# K-Cores

Introduction to Network Science

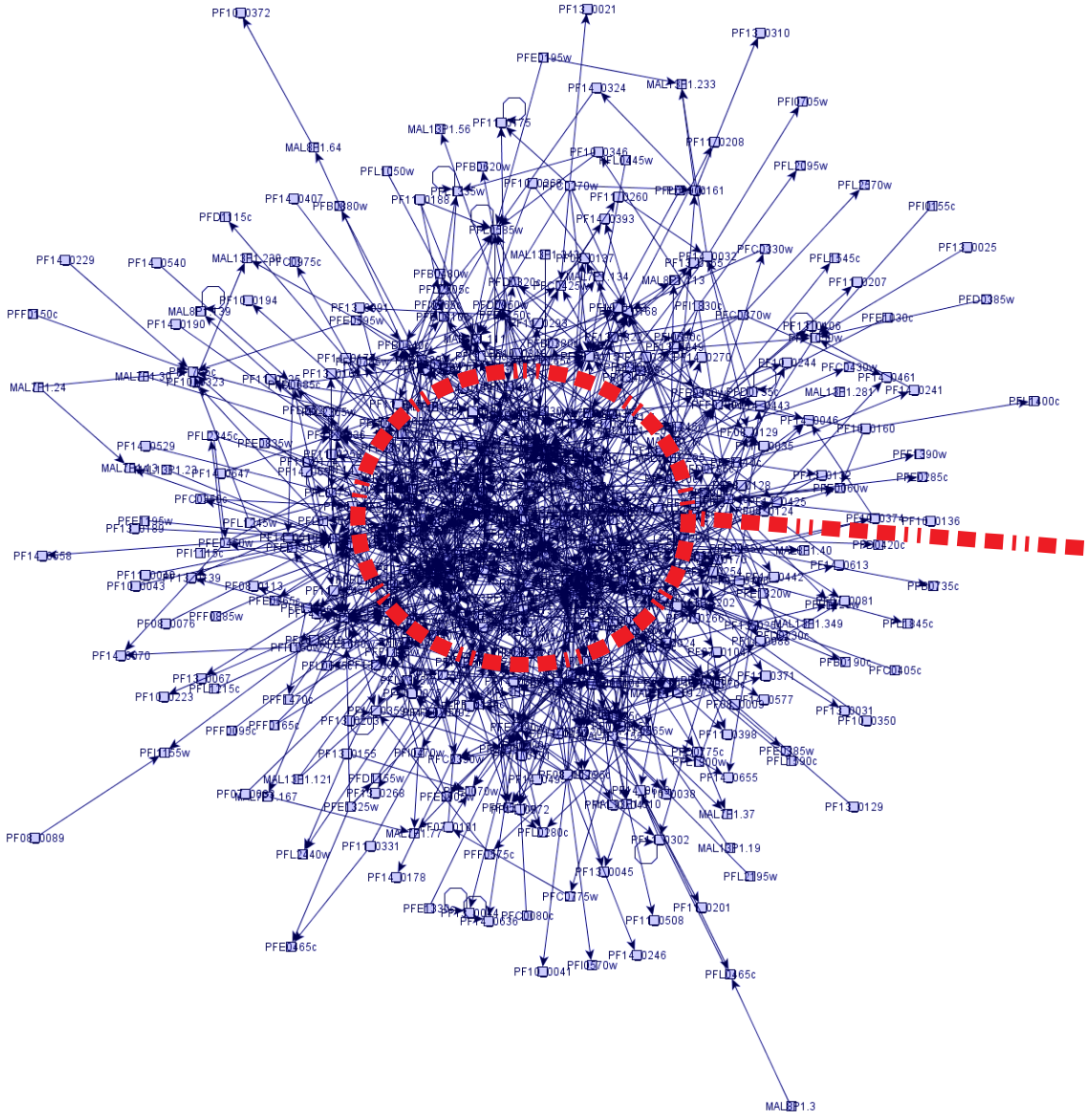
Carlos Castillo

Topic 21

upf. Universitat Pompeu Fabra Barcelona

# Sources

- Barabási 2016 Chapter 9
- Networks, Crowds, and Markets Ch 3
- C. Castillo (2017) Dense Sub-Graphs
- Tutorial by A. Beutel, L. Akoglu, C. Faloutsos [Link]
- Frieze, Gionis, Tsourakakis: “Algorithmic techniques for modeling and mining large graphs (AMAzING)” [Tutorial]
- A survey of algorithms for dense sub-graph discovery [link]

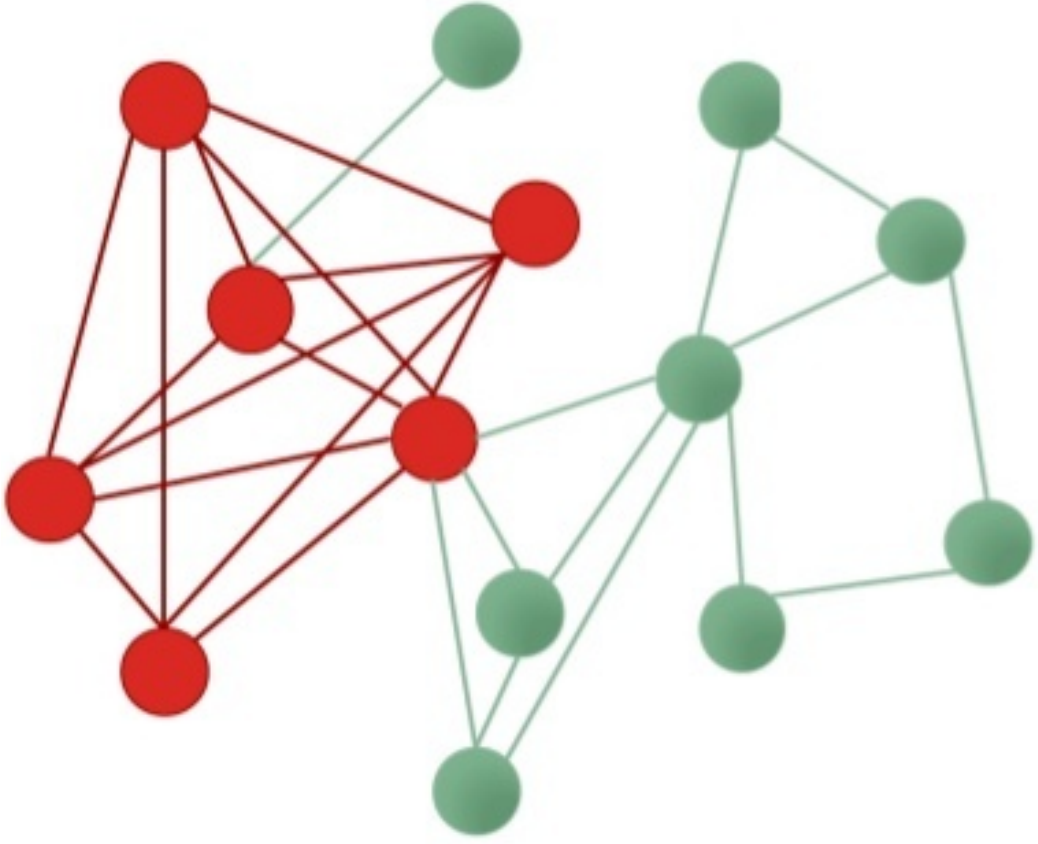


# Remember: “hairballs”

Sometimes, at the center these graphs may have an interesting dense sub-graph

# Remember: densest sub-graph

Sub-graph having the maximum density

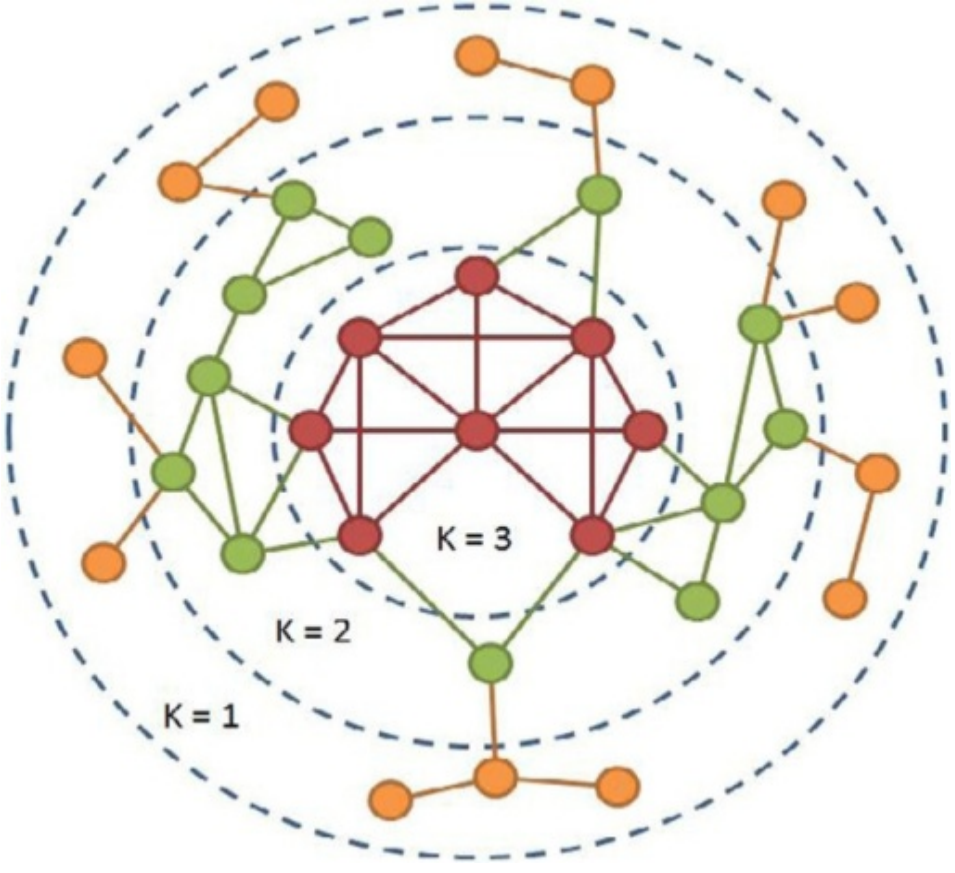


**k-core decomposition**
is a method to decompose
a graph into *layers*

# k-core decomposition

- Remove all nodes having degree 1
  - Those are in the 1-core
- Remove all nodes having degree 2 *in the remaining graph*
  - Those nodes are in the 2-core
- Remove all nodes having degree 3 *in the remaining graph*
  - Those nodes are in the 3-core
- Etc.

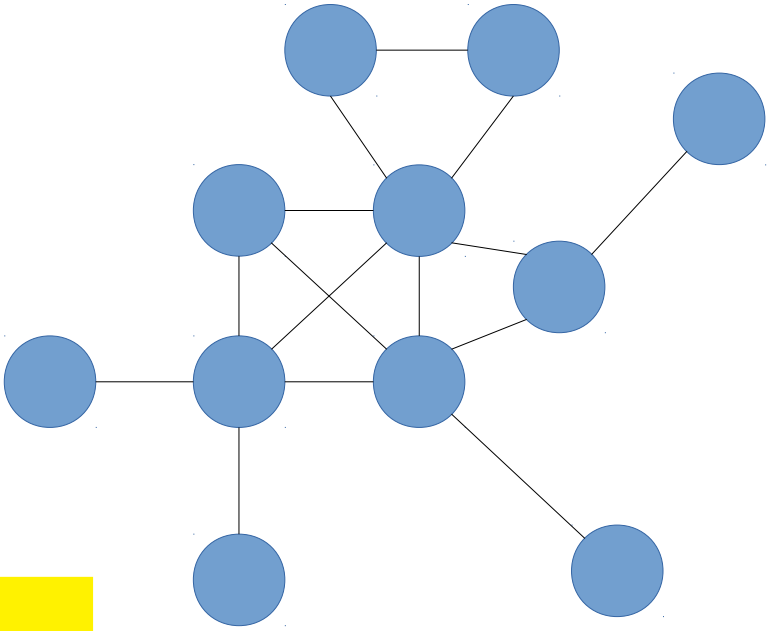
# Example




https://openi.nlm.nih.gov/detailedresult.php?img=3368241_fnagi-04-00013-g0001&req=4

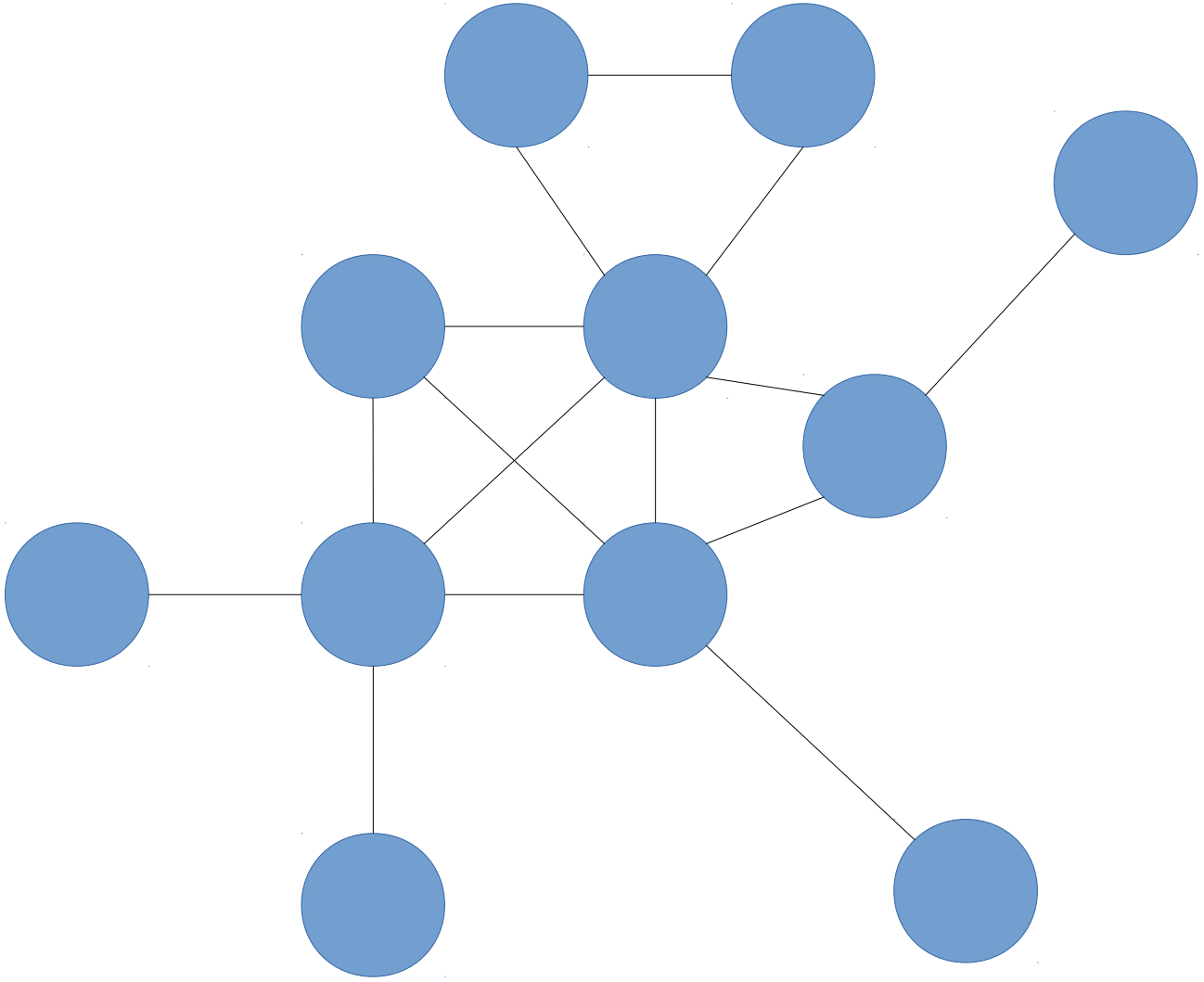
# Exercise

For each node in the graph, indicate the max k-core to which it belongs



Draw in Nearpod Collaborate
https://nearpod.com/student/
Code to be given during class

http://www.cpt.univ-mrs.fr/~barrat/NHM.pdf



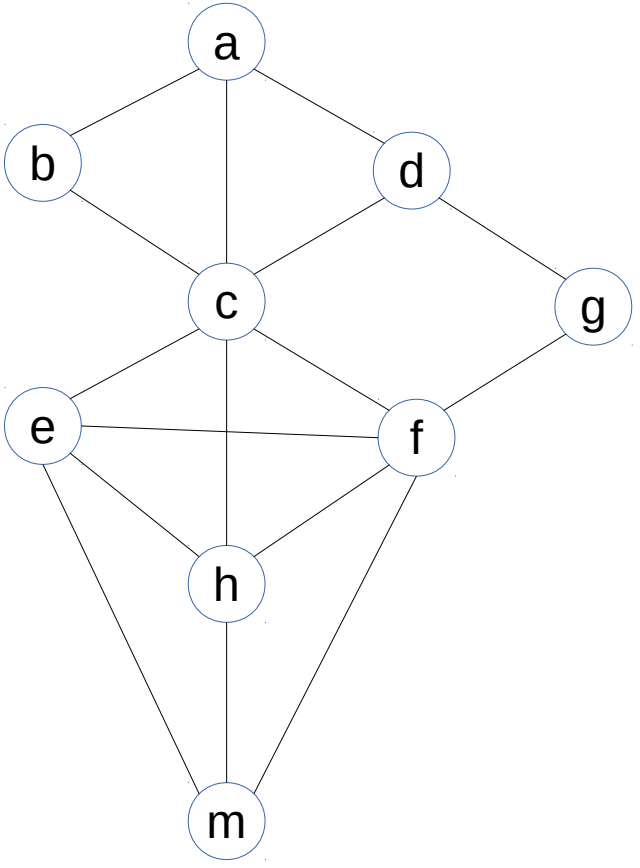
# Summary

# Things to remember

- What is the k-core decomposition
- How to compute it on a graph

# Practice on your own

Find the 3-core of this graph




Solution by Vivekanand Khyade (start at 01:23)
https://youtu.be/8sNZ5d8eNC8?t=83