1.
```
/Users/CaseyJayne/miniconda3/envs/introPython/bin/python /Users/CaseyJayne/miniconda3/envs/intro
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 4
    clusters = [(), (), (), ())]
                            ^
SyntaxError: invalid syntax
```

```
# clusters = [(), (), (), ())] # error one is unmatching bracket which is logical
clusters = [(), (), (), ()]
```

2.
```
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 54
    cluster_changes++
                  ^
SyntaxError: invalid syntax
```

```
    # cluster_changes++  error incrementing cluster_changes
    cluster_changes += 1
```

3.
```
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 85
    print("Cluster " + str(i) + ": " + str(clusters[i])
        ^
SyntaxError: invalid syntax
```

```
# print("Cluster " + str(i) + ": " + str(clusters[i]) unmatched opening bracket
print("Cluster " + str(i) + ": " + str(clusters[i]))
```

4.
```
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 85
    print("Cluster " + str(i) + ": " + str(clusters[i]))
        ^
SyntaxError: invalid syntax

Process finished with exit code 1
```

```
# print("Number of points in Cluster " + str(i) + ": " + str(len(clusters[i]))
print("Number of points in Cluster " + str(i) + ": " + str(len(clusters[i])))
```

5.
```
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 24, in <module>
    x = int(point[0])
ValueError: invalid literal for int() with base 10: '40'
```

```
try:
    x = int(point[0])  # input character error here
    y = int(point[1])  # input structure error here
    points.append([x, y])
except ValueError:  # check for invalid input characters
    print("invalid input, skipping entry: " + str(line))
```

6.

```
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 24, in <module>
    x = int(point[0])  # input character error here
NameError: name 'point' is not defined
```

```
try:
    x = int(point[0])  # input character error here
    y = int(point[1])  # input structure error here
    points.append([x, y])
except ValueError:  # check for invalid input characters
    print("invalid input, skipping entry: " + str(line))
except IndexError:  # check for invalid input structure
    print("Indexing error! invalid x,y input.  Skipping entry: " + str(line))
```

7.

```
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 42, in <module>
    d1 = math.sqrt(centroids[0][0] - point[0] ** 2 + centroids[0][1] - point[1] ** 2)
ValueError: math domain error
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 43, in <module>
    d2 = math.sqrt(centroids[1][0] - point[0] ** 2 + centroids[1][1] - point[1] ** 2)
ValueError: math domain error
```

```
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 44, in <module>
    d3 = math.sqrt(centroids[2][0] - point[0] ** 2 + centroids[2][1] - point[1] ** 2)
ValueError: math domain error
Indexing error! invalid x,y input.  Skipping entry: 72
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 45, in <module>
    d4 = math.sqrt(centroids[3][0] - point[0] ** 2 + centroids[3][1] - point[1] ** 2)
ValueError: math domain error
```

```
# calculate the distance between the current point and each of the 4 centroids
# logical error, parenthesis added around internal equations
d1 = math.sqrt((centroids[0][0] - point[0]) ** 2 + (centroids[0][1] - point[1]) ** 2)
d2 = math.sqrt((centroids[1][0] - point[0]) ** 2 + (centroids[1][1] - point[1]) ** 2)
d3 = math.sqrt((centroids[2][0] - point[0]) ** 2 + (centroids[2][1] - point[1]) ** 2)
d4 = math.sqrt((centroids[3][0] - point[0]) ** 2 + (centroids[3][1] - point[1]) ** 2)
```

8.

```
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 49, in <module>
    clusters[1].append(point)
AttributeError: 'tuple' object has no attribute 'append'
```

```
# clusters = [(), (), (), ()]  # syntax error, change to lists
clusters = [[], [], [], []]
```

9.

```
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 55, in <module>
    clusters[4].append(point)
IndexError: list index out of range
```

```
    clusters[0].append(point)  # index error, decremented
elif d2 == min(d1, d2, d3, d4):
    # append error, tuple changed to list
    clusters[1].append(point)  # index error
elif d3 == min(d1, d2, d3, d4):
    # append error, tuple changed to list
    clusters[2].append(point)  # index error
else:
    # append error, tuple changed to list
    clusters[3].append(point)  # index error
```

10.

```
Traceback (most recent call last):
  File "/Users/CaseyJayne/miniconda3/envs/introPython/assignments_src/kmeans_buggy.py", line 63, in <module>
    if len(clusters[i]) != prev_cluster_size[i]:
NameError: name 'prev_cluster_size' is not defined
```

```
prev_cluster_size = [0, 0, 0, 0]  # added, start with empty clusters
```

```
# store current cluster size for comparison in next iteration
prev_cluster_size[i] = len(clusters[i])
```

No other errors created exceptions, but they are included in my README_kmeansdebug.txt

Corrections/updates without exceptions:

```
# open points.txt for reading points from file
# did not check for file not found errors, added
try:
    f = open("points.txt", "r")
except FileNotFoundError:
    print("Input file not found, exiting ")
else:
    # read number of clustering iterations from file
```

```
# file was not closed! added
f.close()
```

```
# check if any points have changed clusters
prev_changes = cluster_changes  # added to be able to exit after completion
```

```
# added break out
if prev_changes == cluster_changes:
    iterations = r  # save the number of iterations to correct output
    break
```

```
# logical error, this counts the number of times we switched clusters not the total iterations
# print("Iterations to achieve stability: " + str(cluster_changes))
print("Iterations to achieve stability: " + str(iterations))
print("Total cluster changes: " + str(cluster_changes))
```

final output:

```
invalid input, skipping entry: 27
Indexing error! invalid x,y input.  Skipping entry: 72
Iterations to achieve stability: 7
Total cluster changes: 20
Centroid 0: [23.724517412724463, 66.54953363459762]
Number of points in Cluster 0: 30
Cluster 0: [[5, 58], [40, 64], [23.724517412724463, 66.54953363459762], [37, 61], [22, 58], [2, 56], [5, 53], [40, 74], [46, 46], [11, 95], [38,
 45], [22, 81], [44, 62], [10, 87], [37, 57], [7, 44], [16, 47], [13, 85], [1, 61], [43, 67], [26, 97], [17, 71], [18, 75], [19, 61], [30, 97],
 [41, 49], [23, 71], [31, 67], [1, 91], [43, 50]]
Centroid 1: [82.95454552457659, 25.272727607773994]
Number of points in Cluster 1: 23
Cluster 1: [[83, 13], [80, 18], [77, 16], [81, 40], [78, 16], [89, 26], [82.95454552457659, 25.272727607773994], [88, 32], [56, 17], [92, 34], [99,
  15], [86, 57], [86, 36], [58, 32], [71, 21], [96, 14], [56, 15], [89, 16], [97, 35], [91, 7], [98, 24], [93, 40], [81, 32]]
Centroid 2: [62.497833153750015, 84.62581771981482]
Number of points in Cluster 2: 25
Cluster 2: [[37, 95], [40, 96], [93, 73], [64, 91], [97, 99], [51, 80], [55, 82], [42, 86], [53, 82], [41, 95], [47, 97], [65, 85], [78, 81],
 [62.497833153750015, 84.62581771981482], [58, 83], [81, 83], [79, 76], [78, 67], [44, 92], [52, 100], [64, 99], [88, 71], [70, 75], [52, 67],
 [71, 76]]
Centroid 3: [25.284191850170807, 18.759602381383242]
Number of points in Cluster 3: 22
Cluster 3: [[0, 27], [33, 30], [34, 7], [21, 23], [40, 41], [34, 38], [36, 9], [52, 12], [19, 12], [39, 2], [16, 33], [25.284191850170807,
 18.759602381383242], [15, 10], [6, 18], [18, 2], [31, 8], [48, 24], [20, 10], [2, 34], [1, 27], [42, 27], [24, 0]]

Process finished with exit code 0
```