Can language models be used to predict educational concept dependencies?

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GitHub repository: https://github.com/dominikglandorf/learning-dependencies

Abstract

1 Introduction

Effective and efficient instruction does not only incorporate *what* to teach but also *how* to teach. Models of instructional design especially emphasize the importance of order of instruction. More precisely, prerequisites of educational content should be taught first (Morrison et al, 2019). As potential contents, Merill (1983) differentiated learning objectives such as facts, concepts, principles, rules, procedures, interpersonal skills and attitudes as well as their sole recall from their application. In this work we will focus on concepts and their relations. If one concept is a prerequisite of another, we call this relation a learning dependency. For example, to understand the concept of a derivative knowledge about the concept of a function before will facilitate or even enable learning. When the dependencies are thought of as directed edges between nodes that represent concepts, a learning dependency graph emerges which is a special type of a knowledge graph (Wang et al 2016). This graph is also called *concept map* in the field of Learning Sciences. Prerequisites can be inferred from learner behavior by testing their performance after being presented different instructional sequences (Pavlik et al., 2008, Vuong et al., 2011). However, this has the disadvantage of disengaging users with too difficult concepts before teaching easier or necessary ones. Experts usually dispose of the required knowledge about concepts to create concept maps. The high cost of expert knowledge motivates the automatic mining of learning dependencies from appropriate sources which is the core problem of this work.

1.1 Related work

Talukdar and Cohen (2012) defined the prerequisite relation in terms of the consumption of information about concepts. Vuong (2011) if a better graduation rate given prerequisite knowledge is fulfilled. Concepts are often equated with Wikipedia articles (Talukdar and Cohen, 2015; Wang, 2015).

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