InsightSolver API client

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CHAPTER

ONE

INTRODUCTION

Welcome to the technical documentation for the **InsightSolver API Client**.

1.1 About InsightSolver

InsightSolver is a SaaS (Software as a Service) solution designed for advanced rule mining and data insights. Powered by a centralized rule-mining engine, it enables organizations to uncover hidden patterns and generate actionable insights for data-driven decision-making.

1.2 Access Options

InsightSolver can be accessed through the following options:

- The API Client, designed for seamless integration with Python applications and data workflows.
- The **Web App** (not yet available), which will provide an intuitive and interactive interface for exploring rule-mining results, visualization, and analysis.

This documentation specifically covers the API Client. The Web App will have its own documentation once available.

1.3 The InsightSolver API client

The InsightSolver API Client offers a Python-based interface for direct interaction with our rule-mining engine. Designed for data engineers, scientists, and developers, this client integrates InsightSolver's functionalities into custom workflows, applications, and automated pipelines. The API client allows users to configure rule-mining parameters, send encrypted data to the server and retrieve results efficiently.

1.4 Who Should Use This Documentation?

This documentation is for:

- Developers integrating our rule-mining API.
- Engineers needing setup guides and technical references.
- Users looking for examples of effective API use.

1.5 Accessing the API

The API client requires a valid `.json` service key. This key authenticates your identity and ensures secure communication with the InsightSolver API server. If you do not yet have a service key, please contact support@insightsolver.com for assistance.

CHAPTER

TWO

INSTALLATION

This guide provides instructions to install and set up the InsightSolver API client on your local machine.

2.1 Prerequisites

- **Python 3.9 or higher**: Ensure Python is installed on your system. You can check your Python version with:

```
python --version
```

- **pip**: Python's package installer, which is typically included with Python 3 installations.

2.2 Installation Steps

You can install the InsightSolver API client in different ways, depending on your setup:

A. **Install directly using pip (100% CLI)**

If you have git installed and don't need a local copy of the repository, run:

```
pip install git+https://github.com/insightsolver/insightsolver.git
```

B. **Clone the repository and install locally (100% CLI)**

If you have git installed and want to also keep a local copy of the repository, run:

```
git clone https://github.com/insightsolver/insightsolver.git
cd insightsolver
pip install .
```

C. **Download via browser and install (50% GUI + 50% CLI)**

If you don't have git installed, follow these steps:

- Open a browser and go to https://github.com/insightsolver/insightsolver.
- Click on the green button <> `Code v` and select `Download ZIP`.
- Extract the ZIP file to a folder on your machine.
- Open a terminal and navigate to the extracted folder using:

```
cd path/to/unzipped-folder
```

- Then install the package with:

```
pip install .
```

2.3 Testing the Installation

To verify that the installation was successful, you can run a quick test in Python to ensure all dependencies are correctly installed and functioning.

1. Open a terminal and start a Python interpreter by typing:

   ```
   python
   ```

2. Once inside the Python shell, try importing the `InsightSolver` class with the following command:

   ```
   from insightsolver import InsightSolver
   ```

3. If the installation was successful, there should be no errors, and the Python shell should return to the prompt. If you encounter an *ImportError*, ensure that you have installed the package in the correct environment.

4. Exit the Python shell by typing:

   ```
   quit()
   ```

If you encounter any errors or need assistance, please refer to the *Help section*.

CHAPTER

THREE

USAGE

The following sections provide examples on how to use the InsightSolver API client.

3.1 Quick Start Example

This section provides a quick example of how to use the InsightSolver API client. Before running the example script, please ensure that:

1. You have completed the steps in the *Installation Guide*.
2. You have obtained a valid service key.

The following example demonstrates how to the basic usage of the InsightSolver API client, showing how to initialize the solver and generate insights using the InsightSolver API.

```
# Import some data
import pandas as pd
df = pd.read_csv('kaggle_titanic_train.csv') # Dataset here: https://www.kaggle.com/
↪competitions/titanic/data

# Specify the name of the target variable
target_name = 'Survived' # We are interested in whether the passengers survived or not

# Specify the target goal
target_goal = 1 # We are searching rules that describe survivors

# Choose how features should be interpreted
columns_types = {
                  'Survived' : 'binary',
                  'Pclass'   : 'continuous', # Could be 'multiclass' (i.e. unordered) or
↪'continuous' (i.e. ordered)
                  'Name'     : 'ignore',
                  'Sex'      : 'binary',
                  'Age'      : 'continuous',
                  'SibSp'    : 'continuous', # Could be 'multiclass' (i.e. unordered) or
↪'continuous' (i.e. ordered)
                  'Parch'    : 'continuous', # Could be 'multiclass' (i.e. unordered) or
↪'continuous' (i.e. ordered)
                  'Ticket'   : 'ignore',
                  'Fare'     : 'continuous',
                  'Cabin'    : 'ignore',
                  'Embarked' : 'multiclass',
```

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```
        }

# Import the class InsightSolver from the module insightsolver
from insightsolver import InsightSolver

# Create an instance of the class InsightSolver
solver = InsightSolver(
   df           = df,           # A dataset
   target_name  = target_name,  # Name of the target variable
   target_goal  = target_goal,  # Target goal
   columns_types = columns_types, # Columns types
)

# Specify the service key
service_key = 'name_of_your_service_key.json'

# Fit the solver
solver.fit(
   service_key  = service_key, # Use your API service key here
)

# Print the rule mining results
solver.print(mode='dense')
"""
                        contribution variable              rule     nans
i p_value coverage lift

0 2e-67   19.1%    2.47
                               86.2%      Sex            female
                               13.8%   Pclass            [1, 2]
1 6e-13    6.3%    2.19
                               52.7%      Age       [0.42, 15.0]  exclude
                               47.3%    SibSp            [0, 2]
2 3e-20   12.2%    2.06
                               81.4%   Pclass            [1, 1]
                               11.3%     Fare  [7.925, 512.3292]
                                7.3%      Age        [4.0, 42.0]  exclude
"""
```

In this specific example, the InsightSolver API gives us three rules in which we find more survivors of the Titanic:

- `(i=0)` : **Women in 1st or 2nd class.** This group covers 19.1% of the passengers and has a survival gain of +147% compared to the population of the Titanic.
- `(i=1)` : **Children (which we know the age) with not too many siblings.** This group covers 6.3% of the passengers and has a survival gain of +117% compared to the population of the Titanic.
- `(i=2)` : **Rich 1st class that are not too old (which we know the age).** This group covers 12.2% of the passengers and has a survival gain of +106% compared to the population of the Titanic.

Note that there could be a survivor bias in the two rules `i=1` and `i=2` because we know the age of the survivors more than we know the age of the non-survivors of the Titanic. We could also use `target_goal = 0` to look for passengers that did not survive the Titanic:

```
# Specify the target goal
target_goal = 0 # We are searching rules that describe non-survivors

# Create an instance of the class InsightSolver
solver = InsightSolver(
   df            = df,            # A dataset
   target_name   = target_name,   # Name of the target variable
   target_goal   = target_goal,   # Target goal
   columns_types = columns_types, # Columns types
)

# Fit the solver
solver.fit(
   service_key = service_key,
)

# Print the rule mining results
solver.print(mode='dense')

"""
                        contribution variable            rule     nans
i p_value coverage lift

0 7e-55   42.6%    1.46
                               78.8%      Sex            male
                               10.9%     Fare     [0.0, 26.0]
                               10.3%    Parch          [0, 0]
1 1e-12   12.9%    1.45
                               63.6%     Fare  [7.8875, 15.1]
                               36.4%      Age    [19.0, 26.0]  include
"""
```

In this specific example, the InsightSolver API gives us two rules in which we find more non-survivors of the Titanic:

- `(i=0)` : **Poor males without a family.** This group covers 42.6% of the passengers and has a non-survival gain of +46% compared to the population of the Titanic.
- `(i=1)` : **Poor young adults (include missing ages).** This group covers 12.9% of the passengers and has a non-survival gain of +45% compared to the population of the Titanic.

Note that there could be a survivor bias in the rule `i=1` because we know the age of the non-survivors less than we know the age of the survivors of the Titanic. In conclusion, using the InsightSolver API, we know that *Rose DeWitt Bukater* (young rich female, 1st class, with her family) had a higher chance to survive the Titanic than *Jack Dawson* (3rd class young male without a family). For more technical details about the API, please refer to the detailed documentation.

3.2 Advanced usage

This section provides a deeper look at how to use the InsightSolver API client.

Let's revisit the *Titanic* demo. Once the `solver` is fitted, we can do more than simply `print` the results. This becomes particularly important when integrating the InsightSolver API client into a Python pipeline.

3.2.1 Conventions

In InsightSolver, the parameter `target_goal` specifies the target modality of the target variable for which rules should capture a large number of 1's. By convention:

- A data point is considered a `1` if it matches the target modality specified by `target_goal`.
- A data point is considered a `0` otherwise.

It is important to note that these `0`'s and `1`'s are conventions used internally by InsightSolver and should not be confused with the actual values or modalities of the target variable in the dataset.

For instance, consider the Titanic dataset used in the *Titanic* example:

- Dataset: `kaggle_titanic_train.csv`.
- Target variable: `target_name='Survived'`.
- Target modalities: `0` (non-survivor), `1` (survivor).
- Target goals: either `target_goal=0` (looking for non-survivors) either `target_goal=1` (looking for survivors).

Here, the modalities `0` and `1` are specific to the Titanic dataset and represent whether a passenger survived or not.

- Total passengers: `891` rows.
- Non-survivors (`Survived=0`): 549 rows.
- Survivors (`Survived=1`): 342 rows.

Case 1: Looking for Survivors (`target_goal=1`)

When the goal is to identify survivors:

- `M=891`: Total population.
- `M0=549`: Number of `0`'s, representing non-survivors (`Survived=0`).
- `M1=342`: Number of `1`'s, representing survivors (`Survived=1`).

Case 2: Looking for Non-Survivors (`target_goal=0`)

When the goal is to identify non-survivors:

- `M=891`: Total population.
- `M0=342`: Number of `0`'s, representing survivors (`Survived=1`).
- `M1=549`: Number of `1`'s, representing non-survivors (`Survived=0`).

InsightSolver operates under the principle of capturing `1`'s and rejecting `0`'s, regardless of the specific meaning of these values in a given dataset.

3.2.2 Attributes of the solver

The `solver` object includes several relevant attributes, which are described exhaustively here. For now, let's take a brief look at the most important ones:

- `M`: The total number of points in the population.
- `M0`: The number of points classified as `0` in the population.
- `M1`: The number of points classified as `1` in the population.
- `rule_mining_results`: A dictionary containing the results of the rule mining process. Below, we'll explore methods to access and parse specific aspects of these results.

- `benchmark_scores`: A dictionary containing the best scores obtained on shuffled data. This is useful to compare the scores of the rules found in the real data against the scores of the rules found in random data.

3.2.3 Counting the number of rules

To obtain the number of rules found by the solver, we can use the `ruleset_count` method:

```
solver.ruleset_count() # 3

# 3 rules are found by the solver
```

Each rule in the solver is indexed by an integer, conventionally denoted as `i`.

3.2.4 Getting the index of the rules

To retrieve the range of rule indices, we can use the `get_range_i` method:

```
solver.get_range_i() # [0, 1, 2]
```

This shows that the index `i` can take the values `0`, `1` or `2`. Knowing this range is useful when iterating over individual rules in the solver.

3.2.5 Exhaustive dictionary of a given rule

Let's take a closer look at the rule at position `i=0`. We can retrieve an exhaustive dictionary of the rule at position `i=0` as follows:

```
    solver.i_to_rule(i=0)

# {
#     "m": 170,
#     "m0": 9,
#     "m1": 161,
#     "coverage": 0.19079685746352412,
#     "m1/M1": 0.47076023391812866,
#     "mu_rule": 0.9470588235294117,
#     "mu_pop": 0.3838383838383838,
#     "sigma_pop": 0.48659245426485753,
#     "lift": 2.4673374613003096,
#     "p_value": 1.925558554763681e-67,
#     "F_score": 0.62890625,
#     "Z_score": 16.767366956025956,
#     "rule_S": {
#         "Sex": "female",
#         "Pclass": [
#             1,
#             2
#         ]
#     },
#     "complexity_S": 2,
#     "F1_pop": 0.5547445255474452,
#     "G_bad_class": 0.17059483726150393,
#     "G_information": 0.24588549145241542,
#     "G_gini": 0.14958927829841417,
```

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```
#     "p_value_ratio_S": {
#         "Pclass": 5.359920512293736e-08,
#         "Name": 1.0,
#         "Sex": 5.022554571114061e-46,
#         "Age": 1.0,
#         "SibSp": 1.0,
#         "Parch": 1.0,
#         "Ticket": 1.0,
#         "Fare": 1.0,
#         "Cabin": 1.0,
#         "Embarked": 1.0
#     },
#     "F_score_ratio_S": {
#         "Pclass": 1.2812499999999998,
#         "Name": 1.0,
#         "Sex": 0.9302417652027029,
#         "Age": 1.0,
#         "SibSp": 1.0,
#         "Parch": 1.0,
#         "Ticket": 1.0,
#         "Fare": 1.0,
#         "Cabin": 1.0,
#         "Embarked": 1.0
#     },
#     "subrules_S": [
#         {
#             "M": 891,
#             "M0": 549,
#             "M1": 342,
#             "mu_pop": 0.3838383838383838,
#             "sigma_pop": 0.48659245426485753,
#             "F1_pop": 0.5547445255474452,
#             "m": 314,
#             "m0": 81,
#             "m1": 233,
#             "coverage": 0.35241301907968575,
#             "m1/M1": 0.6812865497076024,
#             "mu_rule": 0.7420382165605095,
#             "lift": 1.9332048273550118,
#             "mc": 577,
#             "m0c": 468,
#             "m1c": 109,
#             "p_value": 3.592513266469419e-60,
#             "F_score": 0.7103658536585366,
#             "Z_score": 16.20063097451895,
#             "G_bad_class": 0.17059483726150393,
#             "G_information": 0.21766010666061436,
#             "G_gini": 0.13964795747285225,
#             "complexity": 1,
#             "subrule_S": {
#                 "Sex": "female"
#             },
```

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```
#             "var_name": "Sex",
#             "var_rule": "female",
#             "p_value_ratio": 5.022554571114061e-46,
#             "shuffling_scores": {
#                 "p_value": {
#                     "cohen_d": 75.86463627446636,
#                     "effect_size": "6. huge",
#                     "wy_ratio": 0.0
#                 },
#                 "Z_score": {
#                     "cohen_d": 37.71820414056423,
#                     "effect_size": "6. huge",
#                     "wy_ratio": 0.0
#                 },
#                 "F_score": {
#                     "cohen_d": 51.16755087975539,
#                     "effect_size": "6. huge",
#                     "wy_ratio": 0.0
#                 }
#             }
#         },
#         {
#             "M": 891,
#             "M0": 549,
#             "M1": 342,
#             "mu_pop": 0.3838383838383838,
#             "sigma_pop": 0.48659245426485753,
#             "F1_pop": 0.5547445255474452,
#             "m": 170,
#             "m0": 9,
#             "m1": 161,
#             "coverage": 0.19079685746352412,
#             "m1/M1": 0.47076023391812866,
#             "mu_rule": 0.9470588235294117,
#             "lift": 2.4673374613003096,
#             "mc": 721,
#             "m0c": 540,
#             "m1c": 181,
#             "p_value": 1.925558554763681e-67,
#             "F_score": 0.62890625,
#             "Z_score": 16.767366956025956,
#             "G_bad_class": 0.17059483726150393,
#             "G_information": 0.24588549145241542,
#             "G_gini": 0.14958927829841417,
#             "complexity": 2,
#             "subrule_S": {
#                 "Sex": "female",
#                 "Pclass": [
#                     1,
#                     2
#                 ]
#             },
```

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```
#             "var_name": "Pclass",
#             "var_rule": [
#                 1,
#                 2
#             ],
#             "p_value_ratio": 5.359920512293736e-08,
#             "shuffling_scores": {
#                 "p_value": {
#                     "cohen_d": 85.9832032893128,
#                     "effect_size": "6. huge",
#                     "wy_ratio": 0.0
#                 },
#                 "Z_score": {
#                     "cohen_d": 39.52974355288319,
#                     "effect_size": "6. huge",
#                     "wy_ratio": 0.0
#                 },
#                 "F_score": {
#                     "cohen_d": 23.36359433204899,
#                     "effect_size": "6. huge",
#                     "wy_ratio": 0.0
#                 }
#             }
#         }
#     ],
#     "feature_contributions_S": {
#         "rule_S": {
#             "Sex": "female",
#             "Pclass": "[1, 2]"
#         },
#         "p_value_contribution": {
#             "Sex": 0.8616919700920942,
#             "Pclass": 0.13830802990790583
#         },
#         "F_score_contribution": {
#             "Sex": 1.0,
#             "Pclass": 0.0
#         },
#         "Z_score_contribution": {
#             "Sex": 0.9417181496074654,
#             "Pclass": 0.05828185039253464
#         },
#         "G_bad_class_contribution": {
#             "Sex": 1.0,
#             "Pclass": 0.0
#         },
#         "G_information_contribution": {
#             "Sex": 0.857675593215252,
#             "Pclass": 0.142324406784748
#         },
#         "G_gini_contribution": {
#             "Sex": 0.9099458875412633,
```

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```
#             "Pclass": 0.0900541124587367
#         }
#     },
#     "shuffling_scores": {
#         "p_value": {
#             "cohen_d": 85.9832032893128,
#             "effect_size": "6. huge",
#             "wy_ratio": 0.0
#         },
#         "Z_score": {
#             "cohen_d": 39.52974355288319,
#             "effect_size": "6. huge",
#             "wy_ratio": 0.0
#         },
#         "F_score": {
#             "cohen_d": 23.36359433204899,
#             "effect_size": "6. huge",
#             "wy_ratio": 0.0
#         }
#     }
# }
```

This dictionary contains detailed information and statistics about the rule at position `i=0`. Here are some of the key entries:

- `"m": 170`: This is the number of points captured by the rule. The rule contains 170 points in total.
- `"m0": 9`: This is the number of `0` captured by the rule. The rule contains 9 non-survivors.
- `"m1": 161`: This is the number of `1` captured by the rule. The rule contains 161 survivors.
- `"coverage": 0.19079685746352412`: This is the coverage of the rule, i.e. the ratio `m/M`. The rule covers 19.1% of the population.
- `"m1/M1": 0.47076023391812866`: This is the sensitivity of the rule, i.e. the capture rate of `1`. The rule captures 47.1% of the survivors.
- `"mu_rule": 0.9470588235294117`: This is the average of the target variable in the rule, i.e. the ratio `m1/m`. Here we have a survival rate of 94.7% in the rule.
- `"mu_pop": 0.3838383838383838`: This the average of the target variable in the population, i.e. the ration `M1/M`. Here we have a survival rate of 38.4% in the population.
- `"sigma_pop": 0.48659245426485753`: This is the standard deviation of the target variable in the population.
- `"lift": 2.4673374613003096`: This is the lift of the rule, i.e. the ratio `mu_rule/mu_pop`.
- `"p_value": 1.925558554763681e-67`: This is the p-value (according to the hypergeometric probability law, not the chi-squared) of the rule.
- `"F_score": 0.62890625`: This is the F1-score of the rule.
- `"Z_score": 16.767366956025956`: This is the Z-score of the rule.
- `"rule_S": {"Sex": "female","Pclass": [1,2]}`: The rule reads *Females in first or second class.*
- `"complexity_S": 2`: The complexity of the rule is 2, i.e. two variables are involded in the rule (`"Sex"` and `"Pclass"`).

- `"F1_pop": 0.5547445255474452`: This is the F1-score of the population.
- `"G_bad_class": 0.17059483726150393`: This is the bad classification gain of the rule.
- `"G_information": 0.24588549145241542`: This is the information gain of the rule.
- `"G_gini": 0.14958927829841417`: This is the Gini gain of the rule.
- `"shuffling_scores"`: This contains the scores that measure how strong is the rule compared to what would be found in shuffled data.

3.2.6 DataFrame of subrules

We can retrieve a DataFrame of the subrules for the rule at position `i=0` as follow:

```
    solver.i_to_subrules_dataframe(i=0)

#    p_value_ratio variable    rule  complexity       p_value   F_score  ...  m0c  m1c␣
↪G_bad_class  G_information    G_gini            subrule_S
# 0   5.022555e-46      Sex  female           1  3.592513e-60  0.710366  ...  468  109␣
↪  0.170595       0.217660  0.139648    {'Sex': 'female'}
# 1   5.359921e-08   Pclass  [1, 2]           2  1.925559e-67  0.628906  ...  540  181␣
↪  0.170595       0.245885  0.149589  {'Sex': 'female'...
```

The DataFrame of subrules begins with a rule of complexity 1 (e.g. `{"Sex": "female"}`) and progresses to higher complexities, such as complexity 2 (e.g. `{"Sex": "female","Pclass": [1,2]}`). As we can observe, increasing the complexity from 1 to 2 improves the p-values and the information gain but degrades the F1-score.

The purpose of the subrules DataFrame is to assist in deciding the optimal level of rule complexity based on various metrics.

3.2.7 DataFrame of features contributions

We can retrieve a DataFrame showing the contributions of the features for the rule at position `i=0` as follows:

```
    solver.i_to_feature_contributions_S(i=0)

#                p_value  F_score   Z_score  G_bad_class  G_information    G_gini
# feature_name
# Sex           0.861692      1.0  0.941718          1.0       0.857676  0.909946
# Pclass        0.138308      0.0  0.058282          0.0       0.142324  0.090054
```

As we can observe, the variable `"Sex"` provides the largest contribution. The variable `"Pclass"` adds a slight positive contribution to both the p-value and the information gain, as including it in the rule improves these metrics. However, the contribution of `"Pclass"` is zero for the F-score. This indicates that it does not enhance the F-score (in fact, it degrades it, but by convention, contributions are kept nonnegative).

3.2.8 Printing modes

Earlier in *Titanic* we saw the `dense` printing mode. There are three printing modes:

- `full`: A full print of the results.
- `light`: A lighter version of the full print.
- `dense`: A very compact version of the print.

3.2.9 Column types

The columns of a Pandas DataFrame are associated with a type known as a *dtype*, such as `int64`, `float64`, `object`, and so on. In addition to these, InsightSolver introduces a complementary layer of types called *btype*.

While *dtypes* describe the encoding of the data (e.g., integers or floats), *btypes* define how the data should be interpreted when mining for rules. These *btypes* include:

- `binary`: The variable is treated as a binary categorical variable, and rule mining will focus on finding subsets.
- `multiclass`: The variable is treated as a multiclass categorical variable, and rule mining will aim to find subsets.
- `continuous`: The variable is treated as an ordered variable, and rule mining will focus on identifying meaningful intervals.
- `ignore`: The variable is excluded from rule mining.

The *btypes* of the columns are automatically detected in InsightSolver, so its not mandatory to explicitly specify a *btype* for each variable. However, if the user wishes to specify the *btype* for some or all variables, this can be done using the `columns_types` dictionary (a key is a column name, a value is a *btype*). The `columns_types` dictionary can be passed as a parameter of the `solver`.

CHAPTER

FOUR

MODULES

4.1 insightsolver module

- *Organization*: InsightSolver
- *Project Name*: InsightSolver
- *Module Name*: insightsolver
- *File Name*: __init__.py
- *Author*: Noé Aubin-Cadot
- *Email*: noe.aubin-cadot@insightsolver.com
- *Last Updated*: 2025-04-24
- *First Created*: 2024-09-16

4.1.1 Description

The Python module *insightsolver* is an API client of the InsightSolver SaaS which is designed to generate advanced rule mining and data insights.

4.1.2 License

Exclusive Use License - see LICENSE for details.

---

class insightsolver.**InsightSolver**(*verbose: bool = False*, *df: DataFrame = None*, *target_name: str | int | None = None*, *target_goal: str | Real | uint8 | None = None*, *columns_types: Dict | None = {}*, *columns_descr: Dict | None = {}*, *threshold_M_max: int | None = 10000*, *specified_constraints: Dict | None = {}*, *top_N_rules: int | None = 10*, *filtering_score: str = 'auto'*, *n_benchmark_original: int = 5*, *n_benchmark_shuffle: int = 20*)

Bases: `object`

The class `InsightSolver` is meant to :

1. Take input data.
2. Make an insightsolver API calls to the server.
3. Present the results of the rule mining.

4.1.3 Attributes

df: DataFrame
The DataFrame that contains the data to analyse.

target_name: str (default None)
Name of the target variable (by default it's the first column).

target_goal: (str or int)
Target goal.

target_threshold: (int or float)
Threshold used to convert a continuous target variable to a binary target variable.

M: int
Number of points in the population.

M0: int
Number of points 0 in the population.

M1: int
Number of points 1 in the population.

columns_types: dict
Types of the columns.

columns_descr: dict
Textual descriptions of the columns.

other_modalities: dict
Modalities that are mapped to the modality 'other'.

threshold_M_max: int (default 10000)
Threshold on the maximum number of observations to consider, above which we under sample the observations.

specified_constraints: dict
Dictionary of the specified constraints on `m_min`, `m_max`, `coverage_min`, `coverage_max`.

top_N_rules: int (default 10)
An integer that specifies the maximum number of rules to get from the rule mining.

filtering_score: str (default 'auto')
A string that specifies the filtering score to be used when selecting rules.

n_benchmark_original: int (default 5)
An integer that specifies the number of benchmarking runs to execute where the target is not shuffled.

n_benchmark_shuffle: int (default 20)
An integer that specifies the number of benchmarking runs to execute where the target is shuffled.

monitoring_metadata: dict
Dictionary of monitoring metadata.

benchmark_scores: dict
Dictionary of the benchmarking scores against shuffled data.

rule_mining_results: dict
Dictionary that contains the results of the rule mining.

4.1.4 Methods

validate_class_integrity: None
Validates the integrity of the class.

ingest_dict: None
Ingests a Python dict.

ingest_json_string: None
Ingests a JSON string.

fit: None
Fits the solver.

S_to_index_points_in_rule: Pandas Index
Returns the index of the points in a rule S.

S_to_s_points_in_rule: Pandas Series
Returns a boolean Pandas Series that tells if the point is in the rule S.

S_to_df_filtered: Pandas DataFrame
Returns the filtered df of rows that are in the rule S.

ruleset_count: int
Counts the number of rules held by the InsightSolver.

i_to_rule: dict
Gives the rule i of the InsightSolver.

i_to_S: dict
Returns the rule S for the rule at index i.

i_to_subrules_dataframe: Pandas DataFrame
Returns a DataFrame containing the informations about the subrules of the rule i.

i_to_feature_contributions_S: Pandas DataFrame
Returns a DataFrame of the feature contributions of the variables in the rule S at position i.

i_to_readable_text: str
Returns the readable text of the rule i if it is available.

i_to_print: None
Prints the content of the rule i in the InsightSolver.

get_range_i: list
Gives the range of i in the InsightSolver.

print: None
Prints the content of the InsightSolver.

print_light: None
Prints the content of the InsightSolver ('light' mode).

print_dense: None
Prints the content of the InsightSolver ('dense' mode).

to_dict: dict
Exports the content of the InsightSolver object to a Python dict.

to_json_string: str
Exports the content of the InsightSolver object to a JSON string.

to_dataframe: Pandas DataFrame
Exports the rule mining results to a Pandas DataFrame.

to_csv: str
Exports the rule mining results to a CSV string and/or a local CSV file.

to_excel: None
Exports the rule mining results to a Excel file.

to_excel_string: str
Exports the rule mining results to a Excel string.

get_credits_needed_for_computation: int
Get the number of credits needed for the fitting computation of the solver.

get_df_credits_infos: Pandas DataFrame
Get a DataFrame of the transactions involving credits.

get_credits_available: int
Get the number of credits available.

show_feature_distributions_of_S: None
Generates bar plots of the distributions of the points in the specified rule S.

show_feature_contributions_of_i: None
Generates a horizontal bar plot of the feature contributions for each rule found in the solver.

show_all_feature_contributions: None
Generates the feature contributions and feature distributions for all rules found in the solver.

show_all_feature_contributions_and_distributions: None
Generates the feature contributions and feature distributions for all rules found in the solver.

4.1.5 Example

Here's a sample code to use the class `InsightSolver`:

```
# Specify the service key
service_key = 'name_of_your_service_key.json'

# Import some data
import pandas as pd
df = pd.read_csv('kaggle_titanic_train.csv')

# Specify the name of the target variable
target_name = 'Survived' # We are interested in whether the passengers survived or␣
↪not

# Specify the target goal
target_goal = 1 # We are searching rules that describe survivors

# Import the class InsightSolver from the module insightsolver
from insightsolver import InsightSolver

# Create an instance of the class InsightSolver
solver = InsightSolver(
        df          = df,          # A dataset
        target_name = target_name, # Name of the target variable
        target_goal = target_goal, # Target goal
)
```

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```
# Fit the solver
solver.fit(
        service_key = service_key, # Use your API service key here
)

# Print the rule mining results
solver.print()
```

__init__(*verbose: bool = False*, *df: DataFrame = None*, *target_name: str | int | None = None*, *target_goal: str | Real | uint8 | None = None*, *columns_types: Dict | None = {}*, *columns_descr: Dict | None = {}*, *threshold_M_max: int | None = 10000*, *specified_constraints: Dict | None = {}*, *top_N_rules: int | None = 10*, *filtering_score: str = 'auto'*, *n_benchmark_original: int = 5*, *n_benchmark_shuffle: int = 20*)

The initialization occurs when an `InsightSolver` class instance is created.

Parameters

verbose: bool (default False)
If we want the initialization to be verbose.

df: DataFrame
The DataFrame that contains the data to analyse (a target column and various feature columns).

target_name: str
Name of the column of the target variable.

target_goal: str (or other modality of the target variable)
Target goal.

columns_types: dict
Types of the columns.

columns_descr: dict
Descriptions of the columns.

threshold_M_max: int
Threshold on the maximum number of observations to consider, above which we sample observations.

specified_constraints: dict
Dictionary of the specified constraints on m_min, m_max, coverage_min, coverage_max.

top_N_rules: int (default 10)
An integer that specifies the maximum number of rules to get from the rule mining.

filtering_score: str (default 'auto')
A string that specifies the filtering score to be used when selecting rules.

n_benchmark_original: int (default 5)
An integer that specifies the number of benchmarking runs to execute where the target is not shuffled.

n_benchmark_shuffle: int (default 20)
An integer that specifies the number of benchmarking runs to execute where the target is shuffled.

Returns

solver: InsightSolver
An instance of the class InsightSolver.

Example

Here's a sample code to instantiante the class `InsightSolver`:

```
# Import the class InsightSolver from the module insightsolver
from insightsolver import InsightSolver

# Create an instance of the class InsightSolver
solver = InsightSolver(
        df          = df,          # A Pandas DataFrame
        target_name = target_name, # Name of the target variable
        target_goal = target_goal, # Target goal
)
```

ingest_dict(*d: dict*, *verbose: bool = False*) → None

This method aims to ingest a Python dict in the solver.

ingest_json_string(*json_string: str*, *verbose: bool = False*) → None

This method aims to ingest a JSON string in the solver.

fit(*verbose: bool = False*, *computing_source: str = 'auto'*, *service_key: str | None = None*, *user_email: str | None = None*, *api_source: str = 'auto'*, *do_compress_data: bool = True*, *do_compute_memory_usage: bool = True*, *do_check_enough_credits: bool = False*, *do_llm_readable_rules: bool = True*, *llm_source: str = 'auto'*, *llm_language: str = 'auto'*, *do_store_llm_cache: bool = True*, *do_check_llm_cache: bool = True*) → None

This method aims to fit the solver.

S_to_index_points_in_rule(*S: dict*, *verbose: bool = False*, *df: DataFrame | None = None*) → Index

This method returns the index of the points inside a rule S.

S_to_s_points_in_rule(*S: dict*, *verbose: bool = False*, *df: DataFrame | None = None*) → Series

This method returns a boolean Series that tells if the points are in the rule S or not.

S_to_df_filtered(*S: dict*, *verbose: bool = False*, *df: DataFrame | None = None*)

This method returns the DataFrame of rows of df that lie inside a rule S.

ruleset_count() → int

This method returns the number of rules held in the InsightSolver.

i_to_rule(*i: int*) → dict

i_to_S(*i*)

This method returns the rule S at position i.

i_to_subrules_dataframe(*i: int = 0*) → DataFrame

This method returns a DataFrame which contains the informations about the subrules of the rule i.

i_to_feature_contributions_S(*i: int*, *do_rename_cols: bool = True*, *do_ignore_col_rule_S: bool = True*) → DataFrame

This method returns a DataFrame of the feature contributions of the variables in the rule S at position i.

i_to_readable_text(*i*) → str | None

Returns the readable text of the rule i if it is available.

i_to_print(*i: int*, *indentation: str = ''*, *do_print_rule_DataFrame: bool = False*, *do_print_subrules_S: bool = True*, *do_show_coverage_diff: bool = False*, *do_show_cohen_d: bool = True*, *do_show_wy_ratio: bool = True*, *do_print_feature_contributions_S: bool = True*) → None

This method prints the content of the rule i in the InsightSolver.

get_range_i(*complexity_max: int | None = None*) → list

This method gives the range of i in the InsightSolver. If the integer complexity_max is specified, return only this number of elements.

print(*verbose: bool = False*, *r: int | None = None*, *do_print_dataset_metadata: bool = True*, *do_print_monitoring_metadata: bool = False*, *do_print_benchmark_scores: bool = True*, *do_show_cohen_d: bool = True*, *do_show_wy_ratio: bool = True*, *do_print_rule_mining_results: bool = True*, *do_print_rule_DataFrame: bool = False*, *do_print_subrules_S: bool = True*, *do_show_coverage_diff: bool = False*, *do_print_feature_contributions_S: bool = True*, *separation_width_between_rules: int | None = 79*, *mode: str = 'full'*) → None

This method prints the content of the InsightSolver.

print_light(*print_format: str = 'list'*) → None

This method does a 'light' print of the InsightSolver.

Two formats: - 'list': shows the rules via a loop of prints. - 'compact': shows the rules in a single DataFrame.

print_dense() → None

This method is aimed at printing a 'dense' version of the InsightSolver object.

to_dict() → dict

This method aims to export the content of the InsightSolver object to a dictionary.

to_json_string(*verbose=False*) → str

This method aims to export the content of the InsightSolver object to a JSON string.

to_dataframe(*verbose=False*, *do_append_datetime=False*, *do_rename_cols=False*) → DataFrame

This method aims to export the content of the InsightSolver object to a DataFrame.

to_csv(*output_file=None*, *verbose=False*, *do_rename_cols=False*) → str

This method is meant to export the content of the InsightSolver object to a CSV file.

to_excel(*output_file*, *verbose=False*, *do_rename_cols=False*) → None

This method is meant to export the RuleSet to a Excel file.

to_excel_string(*verbose=False*, *do_rename_cols=False*) → str

This method is meant to export the RuleSet to a Excel string.

get_credits_needed_for_computation() → int

This method is meant to compute the number of credits for the computation during the fitting of the solver.

get_df_credits_infos(*computing_source: str = 'auto'*, *service_key: str | None = None*, *user_email: str | None = None*) → DataFrame

This method is meant to retrieve from the server the transactions involving credits.

get_credits_available(*computing_source: str = 'auto'*, *service_key: str | None = None*, *user_email: str | None = None*) → int

This method is meant to retrieve from the server the amount of credits available.

show_feature_distributions_of_S(*S: dict*, *padding_y: int = 5*, *do_show_kde: bool = False*, *do_show_vertical_lines: bool = False*) → None

This method generates bar plots of the distributions of the points in the specified rule S.

Parameters

S
[dict] The rule S that we wish to visualize.

padding_y: int
The padding used for the ylim.

do_show_kde: bool
Boolean to show the KDE of the continuous features.

show_feature_contributions_of_i(*i: int*, *a: float = 0.5*, *b: float = 1*, *fig_width: float = 12*, *language: str = 'en'*, *do_grid: bool = True*, *do_title: bool = False*, *do_banner: bool = True*, *loss: float | None = None*) → None

This method returns a horizontal bar plots of the feature constributions of a specified rule S.

Parameters

i: int
The index of the rule to show.

a: float
Height per bar.

b: float
Added height to the figure.

fig_width: float
Width of the figure

language: str
Language of the figure ('fr' or 'en').

do_grid: bool
If we want to show a vertical grid behind the horizontal bars.

do_title: bool
If we want to show a title.

do_banner: bool
If we want to show the banner.

loss: float
If we want to show a loss.

show_all_feature_contributions(*a: float = 0.5*, *b: float = 1*, *fig_width: float = 12*, *language: str = 'en'*, *do_grid: bool = True*, *do_title: bool = False*, *do_banner: bool = True*) → None

This method generates a horizontal bar plot of the feature contributions for each rule found in a solver.

Parameters

a: float
Height per bar.

b: float
Added height to the figure.

fig_width: float
Width of the figure

language: str
Language of the figure ('fr' or 'en').

do_grid: bool
If we want to show a vertical grid behind the horizontal bars.

do_title: bool
If we want to show a title.

do_banner: bool
If we want to show the banner.

`show_all_feature_contributions_and_distributions`(*do_banner: bool = True*) → None

This method generates the feature contributions and feature distributions for all rules found in a fitted solver.

Parameters

do_banner: bool
If we want to show the banner.

4.2 api_utilities module

- *Organization*: InsightSolver
- *Project Name*: InsightSolver
- *Module Name*: insightsolver
- *File Name*: api_utilities.py
- *Author*: Noé Aubin-Cadot
- *Email*: noe.aubin-cadot@insightsolver.com
- *Last Updated*: 2025-04-23
- *First Created*: 2024-09-16

4.2.1 Description

This file provides essential utility functions to secure and streamline client-server communication within the API. It includes functions for data compression, encryption, decryption, and transformations of data structures, all designed to facilitate efficient and protected message exchange between the client and server.

While all communications are secured via HTTPS, this file goes a step further by adding an additional layer of encryption, using RSA-4096 and ECDSA-SECP521R1 for secure key exchange and AES-256 for data encryption. These functions are particularly useful for scenarios requiring enhanced data privacy and integrity.

4.2.2 Functions provided

- `hash_string`: Computes the hash of a string.
- `convert_bytes_to_base64_string`: Convert bytes to a base64 string.
- `convert_base64_string_to_bytes`: Convert a base64 string to bytes.
- `compress_string`: Compress a string using gzip.
- `decompress_string`: Decompress a gzip-compressed string.
- `compress_and_encrypt_string`: Compress and encrypt a string for secure transmission.
- `decrypt_and_decompress_string`: Decrypt an encrypted string.
- `transform_dict`: Convert a dictionary for easier client-server communication.
- `untransform_dict`: Reverse the dictionary transformation to restore the original data format.
- `generate_keys`: Generate RSA and ECDSA private and public keys.
- `compute_credits_from_df`: Compute the amount of credits consumed for a given DataFrame.
- `request_cloud_credits_infos`: Request the server for informations about the credits available.
- `request_cloud_public_keys`: Request the server for public keys.
- `request_cloud_computation`: Request the server for computation.
- `search_best_ruleset_from_API_dict`: Make the API call.

4.2.3 License

Exclusive Use License - see LICENSE for details.

`insightsolver.api_utilities.`**`hash_string`**(*string*)

A function to compute the hash of a string using hashlib.

`insightsolver.api_utilities.`**`convert_bytes_to_base64_string`**(*data: bytes*) → str

Convert a bytes object to a base64-encoded string.

4.2.4 Parameters

data

[bytes] The byte data to encode.

4.2.5 Returns

str

The base64-encoded string.

`insightsolver.api_utilities.`**`convert_base64_string_to_bytes`**(*string: str*) → bytes

Convert a base64-encoded string to a bytes object.

4.2.6 Parameters

string

[str] The base64-encoded string.

4.2.7 Returns

bytes
The decoded byte data.

insightsolver.api_utilities.**compress_string**(*original_string: str*) → str

Compress a string using gzip and then encode it to base64.

4.2.8 Parameters

original_string
[str] The original string to be compressed.

4.2.9 Returns

str
The compressed string.

4.2.10 Example

```
original_string = "This is a test string"
compressed_string = compress_string(original_string)
print(compressed_string)  # Example output: 'H4sIAA01/2YC/
↪wvJyCxWAKJEhZLU4hKF4pKizLx0AG3zTmsVAAAA'
```

insightsolver.api_utilities.**decompress_string**(*compressed_string: str*) → str

Decompress a base64-encoded string that was previously compressed using gzip.

This function takes a base64-encoded string, decodes it, and then decompresses the resulting data using gzip to return the original string.

4.2.11 Parameters

compressed_string
[str] The base64-encoded string that contains the compressed data.

4.2.12 Returns

str
The original uncompressed string.

4.2.13 Example

```
compressed_string = 'H4sIAA01/2YC/wvJyCxWAKJEhZLU4hKF4pKizLx0AG3zTmsVAAAA'
original_string = decompress_string(compressed_string)
print(original_string) # 'This is a test string'
```

insightsolver.api_utilities.**compress_and_encrypt_string**(*original_string: str*, *symmetric_key: bytes*) → tuple[str, str]

Compress and encrypt a string using AES-256-GCM.

This function compresses the given string using gzip and then encrypts it using AES-256 in GCM mode. A nonce is used in the encryption process for AES-GCM, and the result is base64-encoded for easy transfer over networks.

Security: - AES-256 encryption - GCM (Galois/Counter Mode) with authentication

4.2.14 Parameters

original_string
[str] The original string to be compressed and encrypted.

symmetric_key
[bytes] The 32-byte symmetric key used for encryption.

4.2.15 Returns

tuple[str, str]
A tuple containing the base64-encoded encrypted compressed string and the base64-encoded nonce used.

4.2.16 Example

```
transformed_string, nonce_string = compress_and_encrypt_string(
        original_string = "Secret data",
        symmetric_key   = token_bytes(32),
)
print(transformed_string, nonce_string) # 'Base64_encoded_result', nonce_string
```

insightsolver.api_utilities.**decrypt_and_decompress_string**(*transformed_string: str*, *symmetric_key: bytes*, *nonce: bytes*) → str

Decrypt and decompress a string using AES-256-GCM.

This function takes a base64-encoded encrypted string, decrypts it using AES-256 in GCM mode with the provided symmetric key and nonce, and then decompresses the result using gzip.

Security: - AES-256 encryption - GCM (Galois/Counter Mode) with authentication

4.2.17 Parameters

transformed_string
[str] The base64-encoded string that contains the encrypted and compressed data.

symmetric_key
[bytes] The 32-byte symmetric key used for decryption.

nonce
[bytes] The nonce used for AES-GCM during encryption.

4.2.18 Returns

str
The original uncompressed and decrypted string.

4.2.19 Raises

Exception
If the decryption fails.

4.2.20 Example

```
original_string = decrypt_and_decompress_string(
        transformed_string = encrypted_compressed_string,
        symmetric_key      = token_bytes(32),
        nonce              = nonce
)
print(original_string) # 'Secret data'
```

insightsolver.api_utilities.**transform_dict**(*d_original: dict*, *do_compress_data: bool = False*, *symmetric_key: bytes | None = None*, *json_format: str = 'json'*) → dict

Transform the contents of a dictionary by optionally compressing and encrypting its data.

This function takes a dictionary and converts it to a string. Depending on the options provided, it can compress the data using gzip, encrypt it using AES-256, or both. The resulting string is returned in a transformed dictionary format for easier transmission or storage.

4.2.21 Parameters

d_original
[dict] The original dictionary that needs to be transformed.

do_compress_data
[bool, optional] Whether or not to compress the dictionary data (default is False).

symmetric_key
[bytes, optional] A symmetric key. Typically generated using from secrets import token_bytes;symmetric_key = token_bytes(32). If provided, the data will be encrypted (default is None).

json_format
[str, optional] The format to convert the dictionary to a string. Can be 'json' or 'jsonpickle' (default is 'json').

4.2.22 Returns

dict
A dictionary containing the transformed string, the transformations applied, and the json format.

4.2.23 Example

```
d_original = {'A':1, 'B':2, 'C':3}
from secrets import token_bytes
symmetric_key = token_bytes(32) # b'\x1a\xef&\x0bR\xe1\x95\xfa\x90\x10r\x93\x1a\xaeN\
↪xc2\xba\x80\xf1\x1a\x0fG\xf4(\x0e#\xd4\xaf`\x81q\xf4'
d_transformed = transform_dict(
        d_original       = d_original,
        do_compress_data = True,
        symmetric_key    = symmetric_key,
        json_format      = 'json',
)
print(d_transformed)
# {
#       'transformations': 'encrypted_gzip_base64',
```

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```
#       'json_format': 'json',
#       'transformed_string':
↪'q30qPkK19Z3sENnfk77t4CnpzWKV+gdHLLSpNNgU3DjdmEbLcZWj+AjZyFmUquuUmh6obZmTh8k=',
#       'nonce_string': '7PpTvoc0Ksx8whRy',
# }
```

insightsolver.api_utilities.**untransform_dict**(*d_transformed: dict*, *symmetric_key: bytes | None = None*, *verbose: bool = False*) → dict

Decompress and decrypt the contents of a transformed dictionary.

This function takes a dictionary that has been transformed (e.g., compressed, encrypted), and restores its original contents by reversing the transformations. Depending on the transformation type, it may decrypt and/or decompress the data.

4.2.24 Parameters

d_transformed
: [dict] The transformed dictionary containing the compressed/encrypted string, the transformations applied, and the json format used.

symmetric_key
: [bytes, optional] A symmetric key. Typically generated using `from secrets import token_bytes; symmetric_key = token_bytes(32)`. If provided, the data will be decrypted using this key (default is None).

verbose
: [bool, optional] If True, additional debug information will be printed (default is False).

4.2.25 Returns

dict
: The original dictionary with its content restored.

4.2.26 Raises

Exception
: If an invalid transformation type or JSON format is provided.

4.2.27 Example

```
d_transformed = {
        'transformations'    : 'encrypted_gzip_base64',
        'json_format'        : 'json',
        'transformed_string' :
↪'q30qPkK19Z3sENnfk77t4CnpzWKV+gdHLLSpNNgU3DjdmEbLcZWj+AjZyFmUquuUmh6obZmTh8k='
        'nonce_string'       : '7PpTvoc0Ksx8whRy',
}
d_untransformed = untransform_dict(
        d_transformed = d_transformed,
        symmetric_key = symmetric_key, # b'\x1a\xef&\x0bR\xe1\x95\xfa\x90\x10r\x93\
↪x1a\xaeN\xc2\xba\x80\xf1\x1a\x0fG\xf4(\x0e#\xd4\xaf^\x81q\xf4'
)
print(d_untransformed) # {'A': 1, 'B': 2, 'C': 3}
```

insightsolver.api_utilities.**generate_keys**()

This function generates RSA and ECDSA private and public keys. The generated keys:

- rsa_private_key
- ecdsa_private_key
- rsa_public_key_pem_bytes
- ecdsa_public_key_pem_bytes

4.2.28 Returns

tuple

A tuple containing four elements:

- rsa_private_key: The generated RSA private key.
- ecdsa_private_key: The generated ECDSA private key.
- rsa_public_key_pem_bytes: The RSA public key serialized in PEM format.
- ecdsa_public_key_pem_bytes: The ECDSA public key serialized in PEM format.

insightsolver.api_utilities.**generate_url_headers**(*computing_source: str*, *input_file_service_key: str | None = None*) → Tuple[str, Dict[str, Any] | None]

This function generates the url and the headers for the POST request.

4.2.29 Parameters

computing_source

[str] Where the server is.

input_file_service_key

[optional] The client's service key, needed if the server is remote. Default is *None*.

insightsolver.api_utilities.**compute_credits_from_df**(*df: DataFrame*) → int

This function computes the number of credits consumed by a rule mining via the API. This number is based on the size of the DataFrame sent to the API.

4.2.30 Parameters

df

[pd.DataFrame] Input DataFrame whose size is used to compute credits.

4.2.31 Returns

int

The computed number of credits consumed.

insightsolver.api_utilities.**request_cloud_credits_infos**(*computing_source: str*, *d_out_credits_infos: dict*, *input_file_service_key: str | None = None*, *user_email: str | None = None*, *timeout: int = 60*) → dict

Send a dict that specifies which infos about the credits are asked for.

4.2.32 Parameters

computing_source
[str] Where the server is.

d_out_credits_infos
[dict] A dictionary containing the infos about the credits that are asked for. The dictionary format is:

- `private_key_id`: private_key_id of the service_key.
- `user_email`: Email of the user.
- `do_compute_credits_available`: A boolean that specifies where the number of credits available is requested.
- `do_compute_df_credits_infos`: A boolean that specifies if a DataFrame containing all credits transactions is asked for.

input_file_service_key
[optional] The client's service key, needed if the server is remote. Default is *None*.

timeout
[int, optional] The timeout duration for the request, in seconds. Default is 60 seconds, as this operation is typically fast and does not involve computation.

`insightsolver.api_utilities.`**`request_cloud_public_keys`**(*computing_source: str*, *d_client_public_keys: dict*, *input_file_service_key: str | None = None*, *timeout: int = 60*) → dict

Send the client's public keys to the server and receive the server's public keys in response.

This function establishes a secure connection to the specified server (`computing_source`) and sends the client's public keys (`d_client_public_keys`). The server responds with its own set of public keys, which are returned in a dictionary format.

4.2.33 Parameters

computing_source
[str] Where the server is.

d_client_public_keys
[dict] A dictionary containing the client's public keys to be sent to the server. The dictionary format is:

- `alice_rsa_public_key_pem_base64`: Client's RSA public key, encoded in base64.
- `alice_ecdsa_public_key_pem_base64`: Client's ECDSA public key, encoded in base64.

input_file_service_key
[optional] The client's service key, needed if the server is remote. Default is *None*.

timeout
[int, optional] The timeout duration for the request, in seconds. Default is 60 seconds, as this operation is typically fast and does not involve computation.

4.2.34 Returns

dict
A dictionary containing the server's public keys and a unique session identifier. The dictionary format is as follows:

- `session_id`: A unique identifier for the session.

- bob_rsa_public_key_pem_base64: Server's RSA public key, encoded in base64.
- bob_ecdsa_public_key_pem_base64: Server's ECDSA public key, encoded in base64.

4.2.35 Example

```
# Client's public keys
d_client_public_keys = {
        'alice_rsa_public_key_pem_base64': '<base64-encoded RSA public key>',
        'alice_ecdsa_public_key_pem_base64': '<base64-encoded ECDSA public key>',
}

# Request server public keys
d_server_public_keys = request_cloud_public_keys(
        computing_source='https://server-address.com',
        d_client_public_keys=d_client_public_keys,
        input_file_service_key='client_service_key'
)

# Access the session ID and server's public keys
session_id = d_server_public_keys['session_id']
bob_rsa_public_key = d_server_public_keys['bob_rsa_public_key_pem_base64']
bob_ecdsa_public_key = d_server_public_keys['bob_ecdsa_public_key_pem_base64']
```

4.2.36 Raises

Exception
If the request fails or the server does not return the expected keys.

insightsolver.api_utilities.**request_cloud_computation**(*computing_source: str*, *d_out_transformed: dict*, *input_file_service_key: str | None = None*, *timeout: int = 600*, *verbose: bool = False*) → dict

Send the transformed dict to the server for it to compute the rule mining.

4.2.37 Parameters

computing_source
[str] The computing source.

d_out_transformed
[dict] The transformed dict to send to the server.

input_file_service_key
[str, optional] The client's service key, needed if the server is remote. Default is *None*.

timeout
[int, optional] Timeout for the request, in seconds. Default is 600 seconds, as computation may take longer.

4.2.38 Returns

dict
The dict that contains the rule mining results.

insightsolver.api_utilities.**search_best_ruleset_from_API_dict**(*d_out_original: dict*, *input_file_service_key: str | None = None*, *user_email: str | None = None*, *computing_source: str = 'remote_cloud_function'*, *do_compress_data: bool = True*, *do_compute_memory_usage: bool = True*, *verbose: bool = False*) → dict

Search for the best ruleset where the computation is done from the server.

4.2.39 Parameters

d_out_original: dict
The original dict, pre-transformation, that contains the necessary data for the server to do rule mining.

input_file_service_key: str, optional
The service key of the client.

user_email: str, optional
Email of the user (only for use inside a Google Cloud Run container).

computing_source: str, optional
The computing source.

do_compress_data: bool, optional
If we want to compress the data to reduce transmission size.

do_compute_memory_usage: bool, optional
If we want to compute the memory usage.

verbose: bool, optional
Verbosity.

4.2.40 Returns

dict
The dict that contain the output of the rule mining from the server.

4.3 visualization module

- *Organization*: InsightSolver
- *Project Name*: InsightSolver
- *Module Name*: insightsolver
- *File Name*: visualization.py
- *Author*: Noé Aubin-Cadot
- *Email*: noe.aubin-cadot@insightsolver.com
- *Last Updated*: 2025-04-25
- *First Created*: 2025-04-24

4.3.1 Description

This file contains some visualization functions, some of which are integrated as a method of the InsightSolver class.

4.3.2 Functions provided

- classify_variable_as_continuous_or_categorical
- compute_feature_label
- show_feature_distributions_of_S
- generate_insightsolver_banner
- show_feature_contributions_of_i
- show_all_feature_contributions
- show_all_feature_contributions_and_distributions

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---

insightsolver.visualization.**classify_variable_as_continuous_or_categorical**(*s: Series*, *unique_ratio_threshold: float = 0.1*) → str

This function is meant to classify a series as continuous or categorical. This is used to decide which plot to do with it.

4.3.4 Parameters

s: pd.Series
Series that needs to be classified.

unique_ratio_threshold: float
Threshold on the *unique_ratio*.

4.3.5 Returns

categorical_or_continuous: str
The classification of the Series.

insightsolver.visualization.**compute_feature_label**(*solver*, *feature_name: str*, *S: dict*) → [<class 'str'>, <class 'str'>]

This function computes the label of a feature in a rule S.

4.3.6 Parameters

solver: InsightSolver
The solver.

feature_name: str
The name of the feature.

S: dict
The rule S.

4.3.7 Returns

feature_label: str
The label of the feature.

feature_relationship: str
The relationship of the feature to the constraints.

insightsolver.visualization.**show_feature_distributions_of_S**(*solver*, *S: dict*, *padding_y: int = 5*, *do_show_kde: bool = False*, *do_show_vertical_lines: bool = False*) → None

This function generates bar plots of the distributions of the points in the specified rule S.

4.3.8 Parameters

solver
[InsightSolver] The solver object.

S
[dict] The rule S that we wish to visualize.

padding_y: int
The padding used for the ylim.

do_show_kde: bool
Boolean to show the KDE of the continuous features.

insightsolver.visualization.**generate_insightsolver_banner**(*solver*, *i: int*, *loss: float | None = None*)

This function returns an image containing the parameters for p-value, purity, lift, coverage, size and loss value of a specified rule.

4.3.9 Parameters

solver: InsightSolver
The solver.

i: int
Index of the rule.

loss: float
Some loss to show in the banner.

4.3.10 Returns

image: Image
Image of the banner (with the values).

insightsolver.visualization.**show_feature_contributions_of_i**(*solver*, *i: int*, *a: float = 0.5*, *b: float = 1*, *fig_width: float = 12*, *language: str = 'en'*, *do_grid: bool = True*, *do_title: bool = False*, *do_banner: bool = True*, *loss: float | None = None*) → None

This function returns a horizontal bar plots of the feature constributions of a specified rule S.

4.3.11 Parameters

solver: InsightSolver
The fitted solver that contains the identified rules.

i: int
The index of the rule to show.

a: float
Height per bar.

b: float
Added height to the figure.

fig_width: float
Width of the figure

language: str
Language of the figure ('fr' or 'en').

do_grid: bool
If we want to show a vertical grid behind the horizontal bars.

do_title: bool
If we want to show a title.

do_banner: bool
If we want to show the banner.

loss: float
If we want to show a loss.

insightsolver.visualization.**show_all_feature_contributions**(*solver*, *a: float = 0.5*, *b: float = 1*, *fig_width: float = 12*, *language: str = 'en'*, *do_grid: bool = True*, *do_title: bool = False*, *do_banner: bool = True*) → None

This function generates a horizontal bar plot of the feature contributions for each rule found in a solver.

4.3.12 Parameters

solver: InsightSolver
The fitted solver that contains the identified rules.

a: float
Height per bar.

b: float
Added height to the figure.

fig_width: float
Width of the figure

language: str
Language of the figure ('fr' or 'en').

do_grid: bool
If we want to show a vertical grid behind the horizontal bars.

do_title: bool
If we want to show a title.

do_banner: bool
If we want to show the banner.

insightsolver.visualization.**show_feature_contributions_and_distributions_of_i**(*solver*, *i: int*, *do_banner: bool = True*, *loss: float | None = None*) → None

This function returns a bar plot of the feature contributions and a distribution of the points in the rule i.

4.3.13 Parameters

solver: InsightSolver
The fitted solver that contains the identified rules.

i: int
The index of the rule to show.

do_banner: bool
If we want to show the banner.

loss: float
If we want to show a loss.

insightsolver.visualization.**show_all_feature_contributions_and_distributions**(*solver*, *do_banner: bool = True*) → None

This function generates the feature contributions and feature distributions for all rules found in a fitted solver.

4.3.14 Parameters

solver: InsightSolver
The fitted solver that contains the identified rules.

do_banner: bool
If we want to show the banner.

CHAPTER

FIVE

HELP

If you need assistance with the InsightSolver API client, please follow the resources below in the suggested order:

5.1 1. Technical Documentation

The technical documentation provides detailed guidance on installation, usage, and troubleshooting. Start here if you are encountering issues.

- **Installation Guide**: Refer to the *Installation Guide* for step-by-step instructions.
- **Quickstart Usage Example**: Check out the *Quickstart Example* for a simple and practical example to get started quickly. This example demonstrates how to use the InsightSolver API client and may inspire you to adapt it to your specific needs.
- **API Reference**: Explore the *API Reference* for detailed information on available methods and parameters.

5.2 2. Frequently Asked Questions (FAQ)

The FAQ section addresses common questions and issues.

- **How do I install the API client?**

  Please see the *Installation Guide*.

- **What should I do if I encounter a connection error?**

  Ensure your service key is valid, and check that your network permits outgoing connections.

5.3 3. GitHub Issues

For reporting bugs or exploring existing issues, visit our GitHub Issues page.

5.4 4. Contact Support

If the above resources do not resolve your issue, you can contact us directly at:

- **Email**: support@insightsolver.com

CHAPTER

SIX

LICENSE

```
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```

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