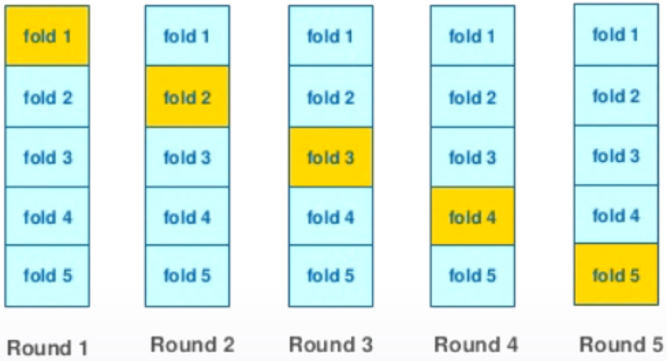
Regularization

1. CV loop inside training data;
2. Smoothing;
3. Adding random noise;
4. Sorting and calculating expanding mean.

1.

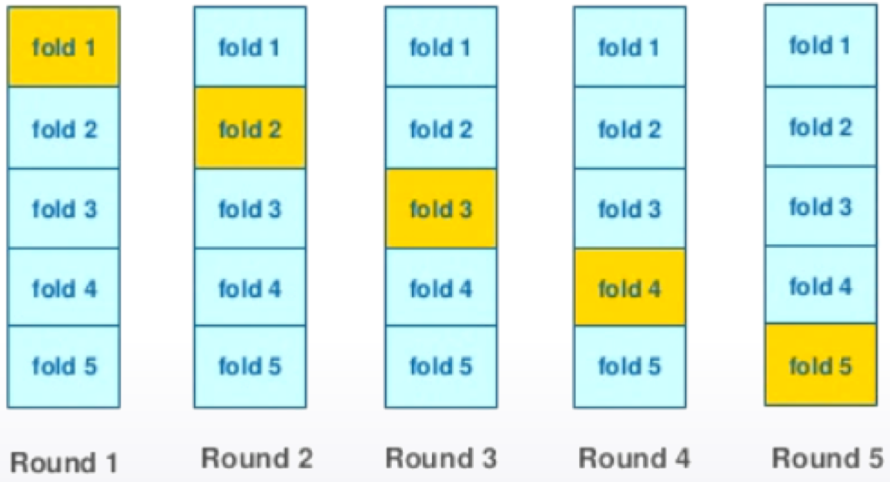


2. $$\frac{mean(target) * nrows + globalmean * alpha}{nrows + alpha}$$

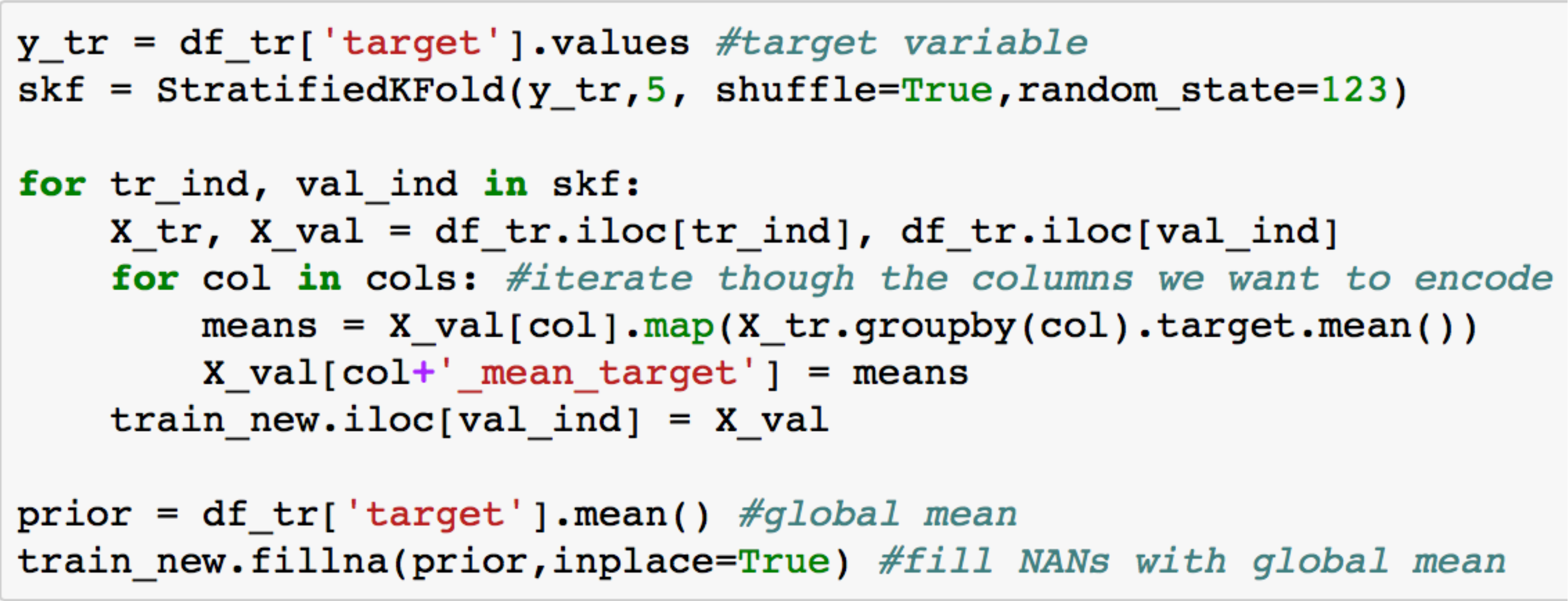
Regularization. CV loop

- Robust and intuitive
- Usually decent results with 4-5 folds across different datasets
- Need to be careful with extreme situations like LOO

KFold scheme



Regularization. CV loop

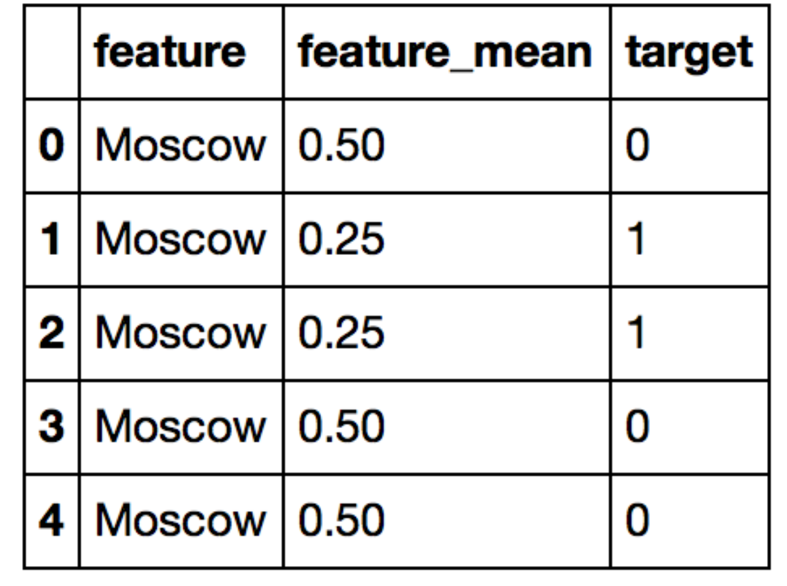


```
y_tr = df_tr['target'].values #target variable
skf = StratifiedKFold(y_tr,5, shuffle=True,random_state=123)

for tr_ind, val_ind in skf:
    X_tr, X_val = df_tr.iloc[tr_ind], df_tr.iloc[val_ind]
    for col in cols: #iterate though the columns we want to encode
        means = X_val[col].map(X_tr.groupby(col).target.mean())
        X_val[col+'_mean_target'] = means
    train_new.iloc[val_ind] = X_val

prior = df_tr['target'].mean() #global mean
train_new.fillna(prior,inplace=True) #fill NANs with global mean
```

Regularization. CV loop

- Perfect feature for LOO scheme
- Target variable leakage is still present even for KFold scheme

Leave-one-out



	feature	feature_mean	target
0	Moscow	0.50	0
1	Moscow	0.25	1
2	Moscow	0.25	1
3	Moscow	0.50	0
4	Moscow	0.50	0

Regularization.Smoothing

- Alpha controls the amount of regularization
- Only works together with some other regularization method

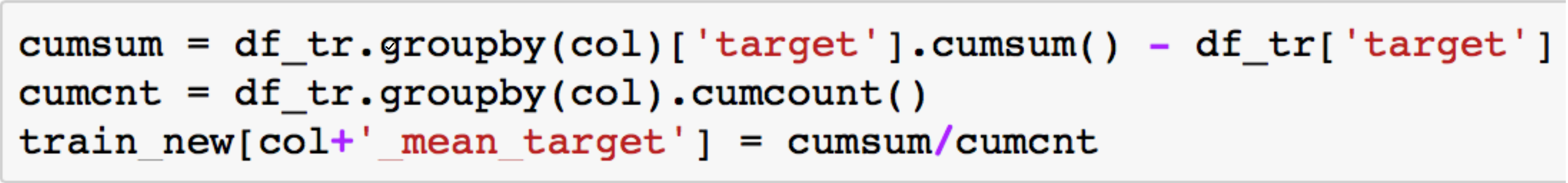
$$\frac{mean(target) * nrows + globalmean * alpha}{nrows + alpha}$$

Regularization. Noise

- Noise degrades the quality of encoding
- How much noise should we add?
- Usually used together with LOO

Regularization. Expanding mean

- Least amount of leakage
- No hyper parameters
- Irregular encoding quality
- Built - in in CatBoost



```
cumsum = df_tr.groupby(col)['target'].cumsum() - df_tr['target']
cumcnt = df_tr.groupby(col).cumcount()
train_new[col+'_mean_target'] = cumsum/cumcnt
```

Regularization. Conclusion

- There are a lot ways to regularize mean encodings
- Unending battle with target variable leakage
- CV loop or Expanding mean for practical tasks