Unsupervised_final_project

December 9, 2024

1 Final Project for Unsupervised Learning

This project is based on a Kaggle competition of Disease Symptom Prediction and can be found here (https://www.kaggle.com/datasets/itachi9604/disease-symptom-description-dataset). The original competition was designed to see if students could come up with a disease prediction score associated with symptoms. Here, I am using the data a bit differently as to not come up with the same exact project. My project here is to just do an unsupervised clustering of symptoms to see if there are general trends in disease and symptom correlation.

I will use a hierarchical clustering and some other dimensionality reduction techniques to put the patients with similar symptoms together and to see if the clustering of symptoms leads to unique disease groups. Overall, the theroy is that patients with the exact same set of symptoms will separate from each other. This in reality isn't practical, but we'll see how well the symptoms separate.

1.1 Data Acquisition

[94]:
```
import kagglehub

# Download latest version
path = kagglehub.dataset_download("itachi9604/
 ↪disease-symptom-description-dataset")

print("Path to dataset files:", path)
```

```
Path to dataset files:
C:\Users\dvanbooven\.cache\kagglehub\datasets\itachi9604\disease-symptom-
description-dataset\versions\2
```

[97]:
```
# Import relevant libraries and then load in the dataset into data

import pandas as pd
import os
from sklearn.feature_extraction.text import TfidfVectorizer
from scipy.cluster.hierarchy import linkage, dendrogram
import matplotlib.pyplot as plt

data = pd.read_csv(os.path.join(path, "dataset.csv"))
```

```
print(data.head())

print(data.shape)
```

```
            Disease   Symptom_1              Symptom_2              Symptom_3  \
0  Fungal infection     itching              skin_rash   nodal_skin_eruptions
1  Fungal infection   skin_rash   nodal_skin_eruptions    dischromic _patches
2  Fungal infection     itching   nodal_skin_eruptions    dischromic _patches
3  Fungal infection     itching              skin_rash    dischromic _patches
4  Fungal infection     itching              skin_rash   nodal_skin_eruptions

              Symptom_4 Symptom_5 Symptom_6 Symptom_7 Symptom_8 Symptom_9  \
0   dischromic _patches       NaN       NaN       NaN       NaN       NaN
1                   NaN       NaN       NaN       NaN       NaN       NaN
2                   NaN       NaN       NaN       NaN       NaN       NaN
3                   NaN       NaN       NaN       NaN       NaN       NaN
4                   NaN       NaN       NaN       NaN       NaN       NaN

  Symptom_10 Symptom_11 Symptom_12 Symptom_13 Symptom_14 Symptom_15  \
0        NaN        NaN        NaN        NaN        NaN        NaN
1        NaN        NaN        NaN        NaN        NaN        NaN
2        NaN        NaN        NaN        NaN        NaN        NaN
3        NaN        NaN        NaN        NaN        NaN        NaN
4        NaN        NaN        NaN        NaN        NaN        NaN

  Symptom_16 Symptom_17
0        NaN        NaN
1        NaN        NaN
2        NaN        NaN
3        NaN        NaN
4        NaN        NaN
(4920, 18)
```

Here we have 18 columns in total. There is 1 disase column, and 17 symptom columns. There are 4920 patients.

[98]:
```
# Notice that the symptoms are spread across different columns.  Now take these␣
 ↪columns and concatenate to get a single descriptor field

data['combined_symptoms'] = data['Symptom_1'] + " " + data['Symptom_2'] + " " +␣
 ↪data['Symptom_3']

data['combined_symptoms'] = data.loc[:, 'Symptom_1':'Symptom_17'].apply(
    lambda row: ' '.join(row.dropna()), axis=1
)

print(data)
```

```
                                  Disease              Symptom_1  \
```

```
0                          Fungal infection              itching
1                          Fungal infection            skin_rash
2                          Fungal infection              itching
3                          Fungal infection              itching
4                          Fungal infection              itching
…                                        …                    …
4915  (vertigo) Paroymsal  Positional Vertigo             vomiting
4916                                 Acne            skin_rash
4917                Urinary tract infection   burning_micturition
4918                              Psoriasis            skin_rash
4919                               Impetigo            skin_rash

                Symptom_2             Symptom_3                  Symptom_4  \
0                skin_rash   nodal_skin_eruptions       dischromic _patches
1     nodal_skin_eruptions    dischromic _patches                       NaN
2     nodal_skin_eruptions    dischromic _patches                       NaN
3                skin_rash    dischromic _patches                       NaN
4                skin_rash   nodal_skin_eruptions                       NaN
…                      …                      …                        …
4915              headache                nausea         spinning_movements
4916    pus_filled_pimples             blackheads                   scurring
4917    bladder_discomfort    foul_smell_of urine   continuous_feel_of_urine
4918           joint_pain           skin_peeling        silver_like_dusting
4919           high_fever                blister       red_sore_around_nose

                Symptom_5            Symptom_6 Symptom_7 Symptom_8  \
0                     NaN                  NaN       NaN       NaN
1                     NaN                  NaN       NaN       NaN
2                     NaN                  NaN       NaN       NaN
3                     NaN                  NaN       NaN       NaN
4                     NaN                  NaN       NaN       NaN
…                     …                    …         …         …
4915      loss_of_balance         unsteadiness       NaN       NaN
4916                  NaN                  NaN       NaN       NaN
4917                  NaN                  NaN       NaN       NaN
4918  small_dents_in_nails   inflammatory_nails       NaN       NaN
4919     yellow_crust_ooze                  NaN       NaN       NaN

     Symptom_9 Symptom_10 Symptom_11 Symptom_12 Symptom_13 Symptom_14  \
0          NaN        NaN        NaN        NaN        NaN        NaN
1          NaN        NaN        NaN        NaN        NaN        NaN
2          NaN        NaN        NaN        NaN        NaN        NaN
3          NaN        NaN        NaN        NaN        NaN        NaN
4          NaN        NaN        NaN        NaN        NaN        NaN
…          …          …          …          …          …          …
4915       NaN        NaN        NaN        NaN        NaN        NaN
4916       NaN        NaN        NaN        NaN        NaN        NaN
4917       NaN        NaN        NaN        NaN        NaN        NaN
```

```
4918       NaN         NaN         NaN         NaN         NaN         NaN
4919       NaN         NaN         NaN         NaN         NaN         NaN

     Symptom_15 Symptom_16 Symptom_17  \
0           NaN         NaN         NaN
1           NaN         NaN         NaN
2           NaN         NaN         NaN
3           NaN         NaN         NaN
4           NaN         NaN         NaN
…          …          …          …
4915        NaN         NaN         NaN
4916        NaN         NaN         NaN
4917        NaN         NaN         NaN
4918        NaN         NaN         NaN
4919        NaN         NaN         NaN

                                       combined_symptoms
0     itching  skin_rash  nodal_skin_eruptions  disc…
1      skin_rash  nodal_skin_eruptions  dischromic _…
2     itching  nodal_skin_eruptions  dischromic _pat…
3               itching  skin_rash  dischromic _patches
4              itching  skin_rash  nodal_skin_eruptions
…                                                   …
4915   vomiting  headache  nausea  spinning_movement…
4916   skin_rash  pus_filled_pimples  blackheads  sc…
4917   burning_micturition  bladder_discomfort  foul…
4918   skin_rash  joint_pain  skin_peeling  silver_l…
4919   skin_rash  high_fever  blister  red_sore_arou…

[4920 rows x 19 columns]
```

Now the combined_symptoms column contains a concatenated version of all of the symptoms in symptom columns 1 through 17

[99]:
```
# The 19th column should now have some sort of data in it.  For safety, let's␣
 ↪check if it is still na, and if so remove it

# Now inspect any rows with an Na

rows_with_na = data[data['combined_symptoms'].isna()]

print(rows_with_na)
```

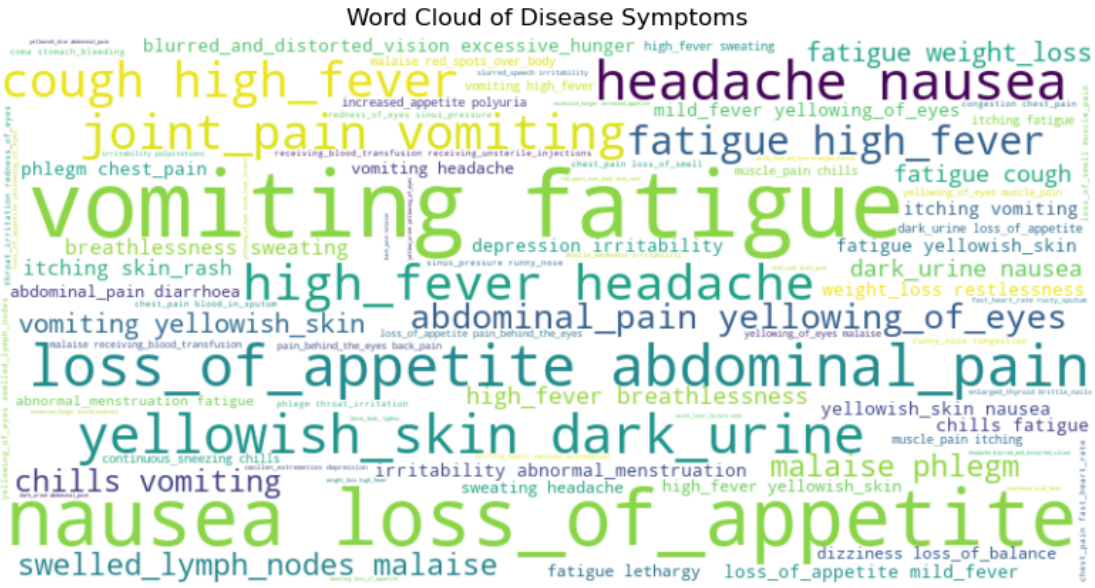
```
Empty DataFrame
Columns: [Disease, Symptom_1, Symptom_2, Symptom_3, Symptom_4, Symptom_5,
Symptom_6, Symptom_7, Symptom_8, Symptom_9, Symptom_10, Symptom_11, Symptom_12,
Symptom_13, Symptom_14, Symptom_15, Symptom_16, Symptom_17, combined_symptoms]
Index: []
```

This is an empty dataframe which means we have at least 1 symptom within each of the rows of the combined_symptoms column.

[100]:
```
#Let's look at the most and least frequent symptoms in the dataset.

from collections import Counter

# Step 1: Create the 'combined_symptoms' column if it doesn't exist
data['combined_symptoms'] = data.loc[:, 'Symptom_1':'Symptom_17'].apply(
    lambda row: ' '.join(row.dropna()), axis=1
)
all_symptoms = ' '.join(data['combined_symptoms'])
symptoms_list = all_symptoms.split()
symptom_counts = Counter(symptoms_list)
top_10_symptoms = symptom_counts.most_common(10)
print(top_10_symptoms)
lowest_10_symptoms = symptom_counts.most_common()[-10:]  # Slice to get the␣
 ↪last 10 (least common)
print(lowest_10_symptoms)
```

```
[('fatigue', 1932), ('vomiting', 1914), ('high_fever', 1362),
('loss_of_appetite', 1152), ('nausea', 1146), ('headache', 1134),
('abdominal_pain', 1032), ('yellowish_skin', 912), ('yellowing_of_eyes', 816),
('chills', 798)]
[('dehydration', 108), ('weakness_in_limbs', 108), ('weakness_of_one_body_side',
108), ('swollen_blood_vessels', 108), ('spinning_movements', 108),
('pus_filled_pimples', 108), ('blackheads', 108), ('scurring', 108),
('foul_smell_of', 102), ('urine', 102)]
```

[101]:
```
# Let's take this a step further and do a word cloud

from wordcloud import WordCloud

wordcloud = WordCloud(width=800, height=400, background_color='white').
 ↪generate(all_symptoms)

plt.figure(figsize=(10, 5))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')  # Hide the axes
plt.title("Word Cloud of Disease Symptoms")
plt.show()
```



1.2 Convert text data to numerical form using TF-IDF

[102]:
```
# Text data being unstructured cannot be directly processed by these clustering␣
↪algorithms unless it is transformed into numerical format

vectorizer = TfidfVectorizer(stop_words='english')
tfidf_matrix = vectorizer.fit_transform(data['combined_symptoms'])
```

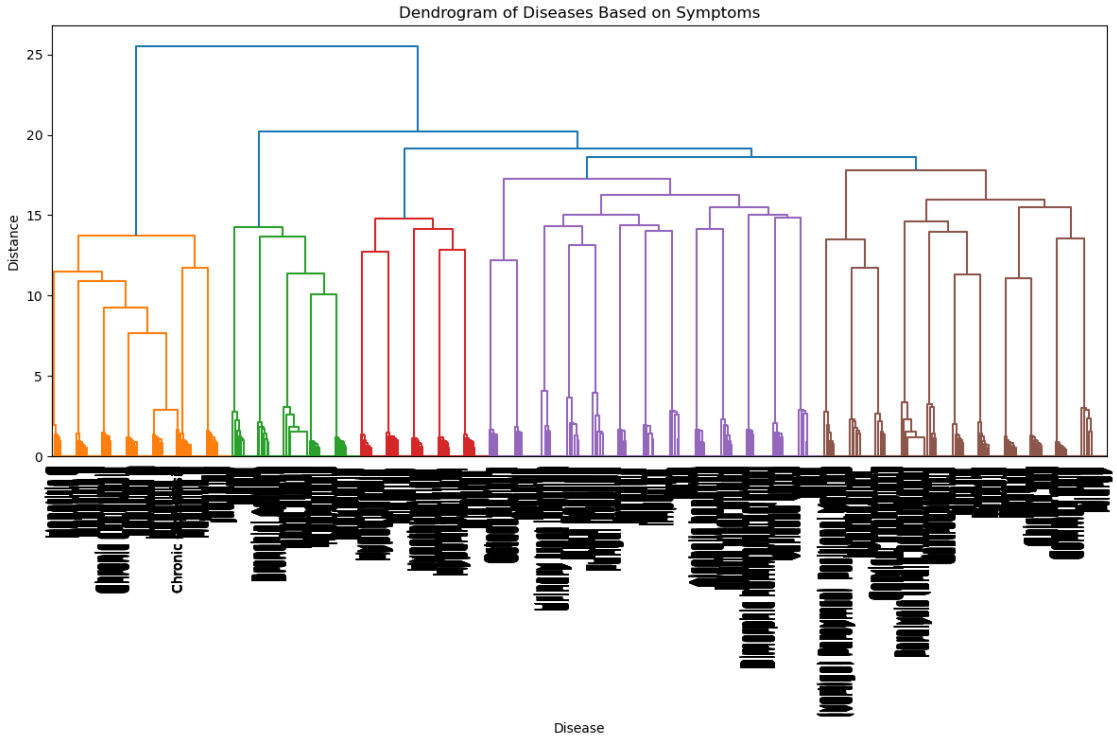
1.3 Model Generation

[103]:
```
from sklearn.cluster import AgglomerativeClustering
from scipy.cluster.hierarchy import dendrogram, linkage


model = AgglomerativeClustering(
    n_clusters=None,  # None means do not predefine the number of clusters
    distance_threshold=1.5,  # Set a threshold for merging clusters
    linkage='ward'
)
model.fit(tfidf_matrix.toarray())
```

[103]:
```
AgglomerativeClustering(distance_threshold=1.5, n_clusters=None)
```

Now we will perform a simple hierarchical clustering to see how the patients separate from each other.

[104]:
```
linkage_matrix = linkage(tfidf_matrix.toarray(), method='ward')

plt.figure(figsize=(12, 8))
dendrogram(linkage_matrix, labels=data['Disease'].values, leaf_rotation=90,␣
 ↪leaf_font_size=10)
plt.title("Dendrogram of Diseases Based on Symptoms")
plt.xlabel("Disease")
plt.ylabel("Distance")
plt.tight_layout()
plt.show()
```

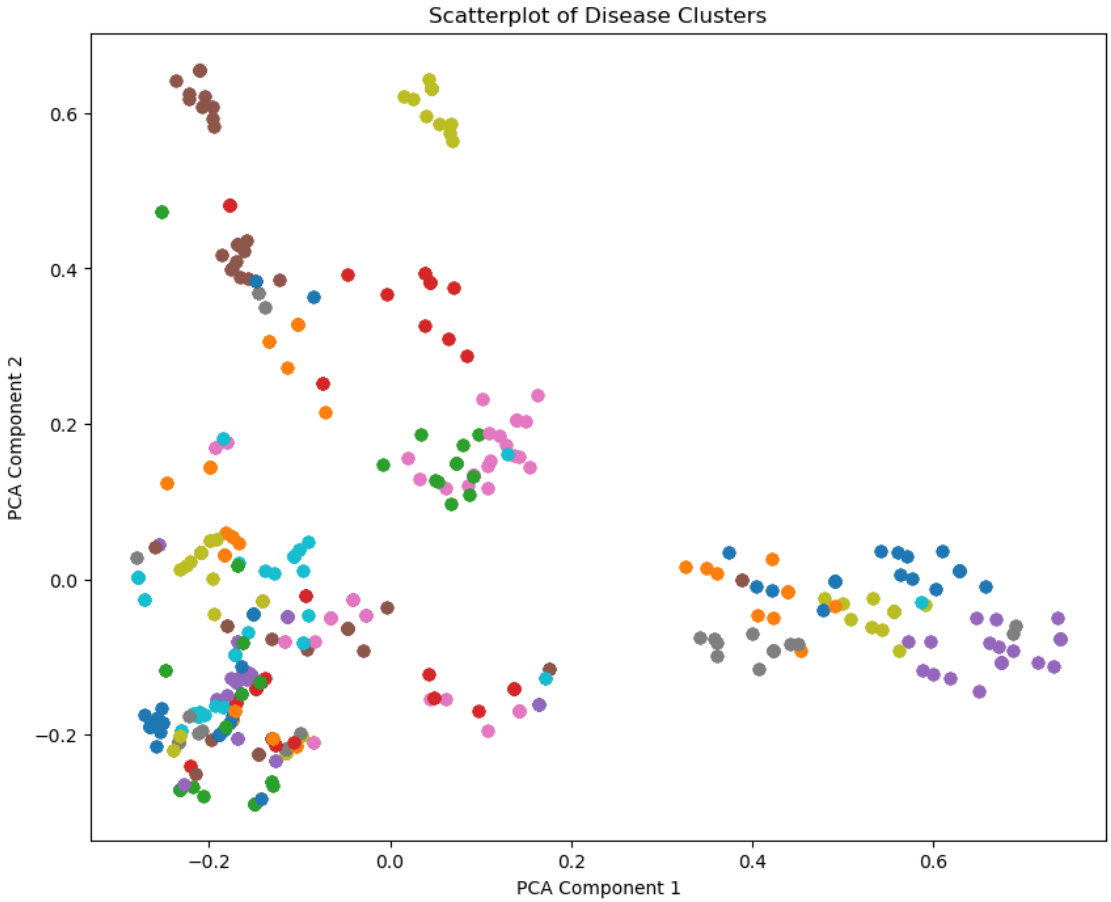


[105]:
```
# Sanity check and to put the clusters within the main table
data['Cluster'] = model.labels_
print(data[['Disease', 'Cluster']])
```

```
                                    Disease  Cluster
0                           Fungal infection       18
1                           Fungal infection      114
2                           Fungal infection       18
3                           Fungal infection       61
4                           Fungal infection       86
…                                        …      …
4915  (vertigo) Paroymsal  Positional Vertigo        5
4916                                  Acne       50
```

```
4917                 Urinary tract infection       30
4918                                Psoriasis       27
4919                                 Impetigo       19

[4920 rows x 2 columns]
```

[106]:
```python
# The dendrogram is nice, but let's do a PCA that will show us a scatterplot of the disease clusters

from sklearn.decomposition import PCA

pca = PCA(n_components=2)
reduced_data = pca.fit_transform(tfidf_matrix.toarray())

plt.figure(figsize=(10, 8))
for cluster in sorted(data['Cluster'].unique()):
    cluster_data = reduced_data[data['Cluster'] == cluster]
    plt.scatter(
        cluster_data[:, 0], cluster_data[:, 1],
        label=f'Cluster {cluster}', alpha=0.7
    )

plt.title("Scatterplot of Disease Clusters")
plt.xlabel("PCA Component 1")
plt.ylabel("PCA Component 2")
plt.show()
```



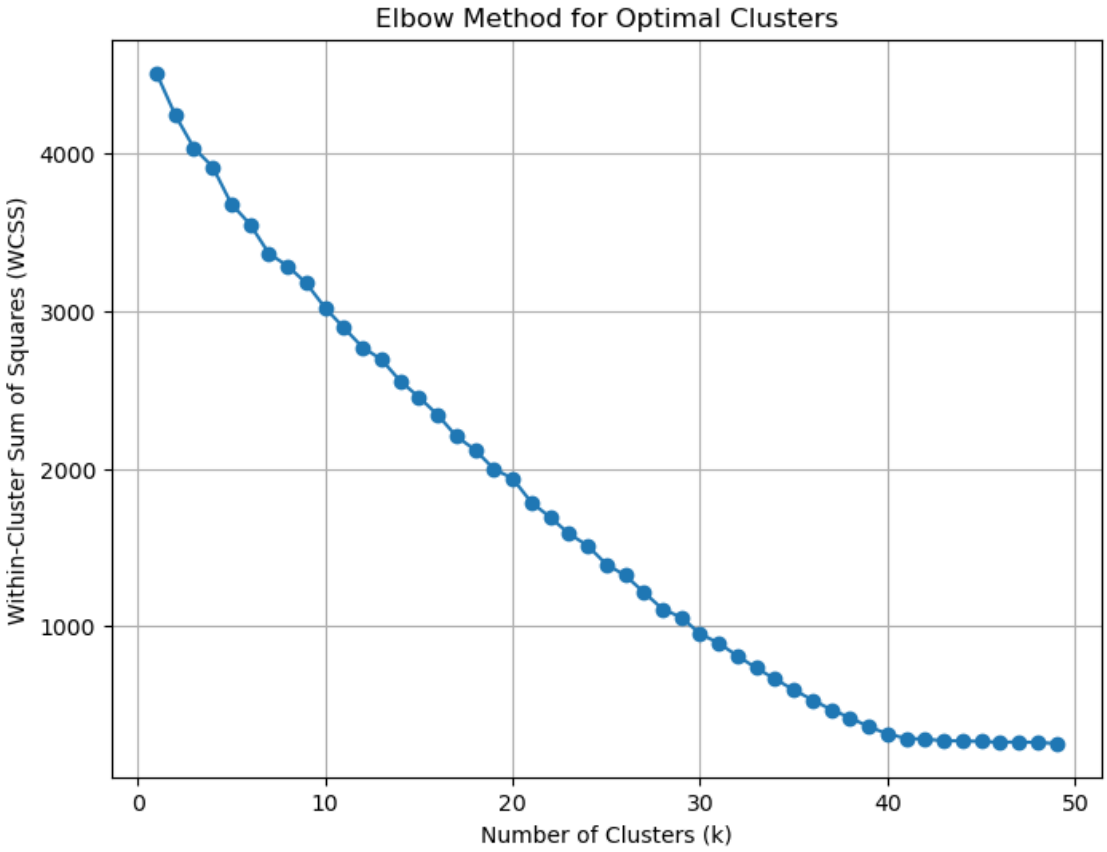
1.4 Model Refinement

This is a lot of clusters. You can kind of see the patterns if you look closely, but this is very noisy. So let's see if we can reduce the number of clusters.

[107]:
```
# Let's apply the elbow method to find the optimal number of clusters.

from sklearn.cluster import KMeans

wcss = []  # List to store WCSS for each k
k_values = range(1, 50)  # Number of clusters to try (1 to 50)

for k in k_values:
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(tfidf_matrix)
    wcss.append(kmeans.inertia_)  # Inertia is the WCSS

plt.figure(figsize=(8, 6))
plt.plot(k_values, wcss, marker='o')
```

```
plt.title("Elbow Method for Optimal Clusters")
plt.xlabel("Number of Clusters (k)")
plt.ylabel("Within-Cluster Sum of Squares (WCSS)")
plt.grid()
plt.show()
```

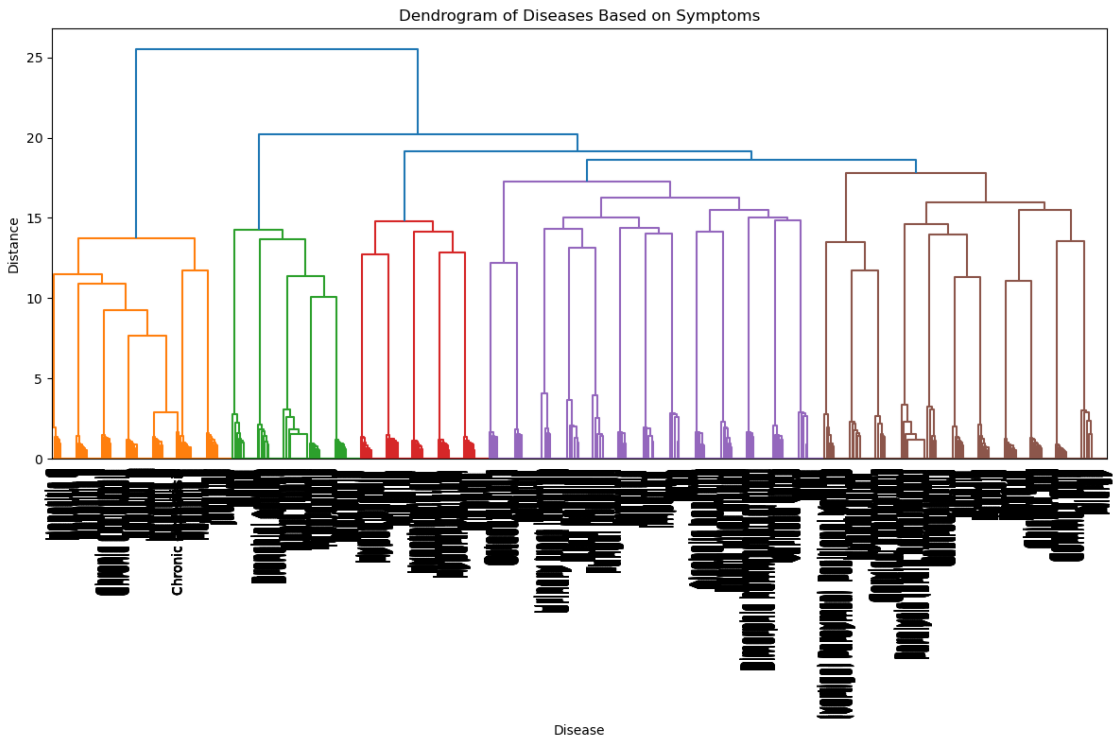
```
C:\Users\dvanbooven\AppData\Local\anaconda3\lib\site-
packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of
`n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init`
explicitly to suppress the warning
  warnings.warn(
```



[108]:
```
# Find the max value of cluster...

n_clusters = len(set(data['Cluster']))  # Count unique cluster labels

print(f"Number of clusters found: {n_clusters}")
```

```
Number of clusters found: 116
```

[109]:
```
# Let's reduce the number of clusters from 116 to 40 and redo the␣
 ↪agglomerativeclustering to see what that does to the analysis.

model = AgglomerativeClustering(
    n_clusters=40,  # None means do not predefine the number of clusters
    linkage='ward'
)

linkage_matrix = linkage(tfidf_matrix.toarray(), method='ward')

plt.figure(figsize=(12, 8))
dendrogram(linkage_matrix, labels=data['Disease'].values, leaf_rotation=90,␣
 ↪leaf_font_size=10)
plt.title("Dendrogram of Diseases Based on Symptoms")
plt.xlabel("Disease")
plt.ylabel("Distance")
plt.tight_layout()
plt.show()
```



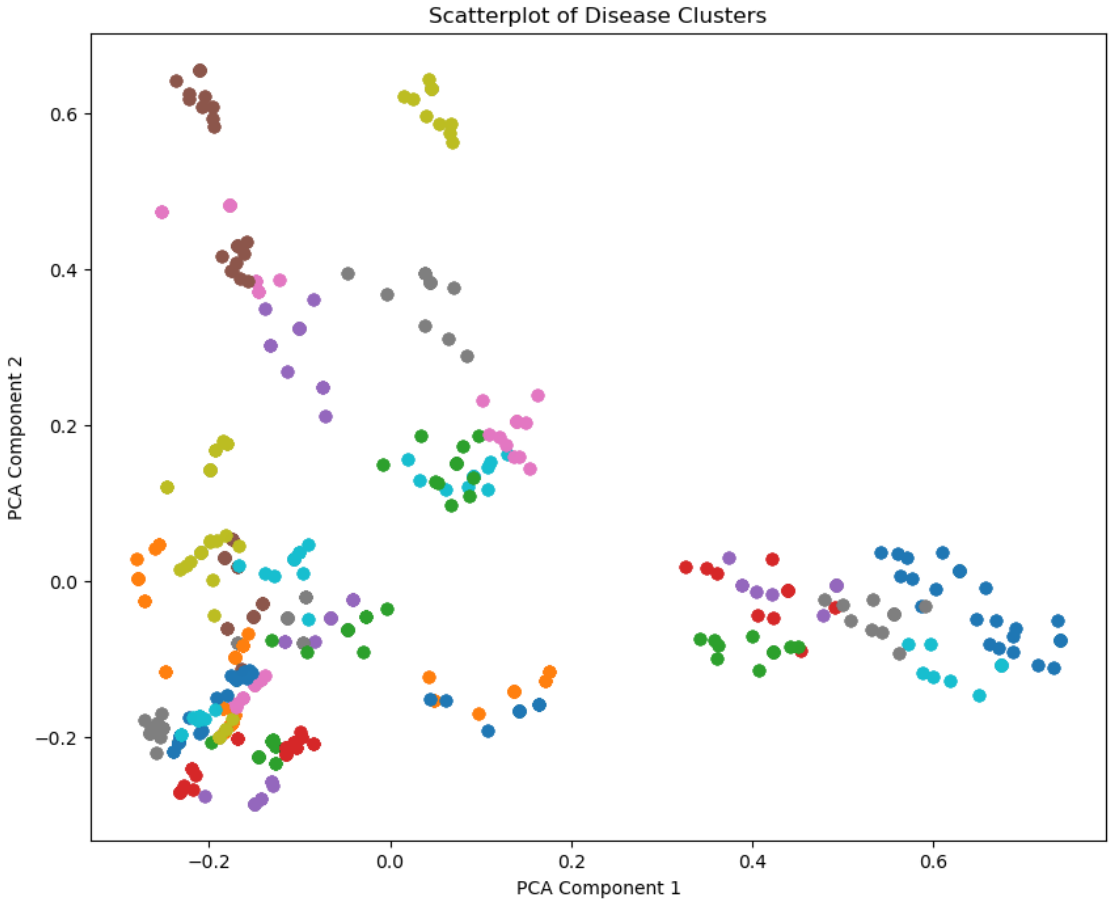
[110]:
```
model.fit(tfidf_matrix.toarray())
data['Cluster'] = model.labels_
print(data[['Disease', 'Cluster']])
```

```
                                    Disease  Cluster
```

```
0                              Fungal infection        3
1                              Fungal infection        3
2                              Fungal infection        3
3                              Fungal infection        3
4                              Fungal infection        3
…                                            …       …
4915  (vertigo) Paroymsal  Positional Vertigo       12
4916                                      Acne        8
4917                   Urinary tract infection        1
4918                                 Psoriasis       33
4919                                  Impetigo       21

[4920 rows x 2 columns]
```

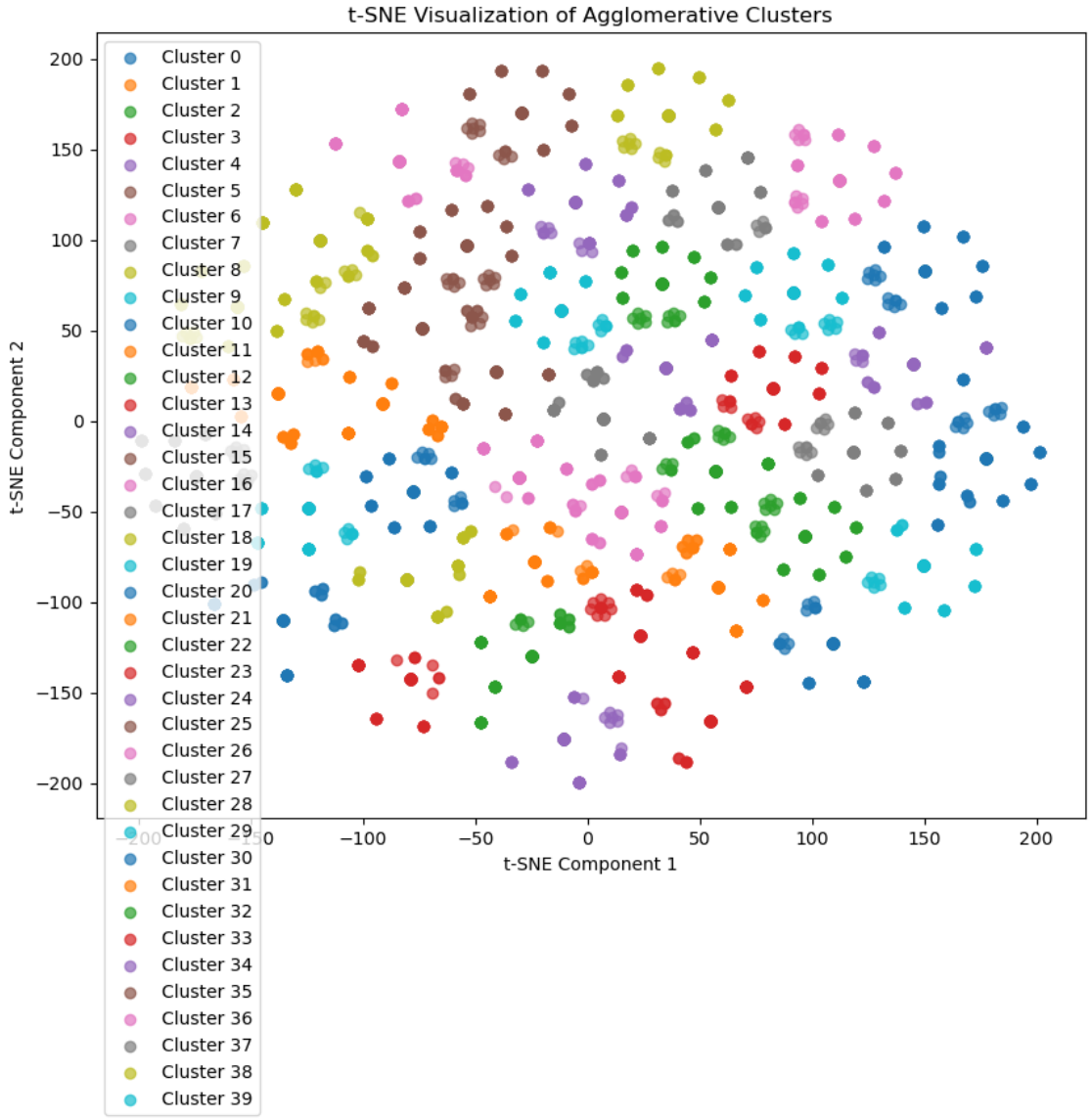
The top 5 values for "fungal infection" now all appear to be headed towards cluster 3 which is a good sign

[111]:
```
# Let's redo the scatterplot PCA to show the 40 cluster model
pca = PCA(n_components=2)
reduced_data = pca.fit_transform(tfidf_matrix.toarray())

plt.figure(figsize=(10, 8))
for cluster in sorted(data['Cluster'].unique()):
    cluster_data = reduced_data[data['Cluster'] == cluster]
    plt.scatter(
        cluster_data[:, 0], cluster_data[:, 1],
        label=f'Cluster {cluster}', alpha=0.7
    )

plt.title("Scatterplot of Disease Clusters")
plt.xlabel("PCA Component 1")
plt.ylabel("PCA Component 2")
plt.show()
```



[112]:
```
from sklearn.manifold import TSNE
tsne = TSNE(n_components=2, random_state=42)
tsne_results = tsne.fit_transform(tfidf_matrix.toarray())
```

[113]:
```
plt.figure(figsize=(10, 8))
for cluster in sorted(data['Cluster'].unique()):
    cluster_data = tsne_results[data['Cluster'] == cluster]
    plt.scatter(
        cluster_data[:, 0], cluster_data[:, 1],
        label=f'Cluster {cluster}', alpha=0.7
    )

plt.title("t-SNE Visualization of Agglomerative Clusters")
plt.xlabel("t-SNE Component 1")
plt.ylabel("t-SNE Component 2")
plt.legend()
plt.show()
```



1.5 Model Evaluation

[114]:
```python
# Let's look at silhouette scores

from sklearn.metrics import silhouette_score

# get model labels
labels = model.labels_

# Calculate silhouette score
score = silhouette_score(tfidf_matrix, labels)
print(f"Silhouette Score: {score}")
```

```
# Remember a silhouette score near 1 are well-separated and cohesive, near 0 is␣
 ↪unclear, and -1 shows misassignment
```

```
Silhouette Score: 0.7698943712079074
```

[115]:
```
import numpy as np

top_terms = {}

feature_names = np.array(vectorizer.get_feature_names_out())

for cluster in np.unique(labels):
    cluster_indices = np.where(labels == cluster)[0]
    cluster_data = tfidf_matrix[cluster_indices]
    avg_tfidf_per_term = cluster_data.mean(axis=0).A1
    top_terms[cluster] = feature_names[np.argsort(avg_tfidf_per_term)[::-1][:
 ↪10]]  # Top 10 terms

# Display top terms for each cluster
for cluster, terms in top_terms.items():
    print(f"Cluster {cluster}: {', '.join(terms)}")
```

```
Cluster 0: dark_urine, yellowing_of_eyes, joint_pain, yellowish_skin,
abdominal_pain, nausea, loss_of_appetite, vomiting, mild_fever, muscle_pain
Cluster 1: bladder_discomfort, continuous_feel_of_urine, urine, foul_smell_of,
burning_micturition, extra_marital_contacts, family_history, fast_heart_rate,
fatigue, increased_appetite
Cluster 2: spotting_, urination, burning_micturition, stomach_pain, itching,
skin_rash, family_history, foul_smell_of, fluid_overload, fatigue
Cluster 3: nodal_skin_eruptions, _patches, dischromic, itching, skin_rash,
lethargy, high_fever, distention_of_abdomen, dizziness, drying_and_tingling_lips
Cluster 4: dehydration, sunken_eyes, diarrhoea, vomiting, dizziness,
drying_and_tingling_lips, enlarged_thyroid, excessive_hunger,
extra_marital_contacts, hip_joint_pain
Cluster 5: shivering, watering_from_eyes, continuous_sneezing, chills,
fast_heart_rate, high_fever, headache, foul_smell_of, fluid_overload, fatigue
Cluster 6: swollen_legs, cramps, prominent_veins_on_calf, bruising,
swollen_blood_vessels, obesity, fatigue, excessive_hunger,
extra_marital_contacts, family_history
Cluster 7: altered_sensorium, weakness_of_one_body_side, headache, vomiting,
fast_heart_rate, hip_joint_pain, high_fever, foul_smell_of, fluid_overload,
fatigue
Cluster 8: blackheads, scurring, pus_filled_pimples, skin_rash, yellowish_skin,
high_fever, headache, foul_smell_of, fluid_overload, fatigue
Cluster 9: belly_pain, toxic_look_, typhos, constipation, diarrhoea, chills,
abdominal_pain, headache, nausea, high_fever
Cluster 10: weakness_in_limbs, neck_pain, back_pain, dizziness, loss_of_balance,
```

fast_heart_rate, high_fever, headache, foul_smell_of, fluid_overload
Cluster 11: passage_of_gases, internal_itching, indigestion, abdominal_pain,
loss_of_appetite, vomiting, fatigue, high_fever, headache, foul_smell_of
Cluster 12: unsteadiness, spinning_movements, loss_of_balance, headache, nausea,
vomiting, yellowish_skin, family_history, foul_smell_of, fluid_overload
Cluster 13: weight_loss, dark_urine, itching, yellowish_skin, abdominal_pain,
high_fever, vomiting, fatigue, headache, foul_smell_of
Cluster 14: knee_pain, hip_joint_pain, swelling_joints, painful_walking,
neck_pain, joint_pain, fast_heart_rate, headache, foul_smell_of, fluid_overload
Cluster 15: patches_in_throat, muscle_wasting, extra_marital_contacts,
high_fever, yellowish_skin, fatigue, hip_joint_pain, headache, foul_smell_of,
fluid_overload
Cluster 16: breathlessness, chest_pain, sweating, vomiting, fatigue, high_fever,
headache, foul_smell_of, fluid_overload, yellowish_skin
Cluster 17: muscle_pain, diarrhoea, sweating, chills, headache, nausea,
high_fever, vomiting, excessive_hunger, extra_marital_contacts
Cluster 18: ulcers_on_tongue, stomach_pain, acidity, cough, chest_pain,
vomiting, yellowish_skin, fluid_overload, high_fever, headache
Cluster 19: itching, yellowing_of_eyes, yellowish_skin, abdominal_pain, nausea,
loss_of_appetite, vomiting, high_fever, headache, foul_smell_of
Cluster 20: distention_of_abdomen, history_of_alcohol_consumption,
fluid_overload, swelling_of_stomach, yellowish_skin, abdominal_pain, vomiting,
loss_of_appetite, loss_of_smell, dizziness
Cluster 21: yellow_crust_ooze, blister, red_sore_around_nose, skin_rash,
high_fever, yellowish_skin, fast_heart_rate, headache, foul_smell_of,
fluid_overload
Cluster 22: red_spots_over_body, swelled_lymph_nodes, mild_fever, lethargy,
malaise, itching, skin_rash, headache, loss_of_appetite, high_fever
Cluster 23: movement_stiffness, swelling_joints, painful_walking, stiff_neck,
muscle_weakness, fast_heart_rate, headache, foul_smell_of, fluid_overload,
fatigue
Cluster 24: mucoid_sputum, family_history, breathlessness, cough, high_fever,
fatigue, yellowish_skin, fluid_overload, hip_joint_pain, headache
Cluster 25: loss_of_smell, throat_irritation, redness_of_eyes, sinus_pressure,
congestion, runny_nose, continuous_sneezing, phlegm, swelled_lymph_nodes,
muscle_pain
Cluster 26: irritation_in_anus, bloody_stool, pain_in_anal_region,
pain_during_bowel_movements, constipation, yellowish_skin, high_fever, headache,
foul_smell_of, fluid_overload
Cluster 27: visual_disturbances, indigestion, acidity, stiff_neck, depression,
blurred_and_distorted_vision, excessive_hunger, irritability, headache,
loss_of_appetite
Cluster 28: muscle_weakness, abnormal_menstruation, mood_swings, restlessness,
fast_heart_rate, irritability, weight_loss, excessive_hunger, diarrhoea,
sweating
Cluster 29: palpitations, slurred_speech, drying_and_tingling_lips, anxiety,
blurred_and_distorted_vision, excessive_hunger, irritability, sweating,
headache, nausea

```
Cluster 30: increased_appetite, polyuria, irregular_sugar_level, restlessness,
obesity, blurred_and_distorted_vision, lethargy, weight_loss, excessive_hunger,
fatigue
Cluster 31: lack_of_concentration, loss_of_balance, dizziness, chest_pain,
headache, yellowish_skin, fatigue, high_fever, foul_smell_of, fluid_overload
Cluster 32: receiving_blood_transfusion, receiving_unsterile_injections,
yellow_urine, lethargy, dark_urine, malaise, itching, yellowing_of_eyes,
yellowish_skin, abdominal_pain
Cluster 33: skin_peeling, silver_like_dusting, small_dents_in_nails,
inflammatory_nails, joint_pain, skin_rash, extra_marital_contacts,
fluid_overload, fatigue, fast_heart_rate
Cluster 34: family_history, yellowish_skin, yellowing_of_eyes, nausea,
loss_of_appetite, fatigue, abnormal_menstruation, fluid_overload,
history_of_alcohol_consumption, hip_joint_pain
Cluster 35: rusty_sputum, fast_heart_rate, phlegm, breathlessness, cough,
chest_pain, sweating, malaise, chills, high_fever
Cluster 36: pain_behind_the_eyes, back_pain, red_spots_over_body, muscle_pain,
joint_pain, malaise, skin_rash, chills, headache, nausea
Cluster 37: coma, stomach_bleeding, acute_liver_failure, dark_urine, joint_pain,
yellowing_of_eyes, abdominal_pain, yellowish_skin, loss_of_appetite, nausea
Cluster 38: blood_in_sputum, swelled_lymph_nodes, mild_fever, phlegm,
breathlessness, weight_loss, cough, chest_pain, malaise, sweating
Cluster 39: brittle_nails, enlarged_thyroid, swollen_extremeties,
puffy_face_and_eyes, weight_gain, cold_hands_and_feets, depression,
abnormal_menstruation, mood_swings, dizziness
```

[116]:
```
# proof of concept, let's look at a cluster and see if we can determine what␣
↪the disease was...

cluster_0_data = data[data['Cluster'] == 0]

# give me a unique set of diseases for this cluster

print(data['Disease'].unique())
```

```
['Fungal infection' 'Allergy' 'GERD' 'Chronic cholestasis' 'Drug Reaction'
 'Peptic ulcer diseae' 'AIDS' 'Diabetes ' 'Gastroenteritis'
 'Bronchial Asthma' 'Hypertension ' 'Migraine' 'Cervical spondylosis'
 'Paralysis (brain hemorrhage)' 'Jaundice' 'Malaria' 'Chicken pox'
 'Dengue' 'Typhoid' 'hepatitis A' 'Hepatitis B' 'Hepatitis C'
 'Hepatitis D' 'Hepatitis E' 'Alcoholic hepatitis' 'Tuberculosis'
 'Common Cold' 'Pneumonia' 'Dimorphic hemmorhoids(piles)' 'Heart attack'
 'Varicose veins' 'Hypothyroidism' 'Hyperthyroidism' 'Hypoglycemia'
 'Osteoarthristis' 'Arthritis' '(vertigo) Paroymsal  Positional Vertigo'
 'Acne' 'Urinary tract infection' 'Psoriasis' 'Impetigo']
```

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