Agent Support for online Learning

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Imagine a haphazard group of people with an interest in educating themselves about a particular subject, say, global warming. They do not know each other, are not university students, nor organised as a group in any other way. They merely share the same desire to become more knowledgeable about global warming. Let's also assume that, within bounds, they are also prepared to share what knowledge they have with others who have the same desire. This characterisation is typical for life-long learners.

Imagine furthermore some educational institution that wants to cater for the needs of life-long learners. The institute has staff experts on global warming, who have created a collection of modules that collectively cover the subject. The modules are relatively small and independent of each other so that they support the browsing-like study habits that are so typical of life-long learners. (Life-long learners are interested in subjects that, at that exact moment of time, they feel the urge to study, rather than in following a set curriculum from beginning to end.) Although the staff people are experts, they are open for the possibility to learn something as well. Often, life-long learners possess particular expertises acquired in their highly specialised line of work that staff simply are not conversant with. Finally, the institution has erected some sort of technological infrastructure that facilitates the online, life-long learner. Let's call this entire ensemble a Learning Network (LN). A LN thus consists of users (people with the intent to learn something and the willingness to share their knowledge), educational materials in the form of small, independent modules, and a technological infrastructure (Koper and Sloep, 2003; Rusman et al., submitted).

Much can be said about the concept of a LN, from a variety of perspectives. Here we focus on three problems that arise from the question of how users of a LN (learners and staff) may best be supported to achieve their goals. Suppose user Matthew has

some educational need, say, know more about the effects of sea currents on global warming. Where should he start, given what he already knows? Perhaps he lacks the requisite oceanographic knowledge to straight-away study the module on sea currents; perhaps he knows enough already to skip the introductory module on sea currents and move on right away to the module on mathematical modelling of sea currents. The LN should support Matthew in making an intelligent choice. This is the positioning problem. Once Matthew has started, how does he move from module to module? This depends on his learning goals, but also on how successful he has been in completing modules so far. Matthew might need modules that offer a shallow learning curve, or rather modules that offer a steep one. Or he might want to collaborate with others rather than study individually. Etc. This is the navigation problem, and the LN should also support learners in solving it intelligently. Finally, when studying some module, Matthew might have questions that he cannot answer on the basis of the module alone. He needs help, from the staff or from his peers. This is the support problem.

Any one of these problems may be solved by deploying massive numbers of staff. The economics of life-long learning make this impossible but for exceptional cases. The LN should somehow self-organise to solve these problems with as little runtime staff involvement as possible. It is our claim that well-chosen software technologies, involving agents, can raise the self-organising powers of the network sufficiently to make a LN a viable option. Finding support for this claim has become a major R&D focus of the Open Universiteit Nederland Educational Technology Expertise Centre. The R&D programme looks into technologies that are neither proven, for these do not belong in an R&D programme, nor very immature, for these would still require fundamental research for their application. We hope to draw insights from implementation projects in other fields, for instance e-business. To illustrate how agents could be used, we'll briefly elaborate the support problem somewhat further.

Suppose some network user, call her Ann, during her studies stumbles upon a problem she can't solve on her own. Help is needed and the LN should provide it. There are two broad ways to approach this issue. She may be steered to some other module in the LN or to an FAQ that has been compiled; alternatively, some of her peer LN users are able to help out. The first approach is the most straightforward one. Ann formulates a question to describe her problem and submits it to her personal agent. Ann’s agent needs a means to find out what document (module,

FAQ entry) best suits her question. Any technique that computes in real-time the semantic similarity between her question and the texts available in the LN can be used for this. Using such a technique yields a series of rank-ordered similarity indices that Ann's agent can feed back to Ann. It is then up to her to decide what document further to study in the hope of finding an answer. In this case, Ann's agent may hardly be called an agent. It really only is a relatively simple piece of software that mediates between Ann and the software that computes semantic similarity indices.

More able agents may however be deployed. Consider the second option, in which Ann looks for a fellow user to help her. Ann will formulate the same question. And the question will be submitted to the same software. This time, however, her question will not be compared to modules and FAQs, but to documents that other LN users have submitted as descriptions of their own capabilities. Such documents are similar to CVs and in the context of learning are often called portfolios. Again a ranking results, this time of fellow users in the order of their suitability to answer Ann's question. Ann now can choose a person from the list with whom to get in touch. This person could be a fellow student, it could also be a staff member. So far, there are no differences.

But note that the suitability measure is based upon semantic similarity only. Obviously, there are all sorts of other considerations that could (and should, we argue) be taken into account before arriving at a list of persons recommended to Ann. Probably, the fellow user that is an expert in the matter will receive the highest rank. Usually, this wil be a paid staff person, say Tricia. This person will likely also rank highest for many other questions. From an organisational point of view it is undesirable that Tricia receives the highest rank in the recommendation: she would rapidly be swamped with questions, also the quite simple ones. Now assume the person with the highest rank would not belong to the staff, but be a fellow learner, say Simon. Having Simon answer these questions would save considerable staff tiem. But the solution of letting Simon rank highest has serious drawbacks. Now Simon would be swamped with questions and, as a consequence, he would rapidly loose his appetite to participate in the network. This argument goes for many of the top-ranking fellow learners. Their dropping out of the LN means there's nobody left to answer questions but the staff. What is needed is an arrangement in which slightly 'smarter' learners answer questions of their slilghtly

'dumber' peers. Only this way there is a chance of keeping the sociology of the LN in working order.

Finally, this near-peer-matching kind of arrangement is also interesting from a pedagogical point of view. Answering a question that concerns a subject that you have just managed to understand yourself can be quite a valuable experience from an educational point of view. So for all these reasons, and probably others (online availability of people, their recent questioning answering history, availability of a FAQ) the ranking of persons that results from the comparison of the question with the user portfolios should be modified. All these factors together then should determine the final recommendation to Ann. Negotations between the users' personal agents, perhaps helped by some mediator agent, are a sensible way to arrive at such a recommendation. It offers the flexibility that is required for a network with constantly changing users, user availabilities, and user portfolios.

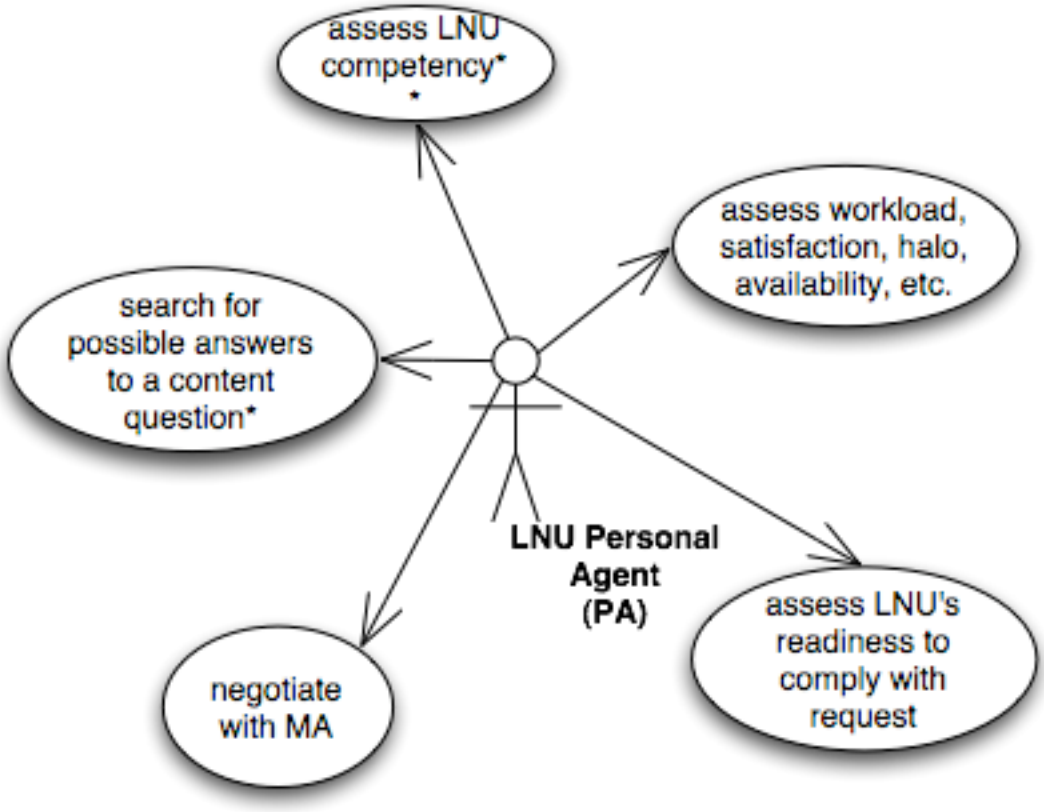

Figure 1 Possible use-case for a learning network user's personal agent.

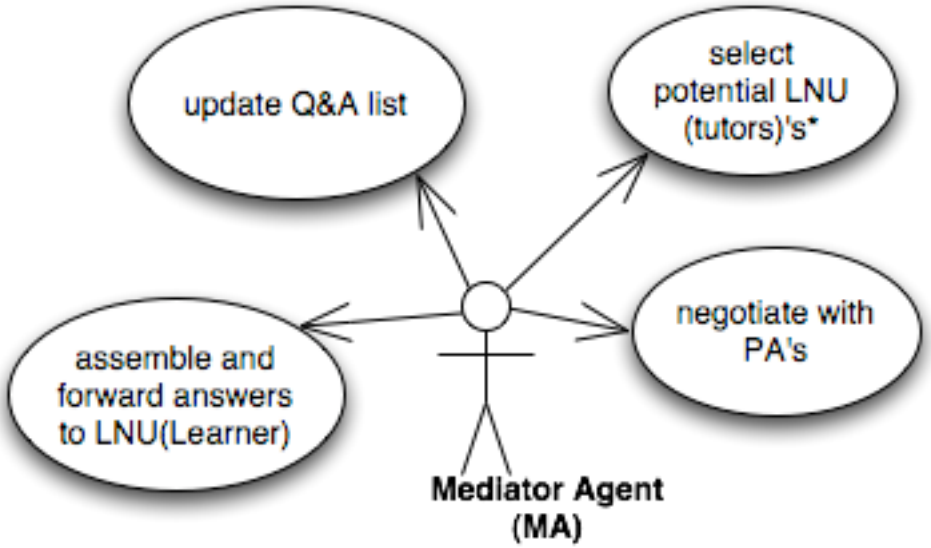

Figure 2 Possible use-case for a mediator agent.

Similar arguments may be used for the positioning and navigation problems. Users are represented by their personal agents which have a particular task. Carrying out that task involves interacting with documents in the LN and with the users behind those documents. Even modules have their authors (staff) behind them. This means that the personal agents may carry out negotiations on behalf of their owners. And this, in turn, means that the agents help weave the social fabric of the Learning Network and thus promote its capacity for self-organisation. Our current efforts are directed towards solving two problems. The first is finding software implementable methods capable of generating document similarities in real time. We are currently looking into the use of latent semantic analysis (Van Bruggen et al, in press).The second is devising an agent architecture – together with a suitable development environment for it - that is conducive to the proper functioning of a Learning Network. No decisions have been made yet here, although agents used in e-business may provide useful role-models.

References

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