ACTISS
ACTION FOR COMPUTATIONAL THINKING
IN SOCIAL SCIENCES

INTRODUCTORY COURSE

Social Network Analysis: The Networks Connecting People

Explore the structure and dynamics of different types of social networks and use models to identify patterns of social influence

MATERIALS FOR WEEK 1

The Hunter Gatherer Tribe – living in communities

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The Hunter Gatherer Tribe – living in communities

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OVERVIEW OF THIS WEEK'S MATERIALS

Humans are a very social species, and they interact a lot. These interactions may address the exchange of information, the sharing of norms, and the transmission of viruses, to name a few examples. Our network history starts with thousands of generations of hunter gatherers, living in relative small tribes and families. This week we will explore some of the fundamentals of interactions within such networks. Because network dynamics evolve over longer time periods, and involve large numbers of people, it is difficult to experiment with them. Therefore, social scientists increasingly use computer simulations to study the dynamics of social networks. This week you will play with easy to use simulation models to get hands-on experience with the dynamics of networks and key concepts of network theory.

Keywords:

STRUCTURE OF THIS WEEK'S MATERIALS

Welcome to Social Networks!
Get to know your lead educator, introduce yourself, and learn a bit about what to expect in the course.

STEPS:

Welcome to the course Social Network Analysis – ARTICLE
Introductions – DISCUSSION
Networks connecting humans – ARTICLE

Welcome to the tribe!
An introduction to the small tribal network that we all come from.

STEPS:

Everything is connected – VIDEO (02:13)
The hunter and gatherer network – ARTICLE
What are your networks? – DISCUSSION

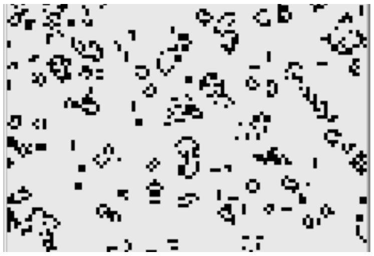
Key Concepts: Nodes and Links
In this activity you will be introduced to two key concepts of social networks: the links connecting the nodes.

STEPS:

Nodes and Links – VIDEO (03:34)

Questions about cellular automata – QUIZ

An Early Social Computational Model
The Game of Life is one of the important starting points of computational social science, which inspired many people. You will learn how complex patterns can grow out of simple rules of interaction.



STEPS:

An early social-computational model – ARTICLE

Six degrees of separation – ARTICLE

Are there still remote tribes? - DISCUSSION

Clustering - VIDEO (01:26)

The impact of social media on our interactions - DISCUSSION

Questions on clustering and path length in networks - QUIZ

Small worlds
In this activity you will explore how clustering and path lengths differ for networks that are regular, random, or display small world properties.

STEPS:

Introduction into the basic properties of small worlds – EXERCISE

Do you have neighbouring nodes? – DISCUSSION

A simulated tribe - ARTICLE

Clustering and tribes - VIDEO (02:00)

Virus in the tribe - EXERCISE

What can we learn from this contagion model? - DISCUSSION

The complexity of virus contagion - ARTICLE

Using models in science communication - DISCUSSION

Wrapping Up Week 1

We look back at the first week and ahead to what is to come in Week 2

STEPS:

Wrapping up Week 1 - ARTICLE

EDUCATIONAL MATERIALS

1. Welcome to the course Social Network Analysis– ARTICLE

Within the next three weeks you will learn what social networks are, how they form and what role they play in the spreading of viruses, information and norms. You will explore the social dynamics that take place in a small tribe, and later experiment with the impact of well-connected powerful people, such as kings and priests in the first cities, and nowadays, the influencers on social media. You will also experience how norms affect the spread of new ideas and products, and find out that better ideas and products can have a hard time spreading in a society when the norm is against it.

Each week of the course has a specific focus:

Week 1: **The Hunter Gatherer Tribe ->** You will be introduced to the basic principles of social networks, and will play with a simulation model on the spreading of a virus in a small tribe.

Week 2: **The Larger Agricultural Society and Hubs ->** You will learn about the spreading of information and the effect of norms, and encounter the impact of well-connected influencers, also known as "hubs".

Week 3: **Global Society and Social Influences ->** You will experiment with a simulation model where the hubs are deliberately influencing the regular people to follow a certain idea or purchase a particular product.

Each week you will learn by engaging in different activities, such as watching videos, undertaking quizzes, reading articles, doing exercises and discussing topics related to social dynamics with other learners.

What will you learn?

At the end of the course you should be able to:

Compare how different network structures affect social dynamics.

Connect key properties of social networks with the spreading of different influences such as viruses, norms and properties of products.

Experiment with different social influences and network structures and how they impact diffusion dynamics.

Analyse situations where "small scale tribal mechanisms" such as local norms have an impact on global network dynamics.

Share with others

We are looking forward to your contributions in the comment sections. Also, consider joining us on social media to build the debate. For those of you who use Twitter, the hashtag #FLsocialdynamics will help you to share ideas and experiences of the course.

2. Introductions - DISCUSSION

In this step the course team is introduced and we invite you to introduce yourselves as well.

TEAM

Wander Jager, lead educator

Wander Jager (1962) is a social scientist with a broad interdisciplinary interest in social complex phenomena and transition to a sustainable society. Being inspired by the work of John Holland on chaos and self-organisation in the 90's, he has since then been working and teaching on social dynamics. His PhD thesis "Modelling Consumer Behaviour" integrated key behavioural theories into a computer simulation of human population behaviour. Over the last 25 years he has been working on social simulation projects addressing the dynamics of opinions, the societal processes of acculturation related to migration, the diffusion of sustainable products and practices, on littering and cleaning strategies, crowd behaviour, team performance, and social innovation in communities, to mention a few examples.

Tracy Poelzer, educational specialist

Tracy Poelzer is an educational specialist and trainer at the University of Groningen who supports instructors in the areas of pedagogy, didactics, and instructional design.

Tom Spits, online learning designer

Tom Spits is online learning design specialist and video-in-education expert at University of Groningen. He specialises in designing Massive Open Online Courses and has co-created all of **University of Groningen's FutureLearn courses since 2014.**

The course was co-developed with support from Computational Social Science specialists:

Agata Komendant-Brodowska, Sociologist

Hi, my name is Agata Komendant-Brodowska, I'm a sociologist at the University of Warsaw and I'm passionate about using models and simulations in order to understand social processes. I love the way even simple models can help illuminate some important issues related to what happens in our society and I'd like you to experience it during the next three weeks. I'm leading the project "Action for Computational Thinking in Social Sciences" and we created this course as a part of this project.

Anna Baczko-Dombi, social researcher

Hi, my name is Anna Baczko-Dombi and I'm a social researcher from the University of Warsaw. I'm leading the Digital Sociology masters programme and I love translating difficult things into easy and understandable ones. In this course we designed the materials in such a way that they are accessible and understandable. I hope you will experience that modelling and simulations are fun and much easier than they might sound.

Katarzyna Abramczuk, co-author of an upcoming course on game theory and socio-ecological models.

Hi, I'm a social scientist working at the University of Warsaw. I enjoy understanding what is happening and how. Hence my interest in formal modelling. Also, I do research on Human-Technology Interaction.

Nataliia Sokolovska, technical project manager.

Hi, my name is Nataliia and I'm a researcher and project manager at the Alexander von Humboldt Institute for Internet and Society in Berlin, where we study digitalisation of society. I'm passionate about finding ways how to connect the world of academic research with societal needs with the help of using digital tools. In the project Action for Computational Thinking in Social Sciences, I developed and implemented strategies for transforming analog study materials into an online course.

Franziska Cagic, video editor and producer.

Hi, my name is Franzi and I'm a video producer and editor. I enjoy creating visual instruments that explain complex material in an accessible format. In the project Action for Computational Thinking in Social Sciences, I was shooting and editing the course videos, and designing short animations.

We would also like to thank Manvi Agarwal who contributed to developing the basic models of network dynamics and Shaoni Wang, who worked out the simulation exercises.

Support

We also thank **Beatrix**, **David**, **Frans**, **Karolina** and **Lena** for their wonderful support in getting all texts, videos and images to the platform.

ACTISS

This course is a part of ACTiSS - an educational initiative Action for Computational Thinking in Social Sciences, co-funded by Erasmus+. It's aim is to develop engaging and accessible online courses introducing the basics of computational social sciences. The project is carried out by a team of simulation, modelling and open education enthusiasts from three partner institutions: University of Warsaw (leader), University of Groningen and The Alexander von Humboldt Institute for Internet and Society. The project is funded by Erasmus+ KA2: Strategic Partnership in the Field of Higher Education. If you'd like to know more, please check out our **website**.

University of Warsaw

University of Warsaw is the leading research university and the largest higher education institution in Poland, with a comprehensive portfolio of research and teaching activities.

University of Groningen

The University of Groningen is a research university with a global outlook, deeply rooted in Groningen, in the north of the Netherlands.

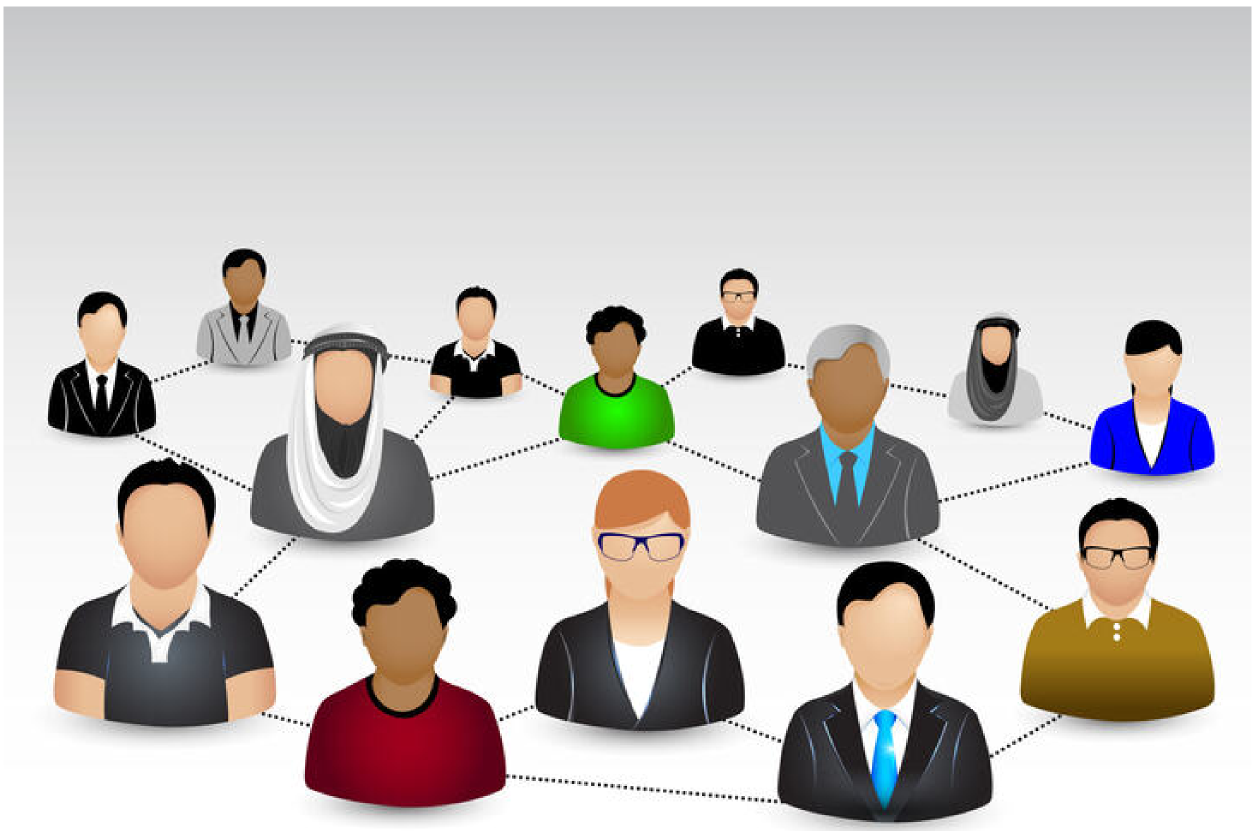
HIIG

The Alexander von Humboldt Institute for Internet and Society from Berlin is exploring digitalisation together with economic, political and civil society stakeholders.

Over to you

So, now you know who we are and what you can expect from us. Maybe you would want to introduce yourself in the discussion section on this page. Please use a few sentences on who you are and why you have joined this course. Also have a look at what other learners posted and start learning together.

3. Networks connecting humans – ARTICLE



Humans are a very social species, and they interact a lot. These interactions may address the exchange of information, the sharing of norms, and the transmission of viruses, to name a few examples. Our network history starts with thousands of generations of hunter gatherers, living in relative small tribes and families.

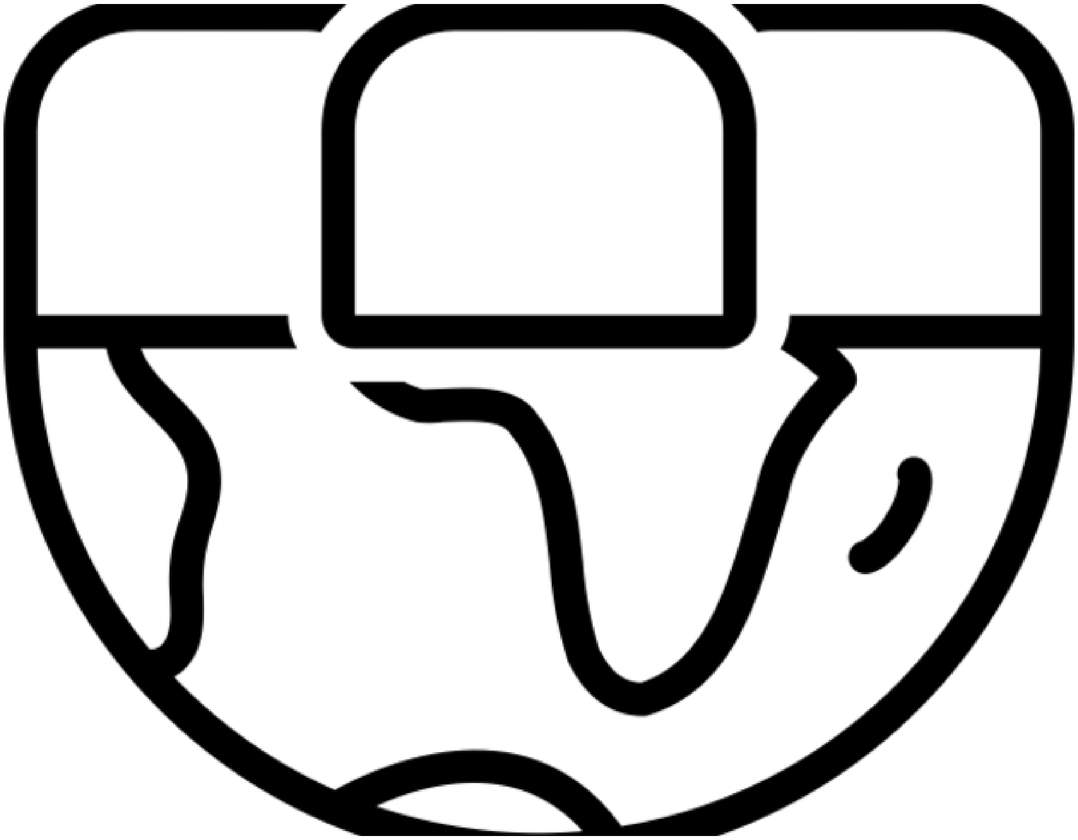
This week we will explore some of the fundamentals of interactions within such networks. Because network dynamics evolve over longer time periods, and involve large numbers of people, it is difficult to experiment with them effectively in a real-world setting. Therefore, social scientists increasingly use computer simulations to study the dynamics of social networks.

This week you will learn about some key concepts of social networks, in particular, how people form closely knitted groups (which is called clustering), and how fast information may travel from one end of a network to another (which is called path-length). You will play with easy-to-use simulation models to get hands-on experience with the dynamics of networks and these key concepts of network theory.

4. Everything is connected – VIDEO

In this video, Wander Jager explains that networks are everywhere, connecting trees, neurons in our brain, or galaxies in space. Networks are all about exchanging materials, or ideas. In this course, we will focus on the networks connecting people.

5. The hunter gatherer network – ARTICLE



By far, the largest part of human history is prehistoric: there was no written language, and the only information we have is based on archeological findings and the old stories that echoed through towards modernity. Nevertheless, on the basis of limited data we can compose a picture of how people were living in tribes for hundreds of thousands of years.

From the perspective of social networks it is assumed that humans lived in groups of a few dozen people, composed of several families (Groeneveld, 2016). They were living as hunter gatherers, often following the species they were predating on. According to Dunbar (1992) we have evolved a cognitive ability to maintain stable social relationships and be aware of the social structure of about 150 people.

These groups of people were collaborating in hunting, communicating about where fruit and edible plants could be found, educating the young and spending time together, sharing stories, developing norms about (in)appropriate behaviour. They also shared vector borne diseases.

The networks based on these tribal interactions are closely knit. Families or households are the basic clusters where young people are raised into the social practices of the family and the tribe. Learning skills, understanding and social practices, such as hunting, identifying edible plants and special celebrations takes place in a wider tribal context.

Whereas today our species is connected globally through the internet, we have to be aware that much of our sociality originates from these tribal networks, and that much of our interactions still take place in smaller networks with dense connections, such as families, groups of friends and colleagues.

6. What are your networks? – DISCUSSION

At this very moment you are connected through the network of the internet with this course. What other networks have you, or will you interact with today? Do some of these networks look like the old hunter-gatherer network?

7. Nodes and links – VIDEO

In this video, Wander Jager shows how nodes and links together construct social networks. He explains that there are many things being transmitted through networks, from viruses to information. A first simulation approach, called cellular automata, is being explained.

What different types of networks can you think of in human society? What is being transported through them? Please share in the discussion section.

8. Questions about cellular automata – QUIZ

In these questions you can demonstrate your understanding of what a cellular automata grid is and what its limitations are.

Quiz rules

- Quizzes do not count towards your course score, they are just to help you learn
- You may take as many attempts as you wish to answer each question

- You can skip questions and come back to them later if you wish

QUESTION 1

What is a Cellular Automata?

A model simulating the physical spread of viruses

A grid of cells that are influencing each other

A simulated agent that can move over a spatial grid

QUESTION 2

How many neighbours does a cell have in a Von Neumann neighbourhood?

4

6

8

QUESTION 3

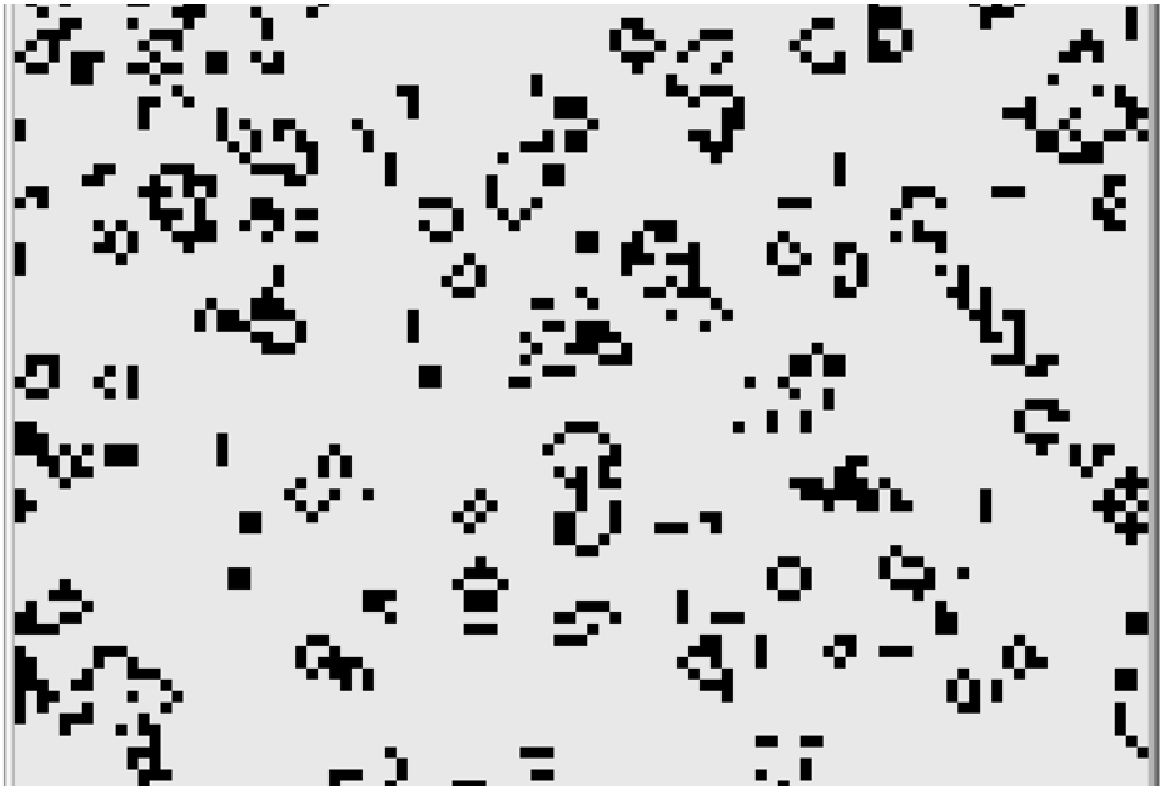
What are the limitations of a cellular automata?

You can only use two types of neighbourhoods, the Moore and the Von Neumann.

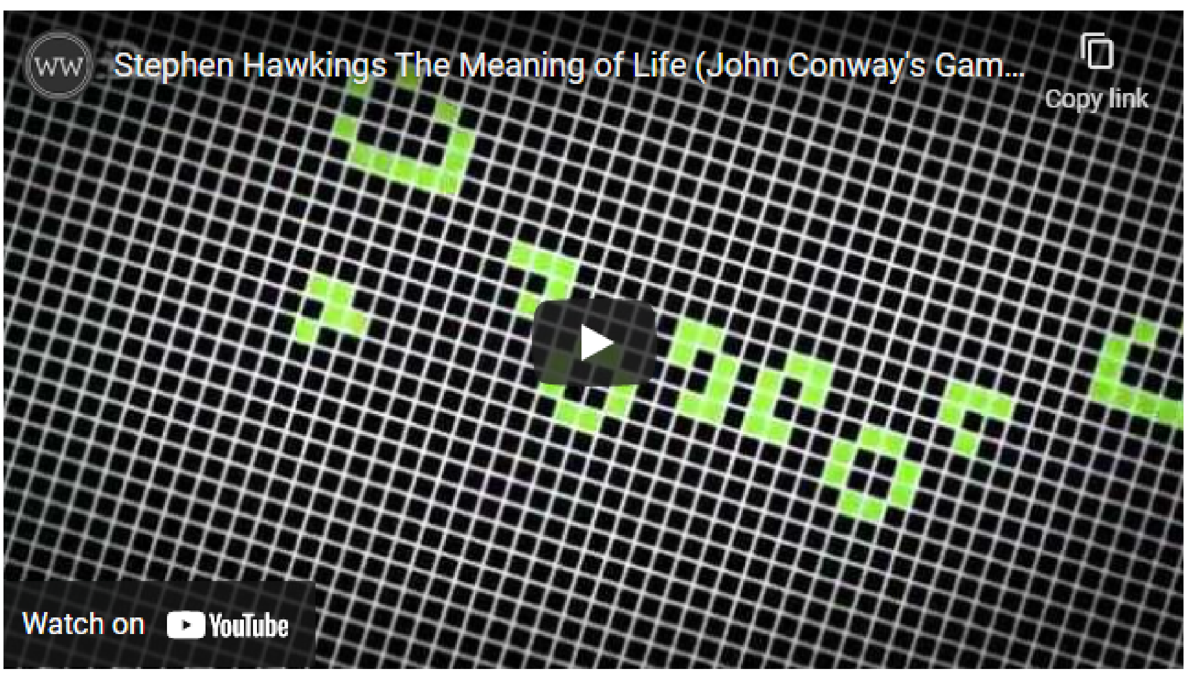
The information exchange between individual cells cannot be made realistic.

The networks in cellular automata are not realistic.

9. An early social-computational model – ARTICLE



James Conway's The Game of Life was an important step for computational social science. It showed that amazing patterns could grow out of simple rules of interaction between cells. In the following video, Conway's game of life is explained.



(click image for video link)

Conway's Game of Life

The game of life is an early social computational model. It simulates a very simple organism: a cell, that can be dead or alive depending on the number of neighbouring cells that are dead or alive. The fascinating thing you can observe is that these simple rules of interaction produce group patterns that move over the grid of cells. In scientific terms we call this "emergence", as rules for interaction defined for individuals (micro) produce behavioural patterns on a group level (macro). Nowadays, social computation uses theory based rules for interaction. Nevertheless, Conway's Game of Life is still a clear example of an essential capability of social computation: interactions between individuals can grow fascinating phenomena at the group level.

We invite you to experiment with **Conway's Game** of life for yourself. Also, a very nice collection of life forms in the Game of Life can be found on **playgameoflife.com.**

10. Six degrees of separation – ARTICLE

You've probably heard about the famous six degrees of separation idea. Not only is this a famous movie, but basically it captures the idea that everybody on the planet can reach each other through a maximum of six steps, or links.

For example, if I want to personally hand over a letter to the US president, I would, as a first step, give the letter to a famous, and hence well-connected, colleague I know in the US. Following that, I will will ask him/her to forward the letter to a person they think is closer to the US president.

Whereas I do not personally know the people further up in the chain who will be forwarding my letter, the core idea of the "six degrees of separation" is that my letter should be capable of reaching the US president in just 6 steps. More generally, every person on the planet should be reachable in just six steps. Mind that the 6 degrees refers to the concept of average path-length between people.

This six degrees of separation story, which originates from the 1930's, has developed into a sort of urban myth, and we can have a more nuanced view on it. For example, some remote tribes have no contacts with the rest of the world, and are unreachable. Additionally, whereas a century ago contacts were only possible through writing a letter, today the internet has an enormous impact on our connectivity. Where the average path-length between people a century ago indeed may have been about six degrees, the **following blog by Smriti Bhagat, Moira Burke, Carlos Diuk, Ismail Onur Filiz, Sergey Edunov** suggest that our current average path length may be closer to 3.5 degrees of separation.

For more information on the six degrees of separation **Wikipedia** offers a complete description.

Whereas it would be nice having a tool that lets you explore how many steps you are removed from any other person on the planet, it is obvious that this data does not exist. However, to get an impression of something like that, we can check the network distance between movie actors, using a database of which actors performed in the same movie. Such a network analysis has been developed starting with the actor Kevin Bacon, and you can find out the network distance with all other actors playing with the website you can find behind the launch button. Try it out!

11. Are there still remote tribes? - DISCUSSION

Today there are still some hunter gatherer tribes living in remote areas. How well connected are these with the rest of society? Can you give examples of technologies that have been developed over the last millennia that contributed to a densification of our networks, and hence a smaller distance?

12. Clustering – VIDEO

In the hunter gatherer society people were living in closely knit social groups. In network theory we speak of highly clustered groups.

When different clusters exist within a large network, and you **rewire** some of the links within clusters to improve the connections between these clusters, information may travel faster through the network.

Today we have many more possibilities to connect people in different clusters than in the hunter gatherer society. Just think of how the inventions of writing, printing, telephony, radio, television and the internet each had an enormous impact in how ideas and news could spread through society. **Average path length** is a word used in network theory to express how many links are needed to make a connection between two random nodes in a network.

13. The impact of social media on our interactions – DISCUSSION

What are the implications of social media for the spreading of information? Do you expect our connectivity will continue to grow and the degree of separation get smaller? How would a further growth of connectivity affect your personal life and/or global human culture? Please share your ideas with other learners.

14. Questions on clustering and path length in networks - QUIZ

Quiz rules

- Quizzes do not count towards your course score, they are just to help you learn
- You may take as many attempts as you wish to answer each question
- You can skip questions and come back to them later if you wish

QUESTION 1

What is the clustering coefficient in a network?

The number of subgroups that form in a wider network

The degree to which the nodes in a network tend to cluster

The preference to attach to well connected nodes

QUESTION 2

What is the average path length in a network?

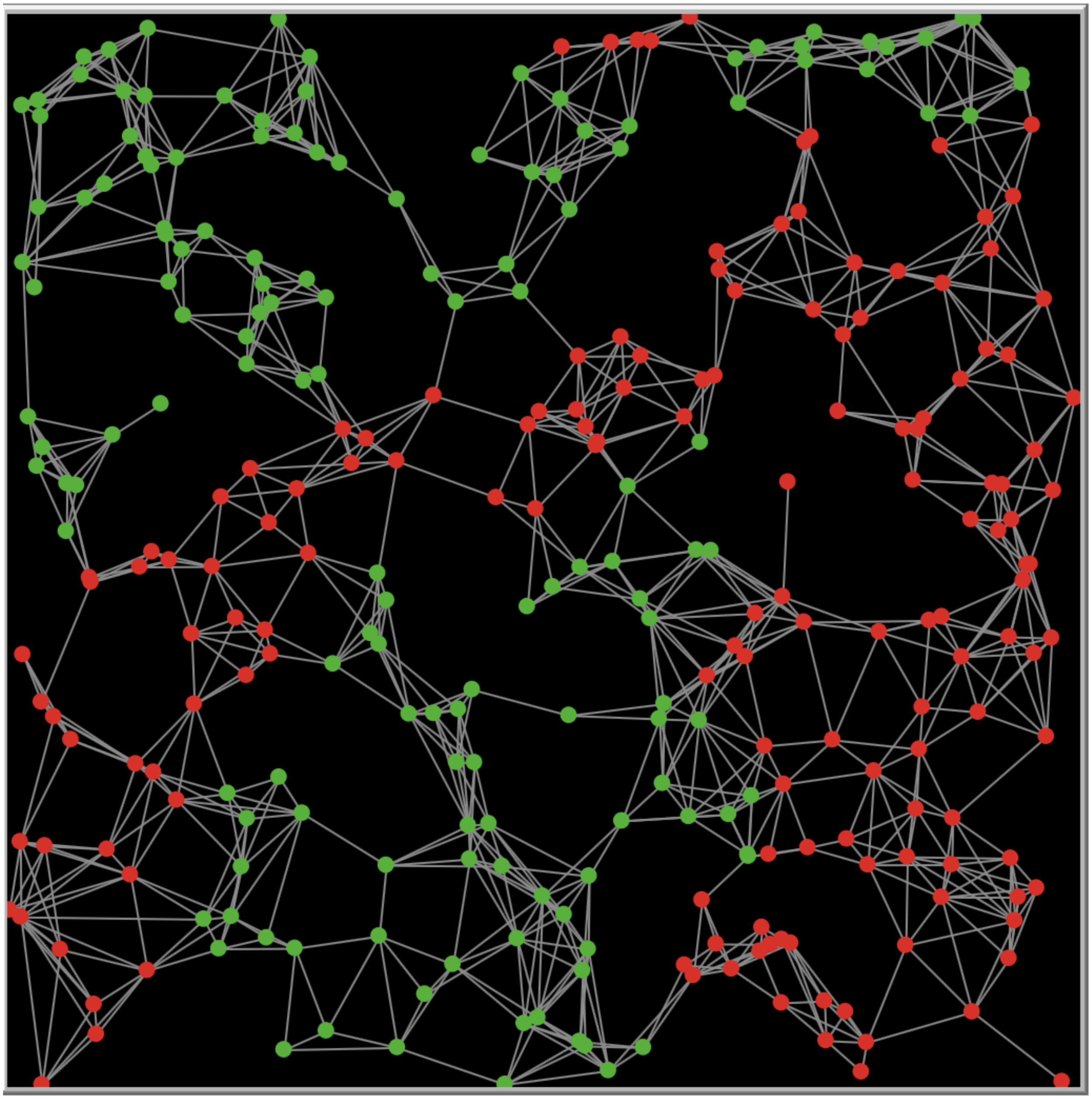
The average path length is calculated by dividing the total number of links by the total number of agents

The average path length is calculated by dividing the number of agents by the number of links

The average path length is calculated by finding the shortest path between all pairs of nodes, adding them up, and then dividing by the total number of pairs.

QUESTION 3

How many clusters do you observe in the following picture?



There are 5 clusters, 2 red, and 3 green (groups of connected nodes having the same color)

There are many (range of 8 - 12) clusters of more dense groups of connected nodes.

The number of clusters is not identifiable

15. Introduction into the basic properties of small worlds – EXERCISE

Agent Based Modelling (ABM) is the name of the computer simulation tool that is being used to simulate social processes, such as networks. Netlogo (Wilensky, 1999) is an easy-to-use ABM platform where you can run social simulations.

Just as you don't need to be a mechanic to drive a car, you don't need to be a programmer to run these simulations. Using Netlogo we can create artificial societies of simulated agents that interact with each other. The core element of the methodology of social simulation is the representation of individuals by interacting computer-coded agents. The use of agents makes it possible to conduct simulation experiments on problems that involve interactions between large groups of individuals with different characteristics.

In this first exercise you will start with a very easy standard model of small world networks. You can interpret this as a tribe of people **(nodes)** that interact with each other **(links)**. You will use this to explore how the **clustering** of a network changes if you rewire links between the nodes. **Clustering** here means the tendency of nodes to form links between them, resulting in the knitting of tight groups (e.g. families in a wider network).

If you rewire links between the nodes, you will also be able to explore how the **average path-length** of a network changes. **Average path-length** expresses the average number of steps along the shortest paths between all possible pairs of network nodes. The **6 degrees of separation** story thus assumes the average path length is 6 steps.

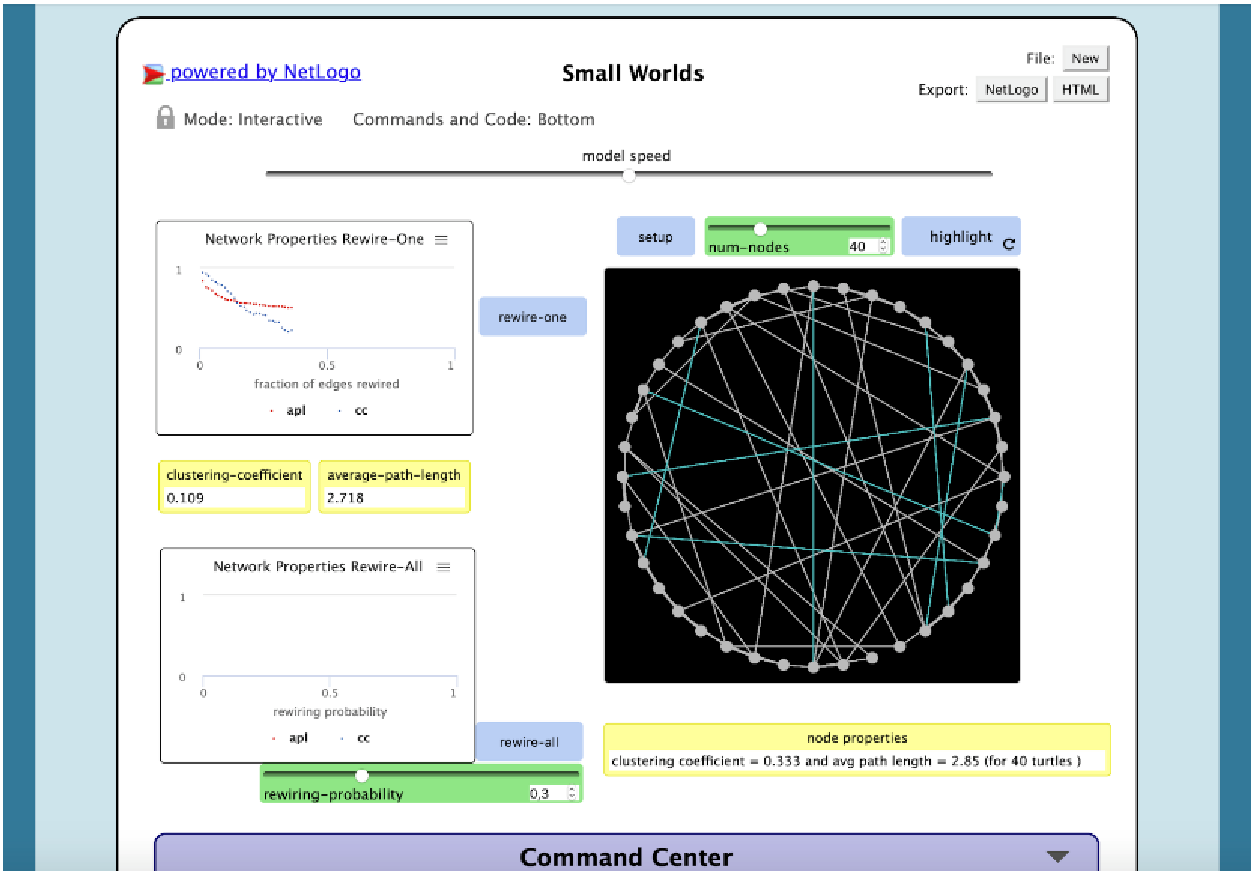
The model we use in this exercise is based on the small worlds article published by Duncan Watts and Steve Strogatz in Nature (1998).

Attention: we highly recommend that this step, and all other exercise steps in this course, are done on a large screen, either a PC, laptop or a tablet at least, as the models will not be easy to operate on a phone. Also, it may be wise to have the instructions and the model in separate tabs to make it easier to follow the instructions. Furthermore, people who are colour-blind may find these exercises harder to do.

Setting up

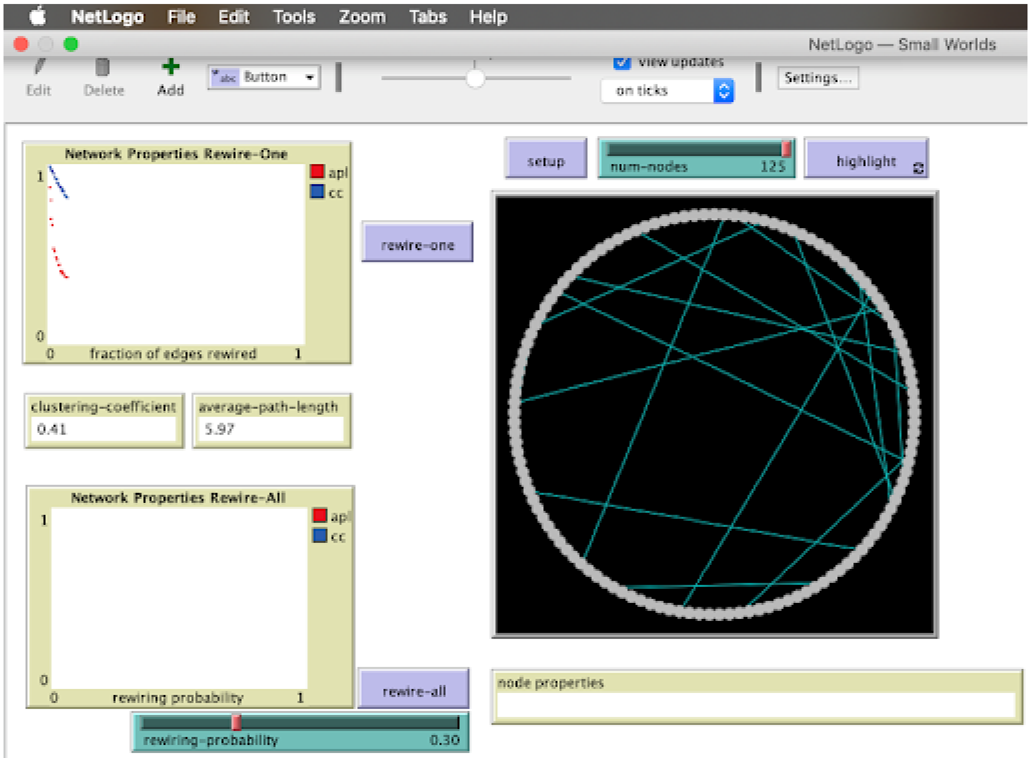
To make it easier to navigate the model used in this step, we have created **[downloadable instructions]** for you.

You can run this exercise from the web by pressing the launch button at the bottom, or you can run it locally.



The layout of the web version of the Small Worlds model.

If you want to run the model locally, you can also download Netlogo for free from **here**. If you have Netlogo installed, open it, go to "file", "models library" and click on the folder "networks". There you find the "small worlds" model.



The layout of the download version of the Small Worlds model.

What do you see?

- Opening the model shows you a circle of 40 nodes, and each node is connected to the 4 nearest neighbors. You can think of the Von Neumann neighborhood we discussed in the previous video.
- On the left you see the values of the **clustering-coefficient** and the **average-path-length.**
- The graphs show how the average-path-length (apl) and clustering-coefficient (cc) change when you rewire the links.

Clicking on the **INFO** tab provides you with a clear description of the model. Clicking on **NETLOGO CODE** shows you how the model has been programmed.

Things to explore

1. Starting with the basic setup you can click on **Rewire-One** several times. Observe how the average-path-length (apl) and clustering-coefficient (cc) change. Which of the two is changing the fastest, and why?
2. Try experimenting with different numbers of nodes by changing **num-nodes** and clicking on setup. Are the average-path-length (apl) and clustering-coefficient (cc) different for larger or smaller groups? And do they respond differently to rewiring?
3. By clicking on **rewiring all** you can rewire all nodes in one step. The **rewiring-probability** determines the chance that each node is being rewired. Experiment with different rewiring-probabilities, and observe how this impacts the average-path-length (apl) and clustering-coefficient (cc).

Things to discuss

The model is obviously way simpler than the social networks that connect real people. What is in your view the value of these simple models for understanding real social networks?

Reflecting on your own network, do you also have "close neighbouring nodes" and more "distant links"? What information do you exchange with these links?

What suggestions do you have to make this small-world network model more realistic? What experiments would you like to do?

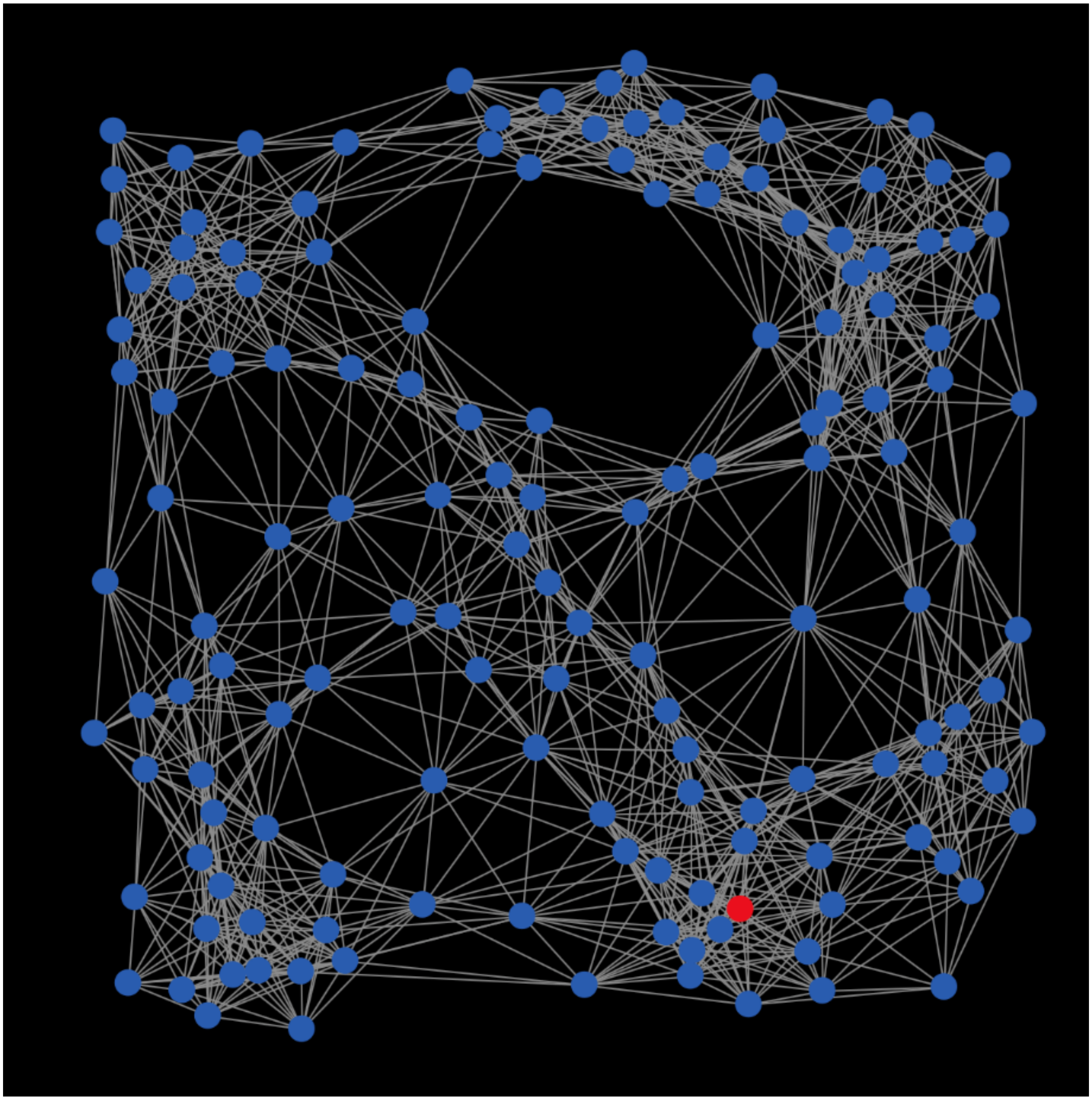
16. Do you have neighbouring nodes? – DISCUSSION

Having just explored a simple model, now try to reflect on your own network. Do you also have "close neighbouring nodes" and more "distant links"? What information do you exchange with these links? Please share with other learners.

17. A simulated tribe – ARTICLE

In social computational models we can connect nodes representing the individual people, and allow interactions between the nodes. We may be interested in exploring different types of influences between people, and see how behaviour and ideas may spread.

In the following picture you see how a small tribal community can be modelled. Different clusters can be identified, such as the one with the red node, where the nodes are closely connected. As you can see, some simulated people are well connected with each other, suggesting family ties within the larger community. Hence you can interpret the following figure as a small tribe composed of a number of dense connected families.



With social computational models we can study how one node, such as the red one, can influence the other nodes around it. The big question is what type of influences we want to model. You can imagine that if the red node represents someone carrying a dangerous virus picked up from an animal, the virus can easily spread through the family and wider tribe. However, when the red node represents a new idea or behaviour, it may not be accepted by the majority unless it is a really good idea.

18. Clustering and tribes – VIDEO

In this video we explain that despite the abundance of social media, humans still have a tendency to cluster in small groups. You will also be introduced to the small tribe we use for simulation exercises.

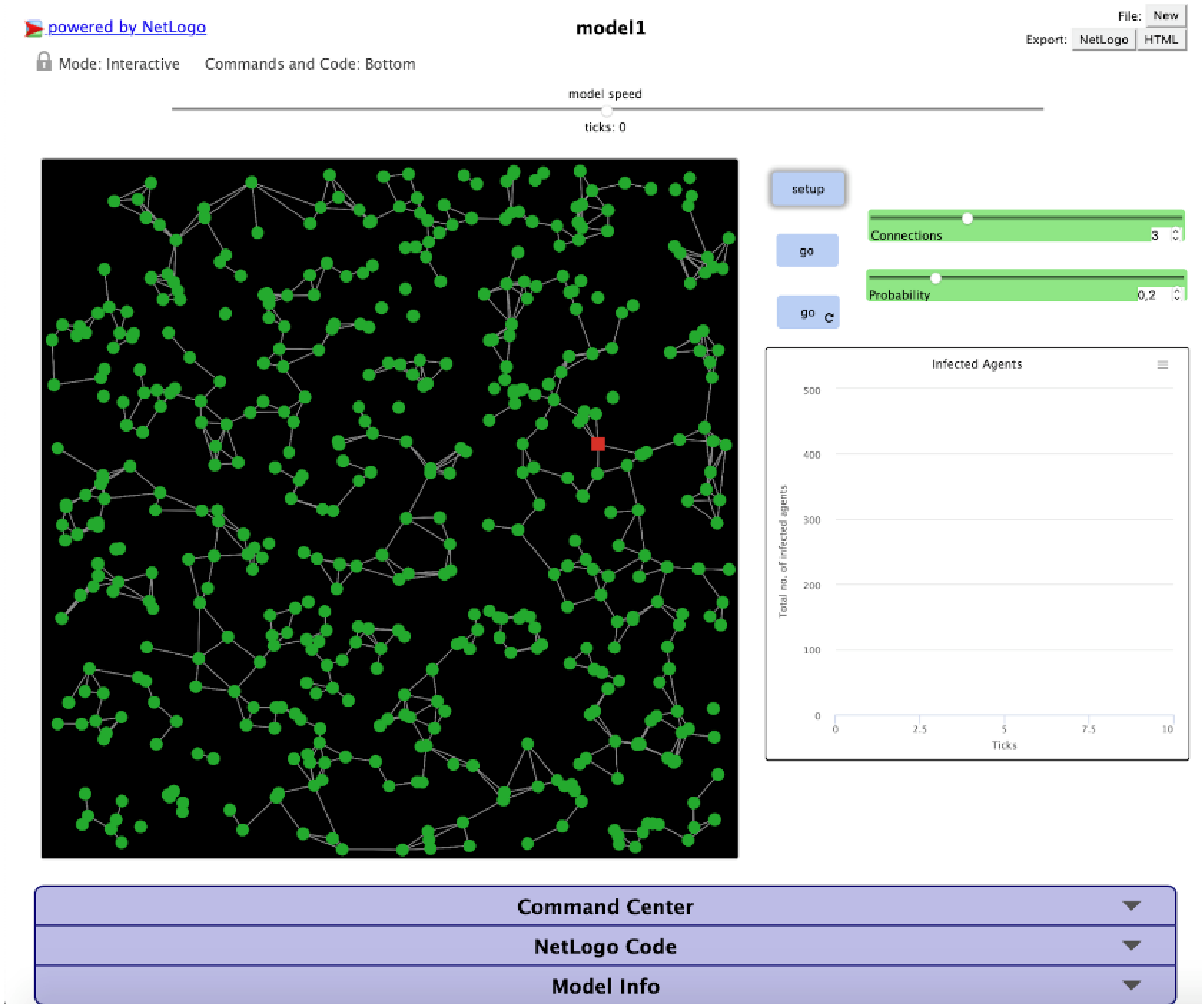
19. Virus in the tribe – EXERCISE

In this exercise you will use the model of a networked tribe we specifically developed for this course module. This Netlogo model of a tribe allows you to explore how the process of contagion depends on the number of connections people have.

Setting up

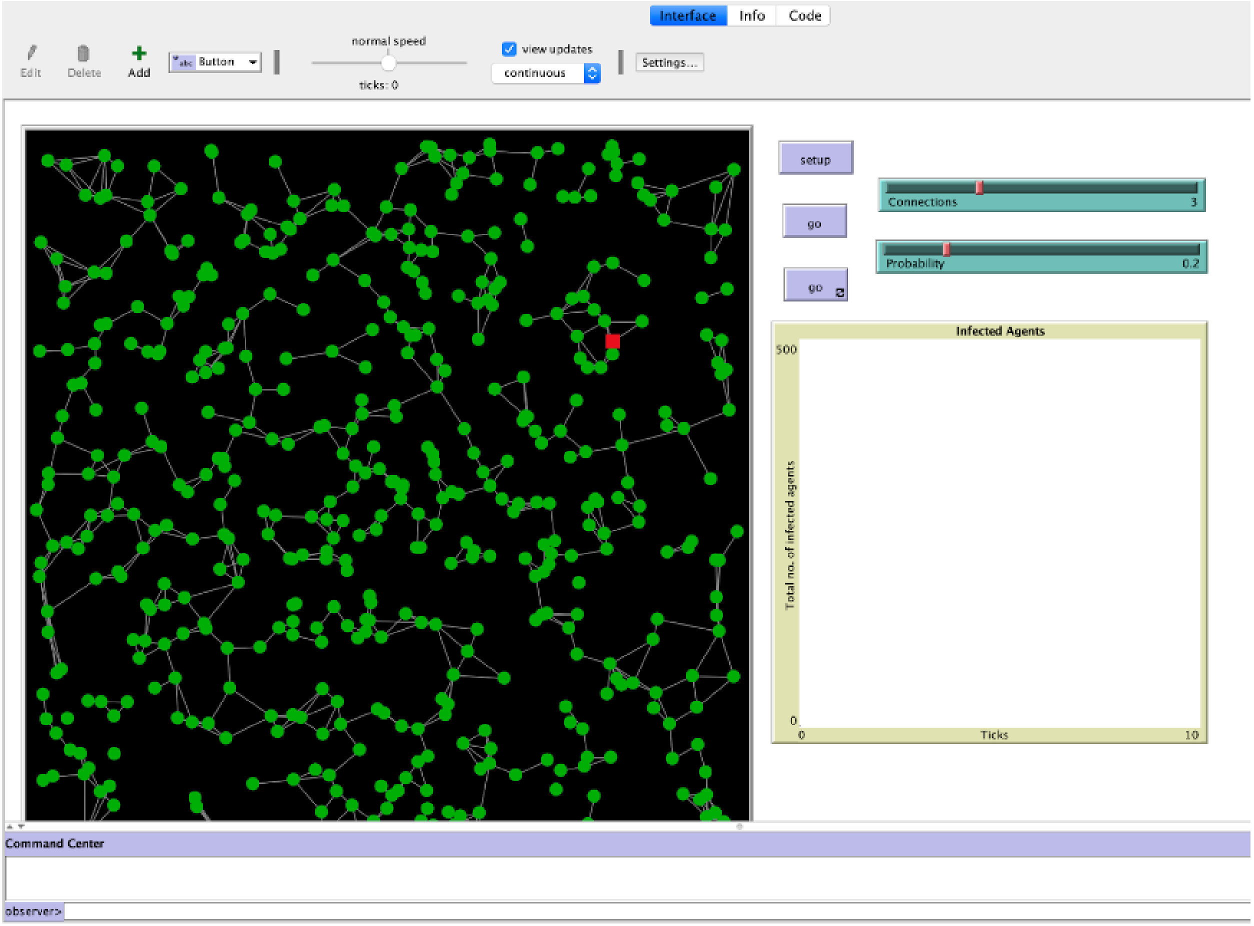
To make it easier to navigate the model used in this step, we have created **downloadable instructions** for you.

You can run this exercise from the web by pressing the launch button at the bottom, or you can run it locally.



The layout of the on-line version of the Virus in the tribe model (Model 1)

Alternatively, you can also download the **Virus in the tribe model** (Model 1). For this, go to the on-line model, click on export netlogo, and store the file model1.nlogo. If you have not done so, you can download **Netlogo.** Next, open your netlogo, go to "file", "open" and find the "model1.nlogo" in the folder where you saved it.



The layout of the download version of the Virus in the tribe model (Model 1).

What do you see?

Opening the model shows you a virtual tribe of 500 nodes, all coloured green, except for one red one. The red node symbolises an infected agent, and it can infect the neighbours through the links.

What you can do is define the number of links each node has by setting **connections**, and set the chance that another node is being infected with the value of **probability**. In the default setting the nodes have three links, and the chance of infecting another linked node is 20% every time step.

Clicking on **go** will show one time step, clicking on **go**↻ will run the model continuously. You can observe how many nodes are being infected as they turn red. As an overall measure, the graph shows the number of infections over time.

Things to explore

Starting with the basic setup shows you how the virus spreads through our simulated tribe under this default condition. Run this default setting of the simulation model multiple times by clicking on go↻ repeatedly, and observe the stability of the outcomes.

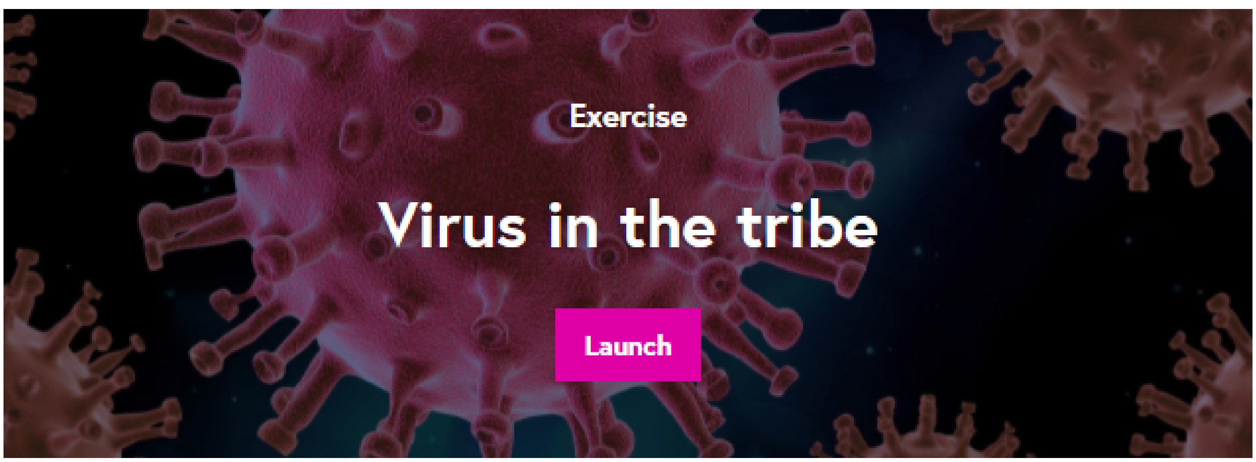
Experiment with different settings of **connections** and **probability**. What do you observe? Please share with other learners

Additional experiments

If you are interested in a more elaborate model on how a virus spreads on a network you can open the **virus on a network model** in the standard Netlogo library.

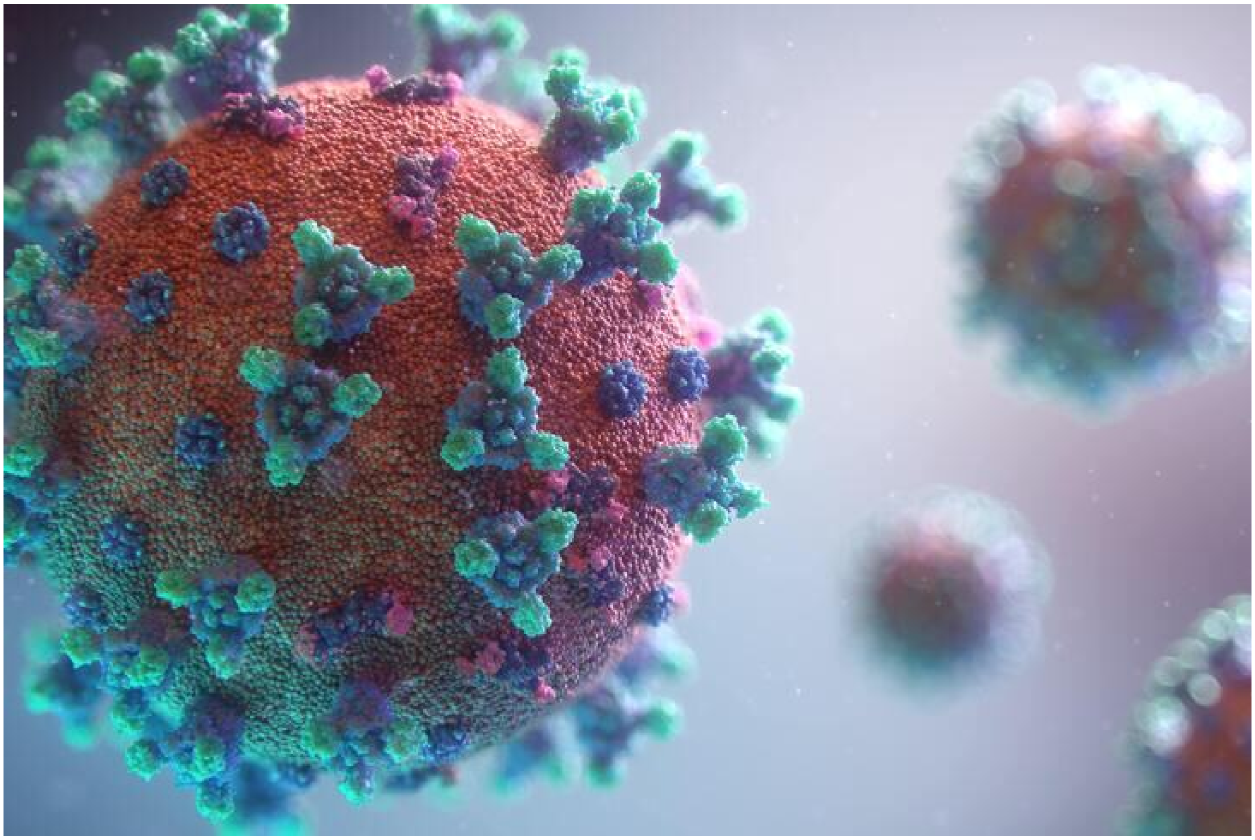
In this model you can, next to network properties, also experiment with settings for the virus, such as the spread-chance, how often the nodes check for a virus, the recovery from the virus and the gaining of resistance.

Please note, by clicking 'Launch' you will be taken to a page containing content provided by a third party website.



Launch Exercise

20. What can we learn from this simple contagion model? – DISCUSSION



In the default setting of the model, you may notice that in some runs the infection is spreading much more than in a next run starting with the same basic conditions. What is the explanation for the, sometimes large, differences between the final number of infected nodes, despite the initial similar setup of the experiment?

What does this simple model tell you about social distancing/reducing the number of links as a means to reduce the spread of the virus?

What is the effect of reducing the contagiousness of the virus by reducing the probability of infection?

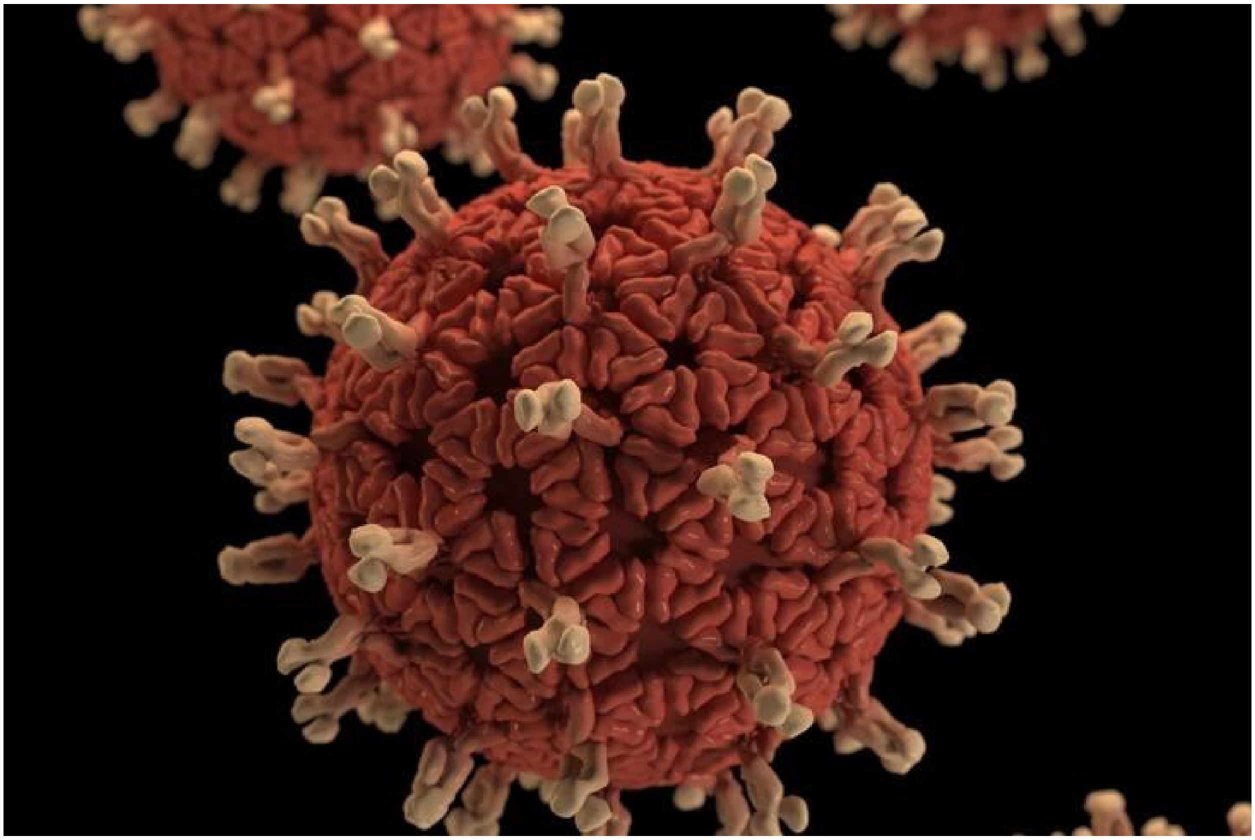
What suggestions do you have for making this model more realistic in studying contagion dynamics? Please share your ideas with other learners and discuss them.

21. The complexity of virus contagion – ARTICLE

Social simulation models can be used to demonstrate how certain processes grow. Especially when we deal with non-linear or exponential growth processes, simulation models may give a clear indication of how such processes may develop.

A clear example is the spreading of a virus, and the impact of policies, such as social distancing, have on the spread of a virus. Observing how this operates, using e.g. videos of simulation models, may support the communication of scientific insights, as in the following blog of Wander Jager on the **contagion dynamics of COVID-19.**

22. Using models in science communication – DISCUSSION



How can simulation models be used by policy makers to evaluate and test policies?

What role do you see for simulation models to inform the general public about the spread of the virus and explaining how certain policies may affect the spread?

How could such information from simulation models be communicated to the general audience in a clear way?

23. Wrapping up Week 1 – ARTICLE

This first week introduced you in the basics of social networks, nodes and links, and how to capture these in computational models.

You learned that the networks connecting people can be described in terms of the **links** between individual people/**nodes**. You have experimented with a **small-world social simulation**, experiencing how **clustering** and **average-path-length** are related to how connections between nodes are formed and rewired. And you have seen how group behaviour, or patterns, can grow (emerge) out of simple rules for interaction, using the **Game of Life** as an example. Finally, you have experimented with how the spread of a virus in a simulated tribe depends on the **connectivity** of the network.

You experienced how fast a virus can spread over a tribal network, and you can imagine that in a close group of friends a virus can spread very fast. You also experienced that social distancing, by reducing the number of links, is capable of halting the spread of a virus.

In the exercises of this week, all the actors had an equal number of contacts. For a hunter gatherer tribe this makes sense, but when larger societies developed, other actors came into play that had more outreach, such as kings and priests. Also, for the spread of a virus the impact of so-called **superspreaders** is of relevance in understanding the dynamics of contagion. Next week we will explore how such nodes having many contacts, which we call **hubs**, affect network dynamics.

Additional material

For the advanced learners you can explore **Virus on a Network** in Netlogo

For an example of a very elaborated model aimed at supporting policy during a pandemic you can have a look at: **ASSOCC**: An example of an applied model: COVID-19 modelling by Dignum et al. we call hubs, affect network dynamics.