```
Python 3.13.5 | packaged by Anaconda, Inc. | (main, Jun 12 2025, 16:37:03) [MSC v.1929 64 bit
(AMD64)]
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IPython 8.30.0 -- An enhanced Interactive Python. Type '?' for help.

In [1]: %runfile C:/Users/somen/Desktop/Project/trialruns_bogus.py --wdir

================================================================================
Starting Analysis for: as20000102.txt
================================================================================

--- Initial State ---
  Graph: 6,474 nodes, 13,895 edges

--- Multi-Point AP Failure Simulation ---
  Found 600 APs to sample from.

  Testing simultaneous removal of 1 APs (1000 trials)...
--------------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
File c:\users\somen\desktop\project\trialruns_bogus.py:150
    146     print(f"ALL ANALYSES COMPLETED in {overall_end_time - overall_start_time:.2f}
seconds.")
    149 if __name__ == "__main__":
--> 150     main()

File c:\users\somen\desktop\project\trialruns_bogus.py:134, in main()
    131 print(f"  Graph: {G.number_of_nodes():,} nodes, {G.number_of_edges():,} edges")
    133 # Run the multi-level analysis
--> 134 results = analyze_multi_ap_impact_levels(G, REMOVAL_COUNTS, NUM_TRIALS)
    136 # Tabulate the results for this file
    137 if results:

File c:\users\somen\desktop\project\trialruns_bogus.py:89, in analyze_multi_ap_impact_levels(G,
removal_counts, num_trials)
     86 aps_to_remove = random.sample(all_aps, num_to_remove)
     88 # Create a fresh copy to simulate the failure
---> 89 G_copy = G.copy()
     90 G_copy.remove_nodes_from(aps_to_remove)
     92 # Record the number of fragments

File C:\ProgramData\anaconda3\Lib\site-packages\networkx\classes\graph.py:1663, in Graph.copy(self,
as_view)
   1661 G.graph.update(self.graph)
   1662 G.add_nodes_from((n, d.copy()) for n, d in self._node.items())
-> 1663 G.add_edges_from(
   1664     (u, v, datadict.copy())
   1665     for u, nbrs in self._adj.items()
   1666     for v, datadict in nbrs.items()
   1667 )
   1668 return G

File C:\ProgramData\anaconda3\Lib\site-packages\networkx\classes\graph.py:1030, in
Graph.add_edges_from(self, ebunch_to_add, **attr)
    975 def add_edges_from(self, ebunch_to_add, **attr):
    976     """Add all the edges in ebunch_to_add.
    977
    978     Parameters
   (...)
   1028     >>> G.add_edges_from(list((5, n) for n in G.nodes))
   1029     """
-> 1030     for e in ebunch_to_add:
```

```
   1031         ne = len(e)
   1032         if ne == 3:

File C:\ProgramData\anaconda3\Lib\site-packages\networkx\classes\graph.py:1664, in <genexpr>(.0)
   1661 G.graph.update(self.graph)
   1662 G.add_nodes_from((n, d.copy()) for n, d in self._node.items())
   1663 G.add_edges_from(
-> 1664     (u, v, datadict.copy())
   1665     for u, nbrs in self._adj.items()
   1666     for v, datadict in nbrs.items()
   1667 )
   1668 return G

KeyboardInterrupt:

In [2]: %runfile C:/Users/somen/Desktop/Project/trialruns_bogus.py --wdir

================================================================================
Starting Analysis for: power_grid_uci.txt
================================================================================

--- Initial State ---
  Graph: 6,659 nodes, 8,309 edges

--- Multi-Point AP Failure Simulation ---
  Found 1,655 APs to sample from.

  Testing simultaneous removal of 1 APs (1000 trials)...
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
File c:\users\somen\desktop\project\trialruns_bogus.py:149
    145     print("\n" + "="*80)
    146     print(f"ALL ANALYSES COMPLETED in {overall_end_time - overall_start_time:.2f}
seconds.")
--> 149 if __name__ == "__main__":
    150     main()

File c:\users\somen\desktop\project\trialruns_bogus.py:133, in main()
    130 print(f"\n--- Initial State ---")
    131 print(f"  Graph: {G.number_of_nodes():,} nodes, {G.number_of_edges():,} edges")
--> 133 # Run the multi-level analysis
    134 results = analyze_multi_ap_impact_levels(G, REMOVAL_COUNTS, NUM_TRIALS)
    136 # Tabulate the results for this file

File c:\users\somen\desktop\project\trialruns_bogus.py:88, in analyze_multi_ap_impact_levels(G,
removal_counts, num_trials)
     84 for i in range(num_trials):
     85     # Select a random sample of APs for this single trial
     86     aps_to_remove = random.sample(all_aps, num_to_remove)
---> 88     # Create a fresh copy to simulate the failure
     89     G_copy = G.copy()
     90     G_copy.remove_nodes_from(aps_to_remove)

File C:\ProgramData\anaconda3\Lib\site-packages\networkx\classes\graph.py:1663, in Graph.copy(self,
as_view)
   1661 G.graph.update(self.graph)
   1662 G.add_nodes_from((n, d.copy()) for n, d in self._node.items())
-> 1663 G.add_edges_from(
   1664     (u, v, datadict.copy())
   1665     for u, nbrs in self._adj.items()
   1666     for v, datadict in nbrs.items()
   1667 )
   1668 return G
```

```
File C:\ProgramData\anaconda3\Lib\site-packages\networkx\classes\graph.py:1049, in
Graph.add_edges_from(self, ebunch_to_add, **attr)
   1047     self._adj[v] = self.adjlist_inner_dict_factory()
   1048     self._node[v] = self.node_attr_dict_factory()
-> 1049 datadict = self._adj[u].get(v, self.edge_attr_dict_factory())
   1050 datadict.update(attr)
   1051 datadict.update(dd)

KeyboardInterrupt:

In [3]: %runfile C:/Users/somen/Desktop/Project/trialruns_bogus.py --wdir

================================================================================
Starting Analysis for: power_grid_uci.txt
================================================================================

--- Initial State ---
  Graph: 6,659 nodes, 8,309 edges

--- Multi-Point AP Failure Simulation ---
  Found 1,655 APs to sample from.

  Testing simultaneous removal of 1 APs (100 trials)...
    > All 100 trials completed in 2.99 seconds.

  Testing simultaneous removal of 3 APs (100 trials)...
    > All 100 trials completed in 2.85 seconds.

  Testing simultaneous removal of 5 APs (100 trials)...
    > All 100 trials completed in 3.01 seconds.

  Testing simultaneous removal of 7 APs (100 trials)...
    > All 100 trials completed in 2.97 seconds.

  Testing simultaneous removal of 10 APs (100 trials)...
    > All 100 trials completed in 3.25 seconds.

  Testing simultaneous removal of 12 APs (100 trials)...
    > All 100 trials completed in 2.97 seconds.

  Testing simultaneous removal of 14 APs (100 trials)...
    > All 100 trials completed in 3.16 seconds.

  Testing simultaneous removal of 16 APs (100 trials)...
    > All 100 trials completed in 2.99 seconds.

  Testing simultaneous removal of 18 APs (100 trials)...
    > All 100 trials completed in 3.20 seconds.

  Testing simultaneous removal of 20 APs (100 trials)...
    > All 100 trials completed in 2.99 seconds.

--- Simulation Results ---
APs Removed     | Avg Fragments   | Max Fragments   | Min Fragments
-----------------------------------------------------------------
1               | 2.80            | 8               | 2
3               | 5.82            | 11              | 4
5               | 9.35            | 23              | 6
7               | 12.68           | 22              | 8
10              | 18.24           | 33              | 11
12              | 21.86           | 32              | 14
14              | 25.65           | 37              | 17
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16              | 28.45           | 48              | 18
18              | 31.74           | 49              | 22
20              | 36.11           | 48              | 27

================================================================================
ALL ANALYSES COMPLETED in 30.42 seconds.

In [4]: %runfile C:/Users/somen/Desktop/Project/trialruns_bogus.py --wdir

================================================================================
Starting Analysis for: power_grid_uci.txt
================================================================================

--- Initial State ---
  Graph: 6,659 nodes, 8,309 edges

--- Multi-Point AP Failure Simulation ---
  Found 1,655 APs to sample from.

  Testing simultaneous removal of 1 APs (100 trials)...
    > All 100 trials completed in 3.07 seconds.

  Testing simultaneous removal of 3 APs (100 trials)...
    > All 100 trials completed in 3.85 seconds.

  Testing simultaneous removal of 5 APs (100 trials)...
    > All 100 trials completed in 5.11 seconds.

  Testing simultaneous removal of 7 APs (100 trials)...
    > All 100 trials completed in 5.08 seconds.

  Testing simultaneous removal of 10 APs (100 trials)...
    > All 100 trials completed in 5.30 seconds.

  Testing simultaneous removal of 12 APs (100 trials)...
    > All 100 trials completed in 5.25 seconds.

  Testing simultaneous removal of 14 APs (100 trials)...
    > All 100 trials completed in 5.04 seconds.

  Testing simultaneous removal of 16 APs (100 trials)...
    > All 100 trials completed in 5.14 seconds.

  Testing simultaneous removal of 18 APs (100 trials)...
    > All 100 trials completed in 5.05 seconds.

  Testing simultaneous removal of 20 APs (100 trials)...
    > All 100 trials completed in 5.29 seconds.

  Testing simultaneous removal of 22 APs (100 trials)...
    > All 100 trials completed in 5.23 seconds.

  Testing simultaneous removal of 24 APs (100 trials)...
    > All 100 trials completed in 5.21 seconds.

  Testing simultaneous removal of 26 APs (100 trials)...
    > All 100 trials completed in 5.30 seconds.

  Testing simultaneous removal of 28 APs (100 trials)...
    > All 100 trials completed in 5.32 seconds.

  Testing simultaneous removal of 30 APs (100 trials)...
    > All 100 trials completed in 5.18 seconds.
```

```
  Testing simultaneous removal of 32 APs (100 trials)...
    > All 100 trials completed in 5.30 seconds.

  Testing simultaneous removal of 34 APs (100 trials)...
    > All 100 trials completed in 5.43 seconds.

  Testing simultaneous removal of 36 APs (100 trials)...
    > All 100 trials completed in 5.35 seconds.

  Testing simultaneous removal of 38 APs (100 trials)...
    > All 100 trials completed in 5.16 seconds.

  Testing simultaneous removal of 40 APs (100 trials)...
    > All 100 trials completed in 5.29 seconds.

  Testing simultaneous removal of 42 APs (100 trials)...
    > All 100 trials completed in 5.19 seconds.

  Testing simultaneous removal of 44 APs (100 trials)...
    > All 100 trials completed in 5.50 seconds.

  Testing simultaneous removal of 46 APs (100 trials)...
    > All 100 trials completed in 5.43 seconds.

  Testing simultaneous removal of 48 APs (100 trials)...
    > All 100 trials completed in 3.95 seconds.

  Testing simultaneous removal of 50 APs (100 trials)...
    > All 100 trials completed in 3.13 seconds.

--- Simulation Results ---
APs Removed     | Avg Fragments   | Max Fragments   | Min Fragments
------------------------------------------------------------------
1               | 2.58            | 8               | 2
3               | 6.19            | 12              | 4
5               | 9.86            | 19              | 6
7               | 12.83           | 29              | 7
10              | 18.72           | 32              | 12
12              | 21.70           | 34              | 14
14              | 23.90           | 38              | 16
16              | 28.51           | 47              | 19
18              | 31.56           | 42              | 21
20              | 35.14           | 49              | 25
22              | 38.51           | 54              | 25
24              | 42.40           | 59              | 29
26              | 45.40           | 66              | 36
28              | 49.61           | 69              | 34
30              | 51.14           | 67              | 37
32              | 54.83           | 81              | 40
34              | 58.33           | 73              | 45
36              | 62.69           | 87              | 44
38              | 65.71           | 85              | 49
40              | 69.42           | 94              | 54
42              | 73.21           | 99              | 58
44              | 76.21           | 95              | 59
46              | 79.99           | 109             | 59
48              | 84.06           | 105             | 66
50              | 86.99           | 107             | 66

================================================================================
ALL ANALYSES COMPLETED in 124.20 seconds.
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In [5]: