

Titre de la thèse/Thesis title :

Real-Time Adaptation of a Training Session using Artificial Intelligence

Laboratoire d'accueil / Host Laboratory : FEMTO-ST DISC

Spécialité du doctorat préparé/Speciality : Computer Science

Mots-clefs / Keywords :

Artificial Intelligence, Deep Learning, Case-Based Reasoning, Education, Learning

Descriptif détaillé de la thèse / Job description

Context

We have been working for several years on the potential use of artificial intelligence as part of an exerciser covering several learning areas. This exerciser, called AI-VT (Artificial Intelligence Virtual Trainer) is based on different concepts of artificial intelligence and its fields of application are the learning of aikido, the basics of algorithms and English (in progress). A first convolution network determines the learner's shortcomings by analyzing one of his exam papers. Then a case-based reasoning system takes over and determines a list of exercises to offer regarding its shortcomings and considering the sessions that have already been offered by the system to this learner. For learning English, a robot is responsible for stating the exercises of the session.

For now, learners have a personalized list of exercises offered by the AI-VT system, but it is up to the teacher to check the validity of the algorithms/solutions proposed by the students and to identify their difficulties. Improving the system and the personalization of the learner's journey involves automatic correction of exercises and this without using specific training for each exercise. The definition of learner profiles by collecting traces also remains to be worked on to optimize aids and exercise sessions.

This work has been the subject of several articles in reviews and international and national conferences [3, 7, 8]. This thesis subject is part of the AI-VT research project. This project is financed by the FEDER (2021-2023, 346 K€).

Thesis Objectives

The objective of this thesis work is to consider in real time the work of the learner for a better personalization of AI-VT. This objective includes both automatic corrections so that the system can modify the exercise sheet during the session, but also the addition of help features linked to the learner's profile (reminder of method, course, solutions).

To do this, the technologies of the artificial intelligence paradigm offer multiple possible solutions [1]. Deep neural networks (Deep Learning, Convolutional Neural Network) can analyze behaviors and attitudes in real time [4], identify learner gaps [5] or even recommend sites or documents to users by analyzing their behavior [2, 6]. We therefore plan to design a tool of this paradigm to directly analyze the source codes/solutions returned by the students. However, other techniques will have to be studied to choose the most appropriate solution. These tools must be correlated with a learner profile capable of evolving in real time according to the answers provided by the user.

Scientific barriers set

The scientific obstacles addressed in the context of this research work will be:

- Automatic correction and identification of learner shortcomings in real time,
- The analysis of copies, behaviors, traces provided by the learner and the results of exercises written in natural language or in a computer programming language by the learner,
- The definition of a learner profile capable of evolving in real time during the training session,
- Real-time help and modification of a training session according to the answers given and the gaps identified,

- The ability for an AI system based on analogy and repetition to offer diversified, varied exercises, course materials or relevant aids to maintain attention and motivation while consolidating acquired knowledge.

Work plan

The first year of this research work will be devoted to identifying tools for analyzing in real time the results of exercises provided by a learner and establishing a dynamic learner profile.

A second step (which we estimate around 9 months) will consist of proposing, implementing, and evaluating a generic and innovative solution based on deep learning and/or analogy capable of analyzing the results provided by the learner and identify the gaps as well as the achievements of the latter.

Finally, a third step will consist in designing, implementing, and evaluating a tool allowing to modify the profile of the learner as well as the current exercise session. These modifications may consider all the indicators available to the system (reflection time, shortcomings identified, results of previous exercises, etc.). The system will be able to offer relevant and targeted help, duration adjustments for the resolution of a particular exercise, the repetition or deletion of one or more exercises.

In addition, the system will take care to maintain the learner's attention and motivation by balancing repetition of exercises and variations/originality. This balance between repetition and originality will consider the discipline that is the subject of the training session.

The tools proposed in this research work can be evaluated and tested with computer science students from the UFR-ST of the UFC, language students from the UFR-SLHS of the UFC as well and sports in different associations.

Références bibliographiques / Bibliography

[1] Ke Zhang, Ayse Begum Aslan. "AI technologies for education: Recent research & future directions", Computers and Education: Artificial Intelligence, 2021 – Elsevier.

[2] TB Lalitha, PS Sreeja. "Personalised Self-Directed Learning Recommendation System", Procedia Computer Science, Volume 171, 2020, pp. 583-592.

[3] Julien Henriet and Françoise Greffier. "AI-VT: An example of CBR that generates a variety of solutions to the same problem". In: International Conference on Case Based Reasoning (ICCBR) (2018), pp. 124-139.

[4] Zhao Jianqiang, Gui Xiaolin, and Zhang Xuejun. "Deep convolution neural networks for twitter sentiment analysis". In: IEEE Access 6 (2018), pp. 23253-23260.

[5] Mushtaq Hussain, Wenhao Zhu, Wu Zhang, S. Abidi, Sadagat Ali. "Using machine learning to predict student difficulties from learning session data". In: Artificial Intelligence Review 52.1 (2019), pp. 381-407.

[6] Hector Yago, Julia Clement, Daniel Rodriguez. "Competence-based recommender systems: a systematic literature review", In: Behaviour and information Technology, 2018, pp. 958-977.

[7] Julien Henriet, Françoise Greffier. "Système AI-VT basé sur l'intelligence artificielle, générateur de listes d'exercices personnalisées et variées". In: 8ème Conférence sur les Environnements Informatiques pour l'Apprentissage Humain (EIAH 2017) / Strasbourg, France (2017), pp. 397-399.

[8] Julien Henriet. "Artificial Intelligence-Virtual Trainer: An educative system based on artificial intelligence and designed to produce varied and consistent training lessons". In: Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology, DOI: 10.1177/1754337116651013, Vol. 231, Issue (2), (2016), pp. 110-124.

Profil demandé / Applicant profile

Diploma:

- Master 2, computer science preferably,
- Engineer

Required Skills:

- Development: Python, JavaScript, node.js
- Knowledge of Deep Learning (Keras – Tensorflow or PyTorch)
- English
- Experience in the field of TEL (Technology Enhanced Learning) appreciated

Preferred selection criteria:

- Knowledge, experience and mastery of artificial intelligence tools
- Knowledge, experience and mastery of programming languages Python, JavaScript, node.js

Personal characteristics:

- *Serious*
- *Method, organization*
- *Attendance*
- *Punctuality*

Financement : MESRI Etablissement

Deadline for the candidature: **May 13th, 2022, 4 p.m.**

Start of contract: October 1st, 2022

Gross monthly salary: 1975€

Direction de la thèse:/ Thesis Supervisor

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Applicants are invited to submit their application to the PhD supervisors.

Application must contain the following documents:

- CV
- Cover letter
- At least 1 reference letter
- Last obtained diplomas or certificate of achievement
- Academic transcripts of the last 2 years