Chapter 17
A Network Analysis Method for Tailoring Academic Programs

Luis Casillas  
University of Guadalajara, Mexico

Thanasis Daradoumis  
University of the Aegean, Greece & Open University of Catalonia, Spain

Santi Caballe  
Open University of Catalonia, Spain

ABSTRACT
Producing or updating an academic program implies a significant effort: involving people, academic units, knowledge elements, regulations, institutions, industry, etc. Such effort entails a complexity related to the volume of elements involved, the diversity of the origins of contributions, the diversity of formats, the representation of information, and the required granularity. Moreover, such effort is a common task performed by humans who collaborate for long periods of time participating in frequent meetings in order to achieve agreement. New educational approaches are heading to adaptive, flexible, ubiquitous, asynchronous, collaborative, hyper-mediated, and personalized strategies based on modern Information and Communication Technologies (ICT). We propose an approach for tailoring academic programs to provide a practical and automated method to discover and organize milestones of knowledge through the use of Complex Networks Analysis (CNA) techniques. Based on indicators from CNA, the act of tailoring an academic program acquires meaning, structure and even body elements.

INTRODUCTION
As most people would agree, there is a continuous digital revolution due to advances in computational capabilities, effective communication protocols, new understanding on data managing/mining/sharing as well as distributed programming approaches; which have allowed achieving standardize new ways to carry out common computer tasks, all over the world. As a consequence, societies nowadays have specific demands on digital services, so significant amounts of knowledge elements have been digitalized. In
the same way, current web-infrastructure is able to support new approaches in scientific and academic developments (Isaila, 2012). In educational institutions, academic programs are the mechanism to manage and lead scientific and academic efforts. Such programs require regular updating in order to provide certainty to students, institutions, industry, and even to society.

Updating an academic program implies a significant effort, involving people, academic units, knowledge pieces, regulations, institutions, industry, and etcetera. Such effort entails a complexity related to the volume of elements involved, the diversity of the origins of contributions, the diversity of formats and representation of information, and the required granularity. Moreover, such effort is a common task performed by humans who collaborate for long periods of time participating in frequent meetings in order to achieve agreement. A preliminary work that aimed to develop an automated method for tailoring academic programs was performed in (Casillas & Castillo, 2012). Here, the authors extend this previous work, by including new formalizations and features that led to a more integrated and effective approach to model and customize academic programs.

Indeed, the new educational approaches are heading to adaptive, flexible, ubiquitous, asynchronous, collaborative, hyper-mediated, and personalized strategies based on modern information and communication technologies (ICT). This approach for tailoring academic programs, focuses on providing a practical and automated method to discover and organize milestones of knowledge, through the use of Complex Networks Analysis (CNA) techniques (Newman, 2003; Aldana, 2008). In the past, the authors had worked with complex interaction scenarios using neural nets (Daradoumis & Casillas, 2006); then the authors found out by 2008, that complex networks are better suited to model the dynamics and interactions among entities. From that very moment, the research efforts are mainly guided by CNA; due to its functional capabilities.

The CNA is a fresh strategy to view and understand diverse phenomena in nature, societies, physics and any other occurrence in the universe; that includes diverse elements interacting with each other. The main promoters of this so called new science of networks are Barabasi (2003), Newman (2003), and Watts & Strogatz (1998). The authors believe that milestones of knowledge populating the traditional syllabuses are inherently organized as scale-free networks, due to its selective binding among concepts, as established by Reka & Barabasi (2002). This proposal is oriented to define a method for building academic programs and will follow up the principles underlying complex-networks, which enables the discovery and construction of educational nuclei. Such nuclei represent the backbone of every academic program.

In current scientific context, the technological advances and the socialization of ICT (social nets, blogs, video repositories, augmented reality, etc.) constitute the basic premises for the development of modern academic programs for present and future higher-education institutions (HEI). Present proposal aims at discovering the pieces of knowledge supporting an academic program, using practical and/or automated steps. The collected knowledge represents the semantic essence of academic programs in HEI. Popolo (2010) and Martin (2003) argue that such collection provides context and trajectory in Bayesian approaches for reality. This perspective agrees with the approach to academic-corpus configuration. Besides, the authors are looking for automating many of the steps from this process. Due to the natural complexity of this challenge, and believe that computers are not able to perform the whole task and complete every known step by themselves. Nevertheless, a creative use of computational capabilities would be very helpful. By modeling the problem elements as a complex network, some automated analysis could be performed on this structure, allowing humans to promptly discover the main aspects and simplifying the discussion. This team has previously dealt with this kind of problem, as described in (Casillas & Daradoumis, 2012) and (Casillas, Daradoumis & Caballé, 2013).
Related Content

Internet of Things Services, Applications, Issues, and Challenges
[www.igi-global.com/chapter/internet-of-things-services-applications-issues-and-challenges/177941?camid=4v1a](www.igi-global.com/chapter/internet-of-things-services-applications-issues-and-challenges/177941?camid=4v1a)

QoS Guaranteed Based Network Management Policies in the Integration of Wired and Wireless Architecture of a Healthcare Network
[www.igi-global.com/chapter/qos-guaranteed-based-network-management/42484?camid=4v1a](www.igi-global.com/chapter/qos-guaranteed-based-network-management/42484?camid=4v1a)

Protecting Data Confidentiality in the Cloud of Things

An Exploration of the Critical Need for Formal Training in Leadership for Cybersecurity and Technology Management Professionals