Welcome to the course!

LINEAR CLASSIFIERS IN PYTHON

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Assumed knowledge

In this course we'll assume you have some prior exposure to:

- Python, at the level of *Intermediate Python*
- scikit-learn, at the level of *Supervised Learning with scikit-learn*
- Supervised learning, at the level of *Supervised Learning with scikit-learn*

Fitting and predicting

```python
import sklearn.datasets

newsgroups = sklearn.datasets.fetch_20newsgroups_vectorized()

X, y = newsgroups.data, newsgroups.target
```

```python
X.shape
```

```
(11314, 130107)
```

```python
y.shape
```

```
(11314,)
```

Fitting and predicting (cont.)

```
from sklearn.neighbors import KNeighborsClassifier

knn = KNeighborsClassifier(n_neighbors=1)
```

```
knn.fit(X,y)
```

```
y_pred = knn.predict(X)
```

Model evaluation

```
knn.score(X,y)
```

```
0.99991
```

```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y)
```

```
knn.fit(X_train, y_train)

knn.score(X_test, y_test)
```

```
0.66242
```

Let's practice!

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Applying logistic regression and SVM

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Using LogisticRegression

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

```python
lr = LogisticRegression()
lr.fit(X_train, y_train)
lr.predict(X_test)
lr.score(X_test, y_test)
```

LogisticRegression example

```
import sklearn.datasets
wine = sklearn.datasets.load_wine()
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression()
lr.fit(wine.data, wine.target)
lr.score(wine.data, wine.target)
```

```
0.966
```

```
lr.predict_proba(wine.data[:1])
```

```
array([[9.966e-01, 2.740e-03, 6.787e-04]])
```

Using LinearSVC

`LinearSVC` works the same way:

```python
import sklearn.datasets

wine = sklearn.datasets.load_wine()
from sklearn.svm import LinearSVC

svm = LinearSVC()

svm.fit(wine.data, wine.target)
svm.score(wine.data, wine.target)
```

```
0.955
```

Using SVC

```python
import sklearn.datasets
wine = sklearn.datasets.load_wine()
from sklearn.svm import SVC
svm = SVC()
svm.fit(wine.data, wine.target);
svm.score(wine.data, wine.target)
```

```
0.708
```

Model complexity review:

- **Underfitting:** model is too simple, low training accuracy
- **Overfitting:** model is too complex, low test accuracy

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Linear decision boundaries

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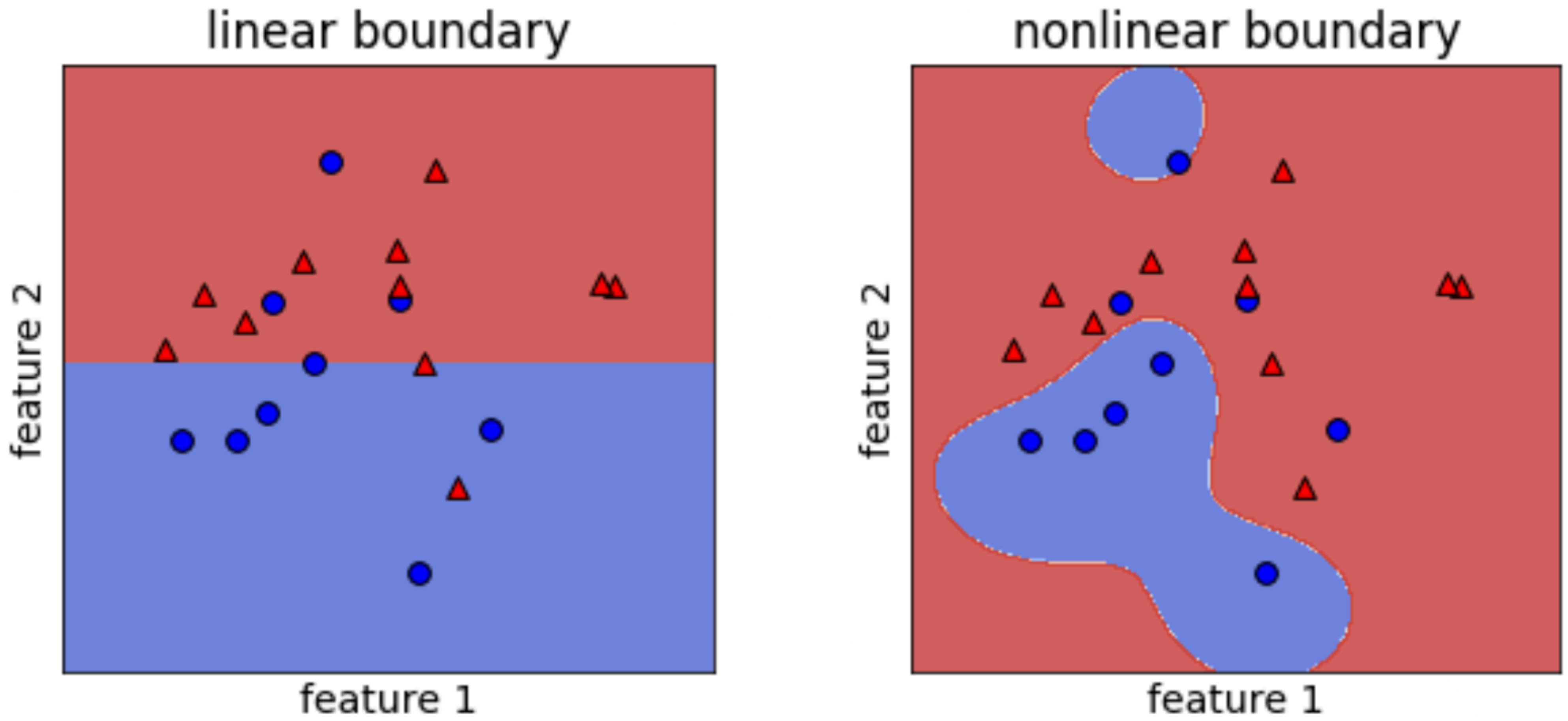
Linear decision boundaries

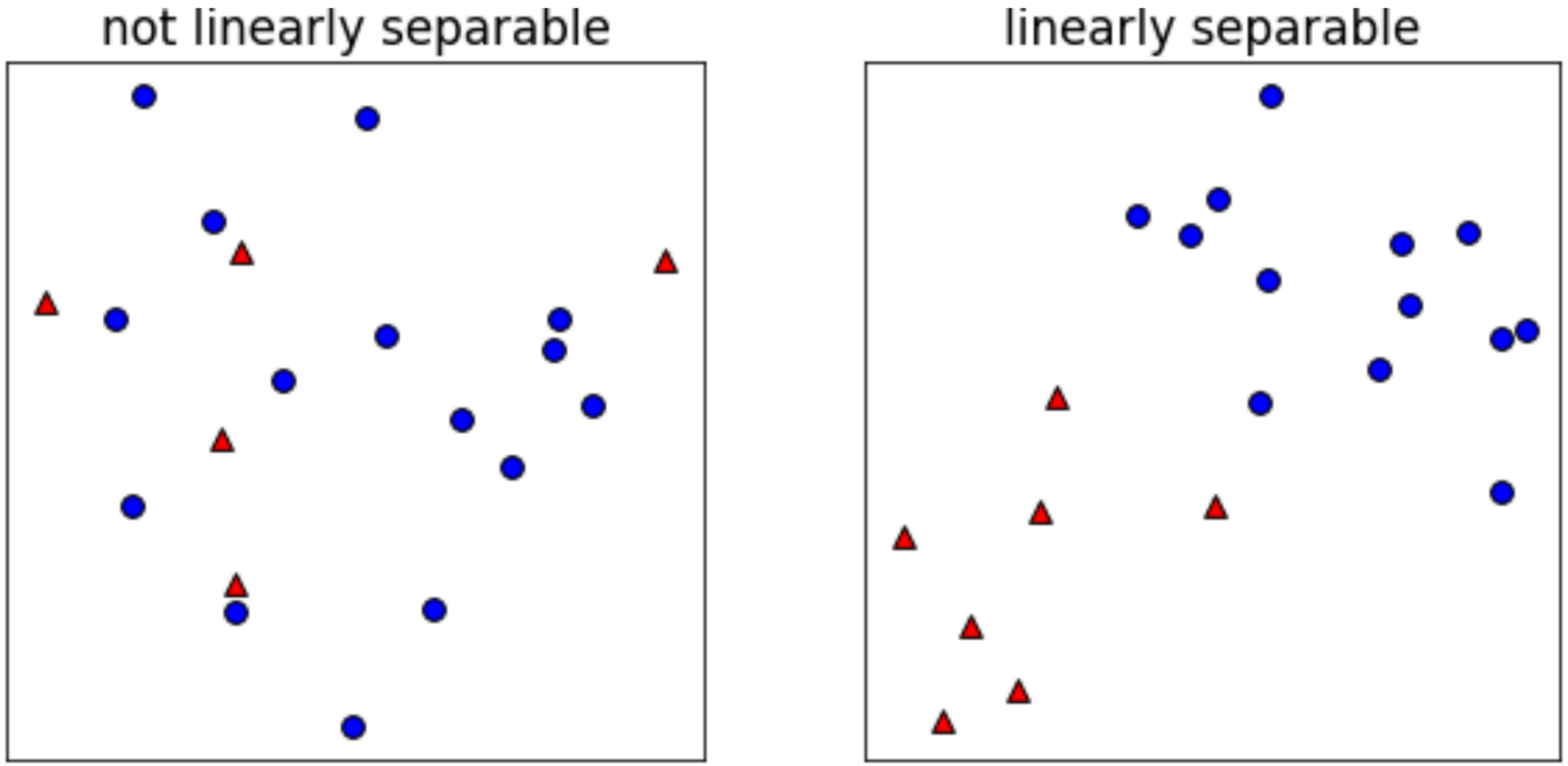


Definitions

Vocabulary:

- **classification:** learning to predict categories
- **decision boundary:** the surface separating different predicted classes
- **linear classifier:** a classifier that learns linear decision boundaries
  - e.g., logistic regression, linear SVM
- **linearly separable:** a data set can be perfectly explained by a linear classifier

Linearly separable data



Let's practice!

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