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This research forms part of the NWO *Norms in Knowledge* project. One of the main aims of this project is the formalization of artifactual functions.

**Research aims:**

**Primary:** Formal semantics for artifactual function

**Preliminary:** Semantics for means-end relations

## 1. Artifactual functions

Artifacts are typically intended for certain uses.



A toaster makes toast. A lighter creates small fires. A starter pistol starts a race.

These are the primary functions of toasters and lighters, respectively.

**Features of functions**

- **Normative:** Artifacts *ought* to perform their functions.
- **Origins:** A function may be *designed*, *accidental* or acquired via *repeated use*.
- **Means-end:** Functions entail *means-end relations*.
- **Practical reasoning:** An agent's actions depend on functions of available tools.

We aim to provide a conceptual analysis of such functions via formal semantics.

**From functions to means-end relations.**

“The function of a toaster is to make toast.”  
 ↓  
 “The toaster is a means to producing toast.”  
 ⇕  
 “There is some way of using the toaster that will produce toast.”

## 2. Means-end relations

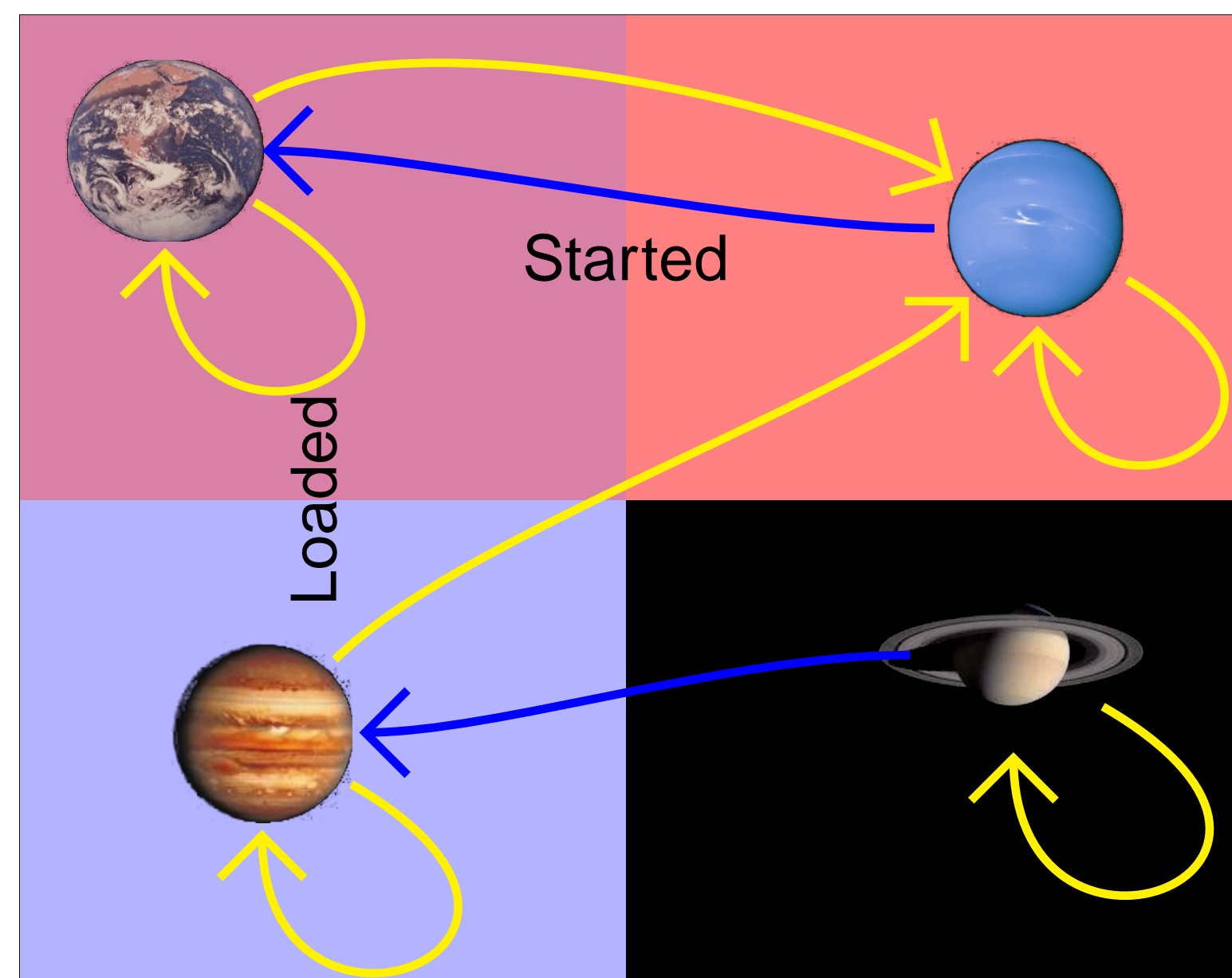
**Practical reasoning** is the process of forming *intentions to act* from premises involving *facts*, *propensities* and *desires*.

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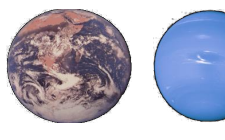

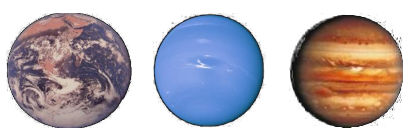



Theories of practical reasoning take means-end relations as premises and yield intentions as conclusions.

Surprisingly, existing theories rarely say anything at all about the *meaning* of means-end relations. We take this as our starting point.

**Example:**



**Figure 1:** A PDL model for a race started by firing a one-shot pistol, with the possibility of misfires. The yellow arrows are transitions for fire and the blue for load.

	fire is a .? . means to Started in	load is a .? . means to Loaded in
Sufficient		
Weakly sufficient		
Necessary		

Means-end reasoning involves *non-monotonic* conditionals, so that evidently valid reasoning yields erroneous conclusions, like so:

If I had money then she would marry me.  
 Robbing her is a means to having money.  
 ∴ If I robbed her then she would marry me.

This is a real problem in automated reasoning (robots forming plans for action). Our semantics includes these features.