**Search Space**

param\_grid = {‘C’: [0.1, 1, 10, 100],

              ‘gamma’: [“scale”, “auto”],

              ‘kernel’: [‘linear’, ‘rbf’, ‘poly’, ‘sigmoid’],

              ‘degree’: [1,2,3,4,5,6]}

cv = 5

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**Support Vector Machine algorithm (Linear)**

**Confusion Matrix:**

[[ 86 27]

 [ 21 142]]

**Classification Report**

**Accuracy of SVM is:** 0.8260869565217391

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**Random Search**

**Best Parameters:** {'kernel': 'linear', 'gamma': 'scale', 'degree': 6, 'C': 10}

**Best Score:** 0.8660610465116279

**Best Estimator:** SVC(C=10, degree=6, kernel='linear')

Time Taken for Random Search: 0.00003409385681152344

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**Grid Search**

**Best Parameters:** {'C': 10, 'degree': 1, 'gamma': 'scale', 'kernel': 'linear'}

**Best Score:** 0.8660610465116279

**Best Estimator:** SVC(C=10, degree=1, kernel='linear')

Time Taken for Grid Search: 0.00013899803161621094

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**Bayes Search**

**Best Parameters:** OrderedDict([('C', 10.0), ('degree', 4), ('gamma', 'scale'), ('kernel', 'linear')]) **Best Score:** 0.8660610465116279

**Best Estimator:** SVC(C=10.0, degree=4, kernel='linear')

Time Taken for Bayes Search: 0.0027780532836914062

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The accuracy of the linear SVM on the heart dataset is approximately 0.826 or 82.6%.

All three search algorithms (i.e. Random Search, Grid Search, or Bayes Search) give the best score of approximately 0.8660610465116279. Hence,

The best estimator results reveal that a ‘linear’ kernel with regularization parameter (C) of 10 gives the optimal result. For linear kernel, the degree should be 1, however, the Random Search CV and Bayes Search CV give a polynomial degree of 6 and 4 which contradicts linearity. However, the Grid Search CV algorithm gives the polynomial degree 1 which justifies the linearity. Considering the timing, best score, and best estimate, **Grid Search CV performs the best for this dataset**.

**Other Tests:**

CV = 50

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Random Search

{'kernel': 'linear', 'gamma': 'scale', 'degree': 5, 'C': 0.1}

0.8641025641025641

SVC(C=0.1, degree=5, kernel='linear')

Time Taken for Random Search: 2.3126602172851562e-05

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Grid Search

{'C': 0.1, 'degree': 1, 'gamma': 'scale', 'kernel': 'linear'}

0.8641025641025641

SVC(C=0.1, degree=1, kernel='linear')

Time Taken for Grid Search: 7.104873657226562e-05

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Bayes Search

OrderedDict([('C', 0.1), ('degree', 5), ('gamma', 'scale'), ('kernel', 'linear')])

0.8641025641025641

SVC(C=0.1, degree=5, kernel='linear')

Time Taken for Bayes Search: 0.0031321048736572266