Name: Aaditya Bhatt Reg.No: 21BEC1531

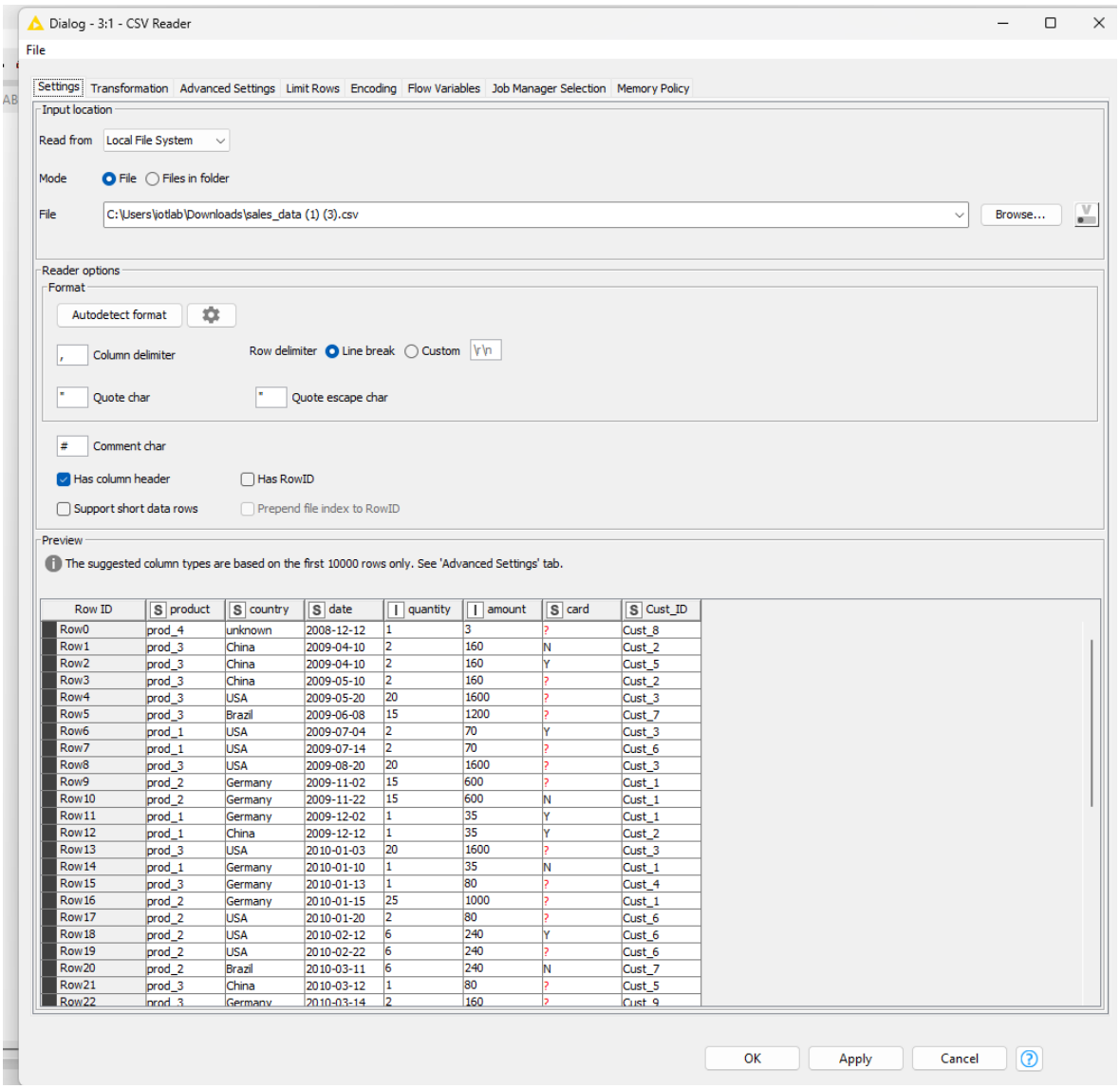
Internet of Things

Experiment 6 to 10

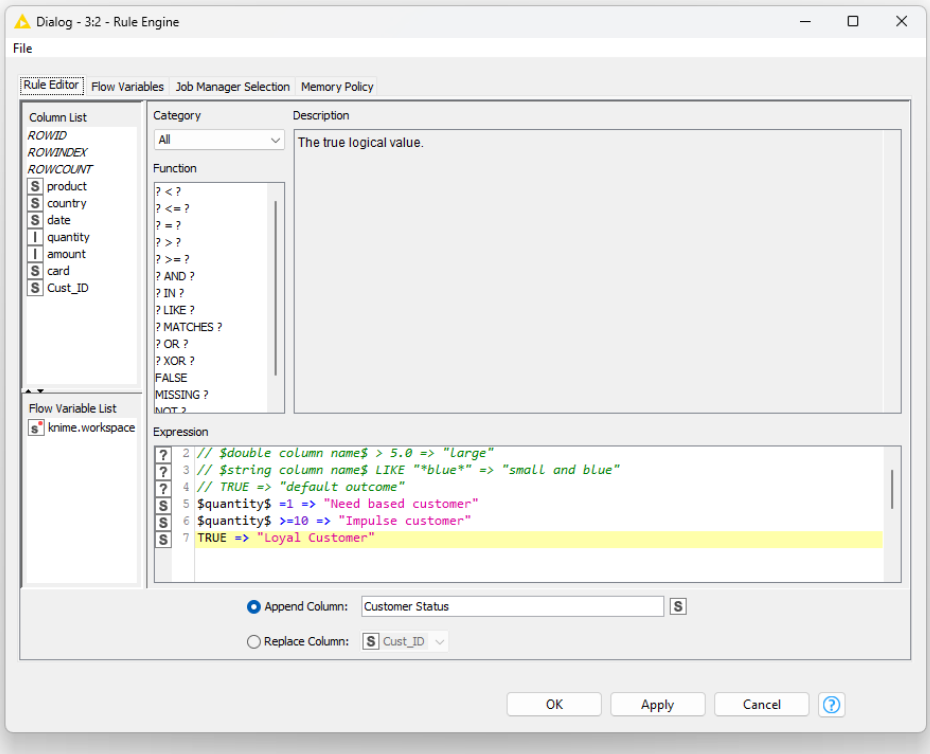
Experiment 6

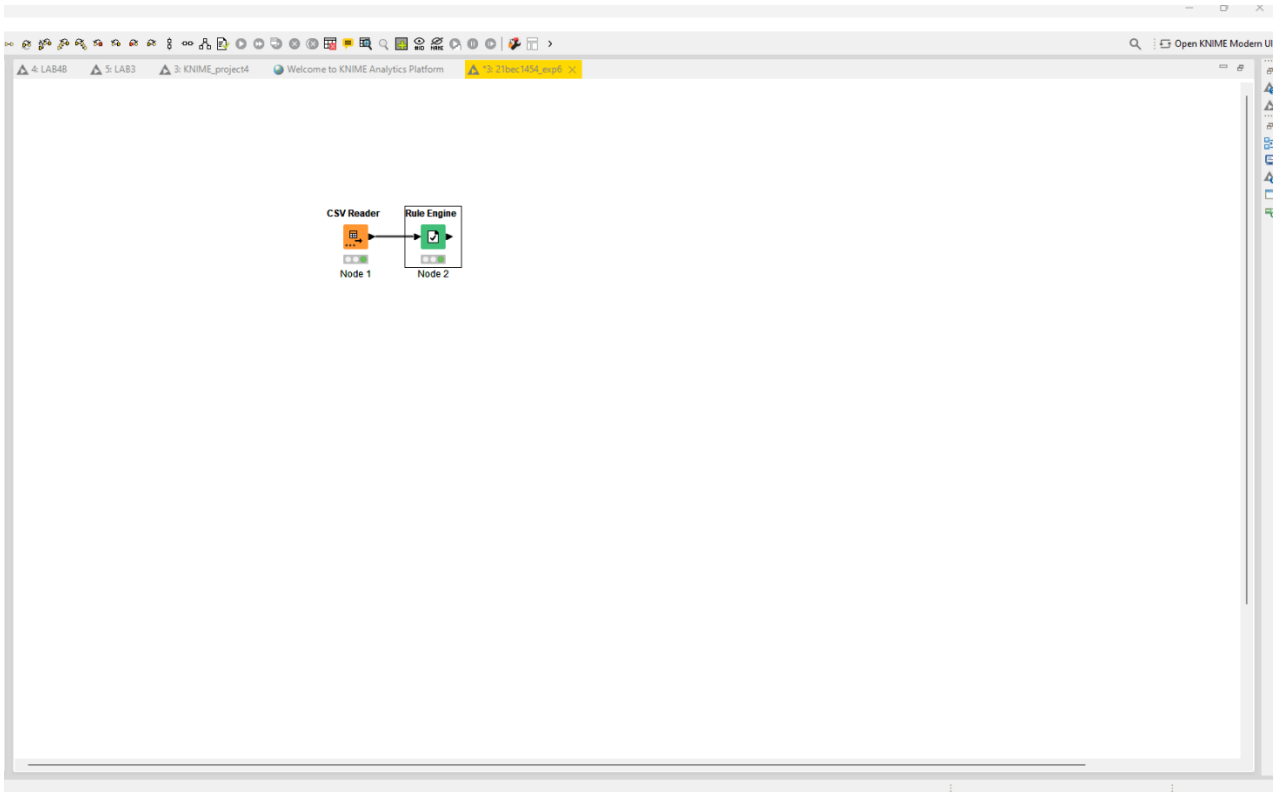
Data manipulation, String manipulation, Math formula and rule engine using KNIME

Aim: The aim of this experiment is to utilize KNIME to develop a comprehensive workflow for data manipulation, string manipulation, mathematical formula application, and rule-based decision-making



Rule engine


Dialog - 3:2 - Rule Engine
File
Rule Editor
Flow Variables
Job Manager Selection
Memory Policy
Column List
ROWID
ROWINDEX
ROWCOUNT
product
country
date
quantity
amount
card
Cust_ID
Flow Variable List
knime.workspace
Category
All
Function
? < ?
? <= ?
? = ?
? > ?
? >= ?
? AND ?
? IN ?
? LIKE ?
? MATCHES ?
? OR ?
? XOR ?
FALSE
MISSING ?
Description
The true logical value.
Expression
// $double column name$ > 5.0 => "large"
// $string column name$ LIKE "*blue*" => "small and blue"
// TRUE => "default outcome"
$quantity$ =1 => "Need based customer"
$quantity$ >=10 => "Impulse customer"
TRUE => "Loyal Customer"
Append Column:
Customer Status
Replace Column:
Cust_ID
OK
Apply
Cancel


CSV Reader
Rule Engine
Node 1
Node 2

Classified values

Classified values - 3:2 - Rule Engine

File Edit Hilite Navigation View

Table "default" - Rows: 47 Spec - Columns: 8 Properties Flow Variables

Row ID	product	country	date	quantity	amount	card	Cust_ID	Customer Status
Row0	prod_4	unknown	2008-12-12	1	3	?	Cust_8	Need based customer
Row1	prod_3	China	2009-04-10	2	160	N	Cust_2	Loyal Customer
Row2	prod_3	China	2009-04-10	2	160	Y	Cust_5	Loyal Customer
Row3	prod_3	China	2009-05-10	2	160	?	Cust_2	Loyal Customer
Row4	prod_3	USA	2009-05-20	20	1600	?	Cust_3	Impulse customer
Row5	prod_3	Brazil	2009-06-08	15	1200	?	Cust_7	Impulse customer
Row6	prod_1	USA	2009-07-04	2	70	Y	Cust_3	Loyal Customer
Row7	prod_1	USA	2009-07-14	2	70	?	Cust_6	Loyal Customer
Row8	prod_3	USA	2009-08-20	20	1600	?	Cust_3	Impulse customer
Row9	prod_2	Germany	2009-11-02	15	600	?	Cust_1	Impulse customer
Row10	prod_2	Germany	2009-11-22	15	600	N	Cust_1	Impulse customer
Row11	prod_1	Germany	2009-12-02	1	35	Y	Cust_1	Need based customer
Row12	prod_1	China	2009-12-12	1	35	Y	Cust_2	Need based customer
Row13	prod_3	USA	2010-01-03	20	1600	?	Cust_3	Impulse customer
Row14	prod_1	Germany	2010-01-10	1	35	N	Cust_1	Need based customer
Row15	prod_3	Germany	2010-01-13	1	80	?	Cust_4	Need based customer
Row16	prod_2	Germany	2010-01-15	25	1000	?	Cust_1	Impulse customer
Row17	prod_2	USA	2010-01-20	2	80	?	Cust_6	Loyal Customer
Row18	prod_2	USA	2010-02-12	6	240	Y	Cust_6	Loyal Customer
Row19	prod_2	USA	2010-02-22	6	240	?	Cust_6	Loyal Customer
Row20	prod_2	Brazil	2010-03-11	6	240	N	Cust_7	Loyal Customer
Row21	prod_3	China	2010-03-12	1	80	?	Cust_5	Need based customer
Row22	prod_3	Germany	2010-03-14	2	160	?	Cust_9	Loyal Customer
Row23	prod_3	USA	2010-03-17	1	80	Y	Cust_3	Need based customer
Row24	prod_2	Germany	2010-03-31	5	200	Y	Cust_4	Loyal Customer
Row25	prod_2	USA	2010-04-22	10	400	Y	Cust_3	Impulse customer
Row26	prod_3	China	2010-05-12	2	160	N	Cust_2	Loyal Customer
Row27	prod_1	USA	2010-05-17	5	175	Y	Cust_6	Loyal Customer
Row28	prod_2	Germany	2010-06-22	6	240	?	Cust_1	Loyal Customer
Row29	prod_1	China	2010-06-28	10	350	Y	Cust_5	Impulse customer
Row30	prod_2	USA	2010-07-07	12	480	?	Cust_3	Impulse customer
Row31	prod_1	Brazil	2010-07-17	5	175	?	Cust_7	Loyal Customer
Row32	prod_1	China	2010-08-28	10	350	N	Cust_2	Impulse customer
Row33	prod_2	Germany	2010-08-31	5	200	?	Cust_1	Loyal Customer
Row34	prod_3	Germany	2010-09-14	2	160	?	Cust_1	Loyal Customer
Row35	prod_1	China	2010-10-01	2	70	?	Cust_5	Loyal Customer
Row36	prod_1	USA	2010-10-11	2	70	Y	Cust_6	Loyal Customer
Row37	prod_2	USA	2010-12-07	15	600	N	Cust_6	Impulse customer

Math formula

Output data - 3:3 - Math Formula

File Edit Hilite Navigation View

Table "default" - Rows: 47 Spec - Columns: 9 Properties Flow Variables

Row ID	product	country	date	quantity	amount	card	Cust_ID	Customer Status	Sales Gain
Row0	prod_4	unknown	2008-12-12	1	3	?	Cust_8	Need based customer	9
Row1	prod_3	China	2009-04-10	2	160	N	Cust_2	Loyal Customer	25,600
Row2	prod_3	China	2009-04-10	2	160	Y	Cust_5	Loyal Customer	25,600
Row3	prod_3	China	2009-05-10	2	160	?	Cust_2	Loyal Customer	25,600
Row4	prod_3	USA	2009-05-20	20	1600	?	Cust_3	Impulse customer	2,560,000
Row5	prod_3	Brazil	2009-06-08	15	1200	?	Cust_7	Impulse customer	1,440,000
Row6	prod_1	USA	2009-07-04	2	70	Y	Cust_3	Loyal Customer	4,900
Row7	prod_1	USA	2009-07-14	2	70	?	Cust_6	Loyal Customer	4,900
Row8	prod_3	USA	2009-08-20	20	1600	?	Cust_3	Impulse customer	2,560,000
Row9	prod_2	Germany	2009-11-02	15	600	?	Cust_1	Impulse customer	360,000
Row10	prod_2	Germany	2009-11-22	15	600	N	Cust_1	Impulse customer	360,000
Row11	prod_1	Germany	2009-12-02	1	35	Y	Cust_1	Need based customer	1,225
Row12	prod_1	China	2009-12-12	1	35	Y	Cust_2	Need based customer	1,225
Row13	prod_3	USA	2010-01-03	20	1600	?	Cust_3	Impulse customer	2,560,000
Row14	prod_1	Germany	2010-01-10	1	35	N	Cust_1	Need based customer	1,225
Row15	prod_3	Germany	2010-01-13	1	80	?	Cust_4	Need based customer	6,400
Row16	prod_2	Germany	2010-01-15	25	1000	?	Cust_1	Impulse customer	1,000,000
Row17	prod_2	USA	2010-01-20	2	80	?	Cust_6	Loyal Customer	6,400
Row18	prod_2	USA	2010-02-12	6	240	Y	Cust_6	Loyal Customer	57,600
Row19	prod_2	USA	2010-02-22	6	240	?	Cust_6	Loyal Customer	57,600
Row20	prod_2	Brazil	2010-03-11	6	240	N	Cust_7	Loyal Customer	57,600
Row21	prod_3	China	2010-03-12	1	80	?	Cust_5	Need based customer	6,400
Row22	prod_3	Germany	2010-03-14	2	160	?	Cust_9	Loyal Customer	25,600
Row23	prod_3	USA	2010-03-17	1	80	Y	Cust_3	Need based customer	6,400
Row24	prod_2	Germany	2010-03-31	5	200	Y	Cust_4	Loyal Customer	40,000
Row25	prod_2	USA	2010-04-22	10	400	Y	Cust_3	Impulse customer	160,000
Row26	prod_3	China	2010-05-12	2	160	N	Cust_2	Loyal Customer	25,600
Row27	prod_1	USA	2010-05-17	5	175	Y	Cust_6	Loyal Customer	30,625
Row28	prod_2	Germany	2010-06-22	6	240	?	Cust_1	Loyal Customer	57,600
Row29	prod_1	China	2010-06-28	10	350	Y	Cust_5	Impulse customer	122,500
Row30	prod_2	USA	2010-07-07	12	480	?	Cust_3	Impulse customer	230,400
Row31	prod_1	Brazil	2010-07-17	5	175	?	Cust_7	Loyal Customer	30,625
Row32	prod_1	China	2010-08-28	10	350	N	Cust_2	Impulse customer	122,500
Row33	prod_2	Germany	2010-08-31	5	200	?	Cust_1	Loyal Customer	40,000
Row34	prod_3	Germany	2010-09-14	2	160	?	Cust_1	Loyal Customer	25,600
Row35	prod_1	China	2010-10-01	2	70	?	Cust_5	Loyal Customer	4,900
Row36	prod_1	USA	2010-10-11	2	70	Y	Cust_6	Loyal Customer	4,900
Row37	prod_2	USA	2010-12-07	15	600	N	Cust_6	Impulse customer	360,000

String manipulation

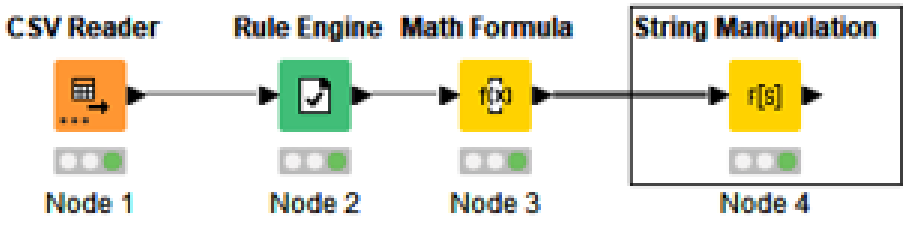
Appended table - 3:4 - String Manipulation

File Edit Hilite Navigation View

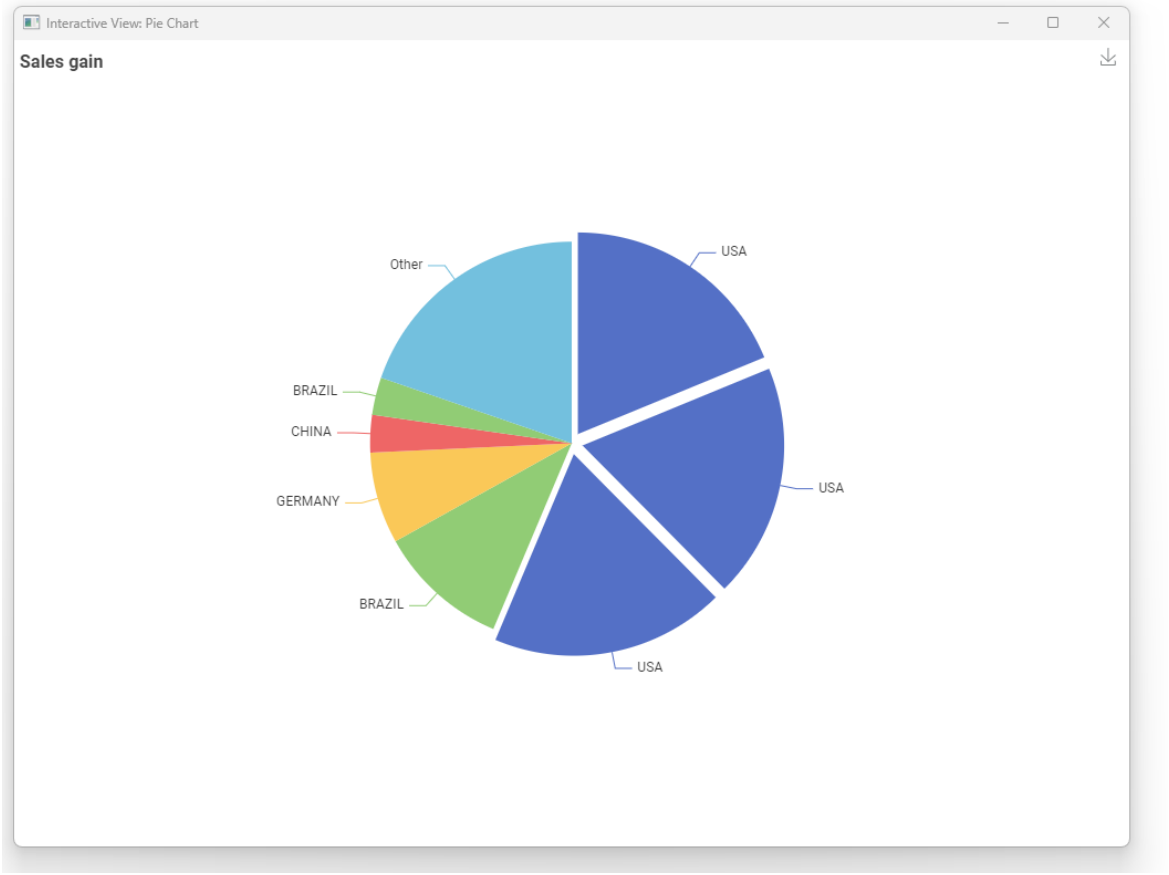
Table "default" - Rows: 47 Spec - Columns: 9 Properties Flow Variables

Row ID	product	country	date	quantity	amount	card	Cust_ID	Customer Status	Sales Gain
Row0	prod_4	UNKNOWN	2008-12-12	1	3	?	Cust_8	Need based customer	9
Row1	prod_3	CHINA	2009-04-10	2	160	N	Cust_2	Loyal Customer	25,600
Row2	prod_3	CHINA	2009-04-10	2	160	Y	Cust_5	Loyal Customer	25,600
Row3	prod_3	CHINA	2009-05-10	2	160	?	Cust_2	Loyal Customer	25,600
Row4	prod_3	USA	2009-05-20	20	1600	?	Cust_3	Impulse customer	2,560,000
Row5	prod_3	BRAZIL	2009-06-08	15	1200	?	Cust_7	Impulse customer	1,440,000
Row6	prod_1	USA	2009-07-04	2	70	Y	Cust_3	Loyal Customer	4,900
Row7	prod_1	USA	2009-07-14	2	70	?	Cust_6	Loyal Customer	4,900
Row8	prod_3	USA	2009-08-20	20	1600	?	Cust_3	Impulse customer	2,560,000
Row9	prod_2	GERMANY	2009-11-02	15	600	?	Cust_1	Impulse customer	360,000
Row10	prod_2	GERMANY	2009-11-22	15	600	N	Cust_1	Impulse customer	360,000
Row11	prod_1	GERMANY	2009-12-02	1	35	Y	Cust_1	Need based customer	1,225
Row12	prod_1	CHINA	2009-12-12	1	35	Y	Cust_2	Need based customer	1,225
Row13	prod_3	USA	2010-01-03	20	1600	?	Cust_3	Impulse customer	2,560,000
Row14	prod_1	GERMANY	2010-01-10	1	35	N	Cust_1	Need based customer	1,225
Row15	prod_3	GERMANY	2010-01-13	1	80	?	Cust_4	Need based customer	6,400
Row16	prod_2	GERMANY	2010-01-15	25	1000	?	Cust_1	Impulse customer	1,000,000
Row17	prod_2	USA	2010-01-20	2	80	?	Cust_6	Loyal Customer	6,400
Row18	prod_2	USA	2010-02-12	6	240	Y	Cust_6	Loyal Customer	57,600
Row19	prod_2	USA	2010-02-22	6	240	?	Cust_6	Loyal Customer	57,600
Row20	prod_2	BRAZIL	2010-03-11	6	240	N	Cust_7	Loyal Customer	57,600
Row21	prod_3	CHINA	2010-03-12	1	80	?	Cust_5	Need based customer	6,400
Row22	prod_3	GERMANY	2010-03-14	2	160	?	Cust_9	Loyal Customer	25,600
Row23	prod_3	USA	2010-03-17	1	80	Y	Cust_3	Need based customer	6,400
Row24	prod_2	GERMANY	2010-03-31	5	200	Y	Cust_4	Loyal Customer	40,000
Row25	prod_2	USA	2010-04-22	10	400	Y	Cust_3	Impulse customer	160,000
Row26	prod_3	CHINA	2010-05-12	2	160	N	Cust_2	Loyal Customer	25,600
Row27	prod_1	USA	2010-05-17	5	175	Y	Cust_6	Loyal Customer	30,625
Row28	prod_2	GERMANY	2010-06-22	6	240	?	Cust_1	Loyal Customer	57,600
Row29	prod_1	CHINA	2010-06-28	10	350	Y	Cust_5	Impulse customer	122,500
Row30	prod_2	USA	2010-07-07	12	480	?	Cust_3	Impulse customer	230,400
Row31	prod_1	BRAZIL	2010-07-17	5	175	?	Cust_7	Loyal Customer	30,625
Row32	prod_1	CHINA	2010-08-28	10	350	N	Cust_2	Impulse customer	122,500
Row33	prod_2	GERMANY	2010-08-31	5	200	?	Cust_1	Loyal Customer	40,000
Row34	prod_3	GERMANY	2010-09-14	2	160	?	Cust_1	Loyal Customer	25,600
Row35	prod_1	CHINA	2010-10-01	2	70	?	Cust_5	Loyal Customer	4,900
Row36	prod_1	USA	2010-10-11	2	70	Y	Cust_6	Loyal Customer	4,900
Row37	prod_2	USA	2010-12-07	15	600	N	Cust_6	Impulse customer	360,000

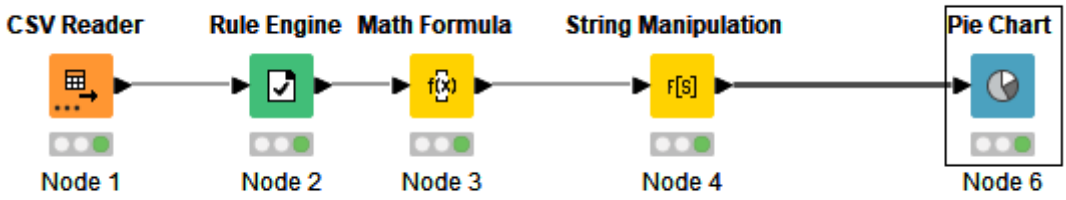
Diagram



Output

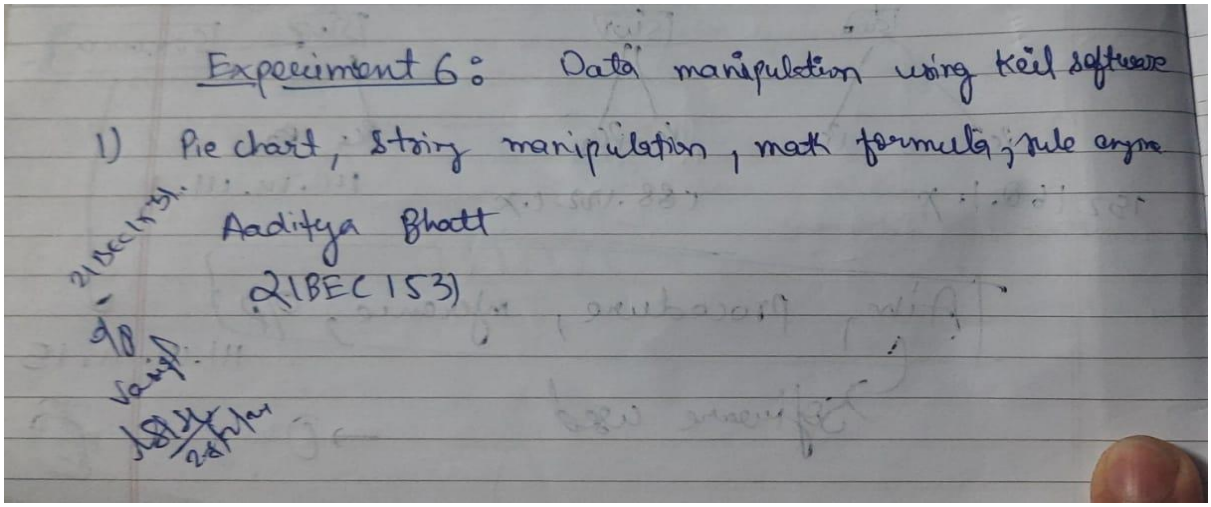


Schematic



Inference: The experiment aims to leverage KNIME's capabilities to create a cohesive workflow encompassing data manipulation, string manipulation, mathematical formula application, and rule-based decision-making. The goal is to optimize data processing efficiency, improve data quality, and facilitate effective decision-making processes within a unified platform, thereby enhancing overall operational effectiveness.

Verification sign:



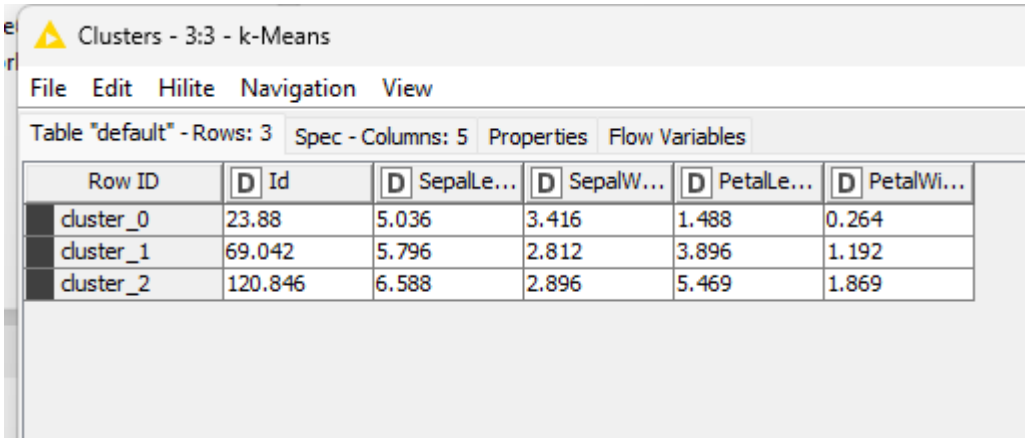
Result: Successfully completed and verified Data manipulation, String manipulation, Math formula and rule engine using Knime

Experiment 7

KNIME clustering, unsupervised machine learning

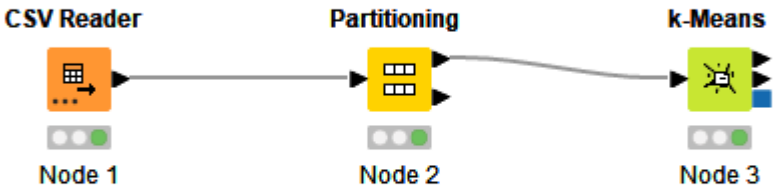
KNIME

Aim: The aim of this experiment is to utilize KNIME for clustering, specifically in the realm of unsupervised machine learning. This involves exploring data patterns and structures to group similar data points together, aiding in insightful data exploration and potentially uncovering hidden relationships within the dataset.

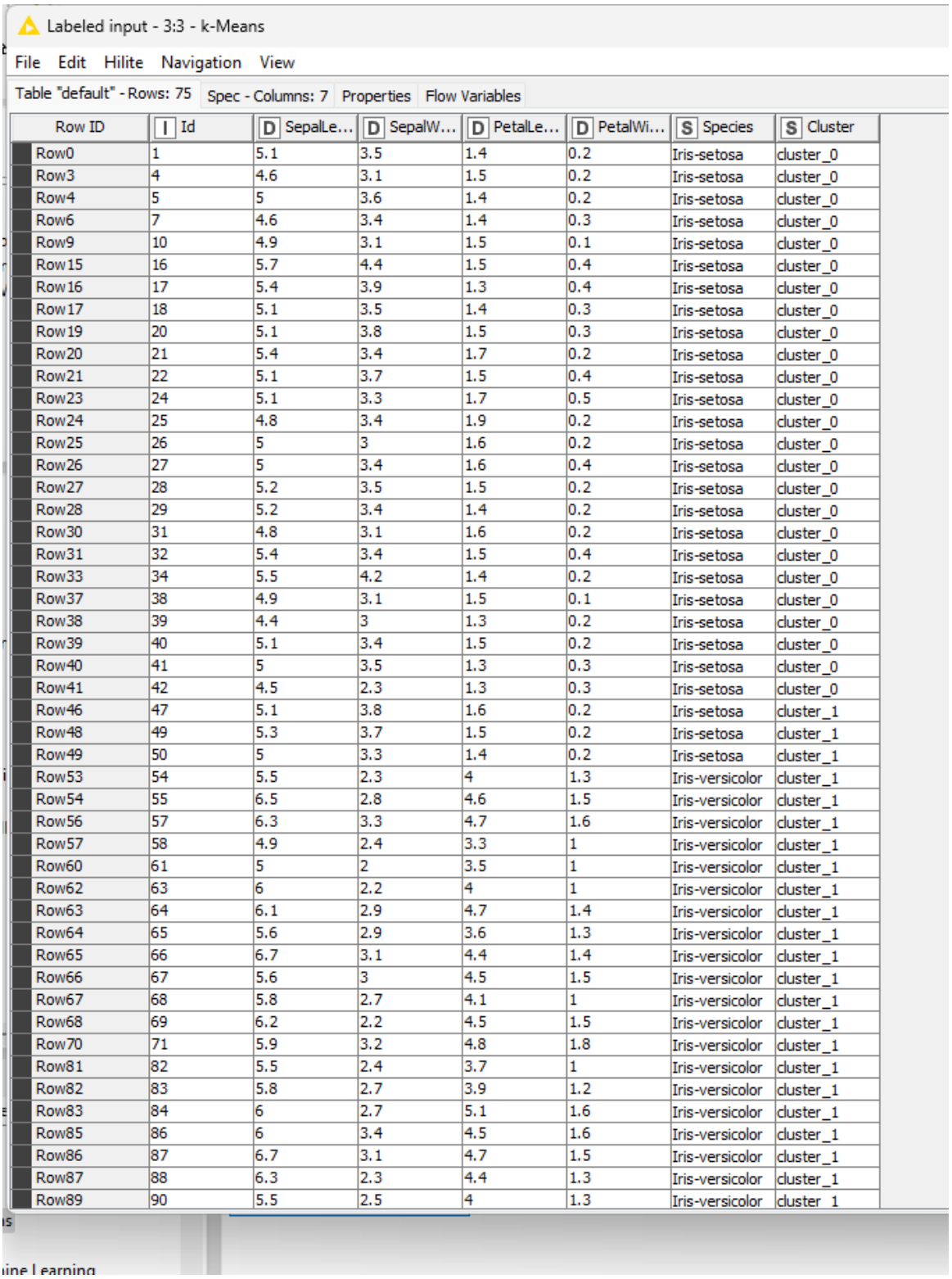


Row ID	D Id	D SepalLe...	D SepalW...	D PetalLe...	D PetalWi...
cluster_0	23.88	5.036	3.416	1.488	0.264
cluster_1	69.042	5.796	2.812	3.896	1.192
cluster_2	120.846	6.588	2.896	5.469	1.869

Schematic



KNIME



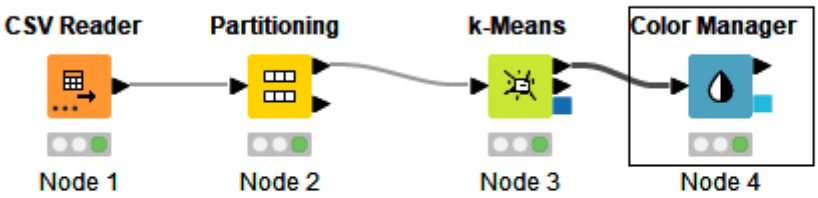
Labeled input - 3:3 - k-Means

File Edit Hilite Navigation View

Table "default" - Rows: 75 Spec - Columns: 7 Properties Flow Variables

Row ID	Id	SepalLe...	SepalW...	PetalLe...	PetalWi...	Species	Cluster
Row0	1	5.1	3.5	1.4	0.2	Iris-setosa	cluster_0
Row3	4	4.6	3.1	1.5	0.2	Iris-setosa	cluster_0
Row4	5	5	3.6	1.4	0.2	Iris-setosa	cluster_0
Row6	7	4.6	3.4	1.4	0.3	Iris-setosa	cluster_0
Row9	10	4.9	3.1	1.5	0.1	Iris-setosa	cluster_0
Row15	16	5.7	4.4	1.5	0.4	Iris-setosa	cluster_0
Row16	17	5.4	3.9	1.3	0.4	Iris-setosa	cluster_0
Row17	18	5.1	3.5	1.4	0.3	Iris-setosa	cluster_0
Row19	20	5.1	3.8	1.5	0.3	Iris-setosa	cluster_0
Row20	21	5.4	3.4	1.7	0.2	Iris-setosa	cluster_0
Row21	22	5.1	3.7	1.5	0.4	Iris-setosa	cluster_0
Row23	24	5.1	3.3	1.7	0.5	Iris-setosa	cluster_0
Row24	25	4.8	3.4	1.9	0.2	Iris-setosa	cluster_0
Row25	26	5	3	1.6	0.2	Iris-setosa	cluster_0
Row26	27	5	3.4	1.6	0.4	Iris-setosa	cluster_0
Row27	28	5.2	3.5	1.5	0.2	Iris-setosa	cluster_0
Row28	29	5.2	3.4	1.4	0.2	Iris-setosa	cluster_0
Row30	31	4.8	3.1	1.6	0.2	Iris-setosa	cluster_0
Row31	32	5.4	3.4	1.5	0.4	Iris-setosa	cluster_0
Row33	34	5.5	4.2	1.4	0.2	Iris-setosa	cluster_0
Row37	38	4.9	3.1	1.5	0.1	Iris-setosa	cluster_0
Row38	39	4.4	3	1.3	0.2	Iris-setosa	cluster_0
Row39	40	5.1	3.4	1.5	0.2	Iris-setosa	cluster_0
Row40	41	5	3.5	1.3	0.3	Iris-setosa	cluster_0
Row41	42	4.5	2.3	1.3	0.3	Iris-setosa	cluster_0
Row46	47	5.1	3.8	1.6	0.2	Iris-setosa	cluster_1
Row48	49	5.3	3.7	1.5	0.2	Iris-setosa	cluster_1
Row49	50	5	3.3	1.4	0.2	Iris-setosa	cluster_1
Row53	54	5.5	2.3	4	1.3	Iris-versicolor	cluster_1
Row54	55	6.5	2.8	4.6	1.5	Iris-versicolor	cluster_1
Row56	57	6.3	3.3	4.7	1.6	Iris-versicolor	cluster_1
Row57	58	4.9	2.4	3.3	1	Iris-versicolor	cluster_1
Row60	61	5	2	3.5	1	Iris-versicolor	cluster_1
Row62	63	6	2.2	4	1	Iris-versicolor	cluster_1
Row63	64	6.1	2.9	4.7	1.4	Iris-versicolor	cluster_1
Row64	65	5.6	2.9	3.6	1.3	Iris-versicolor	cluster_1
Row65	66	6.7	3.1	4.4	1.4	Iris-versicolor	cluster_1
Row66	67	5.6	3	4.5	1.5	Iris-versicolor	cluster_1
Row67	68	5.8	2.7	4.1	1	Iris-versicolor	cluster_1
Row68	69	6.2	2.2	4.5	1.5	Iris-versicolor	cluster_1
Row70	71	5.9	3.2	4.8	1.8	Iris-versicolor	cluster_1
Row81	82	5.5	2.4	3.7	1	Iris-versicolor	cluster_1
Row82	83	5.8	2.7	3.9	1.2	Iris-versicolor	cluster_1
Row83	84	6	2.7	5.1	1.6	Iris-versicolor	cluster_1
Row85	86	6	3.4	4.5	1.6	Iris-versicolor	cluster_1
Row86	87	6.7	3.1	4.7	1.5	Iris-versicolor	cluster_1
Row87	88	6.3	2.3	4.4	1.3	Iris-versicolor	cluster_1
Row89	90	5.5	2.5	4	1.3	Iris-versicolor	cluster_1

Schematic



Colour manager

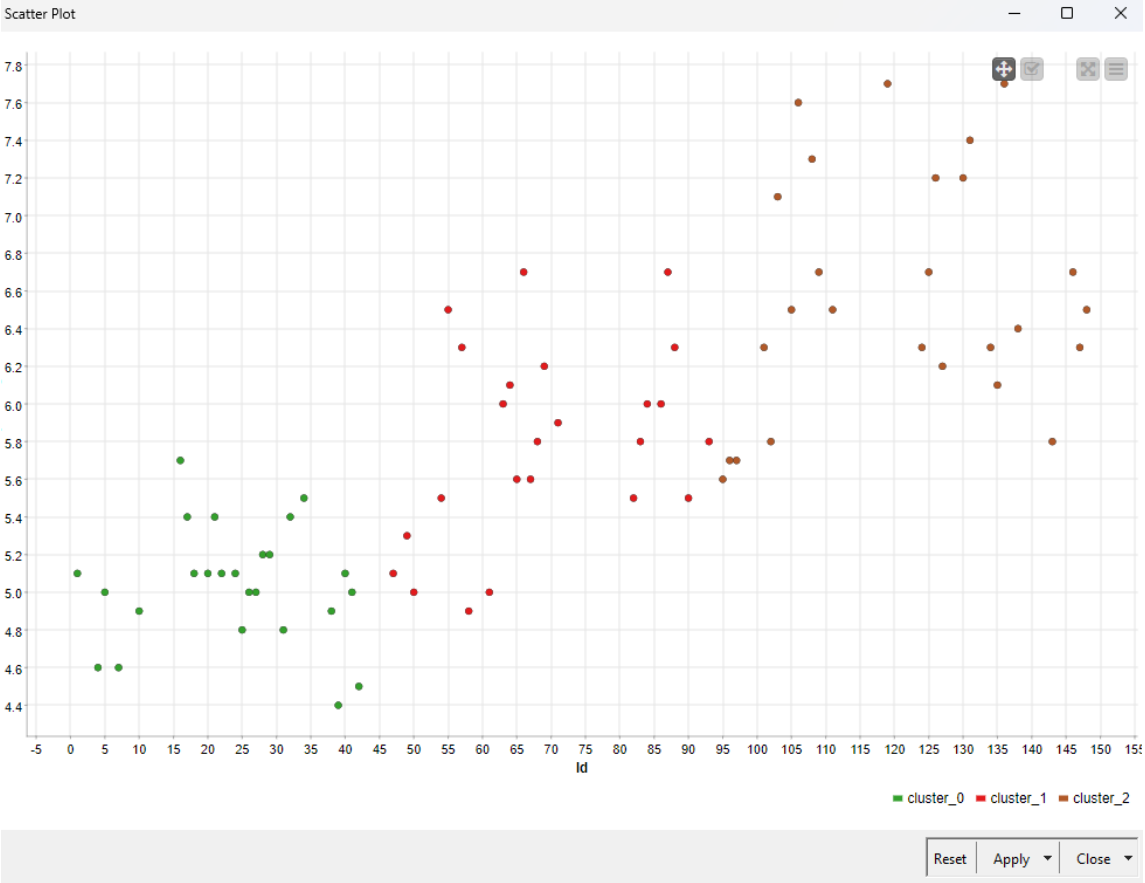
Table with Color information - 3:4 - Color Manager

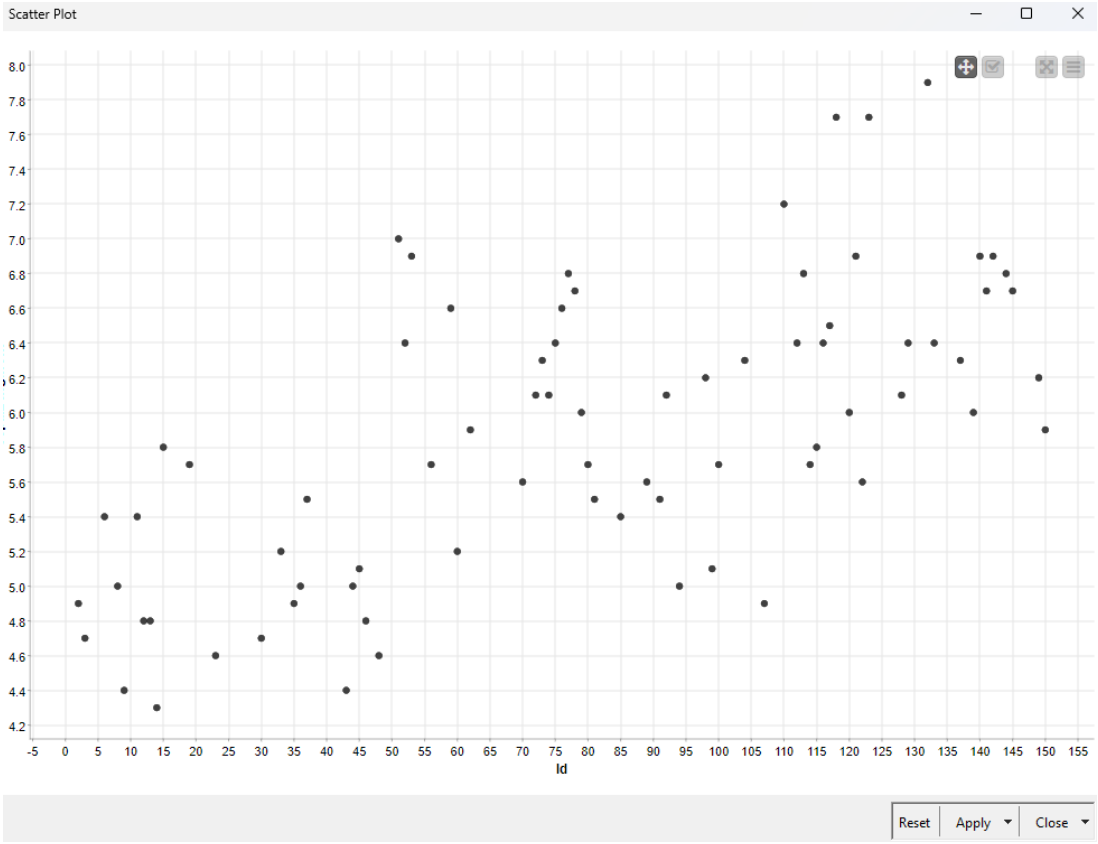
File Edit Hilite Navigation View

Table "default" - Rows: 75 Spec - Columns: 7 Properties Flow Variables

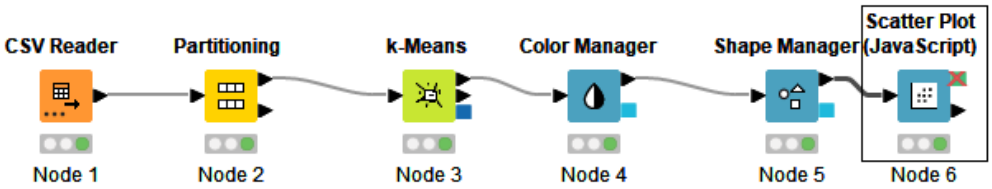
Row ID	I Id	D SepalLe...	D SepalW...	D PetalLe...	D PetalWi...	S Species	S Cluster
Row0	1	5.1	3.5	1.4	0.2	Iris-setosa	cluster_0
Row3	4	4.6	3.1	1.5	0.2	Iris-setosa	cluster_0
Row4	5	5	3.6	1.4	0.2	Iris-setosa	cluster_0
Row6	7	4.6	3.4	1.4	0.3	Iris-setosa	cluster_0
Row9	10	4.9	3.1	1.5	0.1	Iris-setosa	cluster_0
Row15	16	5.7	4.4	1.5	0.4	Iris-setosa	cluster_0
Row16	17	5.4	3.9	1.3	0.4	Iris-setosa	cluster_0
Row17	18	5.1	3.5	1.4	0.3	Iris-setosa	cluster_0
Row19	20	5.1	3.8	1.5	0.3	Iris-setosa	cluster_0
Row20	21	5.4	3.4	1.7	0.2	Iris-setosa	cluster_0
Row21	22	5.1	3.7	1.5	0.4	Iris-setosa	cluster_0
Row23	24	5.1	3.3	1.7	0.5	Iris-setosa	cluster_0
Row24	25	4.8	3.4	1.9	0.2	Iris-setosa	cluster_0
Row25	26	5	3	1.6	0.2	Iris-setosa	cluster_0
Row26	27	5	3.4	1.6	0.4	Iris-setosa	cluster_0
Row27	28	5.2	3.5	1.5	0.2	Iris-setosa	cluster_0
Row28	29	5.2	3.4	1.4	0.2	Iris-setosa	cluster_0
Row30	31	4.8	3.1	1.6	0.2	Iris-setosa	cluster_0
Row31	32	5.4	3.4	1.5	0.4	Iris-setosa	cluster_0
Row33	34	5.5	4.2	1.4	0.2	Iris-setosa	cluster_0
Row37	38	4.9	3.1	1.5	0.1	Iris-setosa	cluster_0
Row38	39	4.4	3	1.3	0.2	Iris-setosa	cluster_0
Row39	40	5.1	3.4	1.5	0.2	Iris-setosa	cluster_0
Row40	41	5	3.5	1.3	0.3	Iris-setosa	cluster_0
Row41	42	4.5	2.3	1.3	0.3	Iris-setosa	cluster_0
Row46	47	5.1	3.8	1.6	0.2	Iris-setosa	cluster_1
Row48	49	5.3	3.7	1.5	0.2	Iris-setosa	cluster_1
Row49	50	5	3.3	1.4	0.2	Iris-setosa	cluster_1
Row53	54	5.5	2.3	4	1.3	Iris-versicolor	cluster_1
Row54	55	6.5	2.8	4.6	1.5	Iris-versicolor	cluster_1
Row56	57	6.3	3.3	4.7	1.6	Iris-versicolor	cluster_1
Row57	58	4.9	2.4	3.3	1	Iris-versicolor	cluster_1
Row60	61	5	2	3.5	1	Iris-versicolor	cluster_1
Row62	63	6	2.2	4	1	Iris-versicolor	cluster_1
Row63	64	6.1	2.9	4.7	1.4	Iris-versicolor	cluster_1
Row64	65	5.6	2.9	3.6	1.3	Iris-versicolor	cluster_1
Row65	66	6.7	3.1	4.4	1.4	Iris-versicolor	cluster_1
Row66	67	5.6	3	4.5	1.5	Iris-versicolor	cluster_1

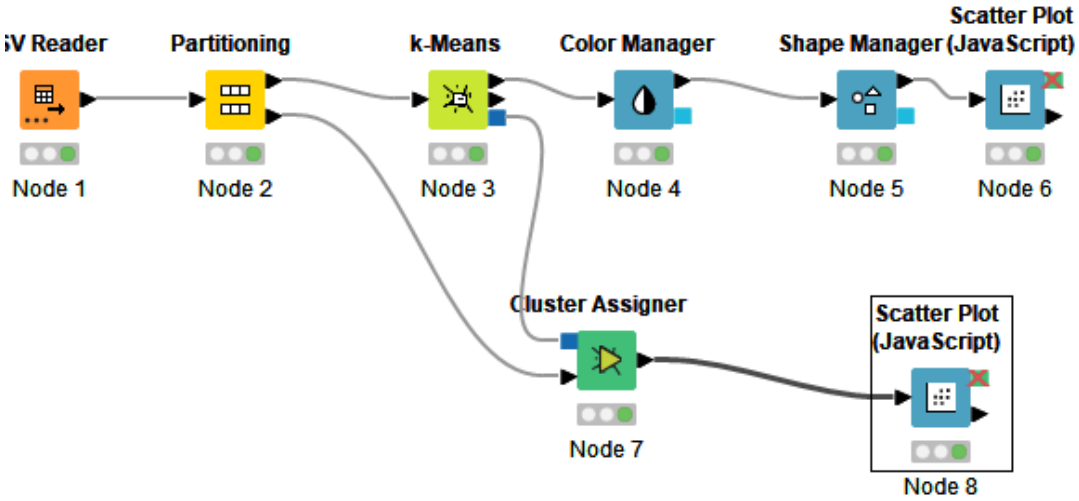
Scatter plot





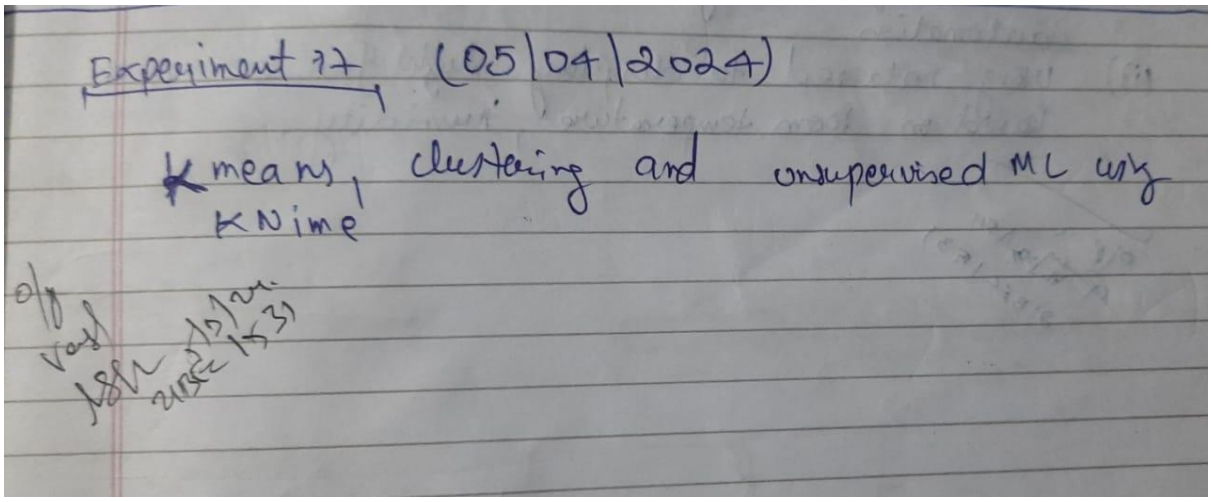
Schematic





Inference: The experiment focuses on leveraging KNIME's clustering capabilities, a form of unsupervised machine learning, to analyse data patterns and structures. By grouping similar data points together, it enables insightful data exploration and potentially reveals hidden relationships within the dataset. This approach facilitates better understanding of the data and can lead to valuable insights for decision-making or further analysis.

Verification Sign:

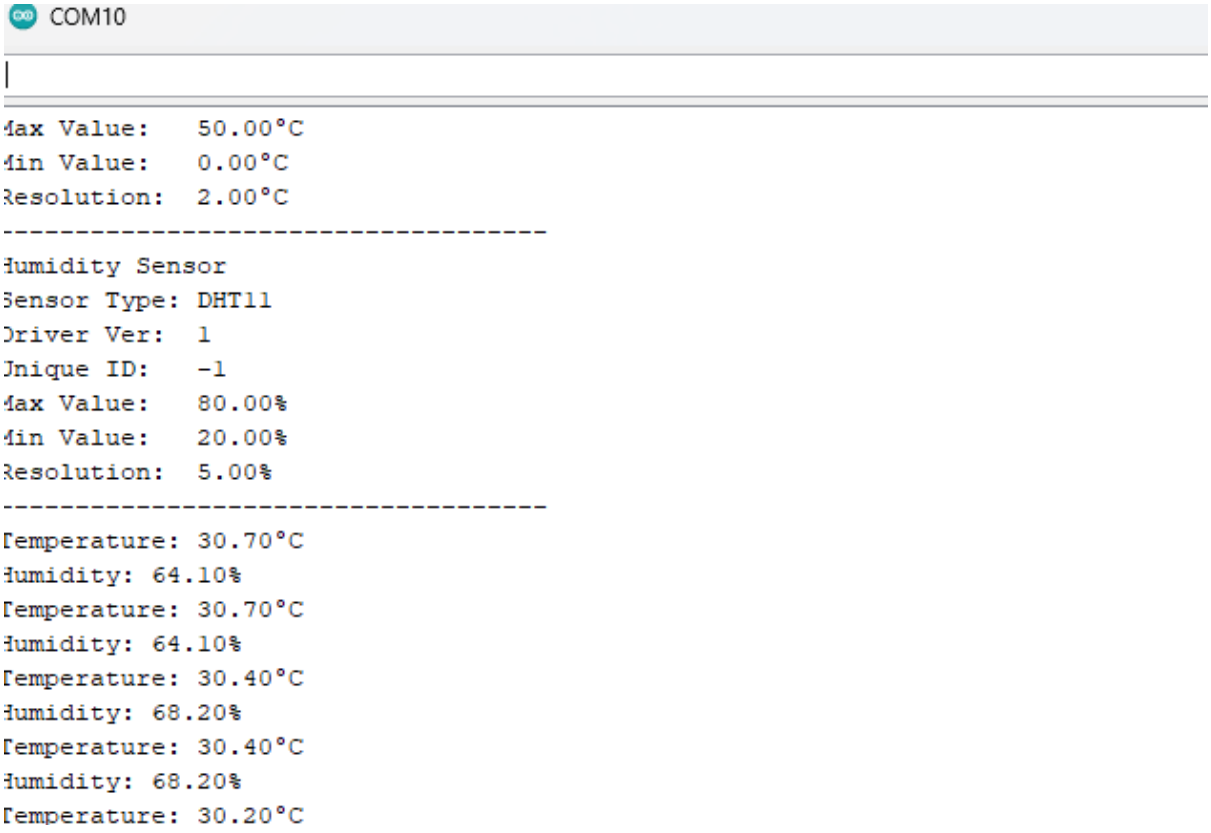


Result: successfully implemented and verified KNIME clustering, unsupervised machine learning

Experiment 8

Hardware: Temperature humidity sensing with Arduino and node red dashboard using dht11

Aim: Collecting the data of temperature and humidity using Arduino and node red and dht11



Code:

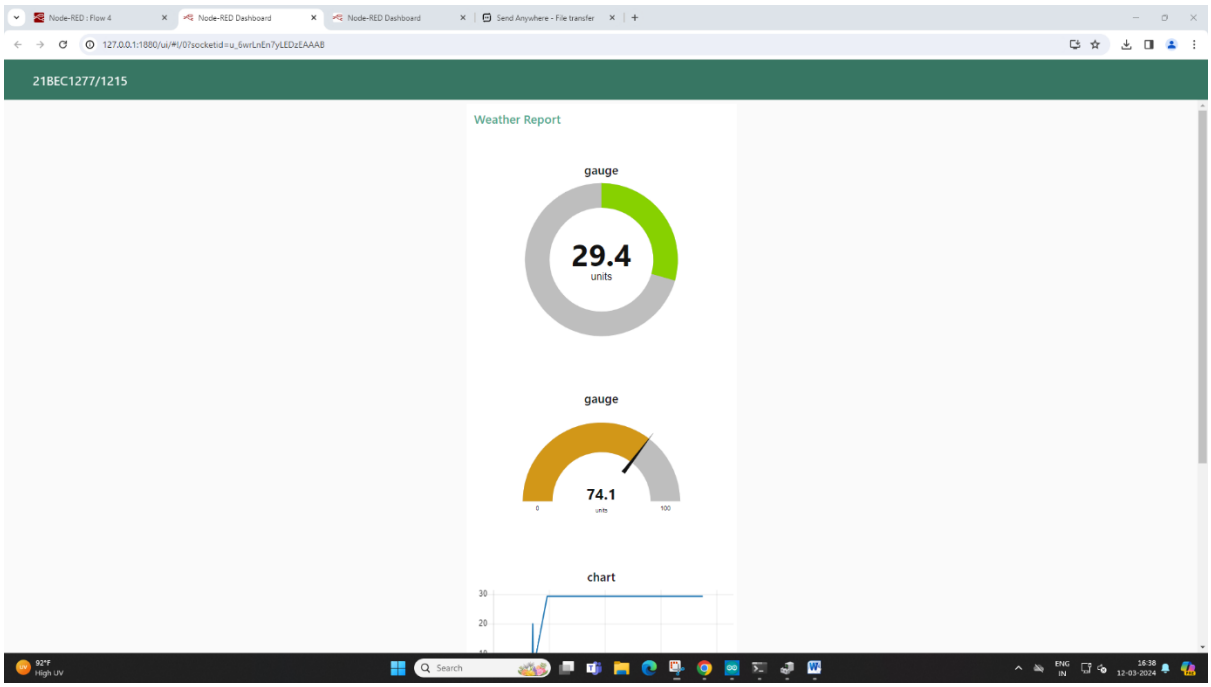
```
// DHT Temperature & Humidity Sensor

// Unified Sensor Library Example

// Written by Tony DiCola for Adafruit Industries

// Released under an MIT license.


// REQUIRES the following Arduino libraries:

// - DHT Sensor Library: https://github.com/adafruit/DHT-sensor-library

// - Adafruit Unified Sensor Lib: https://github.com/adafruit/Adafruit_Sensor
```

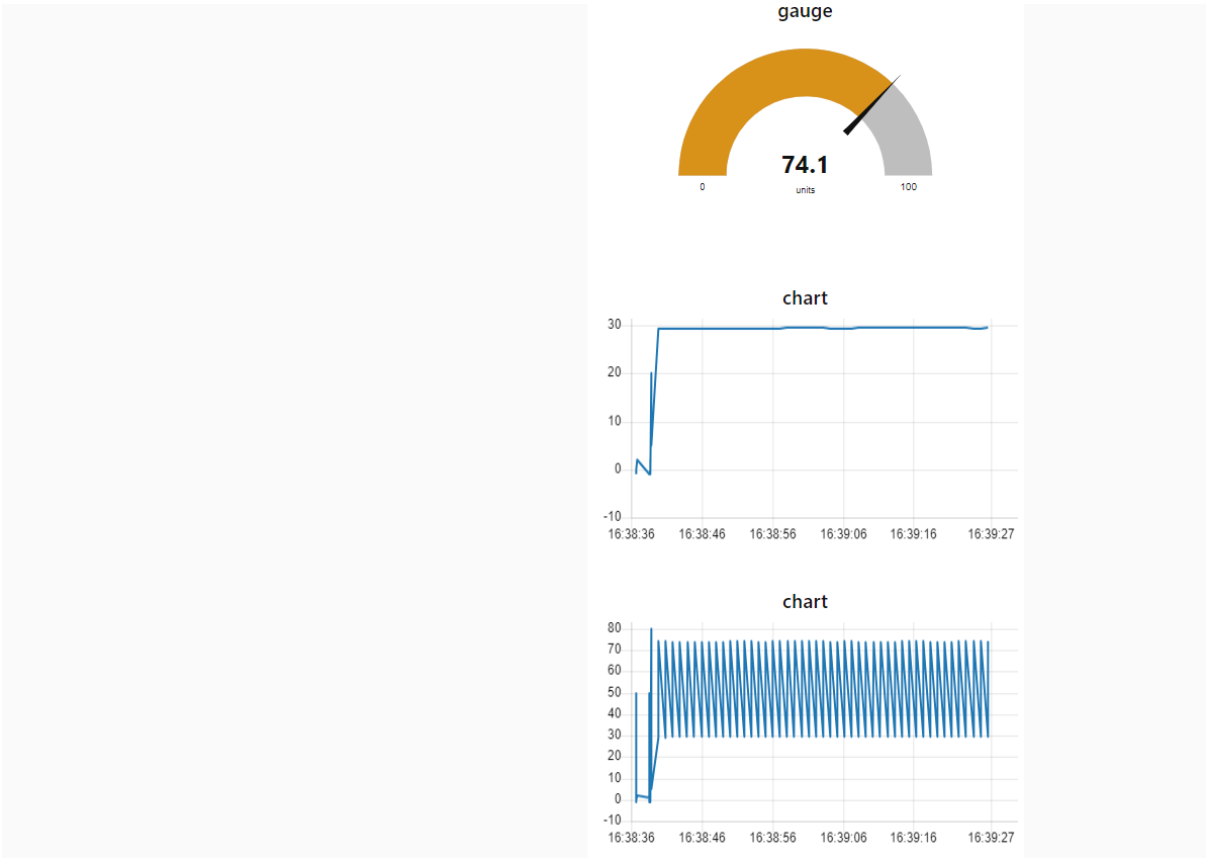
```
#include <Adafruit_Sensor.h>
#include <DHT.h>
#include <DHT_U.h>

#define DHTPIN 7    // Digital pin connected to the DHT sensor
// Feather HUZZAH ESP8266 note: use pins 3, 4, 5, 12, 13 or 14 --
// Pin 15 can work but DHT must be disconnected during program upload.

// Uncomment the type of sensor in use:
#define DHTTYPE    DHT11     // DHT 11
//#define DHTTYPE    DHT22     // DHT 22 (AM2302)
//#define DHTTYPE    DHT21     // DHT 21 (AM2301)

// See guide for details on sensor wiring and usage:
//   https://learn.adafruit.com/dht/overview

DHT_Unified dht(DHTPIN, DHTTYPE);
uint32_t delayMS;
void setup() {
  Serial.begin(9600);
  // Initialize device.
  dht.begin();
  Serial.println(F("DHTxx Unified Sensor Example"));
  // Print temperature sensor details.
  sensor_t sensor;
  dht.temperature().getSensor(&sensor);
  Serial.println(F("------------------------------------"));
  Serial.println(F("Temperature Sensor"));
  Serial.print  (F("Sensor Type: ")); Serial.println(sensor.name);
  Serial.print  (F("Driver Ver:  ")); Serial.println(sensor.version);
```

```
  Serial.print  (F("Unique ID:   ")); Serial.println(sensor.sensor_id);
  Serial.print  (F("Max Value:   ")); Serial.print(sensor.max_value); Serial.println(F("°C"));
  Serial.print  (F("Min Value:   ")); Serial.print(sensor.min_value); Serial.println(F("°C"));
  Serial.print  (F("Resolution:  ")); Serial.print(sensor.resolution); Serial.println(F("°C"));
  Serial.println(F("------------------------------------"));
  // Print humidity sensor details.
  dht.humidity().getSensor(&sensor);
  Serial.println(F("Humidity Sensor"));
  Serial.print  (F("Sensor Type: ")); Serial.println(sensor.name);
  Serial.print  (F("Driver Ver:  ")); Serial.println(sensor.version);
  Serial.print  (F("Unique ID:   ")); Serial.println(sensor.sensor_id);
  Serial.print  (F("Max Value:   ")); Serial.print(sensor.max_value); Serial.println(F("%"));
  Serial.print  (F("Min Value:   ")); Serial.print(sensor.min_value); Serial.println(F("%"));
  Serial.print  (F("Resolution:  ")); Serial.print(sensor.resolution); Serial.println(F("%"));
  Serial.println(F("------------------------------------"));
  // Set delay between sensor readings based on sensor details.
  delayMS = sensor.min_delay / 1000;
}

void loop() {
  // Delay between measurements.
  delay(delayMS);
  // Get temperature event and print its value.
  sensors_event_t event;
  dht.temperature().getEvent(&event);
  if (isnan(event.temperature)) {
    Serial.println(F("Error reading temperature!"));
  }
  else {
    Serial.print(F("Temperature: "));
    Serial.print(event.temperature);
```

```
  Serial.println(F("°C"));
 }
 // Get humidity event and print its value.
 dht.humidity().getEvent(&event);
 if (isnan(event.relative_humidity)) {
  Serial.println(F("Error reading humidity!"));
 }
 else {
  Serial.print(F("Humidity: "));
  Serial.print(event.relative_humidity);
  Serial.println(F("%"));
 }
}
```

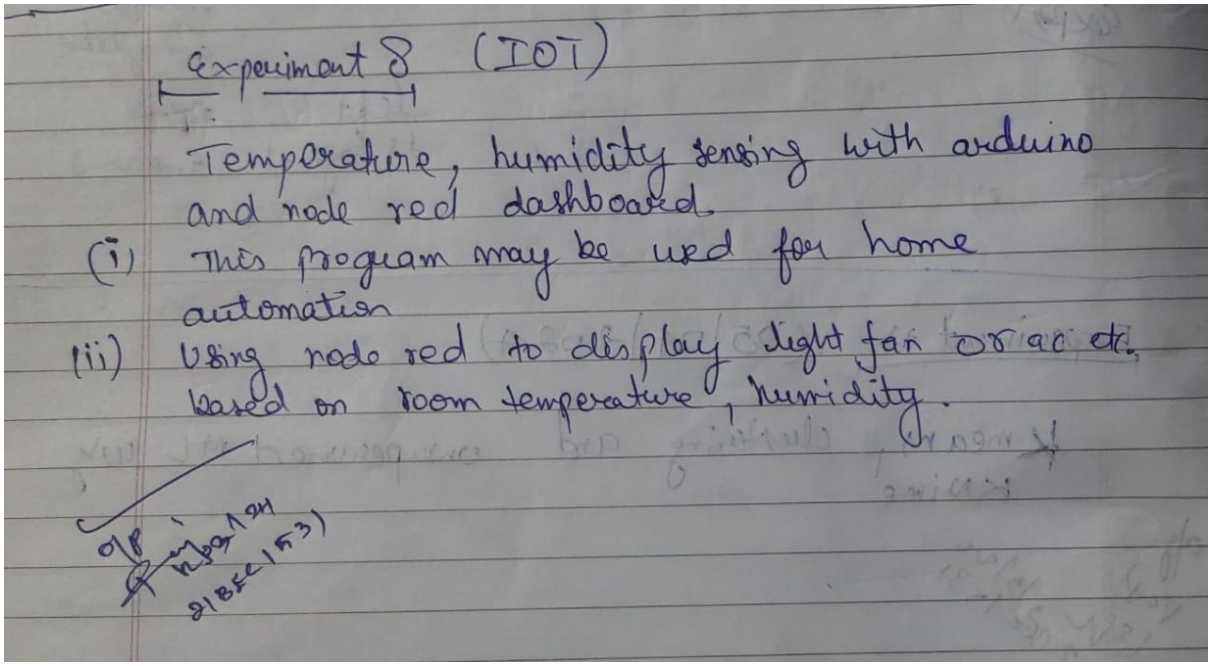
Output:





Inference: This project aims to implement a temperature and humidity sensing system using an Arduino microcontroller and the DHT11 sensor, with data visualization facilitated through a Node-RED dashboard. By integrating hardware and software components, the project seeks to enable real-time monitoring and visualization of environmental conditions, providing users with valuable insights and potentially facilitating automated control systems for maintaining desired environmental parameters.

Verification sign:


Experiment 8 (IOT)

Temperature, humidity sensing with arduino and node red dashboard.

(i) This program may be used for home automation

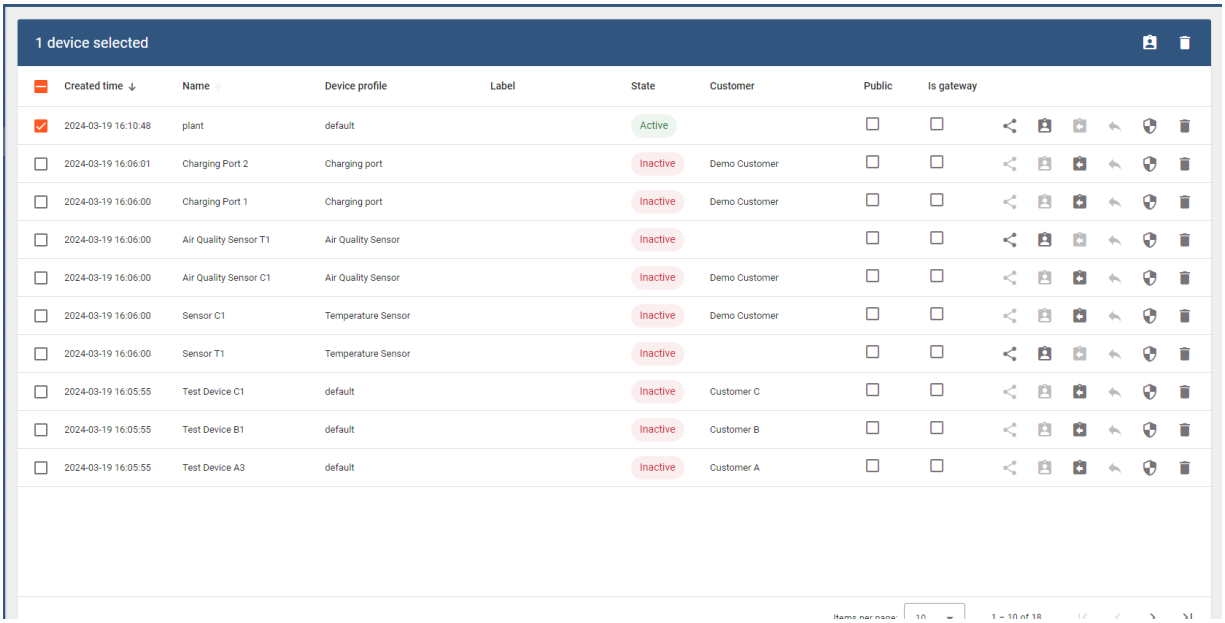
(ii) Using node red to display light fan or ac etc. based on room temperature, humidity.

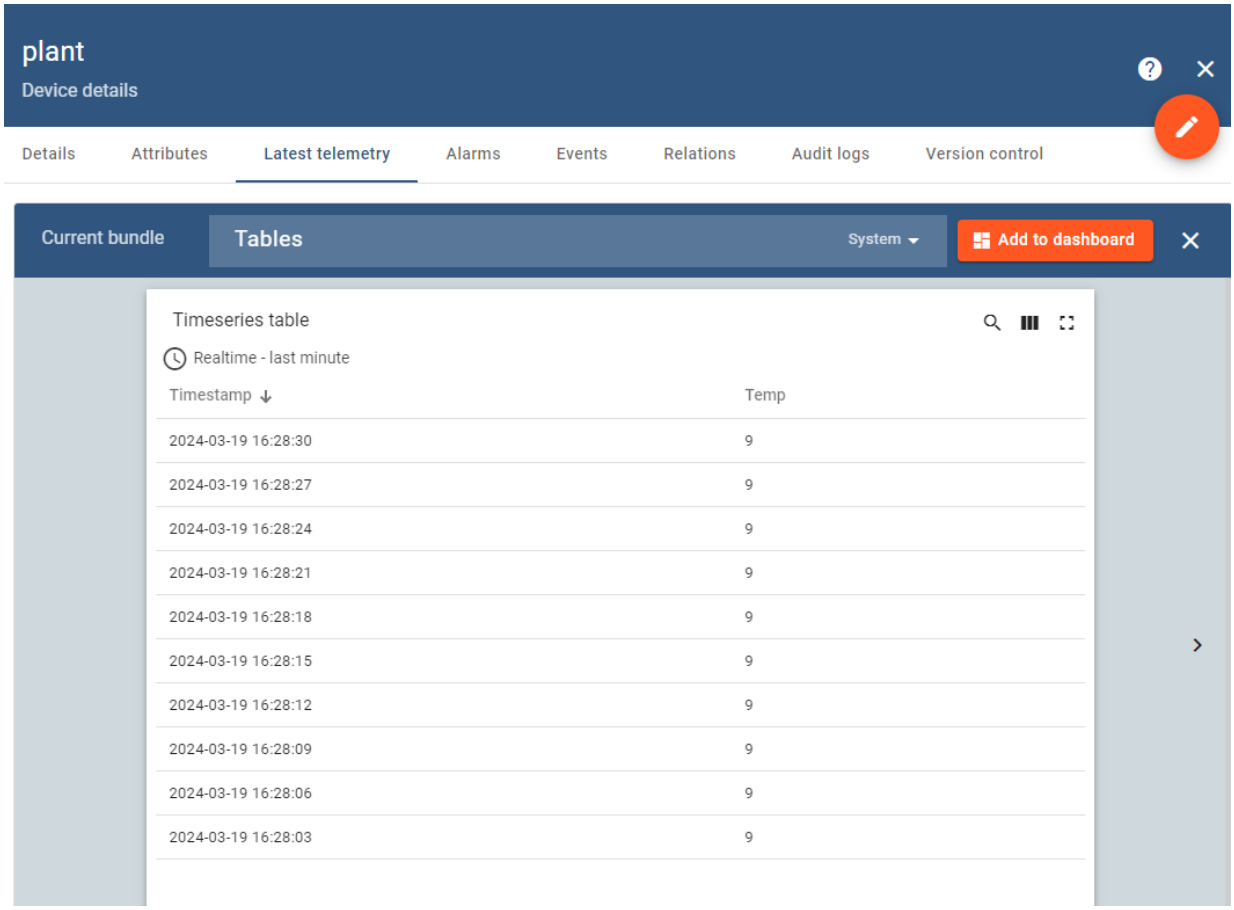
Result: successfully implemented and verified Temperature humidity sensing with Arduino and node red dashboard using dht11

Experiment: 9

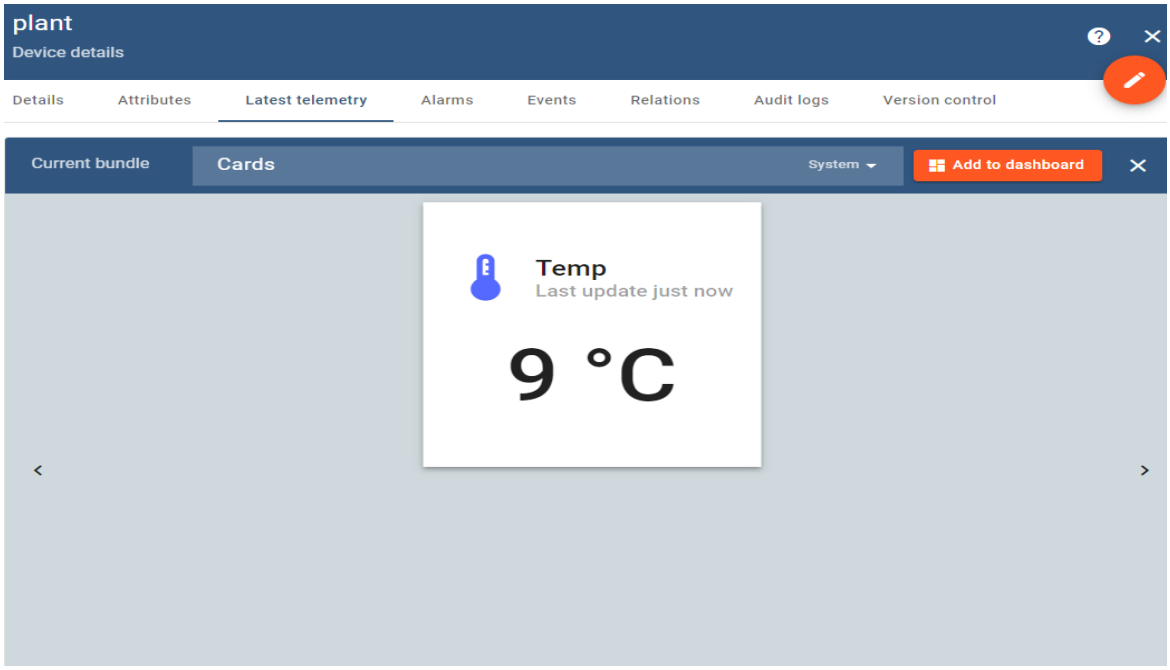
Things Board – Node red posting data in dashboard through http

Aim: The aim of this project is to establish seamless communication between Things Board and Node-RED, enabling the transmission of data from Node-RED to Things Board's dashboard via HTTP. This integration facilitates efficient data visualization and analysis within the Things Board platform, empowering users to monitor and manage IoT devices and data effectively.

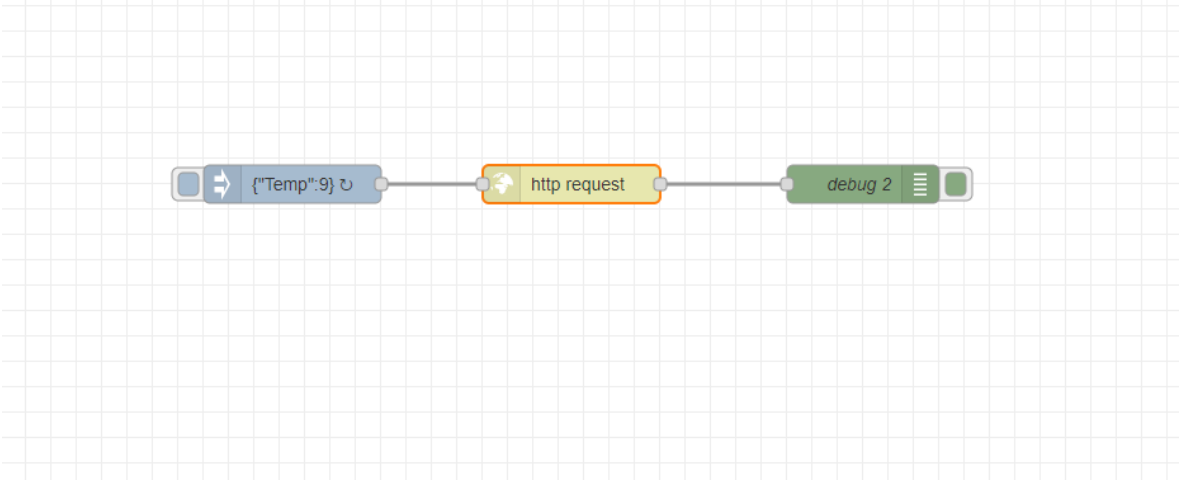



plant
Device details
Details
Attributes
Latest telemetry
Alarms
Events
Relations
Audit logs
Version control
Current bundle
Tables
System
Add to dashboard
Timeseries table
Realtime - last minute
Timestamp
Temp
2024-03-19 16:28:30 9
2024-03-19 16:28:27 9
2024-03-19 16:28:24 9
2024-03-19 16:28:21 9
2024-03-19 16:28:18 9
2024-03-19 16:28:15 9
2024-03-19 16:28:12 9
2024-03-19 16:28:09 9
2024-03-19 16:28:06 9
2024-03-19 16:28:03 9

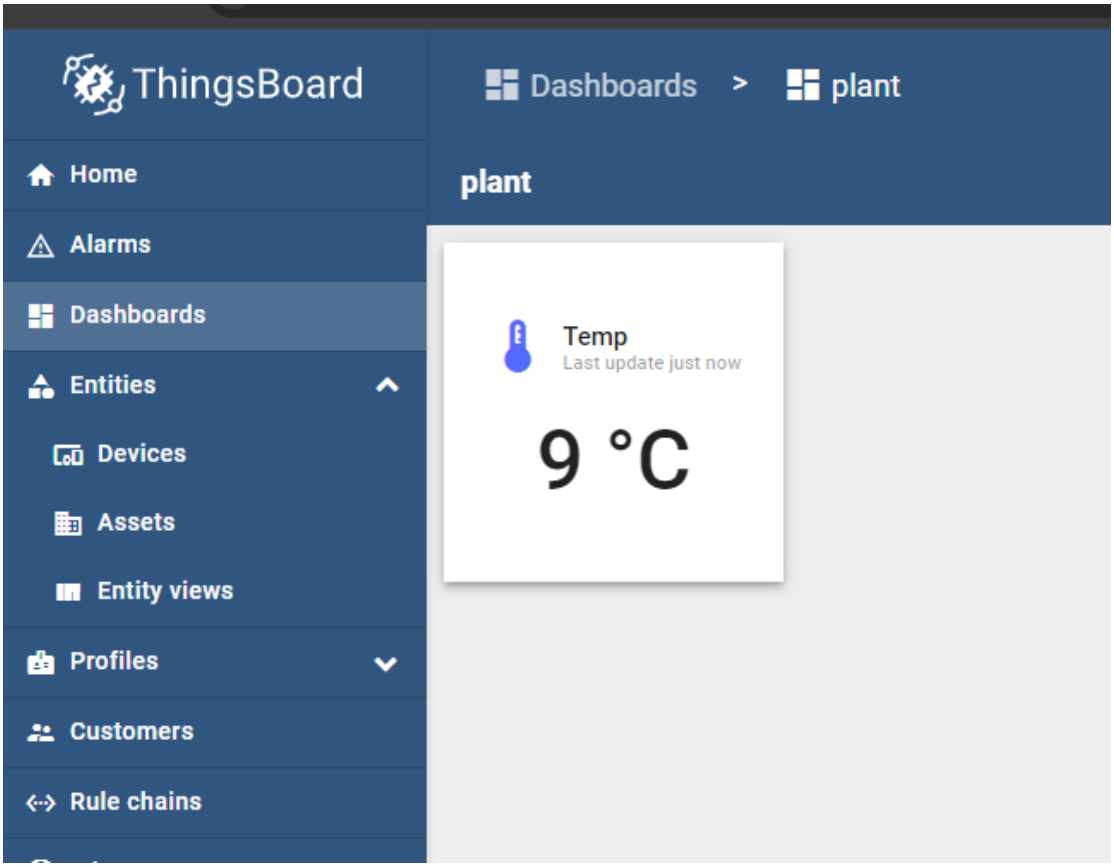
Output


plant
Device details
Details
Attributes
Latest telemetry
Alarms
Events
Relations
Audit logs
Version control
Current bundle
Cards
System
Add to dashboard
Temp
Last update just now
9 °C

Schematic

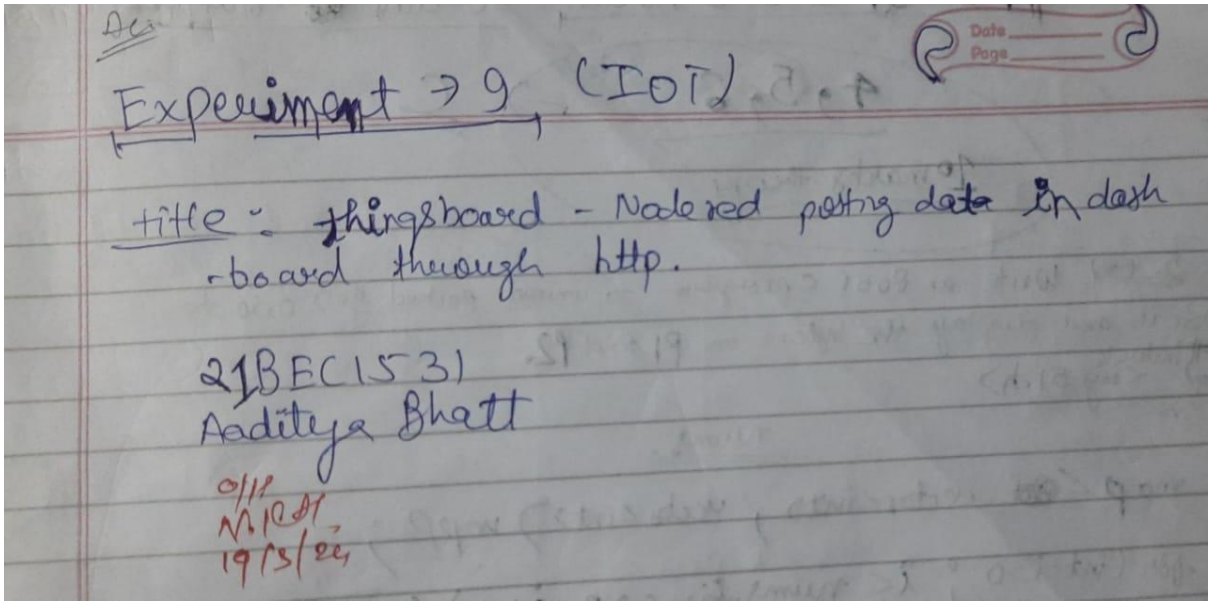


Dashboard Output



Inference: By establishing a connection between Things Board and Node-RED, this project aims to enable the seamless transfer of data from Node-RED to Things Board's dashboard using HTTP. This integration facilitates efficient data visualization and analysis within the Things Board platform, empowering users to monitor and manage IoT devices and data effectively. Ultimately, it enhances the capabilities of IoT solutions by providing a streamlined interface for data visualization and decision-making.

Verification Sign:



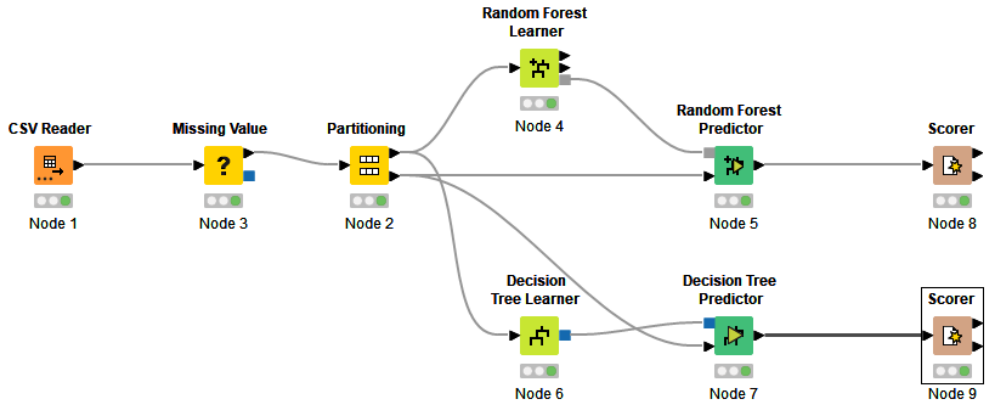
Result: Successfully implemented and verified Things Board – Node red posting data in dashboard through http

Experiment 10

Supervised machine learning using KNIME analytics platform

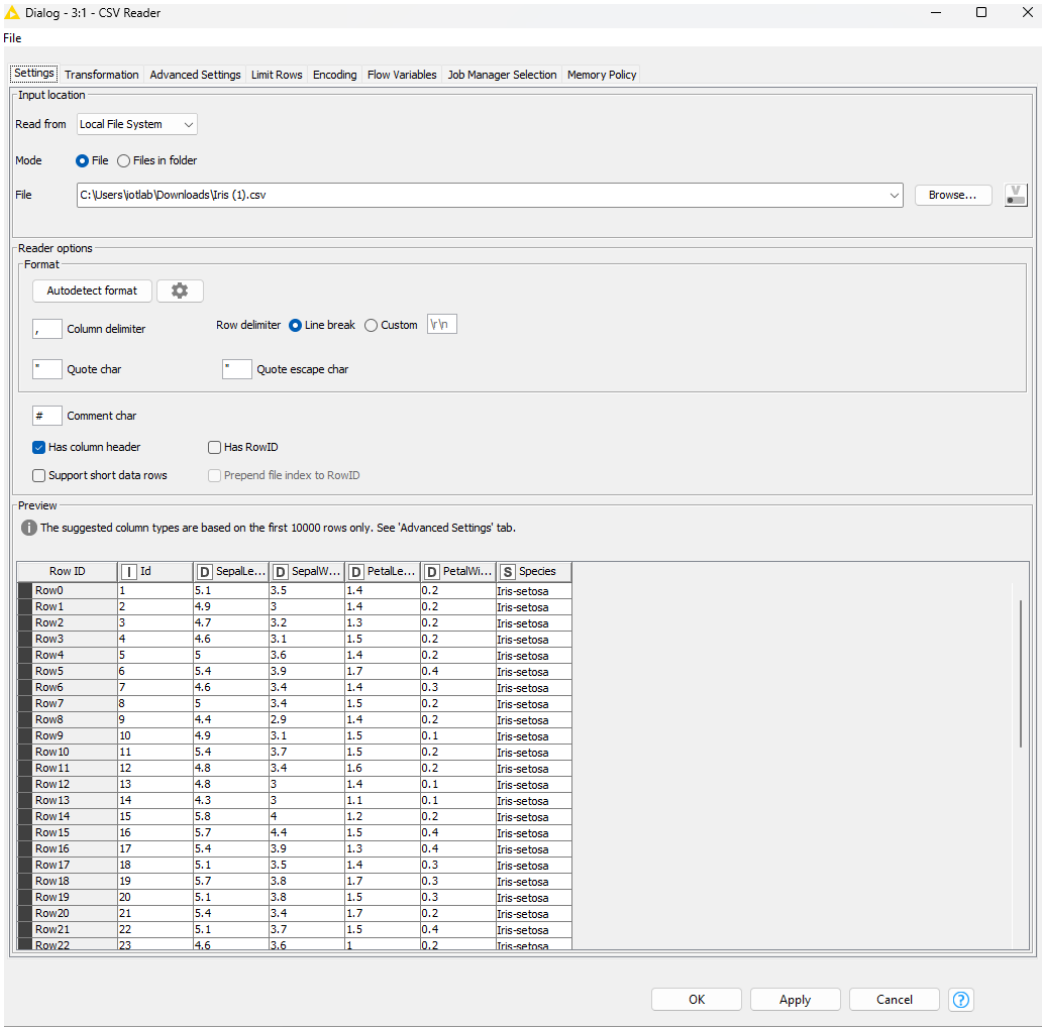
Schematic

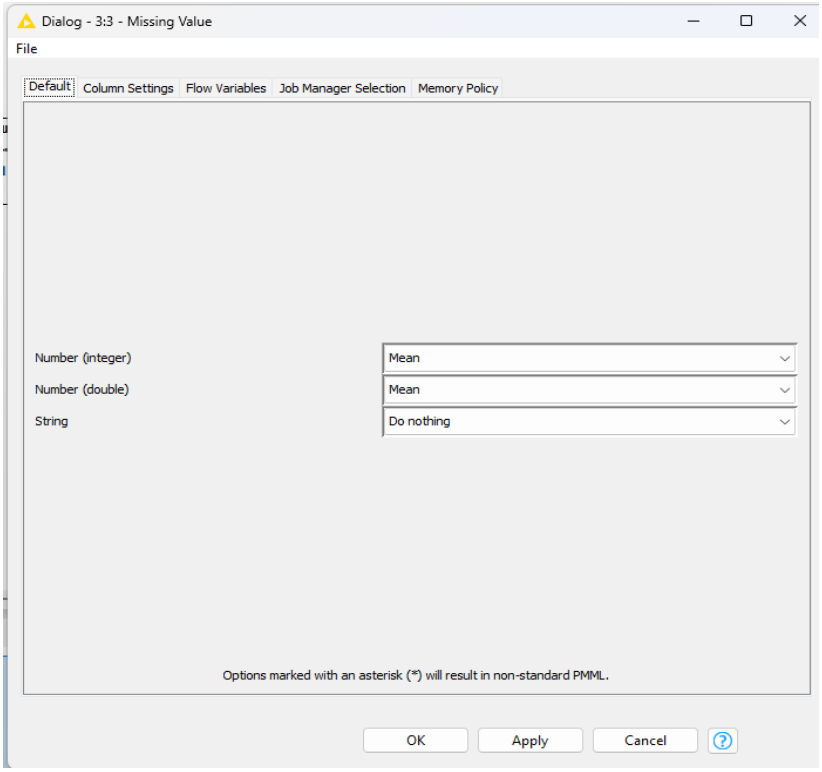
Aim: The aim of this project is to implement supervised machine learning techniques within the KNIME analytics platform. By utilizing KNIME's robust tools and functionalities, the project seeks to develop predictive models that can effectively analyse and classify data based on labelled examples, enabling informed decision-making and insights generation across various domains.



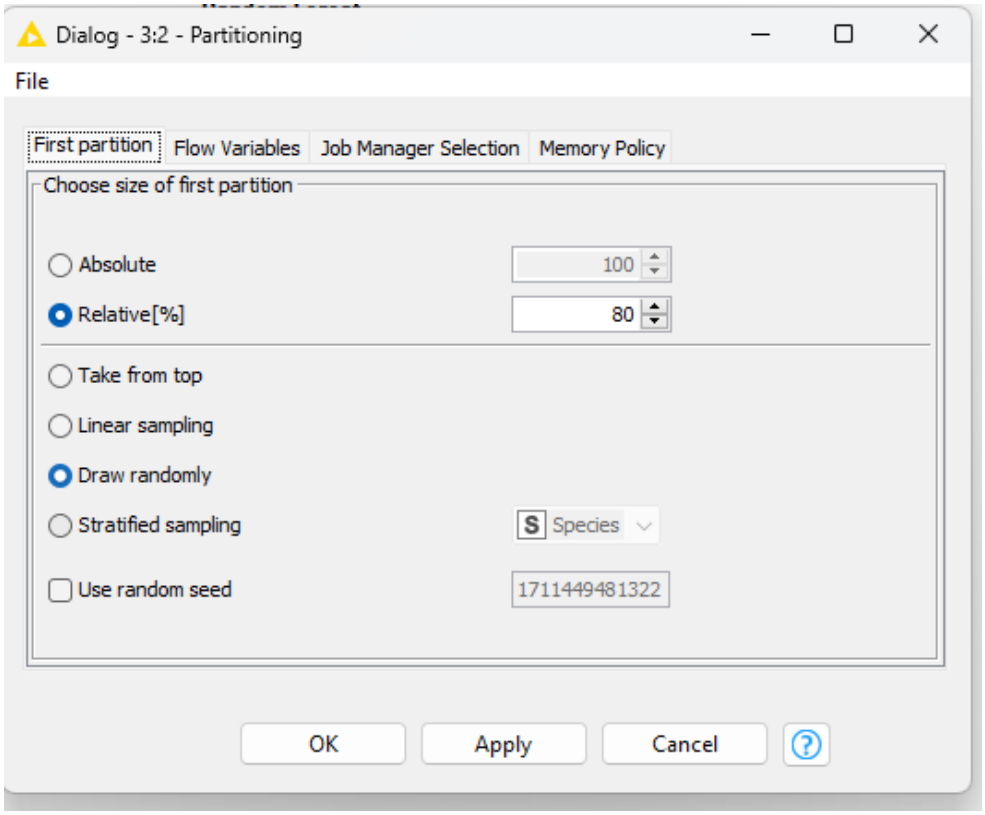
Schematic

CSV reader

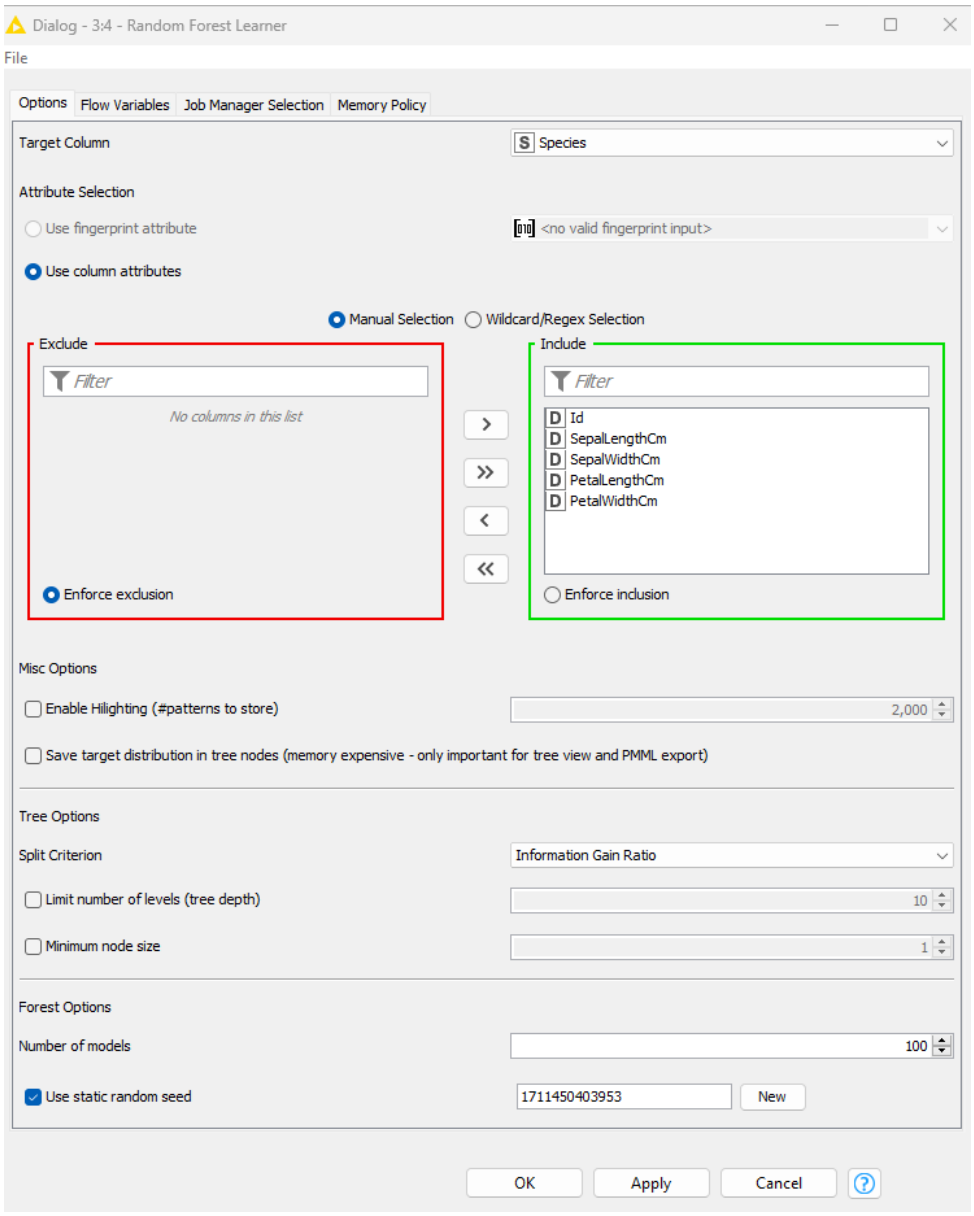

Dialog - 3:1 - CSV Reader
File
Settings
Transformation
Advanced Settings
Limit Rows
Encoding
Flow Variables
Job Manager Selection
Memory Policy
Input location
Read from
Local File System
Mode
File
Files in folder
File
C:\Users\jotlab\Downloads\Iris (1).csv
Browse...
Reader options
Format
Autodetect format
Column delimiter
Row delimiter
Line break
Custom
\r\n
Quote char
Quote escape char
Comment char
Has column header
Has RowID
Support short data rows
Prepend file index to RowID
Preview
The suggested column types are based on the first 10000 rows only. See 'Advanced Settings' tab.
Row ID
Id
SepalLe...
SepalW...
PetalLe...
PetalWi...
Species
Row0 1 5.1 3.5 1.4 0.2 Iris-setosa
Row1 2 4.9 3 1.4 0.2 Iris-setosa
Row2 3 4.7 3.2 1.3 0.2 Iris-setosa
Row3 4 4.6 3.1 1.5 0.2 Iris-setosa
Row4 5 5 3.6 1.4 0.2 Iris-setosa
Row5 6 5.4 3.9 1.7 0.4 Iris-setosa
Row6 7 4.6 3.4 1.4 0.3 Iris-setosa
Row7 8 5 3.4 1.5 0.2 Iris-setosa
Row8 9 4.4 2.9 1.4 0.2 Iris-setosa
Row9 10 4.9 3.1 1.5 0.1 Iris-setosa
Row10 11 5.4 3.7 1.5 0.2 Iris-setosa
Row11 12 4.8 3.4 1.6 0.2 Iris-setosa
Row12 13 4.8 3 1.4 0.1 Iris-setosa
Row13 14 4.3 3 1.1 0.1 Iris-setosa
Row14 15 5.8 4 1.2 0.2 Iris-setosa
Row15 16 5.7 4.4 1.5 0.4 Iris-setosa
Row16 17 5.4 3.9 1.3 0.4 Iris-setosa
Row17 18 5.1 3.5 1.4 0.3 Iris-setosa
Row18 19 5.7 3.8 1.7 0.3 Iris-setosa
Row19 20 5.1 3.8 1.5 0.3 Iris-setosa
Row20 21 5.4 3.4 1.7 0.2 Iris-setosa
Row21 22 5.1 3.7 1.5 0.4 Iris-setosa
Row22 23 4.6 3.6 1 0.2 Iris-setosa
OK
Apply
Cancel

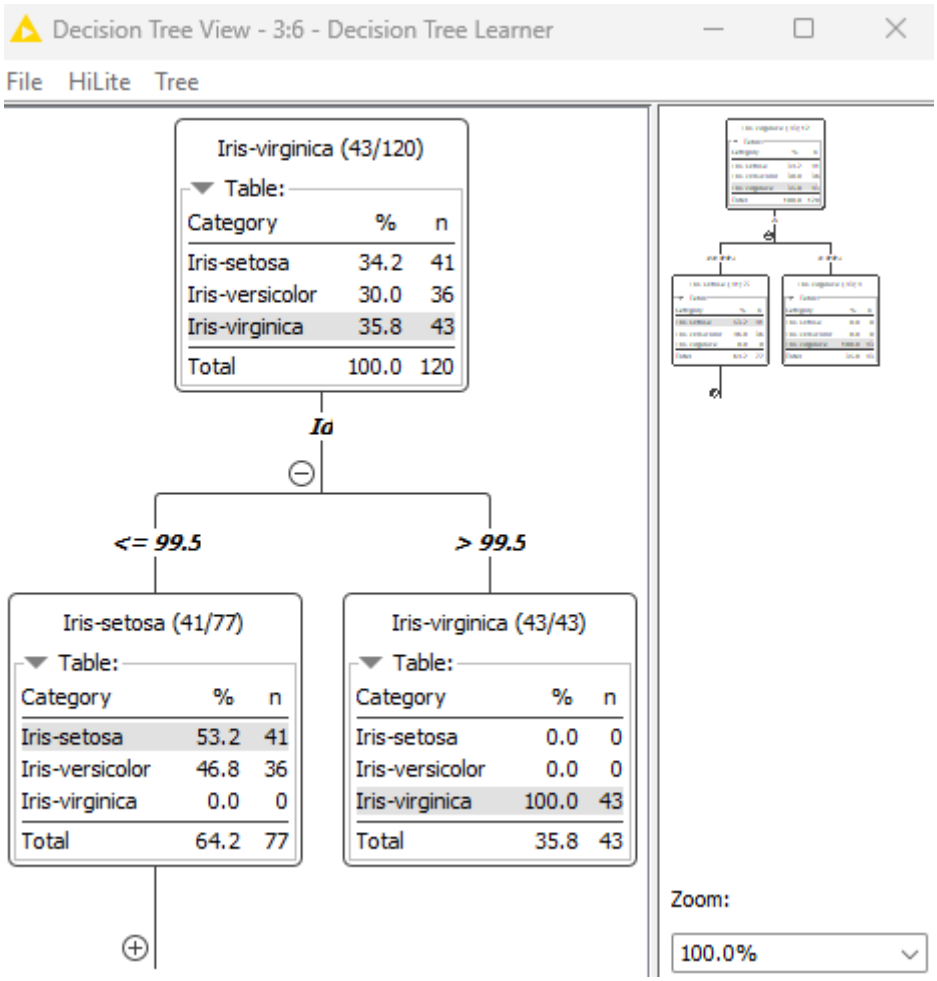


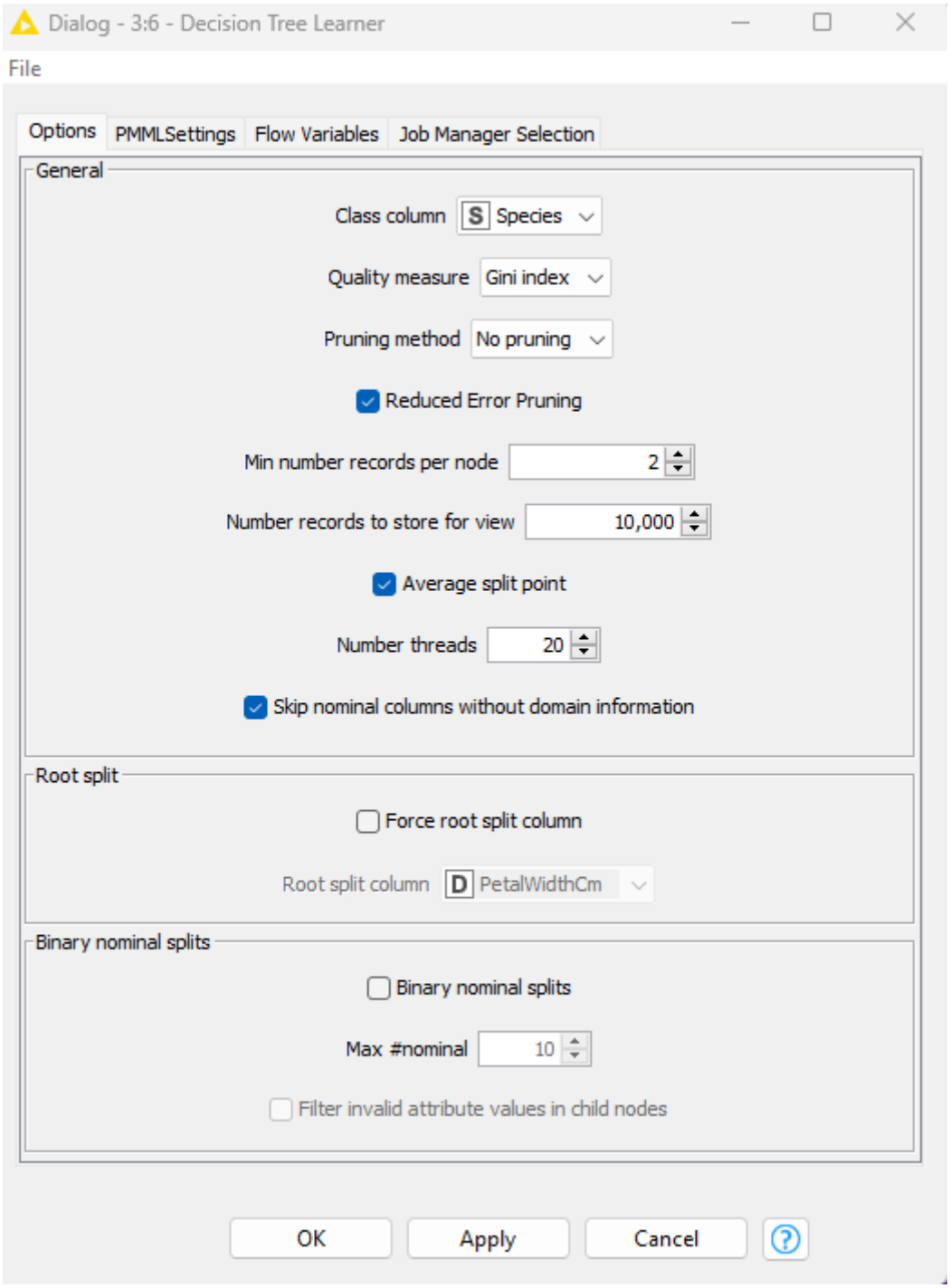
Partitioning



Random forest




Decision Tree View - 3:6 - Decision Tree Learner
File HiLite Tree
Iris-virginica (43/120)
Table:
Category % n
Iris-setosa 34.2 41
Iris-versicolor 30.0 36
Iris-virginica 35.8 43
Total 100.0 120
Ia
<= 99.5
> 99.5
Iris-setosa (41/77)
Table:
Category % n
Iris-setosa 53.2 41
Iris-versicolor 46.8 36
Iris-virginica 0.0 0
Total 64.2 77
Iris-virginica (43/43)
Table:
Category % n
Iris-setosa 0.0 0
Iris-versicolor 0.0 0
Iris-virginica 100.0 43
Total 35.8 43
Zoom:
100.0%


Dialog - 3:6 - Decision Tree Learner
File
Options
PMMLSettings
Flow Variables
Job Manager Selection
General
Class column
S Species
Quality measure
Gini index
Pruning method
No pruning
Reduced Error Pruning
Min number records per node
2
Number records to store for view
10,000
Average split point
Number threads
20
Skip nominal columns without domain information
Root split
Force root split column
Root split column
D PetalWidthCm
Binary nominal splits
Binary nominal splits
Max #nominal
10
Filter invalid attribute values in child nodes
OK
Apply
Cancel

Prediction output - 3:5 - Random Forest Predictor

File Edit Hilite Navigation View

Table "default" - Rows: 30 | Spec - Columns: 8 | Properties | Flow Variables

Row ID	D Id	D SepalLe...	D SepalW...	D PetalLe...	D PetalWi...	S Species	S Predicti...	D Predicti...
Row6	7	4.6	3.4	1.4	0.3	Iris-setosa	Iris-setosa	1
Row11	12	4.8	3.4	1.6	0.2	Iris-setosa	Iris-setosa	1
Row14	15	5.8	4	1.2	0.2	Iris-setosa	Iris-setosa	0.91
Row18	19	5.7	3.8	1.7	0.3	Iris-setosa	Iris-setosa	0.94
Row20	21	5.4	3.4	1.7	0.2	Iris-setosa	Iris-setosa	1
Row24	25	4.8	3.4	1.9	0.2	Iris-setosa	Iris-setosa	1
Row27	28	5.2	3.5	1.5	0.2	Iris-setosa	Iris-setosa	1
Row34	35	4.9	3.1	1.5	0.1	Iris-setosa	Iris-setosa	1
Row40	41	5	3.5	1.3	0.3	Iris-setosa	Iris-setosa	1
Row57	58	4.9	2.4	3.3	1	Iris-versicolor	Iris-versicolor	0.96
Row63	64	6.1	2.9	4.7	1.4	Iris-versicolor	Iris-versicolor	1
Row64	65	5.6	2.9	3.6	1.3	Iris-versicolor	Iris-versicolor	1
Row65	66	6.7	3.1	4.4	1.4	Iris-versicolor	Iris-versicolor	1
Row69	70	5.6	2.5	3.9	1.1	Iris-versicolor	Iris-versicolor	1
Row71	72	6.1	2.8	4	1.3	Iris-versicolor	Iris-versicolor	1
Row72	73	6.3	2.5	4.9	1.5	Iris-versicolor	Iris-versicolor	0.96
Row84	85	5.4	3	4.5	1.5	Iris-versicolor	Iris-versicolor	0.95
Row85	86	6	3.4	4.5	1.6	Iris-versicolor	Iris-versicolor	0.97
Row88	89	5.6	3	4.1	1.3	Iris-versicolor	Iris-versicolor	1
Row92	93	5.8	2.6	4	1.2	Iris-versicolor	Iris-versicolor	1
Row94	95	5.6	2.7	4.2	1.3	Iris-versicolor	Iris-versicolor	1
Row98	99	5.1	2.5	3	1.1	Iris-versicolor	Iris-versicolor	0.93
Row99	100	5.7	2.8	4.1	1.3	Iris-versicolor	Iris-versicolor	0.63
Row117	118	7.7	3.8	6.7	2.2	Iris-virginica	Iris-virginica	1
Row121	122	5.6	2.8	4.9	2	Iris-virginica	Iris-virginica	1
Row129	130	7.2	3	5.8	1.6	Iris-virginica	Iris-virginica	0.92
Row132	133	6.4	2.8	5.6	2.2	Iris-virginica	Iris-virginica	1
Row133	134	6.3	2.8	5.1	1.5	Iris-virginica	Iris-virginica	0.86
Row137	138	6.4	3.1	5.5	1.8	Iris-virginica	Iris-virginica	1
Row140	141	6.7	3.1	5.6	2.4	Iris-virginica	Iris-virginica	1

Dialog - 3:5 - Random Forest Predictor

File

Prediction Settings | Flow Variables | Job Manager Selection | Memory Policy

- [ ] Change prediction column name

Prediction column name: Prediction (Species)

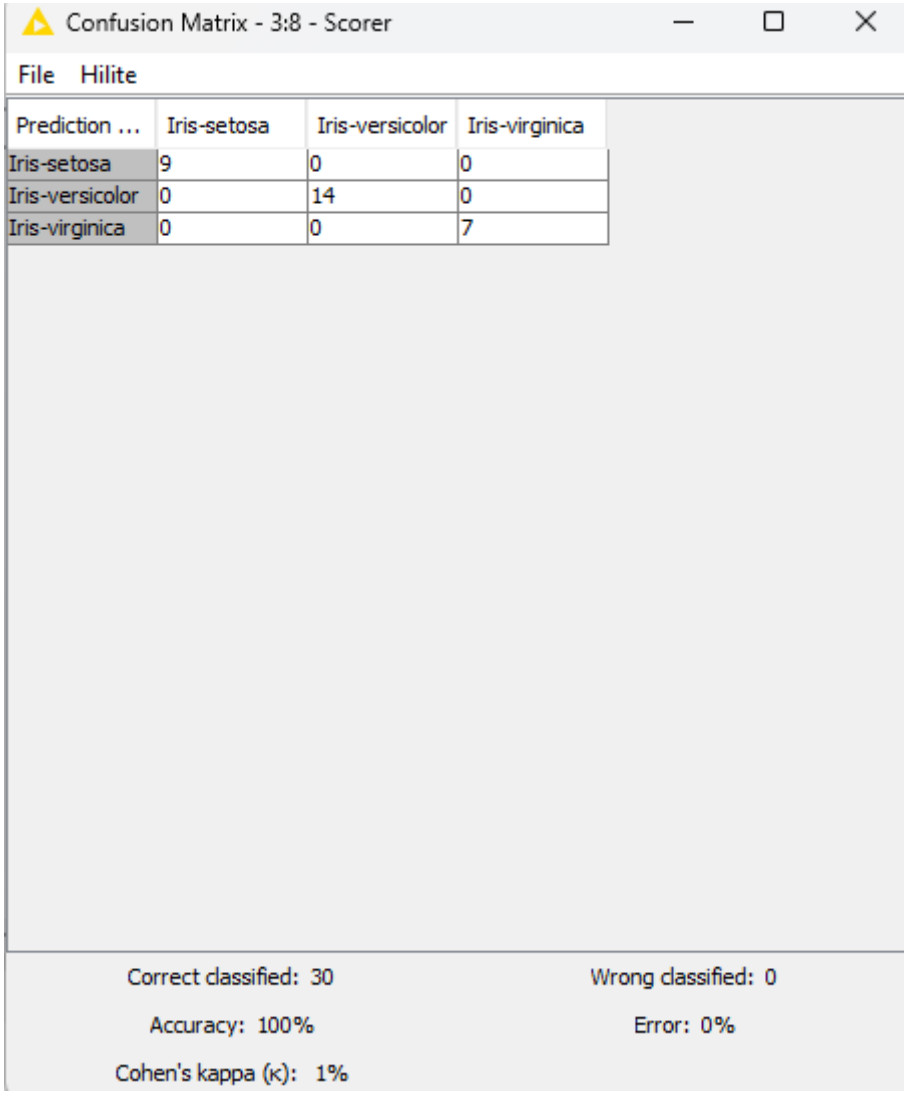
- [x] Append overall prediction confidence
- [ ] Append individual class probabilities

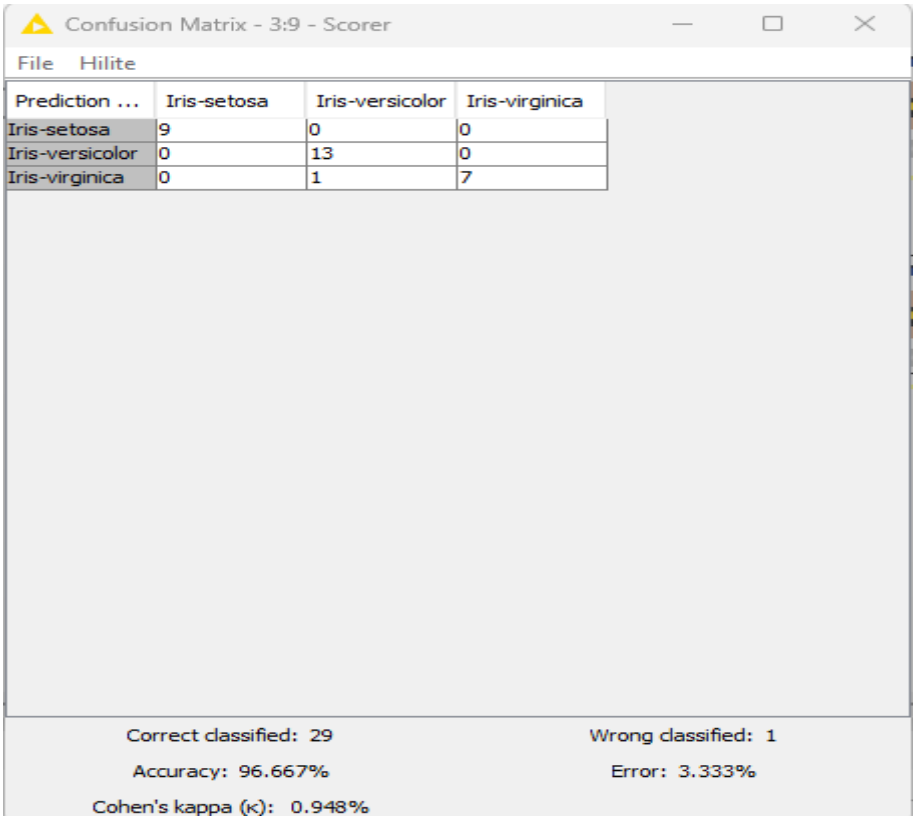
Suffix for probability columns:

- [ ] Use soft voting

OK | Apply | Cancel

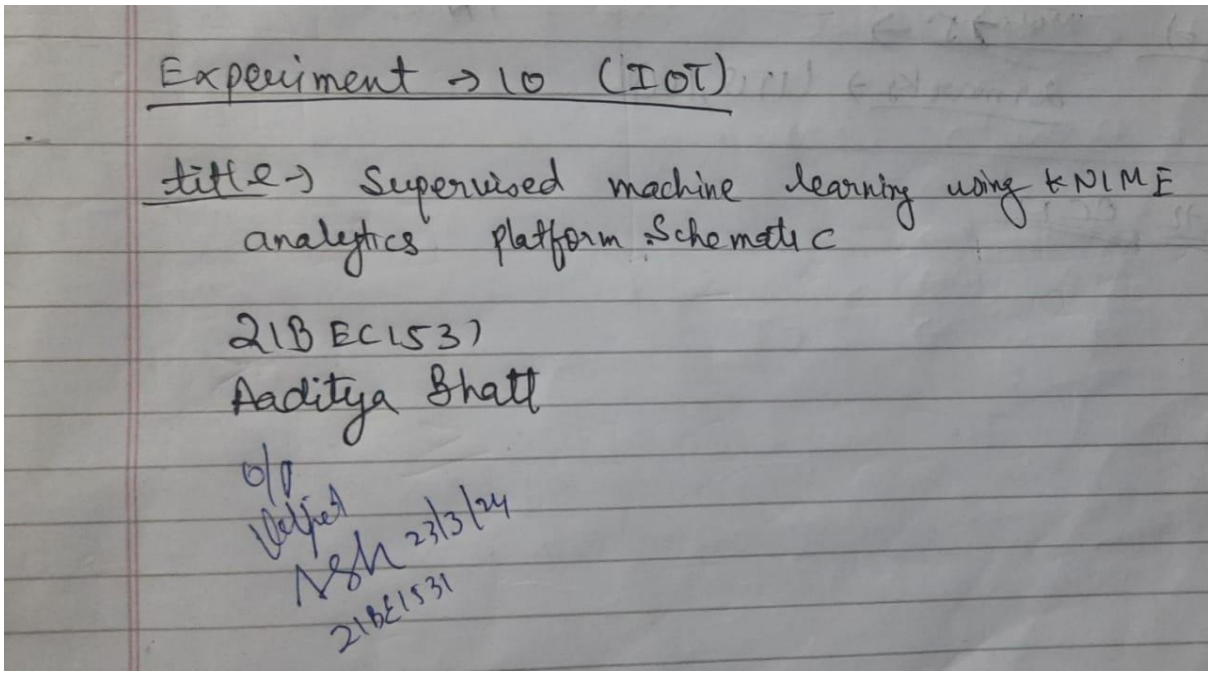
Output


Confusion Matrix - 3:8 - Scorer
File
Hilite
Prediction ...
Iris-setosa
Iris-versicolor
Iris-virginica
Iris-setosa
9
0
0
Iris-versicolor
0
14
0
Iris-virginica
0
0
7
Correct classified: 30
Wrong classified: 0
Accuracy: 100%
Error: 0%
Cohen's kappa (κ): 1%



Inference: By leveraging the KNIME analytics platform, this project aims to implement supervised machine learning techniques. Through the utilization of labelled data examples, the project seeks to develop predictive models capable of analyzing and classifying data effectively. This approach enables informed decision-making and insights generation across diverse domains, leveraging the capabilities of KNIME's tools and functionalities to enhance predictive analytics workflows.

Verification Sign:



Result: Successfully implemented and verified Supervised machine learning using KNIME analytics platform