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# Agents and Multi-agent Systems: Technologies and Applications 2019

13th KES International Conference,  
KES-AMSTA-2019 St. Julians, Malta,  
June 2019 Proceedings

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ISSN 2190-3018 ISSN 2190-3026 (electronic)

Smart Innovation, Systems and Technologies

ISBN 978-981-13-8678-7 ISBN 978-981-13-8679-4 (eBook)

<https://doi.org/10.1007/978-981-13-8679-4>

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[Computer Science \(miscellaneous\)](#)  
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[Springer Verlag](#)

Publication type

Book Series

ISSN

21903018

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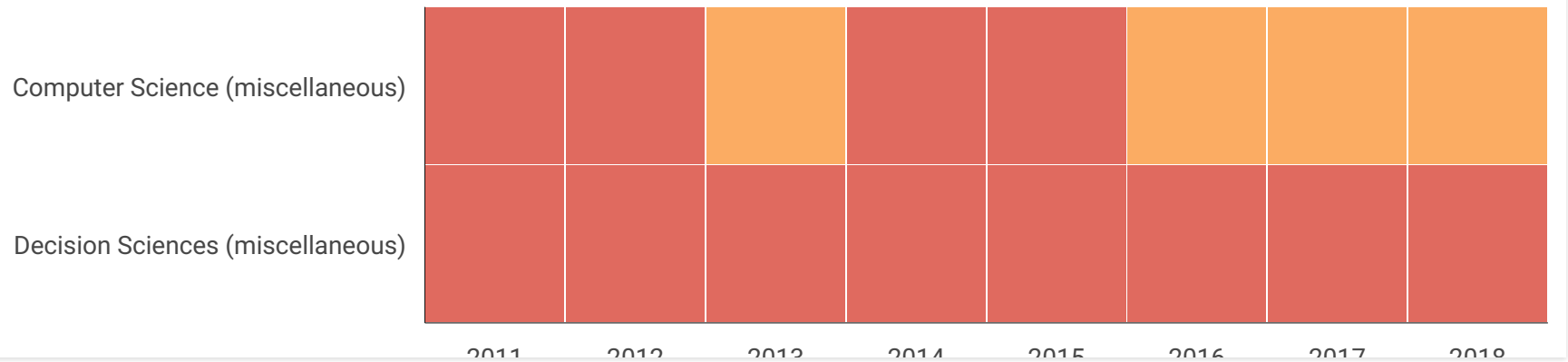
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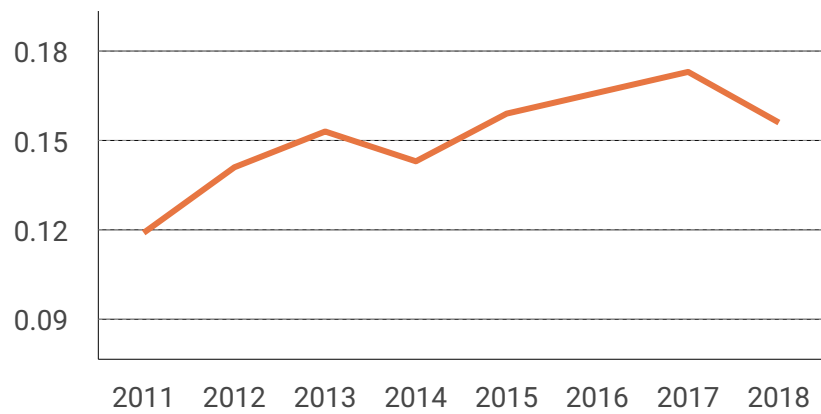
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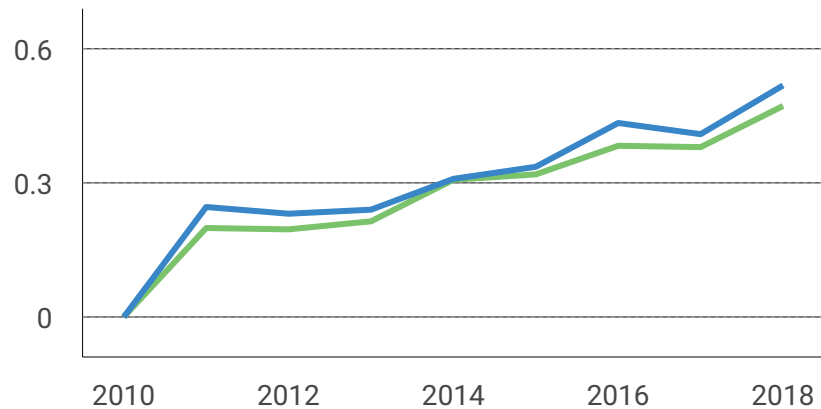


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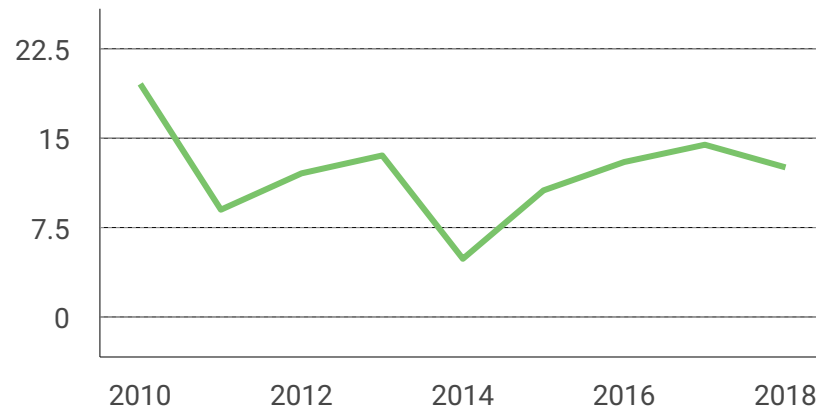
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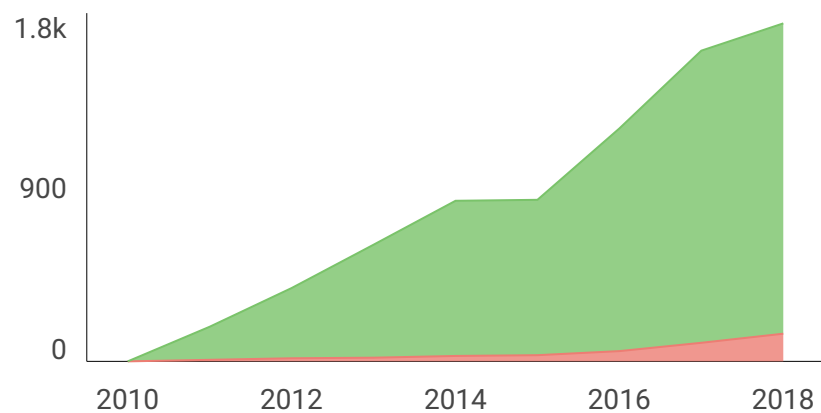
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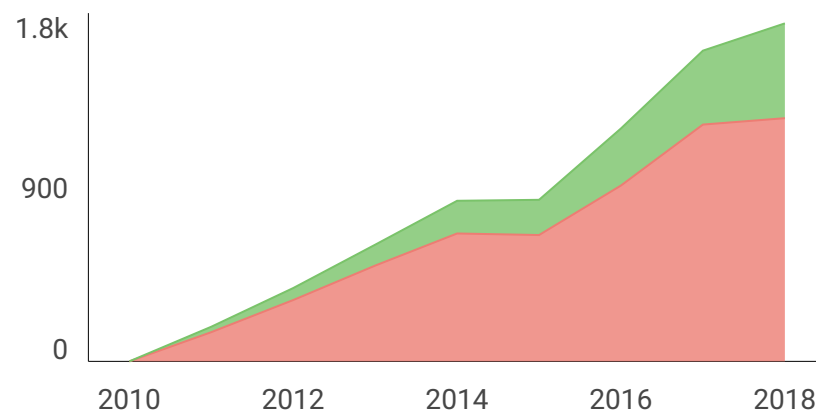
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# Towards a Social Simulator Based on Agents for Management of the Knowledge Base for the Strengthening of Learning Competences



Consuelo Salgado, **Ricardo Rosales**, Felipe Lara-Rosano, Sergio Vázquez and Arnulfo Alanis Garza

**Abstract** In this article, we present a proposal to develop a simulator based on agents, which allow the detection of student behavior patterns, the curriculum, and the labor sector that make up the environment of the school environment with the work environment. The model describes the relationships and iterations of three agents: Student Agent, Study Plan Agent, Employer Agent, these iterations along with their knowledge base will result in the identification of opportunities and strengthening of learning competencies to incorporate the student in the labor sector before the request of a need or request of the current work environment. The detection and action of these particularities will allow orienting the study plan towards the learning needs and strengthening of the competences in the future graduates of the university and achieve the appropriate insertion in a context based on the knowledge and skills of the labor sector.

**Keywords** Complex systems · Agent-Based simulator · Competitions · Higher level education

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© Springer Nature Singapore Pte Ltd. 2020  
G. Jezic et al. (eds.), *Agents and Multi-agent Systems: Technologies and Applications 2019*, Smart Innovation, Systems and Technologies 148,  
[https://doi.org/10.1007/978-981-13-8679-4\\_13](https://doi.org/10.1007/978-981-13-8679-4_13)

## 1 Introduction

The definition that most people know about the system is that all the elements act in a certain way together to achieve a common goal. This conception is focused on traditional systems, delimited and with their own characteristics to address certain situations, leaving complexity aside.

But there are systems that cannot be analyzed and explained from a traditional perspective, given the complex relationship between their components and the lack of specific characteristics between them, these are known as complex systems that arise based on the number of unpredictable behaviors and environmental conditions of the same system that can be emulated with an agent-based model.

This project was born from the interest of identifying the relationship of the educational program of Bachelor of Informatics with the incursion of graduates in the productive and labor sector. The objective is to present a proposal of a social simulator based agents that allows to identify the strengths and improvements of the learning competences of the curriculum and the demands of the labor sector at a certain moment.

## 2 Background

The sense that we can give to the complex can be from the explanation of the human being to do something, as something that is composed of several elements, to something that is difficult to understand because of the variety of the elements so it is integrated and the relationship that occurs between them. The complexity as described [1] is a reality composed of a network of entities that influence temporarily stable situations, or patterns causing stability, you can also associate changes that give small changes in the environment, chaotic changes the existence of a nonlinear dynamic and the appearance of new properties due to sudden changes.

Complexity is a way of studying aspects of nature and society, where it focuses on the characteristics that represent them [2] and defines them as complex systems.

### 2.1 Complex Systems

A system is composed of united, directed, and interrelated parts, which have a purpose and final objectives. Defining a complex system depends on the properties of the environment and the phenomenon being analyzed, of the emerging behaviors that foster feedback, therefore, giving an exact definition could be considered almost impossible since it depends on the viewpoint of the person who defines it, so there is no universally accepted definition of a complex system [3]. In order to reach an exact definition, it would be necessary to observe the iteration of the systems, subsystems,

processes, and other components in the time and space of the phenomenon, the information that is shared between them should also be observed before a defined action or any change in the environment.

In another effort to conceptualize complex systems, as mentioned [4] that these systems are characterized by invariable and unpredictable dynamics, in addition, several characteristic features. These systems have two fundamental properties: the first is that they are structured and the second characteristic is complexity [5].

## ***2.2 Computer Simulation***

The models allow to represent the system, and depending on the language used can be mathematical, computational, logical, conceptual, or theoretical [6]. The simulation is a special type of model that allows to experiment artificially on the system, in order to explore different behaviors and alternative solutions [7].

For this project, we considered, use the benefits of agents. The term agent is a concept that combines several disciplines ranging from the artificial, intelligence, software engineering, databases, distributed systems, to fields of knowledge such as psychology, sociology, medicine, economic theories. The modeling of agent-based systems, as mentioned [8] depends to a large extent on the specific needs to be addressed in the environment and on the characteristics that allow them to take the initiative, share and communicate knowledge, maintain the character social, cooperating and negotiating, as well as committing to common objectives [8].

Modeling and simulation from the point of view of the complexity sciences are focused on addressing the emergence of properties from the interaction between a large numbers of agents [9] with them it is intended to represent something that implies thinking in terms of temporality and variable behaviors [10].

On the other hand, as mentioned [11], the simulation based on agents as a method can allow to treat in a simple way the complexity, the emergence and the nonlinearity typical of many social phenomena. This simulation explains how the different structures that want to be modeled arise from the individual actions of the agents.

Computational simulation is considered as an essential calculation tool that through the variation of the parameters allows testing existing models in the ranges of parameters impossible to reach through experimentation, and allows the visualization of the obtained results [12]. When a system is constructed, it is possible to predict how it will behave by studying the behavior of agents in various conditions through simulation [13] therefore, a computational simulator can be represented in a system that will produce a response predictive based on the behavior of another system [14].

### ***2.3 Higher Education, Skills and Labor Sector***

Education is a human right for all, throughout life, and that access to education must be accompanied by quality [15]. When talking about education, it also includes the higher level that can be conceived as a goal of transformation and creativity for the solution of problems or situations of social, ecological, production, technological, ideological and cultural, in a more efficient and effective way [16].

The Institutions of Higher Education have the task of training students based on a system that fosters an educational environment that solves current social problems together with students, also helping to prepare better professionals for the future [16].

The system to which we refer to the curricula that are applied in universities for the training of students, which is defined by [17] as the structured set of subjects, practices and activities of teaching and learning and containing the purposes of general training, the fundamental contents of the study and the criteria and procedures for evaluation and accreditation.

At the Faculty of Accounting and Administration of the Autonomous University of Baja California, the curriculum for the Bachelor of Computer Science designed in 2009 is currently being developed and was designed to meet the labor, social, and technological demands of the region. a study of relevance. This plan consists of three stages: basic, disciplinary and terminal where the subjects are intentionally located in the three stages mentioned for the achievement of the competences.

Education is much more than collecting knowledge, or building it, education should focus on proposing answers to problems and needs that are faced in the changing conditions in which one lives now [16] and through educational competences can promote the search of those answers and the attention to situations in all the areas that the individual is.

This program of Bachelor of Computer Science is based on a competency plan that focuses on the development, growth, and enrichment of skills, attitudes, practices, knowledge, values and that together are focused on demonstrating what the future professional is capable of doing graduated.

The development and management of Information and Communication Technologies (ICT) belongs to a very competitive and changing labor sector that is based on the needs of companies or organizations. In the case of the Bachelor's Degree, the graduate that involves people, processes and infrastructure, seeks a position in a demanding, closed and demanding work environment.

On the other hand, organizations present changing needs, in addition, which demand innovation and implementation of ICT and experts who are at the forefront.

The problem that will be addressed is the student's relationship, the educational program and the labor sector conceived as a complex system, where said relationship is defined by the new characteristics and unrepeatable needs that define it, although the program and the requirements of the work environment are interconnected in some way do not go hand in hand in the training and terminal competences of the degree.

### 3 Proposal of the Agent-Based Simulator

In professional education, the design of educational programs can be considered as a complex system that seeks emerging solutions to innovate in the teaching process and equalize knowledge, skills, and competencies to integrate into different environments to its graduates.

The proposal is a social simulator based on agents that shows how they adapt to their changing environment through the analysis of the variables that allow such activity to be achieved. Up to this moment, the idea of a first design of a model of linear, cyclic and dynamic type has been conceived that showed certain behavior as a result of the variables do not change with time and that the parameters will be fed intentionally with values to analyze the behavior of the system components in the environment.

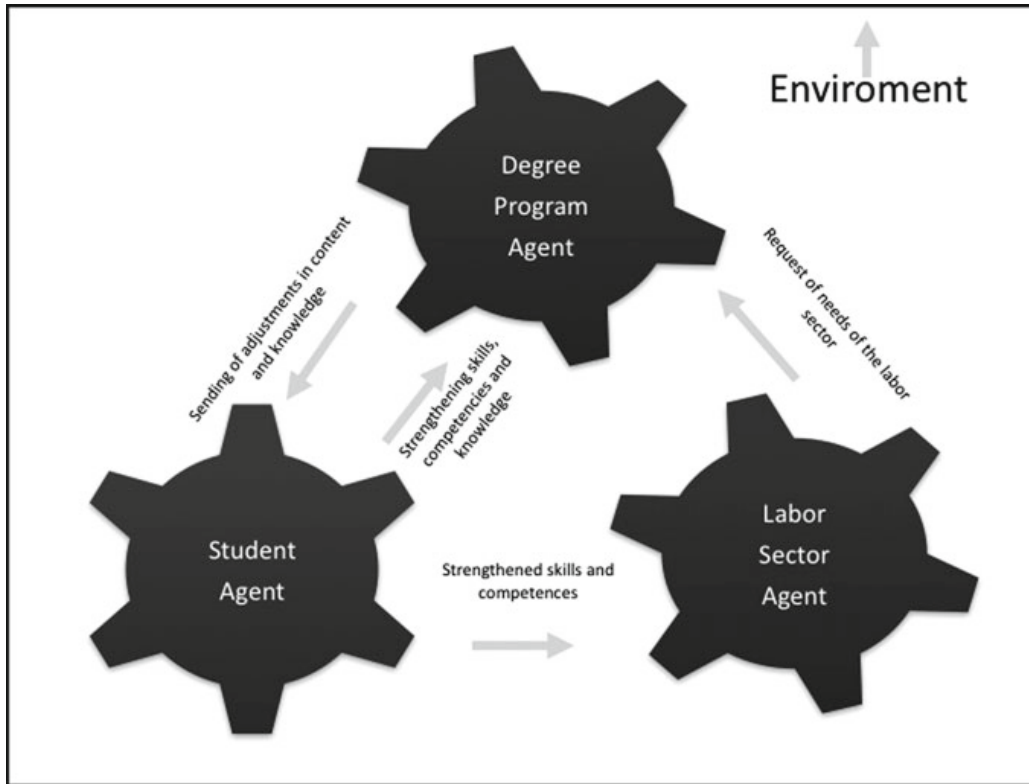
The objective is to present a simulator based on agents that allows the identification of improvements and the strengthening of learning competences in a school environment to match the student's abilities with the needs of the work environment. In other words, the Bachelor of Computer Science is competitive and adapts quickly to its context and allows to reorganize.

The proposed model is a dynamic agent-based simulator composed of agents: Student Agent, Study Plan Agent and Labor Sector Agent (see Fig. 1), where the characteristics are variable in each one of them and in the environment, in addition to the behavior changes over time with alterations that are barely perceived or that can be very marked and at the same time that they are identified as the stimuli or as the responses of the same system.

The relationships that exist with the agents are between the student, the curriculum and the labor sector that contains all the information relevant to the dynamics that occurs in this environment, allowing to analyze it and estimate results based on possible behaviors.

Each of the agents of this model has its activities defined in the simulated environment. These iterations are described below:

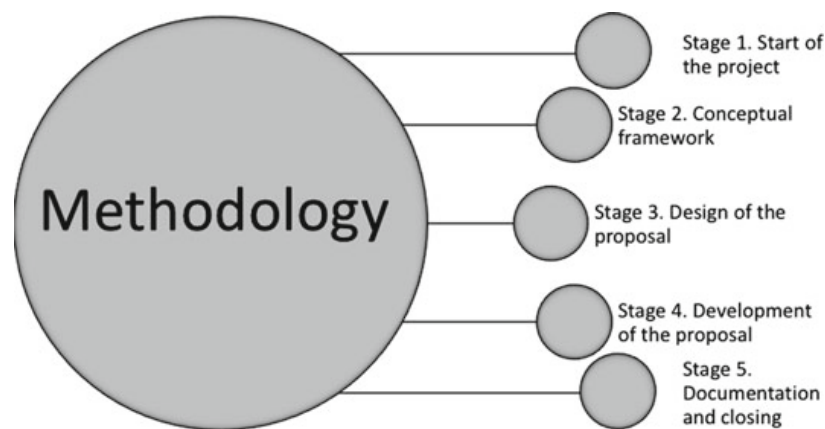
1. The Labor Sector Agent contributes to the needs of information and communication technologies.
2. The Degree Program Agent receives the needs of the Labor Sector Agent.
3. The Degree Program Agent defines the rules and policies to adapt the contents and knowledge required by Labor Sector Agent.
4. The Degree Program Agent sends the appropriate content and knowledge required by the Student Agent.
5. The Student Agent receives the contents and knowledge to place them in their knowledge base.
6. The Student Agent sends the adaptation results of the contents and knowledge.
7. The Degree Program Agent stores the results of adapting the contents and knowledge of the Student Agent in its knowledge base.
8. The Student Agent sends the results of adaptation of the contents and knowledge to the Labor Sector Agent.



**Fig. 1** Proposal of the agent-based simulator

## 4 Methodology

For the development of the social simulator, the tasks, procedures, and techniques that are required to achieve the objective will be considered. This project is divided into several stages as can be seen in Fig. 2.



**Fig. 2** Methodology for the development of the social simulator

As shown in Fig. 2, the methodology considers five stages to achieve the development of the proposal, which are described below:

- Stage 1. Start of the project: This stage is the beginning of the project where the involved will trace the strategies of the project together with those involved and analyze the proposed methodology.
- Stage 2. Conceptual Framework: This stage is very important given that the scope of the project will be defined, which will lead to the integration of the conceptual framework of the proposal.
- Stage 3. Design of the proposal: With the information obtained and analyzed, it will begin with the activity of identifying the characteristics that are required for the simulator and with them modeling it.
- Stage 4. Development of the proposal: In this stage, the simulator will be built using the specialized software for it; The tests will also be carried out to detect the changes that are required and fine-tune the details to implement it and initiate actions with the results.
- Stage 5. Documentation and closing. In this the necessary documentation for the use and application of the simulator will be made, in addition, the final report and the publication of the product will be made.

## 5 Conclusions

The relationship of the educational program of Bachelor of Computing and the labor sector can be conceived as a complex system that is defined by the characteristics of the components, the needs, and the unrepeatable and unpredictable changes.

The proposal aims to ensure that graduates or future graduates are competitive and that they adapt quickly to the work context through the analysis of the student's internal variables, the study plan, competitiveness, and the work environment.

The proposal is a simulation tool that allows to show how the graduate adapts to his changing environment through the improvement of skills, opportunities, and strengthening of skills and analysis of values that allow such adaptation to be achieved.

Up to this moment the idea has been conceived, with a complexity approach, of a first design of a simulation based on agents of the linear, cyclical and dynamic type that would show certain behavior as a result of the variables and the parameters will be intentionally fed with values to analyze the behavior of each of the agents.

With the future development of this idea, the agent-based simulation tool will allow you to show how the student or future graduate adapts to the changing work environment through the opportunities, improvement, and strengthening of skills and analysis of the resulting values.



## 6 Future Works

The present work is a proposal of a simulator based on agents that will allow to detect behaviors through the needs that are presented in the environment of the System by each one of the agents.

The future works contemplated for the development of this project consist of defining the characteristics of each one of the agents and of being necessary to include other agents to facilitate and specialize the learning.

Another activity that must be carried out is formalization to formalize agents through their capabilities.

In addition, define the variables and subvariables that allow storing the values in the knowledge base and as well as outline the agent-based simulator to develop it with specialized software.

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