# EDA_on_Students_performance_in_exams

Dataset:https://www.kaggle.com/spscientist/students-performance-in-exams Context Marks secured by the students Content This data set consists of the marks secured by the students in various subjects. Acknowledgements http://roycekimmons.com/tools/generated_data/exams Inspiration To understand the influence of the parents background, test preparation etc on students performance

In [1]:

```
import pandas as pd
import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt
student_performance=pd.read_csv('datasets_74977_169835_StudentsPerformance.csv')
```

In [2]:

```
student_performance.dtypes
```

Out[2]:

```
gender                         object
race/ethnicity                 object
parental level of education    object
lunch                          object
test preparation course        object
math score                      int64
reading score                   int64
writing score                   int64
dtype: object
```

In [3]:

```
student_performance.head()
```

Out[3]:

| | 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 | 74 |
| **1** | female | group C | some college | standard | completed | 69 | 90 | 88 |
| **2** | female | group B | master's degree | standard | none | 90 | 95 | 93 |
| **3** | male | group A | associate's degree | free/reduced | none | 47 | 57 | 44 |
| **4** | male | group C | some college | standard | none | 76 | 78 | 75 |

In [4]:

```
student_performance.shape
```

Out[4]:

```
(1000, 8)
```

In [5]:

```
student_performance.tail()
```

Out[5]:

| | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score |
|---|---|---|---|---|---|---|---|---|

|  | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score |
|---|---|---|---|---|---|---|---|---|
| **995** | female | group E | master's degree | standard | completed | 88 | 99 | 95 |
| **996** | male | group C | high school | free/reduced | none | 62 | 55 | 55 |
| **997** | female | group C | high school | free/reduced | completed | 59 | 71 | 65 |
| **998** | female | group D | some college | standard | completed | 68 | 78 | 77 |
| **999** | female | group D | some college | free/reduced | none | 77 | 86 | 86 |

In [6]:

```
student_performance.columns
```

Out[6]:

```
Index(['gender', 'race/ethnicity', 'parental level of education', 'lunch',
       'test preparation course', 'math score', 'reading score',
       'writing score'],
      dtype='object')
```

In [7]:

```
student_performance.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 8 columns):
gender                         1000 non-null object
race/ethnicity                 1000 non-null object
parental level of education    1000 non-null object
lunch                          1000 non-null object
test preparation course        1000 non-null object
math score                     1000 non-null int64
reading score                  1000 non-null int64
writing score                  1000 non-null int64
dtypes: int64(3), object(5)
memory usage: 62.6+ KB
```

In [8]:

```
student_performance.describe()
```

Out[8]:

|  | math score | reading score | writing score |
|---|---|---|---|
| **count** | 1000.00000 | 1000.000000 | 1000.000000 |
| **mean** | 66.08900 | 69.169000 | 68.054000 |
| **std** | 15.16308 | 14.600192 | 15.195657 |
| **min** | 0.00000 | 17.000000 | 10.000000 |
| **25%** | 57.00000 | 59.000000 | 57.750000 |
| **50%** | 66.00000 | 70.000000 | 69.000000 |
| **75%** | 77.00000 | 79.000000 | 79.000000 |
| **max** | 100.00000 | 100.000000 | 100.000000 |

Observation:The above cell provides info on the mean, minimum, maximum and quartile range values of the marks scored by students in respective exams.

In [9]:

```
student_performance.isnull()
```

Out[9]:

|  |  |  | parental level of | | test preparation | math | reading | writing |
|---|---|---|---|---|---|---|---|---|

| | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score |
|---|---|---|---|---|---|---|---|---|
| | 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 [10]:

```
student_performance.isnull().any()
```

Out[10]:

```
gender                         False
race/ethnicity                 False
parental level of education    False
lunch                          False
test preparation course        False
math score                     False
reading score                  False
writing score                  False
dtype: bool
```

In [11]:

```
#shows for each column the percentage of null values
student_performance.isnull().sum() / student_performance.shape[0]
```

Out[11]:

```
gender                         0.0
race/ethnicity                 0.0
parental level of education    0.0
lunch                          0.0
test preparation course        0.0
math score                     0.0
reading score                  0.0
writing score                  0.0
dtype: float64
```

In [12]:

```
student_performance['parental level of education'].value_counts()
```

Out[12]:

```
some college          226
associate's degree    222
high school           196
some high school      179
bachelor's degree     118
master's degree        59
Name: parental level of education, dtype: int64
```

Observation: The above cell shows the info on the counts of students based on parent's education level.

In [13]:

In [13]:

```
student_performance['race/ethnicity'].value_counts()
```

Out[13]:

```
group C    319
group D    262
group B    190
group E    140
group A     89
Name: race/ethnicity, dtype: int64
```

In [ ]:

```
Observation:
The above cell shows the info on the counts of students based on their etnicity.
```

In [14]:

```
student_performance['gender'].value_counts()
```

Out[14]:

```
female    518
male      482
Name: gender, dtype: int64
```

In [ ]:

```
Observation:
The above cell shows the info on the counts of students based on gender.
```

In [15]:

```
student_performance['lunch'].value_counts()
```

Out[15]:

```
standard        645
free/reduced    355
Name: lunch, dtype: int64
```

Observation: The above cell shows the info on the counts of students based on lunch, which indiactes their financial background. The standard count indicate the students who are privileged and the free/reduced type indicates underprivileged students.

In [16]:

```
student_performance['test preparation course'].value_counts()
```

Out[16]:

```
none         642
completed    358
Name: test preparation course, dtype: int64
```

Observation: The above cell shows the info on the counts of students based on whether they have taken a preparation course or not.

In [17]:

```
student_performance.iloc[:, 5:8].sum(axis=1)
```

Out[17]:

```
0      218
1      247
2      278
3      148
4      229
      ...
995    282
996    172
997    195
```

```
997    195
998    223
999    249
Length: 1000, dtype: int64
```

In [18]:

```
student_performance['total_marks']= student_performance.iloc[:, 5:8].sum(axis=1)
```

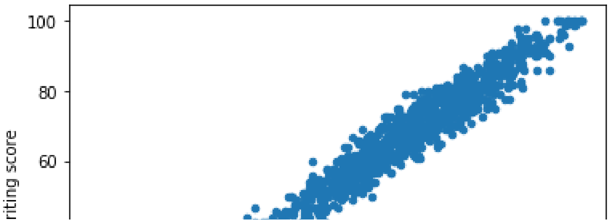
In [19]:

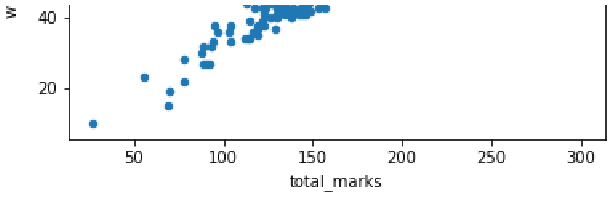
```
print(student_performance)
```

```
    gender race/ethnicity parental level of education         lunch  \
0   female        group B           bachelor's degree      standard
1   female        group C                some college      standard
2   female        group B             master's degree      standard
3     male        group A          associate's degree  free/reduced
4     male        group C                some college      standard
..     ...            ...                         ...           ...
995 female        group E             master's degree      standard
996   male        group C                 high school  free/reduced
997 female        group C                 high school  free/reduced
998 female        group D                some college      standard
999 female        group D                some college  free/reduced

    test preparation course  math score  reading score  writing score  \
0                      none          72             72             74
1                 completed          69             90             88
2                      none          90             95             93
3                      none          47             57             44
4                      none          76             78             75
..                      ...         ...            ...            ...
995               completed          88             99             95
996                    none          62             55             55
997               completed          59             71             65
998               completed          68             78             77
999                    none          77             86             86

     total_marks
0            218
1            247
2            278
3            148
4            229
..           ...
995          282
996          172
997          195
998          223
999          249

[1000 rows x 9 columns]
```

In [20]:

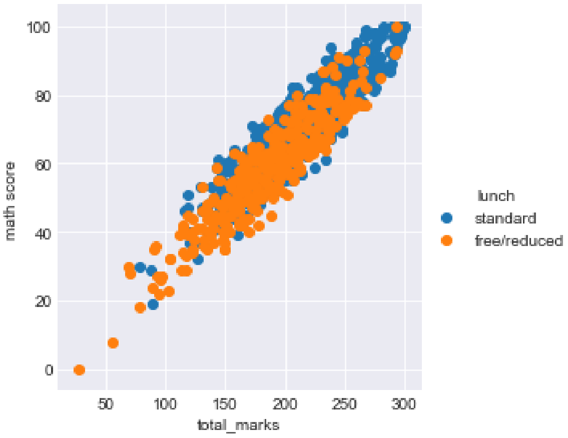
```
#2-D scatter plot:
#ALWAYS understand the axis: labels and scale.

student_performance.plot(kind='scatter', x='total_marks', y='writing score') ;
plt.show()

#cannot make much sense out it.
#What if we color the points by thier class-label/flower-type.
```





In [21]:

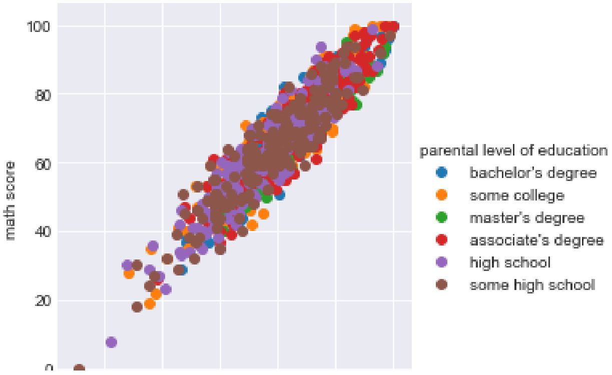
```
# 2-D Scatter plot with color-coding for each flower type/class.
# Here 'sns' corresponds to seaborn.
sns.set_style("darkgrid");
sns.FacetGrid(student_performance, hue="lunch", size=4) \
   .map(plt.scatter, "total_marks", "math score") \
   .add_legend();
#plt.show();

# Notice that the blue points can be easily seperated
# from red and green by drawing a line.
# But red and green data points cannot be easily seperated.
# Can we draw multiple 2-D scatter plots for each combination of features?
# How many cobinations exist? 4C2 = 6.
```



Observation: From the above results, we are unable to come to a conclusion on who scored better marks based on privilege level. But from the plot we can infer a slight advantage for the privileged students over the underprivileged one's.

In [22]:

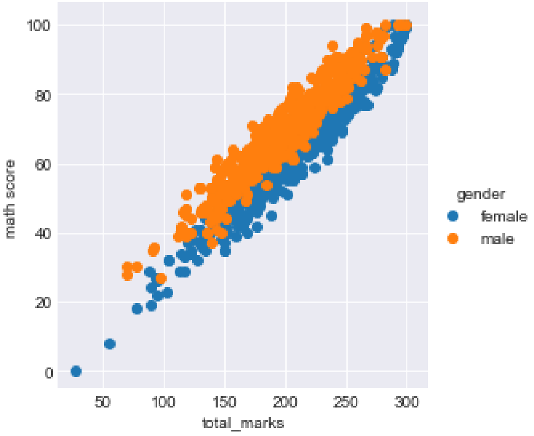
```
# 2-D Scatter plot with color-coding for each flower type/class.
# Here 'sns' corresponds to seaborn.
sns.set_style("darkgrid");
sns.FacetGrid(student_performance, hue="parental level of education", size=4) \
   .map(plt.scatter, "total_marks", "math score") \
   .add_legend();
#plt.show();

# Notice that the blue points can be easily seperated
# from red and green by drawing a line.
# But red and green data points cannot be easily seperated.
# Can we draw multiple 2-D scatter plots for each combination of features?
# How many cobinations exist? 4C2 = 6.
```



Observation: We are unable to infer much abouut students performance based on their parent's education level as all the points overlap each other.

In [23]:

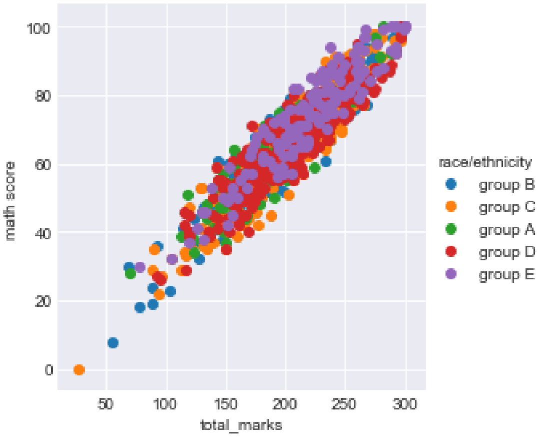
```
# 2-D Scatter plot with color-coding for each flower type/class.
# Here 'sns' corresponds to seaborn.
sns.set_style("darkgrid");
sns.FacetGrid(student_performance, hue="gender", size=4) \
   .map(plt.scatter, "total_marks", "math score") \
   .add_legend();
#plt.show();

# Notice that the blue points can be easily seperated
# from red and green by drawing a line.
# But red and green data points cannot be easily seperated.
# Can we draw multiple 2-D scatter plots for each combination of features?
# How many cobinations exist? 4C2 = 6.
```



Observation: Although the total marks of students of both gender doesn't vary much, boys have scored better than girls in maths.

In [24]:

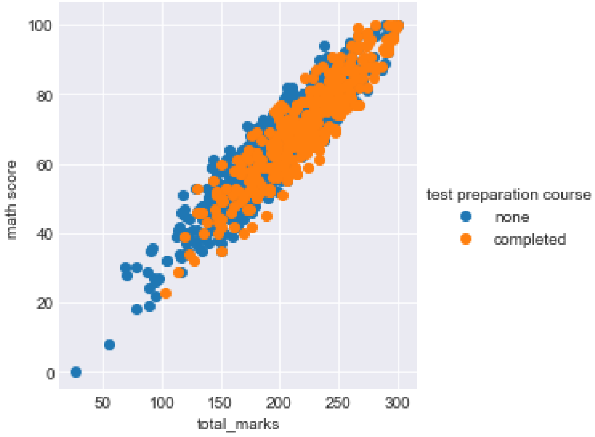
```
# 2-D Scatter plot with color-coding for each flower type/class.
# Here 'sns' corresponds to seaborn.
sns.set_style("darkgrid");
sns.FacetGrid(student_performance, hue="race/ethnicity", size=4) \
   .map(plt.scatter, "total_marks", "math score") \
   .add_legend();
#plt.show();

# Notice that the blue points can be easily seperated
# from red and green by drawing a line.
# But red and green data points cannot be easily seperated.
# Can we draw multiple 2-D scatter plots for each combination of features?
# How many cobinations exist? 4C2 = 6.
```



Observation: There is significant overlap of points from all ethnicity, so not much can be inferred from above plot.

In [25]:

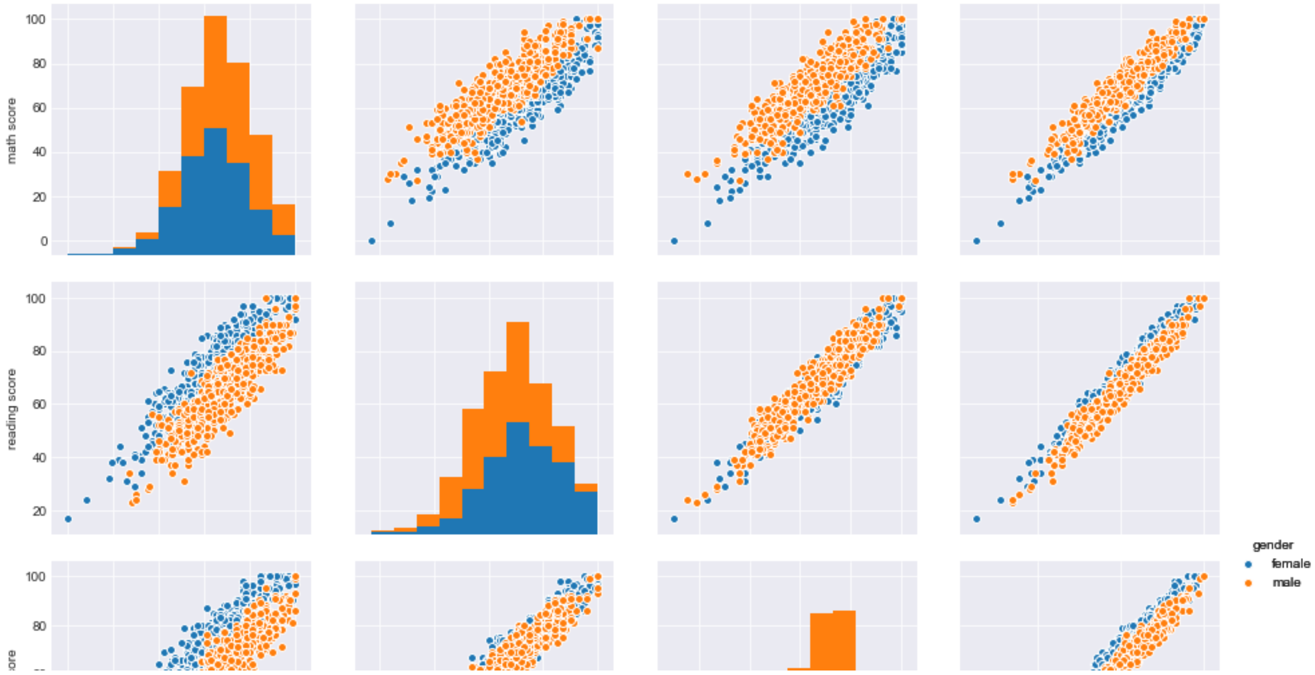
```
# 2-D Scatter plot with color-coding for each flower type/class.
# Here 'sns' corresponds to seaborn.
sns.set_style("darkgrid");
sns.FacetGrid(student_performance, hue="test preparation course", size=4) \
   .map(plt.scatter, "total_marks", "math score") \
   .add_legend();
#plt.show();

# Notice that the blue points can be easily seperated
# from red and green by drawing a line.
# But red and green data points cannot be easily seperated.
# Can we draw multiple 2-D scatter plots for each combination of features?
# How many cobinations exist? 4C2 = 6.
```

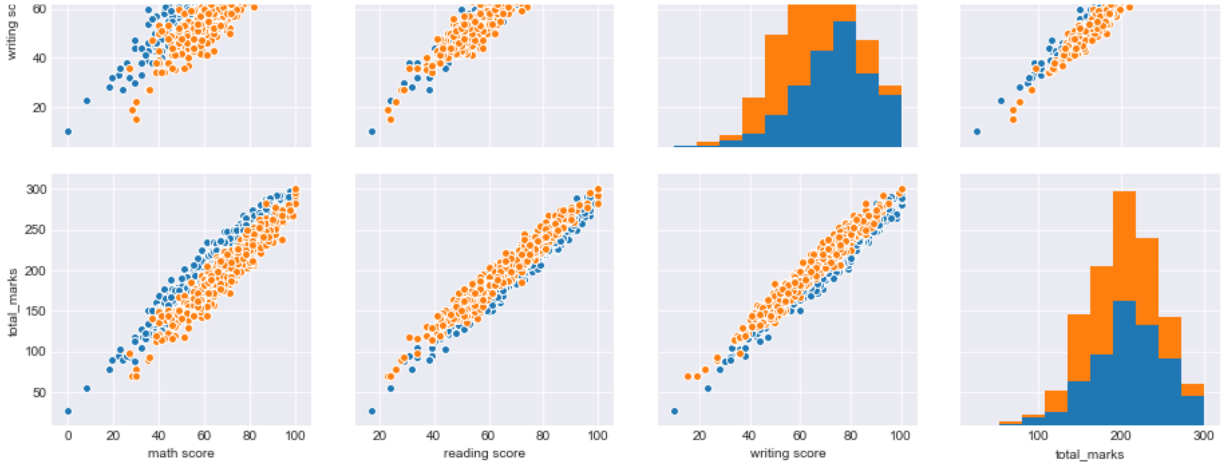


Observation: The above plot indicate a very slight advantage for the students with test preparation course. But its not bery significaant.

In [26]:

```
# pairwise scatter plot: Pair-Plot
# Dis-advantages:
##Cannot be used when number of features are high.
##Cannot visualize higher dimensional patterns in 3-D and 4-D.
#Only possible to view 2D patterns.
plt.close();
sns.set_style("darkgrid");
sns.pairplot(student_performance, hue="gender", size=3).add_legend();
#plt.show()
# NOTE: the diagnol elements are PDFs for each feature. PDFs are expalined below.
```

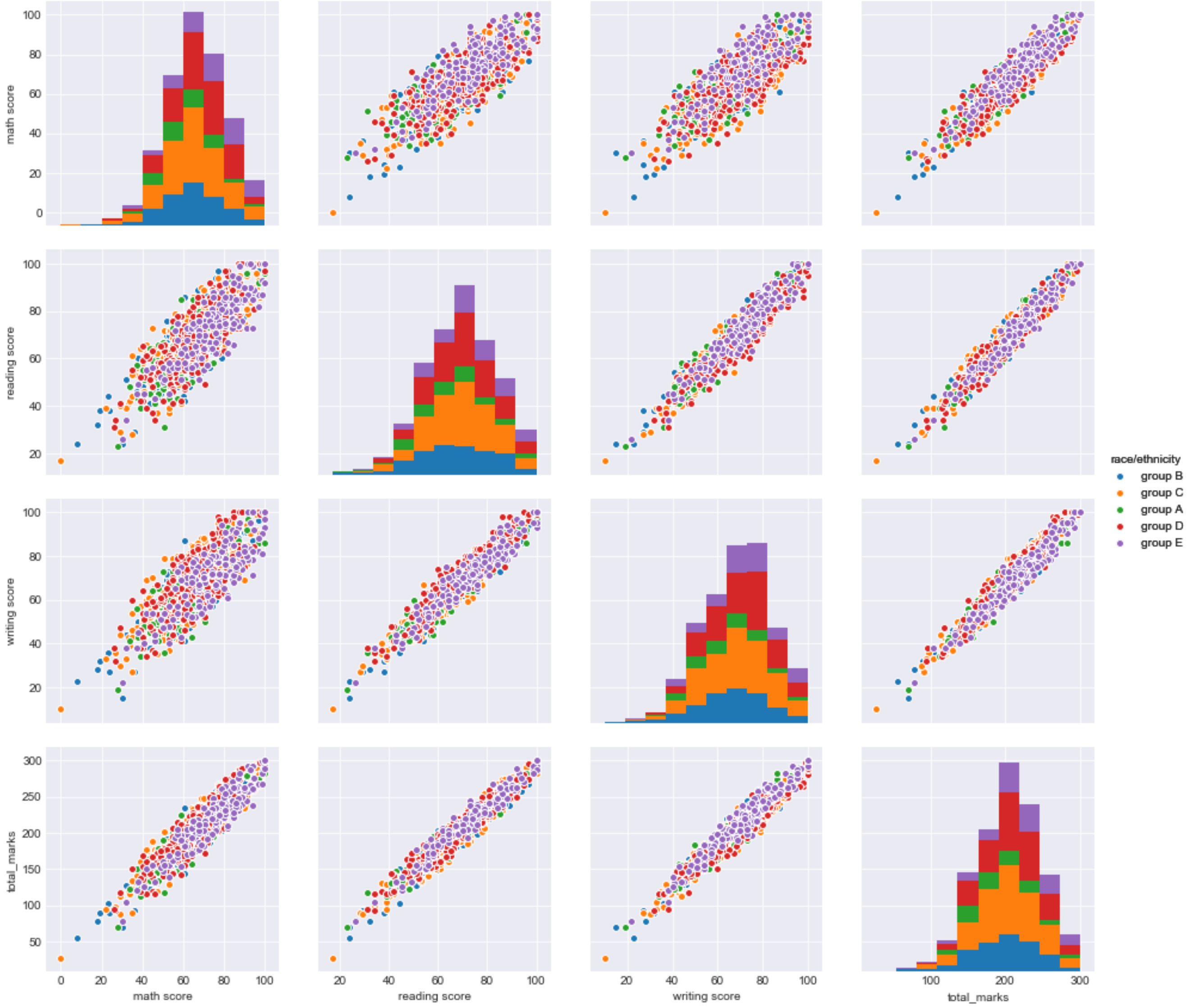




Observation: The above pair plots are plotted based on student's gender. Although girls have a slight advantage over boys in reading and writing score, boys outclassed them in maths.

In [27]:

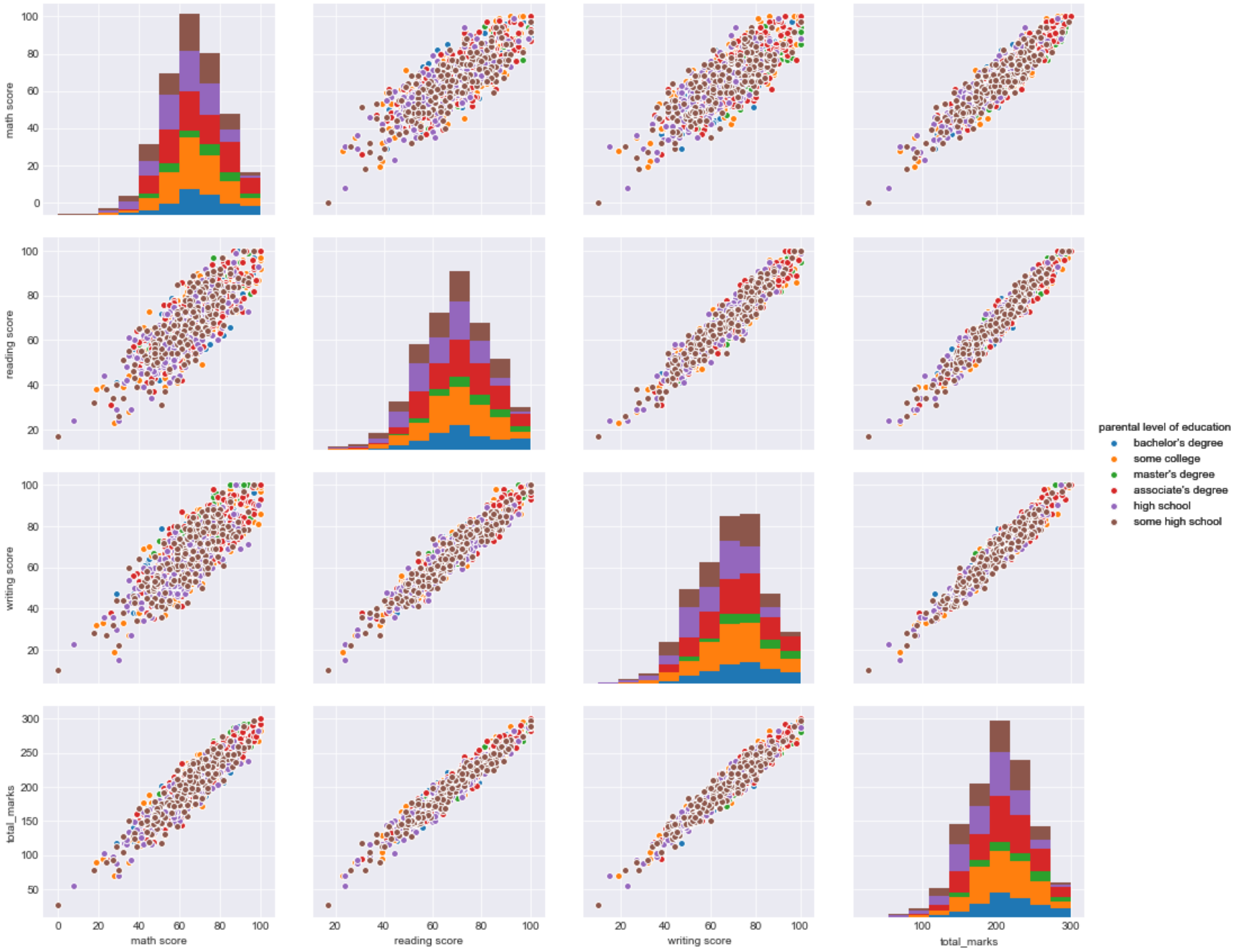
```
# pairwise scatter plot: Pair-Plot
# Dis-advantages:
##Cannot be used when number of features are high.
##Cannot visualize higher dimensional patterns in 3-D and 4-D.
#Only possible to view 2D patterns.
plt.close();
sns.set_style("darkgrid");
sns.pairplot(student_performance, hue="race/ethnicity", size=3).add_legend();
#plt.show()
# NOTE: the diagnol elements are PDFs for each feature. PDFs are expalined below.
```



Observation: The above pair plots are plotted based on student's ethnicity. But not much information ccan be obtained due to overlap of points.

In [28]:

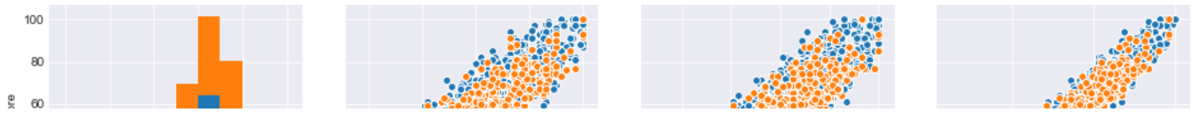
```
# pairwise scatter plot: Pair-Plot
# Dis-advantages:
##Cannot be used when number of features are high.
##Cannot visualize higher dimensional patterns in 3-D and 4-D.
#Only possible to view 2D patterns.
plt.close();
sns.set_style("darkgrid");
sns.pairplot(student_performance, hue="parental level of education", size=3).add_legend();
#plt.show()
# NOTE: the diagnol elements are PDFs for each feature. PDFs are expalined below.
```

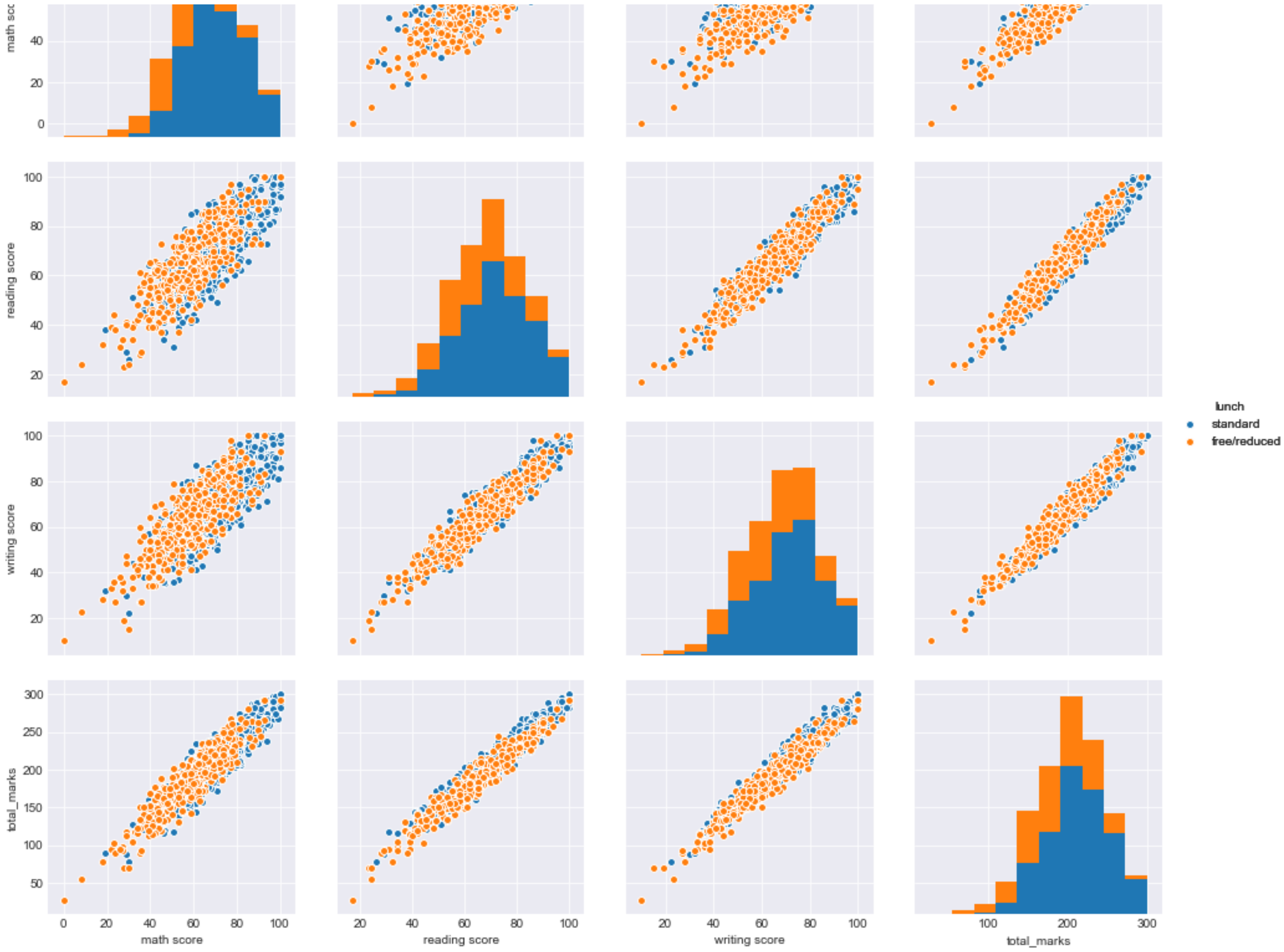


Observation: The above pair plots are plotted based on parental level of education. But not much information ccan be obtained due to overlap of points.

In [29]:

```
# pairwise scatter plot: Pair-Plot
# Dis-advantages:
##Cannot be used when number of features are high.
##Cannot visualize higher dimensional patterns in 3-D and 4-D.
#Only possible to view 2D patterns.
plt.close();
sns.set_style("darkgrid");
sns.pairplot(student_performance, hue="lunch", size=3).add_legend();
#plt.show()
# NOTE: the diagnol elements are PDFs for each feature. PDFs are expalined below.
```

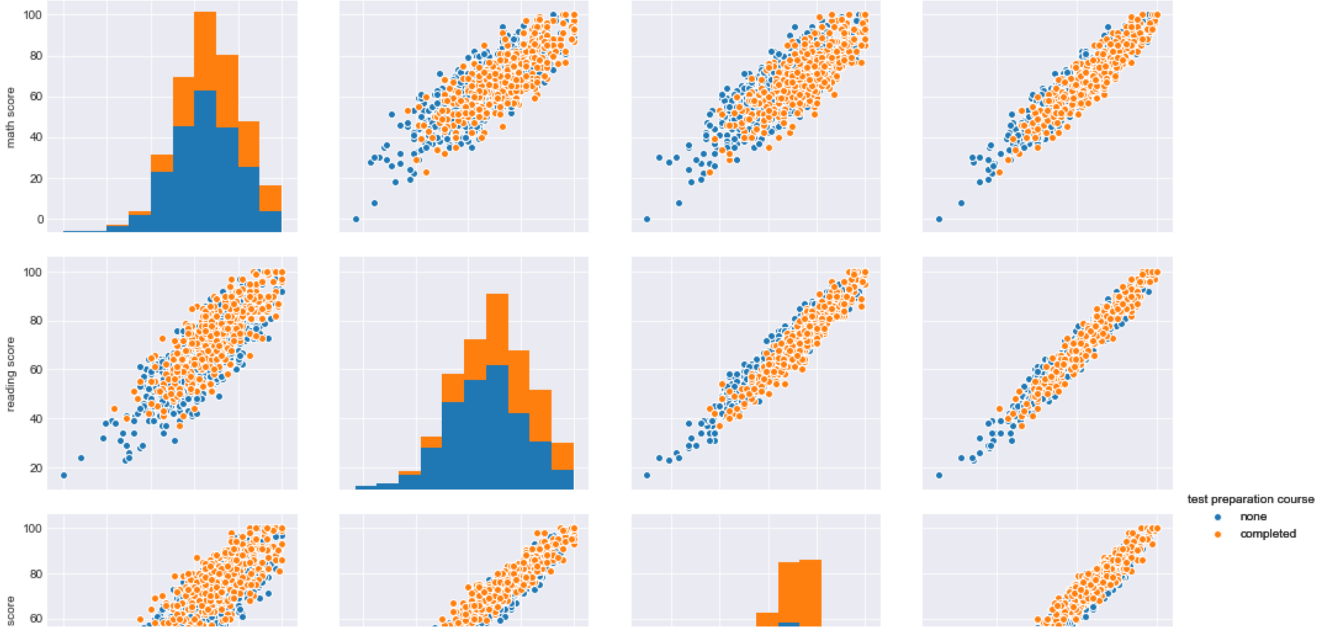


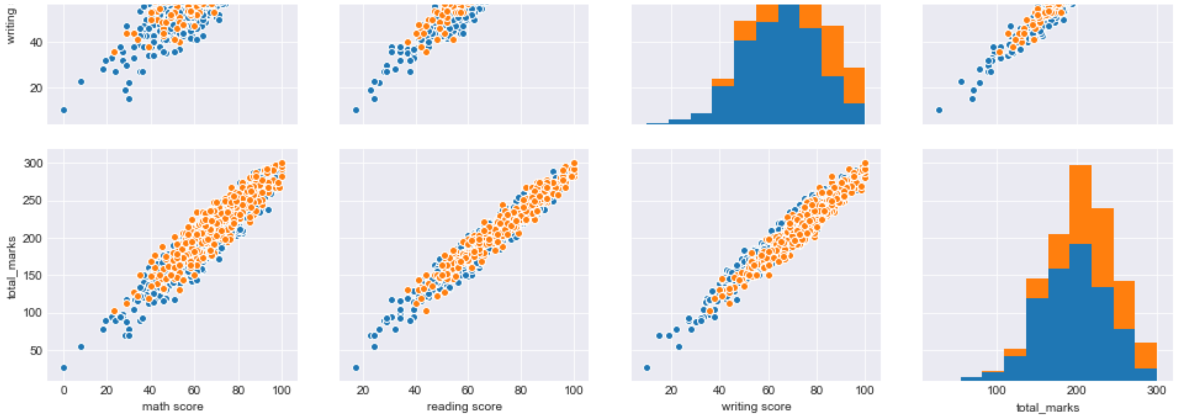


Observation: The above pair plots are plotted based on student's privilege level. But not much information ccan be obtained due to overlap of points.

In [30]:

```
# pairwise scatter plot: Pair-Plot
# Dis-advantages:
##Cannot be used when number of features are high.
##Cannot visualize higher dimensional patterns in 3-D and 4-D.
#Only possible to view 2D patterns.
plt.close();
sns.set_style("darkgrid");
sns.pairplot(student_performance, hue="test preparation course", size=3).add_legend();
#plt.show()
# NOTE: the diagnol elements are PDFs for each feature. PDFs are expalined below.
```





Observation: The above pair plots are plotted based on test preparation course. Student's with course performed better than those without preparation course.

In [31]:

```
student_performance[student_performance.total_marks==student_performance.total_marks.max()]
```

Out[31]:

| | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score | total_marks |
|---|---|---|---|---|---|---|---|---|---|
| **458** | female | group E | bachelor's degree | standard | none | 100 | 100 | 100 | 300 |
| **916** | male | group E | bachelor's degree | standard | completed | 100 | 100 | 100 | 300 |
| **962** | female | group E | associate's degree | standard | none | 100 | 100 | 100 | 300 |

Observation: Three students have scored maximum marks, of which two are girls and one is a boy. Based on the parents education and lunch type, all of them come from a privileged background. Also they belong to same ethnicity which may be a indication level of the quaity of students and teachers in the ethnicity.

In [32]:

```
student_performance[student_performance.total_marks==student_performance.total_marks.min()]
```

Out[32]:

| | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score | total_marks |
|---|---|---|---|---|---|---|---|---|---|
| **59** | female | group C | some high school | free/reduced | none | 0 | 17 | 10 | 27 |

Observation: Above is the details of student with minimum marks. She is an underprivileged student based on the info present.

In [33]:

```
student_performance.sort_values(by=['total_marks']).head(10)
```

Out[33]:

| | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score | total_marks |
|---|---|---|---|---|---|---|---|---|---|
| **59** | female | group C | some high school | free/reduced | none | 0 | 17 | 10 | 27 |
| **980** | female | group B | high school | free/reduced | none | 8 | 24 | 23 | 55 |
| **596** | male | group B | high school | free/reduced | none | 30 | 24 | 15 | 69 |
| **327** | male | group A | some college | free/reduced | none | 28 | 23 | 19 | 70 |
| **76** | male | group E | some high school | standard | none | 30 | 26 | 22 | 78 |
| **17** | female | group B | some high school | free/reduced | none | 18 | 32 | 28 | 78 |
| **601** | female | group C | high school | standard | none | 29 | 29 | 30 | 88 |

|  | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score | total_marks |
|---|---|---|---|---|---|---|---|---|---|
| **787** | female | group B | some college | standard | none | 19 | 38 | 32 | 89 |
| **338** | female | group B | some high school | free/reduced | none | 24 | 38 | 27 | 89 |
| **211** | male | group C | some college | free/reduced | none | 35 | 28 | 27 | 90 |

Observation: Students with no preparation course and who are underprivileged performed poorly compared to the privileged one's.

In [89]:

```
student_performance.sort_values(by=['total_marks']).tail(10)
```

Out[89]:

|  | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score | total_marks |
|---|---|---|---|---|---|---|---|---|---|
| **903** | female | group D | bachelor's degree | free/reduced | completed | 93 | 100 | 100 | 293 |
| **685** | female | group E | master's degree | standard | completed | 94 | 99 | 100 | 293 |
| **165** | female | group C | bachelor's degree | standard | completed | 96 | 100 | 100 | 296 |
| **625** | male | group D | some college | standard | completed | 100 | 97 | 99 | 296 |
| **712** | female | group D | some college | standard | none | 98 | 100 | 99 | 297 |
| **179** | female | group D | some high school | standard | completed | 97 | 100 | 100 | 297 |
| **114** | female | group E | bachelor's degree | standard | completed | 99 | 100 | 100 | 299 |
| **458** | female | group E | bachelor's degree | standard | none | 100 | 100 | 100 | 300 |
| **916** | male | group E | bachelor's degree | standard | completed | 100 | 100 | 100 | 300 |
| **962** | female | group E | associate's degree | standard | none | 100 | 100 | 100 | 300 |

Observation: Out of the top ten students, 7 have completed test preparation course and all of them come from a privileged background.

In [35]:

```
student_privilege=student_performance.groupby('lunch')
```

In [91]:

```
pd.options.display.max_columns = 4000
```

In [92]:

```
print(student_privilege.describe())
```

```
             math score                                                       \
                  count       mean        std   min   25%   50%   75%    max   
lunch                                                                          
free/reduced      355.0  58.921127  15.159956   0.0  49.0  60.0  69.0  100.0   
standard          645.0  70.034109  13.653501  19.0  61.0  69.0  80.0  100.0   

             reading score                                                 \
                     count       mean        std   min   25%   50%   75%   
lunch                                                                       
free/reduced         355.0  64.653521  14.895339  17.0  56.0  65.0  75.0   
standard             645.0  71.654264  13.830602  26.0  63.0  72.0  82.0   

                    writing score                                           \
                max         count       mean        std   min   25%   50%   
lunch                                                                        
free/reduced  100.0         355.0  63.022535  15.433823  10.0  53.0  64.0   
standard      100.0         645.0  70.823256  14.339487  22.0  62.0  72.0   

                          total_marks                                       \
               75%    max       count        mean        std   min    25%   
lunch                                                                        
free/reduced  74.0  100.0       355.0  186.597183  43.374971  27.0  158.5   
standard      81.0  100.0       645.0  212.511628  39.559515  78.0  187.0   
```

```
                50%    75%    max
lunch
free/reduced  188.0  217.5  293.0
standard      214.0  239.0  300.0
```

Observation:The above cell indicate the performance of students based on privileges. The scores indicate that the privileged students performed much better than the underprivileged students in almost all subjects.

In [38]:

```
student_gender=student_performance.groupby('gender')
```

In [39]:

```
print(student_gender.describe())
```

```
       math score                                                     \
            count       mean        std   min   25%   50%   75%    max
gender
female      518.0  63.633205  15.491453   0.0  54.0  65.0  74.0  100.0
male        482.0  68.728216  14.356277  27.0  59.0  69.0  79.0  100.0

       reading score                                                   \
               count       mean        std   min    25%   50%   75%    max
gender
female         518.0  72.608108  14.378245  17.0  63.25  73.0  83.0  100.0
male           482.0  65.473029  13.931832  23.0  56.00  66.0  75.0  100.0

       writing score                                                   \
               count       mean        std   min   25%   50%    75%    max
gender
female         518.0  72.467181  14.844842  10.0  64.0  74.0  82.00  100.0
male           482.0  63.311203  14.113832  15.0  53.0  64.0  73.75  100.0

       total_marks
             count        mean        std   min    25%    50%     75%    max
gender
female       518.0  208.708494  43.625427  27.0  182.0  211.0  236.00  300.0
male         482.0  197.512448  41.096520  69.0  168.0  199.0  228.75  300.0
```

Observation:The above cell indicate the performance of students based on gender. The scores indicate that boys scored better in maths, but girls outshone boys on total_marks because of their domination in reading and writing scores.

In [40]:

```
under_privileged=student_performance[student_performance['lunch']=='free/reduced']
under_privileged.head()
```

Out[40]:

| | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score | total_marks |
|---|---|---|---|---|---|---|---|---|---|
| **3** | male | group A | associate's degree | free/reduced | none | 47 | 57 | 44 | 148 |
| **7** | male | group B | some college | free/reduced | none | 40 | 43 | 39 | 122 |
| **8** | male | group D | high school | free/reduced | completed | 64 | 64 | 67 | 195 |
| **9** | female | group B | high school | free/reduced | none | 38 | 60 | 50 | 148 |
| **17** | female | group B | some high school | free/reduced | none | 18 | 32 | 28 | 78 |

In [41]:

```
under_privilegedloc=student_performance.loc[student_performance['lunch']=='free/reduced']
under_privilegedloc.head()
```

Out[41]:

| | gender | race/ethnicity | parental level of | lunch | test preparation | math | reading | writing | total_marks |
|---|---|---|---|---|---|---|---|---|---|

|  | gender | race/ethnicity | parental level of education | lunch | test preparation course | math score | reading score | writing score | total_marks |
|---|---|---|---|---|---|---|---|---|---|
| **3** | male | group A | associate's degree | free/reduced | none | 47 | 57 | 44 | 148 |
| **7** | male | group B | some college | free/reduced | none | 40 | 43 | 39 | 122 |
| **8** | male | group D | high school | free/reduced | completed | 64 | 64 | 67 | 195 |
| **9** | female | group B | high school | free/reduced | none | 38 | 60 | 50 | 148 |
| **17** | female | group B | some high school | free/reduced | none | 18 | 32 | 28 | 78 |

https://stackoverflow.com/questions/38886080/python-pandas-series-why-use-loc

In [42]:

```
under_privileged[(under_privileged['math score']>=40) & (under_privileged['reading score']>=40) & (
under_privileged['writing score']>=40)].shape
```

Out[42]:

```
(316, 9)
```

In [43]:

```
under_privileged[(under_privileged['math score']<40) | (under_privileged['reading score']<40) | (un
der_privileged['writing score']<40)].shape
```

Out[43]:

```
(39, 9)
```

In [44]:

```
pass_percentage_of_under_privileged_students=((under_privileged[(under_privileged['math score']>=4
0) & (under_privileged['reading score']>=40) & (under_privileged['writing score']>=40)].shape)[0])/
((under_privileged.shape)[0])
pass_percentage_of_under_privileged_students
```

Out[44]:

```
0.8901408450704226
```

Observation:Of the total underprivileged children 89% have passed.

In [45]:

```
under_privileged['gender'].value_counts()
```

Out[45]:

```
female    189
male      166
Name: gender, dtype: int64
```

In [46]:

```
pass_percentage_of_under_privileged_girls=((under_privileged[(under_privileged['math score']>=40)
& (under_privileged['reading score']>=40) & (under_privileged['writing score']>=40) & (under_privil
eged['gender']== 'female')].shape)[0])/((under_privileged[under_privileged['gender']== 'female'].sh
ape)[0])
pass_percentage_of_under_privileged_girls
```

Out[46]:

```
0.8677248677248677
```

Observation:86.77% of the underprivileged girls have passed.

In [94]:

```
pass_percentage_of_under_privileged_boys=((under_privileged[(under_privileged['math score']>=40) &
(under_privileged['reading score']>=40) & (under_privileged['writing score']>=40) & (under_privileg
ed['gender']== 'male')].shape)[0])/((under_privileged[under_privileged['gender']== 'male'].shape)[0
])
pass_percentage_of_under_privileged_boys
```

Out[94]:

```
0.9156626506024096
```

Observation:91.56% of underprivileged boys have passed. So based on percentage underprivileged boys performed better than thier counterparts.

In [96]:

```
privileged=student_performance[student_performance['lunch']=='standard']
privileged.shape
```

Out[96]:

```
(645, 9)
```

In [97]:

```
privileged[(privileged['math score']>=40) & (privileged['reading score']>=40) &
(privileged['writing score']>=40)].shape
```

Out[97]:

```
(633, 9)
```

In [98]:

```
privileged[(privileged['math score']<40) | (privileged['reading score']<40) | (privileged['writing
score']<40)].shape
```

Out[98]:

```
(12, 9)
```

In [51]:

```
pass_percentage_of_privileged_students=((privileged[(privileged['math score']>=40) & (privileged['
reading score']>=40) & (privileged['writing score']>=40)].shape)[0])/((privileged.shape)[0])
pass_percentage_of_privileged_students
```

Out[51]:

```
0.9813953488372092
```

Observation:Of the total privileged children 98% have passed.

In [99]:

```
privileged['gender'].value_counts()
```

Out[99]:

```
female    329
male      316
Name: gender, dtype: int64
```

In [53]:

```
pass_percentage_of_privileged_girls=((privileged[(privileged['math score']>=40) & (privileged['rea
ding score']>=40) & (privileged['writing score']>=40) & (privileged['gender']== 'female')].shape)[0
])/((privileged[privileged['gender']== 'female'].shape)[0])
pass_percentage_of_privileged_girls
```

Out[53]:

```
0.9817629179331308
```

In [54]:

```
pass_percentage_of_privileged_boys=((privileged[(privileged['math score']>=40) &
(privileged['reading score']>=40) & (privileged['writing score']>=40) & (privileged['gender']== 'ma
le')].shape)[0])/((privileged[privileged['gender']== 'male'].shape)[0])
pass_percentage_of_privileged_boys
```

Out[54]:

```
0.9810126582278481
```

Observation:98% of the girls and boys from privileged background have passed.

In [55]:

```
students_with_course=student_performance[student_performance['test preparation
course']=='completed']
students_with_course.shape
```

Out[55]:

```
(358, 9)
```

In [56]:

```
students_with_course.lunch.value_counts()
```

Out[56]:

```
standard        227
free/reduced    131
Name: lunch, dtype: int64
```

In [57]:

```
students_with_course[students_with_course['lunch']=='free/reduced'].shape
```

Out[57]:

```
(131, 9)
```

In [58]:

```
pass_percentage_of_students_with_course=((students_with_course[(students_with_course['math score']
>=40) & (students_with_course['reading score']>=40) & (students_with_course['writing score']>=40)]
.shape)[0])/((students_with_course.shape)[0])
pass_percentage_of_students_with_course
```

Out[58]:

```
0.9804469273743017
```

Observation:98% of children with preparation test have passed.

In [59]:

```
pass_percentage_of_privileged_students_with_course=((students_with_course[(students_with_course['m
ath score']>=40) & (students_with_course['reading score']>=40) & (students_with_course['writing
score']>=40) & (students_with_course['lunch']=='standard')].shape)
[0])/((students_with_course[students_with_course['lunch']=='standard'].shape)[0])
pass_percentage_of_privileged_students_with_course
```

Out[59]:

```
0.9955947136563876
```

Observation:99% of privileged children with preparation test have passed.

In [60]:

```
pass_percentage_of_unprivileged_students_with_course=((students_with_course[(students_with_course[
'math score']>=40) & (students_with_course['reading score']>=40) & (students_with_course['writing
score']>=40) & (students_with_course['lunch']=='free/reduced')].shape)[0])/((students_with_course[s
tudents_with_course['lunch']=='free/reduced'].shape)[0])
pass_percentage_of_unprivileged_students_with_course
```

Out[60]:

```
0.9541984732824428
```

Observation:95% of unprivileged children with preparation test have passed.

In [61]:

```
students_with_course.gender.value_counts()
```

Out[61]:

```
female    184
male      174
Name: gender, dtype: int64
```

In [62]:

```
pass_percentage_of_boys_with_course=((students_with_course[(students_with_course['math score']>=40
) & (students_with_course['reading score']>=40) & (students_with_course['writing score']>=40) & (st
udents_with_course['gender']== 'male')].shape)[0])
/((students_with_course[students_with_course['gender']== 'male'].shape)[0])
pass_percentage_of_boys_with_course
```

Out[62]:

```
0.9885057471264368
```

In [63]:

```
pass_percentage_of_girls_with_course=((students_with_course[(students_with_course['math score']>=4
0) & (students_with_course['reading score']>=40) & (students_with_course['writing score']>=40) & (s
tudents_with_course['gender']== 'female')].shape)[0]) /((students_with_course[students_with_course
['gender']== 'female'].shape)[0])
pass_percentage_of_girls_with_course
```

Out[63]:

```
0.9728260869565217
```

Observation:98.8% of boys with course have passed which is slightly higher than girls with 97.2%.

In [64]:

```
students_without_course=student_performance[student_performance['test preparation course']=='none'
]
students_without_course.shape
```

Out[64]:

```
(642, 9)
```

In [65]:

```
students_without_course[students_without_course['lunch']=='standard'].shape
```

Out[65]:

```
(418, 9)
```

In [66]:

```
students_without_course[students_without_course['lunch']=='free/reduced'].shape
```

Out[66]:

```
(224, 9)
```

In [67]:

```
pass_percentage_of_students_without_course=((students_without_course[(students_without_course['math score']>=40) & (students_without_course['reading score']>=40) & (students_without_course['writing score']>=40)].shape)[0])/((students_without_course.shape)[0])
pass_percentage_of_students_without_course
```

Out[67]:

```
0.9314641744548287
```

Observation:Only 93% of students without preparation course have passed.

In [100]:

```
pass_percentage_of_privileged_students_without_course=((students_without_course[(students_without_course['math score']>=40) & (students_without_course['reading score']>=40) & (students_without_course['writing score']>=40) & (students_without_course['lunch']=='standard')].shape)[0])/((students_without_course[students_without_course['lunch']=='standard'].shape)[0])
pass_percentage_of_privileged_students_without_course
```

Out[100]:

```
0.9736842105263158
```

Observation:97% of privileged students without preparation course have passed.

In [70]:

```
pass_percentage_of_unprivileged_students_without_course=((students_without_course[(students_without_course['math score']>40) & (students_without_course['reading score']>40) & (students_without_course['writing score']>40) & (students_without_course['lunch']=='free/reduced')].shape)[0])/((students_without_course[students_without_course['lunch']=='free/reduced'].shape)[0])
pass_percentage_of_unprivileged_students_without_course
```

Out[70]:

```
0.8392857142857143
```

Observation:84% of unprivileged students without preparation course have passed.

In [101]:

```
pass_percentage_of_boys_without_course=((students_without_course[(students_without_course['math score']>=40) & (students_without_course['reading score']>=40) & (students_without_course['writing score']>=40) & (students_without_course['gender']== 'male')].shape)[0]) /((students_without_course[students_without_course['gender']== 'male'].shape)[0])
pass_percentage_of_boys_without_course
```

Out[101]:

```
0.9415584415584416
```

Observation:94% of boys without preparation course have passed.

In [102]:

```
pass_percentage_of_girls_without_course=((students_without_course[(students_without_course['math score']>=40) & (students_without_course['reading score']>=40) & (students_without_course['writing score']>=40) & (students_without_course['gender']== 'female')].shape)[0]) /((students_without_course[students_without_course['gender']== 'female'].shape)[0])
pass_percentage_of_girls_without_course
```

Out[102]:

```
0.9221556886227545
```

Observation:92% of girls without preparation course have passed.

In [73]:

```
student_performance.columns
```

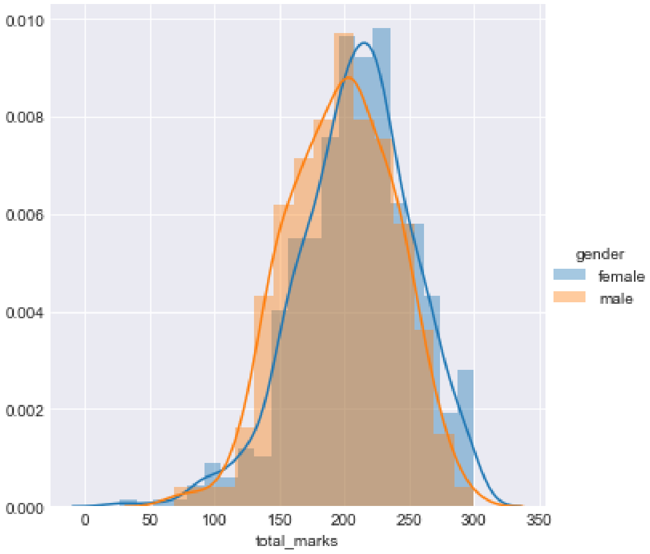
Out[73]:

```
Index(['gender', 'race/ethnicity', 'parental level of education', 'lunch',
       'test preparation course', 'math score', 'reading score',
       'writing score', 'total_marks'],
      dtype='object')
```

In [74]:

```
sns.FacetGrid(student_performance, hue="gender", size=5) \
   .map(sns.distplot, "total_marks") \
   .add_legend();
plt.show();
```

```
C:\Users\manoj\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: FutureWarning: Using a non-t
uple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[s
eq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will r
esult either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```



Observation:The distribution indicate that there is a slight advantage of mean total_marks of girls over boys.

In [75]:

```
sns.FacetGrid(student_performance, hue="race/ethnicity", size=5) \
   .map(sns.distplot, "total_marks") \
   .add_legend();
plt.show();
```

```
C:\Users\manoj\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: FutureWarning: Using a non-t
uple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[s
eq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will r
esult either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
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C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
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C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
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C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
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  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```

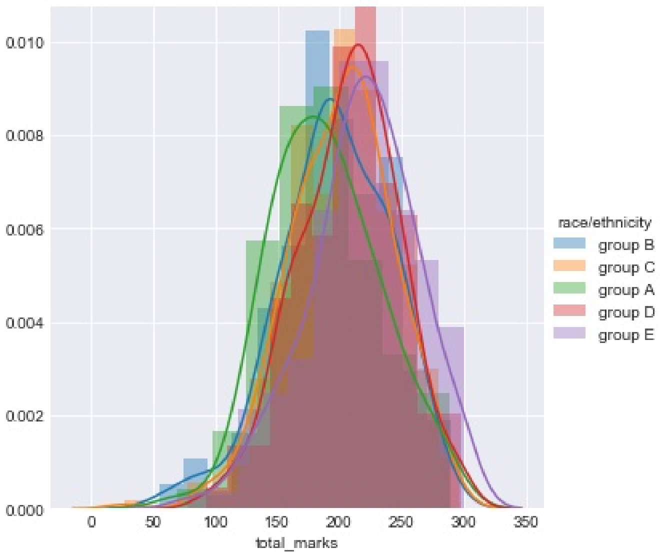

Observation: The overall performance of group D is much better than other groups and group A has the least best preforance.

In [76]:

```
sns.FacetGrid(student_performance, hue="parental level of education", size=5) \
   .map(sns.distplot, "total_marks") \
   .add_legend();
plt.show();
```

```
C:\Users\manoj\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: FutureWarning: Using a non-t
uple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[s
eq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will r
esult either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
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```

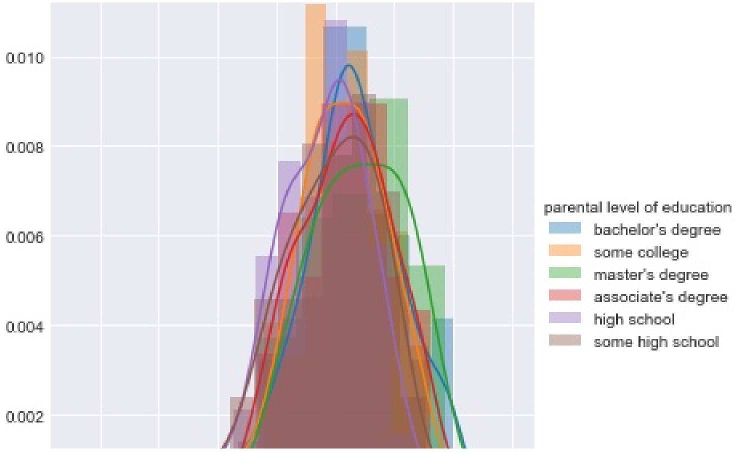

Observation:The above plot indicate the least influence of parent's education over student' performance as students with parents having some schooling performed better than students gaving parents with master's degree.

In [77]:

```
sns.FacetGrid(student_performance, hue="lunch", size=5) \
   .map(sns.distplot, "total_marks") \
   .add_legend();
plt.show();
```

```
C:\Users\manoj\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: FutureWarning: Using a non-t
uple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[s
eq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will r
esult either in an error or a different result.
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C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
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C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
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  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```

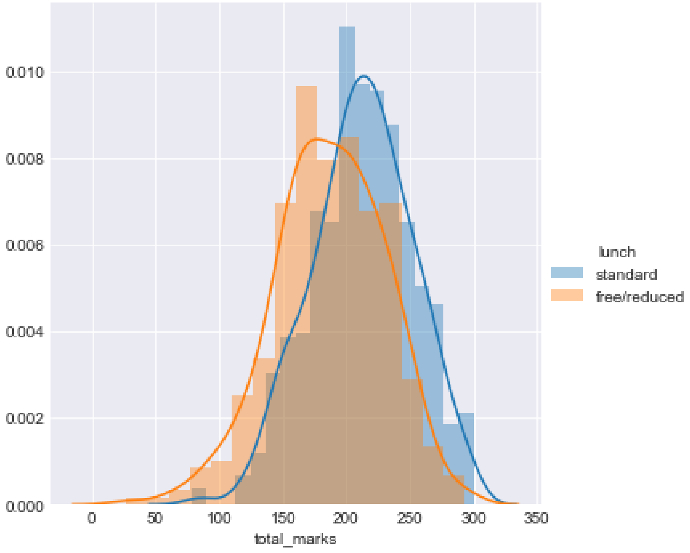

Observation:Privileged students performed better than their counterparts.

In [78]:

```
sns.FacetGrid(student_performance, hue="test preparation course", size=5) \
   .map(sns.distplot, "total_marks") \
   .add_legend();
plt.show();
```

```
C:\Users\manoj\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: FutureWarning: Using a non-t
uple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[s
eq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will r
esult either in an error or a different result.
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'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
C:\Users\manoj\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py:6462: UserWarning: The
'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
```
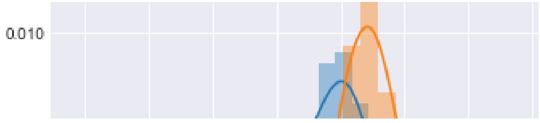
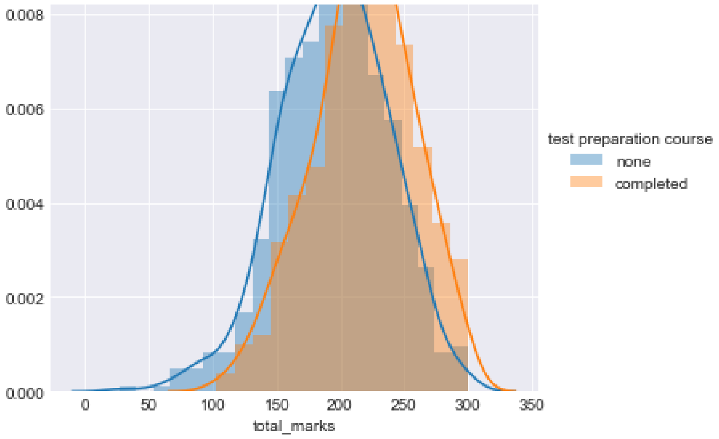



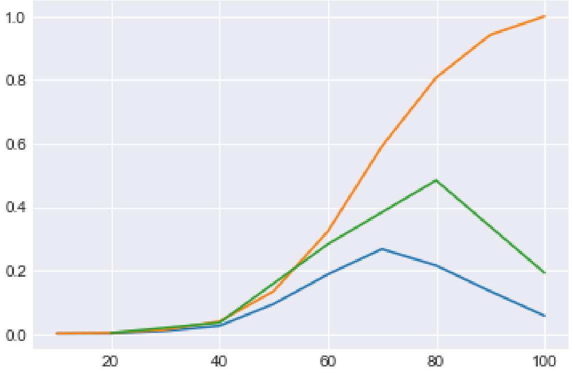


Observation: Students with preparation course performed muuch better than their counterparts.

In [82]:

```
#REFER program.txt
# Need for Cumulative Distribution Function (CDF)
# We can visually see what percentage of versicolor flowers have a
# petal_length of less than 5?
# How to construct a CDF?
# How to read a CDF?

#Plot CDF of petal_length
#print(iris_setosa['petal.length'])
print(np.histogram(student_performance['math score'], bins=10,
                                 density = False))
counts, bin_edges = np.histogram(student_performance['math score'], bins=10,
                                 density = True)
#print(max(iris_setosa['petal.length']))
#print(min(iris_setosa['petal.length']))
#print("counts:",counts)
#print("Sum:",sum(counts))
pdf = counts/(sum(counts))
print(pdf);
print(bin_edges);
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf);
plt.plot(bin_edges[1:], cdf)


counts, bin_edges = np.histogram(student_performance['math score'], bins=5,
                                 density = True)
#print (counts)
#print (bin_edges)
pdf = counts/(sum(counts))
plt.plot(bin_edges[1:],pdf);

plt.show();
```

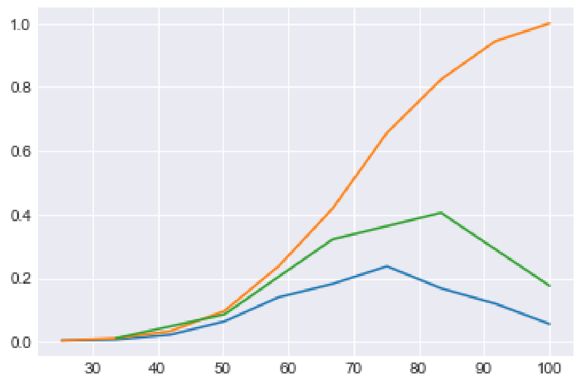
```
(array([  2,   2,  10,  26,  95, 188, 268, 216, 135,  58], dtype=int64), array([  0.,  10.,  20.,
 30.,  40.,  50.,  60.,  70.,  80.,  90., 100.]))
[0.002 0.002 0.01  0.026 0.095 0.188 0.268 0.216 0.135 0.058]
[  0.  10.  20.  30.  40.  50.  60.  70.  80.  90. 100.]
```



In [83]:

```
#REFER program.txt
# Need for Cumulative Distribution Function (CDF)
# We can visually see what percentage of versicolor flowers have a
# petal_length of less than 5?
# How to construct a CDF?
# How to read a CDF?

#Plot CDF of petal_length
#print(iris_setosa['petal.length'])
print(np.histogram(student_performance['reading score'], bins=10,
                                 density = False))
counts, bin_edges = np.histogram(student_performance['reading score'], bins=10,
                                 density = True)
#print(max(iris_setosa['petal.length']))
#print(min(iris_setosa['petal.length']))
#print("counts:",counts)
#print("Sum:",sum(counts))
pdf = counts/(sum(counts))
print(pdf);
print(bin_edges);
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf);
plt.plot(bin_edges[1:], cdf)


counts, bin_edges = np.histogram(student_performance['reading score'], bins=5,
                                 density = True)
#print (counts)
#print (bin_edges)
pdf = counts/(sum(counts))
plt.plot(bin_edges[1:],pdf);

plt.show();
```

```
(array([  4,   7,  22,  64, 140, 182, 237, 168, 120,  56], dtype=int64), array([ 17. ,  25.3,  33.6
,  41.9,  50.2,  58.5,  66.8,  75.1,  83.4,
        91.7, 100. ]))
[0.004 0.007 0.022 0.064 0.14  0.182 0.237 0.168 0.12  0.056]
[ 17.   25.3  33.6  41.9  50.2  58.5  66.8  75.1  83.4  91.7 100. ]
```

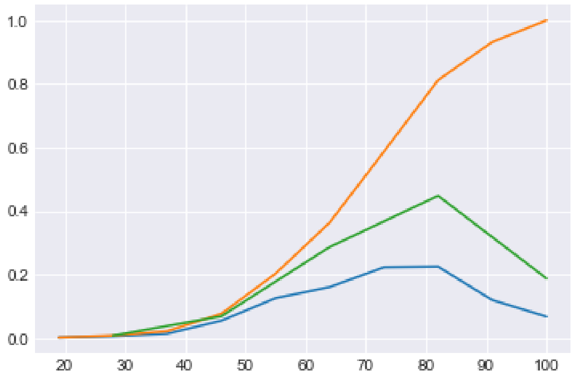


In [84]:

```
#REFER program.txt
# Need for Cumulative Distribution Function (CDF)
# We can visually see what percentage of versicolor flowers have a
# petal_length of less than 5?
# How to construct a CDF?
# How to read a CDF?

#Plot CDF of petal_length
#print(iris_setosa['petal.length'])
print(np.histogram(student_performance['writing score'], bins=10,
                                 density = False))
counts, bin_edges = np.histogram(student_performance['writing score'], bins=10,
                                 density = True)
#print(max(iris_setosa['petal.length']))
#print(min(iris_setosa['petal.length']))
```

```
#print("counts:",counts)
#print("Sum:",sum(counts))
pdf = counts/(sum(counts))
print(pdf);
print(bin_edges);
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf);
plt.plot(bin_edges[1:], cdf)


counts, bin_edges = np.histogram(student_performance['writing score'], bins=5,
                                 density = True)
#print (counts)
#print (bin_edges)
pdf = counts/(sum(counts))
plt.plot(bin_edges[1:],pdf);

plt.show();
```

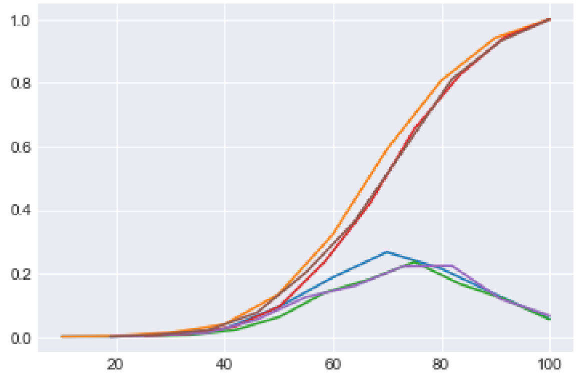
```
(array([  2,   6,  14,  55, 126, 161, 223, 225, 120,  68], dtype=int64), array([ 10.,  19.,  28.,
37.,  46.,  55.,  64.,  73.,  82.,  91., 100.]))
[0.002 0.006 0.014 0.055 0.126 0.161 0.223 0.225 0.12  0.068]
[ 10.  19.  28.  37.  46.  55.  64.  73.  82.  91. 100.]
```



In [85]:

```
# Plots of CDF of petal_length for various types of flowers.

# Misclassification error if you use petal_length only.

counts, bin_edges = np.histogram(student_performance['math score'], bins=10,
                                 density = True)
pdf = counts/(sum(counts))
print(pdf);
print(bin_edges)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:], cdf)


# virginica
counts, bin_edges = np.histogram(student_performance['reading score'], bins=10,
                                 density = True)
pdf = counts/(sum(counts))
print(pdf);
print(bin_edges)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:], cdf)


#versicolor
counts, bin_edges = np.histogram(student_performance['writing score'], bins=10,
                                 density = True)
pdf = counts/(sum(counts))
print(pdf);
print(bin_edges)
cdf = np.cumsum(pdf)
plt.plot(bin_edges[1:],pdf)
plt.plot(bin_edges[1:], cdf)


plt.show();
```

```
[0.002 0.002 0.01  0.026 0.095 0.188 0.268 0.216 0.135 0.058]
[  0.  10.  20.  30.  40.  50.  60.  70.  80.  90. 100.]
[0.004 0.007 0.022 0.064 0.14  0.182 0.237 0.168 0.12  0.056]
[ 17.   25.3  33.6  41.9  50.2  58.5  66.8  75.1  83.4  91.7 100. ]
[0.002 0.006 0.014 0.055 0.126 0.161 0.223 0.225 0.12  0.068]
[ 10.  19.  28.  37.  46.  55.  64.  73.  82.  91. 100.]
```



Observation:The above plots indiacte CDF of each subject for the students. The amount of students below a certain score can be obtained from the CDF.

# SUMMARY:

1.Although the total marks of students of both gender doesn't vary much, boys have scored better than girls in maths. slight advantage for the students with test preparation course. But its not very significant. 2.Three students have scored maximum marks, of which two are girls and one is a boy. Based on the parents education and lunch type, all of them come from a privileged background. Also they belong to same ethnicity which may be a indication level of the quaity of students and teachers in the ethnicity. 3.Student with minimum marks is an underprivileged student. 4.Students with no preparation course and who are underprivileged performed poorly compared to the privileged one's. Out of the top ten students, 7 have completed test preparation course and all of them come from a privileged background. scores indicate that the privileged students performed much better than the underprivileged students in almost all subjects. 5.The scores indicate that boys scored better in maths, but girls outshone boys on total_marks because of their domination in reading and writing scores. 6.Of the total underprivileged children 89% have passed. 86.77% of the underprivileged girls have passed. 91.56% of underprivileged boys have passed. So based on percentage underprivileged boys performed better than thier counterparts. 7.Of the total privileged children 98% have passed.98% of the girls and boys from privileged background have passed. 8.98% of children with preparation test have passed.99% of privileged children with preparation test have passed.95% of unprivileged children with preparation test have passed.98.8% of boys with course have passed which is slightly higher than girls with 97.2%. 9.Only 93% of students without preparation course have passed.97% of privileged students without preparation course have passed.84% of unprivileged students without preparation course have passed.94% of boys without preparation course have passed.92% of girls without preparation course have passed. 10.The distribution indicate that there is a slight advantage of mean total_marks of girls over boys. 11.The overall performance of group D is much better than other groups and group A has the least best preforance. 12.Influence of parent's education over student' performance is least as students with parents having some schooling performed better than students having parents with master's degree.Privileged students performed better than their counterparts. 13.Students with preparation course performed much better than their counterparts.