

Reasoning Agents

*Reasoning about Actions
in Self-Deliberating Dynamic Systems*

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Elective in Artificial Intelligence

Program Synthesis

- *It's a **little odd** that the way we program computers is by giving them **explicit instructions**. Of course, instructions are what computers are good at following extremely quickly, but they're not necessarily what humans are good at writing.*
- *Wouldn't it be more efficient for us to tell the **computer what we want the program to do**, and leave the details of how to the computer to figure out?*
- *It's the **ultimate abstraction**: a programmer who only tells the computer **what** they want, rather than **how** to do it, is completely absolved from any implementation details. This is the promise of program synthesis.*

Program Synthesis Explained
<https://homes.cs.washington.edu/~bornholt/post/synthesis-for-architects.html>

Program Synthesis

Course about “nice” cases of **program synthesis**

- Easy to **understand**, no need to be expert in synthesis
- One **cannot do the job manually**
- Grounded in many **realistic domains**
- Includes all the **main synthesis features**
- Synthesis is a (finite) program, with **loops** and **conditionals**
- **Feasible computationally!**

Program Synthesis

Is a game between the agent and the environment

- **Reachability games**: agent get to final state *in spite* of what environment does.
- **Safety games**: agent remains in the safe area *in spite* of what the environment does
- **Stochastic games**: agent reaches the final state *exploiting the randomness* of the environment
- **Stochastic fairness games**: agent (1) remains in the a “safe area” *in spite* of the environment, and from this area (2) it reaches the final state *exploiting the randomness* of the environment

Reasoning Agents

- **Advanced planning**: FONDs, FONDfair, POND
 - *Reachability games,*
 - *Stochastic fairness games*
- Behavior/service/manufacturer **composition**
 - *Safety games*
- Supervision and **controller synthesis**
 - *Safety games*
- Synthesis from **temporal specifications** (*LTLf and LDLf synthesis*)
 - *Reachability games,*
 - *Stochastic fairness games*
- **Stochastic synthesis**: MDPs, POMDPs, RL
 - *Stochastic games*