Determination of human personality using multi-agent paradigm

Détermination de la personnalité humaine à l'aide d'un paradigme multi-agents

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Résumé

Dans le cadre d'un projet de recherche intitulé "Elaboration d'une Communauté d'étudiants Virtuels pour communiquer avec une plate-forme d'apprentissage en ligne", nous avons proposé la conception d'une Communauté d'étudiants virtuels (CEV) pour simuler le comportement d'un groupe d'étudiants humains, permettant de minimiser le coût élevé de charge et d'organisation d'une expérimentation en contexte réel.

Afin que les étudiants virtuels puissent le plus fidèlement possible représenter des étudiants humains dans leur diversité, nous nous sommes confrontés à la notion de profil et type de personnalité pour un agent informatique. Cet article décrit le concept de notre proposition pour l'intégration des profils psychologiques ou type de personnalité dans le développement de la communauté d'étudiants virtuels.

Abstract

In the current research work "Development of a Virtual students Community to communicate with an e-learning platform", we suggested a virtual student community (VSC) that will substitute a group of human students, which will minimize the support and organization cost.

In order to make virtual students able to represent as faithfully as possible human students in their diversity, we were confronted with the notion of profile and personality type for a computer agent. This article describes the concept of our suggestion for the integration of psychological profiles or personality types in the development of a virtual student community.

Mots-clés

Communauté d'étudiants virtuels, système multi-agents, intelligence artificielle, agent normatif, type de personnalité, profil, communication, E-Learning.

Keywords

Virtual Student Community, multi-agent system, artificial intelligence, normative agents, personality types, profiles, communication, E-learning.

1. Virtual Student Community and Personality Types

E-learning platforms are growing fast and becoming mature and more sophisticated, but their role remains very sensitive. It requires a good evaluation before being put online for specific or public use. To address this problem, evaluation systems have emerged and offer a multitude of statistics in order to monitor and improve the performance of these platforms.

Assessment methods are mostly based on recommendations, test schedule, evaluation steps to be applied manually by testers. They require presence of tutors or intelligent tutoring system (ITS), as well as one or several teams of students to carry out activities on platform. There are many evaluation tools for learning management system (LMS), with different approaches and solutions, such as Sagitec Solutions (Sagitec Solutions, 2016), free Excel-based tool featuring detailed recommended evaluation criteria and more, LMS Evaluation Checklist (Centre for Distributed Learning, 2016). Many other websites propose recommendations lists to help evaluating outcomes, performance and user acceptance of LMS training program (WBT, 2016).

Within the scope of active pedagogies, assisting tutors in collaborative work analyze interactions between students using an e-learning platform. They are new tools aiming to improve such experience, as described by Oumaira (Oumaira et. al., 2011). Such instruments can also be extended to help learning students. The need for a group of students and tutors to conduct exchanges via a LMS in order to extract statistics makes the evaluation action costly and, above all, long if good quality results are sought.

We proposed a virtual student community that will substitute real groups of students. The virtual students (VS) focus only on the task of exchange with the platform and can run at a high frequency to minimize the evaluation time (Rhaimi and Messoussi, 2014). The virtual student community (VSC) is very flexible as we can define the number of individuals (VS agents) within at will. VSC can be divided by subgroups with different profiles, and it is always operational. VSC also allows a detailed follow-up of actions carried out by its agents.

Our focus, here, is on the Virtual Student's profiles module. The goal is to integrate psychological profiles to simulate different communication behaviours, so that each Virtual Student simulates at best a human profile, making VSC closer to reality substitution of a human community. The profiles we want to make available to Virtual Students are based on the 16 personalities of Isabelle Briggs-Myers and Katherine Cook Briggs and Carl Gustav Jung.

In this article, we describe the concept of personality type of an intelligent agent within our Virtual Student Community system. Therefore, we make a brief review of Virtual Student Community system background, its objectives, and then we describe the work purpose. We also review Jung's and Myers-Briggs' works before showing the result of our online survey and linking it to Plety's work in order to get personality types and categories we need to implement into Virtual Students.

2. Personality types : theoretical background

In the scope of analytical psychology, Carl Gustav Jung (1875-1961), a Swiss psychiatrist, has conducted many theoretical researches about psychological types. According to Jung's theory of psychological types (Jung, 1971), people can be characterized i) by their general attitude i.e. Extrovert (E) versus Introvert (I), ii) by their preference for one of the two perceptual functions i.e. Sensation (S) versus Intuition (N), and iii) by their preference for one of the two judgment functions i.e. Thinking (T) versus Feeling (F). The three preferences domains introduced by Jung are dichotomies (bipolar dimensions where each pole represents a different preference). Jung also proposed that a person has one dominant function, either a perceptual or a judgment one.

Isabel Briggs Myers, researcher and practitioner of Jung's theory, proposed to look at the judgment-perceived relationship as a fourth dichotomy that influences personality type (Briggs Myers, 1980) : Judgment (J) versus Perception (P).

> *The first criterion*, **Extroversion E – Introversion I**, means the source and direction of the expression of a person's energy. The source and direction of the expression of the energy of an extrovert is primarily in the outer world, while an introvert has a source of energy primarily in its own inner world.
>
> *The second criterion*, **Sensation S – Intuition I**, represents the method by which a person perceives information. Sensation means that a person primarily believes information that it receives directly from the outside world. Intuition means that a person primarily believes information that it receives from the internal or imaginative world.
>
> *The third criterion*, **Thinking T – Feeling F**, means that a person makes a decision primarily through logic. Feeling means that a person makes a decision based on emotion, namely on the basis of what it feels to do.
>
> *The fourth criterion*, **Judgment J – Perception P**, reflects how a person implements the information it have processed. Judgment means that a person organizes all its events in life and, as a rule, holds to its plans. Perception means that it is inclined to improvise and explore other options.

All possible permutations of preferences in the above four dichotomies result in 16 different combinations, or personality types, representing which of the two poles in each of the four dichotomies is dominant, thus defining 16 different personality types. Each type of personality can be given an acronym of 4 letters (Myers-Briggs Foundation, 2017a):

- ESTJ – Overseer
- ESFJ – Supporter
- ISTJ – Examiner
- ISFJ – Defender

- ESTP – Persuader
- ESFP – Entertainer
- ISTP – Craftsman
- ISFP – Artist

- ENTJ – chief
- ENTP – Originator
- INTJ – Strategist
- INTP – Engineer

- ENFJ – Mentor
- ENFP – Advocate
- INFJ – Confidant
- INFP – Dreamer

Each type belongs to a family of arch-type and has some distinctive characteristics such as temperament, strategic role and quality (Table 1). Recent researches give us the percentage in the world population (Center for Application of Psychological Type, 2016) and (Myers-Briggs Foundation, 2017b).

Type	Family	Temperament (seeking)	Strategic role (works with)	Major Characteristic	Quality	% population
ESTJ	Guardians (SJ)	Security	Material	Regulate	Apply	8-12%
ESFJ	Guardians (SJ)	Security	Material	Support	provide	9-14%
ISTJ	Guardians (SJ)	Security	Material	Regulate	Certify	11-14%
ISFJ	Guardians (SJ)	Security	Material	Support	Protect	9-13%
ESTP	Artisans (SP)	Sensations	Tools	Facilitate	Persuade	4-5%
ESFP	Artisans (SP)	Sensations	Tools	Improvise	demonstrate	4-9%
ISTP	Artisans (SP)	Sensations	Tools	Facilitate	Instrument	4-6%
ISFP	Artisans (SP)	Sensations	Tools	Improvise	Synthesize	5-9%
ENTJ	Rational (NT)	knowledge	Systems	Organize	Mobilize	2-5%
ENTP	Rational (NT)	knowledge	Systems	Construct	Invent	2-5%
INTJ	Rational (NT)	knowledge	Systems	Organize	Implicate	2-4%
INTP	Rational (NT)	knowledge	Systems	Construct	Conceive	3-5%
ENFJ	Idealists (NF)	Identity	Persons	Develop	Educate	2-5%
ENFP	Idealists (NF)	Identity	Persons	Arbitrate	Motivate	6-8%
INFJ	Idealists (NF)	Identity	Persons	Develop	Guide	1-3%
INFP	Idealists (NF)	Identity	Persons	Arbitrate	Consul	4-5%

Table 1. Personality types characteristics

3. Virtual Students' Profiles

3.1. Virtual Student' personality type

Virtual student is BDI agent who has a Belief – Desire – Intention mechanism in place and an open commitment strategy (Wooldrige, 2000) that rules his actions. Open commitment means that an agent maintains its intentions as long as they are also his desires, and once an agent has concluded that his intentions are no longer feasible, he no longer considers them as part of his desires. The other types of commitment are Blind and Limited commitment: an agent will keep his intentions until he believes they are made. This strategy is not the best if the environment changes between when he selected (filtered) his intentions, and the time these intentions must be completed (Rhaimi and Messoussi, 2014). We have chosen open commitment strategy, as it is by definition the most representative of human behaviour.

Goal in life is the object of a person's ambition or effort, an aim or desired result. The BDI model has been originally proposed by Bratman (1987) as a philosophical theory of the practical reasoning, explaining human reasoning with the following attitudes: beliefs, desires and intentions. This theory relies on goals as Desires, and stores the information of the goals to be achieved, as well as properties and costs associated with each goal. They represent the motivational state of the system.

We have chosen BDI architecture because it relates more to human behaviour. Its important aspect is the option of commitment to previous decisions. A commitment embodies the balance between the activity and goal-directedness of an agent-oriented system .In a continuously changing environment, commitment lends a certain sense of stability to an agent's reasoning process. This results in savings in computational effort and hence better overall performance (Rao, 1995).

Here, we sum-up Virtual Student's main preferences as follows:

1. Number of goals,
2. Commitment to his goals,
3. Number of communication connections with other virtual students,
4. Number of requests,
5. Number of responses.
6. Compliance with virtual student community standards (can be assessed as a percentage by virtual students' type).

Number of goals in a period of time varies from a person to another; we consider a minimum of initial goals per virtual student (equal to 3).

In order to link this profile to a personality type, we conducted an online survey among students (Rhaimi and Messoussi, 2015), and we were able to obtain the data for each type of personality. In result, we have managed to add more preferences (connections per day, requests, responses, retry attempts, percentage of community norms' respect) for each personality type.

Survey description

The participant takes a test which consists of several multi choices questions to determine his personality type (optional if he knows it already). Then, he responds to a 6 questions quiz related to previous virtual students' new preferences. We made the quiz as easy and short as possible to get more participants and feedbacks. After submitting a response, we link participant's preferences to his personality type. We managed to get over 400 participants results. The table 2 shows average values for each preference according to a personality type.

Type	Age	Connections per day	Requests	Responses	% norms' respect	Retry attempts	Description
ENFP	20	9	3	1	67	5	Advocate
ESFJ	22	7	2	1.5	65	3.5	Supporter
ESFP	26	6.5	1.5	1	53	2.5	Entertainer
ESTJ	25	8.33	3	2	69	4	Overseer
...							

Table2. Extracted from personality type survey results

These results are processed and inserted into the database of virtual students' creation module to be ready for use. When creating a virtual student, user is prompted with a list of personality types: for example, code ESTJ, description Overseer, preferences, recommended percentage of population and actual percentage in virtual system community. User may respect the real percentages of a type in world population to better simulate real interactions with E-learning platform, or choose to change rates to target a specific behaviour.

This process gives us a virtual student based on a true human profile, which makes the VSC more representative of a real group of students.

We want to go even further and create categories or profiles for previous personality types in order to use them directly in distant learning context, thus behavioural profile comes in play.

3.2. Virtual Student Behavioral profile

Based on three fundamental metrics in intra-community interaction (Volume of interventions, Types of interventions and Reactions of others to interventions), Robert Pléty (1998) was able to identify four major profiles that speakers can play.

Younes Chaabi (Chaabi, 2016) later re-adapted these profile to distant learning context as:

- **Moderator**, that makes a proposal, posts a message of organization and/or encouragement and intervenes to calm a conflict.
- **Inspector**, that reacts to or evaluates a proposal. He can also propose.
- **Seeker**, that do not make a proposal. He asks questions or expresses doubts on an approach or proposition (rather negative spirit).

- **Independent**. His intervention seems out of step with current discussion

and often not followed by reactions from other members of the group.

We added Solver profile (proposes solutions, asks few questions and is very reactive to others) to be able later to encompass all types of personality in these profiles.

In the table 3, the four profiles are presented using a simple scale (1 to 5) as metrics.

Profile	Interventions Volume	Interventions type				Reactions to others actions
		Question	Response	Organization/ Intervention	Evaluation	
Moderator	5/5	40 %	20 %	40 %	0 %	5/5
Inspector	4/5	20 %	40 %	0 %	40 %	2/5
Seeker	2/5	0 %	100 %(as questions)	0 %	0 %	5/5
Independent	1/5	50 %	50 %	0 %	0 %	1/5
Solver	3/5	20 %	80 %	0 %	0 %	5/5

Table 3. Students profiles adapted from (Chaabi, 2016)

To establish a correlation between the personality types of Jung & Myers and Pléty's profiles from previous results, we simply matched both characteristics (tables 1, 2, 3, and detailed descriptions of personality types from Myers-Briggs work (Myers-Briggs Foundation, 2017b) and (NERIS, 2017).

Type	Characteristics							Associated Profiles
	Propose submit	Question ask	Respond share consul	Organize control	Evaluate approve reject	React confirm supporter	Resolve give solution	
ESTJ			X	X		X	X	Moderator/Solver
ESFJ			X			X		Independent
ISTJ	X				X			inspector
ISFJ						X		Independent
ESTP	X	X						Seeker
ESFP	X					X		Independent
ISTP			X				X	Solver
ISFP	X					X		Independent
ENTJ	X			X	X			moderator
ENTP		X						Seeker
INTJ		X	X			X		Independent
INTP	X		X		X			inspector
ENFJ	X		X	X	X		X	Moderator/Inspector
ENFP			X			X	X	Solver
INFJ			X			X	X	Solver
INFP						X	X	Independent/Solver

Table 4. Categories, personality types and key actions

3.3. Implementation

The overall architecture of the virtual students community is presented below, implemented (ongoing, beta phase) in a multi agent system environment JADE, using:
- Lucene as an index search engine,

- a custom web-crawler designed for our VS to search and catalogue unstructured data,
- a Postgresql DBMS to back up and maintain structured data, including profiles and personality types.
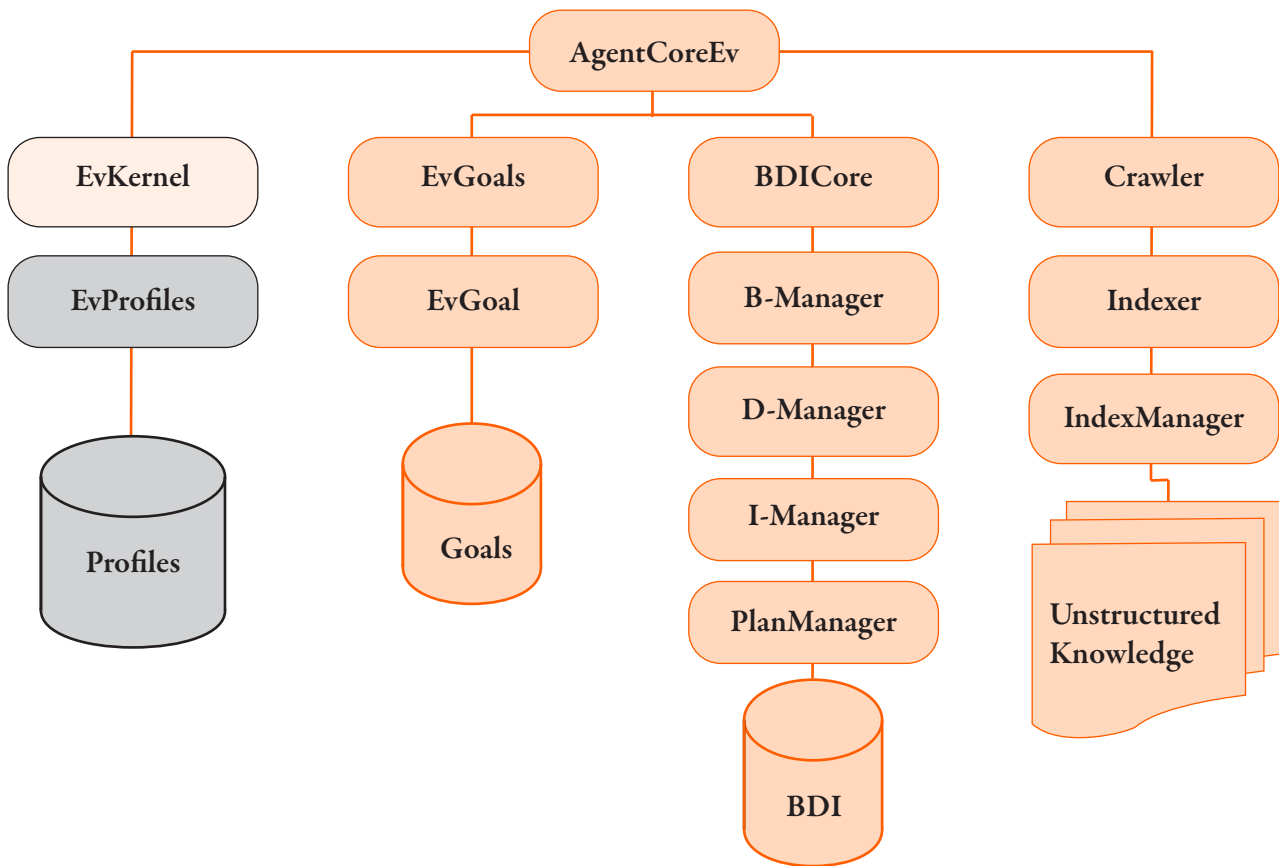

Figure 1. Virtual Student implementation structure

We are interested here in the Profiles module. The profiles module is directly linked to the virtual student core via EvKernel module, which role is to read configuration files and initialization data from Database, before sending it to interface module for display. The profiles and types of personalities are integrated first into the database (fig. 2). Users are then provided with lists of choices when creating a virtual students' agent via dedicated interface (fig. 3). The platform also allows the addition of custom profiles and customized types to perform specific simulations.
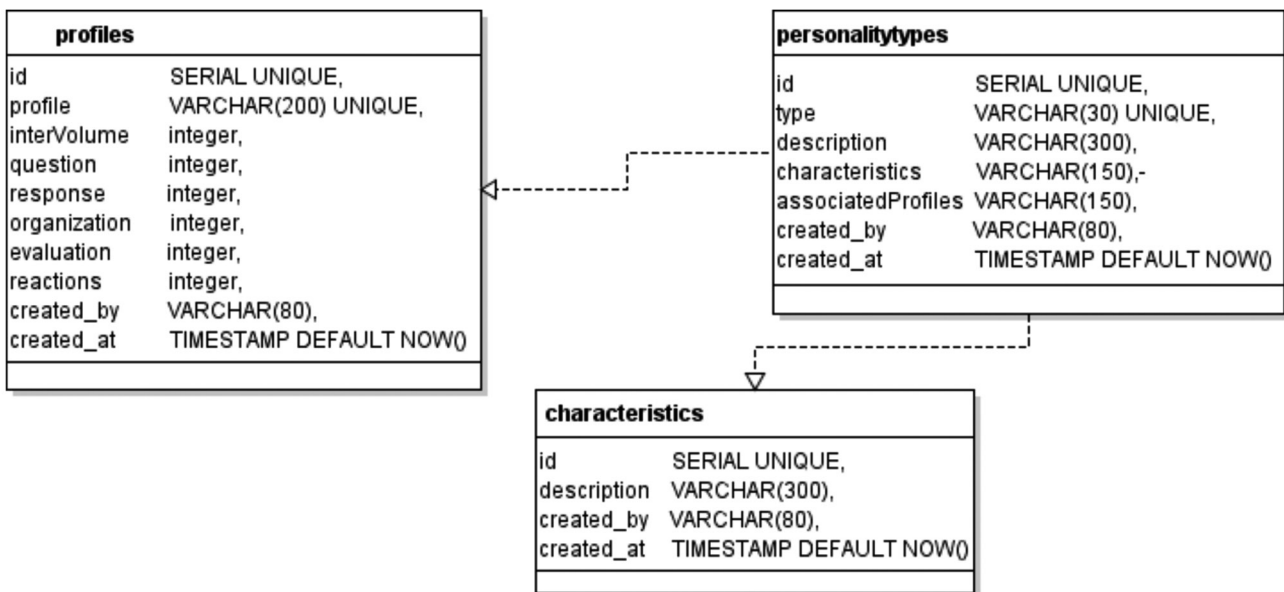

Figure 2. Profiles and types database tables (version beta 0.6)

Personality type characteristics and agent's goals (from EvGoals modules) will be transmitted to DBI core module to use, thus influencing virtual student's behaviour when making plans. The CoreEv agent will execute these plans using Crawler module to search and index target platform pages and data, and Action module (work in progress) to act/react to others via the platform provided tools.
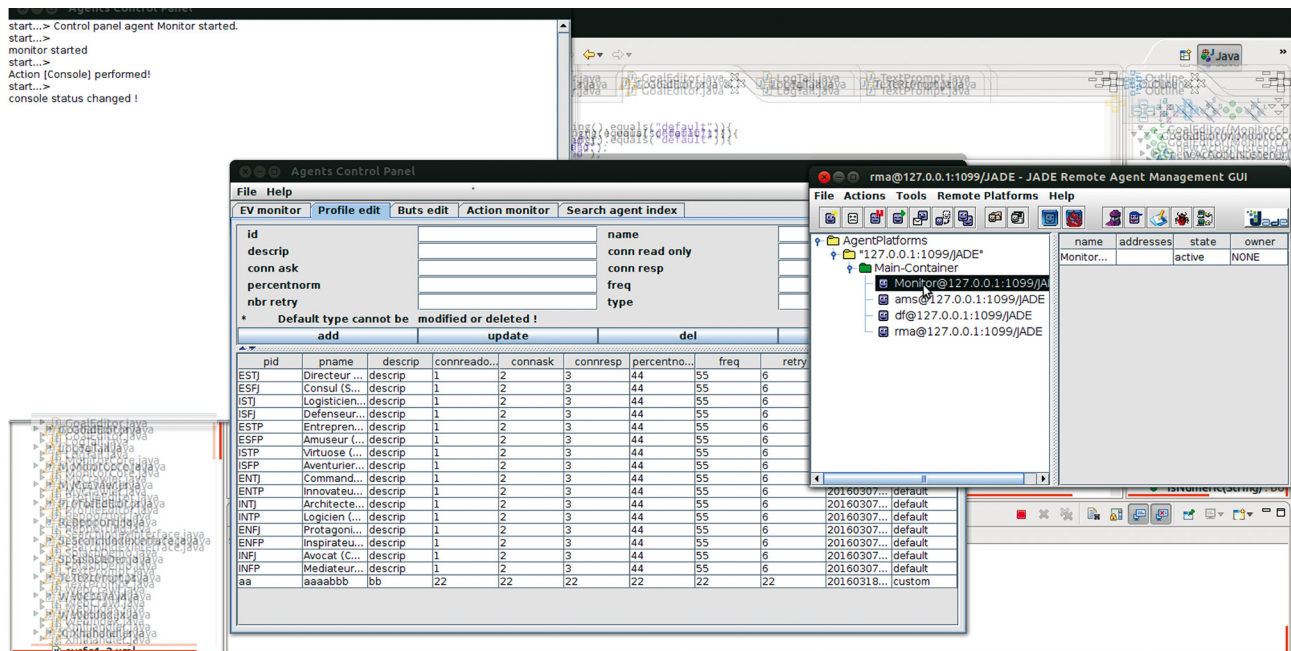

Figure 3. Profile interface (version beta 0.6)

4. Conclusion

The integration of personality types to forge profiles of virtual students is a forward step in representing as best as possible a human students' community. It adds a layer to human personality on-top of the BDI model, the decision making strategy, and the artificial intelligence core of our artificial agents.

Moreover, a sample that respects the real percentages of a type in world's population simulates better interactions between students via E-learning platforms. We are currently implementing the profiles module and testing exchanges between autonomous agents, each one with a different personality type.

Furthermore, we plan to improve the virtual students community, by implementing a conscious model for its intelligent agents, in addition to a learning module making it more versatile and robust. This module could be used to simulate interactions with far more complex platforms in the future.

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