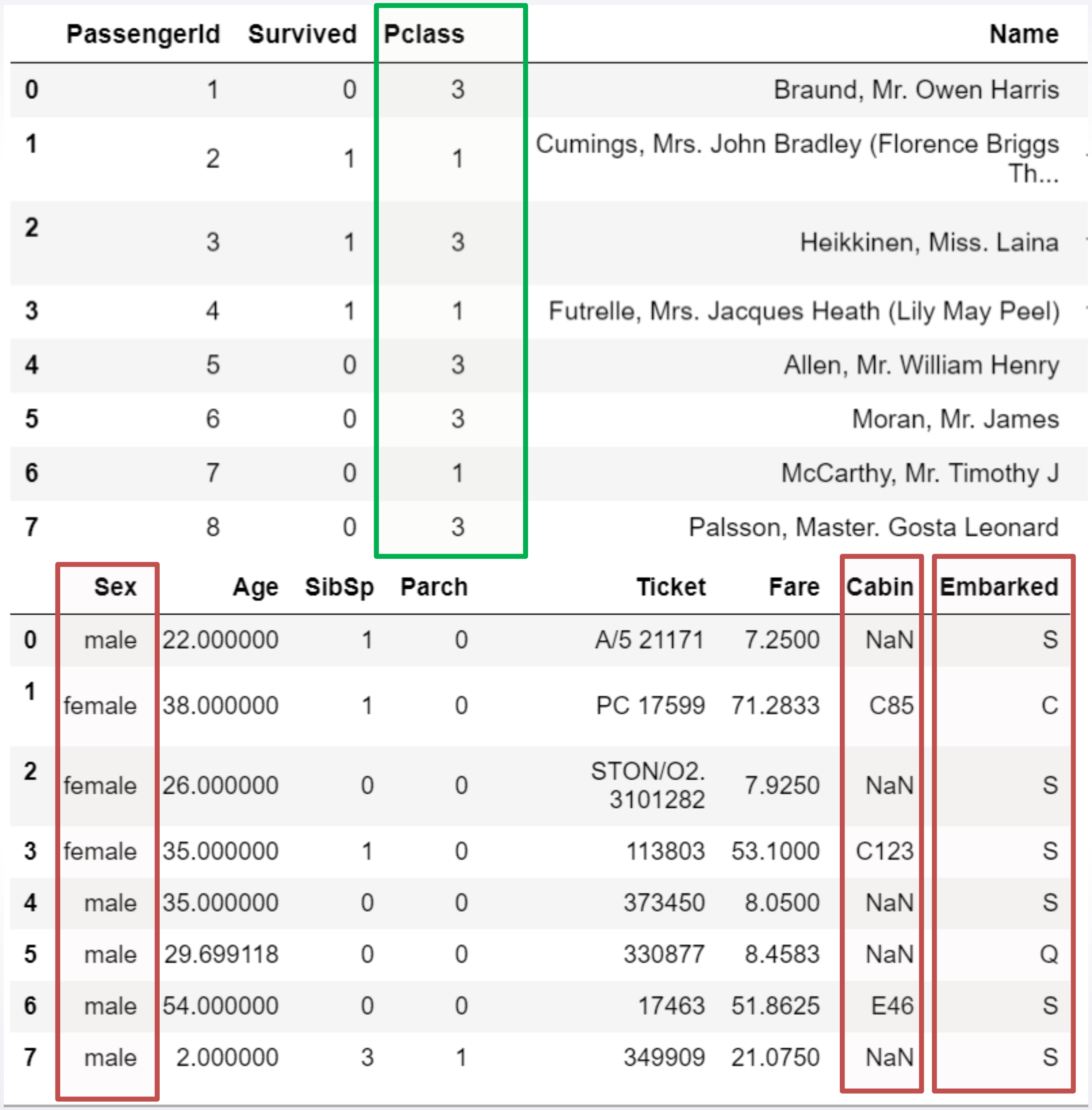
Categorical and ordinal features

Categorical

Their names are: Sex, Cabin and Embarked. These are usual categorical features but there is one more special, the Pclass feature. Pclass stands for ticket class, and has three unique values: one, two, and three. It is ordinal or, in other words, order categorical feature. This basically means that it is ordered in some meaningful way

Titanic dataset



	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.000000	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.000000	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.000000	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.000000	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.000000	0	0	373450	8.0500	NaN	S
5	6	0	3	Moran, Mr. James	male	29.699118	0	0	330877	8.4583	NaN	Q
6	7	0	1	McCarthy, Mr. Timothy J	male	54.000000	0	0	17463	51.8625	E46	S
7	8	0	3	Palsson, Master. Gosta Leonard	male	2.000000	3	1	349909	21.0750	NaN	S

Ordinal features

Ticket class: 1,2,3

Driver's license: A, B, C, D

Education: kindergarden, school, undergraduate, bachelor, master, doctoral

Another example for ordinal feature is a driver's license type. It's either A, B, C, or D. Or another example, level of education, kindergarten, school, undergraduate, bachelor, master, and doctoral. These categories are sorted in increasingly complex order, which can prove to be useful.

The simplest way to encode a categorical feature is to map it's unique values to different numbers. Usually, people referred to this procedure as label encoding.

Label encoding

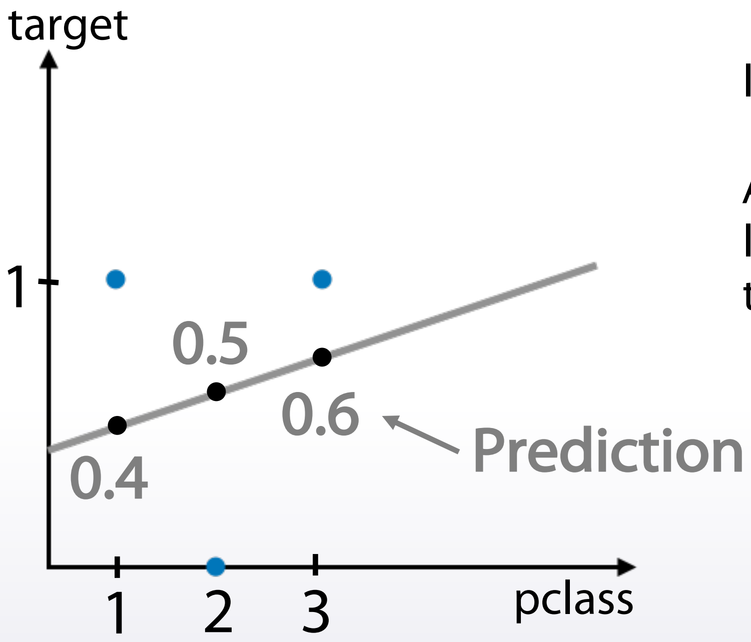
pclass	1	2	3
target	1	0	1

The simplest way to encode a categorical feature is to map it's unique values to different numbers. Usually, people referred to this procedure as label encoding.

Non-tree-based-models, on the other side, usually can't use this feature effectively. And if you want to train linear model kNN on neural network, you need to treat a categorical feature differently.

Label encoding

pclass	1	2	3
target	1	0	1



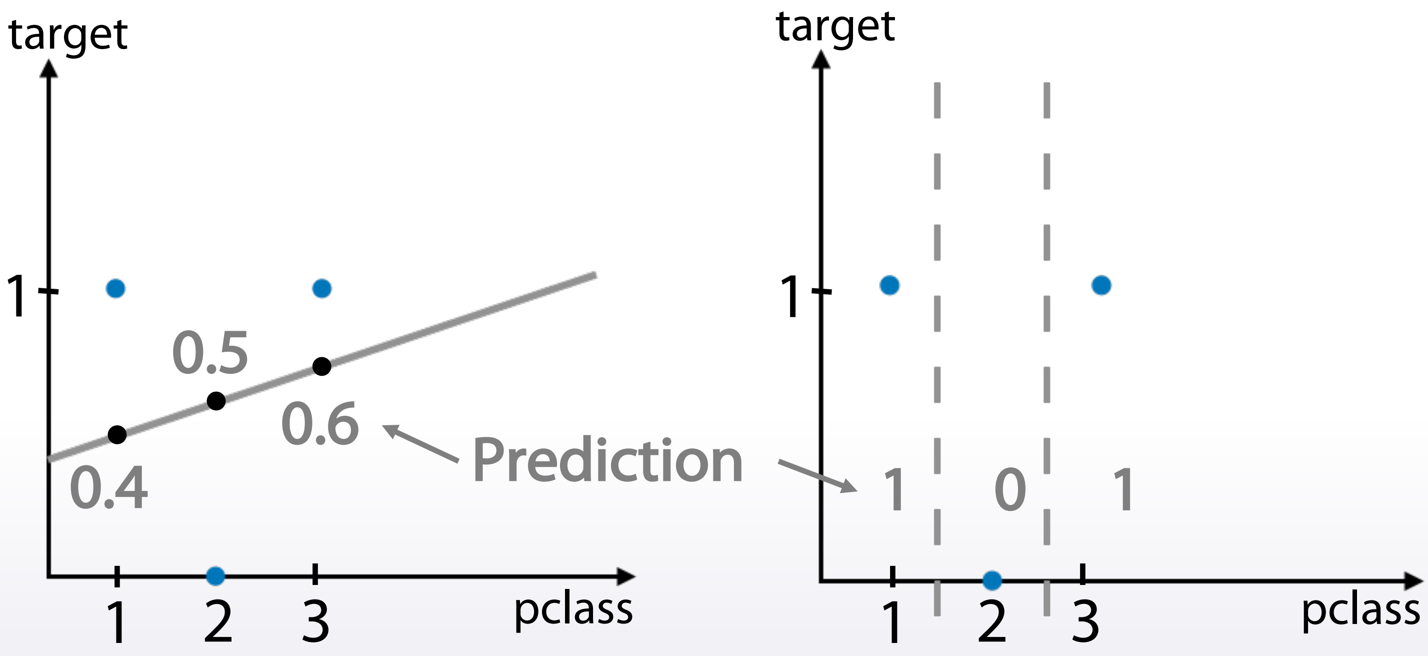
This dependence is not linear, and linear model will be confused.

And indeed, here, we can put linear models predictions, and see they all are around 0.5.

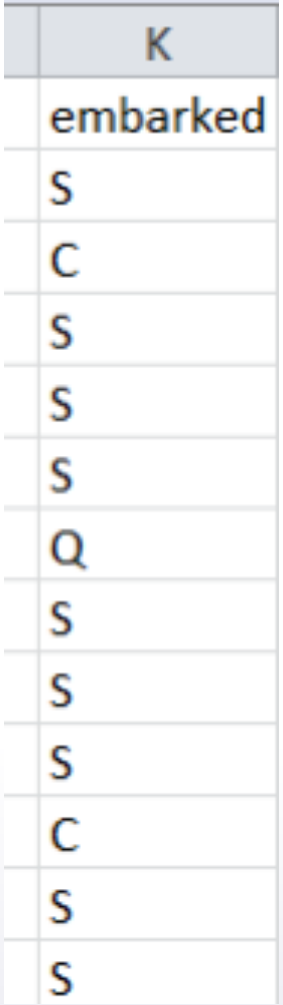
Label encoding

but trees on the other side, we'll just make two splits select in each unique value and reaching it independently.

pclass	1	2	3
target	1	0	1



Label encoding



K
embarked
S
C
S
S
S
Q
S
S
S
C
S
S

apply encoding in the alphabetical or sorted order.
Unique way to solve of this feature namely S, C, Q. Thus,
can be encoded as two,one, three. This is called label
encoder from sklearn works by default.

1. Alphabetical (sorted)
   [S,C,Q] -> [2, 1, 3]

   `sklearn.preprocessing.LabelEncoder`

2. Order of appearance
   [S,C,Q] -> [1, 2, 3]

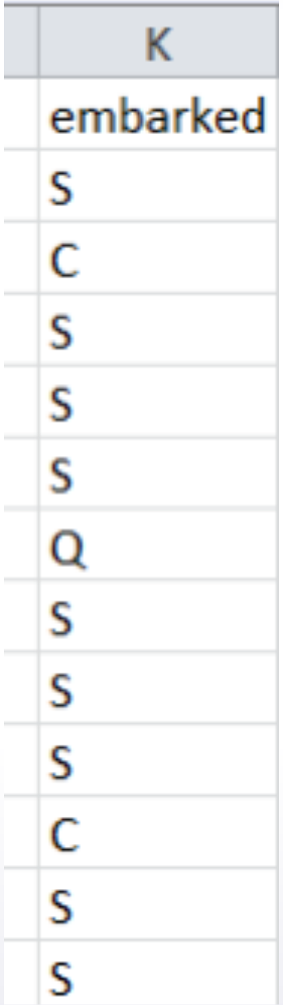
   s will change to one because
   it was meant first in the data.

   `Pandas.factorize`

Frequency encoding

There is another important moment about frequency encoding. If you have multiple categories with the same frequency, they won't be distinguishable in this new feature.

In tree models , frequency encoding can help with less number of split because of the same reason.



K
embarked
S
C
S
S
S
Q
S
S
S
C
S
S

[S,C,Q] -> [0.5, 0.3, 0.2]

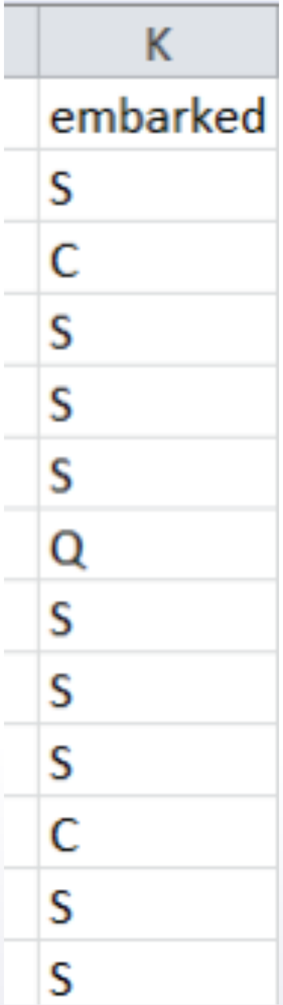
```
encoding = titanic.groupby(‘Embarked’).size()
encoding = encoding/len(titanic)
titanic[‘enc’] = titanic.Embarked.map(encoding)
```

Can frequency encoding be of help for non-tree based models?

Yes, it can

Correct
For example, if frequency of category is correlated with target value, linear model will utilize this dependency.

Frequency encoding



K
embarked
S
C
S
S
S
Q
S
S
S
C
S
S

[S,C,Q] -> [0.5, 0.3, 0.2]

```
encoding = titanic.groupby(‘Embarked’).size()
encoding = encoding/len(titanic)
titanic[‘enc’] = titanic.Embarked.map(encoding)

 from scipy.stats import rankdata
```

Categorical features

So here, for each unique value of Pclass feature, we just created a new column. As I said, this works well for linear methods, kNN, or neural networks. Furthermore, one –hot encoding feature is already scaled because minimum this feature is zero, and maximum is one. Note that if you care for a fewer important numeric features, and hundreds of binary features are used by one–hot encoding, it could become difficult for tree–methods they use first ones efficiently.

One-hot encoding

pclass
1
2
1
3

pclass==1	pclass==2	pclass==3
1		
	1	
1		
		1

```
pandas.get_dummies, sklearn.preprocessing.OneHotEncoder
```

Sparse matrices are often useful when they work with categorical features or text data. Most of the popular libraries can work with these sparse matrices directly namely, XGBoost, LightGBM, sklearn, and others.

栗鹏远
CONFIDENTIAL

Categorical features

Feature Generation

pclass	sex	pclass_sex
3	male	3male
1	female	1female
3	female	3female
1	female	1female

Pclass_sex==					
1male	1female	2male	2female	3male	3female
				1	
	1				
					1
	1				

Categorical features

1. Values in ordinal features are sorted in some meaningful order
2. Label encoding maps categories to numbers
3. Frequency encoding maps categories to their frequencies
4. Label and Frequency encodings are often used for tree-based models
5. One-hot encoding is often used for non-tree-based models
6. Interactions of categorical features can help linear models and KNN