SimSYS: Serious Educational Games

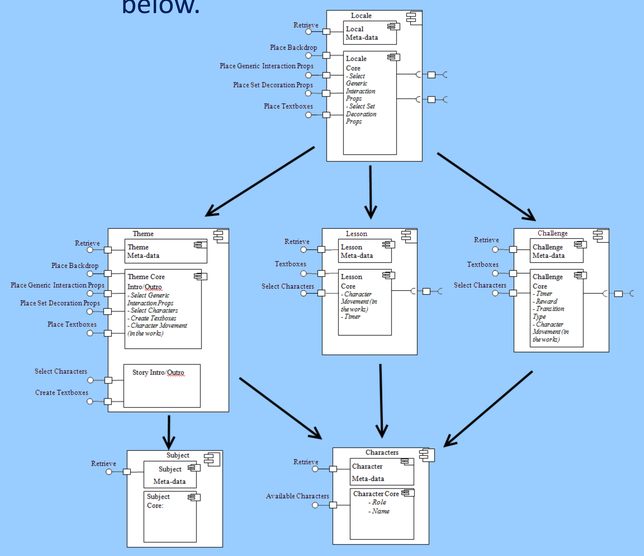
Kaleb Breault , Chris Mojica
Mentors: Shaun Longstreet, Kendra Cooper, Dennis Brylow

Motivation

The use of serious educational games has many advantages, offering immersive, engaging and fun environments that require deep thinking and complex problem solving within a construct of overcoming obstacles and challenges. Developing new games, however, to support broad and rapidly evolving disciplines has remained time consuming, expensive, and requiring the expertise of game designers, software developers, software engineering educators, and players. Here, an intelligent semi-automated component-based engineering approach for generating serious educational games is proposed, which enables educators to rapidly and independently develop their own games across diverse educational topics

Previous Work

Since 2010, teams of graduate and undergraduate students have been working to create the general structure of the project. They have implemented a component based system wherein six separate XML components come together and make an XML game script , which is intended to be run in a game engine currently in development. The component structure is shown below.



Current Project

The goal of this summer's team was to research and implement a search algorithm that would scan a large repository of game components then return one of each that when fit together would create a coherent game.

Difficulties:

1. The algorithm needs to be flexible enough to work for all components.
2. The algorithm needs low enough complexity to return quickly even given large a large search space.
3. The algorithm needs to be able to return semi-randomized results but still make a coherent game.
4. No metadata had been implemented
5. The repository of components was nonexistent

Solution:

After performing some research, we chose to use the Analytic Hierarchy Process (AHP) implemented with fuzzy logic. However, we later found that fuzzy logic implementation had some unintended effects on the results.

Classic AHP Versus Fuzzy AHP

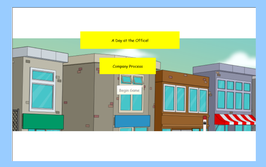
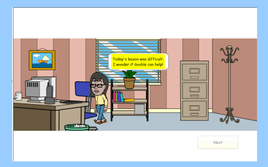
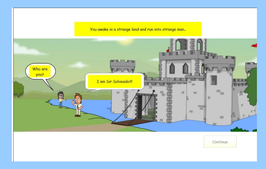
The AHP is a structured system for making complex decisions with multiple criteria. It was developed by Thomas Saaty in the 70s and has been used primarily in business settings to make decisions that have choices with many different and seemingly incomparable criteria. It begins with the creation of a hierarchy of the criteria. Then after this is established, the programmer then compares the elements to each other two at a time, assigning values to every element in relation to all the other elements. The intrinsic values of the choices are then given weight by these elements. The weighted values are added up and the choice with the highest overall score is chosen.

With a fuzzy logic implementation, instead of assigning exact relational values to the criteria, a "fuzzy" relationship is established between the two choices. The hope was to use this as a way of getting semi-randomized results. However, this more often than not simply eliminated certain criteria and made the search much less specific. Therefore the idea was scrapped and a version of the classic AHP algorithm was implemented.

Conclusion

At the conclusion of this summer, we have implemented AHP and additionally set up a basic wizard to collect input from the user. We also created a small library of components to search from. In addition to the implementation of the algorithm, metadata has been assigned to all of the components in a flexible, and easily modifiable way.

AHP-Generated Game Screenshots


Future Work

The SimSYS project continues to grow; however, there are still many features to add.

1. The game engine is currently being implemented by another team.
2. The repository of game components is very small and needs expansion.
3. The amount of metadata on each component could be increased to improve search results.
4. The wizard is very basic and does not show a preview of the game it generates. It is also aesthetically lacking.

References

•Saaty, Thomas L. (2008-06). "Relative Measurement and its Generalization in Decision Making: Why Pairwise Comparisons are Central in Mathematics for the Measurement of Intangible Factors – The Analytic Hierarchy/Network Process". *RACSAM (Review of* the Royal *Spanish Academy of Sciences, Series A, Mathematics)* **102** (2): 251–318.
•S. Longstreet and K. Cooper, "A Meta-model for Developing Simulation Games in Higher Education and Professional Development Training", IEEE 17th International Conference on Computer Games, 2012.
•This work brought to you by grant CCF-1063041 from the National Science Foundation, and viewers like you.