

LLL at the WU Vienna

Ronald Hochreiter

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Section 1

LLL at the WU Vienna - Introduction

LLL at the WU Vienna

LTfLL: Language Technologies for Lifelong Learning

<http://www.ltfll-project.org/>

Main contact: Prof. Dr. Gustaf Neumann

LTfLL - Objective

The objective of the LTfLL project was to **create next-generation support services** to enhance competence building and knowledge creation in educational and organizational settings. The services run (semi-)automatically to **avoid aggravating the workload of tutors**.

LTfLL - Objective

Involving expertise in language technology (LT), cognition, and technology-enhanced learning (TEL) LTfLL designed, developed and validated services that:

- (1) establish a starting position and recommendations for the learner on what to learn,
- (2) give support and feedback during learning and
- (3) support social and informal learning.

LTfLL - Role of WU Vienna

Based on its wide experience in implementing large scale e-learning portals and experience with Natural Language Processing technologies, the WU. . .

- ▶ was the leader of the infrastructure work package;
- ▶ hosted the joint development infrastructure;
- ▶ led the software development process;
- ▶ set-up, maintained, validated, and documented the e-learning infrastructure and its services;
- ▶ defined guidelines for the services to enable their integration in the selected (e-learning) environment(s);
- ▶ designed and developed generic utilities and resources for the NLP activities;
- ▶ adapted existing language technology based tools and components.

LTfLL - Services

- ▶ Learner Positioning Service (4.1)
- ▶ Service for Monitoring Conceptual Development (4.2)
- ▶ Chat & Forum Analysis and Feedback System (5.1)
- ▶ Online Synthesis Advisor PenSum (5.2)
- ▶ Formal Learning Support System Course Editing Service (6.1)
- ▶ Informal Learning Support Service to Locate Content and Peers (6.2)

Section 2

Learner Positioning Service

Learner Positioning Service - Problem

Educational institutions are starting to widen their offerings to a **large number of lifelong learners**. Traditionally, assessments to position learners use **essay writing, questionnaires, multiple choice tests, or simple oral examination**. Due to an **increased diversity** in learners' educational backgrounds, education providers have started to use online learner interactions as part of a wider portfolio analysis to **assess** the learner **position** and to **enable personalised learning**. The growth in the number of registrations and more **complex positioning** threaten to increase the workload of tutors to **unmanageable** levels.

Learner Positioning Service - Solution

Performs a qualitative and a quantitative analysis of learner texts (*knowledge poor approach*). **Qualitative analysis** involves the **scoring of phrases extracted** from learner texts according to distinctive features of their usage by comparing its frequency in high and low quality texts as graded by experts. The output of this analysis is based on the learner's written phrases and not simply on word frequency. Users can inspect the scored phrases visually.

Quantitative analysis uses information such as occurrence **counts of these phrases** to compute a **measure of fit** of the learner language as compared to the relevant CoP. Users of the positioning service should interpret the qualitative and quantitative results to assess the learner's position and to decide what course units the learner needs to study, and where additional support might be needed. The services need fine tuning for each CoP by training them on representative texts (e.g. textbooks, highly graded peer texts, etc.).

Learner Positioning Service - Solution

This builds up into a *reference corpus* which is used to infer the set of relevant concepts. To help experts in building that corpus, the service statistically analyses instructional text materials and suggests which of those should be added to the corpus. Corpus texts then are classified by area of expertise and grading. With these texts the quantitative output for each learner text is generated by measuring the distance between a text and all texts of the 'reference corpus' in two vector space models, i.e. bag of words and bag of phrases. In addition to the *knowledge poor approach*, conceptual coverage of learner texts is computed using an ontology by counting how many associated concepts are found in the learner texts (*knowledge rich approach*). As output the percentage of covered relevant concepts will be presented. The analysis of conceptual coverage of learner texts involves the use of an ontology and lexicalisations of concepts belonging to that ontology (e.g. phrases extracted by means of the qualitative analysis) to count how many relevant concepts are found in the learner texts.

Learner Positioning Service - Solution

Finally, after examining the service output, users can examine the appropriate list of instructional texts from the reference corpus. Tutors can use results to decide which materials need to be studied by the learner, and in which area of conceptual knowledge the learner may require further support. Learners can evaluate their own position and identify their strengths and weaknesses.

Learner Positioning Service - Story

Sylvia attends a four to six hour introduction workshop to help her develop her learning path. During the workshop she uses the positioning service web interface to answer the **questions regarding the course** she will take and provides **additional text material** (her CV, job description etc). This material is uploaded by the tutor. The service generates an output, which grades Sylvia's knowledge for each unit of the course in the scale 1 to 3. Sylvia and her tutor are using the results of the positioning service as the baseline for creating Sylvia's **learning path** and the required **learning methods** for each unit (recommending a set of instructional materials and learning methods covering the area of expertise that she needs to study).

Section 3

Service for Monitoring Conceptual Development (CONSPECT)

CONSPECT - Problem

In modern educational practice, **lifelong learning** is a **mix of formal and informal opportunities**, both of which emphasise development of independent **self-directed learning**. This is encapsulated by workplace learning environments where learning trajectories reflect interactions of learners with peers and professionals from their own domain, as well as with *clients* (e.g. patients, students, or customers). In such complex circumstances, it is sometimes difficult for learners and their tutors to discern clearly how a specific individual covers key topics and how they might apply this to *real life* issues. Hence, self-directed learning requires support, through formative feedback, but a key issue is how to **gather and evaluate the evidence** on which such feedback could be based.

CONSPECT - Solution

CONSPECT is designed to provide a means by which a learner's conceptual development can be monitored and feedback opportunities are promptly and effectively provided. CONSPECT **monitors conceptual coverage of topics** based on an **automated analysis of textual evidence** presented by learners, in comparison with others or over time, to identify shortcomings, misconceptions, and emerging learning opportunities within the learner's zone of proximal development. It uses textual artifacts from both individuals and groups of learners, such as essays or blogs, to establish a visual model, a *conceptogramme*, of how learners relate concepts to one another. Learners are able to compare their own model with an emerging group reference model in order to identify differences, or to get feedback on where to seek advice from their tutor. This enables learners to monitor their development over time. Tutors can inspect the conceptual development of individuals and groups and use the outputs of the service to inform their interactions with learners.

CONSPECT - Story

Marion, a learner in the Medical School is on her placement Cardiology for eight weeks. She attends a series of sessions in which she shadows her tutors, observing how they perform their tasks. In the same period, she assesses her competence in diagnosing symptoms and relating these to treatments within predefined PBL cases. This is done in a collaborative setting where she interacts with peers and tutors in online forums. She typically spends time reviewing her previous learning and researching new topics that help her to understand the workplace tasks and the PBL case. As part of her learning process, she reflects on her progressing knowledge and the lessons learnt, maintaining an online journal.

CONSPECT - Story

Marion launches CONSPECT, selects the topic space Cardiology and submits her knowledge evidences (from her online reflections and discussion contributions). CONSPECT displays a topic representation based on Marion's input, showing the identified concepts and their relations. Marion compares her result with three models: that of her peer Peter, an emerging group model, and a tutor defined reference model. Finally she decides to make her model public to feed the emerging group model and to allow others to compare their representations with hers.

Section 4

Chat & Forum Analysis and Feedback System (C&F-AFS)

C&F-AFS - Problem

Educational institutions have widely embraced the use of internet, web technologies and its collaborative environments to supplement standard learning practices. Learners' interactions show their (individual and group) knowledge regarding the course materials as well as their capacity to apply this knowledge. However, what happens in these interactions is often beyond the control of the teachers, who mainly focus on the results of the collaboration processes. More involvement to assess individual contributions, to moderate or to provide relevant feedback concerning the quality of these web interactions with regards to both content and collaboration appears to be time-consuming and comes with a high cognitive load.

C&F-AFS - Solution

C&F-AFS supports tutors and learners in the analysis of the collaboration among learners and of their individual activities in virtual teams: It produces various kinds of information about discussions in chats and forums, both quantitative and qualitative, such as metrics (e.g. the relative importance of each utterance, learner grades both globally and for particular features like the involvement in the collaboration, the social effect of what they said, etc.), and content analysis results (such as the coverage of the key concepts supposed to be discussed and the discourse threads). C&F-AFS also provides visual feedback about the interactions and the social participation. The visualization of the conversation and forum is interactive, that means the learners and tutors may explore different perspectives and discussion threads, they may view implicit links discovered by the system between utterances or posts, they may see the threading of using different concepts.

C&F-AFS - Story

At the NLP course, we use a forum and a chat system to collaborate with our classmates. Moreover, the evaluation of these activities constitutes an important part of the final grade for each student. Dr. Smith starts discussion topics on the forum after each course. The tutors have to moderate and solve possible conflicts by offering explanations. In addition, the teacher gives us topics to discuss in small groups using the chat system. As preparation for a chat, the tutors group us in small teams of 4-7 participants, each of us being assigned a topic to study and then support in debates. I read the most interesting materials about that topic in order to understand the subject in detail. During the discussions, my peers present other points of view, we debate and inter-animate, all of these improving my own and the others' understanding of the domain. After ending a chat session, the C&F-AFS provides feedback and preliminary scores both for myself and for my group as a whole.

C&F-AFS - Story

When I'm using C&F-AFS for a forum it shows me threads and/or posts that are related to a concept, it recommends peer-learners that have a good understanding of particular topics and it offers preliminary feedback about my activities for self-reflection.

Section 5

Online Synthesis Advisor (PenSum)

PenSum - Problem

In numerous educational contexts, **learners produce textual reports** (e.g. summaries, essays, syntheses) about the learnt notions, and feedback is offered about their results. The problems they encounter are **long waiting time for feedback** (stagnating them in the writing process) and the limited feedback opportunities that do not stimulate explorative approaches (“what if-trials”), but force them to hand in mainly completed versions. During writing, it is **difficult to self-assess ongoing work** and to identify possible misunderstandings. The teacher has only a limited overview of the learners’ progress, may find out specific problems **too late** to use them during the current course, and may be unsure about the **consistency of feedback** given by tutors.

PenSum - Solution

PenSum supports learners in the automatic assessment of their essays (summaries, syntheses) in order to let teachers focus on higher-level activities (e.g., individual learner guidance or course design). It analyses how well learners understand course texts as shown by their textual productions; it provides frequent just-in-time feedback on the ongoing writing activities (relevance of written sentences, inter-sentence coherence of the synthesis, résumé of each course sentence).

PenSum - Story

Ulysses launches Pensum as a Web service. He selects the course domain Natural Language Processing and starts to express the main questions, problems and notions he wants to tackle in this course in a dedicated notepad. Then he starts to write a synthesis of the most important ideas of the course, according to his understanding. Whenever Ulysses is uncertain about whether he grasps the most important notions of a text, he asks support from Pensum. The system gives Ulysses feedback on his written synthesis, e.g. the relevancy of sentences, or the inter-sentence coherence of his synthesis. Ulysses is in control of his own learning process, he requests feedback whenever he wants and he can update his notepad according to the main points he understands and can continue writing on the same synthesis or one on another topic.

Section 6

Formal Learning Support System Course Editing Service (FLSS)

FLSS - Problem

Teachers who develop or adapt courses have insufficient tools to help them locate learning material that is appropriate for the intended learners.

FLSS - Solution

The Formal Learning Support System (FLSS) as part of the **Common Semantic Framework (CSF)** offers various **browsing and searching functionalities**. A simple text search returns documents with a varying degree of relevance. Semantic search makes the results more relevant, by using different wordings of a concept and exploiting implicit semantic relations in the text. Browsing the domain ontology helps the teacher to organize taxonomically his/her curriculum. The learning materials in FLSS are annotated automatically. Users can browse these texts with annotated concepts and contexts, and thus can compile manually a curriculum, a glossary and a test for the learners that will take into account the learner's profile (as a group and individually).

FLSS - Story

FLSS offers a repository of learning objects (tutorials, courses, papers, tests, etc.) as well as facilities for search, concept browsing and document similarity measuring over the information stored in Common Semantic Framework. This information comprises the repository of learning objects, comments from peers, other materials provided by external services. A teacher may begin searching for materials, or (alternatively) may want to get some insights on the topic starting with browsing over the domain ontology to get an appropriate set of concepts. The ontology is accessible as a whole as well as in specific thematic parts for this purpose. In both cases, through the use of various searches – mainly text and semantic, and through the browsing of the domain ontology the teacher can choose materials to be included in the course. The teacher can additionally get results, based on similarity among the learning objects. The teacher may also add documents to the repository. Such documents will be automatically annotated.

FLSS - Story

The automatic pipe annotation includes: word level segmenting; linguistic NLP analysis; concept annotation grammar, coreference relations. The annotated documents and the ontology might be used for semantic and contextualized search, structuring the content, making glossaries and tests for the learners. The coreference annotation improves the coverage and precision of the concept annotation, thus making the retrieved results more informative and to the point.

Section 7

Informal Learning Support Service to Locate Content and Peers (iFLSS)

iFLSS - Problem

Learners have problems **locating content** on the web that is **appropriate for a given learning task**. It is difficult to identify which resources can be trusted to be of sufficient quality, especially for beginners. Moreover, learners often operate in isolation, because neither teachers, nor peers are available to offer support all the time.

iFLSS - Solution

The LTfLL Common Semantic Framework (CSF) supports stakeholders in identifying, retrieving and exchanging the relevant learning material for a given learning task. The iFLSS supports the knowledge discovery process through an ontology enhanced with the vocabulary of the Community of Practice (CoP) and by recommending material on the basis of the content, tags and users belonging to the CoP. Communication is facilitated through the use of social networks and new communities of learners can be established through the recommendations provided by the system.

iFLSS - Story

I need to refresh my knowledge of Java for the implementation part of my thesis. I attended a course in the first year of the program but I have forgotten many details. My tutor told me he can recommend some online courses and books. Rather than waiting for his mail, I decide to use the Common Semantic Framework (CSF) that will help me find relevant content and people with its search system that is based on tags and users. I enter my query and various resources are returned, such as textual material (from Delicious), videos (from YouTube), and slides (from Slideshare). I can also get information on whether other people have used this content and whether I can get in touch with them. I restrict the search to people in my own network and that of my tutor. Some of these social contacts are proficient in Java development and I can contact them when I need assistance. The CSF returns as a result of my query also a fragment of an ontology which shows the relation between the terms of my query and other terms. In this way, I can find additional material and discover new related resources.

Section 8

Conclusion

Questions, Remarks, ...

Thank you for your attention!