This review attempts to present the current state-of-the-art in regard to solving the 'Multi-Agent Problem', which considers a scenario of multiple agents (such as robots, AI systems etc) must interact, whether cooperatively or competitively, to achieve defined goals. To this end, this review categorises work based on the approach towards solving this problem. Each approach often places assumptions on the type of agents present within the system and so each is appropriate in different settings. Briefly, these categories are

- Swarms, in which the agents are often assumed to be homogeneous and with limited sensing and communication capabilities.
- Decentralised-Partially Observable Markov Decision Processes (Dec-POMDPs), in which agents must choose actions with the aim to optimise a known loss function which is applied to the entire team.
- Game Theory, which allows for each agent to have an individual payoff function which they must optimise with respect to the actions of the other agents.
- Multi-Agent Reinforcement Learning, in which agents do not immediately have access to the payoff function and so must determine it through iterations of exploration.
- Control Theory, which considers the low-level operation of each agent and mathematically defines control laws for each agent which satisfy properties such as stability and controllability.
- Hard Coded, a term of the author's devising to categorise systems which do not fit in any of the formal methods above. These systems are built on a series of if-then statements, allowing agents to reason about their current state and future tasks.

0.1 Objective

The aim of the following sections is not to provide an exhaustive list of all work done in the aforementioned areas. To attempt to do this would be an exercise in futility. Instead, it is to identify research directions which lie within the broad scope of Multi-Agent Systems (MAS). Once identified, these directions will form the basis for the remainder of this review, allowing for particular problems to emerge. It will likely be the case that a medley of these problems will be addressed throughout the course of the PhD and, of course, more will likely be added.