

General Game Playing and the Game Description Language

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In Artificial Intelligence (AI), General Game Playing (GGP) consists in constructing artificial agents that are able to act rationally in previously unseen environments. Typically, an agent is presented with a description of a new environment and is requested to select an action among a given set of legal actions. Since the programmers do not have prior access to the description of the environment, they cannot encode domain specific knowledge in the agent, and the artificial agent must be able to infer, reason, and learn about its environment on its own.

The class of environments an agent may face is called Multi-Agent Environments (MAEs), it features many interacting agents in a deterministic and discrete setting. The agents can take turns or act synchronously and can cooperate or have conflicting objectives. For instance, the Travelling Salesman Problem, Chess, the Prisoner's Dilemma, and six-player Chinese Checkers all fall within the MAE framework.

The environment is described to the agents in the Game Description Language (GDL), a declarative and rule based language, related to DATALOG. A state of the MAE corresponds to a set of ground terms and some distinguished predicates allow to compute the legal actions for each agents, the transition function through the effect of the actions, or the rewards each agent is awarded when a final state has been reached.

State of the art GGP players currently process GDL through a reduction to PROLOG and using a PROLOG interpreter. As a result, the raw speed of GGP engines is several order of magnitudes slower than that of an engine specialised to one type of environments (e.g. Chess). GGP is now an established research area and has been described as a *Grand AI Challenge*, but lack of high performance GDL compilers or interpreters is impeding further research development as it creates a high entry barrier for AI practitioners.

Although GDL is based on DATALOG and PROLOG, it has many restricting hypotheses and additions over them and constitute an interesting challenge for Programming Language researchers. Particularly, its dynamic MAE semantics offer a complete new range of potential optimisations.

References

- [1] Michael Genesereth and Nathaniel Love. General game playing: Overview of the AAI competition. *AI Magazine*, 26:62–72, 2005.
- [2] Nathaniel C. Love, Timothy L. Hinrichs, and Michael R. Genesereth. General Game Playing: Game Description Language specification. Technical report, LG-2006-01, Stanford Logic Group, 2006.
- [3] Stephan Schiffel and Michael Thielscher. A multiagent semantics for the game description language. In Joaquim Filipe, Ana Fred, and Bernadette Sharp, editors, *Agents and Artificial Intelligence*, volume 67 of *Communications in Computer and Information Science*, pages 44–55. Springer Berlin Heidelberg, 2010.
- [4] Michael Thielscher. The general game playing description language is universal. In *Proceedings of the 22nd International Joint Conference on Artificial Intelligence, IJCAI*, pages 1107–1112, July 2011.