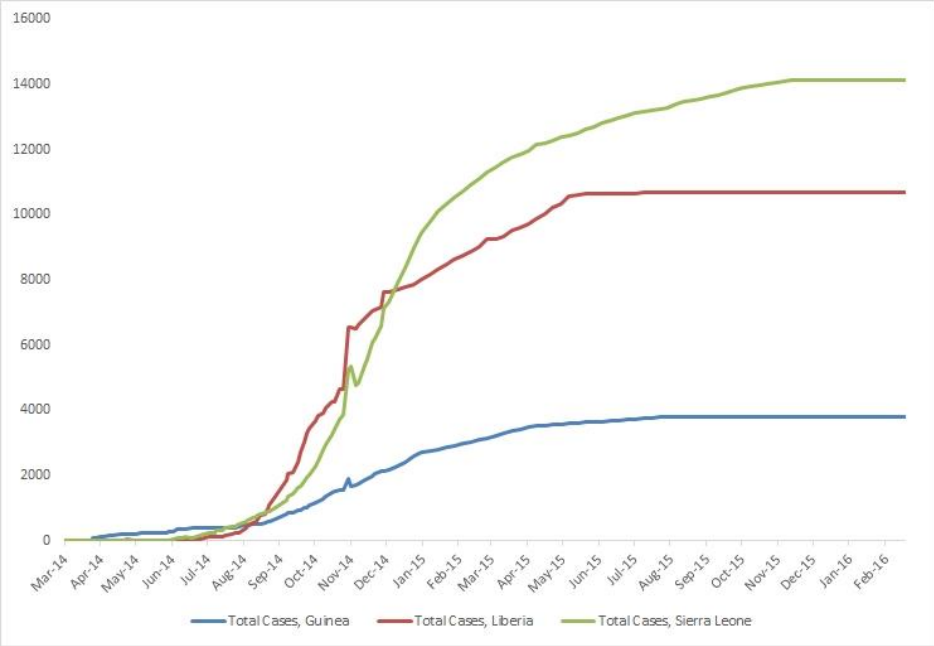
Propagation in networks

Any idea of propagation examples?

Virus propagation

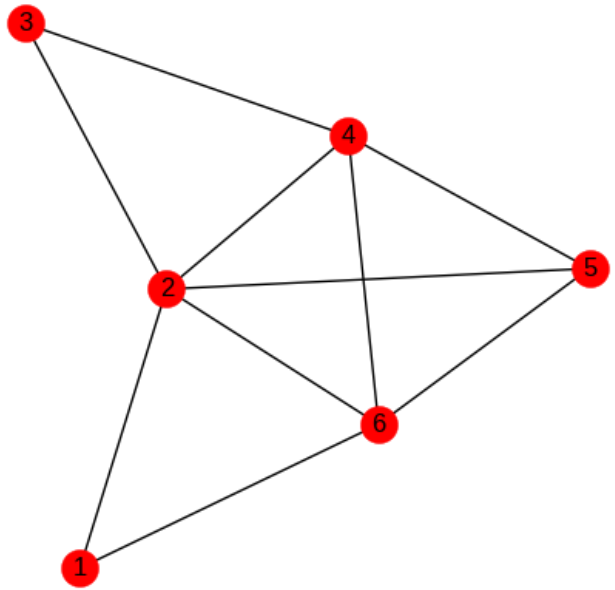
- ❑ Ebola outbreak in West Africa
- ❑ Unprecedented spreading rate

What caused this propagation
Could it have been prevented



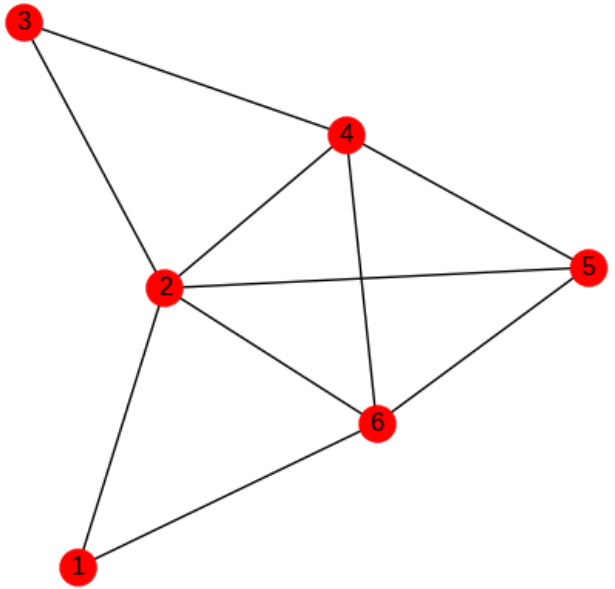
Which concepts are important?

Concept: Degree



Concept: Degree

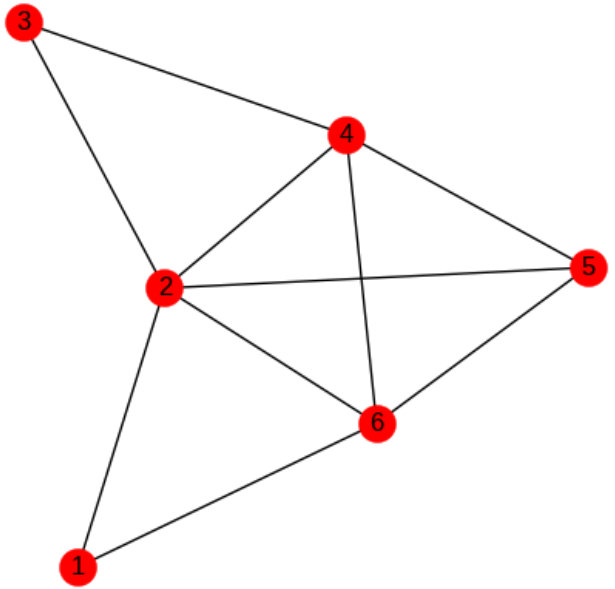
- Number of connections to other nodes



Concept: Degree

- Number of connections to other nodes

- What is the degree of node 2?

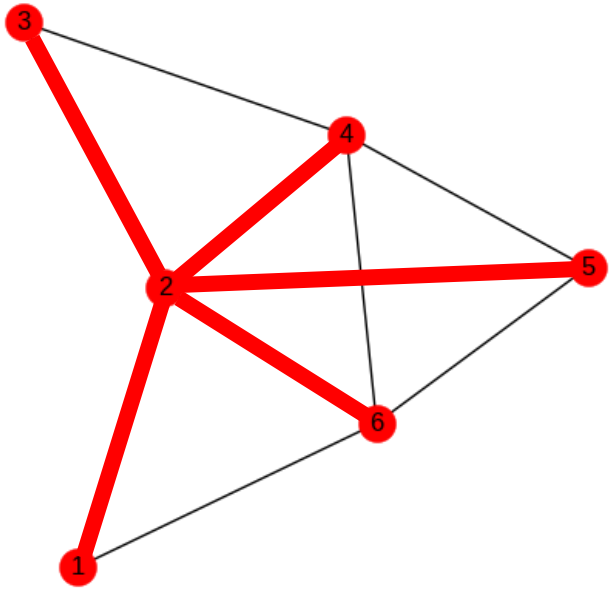


Concept: Degree

- Number of connections to other nodes

- What is the degree of node 2?

2 is connected to: 1, 3, 4, 5, 6

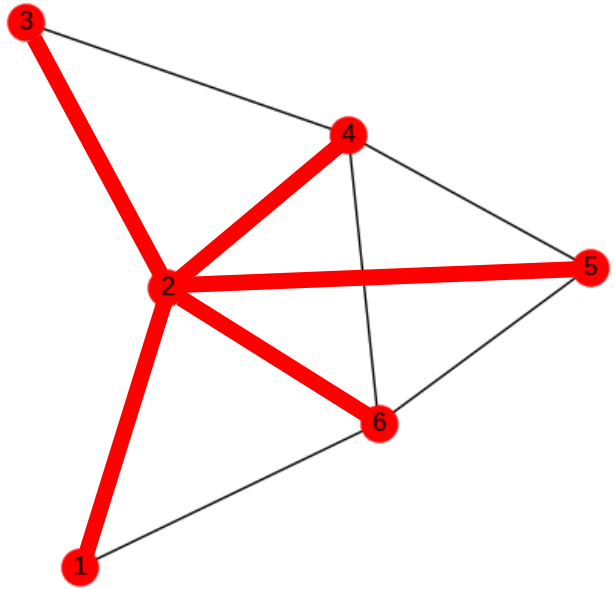


Concept: Degree

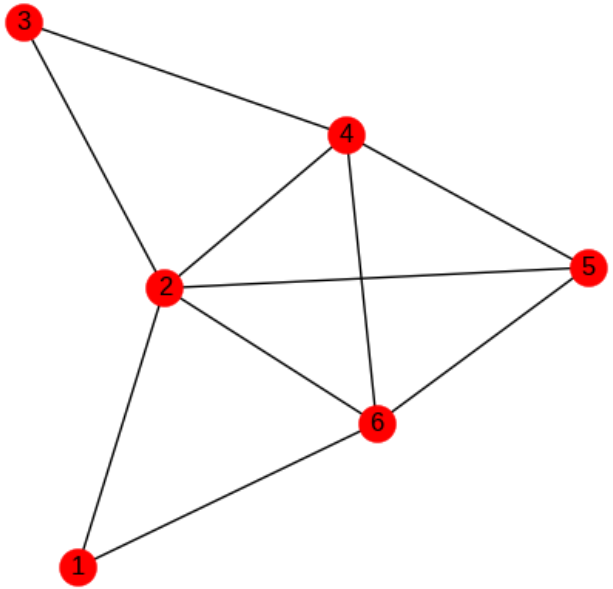
- Number of connections to other nodes
- What is the degree of node 2?

  2 is connected to: 1, 3, 4, 5, 6

  ➜ the degree is 5
- Why do you think it is important?

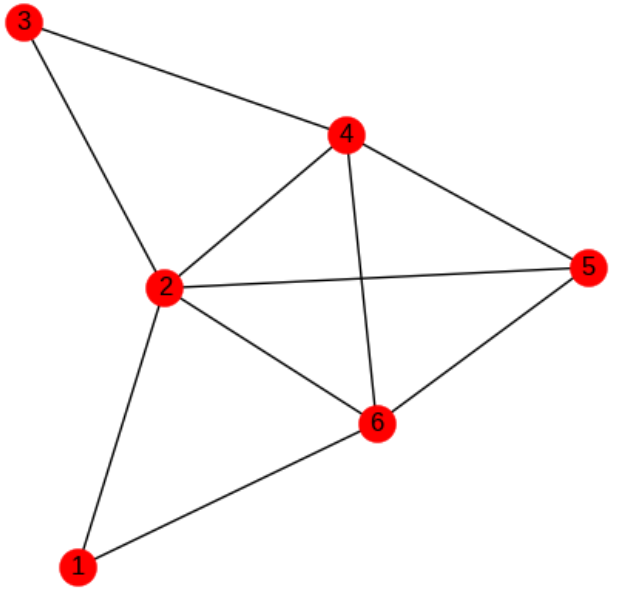


Concept: Clustering coefficient



Concept: Clustering coefficient

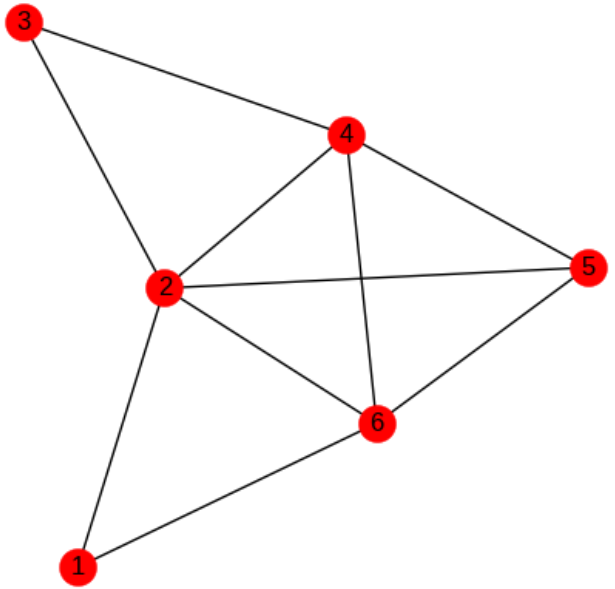
- Number of triangles a node belongs to



Concept: Clustering coefficient

- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

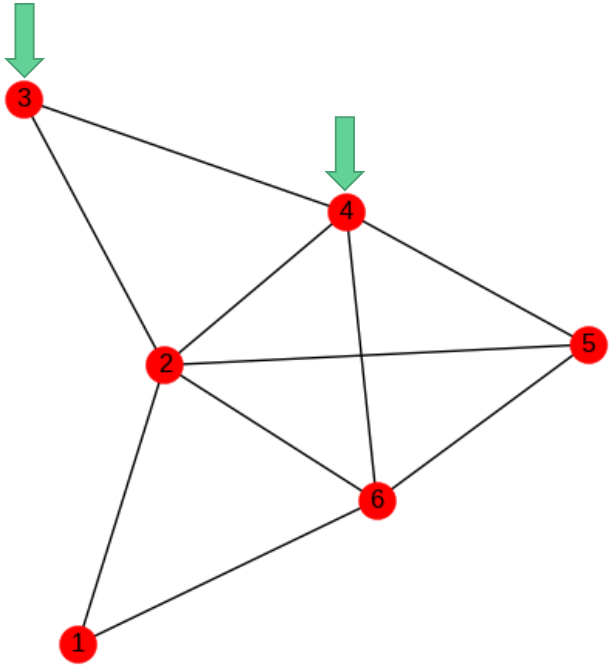


Concept: Clustering coefficient

- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

  -Pick two nodes: (3, 4)



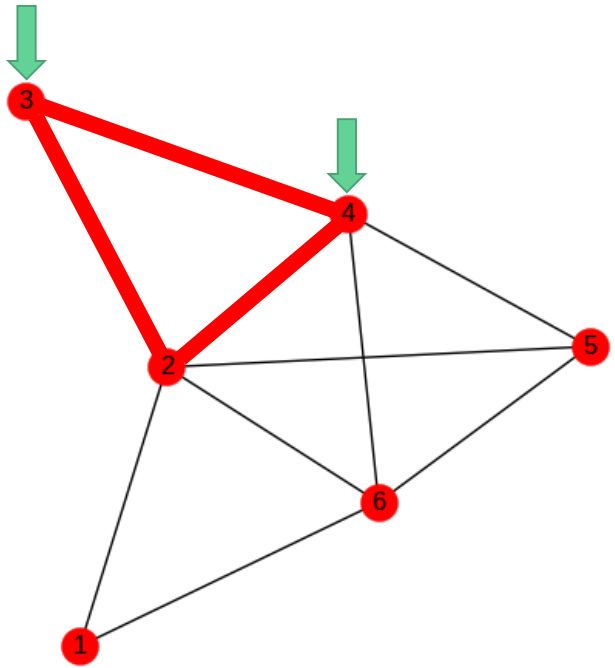
Concept: Clustering coefficient

- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

  -Pick two nodes: (3, 4)

  -Is 2,3,4 a triangle? Yes



Concept: Clustering coefficient

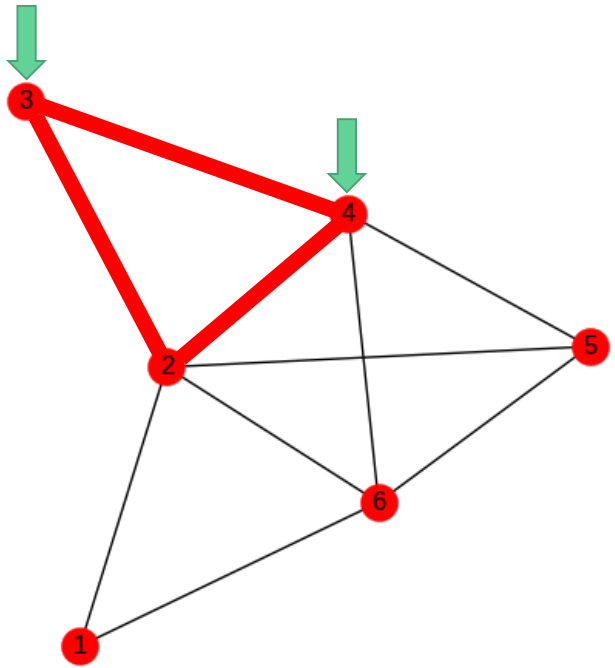
- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

  -Pick two nodes: (3, 4)

  -Is 2,3,4 a triangle? Yes

  -Enumerate the number of triangles for 2



Concept: Clustering coefficient

- Number of triangles a node belongs to

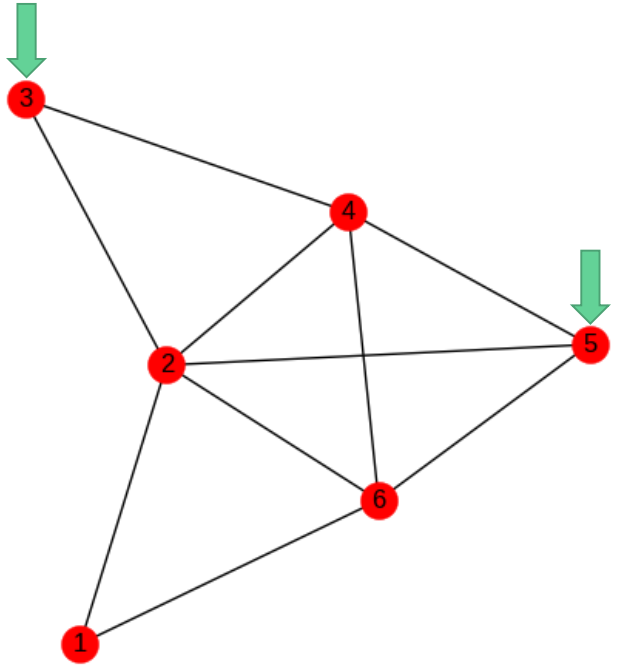
- What is the clustering coefficient of node 2?

  -Pick two nodes: (3, 4)

  -Is 2,3,4 a triangle? Yes

  -Enumerate the number of triangles for 2

  -Loop on all pairs, pick two other nodes...



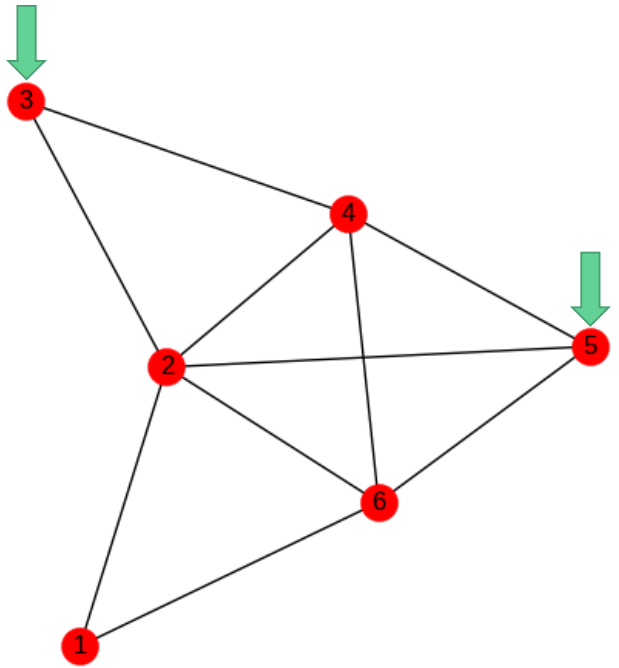
Concept: Clustering coefficient

- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

  (3, 4) → Form a triangle with 2

  (3, 5)



Concept: Clustering coefficient

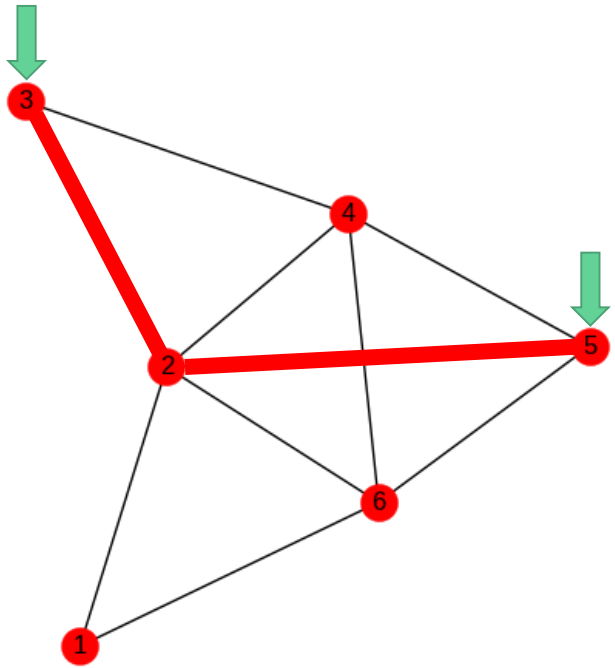
- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

  (3, 4) → Form a triangle with 2

  (3, 5) → Doesn't form a triangle with 2

  ...

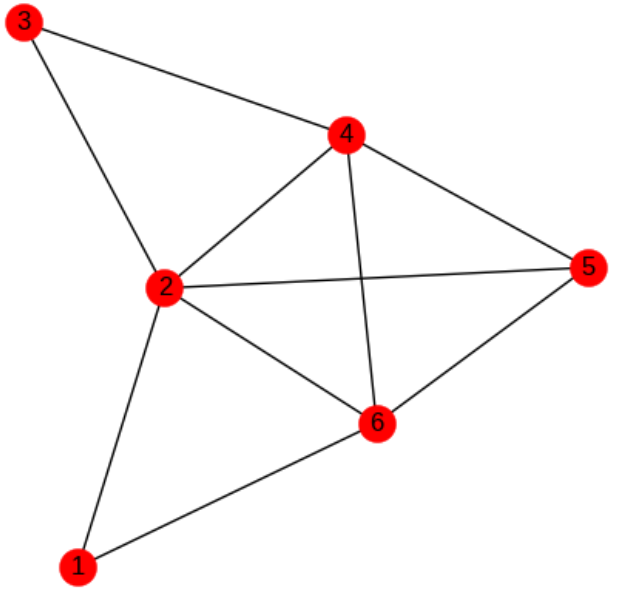


Concept: Clustering coefficient

- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

  How many triangles in total for node 2?



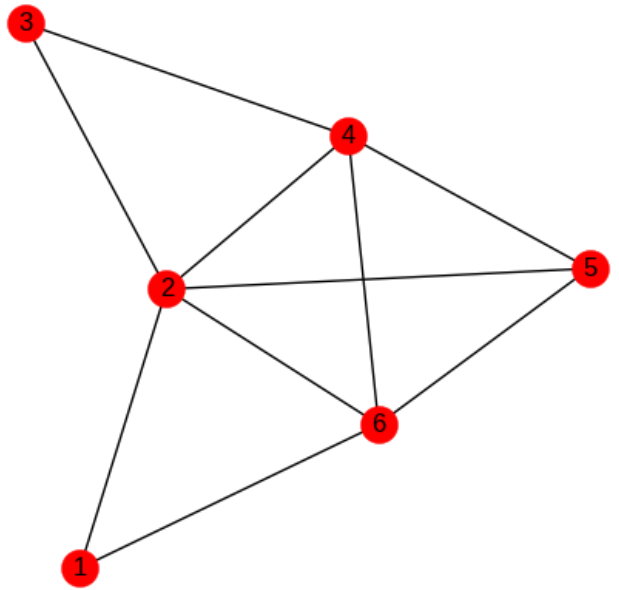
Concept: Clustering coefficient

- Number of triangles a node belongs to

- What is the clustering coefficient of node 2?

  In this example, 2 is in 5 triangles which is the highest clustering of the network.

- Why do you think it is important?



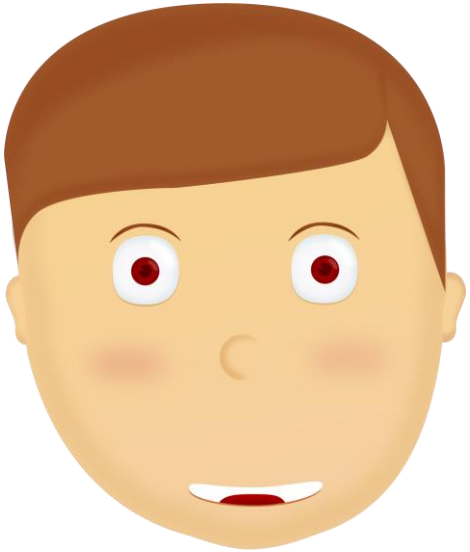
Time to play

Time to play

- ❏ Form two teams
- ❏ One team will have to spread a virus in a network by choosing which node to infect at each round
- ❏ The other team will have to prevent the virus from spreading in the network by giving an antidote to two nodes at each round
- ❏ An infected node will spread the virus to his neighbors with probability one
- ❏ An antidote cure a node if it is infected. This node becomes immune to the virus for 2 rounds

Two states

Healthy



Infected

What to remember

- High degree: spread broadly in the network

- High clustering coefficient: persistence of the transmission (virus, information) in the network