Chapter 7
Use of Centrality Metrics for Ranking of Courses Based on Their Relative Contribution in a Curriculum Network Graph

ABSTRACT

The author proposes a centrality and topological sort-based formulation to quantify the relative contribution of courses in a curriculum network graph (CNG), a directed acyclic graph, comprising of the courses (as vertices), and their pre-requisites (captured as directed edges). The centrality metrics considered are out-degree and in-degree centrality along with betweenness centrality and eigenvector centrality. The author normalizes the values obtained for each centrality metric as well as the level numbers of the vertices in a topological sort of the CNG. The contribution score for a vertex is the weighted sum of the normalized values for the vertex. The author observes the betweenness centrality of the vertices (courses) to have the largest influence in the relative contribution scores of the courses that could be used as a measure of the weights to be given to the courses for curriculum assessment and student ranking as well as to cluster courses with similar contribution.
1. INTRODUCTION

The networks that have been commonly analyzed in the literature are social networks, biological networks, co-authorship networks, transportation networks and etc. Very little focus has been on curriculum network graphs that are the focus of this research. We model a curriculum network graph (CNG) as a directed acyclic graph (DAG) of vertices and edges (Cormen et al., 2009): each course in the curriculum is a vertex and there exists a directed edge from vertex $u$ to vertex $v$ (represented as $u \to v$) if the course corresponding to vertex $u$ (a.k.a. the upstream vertex) is a pre-requisite for the course corresponding to vertex $v$ (a.k.a. the downstream vertex). We define a terminal course as one that has one or more courses as pre-requisites, but is not the pre-requisite for any other course; likewise, we define a seed course as one that serves as a pre-requisite for one or more courses, but does not have any pre-requisite. For the rest of the chapter, the terms ‘course’ and ‘vertex’ are used interchangeably.

Most of the analysis on CNGs (e.g., Aldrich, 2014; Lightfood, 2010; Komenda et al., 2015) has been restricted to identifying one or more courses that satisfy a specific requirement, like: courses that could be used for assessment, incorporating changes to the curriculum, introducing core topics, etc. In this chapter, we seek to address the following research question based on the structural analysis of a CNG: How to comprehensively rank the courses in a curriculum as well as quantify the relative contribution of the courses in the curriculum and cluster them taking into consideration all of these below:

1. The order in which the courses are taken,
2. The number of courses for which a course is a pre-requisite for,
3. The number of courses that are the pre-requisites for a course,
4. The courses that have one or more courses as a common pre-requisite
5. The courses that jointly serve as a pre-requisite for one or more courses
6. The intermediate courses that have one or more courses as pre-requisites as well as serve as pre-requisites for one or more courses.

We seek to address the above research questions by making use of topological sort (Cormen et al., 2009) and centrality metrics (Newman, 2010):

1. A topological sort of the vertices (Cormen, et al., 2009) in a DAG like the CNG would comprise of a sequence of courses such that if there is a directed edge from vertex $u$ to vertex $v$, then vertex $u$ would appear
Related Content

Internet of Things: Privacy and Security Implications
[www.igi-global.com/article/internet-of-things/179894?camid=4v1a](www.igi-global.com/article/internet-of-things/179894?camid=4v1a)

Peer-to-Peer SIP for Mobile Computing: Challenges and Solutions
[www.igi-global.com/chapter/peer-peer-sip-mobile-computing/26805?camid=4v1a](www.igi-global.com/chapter/peer-peer-sip-mobile-computing/26805?camid=4v1a)
Personal Peer-to-Peer Collaboration Based on Shared Objects
[www.igi-global.com/chapter/personal-peer-peer-collaboration-based/28048?camid=4v1a](www.igi-global.com/chapter/personal-peer-peer-collaboration-based/28048?camid=4v1a)

Potential Area of Research in MANET
[www.igi-global.com/chapter/potential-area-research-manet/64712?camid=4v1a](www.igi-global.com/chapter/potential-area-research-manet/64712?camid=4v1a)