



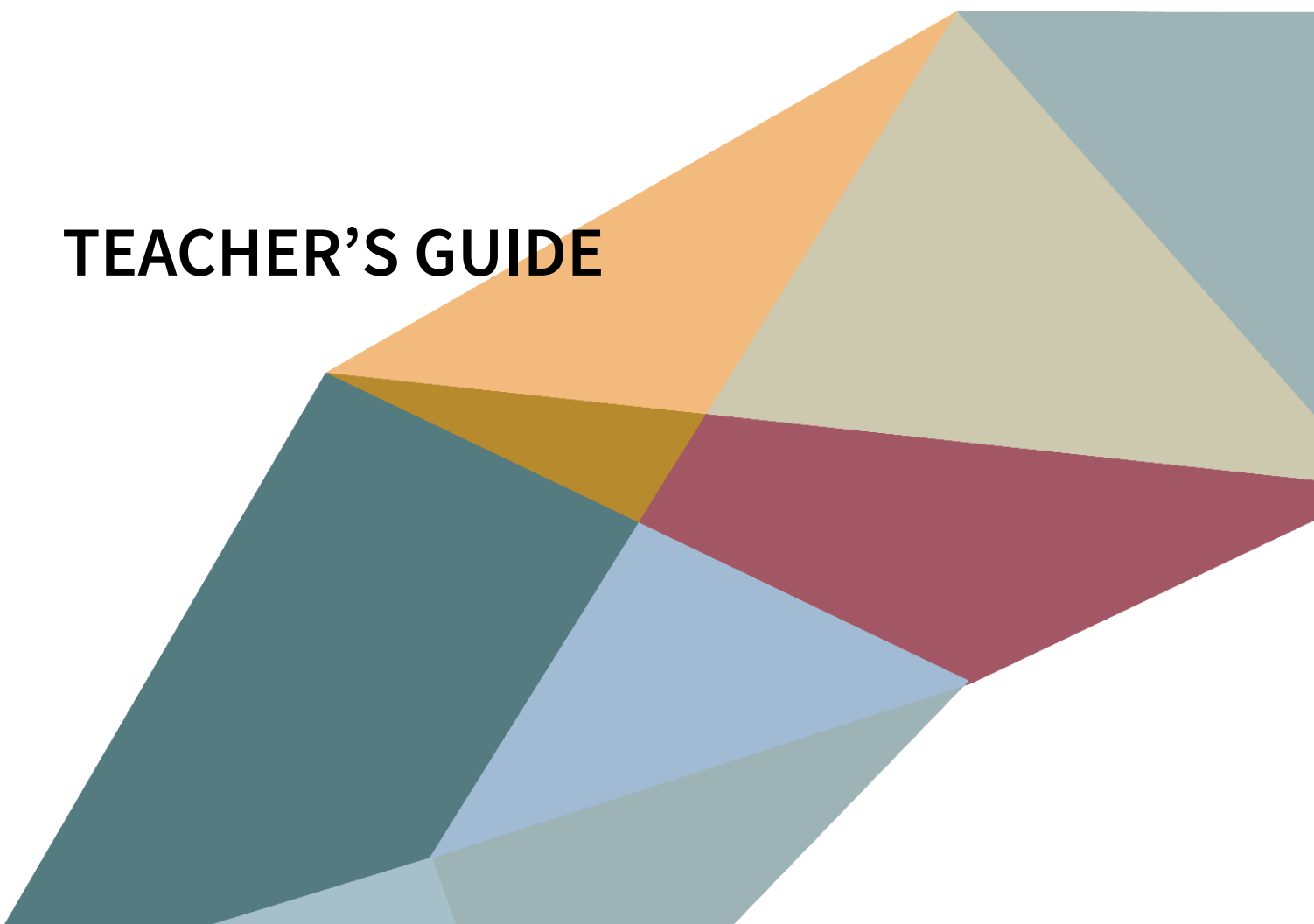
ACTISS

ACTION FOR COMPUTATIONAL THINKING
IN SOCIAL SCIENCES

THEMATIC COURSE

Why do ghettos form in a tolerant society? Schelling's model and the introduction of cellular automata

TEACHER'S GUIDE



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Why do ghettos form in a tolerant society? Schelling's model and the introduction of cellular automata

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GENERAL GUIDELINES FOR TEACHERS

Within ACTISS we are creating and producing open online courses that introduce the basics of computational social science. Our interactive courses are made with two types of audiences in mind:

- individual learners who want to study by themselves -> massive open online courses (MOOCs), available for free on Futurelearn platform
- academic teachers who would like to enrich their courses with engaging and easily accessible materials -> materials available at actiss-edu.eu

The materials available on the website are prepared on the basis of our Futurelearn courses but they are designed in such a way that makes it easy to incorporate them in your courses.

This course is available only in the website version, but we strongly recommend attendance in Futurelearn courses, especially Introductory course (“People, Networks and Neighbours: Understanding Social Dynamics”).

ENGAGING AND ACCESSIBLE CONTENT

It is worth noting that all ACTISS courses are designed in such a way that no prior mathematical and programming skills are required from students. The courses can be used as an easy and engaging introduction to more advanced courses.

In all courses within the ACTISS programme we want to provide people who identify as having ‘no brain for science’ (a fear for computation and formulas) with a very gentle introduction to Computational Social Science, to pen-and-paper formal models and to Agent-Based Models. We want to build up interest in this domain and their confidence in this area. By the end of the course we want the learners to be able to experience how modelling and simulations can help understand social phenomena and to experience how investigating a social phenomenon with the use of an Agent-Based Model works. We also want them to be aware of the potential benefits of using a computational approach to practical situations and be willing to try them out.



HOW TO USE COURSE MATERIALS?

- **We encourage you to use the materials to enrich your courses.** You can download all the materials for the course and use them:
 - as a whole segment (e.g. 12 hours of a 60 hour long seminar)
 - or pick the elements that best suit your needs (e.g. use some videos and exercises as homework for students and then discuss the homework during a meeting).
- Educational materials are divided in weeks (units) and each week consists of a series of appr. 20 small steps:
 - short articles - max.1000 words, usually followed by a discussion prompt,
 - short videos - max. 6 minutes (links are included in the text),
 - discussion questions,
 - exercises (if they relate to models, links are included in the text),
 - quizzes (2-6 questions to check student understanding)
- Some steps may be used as a homework assignment (articles, videos, exercises), some can be used within a classroom setting (discussion questions, exercises, quizzes)
- In each course there are some NetLogo models that were designed for the course or adjusted to the needs of the course. A complete list of models is available on the [project's website](#) and also on [project's Github](#).
- Educational materials are downloadable as a set of pdf files, each containing one week's materials preceded by a list of steps and followed by a list of correct answers to all quizzes
- The best way to browse the materials for the course is to first check the Curriculum document and check out the documents for specific weeks/units (especially short description at the beginning of all such documents) or, provided a certain course is available on Futurelearn, to enrol to the course and go through the steps there.
- Additional exercises and educational scenarios are provided at the end of each Teacher's Guide. These are mainly exercises that take longer time to complete or require more teacher's support, or require some group work, or can be used as a basis of a whole lesson/meeting.



GUIDELINES FOR TEACHERS RELATED TO: Why do ghettos form in a tolerant society? Schelling's model and the introduction of cellular automata

In this course we start from the problem of spatial segregation with its specific mechanisms is a fascinating example of a macroscale social phenomena which is not only a simple sum of individual actions - if we compare it with answers for survey questions about level of tolerance (which base on individual declarations), they cannot be translated in an easy way into results on maps. It shows that there is a need for a tool which could help us understand the underlying mechanisms of spatial segregation. Then agent based models that focus on dynamics of agents in a certain physical space - called spatial models, namely cellular automata - are introduced. We are starting from Thomas Schelling's segregation model, then - in week two - more examples of cellular automata - game of life, forest fire. Learners are also trying to translate one model into another and bring models closer to reality. At the end we came back to Schelling's model, and advantages associated with dynamic approach to spatial segregation topic. For all of that we will use examples, animations and simple tools - no mathematical and programming skills are required!



COURSE STRUCTURE

- **Week 1: Spatial segregation and Schelling's model**

We will start by introducing some social phenomena in which space is important. It's happening with residential - or wider - spatial segregation. Then we will talk about one of the best known models - Thomas Schelling's model of spatial segregation and you will have a possibility to experiment a bit with it.

Keywords: *Schelling's segregation model, neighbourhood, rules of change the state, dynamics, iteration, census data, segregations maps*

- **Week 2: Cellular automata**

In the second part of the materials we will look at the models in this group in more detail from the "technical and structural" point of view, you will learn what Cellular Automata is and what it has in common with forest fire and simulation of life. Then - at the end we will keep coming back to spatial segregation and we will see what the model approach can contribute to its understanding.

Keywords: *Cellular Automata, cells, iteration, grid, borders of grid, attributes of an agent, Game of life, forest fire, neighbourhood*



ADDITIONAL MATERIALS

The materials below can be used as homework assignments or within a classroom setting. All elements listed below provide materials for a total **of. 5-7 hours of workload.**

Educational game - Schelling model - educational game



Archive photo from “Micro to macro” classes by Anna Baczko-Dombi and Agata Komendant-Brodowska in Faculty of Sociology, University of Warsaw

Below there are photos from a workshop titled “Why do ghettos appear in tolerant societies?” which we have been conducting at the University of Warsaw since almost 10 years.

It is an educational game in which participants create a live cellular automata and play roles of representatives of two populations living in a limited space, with assigned levels of tolerance and rules of moving to new locations. The participants have an opportunity to understand and experience on their own skin mechanisms that push relatively tolerant actors to spatial segregation. Moreover, our educational game results in more advanced discussion about the idea and types of cellular automata, emergence, types of equilibrium in dynamic complex systems, or possible modification of the model.

For our experience, it's best if there are 10-20 people, but the game is very flexible.



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Archive photos from "Why do ghettos appear in tolerant societies?" workshop organised by by Anna Baczko-Dombi and Agata Komendant-Brodowska; University of Warsaw

Accessories and preparation:

- 1) You need symbols of attendance to two subgroups and "well-being". In the simplest version they can be sheets of paper - as many as there are students. The pages should be in two (possible neutral) colors (orange-purple, green-blue etc.) and colored on both sides. One side of the pages should be painted with a smiling face, on the other - a sad face. You can also use another symbol showing satisfaction or not - in the pictures above, we use the like / dislike handles. If we base this on this course material we can inform them that they are linevillers and use some slides from the video.
- 2) You need numbers - they can be written on pieces of paper

Rules of the game:

We inform students that they are divided into two tribes or groups in two colours and give them symbols. They should stand in a line, we ask them to mix (not to start from segregation). We inform them about rules:

- There are two types - orange and green
- Everybody has neighbours - two on each side; those who live next to the end of Lineville has less neighbours
- They are happy if they have minimum 2 neighbours in the same "colour"



- If they are unhappy they look for a new location, from the left to the right (here we emphasize that this is one of the many decisions we make)
- We ask the students to look around and consider whether they are happy or not and made it clear by arranging the accessories appropriately.
- We give extra attention to those who are close to the end of the village and have no neighbors. For them, the rule is the same as far as the proportions of the neighbors are concerned.
- Those who are unhappy are asked to pick up accessories. We give them cards with numbers one by one, so as not to get confused when moving.
- We begin the moving phase. We ask the person with number 1 to look for the first place where she will be happy and move there. Then we ask the person with the number two, three, and so on. Note: old / new neighbors of the moving person do not change "well-being" until the end of the round.
- Update phase: We ask everyone to think about their satisfaction in the neighborhood. If they are still dissatisfied, we repeat the moving phase and update until everyone is satisfied.
- Reflexion and discussion phase: We ask the students to look around. It turns out that the group is highly segregated. Most likely, she will naturally start commenting on it, also talking about people who still have neighbors of a different "color". We pay attention to this, we emphasize that we started from a fairly high level of tolerance. We are asking for people who have no neighbors in a different "color" to raise their hands. We draw your attention to the fact that today they remember what it was like to mix around green / orange, but they will stop meeting them soon, their children will only play with such children that stereotypes and prejudices will arise soon ...
- Discussion on the development of the model. We ask students to think about what can be changed in the game. We recommend trying to repeat the game with a clear minority (the course will be similar, often segregation is even faster and clearer here) and joining the ends of the city. Then we watch a video about the development of the game.
- If the group is big enough and you have enough time it is worth trying a 2D model - you need a square grid - you can stick it out of tape, draw it, use an existing base (for example, paving tiles). The number of fields must be slightly greater than the number of participants. Some of the fields remain free, dissatisfied transfer to them. We assume the neighbourhood of Moore (8 neighbours) and the tolerance level of 50%. The rest of the game flows - as in the "Lineville" model.





Archive photos from "Why do ghettos appear in tolerant societies?" workshop organised by by Anna Baczko-Dombi and Agata Komendant-Brodowska; University of Warsaw

The educational game "Why do ghettos appear in tolerant societies?" was developed by Anna Baczko-Dombi and Agata Komendant-Brodowska for the needs of classes on modelling social phenomena at the Institute of Sociology of the University of Warsaw and has been used for over 10 years in and outside the classes, e.g. at the Science Festival. The flow of the game, played over several rounds and with various additional instructions and conditions, is usually very similar. It is also a very good start for discussion about social segregation, students feel that they are divided, there is also a space for telling them about labelling and stereotypes.



SCHELLING'S MODEL online games and applications

-> For students who are less familiar with computer applications and simulations (especially visually), we recommend this version of the Schelling model:

<https://ncase.me/polygons/>

-> Students can also play more advanced versions of Schelling's model:

<http://ccl.northwestern.edu/netlogo/models/SegregationSimpleExtension1>

<http://ccl.northwestern.edu/netlogo/models/SegregationSimpleExtension2>

<http://ccl.northwestern.edu/netlogo/models/SegregationSimpleExtension3>

-> Literature

Classic paper of Thomas C. Schelling:

“Schelling, T. C. (1971). Dynamic models of segregation. *Journal of Mathematical Sociology*, 1(2), 143-186.”

It is also worth reading the entire book (or fragments): Schelling, T. (1978) *Micromotives and Macrobehavior*, New York: Norton. Nowak, A., Szamrej, *Micromotives and Macrobehaviour*

-> For classes more oriented on Thomas C. Schelling's works is worth to watch Nobel Prize Lecture and read biographical materials:

<https://www.nobelprize.org/prizes/economic-sciences/2005/schelling/lecture/>

Place within the course: Week 1

More about spatial segregation:

Come back to spatial segregation. Is there a place for the public policy? What could we add to the discussion thanks to CSS?

<https://www.lincolnst.edu/publications/articles/urban-spatial-segregation>

<https://www.theguardian.com/commentisfree/2018/jul/10/denmark-ghetto-laws-niqab-circumcision-i-slamophobic>

https://www.youtube.com/watch?v=SpGHKkp8uxM&t=0s&list=PL3YjZETJFvLumP_A_5wuAAM1dihPOEJEF&index=14



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Place within the course: Week 1/2

CELLULAR AUTOMATA

Literature:

Hegselmann, R., & Flache, A. (1998). Understanding complex social dynamics: A plea for cellular automata based modelling. *Journal of Artificial Societies and Social Simulation*, 1(3), 1.

Series of interviews with John Conway on Numerophilie

<https://www.youtube.com/playlist?list=PLt5AfwLFPxWIL8XA1npoNAHseS-j1y-7V>

Other examples of CA models:

-> Forest fire - more advanced models - as an inspiration for students:

Forest fire model with <https://www.youtube.com/watch?v=HG3htU2ycfA>

Rohan Fisher models: <https://rohanfisher.wordpress.com/incendiary-a-fire-spread-modelling-tool/>

-> Model of social influence:

Nowak, A., Szamrej, J., Latane', B. (1990) From private attitude to public opinion: A dynamic theory of social impact. *Psychological Review*, 97, s. 362-376.

Video material: Social influence and social transitions: Computational model and empirical data

[ESSA2013 Keynote Lectures, Warsaw School Economics, Decision Support and Analysis Division](#)

Evacuation models:

<https://www.youtube.com/watch?v=Zq4lOzpz85l>

Place within the course: Week 2



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