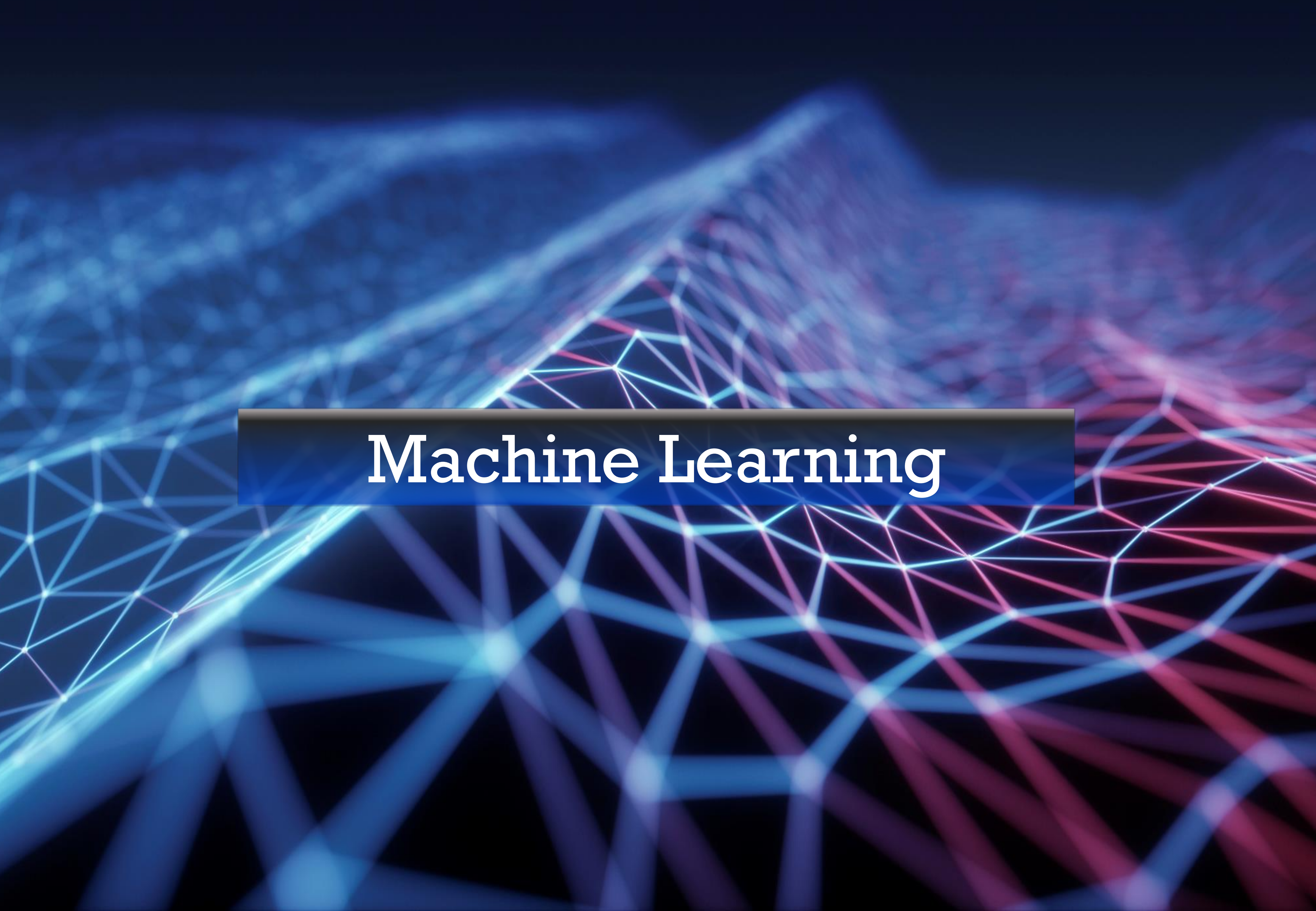
Machine Learning



MachineLearning Overview

MACHINE LEARNING IN EMOJI

BecomingHuman.AI

SUPERVISED — human builds model based on input / output

UNSUPERVISED — human input, machine output; human utilizes if satisfactory

REINFORCEMENT — human input, machine output; human reward/punish, cycle continues

BASIC REGRESSION

LINEAR
linear_model.LinearRegression()
Lots of numerical data

LOGISTIC
linear_model.LogisticRegression()
Target variable is categorical

CLUSTER ANALYSIS

K-MEANS
cluster.KMeans()
Similar datum into groups based on centroids

ANOMALY DETECTION
covariance.EllipticalEnvelope()
Finding outliers through grouping

CLASSIFICATION

NEURAL NET
neural_network.MLPClassifier()
Complex relationships. Prone to overfitting
Basically magic.

K-NN
neighbors.KNeighborsClassifier()
Group membership based on proximity

DECISION TREE
tree.DecisionTreeClassifier()
If/then/else. Non-contiguous data.
Can also be regression.

RANDOM FOREST
ensemble.RandomForestClassifier()
Find best split randomly
Can also be regression

SVM
svm.SVC() svm.LinearSVC()
Maximum margin classifier. Fundamental Data Science algorithm

NAIVE BAYES
GaussianNB() MultinominalNB() BernoulliNB()
Updating knowledge step by step with new info

FEATURE REDUCTION

T-DISTRIB STOCHASTIC NEIB EMBEDDING
manifold.TSNE()
Visual high dimensional data. Convert similarity to joint probabilities

PRINCIPLE COMPONENT ANALYSIS
decomposition.PCA()
Distill feature space into components that describe greatest variance

CANONICAL CORRELATION ANALYSIS
decomposition.CCA()
Making sense of cross-correlation matrices

LINEAR DISCRIMINANT ANALYSIS
lda.LDA()
Linear combination of features that separates classes

OTHER IMPORTANT CONCEPTS

BIAS VARIANCE TRADEOFF

UNDERFITTING / OVERFITTING

INERTIA

ACCURACY FUNCTION
(TP+TN) / (P+N)

PRECISION FUNCTION
manifold.TSNE()

SPECIFICITY FUNCTION
TN / (FP+TN)

SENSITIVITY FUNCTION
TP / (TP+FN)

Originally Created by Emily Barry. **See original here**.

Cheat-Sheet Skicit learn

Phyton For Data Science

BecomingHuman.AI DataCamp

Skicit Learn

Skicit Learn is an open source Phyton library that implements a range if machine learning, processing, cross validation and visualization algorithm using a unified

A basic Example

```
>>> from sklearn import neighbors, datasets, preprocessing
>>> from sklearn.cross validation import train_test_split
>>> from sklearn.metrics import accuracy_score
>>> iris = datasets.load _iris() >>> X, y = iris.data[:, :2], iris.target
>>> Xtrain, X test, y_train, y test = train_test_split (X, y, random stat33)
>>> scaler = preprocessing.StandardScaler().fit(X_train)
>>> X train = scaler.transform(X train)
>>> X test = scaler.transform(X test)
>>> knn = neighbors.KNeighborsClassifier(n_neighbors=5)
>>> knn.fit(X_train, y_train)
>>> y_pred = knn.predict(X_test)
>>> accuracy_score(y_test, y_pred)
```

Prediction

Supervised Estimators

```
>>> y_pred = svc.predict(np.random.radom((2,5)))   Predict labels
>>> y_pred = lr.predict(X_test)                    Predict labels
>>> y_pred = knn.predict_proba(X_test)             Estimate probability of a label
```

Unsupervised Estimators

```
>>> y_pred = k_means.predict(X_test)               Predict labels in clustering algos
```

Loading the Data

Your data beeds to be nmueric and stored as NumPy arrays or SciPy sparse matric. other types that they are comvertible to numeric arrays, such as Pandas Dataframe, are also acceptable

```
>>> import numpy as np >> X = np.random.random((10,5))
>>> y = np . array ( PH', IM', 'F', 'F' , 'M', 'F', 'NI', 'tvl' , 'F', 'F', 'F' ))
>>> X [X < 0.7] = 0
```

Preprocessing The Data

Standardization

```
>>> from sklearn.preprocessing import StandardScaler
>>> scaler = StandardScaler().fit(X_train)
>>> standardized_X = scaler.transform(X_train)
>>> standardized_X_test = scaler.transform(X_test)
```

Normalization

```
>>> from sklearn.preprocessing import Normalizer
>>> scaler = Normalizer().fit(X_train)
>>> normalized_X = scaler.transform(X_train)
>>> normalized_X_test = scaler.transform(X_test)
```

Binarization

```
>>> from sklearn.preprocessing import Binarizer
>>> binarizer = Binarizer(threshold=0.0).fit(X)
>>> binary_X = binarizer.transform(X)
```

Encoding Categorical Features

```
>>> from sklearn.preprocessing import Imputer
>>> imp = Imputer(missing_values=0, strategy='mean', axis=0)
>>> imp.fit_transform(X_train)
```

Imputing Missing Values

```
>>> from sklearn.preprocessing import Imputer
>>> imp = Imputer(missing_values=0, strategy='mean', axis=0)
>>> imp.fit_transform(X_train)
```

Generating Polynomial Features

```
>>> from sklearn.preprocessing import PolynomialFeatures
>>> poly = PolynomialFeatures(5)
>>> poly.fit_transform(X)
```

Evaluate Your Model's Performance

Classification Metrics

Accuracy Score

```
>>> knn.score(X_test, y_test)                                Estimator score method
>>> from sklearn.metrics import accuracy_score               Metric scoring functions
>>> accuracy_score(y_test, y_pred)
```

Classification Report

```
>>> from sklearn.metrics import classification_report        Precision, recall, f1-score
>>> print(classification_report(y_test, y_pred))             and support
```

Confusion Matrix

```
>>> from sklearn.metrics import confusion_matrix
>>> print(confusion_matrix(y_test, y_pred))
```

Regression Metrics

Mean Absolute Error

```
>>> from sklearn.metrics import mean_absolute_error
>>> y_true = [3, -0.5, 2]
>>> mean_absolute_error(y_true, y_pred)
```

Mean Squared Error

```
>>> from sklearn.metrics import mean_squared_error
>>> mean_squared_error(y_test, y_pred)
```

R^2 Score

```
>>> from sklearn.metrics import r2_score
>>> r2_score(y_true, y_pred)
```

Clustering Metrics

Adjusted Rand Index

```
>>> from sklearn.metrics import adjusted_rand_score
>>> adjusted_rand_score(y_true, y_pred)
```

Homogeneity

```
>>> from sklearn.metrics import homogeneity_score
>>> homogeneity_score(y_true, y_pred)
```

V-measure

```
>>> from sklearn.metrics import v_measure_score
>>> metrics.v_measure_score(y_true, y_pred)
```

Cross-Validation

```
>>> from sklearn.cross_validation import cross_val_score
>>> print(cross_val_score(knn, X_train, y_train, cv=4))
>>> print(cross_val_score(lr, X, y, cv=2))
```

Model Fitting

Supervised learning

```
>>> lr.fit(X, y)                                   Fit the model to the data
>>> knn.fit(X_train, y_train)
>>> svc.fit(X_train, y_train)
```

Unsupervised Learning

```
>>> k_means.fit(X_train)                           Fit the model to the data
>>> pca_model = pca.fit_transform(X_train)         Fit to data, then transform it
```

Create Your Model

Supervised Learning Estimators

Linear Regression

```
>>> from sklearn.linear_model import LinearRegression
>>> lr = LinearRegression(normalize=True)
```

Support Vector Machines (SVM)

```
>>> from sklearn.svm import SVC
>>> svc = SVC(kernel='linear')
```

Naive Bayes

```
>>> from sklearn.naive_bayes import GaussianNB
>>> gnb = GaussianNB()
```

KNN

```
>>> from sklearn import neighbors
>>> knn = neighbors.KNeighborsClassifier(n_neighbors=5)
```

Unsupervised Learning Estimators

Principal Component Analysis (PCA)

```
>>> from sklearn.decomposition import PCA
>>> pca = PCA(n_components=0.95)
```

K Means

```
>>> from sklearn.cluster import KMeans
>>> k_means = KMeans(n_clusters=3, random_state=0)
```

Training And Test Data

```
>> from sklearn.cross validation import train_test_split
>> X train, X test, y train, y test - train_test_split(X,
                                                        y,
                                                        random state-0)
```

Tune Your Model

Grid Search

```
>>> from sklearn.grid_search import GridSearchCV
>>> params = {"n_neighbors": np.arange(1,3)
              "metric": ["euclidean","cityblock"]}
>>> grid = GridSearchCV(estimator=knn,
                        param_grid=params)
>>> grid.fit(X_train, y_train)
>>> print(grid.best_score_)
>>> print(grid.best_estimator_.n_neighbors)
```

Randomized Parameter Optimization

```
>>> from sklearn.grid_search import RandomizedSearchCV
>>> params = {"n_neighbors": range(1,5),
              "weights": ["uniform", "distance"]}
>>> rsearch = RandomizedSearchCV(estimator=knn,
                                 param_distributions=params,
                                 cv=4,
                                 n_iter=8,
                                 random_state=5)
>>> rsearch.fit(X_train, y_train)
>>> print(rsearch.best_score_)
```

Skicit-learn Algorithm

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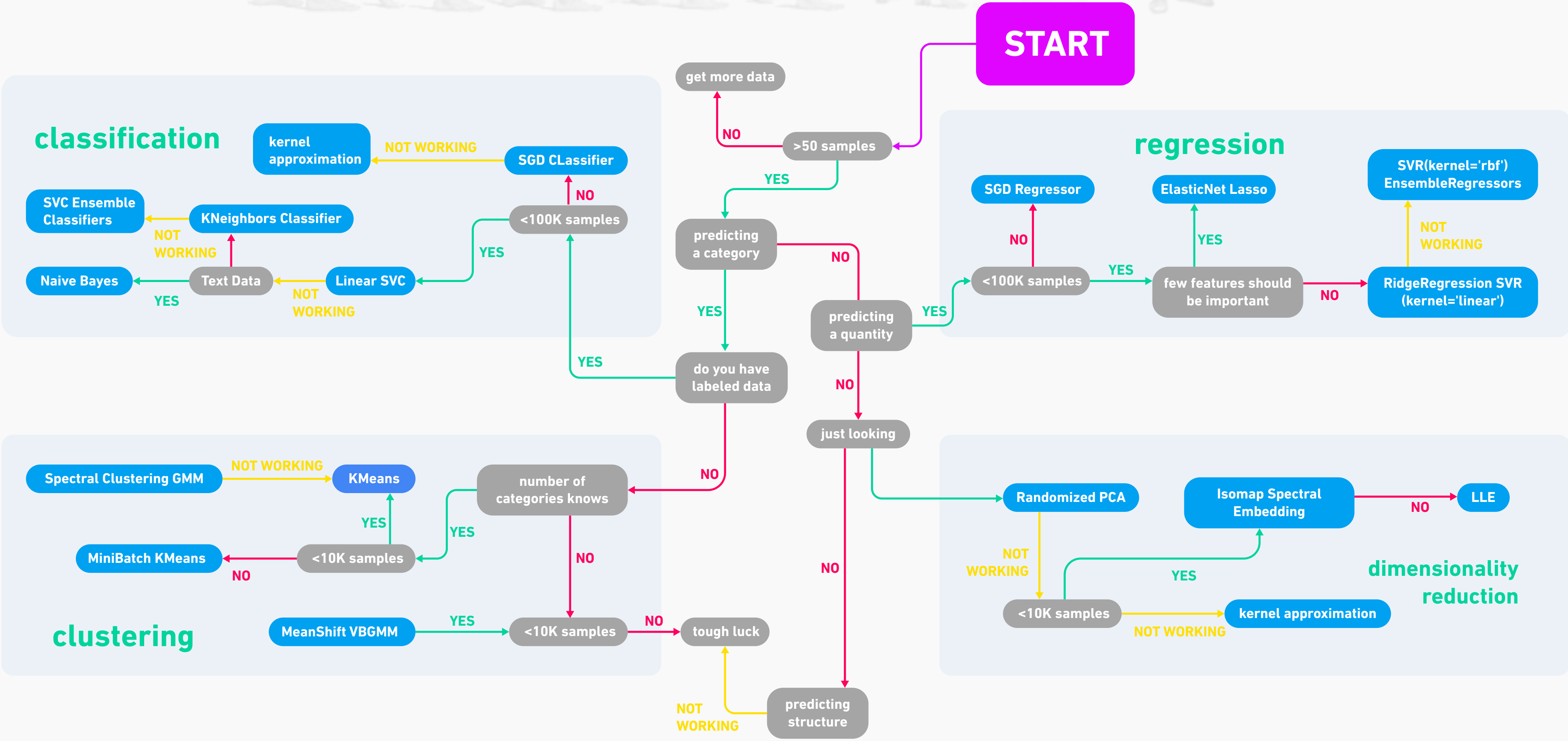

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Algorithm Cheat Sheet

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This cheat sheet helps you choose the best Azure Machine Learning Studio algorithm for your predictive analytics solution. Your decision is driven by both the nature of your data and the question you're trying to answer.