

Situated Agents Can Have Plans

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Much of our everyday activity is not made up of solving isolated problems with single clear-cut goals, but rather dedicated to the ongoing maintenance of many goals or policies such as eating when hungry and maintaining a comfortable personal space. Furthermore, in many complex, dynamic worlds, an agent must maintain many goals at the same time and be able to act quickly and flexibly, because some decisions are time critical and the world is not perfectly predictable.

The domain of SimCity requires this kind of behavior. In the simulation, you are never finished repairing the roads or fighting crime, because disasters and evolution will always require more work in the future. Survival depends on deciding what you should work on now, and by what you will allow yourself to be interrupted. In short, playing SimCity requires a robust theory of attention.

Situated agents are built to address problems of timely activity in complex, dynamic worlds. (Maes) Such systems stress that competent behavior can arise out of continually selecting primitive actions based on information about the environment. Situated activity theories propose that resource conflicts can be avoided by noticing conflicts at compile time. Most situated agents, however, are not required to accomplish long-term activities such as building an industrial complex.

Memory-based planning (Hammond), on the other hand, contends that in some interesting worlds an episodic memory of plans can adequately cover the longer-term problems an agent will face, thus providing an alternative to the intractability of exhaustive search.

How do we arbitrate between memory-based, long-term behavior, and reactive, short-term maintenance?

The Problem of Interruption in SimCity

Imagine that in response to the problem of unemployment in the city, you decide to build an industrial park on the outskirts of town. You develop a plan for this, and you have the funds to execute it. Such a project could take three simulator months, but during the execution of this plan, an earthquake strikes. If you continue to carry out your plan, half the city may be destroyed by fires. Since you can only do one thing at a time, you must interrupt your industrial development plan and deal with the earthquake.

The MAYOR Project

The goal of the MAYOR project is to build a planner which will be sensitive to long-term abstract goals such as

increasing population or generating income and long-term activity such as building a suburb outside the city center. At the same time, MAYOR must react to unpredictable phenomena such as earthquakes, and the continual maintenance of the infrastructure of the city (roads, power lines, etc.).

The main point of the planner is to provide a model for how attention may be focused in a complex world like SimCity.

Inspired by (Minsky), MAYOR consists in a network of agents called advocates, each of which are dedicated to working on specific tasks. Some advocates are designed to monitor certain conditions in the world, and develop plans to address their task or purpose. Other advocates are designed not to monitor the world, but to monitor other advocates, settling disputing claims to the same resources.

Some conflicts between goals are settled at compile time; advocates which address the same goals inhibit each other. For example, while the Urban-Planner advocate is building an industrial complex to increase employment, the Roadworker is blocked from maintaining roads while the complex is being constructed, because the Urban-Planner's plan addresses this goal. On the other hand if a fire breaks out, since the Urban-Planner does not handle fires, the Urban-Planner may be interrupted by the Firefighter advocate. Instead of attempting to foresee all the possible conflicts, MAYOR proposes that such activity conflicts should be handled at run time, with a set of task arbitration strategies. An example of an implemented strategies is "seize-cheap-opportunity" which stops work on an long-term task in favor of an inexpensive, local, short-term plan.

Currently MAYOR attempts to service the long-term goal of maintaining a minimum income while handling problems of crime, fire protection and fires, and pollution control. At this stage of development, however, it is clear that success hinges on a robust theory of attention.

References

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