```
ingredients (generic function with 1 method)
```

# Project: Titanic - Machine Learning from Disaster

## Overview

1. Exploring the data
2. Data Cleaning / Preprocessing
3. Model Building
4. Results

```
using Plots
```

```
using CSV
```

```
using DataFrames
```

```
using ScikitLearn
```

```
using VegaLite
```

```
using Statistics
```

```
using Distributions
```

| | PassengerId | Survived | Pclass | Name | Sex | A |
|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 3 | "Braund, Mr. Owen Harris" | "male" | 22. |
| 2 | 2 | 1 | 1 | "Cumings, Mrs. John Bradley (Florence | "female" | 38. |
| 3 | 3 | 1 | 3 | "Heikkinen, Miss. Laina" | "female" | 26. |
| 4 | 4 | 1 | 1 | "Futrelle, Mrs. Jacques Heath (Lily Ma | "female" | 35. |
| 5 | 5 | 0 | 3 | "Allen, Mr. William Henry" | "male" | 35. |
| 6 | 6 | 0 | 3 | "Moran, Mr. James" | "male" | mis |
| 7 | 7 | 0 | 1 | "McCarthy, Mr. Timothy J" | "male" | 54. |
| 8 | 8 | 0 | 3 | "Palsson, Master. Gosta Leonard" | "male" | 2.( |
| 9 | 9 | 1 | 3 | "Johnson, Mrs. Oscar W (Elisabeth Vilh | "female" | 27. |
| 10 | 10 | 1 | 2 | "Nasser, Mrs. Nicholas (Adele Achem)" | "female" | 14. |
| more | | | | | | |
| 891 | 891 | 0 | 3 | "Dooley, Mr. Patrick" | "male" | 32. |

```
begin
    # load Train Data
    path_train = "train.csv"
    data_train = CSV.read(path_train, DataFrame)
end
```

| | PassengerId | Pclass | Name | Sex | Age | Sil |
|---|---|---|---|---|---|---|
| 1 | 892 | 3 | "Kelly, Mr. James" | "male" | 34.5 | 0 |
| 2 | 893 | 3 | "Wilkes, Mrs. James (Ellen Needs)" | "female" | 47.0 | 1 |
| 3 | 894 | 2 | "Myles, Mr. Thomas Francis" | "male" | 62.0 | 0 |
| 4 | 895 | 3 | "Wirz, Mr. Albert" | "male" | 27.0 | 0 |
| 5 | 896 | 3 | "Hirvonen, Mrs. Alexander (Helga E Lin | "female" | 22.0 | 1 |
| 6 | 897 | 3 | "Svensson, Mr. Johan Cervin" | "male" | 14.0 | 0 |
| 7 | 898 | 3 | "Connolly, Miss. Kate" | "female" | 30.0 | 0 |
| 8 | 899 | 2 | "Caldwell, Mr. Albert Francis" | "male" | 26.0 | 1 |
| 9 | 900 | 3 | "Abrahim, Mrs. Joseph (Sophie Halaut E | "female" | 18.0 | 0 |
| 10 | 901 | 3 | "Davies, Mr. John Samuel" | "male" | 21.0 | 2 |
| | more | | | | | |
| 418 | 1309 | 3 | "Peter, Master. Michael J" | "male" | missing | 1 |

```
begin
    # load Test Data
        path_test = "test.csv"
        data_test = CSV.read(path_test, DataFrame)
end
```

# Exploring the data

| | variable | mean | min | median | max |
|---|---|---|---|---|---|
| 1 | :PassengerId | 446.0 | 1 | 446.0 | 891 |
| 2 | :Survived | 0.383838 | 0 | 0.0 | 1 |
| 3 | :Pclass | 2.30864 | 1 | 3.0 | 3 |
| 4 | :Name | nothing | "Abbing, Mr. Anthony" | nothing | "van Melkebeke, Mr. Philemo |
| 5 | :Sex | nothing | "female" | nothing | "male" |
| 6 | :Age | 29.6991 | 0.42 | 28.0 | 80.0 |
| 7 | :SibSp | 0.523008 | 0 | 0.0 | 8 |
| 8 | :Parch | 0.381594 | 0 | 0.0 | 6 |
| 9 | :Ticket | nothing | "110152" | nothing | "WE/P 5735" |
| 10 | :Fare | 32.2042 | 0.0 | 14.4542 | 512.329 |
| 11 | :Cabin | nothing | "A10" | nothing | "T" |
| 12 | :Embarked | nothing | "C" | nothing | "S" |

```
describe(data_train)
```

| | variable | mean | min | median | m |
|---|---|---|---|---|---|
| 1 | :PassengerId | 1100.5 | 892 | 1100.5 | 1309 |
| 2 | :Pclass | 2.26555 | 1 | 3.0 | 3 |
| 3 | :Name | nothing | "Abbott, Master. Eugene Joseph" | nothing | "van Billiard, Ma |
| 4 | :Sex | nothing | "female" | nothing | "male" |
| 5 | :Age | 30.2726 | 0.17 | 27.0 | 76.0 |
| 6 | :SibSp | 0.447368 | 0 | 0.0 | 8 |
| 7 | :Parch | 0.392344 | 0 | 0.0 | 9 |
| 8 | :Ticket | nothing | "110469" | nothing | "W.E.P. 5734" |
| 9 | :Fare | 35.6272 | 0.0 | 14.4542 | 512.329 |
| 10 | :Cabin | nothing | "A11" | nothing | "G6" |
| 11 | :Embarked | nothing | "C" | nothing | "S" |

```
describe(data_test)
```

# Data Overview / Plots

## Numeric Data

- Age
- SibSp (Siplings and Spouses)
- Parch (Partens and Children)
- Fare

### Plots for numeric data

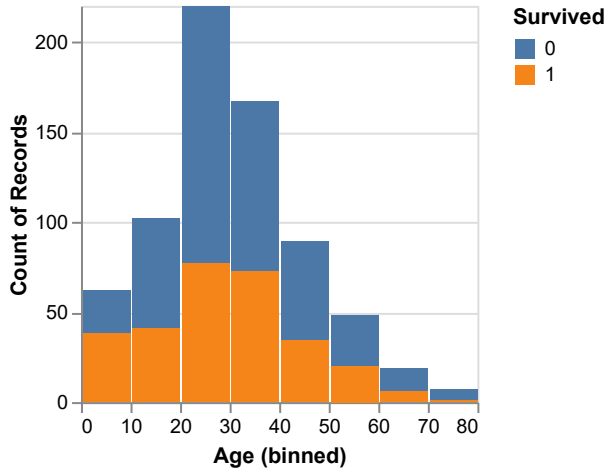
- Histograms to understand distributions
- Correlation Plot

`numeric_df =`

| | Age | SibSp | Parch | Fare |
|---|---|---|---|---|
| 1 | 22.0 | 1 | 0 | 7.25 |
| 2 | 38.0 | 1 | 0 | 71.2833 |
| 3 | 26.0 | 0 | 0 | 7.925 |
| 4 | 35.0 | 1 | 0 | 53.1 |
| 5 | 35.0 | 0 | 0 | 8.05 |
| 6 | missing | 0 | 0 | 8.4583 |
| 7 | 54.0 | 0 | 0 | 51.8625 |
| 8 | 2.0 | 3 | 1 | 21.075 |
| 9 | 27.0 | 0 | 2 | 11.1333 |
| 10 | 14.0 | 1 | 0 | 30.0708 |
| more | | | | |
| 891 | 32.0 | 0 | 0 | 7.75 |

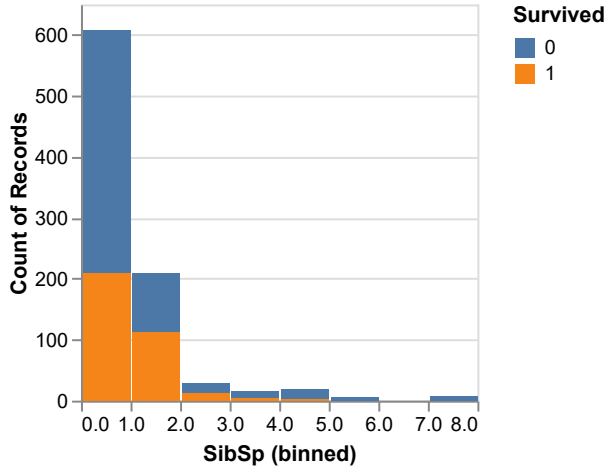
```
numeric_df = data_train[:,[:Age,:SibSp,:Parch,:Fare]]
```

hist_Age =



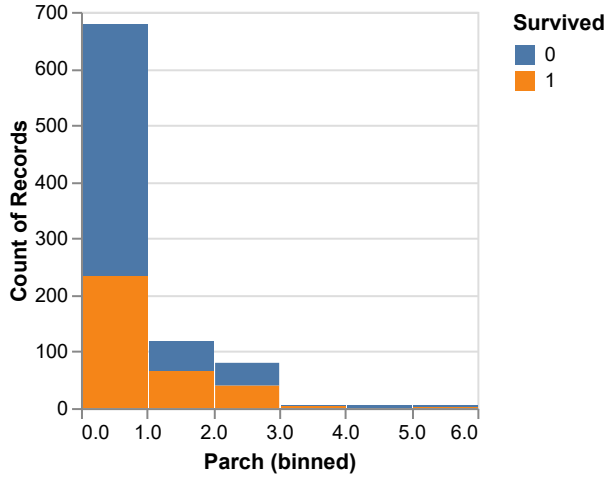

```
hist_Age= @vlplot(data=data_train)+
    @vlplot(:bar, x={:Age, bin=true}, y="count()", color={:Survived, type =
    "nominal"})
```

hist_SibSp =



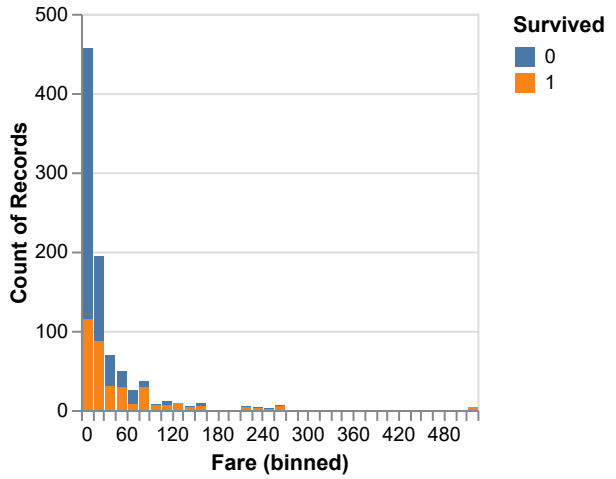

```
hist_SibSp= @vlplot(data=data_train)+
    @vlplot(:bar, x={:SibSp, bin=true}, y="count()", color={:Survived, type =
    "nominal"})
```

hist_Parch =




```
hist_Parch = @vlplot(data=data_train)+
    @vlplot(:bar, x={:Parch , bin=true}, y="count()", color={:Survived, type =
    "nominal"})
```

```
hist_Fare =
```



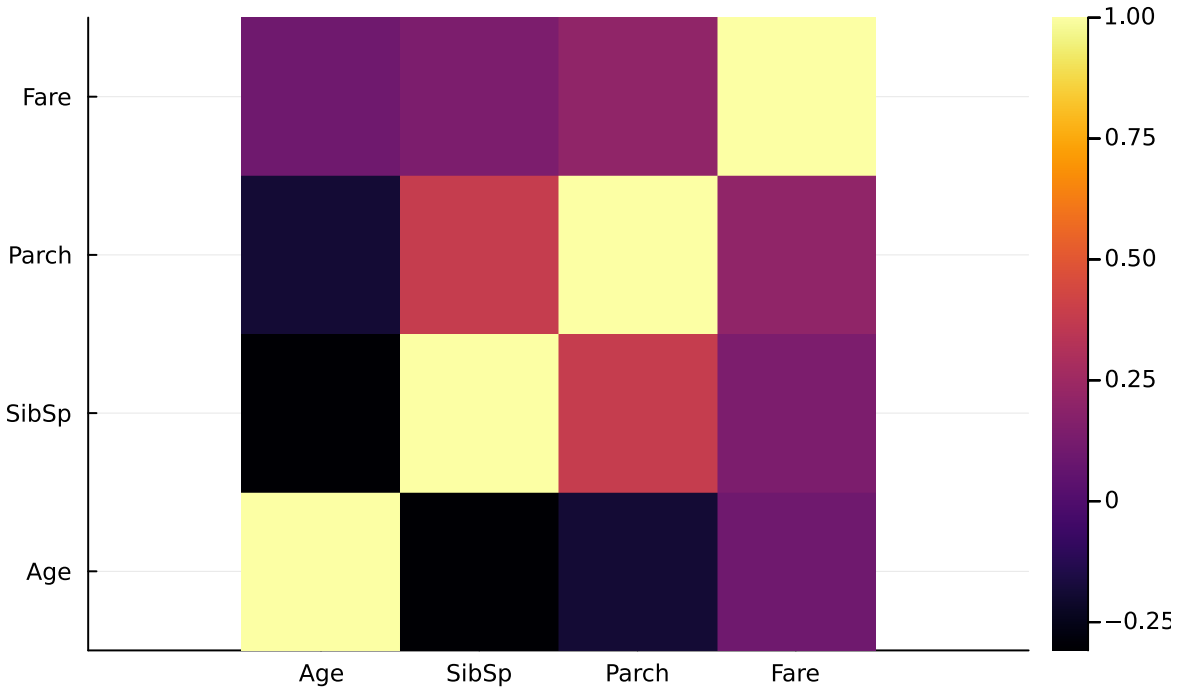

```
hist_Fare = @vlplot(data=data_train)+
    @vlplot(:bar, x={:Fare, bin={step=15}}, y="count()", color={:Survived, type =
    "nominal"})
```

```
cor_numeric = 4×4 Matrix{Float64}:
               1.0        -0.308247  -0.189119  0.0960667
              -0.308247    1.0        0.38382   0.138329
              -0.189119    0.38382    1.0       0.205119
               0.0960667   0.138329   0.205119  1.0
```

```
cor_numeric=cor(Matrix(dropmissing(numeric_df)))
```

```
GRBackend()
```

```
gr()
```




```
Plots.heatmap(names(numeric_df),names(numeric_df),cor_numeric,aspect_ratio = 1)
```

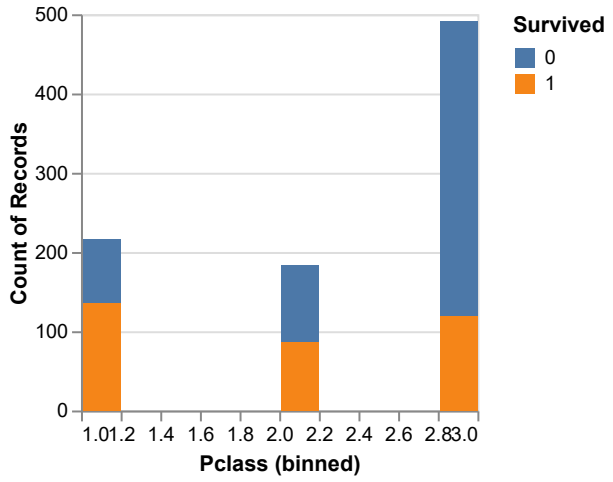
# Categorical

- Survived
- Pclass
- Sex
- *(Cabin)*
- Embarked

## Plots for Categorical Data

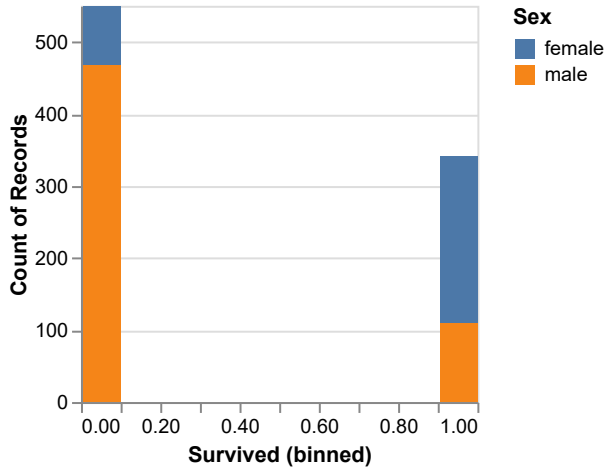
- Bar charts to understand balance of classes

`bar_Pclass =`



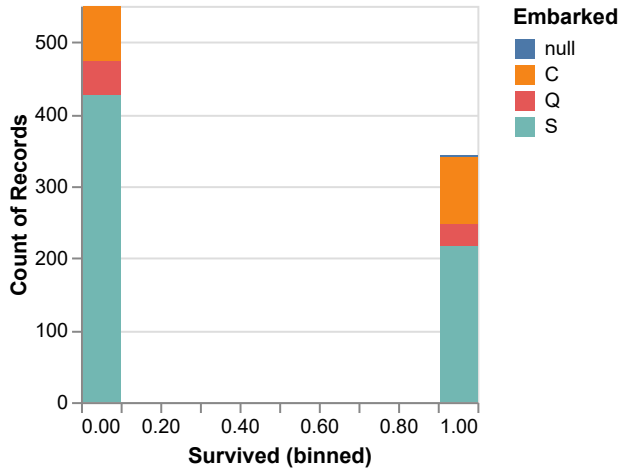

```
bar_Pclass = @vlplot(data=data_train)+
    @vlplot(:bar, x={:Pclass , bin=true}, y="count()", color={:Survived, type =
    "nominal"})
```

`bar_Sex =`




```
bar_Sex = @vlplot(data=data_train)+
    @vlplot(:bar, x={:Survived , bin=true}, y="count()", color={:Sex, type =
    "nominal"})
```

bar_Embarked =




```
bar_Embarked = @vlplot(data=data_train)+
    @vlplot(:bar, x={:Survived , bin=true}, y="count()", color={:Embarked, type =
    "nominal"})
```

# Other Data

- Name
- Ticket

```
891-element SentinelArrays.ChainedVector{String, Vector{String}}:
 "Braund, Mr. Owen Harris"
 "Cumings, Mrs. John Bradley (Florence Briggs Thayer)"
 "Heikkinen, Miss. Laina"
 "Futrelle, Mrs. Jacques Heath (Lily May Peel)"
 "Allen, Mr. William Henry"
 "Moran, Mr. James"
 "McCarthy, Mr. Timothy J"
 ⋮
 "Rice, Mrs. William (Margaret Norton)"
 "Montvila, Rev. Juozas"
 "Graham, Miss. Margaret Edith"
 "Johnston, Miss. Catherine Helen \"Carrie\""
 "Behr, Mr. Karl Howell"
 "Dooley, Mr. Patrick"
```

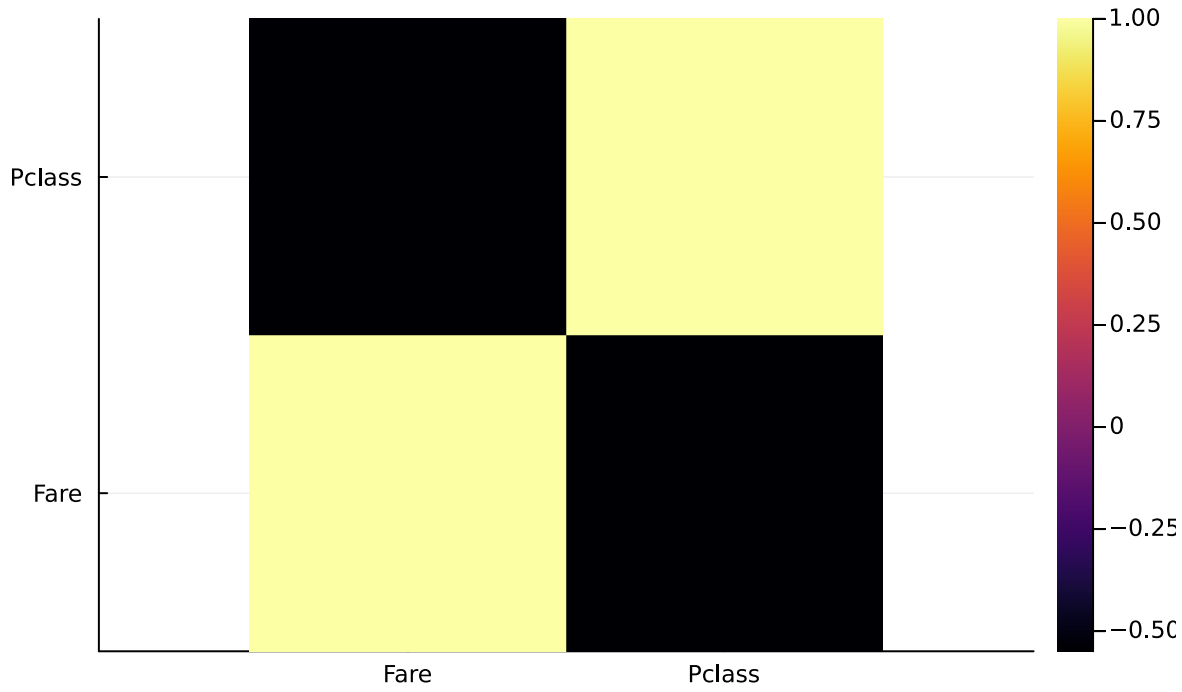
```
data_train.Name
```

```
891-element SentinelArrays.ChainedVector{String31, Vector{String31}}:
 "A/5 21171"
 "PC 17599"
 "STON/O2. 3101282"
 "113803"
 "373450"
 "330877"
 "17463"
 ⋮
 "382652"
 "211536"
 "112053"
 "W./C. 6607"
 "111369"
 "370376"
```

```
data_train.Ticket
```

```
2×2 Matrix{Float64}:
  1.0     -0.5495
 -0.5495   1.0
```

```
begin
    # correlation between Pclass and Fare
    dat = dropmissing(select(data_train, [:Fare, :Pclass]))
    cor_Pclass_Fare=cor(Matrix(dat))
end
```




```
begin
    gr()
    Plots.heatmap(names(dat),names(dat),cor_Pclass_Fare,aspect_ratio = 1)
end
```

## Conclusion

### Dealing with missing values

The training data set has a total of 891 samples.

- Age
  - 177 missing values (in training data)
  - replace missing values with mean ± sd
- Cabin
  - 687 missing values (in training data)
  - don't use Cabin as feature
- Embarked
  - 2 missing values (in training data)
  - drop missing
- Fare
  - high (negative) correlation with class
  - if missing: replace with mean for the corresponding class

### Feature Selection

Y = Survived

- Exclude:
  - PassengerId
  - Name
  - Ticket
  - Cabin
- Include:
  - Pclass
  - Sex
  - Age
  - SibSp and Parch
  - Fare
  - Embarked

# Data Cleaning

```
clean_function = Main.var"final_function.jl"
```

```
clean_function = ingredients("final_function.jl")
```

(

| | Age | Relatives | pclass_3 | pclass_1 | pclass_2 | sex_male | sex_female | Fa |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.278455 | 0.1 | true | false | false | true | false | 0.01 |
| 2 | 0.477502 | 0.1 | false | true | false | false | true | 0.13 |
| 3 | 0.328217 | 0.0 | true | false | false | false | true | 0.01 |
| 4 | 0.440181 | 0.1 | false | true | false | false | true | 0.10 |
| 5 | 0.440181 | 0.0 | true | false | false | true | false | 0.01 |
| 6 | 0.241871 | 0.0 | true | false | false | true | false | 0.01 |
| 7 | 0.676549 | 0.0 | false | true | false | true | false | 0.10 |
| 8 | 0.0296465 | 0.4 | true | false | false | true | false | 0.04 |
| 9 | 0.340657 | 0.2 | true | false | false | false | true | 0.02 |
| 10 | 0.178932 | 0.1 | false | false | true | false | true | 0.05 |
| more | | | | | | | | |
| 889 | 0.402859 | 0.0 | true | false | false | true | false | 0.01 |

```
df_train_X, train_y = clean_function.final_function_train(data_train)
```

df_test_X =

| | Age | Relatives | pclass_3 | pclass_2 | pclass_1 | sex_male | sex_female | Fare |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.480632 | 0.0 | true | false | false | true | false | 0.0152816 |
| 2 | 0.637068 | 0.1 | true | false | false | false | true | 0.0136631 |
| 3 | 0.824791 | 0.0 | false | true | false | true | false | 0.0189087 |
| 4 | 0.38677 | 0.0 | true | false | false | true | false | 0.0169081 |
| 5 | 0.324196 | 0.2 | true | false | false | false | true | 0.0239836 |
| 6 | 0.224077 | 0.0 | true | false | false | true | false | 0.018006 |
| 7 | 0.424315 | 0.0 | true | false | false | false | true | 0.0148912 |
| 8 | 0.374255 | 0.2 | false | true | false | true | false | 0.0566042 |
| 9 | 0.274136 | 0.0 | true | false | false | false | true | 0.0141105 |
| 10 | 0.311681 | 0.2 | true | false | false | true | false | 0.0471377 |
| more | | | | | | | | |
| 418 | 0.530825 | 0.2 | true | false | false | true | false | 0.0436405 |

```
df_test_X = clean_function.final_function_test(data_test)
```

```
(889×11 Matrix{Float64}:                                                , 418×11 Matrix{Float6
 0.278455  0.1  1.0  0.0  0.0  1.0  0.0  0.0141511  1.0  0.0  0.0   0.480632  0.0  1.0
 0.477502  0.1  0.0  1.0  0.0  0.0  1.0  0.139136   0.0  1.0  0.0   0.637068  0.1  1.0
 0.328217  0.0  1.0  0.0  0.0  0.0  1.0  0.0154686  1.0  0.0  0.0   0.824791  0.0  0.0
 0.440181  0.1  0.0  1.0  0.0  0.0  1.0  0.103644   1.0  0.0  0.0   0.38677   0.0  1.0
 0.440181  0.0  1.0  0.0  0.0  1.0  0.0  0.0157126  1.0  0.0  0.0   0.324196  0.2  1.0
 0.241871  0.0  1.0  0.0  0.0  1.0  0.0  0.0165095  0.0  0.0  1.0   0.224077  0.0  1.0
 0.676549  0.0  0.0  1.0  0.0  1.0  0.0  0.101229   1.0  0.0  0.0   0.424315  0.0  1.0
 ⋮                                   ⋮                          ⋮     ⋮
 0.489942  0.5  1.0  0.0  0.0  0.0  1.0  0.0568482  0.0  0.0  1.0   0.399285  0.0  1.0
 0.340657  0.0  0.0  0.0  1.0  1.0  0.0  0.0253743  1.0  0.0  0.0   0.604535  0.0  1.0
 0.241134  0.0  0.0  1.0  0.0  0.0  1.0  0.0585561  1.0  0.0  0.0   0.536949  0.0  0.0
 0.444414  0.3  1.0  0.0  0.0  0.0  1.0  0.0457714  1.0  0.0  0.0   0.530692  0.0  1.0
 0.328217  0.0  0.0  1.0  0.0  1.0  0.0  0.0585561  0.0  1.0  0.0   0.44686   0.0  1.0
 0.402859  0.0  1.0  0.0  0.0  1.0  0.0  0.015127   0.0  0.0  1.0   0.530825  0.2  1.0
```

```
train_X, test_X = Matrix{Float64}(df_train_X), Matrix{Float64}(df_test_X)
```

# Model Building

- Linear Regression
- Ridge Regression
- LASSO Regression
- Logistic Regression
- K Nearest Neighbor
- Decision Tree
- Random Forest
- Naive Bayes

```
PyObject <class 'sklearn.linear_model._base.LinearRegression'>
```

```
@sk_import linear_model: LinearRegression
```

```
PyObject <class 'sklearn.linear_model._ridge.Ridge'>
```

```
@sk_import linear_model: Ridge
```

```
PyObject <class 'sklearn.linear_model._coordinate_descent.Lasso'>
```

```
@sk_import linear_model: Lasso
```

```
PyObject <class 'sklearn.linear_model._logistic.LogisticRegression'>
```

```
@sk_import linear_model: LogisticRegression
```

```
PyObject <class 'sklearn.neighbors._classification.KNeighborsClassifier'>
```

```
@sk_import neighbors: KNeighborsClassifier
```

```
PyObject <class 'sklearn.tree._classes.DecisionTreeClassifier'>
```

```
@sk_import tree: DecisionTreeClassifier
```

```
PyObject <class 'sklearn.ensemble._forest.RandomForestClassifier'>
```

```
@sk_import ensemble: RandomForestClassifier
```

```
PyObject <class 'sklearn.naive_bayes.GaussianNB'>
```

```
@sk_import naive_bayes: GaussianNB
```

```
PyObject <class 'sklearn.ensemble._voting.VotingClassifier'>
```

```
@sk_import ensemble: VotingClassifier
```

# Gridsearching

```
bestfit = Main.var"find_best_fit.jl"
```

```
bestfit = ingredients("find_best_fit.jl")
```

```
Module model_selection has been ported to Julia - try `import ScikitLearn: CrossValidation` instead
```

```
findfit = find_best_fit (generic function with 1 method)
```

```
findfit = bestfit.find_best_fit
```

(LogisticRegression(C=1.1, class_weight='balanced'), GridSearchCV estimator: LogisticRegression LogisticRegression)

```
findfit(train_X,train_y,LogisticRegression(),Dict("C"=> 0.1:0.1:1.5, "class_weight" => ("balanced", nothing)))
# using default
```

(KNeighborsClassifier(n_neighbors=7, weights='distance'), GridSearchCV estimator: KNeighborsClassifi KNeighborsClassifier)

```
findfit(train_X,train_y,KNeighborsClassifier(),Dict("n_neighbors" => 1:10, "weights" => ("uniform", "distance")))
# using n_neighbors=3
```

```
begin
    minsplits_dt = []
    for i in 1:5
    push!(minsplits_dt,findfit(train_X,train_y,DecisionTreeClassifier(),
    Dict("criterion" => ("gini", "entropy", "log_loss"),"class_weight" =>
    ("balanced", nothing), "min_samples_split" => 6:2:20)))
    end
end
# using default
```

```
DecisionTreeClassifier
DecisionTreeClassifier(class_weight='balanced', criterion='log_loss',
                       min_samples_split=16)
```

```
Gr
estimator: De
Decisio
```

```
minsplits_dt # using min_samples_split=16
```

```
begin
    minsplits = []
    for i in 1:5
        push!(minsplits,findfit(train_X,train_y,RandomForestClassifier(),
        Dict("min_samples_split" => 6:10)))
    end
end
```

```
RandomForestClassifier
RandomForestClassifier(min_samples_split=8)
```

```
GridSearchCV
estimator: RandomForestClassifier
RandomForestClassifier
```

```
Ra
```

```
minsplits #using min_samples_split=8
```

# Crossvalidation Scoring

```
using ScikitLearn   .CrossValidation: cross_val_score
```

## Linear Regression

```
cv_linear =  [0.320223, 0.369906, 0.384369, 0.342923, 0.446206]
```

```
cv_linear = cross_val_score(LinearRegression(),train_X,train_y,cv=5)
```

```
print(mean(cv_linear))
```

```
0.37272518532863463
```

## Ridge Regression

```
cv_ridge =  [0.319937, 0.371325, 0.386463, 0.34353, 0.444423]
```

```
cv_ridge = cross_val_score(Ridge(),train_X,train_y,cv=5)
```

```
print(mean(cv_ridge))
```

```
0.3731356332626749
```

## LASSO Regression

```
cv_lasso =  [-0.0228073, -0.0238521, -0.000177285, -0.00315337, -0.00708916]
```

```
cv_lasso = cross_val_score(Lasso(),train_X,train_y,cv=5)
```

```
print(mean(cv_lasso))
```

```
-0.011415839277551543
```

## Logistic Regression

```
cv_logistic =  [0.786517, 0.786517, 0.780899, 0.780899, 0.819209]
```

```
cv_logistic = cross_val_score(LogisticRegression(),train_X,train_y,cv=5)
```

```
print(mean(cv_logistic))
```

```
0.790808100044436
```

## K Nearest Neighbor

```
cv_kneighbors =  [0.764045, 0.780899, 0.803371, 0.775281, 0.79661]
```

```
cv_kneighbors = cross_val_score(KNeighborsClassifier(n_neighbors=3),train_X,train_y,cv=5)
```

```
print(mean(cv_kneighbors))
```

```
0.7840411350219006
```

## Decision Tree

```
cv_destree =  [0.803371, 0.747191, 0.842697, 0.820225, 0.79661]
```

```
cv_destree = cross_val_score(DecisionTreeClassifier(min_samples_split=16),train_X,train_y,cv=5)
```

```
print(mean(cv_destree))
```

```
0.8020186631117883
```

## Random Forest

```
cv_randforest =  [0.797753, 0.808989, 0.865169, 0.814607, 0.847458]
```

```
cv_randforest = cross_val_score(RandomForestClassifier(min_samples_split=8),train_X,train_y,cv=5)
```

```
print(mean(cv_randforest))
```

```
0.8267948962102455
```

## Naive Bayes

```
cv_naibay =  [0.752809, 0.775281, 0.780899, 0.820225, 0.813559]
```

```
cv_naibay = cross_val_score(GaussianNB(),train_X,train_y,cv=5)
```

```
print(mean(cv_naibay))
```

```
0.7885545610359932
```

## Voting Classifier

```
voting_clf_soft =
```


```
voting_clf_soft = VotingClassifier(estimators = [
    ("lr", LogisticRegression()),
    ("knn", KNeighborsClassifier(n_neighbors=3)),
    ("dt", DecisionTreeClassifier(min_samples_split=16)),
    ("rf", RandomForestClassifier(min_samples_split=8)),
    ("gnb", GaussianNB())],
    voting = "soft")
```

```
voting_clf_hard = VotingClassifier(estimators = [
    ("lr", LogisticRegression()),
    ("knn", KNeighborsClassifier(n_neighbors=3)),
    ("dt", DecisionTreeClassifier(min_samples_split=16)),
    ("rf", RandomForestClassifier(min_samples_split=8)),
    ("gnb", GaussianNB())],
    voting = "hard");
```

```
voting_clf_test = VotingClassifier(estimators = [
    ("knn", KNeighborsClassifier(n_neighbors=3)),
    ("dt", DecisionTreeClassifier(min_samples_split=16)),
    ("rf", RandomForestClassifier(min_samples_split=8))],
    voting = "hard");
```

```
cv_test =  [0.820225, 0.797753, 0.848315, 0.808989, 0.824859]
```

```
cv_test = cross_val_score(voting_clf_test,train_X,train_y,cv=5)
```

```
print(mean(cv_test))
```

```
0.8200279311877103
```

```
cv_soft =  [0.792135, 0.769663, 0.837079, 0.820225, 0.80791]
```

```
cv_soft = cross_val_score(voting_clf_soft,train_X,train_y,cv=5)
```

```
cv_hard =  [0.808989, 0.780899, 0.831461, 0.814607, 0.824859]
```

```
cv_hard = cross_val_score(voting_clf_hard,train_X,train_y,cv=5)
```

```
print(mean(cv_soft))
```

```
0.805402145623056
```

```
print(mean(cv_hard))
```

```
0.8121627626483845
```

# Model Fitting

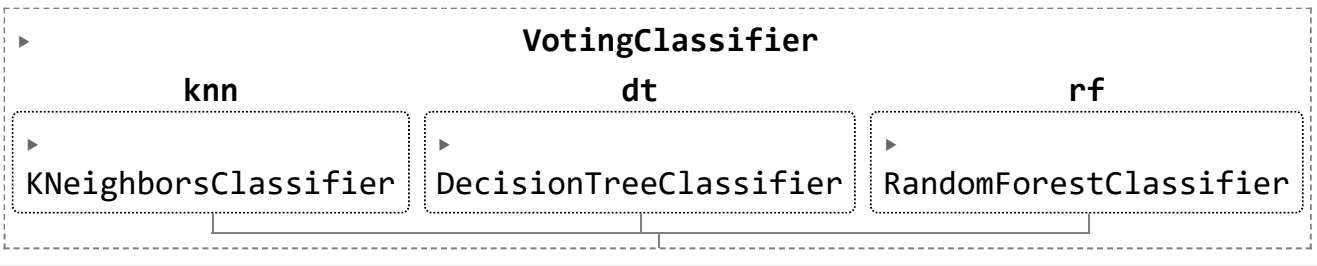
```
[0, 1, 0, 0, 2, 0, 0, 2, 0, 2, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0,  more ,0, 2, 0, 1, 0, 0, 0, 0,
```

```
data_test.Relatives = data_test.SibSp + data_test.Parch
```

```
prov_X_test = 418×5 Matrix{Float64}:
  892.0  3.0  34.5     0.0    7.8292
  893.0  3.0  47.0     1.0    7.0
  894.0  2.0  62.0     0.0    9.6875
  895.0  3.0  27.0     0.0    8.6625
  896.0  3.0  22.0     2.0   12.2875
  897.0  3.0  14.0     0.0    9.225
  898.0  3.0  30.0     0.0    7.6292
    ⋮
 1304.0  3.0  28.0     0.0    7.775
 1305.0  3.0  44.4005  0.0    8.05
 1306.0  1.0  39.0     0.0  108.9
 1307.0  3.0  38.5     0.0    7.25
 1308.0  3.0  31.8015  0.0    8.05
 1309.0  3.0  38.5107  2.0   22.3583
```

```
prov_X_test=Matrix(dropmissing(data_test[:,[:PassengerId, :Pclass, :Age, :Relatives,
:Fare ]]))
```

```
model =
```




```
model = fit!(voting_clf_test,train_X,train_y)
```

```
y_pred =
 [0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1,    more ,1, 1, 1, 1, 1, 0, 1, 0,
```

```
y_pred = predict(model,test_X)
```

```
Enter cell code...
```

```
df_submission =
```

| | PassengerId | Survived |
|---|---|---|
| 1 | 892 | 0 |
| 2 | 893 | 1 |
| 3 | 894 | 0 |
| 4 | 895 | 0 |
| 5 | 896 | 1 |
| 6 | 897 | 0 |
| 7 | 898 | 0 |
| 8 | 899 | 0 |
| 9 | 900 | 1 |
| 10 | 901 | 0 |
| | more | |
| 418 | 1309 | 0 |

```
df_submission = DataFrame("PassengerId" => 892:1309,
                  "Survived" => y_pred)
```

```
submissionfile = "submission.csv"
```

```
submissionfile = "submission.csv"
```

```
"submission.csv"
```

```
CSV.write(submissionfile, df_submission)
```