ADAPTIVE TRAINING AND GAMIFICATION FOR SIMULATORS

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Research Questions

1. How can we utilise adaptive training to improve efficiency of military training?
2. Which Machine Learning (ML) and Adaptive Learning (AL) models are best suited to improve military training? What is the best implementation?

Evaluation of ML and AL Models

For ML models, we compared three **Reinforcement Learning (RL)** models that have different methods of learning:

We chose RL as it does not require data to be fed into the agent initially for model training, thus alleviating potential issues of having low data quantity in military simulators that is available for use. The agent collects its own data through trial and error with the environment.

Model Type	Data size (relative)	Precision	Scalability
Q-Learning (Value-Based)	Small, but gets bigger as complexity of the scenario increases	Low, especially in complex action spaces	Low: Simple and effective for small action spaces, however struggles to handle larger environments or scenarios
Proximal Policy Optimisation (Policy-based)	Very large	High	High: Easily scalable to handle both simple and more complex scenarios
Advantage Actor-Critic (Actor Critic Approach)	Moderate	Moderate	High: Can suit both simple and more complex scenarios

For AL, we compared three models:

Model Type	Pros	Cons	Scalability
Intelligent Intervention System	The real-time feedback provides timely guidance to users in correcting behaviour or actions	Risk of providing too much assistance to the user, thus creating an over-reliance on the AL system Complex, costly and time consuming to implement	High: Adaptable across domains, and scalable for multiple users in the same simulation
Behaviour Change Interventions	Encourages motivation due to having many objectives	Too narrow-minded for a complex domain, as objectives may be too simplistic	Low: Not as effective with complex domains like military simulators
Rule-Based Expert System	Binary, straightforward "rules" ensure efficiency in assessment and selection of interventions	Overly-simple for a military training context, may not provide a complete or fully accurate coverage or adaptivity	Low: Poor scalability limits system's ability to work with changing or increasing number of variables to keep track of

Our goal is to pair an ML model with an AL model to achieve an efficient and scalable adaptive training system for implementation in military simulators.

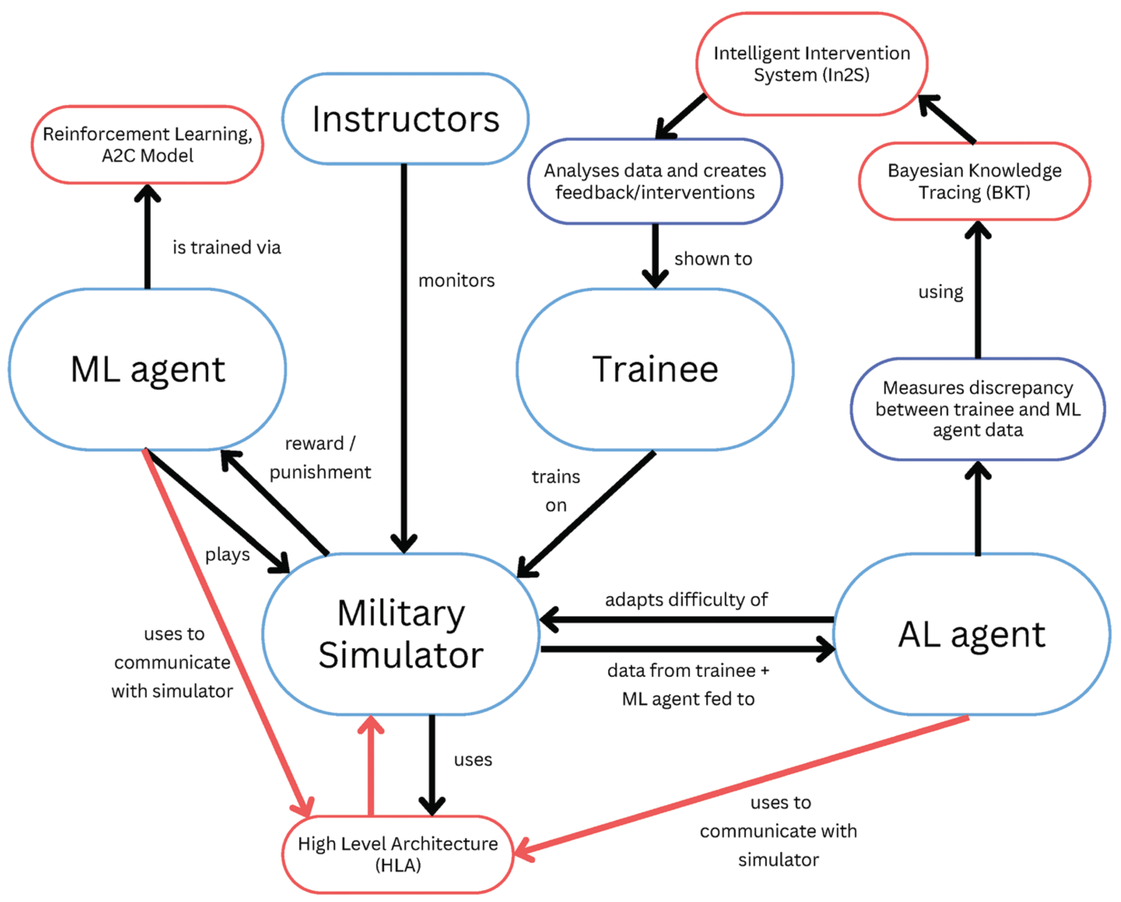
Introduction/Background

Adaptive Learning/Training:
- Personalised approach to learning/teaching
- Tailors learning content to trainees' needs
- Maximises growth of every trainee if used properly

Military Simulators:
- Simulations of real warfare to be **as realistic as possible**
- A platform for adaptive training, allowing AI models to give feedback based on simulator data

Due to the success of adaptive learning in the education industry, we aim to implement it into a military training context to allow trainees to grow and learn faster.

Implementation



*red arrows show how the agents interact with the simulator through HLA

Conclusion and Future Work

Selected models:
- **ML model: Advantage Actor-Critic (A2C), using RL**
- **AL model: Intelligent Intervention System (In2S)**

We propose the use of a dual-model framework, as described in the implementation above, to create an efficient adaptive training module in a military simulator.

As our study is purely theoretical, future work would be to investigate the practicality of this proposed framework, by running training simulations with varying scales to decide whether the framework would be effective for a complex system like military simulators.