The Generalized Intelligent Framework for Tutoring (GIFT) as a Tool for Human Factors Professionals

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The Generalized Intelligent Framework for Tutoring (GIFT) is an open-source domain-independent intelligent tutoring system (ITS) framework. It provides the tools and capabilities to design a complete ITS, manage student instruction, and serve as a testbed for experimentation and analysis. GIFT was developed to provide a cost-effective and efficient means for developing ITSs that have interchangeable parts and can be reused. Additionally, GIFT provides the ability for human factors professionals to develop and run complete experiments in a computer-based environment. This demonstration will provide an introduction to GIFT, along with the motivation behind its design. Further, a demonstration of the tools that are useful to human factors practitioners and psychologists will be provided, and examples of courses that have been developed using GIFT will be shown.

INTRODUCTION

Computer-based instruction has become an important component in the way today's students learn. Online and computer-based college courses are becoming common, and require students to interact with provided material at their own pace, and to regulate their own learning in lieu of live instruction (Azevedo & Hadwin, 2005). This shift from traditional classroom instruction to online and computer-based learning has created new issues and considerations that need to be taken into account when designing learning materials (Dabbagh, 2003). With this shift in educational practice, it is more important than ever to keep students engaged, since they are the one determining how much time and effort they spend with the material.

The use of intelligent tutoring systems (ITSs) is an approach that can be extremely useful in traditional, online, and mixed-mode classes. From a theoretical perspective, ITSs are designed to provide customized learning experiences that adjust for an individual student's performance, and can lead to learning outcomes that are as effective as one-to-one human tutoring (VanLehn, 2011). ITSs can be utilized in traditional classes for specific lessons/practice, and can even be used to provide focused instruction in an entirely online class. However, despite the increased availability of technology such as computers and tablets to support student learning, it is often costly and time-consuming to develop ITSs. Further, they are often designed for a very specific application, which makes it difficult to reuse the systems with new content and materials (Picard, 2006). Additionally, ITS development is an interdisciplinary endeavor, oftentimes requiring a team of computer scientists, cognitive psychologists, instructional system designers, and systems engineers.

Ideally, an ITS would be designed by an individual instructor to include material that is specific to his or her course. The tools and methods an instructor uses to design a course should be straightforward, and understandable without a background in multiple disciplines associated with the field. The instructor should be able to determine how material is presented to the student, the assessments that are used to gauge competency, and the feedback presented based on student performance. The Generalized Intelligent Framework for Tutoring (GIFT) is being designed to assist in making these goals a reality.

GIFT is a freely available open-source domain-independent ITS framework based on modular components, and can be downloaded from www.gifttutoring.org. GIFT was designed to provide a cost and time efficient means to create intelligent tutoring functions across any computer-based educational environment. It includes tools that are intended for use by a range of different users, including researchers, instructional designers, instructors, and students. A current goal of GIFT is to make the included tools more user-friendly and accessible to individuals with varying backgrounds and to produce a number of different functions.

One of the major drawbacks of traditional ITSs is that they are tightly coupled to the topic they are tutoring, and lack the flexibility to make adjustments to associated learning materials (Picard, 2006). However, GIFT is designed as a domain-independent architecture, which provides standardized approaches for authoring ITS capabilities. This approach promotes reusability of components and materials, and leads to shortened developmental timelines for authored ITSs.

The authoring goals which serve as a motivation for GIFT's design were developed from Murray (1999; 2003), and Sottilare and Gilbert (2011). This domain

independence allows an instructor to design an intelligent tutor and course in one domain (e.g., math), and then subsequently produce an additional tutor (e.g., physics) by making adjustments to the original tutor and changing the content that is provided to the student. For instance, instruction in the form of PowerPoint presentations can easily be switched out in tutors that are developed with GIFT. This integration of PowerPoint can facilitate reuse of materials, and make it easy for instructors to integrate their previously developed course materials into GIFT courses.

GIFT has a number of different functions that are complimentary to the development of ITSs. Of particular interest to human factors professionals is the use of GIFT as an experimental testbed. The flexibility and ease with which an individual can modify content and pedagogy using GIFT allows for experiments to be run that examine the effectiveness of specific material and configurations. Additionally, GIFT offers the ability to provide focused feedback to users, give guidance, open and close programs, and give users surveys. In this context, GIFT can be used to develop and run traditional psychology experiments in controlled computer-based environments without intervention from an experimental proctor. GIFT can manage an entire procedure, which reduces the amount of time effort an experimental proctor expends, and can result in the ability to run multiple participants during a single experimental session.

DEMONSTRATION

As part of this demonstration, we will present the rationale behind the development of GIFT, provide an explanation of the gap that it fills in the education/research community, and give an overview of the different functions that GIFT currently offers (e.g., ITS development, experimental testbed). Additionally, we will provide brief demonstrations of the authoring tools (e.g., course authoring tool, survey authoring system, event reporting tool, etc.) that may be of use to human factors professionals who wish to create courses in GIFT and evaluate their effectiveness. Further, we will demonstrate an example of a course/experiment that was developed using GIFT. See Figure 1 for a screenshot example of GIFT integrated with a serious-game training application, and Figure 2 for a screenshot example of GIFT's survey authoring system interface.

Figure 1. A screenshot of GIFT integrated with a serious game training application.

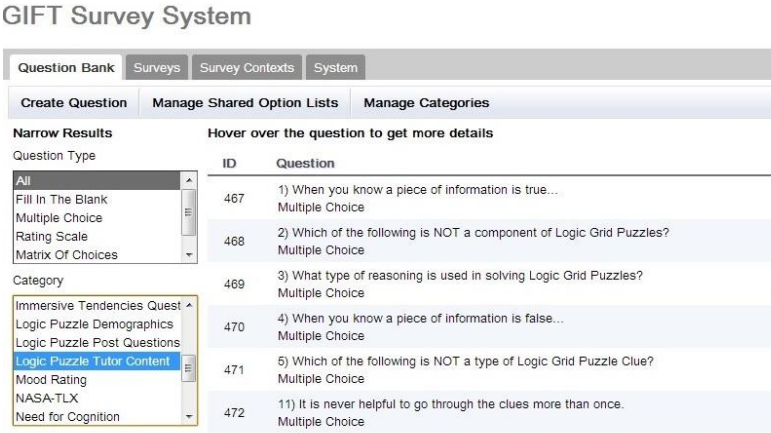

Figure 2. A screenshot of GIFT's survey authoring system interface.

The authors will bring a PC laptop with them to the demonstration. The laptop will have the most recent version of GIFT installed, as the software is iteratively released to provide new capabilities to the user community. It is preferred that a projector be available, as well as a PC connector so that the demonstration laptop can be directly connected. The rationale behind GIFT will be provided in the form of PowerPoint slides, followed by a demonstration of the software in action. If a projector is not available, a table on which the demonstration laptop can be placed would be sufficient. Between demonstrations, individual attendees will have the ability to interact with the GIFT software if they wish to do so. Attendees will also have an opportunity to have their questions about GIFT answered.

OBJECTIVES

The main objective of the demonstration is to familiarize human factors professionals with GIFT and its capabilities. The expanded objectives of the demonstration are as follows:

1) Familiarize the human factors community with the functions of GIFT.

2) Receive feedback from human factors professionals regarding the features and changes that they would like to see integrated into GIFT.

3) Demonstrate the tools that are useful to human factors professionals when they design a course in GIFT. Attendees will be shown the new GIFT Course Authoring Tool, which allows individuals to set up their course to include instructional material, guidance, and surveys. The Course Authoring Tool has recently been redesigned to be more user-friendly. Additionally, they will see the survey authoring system, which allows for the development and entry of surveys and questionnaires. Further, a demonstration of GIFT's Event Reporting Tool (ERT) will be presented, showing how data can be organized for analysis purposes following data collection.

4) Show an example of an actual course that was developed using GIFT and its functionality.

5) Demonstrate an available plug-in tool named Student Information Models for Intelligent Learning Environments (SIMILE). SIMILE provides a standardized approach for authoring assessments in game-based training applications by linking game state messages with designated concepts being assessed. The SIMILE Workbench is the complimentary authoring environment that allows a user to build these rules with a graphical user interface and to associated feedback with rules when they are triggered during interaction.

6) Provide examples of ways in which human factors professionals can use GIFT in their own research and in the classes that they teach.

This demonstration will provide an avenue to not only familiarize attendees with GIFT, but also to engage in discussions and to receive their feedback and suggestions. GIFT is an open-source project and community based, which can be improved through comments of those who use the software. Recommendations and improvements from the user community are highly valued, and can help shape future GIFT developments.

APPLICATIONS

GIFT is of interest to human factors professionals, as it offers the ability to develop complete ITSs that offer adaptive feedback, and provides a testbed in order to conduct experiments. It is a useful tool for both instructors and for researchers.

Those who teach courses may find GIFT to be particularly useful in developing coursework that their students can interact with, and receive adaptive feedback from. These courses could be useful in multiple types of classroom environments: in-person, mixed-mode, and online. The developed ITSs can be used as a supplement to in class material or even provide independent material to students in a distributed online format.

GIFT can additionally be used as a tool to teach students about the development of computerized course content and ITSs. There are a number of different considerations that need to go into developing educational materials and tutoring systems. The flexibility of GIFT and tools that are included with it provide an avenue for students enrolled in courses to develop their own tutoring systems, and gain experience in course development. There are courses that are included within GIFT that students can use as examples for how to develop their own applications.

Further, GIFT can, and has been used to run traditional human factors and psychology experiments in computerized environments (Goldberg & Cannon-Bowers, 2013; Sinatra, 2013). GIFT includes a survey authoring system, which provides the ability to author individual questions, and surveys. GIFT has been used in a number of different experiments in order to move individuals through the experiment without the use of numerous research assistants, which allows for a more efficient use of time and resources. When designing a GIFT course, the researcher can provide an experimental course flow that will provide surveys, offer guidance, direct participants to external web-pages, and open/close programs (current supported programs include PowerPoint, VBS2, and TC3 Sim/vMedic). The GIFT course can then be exported and installed on individual experimental computers. After data collection, the researcher can extract the data using GIFT's ERT, which provides the output in a format that can easily be edited and imported into SPSS for analysis.

CONCLUSIONS

GIFT is an open-source domain-independent ITS framework that has multiple functions that are of interest to human factors professionals. GIFT provides a means to develop and offer adaptive course content and feedback to students, as well as a way to run human factors experiments in computerized environments (e.g, serious games). As a continually developing open-source project, the comments and recommendations of those in the user community can have a positive impact on the future of GIFT. This demonstration will familiarize the attendees with GIFT, provide examples of GIFT's functionality, and provide an opportunity for attendees to provide feedback about future features that they would like to see included in GIFT.

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