

IMPLEMENTATION



Language

Server

Protocol

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Jupytei

- full-featured, state-of-the-art analysis framework
- used in tools such as IBM Security AppScan
- extend for Python, using flexible language front end
- Communication between IDEs and Information Providers
- Use JSON-RPC to decouple IDEs from Analysis
- Originated in VSCode, now increasingly supported

Through LSP, Ariadne functionality is available for all of these IDEs.



LANGUAGE SERVER **PROTOCOL (LSP)**

About LSP:

- A communication protocol for IDEs and servers
- Developed by Microsoft for Visual Studio Code
- IDEs inform servers of files they are editing
- IDEs request information for features e.g. hovers
- Servers reply with text-based information
- No defined structure for information
- Servers push information like diagnostics and fixes

How is it integrated?

- JupyterLab is an IDE client of LSP servers
- JupyterLab supports Microsoft's Monaco editor
- Monaco implements an LSP client
- JupyterLab defines the LSP servers for Monaco to use
- Monaco supports LSP using WebSockets
- LSP servers need to use WebSockets to talk to Jupyter
- Many WebSocket server implementations, e.g. Tomcat

How can others use it?

- Other WebSocket LSP servers can be used
- E.g., python-language-server
- Configuration option in JupyterLab
- Simply specify URL of WebSocket server

Ariadne: Types for Machine Learning - <u>https://wala.github.io/ariadne</u>

Allison Allain, Julian Dolby, Avraham Shinnar, and Jenna Reinen

SUPPORTIVE TOOLING

Traditional Python

- # MNIST data input is a 1-D vector of 784 features (28*28 pixe # Reshape to match picture format [Height x Width x Channel z = tf.reshape(x, shape=[-1, 28, 28, 1])# Convolution Layer with 32 filters and a kernel size of 5 conv1 = tf.layers.conv2d(z, 32, 5, activation=tf.nn.relu)
- •No type information, therefore needs extensive type comments

conv1 = tf.layers.max_pooling2d(conv1, 2, 2)

Manually written, therefore tedious and error prone

- are no longer necessary



Python with Ariadne

z = tf.reshape(x, shape=[-1, 28, 28, 1])z type: pixel[?][28][28][1] × r with 32 filters and a kernel size of 5 conv1 = tf.layers.conv2d(z, 32, 5, activation=tf.nn.relu)

conv1 = tf.layers.max_pooling2d(conv1, 2, 2)

• Type information exposed, type comments

Automatic information, effortless and correct

ARIADNE IN JUPYTERLAB

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| Ē | ▲ | | 22 | learning_rate = 0.001 | Entertaine des Balances a sur- Strain Talances autors Strain Talances autors Talances de la suran Santa de la suran Santa de la surante de la surante Santa de la surante de la surante surante de la surante de la surante surante de la surante de la surante surante de la surante de la surante de la surante surante de la surante de la surante de la surante surante de la surante de la surante de la surante surante de la surante de la surante de la surante surante de la surante de la surante de la surante de la surante surante de la surante de la surante de la surante de la surante surante de la surante de la surante de la surante de la surante surante de la surante de la surante de la surante de la surante de la surante surante de la surante de la surante de la surante de la surante de la surante surante de la surante de la surante de la surante de la surante de la surante surante de la surante de la surante surante de la surante | | | |
| | •• | | 23 | num_steps = 2000 | | | | |
| D | Name | Last Modified | 24 | batch_size = 120 | Alexandrian Annalis Marine Annal Alexandrian Annalis Marine Annalis | | | |
| - Line Line Line Line Line Line Line Line | 🗖 lib | 2 days ago | 25 | # Network Parameters | Louis to apply a Property of the second seco | | | |
| л | 🗖 node modules | 2 davs ago | 20 | num input = 784 # MNTST data input (img shape: 28*28) | | | | |
| | | a month ago | 28 | num classes = 10 # MNIST total classes (0-9 digits) | | | | |
| | | a month ago | | dropout = 0.75 # Dropout, probability to keep units | | | | |
| ds | □ src | 2 days ago | 30 | Los angenes 2 - L. Cartalo Co. Kr El 2000 and and | Line house of | | | |
| nan | 🗖 style | a month ago | 31 | 31 # Create the neural network | | | | |
| L L L | buggy_convolutional | a day ago | | x_dict: {images: pixel[n][28 * 28]} | | | | |
| ပိ | la factor baseline draft | 25 days ago | 32 | <pre>def conv_net(x_dict, n_classes, dropout, reuse, is_training):</pre> | 1 The Construction of the | | | |
| | | 20 days ago | 33 | <pre># Define a scope for reusing the variables with tf.variable_scope('ConvNet', reuse=reuse):</pre> | | | | |
| Ś | | a month ago | 34 | | | | | |
| Tab | 😫 package-lock.json | 22 days ago | 35 | # TF Estimator input is a dict, in case of multiple inputs | a Tauli, Subsection and Tables Report | | | |
| | 😫 package.json | 2 days ago | 36 | <pre>xxx:pixel[n][28 * 28] [Ariadne] Cannot reshape pixel[n][28 * 28] to pixel[?][11][xxx = x dict['image</pre> | 28][1] | | | |
| | 🕏 pandas1.py | 23 days ago | 37 | xxx type: pixel[n][28 * 28] target: tensorflow.functions.reshape | | | | |
| | 🗅 proxy.js | 22 days ago | 38 | $bad_x = tf.reshape(x_x, shape=[-1, 11, 28, 1])$ | | | | |
| | M README md | a month ago | 39 | | | | | |
| | | a month ago | 40 | <pre># MNIST data input is a 1-D vector of 784 features (28*28 pixels)</pre> | | | | |
| | tsconfig.json | a month ago | 41 | # Reshape to match picture format [Height x Width x Channel] | | | | |
| | 🗅 webpack.config.js | 11 days ago | 42 | <pre># Tensor input become 4-D: [Batch Size, Height, Width, Channel] z: pixel[?][28][28][1] z = tf.reshape(xxx, shape=[-1, 28, 28, 1])</pre> | | | | |
| | ne x.py | a month ago | 43 | | | | | |
| | 🗅 yarn-error.log | a month ago | 44 | | | | | |
| | 🗅 yarn.lock | 2 days ago | 45 | <pre># Convolution Layer with 32 filters and a kernel size of 5 conv1: pixel[?][28][28][1]</pre> | | | | |
| | | | 46 | <pre>conv1 = tf.layers.conv2d(z, 32, 5, activation=tf.nn.relu)</pre> | | | | |

- Monaco editor available as JupyterLab extension
- Monaco supports LSP using Websockets
- Ariadne implemented as LSP server
- IDE features, e.g. hovers, provided by Monaco editor



- manipulate data, for example ad hoc item comparison to join tables
- gain visibility into which fields are used
- dfdemoa['PID'] = dfdemoa['Patient ID'].str.replace('-','' dfpcs['PID'] = dfpcs['PID'].str.replace("'",'') dffaba['PID'] = dffaba['PID'].str.replace("'",' dfbdi['PID'] = dfbdi['PID'].str.replace("'",'' 39 dfqol['PID'] = dfqol['PID'].str.replace("'",'')
- # keep only baseline visit data # may want to exclude dropped subs - ask Sara 3 dfpcs_baseline = dfpcs[dfpcs['VISITINF0'].str.contains("aseline", na = False)]



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- General LSP support created in JupyterLab
- Servers configurable with Jupyter settings

AVAILABLE FEATURES

- # TF Estimator input is a dict, in case of multiple inputs
- # TF Estimator input is a dict in case of multiple inputs
- [Ariadne] Cannot reshape pixel[n][28 * 28] to pixel[?][11][28][1] xxx type: pixel[n][28 * 28] target: tensorflow.functions.reshape conv2 = tf.layers.conv2d(co [Ariadne] Bad type to convolve pixel[n][28 * 28], needs 4 dimension xxx type: pixel[n][28 * 28] target: tensorflow.functions.conv2d bad_conv1 = tf.layers.conv2d(xxx, 32, 5, activation=tf.nn.relu) tf.reshape(xxx, [-1, 28, 28, 1]) to a 1-D vector for the fully connected layer bad_conv1 = tf.layers.conv2d(tf.reshape(xxx, [-1, 28, 28, 1]), 32, 5, activation=t dfdemog = pd_read_excel("Master_Data_Sheet_06252018.xlsx", sheetname="Patient_Info_Demographics", skiprows = 1

- Uses WALA dataflow
- Propagates tensor shapes
- Usual fixpoint dataflow
- Models tensor operations
- Tensor models for dataflow
- Heuristics for unlikely usage
- Tensor models for misuse
- Heuristics to suggest fixes
- WALA backward data flow analysis from the point where the table is read
- determine what fields are used
- the fields in python correspond to table columns in a one to one way