DIGIPEN INSTITUTE OF TECHNOLOGY

Battle Royale

MAT362 Fuzzy Logic Project

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An experiment in modeling large-scale battles between armies controlled by an artificial intelligence engine based on fuzzy logic.

Introduction

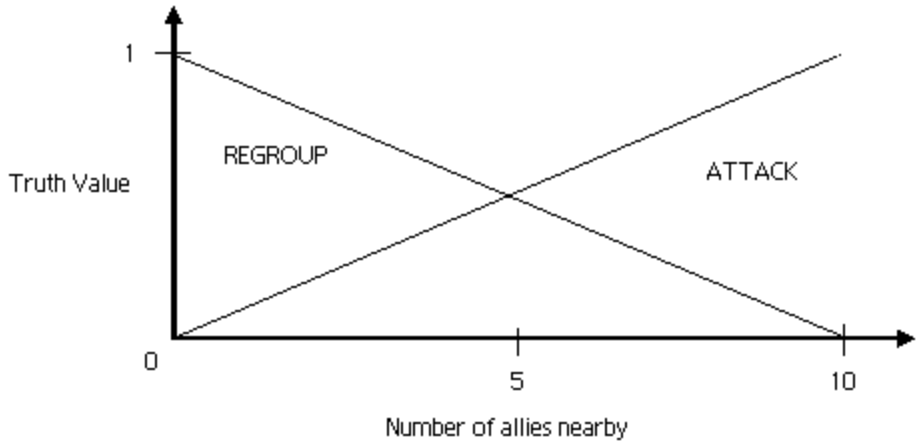
Battle Royale simulates a medieval battle between two armies. Each soldier is controlled by an artificial intelligence engine which incorporates fuzzy logic and reasoning. The artificial intelligence engine takes into consideration the number of enemies and the number of allies near each individual soldier and then uses fuzzy logic to determine each individual soldier's actions. Battle Royale is an interesting simulation because it is able to simulate battles consisting of many, many soldiers.

Fuzzy Concepts Utilized in Battle Royale

Battle Royale uses an artificial intelligence engine to control the behavior of each soldier in three different armies. Each solider calculates the number of allies within a specified proximity and uses this value as input into a fuzzy logic system. Additionally, in *Battle Royale,* each army is designated a "courage" value. This value is a fuzzy truth qualifier that adds a modifier to the propositions generated by the fuzzy logic system. The following is a step-by-step example of how the artificial intelligence engine in *Battle Royale* determines the action for an individual soldier.

First Step: Recommending an Action

The first step in the artificial intelligence engine is to evaluate the number of allies located within a given proximity in order to prescribe an action. The number of allies within a given proximity is used as input into a fuzzy truth-value function, and the output of this function is then used to recommend an action. The proximity is representative of a human soldier's line-of-sight radius. Below is an example truth-value graph used in determining action:



$$f(\alpha)=\begin{cases} m_1\alpha + b_1, & \alpha \in [0,10] \\ m_2\alpha + b_2, & \alpha \in [0,10] \end{cases}$$

For the sake of demonstration, let α be the number of allies within range of the soldier being evaluated. When α is "very low", the fuzzy truth for the REGROUP behavior is very high and the truth value for the ATTACK behavior is very low. When α is "very high", the recommendation for the REGROUP behavior is very low and the recommendation for the ATTACK behavior is very high. In this sense, the engine is generating a proposition, such as "My will to ATTACK is very high", or "My will to REGROUP is low".

Second Step: Introducing a Fuzzy Truth Qualifier

Once the soldier receives a recommendation from the artificial intelligence engine on which action should be taken based on the number of allies nearby, the soldier then uses his army's "courage" modifier to determine which recommended action he will actually use. The courage modifier changes the proposition's truth value in the following way:

$$T_s(p_\alpha) = S(A(x))$$

For example, if the proposition generated is “My will to REGROUP is very high”, but the army has very high courage, the truth modifier will change this to “My will to REGROUP is very high” *IS VERY FALSE*, resulting in this solider ignoring this recommendation.

Conclusions

The fuzzy logic and reasoning utilized by the artificial intelligence engine in *Battle Royale* yields interesting results. In our demonstration, we have developed a few scenarios that demonstrate some interesting behaviors which fell out of how the system was designed. The simulation is reflective of something that might be found in a commercial videogame and the concepts applied were useful in creating interesting artificial intelligence while keeping computational cost low. The fuzzy logic applied does indeed make a difference when two equal armies, each having different “courage” values, engage in combat. For example, the army with a lesser courage value will tend to group into larger groups before attacking while the army with a higher courage value will simply attack without forming groups.