CST8390 BI & Data Analytics

Assignment II: Decision Tress with Titanic Dataset

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Abstract

This famous data set focuses on the passengers of the largest passenger line ever made which sunk over 100 years ago, Titanic. Even though the incident happened a lot of years ago, the data set is still quite useful to develop machine learning algorithms. Most people could not survive from the incident since there were not enough bots.

The likelihood of a passenger's survival depended on certain elements such as, passenger's class, gender, number of relatives, and so on. There were 2224 passengers on Titanic, but in this data set, 887 passengers' information were used. The information includes passenger's name, number of siblings/spouses, number of parents/children, and port of embarkation alongside with the other elements. The aim of the data set is to develop an algorithm that can be used to predict whether the passenger survived or not by the given training and test data sets.

Attributes & Description

Attribute	Description
PassengerId	Primary key given to the passenger to differentiate all the passengers
Pclass	Class of the passenger (1 = 1st , 2 = 2nd , 3 = 3rd)
Name	Name of the passenger.
Sex	Gender of the passenger (Male, Female)
Age	Age of the passenger.
SibSp	Number of siblings/spouses does the passenger have
Parch	Number of parents/children does the passenger have
Ticket	Ticket number of the passenger
Fare	Amount of fare that the passenger paid
Cabin	Cabin of the passenger (If having one)
Embarked	Port of embarkation (C = Cherbourg, Q = Queenstown, S = Southampton)
Survival	Whether the passenger survived (0 = No, 1 = Yes) Not included in the test file

What attributes are further needed?

From the 11 attributes presented above we have picked the most relevant attributes. These are Pclass, Sex, Age, SibSp, Parch, embarked and survival. These are the factors in which we think mainly contribute to the survival rate of each passengers. To classify these factors, we created new attribute Age Group which was derived from Age and Relatives sums up SibSp and Parch. Then the Age, SibSp and Parch was remove from the datasets to not create a biased decision. The image below shows the csv file processed from the original datasets.

	A	B	C	D	E	F	G	H	I
1	**Survived**	**Pclass**	**Sex**	**Age Group**	**Relatives**	**Embarked**			
2	0	3	male	Adult	1	S			
3	1	1	female	Adult	1	C			
4	1	3	female	Adult	0	S			
5	1	1	female	Adult	1	S			
6	0	3	male	Adult	0	S			
7	0	3	male	NK	0	Q			
8	0	1	male	Adult	0	S			
9	0	3	male	Child	4	S			
10	1	3	female	Adult	2	S			
11	1	2	female	Adolescent	1	C			
12	1	3	female	Child	2	S			
13	1	1	female	Adult	0	S			
14	0	3	male	Adolescent	0	S			
15	0	3	male	Adult	6	S			
16	0	3	female	Adolescent	0	S			
17	1	2	female	Adult	0	S			
18	0	3	male	Child	5	Q			
19	1	2	male	NK	0	S			
20	0	3	female	Adult	1	S			
21	1	3	female	NK	0	C			
22	0	2	male	Adult	0	S			
23	1	2	male	Adult	0	S			
24	1	3	female	Adolescent	0	Q			
25	1	1	male	Adult	0	S			
26	0	3	female	Child	4	S			
27	1	3	female	Adult	6	S			
28	0	3	male	NK	0	C			
29	0	1	male	Adolescent	5	S			
30	1	3	female	NK	0	Q			

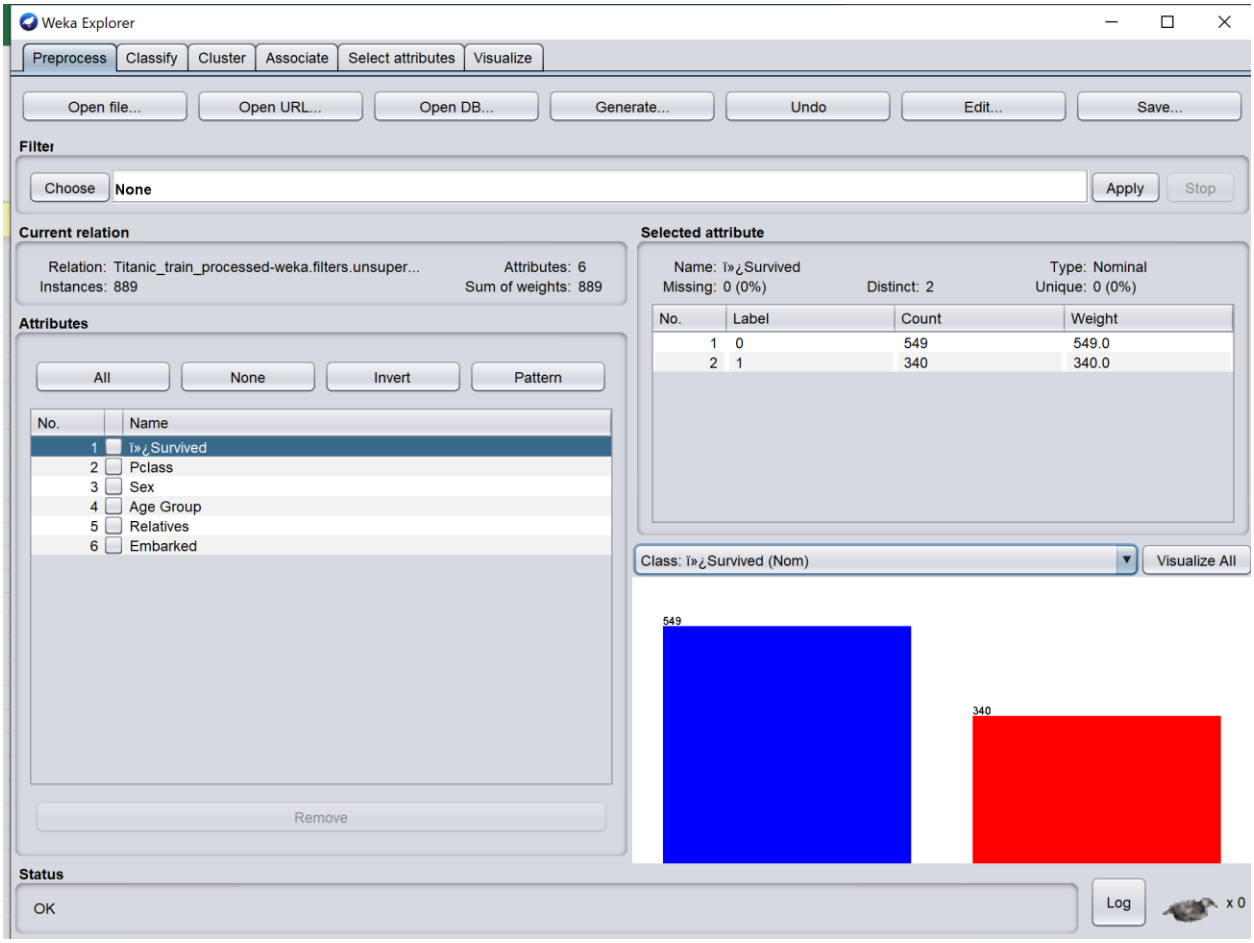
Titanic_train_processed

Loading the File To Weka

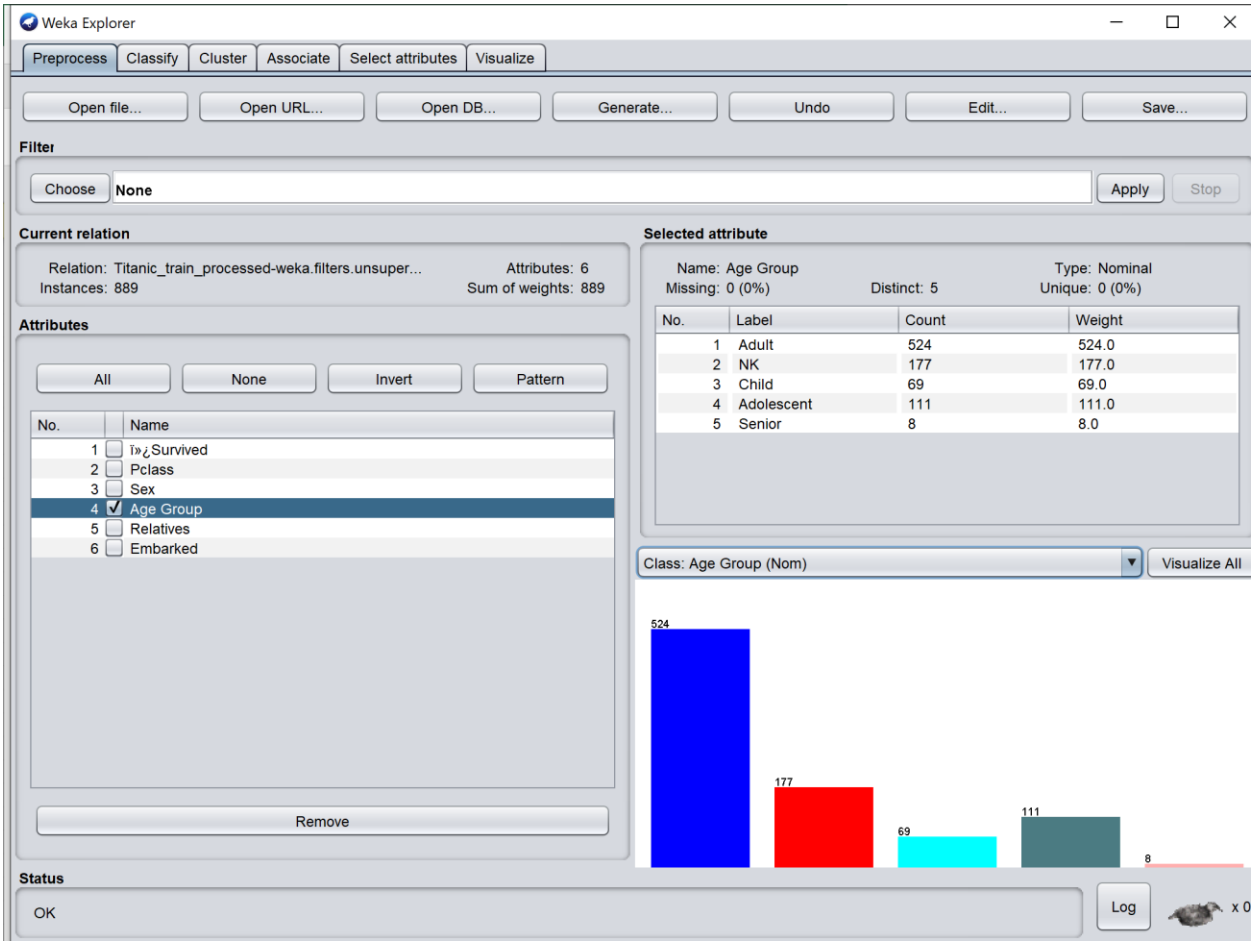
Upon loading to Weka, each attribute was checked if they are set into their expected type. Survived, Pclass and Rleatives were in numeric form, so they were converted to be nominal. All attributes are all in nominal form.

Class and Age Group Attributes

a. Survived

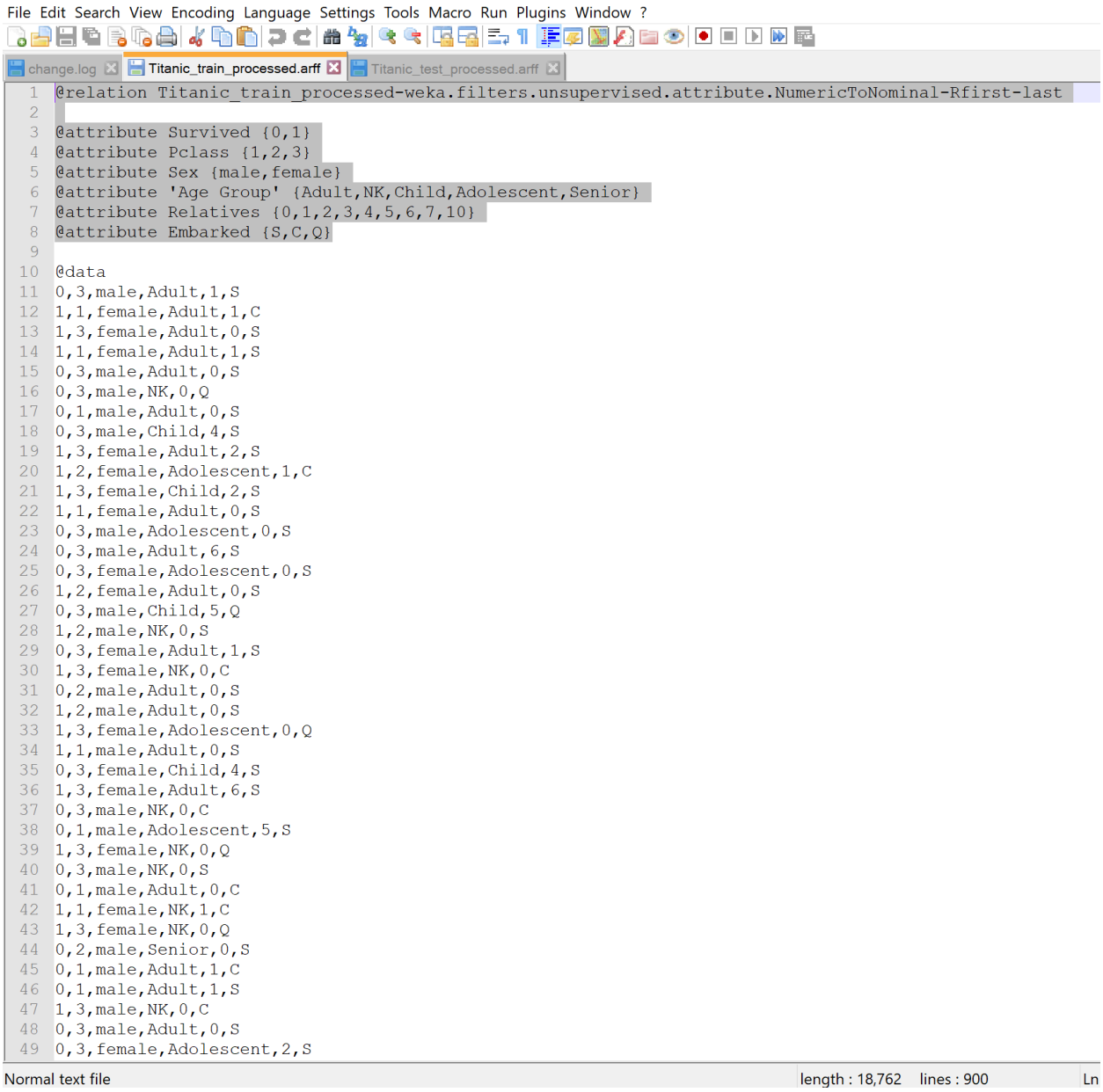


b. Age Group


Weka Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Generate...
Undo
Edit...
Save...
Filter
Choose
None
Apply
Stop
Current relation
Relation: Titanic_train_processed-weka.filters.unsuper...
Attributes: 6
Instances: 889
Sum of weights: 889
Attributes
All
None
Invert
Pattern
No.
Name
1 ï»¿Survived
2 Pclass
3 Sex
4 Age Group
5 Relatives
6 Embarked
Remove
Selected attribute
Name: Age Group
Type: Nominal
Missing: 0 (0%)
Distinct: 5
Unique: 0 (0%)
No.
Label
Count
Weight
1 Adult 524 524.0
2 NK 177 177.0
3 Child 69 69.0
4 Adolescent 111 111.0
5 Senior 8 8.0
Class: Age Group (Nom)
Visualize All
524
177
69
111
8
Status
OK
Log
x 0

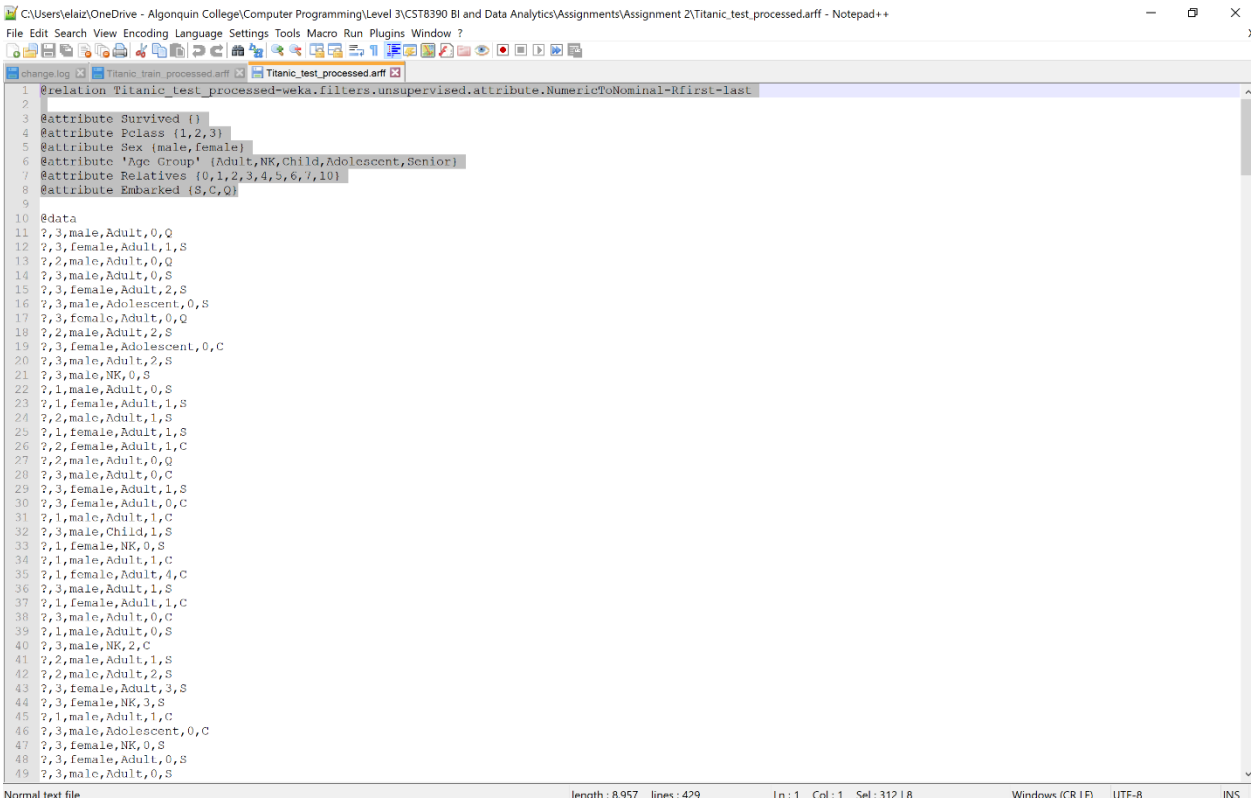
Saving the File in ".arff" format

After converting the attributes to their expected type. The file was ready to save as .arff file. Below is the screenshot of the file opened in Notepad++



The Test File is Prepared in the Same Format with the Train File

The Titanic test file was then prepared the same way as the training sets. With the same format but with the Survive attribute set to "?" as a value. To test and compare the result with the training sets. Below is the screenshot of the test.arff file opened in notepad++.



Classification

The classification was performed by using decision tree method. First the file is loaded to Weka, and J48 classifier was chosen with 10-fold validation. The confusion matrix produced from the cross validation can be seen below, which has overall 713 correctly classified instances out of 889 instances (80% correct).

```
  a   b   c   <-- classified as
498  51   0 |   a = 0
125 215   0 |   b = 1
  0   0   0 |   c = ?
```

Confusion Matrix

Decision Tree

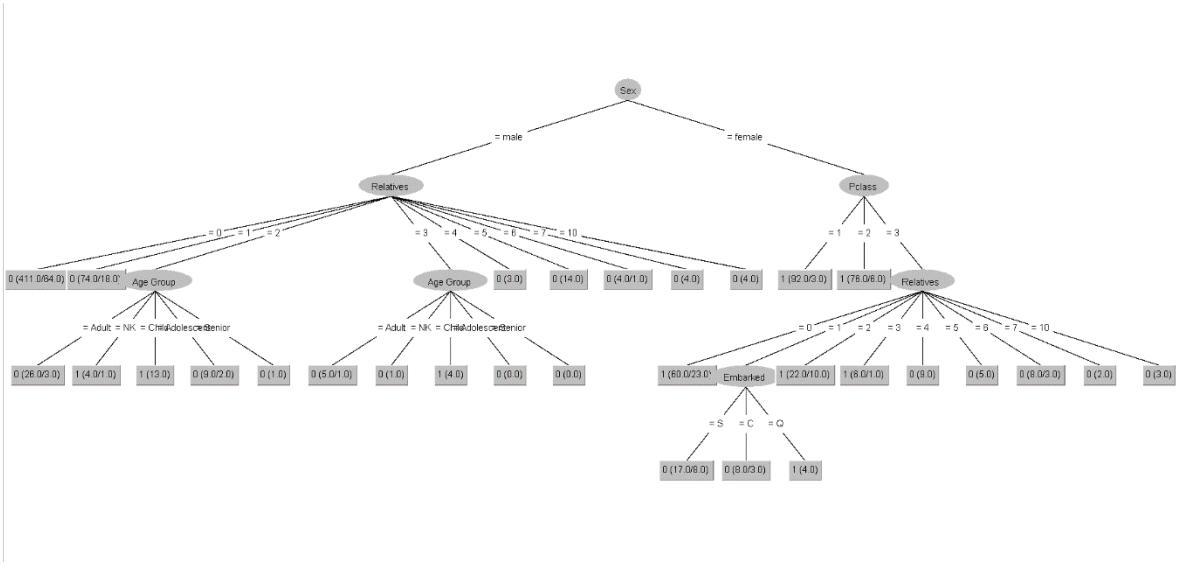
Here are the predictions made by the decision tree from the training data set.

-> The decision tree has the root value of sex, indicating it is the most relevant attribute of a passenger's survival. Females had a better chance of survival.

-> Females in first and second classes survived.
-> Third class females who have more than 3 relatives did not survive. The ones having one relative and embarked from Queenstown survived, the others did not.

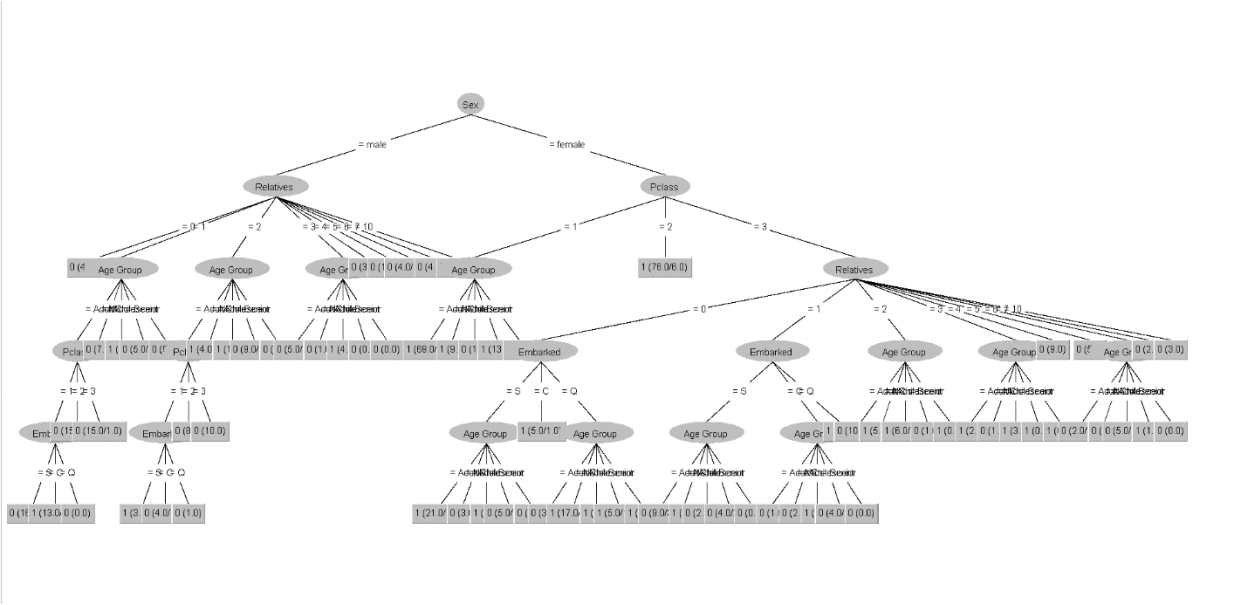
-> Regarding the males, only the children having 2 or 3 children had a chance of survival. There are also survivors with the unknown ages.

Below is the decision tree for more detailed information.



Bonus: What if the Tree Was Unpruned?

By default, the tree is pruned, which means the non-critical and redundant classify instances are removed. When the “unPruned” option is set to true, the size of the tree gets drastically bigger as it can be seen below.



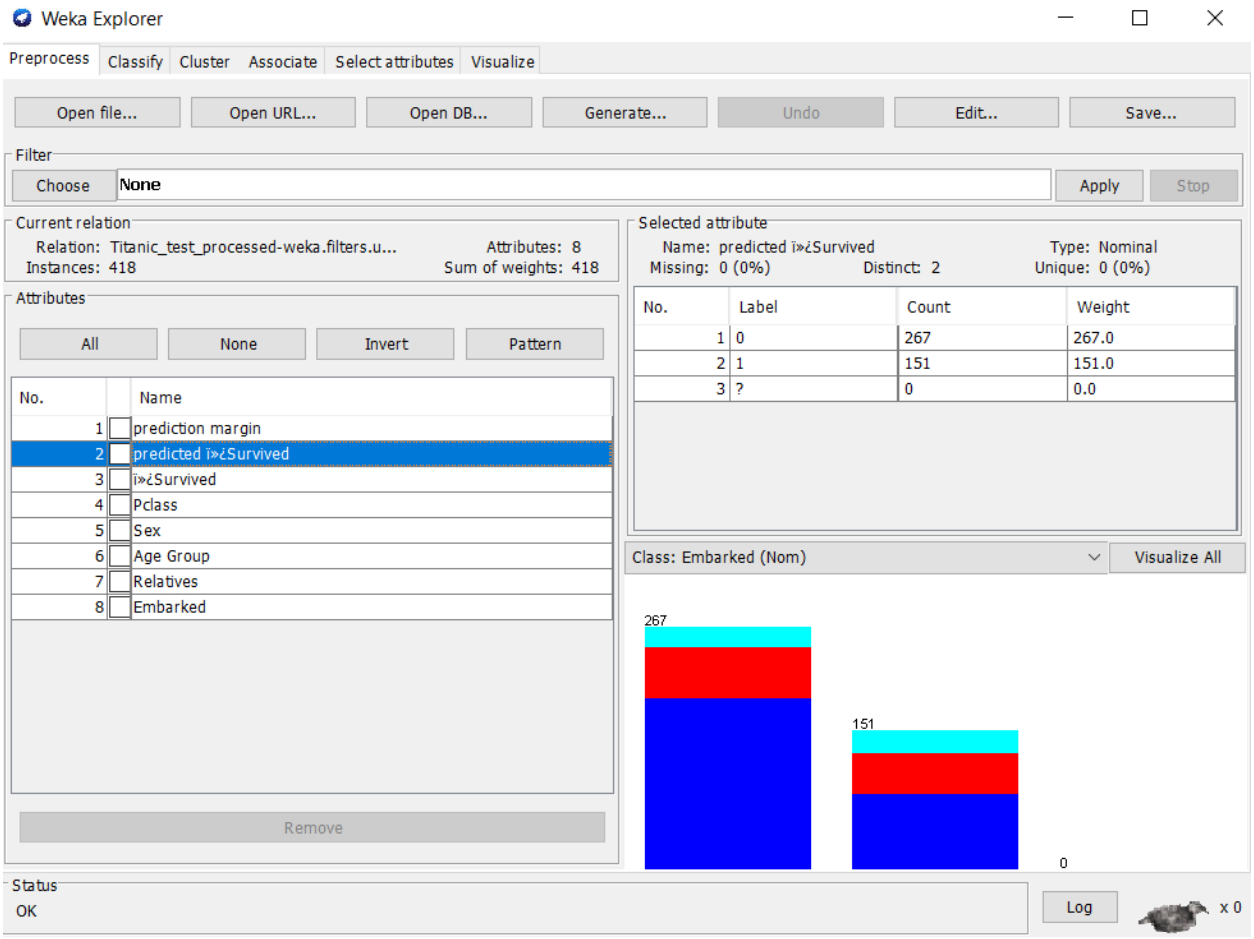
The pruned tree is used for the analysis as it is less complex and it improves predictive accuracy by reduction of overfitting. (Info retrieved from WikiPedia.)

Adjusting the arff File For the Test Set

When we tried to run the decision trees for the test set, we encountered with the error saying these data sets are not compatible. The reason was that all the attributes should have been identical in which, the Survived attributes had different value categories. So, both attributes were changed in the .arff files to “*Survived {?,0,1}”* since the training set had 0 and 1, whereas the test set had only “?” As the value.

Test Set and “res” File

After making the changes, the test set became able to be supplied. The same decision tree algorithm was run on the test set, and got the output of all empty values as there was no actual survival information. In order to see the actual results, the classifier errors were visualized on the output file and saved as another file(res.arff).



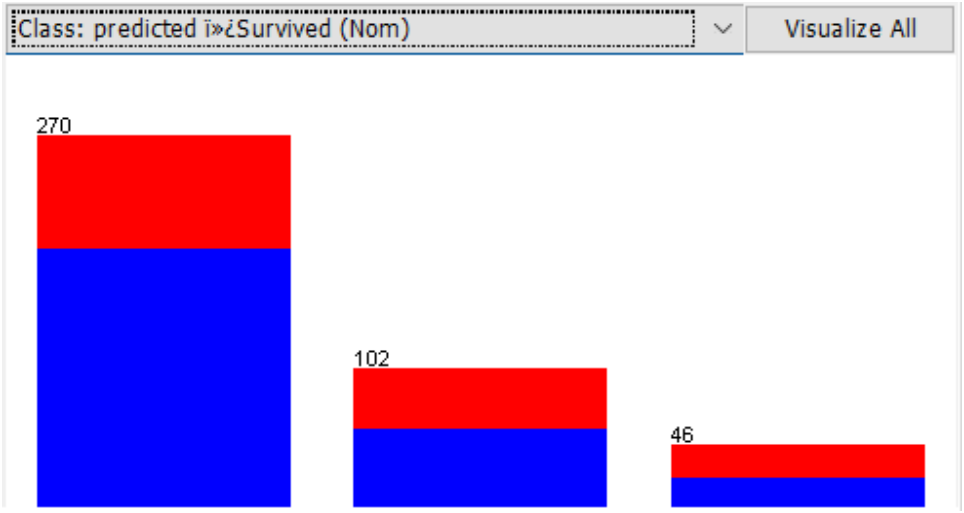
The prediction results can be seen on res.arff file. Prediction margin and predicted survived attributes are automatically generated by Weka, and we are looking at the predicted survived attribute for the relevant information. Here are the results of the prediction based on the decision tree.

- There are total of 418 instances in the test file.
- 151 persons were predicted to survive.
- 267 persons were predicted not to survive.
- Percentage of predicted survival is 36.12%.

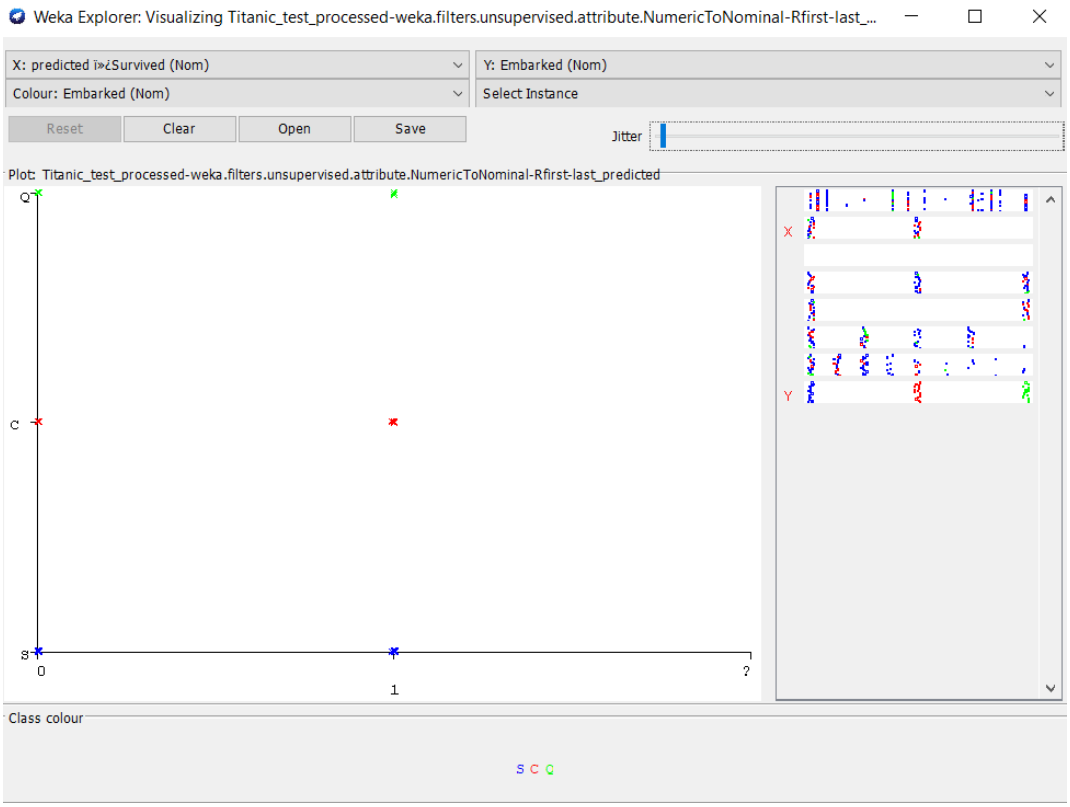
Comparing to the Actual Results

According to the actual results, 492 passengers were survived from the incident, which has a survivor percentage of 37%. The result is fairly close to our algorithm's prediction with roughly **1%** deviation.

There are certain reasons influencing the deviation difference.
As it can be seen from the chart of port of embarkation and survival prediction, the port has no significant effect on a passenger's survival more than a coincidence. However, in the decision tree generated, it was one of the factors deciding whether the person will survive or not.

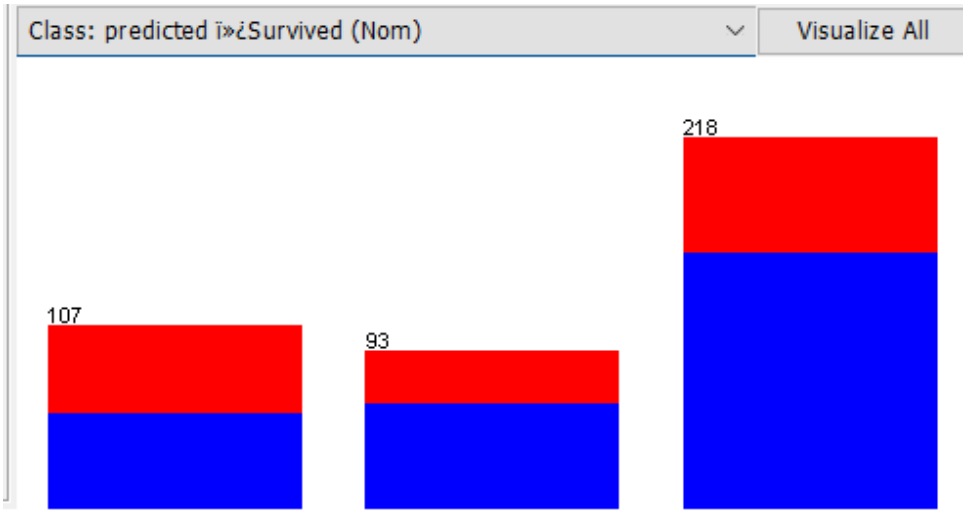


Here is the comparison of embarkment ports and survived data. There is no real-life information on if the embarkment port has an effect on survival.

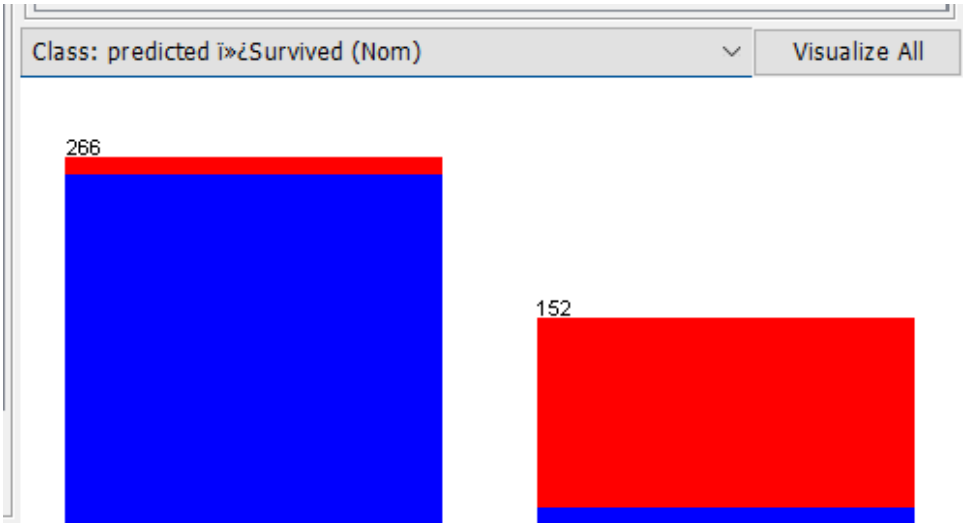


Also, the cabin might have been a factor for prediction, but since there were too many missing data on cabinet, we preferred to not include it on the data sets.

The success of the prediction is because for the decision tree, the most significant factors were sex and class, so was for the actual statistics.



Respectively first, second, and third class (Victims are blue, survivors are red)



Respectively female and male (Victims are blue, survivors are red)