Maximizing the Potential of Data Science with KNIME and Python

Paolo Tamagnini
paolo.tamagnini@knime.com

Mahantesh Pattadkal
mahantesh.pattadkal@knime.com

Carsten Haubold
carsten.haubold@knime.com

April 19, 2023

Presenters

Paolo Tamagnini

Data Scientist

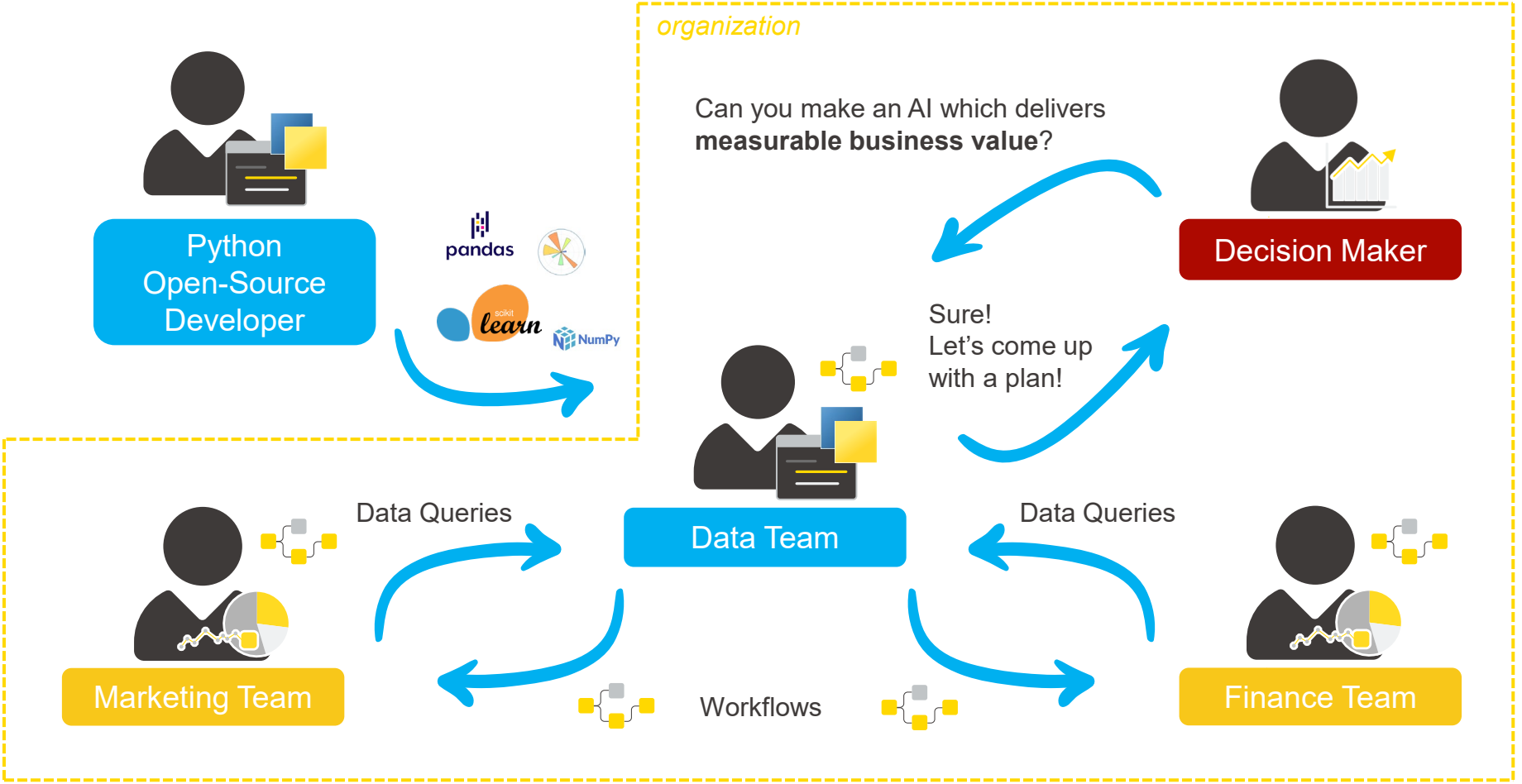
Mahantesh Pattadkal

Data Scientist

Carsten Haubold

Python Integration
Product Owner

How Low Code can be Adopted in an Organization



Main Agenda

1. Introduction

2. Example 1: Build Low Code Workflows to Compute Geo Distances

3. Example 2: Pure-Python KNIME nodes for Geo Distances

4. Wrap up

Example 1:

Build Low-Code Workflows to Compute Distances

- The Python Script node

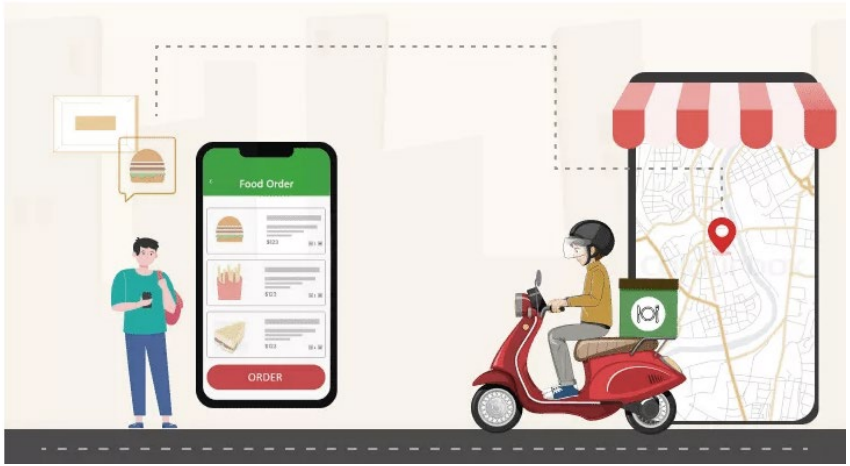
- Adopting Bundled Packages

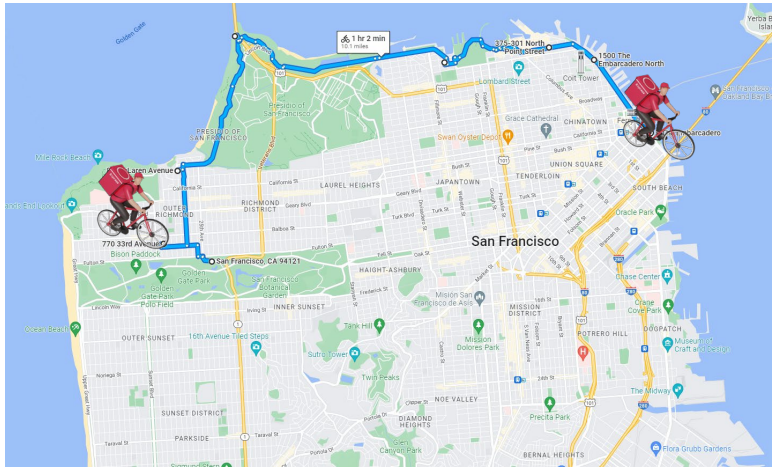
- Wrapping Low Code in Components

- Adopting Custom Packages

Today’s Use Case

- A Pizza Company operating in San Francisco have several delivery agents who are responsible for delivering Pizza 🍕 across the city.





- The Company wants to compute the total trip distance of the delivery agents based on their trip coordinates

Let's Dive into the Data

- The data is stored in 2 tables, “Location” table contains the GPS coordinates of major locations in San Francisco and “Trip” table consist of the Trip details of the Delivery Agent

Trip Details

Row ID	Agent ...	Trip	Trip Point
Row0	007	Golden Gate Park	Start
Row1	007	Fulton Playgorund	Drop
Row2	007	World War II W...	Drop
Row3	007	Alessandro DeS...	Drop
Row4	007	Golden Gate Po...	Drop
Row5	007	Presidio Tunnel ...	Drop
Row6	007	Twister Trees	Drop
Row7	007	Madam Tussads	Drop
Row8	007	Waterfront Plaza	Drop
Row9	007	Rincon Park	Finish

Location Coordinates

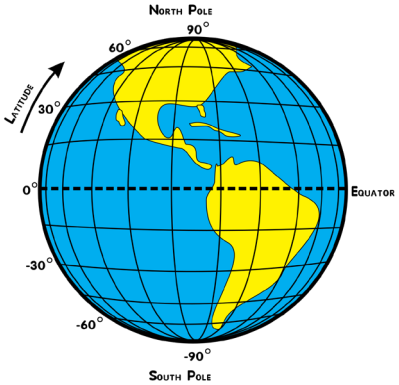
Row ID	Location	Latitude	Longitude
Row0	Golden Gate Park	37.771712	-122.4824576
Row1	Fulton Playgorund	37.774591	-122.4924962
Row2	Alessandro DeS...	37.786556	-122.4895785
Row3	Golden Gate Po...	37.808685	-122.4776187
Row4	Twister Trees	37.804342	-122.4341242
Row5	Madam Tussads	37.806798	-122.4123781
Row6	Waterfront Plaza	37.804758	-122.4030593
Row7	Rincon Park	37.792771	-122.3914055
Row8	Mission Dolores...	37.781329	-122.4130082
Row9	Coit Tower	37.781329	-122.4130082

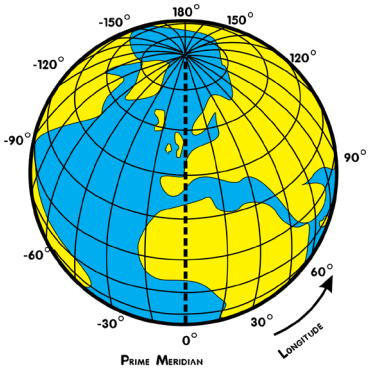
Trip Coordinates

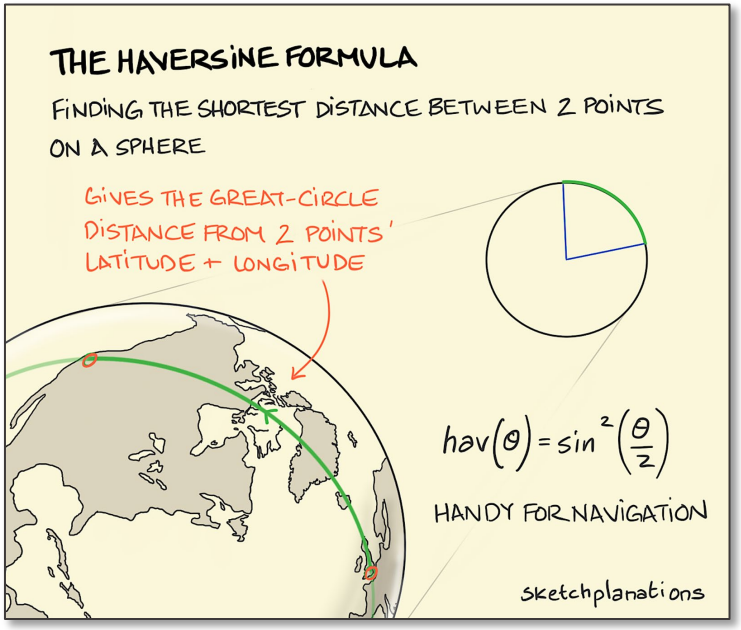
Row ID	Agent ...	Trip	Trip Point	Latitude	Longitude
Row0	007	Golden Gate Park	Start	37.772	-122.482
Row1	007	Fulton Playgorund	Drop	37.775	-122.492
Row2	007	World War II W...	Drop	37.796	-122.481
Row3	007	Alessandro DeS...	Drop	37.787	-122.49
Row4	007	Golden Gate Po...	Drop	37.809	-122.478
Row5	007	Presidio Tunnel ...	Drop	37.801	-122.458
Row6	007	Twister Trees	Drop	37.804	-122.434
Row7	007	Madam Tussads	Drop	37.807	-122.412
Row8	007	Waterfront Plaza	Drop	37.805	-122.403
Row9	007	Rincon Park	Finish	37.793	-122.391

Haversine Formula for Distance Computation

- The Distance (approx.) between two points can be computed using Haversine Formula







Source : https://sketchplanations.com/the-haversine-formula

Geo Distance Computation with Python Script

- Use Scikit-learn package to calculate the distance using Haversine Formula

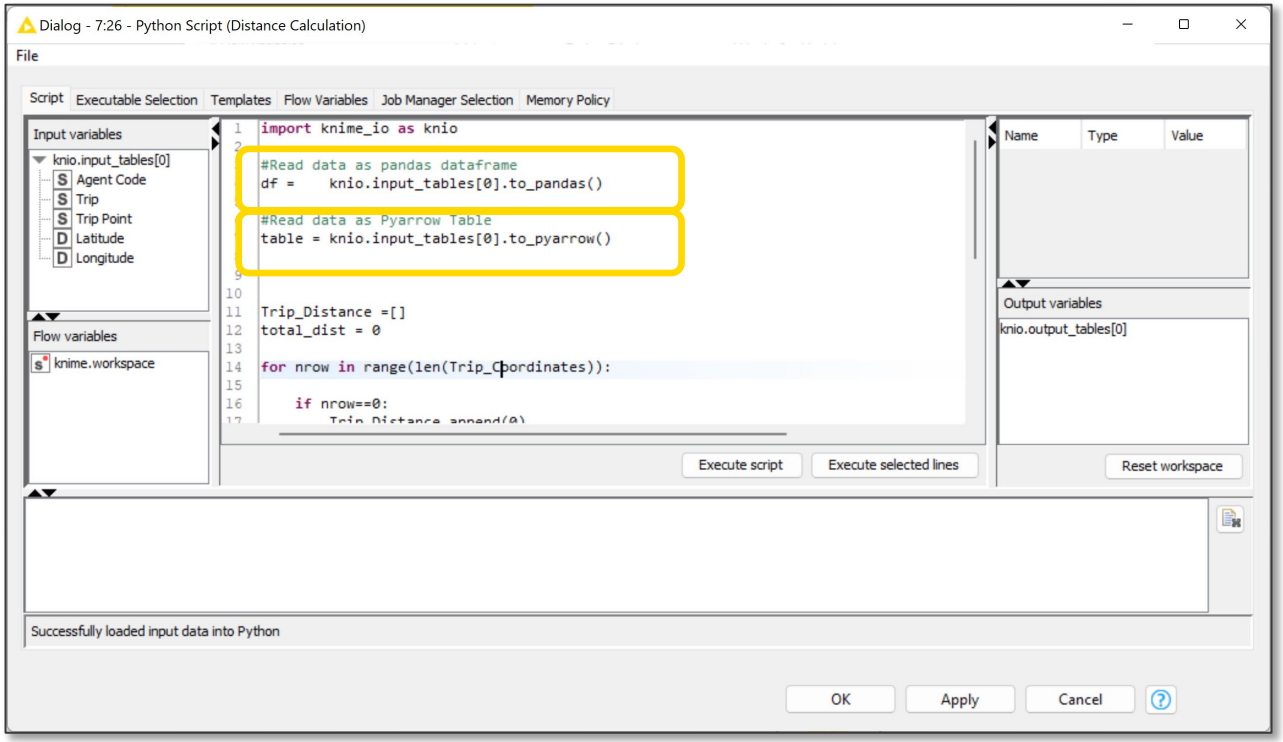
```python
from sklearn.metrics.pairwise import haversine_distances
from math import radians

def geodistance(coord1, coord2):
    coord1_radians = [radians(_) for _ in coord1]
    coord2_radians = [radians(_) for _ in coord2]
    result = haversine_distances([coord1_radians, coord2_radians])
    result = result*6371000/1000
    distance = result[0][1]
    return distance
```

Add an Output Column “Trip Distance (km)”

	Agent Code	Trip	Trip Point	Location	Latitude	Longitude	Trip Distance (km)
0	007'	Golden Gate Park	Start	Golden Gate Park	37.771712	-122.482458	0.000000
1	007'	Fulton Playgorund	Drop	Fulton Playgorund	37.774591	-122.492496	0.938605
2	007'	World War II West Coast Memorial	Drop	World War II West Coast Memorial	37.795650	-122.481000	3.488898
3	007'	Alessandro DeSogos Portrait Photography	Drop	Alessandro DeSogos Portrait Photography	37.786556	-122.489578	4.750154
4	007'	Golden Gate Postcard Viewpoint	Drop	Golden Gate Postcard Viewpoint	37.808685	-122.477619	7.425779
5	007'	Presidio Tunnel Tops	Drop	Presidio Tunnel Tops	37.801140	-122.458000	9.342727
6	007'	Twister Trees	Drop	Twister Trees	37.804342	-122.434124	11.470408
7	007'	Madam Tussads	Drop	Madam Tussads	37.806798	-122.412378	13.400323
8	007'	Waterfront Plaza	Drop	Waterfront Plaza	37.804758	-122.403059	14.249865
9	007'	Rincon Park	Finish	Rincon Park	37.792771	-122.391406	15.930652

Python Script Node

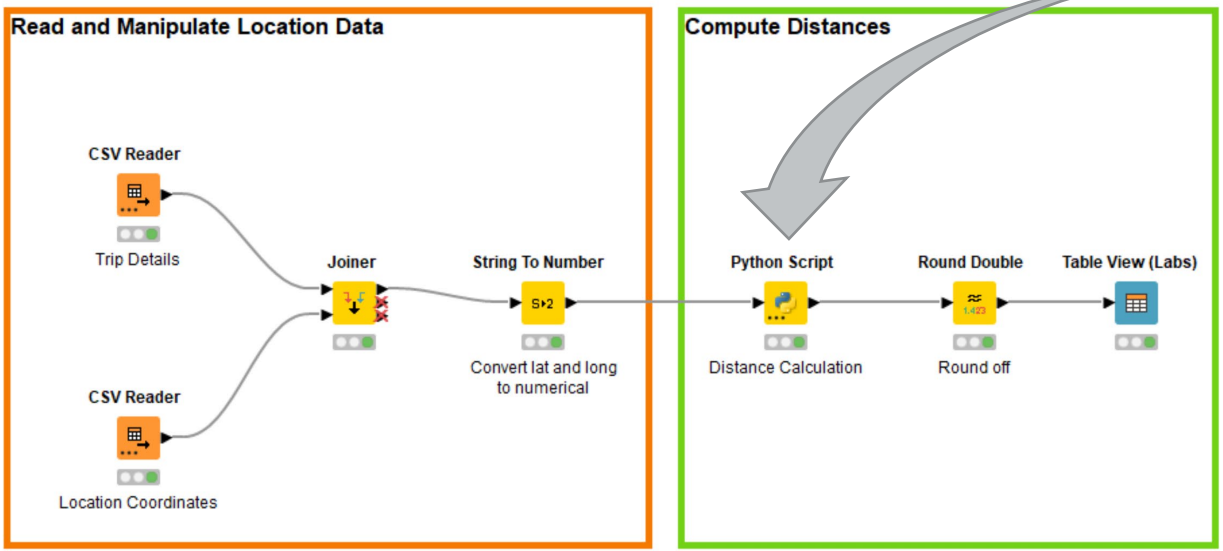
- The node allows executing a Python script in a local Python 3 environment
- Supports conversion to both Pandas DataFrame and PyArrow Tables



Blog : [Lightning Fast Data Transfer between KNIME and Python with the KNIME Python Integration]

Low-code Approach: Using Python code inside KNIME

- Use the Python code for distance computation inside Python Script node




```python
from sklearn.metrics.pairwise import haversine_distances
from math import radians

def geodistance(coord1, coord2):
    coord1_radians = [radians(_) for _ in coord1]
    coord2_radians = [radians(_) for _ in coord2]
    result = haversine_distances([coord1_radians, coord2_radians])
    result = result*6371000/1000
    distance = result[0][1]
    return distance
```

Advantages

- Easy to debug and maintain
- Easy to explain
- Easy to edit and make changes for others

Live Demo

Live Demo

Example 1:

Build Low-Code Workflows to Compute Distances

- Python Script node

- Adopting Bundled Packages

- Wrapping Low Code in Components

- Adopting Custom Packages

What are Bundled Packages?

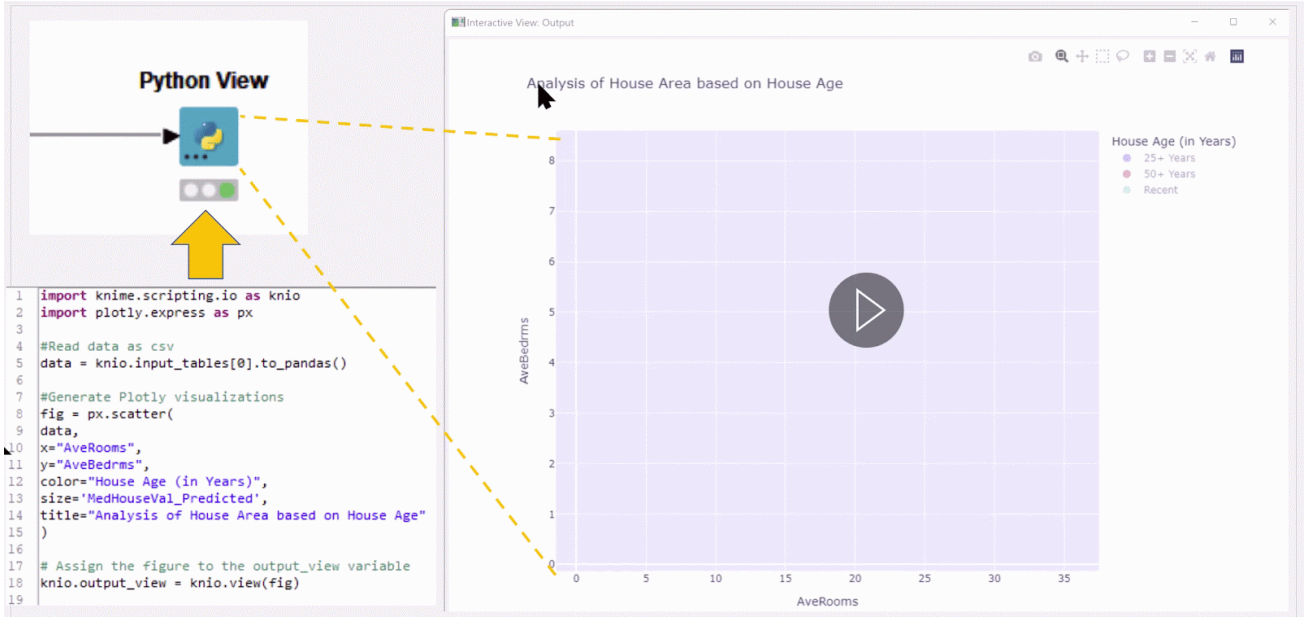
- The KNIME Python extensions installs a Python Environment that comes inbuilt with the KNIME Analytics Platform
- Provided with a selection of Python packages to get you started
- Allows for using the Python Script node without installing, configuring or even knowing environments

beautifulsoup4	Scikit-learn	pandas	numpy
scipy	Seaborn	statsmodel	cloudpickle
Matplotlib-base	ipython	nltk	plotly
requests	pyarrow	nbformat	packaging
py4j	pytz	pyaml	Jedi
openpyxl	nbformat	nomkl	pillow

[13] KNIME Python Integration – KNIME Docs

Python View Node for All Python based Visualizations

- The node allows executing a Python script that creates visualizations
- Supports static as well as interactive visualizations by plotly and share the same “interactivity” properties as native KNIME View nodes



Blog : [All Python-based Visualization Libraries Easily Accessible through KNIME]

Example 1:

Build Low-Code Workflows to Compute Distances

- Python Script node

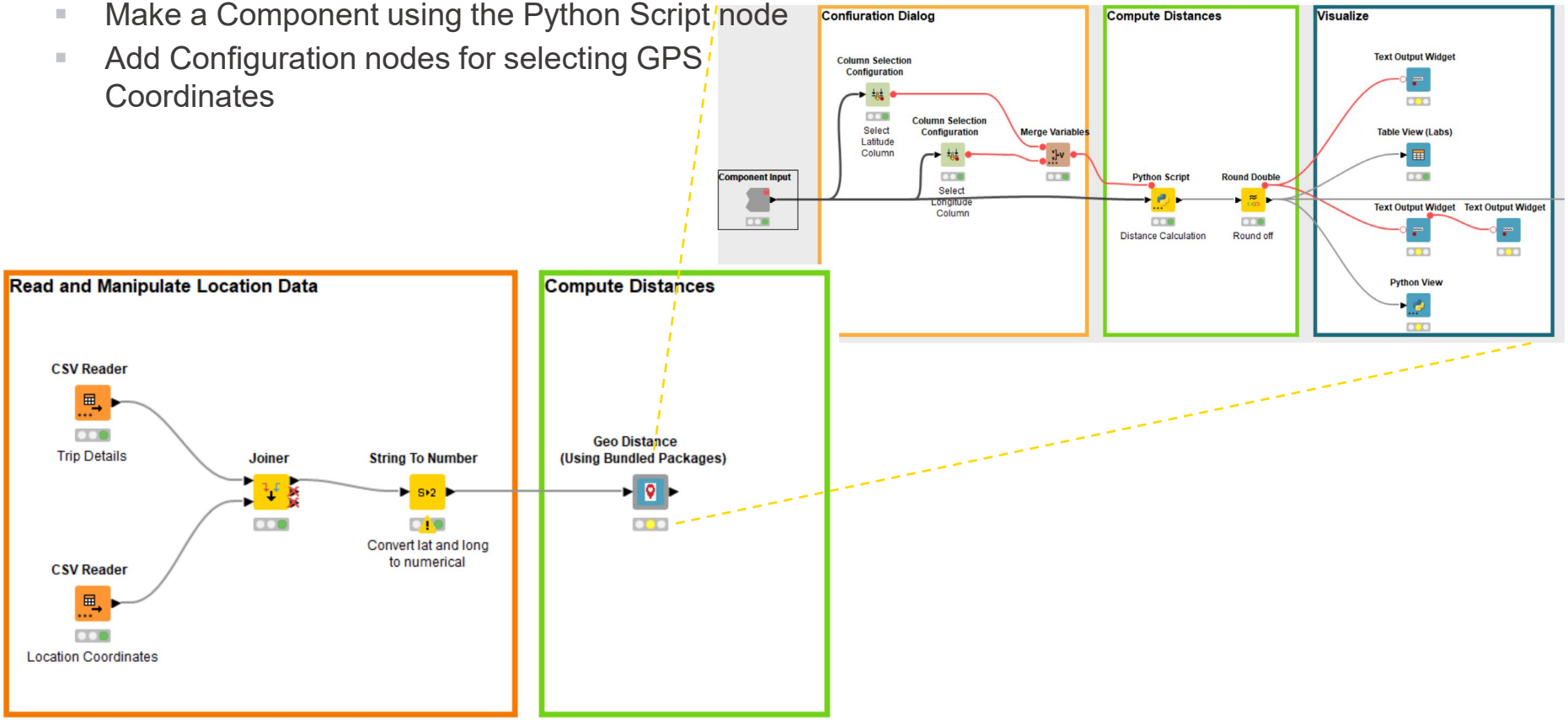
- Adopting Bundled Packages

- Wrapping Low Code in Components

- Adopting Custom Packages

Reliable and Reusable Solution with Components

- Build Python Scripted Components
  - Make a Component using the Python Script node
  - Add Configuration nodes for selecting GPS Coordinates



Live Demo

Live Demo

Example 1:

Build Low-Code Workflows to Compute Distances

- Python Script node

- Adopting Bundled Packages

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- Adopting Custom Packages

Low code Solution – Using GeoPy Package

- Now you are made aware of a new package in Python called “GeoPy” that can compute the distance much accurately and provide distance in kms and miles

Link : https://geopy.readthedocs.io/en/stable/

- The bundled environment lacks this package, but you want to use this package for distance calculation

Let’s understand how to implement this solution

What is Bundled Environment?

- The KNIME Python extensions installs a Python Environment that comes inbuilt with the KNIME Analytics Platform
- Provided with a selection of Python packages to get you started
- Allows for using the Python Script node without installing, configuring or even knowing environments

beautifulsoup4	Scikit-learn	pandas	numpy
scipy	Seaborn	statsmodel	cloudpickle
Matplotlib-base	ipython	nltk	plotly
requests	pyarrow	nbformat	packaging
py4j	pytz	pyaml	Jedi
openpyxl	nbformat	nomkl	pillow

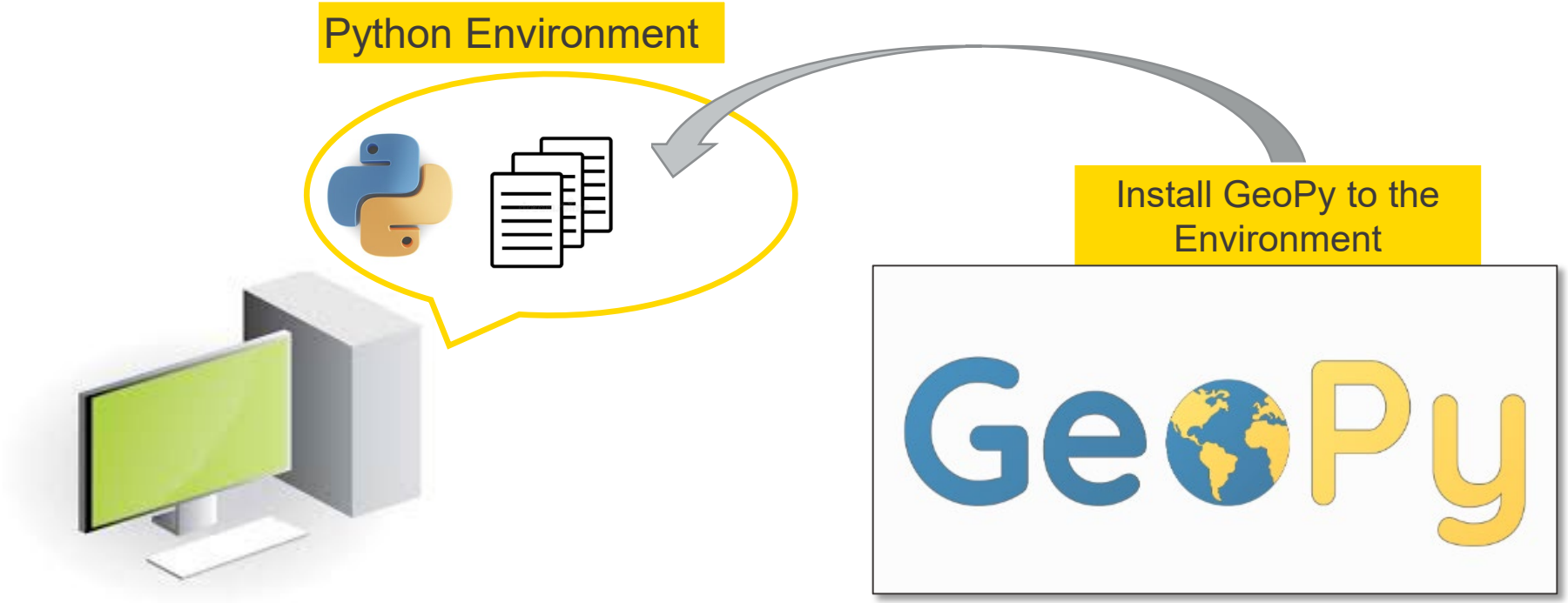
Not included

GeoPy??

Documentation : [Bundled Environment with KNIME]

Steps for Implementing Low-Code Solution

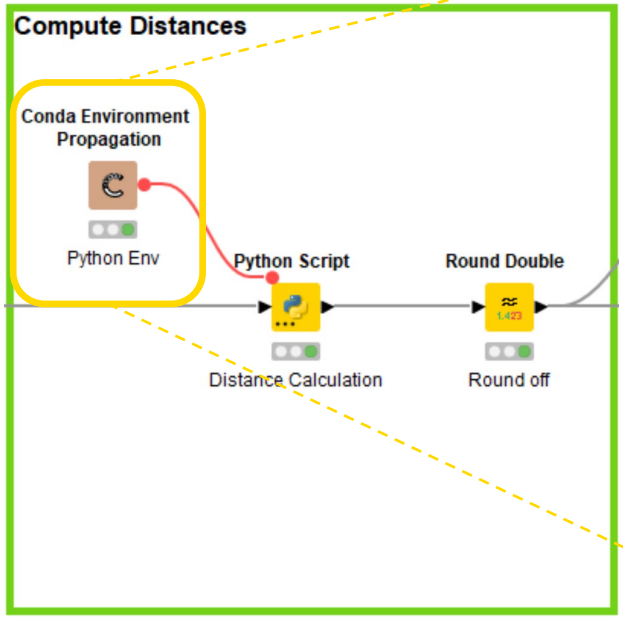
- Step 1 : Create New Python Environment via Conda and install GeoPy package



Note : Please make sure Anaconda or minconda is installed on your system

Steps for Implementing Low-Code Solution

- Step 2 : Add Conda Environment Propagation node with Python Script node
  - Choose “Include only explicitly installed” option for propagating necessary packages
  - Specify the Output variable name



Conda environment: py3_knime_geodistance

Include?	Name	Version	Build	Channel
☑	geopy	2.2.0	pypi_0	pypi
☐	gflags	2.2.2	ha925a31_0	pkgs/main
☐	glib	2.69.1	h5dc1a3c_1	pkgs/main
☐	glog	0.6.0	h4797de2_0	conda-forge
☐	grpc-cpp	1.45.2	hb22af2e_3	conda-forge
☐	h5py	2.10.0	py39hc0c1f7e_0	pkgs/main
☐	hdf5	1.10.6	h1756f20_1	pkgs/main
☐	icc_rt	2019.0.0	h0cc432a_1	pkgs/main
☐	icu	58.2	vc14hc45fdbb_0	anaconda
☑	ipython	8.4.0	py39haa95532_0	pkgs/main
☐	jedi	0.17.2	py39haa95532_1	pkgs/main
☐	jpeg	9b	vc14h4d7706e_1	anaconda
☐	jpype1	1.4.0	pypi_0	pypi
☐	jsonschema	4.4.0	py39haa95532_0	pkgs/main
☐	jupyter_core	4.10.0	py39haa95532_0	pkgs/main
☐	kiwisolver	1.4.2	py39hd77b12b_0	pkgs/main
☐	libblas	3.9.0	5_hd5c7e75_netlib	conda-forge
☐	libbrotlicommon	1.0.9	h2bbff1b_7	pkgs/main
☐	libbrotlidec	1.0.9	h2bbff1b_7	pkgs/main
☐	libbrotlienc	1.0.9	h2bbff1b_7	pkgs/main
☐	libcblas	3.9.0	5_hd5c7e75_netlib	conda-forge
☐	libcurl	7.84.0	h86230a5_0	pkgs/main
☐	libffi	3.4.2	hd77b12b_4	pkgs/main
☑	libiconv	1.16	h2bbff1b_2	pkgs/main

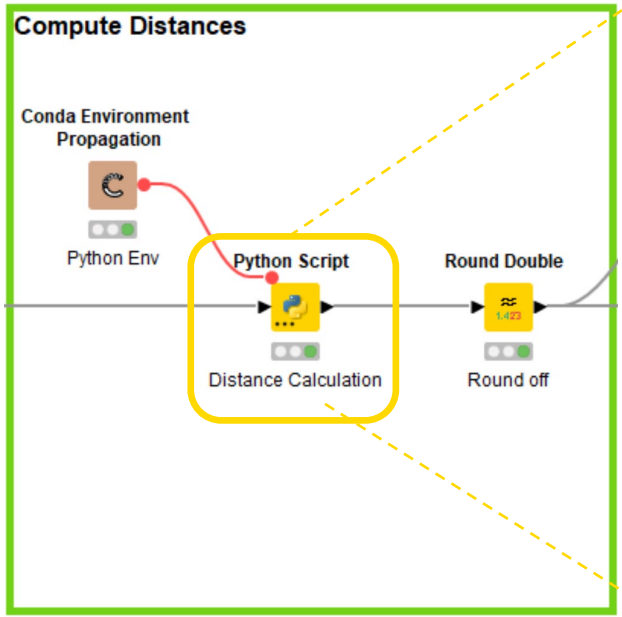
Include all | Exclude all | Include only explicitly installed

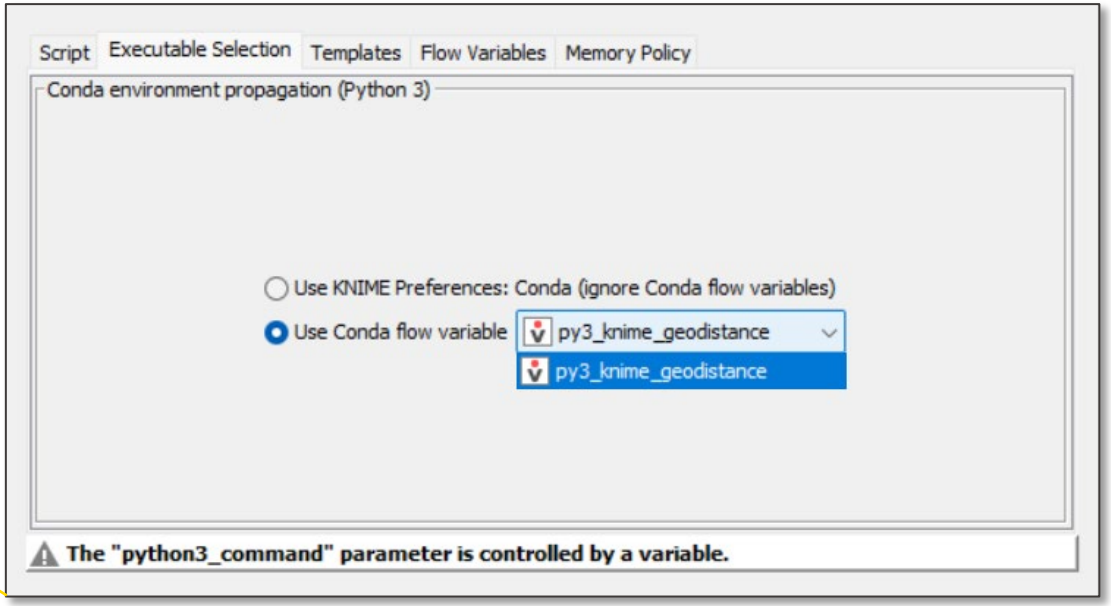
Environment validation
- ○ Check name only
- ◉ Check name and packages
- ○ Always overwrite existing environment

Output variable name: py3_knime_geodistance

Steps for Implementing Low-Code Solution

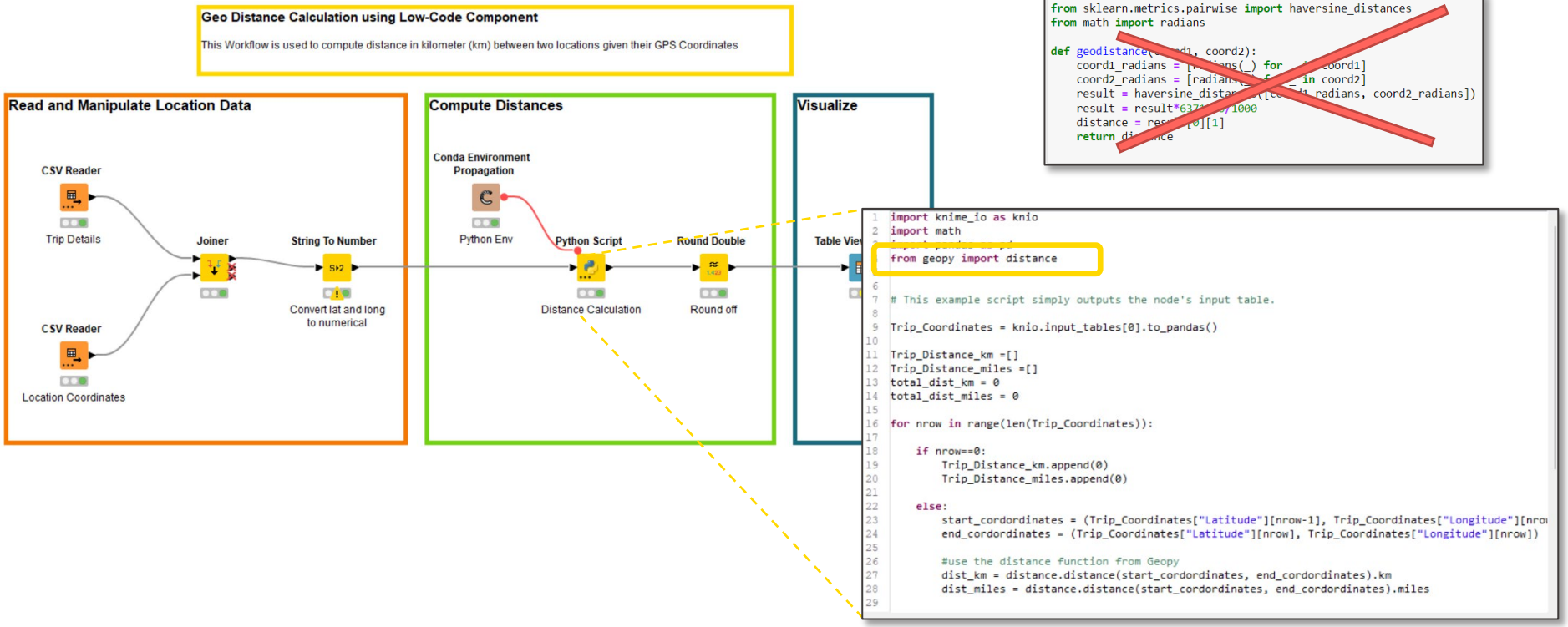
- Step 2 : Add Conda Propagation node with Python Script node
  - Choose “Include only explicitly installed” option for propagating necessary packages
  - Specify the Output variable name
  - Set the Conda flow variable in “Executable Selection” tab of Python Script node





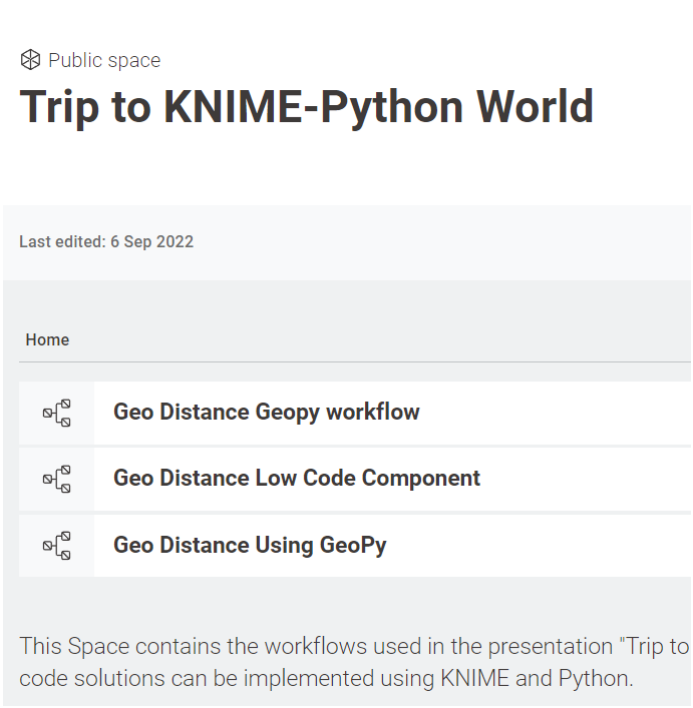
Steps for Implementing Low-Code Solution

- Step 3 : Build KNIME Workflow with Python Script node
  - Use the Reader nodes to read data into KNIME
  - Insert the code with GeoPy package inside the Python Script node



Where to find these workflows?

Monty's workflows available at:
tinyurl.com/Trip-KNIME-Python-World



More Low Code Examples at:
tinyurl.com/Python-Script-Space

Main Agenda

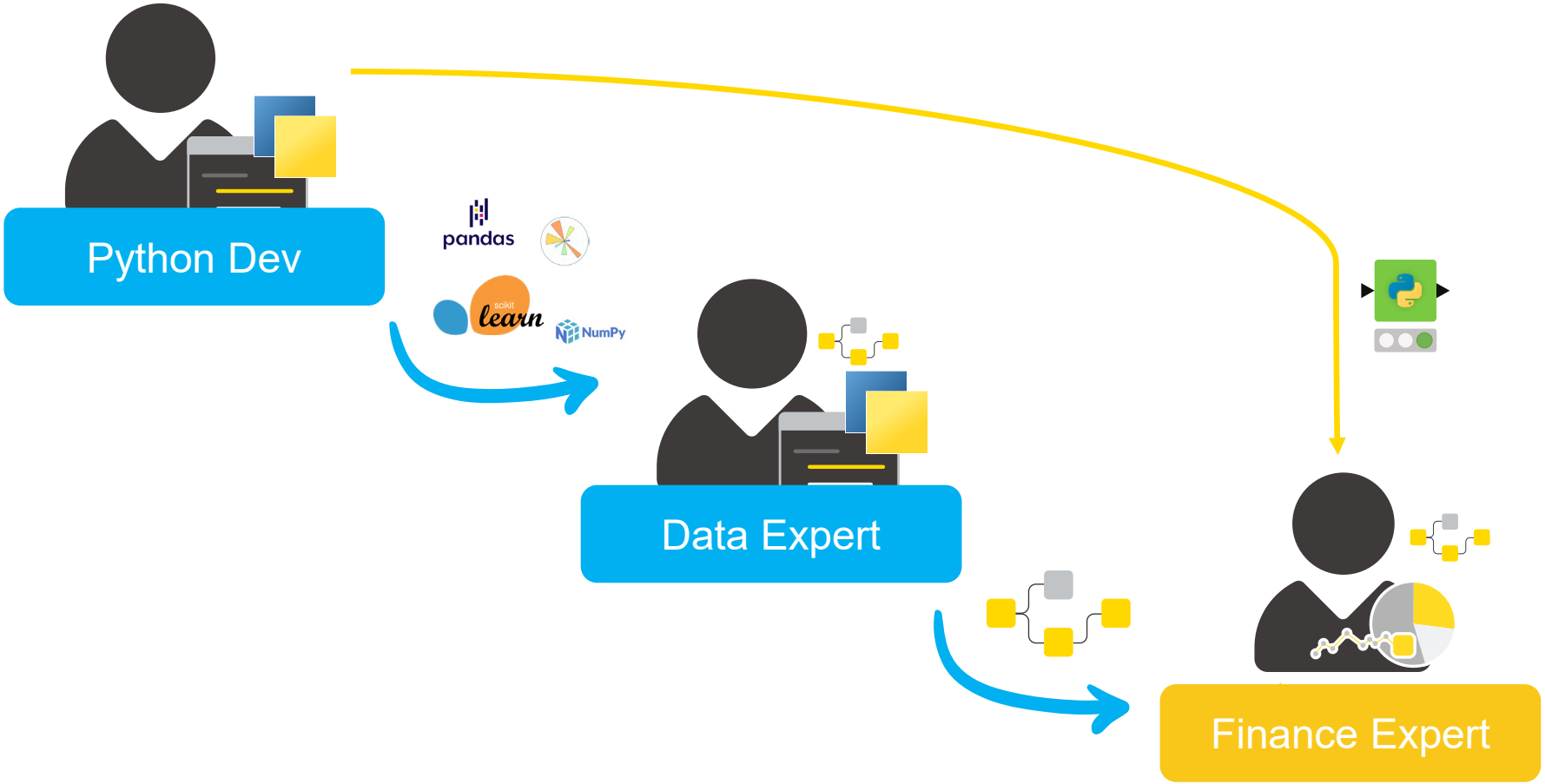
1. Introduction

2. Example 1: Build Low Code Workflows to Compute Geo Distances

3. Example 2: Pure-Python KNIME nodes for Geo Distances

4. Wrap up

From Low Code to Pure Code KNIME Solutions



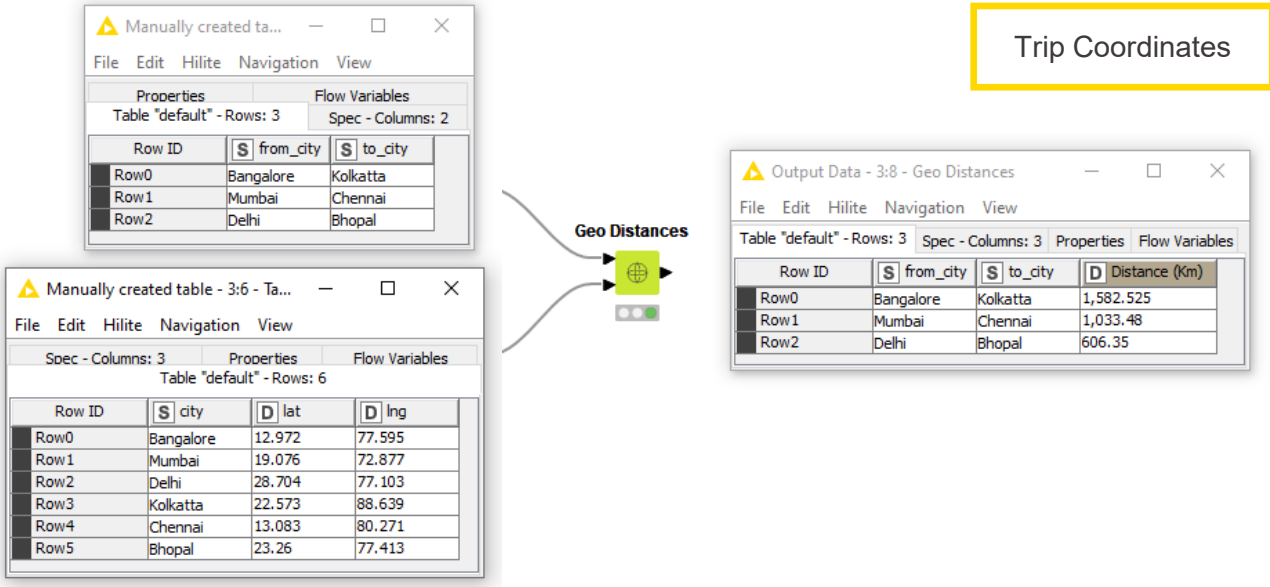
Example 2:

Pure-Python KNIME nodes for Geo Distances

A KNIME node implemented in Python

Trip Details

Location Coordinates



Trip Coordinates

Developing a pure-Python KNIME node

```python
@knext.node(name="Geo Distances", node_type=knext.NodeType.MANIPULATOR, icon_path="...", category="/")

@knext.input_table(name="Distances Table", description="Location pairs")
@knext.input_table(name="Coordinates Table", description="Lat/Long...")

@knext.output_table(name="Output Data", description="Distances...")
@knext.output_view("Scatter View", "Distances in a scatter plot")

class GeoDistances:
    """
    This node is able to compute distances between locations given latitude and longitude coordinates
    """

    location_column = knext.ColumnParameter("Location Column", "...", port_index=1)
    lat_column = knext.ColumnParameter("Latitude Column", "...", port_index=1)
    long_column = knext.ColumnParameter("Longitude Column", "...", port_index=1)
    output_column_name = knext.StringParameter("Title of Output Column", "...", "Distance (Km)")


    def configure(self, configure_context, input_schema_1, input_schema_2):

        # Return output table schema
        return input_schema_1.append(knext.Column(knext.double(), name=self.output_column_name))


    def execute(self, exec_context, input_1, input_2):

        # TODO: do something useful here
        trips_df = pd.DataFrame()

        # Return results
        return knext.Table.from_pandas(trips_df), knext.view_matplotlib()
```

Title of node, category/color, PNG name, location

Input ports with description

Output ports with description

Node class and node description

Parameters for node dialog

“configure” defines input and output table spec

“execute” defines your data analysis

Live Demo

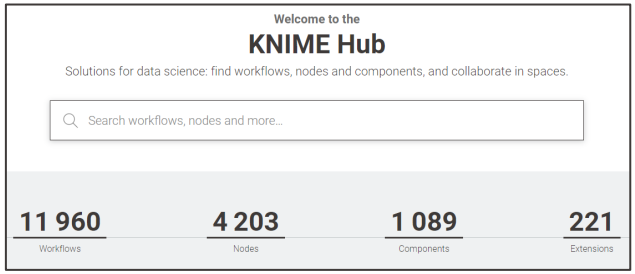
Live Demo

Pure-Python KNIME node setup

What do you need?

1. **Python code** describing the node
2. **A conda environment** recipe containing all used Python libraries
3. **A knime.yml** file describing your extension

Sharing a Python Extension



Python Team

Pure-Python Nodes

Finance Team

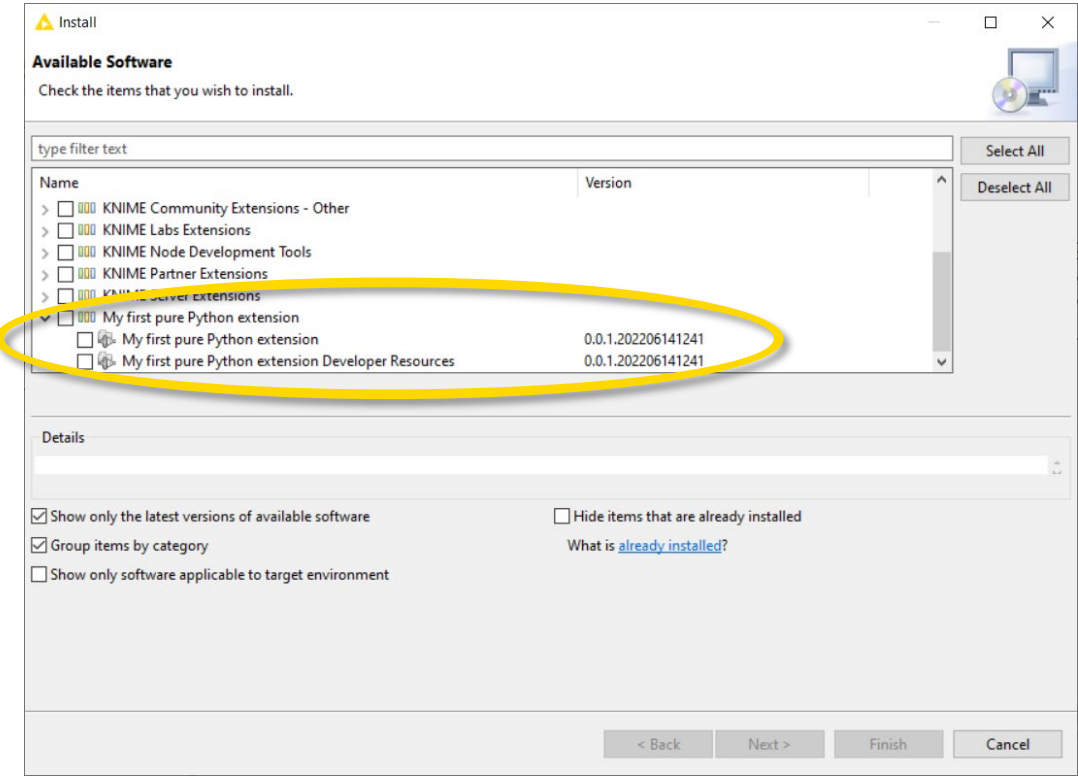
Extensions can be shared

- Publicly on the KNIME Hub
- Within an organization

Bundling and Sharing Within An Organization

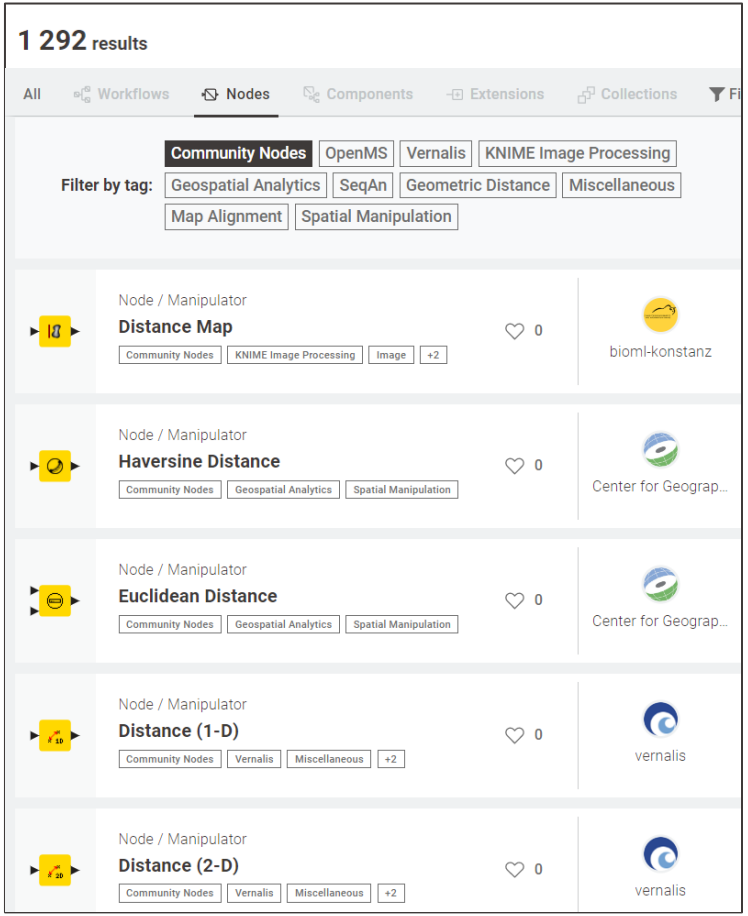
We provide a command line tool and instructions to turn your Python code into a KNIME extension that can be installed in the KNIME Analytics Platform

1. Set up a conda environment for bundling
2. Build a local update site that can be used by KNIME
3. Share this update site with colleagues
4. Let them install your Python-based KNIME extension



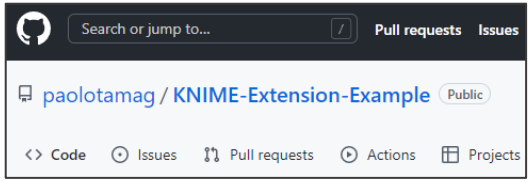
Sharing to the Entire Open-Source Community

- Share your code in a publicly available git repository
  (e.g. BitBucket, GitLab, GitHub)
- Send a request to community-contributions@knime.org
- We will build the extension for you
- Your nodes will go live on: hub.knime.com

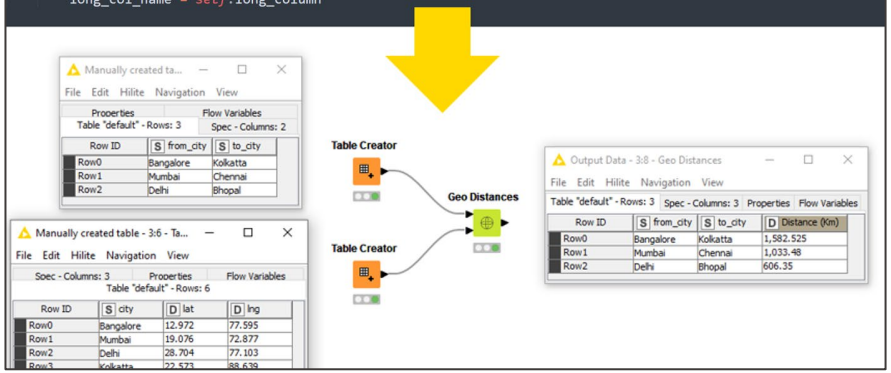


Develop KNIME nodes using Python

- Since KNIME Analytics Platform 4.6
- Pure-Code approach:
  adopting an API define the node
  from input to output




```python
@knext.node(name="Geo Distances", node_type=knext.NodeType.LEARNER, icon_path="icons/my_node_icon.png", category
@knext.input_table(name="Distances Table", description="Location pairs")
@knext.input_table(name="Coordinates Table", description="Lat/Long Coordinates of Cities")
@knext.output_table(name="Output Data", description="Distances in KM Attached to Second Input")

@knext.output_view("Scatter View", "Distances in a scatter plot")

class GeoDistances:
    """

    This node is able to compute distances between locations given latitude and longitude coordinates

    """
    another_param = knext.StringParameter("Title of Distance Column", "Name for the new column reporting distanc
    location_column = knext.ColumnParameter("Location Column", "Name of locations as reported in second input",
    lat_column = knext.ColumnParameter("Latitude Column", "Latitude column in decimal format", port_index=1)
    long_column = knext.ColumnParameter("Longitude Column", "Longitude column in decimal format", port_index=1)

    def configure(self, configure_context, input_schema_1, input_schema_2):
        return input_schema_1.append(knext.Column(knext.double(), name=self.another_param))


    def execute(self, exec_context, input_1, input_2):

        exec_context.set_warning("This node was developed on Friday evening.")

        input_1_pandas = input_1.to_pandas()
        input_2_pandas = input_2.to_pandas()

        loc_col_name = self.location_column
        lat_col_name = self.lat_column
        long_col_name = self.long_column
```



Open for Innovation KNIME

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3. Example 2: Pure-Python KNIME nodes for Geo Distances

4. Wrap up

KNIME Python Integrations: From Low-Code to Pure-Code

	Adopting the Python Script node with the Bundled Environment 	**Adding the Conda node for a Custom Environment** 	**Implementing a new KNIME Extension in Python** 
What?			
Why?	Code Snippet with commonly used packages	Code Snippet with a special package	Make your Python code available as KNIME nodes
What your users will need:	Install KNIME Python Integration	Install KNIME Python Integration + Conda installed and configured in KNIME Preferences	Install your new KNIME extension

Thank You
Questions?

#KNIMESpringSummit
#KNIME