Python Notebook Viewer

In []:

In []:

In []:

In [1152]:
```
import warnings
warnings.filterwarnings("ignore")
```

In [1153]:
```
import sys
import pandas as pd
import numpy as np
from pandas_profiling import ProfileReport
from sklearn.pipeline import make_pipeline
from sklearn.pipeline import Pipeline
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder, StandardScaler
from sklearn.model_selection import GridSearchCV
from sklearn import preprocessing
from sklearn.model_selection import train_test_split
import statsmodels.api as sm
from statsmodels.stats.outliers_influence import variance_inflation_factor
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import cross_val_score
from sklearn.metrics import mean_absolute_error,mean_squared_error
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import cross_val_score
from sklearn.metrics import mean_absolute_error,mean_squared_error
import matplotlib.pyplot as plt
import seaborn as sns
import copy

import re
import nltk
from nltk.corpus import stopwords
nltk.download('stopwords')
from nltk.stem import PorterStemmer
from nltk.stem import WordNetLemmatizer
nltk.download('wordnet')
from nltk.tokenize import word_tokenize
from nltk.tokenize import sent_tokenize
nltk.download('punkt')
from nltk.corpus import wordnet
import string
import re
from nltk.tokenize import word_tokenize
from nltk.corpus import wordnet
from nltk.stem import WordNetLemmatizer
from bs4 import BeautifulSoup
from textblob import TextBlob
from unidecode import unidecode
import contractions

# magic function matplotlib inline
%matplotlib inline
```

Out [1153]:
```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
```

```
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
```

In [1154]:

```
lemmatizer = WordNetLemmatizer()
```

In [1155]:

```
data = pd.read_csv("./superheroes/superheroes_nlp_dataset.csv")
data.head(10)
```

Out [1155]:

	name	real_name	full_name	overall_score	history_text	powers_text	intelligence_sco
0	3-D Man	Delroy Garrett, Jr.	Delroy Garrett, Jr.	6	Delroy Garrett, Jr. grew up to become a track ...	NaN	85
1	514A (Gotham)	Bruce Wayne	NaN	10	He was one of the many prisoners of Indian Hil...	NaN	100
2	A-Bomb	Richard Milhouse Jones	Richard Milhouse Jones	20	Richard "Rick" Jones was orphaned at a young ...	On rare occasions, and through unusual circu...	80
3	Aa	Aa	NaN	12	Aa is one of the more passive members of the P...	NaN	80
4	Aaron Cash	Aaron Cash	Aaron Cash	5	Aaron Cash is the head of security at Arkham A...	NaN	80
5	Aayla Secura	Aayla Secura	NaN	8	ayla Secura was a Rutian Twi'lek Jedi Knight (...	NaN	90
6	Abe Sapien	Abraham Sapien	Abraham Sapien	10	Sapien began life as Langdon Everett Caul, a ...	Abe is a humanoid amphibious creature. He has...	95
7	Abin Sur	NaN	NaN	9	Originally a history professor on the planet ...	Abin Sur possessed an exceptionally strong s...	75
8	Abomination	Emil Blonsky	Emil Blonsky	22	Formerly known as Emil Blonsky, a spy of Sovie...	'Blonsky"s transformation into the Abominatio...	85

	name	real_name	full_name	overall_score	history_text	powers_text	intelligence_sco
9	Abra Kadabra (CW)	Unknown	Unknown	13	"Abra Kadabra" was a criminal time traveler fr...	Abra Kadabra was augmented with various nanot...	100

10 rows × 81 columns

In [1156]:
```
# pd.set_option('display.max_columns', None)
# pd.set_option('display.max_colwidth', -1)
# data['powers_text'].head(10)
data.shape
```

Out [1156]:
```
(1450, 81)
```

In [1157]:
```
data.info()
```

Out [1157]:
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1450 entries, 0 to 1449
Data columns (total 81 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   name                            1448 non-null   object 
 1   real_name                       1301 non-null   object 
 2   full_name                       956 non-null    object 
 3   overall_score                   1450 non-null   object 
 4   history_text                    1360 non-null   object 
 5   powers_text                     1086 non-null   object 
 6   intelligence_score              1450 non-null   int64  
 7   strength_score                  1450 non-null   int64  
 8   speed_score                     1450 non-null   int64  
 9   durability_score                1450 non-null   int64  
 10  power_score                     1450 non-null   int64  
 11  combat_score                    1450 non-null   int64  
 12  superpowers                     1450 non-null   object 
 13  alter_egos                      1450 non-null   object 
 14  aliases                         1450 non-null   object 
 15  place_of_birth                  788 non-null    object 
 16  first_appearance                1247 non-null   object 
 17  creator                         1311 non-null   object 
 18  alignment                       1368 non-null   object 
 19  occupation                      1014 non-null   object 
 20  base                            878 non-null    object 
 21  teams                           1450 non-null   object 
 22  relatives                       901 non-null    object 
 23  gender                          1305 non-null   object 
 24  type_race                       1043 non-null   object 
 25  height                          1448 non-null   object 
 26  weight                          1448 non-null   object 
 27  eye_color                       1186 non-null   object 
 28  hair_color                      1202 non-null   object 
 29  skin_color                      173 non-null    object 
 30  img                             1363 non-null   object 
 31  has_electrokinesis              1383 non-null   float64
 32  has_energy_constructs           1383 non-null   float64
 33  has_mind_control_resistance     1383 non-null   float64
 34  has_matter_manipulation         1383 non-null   float64
 35  has_telepathy_resistance        1383 non-null   float64
 36  has_mind_control                1383 non-null   float64
 37  has_enhanced_hearing            1383 non-null   float64
 38  has_dimensional_travel          1383 non-null   float64
 39  has_element_control             1383 non-null   float64
 40  has_size_changing               1383 non-null   float64
 41  has_fire_resistance             1383 non-null   float64
 42  has_fire_control                1383 non-null   float64
 43  has_dexterity                   1383 non-null   float64
 44  has_reality_warping             1383 non-null   float64
```

```
45  has_illusions                      1383 non-null   float64
46  has_energy_beams                   1383 non-null   float64
47  has_peak_human_condition           1383 non-null   float64
48  has_shapeshifting                  1383 non-null   float64
49  has_heat_resistance                1383 non-null   float64
50  has_jump                           1383 non-null   float64
51  has_self-sustenance                1383 non-null   float64
52  has_energy_absorption              1383 non-null   float64
53  has_cold_resistance                1383 non-null   float64
54  has_magic                          1383 non-null   float64
55  has_telekinesis                    1383 non-null   float64
56  has_toxin_and_disease_resistance   1383 non-null   float64
57  has_telepathy                      1383 non-null   float64
58  has_regeneration                   1383 non-null   float64
59  has_immortality                    1383 non-null   float64
60  has_teleportation                  1383 non-null   float64
61  has_force_fields                   1383 non-null   float64
62  has_energy_manipulation            1383 non-null   float64
63  has_endurance                      1383 non-null   float64
64  has_longevity                      1383 non-null   float64
65  has_weapon-based_powers            1383 non-null   float64
66  has_energy_blasts                  1383 non-null   float64
67  has_enhanced_senses                1383 non-null   float64
68  has_invulnerability                1383 non-null   float64
69  has_stealth                        1383 non-null   float64
70  has_marksmanship                   1383 non-null   float64
71  has_flight                         1383 non-null   float64
72  has_accelerated_healing            1383 non-null   float64
73  has_weapons_master                 1383 non-null   float64
74  has_intelligence                   1383 non-null   float64
75  has_reflexes                       1383 non-null   float64
76  has_super_speed                    1383 non-null   float64
77  has_durability                     1383 non-null   float64
78  has_stamina                        1383 non-null   float64
79  has_agility                        1383 non-null   float64
80  has_super_strength                 1383 non-null   float64
dtypes: float64(50), int64(6), object(25)
memory usage: 917.7+ KB
```

Text preprocessing

In [1158]:

```
# def lemmatize_pos_tagged_text(text, lemmatizer, pos_tag_dict):
#     sentences = nltk.sent_tokenize(text)
#     new_sentences = []

#     for sentence in sentences:
#         sentence = sentence.lower()
#         new_sentence_words = []
#         #one pos_tuple for sentence
#         pos_tuples = nltk.pos_tag(nltk.word_tokenize(sentence))

#     for word_idx, word in enumerate(nltk.word_tokenize(sentence)):
#         nltk_word_pos = pos_tuples[word_idx][1]
#         wordnet_word_pos = pos_tag_dict.get(
#                             nltk_word_pos[0].upper(), None)
#         if wordnet_word_pos is not None:
#             new_word = lemmatizer.lemmatize(word, wordnet_word_pos)
#         else:
#             new_word = lemmatizer.lemmatize(word)

#         new_sentence_words.append(new_word)

#     new_sentence = " ".join(new_sentence_words)
#     new_sentences.append(new_sentence)

#     return " ".join(new_sentences)
```

```
def lemmatize_pos_tagged_text(text, lemmatizer, pos_tag_dict):
  sentences = nltk.sent_tokenize(text)
  new_sentences = []

  for sentence in sentences:
    sentence = sentence.lower()
    new_sentence_words = []
    #one pos_tuple for sentence
    pos_tuples = nltk.pos_tag(nltk.word_tokenize(sentence))

    for word_idx, word in enumerate(nltk.word_tokenize(sentence)):
      nltk_word_pos = pos_tuples[word_idx][1]
      wordnet_word_pos = pos_tag_dict.get(
                          nltk_word_pos[0].upper(), None)
      if wordnet_word_pos is not None:
        new_word = lemmatizer.lemmatize(word, wordnet_word_pos)
      else:
        new_word = lemmatizer.lemmatize(word)

      new_sentence_words.append(new_word)
```

```
    new_sentence = " ".join(new_sentence_words)
    new_sentences.append(new_sentence)

  return " ".join(new_sentences)

def download_if_non_existent(res_path, res_name):
    try:
        nltk.data.find(res_path)
    except LookupError:
        print(f'resource {res_path} not found. Downloading now...')
        nltk.download(res_name)

class NltkPreprocessingSteps:
    def __init__(self, X):
        self.X = X
        download_if_non_existent('corpora/stopwords', 'stopwords')
        download_if_non_existent('tokenizers/punkt', 'punkt')
        download_if_non_existent('taggers/averaged_perceptron_tagger',
                                 'averaged_perceptron_tagger')
        download_if_non_existent('corpora/wordnet', 'wordnet')
        download_if_non_existent('corpora/omw-1.4', 'omw-1.4')
```

```
        self.sw_nltk = stopwords.words('english')
        new_stopwords = ['<*>']
        self.sw_nltk.extend(new_stopwords)
        self.sw_nltk.remove('not')
        self.pos_tag_dict = {"J": wordnet.ADJ,
                             "N": wordnet.NOUN,
                             "V": wordnet.VERB,
                             "R": wordnet.ADV}


        # '!"#$%&'()*+,-./:;<=>?@[\]^_`{|}~' 32 punctuations in python
        # we dont want to replace . first time around
        self.remove_punctuations = string.punctuation.replace('.','')


    def deal_contractions(self):
        print('in remove contractions')
        self.X = self.X.apply(lambda x:contractions.fix(x))
        return self
```

```
    def remove_html_tags(self):
            print('in remove_html_tags')
            self.X = self.X.apply(
                    lambda x: BeautifulSoup(x, 'html.parser').get_text())
            return self

    def replace_diacritics(self):
            print('in replace_diacritics')
            self.X = self.X.apply(
                    lambda x: unidecode(x, errors="preserve"))
            return self
    def to_lower(self):
            print('in to_lower')
            self.X = np.apply_along_axis(lambda x: x.lower(), self.X)
            return self

    def expand_contractions(self):
            print('in expand_contractions')
            self.X = self.X.apply(
                    lambda x: " ".join([contractions.fix(expanded_word)
                                        for expanded_word in x.split()]))
            return self

    def remove_numbers(self):
            print('in remove_numbers')
            self.X = self.X.apply(lambda x: re.sub(r'\d+', '', x))
            return self

    def replace_dots_with_spaces(self):
            print('in replace_dots_with_spaces')
            self.X = self.X.apply(lambda x: re.sub("[.]", " ", x))
            return self

    def remove_punctuations_except_periods(self):
            print('in remove_punctuations_except_periods')
            self.X = self.X.apply(
                        lambda x: re.sub('[%s]' %
                         re.escape(self.remove_punctuations), '' , x))
            return self

    def remove_all_punctuations(self):
            print('in remove_all_punctuations')
            self.X = self.X.apply(lambda x: re.sub('[%s]' %
                                    re.escape(string.punctuation), '' , x))
            return self

    def remove_double_spaces(self):
            print('in remove_double_spaces')
            self.X = self.X.apply(lambda x: re.sub(' +', ' ', x))
            return self

    def fix_typos(self):
#             print('in fix_typos')
#             self.X = self.X.apply(lambda x: str(TextBlob(x).correct()))
            return self

    def remove_stopwords(self):
            print('in remove_stopwords')
            # remove stop words from token list in each column
            self.X = self.X.apply(
                    lambda x: " ".join([ word for word in x.split()
                            if word not in self.sw_nltk]) )
```

```
            return self

    def lemmatize(self):
            print('in lemmatize')
            lemmatizer = WordNetLemmatizer()
            self.X = self.X.apply(lambda x: lemmatize_pos_tagged_text(
                                    x, lemmatizer, self.pos_tag_dict))
            return self

    def get_processed_text(self):
            return self.X

from sklearn.base import BaseEstimator, TransformerMixin

class NltkTextPreprocessor(TransformerMixin, BaseEstimator):
    def __init__(self):
        pass

    def fit(self, X):
        return self

    def transform(self, X):
        txt_preproc = NltkPreprocessingSteps(X.copy())
        processed_text = \
                txt_preproc \
                .deal_contractions()\
                .remove_html_tags()\
                .replace_diacritics()\
                .expand_contractions()\
                .remove_numbers()\
                .fix_typos()\
                .remove_punctuations_except_periods()\
                .lemmatize()\
                .remove_double_spaces()\
                .remove_all_punctuations()\
                .remove_stopwords()\
                .get_processed_text()

        return processed_text
```

In [1159]:

```
text_cols = data.select_dtypes(include='object').head(2)
```

In [1160]:

```
text_cols.info()
```

Out [1160]:

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2 entries, 0 to 1
Data columns (total 25 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   name              2 non-null      object
 1   real_name         2 non-null      object
 2   full_name         1 non-null      object
 3   overall_score     2 non-null      object
 4   history_text      2 non-null      object
 5   powers_text       0 non-null      object
 6   superpowers       2 non-null      object
 7   alter_egos        2 non-null      object
 8   aliases           2 non-null      object
 9   place_of_birth    0 non-null      object
 10  first_appearance  0 non-null      object
 11  creator           2 non-null      object
 12  alignment         1 non-null      object
 13  occupation        0 non-null      object
```

```
 14  base              0 non-null      object
 15  teams             2 non-null      object
 16  relatives         1 non-null      object
 17  gender            1 non-null      object
 18  type_race         1 non-null      object
 19  height            2 non-null      object
 20  weight            2 non-null      object
 21  eye_color         0 non-null      object
 22  hair_color        0 non-null      object
 23  skin_color        0 non-null      object
 24  img               1 non-null      object
dtypes: object(25)
memory usage: 528.0+ bytes
```

In [1161]:

```
object_cols = list(text_cols.columns)
object_cols.remove('overall_score')
object_cols.remove('teams')
object_cols.remove('relatives')
```

In [1162]:

```
pure_transformation_pipeline = Pipeline(steps=[
           ('text_preproc', NltkTextPreprocessor()),
])
```

In [1163]:

```
for col in object_cols:
    print(col)
    data[col] = data[col].astype(str)
    data[col] = pure_transformation_pipeline.fit_transform(data[col])
```

Out [1163]:

```
name
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
in remove contractions
in remove_html_tags
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package omw-1.4 to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package omw-1.4 is already up-to-date!
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
real_name
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
in remove contractions
in remove_html_tags
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package omw-1.4 to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package omw-1.4 is already up-to-date!
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
full_name
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
```

```
in remove contractions
in remove_html_tags
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package omw-1.4 to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package omw-1.4 is already up-to-date!
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
history_text
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
in remove contractions
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package omw-1.4 to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package omw-1.4 is already up-to-date!
in remove_html_tags
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
powers_text
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
in remove contractions
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[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package omw-1.4 is already up-to-date!
in remove_html_tags
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
superpowers
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
in remove contractions
in remove_html_tags
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package omw-1.4 to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
[nltk_data]   Package omw-1.4 is already up-to-date!
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
alter_egos
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
```

```
in remove contractions
in remove_html_tags
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\sudip\AppData\Roaming\nltk_data...
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[nltk_data]   Package omw-1.4 is already up-to-date!
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
aliases
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
in remove contractions
in remove_html_tags
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[nltk_data]   Package omw-1.4 is already up-to-date!
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
place_of_birth
resource corpora/wordnet not found. Downloading now...
resource corpora/omw-1.4 not found. Downloading now...
in remove contractions
in remove_html_tags
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[nltk_data]   Package wordnet is already up-to-date!
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[nltk_data]   Package omw-1.4 is already up-to-date!
in replace_diacritics
in expand_contractions
in remove_numbers
in remove_punctuations_except_periods
in lemmatize
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in remove_numbers
in remove_punctuations_except_periods
in lemmatize
in remove_double_spaces
in remove_all_punctuations
in remove_stopwords
```

End of text preprocessing

In [1164]:
```
data.head(3)
```

Out [1164]:

	name	real_name	full_name	overall_score	history_text	powers_text	intelligence_score	stre
0	man	delroy garrett jr	delroy garrett jr	6	delroy garrett jr grow become track star compe...	nan	85	30
1	gotham	bruce wayne	nan	10	one many prisoner indian hill transfer another...	nan	100	20
2	abomb	richard milhouse jones	richard milhouse jones	20	richard rick jones orphan young age expel seve...	rare occasion unusual circumstance jones able ...	80	100

3 rows × 81 columns

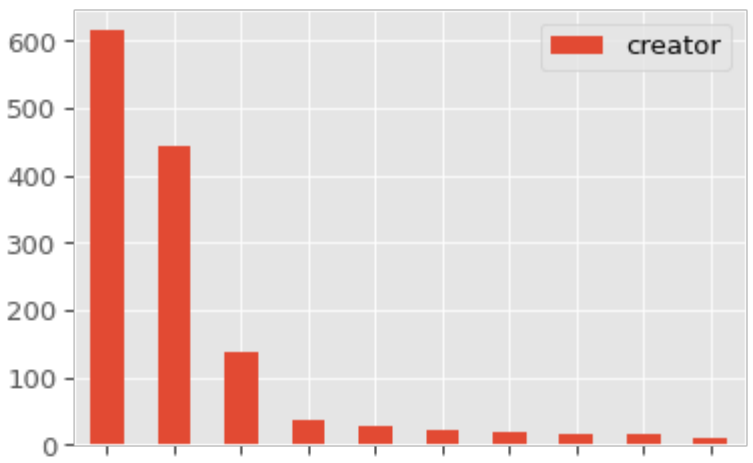
In []:
```
```

- Exploratiry Data Analysis

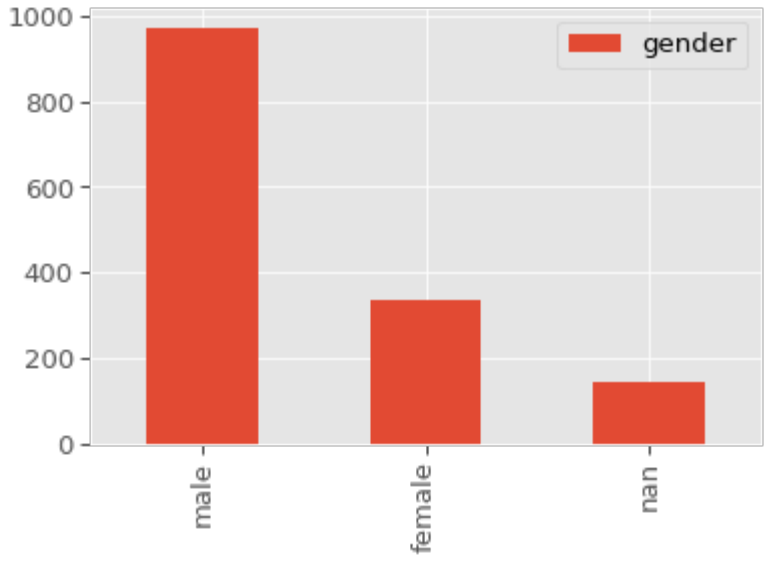
In [1165]:
```
def dist_plot(col):
    creator = pd.DataFrame(data[col].value_counts())
    creator.head(10).plot.bar()
```

In [1166]:
```
dist_plot('creator')
```

Out [1166]:



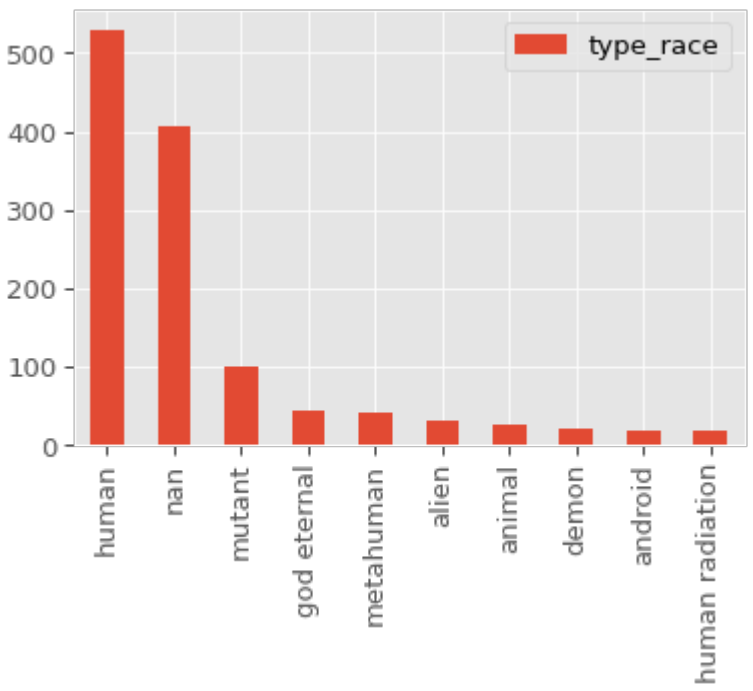
In [1167]:
```
dist_plot('gender')
```



In [1168]:

```
col = 'type_race'
dist_plot(col)
```

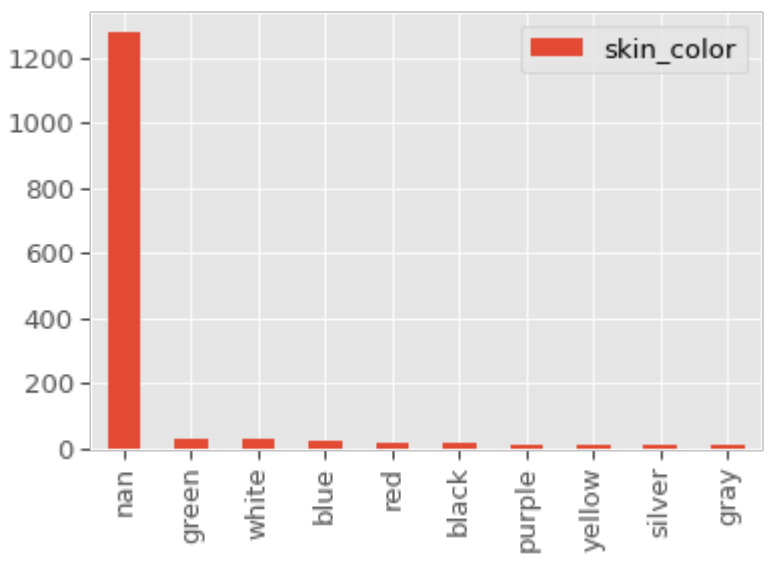
Out [1168]:



In [1169]:

```
col = 'skin_color'
dist_plot(col)
```

Out [1169]:



In [1170]:

```
# pd.set_option('display.max_colwidth', None)
print("number of values with '∞' as overall_score",sum(data['overall_score
print("number of values with '-' as overall_score",sum(data['overall_score
```

Out [1170]:

```
number of values with '∞' as overall_score 18
number of values with '-' as overall_score 107
```

In [1171]:

```
print('max value',data['overall_score'].max())
print('min value',data['overall_score'].min())
# data['overall_score'].nlargest(2)
```

Out [1171]:

```
max value ∞
```

```
min value -
```

- replace max value with max integer
- drop the rows with value '-' : we dont know what values they are

In [1172]:
```
# data['overall_score'=='-'].count()
# print('count of missing overall score :',data['overall_score'].value_cour
```

In [1173]:
```
clean_data=data[data['overall_score']!='-']
clean_data=clean_data[clean_data['overall_score']!='∞']
clean_data=clean_data[clean_data['overall_score'].notnull()]
```

In [1174]:
```
clean_data.shape
```

Out [1174]:
```
(1325, 81)
```

- Most common super power

In [1175]:
```
superpowers = data.loc[:, data.columns.str.startswith('has')].dropna()
superpowers.columns = superpowers.columns.str.replace(r'has_', '')
superpowers = superpowers.T.reset_index()
superpowers['Total'] = superpowers.sum(axis=1)
superpowers = superpowers.sort_values('Total',ascending=False)
superpowers.head(1)
```

Out [1175]:

	index	0	1	2	3	4	5	6	7	8	...	1440	1441	1442	1444	1445	1446	1447	1448
48	agility	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0	1.0	...	0.0	1.0	1.0	1.0	0.0	1.0	1.0	0.0

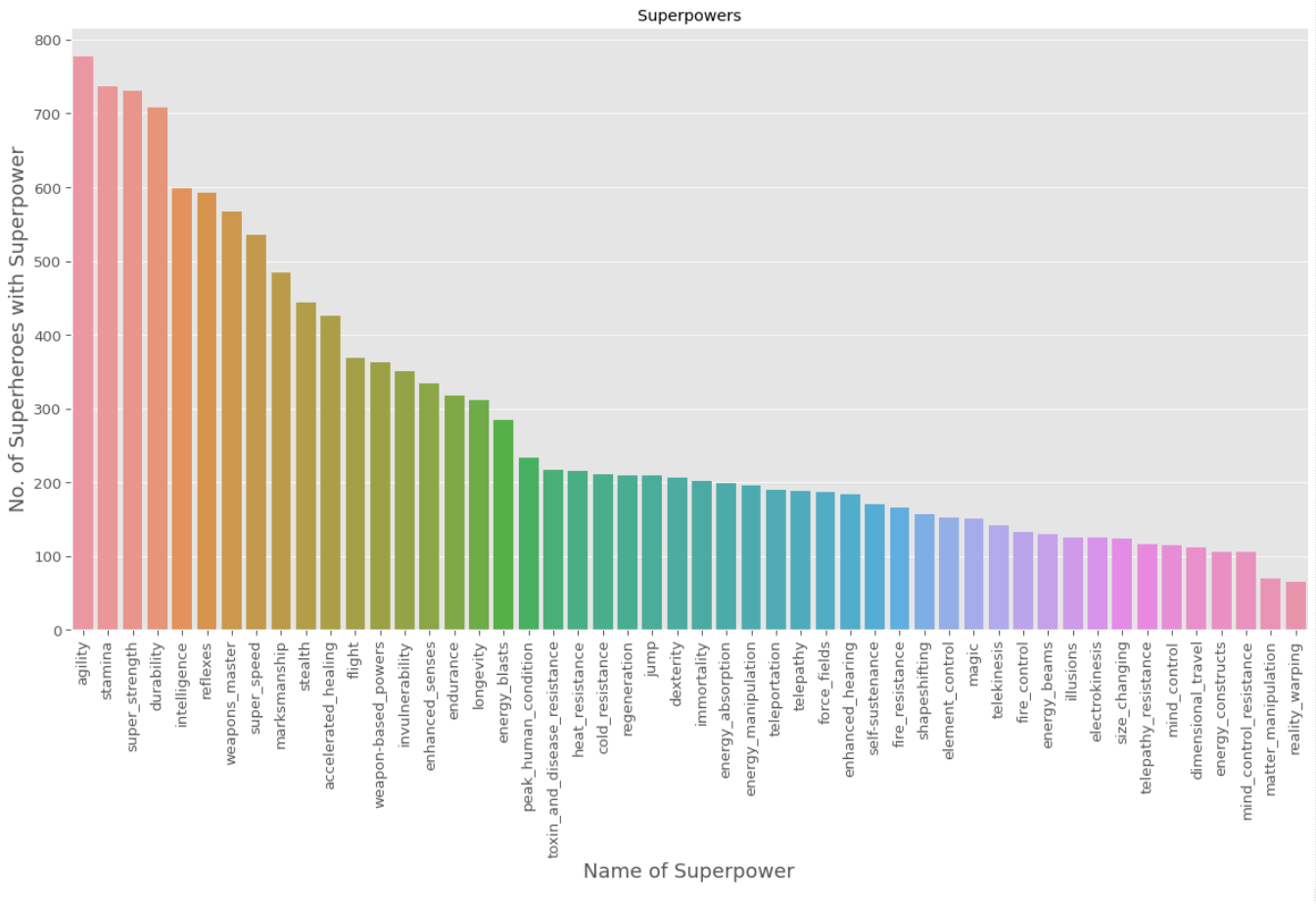
1 rows × 1385 columns

In [1176]:
```
plt.style.use('ggplot') # Using ggplot2 style visuals

fig, ax = plt.subplots()

fig.set_size_inches(20, 10)

sns.set_context("paper", font_scale=1.5)
f=sns.barplot(x=superpowers['index'], y=superpowers['Total'], data=superpow
f.set_xlabel("Name of Superpower",fontsize=18)
f.set_ylabel("No. of Superheroes with Superpower",fontsize=18)
f.set_title('Superpowers')
for item in f.get_xticklabels():
    item.set_rotation(90)
```



10 Most Common Superpowers

1. agility
2. stamina
3. super strength
4. durability
5. intelligence
6. reflexes
7. weapons_master
8. super_speed
9. marksmanship
10. stealth

- Most number of powers

In [1177]:

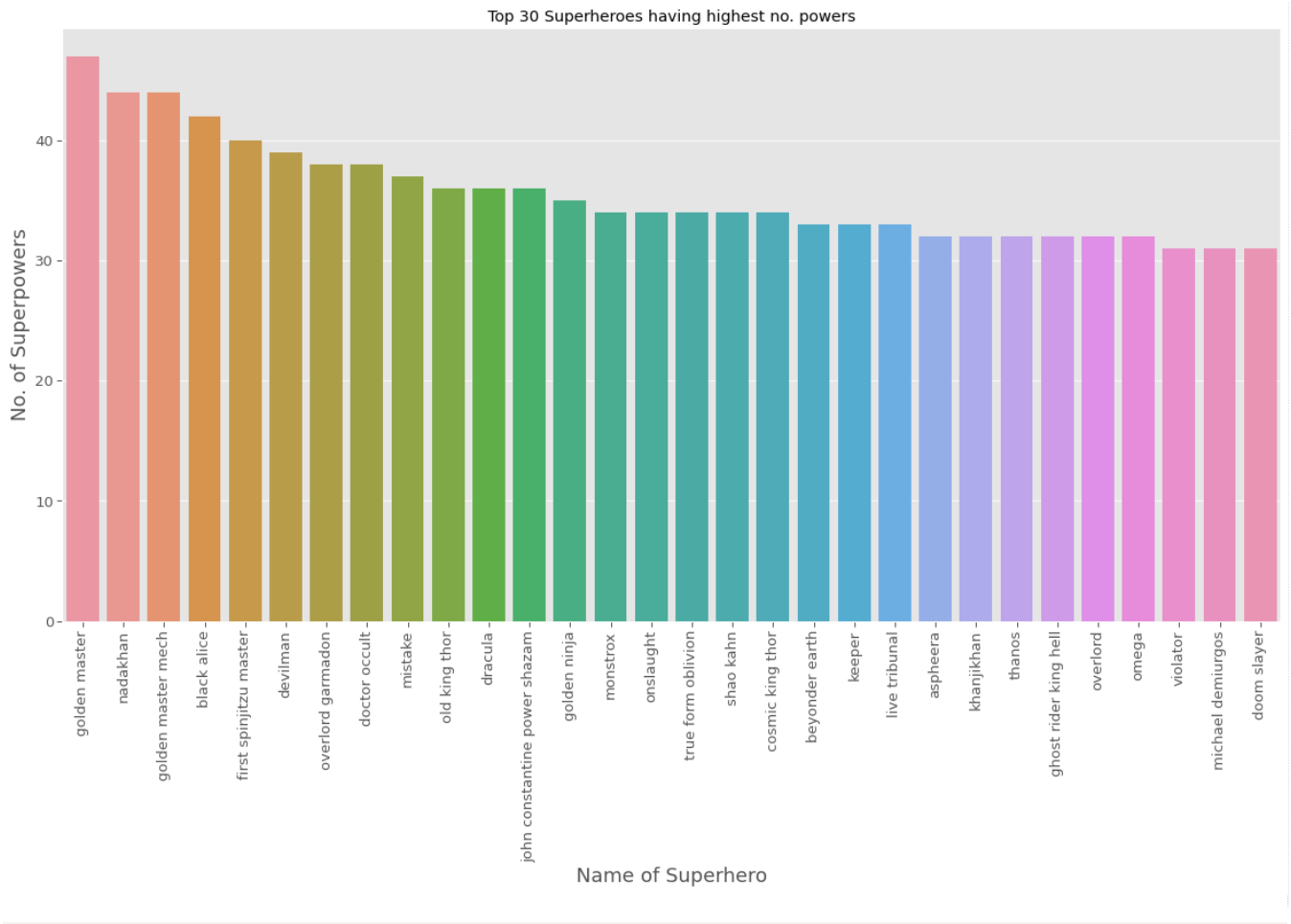
```
data_y = data.drop(['overall_score','intelligence_score','strength_score',
data.loc[:, 'total_superpowers'] = data_y.iloc[:, 1:].sum(axis=1)
data_powers_alignment=data[['name','total_superpowers','alignment','creator

plt.style.use('ggplot') # Using ggplot2 style visuals

fig, ax = plt.subplots()

fig.set_size_inches(20, 10)

sns.set_context("paper", font_scale=1.5)
f=sns.barplot(x=data_powers_alignment["name"].head(30), y=data_powers_alignm
f.set_xlabel("Name of Superhero",fontsize=18)
f.set_ylabel("No. of Superpowers",fontsize=18)
f.set_title('Top 30 Superheroes having highest no. powers')
for item in f.get_xticklabels():
    item.set_rotation(90)
```



In []:

In []:

In [1178]:
```
# clean_data['overall_score']
```

In [1179]:
```
clean_data.isnull().sum()
```

Out [1179]:
```
name                 0
real_name            0
full_name            0
overall_score        0
history_text         0
                    ..
has_super_speed      9
has_durability       9
has_stamina          9
has_agility          9
has_super_strength   9
Length: 81, dtype: int64
```

- Convert overall_score to int

In [1180]:
```
clean_data['overall_score'] = clean_data['overall_score'].astype('int')
```

In [1181]:
```
print('second highest value of overall_score: ',np.sort(clean_data['overall
print('highest value of overall_score: ', clean_data['overall_score'].max()
print('lowest value of overall_score: ', clean_data['overall_score'].min()
```

Out [1181]:
```
second highest value of overall_score:  229
highest value of overall_score:  237
lowest value of overall_score:  1
```

In [1182]:
```
# temp = np.sort(temp)
# temp[0]
```

- Second highest score = 237
- set the highest score = 300

In [1183]:
```
# clean_data.loc[clean_data["overall_score"] == 92233, "overall_score"] = 3
```

In [1184]:
```
number_cols = clean_data.select_dtypes(include='number').head()
print("Number Columns:\n",number_cols.columns)
```

Out [1184]:
```
Number Columns:
 Index(['overall_score', 'intelligence_score', 'strength_score', 'speed_score',
       'durability_score', 'power_score', 'combat_score', 'has_electrokinesis',
       'has_energy_constructs', 'has_mind_control_resistance',
       'has_matter_manipulation', 'has_telepathy_resistance',
       'has_mind_control', 'has_enhanced_hearing', 'has_dimensional_travel',
       'has_element_control', 'has_size_changing', 'has_fire_resistance',
       'has_fire_control', 'has_dexterity', 'has_reality_warping',
       'has_illusions', 'has_energy_beams', 'has_peak_human_condition',
       'has_shapeshifting', 'has_heat_resistance', 'has_jump',
       'has_self-sustenance', 'has_energy_absorption', 'has_cold_resistance',
       'has_magic', 'has_telekinesis', 'has_toxin_and_disease_resistance',
       'has_telepathy', 'has_regeneration', 'has_immortality',
       'has_teleportation', 'has_force_fields', 'has_energy_manipulation',
       'has_endurance', 'has_longevity', 'has_weapon-based_powers',
       'has_energy_blasts', 'has_enhanced_senses', 'has_invulnerability',
       'has_stealth', 'has_marksmanship', 'has_flight',
       'has_accelerated_healing', 'has_weapons_master', 'has_intelligence',
       'has_reflexes', 'has_super_speed', 'has_durability', 'has_stamina',
       'has_agility', 'has_super_strength'],
      dtype='object')
```

In [1185]:
```
clean_data = clean_data[number_cols.columns]
```

In [1186]:
```
clean_data.isnull().sum()
```

Out [1186]:
```
overall_score                   0
intelligence_score              0
strength_score                  0
speed_score                     0
durability_score                0
power_score                     0
combat_score                    0
has_electrokinesis              9
has_energy_constructs           9
has_mind_control_resistance     9
has_matter_manipulation         9
has_telepathy_resistance        9
has_mind_control                9
has_enhanced_hearing            9
has_dimensional_travel          9
has_element_control             9
has_size_changing               9
has_fire_resistance             9
has_fire_control                9
has_dexterity                   9
has_reality_warping             9
has_illusions                   9
has_energy_beams                9
has_peak_human_condition        9
has_shapeshifting               9
has_heat_resistance             9
has_jump                        9
has_self-sustenance             9
has_energy_absorption           9
has_cold_resistance             9
has_magic                       9
has_telekinesis                 9
has_toxin_and_disease_resistance    9
has_telepathy                   9
has_regeneration                9
has_immortality                 9
has_teleportation               9
has_force_fields                9
```

```
has_energy_manipulation            9
has_endurance                      9
has_longevity                      9
has_weapon-based_powers            9
has_energy_blasts                  9
has_enhanced_senses                9
has_invulnerability                9
has_stealth                        9
has_marksmanship                   9
has_flight                         9
has_accelerated_healing            9
has_weapons_master                 9
has_intelligence                   9
has_reflexes                       9
has_super_speed                    9
has_durability                     9
has_stamina                        9
has_agility                        9
has_super_strength                 9
dtype: int64
```

- We observe a list of consistent 9 null rows
- Exploring those

In [1187]:

```
# clean_data['as_electrokinesis'].isnull()
null_mask=clean_data.isnull().any(axis=1)
null_rows = clean_data[null_mask]
null_rows
```

Out [1187]:

	overall_score	intelligence_score	strength_score	speed_score	durability_score	power_scor
37	5	80	10	15	10	5
261	2	40	10	60	45	40
303	6	90	10	15	10	5
495	3	70	10	0	0	0
657	7	95	10	10	10	5
752	6	90	20	25	40	15
994	1	45	10	20	50	5
1114	5	80	10	20	10	15
1427	2	60	10	10	0	0

9 rows × 57 columns

- Same 9 rows null always , we can drop it

In [1188]:

```
clean_data=clean_data[clean_data['has_electrokinesis'].notnull()]
```

In [1189]:

```
clean_data.isnull().sum()
```

Out [1189]:

```
overall_score                    0
intelligence_score               0
strength_score                   0
speed_score                      0
durability_score                 0
power_score                      0
combat_score                     0
has_electrokinesis               0
has_energy_constructs            0
has_mind_control_resistance      0
has_matter_manipulation          0
has_telepathy_resistance         0
has_mind_control                 0
has_enhanced_hearing             0
```

```
has_dimensional_travel             0
has_element_control                0
has_size_changing                  0
has_fire_resistance                0
has_fire_control                   0
has_dexterity                      0
has_reality_warping                0
has_illusions                      0
has_energy_beams                   0
has_peak_human_condition           0
has_shapeshifting                  0
has_heat_resistance                0
has_jump                           0
has_self-sustenance                0
has_energy_absorption              0
has_cold_resistance                0
has_magic                          0
has_telekinesis                    0
has_toxin_and_disease_resistance   0
has_telepathy                      0
has_regeneration                   0
has_immortality                    0
has_teleportation                  0
has_force_fields                   0
has_energy_manipulation            0
has_endurance                      0
has_longevity                      0
has_weapon-based_powers            0
has_energy_blasts                  0
has_enhanced_senses                0
has_invulnerability                0
has_stealth                        0
has_marksmanship                   0
has_flight                         0
has_accelerated_healing            0
has_weapons_master                 0
has_intelligence                   0
has_reflexes                       0
has_super_speed                    0
has_durability                     0
has_stamina                        0
has_agility                        0
has_super_strength                 0
dtype: int64
```

In [1190]:
```
# clean_data.info()
```

- outlier removal

In [1191]:
```
def outlier_remover(df,col):
    Q1 = np.percentile(df[col], 25, method='midpoint')
    Q3 = np.percentile(df[col], 75, method='midpoint')
    IQR = Q3 - Q1
    upper = Q3 +1.5*IQR
    lower = Q1 - 1.5*IQR
    df = df[(df[col]>=lower) & (df[col]<=upper)]
    return df
```

In [1192]:
```
# clean_data[(clean_data['intelligence_score']>=100) & (clean_data['intelli
```

In [1193]:
```
number_cols = clean_data.select_dtypes(include='int').head()
print("Number Columns:\n",number_cols.columns)
```

```
Number Columns:
 Index(['overall_score', 'intelligence_score', 'strength_score', 'speed_score',
       'durability_score', 'power_score', 'combat_score'],
      dtype='object')
```

In [1194]:
```
clean_data.shape
```

Out [1194]:
```
(1316, 57)
```

In [1195]:
```
for col in number_cols.columns:
    clean_data = outlier_remover(clean_data,col)
```

In [1196]:
```
clean_data.shape
```

Out [1196]:
```
(1169, 57)
```

In [1197]:
```
ProfileReport(clean_data)
```

Out [1197]:
```
Summarize dataset:   0%|          | 0/5 [00:00<?, ?it/s]
```

Out [1197]:
```
Generate report structure:   0%|          | 0/1 [00:00<?, ?it/s]
```

Out [1197]:
```
Render HTML:   0%|          | 0/1 [00:00<?, ?it/s]
```

Out [1197]:

Overview

Dataset statistics

Number of variables	57
Number of observations	1169
Missing cells	0
Missing cells (%)	0.0%
Duplicate rows	2
Duplicate rows (%)	0.2%
Total size in memory	557.4 KiB
Average record size in memory	488.3 B

Variable types

Numeric	7
Categorical	50

Alerts

Dataset has 2 (0.2%) duplicate rows	**Duplicates**
`overall_score` is highly overall correlated with `intelligence_score` and 3 other fields (intelligence_score, strength_score, durability_score, power_score)	**High correlation**
`intelligence_score` is highly overall correlated with `overall_score` and 1 other fields (overall_score, has_intelligence)	**High correlation**

Out [1197]:

In []:

In [1198]:
```
cols = list(clean_data.columns)
cols.remove('overall_score')
```

In [1199]:
```
number_cols_scale=list(number_cols)
number_cols_scale.remove('overall_score')
```

In [1200]:
```
y = clean_data['overall_score']
X = clean_data[cols]
```

In [1201]:
```
scaler = StandardScaler()
# scaler.fit(X_train[number_cols])
# X[number_cols_scale] = pd.DataFrame(scaler.transform(X[number_cols]), col

X[number_cols_scale] = scaler.fit_transform(X[number_cols_scale])

# X_test = pd.DataFrame(scaler.transform(X_test), columns = X_test.columns)
```

In [1202]:
```
X
```

Out [1202]:

	intelligence_score	strength_score	speed_score	durability_score	power_score	combat_sco
0	-0.063125	-0.259452	0.545997	0.096876	-1.012837	-0.158800
1	1.422643	-0.582627	-0.675964	-0.276264	-1.186853	1.173524
2	-0.558381	2.002773	1.360638	1.589437	1.075357	0.285308
3	-0.558381	0.386898	0.342337	-0.462834	1.075357	-0.824962
4	-0.558381	-0.905803	-0.879624	-0.649405	-1.360869	-1.047016
...	...	...	...	...	...	...
1444	1.422643	-0.097865	0.138677	0.096876	1.075357	1.173524
1445	0.432131	-0.905803	-0.879624	-1.022545	1.075357	-0.824962
1446	-0.558381	2.002773	2.175279	1.589437	1.075357	0.285308
1447	0.927387	0.386898	2.175279	0.656587	1.075357	0.285308
1448	-1.053637	-0.905803	2.175279	-1.022545	1.075357	-1.935231

1169 rows × 56 columns

In [1203]:
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.3,random_s
```

In [1204]:
```
X_train.shape,X_test.shape,y_train.shape,y_test.shape
```

Out [1204]:
```
((818, 56), (351, 56), (818,), (351,))
```

In [1205]:
```
# Adding a constant column to our X_train dataframe
X_mod = sm.add_constant(X_train)

# create a first fitted model
linear_model_1 = sm.OLS(y_train,X_mod).fit()
```

In [1206]:
```
print(linear_model_1.summary())
```

Out [1206]:
```
                            OLS Regression Results
==============================================================================
```

Dep. Variable:	overall_score	R-squared:	0.846
Model:	OLS	Adj. R-squared:	0.835
Method:	Least Squares	F-statistic:	74.64
Date:	Tue, 26 Sep 2023	Prob (F-statistic):	9.31e-270
Time:	06:43:09	Log-Likelihood:	-1669.7
No. Observations:	818	AIC:	3453.
Df Residuals:	761	BIC:	3722.
Df Model:	56		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	7.3822	0.195	37.917	0.000	7.000	7.764
intelligence_score	1.8214	0.085	21.437	0.000	1.655	1.988
strength_score	1.1298	0.118	9.539	0.000	0.897	1.362
speed_score	0.7826	0.108	7.250	0.000	0.571	0.994
durability_score	0.2227	0.121	1.837	0.067	-0.015	0.461
power_score	0.2068	0.113	1.822	0.069	-0.016	0.430
combat_score	-0.1133	0.093	-1.217	0.224	-0.296	0.069
has_electrokinesis	0.7881	0.294	2.681	0.008	0.211	1.365
has_energy_constructs	0.4907	0.363	1.351	0.177	-0.222	1.204
has_mind_control_resistance	1.1278	0.427	2.638	0.009	0.289	1.967
has_matter_manipulation	2.5903	0.655	3.953	0.000	1.304	3.877
has_telepathy_resistance	0.0257	0.350	0.074	0.941	-0.661	0.713
has_mind_control	1.5616	0.371	4.205	0.000	0.833	2.291
has_enhanced_hearing	0.2420	0.258	0.938	0.348	-0.264	0.748
has_dimensional_travel	1.4241	0.370	3.849	0.000	0.698	2.151
has_element_control	0.4690	0.271	1.734	0.083	-0.062	1.000
has_size_changing	0.7378	0.334	2.207	0.028	0.082	1.394
has_fire_resistance	0.4724	0.311	1.518	0.129	-0.139	1.083
has_fire_control	0.3781	0.320	1.182	0.237	-0.250	1.006
has_dexterity	0.0080	0.250	0.032	0.975	-0.483	0.499
has_reality_warping	0.7353	1.172	0.627	0.531	-1.565	3.036
has_illusions	0.0007	0.371	0.002	0.999	-0.728	0.730
has_energy_beams	0.3069	0.363	0.847	0.398	-0.405	1.019
has_peak_human_condition	-0.2445	0.220	-1.110	0.267	-0.677	0.188
has_shapeshifting	0.2737	0.281	0.975	0.330	-0.277	0.825
has_heat_resistance	-0.0828	0.322	-0.257	0.797	-0.715	0.549
has_jump	0.4642	0.230	2.018	0.044	0.013	0.916
has_self-sustenance	1.1938	0.293	4.073	0.000	0.618	1.769
has_energy_absorption	0.3689	0.272	1.356	0.176	-0.165	0.903
has_cold_resistance	0.6403	0.302	2.118	0.035	0.047	1.234
has_magic	1.3427	0.302	4.439	0.000	0.749	

```
1.937
has_telekinesis                      0.6944      0.352      1.972      0.049       0.003
1.386
has_toxin_and_disease_resistance     0.1346      0.247      0.545      0.586      -0.351
0.620
has_telepathy                        0.5497      0.287      1.917      0.056      -0.013
1.113
has_regeneration                     1.4963      0.258      5.794      0.000       0.989
2.003
has_immortality                      3.4241      0.296     11.571      0.000       2.843
4.005
has_teleportation                    1.5106      0.288      5.248      0.000       0.946
2.076
has_force_fields                     0.6106      0.276      2.216      0.027       0.070
1.151
has_energy_manipulation              0.1991      0.303      0.656      0.512      -0.397
0.795
has_endurance                        0.4813      0.226      2.133      0.033       0.038
0.924
has_longevity                       -0.2519      0.222     -1.134      0.257      -0.688
0.184
has_weapon-based_powers              0.0488      0.188      0.260      0.795      -0.320
0.418
has_energy_blasts                    0.7198      0.244      2.948      0.003       0.240
1.199
has_enhanced_senses                  0.2757      0.217      1.270      0.204      -0.150
0.702
has_invulnerability                  0.6328      0.232      2.727      0.007       0.177
1.088
has_stealth                          0.2048      0.192      1.065      0.287      -0.173
0.582
has_marksmanship                     0.2185      0.198      1.106      0.269      -0.169
0.606
has_flight                           0.0388      0.195      0.199      0.842      -0.344
0.421
has_accelerated_healing              1.2516      0.202      6.209      0.000       0.856
1.647
has_weapons_master                   0.0767      0.206      0.372      0.710      -0.328
0.481
has_intelligence                     0.6461      0.181      3.575      0.000       0.291
1.001
has_reflexes                        -0.1354      0.201     -0.675      0.500      -0.529
0.258
has_super_speed                      0.7250      0.214      3.388      0.001       0.305
1.145
has_durability                      -0.5467      0.186     -2.933      0.003      -0.913
-0.181
has_stamina                          0.0542      0.197      0.274      0.784      -0.333
0.442
has_agility                         -0.2338      0.187     -1.253      0.211      -0.600
0.132
has_super_strength                  -0.7664      0.218     -3.518      0.000      -1.194
-0.339
==============================================================================
Omnibus:                      121.813   Durbin-Watson:                   1.914
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              347.478
Skew:                           0.748   Prob(JB):                     3.52e-76
Kurtosis:                       5.821   Cond. No.                         38.2
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

In [1207]:

```
results_summary = linear_model_1.summary()
```

In []:

In [1208]:

```
ols_summary=pd.DataFrame(results_summary.tables[1].data)
ols_summary=ols_summary.drop(index=0)
ols_summary.columns=["column_name","coeff","std err", "t" ,"p" , "0.025" ,
```

In [1209]:
```
ols_summary.head(2)
```

Out [1209]:

	column_name	coeff	std err	t	p	0.025	0.975
1	const	7.3822	0.195	37.917	0.000	7.000	7.764
2	intelligence_score	1.8214	0.085	21.437	0.000	1.655	1.988

In [1210]:
```
ols_summary.info()
```

Out [1210]:
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 57 entries, 1 to 57
Data columns (total 7 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   column_name  57 non-null     object
 1   coeff        57 non-null     object
 2   std err      57 non-null     object
 3   t            57 non-null     object
 4   p            57 non-null     object
 5   0.025        57 non-null     object
 6   0.975        57 non-null     object
dtypes: object(7)
memory usage: 3.2+ KB
```

In [1211]:
```
num_col = ["coeff","std err", "t" ,"p" , "0.025" , "0.975"]
ols_summary[num_col]=ols_summary[num_col].apply(pd.to_numeric)
```

In [1212]:
```
ols_summary = ols_summary[ols_summary['p']<0.05]
```

In [1213]:
```
ols_summary.sort_values(by=['coeff'], ascending=False)
```

Out [1213]:

	column_name	coeff	std err	t	p	0.025	0.975
1	const	7.3822	0.195	37.917	0.000	7.000	7.764
36	has_immortality	3.4241	0.296	11.571	0.000	2.843	4.005
11	has_matter_manipulation	2.5903	0.655	3.953	0.000	1.304	3.877
2	intelligence_score	1.8214	0.085	21.437	0.000	1.655	1.988
13	has_mind_control	1.5616	0.371	4.205	0.000	0.833	2.291
37	has_teleportation	1.5106	0.288	5.248	0.000	0.946	2.076
35	has_regeneration	1.4963	0.258	5.794	0.000	0.989	2.003
15	has_dimensional_travel	1.4241	0.370	3.849	0.000	0.698	2.151
31	has_magic	1.3427	0.302	4.439	0.000	0.749	1.937
49	has_accelerated_healing	1.2516	0.202	6.209	0.000	0.856	1.647
28	has_self-sustenance	1.1938	0.293	4.073	0.000	0.618	1.769
3	strength_score	1.1298	0.118	9.539	0.000	0.897	1.362
10	has_mind_control_resistance	1.1278	0.427	2.638	0.009	0.289	1.967
8	has_electrokinesis	0.7881	0.294	2.681	0.008	0.211	1.365
4	speed_score	0.7826	0.108	7.250	0.000	0.571	0.994
17	has_size_changing	0.7378	0.334	2.207	0.028	0.082	1.394
53	has_super_speed	0.7250	0.214	3.388	0.001	0.305	1.145
43	has_energy_blasts	0.7198	0.244	2.948	0.003	0.240	1.199
32	has_telekinesis	0.6944	0.352	1.972	0.049	0.003	1.386
51	has_intelligence	0.6461	0.181	3.575	0.000	0.291	1.001
30	has_cold_resistance	0.6403	0.302	2.118	0.035	0.047	1.234

	column_name	coeff	std err	t	p	0.025	0.975
45	has_invulnerability	0.6328	0.232	2.727	0.007	0.177	1.088
38	has_force_fields	0.6106	0.276	2.216	0.027	0.070	1.151
40	has_endurance	0.4813	0.226	2.133	0.033	0.038	0.924
27	has_jump	0.4642	0.230	2.018	0.044	0.013	0.916
54	has_durability	-0.5467	0.186	-2.933	0.003	-0.913	-0.181
57	has_super_strength	-0.7664	0.218	-3.518	0.000	-1.194	-0.339

In [1214]:
```
req_cols = list(ols_summary['column_name'])
req_cols.remove('const')
```

In [1215]:
```
X_train = X_train[req_cols]
X_test = X_test[req_cols]
```

- Checking for VIF

In [1216]:
```
vif_data = pd.DataFrame()
vif_data["feature"] = X_train.columns

# calculating VIF for each feature
vif_data["VIF"] = [variance_inflation_factor(X_train.values, i)
                           for i in range(len(X_train.columns))]

vif_data[vif_data['VIF']>5]
```

Out [1216]:

	feature	VIF

- No column to drop

Base model

In [1217]:
```
def plot_result(y_pred,y_test):
    # Actual values vs Predicted values graph

    plt.figure(figsize=(18,7))
    count = [i for i in range(0,len(y_pred),1)]
    plt.plot(count,y_test,c='blue',linewidth=2.5,linestyle='-',label='Actua
    plt.plot(count,y_pred,c='red',linewidth=2.5,linestyle='-',label='Predic

    # Plot heading
    plt.legend(loc=0)
    plt.title('Actual vs Predicted Values',fontsize=20)
    plt.xlabel('Index',fontsize=18)
    plt.ylabel('Overall Score',fontsize=18)

    plt.show()
```

In [1218]:
```
def scores(y_test,y_pred):
    mse=mean_squared_error(y_test,y_pred)
    mae=mean_absolute_error(y_test,y_pred)
    rmse=np.sqrt(mse)
    print('mse :',mse)
    print('mae :',mae)
    print('rmse :',rmse)
```

In [1219]:
```
y_test.shape
```

Out [1219]:
```
(351,)
```

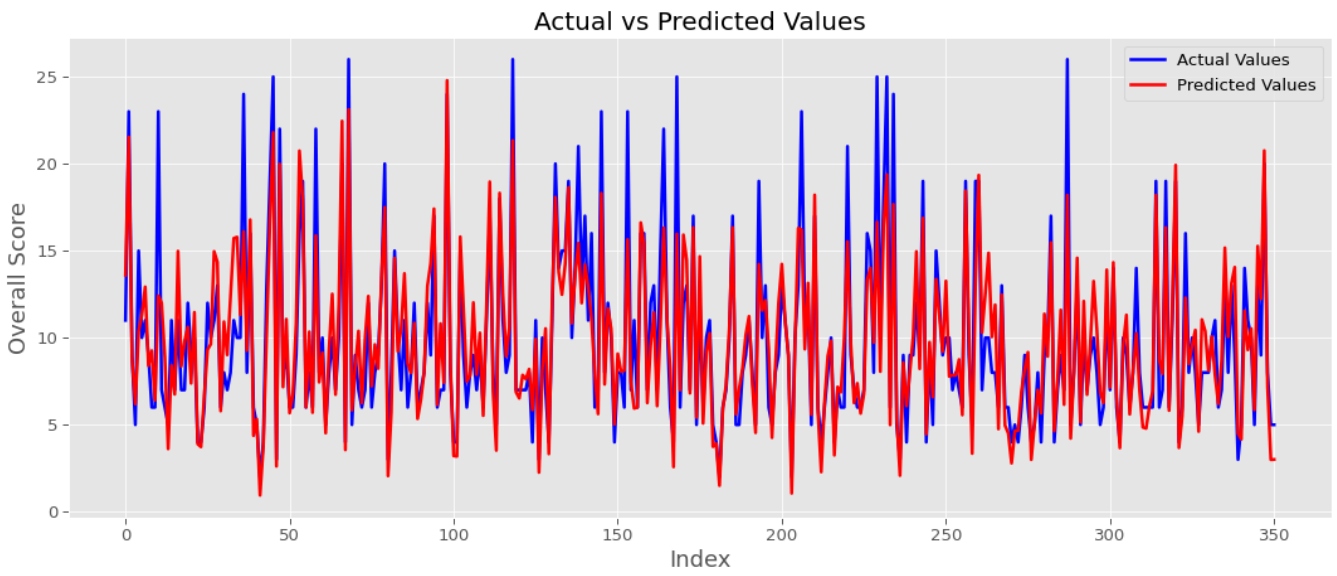
In [1220]:
```
def model(model , X_train ,y_train,y_test):
    model.fit(X_train,y_train)
    y_pred=model.predict(X_test)
    print(y_pred.shape)
    plot_result(y_pred,y_test)
    validation_score=cross_val_score(model,X_train,y_train,scoring='neg_mea
    val = np.mean(validation_score)
    print('cross_val_score :',val)
    scores(y_test,y_pred)
```

In [1221]:
```
regression=LinearRegression()
```

In [1222]:
```
model(regression , X_train ,y_train,y_test)
```

Out [1222]:
```
(351,)
```

Out [1222]:



Out [1222]:
```
cross_val_score : -4.291615442282995
mse : 5.399650587621573
mae : 1.6378420876753936
rmse : 2.323714824934758
```

- Overall performance of the model is satisfactory
- We will use the basemodel itself for now

Predicting score for the data where overall_score is missing

prediction for overall_score = '∞'

In [1223]:
```
infinity_data=data[data['overall_score']=='∞']
# Standard scaling
infinity_data[number_cols_scale] = scaler.transform(infinity_data[number_co
new_req_cols = copy.deepcopy(req_cols)
new_req_cols.append('name')
infinity_data = infinity_data[new_req_cols]
# clean_data=clean_data[clean_data['overall_score']!='∞']
```

In [1224]:
```
over_score = regression.predict(infinity_data[req_cols])
```

In [1225]:
```
# infinity_data[number_cols_scale] = scaler.transform(infinity_data[number_
# over_score
```

In [1226]:
```
temp = pd.DataFrame(over_score)
temp.columns=['overall_score']
# temp
```

In [1227]:
```
# temp
```

In [1228]:
```
# infinity_data.append(temp, ignore_index=True)
# df_concat = pd.concat([df1.reset_index(drop=True), df2.reset_index(drop=T
concatenated_df = pd.concat([infinity_data['name'].reset_index(drop=True),
                             temp['overall_score'].reset_index(drop=True)],
                            axis=1)
```

In [1229]:
```
concatenated_df = concatenated_df.sort_values(by=['overall_score'], ascendi
concatenated_df.head(5)
```

Out [1229]:

	name	overall_score
6	golden master mech	39.412689
14	golden master	39.315131
2	black alice	37.710292
17	true form oblivion	37.678308
9	live tribunal	37.294927

prediction for overall_score = '-'

In [1230]:
```
un_data=data[data['overall_score']=='-']
# Standard scaling
un_data[number_cols_scale] = scaler.transform(un_data[number_cols_scale])
new_req_cols = copy.deepcopy(req_cols)
new_req_cols.append('name')
un_data = un_data[new_req_cols]
# over_score = regression.predict(infinity_data[req_cols])
# over_score
```

In [1231]:
```
# un_data.isnull().sum()
```

In [1232]:
```
un_data=un_data[un_data['has_super_strength'].notnull()]
# un_data.isnull().sum()
```

In [1233]:
```
un_score = regression.predict(un_data[req_cols])
# un_score
```

In [1234]:
```
# def table_prepare(infinity_data,number_cols_scale,req_cols,reference_col)
#     infinity_data[number_cols_scale] = scaler.transform(infinity_data[num
#     new_req_cols = copy.deepcopy(req_cols)
#     new_req_cols.append(reference_col)
#     new_req_cols.append('name')
#     infinity_data = infinity_data[new_req_cols]
#     infinity_data=infinity_data[infinity_data['has_super_strength'].notnu
#     return infinity_data

def table_prepare(infinity_data,number_cols_scale,req_cols,reference_col,mo
    infinity_data[number_cols_scale] = scaler.transform(infinity_data[numbe
    new_req_cols = copy.deepcopy(req_cols)
    new_req_cols.append(reference_col)
```

```
    new_req_cols.append('name')
    infinity_data = infinity_data[new_req_cols]
    infinity_data=infinity_data[infinity_data['has_super_strength'].notnul
    over_score = model.predict(infinity_data[req_cols])
    temp = pd.DataFrame(over_score)
    temp.columns=['overall_score']
    concatenated_df = pd.concat([infinity_data[['name',reference_col]].rese
                                 temp['overall_score'].reset_index(drop=True)]

    return concatenated_df
```

In [1235]:

```
print('number_cols_scale :',number_cols_scale)
print('req_cols :',req_cols)
# print('reference_col',reference_col)
```

Out [1235]:

```
number_cols_scale : ['intelligence_score', 'strength_score', 'speed_score',
'durability_score', 'power_score', 'combat_score']
req_cols : ['intelligence_score', 'strength_score', 'speed_score', 'has_electrokinesis',
'has_mind_control_resistance', 'has_matter_manipulation', 'has_mind_control',
'has_dimensional_travel', 'has_size_changing', 'has_jump', 'has_self-sustenance',
'has_cold_resistance', 'has_magic', 'has_telekinesis', 'has_regeneration',
'has_immortality', 'has_teleportation', 'has_force_fields', 'has_endurance',
'has_energy_blasts', 'has_invulnerability', 'has_accelerated_healing', 'has_intelligence',
'has_super_speed', 'has_durability', 'has_super_strength']
```

Question 1

1) How would you define most powerful superhero from the information available in dataset?
a> Who is the most powerful superhero from each creator?

- The field provided in the data set 'overall_score' is a good estimate of the power of the superhero.
- However, the challenge is that there are :

    18 incidents with '∞' as overall_score
    107 incidents with '-' as overall_score

- To overcome this challenge we built a linear rgressor model to predict the score given the features
- Then we predict the score for

    18 incidents with '∞' as overall_score
    107 incidents with '-' as overall_score

- Who ever gets the maximum score is the strongest superhero

Note : More sophisticated model than linear regressor can be used.However, to provide an intution of the solution we stuck to the base model.

> Who is the most powerful superhero from each creator ?

- Top 10 creator details provided
- Incidents for which creator information is not provided is grouped as nan

In [1236]:

```
reference_col = 'creator'
# regression
res = table_prepare(data,number_cols_scale,req_cols,reference_col,regressio
```

In [1237]:

```
des_op =res.sort_values(['overall_score'], ascending=False).groupby('creato
des_op[['name','creator']].head(10)
```

Out [1237]:

	name	creator
508	golden master mech	nan

	name	creator
173	black alice	dc comic
1285	true form oblivion	marvel comic
381	devilman	shueisha
408	dracula	konami
1294	unicron	hasbro
509	golden ninja	lego
818	man miracle	image comic
1141	skeletor	mattel
776	link	nintendo

In [1238]:
```
#
```

Question 2

2) Find the top 5 superpowers in descending order.

- Intution

  We observe the contribution of various powers to the 'overall_score' field.
  Larger the positive coefficient greater the contribution.
  Hence sorting and picking top 5 gives the result.

In [1239]:
```
top_5 = ols_summary.sort_values(['coeff'], ascending=False)
top_5=top_5.iloc[1: , :]
top_5[['column_name','coeff']].head(5)
```

Out [1239]:

	column_name	coeff
36	has_immortality	3.4241
11	has_matter_manipulation	2.5903
2	intelligence_score	1.8214
13	has_mind_control	1.5616
37	has_teleportation	1.5106

Question 3

Which race has the most immortal superheroes?

nan = undefined group

In [1240]:
```
immortals = data[data['has_immortality']==1]
immortals['type_race'].value_counts().head(5)
```

Out [1240]:
```
nan            38
god eternal    36
human          29
demon          18
new god        11
Name: type_race, dtype: int64
```

Question 4

4)Name the creator having most superheroes of type “Parademon”.

In [1241]:
```
data[data['type_race']=='parademon']['creator']
```

```
991    dc comic
Name: creator, dtype: object
```

Question 5

- Which comic creator has most superhero teams?
  a. Find names, real names and alias of superhero who is part of most teams.
  b. Are there any crossovers between creators and teams?

In [1242]:
```
# temp
```

In [1243]:
```
creator_team=data[data['teams']!='[]'][['creator','teams','name','real_name
# creator_team['creator'].value_counts()
```

In [1244]:
```
creator_team.head()
```

Out [1244]:

	creator	teams	name	real_name	aliases
0	marvel comic	['Annihilators', 'Asgardians', 'Avengers', 'Ne...	man	delroy garrett jr	
2	marvel comic	['Teen Brigade', 'Ultimate Fantastic Four', 'U...	abomb	richard milhouse jones	rick jones
3	dc comic	['Blue Lantern Corps', 'Green Lantern Corps', ...	aa	aa	
5	george lucas	['Jedi Order']	aayla secura	aayla secura	
6	dark horse comic	['Bureau for Paranormal Research and Defense']	abe sapien	abraham sapien	langdon everett caul abraham sapien langdon caul

In [1245]:
```
df1 = creator_team.groupby('creator')['teams'].apply(' '.join).reset_index
```

In [1246]:
```
df1.head(2)
```

Out [1246]:

	creator	teams
0	cartoon network	['Flex Fighters']
1	dark horse comic	['Bureau for Paranormal Research and Defense']...

In [1247]:
```
# df1
# direct=direct.assign(country=direct['country'].str.split(',')).explode('c
```

In [1248]:
```
pattern = '(\[\')[a-zA-Z0-9 +]+(\'\])'
sub1="['"
sub2="']"
import re
def length_count(x, denote = 'creator'):
    text = ''.join(x)
    text = text.lower()
#     print(">",text)
    test_str = text.replace("'] ['",",# ")
#     test_str = text.replace('"',"'")
#     print('>',test_str)
    # getting index of substrings
    idx1=0
    id2 =0
    try:
```

```
        idx1 = test_str.index(sub1)
    except:
        subk='["'
        idx1 = test_str.index(subk)
    try:
        idx2 = test_str.index(sub2)
    except :
        subl='"]'
        idx2 = test_str.index(subl)
    res = test_str[idx1 + len(sub1) : idx2]
    res_str = res.replace("'","",# ")

#     print('>',res_str)
    s = re.sub(r"[^a-zA-Z0-9,#']+", ' ', res_str)
#     print('>',s)
    final_string = []
    temp_store = re.split(',#', s)
#     print('>',temp_store)
    for i in temp_store:
        i = i.strip()
        i = i.replace("'","")
        if i not in final_string:
#             i = i.strip()
            final_string.append(i)
#     print('>',final_string)
    length = len(final_string)
#     print('>',final_string)
    new_final_string = ', '.join(final_string)

#     text = res.split(',#')

#     print('>',new_final_string)
    return length
#     return len(x)
```

In [1249]:

```
df1['team_count']=df1['teams'].apply(length_count)
# df.keywords.str.len()
# apply(function)
```

- Which comic creator has most superhero teams?

In [1250]:

```
df1.sort_values('team_count',ascending=False).head(2)
```

Out [1250]:

	creator	teams	team_count
2	dc comic	['Blue Lantern Corps', 'Green Lantern Corps', ...	73
8	marvel comic	['Annihilators', 'Asgardians', 'Avengers', 'Ne...	56

In [1251]:

```
df2 = creator_team.groupby('name')['teams'].apply(' '.join).reset_index()
```

In [1252]:

```
df2=df2[df2['name']!='']
df2.head()
```

Out [1252]:

	name	teams
1	aa	['Blue Lantern Corps', 'Green Lantern Corps', ...
2	aayla secura	['Jedi Order']
3	abe sapien	['Bureau for Paranormal Research and Defense']
4	abin sur	['Legion of Super-Heroes', 'Green Lantern Corps']

	name	teams
5	abomb	['Teen Brigade', 'Ultimate Fantastic Four', 'U...

In [1253]:
```
# def length_count_df2(text):
#     text = ''.join(text)
#     text = text.lower()
#     sub1="['"
# #     idx1 = text.index(sub1)
#     print('>',text)
#     return 1
```

In [1254]:
```
df2['team_count']=df2['teams'].apply(length_count)
```

In [1255]:
```
# df2.head()
```

In [1256]:
```
df2.sort_values('team_count',ascending=False).head(5)
```

Out [1256]:

	name	teams	team_count
142	deadpool	['Deadpool Corps', 'Agency X', 'X-Force', 'Dee...	14
530	wolverine	['X-Force', 'X-Men', 'Weapon X', 'Secret Defen...	14
229	hulk	['The Mighty Avengers', 'Agency X', 'Contingen...	12
307	luke cage	['Mighty Avengers', 'New Avengers', 'Defenders...	10
152	doctor strange classic	['Defenders', 'Neo-Knights', 'The Mighty Aveng...	10

Find names, real names and alias of superhero who is part of most teams.

In [1257]:
```
data[(data['name']=='deadpool') | (data['name']=='wolverine')][['name','rea
# ['name','real_name','aliases']
```

Out [1257]:

	name	real_name	aliases
370	deadpool	wade wilson	wade wilson jack chiyonosake wolf rice wine rh...
1415	wolverine	logan	weapon x weapon ten death mutate jim logan emi...

In [1258]:
```
pattern = '(\[\')[a-zA-Z0-9 +]+(\'\])'
sub1="['"
sub2="']"
import re
def clean_team(x, denote = 'creator'):
    text = ''.join(x)
    text = text.lower()
#     print(">",text)
    test_str = text.replace("'] ['",",# ")
#     test_str = text.replace('"',"'")
#     print('>',test_str)
    # getting index of substrings
    idx1=0
    id2 =0
    try:
        idx1 = test_str.index(sub1)
    except:
        subk='["'
        idx1 = test_str.index(subk)
    try:
        idx2 = test_str.index(sub2)
    except :
```

```
        subl='"]'
        idx2 = test_str.index(subl)
    res = test_str[idx1 + len(sub1) : idx2]
    res_str = res.replace("'","",# ")

#     print('>',res_str)
    s = re.sub(r"[^a-zA-Z0-9,#']+", ' ', res_str)
#     print('>',s)
    final_string = []
    temp_store = re.split(',#', s)
#     print('>',temp_store)
    for i in temp_store:
        i = i.strip()
        i = i.replace("'","")
        if i not in final_string:
#             i = i.strip()
            final_string.append(i)
#     print('>',final_string)
    length = len(final_string)
#     print('>',final_string)
    new_final_string = ', '.join(final_string)

#     text = res.split(',#')

#     print('>',new_final_string)
    return new_final_string
```

In [1259]:

```
check_overlap = creator_team[['creator','teams']]
```

In [1260]:

```
check_overlap['clean_team']=check_overlap['teams'].apply(clean_team)
```

In [1261]:

```
check_overlap.head()
```

Out [1261]:

	creator	teams	clean_team
0	marvel comic	['Annihilators', 'Asgardians', 'Avengers', 'Ne...	annihilators, asgardians, avengers, new avengers
2	marvel comic	['Teen Brigade', 'Ultimate Fantastic Four', 'U...	teen brigade, ultimate fantastic four, u men, ...
3	dc comic	['Blue Lantern Corps', 'Green Lantern Corps', ...	blue lantern corps, green lantern corps, justi...
5	george lucas	['Jedi Order']	jedi order
6	dark horse comic	['Bureau for Paranormal Research and Defense']	bureau for paranormal research and defense

In [1262]:

```
check_overlap_split=check_overlap.assign(clean_team=check_overlap['clean_te
# direct=direct.assign(director=direct['director'].str.split(',')).explode(
```

In [1263]:

```
check_overlap_split.head()
```

Out [1263]:

	creator	teams	clean_team
0	marvel comic	['Annihilators', 'Asgardians', 'Avengers', 'Ne...	annihilators
0	marvel comic	['Annihilators', 'Asgardians', 'Avengers', 'Ne...	asgardians
0	marvel comic	['Annihilators', 'Asgardians', 'Avengers', 'Ne...	avengers
0	marvel comic	['Annihilators', 'Asgardians', 'Avengers', 'Ne...	new avengers
2	marvel comic	['Teen Brigade', 'Ultimate Fantastic Four', 'U...	teen brigade

In [1264]:
```
agg_by_team = check_overlap_split.groupby('clean_team')['creator'].apply('
```

In [1265]:
```
def creator_count(text):
    text = ''.join(text)
#     text = text.lower()
    creators = text.split(',')
    inter_m_list = list(set(creators))
    length = len(inter_m_list)
    if 'nan' in inter_m_list and length>1:
        inter_m_list.remove('nan')
        length-=1
#     print('>',set(creators))
    return length
```

In [1266]:
```
def clean_creator(text):
    text = ''.join(text)
#     text = text.lower()
    creators = text.split(',')
    inter_m_list = list(set(creators))
    length = len(inter_m_list)
    if 'nan' in inter_m_list and length>1:
        inter_m_list.remove('nan')
        length-=1
    clean = ' ,'.join(inter_m_list)
    return clean
```

In [1267]:
```
agg_by_team.head()
```

Out [1267]:

	clean_team	creator
0	a force	marvel comic,marvel comic,marvel comic,marvel ...
1	a i m	marvel comic,marvel comic,marvel comic
2	a r m o r	marvel comic,marvel comic,marvel comic,marvel ...
3	acolytes	marvel comic,marvel comic
4	agency x	marvel comic,marvel comic,marvel comic,marvel ...

In [1268]:
```
agg_by_team['creator_count']=agg_by_team['creator'].apply(creator_count)
```

```
agg_by_team['clean_creator']=agg_by_team['creator'].apply(clean_creator)
```

In [1269]:
```
agg_by_team.head()
```

Out [1269]:

	clean_team	creator	creator_count	clean_creator
0	a force	marvel comic,marvel comic,marvel comic,marvel ...	1	marvel comic
1	a i m	marvel comic,marvel comic,marvel comic	1	marvel comic
2	a r m o r	marvel comic,marvel comic,marvel comic,marvel ...	1	marvel comic
3	acolytes	marvel comic,marvel comic	1	marvel comic
4	agency x	marvel comic,marvel comic,marvel comic,marvel ...	1	marvel comic

b. Are there any crossovers between creators and teams?

yes

In [1270]:
```
agg_by_team.sort_values('creator_count',ascending=False).head(5)[['clean_te
```

Out [1270]:

	clean_team	creator_count	clean_creator
289	incredible family	2	disney ,dark horse comic
186	titans	2	marvel comic ,dc comic
0	a force	1	marvel comic
257	demon knights	1	dc comic
266	female furies	1	dc comic

Question 6

- What are the characteristics that can predict a superhero alignment.

In [1271]:
```
alignment=data[data['alignment']=='good']
alignment=alignment[alignment['has_agility'].notnull()]
alignment=alignment[(alignment['overall_score']!='-') & (alignment['overall
alignment['overall_score'] = alignment['overall_score'].astype(int)
alignment.isnull().sum()
```

Out [1271]:
```
name                0
real_name           0
full_name           0
overall_score       0
history_text        0
                   ..
has_durability      0
has_stamina         0
has_agility         0
has_super_strength  0
total_superpowers   0
Length: 82, dtype: int64
```

Out [1272]:
```
ProfileReport(alignment[alignment['alignment']=='good'])
```

Out [1272]:
```
Summarize dataset:   0%|          | 0/5 [00:00<?, ?it/s]
```

Out [1272]:
```
Generate report structure:   0%|          | 0/1 [00:00<?, ?it/s]
```

Out [1272]:
```
Render HTML:   0%|          | 0/1 [00:00<?, ?it/s]
```

Overview

Dataset statistics

Number of variables	82
Number of observations	713
Missing cells	193
Missing cells (%)	0.3%
Duplicate rows	0
Duplicate rows (%)	0.0%
Total size in memory	475.7 KiB
Average record size in memory	683.2 B

Variable types

Categorical	74
Numeric	8

Alerts

`alignment` has constant value "good"	**Constant**
`name` has a high cardinality: 709 distinct values	**High cardinality**
`real_name` has a high cardinality: 560 distinct values	**High cardinality**
`full_name` has a high cardinality: 469 distinct values	**High cardinality**
`history_text` has a high cardinality: 668 distinct values	**High cardinality**

In [1273]:
```
alignment=data[data['alignment']=='bad']
alignment=alignment[alignment['has_agility'].notnull()]
alignment=alignment[(alignment['overall_score']!='-') & (alignment['overall
alignment['overall_score'] = alignment['overall_score'].astype(int)
alignment.isnull().sum()
ProfileReport(alignment[alignment['alignment']=='bad'])
```

Out [1273]:
```
Summarize dataset:   0%|          | 0/5 [00:00<?, ?it/s]
```

Out [1273]:
```
Generate report structure:   0%|          | 0/1 [00:00<?, ?it/s]
```

Out [1273]:
```
Render HTML:   0%|          | 0/1 [00:00<?, ?it/s]
```

Overview

Dataset statistics

Number of variables	82
Number of observations	410
Missing cells	197
Missing cells (%)	0.6%
Duplicate rows	0
Duplicate rows (%)	0.0%
Total size in memory	280.4 KiB
Average record size in memory	700.4 B

Variable types

Categorical	74
Numeric	8

Alerts

`alignment` has constant value "bad"	**Constant**
`name` has a high cardinality: 406 distinct values	**High cardinality**
`real_name` has a high cardinality: 313 distinct values	**High cardinality**
`full_name` has a high cardinality: 229 distinct values	**High cardinality**
`history_text` has a high cardinality: 393 distinct values	**High cardinality**

- What are the characteristics that can predict a superhero alignment.

  The traditional way would be to build a classifier and observe the factord that contribute most to it's success.
  Considering the time constraint I couldn't follow that approach
  However by analysis/profiling of data following observations were made :
  1> Superheros with negative alignment have higher strength, speed , durability,power score
  2>Superheros with positive alignment have higher intelligence and combat score

Question 7

- From history of superheroes,
  a. Find list of superheroes having negative past but now aligned positively.
  (Negativity of past can be decided by multiple methods, please use which is familiar to you)
  b. Extract patterns from superhero history for each creator.

In [1274]:
```
from transformers import pipeline
summarizer = pipeline("summarization", model="stevhliu/my_awesome_billsum_r
classifier = pipeline("sentiment-analysis", model="stevhliu/my_awesome_mode
warnings.filterwarnings('ignore')
from transformers import logging
# logging.getLogger("pytorch_pretrained_bert.tokenization").setLevel(loggir
logging.set_verbosity_error()
```

In [1275]:
```
count=0
def past_alignment_check(text):
```

```
    global count
    count = count+1
    print("completed ",count," of 795")
    text = ''.join(text)
    res = summarizer(text)
    test_sentence = res[0]['summary_text']
    result = classifier(test_sentence)
    senti = 'good'
    score = 0
    if result[0]['label']== 'LABEL_0':
        senti = 'bad'
#     classifier(test_sentence)

# [{'label': 'LABEL_0', 'score': 0.9466749429702759}]
#     print(text)
    return senti
```

In [1276]:

```
# warnings.filterwarnings('ignore')

past=data[(data['history_text']!='') & (data['alignment']=='good')][['name
past.shape
```

Out [1276]:

```
(50, 4)
```

In [1277]:

```
from pathlib import Path

# create a Path object with the path to the file
path = Path('./predicted.csv')

if path.is_file():
    print("reading pretrained model....")
    past = pd.read_csv('./predicted.csv')
    print('done')

else:
    past['past_alignment']=past['history_text'].apply(past_alignment_check)
    past.to_csv('predicted1.csv')
```

Out [1277]:

```
reading pretrained model....
done
```

In [1278]:

```
past.head()
```

Out [1278]:

	Unnamed: 0	name	creator	history_text	alignment	past_alignment
0	0	man	marvel comic	delroy garrett jr grow become track star compe...	good	bad
1	2	abomb	marvel comic	richard rick jones orphan young age expel seve...	good	bad
2	3	aa	dc comic	aa one passive member pumice people race stone...	good	bad
3	4	aaron cash	dc comic	aaron cash head security arkham asylum hook ha...	good	bad
4	5	aayla secura	george lucas	ayla secura rutian twilek jedi knight onetime ...	good	good

- predicting past_alignment from history_text took too much time

- Hence, we limited ourself to picking just 50 samples

a. Find list of superheroes having negative past but now aligned positively

In [1279]:
```
past[past['past_alignment']=='bad']['name']
```

Out [1279]:
```
0                           man
1                         abomb
2                            aa
3                    aaron cash
5                    abe sapien
6                      abin sur
7                 absorb man mcu
10                  adam strange
12                         agent
13                     agent bob
15    agent coulson destroyer gun
16             agent coulson mcu
17                 agent may mcu
18                    agent zero
19                         akita
22             alfred pennyworth
24                allan quatermain
27                 ancient one mcu
28                  ando masahashi
29                      angel dust
30                 angel salvadore
31                           angel
32                     animal man
34                      antman ii
36                         antman
37                       aquababy
38                       aquagirl
41              aquaman injustice
45                         ardina
46                          ariel
47                          armor
Name: name, dtype: object
```

b. Extract patterns from superhero history for each creator.

- Creators distribution with superheroes having negative past but now aligned positively

In [1280]:
```
past[past['past_alignment']=='bad']['creator'].value_counts()
```

Out [1280]:
```
marvel comic        17
dc comic             9
dark horse comic     2
lego                 1
wildstorm            1
nbc hero             1
Name: creator, dtype: int64
```

- Creators distribution with superheroes having positive past and now aligned positively

In [1281]:
```
past[past['past_alignment']=='good']['creator'].value_counts()
```

Out [1281]:
```
dc comic         6
marvel comic     5
ubisoft          2
george lucas     1
nbc hero         1
j r r tolkien    1
Name: creator, dtype: int64
```

Question 8

- Report on the 10 superheroes with most relatives,
- status of those relatives where possible,
- and the alignment of those superheroes.

In [1282]:
```
relatives = data[data['name']!=''][['name','relatives','alignment']]
```

In [1283]:
```
relatives.head()
```

Out [1283]:

	name	relatives	alignment
0	man	NaN	good
1	gotham	Bruce Wayne (genetic template)	nan
2	abomb	Marlo Chandler-Jones (wife); Polly (aunt); Mrs...	good
3	aa	NaN	good
4	aaron cash	NaN	good

In [1284]:
```
def clean_relatives(text):
    text=str(text).strip()
    text = text.replace(';',',')
    if text=='nan':
#         print('hola',end = ' ')
        return "No info available"
#     print('>',text)
    return text

def clean_relatives_count(text):
    text=str(text).strip()
    if text=='No info available':
        return 0
    else :
        list_count = text.split(',')
        length=len(list_count)
#         print('>',list_count)
    return length
```

In [1285]:
```
relatives['relatives_cleaned']=relatives['relatives'].apply(clean_relatives
relatives['relatives_count']=relatives['relatives_cleaned'].apply(clean_rel
```

In [1286]:
```
relatives.head()
```

Out [1286]:

	name	relatives	alignment	relatives_cleaned	relatives_count
0	man	NaN	good	No info available	0
1	gotham	Bruce Wayne (genetic template)	nan	Bruce Wayne (genetic template)	1
2	abomb	Marlo Chandler-Jones (wife); Polly (aunt); Mrs...	good	Marlo Chandler-Jones (wife), Polly (aunt), Mrs...	9
3	aa	NaN	good	No info available	0
4	aaron cash	NaN	good	No info available	0

Question 8

- Report on the 10 superheroes with most relatives, status of those relatives where possible, and the alignment of those superheroes.

In [1287]:
```
relatives.sort_values('relatives_count',ascending=False).head(10)[['name',
```

Out [1287]:

	name	relatives_cleaned	alignment	relatives_count
936	namor	Elanna (maternal ancestor), Tanas (maternal an...	good	53
574	havok	Oscar Summers (adoptive paternal distant ances...	good	48
75	aquaman	Koryak (son), Arthur Curry, Jr. (son), A.J. (s...	good	37
1100	robin v	Talia al Ghul (mother),\nBruce Wayne (Batman, ...	good	36
121	baron zemo	Harbin Zemo (distant ancestor, deceased),\nHad...	bad	33
515	ghost rider king hell	Illyana Kale (maternal ancestor, deceased), De...	good	33
1251	supergirl	Zor-El (father), Allura In-Ze (mother), Jor-El...	good	33
340	cyclops	Oscar Summers (adoptive paternal distant ances...	good	33
1328	toxin	Carl Brock (father, estranged), Janine Brock (...	good	28
312	colossus	Grigory Efimovich Rasputin (great-grandfather,...	good	28

Question 9

- Find out any other interesting insights from given data.
- Which 3 comic characters can you recommend to your friends to read or watch?

    - Super heros are product of an imaginitive mind with escapist tendencies.
    - Failing to deal with the reality we resort to imagination of super power or super being to seek comfort in the
      thought that a miracle would set us free.
    - But miracles rarely do happen and even less to those waiting for it.
    - Hence, I would recommend watching superheros with the least 'over_all' score.
    - It doesn't take a lot of courage to stand before the bullet when you know it would bounce off your skin.
      but takes a mighty heart to do so knowing full well that it would pierce through them.
    - Hence I believe superheros with the least 'over_all' score rank higher when it come to attitude.
    - Sends the message a sharp blade don't defeat the dragon, but a valiant warrior does.

    - But knowing my friends how shallow they are they would rather enjoy watching the strongest superheros.
    - Because I care for their happiness I would recommend superheros with the highest 'over_all' score.

In [1288]:
```
des_op[['name']].head(3)
```

Out [1288]:

	name
508	golden master mech
173	black alice
1285	true form oblivion

In []:
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