Using a Chatterbot as a FAQ Assistant in a Course about Computers Architecture

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***Abstract*— This Research to Practice Work in Progress presents a chatterbot used as a frequently asked questions assistant for students that follow a Computers Architecture course in the degree of Telecommunication Engineering Technology at the University of Vigo (Spain). The chatterbot is a conversational agent that interacts in natural language with the students. This agent will be in charge of doing the tasks, usually carried out by the teachers, such as answering the students' questions and solving the common doubts that arise over and over again in every academic year. The bot is being developed in AIML (Artificial Intelligence Markup Language).**

Keywords—AIML; assistant systems; autonomous learning; chatterbots

I. INTRODUCTION

Based on years of experience teaching Computers Architecture in the first year of the degree of Telecommunication Engineering Technology at the University of Vigo (Spain), the teachers of this subject have been gathering together a collection of questions that students ask along the years over and over again. From this experience, the teachers conceived the development of a repository of Frequently Asked Questions (FAQ) made up by the set of all these questions and their corresponding answers. The goal is that students can search for information in an autonomous way and from several devices, without the direct intervention of the teacher to solve their doubts.

This goal is being approached through the use of a conversational agent, a chatterbot [1], to interact in natural language with the students. This agent will be in charge of answering the students' questions and solving their common doubts related to the considered subject that arise every year, as teachers usually do. In the case of Computers Architecture subject, the majority of questions and doubts are about the use of an assembling language emulator that the students use in the lab sessions. For instance, questions such as: "How can I install the emulator in my Linux system?", "Why can`t I see the ASCII characters in memory?", "Where is pointing the stack pointer when I pop something from the stack?", etc.

The proposed FAQ assistant system has two main parts oriented to teachers and students respectively:

- The teachers' tool is a web management system to manage the repository of frequently asked questions. Thanks to this tool teachers can create, modify, and erase questions, and its corresponding answers, from the repository. These answers are not limited to be a simple sentence in raw text, but they are stored in HTML format, and they can be accessed through a simple web browser. Therefore, they can include multimedia content (video, images, audio records, animations), and links to external web resources. Besides, this tool also includes an AIML editor.
- The tool for students is a web page that includes the conversational agent itself. The chatterbot interacts with the students in natural language. It is being developed in AIML (Artificial Intelligence Markup Language) [2], which is one of the most used languages for developing chatterbots in the last years. When the bot receives the input of a student, usually as a question, it looks for an appropriate response in its knowledge base, linked to a document in the repository of questions. This document will be the answer provide by the chatterbot to the student. In this way, the students can ask the chatterbot in natural language all kind of questions related to the course they are following.

The final objective of the system is twofold. On the one hand, to free teachers from the tedious task of answering the same questions that the students ask repeatedly year over year. On the other hand, to allow students get a quick answer to their questions, at any time and place, without the need of contacting the teacher directly. This is important to support a more autonomous learning approach.

The structure of the paper is as follows: section II is a brief introduction to chatterbots; section III and IV are dedicated to the teachers' and students' tools respectively; finishing the paper with some conclusions and future work.

II. CHATTERBOTS AND AIML

The AIML language is a widely used technology to develop chatterbots. This language was developed by Richard Wallace and the Alicebot open source community. AIML produces XML text files with a specific structure, which constitutes the knowledge base of a conversational agent. The "brain" of the bot consists of a set of AIML files. The basic knowledge units of the chatterbots' brain are called "categories", and they are made up by at least two elements: the "pattern" and the

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"template". In general, the behavior of a conversational agent that uses AIML language is based on a stimulus-response model. The user's input (stimulus) matches the pattern, and the bot will show to the user (response) the associated template to such pattern (Fig. 1).Besides these two mandatory elements (pattern and template), the categories may contain several optional elements (wildcards, context information, operative system calls, links, etc.), which allow the bot to develop all its potential.

There are two additional main parts of an AIML chatterbot: (i) the Bot-User Interface, which is a text area where the bot shows the messages of the conversation; and (ii) the Interpreter, in charge of analyzing the inputs provided by the user and finding the right response action from the knowledge base of the bot.

III. Teachers' Tool

This part of the system allows the teachers to carry out a complete management of the frequently asked questions and their associated answers. These answers can include several elements, such as video, audio, animations, and links (all of them embedded into an HTML web page format). Besides, teachers can also manage the brain's contents of the chatterbot related to those FAQ. To do this, using a web browser, teachers can access several parts of the system for creating, modifying, and erasing questions/answers; and also for editing the chatterbot's base of knowledge.

A. General Management of Questions and Answers

The actions that teachers can carry out will be, as we said before, creating, modifying, and erasing questions and answers.

Both the creation of a question/answer and the possible modification of one of them imply several very similar actions. In the creation case, a blank form is shown to the teachers. They have to fill in with the appropriate content. In a modification, the same form will be shown, but this time it will be initially fulfilled with the data of the question/answer to modify (as a result of a previous searching).

Erasing a question/answer simply implies to search that question/answer to erase and proceed with its elimination. This action implies both the elimination of the information from the FAQ repository and from the chatterbot's brain.

1) Creation of a question/answer

To carry out this action a blanked form is presented to the teacher. Then, he/she has to fill in with content. A screen capture of this form is showed in Fig. 2 (in Spanish, because the tool is being developed in this language).

In this figure we can see a zone where the teacher has to write the title of the question that he/she wants to add to the system. This title can be unique or not, i.e. the teacher can add several alternative titles for a question, and all of them will be associated to the same answer.

A very important part of the creation of a question/answer is the definition of several associated keywords. Every question must to have one or more associated keywords. They will be used by the chatterbot to find the appropriate answers to the questions the students ask. These keywords can be provided in two different ways:

- Directly by the teacher. He/she fills this field with the words (separated by comas) that he/she thinks better match the subject of the question.
- Through a syntactic analyzer applied over the title of the question. The keywords obtained by this method will be added automatically to the ones proposed by the teacher.

Addressing the answer, there are several fields in the form that allow to add text, images, audio, video, animations, and links to external resources. Every time the teacher adds some of these elements to the form, that element is automatically shown in the page (below the form). In this way, the teacher can see in real time the appearance of the page. At the same time, any one of these added elements can be deleted directly from this preview.

```
<category>
        <pattern>
                <!– User's input model -->
        </pattern>
        <template>
                <!– Chatterbot's reaction -->
        </template>
</category>
```

⇩

```
<category>
        <pattern>
                Do you have any information about loops?
        </pattern>
        <template>
                Of course, I know plenty of things about loops.
        </template>
</category>
```

Fig. 1. AIML

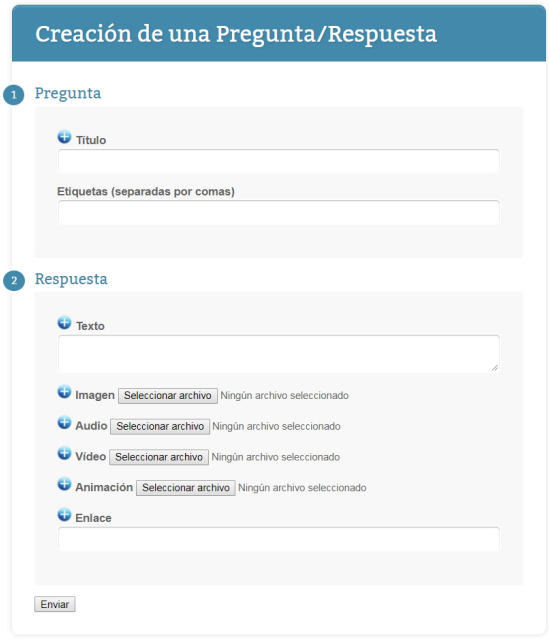

Fig. 2. Creation of a Question/Answer

When the teacher finishes adding information to the form and sends it to the system, two actions are being carried out:

- Storage of the information from the sent form in a repository (database). This storage is made in two phases: first, the title and the keywords of the question; and second, the answer. This answer is stored in HTML format, as a web page composed by all the elements the teacher added to it.
- Update of the chatterbot's brain taking into account the new content. This update implies adding to the bot's knowledge base a new category associated to the new question/answer. When a student asks a question that can be related to the new question through its keywords, the chatterbot will be able to show him/her the right HTML page as an answer. To do this, the system incorporates in the pattern of the new category information about the keywords of the question, and in its template a link to the HTML web page to be shown.

2) Modification of a question/answer

The modification of a question/answer implies several actions very similar to the creation. The only difference is that the form shown to the teacher (and the previsualization area) will not be empty, but it will have the information stored of the question/answer to modify. When the modification is done, the content in the repository and in the chatterbot's brain will be updated if it is necessary (for instance, it will not be necessary to update the bot's knowledge base if the keywords or title are not modified).

B. *Management of Questions in the Chatterbot*

Every time a new question/answer is created, new AIML code (a category) is added to the chatterbot's brain. In this way, the bot is capable of "understanding" a student that asks a question related to that question/answer. Besides, it is possible that teachers with knowledge about AIML want to edit the code that is automatically added.

In this way, they can refine the code to improve the understanding of the bot. To do that, it is being developed an AIML editor (Fig. 3, in Spanish because the tool is being developed in this language) to allow the teachers to edit those questions/answers they think that can improve the chatterbot's behavior (for instance, because they think that the automatic process that made the category in the bot's brain can be improved). As a simple example of this kind of edition we can point out the use of wildcards in the pattern of a category to increase the possibility of understanding a question made by a student.

IV. Students' Tool

The system works as an assistant for students in their learning processes, with the final objective of making a student able to ask questions about a course. The student can carry out this accessing a web page (using an internet browser) where the chatterbot is waiting for him/her to ask a question in natural language.

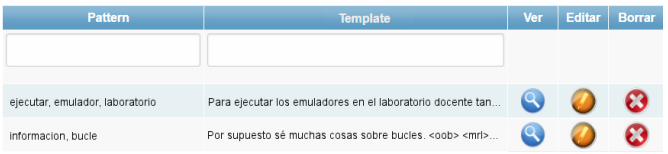

Fig. 3. Screen capture of the AIML editor

Fig. 4 shows a screen capture of the students' tool, which is divided into two main areas (in Spanish because the tool is being developed in this language):

- On the right side there is a conversation zone with the usual design that we can see in instant messaging applications widely used nowadays. At the bottom of this area there is a textbox where the student can write the text he/she wants to send to the chatterbot (with a button to send it). Above this, the system shows the recent conversation between the student and the bot, with a corresponding profile photo next to their respective texts (to easily know who is the author of the text).
- On the left side the system shows to the student the content of the answer (the HTML web page stored in the repository of FAQ) that the bot estimates as the most appropriate to answer the student's question. As we said before, the chatterbot is capable to find this answer through the categories stored in its knowledge base.

From the point of view of the student, the use of the tool will be as easy as accessing the web page and log in (so, the chatterbot can recognize him/her). Once the bot greets the student, he/she can start asking it questions through the chat frame. Then, the bot will show him/her the contents at the left side of the same web page.

V. Conclusions and Future Work

In this paper we have presented a system to help both students and teachers in the process of asking and answering frequently asked questions belonging to a course about Computers Architecture in the first year of the degree of Telecommunication Engineering Technology at the University of Vigo (Spain). The system helps students in their learning processes, making them more autonomous, and place and time independent. Teachers get benefit too, because they avoid the repetitive task of answering the same questions over and over again every academic year. The system is able to answer the doubts the students have course over course. Questions that teachers usually answer repetitively in the classroom or in their offices (both in person and online).

To do that, the system has a conversational agent to interact in natural language with the students, and a repository of frequently asked questions (with their correspondent associated answers).

Through the use of specific tools, teachers are able to manage questions/answers in the system's repository, and the information that the bot needs in its knowledge base.

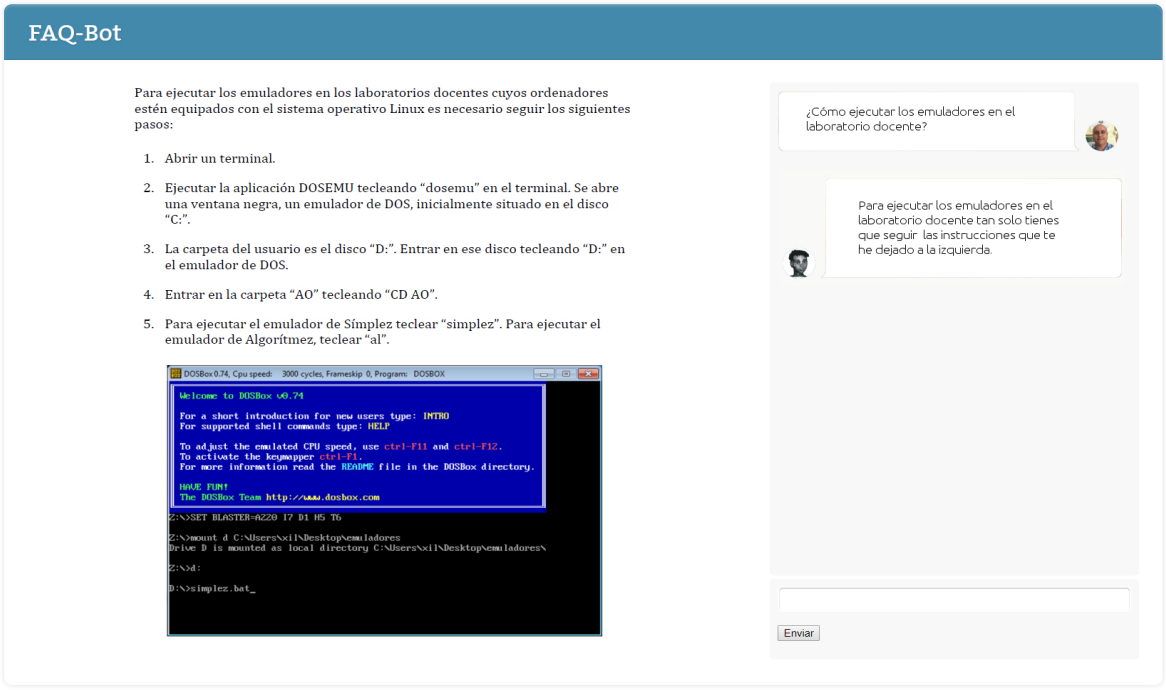

Fig. 4. Students' tool

The students can have a conversation in natural language with the chatterbot, and so they can ask to the bot any questions about the matter of the course they are following, getting access to the appropriate answers for the questions they ask. These answers will be found by the chatterbot and shown as a web page next to the conversation itself.

Thanks to our system, teachers can save time usually dedicated to answer frequently asked questions to the students, and students can resolve their doubts quickly, in any moment they were learning because the bot is always ready to help them (the teachers are available only in an specific time), and in any place (not only in the classroom or in the teacher's office). In this way, the learning process of the students will be more autonomous, and independent from time and place.

As future work, in addition to carry out the development of the system with all the functionalities that are detailed in the paper, we are thinking about measuring the effectiveness of the chatterbot introducing a scoring system of the answers given by the bot. So, every time the chatterbot shows an HTML page as an answer, the student can score that answer with 1 to 5 stars, according to his/her level of satisfaction. Later, the teacher can check that score (in his/her management tool) and if he/she consider that it is low, he/she can try to make some improvements.

We are also planning to use the conversational agent in a MOOC on Computers Architecture that we are currently developing. This MOOC will serve as support to students who follow the course. The role of the conversational agent in the MOOC will be the same as the one described in this paper, helping the students to resolve any doubts that may arise through the MOOC. The idea is that the chatterbot is always active in the browser used by the students to follow the MOOC, and in this way they will be able to ask the questions related to the part of the MOOC in which they are at any time.

Finally, just point out that the presented system is a part of a bigger one called BeA [3], which has been developed by the authors and used along the last years in a course of Computers Architecture. Briefly, the system is an assessment solution that supports both teachers evaluating and students accessing and reviewing their assessments on line, anytime and anywhere. Students perform their exams in paper, but the assessment made by teachers and reporting of results to students is performed on-line using scanned copies of the papers. It includes functionalities allowing teachers to classify and manage common errors, guaranteeing coherence and consistence along the assessment process.

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REFERENCES

[1] A. M. M. Neves, I. Diniz, and F. A. Barros, "Natural language communication via aiml plus chatterbots," V Symposium on Human Factors in Computers Systems (IHC 2002), pp. 329-346, 2002J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[2] R. Wallace, "The elements of aiml style," URL: https://files.ifi.uzh.ch/cl/hess/classes/seminare/chatbots/style.pdf, 2003.

[3] M. Llamas-Nistal, M. J. Fernández-Iglesias, J. González-Tato, and F. A Mikic-Fonte, "Blended e-assessment: Migrating classical exams to the digital world," Computers & Education, vol. 62, pp. 72-87, 2013.