Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	**Network Thinking and Agent-based modeling**
Course code	25556
Scientific sector	
Degree	Master in Entrepreneurship and Innovation
Semester and academic year	1st semester, a.y. 2022-23
Year	1st study year
Credits	2
Modular	No

Total lecturing hours	12
Total lab hours	Not foreseen
Total exercise hours	Not foreseen
Attendance	not required
Prerequisites	Not foreseen
Course page	Course Offering - enrolled from 2022 / Free University of Bozen-Bolzano (unibz.it)

Specific educational objectives	Network thinking and agent-based modeling (ABM) are conceptually related to the Growth mindset course, where students have been introduced to algorithmic thinking and design thinking as ways to conceptualize complexity in the phenomena they observe. The main objective is to approach different phenomena with a complexity lens and understand how current behaviors and patterns emerge. In this regard, network thinking and agent-based modeling provide a third logic to tackle the complexity of adaptive systems, in the context of business (e.g. innovation and entrepreneurship). The lecturer will introduce the students to ABM thinking and to the NetLogo as a simulation environment to describe and analyze open innovation phenomena. In addition, the lectures introduce a few models, such as organizational learning in innovation networks, coalitions in networked innovation, and diffusion of innovation on social networks. Last but not least, the application of complexity and simulation on applied projects will be introduced.

Lecturer	Siavash Farahbakhsh
Scientific sector of the lecturer	Business Economics
Teaching language	English
Office hours	please refer to the lecturer's web page
Lecturing assistant	Not foreseen
Teaching assistant	Not foreseen
Office hours	6

List of topics covered	• Introduction to systems and complexity • Introduction to networks • Introduction to agent-based modeling • Modeling Diffusion dynamics • Application of complexity on timely topics such as sustainability
Teaching format	Frontal lectures, combined with a few exercises.

Learning outcomes	This course will provide knowledge and understanding of complex adaptive systems, networks and their properties, and how patterns are emerging in systems. In the context of innovation and entrepreneurship, emerging patterns are related to innovation diffusions under different mechanisms. During this course, students will be given a framework with which they can assess innovation diffusion phenomena as well as how to apply a complex adaptive system perspective. With this approach, students will be able to critically assess and judge different phenomena given the complexity and systems perspective lens rather than linear thinking rooted in micro-level views. Moreover, using the complexity framework students will be able to communicate their assessments in a systemic way starting from identifying the problem, agents' heterogeneity and behaviors, dynamics and interaction, and emerging outcomes. Last but not least, students will be introduced to agent-based modeling via the NetLogo program, which is a widely used, arguably, easy software with which they can further simulate and explore complex adaptive systems.

Assessment	Attending students: Project work and oral: a group work will be assigned to the students and the final evaluation will be made through the presentation of the assigned work and oral questions during the presentation. Non-attending students: Project work and oral: a project will be assigned to the non-attending student to be carried on individually and the final evaluation will be based on the written report of the work and oral test related to the assigned work.

Assessment language	English
Evaluation criteria and criteria for awarding marks	Attending students: Participation: 20%, project work presentation 80% Non-attending students: Project work presentation 100% **Assessment criteria**: clarity of the project work presentation, correct application of the complexity framework and simulation approach, show critical views on the topic of the project work, sound argumentations.

Required readings	• *Holland, J.H., 2014. Complexity: A very short introduction. Oxford.* • *Mitchell, M., 2009. Complexity: A guided tour. Oxford university press.* • *Arthur, W.B., 2021. Foundations of complexity economics. Nature Reviews Physics, 3(2), pp.136-145.* • *Newman, M., 2018. Networks. Oxford university press.*
Supplementary readings	• *Garcia, R., 2005. Uses of agent-based modeling in innovation/new product development research. Journal of Product Innovation Management, 22(5), pp.380-398.* • *Gilbert, N., Ahrweiler, P. and Pyka, A. eds., 2014. Simulating knowledge dynamics in innovation networks. Heidelberg: Springer.* • *Arthur, W.B., 1999. Complexity and the economy. science, 284(5411), pp.107-109.* • *Bocken, Nancy MP, Ingrid De Pauw, Conny Bakker, and Bram van der Grinten. "Product design and business model strategies for a circular economy." Journal of Industrial and Production Engineering 33, no. 5 (2016): 308-320.* • *Clift, Roland, and Angela Druckman, eds. Taking stock of industrial ecology. Springer, 2015.* • *De Jesus, Ana, and Sandro Mendonca. "Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy." Ecological economics 145 (2018): 75-89.* • *Inigo, Edurne A., and Laura Albareda. "Understanding sustainable innovation as a complex adaptive system: a systemic approach to the firm." Journal of Cleaner Production 126 (2016): 1-20.* • *Kirchherr, Julian, Denise Reike, and Marko Hekkert. "Conceptualizing the circular economy: An analysis of 114 denitions." Resources, conservation and recycling 127 (2017): 221-232.* • *Nowak, A., Szamrej, J. and Latané, B., 1990. From*

private attitude to public opinion: A dynamic theory of social impact. Psychological review, 97(3), p.362.

- *Rogers, E.M., 2010. Diffusion of innovations. Simon and Schuster.*
- *Schelling, T.C., 1969. Models of segregation. The American Economic Review, 59(2), pp.488-493.*
- *Schelling, T. C. "Dynamic models of segregation." Journal of mathematical sociology 1, no. 2 (1971): 143-186.*
- *Snowden, D., 2003. Innovation as an objective of knowledge management. Part I: The landscape of management. Knowledge Management Research & Practice, 1(2), pp.113-119.*
- *Stahel, Walter R. "The circular economy." Nature 531, no. 7595 (2016): 435-438.*
- *Phelps, C., Heidl, R. and Wadhwa, A., 2012. Knowledge, networks, and knowledge networks: A review and research agenda. Journal of management, 38(4), pp.1115-1166.*
- *Carayannis, E.G., Grigoroudis, E., Campbell, D.F., Meissner, D. and Stamati, D., 2018. The ecosystem as helix: an exploratory theory-building study of regional co-opetitive entrepreneurial ecosystems as Quadruple/Quintuple Helix Innovation Models. R&D Management, 48(1), pp.148-162.*
- *Zink, Trevor, and Roland Geyer. "Circular economy rebound." Journal of Industrial Ecology 21, no. 3 (2017): 593-602.*