Complex Networks

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1 Short info

i. language: Python 3.9.6

ii. environment: Visual Studio Code version 1.72.2 (Universal)

iii. computer: MacBook Pro (13-inch, 2019, Four Thunderbolt 3 ports), 2.4GHz quad-core Intel Core i5 with Retina display, 16GB of 2133 MHz LPDDR3 onboard memory, Intel Iris Plus Graphics 655 1536 MB

2 Presentation of results

[1]D. Lusseau, K. Schneider, O. J. Boisseau, P. Haase, E. Slooten, and S. M. Dawson, Behavioral Ecology and Sociobiology 54, 396-405 (2003)

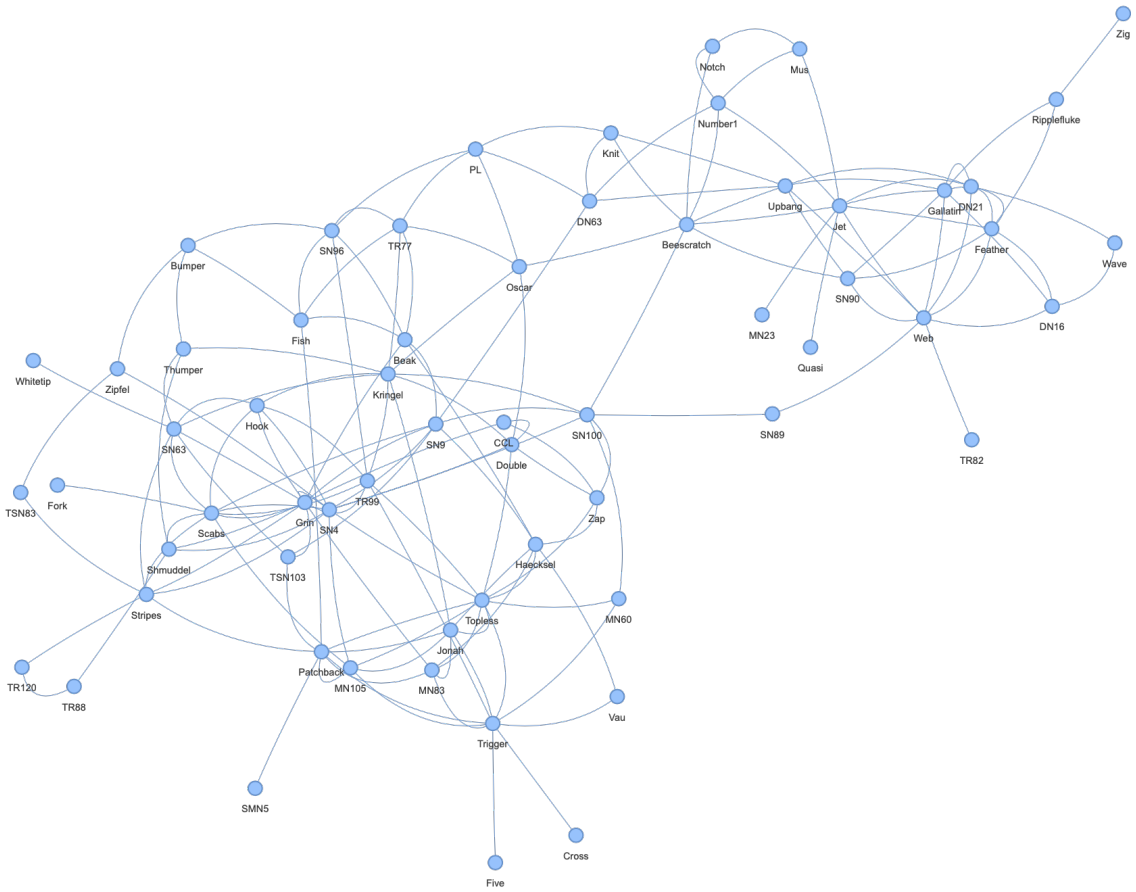
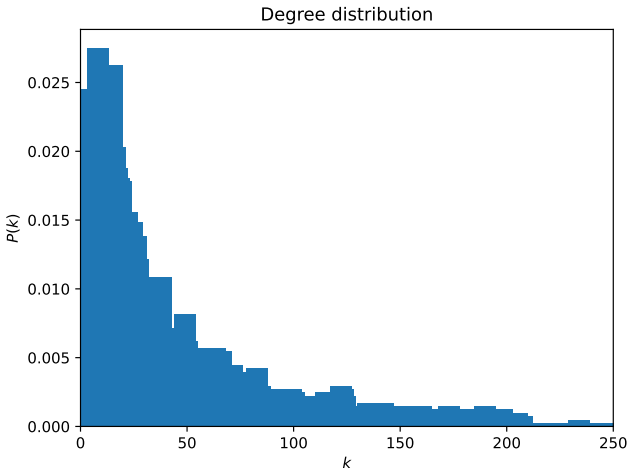
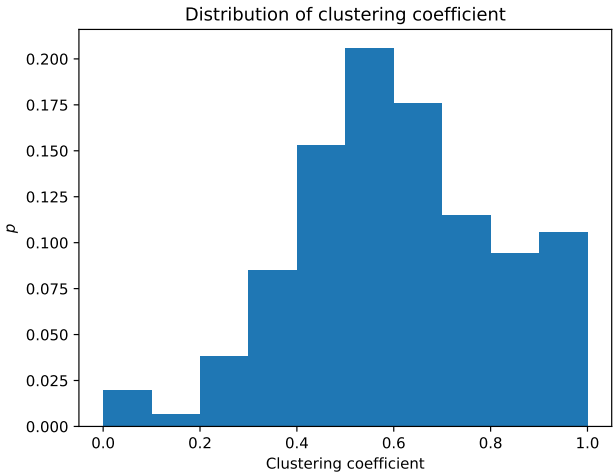


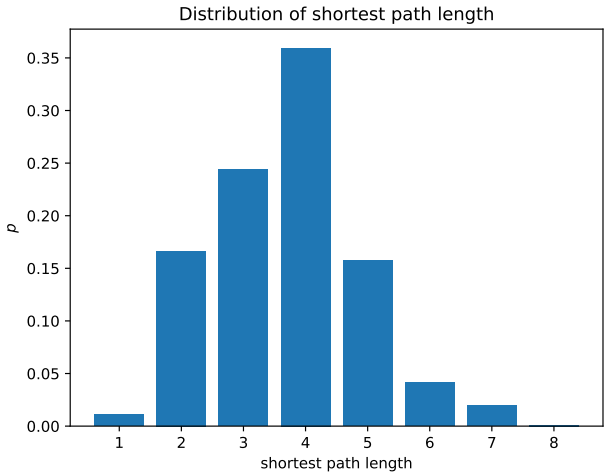
Figure 1: An undirected social network of frequent associations between 62 dolphins in a community living off Doubtful Sound, New Zealand[1].



(a) Degree distribution $P(k)$



(b) Distribution of clustering coefficients



(c) Distribution of the shortest paths

Figure 2: Presentation of the results for the social circles from Facebook (ego-Facebook) with an average degree $< k >$ equal to 43.69, an average clustering coefficient equal to 0.6055, the diameter equal to 8, and the average path length equal to 3.69.

```
def erdos_renyi_gilbert(N, p):
  # Create an empty graph object
  g = nx.Graph()

  # Start with N isolated nodes
  g.add_nodes_from(range(1, N + 1))

  # Select a node pair and generate r ~ U(0, 1).
  for i in g.nodes():
    for j in g.nodes():
      if i < j:
        r = random.random()
        if p < r:
          # If p < r then connect the selected pair,
          # otherwise leave them disconnected
          g.add_edge(i, j)
    pos = nx.shell_layout(g)

  return g
```

Listing 1: Implementation of Erdős–Rényi-Gilbert model

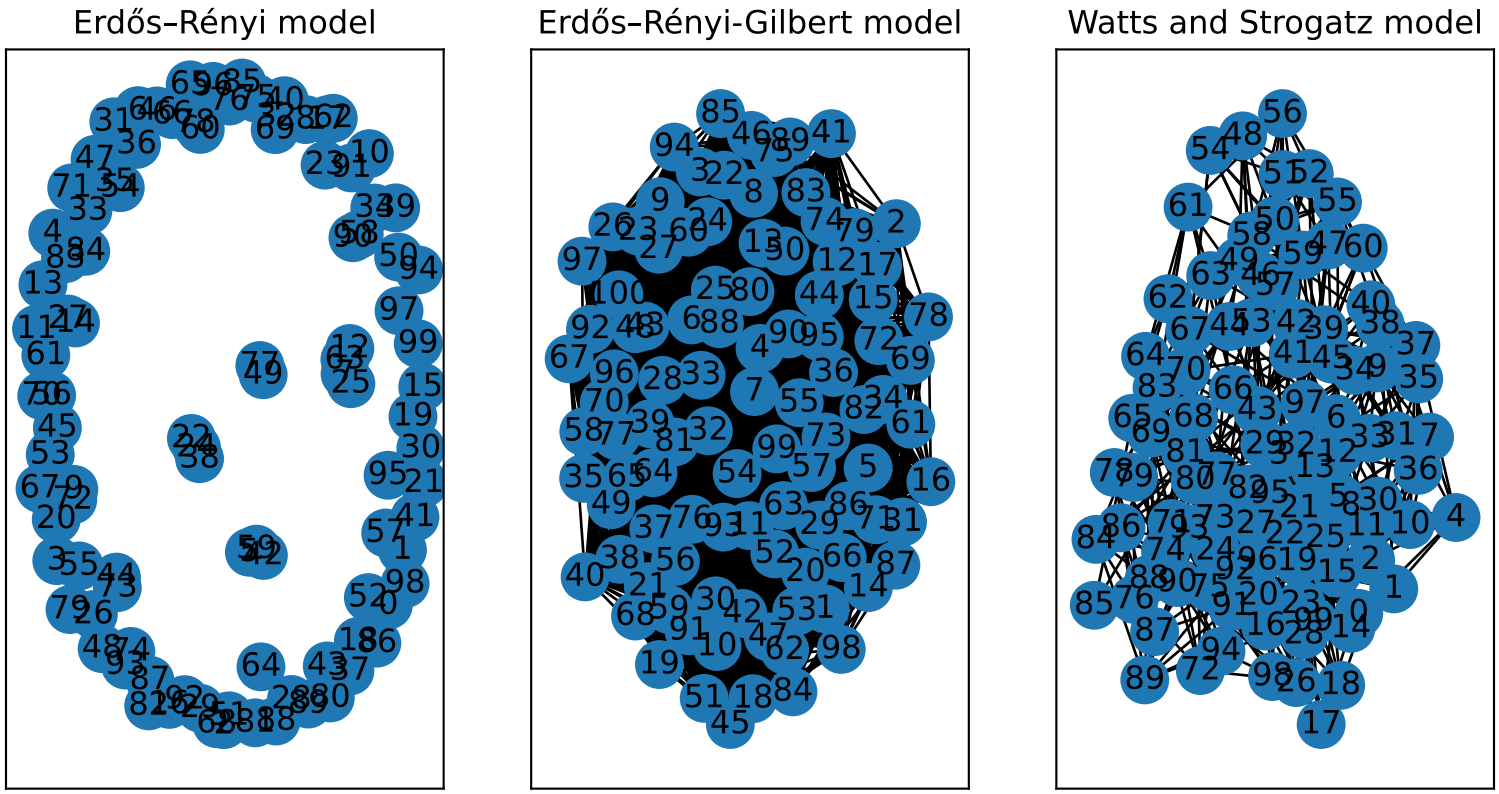
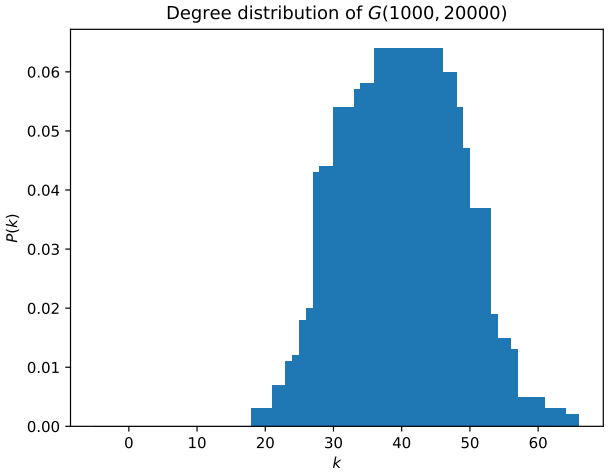
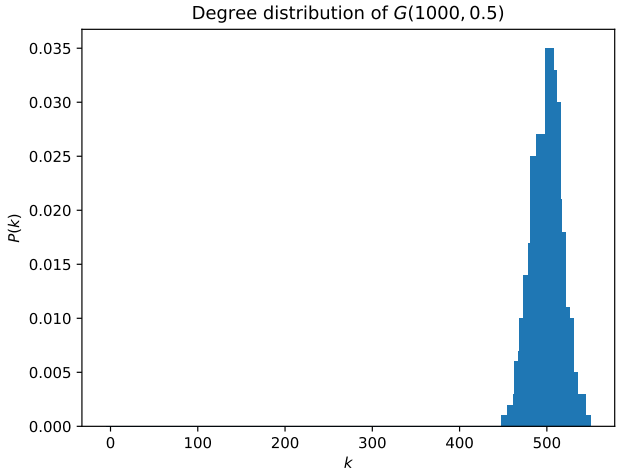


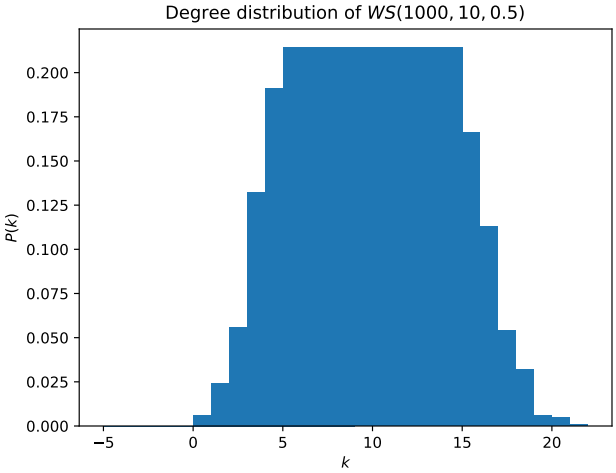
Figure 3: Comparison of the Erdős–Rényi, Erdős–Rényi-Gilbert, Watts and Strogatz models.



(a) $< k >= 40$

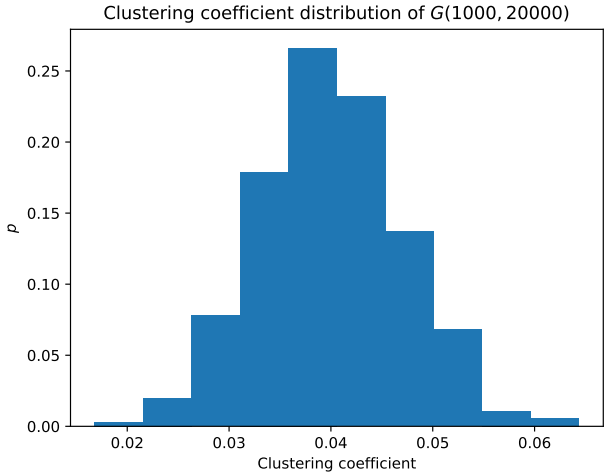


(b) $< k >= 498.982$

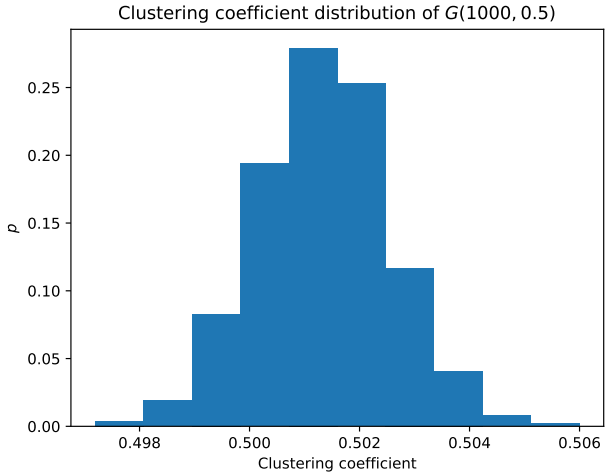


(c) $< k >= 10$

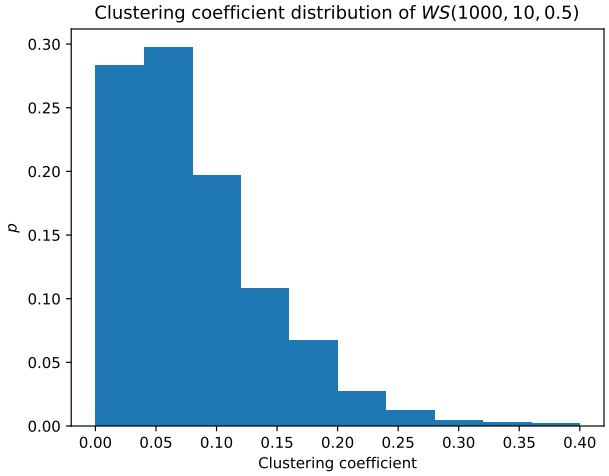
Figure 4: Comparison of the degree distributions for the social circles from Facebook (ego-Facebook).



(a) average clustering coefficient = 0.039

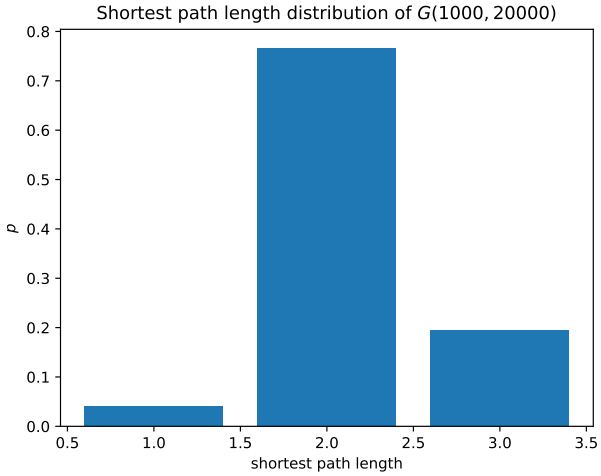


(b) average clustering coefficient = 0.5

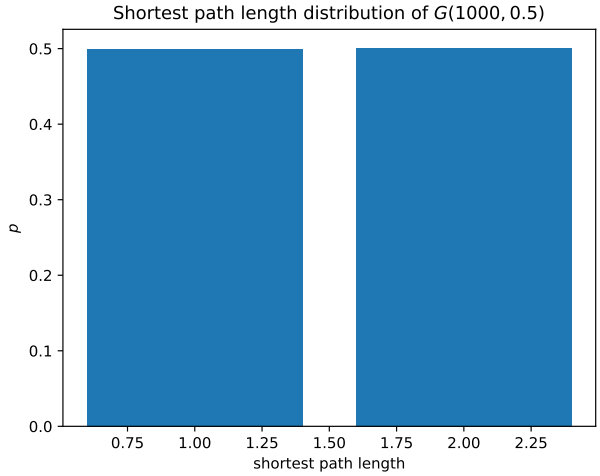


(c) average clustering coefficient = 0.089

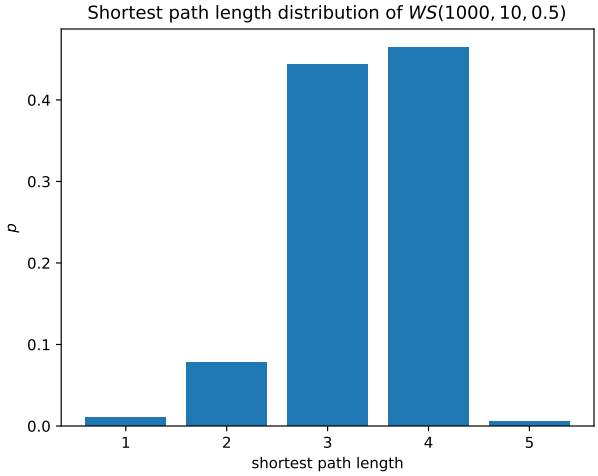
Figure 5: Comparison of the distribution of clustering coefficients for the social circles from Facebook (ego-Facebook).



(a) diameter = 3, average path length = 2.15



(b) diameter = 2, average path length = 1.5



(c) diameter = 5, average path length = 3.37

Figure 6: Comparison of the distribution of the shortest paths for the social circles from Facebook (ego-Facebook).