Multitype branching processes

for modeling complex contagion on social networks

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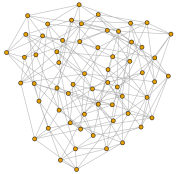
Motivation and background

- Centola's experiment on social contagion
- Complex contagion:
  $p_1 := \mathbb{P}(\text{A node getting infected from the first active node contact})$,
  $q_1 := \mathbb{P}(\text{A node not getting infected from the first contact}) = 1 - p_1$,
  $q_k := \mathbb{P}(\text{A node not getting infected from the } k\text{th contact}) = q_1(1-\alpha)^{k-1}$,
  $p_k := \mathbb{P}(\text{A node gets infected from the } k\text{th contact}) = 1 - q_k$
- Newman-Miller graphs
- Multitype branching process using motifs to simulate

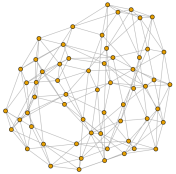
Key results in programming

- Generating particular graphs with a given structure

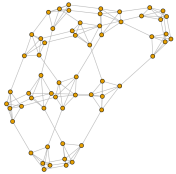
Three 6-regular graphs on 60 vertices:



Each vertex in six K_2



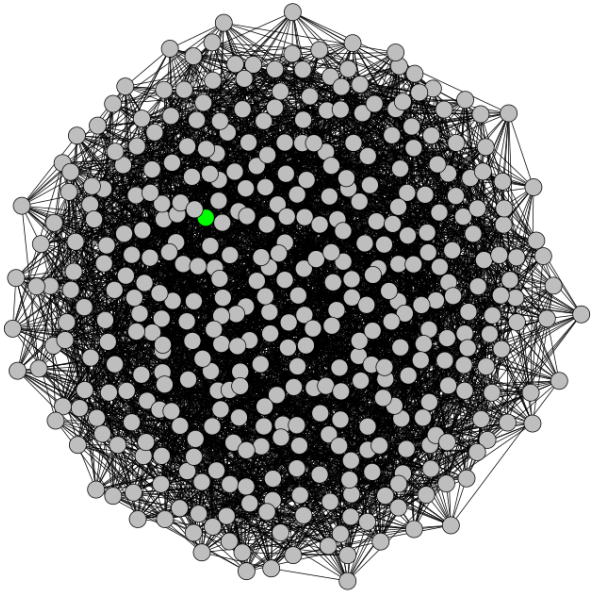
Each vertex in two K_4

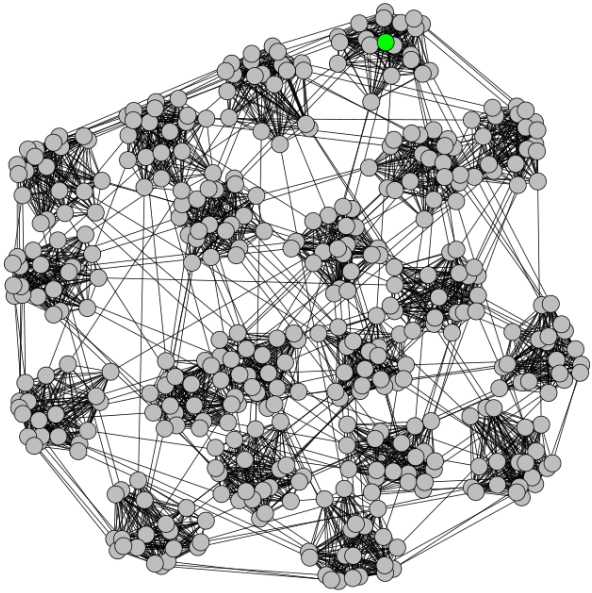


Each vertex in a K_2 and a K_5

Key results in programming

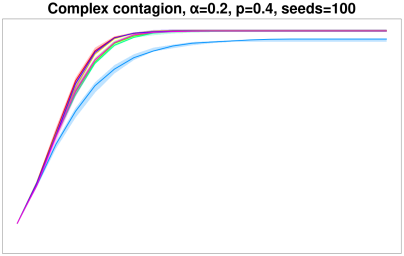
- Generating graphs with a given structure
- Visualisation of the spreading with different parameters

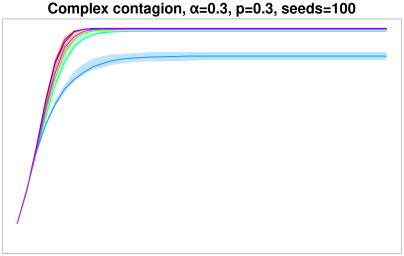

Complex contagion — t=1 (alpha=0.1, p1=0.1)

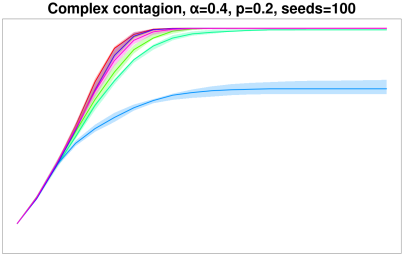

Complex contagion — t=1 (alpha=0.1, p1=0.1)

Key results in programming

- Generating graphs with a given structure
- Visualisation of the spreading with different parameters
- Simulations on differently structured graphs with varying parameters


Complex contagion, α=0.2, p=0.4, seeds=100


Complex contagion, α=0.3, p=0.3, seeds=100


Complex contagion, α=0.4, p=0.2, seeds=100


6_K2
3_K3
2_K4
1_K5_1_K3
1_K6_1_K2
2_K3_2_K2
1_K4_1_K3_1_K2

Future work

- Simulations using branching processes
- Expanding the research to larger cliques and higher-degree graphs
- Multiple directions for further development

Thank you for your attention

References

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Use of AI Tools

AI-based tools were used for

- improving wording and structure of the presentation and summary,
- LaTeX formatting and layout assistance,
- programming.