# Design Factors of *Maestro*: A Serious Game for Robust AI Education

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## ABSTRACT

Training tools targeting *robust AI* are still in their infancy. We present *Maestro*, an effective open-source game-based platform for *robust AI* training in higher education, which includes countermeasures and prevention of AI vulnerabilities. *Maestro* provides *goal-based scenarios* (GBSs) where students are exposed to challenging life-inspired assignments in a *competitive programming* environment. The assessment of *Maestro* showed that its leaderboard, a key gamification element, has been crucial for effective student learning. Students who felt the acquisition of new skills in *robust AI* tended to appreciate highly *Maestro* and scored highly on material consolidation, curiosity and maestry in *robust AI*.

## KEYWORDS

education, gamification, leaderboard, robust AI, adversarial AI

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## 1 INTRODUCTION / PROBLEM

Potential vulnerabilities in fast-spreading AI-based systems, likewise in the cybersecurity field, have created concerns and motivated new directions and strategies to educate the future AI workforce in countermeasures and the prevention of AI vulnerabilities. This domain of expertise is known as *robust AI* and, despite it being an active area of research, there is a clear lack of educational tools.

## 2 OVERIEW / METHODS

The present project goal was to design, implement and evaluate an innovative open-source educational tool (*Maestro*) for training courses in *robust AI*. To encourage active student participation, we proposed using game-based assignments [1], which include game stories, use cases and standard scenarios to reproduce settings covered by *Maestro*. The game is structured as an engaging project competition, where each student or team is assigned roles of attacker or defender, and *Maestro* assigns scores and ranks participants based on the quality of their attack or defense. These results are displayed in a user-friendly interface. Specifically, in the course described in this study, students are introduced to three different *goal-based scenarios* (GBSs) [2].

## 3 RESULTS

We assessed the effectiveness of *Maestro* in two offerings of an undergraduate AI course, and collected students feedback with a thoroughly designed reflection survey. Our results suggest that *Maestro* has successfully gamified the learning environment driving students to interaction, *robust AI* mastery and autonomy. The game elements provided in *Maestro* played a crucial role in students' effective learning and skill-development. The *Maestro* leaderboard became a key game design element that provided a challenging environment for the students by creating social pressure to increase their level of engagement and participation. Overall, students who felt the acquisition of new skills in *robust AI* tended to appreciate highly *Maestro*.

## 4 CONTRIBUTIONS / FUTURE WORK

Our next step is to continue the development and assessment of *Maestro* by offering it as an open-source platform to other instructors, students and the broad *robust AI* community. Future users of *Maestro* can test it and contribute further to its implementation and maintenance. The authors plan to launch an updated version of *Maestro* during 2022-2023 academic year, and continue working on its effective integration in AI courses on and off campus.

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