Research Project for MA 4404:
Evolving synthetic networks

1 Introduction:

Traditional education engages all students with the same topics, at the same time, and at the same speed. Such a system leaves some students behind and fails to challenge others. It also produces similarly skilled graduates, rather than enhancing the skills, experiences, and abilities that learners already have. An alternative would be to imagine a world in which professionals engage in lifelong learning complementing their formal education, while balancing personal and professional tasks because learning is personalized, adaptive, succinct and at their fingertips. This would be an adaptive & flexible learning environment that is learner-centric, where content is recommended to learners to meet their learning outcomes while building on each person's interests and existing skills. Additionally, unlike a traditional textbook whose content is static, this model needs to be supported by a network of knowledge that can grow in time as authors add new content to an existing repository of micro-lectures. Unlike most established sciences, new research fields such as Network Science hint at non-traditional methods of education that network the modules providing guided learning that can be influential on how we structure the future of learning.

The current project proposes to create a synthetic network of knowledge that incorporates network evolution to support dynamic growth of a network of knowledge as follows:

- Basis: a static network showing the connections between the sections textbook
- Evolving step: additional content is added to the network, one author at the time, to create alternative choices of content for the nodes in the basis network, with the goal of supporting personalization of learning. As such, we seek to introduce a structure over a repository of micro-learning content (collection of short PDFs, videos, code, PPT, simulations, examples, exercises, etc) that allows for the new content to be incorporated and discoverable by learners or instructors.

This network's function is to allow the creation of personalized and adaptive learning paths to enhance learner's education by filling in the exact missing gaps ('just in time' learning) while building on each learner's knowledge and experiences using adaptable targeted learning modules. This contrasts the linear, one-size-fits-all approach to traditional classroom and many current online approaches that includes all possible topics that may be covered in a traditional course catering to many students ('just in case' learning).

Much like a GPS navigation system dynamically adjusts a driving path from a source to a destination while roads are being built or closed, the structure or curation of the content allows a recommender system to assist the learner in moving through educational materials dynamically while the network evolves (some content may become obsolete, while new content and new concepts are being added, and these changes can take place daily). Based on each learner's background, a learning and development system would provide different choices in how to engage the learning content, while ensuring the learner reached the desired destination based on the competency needed by the learner (captured as individualized learning goals). Each student benefits differently from the available content as the suggested learning materials depend on learners' pre-existing knowledge, and allow the learner to dive deeper in topics, if desired.

2 Task for each team:

The project is broken down into two components: In MA 4027 we created a synthesis of existing work that can influence the direction your group can take for the creation of a Dynamic network of knowledge. This becomes Chapter 2 of a research paper (the equivalent of Chapter 2 of a thesis). In MA 4404 we create a paper that builds on the lit review, and introduces the methodology for the synthetic network either as an extension of one or more models discovered in the literature review, or as a brand new model (it may be infused by ideas from other models). This methodology creates the environment that supports algorithm testing for personalized learning paths:

- can be created at different scales of networks (like a network of 100 nodes, or 1000 nodes),
- accounts for the dynamic nature of the network as modules are added (possibly retired as well), and
- the resultant synthetic network's nodes represent educational modules tagged with learning outcomes, and may include authors, and other needed tags.

Exploit existing methodologies and introduce innovative approaches to link the network's modules. Think outside the box, take a chance and try an out of the ordinary model! "The significant problems we face cannot be solved at the same level of thinking we were when we created them."– Albert Einstein.

References