In [2]:

```python
import numpy as np
from sklearn.datasets import fetch_openml

yeast = fetch_openml('yeast', version=4)

X = yeast['data']
Y = yeast['target']

Y = Y == 'TRUE'
```

In [3]:

```python
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_state=42)
```

In [4]:

```python
from sklearn.linear_model import LogisticRegression
from sklearn.multiclass import OneVsRestClassifier

ovr = OneVsRestClassifier(LogisticRegression(solver='liblinear'))
ovr.fit(X_train, Y_train)
pred_ovr = ovr.predict(X_test)
```

In [5]:

```python
from sklearn.metrics import jaccard_similarity_score
ovr_score = jaccard_similarity_score(Y_test, pred_ovr)
ovr_score
```

C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)

Out[5]:

0.5081742752197298

In [6]:

```python
from sklearn.multioutput import ClassifierChain

cc = ClassifierChain(LogisticRegression(), order='random', random_state=42)
cc.fit(X_train, Y_train)
pred_cc = cc.predict(X_test)
cc_score = jaccard_similarity_score(Y_test, pred_cc)
cc_score
```

```
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
```

Out[6]:

0.5118178538633084

In [7]:

```python
chains = [ClassifierChain(LogisticRegression(), order='random', random_state=42+i)
          for i in range(10)]
for chain in chains:
    chain.fit(X_train, Y_train)

pred_chains = np.array([chain.predict(X_test) for chain in chains])
chain_scores = [jaccard_similarity_score(Y_test, pred_chain)
                for pred_chain in pred_chains]
```

```
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
```

Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi

s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.

```
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)

C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
```

```
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.

s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
```

```
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
      FutureWarning)
C:WAnacondaWlibWsite-packagesWsklearnWlinear_modelWlogistic.py:432: FutureWarning:
```

Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning:
Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence thi
s warning.
  FutureWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)

In [10]:

```
chain_scores
```

Out[10]:

```
[0.5118178538633084,
 0.5261753455451803,
 0.5298506016481224,
 0.5150574517310055,
 0.5076409758744469,
 0.49889807162534433,
 0.5104657108272811,
 0.49708858061130784,
 0.5161265846183202,
 0.4871433490751672]
```

In [8]:

```
proba_chains = np.array([chain.predict_proba(X_test) for chain in chains])
proba_ensemble = proba_chains.mean(axis=0)
ensemble_score = jaccard_similarity_score(Y_test, proba_ensemble >= 0.5)
```

C:\Anaconda\lib\site-packages\sklearn\metrics\classification.py:635: DeprecationWa
rning: jaccard_similarity_score has been deprecated and replaced with jaccard_scor
e. It will be removed in version 0.23. This implementation has surprising behavior
for binary and multiclass classification tasks.
  'and multiclass classification tasks.', DeprecationWarning)
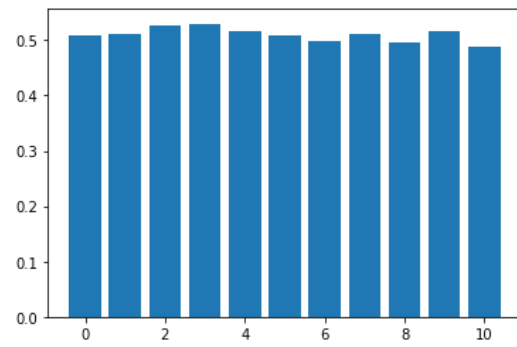
In [9]:

```
ensemble_score
```

Out[9]:

```
0.5180391578118851
```

In [12]:
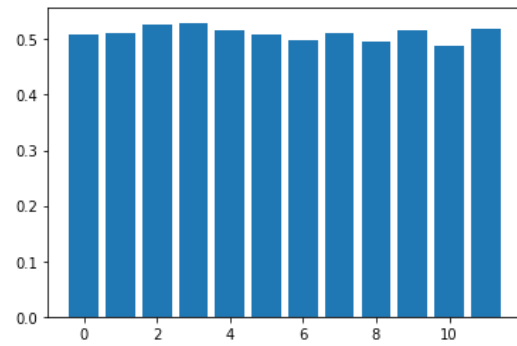
```
import matplotlib.pyplot as plt
```

```
plt.bar(np.arange(11), [ovr_score]+chain_scores)
plt.show()
```

```
plt.bar(np.arange(12), [ovr_score]+chain_scores+[ensemble_score])
plt.show()
```