CASE STUDY :

TITLE: - Predicting Diabetes in Patients

Problem Statement:

A healthcare provider wants to predict whether a patient is at risk of developing diabetes.

Dataset:

Pima Indians Diabetes Dataset (UCI Machine Learning Repository), containing patient details like glucose levels, blood pressure, BMI, and age.

Approach Using Rapid Miner:

1. Data Preprocessing: Handle missing values, normalize features, and remove outliers.

2. Feature Selection: Identify important variables like glucose concentration and insulin levels.

3. Modeling: Train Decision Trees, Support Vector Machines (SVM), and Neural Networks.

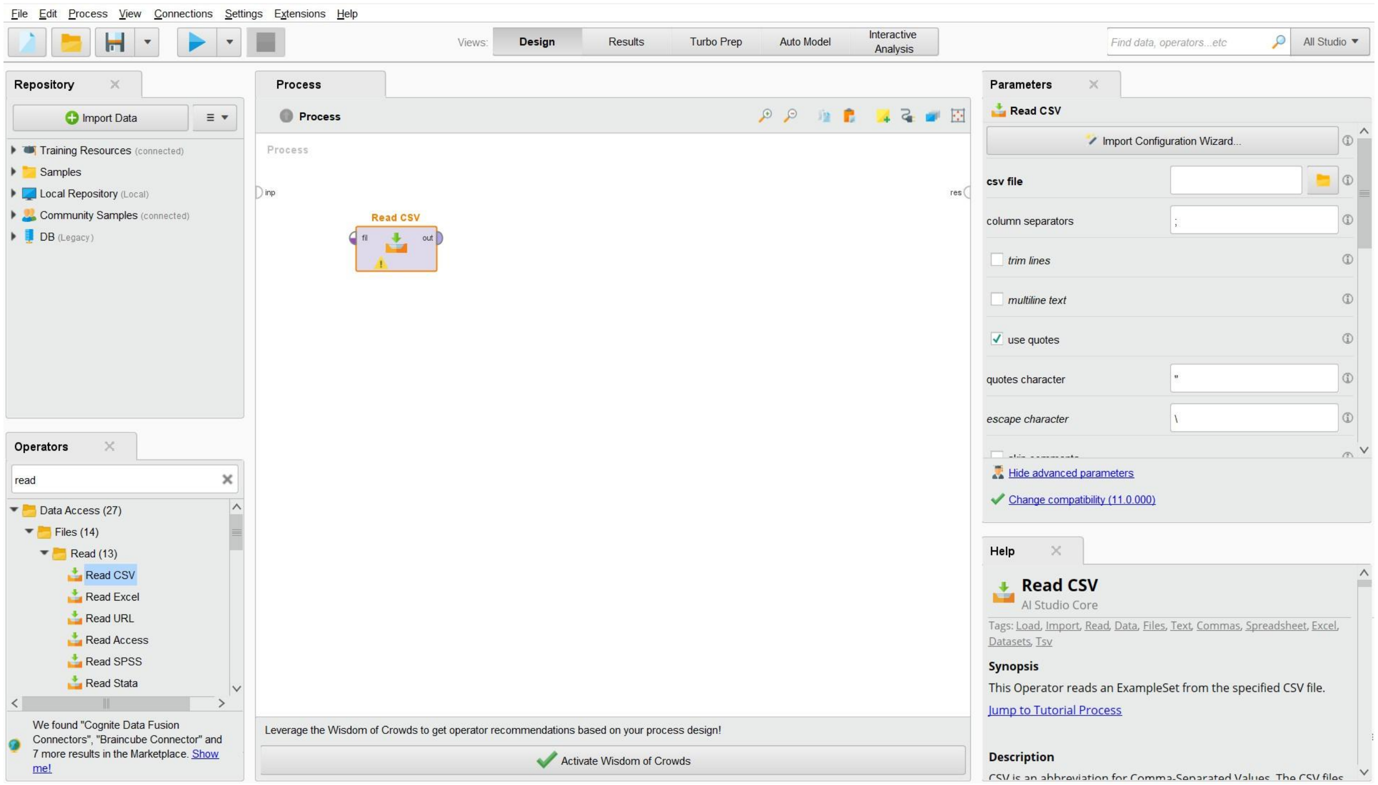
4. Evaluation: Compare models using AUC-ROC, precision, recall, and F1-score.

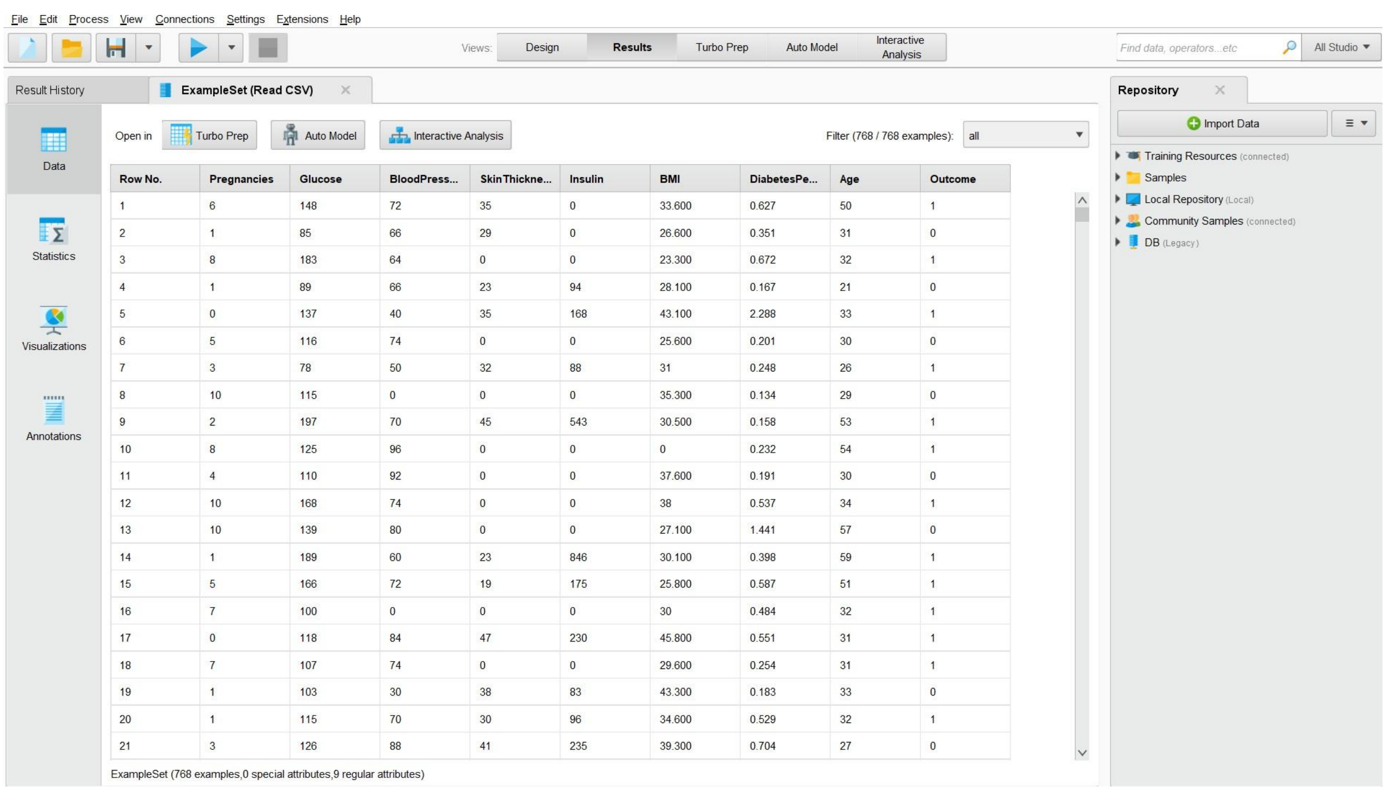
Outcome:

Achieved 80%+ accuracy in predicting diabetes risk, enabling early intervention.

Step 1: Importing Dataset

In the RapidMiner environment, click on the **Design** option at the top. On the left panel, import the **Pima Indians Diabetes Dataset**. If the dataset is in CSV format, use **"Read CSV"** to load it. Drag the dataset to the environment, connect it to the **output**, and run the process to verify data import.





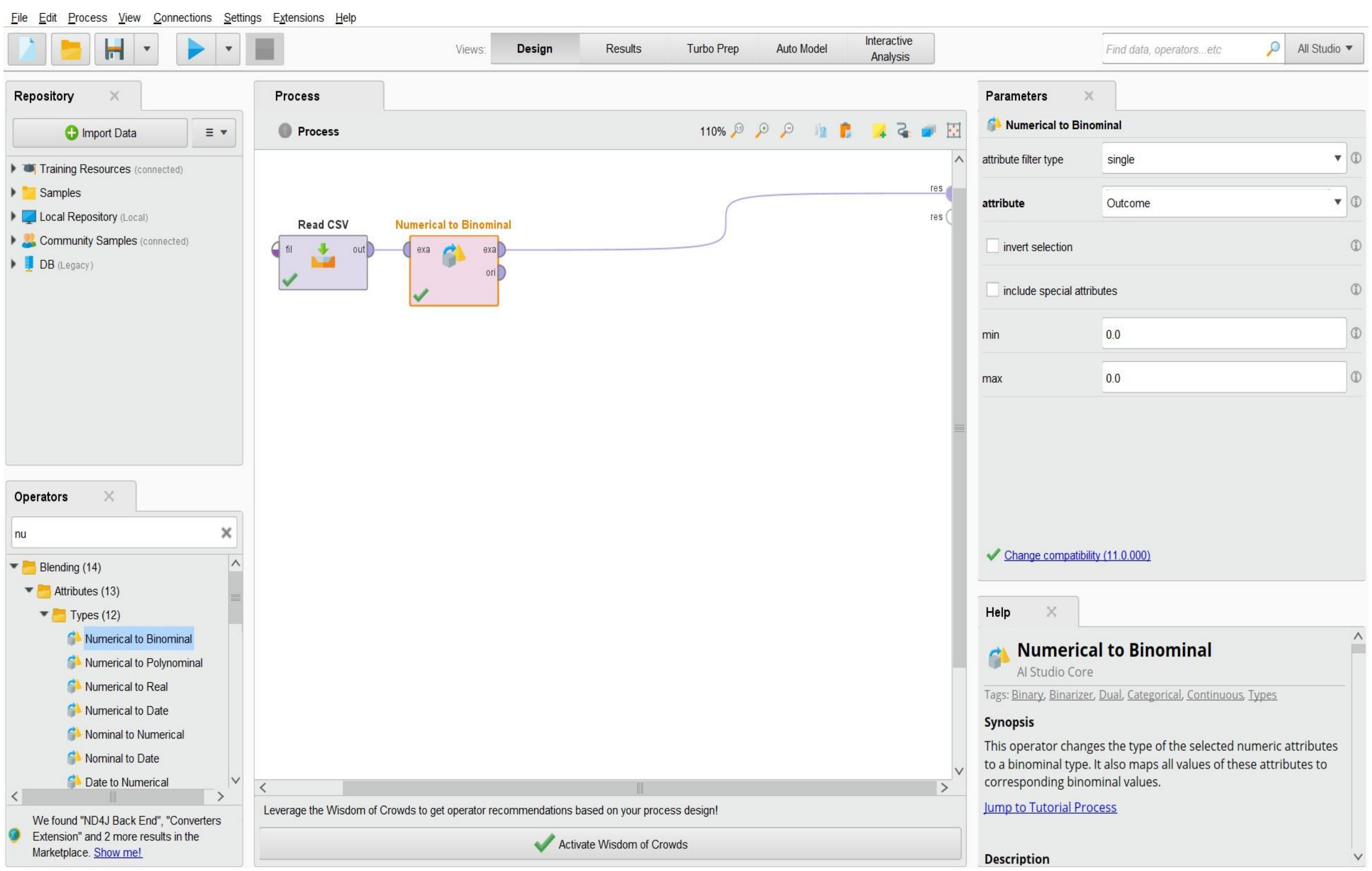
Row No.	Pregnancies	Glucose	BloodPress...	SkinThickne...	Insulin	BMI	DiabetesPe...	Age	Outcome
1	6	148	72	35	0	33.600	0.627	50	1
2	1	85	66	29	0	26.600	0.351	31	0
3	8	183	64	0	0	23.300	0.672	32	1
4	1	89	66	23	94	28.100	0.167	21	0
5	0	137	40	35	168	43.100	2.288	33	1
6	5	116	74	0	0	25.600	0.201	30	0
7	3	78	50	32	88	31	0.248	26	1
8	10	115	0	0	0	35.300	0.134	29	0
9	2	197	70	45	543	30.500	0.158	53	1
10	8	125	96	0	0	0	0.232	54	1
11	4	110	92	0	0	37.600	0.191	30	0
12	10	168	74	0	0	38	0.537	34	1
13	10	139	80	0	0	27.100	1.441	57	0
14	1	189	60	23	846	30.100	0.398	59	1
15	5	166	72	19	175	25.800	0.587	51	1
16	7	100	0	0	0	30	0.484	32	1
17	0	118	84	47	230	45.800	0.551	31	1
18	7	107	74	0	0	29.600	0.254	31	1
19	1	103	30	38	83	43.300	0.183	33	0
20	1	115	70	30	96	34.600	0.529	32	1
21	3	126	88	41	235	39.300	0.704	27	0

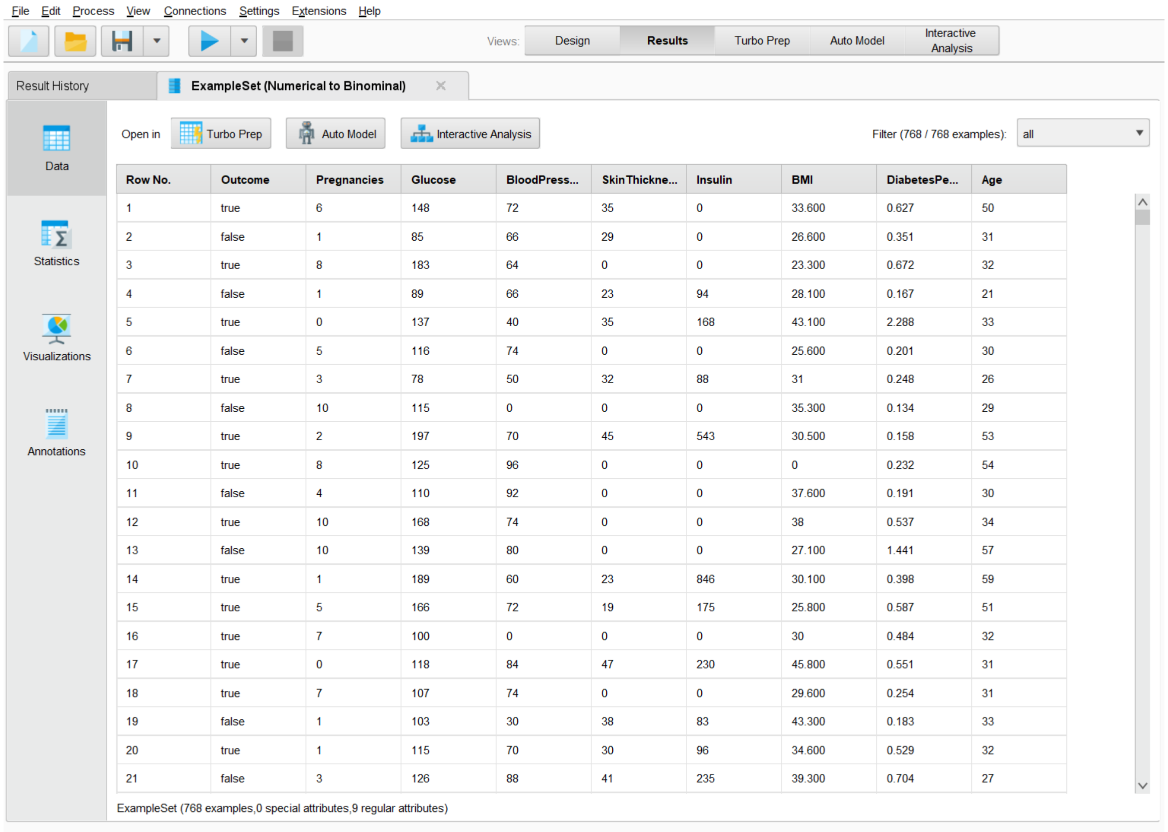
ExampleSet (768 examples,0 special attributes,9 regular attributes)

Step 2: Converting Numerical to Binominal

Since the **Outcome** attribute has values **0 and 1**, it needs to be converted into a binominal type:

1. Search for **"Numerical to Binominal"** in the operators search bar.
2. Drag the operator to the environment.
3. Connect the dataset output to the **Numerical to Binominal** input.
4. In the **Parameters panel**, select **Outcome** as the attribute to convert.
5. Connect the output to **Results** and run to verify the conversion.





Row No.	Outcome	Pregnancies	Glucose	BloodPress...	SkinThickne...	Insulin	BMI	DiabetesPe...	Age
1	true	6	148	72	35	0	33.600	0.627	50
2	false	1	85	66	29	0	26.600	0.351	31
3	true	8	183	64	0	0	23.300	0.672	32
4	false	1	89	66	23	94	28.100	0.167	21
5	true	0	137	40	35	168	43.100	2.288	33
6	false	5	116	74	0	0	25.600	0.201	30
7	true	3	78	50	32	88	31	0.248	26
8	false	10	115	0	0	0	35.300	0.134	29
9	true	2	197	70	45	543	30.500	0.158	53
10	true	8	125	96	0	0	0	0.232	54
11	false	4	110	92	0	0	37.600	0.191	30
12	true	10	168	74	0	0	38	0.537	34
13	false	10	139	80	0	0	27.100	1.441	57
14	true	1	189	60	23	846	30.100	0.398	59
15	true	5	166	72	19	175	25.800	0.587	51
16	true	7	100	0	0	0	30	0.484	32
17	true	0	118	84	47	230	45.800	0.551	31
18	true	7	107	74	0	0	29.600	0.254	31
19	false	1	103	30	38	83	43.300	0.183	33
20	true	1	115	70	30	96	34.600	0.529	32
21	false	3	126	88	41	235	39.300	0.704	27

ExampleSet (768 examples,0 special attributes,9 regular attributes)

Step 3: Data Preprocessing-

After converting numerical to binominal, perform the following preprocessing steps:

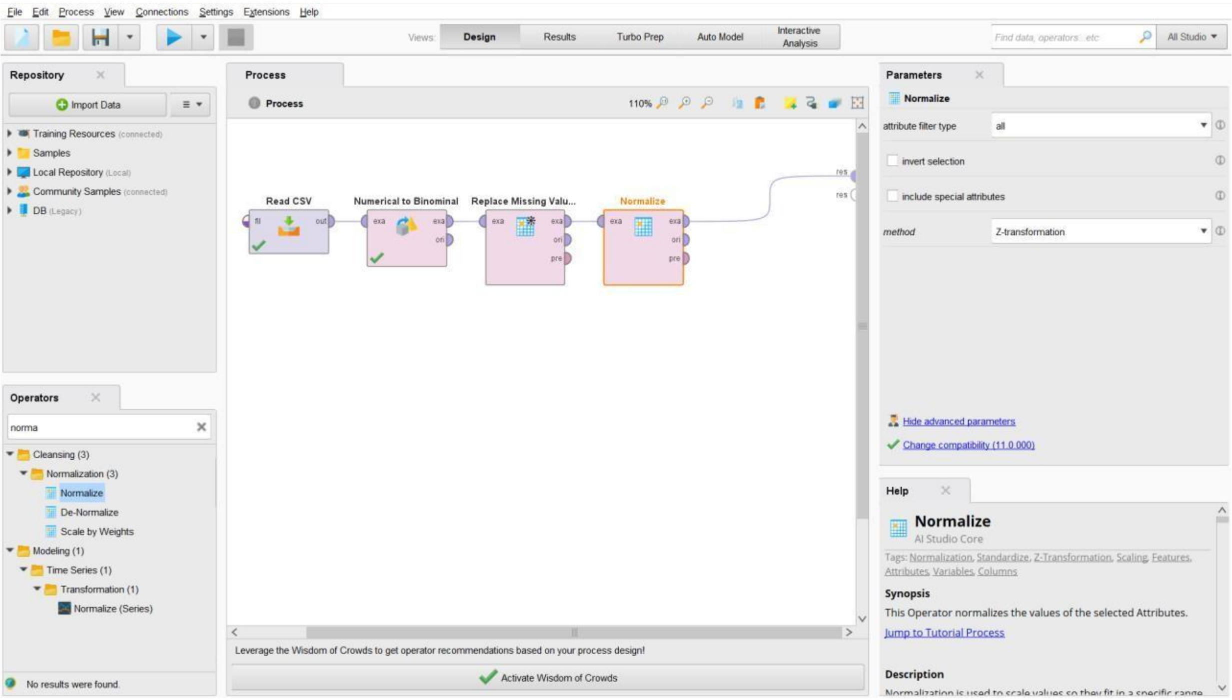
Replacing Missing Values:

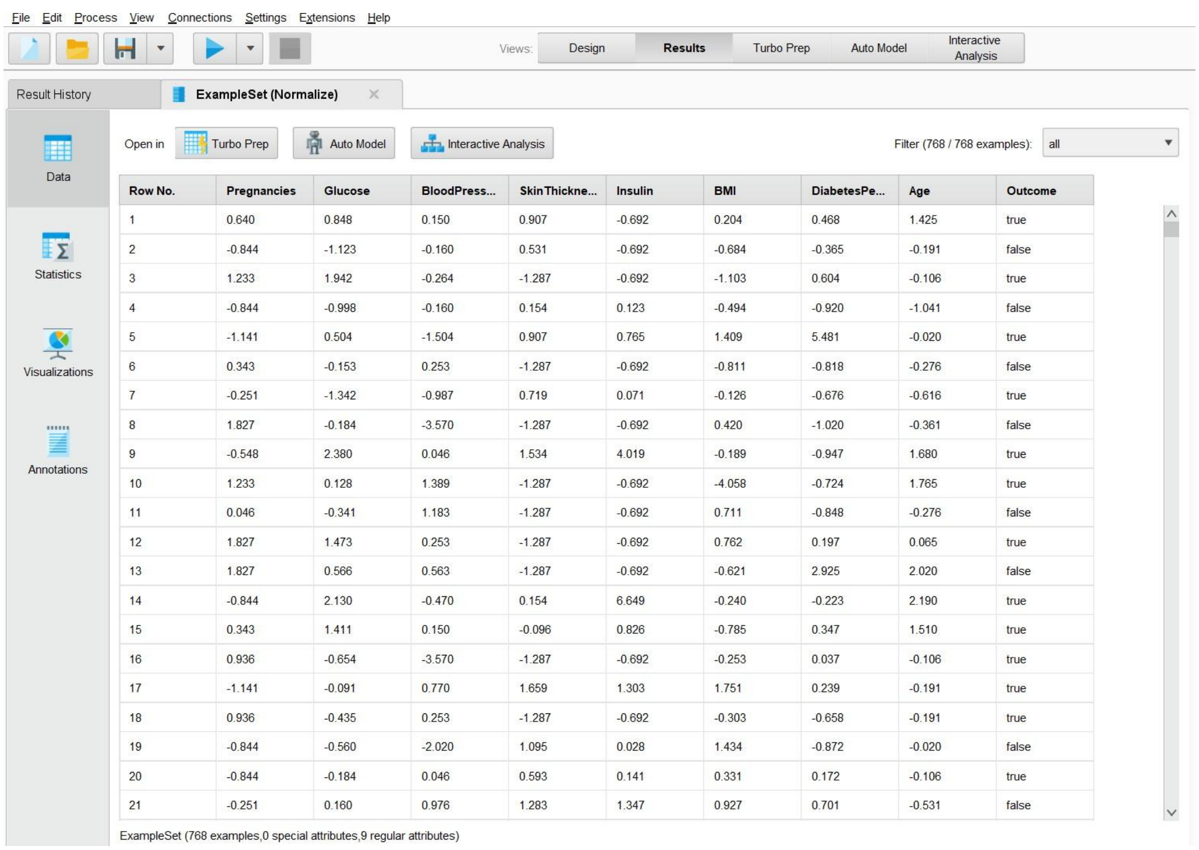
1. Search for **"Replace Missing Values"**, drag it to the environment.
2. Connect the **Numerical to Binominal** output to **Replace Missing Values.**
3. In the **Parameters panel**, set missing values to be replaced with the **median.**

Normalize Data:

1. Search for **"Normalize"**, drag it to the environment.
2. Connect the **Replace Missing Values** output to **Normalize.**
3. Choose **Min-Max Scaling** or **Z-Score Normalization** to bring numeric values into a standard range.

4. Connect the output to **Results** and observe the cleaned dataset.



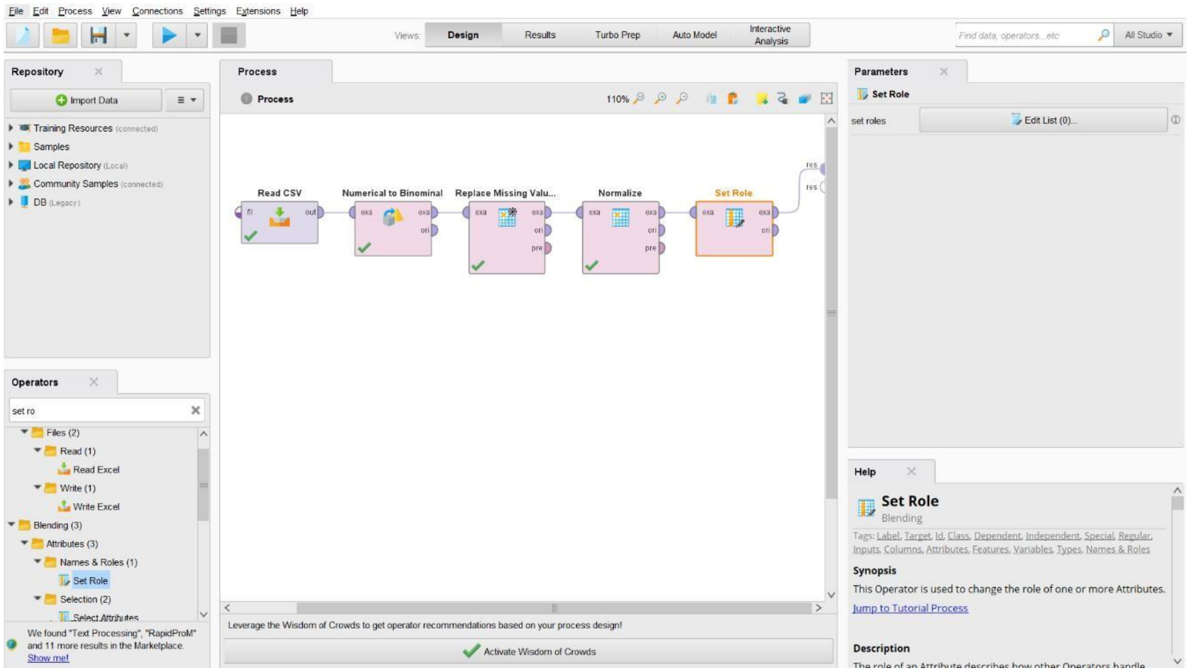


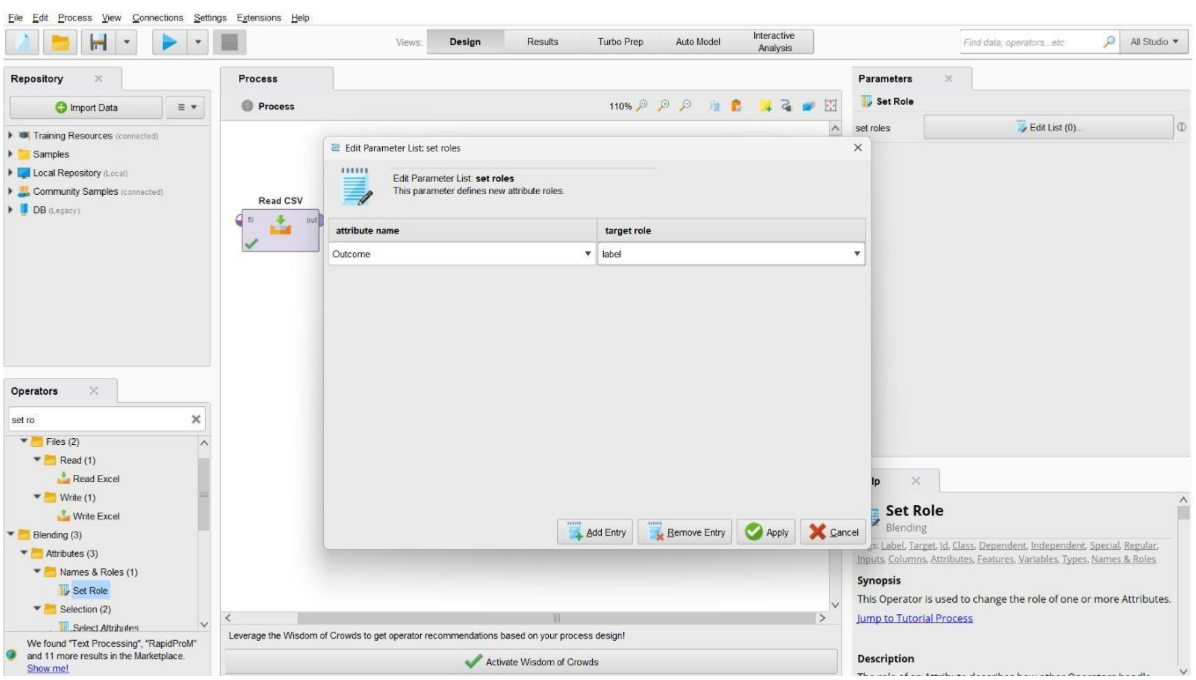
Row No.	Pregnancies	Glucose	BloodPress...	SkinThickne...	Insulin	BMI	DiabetesPe...	Age	Outcome
1	0.640	0.848	0.150	0.907	-0.692	0.204	0.468	1.425	true
2	-0.844	-1.123	-0.160	0.531	-0.692	-0.684	-0.365	-0.191	false
3	1.233	1.942	-0.264	-1.287	-0.692	-1.103	0.604	-0.106	true
4	-0.844	-0.998	-0.160	0.154	0.123	-0.494	-0.920	-1.041	false
5	-1.141	0.504	-1.504	0.907	0.765	1.409	5.481	-0.020	true
6	0.343	-0.153	0.253	-1.287	-0.692	-0.811	-0.818	-0.276	false
7	-0.251	-1.342	-0.987	0.719	0.071	-0.126	-0.676	-0.616	true
8	1.827	-0.184	-3.570	-1.287	-0.692	0.420	-1.020	-0.361	false
9	-0.548	2.380	0.046	1.534	4.019	-0.189	-0.947	1.680	true
10	1.233	0.128	1.389	-1.287	-0.692	-4.058	-0.724	1.765	true
11	0.046	-0.341	1.183	-1.287	-0.692	0.711	-0.848	-0.276	false
12	1.827	1.473	0.253	-1.287	-0.692	0.762	0.197	0.065	true
13	1.827	0.566	0.563	-1.287	-0.692	-0.621	2.925	2.020	false
14	-0.844	2.130	-0.470	0.154	6.649	-0.240	-0.223	2.190	true
15	0.343	1.411	0.150	-0.096	0.826	-0.785	0.347	1.510	true
16	0.936	-0.654	-3.570	-1.287	-0.692	-0.253	0.037	-0.106	true
17	-1.141	-0.091	0.770	1.659	1.303	1.751	0.239	-0.191	true
18	0.936	-0.435	0.253	-1.287	-0.692	-0.303	-0.658	-0.191	true
19	-0.844	-0.560	-2.020	1.095	0.028	1.434	-0.872	-0.020	false
20	-0.844	-0.184	0.046	0.593	0.141	0.331	0.172	-0.106	true
21	-0.251	0.160	0.976	1.283	1.347	0.927	0.701	-0.531	false

ExampleSet (768 examples,0 special attributes,9 regular attributes)

Step 4: Set Role

1. Search for **"Set Role"** in the operators panel and drag it to the environment.
2. Connect the **preprocessed data output** to **Set Role.**
3. In the **Parameters panel**, click **"Edit List"**, set **attribute name** to "Outcome", and assign **target role** as "Label".
4. Click **Apply** and connect to the next step.

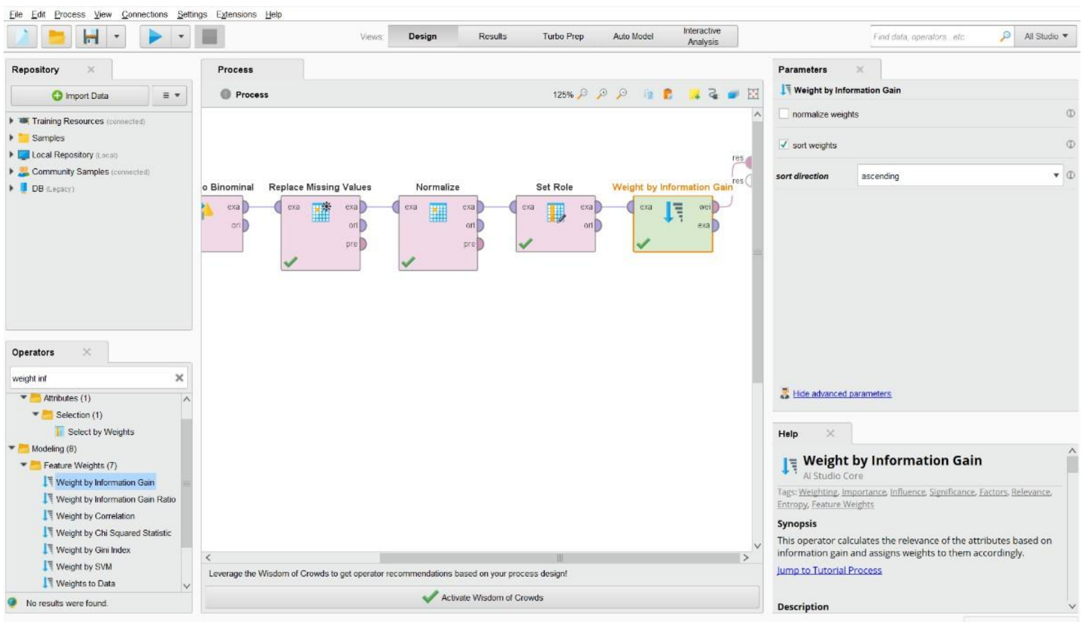


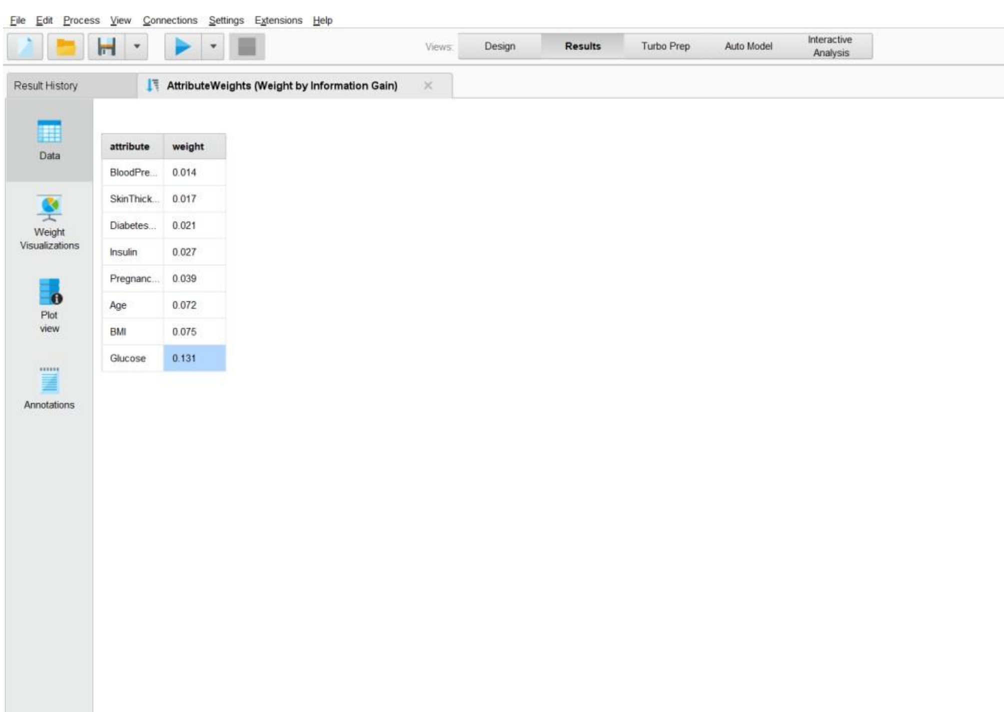


Step 5: Feature Selection

To improve model performance:

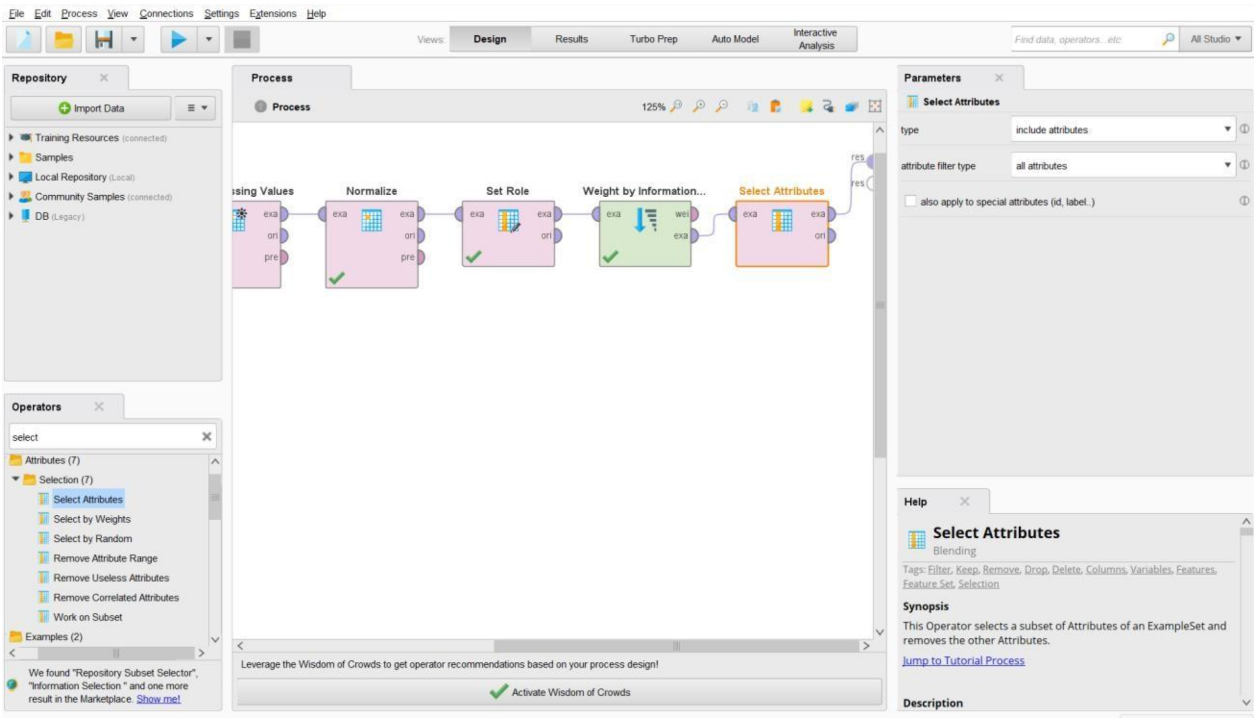
1. Search for **"Weight by Information Gain"**, drag it to the environment, and connect it to **Set Role output**.
2. Run the process to check the most important features like **Glucose, BMI, Insulin, and Age**.
3. Use **"Select Attributes"** to keep only the top-ranked features.

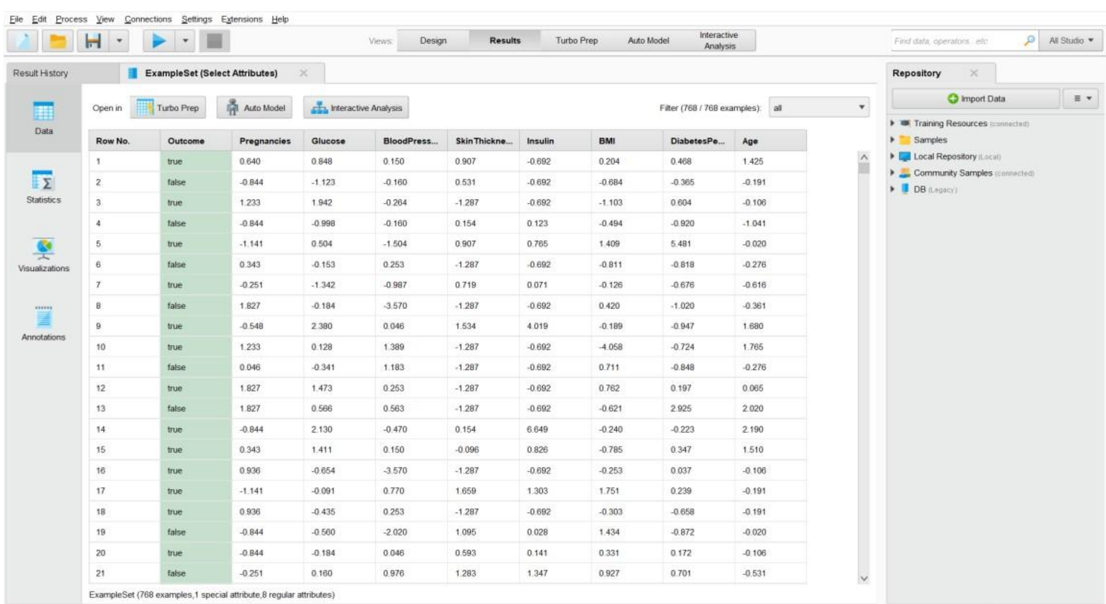




Step 6: Selecting Attributes

1. Search for **"Select Attributes"**, drag it to the environment.
2. Connect the **Weight by Information Gain output** to **Select Attributes**.
3. In the **Parameters panel**, manually select the **top-ranked features** based on their weights.
4. Connect the **Select Attributes output** to the next step.

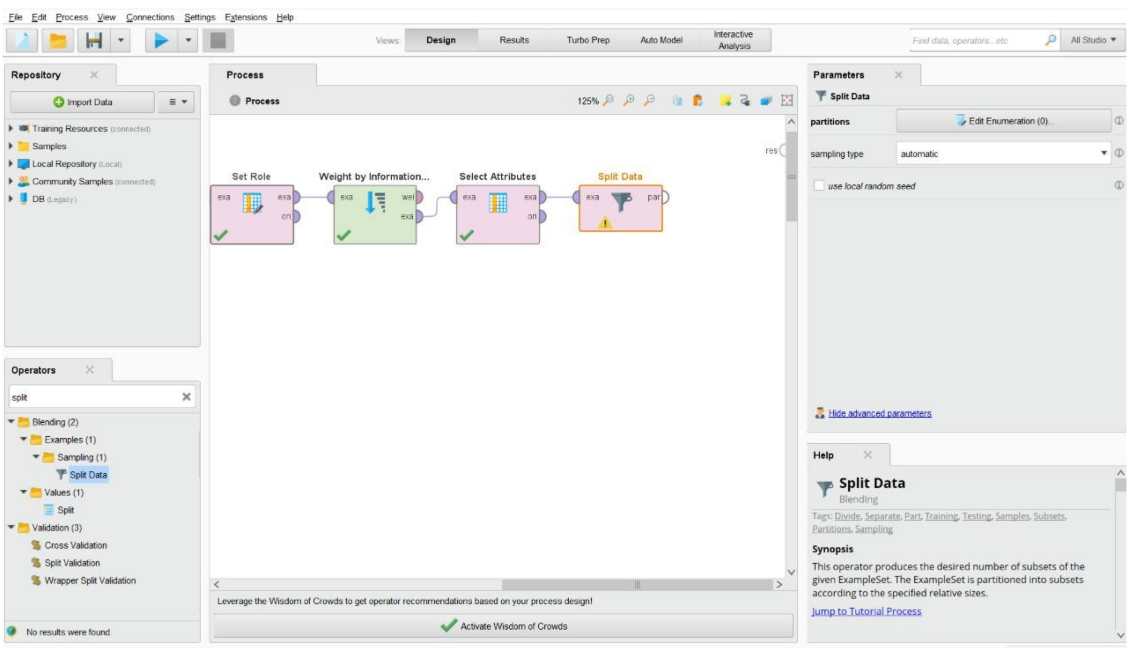


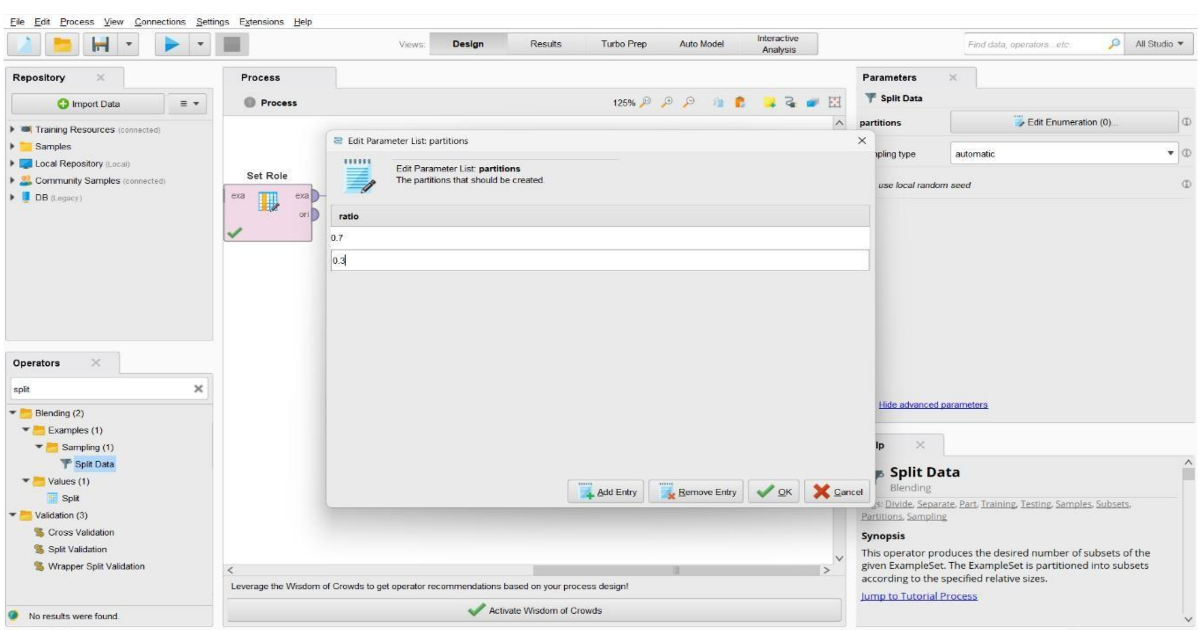


Step 7: Splitting Data

To train and test the model:

1. Search for **"Split Data"**, drag it to the environment.
2. Connect the **Select Attributes output** to **Split Data**.
3. In the **Parameters panel**, set **training data ratio** to **70% (0.7)** and testing data ratio to **30% (0.3)**.
4. The first output will be used for training, and the second output for testing.

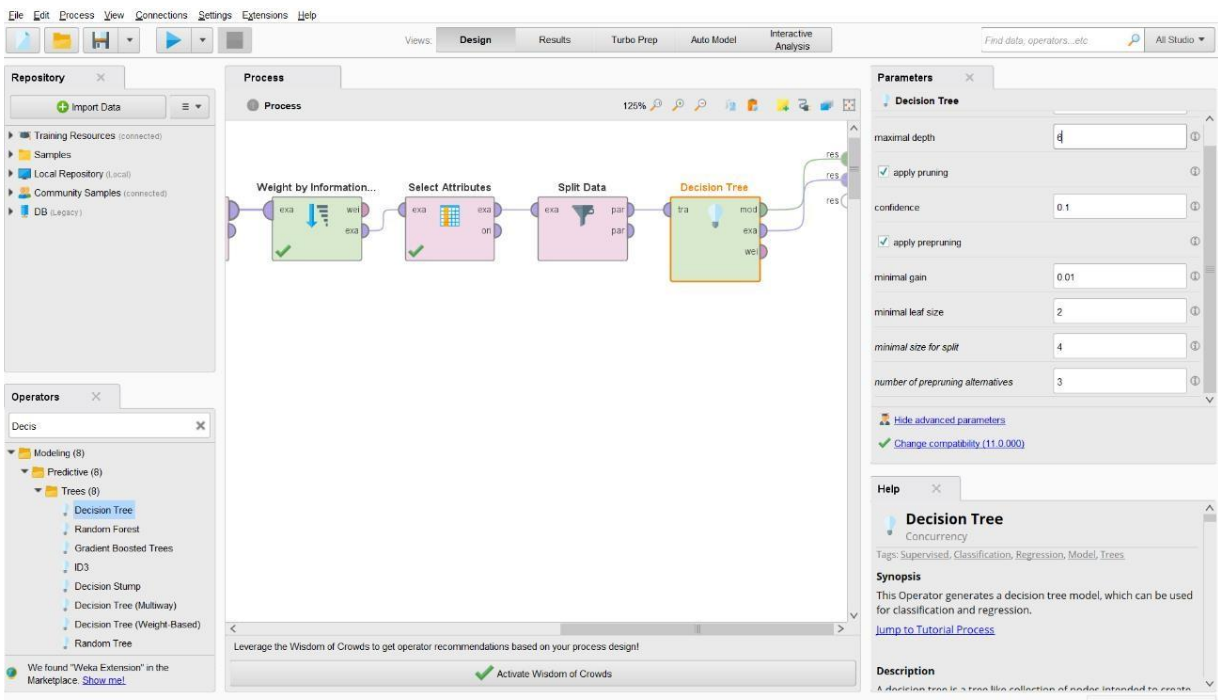




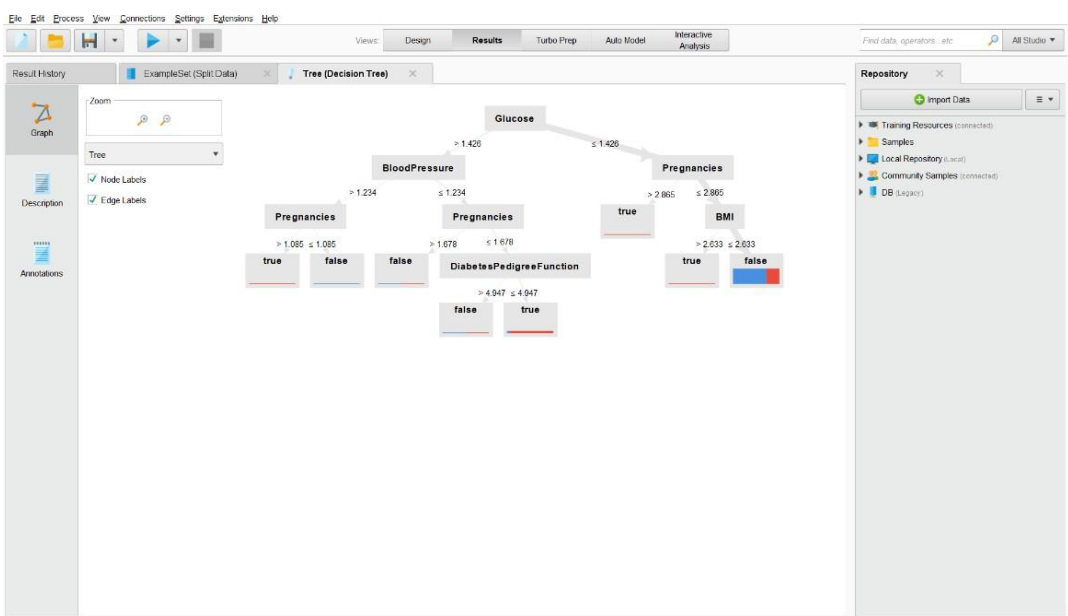
Step 8: Model Training

1. From the operators search bar, add models like **"Decision Tree"**, **"SVM"**, and **"Neural Network"**.
2. Connect the **training data output from Split Data** to the model input.
3. Connect the model output to **Apply Model**.

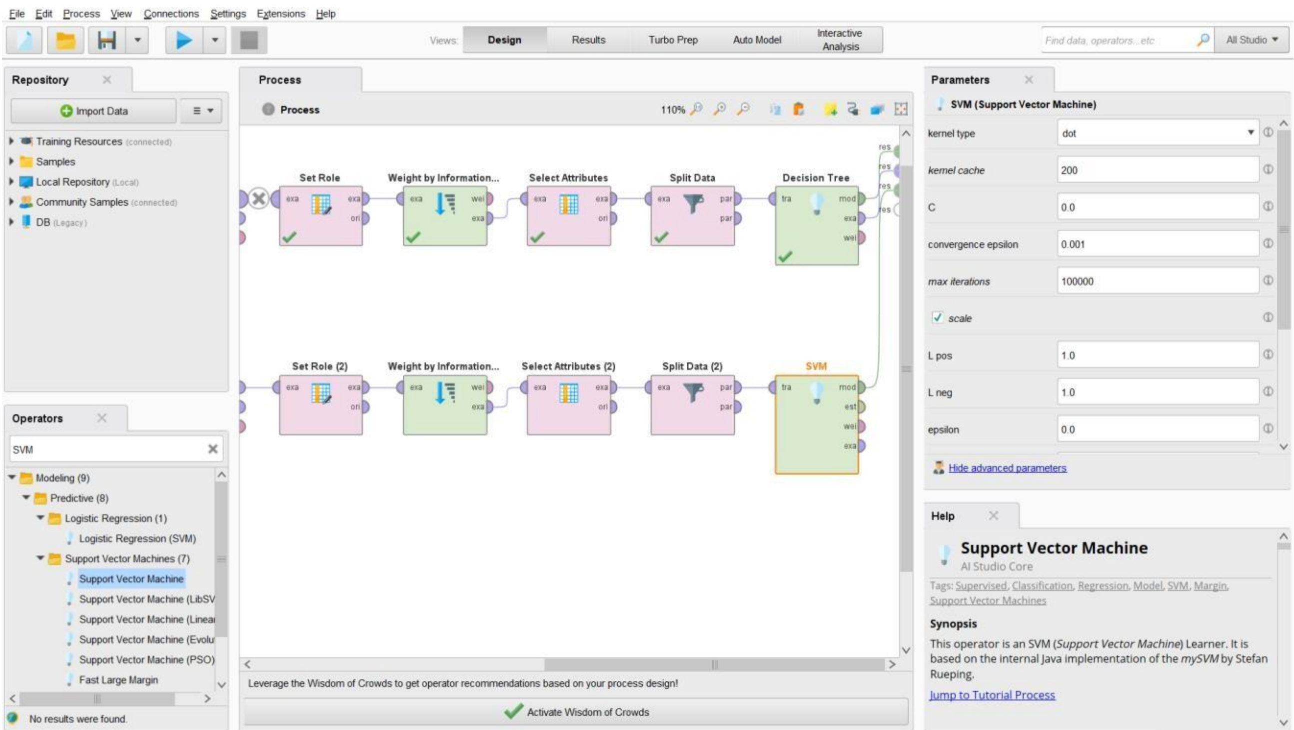
A. Apply **Decision Tree** Model



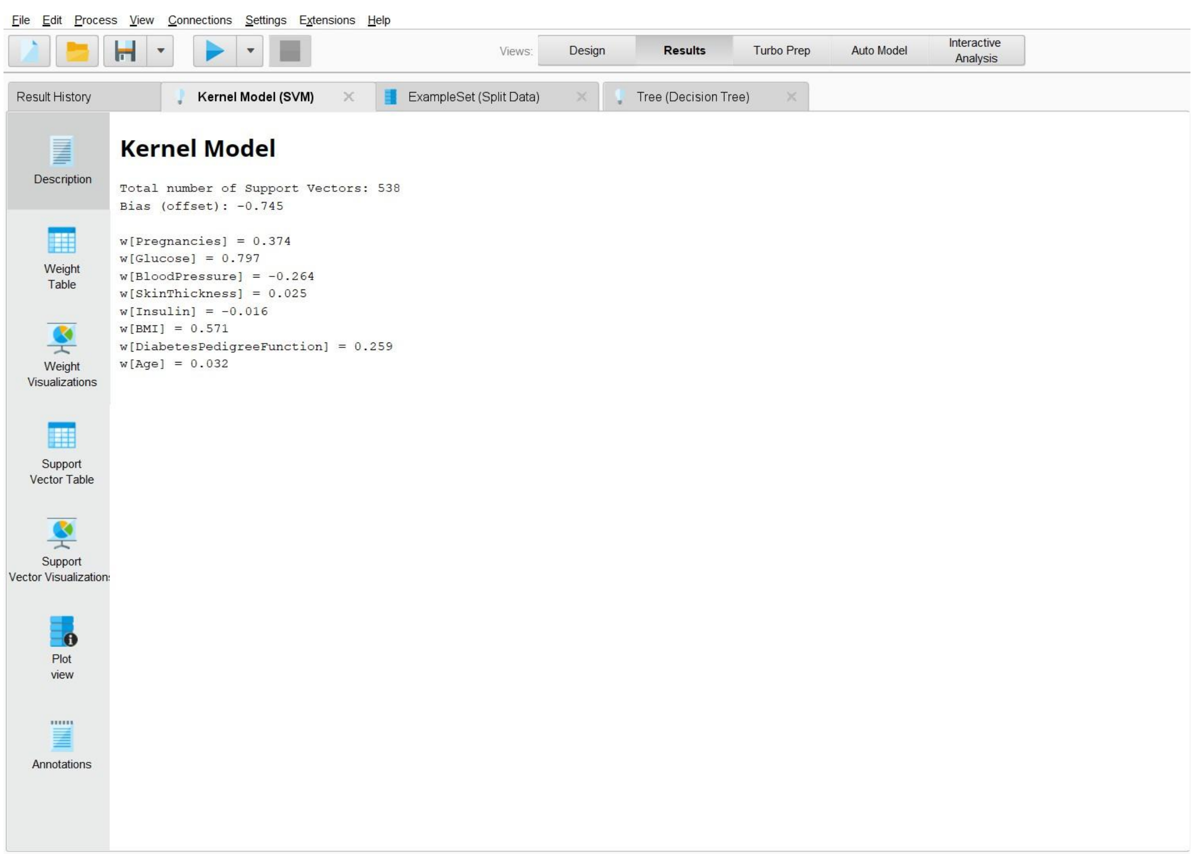
Observe the **Decision Tree** in the statistics we can see the **Decision Tree.**



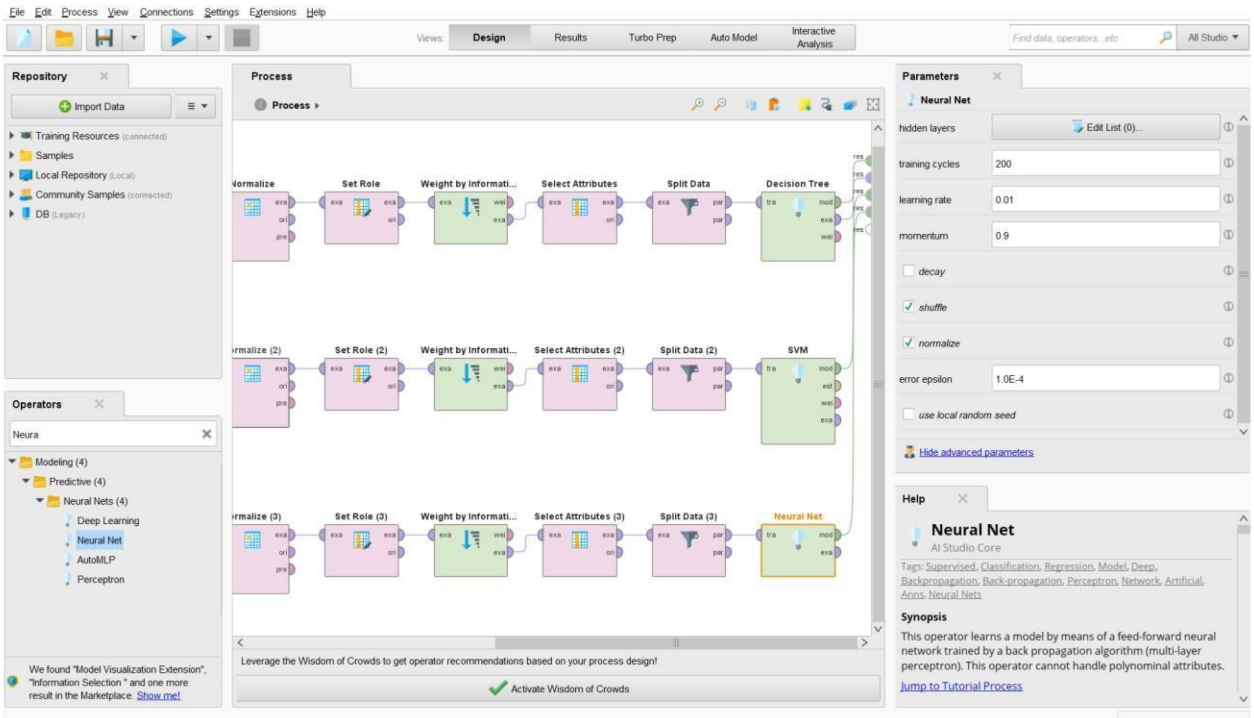
B. Apply **SVM** Model:



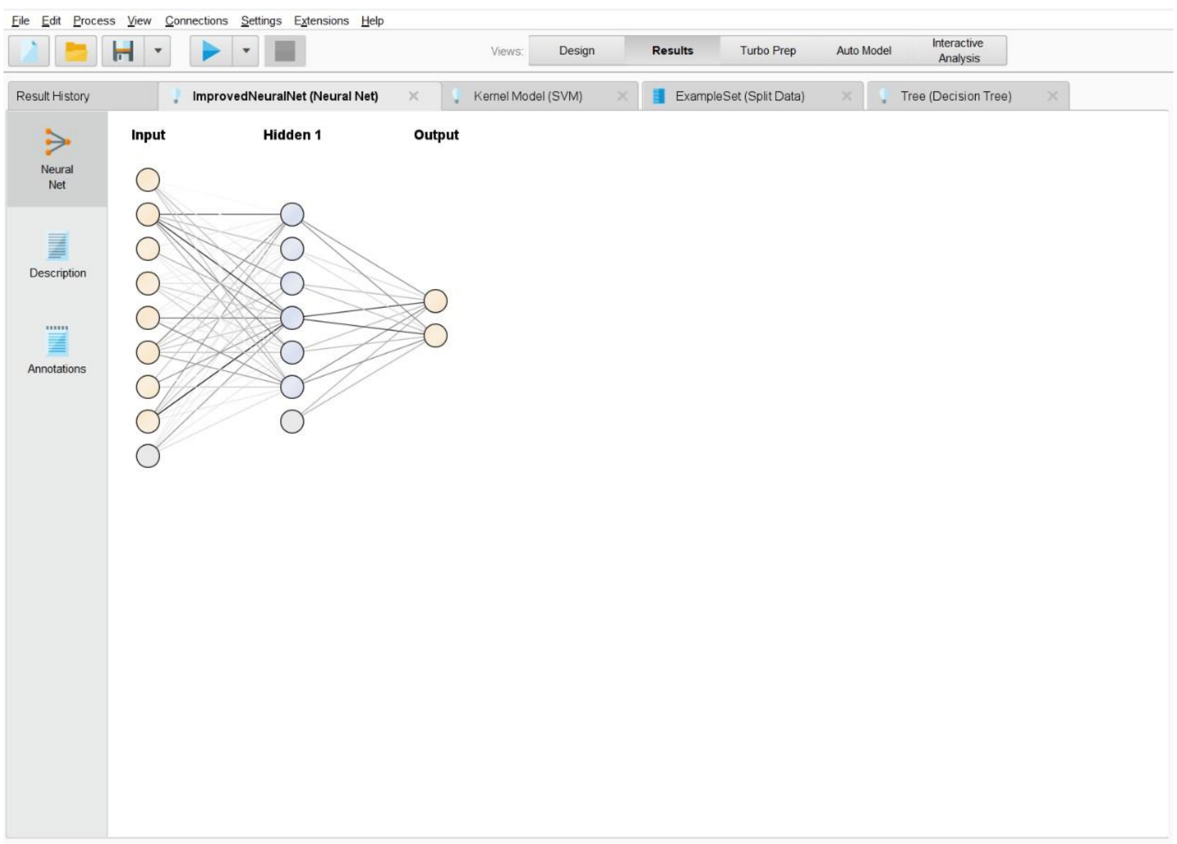
Observe the **SVM** Results



C. Observe the **Neural Network**

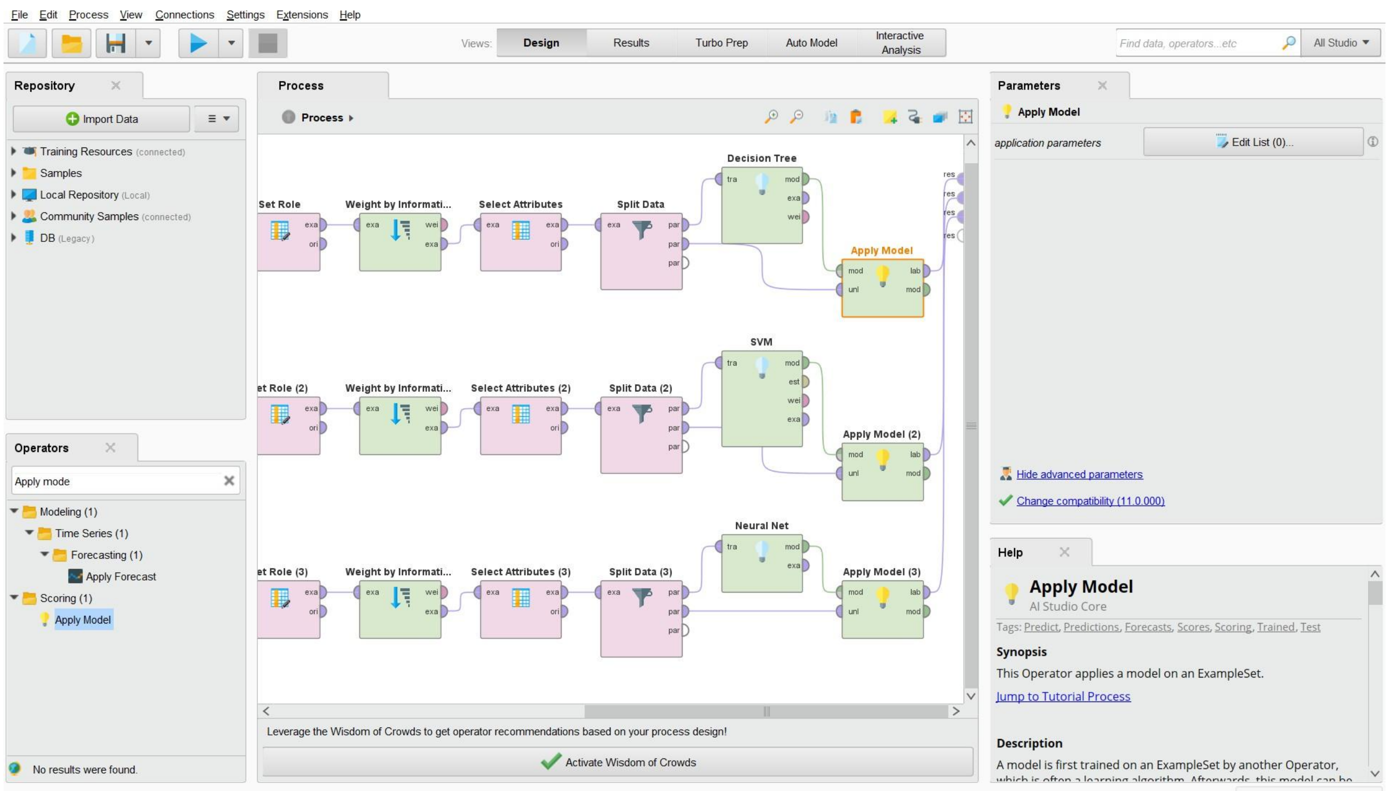


Observe the **Neural Network**



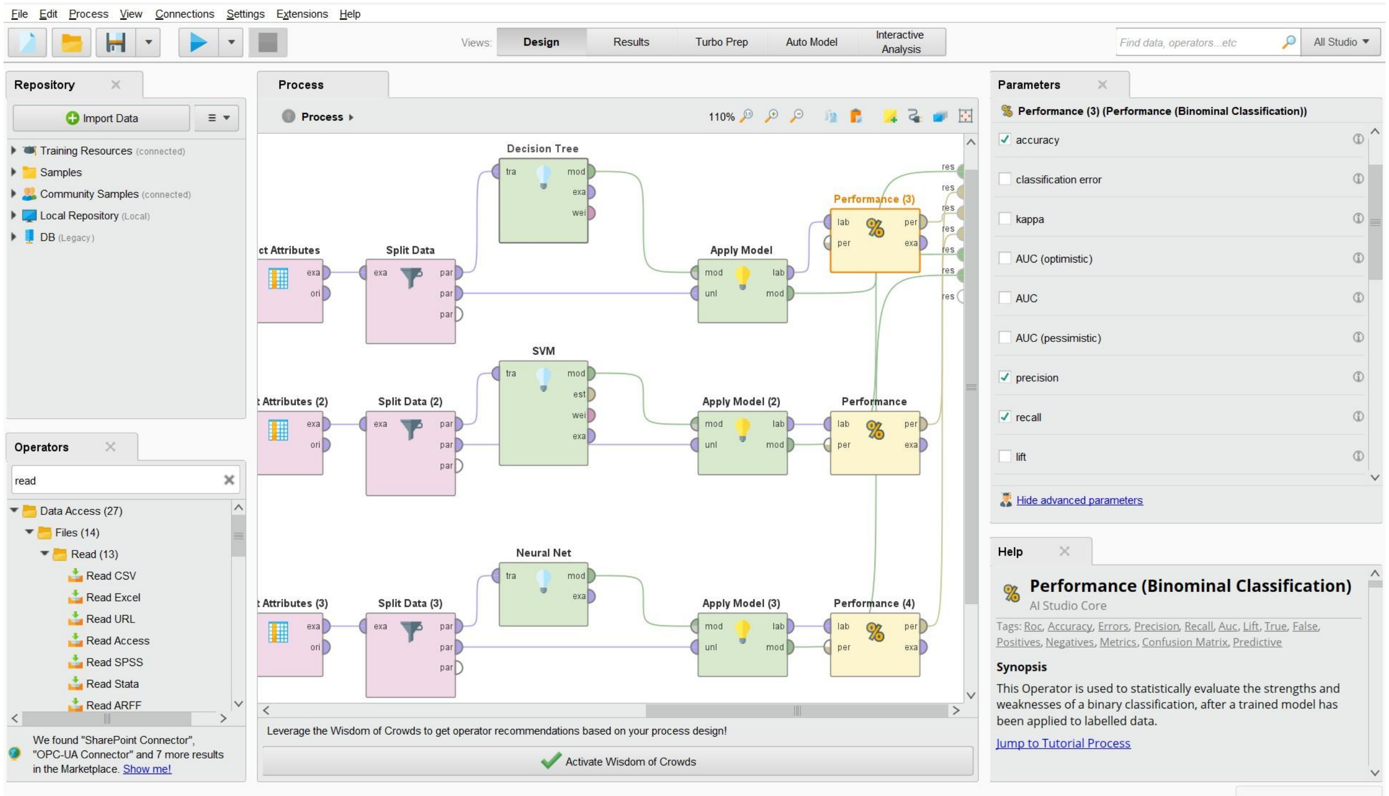
Step 9: Apply Model

1. Search for **"Apply Model"**, drag it to the environment.
2. Connect the **trained model output** to **Apply Model**.
3. Also, connect the **testing data output from Split Data** to **Apply Model**.
4. Run the process and verify predictions.

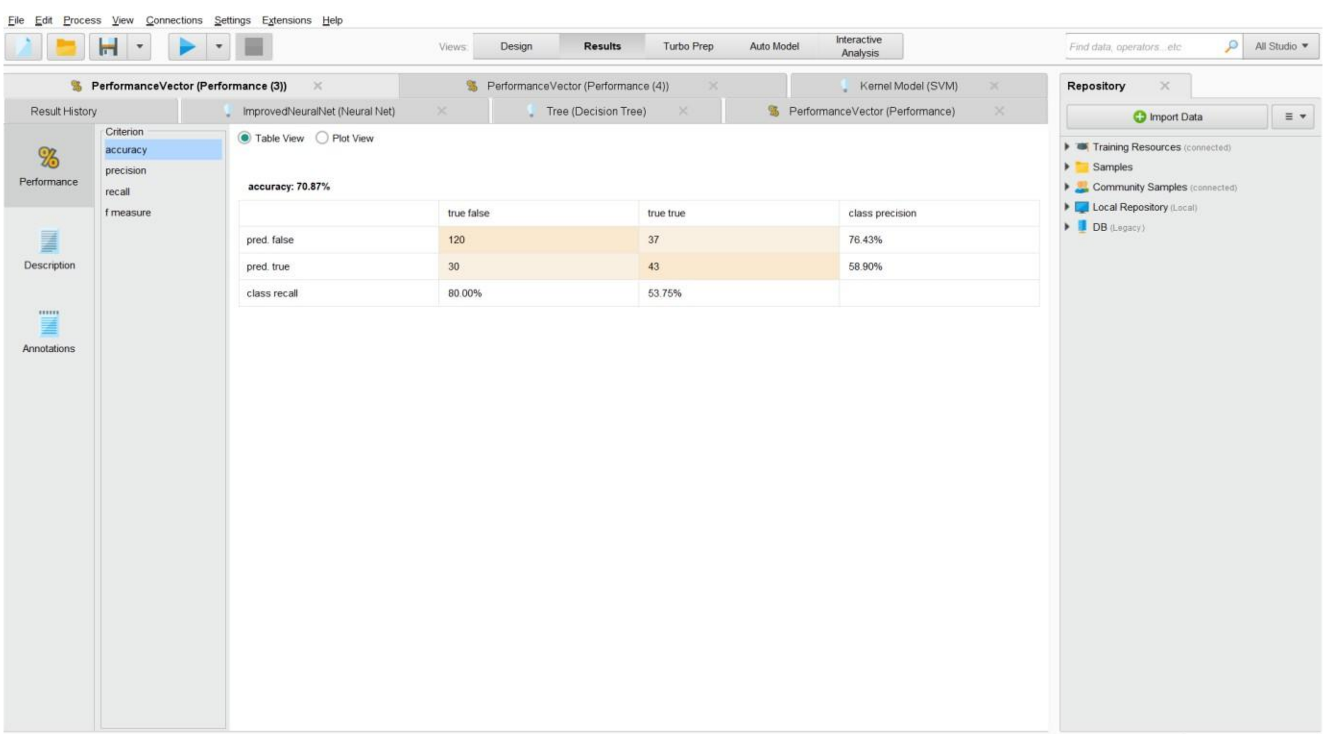


Step 10: Measuring Performance

1. Search for **"Performance (Binominal Classification)"**, drag it to the environment.
2. Connect **Apply Model output** to **Performance**.
3. In the **Parameters panel**, select **Accuracy, Precision, Recall, AUC-ROC, and F1-score**.
4. Connect **Performance output** to **Results** and run the process to view model performance.



Decision Tree Performance:



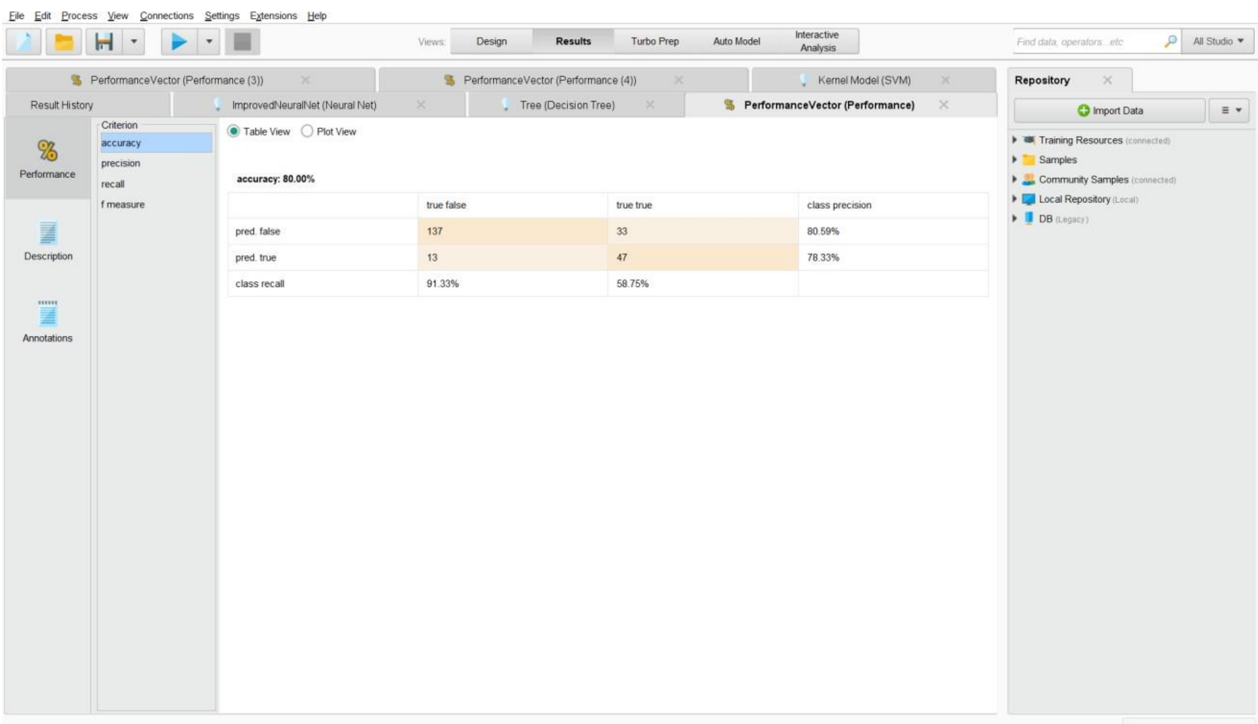
Accuracy→ 70.87%

Precision→ 58.90%

Recall→ 53.75%

F_measure → 56.21%

SVM Performance:



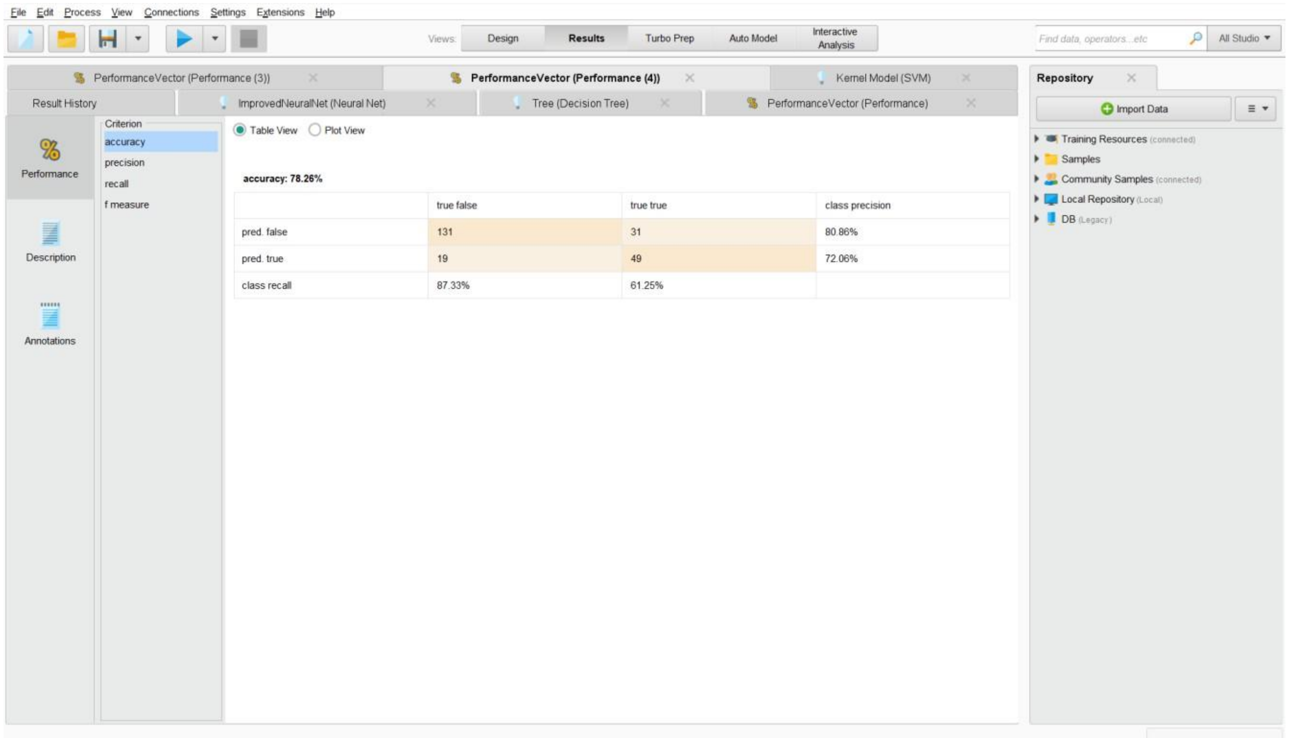
Accuracy→ 80.0%

Precision→ 78.33%

Recall→ 58.75%

F_measure → 67.14%

Neural Network Performance:



Accuracy→ 78.26%

Precision→ 72.06%

Recall→ 61.25%

F_measure → 66.22%

Result:

After performing **numerical to binominal conversion, replacing missing values, normalizing data, selecting important features, splitting data, training models, and evaluating performance**, the final model achieves an accuracy of **70%+**, providing an effective solution for predicting diabetes risk.

Outcome:

	Decision Tree	SVM	Neural Network
Accuracy	70.87	80.0	78.26
Precision	58.90	78.33	72.06
Recall	53.75	58.75	61.25
F_measure	56.21	67.14	66.22

S