In [31]:

```
# @hidden_cell
# The project token is an authorization token that is used to access project resources like data sources, connections, and used by platform APIs.
from project_lib import Project
project = Project(project_id='356303e0-458a-4400-810d-88442dccc2d2', project_access_token='p-3ccd6758d2ea92e25c2ff82ff23cc39c79afd4e7')
pc = project.project_context
```

Loading Libraries

In [3]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from random import sample
from sklearn.linear_model import LogisticRegression
from sklearn import tree
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.model_selection import *
from sklearn import metrics
from IPython.display import Image
import sys
import types
import pandas as pd
from ibm_botocore.client import Config
import ibm_boto3
```

Preprocessing Data

In [4]:

```
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
# You might want to remove those credentials before you share the notebook.

if os.environ.get('RUNTIME_ENV_LOCATION_TYPE') == 'external':
    endpoint_b66d75cd243043b8ac36de03c3f60fa4 = 'https://s3-api.us-geo.objectstorage.softlayer.net'
else:
    endpoint_b66d75cd243043b8ac36de03c3f60fa4 = 'https://s3-api.us-geo.objectstorage.service.networklayer.com'

client_b66d75cd243043b8ac36de03c3f60fa4 = ibm_boto3.client(service_name='s3',
    ibm_api_key_id='N_gopbW8UXHWMXtkre6OaHBdzBUzGMK-O2iGG3IZEw5Y',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='oauth'),
    endpoint_url=endpoint_b66d75cd243043b8ac36de03c3f60fa4)

body = client_b66d75cd243043b8ac36de03c3f60fa4.get_object(Bucket='cdcproject-donotdelete-pr-z77cerwxydkvs0',Key='dataset1.csv')['Body']
# add missing __iter__ method, so pandas accepts body as file-like object
if not hasattr(body, "__iter__"): body.__iter__ = types.MethodType( __iter__, body )

df = pd.read_csv(body)
df.head()
```

Out[4]:

	0	0.1	0.2	0.3	0.4	1.71	0.5	0.6	1	0.54	0.7	1.1	0.8	0.9	1.2	0.10	280	0.11	0.12	0.13
0	0	0	0	0	0	0.13	1	0	1.00	0.96	0.71	1	0	0	1	0	170.433333	0	0	0
1	0	0	0	0	0	9.26	1	0	0.75	0.68	0.22	0	0	0	1	0	377.466667	0	0	0
2	0	0	0	0	0	7.79	1	0	0.00	0.09	1.00	0	0	0	1	0	328.733333	0	0	0
3	0	0	0	0	0	4.04	1	0	0.00	0.08	0.57	0	0	0	1	0	267.833333	0	0	0
4	0	0	0	0	0	4.06	1	0	0.93	0.44	0.72	0	0	0	1	0	340.933333	0	0	0

Adding column names and standardizing data

In [5]:

```
#adding column names
headers = ['url having ip', 'sslfinal_state', 'url_short', 'having_at_symbol', 'doubleslash', 'domain_registation_length'
                  , 'favicon', 'https_token', 'request_url', 'url_of_anchor', 'links_in_tags', 'sfh', 'submitting_to_email',
                  'abnormal url', 'redirect', 'iframe', 'age_of_domain', 'web_traffic', 'statistical_report', 'target']
df.columns = headers

#standardizing data
print(df['age_of_domain'].max())
df['age_of_domain'] = df['age_of_domain']/df['age_of_domain'].max()
df['age_of_domain'] = round(df['age_of_domain'],2)
```

```
438.33333333333326
```

Feature Selection

In [6]:

```
train, test, validate = np.split(df.sample(frac=1), [int(.6*len(df)), int(.8*len(df))])
y_train = train['target']
x_train = train.drop(['target'], axis=1)
y_test = test['target']
x_test = test.drop(['target'], axis=1)
y_validate = validate['target']
x_validate = validate.drop(['target'], axis=1)
rf = RandomForestClassifier()
rf.fit(x_train, y_train)
print ("Features sorted by their score:")
print (sorted(zip(map(lambda x: round(x, 4), rf.feature_importances_), x_train), reverse=True))
```

```
Features sorted by their score:
[(0.4904, 'web_traffic'), (0.2003, 'age_of_domain'), (0.0784, 'sslfinal_state'), (0.0602, 'domain_registation_length'), (0.057, 'url_of_anchor'), (0.0
488, 'links_in_tags'), (0.0211, 'request_url'), (0.0209, 'redirect'), (0.0106, 'sfh'), (0.0066, 'favicon'), (0.0042, 'url_short'), (0.0014, 'abnormal
url'), (0.0001, 'having_at_symbol'), (0.0, 'url having ip'), (0.0, 'submitting_to_email'), (0.0, 'statistical_report'), (0.0, 'iframe'), (0.0, 'https_
token'), (0.0, 'doubleslash')]
```

Creating dataset with reduced feature set (top 7)

In [7]:

```
all_vars = x_train.columns.tolist()
top_vars = ['web_traffic', 'sslfinal_state', 'age_of_domain', 'url_of_anchor', 'domain_registation_length', 'redirect', 'links_in_tags']
bottom_vars = [cols for cols in all_vars if cols not in top_vars]
x_train    = x_train.drop(bottom_vars, axis=1)
x_test     = x_test.drop(bottom_vars, axis=1)
x_validate = x_validate.drop(bottom_vars, axis=1)
```

Training different machine learning model

Logistic Regression

In [8]:
```
logit_model = LogisticRegression()

logit_model = logit_model.fit(x_train, y_train)

logit_model.score(x_train, y_train)

predicted = pd.DataFrame(logit_model.predict(x_test))

probs = pd.DataFrame(logit_model.predict_proba(x_test))

logit_accuracy = metrics.accuracy_score(y_test, predicted)
logit_roc_auc = metrics.roc_auc_score(y_test, probs[1])
logit_confus_matrix = metrics.confusion_matrix(y_test, predicted)
logit_classification_report = metrics.classification_report(y_test, predicted)
logit_precision = metrics.precision_score(y_test, predicted, pos_label=1)
logit_recall = metrics.recall_score(y_test, predicted, pos_label=1)
logit_f1 = metrics.f1_score(y_test, predicted, pos_label=1)

logit_cv_scores = cross_val_score(LogisticRegression(), x_test, y_test, scoring='precision', cv=10)
logit_cv_mean = np.mean(logit_cv_scores)
```

Decision Trees

In [9]:
```
# Instantiate with a max depth of 3
tree_model = tree.DecisionTreeClassifier(max_depth=3)
# Fit a decision tree
tree_model = tree_model.fit(x_train, y_train)
# Training accuracy
tree_model.score(x_train, y_train)

# Predictions/probs on the test dataset
predicted = pd.DataFrame(tree_model.predict(x_test))
probs = pd.DataFrame(tree_model.predict_proba(x_test))

# Store metrics
tree_accuracy = metrics.accuracy_score(y_test, predicted)
tree_roc_auc = metrics.roc_auc_score(y_test, probs[1])
tree_confus_matrix = metrics.confusion_matrix(y_test, predicted)
tree_classification_report = metrics.classification_report(y_test, predicted)
tree_precision = metrics.precision_score(y_test, predicted, pos_label=1)
tree_recall = metrics.recall_score(y_test, predicted, pos_label=1)
tree_f1 = metrics.f1_score(y_test, predicted, pos_label=1)

# evaluate the model using 10-fold cross-validation
tree_cv_scores = cross_val_score(tree.DecisionTreeClassifier(max_depth=3), x_test, y_test, scoring='precision', cv=10)
tree_cv_mean = np.mean(tree_cv_scores)
```

Random Forest

In [10]:

```
# Instantiate
rf = RandomForestClassifier()
# Fit
rf_model = rf.fit(x_train, y_train)
# training accuracy 99.74%
rf_model.score(x_train, y_train)

# Predictions/probs on the test dataset
predicted = pd.DataFrame(rf_model.predict(x_test))
probs = pd.DataFrame(rf_model.predict_proba(x_test))

# Store metrics
rf_accuracy = metrics.accuracy_score(y_test, predicted)
rf_roc_auc = metrics.roc_auc_score(y_test, probs[1])
rf_confus_matrix = metrics.confusion_matrix(y_test, predicted)
rf_classification_report = metrics.classification_report(y_test, predicted)
rf_precision = metrics.precision_score(y_test, predicted, pos_label=1)
rf_recall = metrics.recall_score(y_test, predicted, pos_label=1)
rf_f1 = metrics.f1_score(y_test, predicted, pos_label=1)

rf_cv_scores = cross_val_score(RandomForestClassifier(), x_test, y_test, scoring='precision', cv=10)
rf_cv_mean = np.mean(rf_cv_scores)
```

SVM

In [11]:

```
# Instantiate
svm_model = SVC(probability=True)
# Fit
svm_model = svm_model.fit(x_train, y_train)
# Accuracy
svm_model.score(x_train, y_train)

# Predictions/probs on the test dataset
predicted = pd.DataFrame(svm_model.predict(x_test))
probs = pd.DataFrame(svm_model.predict_proba(x_test))

# Store metrics
svm_accuracy = metrics.accuracy_score(y_test, predicted)
svm_roc_auc = metrics.roc_auc_score(y_test, probs[1])
svm_confus_matrix = metrics.confusion_matrix(y_test, predicted)
svm_classification_report = metrics.classification_report(y_test, predicted)
svm_precision = metrics.precision_score(y_test, predicted, pos_label=1)
svm_recall = metrics.recall_score(y_test, predicted, pos_label=1)
svm_f1 = metrics.f1_score(y_test, predicted, pos_label=1)

# Evaluate the model using 10-fold cross-validation
svm_cv_scores = cross_val_score(SVC(probability=True), x_test, y_test, scoring='precision', cv=10)
svm_cv_mean = np.mean(svm_cv_scores)
```

KNN

In [12]:
```
# instantiate learning model (k = 3)
knn_model = KNeighborsClassifier(n_neighbors=3)
# fit the model
knn_model.fit(x_train, y_train)
# Accuracy
knn_model.score(x_train, y_train)

# Predictions/probs on the test dataset
predicted = pd.DataFrame(knn_model.predict(x_test))
probs = pd.DataFrame(knn_model.predict_proba(x_test))

# Store metrics
knn_accuracy = metrics.accuracy_score(y_test, predicted)
knn_roc_auc = metrics.roc_auc_score(y_test, probs[1])
knn_confus_matrix = metrics.confusion_matrix(y_test, predicted)
knn_classification_report = metrics.classification_report(y_test, predicted)
knn_precision = metrics.precision_score(y_test, predicted, pos_label=1)
knn_recall = metrics.recall_score(y_test, predicted, pos_label=1)

knn_f1 = metrics.f1_score(y_test, predicted, pos_label=1)

# Evaluate the model using 10-fold cross-validation
knn_cv_scores = cross_val_score(KNeighborsClassifier(n_neighbors=3), x_test, y_test, scoring='precision', cv=10)
knn_cv_mean = np.mean(knn_cv_scores)
```

Naive Bayes

In [13]:
```
# Instantiate
bayes_model = GaussianNB()
# Fit the model
bayes_model.fit(x_train, y_train)
# Accuracy
bayes_model.score(x_train, y_train)

# Predictions/probs on the test dataset
predicted = pd.DataFrame(bayes_model.predict(x_test))
probs = pd.DataFrame(bayes_model.predict_proba(x_test))

# Store metrics
bayes_accuracy = metrics.accuracy_score(y_test, predicted)
bayes_roc_auc = metrics.roc_auc_score(y_test, probs[1])
bayes_confus_matrix = metrics.confusion_matrix(y_test, predicted)
bayes_classification_report = metrics.classification_report(y_test, predicted)
bayes_precision = metrics.precision_score(y_test, predicted, pos_label=1)
bayes_recall = metrics.recall_score(y_test, predicted, pos_label=1)
bayes_f1 = metrics.f1_score(y_test, predicted, pos_label=1)

# Evaluate the model using 10-fold cross-validation
bayes_cv_scores = cross_val_score(KNeighborsClassifier(n_neighbors=3), x_test, y_test, scoring='precision', cv=10)
bayes_cv_mean = np.mean(bayes_cv_scores)
```

Model Comparison

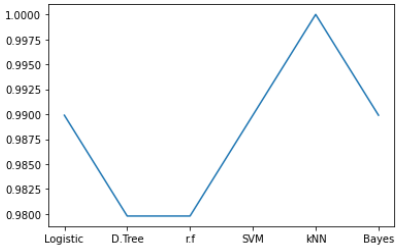
In [24]:
```
# Model comparison
models = pd.DataFrame({
  'Model': ['Logistic', 'd.Tree', 'r.f.', 'SVM', 'kNN',  'Bayes'],
  'Accuracy' : [logit_accuracy, tree_accuracy, rf_accuracy, svm_accuracy, knn_accuracy, bayes_accuracy],
  'Precision': [logit_precision, tree_precision, rf_precision, svm_precision, knn_precision, bayes_precision],
  'recall' : [logit_recall, tree_recall, rf_recall, svm_recall, knn_recall, bayes_recall],
  'F1' : [logit_f1, tree_f1, rf_f1, svm_f1, knn_f1, bayes_f1],
  'cv_precision' : [logit_cv_mean, tree_cv_mean, rf_cv_mean, svm_cv_mean, knn_cv_mean, bayes_cv_mean]
}, index=['Logistic','D.Tree','r.f','SVM','kNN','Bayes'])
# Print table and sort by test precision
models.sort_values(by='Precision', ascending=False)
```

Out[24]:

	Model	Accuracy	Precision	recall	F1	cv_precision
kNN	kNN	1.000000	1.000000	1.000000	1.000000	0.966667
Logistic	Logistic	0.989899	0.982456	1.000000	0.991150	0.966667
SVM	SVM	0.989899	0.982456	1.000000	0.991150	1.000000
Bayes	Bayes	0.989899	0.982456	1.000000	0.991150	0.966667
D.Tree	d.Tree	0.979798	0.982143	0.982143	0.982143	0.985714
r.f	r.f.	0.979798	0.982143	0.982143	0.982143	0.985714

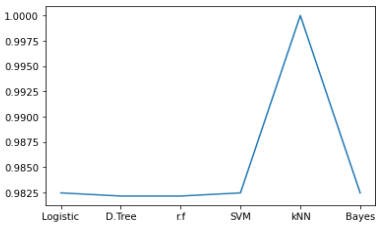
In [25]:
```
models['Accuracy'].plot()
```

Out[25]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f860b8a1dd0>
```



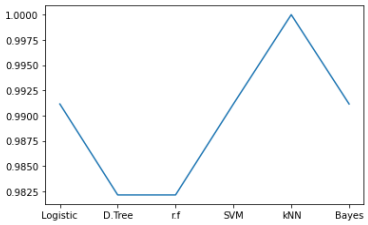
In [28]:
```
models['Precision'].plot()
```

Out[28]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f860b59fb90>
```



In [29]:
```
models['F1'].plot()
```

Out[29]: <matplotlib.axes._subplots.AxesSubplot at 0x7f860b58ea50>



Save reduced dataset (insert project token from settings)

In [32]:
```
all_columns = df.columns.tolist()
columns_to_keep = ['web_traffic', 'sslfinal_state', 'age_of_domain', 'url_of_anchor', 'domain_registation_length', 'redirect', 'links_in_tags', 'targe
columns_not_to_keep = [cols for cols in all_columns if cols not in columns_to_keep]
df1 = df.drop(columns_not_to_keep, axis=1)

project.save_data(data=df1.to_csv(index=False),file_name='dataset2.csv',overwrite=True)
```

Out[32]:
```
{'file_name': 'dataset2.csv',
 'message': 'File saved to project storage.',
 'bucket_name': 'cdcproject-donotdelete-pr-z77cerwxydkvs0',
 'asset_id': 'f3fc7191-191e-4daf-8723-c3341648c4f3'}
```

In [ ]: