ASSIGNMENT 1

FOUNDATIONS OF MACHINE LEARNING

SUBJECT CODE: CS564

Submitted by

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MTech 1st year

1. Creation of data frame from given data:

Top four rows of data

	country	child_mort	exports	health	imports	income	inflation	life_expec	total_fer	gdpp
0	Afghanistan	90.2	10.0	7.58	44.9	1610	9.44	56.2	5.82	553
1	Albania	16.6	28.0	6.55	48.6	9930	4.49	76.3	1.65	4090
2	Algeria	27.3	38.4	4.17	31.4	12900	16.10	76.5	2.89	4460
3	Angola	119.0	62.3	2.85	42.9	5900	22.40	60.1	6.16	3530
4	Antigua and Barbuda	10.3	45.5	6.03	58.9	19100	1.44	76.8	2.13	12200

2. Data cleaning:

I checked null and NAN values presence

```
df_given_data.isna().sum().sum()
```

```
No of NAN values in given data
0
```

```
df_given_data.isnull().sum().sum()
```

```
No of NULL values in given data
0
```

I also checked if all names in country column are unique

```
print(df_given_data.country.nunique())
print(len(df_given_data.index))
```

```
Printing no of unique names in country coloumn and no of rows in data frame
If the both the counts are same then there no duplicates name of any country present in given data
167
167
```

3. Scaling:

I scaled data to get data of all column in same range

Top 4 rows of data before scaling

	child_mort	exports	health	imports	income	inflation	life_expec	total_fer	gdpp
0	90.2	10.0	7.58	44.9	1610	9.44	56.2	5.82	553
1	16.6	28.0	6.55	48.6	9930	4.49	76.3	1.65	4090
2	27.3	38.4	4.17	31.4	12900	16.10	76.5	2.89	4460
3	119.0	62.3	2.85	42.9	5900	22.40	60.1	6.16	3530
4	10.3	45.5	6.03	58.9	19100	1.44	76.8	2.13	12200

Top 4 rows of data after scaling

	child_mort	exports	health	imports	income	inflation	life_expec	total_fer	gdpp
0	0.426485	0.049482	0.358608	0.257765	0.008047	0.126144	0.475345	0.736593	0.003073
1	0.068160	0.139531	0.294593	0.279037	0.074933	0.080399	0.871795	0.078864	0.036833
2	0.120253	0.191559	0.146675	0.180149	0.098809	0.187691	0.875740	0.274448	0.040365
3	0.566699	0.311125	0.064636	0.246266	0.042535	0.245911	0.552268	0.790221	0.031488
4	0.037488	0.227079	0.262275	0.338255	0.148652	0.052213	0.881657	0.154574	0.114242

4. Dimension Reduction using pca:

I reduced 9 dimensional data into 2 dimensional data using pca

Top 4 rows of data before pca

	child_mort	exports	health	imports	income	inflation	life_expec	total_fer	gdpp
0	0.426485	0.049482	0.358608	0.257765	0.008047	0.126144	0.475345	0.736593	0.003073
1	0.068160	0.139531	0.294593	0.279037	0.074933	0.080399	0.871795	0.078864	0.036833
2	0.120253	0.191559	0.146675	0.180149	0.098809	0.187691	0.875740	0.274448	0.040365
3	0.566699	0.311125	0.064636	0.246266	0.042535	0.245911	0.552268	0.790221	0.031488
4	0.037488	0.227079	0.262275	0.338255	0.148652	0.052213	0.881657	0.154574	0.114242

Top 4 rows of data after pca

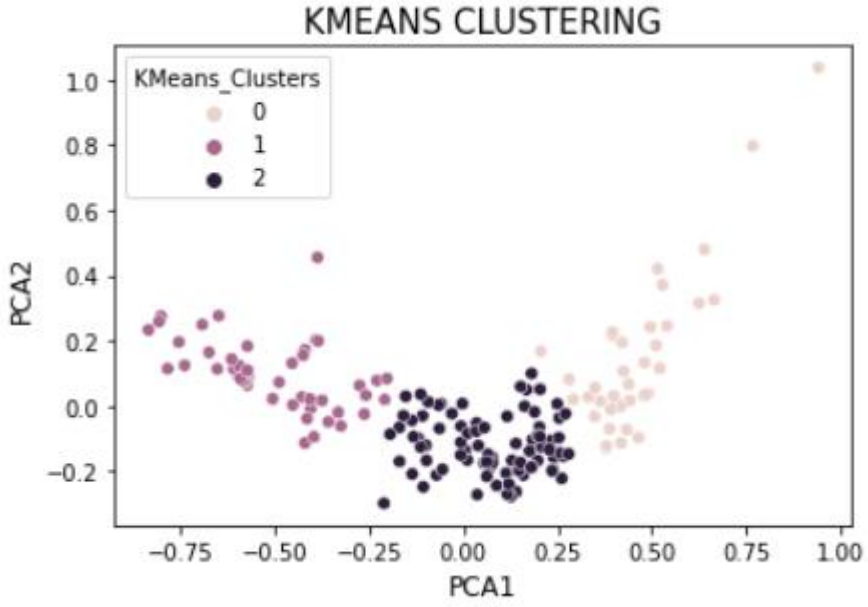
	x	y
0	-0.599078	0.095490
1	0.158474	-0.212092
2	0.003686	-0.135867
3	-0.650235	0.275975
4	0.200711	-0.064662

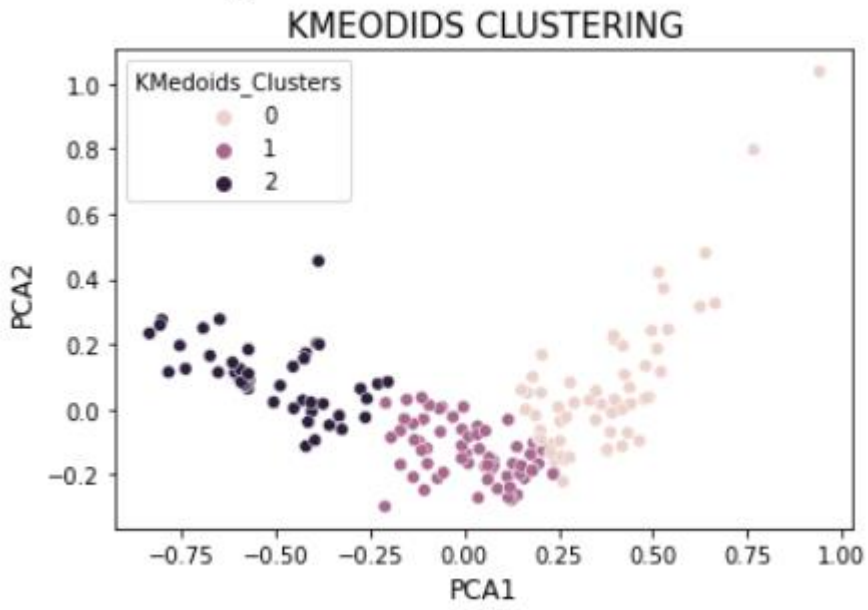
5. CLUSTEERING:

I applied KMeans, KMediods on scaled and dimensionally reduced version of data. I assumed k value as 3

```
Assume k value 3
Printing the no of values in each cluster using KMeans
2    83
1    46
0    38
dtype: int64
Printing the no of values in each cluster using KMedoids
1    64
0    58
2    45
dtype: int64
```

6. Visualization:





7. Silhouette Coefficient Calculation:

I calculated to know how strong my clustering using Silhouette score

```
Printing shilhouette score using KMeans
0.7794811747288485
Printing shilhouette score using KMedoids
0.6628757821417425
```

8. Print countries cluster wise:

Printing list of under developing countries using KMeans

['Afghanistan', 'Angola', 'Benin', 'Burkina Faso', 'Burundi', 'Cameroon', 'Central African Republic', 'Chad', 'Comoros', 'Congo, Dem. Rep.', 'Congo, Rep.', "Cote d'Ivoire", 'Equatorial Guinea', 'Eritrea', 'Gabon', 'Gambia', 'Ghana', 'Guinea', 'Guinea-Bissau', 'Haiti', 'Iraq', 'Kenya', 'Kiribati', 'Lao', 'Lesotho', 'Liberia', 'Madagascar', 'Malawi', 'Mali', 'Mauritania', 'Mozambique', 'Namibia', 'Niger', 'Nigeria', 'Pakistan', 'Rwanda', 'Senegal', 'Sierra Leone', 'Solomon Islands', 'Sudan', 'Tanzania', 'Timor-Leste', 'Togo', 'Uganda', 'Yemen', 'Zambia']

Printing list of developed countries using KMeans

['Australia', 'Austria', 'Bahrain', 'Belgium', 'Brunei', 'Canada', 'Cyprus', 'Czech Republic', 'Denmark', 'Estonia', 'Finland', 'France', 'Germany', 'Greece', 'Hungary', 'Iceland', 'Ireland', 'Italy', 'Japan', 'Kuwait', 'Luxembourg', 'Malta', 'Netherlands', 'New Zealand', 'Norway', 'Portugal', 'Qatar', 'Seychelles', 'Singapore', 'Slovak Republic', 'Slovenia', 'South Korea', 'Spain', 'Sweden', 'Switzerland', 'United Arab Emirates', 'United Kingdom', 'United States']

Printing list of developing countries using KMeans

['Albania', 'Algeria', 'Antigua and Barbuda', 'Argentina', 'Armenia', 'Azerbaijan', 'Bahamas', 'Bangladesh', 'Barbados', 'Belarus', 'Belize', 'Bhutan', 'Bolivia', 'Bosnia and Herzegovina', 'Botswana', 'Brazil', 'Bulgaria', 'Cambodia', 'Cape Verde', 'Chile', 'China', 'Colombia', 'Costa Rica', 'Croatia', 'Dominican Republic', 'Ecuador', 'Egypt', 'El Salvador', 'Fiji', 'Georgia', 'Grenada', 'Guatemala', 'Guyana', 'India', 'Indonesia', 'Iran', 'Israel', 'Jamaica', 'Jordan', 'Kazakhstan', 'Kyrgyz Republic', 'Latvia', 'Lebanon', 'Libya', 'Lithuania', 'Macedonia, FYR', 'Malaysia', 'Maldives', 'Mauritius', 'Micronesia, Fed. Sts.', 'Moldova', 'Mongolia', 'Montenegro', 'Morocco', 'Myanmar', 'Nepal', 'Oman', 'Panama', 'Paraguay', 'Peru', 'Philippines', 'Poland', 'Romania', 'Russia', 'Samoa', 'Saudi Arabia', 'Serbia', 'South Africa', 'Sri Lanka', 'St. Vincent and the Grenadines', 'Suriname', 'Tajikistan', 'Thailand', 'Tonga', 'Tunisia', 'Turkey', 'Turkmenistan', 'Ukraine', 'Uruguay', 'Uzbekistan', 'Vanuatu', 'Venezuela', 'Vietnam']

Printing list of under developing countries using KMedoids

['Afghanistan', 'Angola', 'Benin', 'Burkina Faso', 'Burundi', 'Cameroon', 'Central African Republic', 'Chad', 'Comoros', 'Congo, Dem. Rep.', 'Congo, Rep.', "Cote d'Ivoire", 'Equatorial Guinea', 'Eritrea', 'Gabon', 'Gambia', 'Ghana', 'Guinea', 'Guinea-Bissau', 'Haiti', 'Iraq', 'Kenya', 'Kiribati', 'Lao', 'Lesotho', 'Liberia', 'Madagascar', 'Malawi', 'Mali', 'Mauritania', 'Mozambique', 'Namibia', 'Niger', 'Nigeria', 'Pakistan', 'Rwanda', 'Senegal', 'Sierra Leone', 'Solomon Islands', 'Sudan', 'Tanzania', 'Timor-Leste', 'Togo', 'Uganda', 'Yemen', 'Zambia']

Printing list of developed countries using KMedoids

['Australia', 'Austria', 'Bahrain', 'Belgium', 'Brunei', 'Canada', 'Cyprus', 'Czech Republic', 'Denmark', 'Estonia', 'Finland', 'France', 'Germany', 'Greece', 'Hungary', 'Iceland', 'Ireland', 'Italy', 'Japan', 'Kuwait', 'Luxembourg', 'Malta', 'Netherlands', 'New Zealand', 'Norway', 'Portugal', 'Qatar', 'Seychelles', 'Singapore', 'Slovak Republic', 'Slovenia', 'South Korea', 'Spain', 'Sweden', 'Switzerland', 'United Arab Emirates', 'United Kingdom', 'United States']

Printing list of developing countries using KMedoids

['Albania', 'Algeria', 'Antigua and Barbuda', 'Argentina', 'Armenia', 'Azerbaijan', 'Bahamas', 'Bangladesh', 'Barbados', 'Belarus', 'Belize', 'Bhutan', 'Bolivia', 'Bosnia and Herzegovina', 'Botswana', 'Brazil', 'Bulgaria', 'Cambodia', 'Cape Verde', 'Chile', 'China', 'Colombia', 'Costa Rica', 'Croatia', 'Dominican Republic', 'Ecuador', 'Egypt', 'El Salvador', 'Fiji', 'Georgia', 'Grenada', 'Guatemala', 'Guyana', 'India', 'Indonesia', 'Iran', 'Israel', 'Jamaica', 'Jordan', 'Kazakhstan', 'Kyrgyz Republic', 'Latvia', 'Lebanon', 'Libya', 'Lithuania', 'Macedonia, FYR', 'Malaysia', 'Maldives', 'Mauritius', 'Micronesia, Fed. Sts.', 'Moldova', 'Mongolia', 'Montenegro', 'Morocco', 'Myanmar', 'Nepal', 'Oman', 'Panama', 'Paraguay', 'Peru', 'Philippines', 'Poland', 'Romania', 'Russia', 'Samoa', 'Saudi Arabia', 'Serbia', 'South Africa', 'Sri Lanka', 'St. Vincent and the Grenadines', 'Suriname', 'Tajikistan', 'Thailand', 'Tonga', 'Tunisia', 'Turkey', 'Turkmenistan', 'Ukraine', 'Uruguay', 'Uzbekistan', 'Vanuatu', 'Venezuela', 'Vietnam']

THANK YOU