**Related work**

Identifying courses that are both of interest to the (university) students and of an appropriate level is a task that has recently gained attention in the literature. Gulzar, Leema and Deepak (2017) proposed a recommender system that uses information retrieval techniques to select courses based on student interests. Their system uses key words to search the space of possible courses but tries to improve the quality of the query by finding synonyms and generating N-grams so that the search returns a higher number of courses. Then, an Ontological Model is used to expand the search even further and retrieve courses that are related in the Ontological Model to the previously extracted courses. In this context, an Ontological Model is a knowledge model that represents relationships between concepts of a previously specified domain, such as ‘Computer Science’ (Gulzar, Leema, 2016). The system is considered to be content based because it is the contents of the courses that are matched to the concepts of the ontological model or the key words of the query. In this manner, the recommender system allows the interest of the students to be matched to the contents of the course. However, the system suffers from several drawbacks: first, the domains (e.g. Computer Science or Medicine) from which the ontological models are built must be defined a-priori (Gulzar, Leema, 2016). Second, the recommender system is dependent on a well-built database that is not always available at interested institutions.

Bydžovská (2016), developed a recommender system that takes into account a student’s past performance and interest profile to make course recommendations. Students interests are defined in a narrow sense, that is, a course is considered of interest if a student has taken the course or marked it as a favorite in the university system. Course recommendations based on interest are then made through a collaborative filtering approach: the suggested courses were the most selected courses by other students in the same field of study, or those that were taken by the n-most similar students that had already graduated. To detect risk of failure, Bydžovská (2016) predicted grades of students using classification and regression, or nearest neighbor depending on the course, binned the predicted grades into excellent, good, or bad and then issued warnings accordingly. The main innovation of the system, was that it proceeded to include social behavior and consider courses taught by a favorite teacher or taken by friends of students into the recommendations. Although the system attempts to handle both interest and appropriateness of level for a course, it suffers from a three major disadvantages: firstly, it does not provide the kind of transparent recommendation that would allow students to reflect on their course selection because the content of the course is not explicitly taken into account. Secondly, it does not give students suggestions of how to address their deficiencies. Thirdly, it does allow for a change in student interests, which is particularly important in a liberal arts context where students go through a broad exploratory phase before specializing.

Bakhshinategh, Spanakis et. al, (2017) tried to address the issue of student recommending courses that helped students address their deficiencies whilst accounting for changes over time. They view a study program as a path to obtain graduating attributes (skills, qualities, understandings) and attach to each course the impact that it has on promoting those graduating attributes for a particular student based on the self-assessment of students. The system then uses collaborative filtering to recommend courses that have the highest chance in developing desired graduating attributes for a student and introduce a decaying factor that gives weight to more recent self-assessment reports. In other words, if a student lacks “analytical skills”, the system identifies courses that improve these skills so that a student comes closer to the level of “analytical skills” that is required for graduation.