



# Developer Manual

TeamAFK - Project Predire in Grafana

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## Informations about the document

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## Description

Developer manual made by *TeamAFK* for the project *Predire in Grafana*.

## Changelog

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# 1 Introduction

## 1.1 Document's purpose

The developer's manual allows each developer reader to absorb *"Predire in Grafana<sub>G</sub>"*'s product key information to maintain and extend the product itself. This document describes the product in its totality, giving the developer an exhaustive explanation required for his tasks.

## 1.2 Predire in Grafana's Purpose

*"Predire in Grafana"* is a plugin made for Grafana which is an open source<sub>G</sub> platform commonly used to analyze data series. The plugin allows users to predict datas on a stream data. *"Predire in Grafana"* plugin uses a JSON<sub>G</sub> file which contains a trained algorithm definition to get predictions. Users can use an external training tool, which use Machine Learning<sub>G</sub>, to get these JSON' files. At the moment only Support Vector Machine and Linear Regression algorithm are implemented. In more detail input datas, like cpu's usage and cpu's temperature, are constantly monitored to get predictions on the aspect you want to examine. Predictions are shown throught Grafana GUI<sub>G</sub> and continue to be updated after being calculated from datas coming from a database. Thanks to this operators can monitor each process and intervene at the root of the problem whenever neccessary.

## 1.3 Glossary

At the end of the document in the appendix is available a glossary where explanations for new or ambiguous terms can be found. These are marked with a subscript G.

## 1.4 References

### 1.4.1 Installation

- <https://nodejs.org/en/> (<https://nodejs.org/it/>);
- <https://git-scm.com/>;
- <https://www.gitkraken.com/>;
- <https://grafana.com/get>;
- <https://www.jetbrains.com/idea/>.

### 1.4.2 Technologies

- <https://reactjs.org/docs/getting-started.html>;
- <https://grafana.com/docs/grafana/latest/developers/plugins/>;
- <https://www.jetbrains.com/help/idea/eslint.html>.

### 1.4.3 Legal

- <https://www.apache.org/licenses/LICENSE-2.0>.

### 1.4.4 Informative

- [https://en.wikipedia.org/wiki/Linear\\_regression](https://en.wikipedia.org/wiki/Linear_regression);
- [https://en.wikipedia.org/wiki/Support\\_vector\\_machine](https://en.wikipedia.org/wiki/Support_vector_machine).



## 2 System Requirements

Here the requirements for use of the product are listed.

### 2.1 Minimum Hardware Requirements

Here the requirements for use of the product are listed.

- 2GB of RAM;
- 5GB of space on a drive;
- Dual core processor.

### 2.2 Compatible Operating Systems

The software was developed and tested on the following:

- Windows 10;
- MacOS 10.15;
- Ubuntu 18, 20.

### 2.3 Compatible Browsers

*Predire in Grafana* can be accessed through the following browsers:

- Google Chrome: version 58 or newer;
- Mozilla Firefox: version 54 or newer;
- Apple Safari: version 10 or newer;
- Microsoft Edge: version 14 or newer;
- Opera version: 55 or newer.

## 3 Installation

### 3.1 Instruments installation

#### 3.1.1 Node.js installation

The installation of the runtime JavaScript Node.js can be done by visiting Node.js page at <https://nodejs.org/en/download/>. In this site the developer can download the most suitable version of Node.js for his operative system. For Linux user is also possible to use the package manager provided by the OS<sub>G</sub> and exclusively for **Ubuntu/Debian** developers can run in terminal this code:

```
apt-get install nodejs
```

#### 3.1.2 Git installation

For the installation of the version control system, the developer needs to reach Git site's at <https://git-scm.com/downloads>. Inside the 'Download' section are available the links to download the compatible version with his operative system. Also Linux base system can install Git from their package manager or running from **Ubuntu/Debian** terminal this line:

```
apt-get install git
```

### 3.2 Grafana installation

Developers can install Grafana by reaching its download page at <https://grafana.com/grafana/download>. There they can download compatible version for MacOS, Windows and Linux base system. Furthermore, the most common Unix base systems can install Grafana running terminal lines showed in the same page.

#### 3.2.1 WEB Grafana execution

Depending from which OS the developer is working on, the execution of WEB Grafana can be done by:

- **Windows:** opening "bin" folder in Grafana installation folder (the path should be like C:/Program Files/grafana-6.7.3/bin/), and double-clicking on "grafana-server.exe";
- **Linux and MacOS:** running on terminal the following line:  

```
systemctl start grafana-server
```

After that, the developer needs to reach the address <http://localhost:3000/> through a browser. For the first access, the developer needs to fill the fields username with "admin" and password with "admin", and once he/she is in, he/she will need to register himself/herself into the system for next accesses.

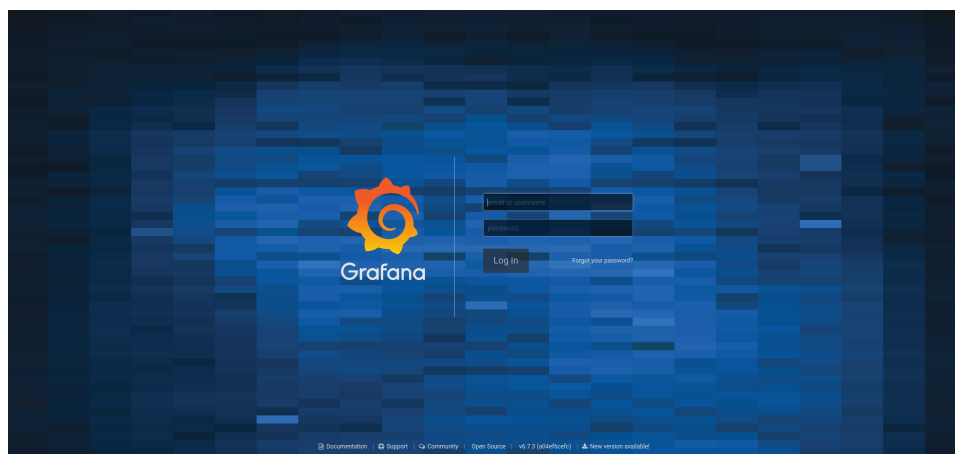


Figure 3.2.1: WEB Grafana page at <http://localhost:3000>

### 3.3 Plugin and Tool installation

The following sections will guide developers to install correctly both Training Tool and Prediction Tool.

#### 3.3.1 GitHub repository clone

The developer to clone the GitHub repository needs to open the terminal and choose a folder inside the filesystem with command:

```
cd /path/to/folder
```

After that, in the same location, the developer needs to run this line:

```
git clone https://github.com/teamafkSWE/PredireInGrafana-SW.git
```

This line creates the folder that contains the source code of Training Tool and Prediction Plugin.

### 3.4 Dependencies

Dependencies are a list of packages needed to develop and run the project. For this reason, other developers will need to install all them to run correctly the tool and plugin. This operation can be done by moving to tool or plugin's folder and there run this line:

```
npm install
```

The following tables contain all the dependencies adopted to make both tool and plugin.

Table 3.4.1: Table of Training Tool dependency

Package	Version
@testing-library/react	9.5.0
@testing-library/user-event	7.2.1
bootstrap	4.4.1
chart.js	2.9.3

Table 3.4.1: (continua)

Package	Version
is-promise	2.2.2
libsvm-js	0.2.1
ml-svm	2.1.2
react	16.13.1
react-bootstrap	1.0.1
react-chartjs-2	2.9.0
react-csv-reader	3.5.0
react-dom	16.13.1
react-script	3.4.1
svm	0.1.1

Table 3.4.2: Table of Prediction Plugin dependency

Package	Version
@influxdata/influxdb-client	1.3.0
axios	0.19.2
react-datepicker	2.16.0
react-files	2.4.8

### 3.4.0.1 Developer dependency

Developer will have to install dependencies to run correctly the project. All them are reported down below.

Table 3.4.3: Table of Prediction Tool developer dependency

Package	Version
@testing-library/jest-dom	4.2.4
csv-parser	2.3.2
eslint-plugin-react-hooks	4.0.4

Table 3.4.4: Table of Prediction Plugin developer dependency

Package	Version
@grafana/data	next
@grafana/toolkit	6.7.2
@grafana/ui	next
webpack	4.43.0

### 3.5 IDE IntelliJ IDEA installation

To install the integrated developing environment (IDE), it's necessary to reach the page <https://www.jetbrains.com/idea/download/>. This will address directly inside the section where IntelliJ IDEA can be downloaded for Windows, MacOS and Linux version. Ubuntu users can run one of the following lines to install the snap package:

- **Community version:**  
`sudo snap install intellij-idea-community -classic`
- **Ultimate version:**  
`sudo snap install intellij-idea-ultimate -classic`
- **Educatoinal version:**  
`sudo snap install intellij-idea-educational -classic`

## 4 System environment configuration

### 4.1 IntelliJ IDEA integrated development environment configuration

A correct IntelliJ IDEA configuration needs to configure the path `system_G` and after that to import an existing project.

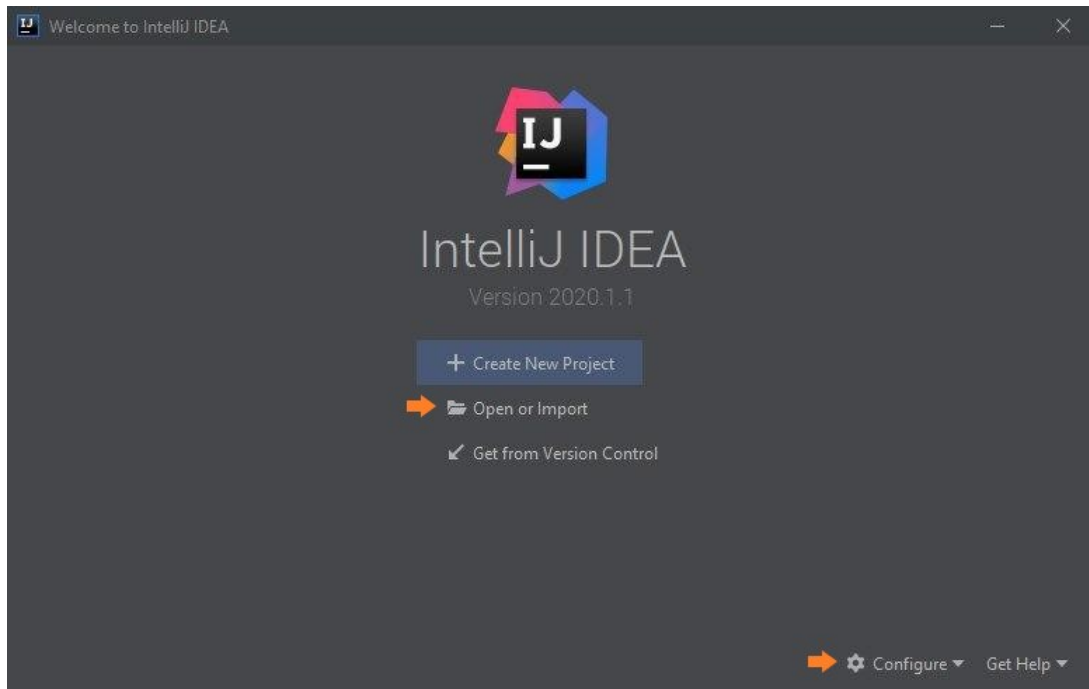


Figure 4.1.1: IntelliJ IDEA first execution

#### 4.1.1 Path system configuration

Once you run IntelliJ IDEA move to "Configure" then "Settings" in the lower-right corner. Write "Node.js and NPM" in the search bar and check for the correct settings of fields "Node interpreter" and "Package manager", otherwise update them with the correct paths.

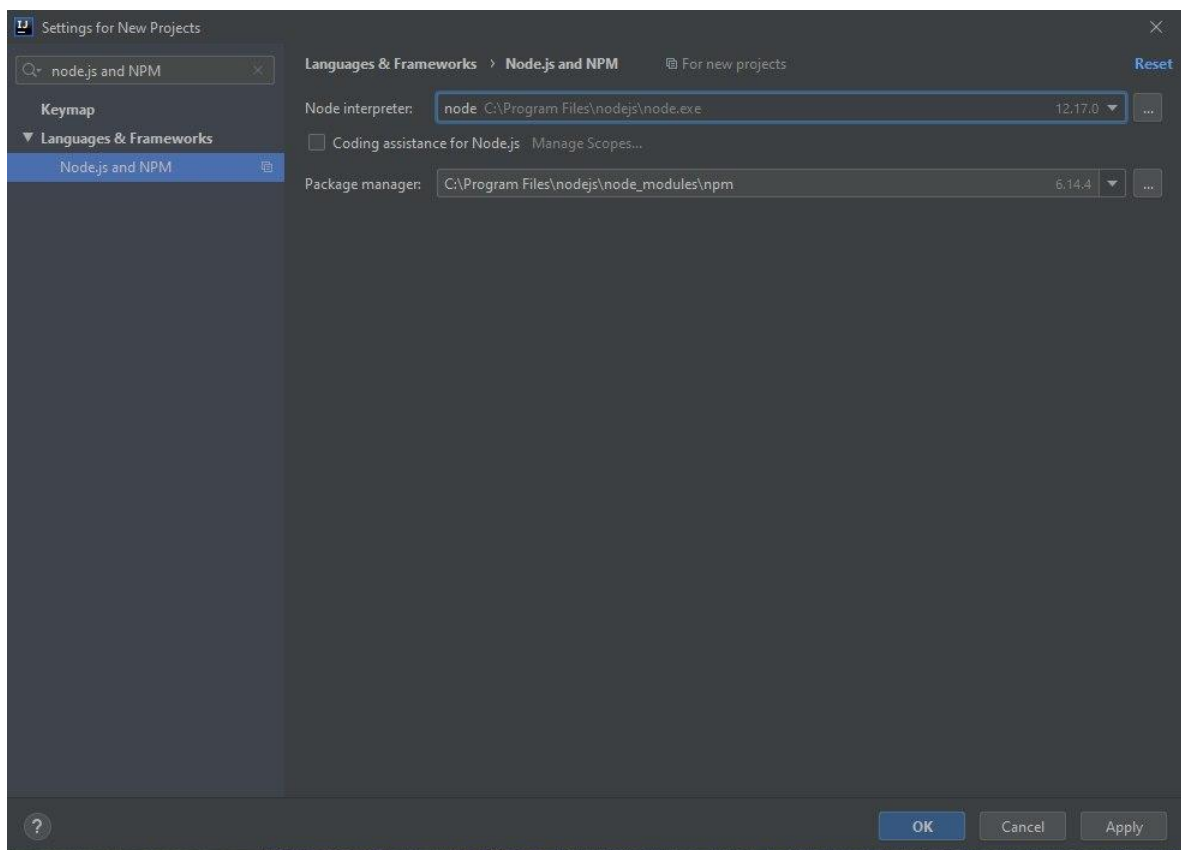


Figure 4.1.2: Node.js and NPM settings

## 4.2 Project import

From IntelliJ IDEA main window click on "Open or Import" and select the root directory of our project repository folder.

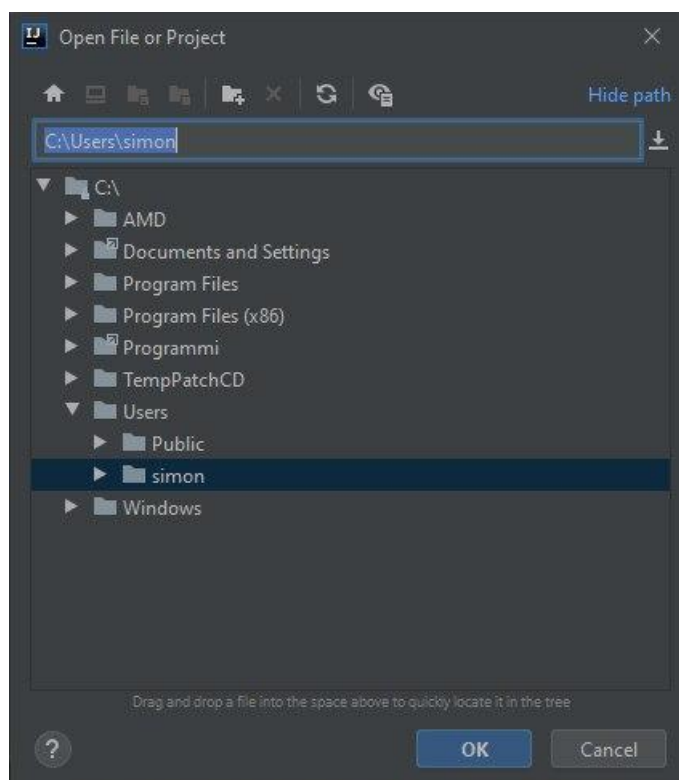


Figure 4.2.1: Project path on opening

## 4.3 ESLint configuration

### 4.3.1 Automatic configuration

When ESLint is listed as a dependency in our project IntelliJ IDEA automatically configures it. Move to "File" | "Settings" | "Languages and Frameworks" | "JavaScript" | "Code Quality Tools" | "ESLint" and check that Automatic ESLint configuration option is enabled.



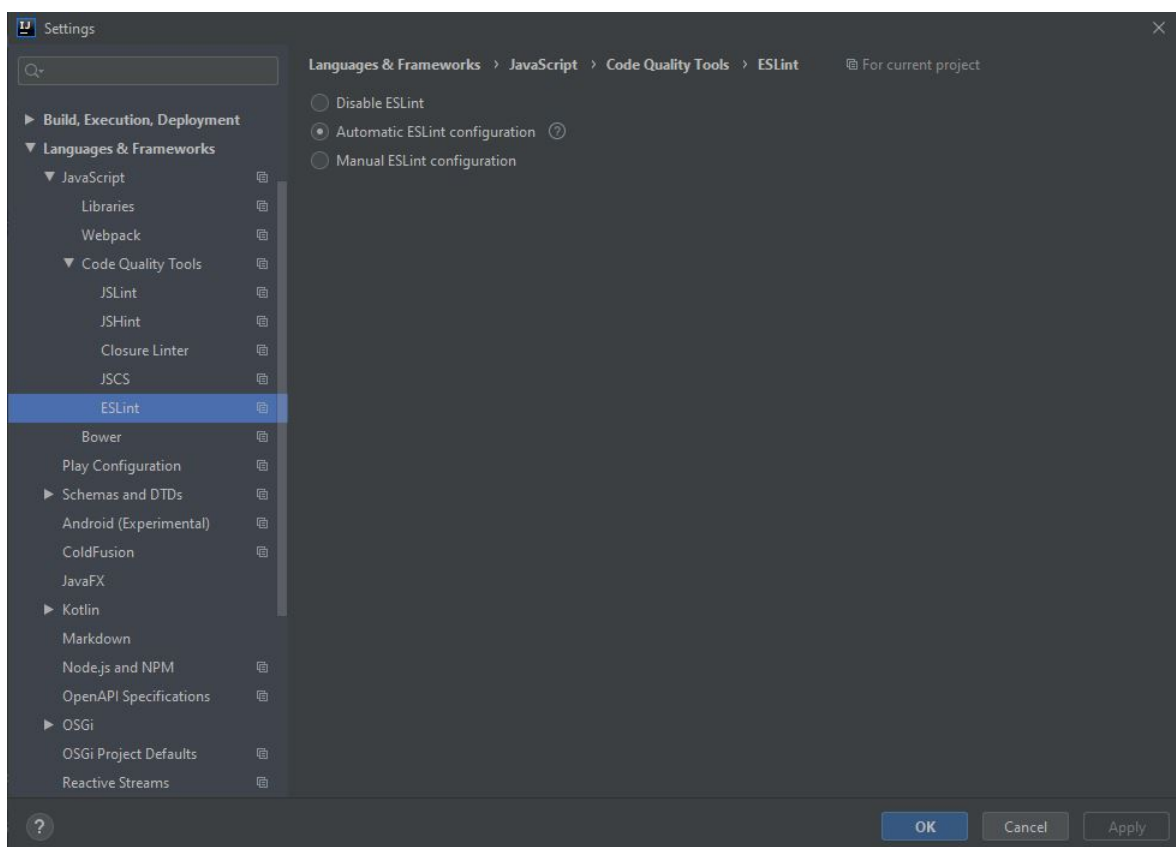


Figure 4.3.1: Automatic ESLint configuration

### 4.3.2 Manual configuration

You can also configure ESLint manually checking the Manual ESLint configuration option and complete fields as it follows:

1. in the "Node Interpreter" field, specify the path to Node.js;
2. in the "ESLint Package" field, specify the location of the eslint or standard package;
3. choose the configuration file to use checking "Automatic search" if you want to let IntelliJ IDEA do it for you or specify the file location in the path field;
4. optionally specify additional command-line options to run ESLint in "Extra ESLint Options" field and specify the location of the files with additional code verification rules in the "Additional Rules Directory" field then confirm the whole configuration.

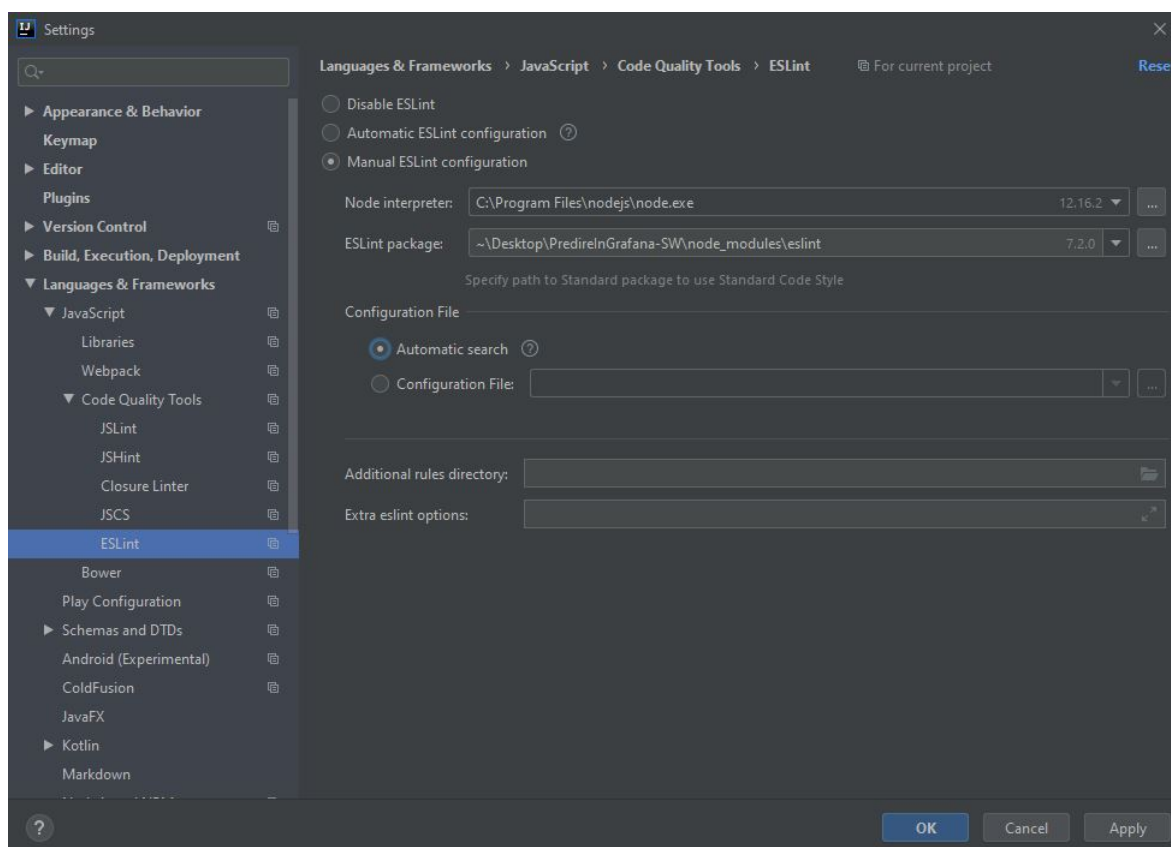


Figure 4.3.2: Manul ESLint configuration

## 4.4 Grafana plugin panel enviroment configuration

### 4.4.1 package.json content

In package.json file you can find all the app informations and requirements needed for its proper functioning. Attributes which represent important information are listed below:

- **scripts:** it contains all CLI command lines used from the developer:
  - **build:** this command creates a production-ready build of your plugin. It generates a folder named dist which contains our plugin production files ;  
npm run build
  - **test:** this command runs Jest against your codebase (used in automatic tests);  
npm run test
  - **dev :** this command creates a development build that's easy to play with and debug using common browser tooling;  
npm run dev
  - **watch:** this command run development task in a watch mode.  
npm run dev -watch
- **dependencies:** it contains the following packages needed for our app proper functioning:

- **@influxdata/influxdb-client**: the reference javascript client for InfluxDB. Both node and browser environments are supported;
- **axios**: promise based HTTP client for the browser and node.js;
- **react-files**: a file input (dropzone) management component for React we use when loading JSON files.
- **devDependencies**: it contains the following packages needed for our app proper functioning during development:
  - **@grafana/data**: a library containing most of the core functionality and data types used in Grafana.
  - **@grafana-toolkit**: a CLI<sub>G</sub> that enables efficient development of Grafana plugins.
  - **@grafana/ui**: a library containing the different design components of the Grafana ecosystem;
  - **webpack**: used to compile JavaScript modules. Once installed, you can interface with webpack either from its CLI or API.

## 4.5 Training tool enviroment configuration

### 4.5.1 package.json content

In package.json file you can find all the app informations and requirements needed for its proper functioning. Attributes which represent important information are listed below:

- **scripts**: it contains all CLI command lines used from the developer:
  - **start**: the command runs the app in development mode. Open `http://localhost:3000` to view it in the browser. The page will automatically reload if you make changes to the code. You will see the build errors and lint warnings in the console;  
`npm start`
  - **build**: this command builds the app for production to the build folder. It correctly bundles React in production mode and optimizes the build for the best performance. The build is minified and the filenames include the hashes. In the end our app is ready to be deployed;  
`npm run build`
  - **test**: this command runs the test watcher in an interactive mode. By default, runs tests related to files changed since the last commit.  
`npm test`
  - **eject**: this command will copy all the configuration files and the transitive dependencies into our project as dependencies in package.json ;  
`npm run eject`
- **dependencies**: it contains the following packages needed for our app proper functioning:

- **@testing-library/react**: simple and complete React DOM testing utilities that encourage good testing practices. ;
  - **@testing-library/user-event**: simulate user events for react-testing-library;
  - **bootstrap**: sleek, intuitive, and powerful front-end framework for faster and easier web development;
  - **chart.js**: simple yet flexible JavaScript charting for designers and developers;
  - **is-promise**: test whether an object looks like a promises-a+ promise;
  - **libsvm-js**: c++ library that allows to do Support Vector Machine classification and regression;
  - **ml-svm**: Support Vector Machine in Javascript;
  - **react**: JavaScript library for creating user interfaces. The react package contains only the functionality necessary to define React components;
  - **react-bootstrap**: bootstrap components built with React;
  - **react-chartjs-2**: React wrapper for Chart.js 2;
  - **react-csv-reader**: React component that handles csv file input. It handles file input and returns its content as a matrix;
  - **react-dom**: package that serves as the entry point to the DOM and server renderers for React. It is intended to be paired with the generic React package, which is shipped as react to npm;
  - **react-scripts**: this package includes scripts and configuration used by Create React App;
  - **svm**: is a lightweight implementation of the SMO algorithm to train a binary Support Vector Machine. As this uses the dual formulation, it also supports arbitrary kernels.
- **devDependencies**: it contains the following packages needed for our app proper functioning during development:
    - **@testing-library/jest-dom**: custom jest matchers to test the state of the DOM;
    - **csv-parser**: streaming CSV parser that aims for maximum speed as well as compatibility with the csv-spectrum CSV acid test suite. Csv-parser can convert CSV into JSON;
    - **eslint-plugin-react-hooks**: this ESLint plugin enforces the Rules of Hooks. It is a part of the Hooks API for React.

## 5 Test

A unity test is the operation that aims to check the correct execution of functions of a component. To run tests in this project, the developer needs to open the terminal and to move inside the folder of the product that needs to be tested (in this case `PredireInGrafanaSW/my-plugin` or `PredireInGrafanaSW/prediction-tool`). Inside the folder, the developer has to run the command `npm run test` inside the terminal.

### 5.1 Edit tests

Inside the project every component needs to be tested. For this reason the developer has to name a test with `<component name>.test.ts`. Doing so a single component can be checked by a single file.

### 5.2 Code Coverage

Code coverage is the percentage of the project's code that is analysed by tests. This operation is made by Coverall which is an external tool linked to the code through the project's repository. So if the developer wants to check coverage's value, he has to reach the README file inside the GitHub repository at <https://github.com/teamafkSWE/PredireInGrafana-SW>. Inside that file there are two badges and the one with the label "coverage" shows the value of code coverage until the last build.

## 6 Product architecture

Our product consists of a plug-in developed for the Grafana platform and a Training Tool external to this platform. Therefore the analysis of the architecture is divided into these two components.

### 6.1 Training tool

The Training tool deals with training an SVM or LR algorithm using a dataset inserted by the user, to then generate a JSON file containing the necessary information to perform the prediction. This module has been developed following the *MVVM* behavioral design pattern.

#### 6.1.1 Architectural design

We decided to implement this pattern because  $\text{React}_G$  was used to build the component and we believed that this pattern coupled well with the structure of the latter. Moreover, it allows to divide the *Presentation Logic<sub>G</sub>* and the *Business Logic<sub>G</sub>* and it allows to reuse some components in other contexts, without having to change them.

As can be seen in the following figure, we have the View that exchanges information on user interactions with the ViewModel, which in turn transforms them into actions on the data performed by the Model. The data transition from the View to the Model occurs through the instantiation of the ViewModel inside the View. Through this instance, the ViewModel calls the correct functions when the user interacts with the View. The Model provides functionality for the management of the algorithms through the **SVMtrain** and **RLtrain** classes that will be used by the ViewModel. Finally there is a communication between Model and View for the constant updating of the latter, thanks to a functionality provided by the Grafana platform.

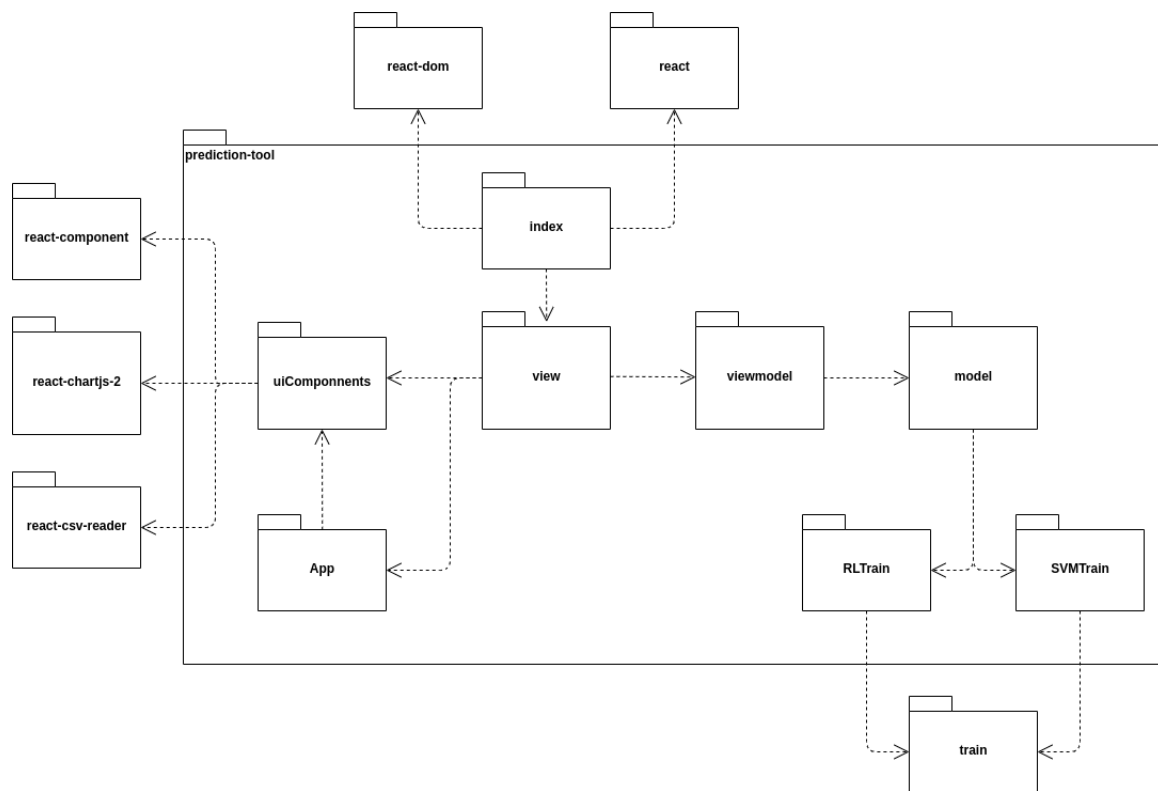


Figure 6.1.1: Training tool package diagram

Analyzing the specific components, our architecture is structured as follows:

- **Model:** it manages the *business logic*. It contains the data prediction algorithms that have been presently implemented and writing the result of the predictions to an Influx database;
- **View:** it manages the *presentation logic*. It allows the creation of a customized graphic panel within a Grafana dashboard. With this panel the user can select prediction algorithm settings, incoming data streams and the minimum and maximum thresholds;
- **ViewModel:** it manages the *application logic<sub>G</sub>*. The ViewModel is an abstraction of the View exposing public commands.

#### 6.1.1.1 Grafana's role

Grafana plays a fundamental role in the architecture as it allows continuous updating of the View to change the data in the Model. In particular, whenever there are updates on the data in the Model, Grafana makes them available to View through specific methods, together with the configuration of the queries with which this data was obtained. Moreover, through React, it manages the two-way data binding between HTML View and Javascript code, in addition to offering most of the necessary graphic components for the realization of the plug-in View.

## 6.1.2 Detail design

### 6.1.2.1 Model

The main component of the Model is the abstract class of the prediction algorithms called **Train**. Starting with this, we have implemented two algorithms: Support Vector Machine and Linear Regression. They are represented respectively by the concrete classes **SupportSVM** and **SupportRL**. We have found that, for families algorithms such as Support Vector Machine and Linear Regression algorithms, it is possible to trace them to a single abstract class as we have provided.

#### **Train**

The abstract class of the prediction algorithms is called **Train** and it represents the contract that all concrete classes must abide to be able to characterize a prediction algorithm. It contains only one parameter: **algorithm**. The **train()** method allows you to perform the prediction on a specific dataset. The **getJSON()** method writes the configuration parameters into the JSON file.

#### **SupportSVM**

To implement the SVM algorithm we developed the concrete class **SupportSVM**. This class performs the prediction on the dataset. It also makes use of components specific to the SVM class imported from the SVM library to perform the real prediction. **SupportSVM** also contains two fields data:

- **dataSVM**: reference to the dataset;
- **weights**: the weights are the SVM coefficients that will be used to make the prediction.

Finally, there is the constructor that allows you to run the method binding to the class.

#### **SupportRL**

To implement the Linear Regression algorithm we developed the concrete class **SupportRL**. This class performs the prediction on the dataset. It also makes use of components specific to the RL class imported from the RL library to perform the real prediction. **SupportRL** also contains three fields data:

- **dataRL**: reference to the dataset;
- **numOfX**: the numbers of X founded on the CSV file;
- **coefficients**: the coefficients needed to make the prediction.

Finally, there is the constructor that allows you to run the method binding to the class.



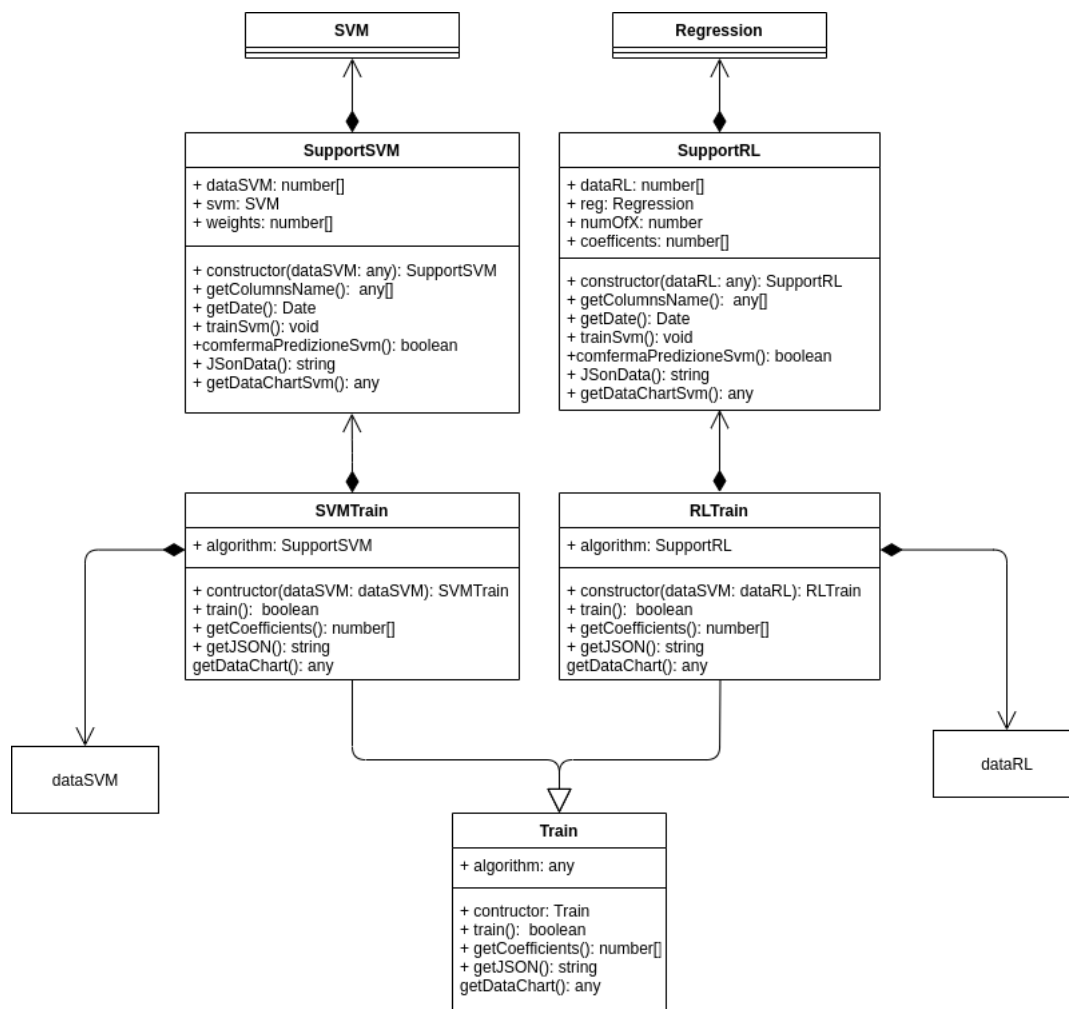


Figure 6.1.2: Training tool Model class diagram

### 6.1.2.2 View

Inside the View there are all the view components. The **App** class is the main component and it represents the tool's entry point. Each part of the View has been divided into components and rendered by the App. The communication between these components and the App takes place through the **props** (conceptually, the components are like JavaScript functions): it accepts arbitrary data (under the name of "props") and returns React elements that describe what should appear on the screen. Inside there is an instance of the ViewModel for data-binding.

### App

The **App** class is the main component and it represents the tool's entry point. Each part of the View has been divided into components and rendered by the App. This class has just one parameter: **viewModel** is an instance of the ViewModel. The constructor contains the properties in common with the ViewModel. Moreover, it has the following methods:

- `changeAlgorithm(event)`: it manages the algorithm user's choice, setting the algorithm state value after the event was made;
- `resetAlgorithm(algorithm)`: it sets the algorithm state parameter to the default value;
- `setDataFromFile(data, fileInfo)`: it sets the data state parameter and the fileName state parameter with the inserted file's name;
- `handleTraining()`: it sends the data to the ViewModel and if the `performTraining()` method success, it calls the function to write the information into the JSON file, otherwise it resets the algorithm;
- `downloadJsonData()`: it creates the DownloadJson component;
- `render()`: it creates the InsertCsvButton, ComboBoxAlgorithm, TrainButton and Chart components and it calls the `downloadJsonData()` function.

### **combo\_box\_algorithm**

It renders the combo box for the algorithm's choice.

The `render()` method renders the `JSX_G` element wanted.

### **download\_json**

It manages and render the "Download" button.

The `downloadJsonFile()` method allow to download the file, making the connection between the browser and the local pc. The `render()` method renders the "Download" button.

### **chart**

It renders the chart. This component contains the following parameters:

- **data**: contains the data that must be shown;
- **options**: contains the various options that can be applied to the graph, such as colors, axes and the regression line.

It also implements the following methods:

- **RLChart**: it contains the methods to print the graphic of a rl-trained file on the screen;
- **SVMChart()**: it contains the methods to print the graphic of a svm-trained file on the screen;
- **formatData()**: it associates and manages the data to the graph;
- **render()**: it renders the chart graph.

### insert\_csv\_button

It renders the insert button for the CSV file.

The `render()` method renders the "Inserisci file" button.

### header

It renders the header.

The `render()` method renders the site's header.

### train\_button

It renders the train button, that will start the training.

The `render()` method renders the "Conferma" button.

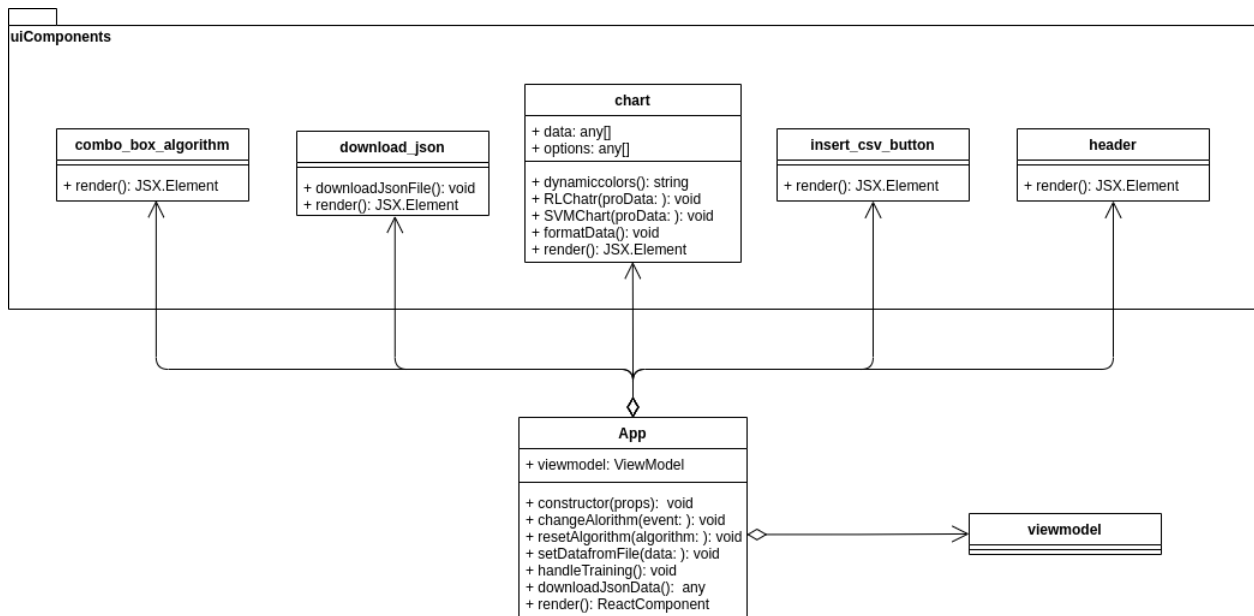


Figure 6.1.3: Training tool Model class diagram

#### 6.1.2.3 ViewModel

The data transition from the views to the model occurs through an instance of the ViewModel inside the View. Through this instance, the ViewModel calls the correct functions when the user interacts with the View. The ViewModel has functions that interact with both the View and the Model (e.g. `RLChart()` and `performTraining()`). To communicate with the Model, there is an `RLTrain` or `SVMTrain` instance. In order to instantiate the correct algorithm, the behavioral design pattern Strategy is applied.

The ViewModel contains the following variables :

- **algorithm**: it contains the string of the chosen algorithm (combo-box component);
- **file**: it contains the data of the inserted CSV;

- **hasFile**: true if the file CSV has been inserted, false otherwise;
- **strategy**: it contains the RLTrain or SVMTrain object.

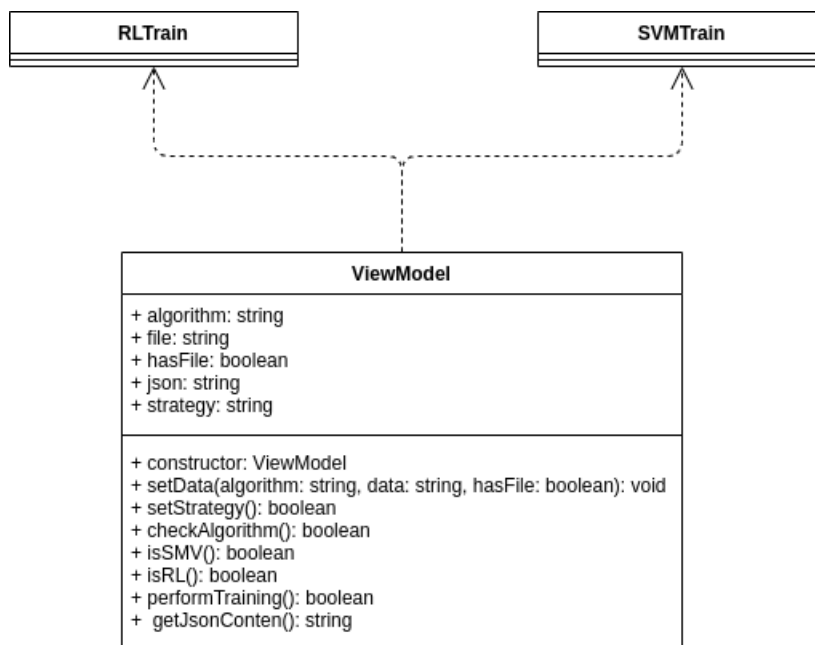


Figure 6.1.4: Training tool Model class diagram

## A Glossary

### A

#### **Application Logic**

Application Logic is any logic that is specific to some application

### B

#### **Business Logic**

It is the processing logic, in the form of source code, which manages the communication between a user interface and a database. It therefore contains the information that defines or they bind the way a company operates.

### C

#### **CSV**

CSV (comma-separated values) is a simple file format used to store tabular data, such as a spreadsheet or database.

### D

#### **DOM**

The Document Object Model (DOM) is a platform and language-neutral interface that allows programs and scripts to dynamically access and update the content, structure, and style of a document.

### L

#### **Linear Regression (LR)**

Linear regression (LR) is a linear approach to modeling the relationship between a scalar response (or dependent variable) and one or more explanatory variables (or independent variables). The case of one explanatory variable is called simple linear regression.

### G

#### **Grafana**

Grafana is a multi-platform open source analytics and interactive visualization web application. It provides charts, graphs, and alerts for the web when connected to supported data sources. It is expandable through a plug-in system. End users can create complex monitoring dashboards using interactive query builders.

#### **GUI**

A graphical user interface (GUI) is an interface through which a user interacts with electronic devices such as computers, hand-held devices and other appliances.

### J

## JavaScript

JS is a programming language that conforms to the ECMAScript specification. JavaScript is high-level, often just-in-time compiled, and multi-paradigm.

## JSON

JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for machines to parse and generate.

## JSX

JSX is an extension of the JavaScript language based on ES6, and is translated into regular JavaScript at runtime.

# M

## Machine learning

Machine learning (ML) is the study of computer algorithms that improve automatically through experience. Machine learning algorithms, such as LR or SVM, build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to do so.

# N

## Node.js

Node.js is an open-source, cross-platform, JavaScript runtime environment that executes JavaScript code outside a web browser. Node.js lets developers use JavaScript to write command line tools and for server-side scripts to produce dynamic web page content before the page is sent to the user's web browser.

## NPM

NPM (Node Package Manager) is a package manager for the JavaScript programming language. It is the default package manager for the JavaScript runtime environment Node.js.

# O

## OS

An Operating System (OS) is an interface between a computer user and computer hardware. An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices.

# P

## Package

A package (java package) is used to group related classes. They are used to avoid name conflicts, and to write a better maintainable code.

## Presentation Logic

The presentation logic of an application is where occurs almost of all interactions with the end user. Manages the reception of user inputs and the presentation of the output of the application to the latter.

## R

### **React**

React is a JavaScript library for building user interfaces.

## S

### **Support Vector Machine (SVM)**

In machine learning, Support Vector Machines (SVM) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis.

## T

### **Typescript**

TypeScript is a typed superset of JavaScript that compiles to plain JavaScript.