In [1]:
```
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.model_selection import GridSearchCV
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import mean_squared_error
```

In [2]:
```
titanic = pd.read_csv('titanic.csv', index_col=0)
titanic
```

Out[2]:

PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S
...	...	...	...	...	...	...	...	...	...	...	...
887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.0000	NaN	S
888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.0000	B42	S
889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	NaN	1	2	W./C. 6607	23.4500	NaN	S
890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.0000	C148	C
891	0	3	Dooley, Mr. Patrick	male	32.0	0	0	370376	7.7500	NaN	Q

891 rows × 11 columns

In [3]:
```
titanic.isna().any()
```

Out[3]:
```
Survived    False
Pclass      False
Name        False
Sex         False
Age          True
SibSp       False
Parch       False
Ticket      False
Fare        False
Cabin        True
Embarked     True
dtype: bool
```

In [4]:
```
titanic.drop(['Name', 'Ticket', 'Cabin'], axis=1, inplace=True)
titanic
```

Out[4]:

PassengerId	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked
1	0	3	male	22.0	1	0	7.2500	S
2	1	1	female	38.0	1	0	71.2833	C
3	1	3	female	26.0	0	0	7.9250	S
4	1	1	female	35.0	1	0	53.1000	S
5	0	3	male	35.0	0	0	8.0500	S
...	...	...	...	...	...	...	...	...
887	0	2	male	27.0	0	0	13.0000	S
888	1	1	female	19.0	0	0	30.0000	S
889	0	3	female	NaN	1	2	23.4500	S
890	1	1	male	26.0	0	0	30.0000	C
891	0	3	male	32.0	0	0	7.7500	Q

891 rows × 8 columns

In [5]:
```
titanic.Embarked.isna().sum()
```

Out[5]:
```
2
```

In [6]:
```
titanic.Embarked.value_counts()
```

Out[6]:
```
S    644
C    168
Q     77
Name: Embarked, dtype: int64
```

In [7]:
```
titanic.Embarked.fillna(titanic.Embarked.value_counts().idxmax(), inplace=True)
titanic
```

Out[7]:

PassengerId	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked
1	0	3	male	22.0	1	0	7.2500	S
2	1	1	female	38.0	1	0	71.2833	C
3	1	3	female	26.0	0	0	7.9250	S
4	1	1	female	35.0	1	0	53.1000	S
5	0	3	male	35.0	0	0	8.0500	S
...	...	...	...	...	...	...	...	...
887	0	2	male	27.0	0	0	13.0000	S
888	1	1	female	19.0	0	0	30.0000	S
889	0	3	female	NaN	1	2	23.4500	S
890	1	1	male	26.0	0	0	30.0000	C
891	0	3	male	32.0	0	0	7.7500	Q

891 rows × 8 columns

In [8]:
```
mean_ages = titanic.groupby('Sex').Age.mean()
mean_ages
```

Out[8]:
```
Sex
female    27.915709
male      30.726645
Name: Age, dtype: float64
```

In [9]:
```
def fill_age(row: pd.Series):
    if row.Age != row.Age:
        row.Age = mean_ages[row.Sex]
    return row
```

In [10]:
```
titanic = titanic.apply(fill_age, axis=1)
titanic.isna().any()
```

Out[10]:
```
Survived    False
Pclass      False
Sex         False
Age         False
SibSp       False
Parch       False
Fare        False
```

```
Embarked    False
dtype: bool
```

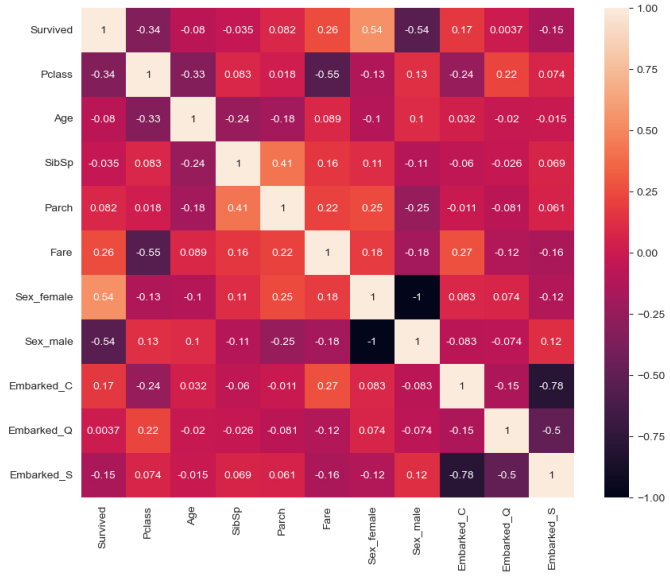
In [11]:
```
titanic = pd.get_dummies(titanic, columns=['Sex', 'Embarked'])
titanic
```

Out[11]:

PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare	Sex_female	Sex_male	Embarked_C	Embarked_Q	Embarked_S
1	0	3	22.000000	1	0	7.2500	0	1	0	0	1
2	1	1	38.000000	1	0	71.2833	1	0	1	0	0
3	1	3	26.000000	0	0	7.9250	1	0	0	0	1
4	1	1	35.000000	1	0	53.1000	1	0	0	0	1
5	0	3	35.000000	0	0	8.0500	0	1	0	0	1
...	...	...	...	...	...	...	...	...	...	...	...
887	0	2	27.000000	0	0	13.0000	0	1	0	0	1
888	1	1	19.000000	0	0	30.0000	1	0	0	0	1
889	0	3	27.915709	1	2	23.4500	1	0	0	0	1
890	1	1	26.000000	0	0	30.0000	0	1	1	0	0
891	0	3	32.000000	0	0	7.7500	0	1	0	1	0

891 rows × 11 columns

In [12]:
```
_, axes = plt.subplots(figsize=(10, 8))
sns.heatmap(titanic.corr(), annot=True);
```



In [13]:
```
titanic.drop(['SibSp', 'Parch'], axis=1, inplace=True)
titanic
```

Out[13]:

PassengerId	Survived	Pclass	Age	Fare	Sex_female	Sex_male	Embarked_C	Embarked_Q	Embarked_S
1	0	3	22.000000	7.2500	0	1	0	0	1
2	1	1	38.000000	71.2833	1	0	1	0	0
3	1	3	26.000000	7.9250	1	0	0	0	1
4	1	1	35.000000	53.1000	1	0	0	0	1
5	0	3	35.000000	8.0500	0	1	0	0	1
...	...	...	...	...	...	...	...	...	...
887	0	2	27.000000	13.0000	0	1	0	0	1
888	1	1	19.000000	30.0000	1	0	0	0	1
889	0	3	27.915709	23.4500	1	0	0	0	1
890	1	1	26.000000	30.0000	0	1	1	0	0
891	0	3	32.000000	7.7500	0	1	0	1	0

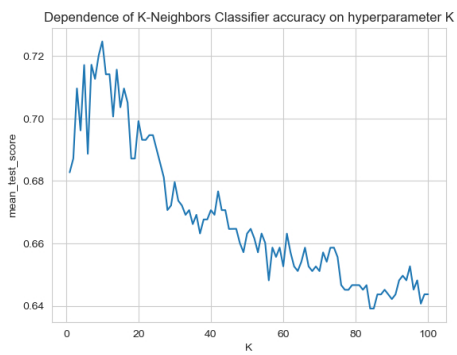
891 rows × 9 columns

In [14]:
```
X_train, X_test, y_train, y_test = train_test_split(titanic.drop('Survived', axis=1), titanic.Survived)
```

In [15]:
```
knn_cv = GridSearchCV(KNeighborsClassifier(), param_grid={'n_neighbors': range(1, 101)}, cv=5, n_jobs=-1)
knn_cv.fit(X_train, y_train)
knn_cv.best_score_
```

Out[15]:
```
0.7246661429693637
```

In [16]:
```
_, axes = plt.subplots()
axes.set_xlabel('K')
axes.set_ylabel('mean_test_score')
axes.set_title('Dependence of K-Neighbors Classifier accuracy on hyperparameter K')
sns.lineplot(x=range(1, 101), y=knn_cv.cv_results_['mean_test_score'], ax=axes);
```



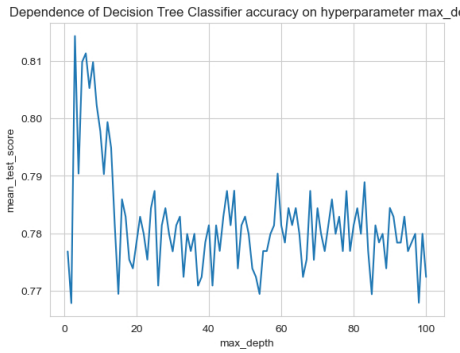
In [17]:
```
knn_score = mean_squared_error(knn_cv.predict(X_test), y_test)
knn_score
```

Out[17]:
```
0.2690582959641256
```

In [18]:
```
dtc_cv = GridSearchCV(DecisionTreeClassifier(), param_grid={'max_depth': range(1, 101)})
dtc_cv.fit(X_train, y_train)
dtc_cv.best_score_
```

Out[18]: 0.8143081584558411

In [19]:
```
_, axes = plt.subplots()
axes.set_xlabel('max_depth')
axes.set_ylabel('mean_test_score')
axes.set_title('Dependence of Decision Tree Classifier accuracy on hyperparameter max_depth')
sns.lineplot(x=range(1, 101), y=dtc_cv.cv_results_['mean_test_score'], ax=axes);
```



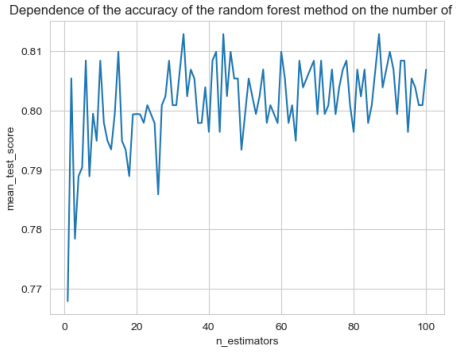
In [20]:
```
dtc_score = mean_squared_error(dtc_cv.predict(X_test), y_test)
dtc_score
```

Out[20]: 0.18834080717488788

In [21]:
```
rfc_cv = GridSearchCV(RandomForestClassifier(), param_grid={'n_estimators': range(1, 101)})
rfc_cv.fit(X_train, y_train)
rfc_cv.best_score_
```

Out[21]: 0.8128717315677253

In [22]:
```
_, axes = plt.subplots()
axes.set_xlabel('n_estimators')
axes.set_ylabel('mean_test_score')
axes.set_title('Dependence of the accuracy of the random forest method on the number of trees')
sns.lineplot(x=range(1, 101), y=rfc_cv.cv_results_['mean_test_score'], ax=axes);
```



In [23]:
```
rfc_score = mean_squared_error(rfc_cv.predict(X_test), y_test)
rfc_score
```

Out[23]: 0.17040358744394618

In [24]:
```
sns.barplot(
    x=['K-Nearest Neighbors', 'Decision Tree', 'Random Forest'],
    y=[knn_score, dtc_score, rfc_score]
);
```