn'
```

2. Register the api key.

The purpose of this method is to set a password and an email address for an *api\_key*. Each *api\_key* is synonymous with a service. This method must be invoked once for each *api\_key* to establish a password for that key.

**Note:** After successful registration, the service uses `auth_login()` to login as a service.

#### Example

```
>>> from amb_sdk.sdk import DarwinSdk
>>> s = DarwinSdk()
>>> s.auth_register('asdf', 'iRgwut4kGs0ymULiuKtMd0WFvBYLMWSj16q2uysQeteqH9ssc+\\
EETUvcysnPojRpfycLVHa2IlN1IlrfEk1YMA', 'admin@company.com')
```

```
(True, 'Bearer eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJleHAiOiJlMTU1MzM4NjEsImh\ndCI6MTUxNTUzMDI2MS ... F56xZQIBT-89nrRzlnIXD5LfawHIj_MlUHQQM36vU')
```

### 3. Login as a *service* or *create a user* under the service and login as a user.

The following explains how to log in as a *service*.

#### Notes:

- Although Bearer <auth-token>, returned by `auth_login()`, is used in subsequent calls to validate authenticity, it is not required for each method.
- The SDK remembers the auth token for the `DarwinSdk` object. Although an auth token is currently valid for 1 hour, if the `DarwinSdk` object session life time exceeds 1 hour, the SDK will request another auth token until the session ends.

#### Example

```
>>> s.auth_login('asdf', 'iRgwut4kGs0ymULiuKtMd0WFvBYLMWSj16q2uysQeteqH9ssc+EET\UvcysnPojRpfycLVHa2I1N1I1rfEk1YMA')
(True, 'Bearer eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJleHAiOiJlMTU1MzQxNzIsImh\ndCI6MTUxNTUzMMD ... UQQfoXqYFKJSorXXDNPE985-a08cE6_o')
```

When login (as a service) successfully completes, the SDK can be used to create and model a workflow.

Note, there are also `auth_register_user()` and `auth_login_user()` methods that allow you to create users and login as a specific user. You can choose to use the SDK as a service or create users underneath the service to partition datasets/models to be owned by specific users. It is more convenient to employ user accounts because the `api_key` is not necessary for logging in as a user.

#### Example

```
>>> s.auth_register_user('atestuser', 'apassword', 'anemail')
(True,
 'Bearer eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJqdGkiOiJkNjY0MmJjOC1iMmU5LTQxO\ndCI6MTUxNTUzMMD ... 5zMp_1FfxU')

>>> s.auth_login_user('atestuser', 'apassword')
(True,
 'Bearer eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJqdGkiOiI3NGYzYmUxZS0yOTlmLTRhN\zMtODU5ZC01NGRmM2F ... ulzGCeCONA')
```

### 4. Verify the connection.

The default url in the SDK is `https://darwin-api.sparkcognition.com/v1/`. Use `get_url()` and `set_url()` to verify connection to the right Darwin service.

---

## Darwin SDK methods

### URL Get/Set methods

#### **DarwinSdk.get\_url()**

Get Darwin service url.

**Parameters:** None

**Returns:**

(True, <url-string>)

#### **Example**

```
In [10]: s.get_url()

Out[10]: (True, 'https://darwin-api.sparkcognition.com/v1/')

```

---

#### **DarwinSdk.set\_url(url, version='v1')**

Set Darwin service url and version.

**Parameters:**

- **url** - URL to the Darwin service
- **version** - (optional) defaults to 'v1'

**Returns:**

(True, <url>) or (False, 'invalid url')

#### **Example**

```
In [9]: s.set_url('https://darwin-api.sparkcognition.com/v1/')

Out[9]: (True, 'https://darwin-api.sparkcognition.com/v1/')

```

---

## Authentication methods

#### **DarwinSdk.auth\_register(password, api\_key, email)**

Register as a service. The purpose of this method is to set a password for an api\_key. Each api\_key is synonymous with a service. This method is invoked only once for each api\_key to establish a password for that key. After registration, the service can use `auth_login()` to login as a service.

**Parameters:**

- *password* - The service level password
- *api\_key* - The api key for the service
- *email* - Email address

**Returns:**

```
(True, 'Bearer <auth-token>') or (False, <error-message>)
```

Bearer <auth-token> is used in subsequent calls to validate authenticity.

The SDK remembers the auth token for the DarwinSdk object.

**Note:** Although an auth token is currently valid for 1 hour, if the DarwinSdk object session life time exceeds 1 hour, the SDK will request another auth token until the session ends.

**Example**

```
In [4]: s.auth_register('asdf', 'RsJ74ZS5AvwznbHh0AfVSgrchhS9KxACDy\
3jefaQnxb9f6QTSDBFmhnGa0cOIWtNAIFRAG9ToOTpi0mnEo3zFA', 'email')
Out[4]:
(True,
'Bearer eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJleHAiO...iSdU8xlF4yJk')
```

**DarwinSdk.auth\_login(password, api\_key)**

Login as a service.

**Note:** A service must have a password set using *auth\_register()* to login successfully.

**Parameters:**

- *password* - The service level password
- *api\_key* - The api key for the service

**Returns:**

```
(True, 'Bearer <auth-token>') or (False, <error-message>)
```

Bearer <auth-token> is used in subsequent calls to validate authenticity. The SDK remembers the auth token for the DarwinSdk object.

**Note:** Although an auth token is currently valid for 1 hour, if the DarwinSdk object session life time exceeds the 1 hour limit, the SDK will acquire another auth token until the session ends.

**Example**

```
In [5]: s.auth_login('asdf',
'iRgwut4kGs0ymULiuKtMd0WFvBYLMWSj16q2uysQeteqH9ssc+EETUvcysnPojRpfyc\
LVHa2IlN1IlrfEk1YMA')
Out[5]:
(True,
```

```
'Bearer  
eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJleHAiOiE1MTU1MzQxN....')
```

---

### **DarwinSdk.auth\_register\_user(username, password, email)**

Register a user. This method registers a new user.

**Note:** You must be logged in as a service to create a user.

#### **Parameters:**

- *username* - The new end user's username
- *password* - The new end user's password
- *email* - The new end user's email address

#### **Returns:**

```
(True, 'Bearer <auth-token>') or (False, <error-message>)
```

Bearer <auth-token> is used in subsequent calls to validate authenticity. The SDK remembers the auth token for the DarwinSdk object.

**Note:** Although an auth token is currently valid for 1 hour, if the DarwinSdk object session life time exceeds the 1 hour limit, the SDK will acquire another auth token until the session ends.

#### **Example**

```
In [8]: s.auth_register_user('user1', 'user1-password', 'user-email',  
'iRgwut4kGs0ymULiuKtMd0WFvBYLMWSj16q2uysQeteqH9ssc+EETUvcysnPojRpfycLV\  
Ha2IlN1IlrfEk1YMA')
```

```
Out[8]:
```

```
(True,
```

```
'Bearer  
eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJleHAiOiE1MTU1MzQyN....')
```

---

### **DarwinSdk.auth\_set\_email(username, email)**

Add or change a user's email address.

#### **Parameter:**

- *username* - The end user's username
- *email* - The end user's email address

#### **Returns:**



(True, None) or (False, <error-message>)

User must be logged in to add or change an email address. This email address will be used for password resets and other notifications.

### Example

```
In [9]: s.auth_set_email('user1', 'user1@company.com')
```

```
Out [9]: (True, None)
```

---

### DarwinSdk.auth\_login\_user(username, password)

Login as a user.

**Note:** A user must have a username and password set using **auth\_register\_user()** to successfully login.

#### Parameters:

- *username* - The end user's username
- *password* - The end user's password

#### Returns:

(True, 'Bearer <auth-token>') or (False, <error-message>)

Bearer <auth-token> is used in subsequent calls to validate authenticity. The SDK remembers the auth token for the DarwinSdk object.

**Note:** Although an auth token is currently valid for 1 hour, if the DarwinSdk object session life time exceeds the 1 hour limit, the SDK will acquire another auth token until the session ends.

### Example

```
In [9]: s.auth_login_user('user1', 'user1-password',  
'iRgwut4kGs0ymULiuKtMd0WFvBYLMWSj16q2uysQeteqH9ssc+EETUvcysnPojRpfycLV\  
Ha2IlN1IlrfEk1YMA')
```

```
Out [9]:
```

```
(True,
```

```
'Bearer
```

```
eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJleHAiOiE1MTU1MzQzM....')
```

---

### DarwinSdk.auth\_change\_password(curpass, newpass)

Change the current user's password.

#### Parameters::

- *curpass* - User's current password
- *newpass* - User's new password

**Returns:**

(True, None) or (False, <error-message>)

User must be logged in to change password. If the current password is forgotten, use the following **DarwinSdk.auth\_reset\_password(username)** method to reset it. An email will be generated with a temporary password.

**Example**

```
In [10]: s.auth_change_password('mypassword', 'newpassword')
```

```
Out[10]: (True, None)
```

---

**DarwinSdk.auth\_reset\_password(username)**

Reset a user's password. A temporary password will be sent to the user's email address.

**Parameter:**

- *username* - Username to reset password for.

**Returns:**

(True, <deleted-user-id>) or (False, <error-message>)

**Example**

```
In [8]: s.auth_reset_password('username')
```

```
Out[8]: (True, None)
```

---

**DarwinSdk.auth\_delete\_user(username)**

Remove/Unregister a user.

**Parameter:**

- *username* - Username of the user to be deleted.

**Returns:**

(True, <deleted-user-id>) or (False, <error-message>)

You must be logged in with your api\_key and password to delete a user.

**Example**

```
In [8]: s.lookup_username('testuser2')
Out[8]:
(True,
 [{'client_api_key': 'RsJ74ZS5AvwznbHh0AfVSgrch...Eo3zFA',
   'created_at': '2018-01-03T12:54:30.653478',
   'parent_id': '2516b462-df85-11e7-bdd1-e37424c63ea4',
   'tier': 0,
   'username': 'testuser2'}])

In [9]: s.auth_delete_user('testuser2')
Out[9]: (True, '87d721fc-f0b7-11e7-b58d-a3441423b160')

In [10]: s.auth_delete_user('testuser2')
Out[10]:
(False,
 '404: NOT FOUND - {\n      "message": "Username not found. \\  
You have requested this URI [/v1/auth/register/user/testuser2] \\  
but did you mean /v1/auth/register/user/ <username> or /v1/auth/register/user \\  
or /v1/auth/register ?"\n}\n')
```

---

## Job status methods

### **DarwinSdk.lookup\_job\_status(*age=None, status=None*)**

Get status information for all jobs belonging to the current user or service.

#### **Parameters:**

- *age* - (optional) Filter jobs that are less than *X* units old, for example 3w, 2d, or 1h.
- Optional parameters:
  - *status* - If not specified, returns all jobs.
  - *running* (Note that only 2 jobs can be running concurrently.)
  - *requested*
  - *complete*
  - *failed*

#### **Returns:**

(True, <list-of-jobs>) or (False, <error-message>)

#### **Example**

```
In [6]: s.lookup_job_status(status='Complete')
Out[6]:
(True,
 [{'artifact_names': None,
   'dataset_names': ['cancer-train'],
```

```
'endtime': '2018-02-01T10:53:50.451598',
'generations': 0,
'job_name': 'eeef500d629e4a2185eb8af6e18a83b4',
'job_type': 'TrainModel',
'loss': 2.0,
'model_name': 'cancer-model',
'percent_complete': 100,
'starttime': '2018-02-01T10:52:42.280929',
'status': 'Complete']])
```

---

### **DarwinSdk.lookup\_job\_status\_name(job\_name)**

Get job status information for a job by its name.

#### **Parameters:**

- *job\_name* - The name of the job you want status on

#### **Returns:**

(True, <job-info>) or (False, <error-message>)

#### **Example**

```
In [19]: s.lookup_job_status_name('eeef500d629e4a2185eb8af6e18a83b4')
```

```
Out[19]:
```

```
(True,
{'artifact_names': None,
 'dataset_names': ['cancer-train'],
 'endtime': None,
 'generations': 0,
 'job_error': "MultipleDateColumns: multiple date columns - ['Date' 'PeakMonth' 'PeakQuarter'",
 'job_type': 'TrainModel',
 'loss': None,
 'model_name': 'cancer-model',
 'percent_complete': 0,
 'starttime': '2018-02-01T10:52:42.280929',
 'status': 'Running'})
```

```
In [20]: s.lookup_job_status('Running')
```

---

### **DarwinSdk.delete\_job(job\_name)**

Delete a job.

#### **Parameter:**

- *job\_name* - The name of the job you want to delete

**Returns:**

(True, None) or (False, <error-message>)

**Example**

```
In [17]: s.lookup_job_status_name('7df54dfddfa046d581522f7540e3256c')
Out[17]:
(True,
 {'artifact_names': ['7a245119ca3b42efadc27006e75a225d'],
  'dataset_names': ['market-train'],
  'endtime': '2018-03-06T14:23:59.975793',
  'generations': None,
  'job_error': '',
  'job_type': 'AnalyzeData',
  'loss': None,
  'model_name': None,
  'percent_complete': 100,
  'starttime': '2018-03-06T14:23:57.18095',
  'status': 'Complete'})

In [18]: s.delete_job('7df54dfddfa046d581522f7540e3256c')
Out[18]: (True, None)

In [19]: s.lookup_job_status_name('7df54dfddfa046d581522f7540e3256c')
Out[19]: (False, '404: NOT FOUND - {\n      "message": "Job name not found"\n}\n')
```

---

**DarwinSdk.stop\_job(*job\_name*)**

Stop a job.

**Parameter:**

- *job\_name* - The name of the job.

**Returns:**

(True, 'Job is scheduled to stop') or (False, <error-message>)

**Example**

```
In [21]: s.stop_job('34787793a48b42b48a319bbbf68f13ea')
Out[21]: (True, 'Job is scheduled to stop')
```

---

## Lookup methods

### **DarwinSdk.lookup\_artifact(*type=None*)**

Get a list of artifacts belonging to the current user or service.

**Parameter:**

- *type* - (optional) specifies the type of artifact. Values can be 'Model', 'Dataset', 'Run'.

**Returns:**

(True, <artifact-list>) or (False, <error-message>)

**Example:**

```
In [30]: s.lookup_artifact('Run')
http://localhost:5000/v1/lookup/artifact
Out[30]:
(True,
 [{ 'created_at': '2018-02-01T11:09:55.731040',
    'id': 'b9a9205a-0772-11e8-a003-3b1c8766dad0',
    'mbytes': 0.0,
    'name': '8a63e21030d1483abb0f892963c1728f',
    'type': 'Run' },
  { 'created_at': '2018-02-01T11:11:17.560360',
    'id': 'ea6f3f80-0772-11e8-9abe-77bc32e350c5',
    'mbytes': 0.0,
    'name': 'artifact-1',
    'type': 'Run' } ])
```

---

### **DarwinSdk.lookup\_artifact\_name(*artifact\_name*)**

Get information for an artifact specified by its name.

**Parameter:**

- *artifact* - specifies an artifact by its name

**Returns:**

(True, <job-info>) or (False, <error-message>)

**Example:**

```
In [31]: s.lookup_artifact_name('artifact-1')
Out[31]:
(True,
 { 'created_at': '2018-02-01T11:11:17.560360',
   'mbytes': 0.0,
   'name': 'artifact-1',
```

```
'type': 'Run'}})
```

---

### **DarwinSdk.lookup\_limits()**

Get a client's metadata. A client is the current user or service in context.

**Parameters:** None

**Returns:**

(True, <client-info>) or (False, <error-message>)

#### **Example**

```
In [21]: s.lookup_limits()
Out[21]:
(True,
 {'job_limit': None,
  'model_limit': None,
  'tier': 0,
  'upload_limit': None,
  'user_limit': None,
  'username': None})
```

---

### **DarwinSdk.lookup\_dataset()**

Get the dataset(s) metadata for a user. The user is the current user or service in the current context. This is useful for listing all created datasets.

**Parameters:** None

**Returns:**

(True, <list-of-dataset-info>) or (False, <error-message>)

#### **Example**

```
In [4]: s.lookup_dataset()
Out[4]:
(True,
 [{'categorical': None,
  'imbalanced': None,
  'mbytes': 0.02019977569580078,
  'name': 'unittest-cancer-dataset2',
  'sequential': None,
  'updated_at': '2018-01-31T15:37:28.310994'},
 {'categorical': None,
```

```
'imbalanced': None,
'mbytes': 0.02019977569580078,
'name': 'cancer-train',
'sequential': None,
'updated_at': '2018-02-01T10:52:06.076279']])
```

---

### **DarwinSdk.lookup\_dataset\_name(dataset\_name)**

Get a specific dataset's metadata.

#### **Parameters:**

- *dataset\_name* - The name of the dataset. The name of a dataset is established in the **upload\_dataset()** method.

#### **Returns:**

(True, <dataset-info>) or (False, <error-message>)

#### **Example**

```
In [36]: s.lookup_dataset_name('cancer-train')
Out[36]:
(True,
{'categorical': None,
 'imbalanced': None,
 'mbytes': 0.02019977569580078,
 'sequential': None,
 'updated_at': '2018-02-01T10:52:06.076279'})
```

---

### **DarwinSdk.lookup\_model()**

Get the model(s) metadata for a user. The user is the current user or service in the current context. This is useful for listing all models.

#### **Parameters:** None

#### **Returns:**

(True, <list-of-model-info>) or (False, <error-message>)

#### **Example**

```
In [37]: s.lookup_model()
Out[37]:
(True,
[{'generations': 0,
  'loss': 2.0,
```



```
'name': 'cancer-model',
'parameters': {'target': 'Diagnosis'},
'trained_on': ['cancer-train'],
'updated_at': '2018-02-01T10:53:50.443166',
'description': {"best_genome": "DeepNet(\n  (10): LSTM(20, 18, num_layers=2)\n  (11): Linear(in_features=18, out_features=1, bias=True)\n)", "recurrent": true}
}]
)
```

### DarwinSdk.lookup\_model\_name(model\_name)

Get a specific model's metadata. The name of a model is established in the *create\_model()* method.

#### Parameters:

- *model\_name* - The name of the model

#### Returns:

(True, <model-info>) or (False, <error-message>)

#### Example

```
In [40]: s.lookup_model_name('cancer-model')
Out[40]:
(True,
[{'generations': 0,
'loss': 2.0,
'parameters': {'target': 'Diagnosis'},
'trained_on': ['cancer-train'],
'updated_at': '2018-02-01T10:53:50.443166',
'description': {"best_genome": "DeepNet(\n  (10): LSTM(20, 18, num_layers=2)\n  (11): Linear(in_features=18, out_features=1, bias=True)\n)", "recurrent": true}
}])
)
```

### DarwinSdk.lookup\_tier()

Get metadata for all tiers. A tier specifies certain usage limits such as *number of models* and *datasets*.

#### Parameters: None

#### Returns:

(True, <list-of-tier-info>) or (False, <error-message>)

#### Example

```
In [41]: s.lookup_tier()
Out[41]:
(True,
 [{ 'job_limit': None,
    'model_limit': None,
    'tier': 0,
    'upload_limit': None,
    'user_limit': None},
  { 'job_limit': 10000,
    'model_limit': 10000,
    'tier': 1,
    'upload_limit': 10000,
    'user_limit': 1000}])
```

---

### **DarwinSdk.lookup\_tier\_num(*tier\_num*)**

Get a specific tier's metadata. A tier specifies certain usage limits such as the *number of models* or *datasets*.

#### **Parameters:**

- *tier\_num* - The name of the model

#### **Returns:**

(True, <tier-info>) or (False, <error-message>)

#### **Example**

```
In [44]: s.lookup_tier_num(1)
Out[44]:
(True,
 { 'job_limit': 10000,
  'model_limit': 10000,
  'tier': 1,
  'upload_limit': 10000,
  'user_limit': 1000})
```

---

### **DarwinSdk.lookup\_user()**

Returns information for users that were created with the current *api\_key*.

**Note:** Each customer site is assigned a *unique api\_key*. All users from that site have the same *api\_key*.

**Parameters:** None

#### **Returns:**

(True, <list-of-user-info>) or (False, <error-message>)

**Example**

```
In [25]: s.lookup_user()
Out[25]:
(True,
 [{'client_api_key': 'RsJ74ZS5AvwznbHh0AfVSgrchhS9...3zFA',
   'created_at': '2018-01-03T12:54:30.653478',
   'parent_id': '2516b462-df85-11e7-bdd1-e37424c63ea4',
   'tier': 0,
   'username': 'testuser2'}],
 [{'client_api_key': 'RsJ74ZS5AvwznbHh0AfVSgrchhS9...3zFA',
   'created_at': '2018-01-03T13:14:36.188371',
   'parent_id': '2516b462-df85-11e7-bdd1-e37424c63ea4',
   'tier': 0,
   'username': 'testuser5'}],
 [{'client_api_key': 'RsJ74ZS5AvwznbHh0AfVSgrchhS9...3zFA',
   'created_at': '2018-01-03T13:21:21.099148',
   'parent_id': '2516b462-df85-11e7-bdd1-e37424c63ea4',
   'tier': 0,
   'username': 'testuser6'}]])
```

---

**DarwinSdk.lookup\_username(username)**

Returns information for a user.

**Notes:**

- The user in question should have been created using the current `api_key`.
- Each customer site is assigned a *unique api\_key*. All users from that site have the same `api_key`.

**Parameters:** None

**Returns:**

(True, <user-info>) or (False, <error-message>)

**Example**

```
In [26]: s.lookup_username('testuser2')
Out[26]:
(True,
 [{'client_api_key': 'RsJ74ZS5AvwznbHh0AfVSgrchhS9...3zFA',
   'created_at': '2018-01-03T12:54:30.653478',
   'parent_id': '2516b462-df85-11e7-bdd1-e37424c63ea4',
   'tier': 0,
   'username': 'testuser2'}]])
```

## Datasets and artifact methods

### **DarwinSdk.upload\_dataset(dataset, dataset\_name=None)**

Upload a dataset.

**Note:** Supported file formats are .csv and .h5.

**Note:** The maximum size that can be uploaded is 10GB. Files larger than ~2GB can be processed by `analyze_data()` only. Model creation might not be successful for files larger than ~2GB until Big Data is fully supported. `Analyze_data()` is the only method that supports Big Data.

#### **Parameters:**

- *dataset*- Path to dataset
- *dataset\_name* - Name to be given to dataset, or defaults to filename

#### **Returns:**

(True, {dataset\_name: <name-given-to-dataset>}) or (False, <error-message>)

#### **Example**

```
In [5]: s.upload_dataset('sets/cancer_train.csv', 'unittest-cancer-dataset')
Out[5]:
(True,
 {'dataset_name': 'unittest-cancer-dataset'})
```

---

### **DarwinSdk.download\_dataset(dataset\_name)**

Download a dataset artifact given its name.

#### **Parameters:**

- *dataset\_name* - Name of the dataset to be downloaded.

#### **Returns:**

(True, <path-to-file>) or (True, <python-list>) or (False, <error-message>)

#### **Example**

```
In [5]: s.download_dataset('cancer-cleandata3', artifact_path='/Users/username/Downloads/arti
Out[5]:
(True,
 {'filename': '/Users/username/Downloads/artifacts/cancer-cleandata3-cleaned-8m38g07j.csv'})
```

---

### **DarwinSdk.delete\_dataset(dataset\_name)**

Delete the named dataset.

**Parameters:**

- *dataset\_name* - Name of the dataset to be deleted.

**Returns:**

(True, None) or (False, <error-message>)

**Example**

```
In [6]: s.delete_dataset('unittest-cancer-dataset')
Out[6]:
(True, None)
```

---

**DarwinSdk.download\_model(model\_name, path=None)**

Download a supervised model given its name.

**Parameters:**

- *model\_name* - Name of the model to be downloaded.
- *path* - (optional) Relative or absolute path of the directory to download the model to. This directory must already exist prior to model download. If no path is specified, the current directory is used. There are two files associated with a model: '*model*' and '*data\_profiler*'.

**Returns:**

(True, None) or (False, <error-message>)

**Example**

```
In [6]: s.download_model('my-model-name', path='Users/ausser/Downloads/mymodel')
Out[6]:
(True, None)
% ls -l ~/Downloads/mymodel
total 272
-rw-r--r-- 1 ausser staff 58609 Oct 10 15:55 data_profiler
-rw-r--r-- 1 ausser staff 75507 Oct 10 15:55 model
```

---

**DarwinSdk.download\_artifact(artifact\_name, artifact\_path=None)**

Download artifact given its name. The methods that return artifacts are:

- *analyze\_data()*
- *analyze\_model()*
- *analyze\_predictions()*
- *run\_model()*

**Note:** The artifact for *analyze\_model()* is a pandas Series. The artifact displays a two-column series where the name of the feature is in the first column and the second column is a number between 0 and

1 indicating how much that feature influenced the model's predictions over the entire dataset that the model was trained on.

**Note:** The artifact for *analyze\_predictions* is a pandas DataFrame. The artifact has one column for each feature that indicates how much that feature influenced the model's prediction, plus additional columns for the average model prediction ("base\_value"), and the model prediction for each row ("predicted\_value" for regression or "predicted-class" and "predicted\_probability" for classification).

#### Parameters:

- *artifact\_name* - Name of the artifact to download.
- *artifact\_path*: (optional) Relative path of the directory to download the artifact to (only applicable for the artifacts where a temporary file is created). This directory must already exist prior to artifact download.

#### Returns:

(True, <path-to-file>) or (True, <python-list>) or (False, <error-message>)

#### Example *run\_model()* or prediction artifact

```
In [16]: s.download_artifact('5da17d64be9c4441899316edb9afd403')
```

```
Out[16]:
```

```
(True,      Diagnosis  prob_BENIGN  prob_MALIGNANT
0      BENIGN      0.999400      6.002134e-04
1      BENIGN      1.000000      3.600000e-09
2      BENIGN      0.999999      8.689000e-07
3      BENIGN      1.000000      2.500000e-09
4  MALIGNANT      0.004159      9.958413e-01
5  MALIGNANT      0.002674      9.973264e-01
..          ...          ...          ...)
```

```
92  MALIGNANT      0.002499      9.975013e-01
93      BENIGN      1.000000      5.250000e-08
94      BENIGN      1.000000      3.100000e-08
95      BENIGN      0.999901      9.866350e-05
96      BENIGN      1.000000      9.230000e-08
97  MALIGNANT      0.003884      9.961160e-01
98  MALIGNANT      0.002777      9.972232e-01
99  MALIGNANT      0.003686      9.963139e-01
```

```
[100 rows x 3 columns])
```

#### Example *analyze\_data()* artifact

```
In [19]: s.download_artifact('923338b7512f4770b239e1b53406cfa6')
```

```
Out[19]:
```

```
(True,      col_name      col_type  drop is_cat      max \
0      Code      int64      true  False  8233704
1      Clump Thickness  categorical  false  True      None)
```

2	Uniformity of Cell Size	categorical	false	True	None
3	Uniformity of Cell Shape	categorical	false	True	None
4	Marginal Adhesion	categorical	false	True	None
5	Single Epithelial Cell Size	categorical	false	True	None
6	Bare Nuclei	LongType	false	False	10
7	Bland Chromatin	categorical	false	True	None
8	Normal Nucleoli	categorical	false	True	None
9	Mitoses	categorical	false	True	None
10	Diagnosis	categorical	false	True	None

  

	mean	min	missing	num_uniques	\
0	1044171.0667779633	61634	0.0	559	
1	4.555926544240401	None	0.0	10	
2	3.2153589315525877	None	0.0	10	
3	3.287145242070117	None	0.0	10	
4	2.8597662771285477	None	0.0	10	
5	3.290484140233723	None	0.0	10	
6	-2.30969249670820768E17	-9223372036854775808	0.0	11	
7	3.5208681135225377	None	0.0	10	
8	2.96661101836394	None	0.0	10	
9	1.6076794657762938	None	0.0	9	
10	None	None	0.0	2	

  

	scalable	stddev	uniques
0	True	414096.3687689267	None
1	False	2.887487844960718	[9, 1, 5, 2, 6, 3, 10, 7, 4, 8]
2	False	3.044601202894244	[9, 1, 5, 2, 6, 3, 10, 7, 4, 8]
3	False	2.9710450562657416	[9, 1, 5, 2, 6, 3, 10, 7, 4, 8]
4	False	2.873655092520189	[9, 1, 5, 2, 6, 3, 10, 7, 4, 8]
5	False	2.2751587689827613	[9, 1, 5, 2, 6, 3, 10, 7, 4, 8]
6	True	1.44237363952833229E18	None
7	False	2.369500020847775	[9, 1, 5, 2, 6, 3, 10, 7, 4, 8]
8	False	3.0844664820475916	[9, 1, 5, 2, 6, 3, 10, 7, 4, 8]
9	False	1.7343686380557295	[1, 5, 2, 6, 3, 10, 7, 4, 8]
10	False	None	['BENIGN', 'MALIGNANT'] )

### Example `analyze_model()` or prediction artifact

```
In [5]: s.download_artifact('6e4861de29424cb7ad09e467d1869c17',\
'path_to_download_dir/')
```

```
Out[5]:
```

```
True RM          0.216088
CRIM             0.141956
LSTAT            0.134069
DIS              0.104101
PTRATIO          0.089905
```

```

AGE          0.078864
NOX          0.074132
B            0.067823
TAX          0.045741
INDUS        0.023659
ZN           0.011041
RAD = 4.0    0.009464
RAD = 5.0    0.001577
RAD = 6.0    0.001577
RAD = 24.0   0.000000
RAD = 3.0    0.000000
RAD = 7.0    0.000000
CHAS = 1.0   0.000000
RAD = 8.0    0.000000
RAD = 2.0    0.000000
dtype: float64

```

### Example `analyze_predictions()` artifact

```
In [8]: (code, fis) = s.download_artifact('34b461c7a52a48318e982068f87e6562', \
      'path_to_download_dir/')
```

```
In [9]: fis.head()
```

```

Out[9]:    ##Sample return for regression, has predicted_value column

      AGE          B  CHAS = 1.0      CRIM      DIS      INDUS      LSTAT  \
0  0.000000  0.000000   0.000000 -0.664664 -0.923219 -0.720941  2.328635
1 -1.220243 -0.648893   0.000000  0.000000  1.187539 -0.630767  3.506132
2 -0.456561 -0.226880  -0.424802  0.000000 -0.077616 -0.333270 -0.292705
3 -0.195096  0.352712   0.000000 -1.867664 -0.152037  0.273082 -3.583178
4  0.632119  0.079678   0.000000  0.076080 -0.488128 -0.016690 -0.102031

      NOX    PTRATIO  RAD = 2.0      ...      RAD = 4.0  RAD = 5.0  \
0 -0.342404  0.224360      0.0      ...      -0.641678 -0.570788
1 -0.556636 -2.168356      0.0      ...      0.000000 -0.741561
2  0.000000  1.458677      0.0      ...      0.000000 -0.340486
3 -0.945060 -1.068743      0.0      ...      0.000000  0.217991
4  0.309544  0.298940      0.0      ...      0.000000 -0.047708

      RAD = 6.0  RAD = 7.0  RAD = 8.0      RM      TAX      ZN  base_value  \
0      0.0      0.0      0.0 -1.835851 -0.563795 -0.600155  21.63455
1      0.0      0.0      0.0 -1.016655 -0.699813 -0.727181  21.63455
2      0.0      0.0      0.0 -1.137559  0.000000 -0.310209  21.63455
3      0.0      0.0      0.0 -1.220045  0.156790  0.256763  21.63455
4      0.0      0.0      0.0 -0.999328 -0.149627 -0.045493  21.63455

predicted_value

```



```

0      24.620939
1      26.128595
2      24.200972
3      11.255393
4      21.982929

[5 rows x 22 columns]

Out[9]: ##Sample return for classification, returns predicted_class as well

      petal length (cm)  petal width (cm)  sepal length (cm)  sepal width (cm)  \
0          0.217699          0.424209          0.026237          0.005834
1          0.292612          0.315358          0.019236         -0.014442
2          0.325615          0.329229          0.003208          0.016954
3          0.232265          0.410938          0.043014          0.004154
4          0.317190          0.339065          0.015227          0.003523

      base_value  predicted_value predicted_class
0      0.309628          0.983607         virginica
1      0.365378          0.978142         versicolor
2      0.324994          1.000000            setosa
3      0.309628          1.000000         virginica
4      0.324994          1.000000            setosa

```

### **DarwinSdk.delete\_artifact(*artifact\_name*)**

Delete the artifact given its name.

#### **Parameters:**

- *artifact\_name* - Name of the artifact to be deleted.

#### **Returns:**

(True, None) or (False, <error-message>)

#### **Example**

```

In [8]: s.delete_artifact('6c482eac9f894cdb9b0e1e487e41730a')
Out[8]:
(True, None)

```

## Data Analysis and Data Cleaning methods

### **DarwinSdk.analyze\_data(dataset\_name, \*\*kwargs)**

Analyze the dataset given its *name*. Basic statistics about the data are returned. This method supports Big Data (greater than 2GB) although *upload\_dataset()* is artificially limited to 10GB for version 1.4.

**Note:** Please contact us if you have data greater than 10GB. We would like to see a sampling of the large datasets that you'd like to see supported.

#### **Parameters:**

*dataset\_name* - The name of the dataset to be analyzed.

**\*\*kwargs** - variable number of keyword arguments, described below:

- *job\_name* - (optional) If not specified, a uuid will be created as the *job\_name*.
- *artifact\_name*: (optional) If not specified, a uuid will be created as the *artifact\_name*.
- *max\_unique\_values*: Expected input/type: *integer*. Default value of 15. Threshold for automatic pruning of categorical columns prior to one hot encoding based on the number of unique values.  
**Note:** If a categorical column contains at least *max\_unique\_values*, it is dropped during preprocessing prior to one hot encoding.

#### **Returns:**

(True, {"job\_name": <string>, "artifact\_name": <string>}) or (False, <error-message>)

Statistics included in the artifact:

- *col\_name* - name of the column (any periods ('.') in the column name will be replaced by underscores ('\_'))
- *col\_type* - type of column
- *drop* - returns True if column is dropped for modeling. Also returns True if the number of unique values is greater than the number defined in *max\_unique\_values* (default of 15) or if it has more than 80% missing values or has a standard deviation of 0.
- *is\_cat* - returns True for categorical otherwise returns False
- *max* - column maximum
- *mean* - column mean
- *min* - column minimum
- *missing* - percentage of missing values
- *num\_uniques* - number of unique values if the distinct count is less than the number defined in *max\_unique\_values* (default of 15), otherwise the value is the approximate number of unique values.
- *scalable* - returns True if column is scalable
- *stddev* - column standard deviation
- *uniques* - actual unique values if there are less than the number defined in *max\_unique\_values* (default of 15). Otherwise, nothing is returned, see *num\_uniques* for the approximate number of unique values.

#### **Example**

```
In [6]: s.analyze_data('boston')
```

```
Out[6]:
```

```
(True,
 {'artifact_name': 'db968d77d2c4444ab731777d01e5e0c0',
  'job_name': '8c12f0df4c39485f9a488fa63196e00c'})
```

```
In [8]: s.download_artifact('db968d77d2c4444ab731777d01e5e0c0')
```

```
Out[8]:
```

```
(True,
      col_name      col_type  drop  is_cat      max  \
0          PID  StringType  true  False  2205663001_
1        ST_NUM  StringType  true  False        999
2        ST_NAME  StringType  true  False      ZELLER
3    ST_NAME_SUF  StringType  true  False         XT
4        ZIPCODE  StringType  true  False    02467_
5    Assessed_Value      int64  true  False  23095700
6        Lot_Area      int64  true  False   107158
7        Gross_Area      int64  true  False   23335
8        Living_Area      int64  true  False   21711
9    Owner_Occupied  categorical  false  True      None
10       Year_Built      int64  true  False   2016
11  Number_of_Floors      float64  false  False     5.0
12  Total_Number_of_Rooms      int64  true  False     27
13  Number_of_Bedrooms  categorical  false  True      None
14  Number_of_Full_Baths  categorical  false  True      None
15  Number_of_Half_Baths  categorical  false  True      None
16  Number_of_Kitchens  categorical  false  True      None
17           Has_AC  categorical  false  True      None
18  Number_of_Fireplaces  categorical  false  True      None
19  Year_Since_Remodel_or_Build      int64  true  False    307
20       Year_Remodeled  StringType  true  False  Unremodeled
21      Structure_Type  categorical  false  True      None
22      Building_Style  StringType  true  False   Victorian
23         Roof_Type  categorical  false  True      None
24    Exterior_Finish  categorical  false  True      None
25  Main_Bathroom_Style  categorical  false  True      None
26    Main_Kitchen_Style  categorical  false  True      None
27         Heating_type  categorical  false  True      None
28    Exterior_Condition  categorical  false  True      None
29    Overall_Condition  categorical  false  True      None
30    Interior_Condition  categorical  false  True      None
31    Interior_Finish  categorical  false  True      None
32          View  categorical  false  True      None

      mean      min  missing  num_uniques  scalable  \
```

0		None	0100021000_	0.000000	28578	True
1	122.09705524787249		1005R	0.010223	1922	True
2		None	ABBOTSFORD	0.000000	2246	True
3		None	ST	0.003015	21	True
4		None	02108_	0.000000	28	True
5	534716.6815977456		101300	0.000000	7737	True
6	5116.273150271971		375	0.000000	8342	True
7	2931.1126220591127		510	0.000000	4472	True
8	1752.7717084999017		332	0.000000	3169	True
9	0.8408480241169146		None	0.000000	2	False
10	1926.970935185792		1710	0.000000	225	True
11	1.8748115866046269		1.0	0.000000	9	True
12	7.233632610262796		2	0.000000	26	True
13	3.3851169801428664		None	0.000000	12	False
14	1.4273543482534898		None	0.000000	10	False
15	0.5716953928828888		None	0.000000	7	False
16	1.0287043711907726		None	0.000000	4	False
17	0.18733206632151517		None	0.000000	2	False
18	0.590995478078511		None	0.000000	13	False
19	60.88419948882627		1	0.000000	190	True
20	2000.3376960831488		1890	0.000000	82	True
21		None	None	0.000000	5	False
22		None	Bi-Level	0.000000	17	True
23		None	None	0.000000	7	False
24		None	None	0.000000	13	False
25		None	None	0.000000	4	False
26		None	None	0.000000	4	False
27		None	None	0.000000	6	False
28		None	None	0.000000	5	False
29		None	None	0.000000	5	False
30		None	None	0.000000	5	False
31		None	None	0.000000	3	False
32		None	None	0.000000	5	False

	stddev	uniques
0	None	None
1	294.1511958893473	None
2	None	None
3	None	None
4	None	None
5	634750.7826113638	None
6	3218.286557124007	None
7	1069.3847598444354	None
8	758.9874732061347	None
9	0.3658237412175791	[0, 1]

```

10      34.9170355483078      None
11      0.5737101635770085      None
12      1.8082562295656077      None
13      1.0095185504254367      [12, 9, 1, 5, 2, 6, 3, 10, 7, 4, 11, 8]
14      0.6850264359951297      [12, 9, 1, 5, 2, 6, 3, 7, 4, 8]
15      0.5645602408681473      [0, 1, 5, 2, 6, 3, 4]
16      0.17162236936210065      [0, 1, 2, 3]
17      0.3901842537872663      [0, 1]
18      0.8584446055814273      [0, 12, 9, 1, 5, 2, 6, 3, 10, 7, 4, 11, 8]
19      43.323487380439225      None
20      13.578956800881818      None
21      None      ['Residential', 'Wood/Frame', 'Unknown', 'Bric...
22      None      None
23      None      ['Shed', 'Gambrel', 'Flat', 'Other', 'Mansard'...
24      None      ['Cement Board', 'Frame/Clapboard', 'Wood Shak...
25      None      ['Semi-Modern', 'Luxury', 'No Remodeling', 'Mo...
26      None      ['Semi-Modern', 'Luxury', 'No Remodeling', 'Mo...
27      None      ['Electric', 'Other', 'None', 'Hot Water', 'Sp...
28      None      ['Poor', 'Good', 'Excellent', 'Average', 'Fair']
29      None      ['Poor', 'Good', 'Excellent', 'Average', 'Fair']
30      None      ['Poor', 'Good', 'Excellent', 'Average', 'Fair']
31      None      ['Elaborate', 'Normal', 'Substandard']
32      None      ['Poor', 'Good', 'Excellent', 'Average', 'Fair'] )

```

### DarwinSdk.clean\_data(dataset\_name, \*\*kwargs)

Clean the dataset given its name. The output is the cleaned dataset which is scaled and one-hot-encoded based on parameters in `analyze_data()`. Use `download_dataset()` to retrieve the cleaned dataset. **Note:** `analyze_data()` must be run first before `clean_data()` can be run. `clean_data()` is only used for visualizing what Darwin would do or for when you want to use the cleaned data outside of Darwin. Do not clean data and then train on the cleaned data with Darwin. Invoking `create_model()` has its own cleaning function as part of the model creation process.

#### Parameters:

- `dataset_name` - The name of the dataset to be analyzed.
- `**kwargs` - variable number of keyword arguments, described below:
  - `job_name` - (optional) If not specified, a uuid will be created as the `job_name`.
  - `artifact_name`: (optional) If not specified, a uuid will be created as the `artifact_name`.

#### Example

```

In [6]: s.clean_data('cancer', artifact_name='cancer-cleandata')
Out[6]:
(True,
 {'artifact_name': 'cancer-cleandata',

```

```
'job_name': 'baa07cf9a7734c8da2afcf805b2d0571'})

In [8]: s.download_dataset('cancer-cleandata', \
    artifact_path='/Users/username/Downloads/artifacts')
Out[8]:
(True,
 {'filename': \
    '/Users/username/Downloads/artifacts/cancer-cleandata3-cleaned-8m38g07j.csv'})
```

## Modeling and analysis methods

### DarwinSdk.create\_model(dataset\_names, \*\*kwargs)

Create a model trained on the dataset identified by `dataset_names`. The name of a model is specified in a parameter in `kwargs`.

**Note:** If no name is specified, the model is named with a *uuid-like* name.

#### Parameters:

*dataset\_names* - A single dataset name as a string or a list of dataset string names to be used for training

*\*\*kwargs* - variable number of keyword arguments, described in *parameters*.

*parameters* -

- *model\_name*: The string identifier of the model to be trained. If no name is specified, the model is named with a *uuid-like* name.
- *job\_name*: If no name is specified, the job is named with a *uuid-like* name.
- *target*: String denoting target prediction column in input data. If the target is not specified, the model would default to unsupervised.
- *max\_train\_time* (supervised only): Sets the training time for the model in 'HH:MM' format. Default value is 00:01.
- *max\_epochs* (unsupervised only): Expected input/type: *numeric*. Sets the training time for the model in epochs. Default value is 10.
- *recurrent*: Expected input/type: *true/false*. Enables recurrent connections to be evolved in the model. This option can be useful for timeseries or sequential data.

**Note:** This option is automatically enabled if a *datetime* column is detected in the input data. This can result in slower model evolution.

- *impute*: String alias that indicates how to fill in missing values in input data.

ALIAS	DESCRIPTION	COMPLEXITY
'ffill'	(Default) Forward Fill: Propagate values forward from one example into the missing cell of the next example. Might be useful for timeseries data, but also applicable for both numerical and categorical data.	Linear Fast
'bfill'	Backward Fill: Propagate values backward from one example into the missing cell of the previous example. Might be useful for timeseries data, but also applicable for both numerical and categorical data.	Linear Fast
'mean'	Mean Fill: Computes the mean value of all non-missing examples in a column to fill in missing examples. The result may or might not be interpretable in terms of the input space for categorical variables.	Linear Fast
'median'	Median Fill: Computes the median value of all non-missing examples in a column to fill in missing examples. While the result is interpretable in terms of the input space for categorical variables, the approach might not be appropriate for non-ordinal data.	Linear Fast
'mode'	Mode Fill: Uses the most common value on a column-by-column basis to fill in missing examples. The result is interpretable for both numerical and categorical variables.	Linear Fast
'spline'	Spline Fill: Interpolation using a spline (piecewise function). Might be useful for timeseries or sequential data.	Linear Fast
'Linear'	Linear Interpolation Fill: Interpolation using a Linear function. Might be useful for timeseries or sequential data.	Linear Fast

- *drop*: Expected input/type: *true/false*. Enables automatic pruning of input columns based on different criteria such as amount of missing data, number of unique values, and standard deviation. **Note:** This automatically drops identifier columns (unique value for each sample) and columns that do not contain sufficient data to aid prediction.
- *max\_int\_uniques*: Expected input/type: *integer*. Threshold for automatic encoding of categorical variables. If a column contains less than *max\_int\_uniques* unique values, it is treated as categorical and one hot encoded during preprocessing. **Note:** If the target has more numeric values than the *max\_int\_uniques* set point, the problem is treated as a regression and will use MSE.
- *max\_unique\_values*: Expected input/type: *integer*. Threshold for automatic pruning of categorical columns prior to one hot encoding based on the number of unique values. **Note:** If a categorical column contains at least *max\_unique\_values*, it is dropped during preprocessing prior to one hot encoding.
- *feature\_eng*: Enables automatic feature generation. Identifies an appropriate time window and augments input with new features derived in the frequency and time domains. **Note:** Can only be applied to timeseries data. String aliases specify methods for window computation.

ALIAS	DESCRIPTION
'mi'	Uses mutual information to estimate the window length.
'auc'	<b>(Default)</b> Uses autocorrelation to estimate the window length.
'user'	User specified window length: see <i>window_len</i> .

- *window\_len*: Expected input/type: *integer*. User specified window length for feature generation.  
**Note:** This parameter is used only in the case that *user* is provided for the *feature\_eng* parameter.
- *feature\_select*: A number in [0,1] specifying the percentage of numerical features to maintain based on their dependency to the target. Ranks all features using mutual information and drops (1 - *feature\_select*)% of the lowest-ranking features. Default is **1** (keep all features).
- *outlier*: A string alias that indicates the outlier detection to apply during preprocessing.  
**Note:** Outliers are removed and later filled using imputation.

ALIAS	DESCRIPTION
None	<b>(Default)</b> No outlier detection is applied.
'mad'	Uses Median Absolute Deviation to detect outliers.
'perc'	Uses Percentile-based outlier detection.
'isol'	Uses an Isolation Forest to detect outliers.

- *auto\_save\_per* (supervised only): Expected input/type: *integer*. Sets the checkpoint frequency. The model creation progress is recorded after every *auto\_save\_per* generations.  
**Note:** If the model is retrained, the model begins from the last recorded checkpoint. The model is automatically saved at the end of evolution.
- *imbalance* (supervised only): Expected input/type: *true/false*. Enables automatic imbalance correction that selectively applies random oversampling, random undersampling, synthetic minority oversampling (SMOTE), or adaptive synthetic sampling (ADASYN) to the input data depending on problem characteristics.
- *clustering* (unsupervised only): Enables clustering for unsupervised problems. If false, detects outliers.
- *n\_clusters* (unsupervised only): Expected input/type: *integer*. Specifies the number of clusters.  
**Note:** If this value is not provided, the number of clusters will be heuristically determined.
- *anomaly\_prior* (unsupervised only): Expected input/type: *between [0,1]*. Significance level at which a point is defined as anomalous. This is only used for unsupervised problems if *clustering* is disabled.
- *loss\_func*: Specify the loss function. Possible values include: "CrossEntropy", "MSE", "BCE", "L1", "NLL", "BCEWithLogits", "SmoothL1". "CrossEntropy" can be used for classification data, while all others can be used for regression data. The default value is *CrossEntropy* if this field is left empty.
- *lead\_time\_days* (*nbm* only): Expected input/type: *integer*. Default value is 60. The number of days prior to failure when the behavior starts trending toward either abnormal behavior or failure.



- *nbm\_window\_size* (*nbm* only): Expected input/type: *integer*. Default value is 256. The number of sample points to consider for each failure detection.
- *nbm* (*nbm* only): Expected input/type: *true/false*. Default value is *false*. Set value to *true* for a normal behavioral model (NBM).
- *failure\_dates* (*nbm* only): Expected input/type: *string*. List of failure dates to use for the calculation. Currently, only a list of one date can be used in the query. Example date format: "07/01/2015"
- *recovery\_dates* (*nbm* only): Expected input/type: *string*. List of recovery dates to use for the calculation. Currently, only a list of one date can be used in the query. Example date format: "11/01/2015"

**Returns:**

(True, {'job\_id': <uuid>, model\_name: <model\_name>}) or (False, <error-message>)

**Example**

```
In [10]: s.create_model('cancer-data', target="Diagnosis", model_name="cancer-\
model", max_train_time="00:01", max_epochs=0)
Out[10]:
(True,
 {'job_id': 'f5124576a4f34e5c9ab3499770455509',
  'model_name': 'cancer-model'})
```

---

**DarwinSdk.delete\_model(model\_name)**

Delete a model named by *model\_name*.

**Parameters:**

- *model\_name* - Name of the model to be deleted.

**Returns:**

(True, None) or (False, <error-message>)

**Example**

```
In [5]: s.delete_model('unittest-cancer-model')
Out[5]: (True, None)
```

---

**DarwinSdk.resume\_training\_model(model\_name, dataset\_names, \*\*kwargs)**

Resume training for a model on the dataset(s) identified by *dataset\_names*.

**Parameters:**

- *model\_name* - Name of the model to be trained.
- *dataset\_name*- Name of dataset(s) used for training.

- **\*\*kwargs** - variable number of keyword arguments, described below:.
  - *job\_name* - If not specified, a uuid is created as the *job\_name*.
  - *max\_train\_time* - If not specified, the *default* is used.

#### Returns:

(True, {"job\_id": "<uuid>", "model\_name": "<model\_name>"}) or (False, <error-message>)

#### Example

```
In [8]: s.resume_training_model('unittest-cancer-model', 'unittest-cancer-\ndataset', max_train_time="00:01")
Out[8]:
(True, {"job_id": "4e59ffc425e047e1a3b872f1e7396976", "model_name": "unittest-\ncancer-model"})
```

### DarwinSdk.analyze\_model(model\_name, job\_name=None, artifact\_name=None)

Analyze the universal feature importances for a particular model given the model name.

#### Parameters:

- *model\_name* - The name of the model to be analyzed.
- *job\_name* - (optional) If not specified, a uuid is created as the *job\_name*.
- *artifact\_name* - (optional) If not specified, a uuid is created as the *artifact\_name*.
- *category\_name* - (optional) The name of the class for supervised or cluster for unsupervised to get feature importance for. If this is not specified, the feature importance will be over all classes/clusters.

#### Returns:

(True, {"job\_name": <string>, "artifact\_name": <string>}) or (False, <error-message>)

#### Example

```
In [5]: s.analyze_model('unittest-cancer-model')
Out [5]:
(True, {'artifact_id': '71a8ae55f2934014b45c13a3975f419c', 'job_id': \n'4e59ffc425e047e1a3b872f1e7396976'})
```

### DarwinSdk.analyze\_predictions(model\_name, dataset\_name, job\_name=None, artifact\_name=None)

Analyze specific feature importances for a particular sample or samples given the model name and sample data.

#### Parameters:

- *dataset\_name* - The name of the dataset containing the data to analyze predictions for. This is a new dataset that was not used during training for which you want feature importance scores for each row of this dataset. This dataset has a limit of 500 rows. There is no limit for columns.

- *model\_name* - The name of the model to be analyzed.
- *job\_name* - (optional) If not specified, a uuid is created as the *job\_name*.
- *artifact\_name* - (optional) If not specified, a uuid is created as the *artifact\_name*.

#### Returns:

(True, {"job\_name": <string>, "artifact\_name": <string>}) or (False, <error-message>)

#### Example

```
In [5]: s.analyze_predictions('model_name', 'dataset_name')
Out [5]:
(True, {'artifact_name': '71a8ae55f2934014b45c13a3975f419c', 'job_name': \
'4e59ffc425e047e1a3b872f1e7396976'})
```

### DarwinSdk.run\_model(dataset\_name, model\_name, job\_name=None, artifact\_name=None)

Run the model given its name and a dataset to use. Use **upload\_dataset()** to upload a data set.

#### Parameters:

- *dataset\_name* - The name of a dataset to use for running the model.
- *model\_name* - The name of the model to run.
- *supervised* - (**Deprecated:** This argument exists only for backward compatibility.) (optional) A boolean (true/false) indicating whether the model is supervised or not, for example, set this to *false* for *unsupervised*.
- *job\_name* - (optional) If not specified, a uuid is created as the *job\_name*.
- *artifact\_name* - (optional) If not specified, a uuid is created as the *artifact\_name*.

#### Returns:

(True, {"job\_name": <string>, "artifact\_name": <string>}) or (False, <error-message>)

#### Example

```
[In [9]: s.run_model('unittest-cancer-testdataset', 'unittest-cancer-model')
Out [9]:
(True, {'artifact_id': '6c482eac9f894cdb9b0e1e487e41730a', 'job_id': \
'1696e03c8165404c8e05685ea68baa3c'})
```

## Convenience methods

### DarwinSdk.delete\_all\_datasets()

Deletes user datasets. This method deletes all datasets in the current user or service context.

**Note:** Use *lookup\_dataset()* to view/verify the datasets for deletion.

**Parameters:** None

**Returns:**

(True, None) or (False, <error-message>)

---

**DarwinSdk.delete\_all\_models()**

Delete all models for a user. This method will delete all models in the current user's or service's context.

**Note:** Use *lookup\_model()* to review and verify that you want to delete all listed models.

**Parameters:** None

**Returns:**

(True, None) or (False, <error-message>)

---

**DarwinSdk.wait\_for\_job(job\_name, time\_limit=600)**

Synchronously wait for a job to complete, limited by *time\_limit* that defaults to 600 seconds.

**Parameters:**

- *job\_name* - The id for the job
- *time\_limit* - (optional) defaults to 600 seconds

**Returns:**

(True, None) or (False, <error-message>)

---

## Reference

- [SDK modeling example](#)
- [SDK analyze data workflow example](#)
- [Revision table](#)

### SDK modeling example

The following example shows the Darwin SDK performing a modeling process:

```
---
In [1]: from amb_sdk.sdk import DarwinSdk

In [2]: s = DarwinSdk()

In [3]: s.auth_login_user('username', 'password')
```

```
Out[3]:
(True,
 'Bearer eyJhbGciOiJIUzI1NiIs...lAgKQoQHk6nYtetg4')

In [12]: s.upload_dataset('sets/cancer_train.csv', 'mydata')
Out[12]: (True, {'dataset_name': 'mydata'})

In [14]: s.create_model('mydata', target="Diagnosis", model_name="my-model")
Out[14]:
(True,
 {'job_name': '1661fb302af149798c34ca9db9e1b0ae', 'model_name': 'my-model'})

In [15]: s.wait_for_job('1661fb302af149798c34ca9db9e1b0ae')
{'percent_complete': 39, 'job_type': 'TrainModel', 'model_name': 'my-model', \
'dataset_names': ['mydata'], 'endtime': None, 'loss': 0.4169575273990631, \
'generations': 11, 'status': 'Running', 'starttime': '2018-02-01T14:16:51.4\
64827', 'artifact_names': None}
{'percent_complete': 62, 'job_type': 'TrainModel', 'model_name': 'my-model', \
'dataset_names': ['mydata'], 'endtime': None, 'loss': 0.39973780512809753, \
'generations': 17, 'status': 'Running', 'starttime': '2018-02-01T14:16:51.4\
64827', 'artifact_names': None}
{'percent_complete': 84, 'job_type': 'TrainModel', 'model_name': 'my-model', \
'dataset_names': ['mydata'], 'endtime': None, 'loss': 0.39636287093162537, \
'generations': 21, 'status': 'Running', 'starttime': '2018-02-01T14:16:51.4\
64827', 'artifact_names': None}
{'percent_complete': 100, 'job_type': 'TrainModel', 'model_name': 'my-model', \
'dataset_names': ['mydata'], 'endtime': '2018-02-01T14:18:02.072976', 'loss': \
0.39636287093162537, 'generations': 23, 'status': 'Complete', 'starttime': \
'2018-02-01T14:16:51.464827', 'artifact_names': None}
Out[15]: (True, 'Job completed')

In [16]: s.upload_dataset('sets/cancer_test.csv', 'mytestdata')
Out[16]: (True, {'dataset_name': 'mytestdata'})

In [19]: s.run_model('mytestdata', 'my-model')
Out[19]:
(True,
 {'artifact_name': '9a6d41532cec47618beee6236b02c129',
 'job_name': '91c7813334ee4c37a733761dce71c0b3'})

In [21]: s.wait_for_job('91c7813334ee4c37a733761dce71c0b3')
{'loss': 0.39636287093162537, 'job_type': 'RunModel', 'artifact_names': \
['9a6d41532cec47618beee6236b02c129'], 'endtime': '2018-02-01T14:22:39.05466', \
'percent_complete': 100, 'generations': 23, 'model_name': 'my-model', 'status'\
: 'Complete', 'starttime': '2018-02-01T14:22:34.219185', 'dataset_names': \
```

```
['mytestdata']}]
Out[21]: (True, 'Job completed')

In [22]: s.download_artifact('9a6d41532cec47618beee6236b02c129')
(True,      Diagnosis
0         BENIGN
1         BENIGN
2         BENIGN
3         BENIGN
4         BENIGN
5    MALIGNANT
6    MALIGNANT
...
98    MALIGNANT
99    MALIGNANT

[100 rows x 1 columns])
```

---

## SDK analyze data workflow example

The following example shows a Darwin SDK data analysis workflow example: (some lines have been truncated for PDF display)

```
In [1]: from amb_sdk.sdk import DarwinSdk

In [2]: s = DarwinSdk()

In [4]: s.auth_login_user('username', 'password')
Out[4]:
(True,
 'Bearer eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9...eyJqdGkiOiIxYzg5MTA2YS1hYTUyLT...')

In [5]: s.upload_dataset('sets/boston.csv', 'boston-data')
Out[5]: (True, {'dataset_name': 'boston-data'})

In [8]: s.analyze_data('boston-data', max_unique_values=25)
Out[8]:
(True,
 {'artifact_name': '966005fe955347da8acdcf6d5a787b55',
  'job_name': 'cafa05e5af9c48679521fb6719a54150'})

In [9]: s.wait_for_job('cafa05e5af9c48679521fb6719a54150')
{'generations': None, 'job_error': None, 'artifact_names': \
['966005fe955347da8acdcf6d5a787b55'], 'job_type': 'AnalyzeData', \
```

```
'endtime': None, 'dataset_names': ['boston-data'], 'starttime': \
'2018-07-10T14:57:53.624914', 'percent_complete': 0, 'loss': None, \
'status': 'Requested', 'model_name': None}
{'generations': None, 'job_error': None, 'artifact_names': \
['966005fe955347da8acdcf6d5a787b55'], 'job_type': 'AnalyzeData', \
'endtime': None, 'dataset_names': ['boston-data'], 'starttime': \
'2018-07-10T14:57:53.624914', 'percent_complete': 10, 'loss': None, \
'status': 'Running', 'model_name': None}
{'generations': None, 'job_error': None, 'artifact_names': \
['966005fe955347da8acdcf6d5a787b55'], 'job_type': 'AnalyzeData', \
'endtime': None, 'dataset_names': ['boston-data'], 'starttime': \
'2018-07-10T14:57:53.624914', 'percent_complete': 10, 'loss': None, \
'status': 'Running', 'model_name': None}
{'generations': None, 'job_error': None, 'artifact_names': \
['966005fe955347da8acdcf6d5a787b55'], 'job_type': 'AnalyzeData', \
'endtime': None, 'dataset_names': ['boston-data'], 'starttime': \
'2018-07-10T14:57:53.624914', 'percent_complete': 10, 'loss': None, \
'status': 'Running', 'model_name': None}
{'generations': None, 'job_error': None, 'artifact_names': \
['966005fe955347da8acdcf6d5a787b55'], 'job_type': 'AnalyzeData', \
'endtime': None, 'dataset_names': ['boston-data'], 'starttime': \
'2018-07-10T14:57:53.624914', 'percent_complete': 10, 'loss': None, \
'status': 'Running', 'model_name': None}
{'generations': None, 'job_error': None, 'artifact_names': \
['966005fe955347da8acdcf6d5a787b55'], 'job_type': 'AnalyzeData', \
'endtime': '2018-07-10T14:59:01.069', 'dataset_names': ['boston-data'], \
'starttime': '2018-07-10T14:57:53.624914', 'percent_complete': 100, \
'loss': None, 'status': 'Complete', 'model_name': None}
Out[9]: (True, 'Job completed')
```

```
In [10]: s.download_artifact('966005fe955347da8acdcf6d5a787b55')
```

```
Out[10]:
```

```
(True,
```

	col_name	col_type	drop	is_cat	max	\
0	PID	StringType	true	False	2205663001_	
1	ST_NUM	StringType	true	False	999	
2	ST_NAME	StringType	true	False	ZELLER	
3	ST_NAME_SUF	categorical	false	True	None	
4	ZIPCODE	StringType	true	False	02467_	
5	Assessed_Value	int64	true	False	23095700	
6	Lot_Area	int64	true	False	107158	
7	Gross_Area	int64	true	False	23335	
8	Living_Area	int64	true	False	21711	
9	Owner_Occupied	categorical	false	True	None	
10	Year_Built	int64	true	False	2016	

11	Number_of_Floors	float64	false	False	5.0
12	Total_Number_of_Rooms	int64	true	False	27
13	Number_of_Bedrooms	categorical	false	True	None
14	Number_of_Full_Baths	categorical	false	True	None
15	Number_of_Half_Baths	categorical	false	True	None
16	Number_of_Kitchens	categorical	false	True	None
17	Has_AC	categorical	false	True	None
18	Number_of_Fireplaces	categorical	false	True	None
19	Year_Since_Remodel_or_Build	int64	true	False	307
20	Year_Remodeled	StringType	true	False	Unremodeled
21	Structure_Type	categorical	false	True	None
22	Building_Style	categorical	false	True	None
23	Roof_Type	categorical	false	True	None
24	Exterior_Finish	categorical	false	True	None
25	Main_Bathroom_Style	categorical	false	True	None
26	Main_Kitchen_Style	categorical	false	True	None
27	Heating_type	categorical	false	True	None
28	Exterior_Condition	categorical	false	True	None
29	Overall_Condition	categorical	false	True	None
30	Interior_Condition	categorical	false	True	None
31	Interior_Finish	categorical	false	True	None
32	View	categorical	false	True	None

		mean	min	missing	num_uniques	scalable	\
0	None	0100021000_	0.000000	28578	True		
1	122.09705524787249	1005R	0.010223	1922	True		
2	None	ABBOTSFORD	0.000000	2246	True		
3	None	None	0.003015	21	False		
4	None	02108_	0.000000	28	True		
5	534716.6815977456	101300	0.000000	7737	True		
6	5116.273150271971	375	0.000000	8342	True		
7	2931.1126220591127	510	0.000000	4472	True		
8	1752.7717084999017	332	0.000000	3169	True		
9	0.8408480241169146	None	0.000000	2	False		
10	1926.970935185792	1710	0.000000	225	True		
11	1.8748115866046269	1.0	0.000000	9	True		
12	7.233632610262796	2	0.000000	26	True		
13	3.3851169801428664	None	0.000000	12	False		
14	1.4273543482534898	None	0.000000	10	False		
15	0.5716953928828888	None	0.000000	7	False		
16	1.0287043711907726	None	0.000000	4	False		
17	0.18733206632151517	None	0.000000	2	False		
18	0.590995478078511	None	0.000000	13	False		
19	60.88419948882627	1	0.000000	190	True		
20	2000.3376960831488	1890	0.000000	82	True		



21	None	None	0.000000	5	False
22	None	None	0.000000	17	False
23	None	None	0.000000	7	False
24	None	None	0.000000	13	False
25	None	None	0.000000	4	False
26	None	None	0.000000	4	False
27	None	None	0.000000	6	False
28	None	None	0.000000	5	False
29	None	None	0.000000	5	False
30	None	None	0.000000	5	False
31	None	None	0.000000	3	False
32	None	None	0.000000	5	False
	stddev				uniques
0	None				None
1	294.1511958893473				None
2	None				None
3	None	['PL', 'RD', 'PA', 'CT', 'AV', 'CI', 'HW', 'DR...			
4	None				None
5	634750.7826113639				None
6	3218.2865571240072				None
7	1069.3847598444358				None
8	758.9874732061344				None
9	0.3658237412175791				[0, 1]
10	34.917035548307794				None
11	0.5737101635770088				None
12	1.808256229565608				None
13	1.009518550425437		[12, 9, 1, 5, 2, 6, 3, 10, 7, 4, 11, 8]		
14	0.6850264359951295		[12, 9, 1, 5, 2, 6, 3, 7, 4, 8]		
15	0.5645602408681472		[0, 1, 5, 2, 6, 3, 4]		
16	0.17162236936210065		[0, 1, 2, 3]		
17	0.3901842537872663		[0, 1]		
18	0.8584446055814273		[0, 12, 9, 1, 5, 2, 6, 3, 10, 7, 4, 11, 8]		
19	43.32348738043924				None
20	13.57895680088182				None
21	None	['Residential', 'Wood/Frame', 'Unknown', 'Bric...			
22	None	['Ranch', 'Other', 'Split Level', 'Raised Ranc...			
23	None	['Shed', 'Gambrel', 'Flat', 'Other', 'Mansard'...			
24	None	['Cement Board', 'Frame/Clapboard', 'Wood Shak...			
25	None	['Semi-Modern', 'Luxury', 'No Remodeling', 'Mo...			
26	None	['Semi-Modern', 'Luxury', 'No Remodeling', 'Mo...			
27	None	['Electric', 'Other', 'None', 'Hot Water', 'Sp...			
28	None	['Poor', 'Good', 'Excellent', 'Average', 'Fair']			
29	None	['Poor', 'Good', 'Excellent', 'Average', 'Fair']			
30	None	['Poor', 'Good', 'Excellent', 'Average', 'Fair']			

```

31         None          ['Elaborate', 'Normal', 'Substandard']
32         None          ['Poor', 'Good', 'Excellent', 'Average', 'Fair'] )

```

## Revision Table

Version	Date	Notes
v 1.0	05-Feb-2018	Initial Release
v 1.2	28-Mar-2018	Added: <ul style="list-style-type: none"> <li>• DarwinSdk.auth_change_password</li> <li>• DarwinSdk.delete_job</li> <li>• DarwinSdk.stop_job</li> <li>• DarwinSdk.lookup_user</li> <li>• DarwinSdk.lookup_username</li> <li>• DarwinSdk.auth_delete_user</li> </ul> Name change: lookup_client to lookup_limits
v 1.3	23-May-2018	Added: <ul style="list-style-type: none"> <li>• DarwinSdk.auth_reset_password</li> <li>• DarwinSdk.auth_set_email</li> <li>• DarwinSdk.analyze_predictions</li> </ul> Updated endpoints: <ul style="list-style-type: none"> <li>• DarwinSdk.auth_register_user</li> <li>• DarwinSdk.analyze_model</li> </ul>
v 1.3.1	14-Jun-2018	Fixed issues only. See Release Notes.
v 1.4	31-Jul-2018	<ul style="list-style-type: none"> <li>• Island Models implemented to allow model types to reproduce at their own speeds</li> <li>• User selectable loss functions</li> <li>• Output model confidence value</li> <li>• Specify download paths for artifacts</li> <li>• Parameter validation</li> <li>• Stored data is encrypted</li> <li>• <b>DarwinSdk.lookup_model()</b> and <b>DarwinSdk.lookup_model_name(model_name)</b> calls display model description</li> </ul>