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**Endo M., Yuda K., Mozgovoy M.**

# Developing Emotional AI with Gamygdala for Universal Fighting Engine

*Recommended for publication by associate professor Mozgovoy M.*

## Abstract

The behavior of computer-controlled opponents in competitive computer games is often perceived as non-human-like by the players. One of the reasons might include the fact that many AI systems operate on the same difficulty level during the whole game. In contrast, real people can play weaker when they are tired or stronger when they are excited. In this paper, we introduce an AI system that is affected by emotions for a popular fighting game engine UFE. Our AI is backed with GAMYGDALA, an emotional appraisal engine that enables the game developers to add emotions to their non-player characters, and Fuzzy A.I. a fine-tunable AI system for UFE. We strive to increase believability of computer-controlled fighters and to increase overall user enjoyment of the game.

**1. Introduction.** Often computer-controlled opponents in competitive computer games behave in a non-natural, mechanical way. It happens due to the fact that their actions are scripted by the game AI developers, and feel predictable. We decided to address this issue in the game of one-vs-one fighting by adding emotions for non-player characters and thus increase their human-likeness. In practice it means that some AI actions will be triggered with changes in non-player character's emotional state, which should contribute to the entertainment value of the game AI.

In our project this is done via GAMYGDALA, an emotional appraisal engine that enables game developers to easily add emotions to their

*Endo Masaki* – Undergraduate student, University of Aizu;
e-mail: s1240045@u-aizu.ac.jp, phone: +81-242-2664
*Yuda Kaori* – Undergraduate student, University of Aizu;
e-mail: s1240239@u-aizu.ac.jp, phone: +81-242-2664
*Mozgovoy Maxim* – Ph.D., Associate Professor, University of Aizu;
e-mail: mozgovoy@u-aizu.ac.jp, phone: +81-242-2664

non-player characters [1]. This paper shows how GAMYGDALA can work in combination with the built-in AI system of a popular fighting game engine UFE [2] and facilitate affective behavior of AI-controlled characters.

**2. Emotional appraisal in GAMYGDALA.** GAMYGDALA is based on *cognitive appraisal* theories that treat emotions as a result of a cognitive process, evaluating world events in terms of relevance to the goals of emotional agents. In particular, GAMYGDALA relies on the OCC theory [3] that defines 22 emotion types associated with different types of events. Currently, the system implements only one factor influencing the resulting emotion — direct desirability of consequences of the event according to the agents goals.

Technically it is achieved as follows. The user has to specify goals and their values for each agent in the game, and generate "emotional events" when necessary, forcing GAMYGDALA to re-evaluate agent's emotional states. The user can also generate "empty" events (clock ticks) causing emotional decay as a result of passing time. Events can be marked as "incremental", which forces GAMYGDALA to treat subsequent repetitions of an event as gradual contributions for (or against) agent goals. At any moment, the user can request the list of emotional intensities of each agent from the engine and use it as desired.

**3. Agent goals and events in UFE.** Since UFE is fighting game engine implementing one-vs-one matches and we would like to appraise emotions of enemy, we only have to manage player a enemy character agent. Thus, we define three goals of the character as follows:

```
// 'npc' represents  the enemy character.
emotionEngine.createGoalForAgent('npc', 'survive', 0.5);
emotionEngine.createGoalForAgent('npc', 'win', 1);
emotionEngine.createGoalForAgent('npc', 'lose', -1);
```

We also implement the following events, affecting the emotional states of game agents:

- **Survive**. Incremental event, triggered by passing time.

- **Win**. Incremental event, generated when the enemy character damages its opponent. The "emotional value" is equivalent to the amount of damage (life points taken) caused to the opponent.

- **Lose**. Incremental event, generated when the enemy player is damaged by its opponent. It is handled similarly to "Win".

- **Decay**. Clock-based event causing emotional decay for all registered agents. Currently one decay event is generated every second.

**4. Translating emotions into actions.** GAMYGDALA represents emotional state of an agent as a vector of supported emotions and their respective intensities. In our project, we use three emotions:

- **anger** — rises when an undesirable event is caused to the agent by another NPC;

- **hope** — rises when the agent approaches a desirable goal or avoids an undesirable goal;

- **fear** — rises when the agent approaches an undesirable goal or moves away from a desirable goal.

These emotions have to be translated into specific rules, adjusting agent behavior. UFE has a high-quality built-in AI engine, called "Fuzzy AI". It is fine-tunable: the users can edit a large number of logical settings (such as aggressiveness or skill level of AI agents) and physical parameters or the characters. Thus, we had no need to design our own AI system. Instead, we modify built-in settings according to changing emotional states.

Our current modifications of UFE include four rules:

1. IF intensity-of-anger **>** 0.1:
   Cause higher damage than usual (+20).

2. IF intensity-of-hope **>** 0.1:
   Increase speed of moving forward by 10*intensity.
   Reduce speed of moving backward by 10*intensity.

3. IF intensity-of-fear **>** 0.1:
   Increase speed of moving backward by 10*intensity.
   Reduce speed of moving forward by 10*intensity.

**5. Conclusion.** In this work we have integrated GAMYGDALA emotional engine into UFE fighting environment. We generate events

that cause changes in the emotional state of the AI-controlled enemy character, and use GAMYGDALA to evaluate them. The resulting vector of emotional intensities is used to adjust parameters of the AI-controlled character during the match in order to obtain affective behavior. We believe that this approach is able to contribute to user enjoyment of the game, and consequently to the overall success of the game project.

## References

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