DSBDAL Assignment 2
Shrikrushna Zirape
31284 N2 batch

Data Wrangling II

Create an “Academic performance” dataset of students and perform the following operations using Python.

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1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them.
2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them.
3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution. Reason and document your approach properly.

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
```

In [2]:
```
data = pd.read_csv("StudentsPerformance_modified.csv")
data.shape
```

Out[2]:
```
(1000, 8)
```

In [3]:
```
data.describe()
```

Out[3]:

	reading score	writing score
count	994.000000	991.000000
mean	68.008048	69.487386
std	16.602270	29.563757
min	3.000000	10.000000
25%	58.000000	57.000000
50%	69.500000	69.000000
75%	79.000000	79.000000
max	100.000000	567.000000

In [4]:
```
data.head()
```

Out[4]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	female	group B	bachelor's degree	standard	none	72	72.0	74.0
1	female	group C	some college	standard	completed	69	90.0	88.0
2	female	group B	master's degree	standard	none	90	95.0	93.0
3	male	group A	associate's degree	free/reduced	none	47	57.0	44.0
4	male	group C	some college	standard	none	76	78.0	75.0

In [5]:
```
data.dtypes
```

Out[5]:
```
gender                         object
race/ethnicity                 object
parental level of education    object
lunch                          object
test preparation course        object
math score                     object
reading score                 float64
writing score                 float64
dtype: object
```

In [6]:
```
data['race/ethnicity'].unique()
```

Out[6]:
```
array(['group B', 'group C', 'group A', 'group D', 'group E'],
      dtype=object)
```

In [7]:
```
data['parental level of education'].unique()
```

Out[7]:
```
array(["bachelor's degree", 'some college', "master's degree",
       "associate's degree", 'high school', 'some high school'],
      dtype=object)
```

In [8]:
```
data['lunch'].unique()
```

Out[8]:
```
array(['standard', 'free/reduced'], dtype=object)
```

In [9]:
```
data['test preparation course'].unique()
```

Out[9]:
```
array(['none', 'completed'], dtype=object)
```

In [10]:
```
data['math score'].unique()
```

Out[10]:
```
array(['72', '69', '90', '47', '76', '71', '88', '40', '64', '38', '58',
       '65', '78', '50', nan, '74', '73', '67', '70', '62', '63', '56',
       '81', '75', '57', '55', '53', '59', '66', '82', '77', '33', '52',
       '0', '79', '39', '45', '60', '61', '41', '49', '44', '30', '80',
       '42', '27', '43', '68', '85', '98', '87', '54', '51', '99', '84',
       '91', '83', '89', '22', '100', '96', '94', '46', '97', '48', '35',
       '34', '86', '92', '37', '28', '24', '113', '123', '?', '-89', '26',
       '334', '95', '36', '29', '32', '93', '19', '23', '8'], dtype=object)
```

In [11]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 8 columns):
 #   Column                       Non-Null Count  Dtype  
---  ------                       --------------  -----  
 0   gender                       1000 non-null   object 
 1   race/ethnicity               1000 non-null   object 
 2   parental level of education  1000 non-null   object 
 3   lunch                        1000 non-null   object 
 4   test preparation course      1000 non-null   object 
 5   math score                   992 non-null    object 
 6   reading score                994 non-null    float64
 7   writing score                991 non-null    float64
dtypes: float64(2), object(6)
memory usage: 62.6+ KB
```

In [12]:
```
data.isnull().sum()
```

Out[12]:
```
gender                       0
race/ethnicity               0
parental level of education  0
lunch                        0
test preparation course      0
math score                   8
reading score                6
writing score                9
dtype: int64
```

In [13]:
```
data.isnull()
```

Out[13]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...
995	False	False	False	False	False	False	False	False
996	False	False	False	False	False	False	False	False
997	False	False	False	False	False	False	False	False
998	False	False	False	False	False	False	False	False
999	False	False	False	False	False	False	False	False

1000 rows × 8 columns

In [14]:
```
data2 = data
data2
```

Out[14]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	female	group B	bachelor's degree	standard	none	72	72.0	74.0
1	female	group C	some college	standard	completed	69	90.0	88.0
2	female	group B	master's degree	standard	none	90	95.0	93.0
3	male	group A	associate's degree	free/reduced	none	47	57.0	44.0
4	male	group C	some college	standard	none	76	78.0	75.0
...	...	...	...	...	...	...	...	...
995	female	group E	master's degree	standard	completed	88	99.0	95.0
996	male	group C	high school	free/reduced	none	62	55.0	55.0
997	female	group C	high school	free/reduced	completed	59	71.0	65.0
998	female	group D	some college	standard	completed	68	78.0	77.0
999	female	group D	some college	free/reduced	none	77	86.0	86.0

1000 rows × 8 columns

Converting Categorical values into Quantitative Values

In [15]:
```
encoder = LabelEncoder()
data2['parental level of education'] = encoder.fit_transform(data2['parental leve
data2['test preparation course'] = encoder.fit_transform(data2['test preparation
data2['lunch'] = encoder.fit_transform(data2['lunch'])
```

In [16]:
```
data2.head()
```

Out[16]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	female	group B	1	1	1	72	72.0	74.0
1	female	group C	4	1	0	69	90.0	88.0
2	female	group B	3	1	1	90	95.0	93.0
3	male	group A	0	0	1	47	57.0	44.0
4	male	group C	4	1	1	76	78.0	75.0

Handling Missing Values

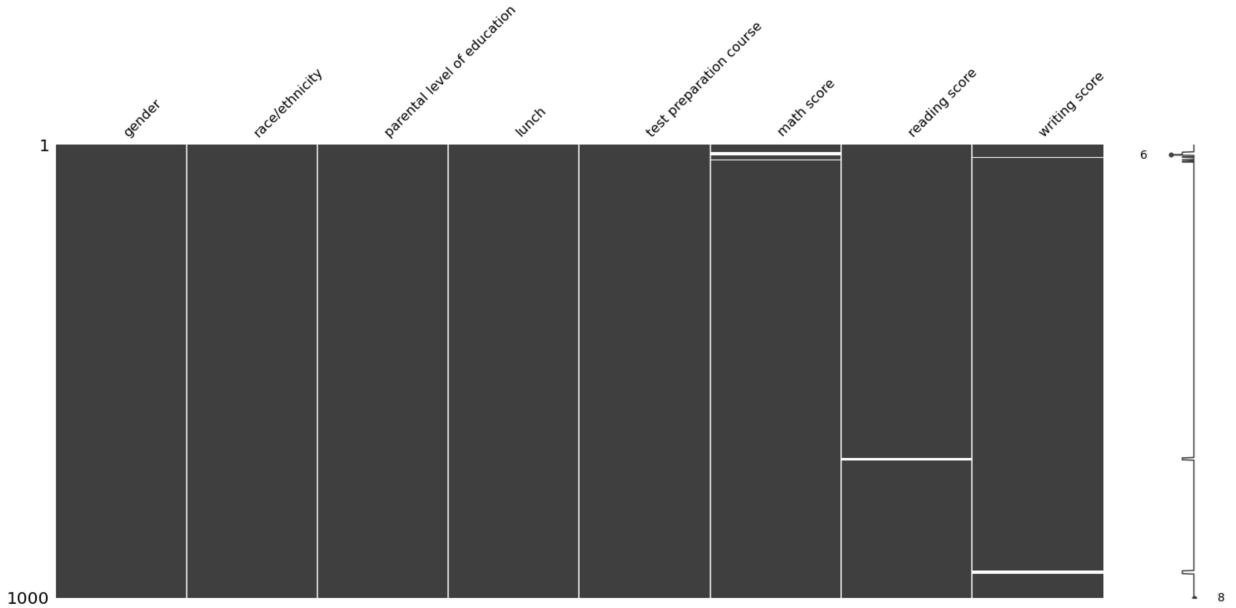
In [17]:
```
data2.isnull().sum()
```

Out[17]:
```
gender                         0
race/ethnicity                 0
parental level of education    0
lunch                          0
test preparation course        0
math score                     8
reading score                  6
writing score                  9
dtype: int64
```

In [19]:
```
import missingno as msno
```

In [20]:
```
msno.matrix(data2)
```

Out[20]: <AxesSubplot:>



In [21]:
```
data2.dtypes
```

Out[21]:
```
gender                         object
race/ethnicity                 object
parental level of education     int32
lunch                           int32
test preparation course         int32
math score                     object
reading score                 float64
writing score                 float64
dtype: object
```

In [25]:
```
data2['math score'] = data2["math score"].apply(pd.to_numeric, errors='coerce')
```

In [26]:
```
data2['reading score']=data2['reading score'].fillna(data2['reading score'].media
```

In [27]:
```
data2['writing score']=data2['writing score'].fillna(data2['writing score'].media
```

In [28]:
```
data2['math score']=data2['math score'].fillna(data2['math score'].median())
```

In [29]:
```
data2.isnull().sum()
```

Out[29]:
```
gender                         0
race/ethnicity                 0
parental level of education    0
lunch                          0
test preparation course        0
math score                     0
reading score                  0
writing score                  0
dtype: int64
```

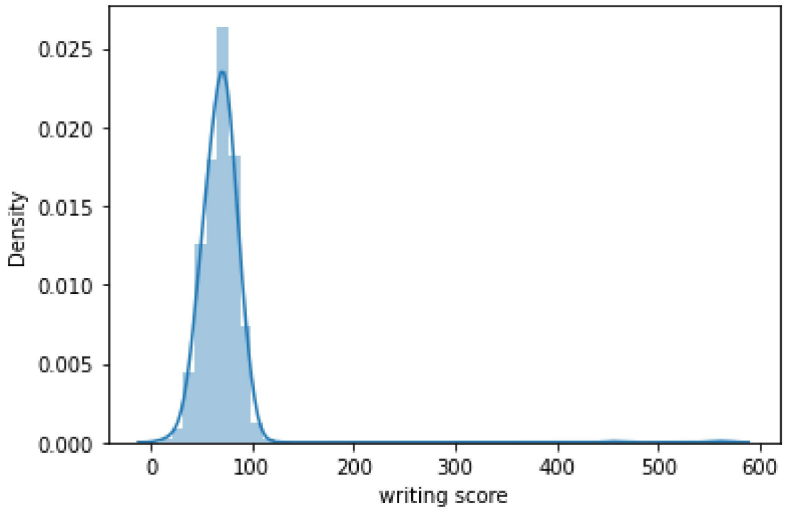
In [30]:
```
data2.dtypes
```

Out[30]:
```
gender                          object
race/ethnicity                  object
parental level of education      int32
lunch                            int32
test preparation course          int32
math score                     float64
reading score                  float64
writing score                  float64
dtype: object
```

In [31]:
```
sns.distplot(data2['writing score'])
```

```
c:\users\lenovo\appdata\local\programs\python\python39\lib\site-packages\seabor
n\distributions.py:2619: FutureWarning: `distplot` is a deprecated function and
will be removed in a future version. Please adapt your code to use either `disp
lot` (a figure-level function with similar flexibility) or `histplot` (an axes-
level function for histograms).
  warnings.warn(msg, FutureWarning)
```

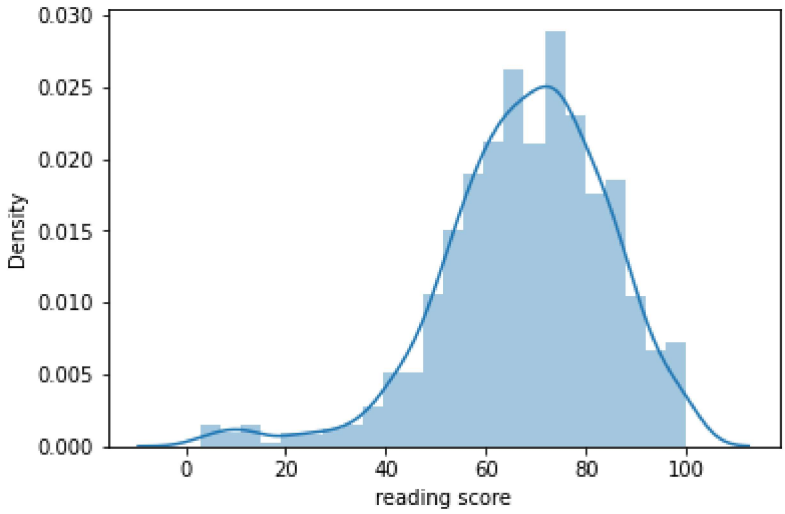
Out[31]: <AxesSubplot:xlabel='writing score', ylabel='Density'>



In [32]:
```
sns.distplot(data2['reading score'])
```

```
c:\users\lenovo\appdata\local\programs\python\python39\lib\site-packages\seabor
n\distributions.py:2619: FutureWarning: `distplot` is a deprecated function and
will be removed in a future version. Please adapt your code to use either `disp
lot` (a figure-level function with similar flexibility) or `histplot` (an axes-
level function for histograms).
  warnings.warn(msg, FutureWarning)
```

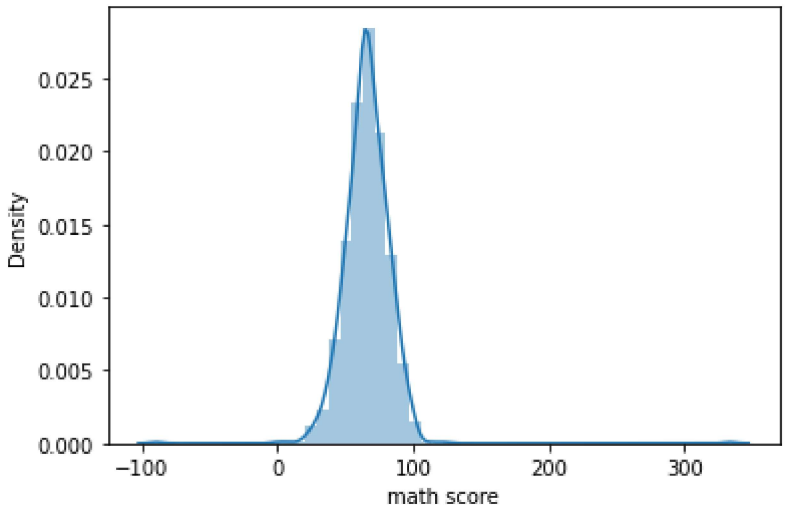
Out[32]: <AxesSubplot:xlabel='reading score', ylabel='Density'>



In [33]:
```
sns.distplot(data2['math score'])
```

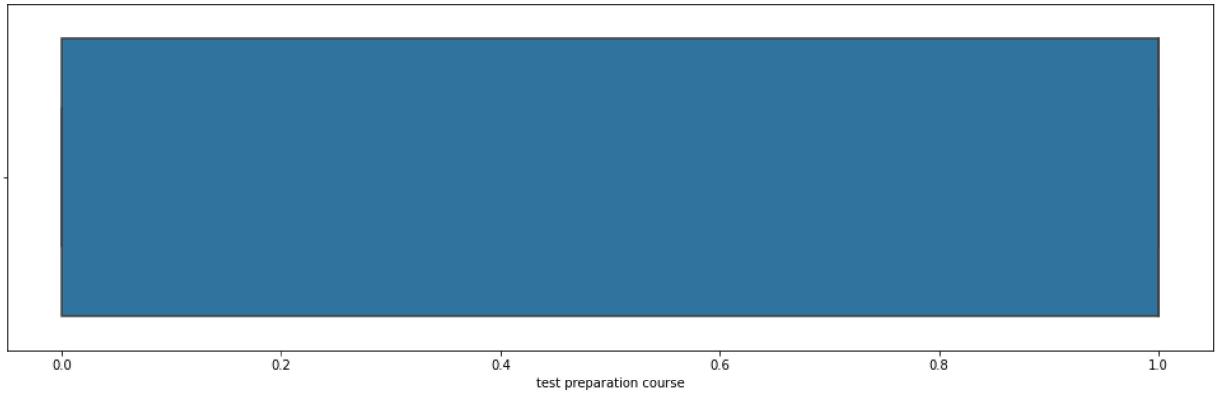
```
c:\users\lenovo\appdata\local\programs\python\python39\lib\site-packages\seabor
n\distributions.py:2619: FutureWarning: `distplot` is a deprecated function and
will be removed in a future version. Please adapt your code to use either `disp
lot` (a figure-level function with similar flexibility) or `histplot` (an axes-
level function for histograms).
  warnings.warn(msg, FutureWarning)
```

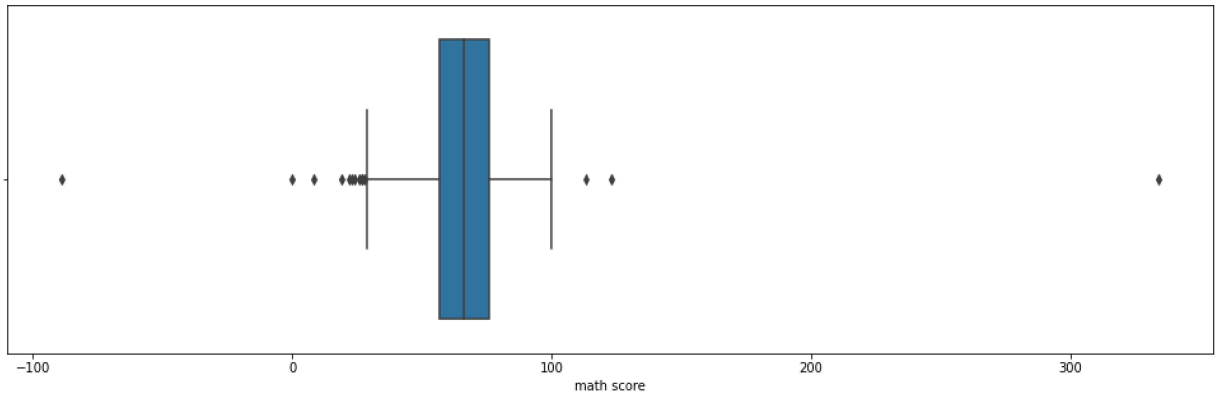
Out[33]:
```
<AxesSubplot:xlabel='math score', ylabel='Density'>
```

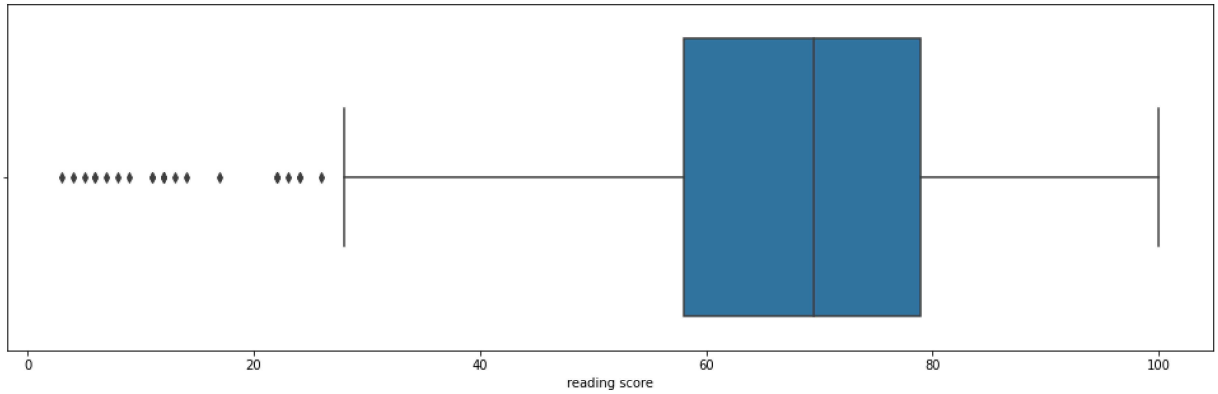


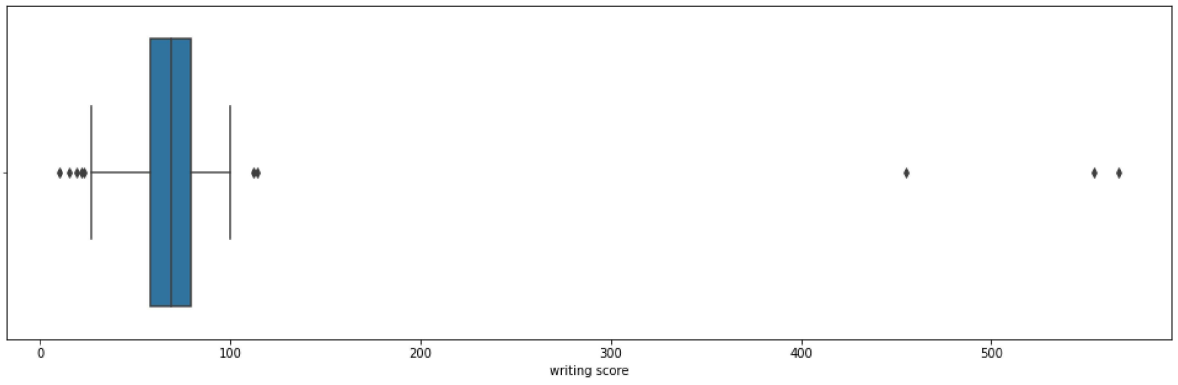
In [34]:
```
num_cols = ['test preparation course', 'math score', 'reading score', 'writing sc
```

In [36]:
```
for col in num_cols :
    plt.figure(figsize = (17,5))
    sns.boxplot(data=data2, x = col)
```









In [37]:
```
data2.dtypes
```

Out[37]:
```
gender                         object
race/ethnicity                 object
parental level of education     int32
lunch                           int32
test preparation course         int32
math score                    float64
reading score                 float64
writing score                 float64
dtype: object
```

In [38]:
```
### getting interquartile range (IQR) to get variation of outliers:
Q1=data2.quantile(0.25)
Q3=data2.quantile(0.75)
iq_range=Q3-Q1
iq_range
```

Out[38]:
```
parental level of education     3.0
lunch                           1.0
test preparation course         1.0
math score                     19.0
reading score                  21.0
writing score                  21.0
dtype: float64
```

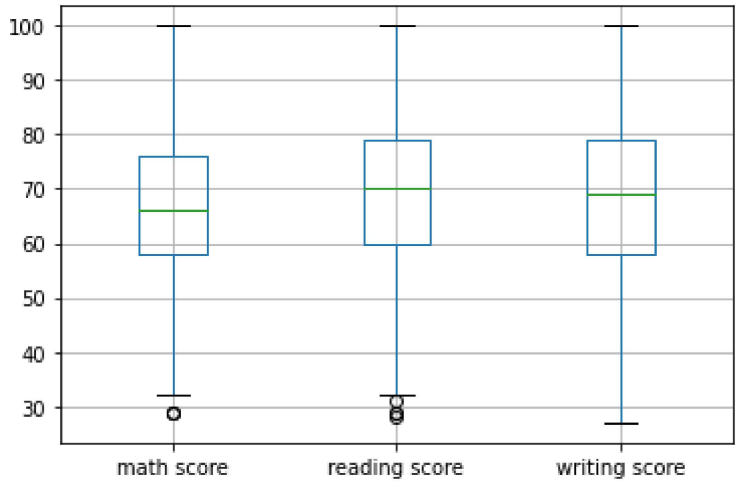
In [39]:
```
for i in ["math score", "reading score", "writing score"]:
    q1 = data2[i].quantile(0.25)
    q2 = data2[i].median()
    q3 = data2[i].quantile(0.75)

    iqr = q3 - q1

    lower_limit = q1 - 1.5 * iqr
    upper_limit = q3 + 1.5 * iqr

    lower_outliers = data2[i] < lower_limit
    upper_outliers = data2[i] > upper_limit

    data2[i] = data2[i][~(lower_outliers | upper_outliers)]
data2.dropna(inplace=True)
```

In [40]:
```
data2.shape
```

Out[40]:
```
(960, 8)
```

In [42]:
```
data2.boxplot(column=["math score", "reading score", "writing score"])
```

Out[42]: <AxesSubplot:>



In [43]:
```
data3 =data2[["math score", "reading score", "writing score"]]
```

In [44]:
```
data3.describe()
```

Out[44]:

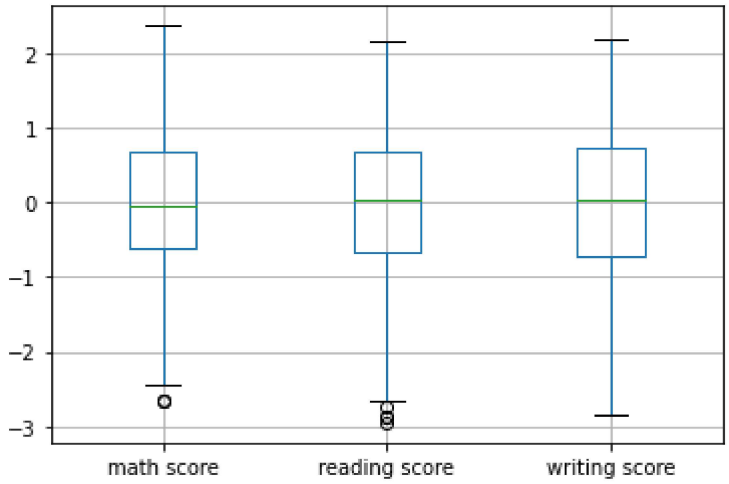
	math score	reading score	writing score
count	960.000000	960.000000	960.000000
mean	66.598958	69.498958	68.490625
std	14.140093	14.079119	14.536421
min	29.000000	28.000000	27.000000
25%	58.000000	60.000000	58.000000
50%	66.000000	70.000000	69.000000
75%	76.000000	79.000000	79.000000
max	100.000000	100.000000	100.000000

In [45]:
```
dfzscore = (data3 - data3.mean()) / data3.std()
print(dfzscore.describe())
```

```
         math score  reading score  writing score
count  9.600000e+02   9.600000e+02   9.600000e+02
mean   3.312165e-16  -7.031412e-17   4.033810e-16
std    1.000000e+00   1.000000e+00   1.000000e+00
min   -2.659032e+00  -2.947554e+00  -2.854253e+00
25%   -6.081260e-01  -6.746842e-01  -7.216787e-01
50%   -4.235887e-02   3.558757e-02   3.504129e-02
75%    6.648501e-01   6.748321e-01   7.229686e-01
max    2.362151e+00   2.166403e+00   2.167616e+00
```

In [46]:
```
dfzscore.boxplot()
```

Out[46]: <AxesSubplot:>

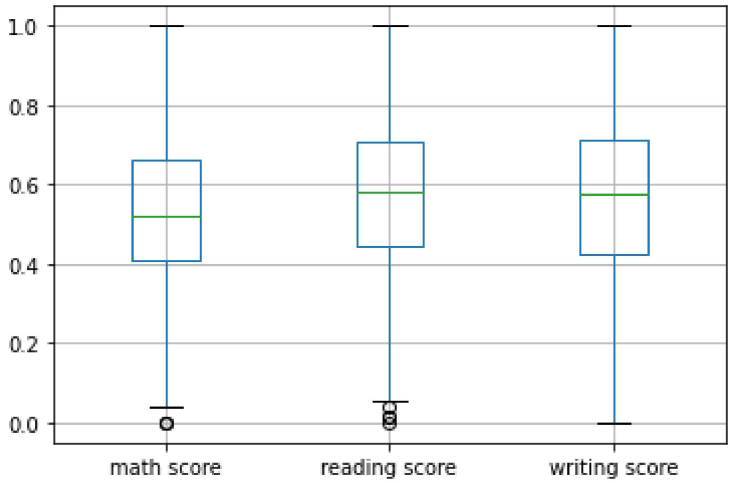


In [47]:
```
dfminmax = (data3 - data3.min()) / (data3.max() - data3.min())
print(dfminmax.describe())
```

```
       math score  reading score  writing score
count  960.000000     960.000000     960.000000
mean     0.529563       0.576374       0.568365
std      0.199156       0.195543       0.199129
min      0.000000       0.000000       0.000000
25%      0.408451       0.444444       0.424658
50%      0.521127       0.583333       0.575342
75%      0.661972       0.708333       0.712329
max      1.000000       1.000000       1.000000
```

In [48]:
```
dfminmax.boxplot()
```

Out[48]: <AxesSubplot:>



In [49]:
```
data3.head()
```

Out[49]:

	math score	reading score	writing score
0	72.0	72.0	74.0
1	69.0	90.0	88.0
2	90.0	95.0	93.0
3	47.0	57.0	44.0
4	76.0	78.0	75.0

In [ ]:

In [ ]:

In [74]:
```
### removing outliers using z-score.
### Any z-score greater than 3 or less than -3 is considered to be an outlier.
from scipy import stats
numeric_columns=["math score", "reading score", "writing score"]
z=np.abs(stats.zscore(data2[numeric_columns]))
print(z)

threshold1=-3
threshold2=3

# print(np.where(((z>threshold1) & (z<threshold2)), z))
# print(np.where(((z>threshold1) & (z<threshold2))))
z[(z>threshold1) & (z<threshold2)]
```

```
     math score  reading score  writing score
0      0.318347       0.240745       0.153558
1      0.150502       1.328723       0.629496
2      1.325422       1.630939       0.799474
3      1.080367       0.665903       0.866309
4      0.542142       0.603404       0.187554
..          ...            ...            ...
995    1.213525       1.872711       0.867465
996    0.241138       0.786789       0.492358
997    0.408984       0.180302       0.152402
998    0.094553       0.603404       0.255545
999    0.598090       1.086950       0.561505

[1000 rows x 3 columns]
```

Out[74]:

	math score	reading score	writing score
0	0.318347	0.240745	0.153558
1	0.150502	1.328723	0.629496
2	1.325422	1.630939	0.799474
3	1.080367	0.665903	0.866309
4	0.542142	0.603404	0.187554
...	...	...	...
995	1.213525	1.872711	0.867465
996	0.241138	0.786789	0.492358
997	0.408984	0.180302	0.152402
998	0.094553	0.603404	0.255545
999	0.598090	1.086950	0.561505

1000 rows × 3 columns

In [ ]: