In [3]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
%matplotlib inline
warnings.filterwarnings('ignore')
```

In [ ]:
```
```

In [4]:
```
df = pd.read_csv(r"C:\Users\HP\Downloads\Boston Dataset.csv")
df.drop(columns=['Unnamed: 0'], axis=0, inplace=True)
df.head()
```

Out[4]:

	crim	zn	indus	chas	nox	rm	age	dis	rad	tax	ptratio	black	lstat	medv
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.98	24.0
1	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.14	21.6
2	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03	34.7
3	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94	33.4
4	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	5.33	36.2

In [5]:
```
# statistical info
df.describe()
```

Out[5]:

	crim	zn	indus	chas	nox	rm	age	
count	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.00
mean	3.613524	11.363636	11.136779	0.069170	0.554695	6.284634	68.574901	3.79
std	8.601545	23.322453	6.860353	0.253994	0.115878	0.702617	28.148861	2.10
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	2.900000	1.12
25%	0.082045	0.000000	5.190000	0.000000	0.449000	5.885500	45.025000	2.10
50%	0.256510	0.000000	9.690000	0.000000	0.538000	6.208500	77.500000	3.20
75%	3.677083	12.500000	18.100000	0.000000	0.624000	6.623500	94.075000	5.18
max	88.976200	100.000000	27.740000	1.000000	0.871000	8.780000	100.000000	12.12

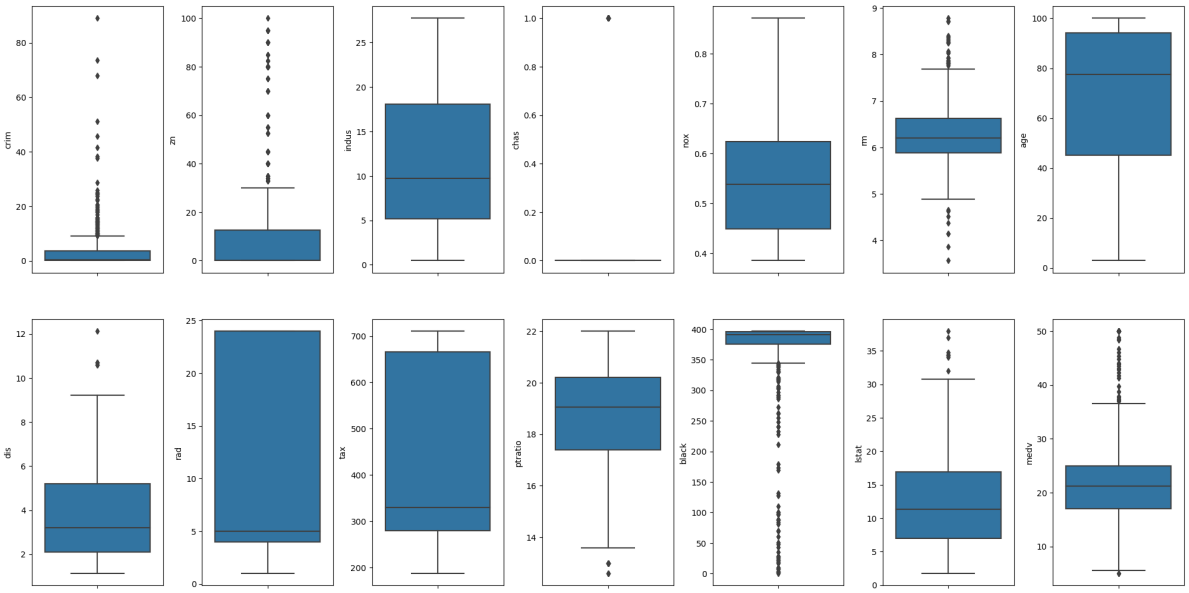
In [6]:
```
# datatype info
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
Data columns (total 14 columns):
 #   Column   Non-Null Count  Dtype  
---  ------   --------------  -----  
 0   crim     506 non-null    float64
 1   zn       506 non-null    float64
 2   indus    506 non-null    float64
 3   chas     506 non-null    int64  
 4   nox      506 non-null    float64
 5   rm       506 non-null    float64
 6   age      506 non-null    float64
 7   dis      506 non-null    float64
 8   rad      506 non-null    int64  
 9   tax      506 non-null    int64  
 10  ptratio  506 non-null    float64
 11  black    506 non-null    float64
 12  lstat    506 non-null    float64
 13  medv     506 non-null    float64
dtypes: float64(11), int64(3)
memory usage: 55.5 KB
```

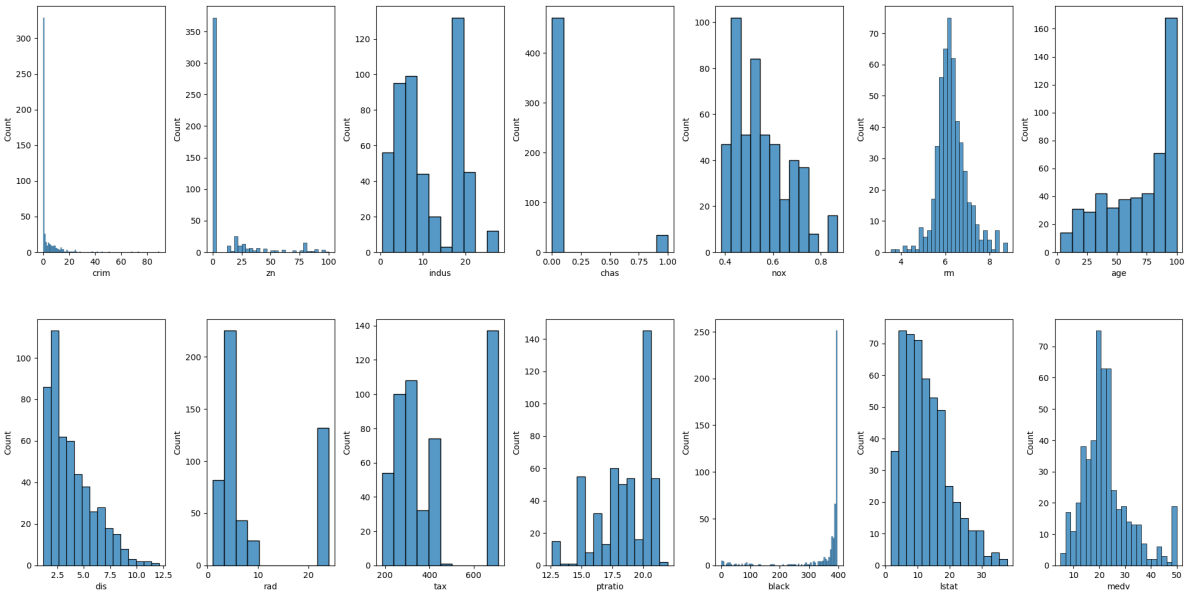
In [7]:
```
# check for null values
df.isnull().sum()
```

Out[7]:
```
crim       0
zn         0
indus      0
chas       0
nox        0
rm         0
age        0
dis        0
rad        0
tax        0
ptratio    0
black      0
lstat      0
medv       0
dtype: int64
```

In [8]:
```
# create box plots
fig, ax = plt.subplots(ncols=7, nrows=2, figsize=(20, 10))
index = 0
ax = ax.flatten()

for col, value in df.items():
    sns.boxplot(y=col, data=df, ax=ax[index])
    index += 1
plt.tight_layout(pad=0.5, w_pad=0.7, h_pad=5.0)
```

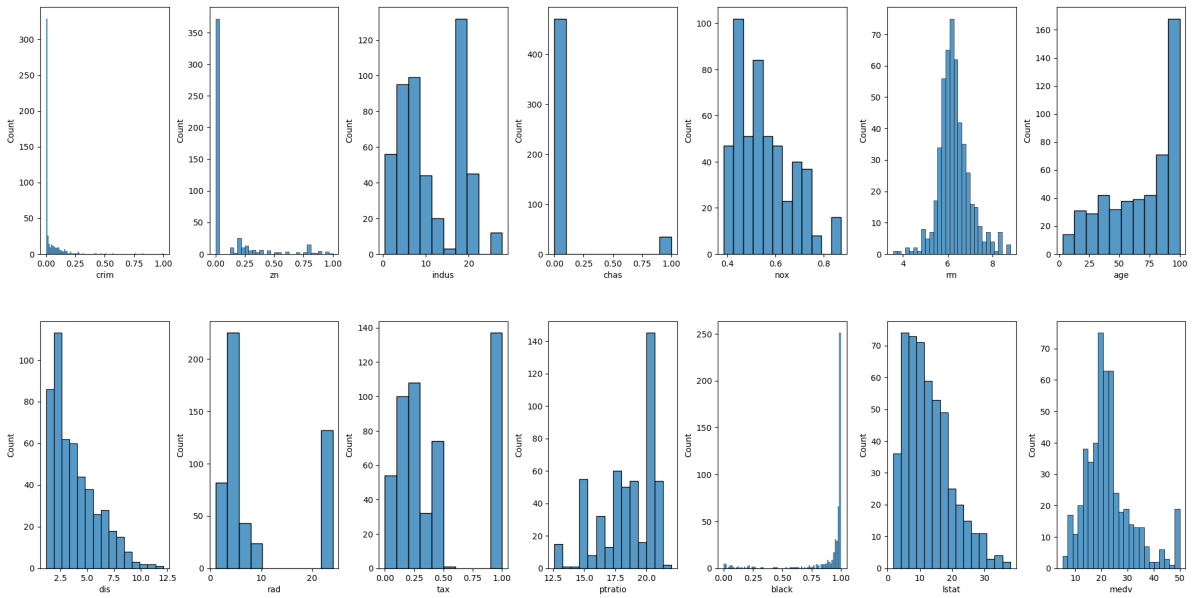


In [9]:
```
# create dist plot
fig, ax = plt.subplots(ncols=7, nrows=2, figsize=(20, 10))
index = 0
ax = ax.flatten()

for col, value in df.items():
    sns.histplot(value, ax=ax[index])
    index += 1
plt.tight_layout(pad=0.5, w_pad=0.7, h_pad=5.0)
```



In [13]:
```
cols = ['crim', 'zn', 'tax', 'black']
for col in cols:
    # find minimum and maximum of that column
    minimum = min(df[col])
    maximum = max(df[col])
    df[col] = (df[col] - minimum) / (maximum - minimum)
```

In [12]:
```
fig, ax = plt.subplots(ncols=7, nrows=2, figsize=(20, 10))
index = 0
ax = ax.flatten()

for col, value in df.items():
    sns.histplot(value, ax=ax[index])
    index += 1
plt.tight_layout(pad=0.5, w_pad=0.7, h_pad=5.0)
```



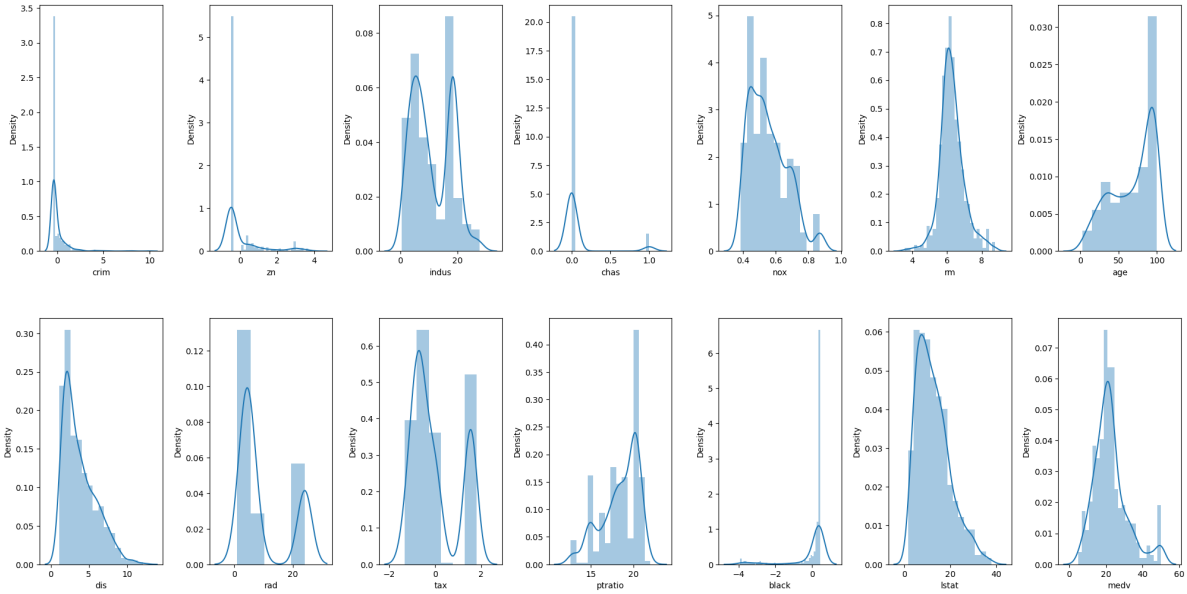
In [14]:
```
# standardization
from sklearn import preprocessing
scalar = preprocessing.StandardScaler()

# fit our data
scaled_cols = scalar.fit_transform(df[cols])
scaled_cols = pd.DataFrame(scaled_cols, columns=cols)
scaled_cols.head()
```

Out[14]:

	crim	zn	tax	black
0	-0.419782	0.284830	-0.666608	0.441052
1	-0.417339	-0.487722	-0.987329	0.441052
2	-0.417342	-0.487722	-0.987329	0.396427
3	-0.416750	-0.487722	-1.106115	0.416163
4	-0.412482	-0.487722	-1.106115	0.441052

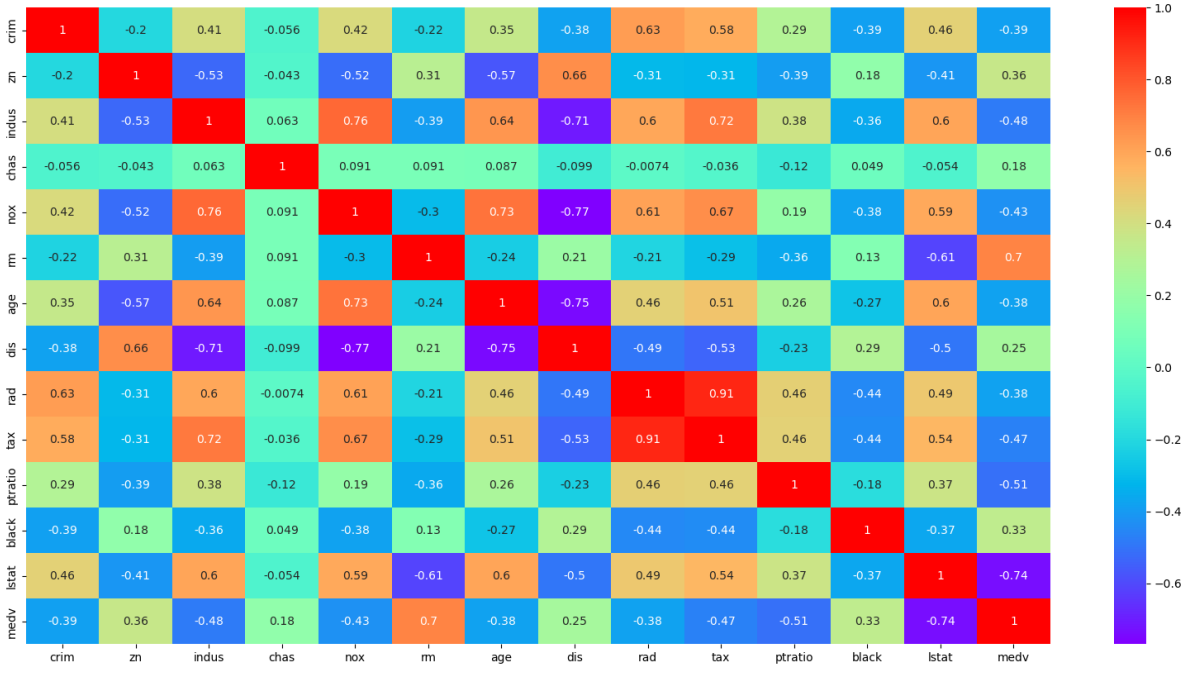
In [15]:
```
for col in cols:
    df[col] = scaled_cols[col]
```

In [17]:
```
fig, ax = plt.subplots(ncols=7, nrows=2, figsize=(20, 10))
index = 0
ax = ax.flatten()

for col, value in df.items():
    sns.distplot(value, ax=ax[index])
    index += 1
plt.tight_layout(pad=0.5, w_pad=0.7, h_pad=5.0)
```



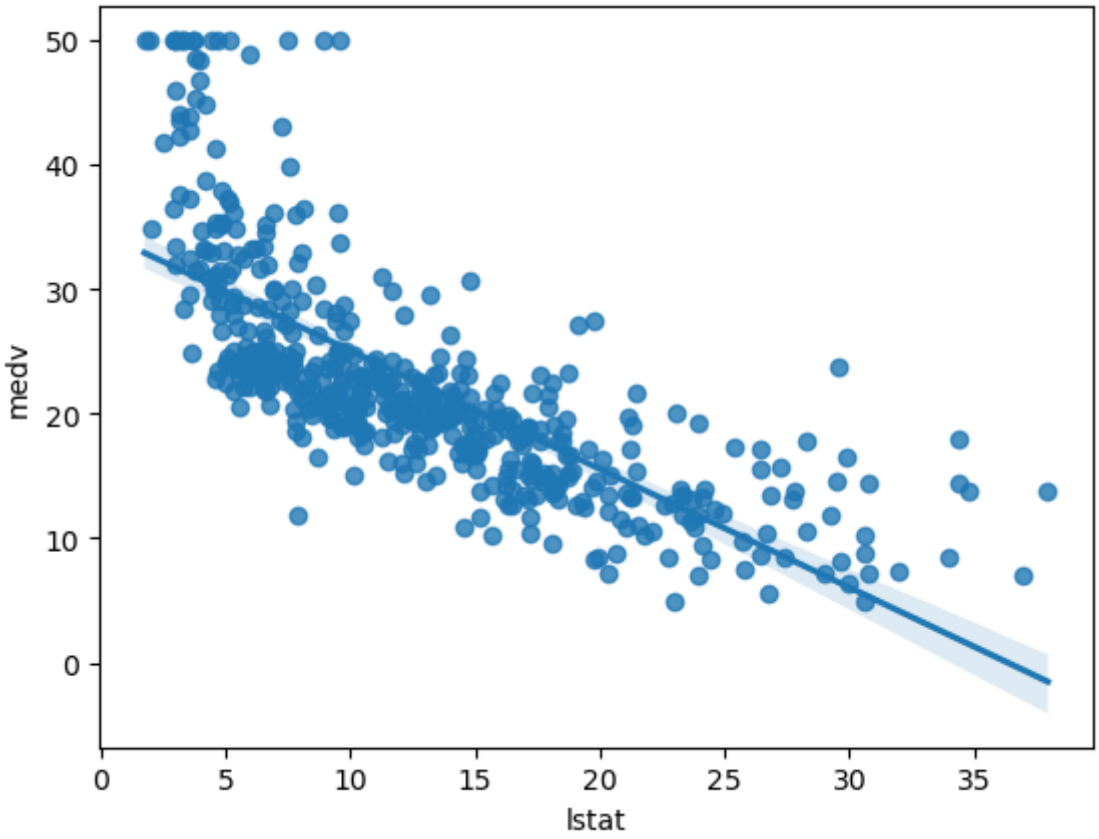
In [18]:
```
corr = df.corr()
plt.figure(figsize=(20,10))
sns.heatmap(corr, annot=True, cmap='rainbow')
```

Out[18]:
```
<Axes: >
```



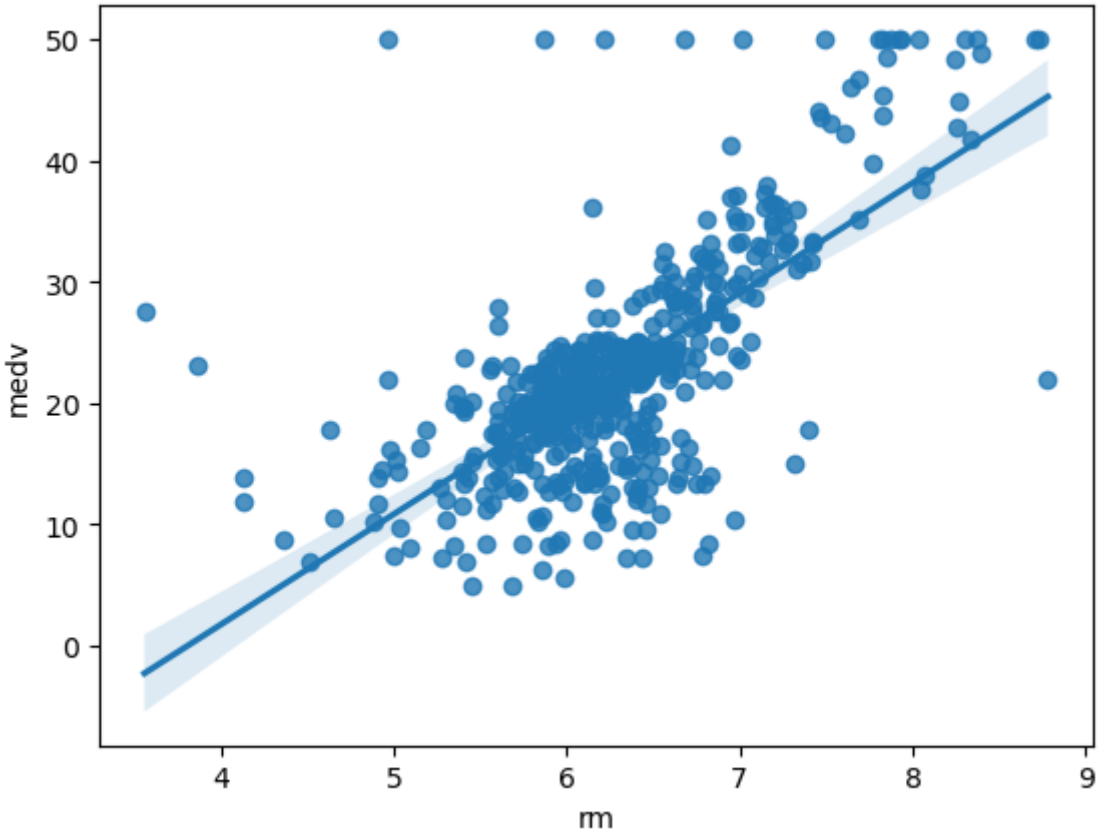
In [19]:
```
sns.regplot(y=df['medv'], x=df['lstat'])
```

Out[19]:
```
<Axes: xlabel='lstat', ylabel='medv'>
```



In [20]:
```
sns.regplot(y=df['medv'], x=df['rm'])
```

Out[20]:
```
<Axes: xlabel='rm', ylabel='medv'>
```

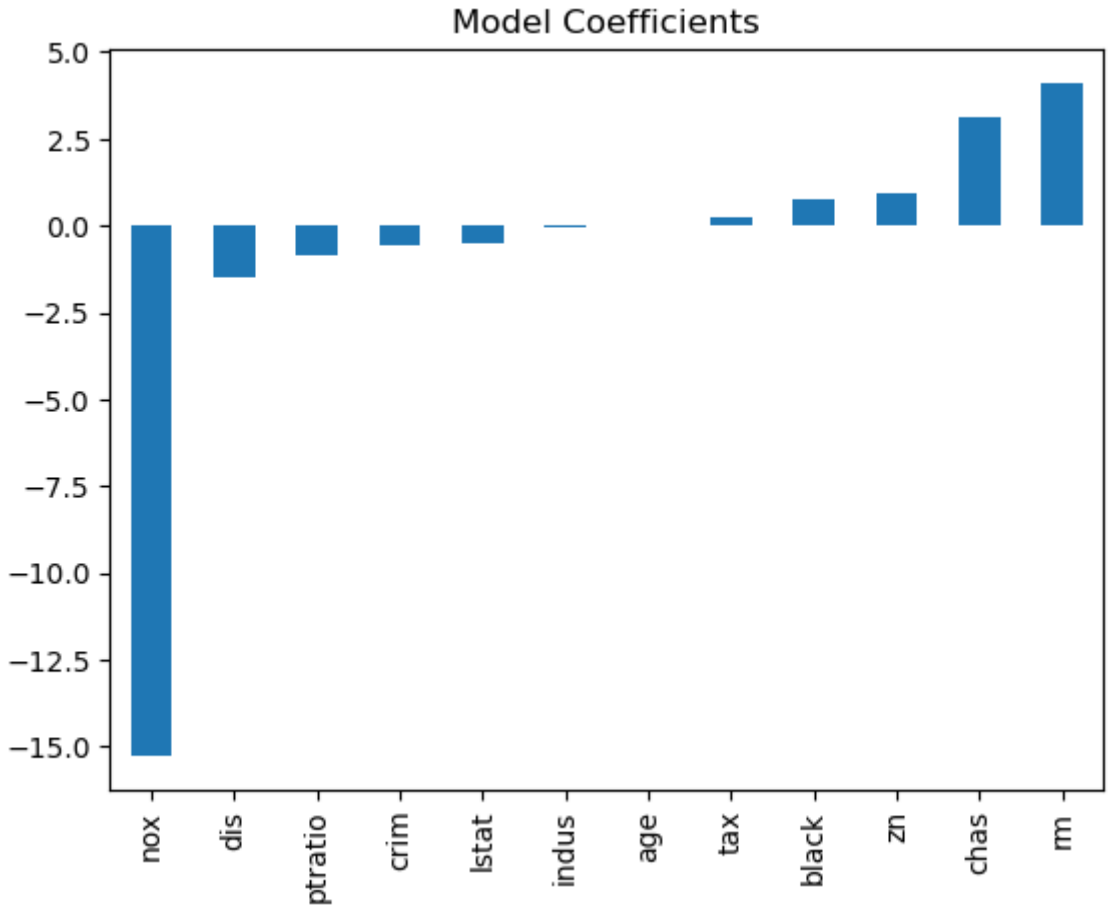


In [21]:
```
X = df.drop(columns=['medv', 'rad'], axis=1)
y = df['medv']
```

In [30]:
```
from sklearn.model_selection import cross_val_score, train_test_split
from sklearn.metrics import mean_squared_error
def train(model, X, y):
    # train the model
    x_train, x_test, y_train, y_test = train_test_split(X, y, random_state=38)
    model.fit(x_train, y_train)

    # predict the training set
    pred = model.predict(x_test)

    # perform cross-validation
    cv_score = cross_val_score(model, X, y,
    scoring='neg_mean_squared_error', cv=5)
    cv_score = np.abs(np.mean(cv_score))

    print("Model Report")
    print("MSE:",mean_squared_error(y_test, pred))
    print('CV Score:', cv_score)
```

In [28]:
```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
train(model, X, y)
coef = pd.Series(model.coef_, X.columns).sort_values()
coef.plot(kind='bar', title='Model Coefficients')
```

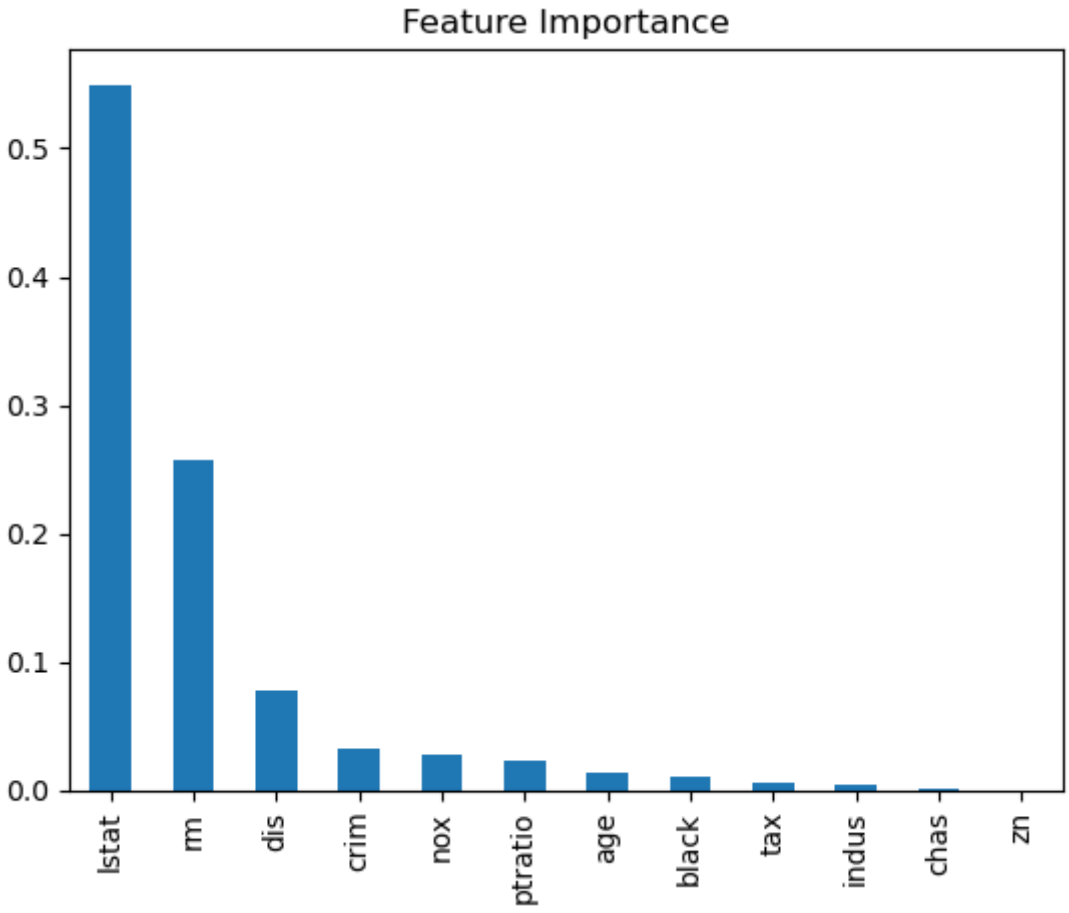
Out[28]:
```
<Axes: title={'center': 'Model Coefficients'}>
```



In [32]:
```
from sklearn.tree import DecisionTreeRegressor
model = DecisionTreeRegressor()
train(model, X, y)
coef = pd.Series(model.feature_importances_, X.columns).sort_values(ascending=Fals
coef.plot(kind='bar', title='Feature Importance')
```

```
Model Report
MSE: 19.898897637795276
CV Score: 41.547233352747035
```

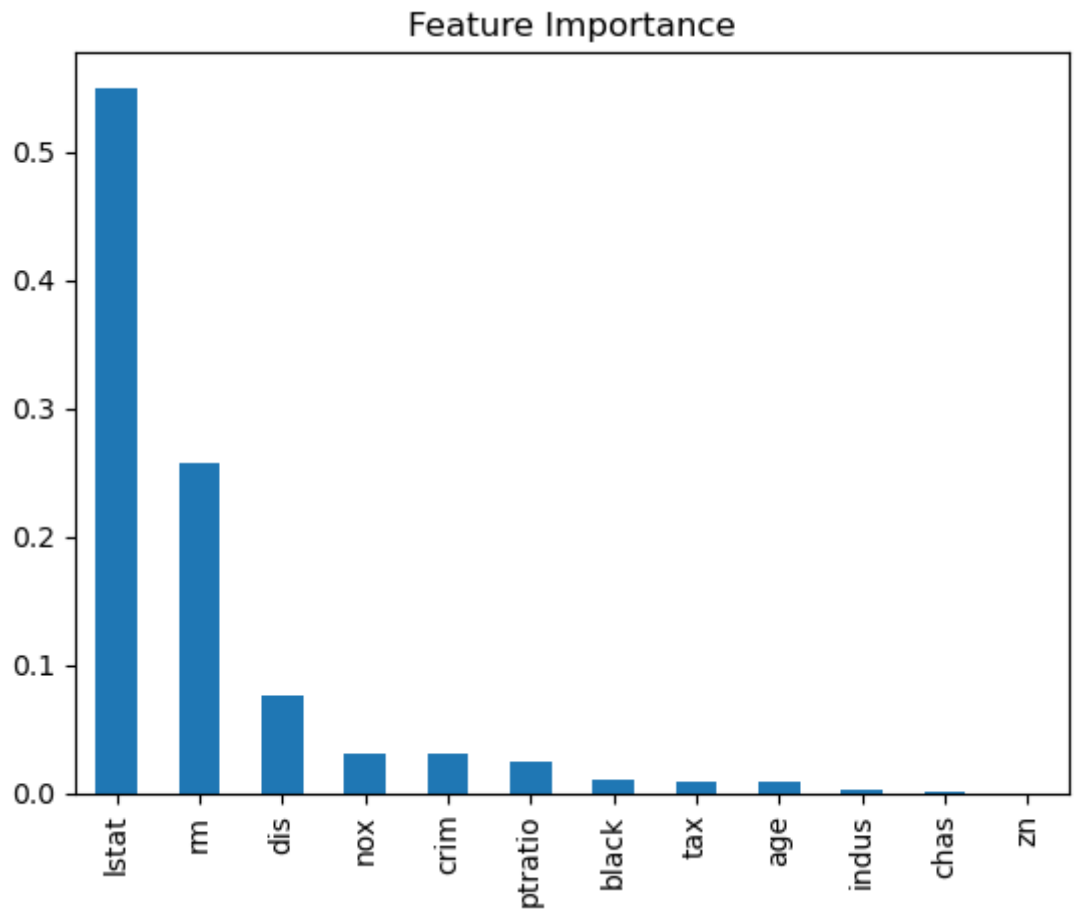
Out[32]: <Axes: title={'center': 'Feature Importance'}>



In [33]:
```
from sklearn.tree import DecisionTreeRegressor
model = DecisionTreeRegressor()
train(model, X, y)
coef = pd.Series(model.feature_importances_, X.columns).sort_values(ascending=Fals
coef.plot(kind='bar', title='Feature Importance')
```

```
Model Report
MSE: 20.81417322834645
CV Score: 41.47353659483595
```

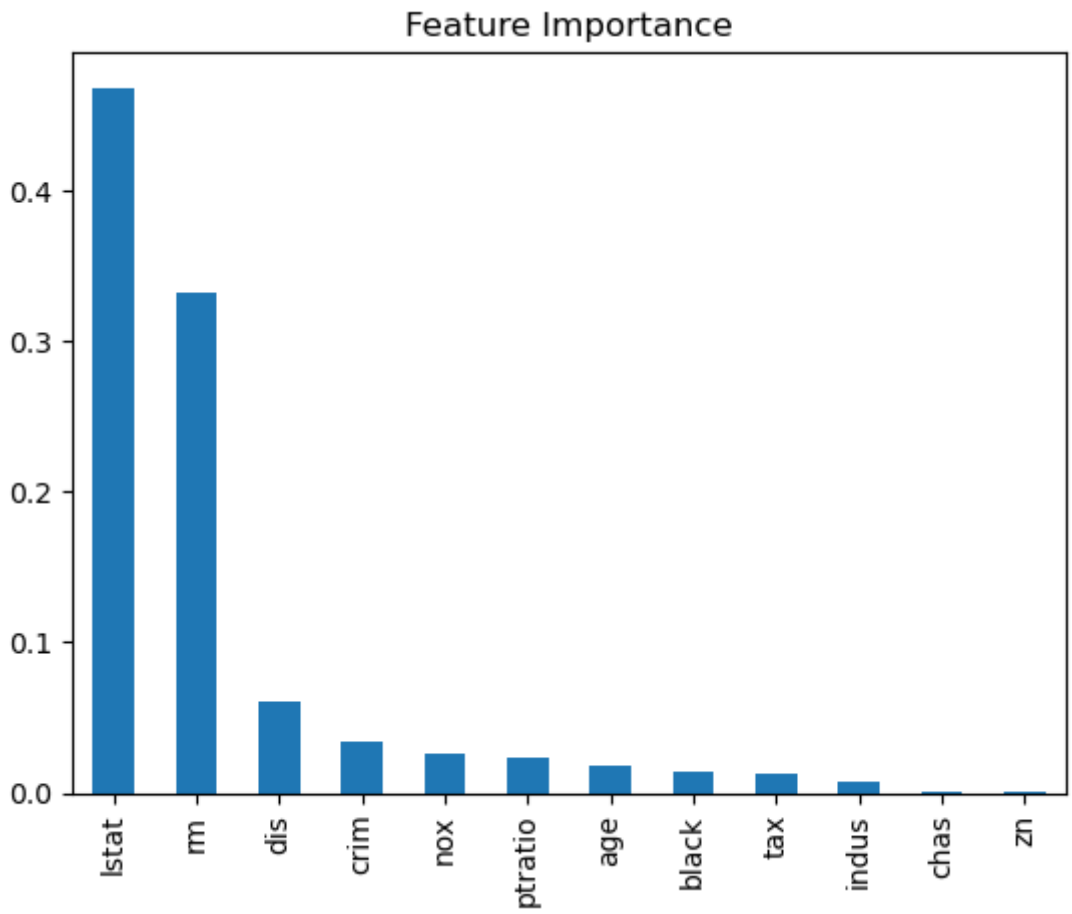
Out[33]: <Axes: title={'center': 'Feature Importance'}>



In [35]:
```
from sklearn.ensemble import RandomForestRegressor
model = RandomForestRegressor()
train(model, X, y)
coef = pd.Series(model.feature_importances_, X.columns).sort_values(ascending=Fals
coef.plot(kind='bar', title='Feature Importance')
```

```
Model Report
MSE: 8.782391834645663
CV Score: 21.2813220670161
```

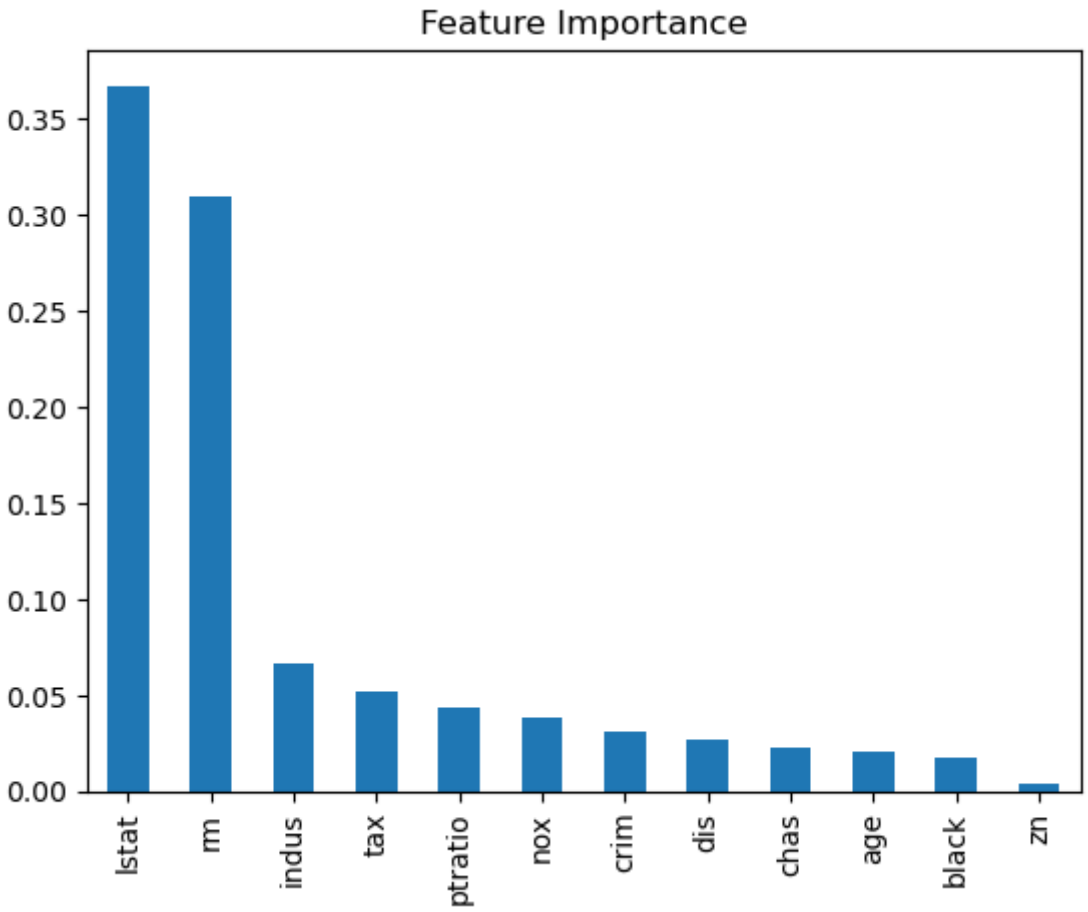
Out[35]: <Axes: title={'center': 'Feature Importance'}>



In [36]:
```
from sklearn.ensemble import ExtraTreesRegressor
model = ExtraTreesRegressor()
train(model, X, y)
coef = pd.Series(model.feature_importances_, X.columns).sort_values(ascending=Fals
coef.plot(kind='bar', title='Feature Importance')
```

```
Model Report
MSE: 11.822347377952749
CV Score: 19.925448011745278
```

Out[36]: <Axes: title={'center': 'Feature Importance'}>


Feature Importance
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
lstat
rm
indus
tax
ptratio
nox
crim
dis
chas
age
black
zn

In [ ]: