Setting up the presentation:

- This presentation uses videos that start by clicking on the respecting picture.
- Not every PDF viewer is capable handling embedded videos. On Linux, at least Okular works (but for it to work you need to be in “nagivation mode”, not in “selection mode”, otherwise the mouse click has no effect).
- Download these videos[1] and put them into a folder called “movies”. Put the folder next to the presentation PDF.

[1] *hierarchical-task.net/pb/2018/Bercher2018InvitedCompanionTalk.zip* (18 MB)

Companion-Technology – Vision and Results

Pascal Bercher

Institute of Artificial Intelligence, Ulm University, Germany
Director: Susanne Biundo-Stephan

4. September 2018

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Companion-Technology – Vision and Results ... From an AI Planner's Point of View

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Definition of Companion-Technology

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- All these approaches share: they are designed to improve humans' life ranging from simple gadgets to evolved technology

Our Definition of Companion-Technology

Whose Definition?

- Transregional Collaborative Research Centre CRC/TRR 62 "*Companion*-Technology for Cognitive Technical Systems" (German: Sonderforschungsbereich Transregio SFB/TRR 62 „Eine *Companion*-Technologie für kognitive technische Systeme“)

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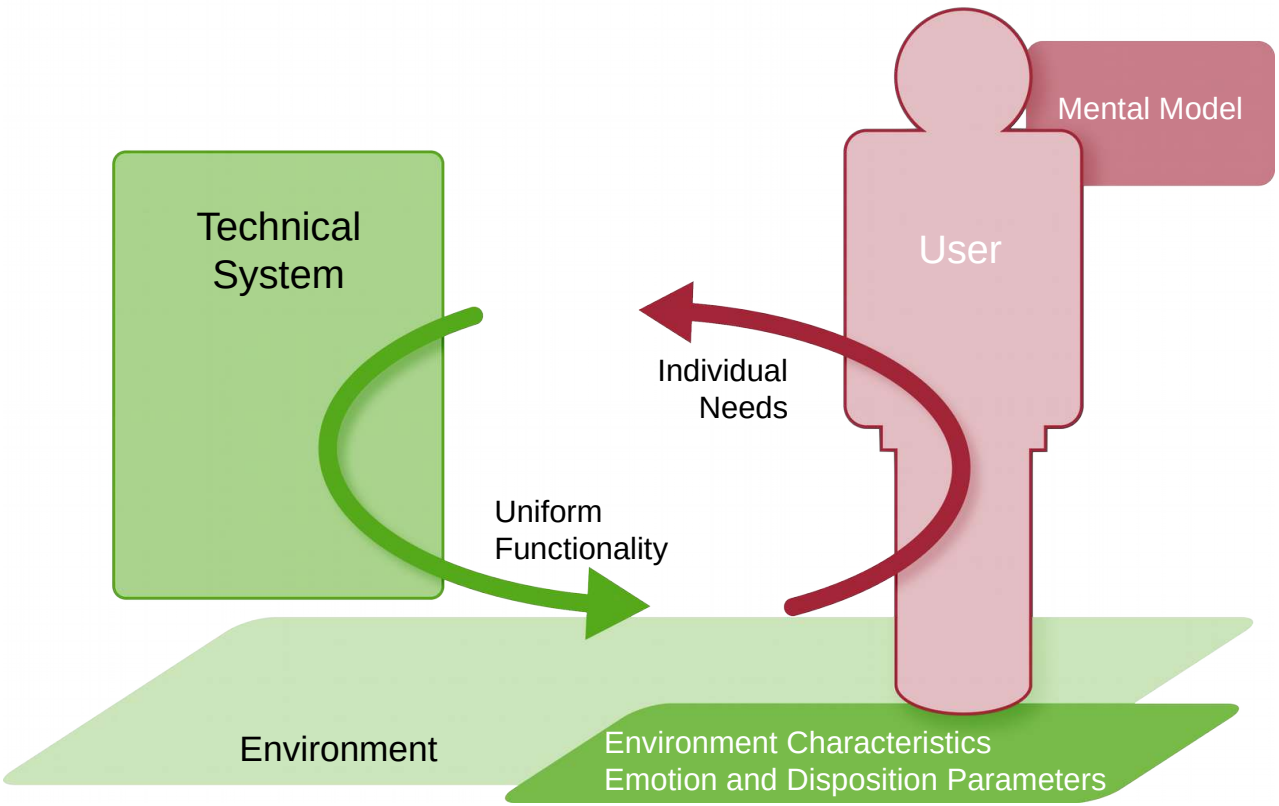
- Inderdisciplinary research project (from 2009 to 2017)
- More than 100 scientists from the areas of computer science, electrical engineering, medicine, neurobiology, and psychology

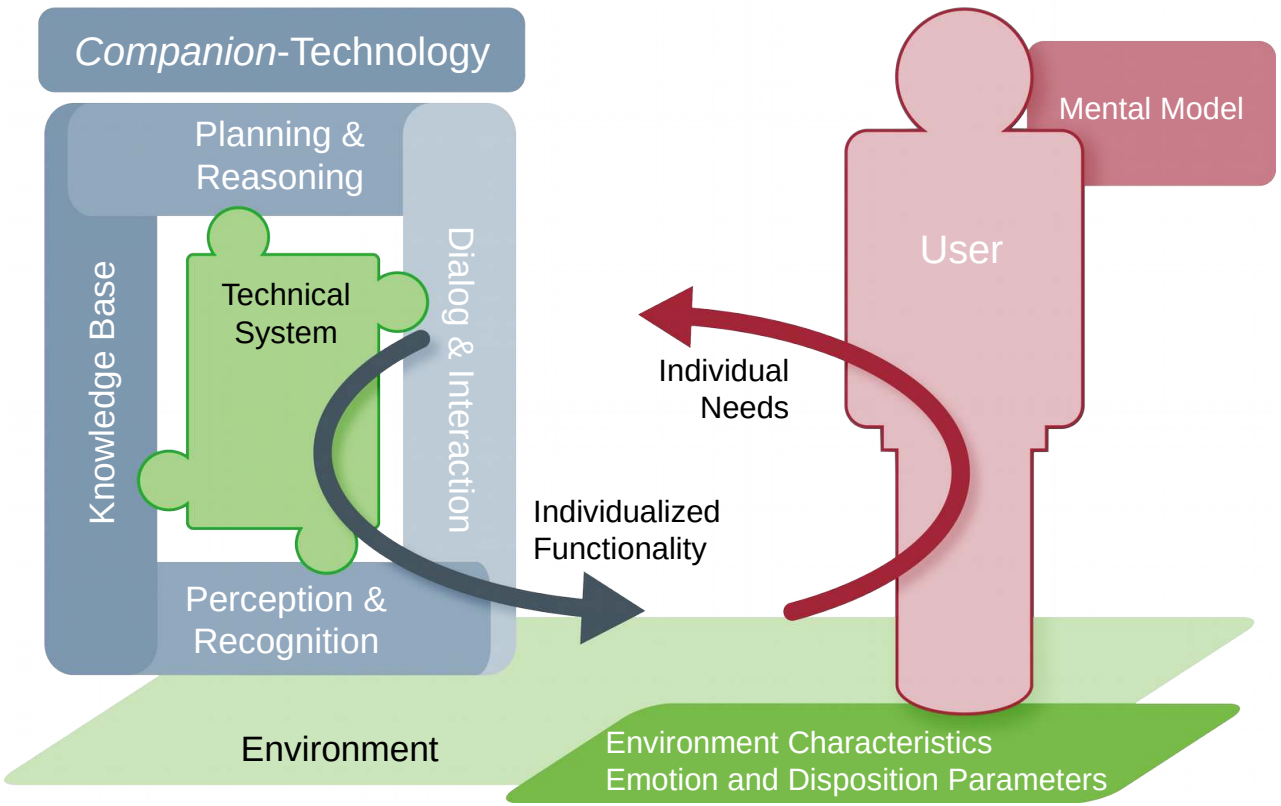
Companion-Technology – Motivation

The current situation:



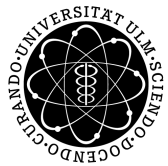
Companion-Technology – Motivation

The envisioned situation:



From Cognitive Technical Systems to Companion-Systems

Cognitive technical systems are technical systems that perceive their environment and act accordingly – thus they have basic cognitive capabilities such as perception, reasoning, learning, and planning.



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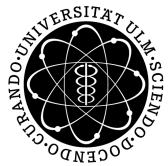

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- cooperativeness
- trustworthiness

A (brief) Introduction to Planning

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- States are sets of propositions, e.g.,

  $\{HasPort(AMPLIFIER, HDMI),$
  $HasPort(AMPLIFIER, CINCH),$
  $HasPort(cable\_HDMI, HDMI),$
  $IsConnected(AMPLIFIER, cable\_HDMI, HDMI)\}$ forms a state

A (brief) Introduction to Planning

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- Actions state their preconditions and effects, e.g.,

  $plugin(?cable, ?device, ?port)$

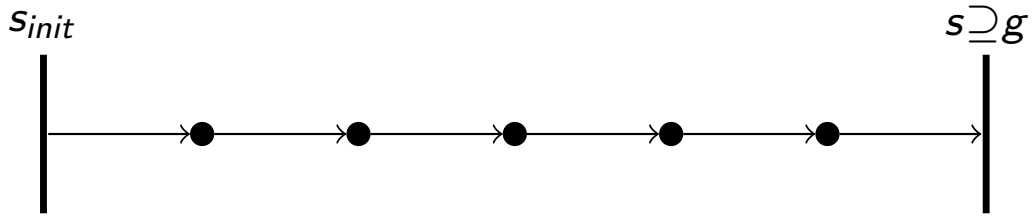
  precondition: $HasPort(?device, ?port) \wedge$
  $HasPort(?cable, ?port) \wedge$
  $\nexists ?cable' : IsConnected(?device, ?cable', ?port)$

  effect: $IsConnected(?device, ?cable, ?port)$

A (brief) Introduction to Planning

Planning, in its most simple form, is about computing a sequence of actions that transforms an initial state (current situation) into a goal state (desired situation)

- Planning systems fully autonomously find such goal-leading sequences of action.



Hybrid Planning

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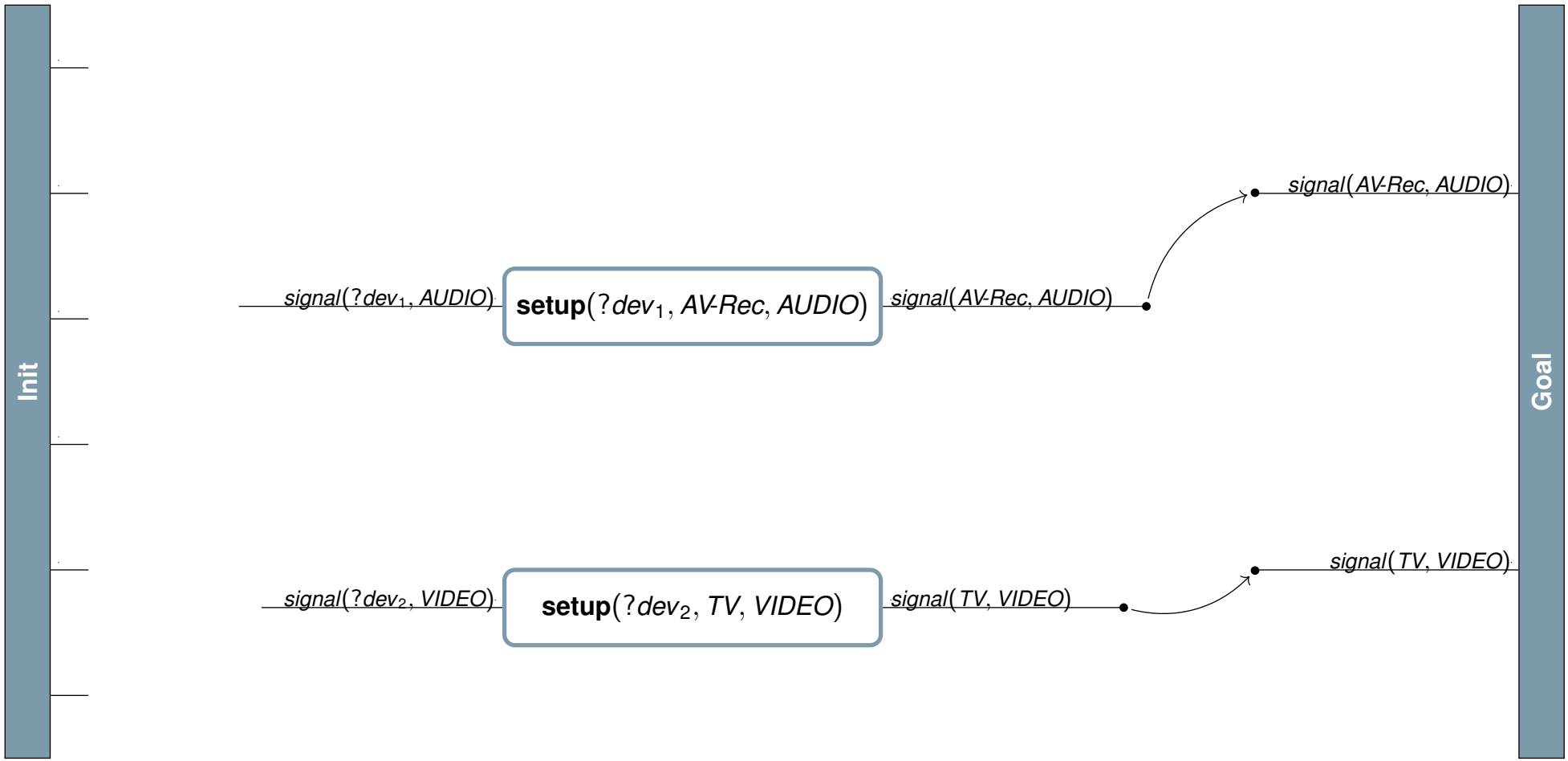
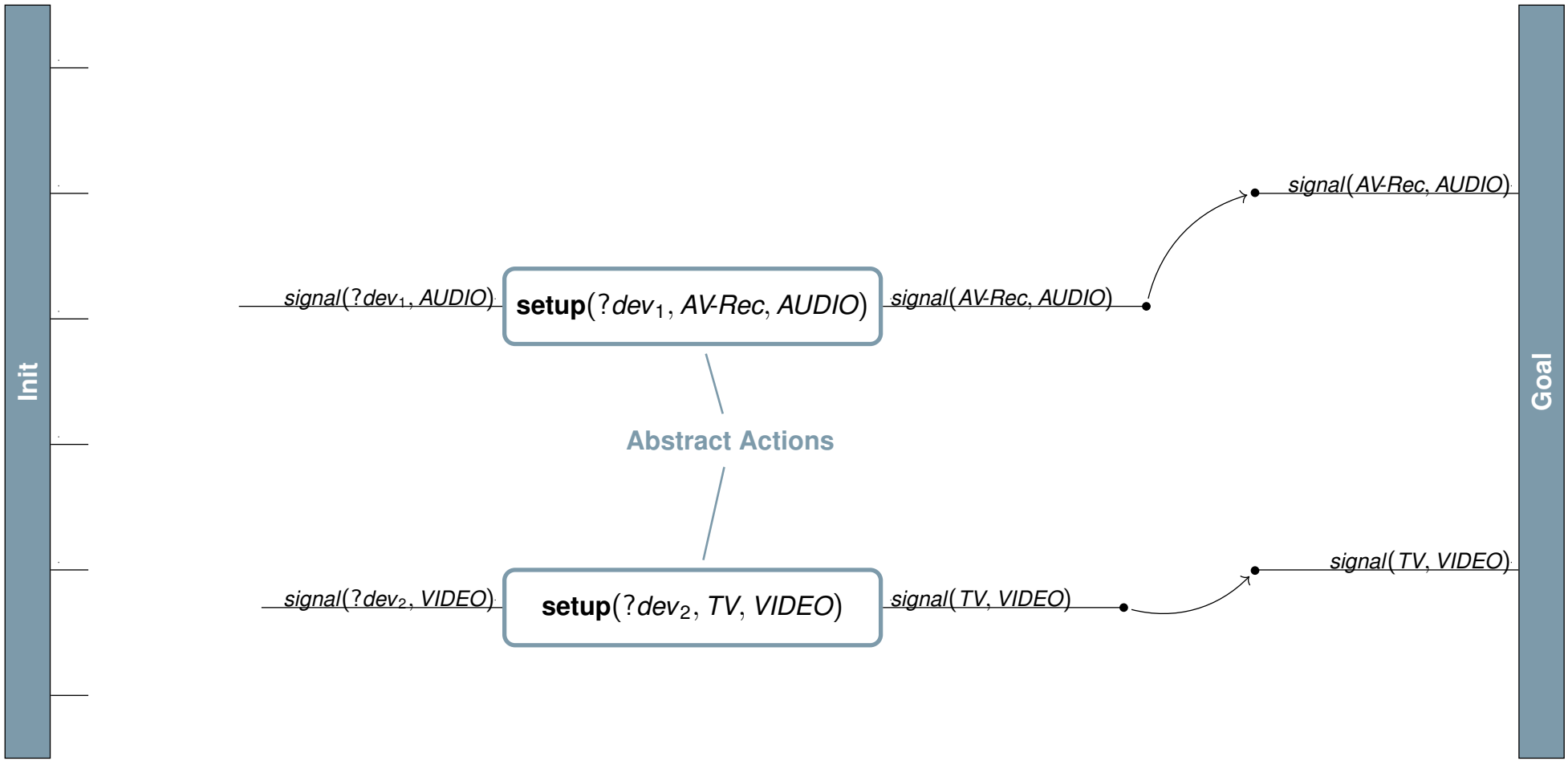
- Abstract actions allow to present instructions on different levels of abstraction
- The task hierarchy can be included in the explanations
- The task hierarchy allows to exploit expert knowledge (just for modeling purposes or to reduce search effort)

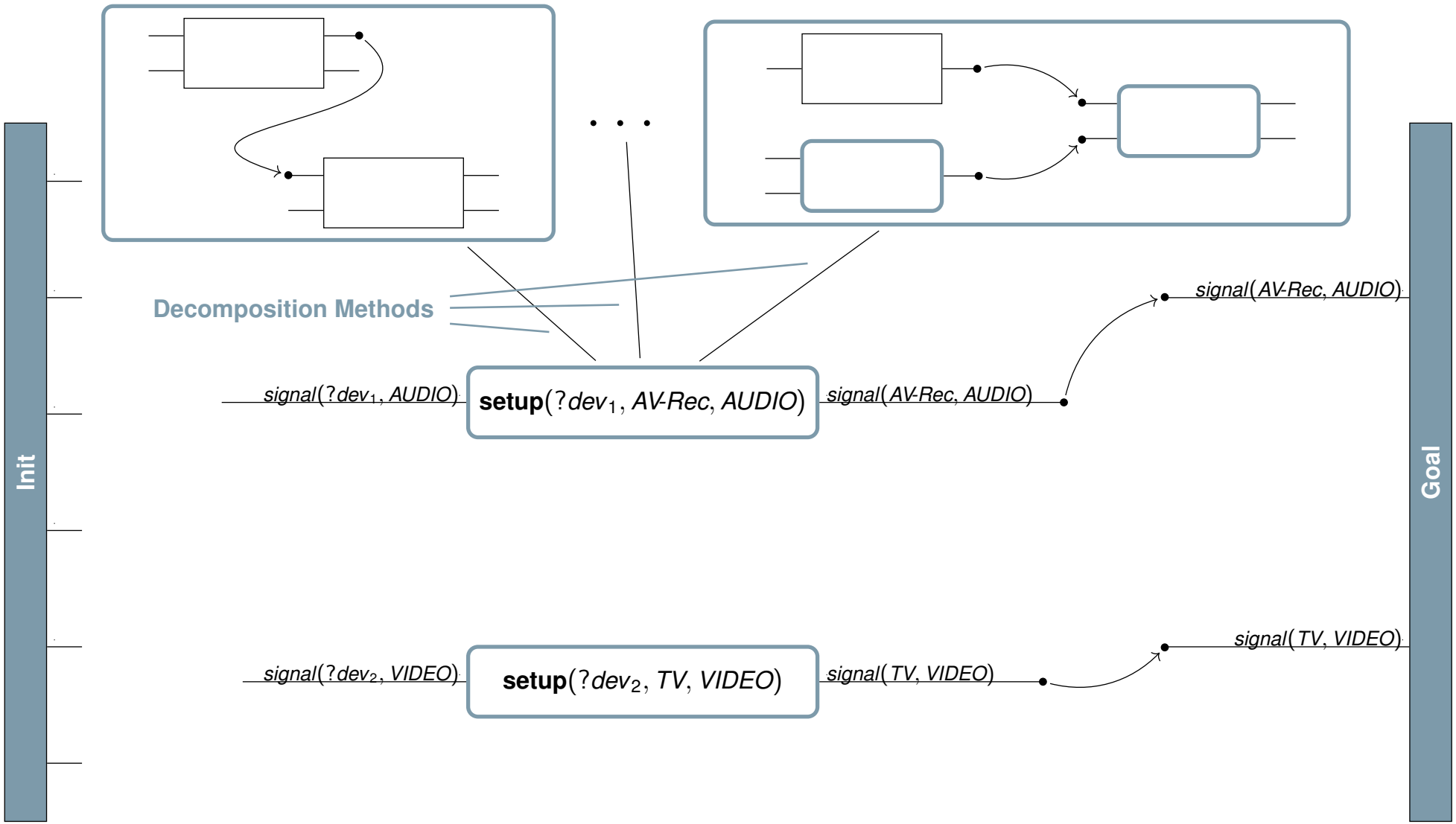
Hybrid Planning (Cont'd)



Hybrid Planning (Cont'd)



Hybrid Planning (Cont'd)



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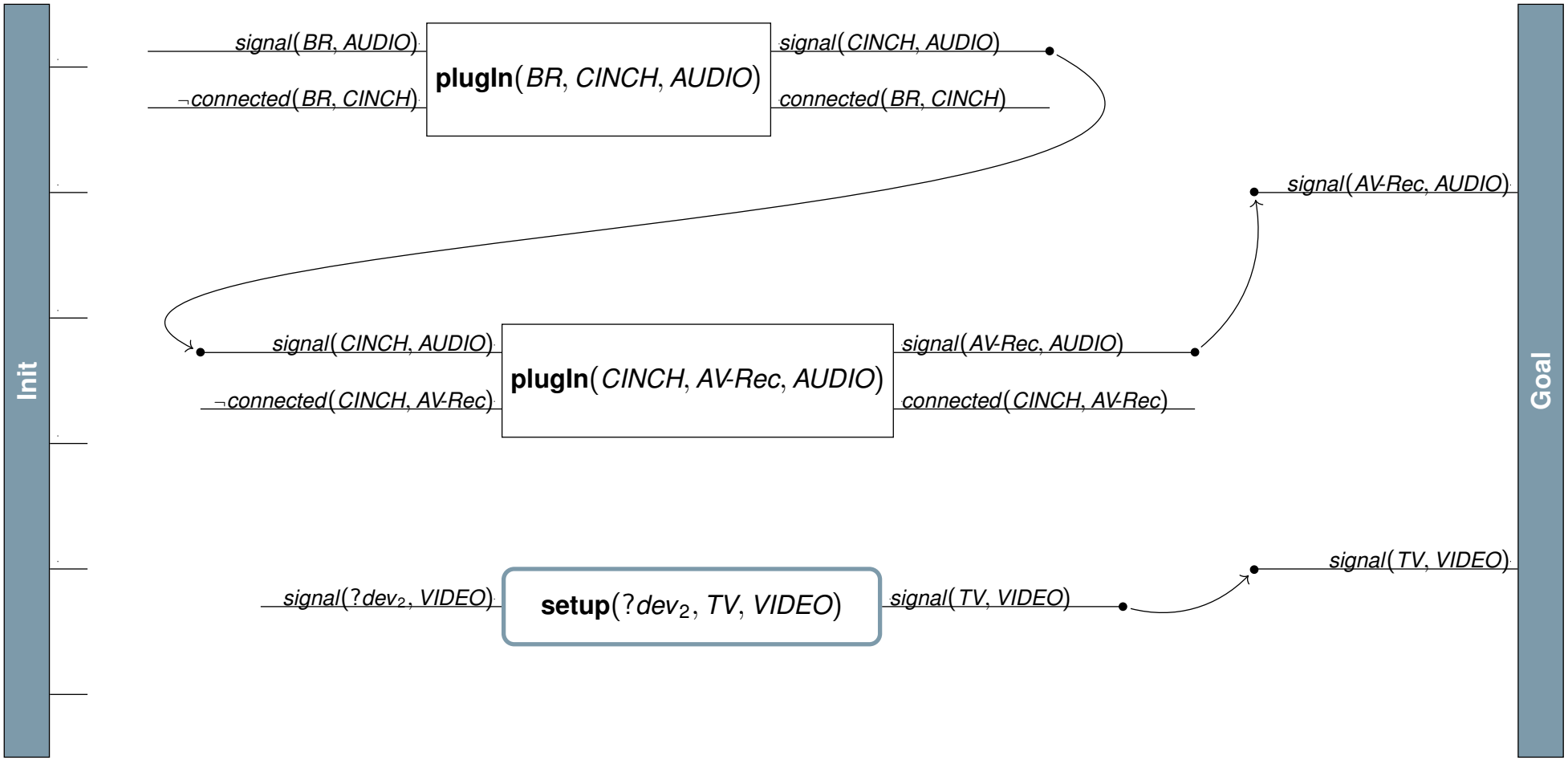

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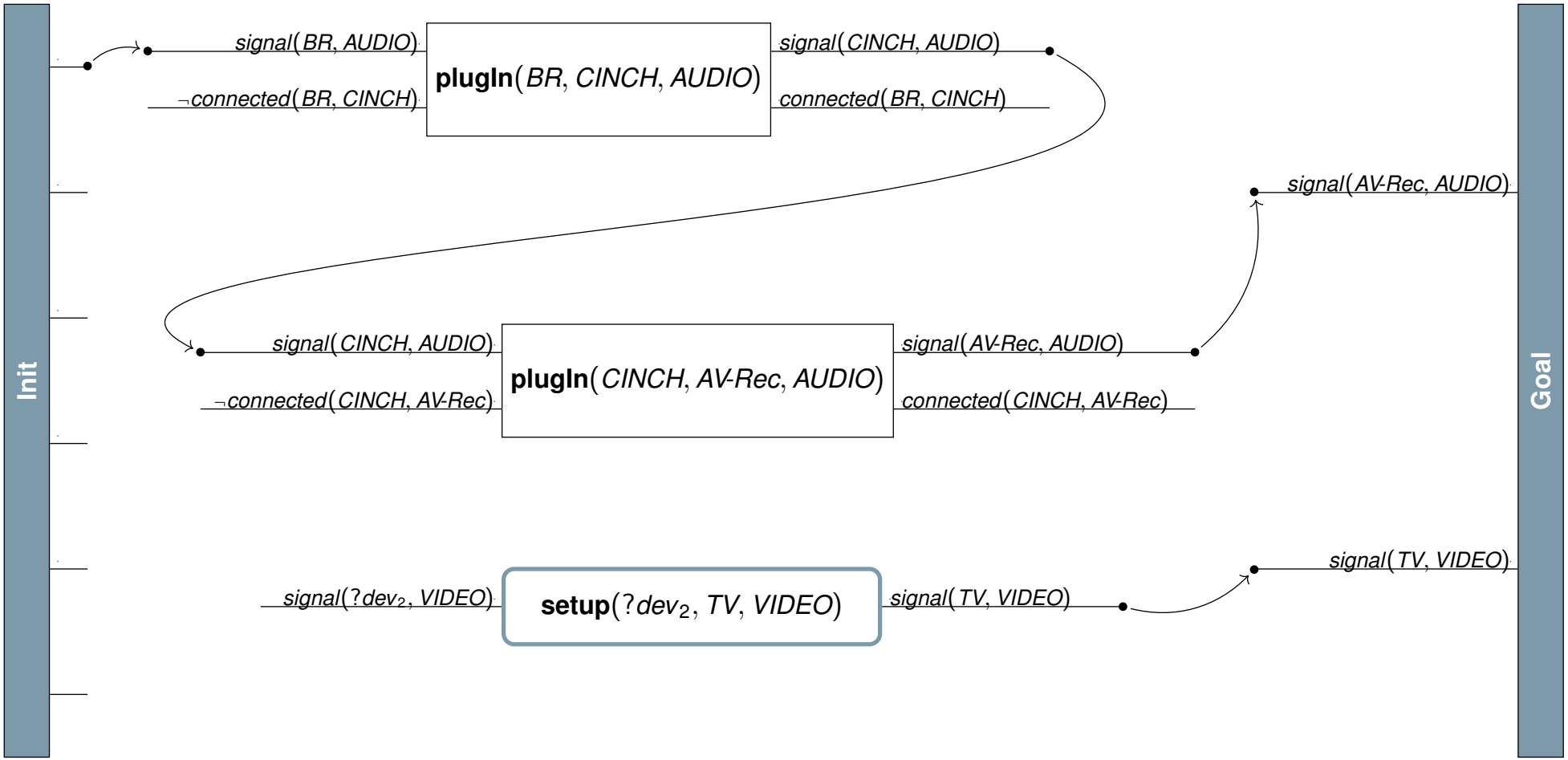

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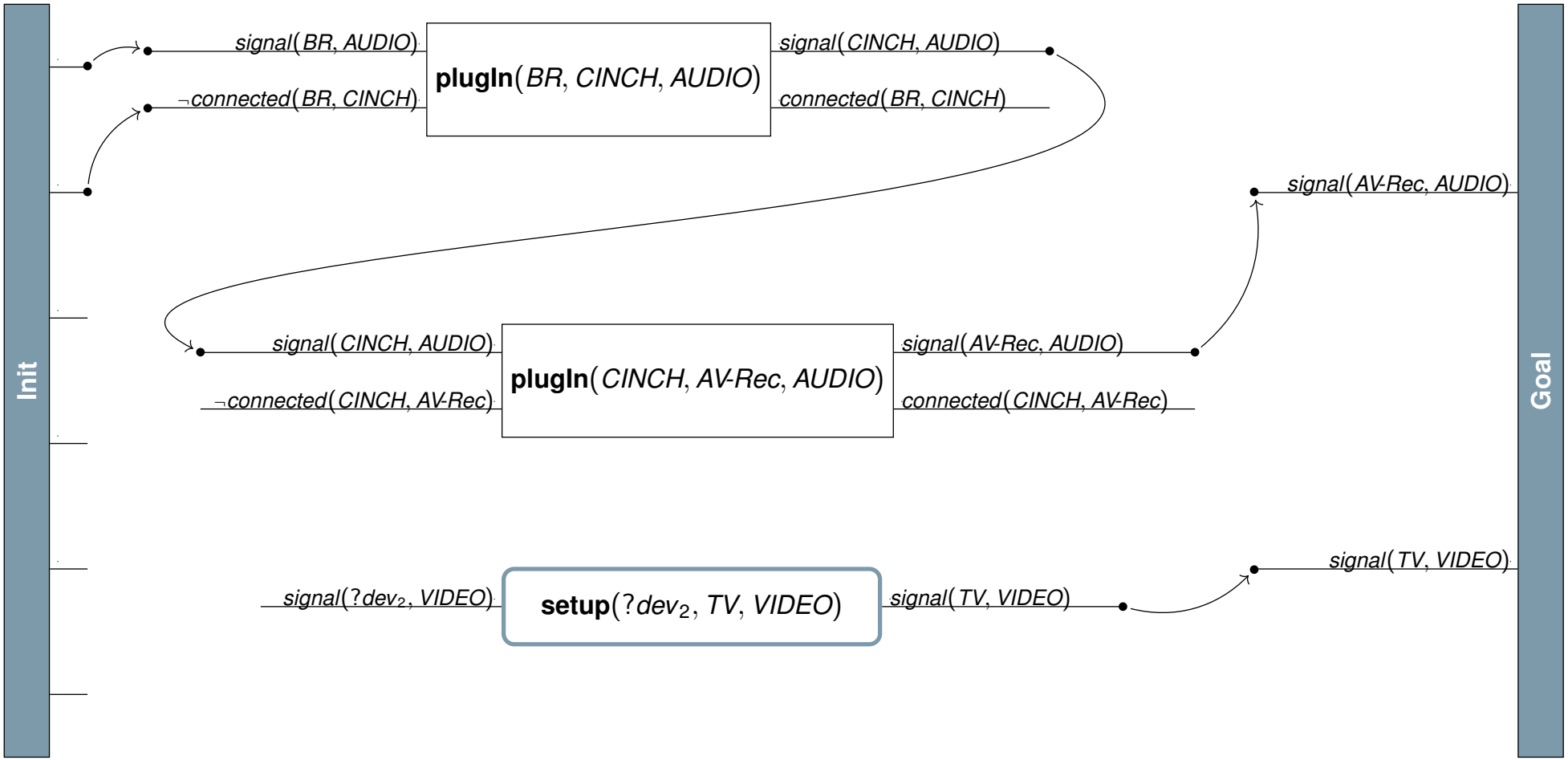

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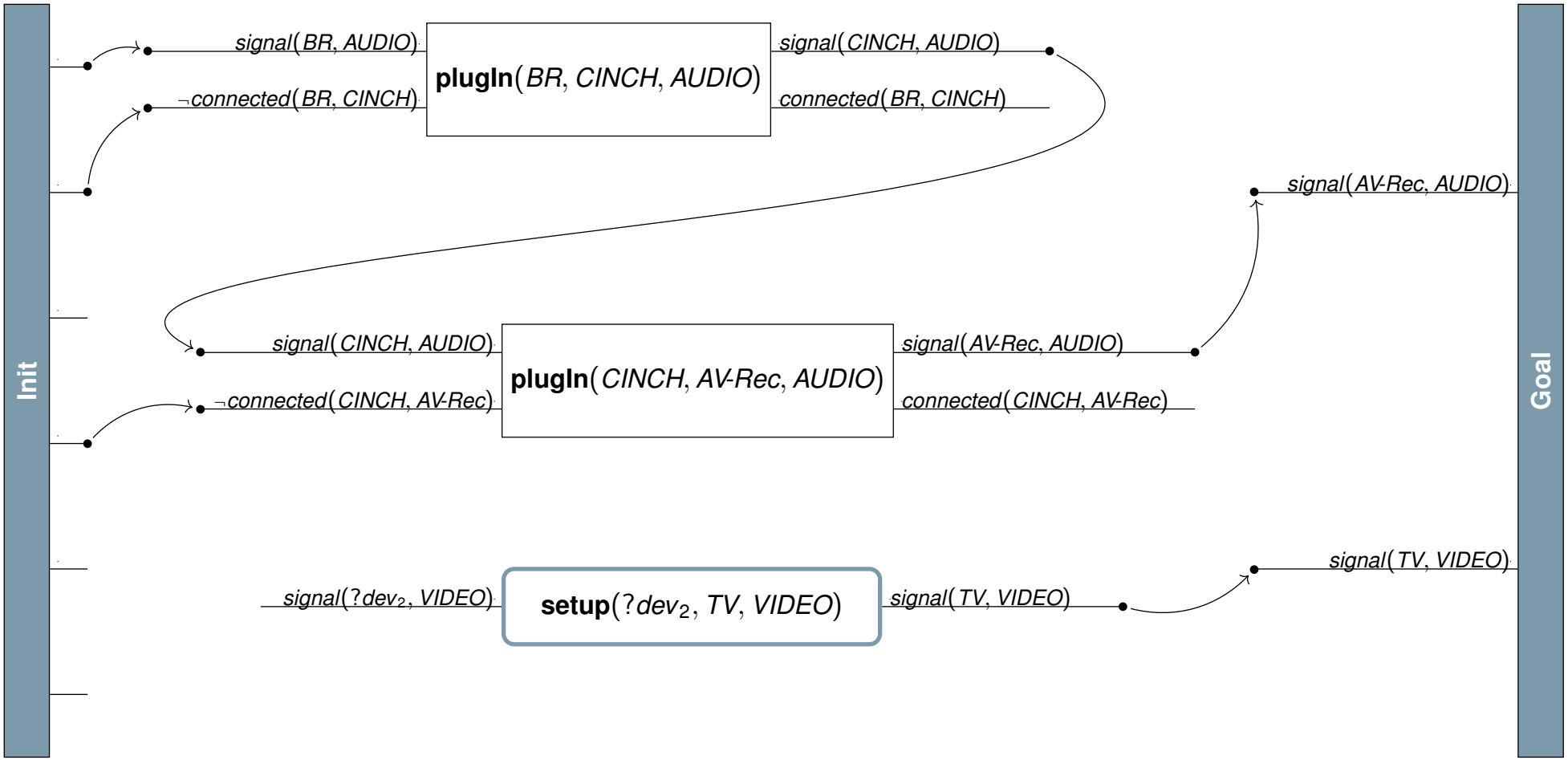

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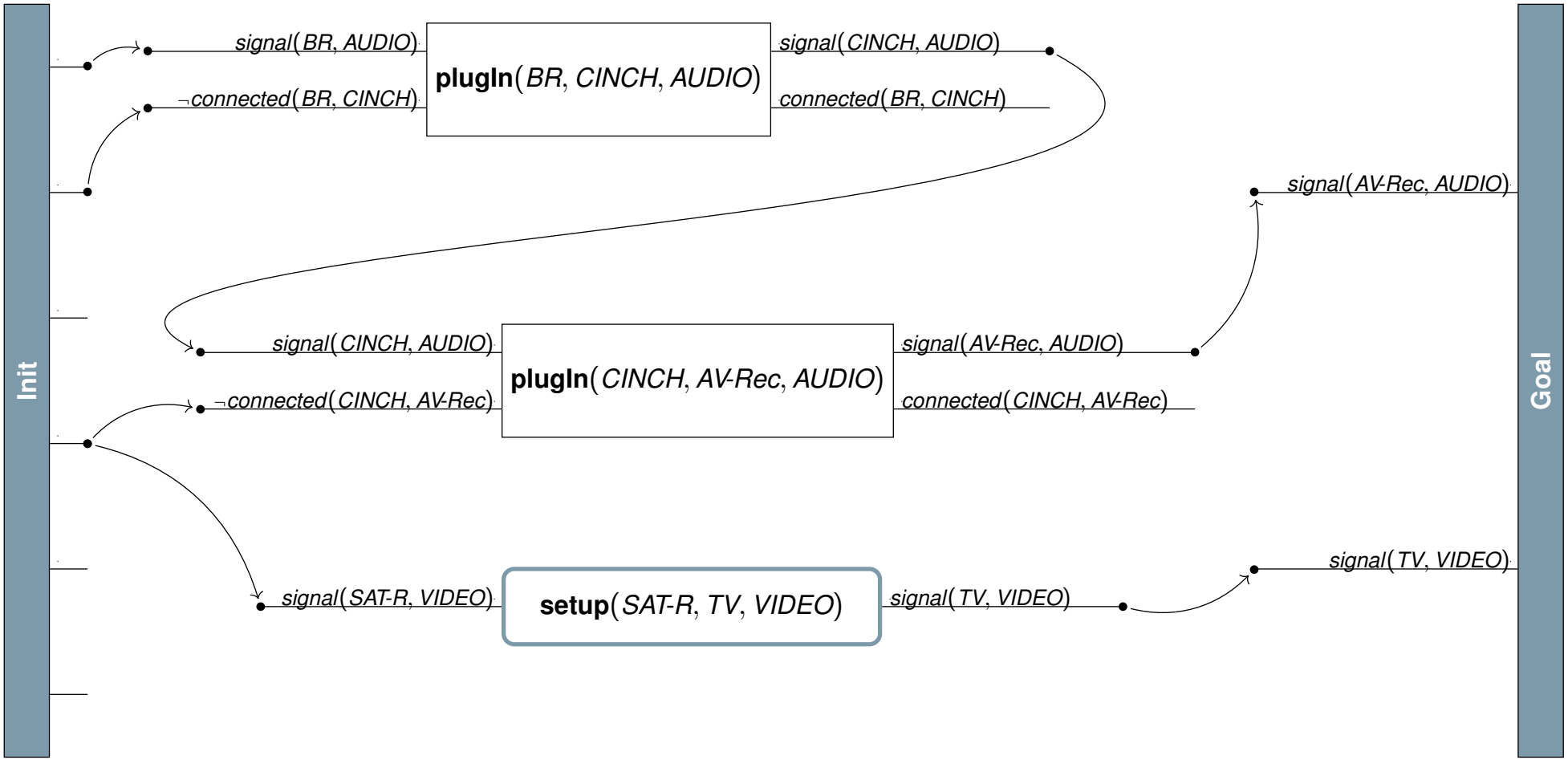

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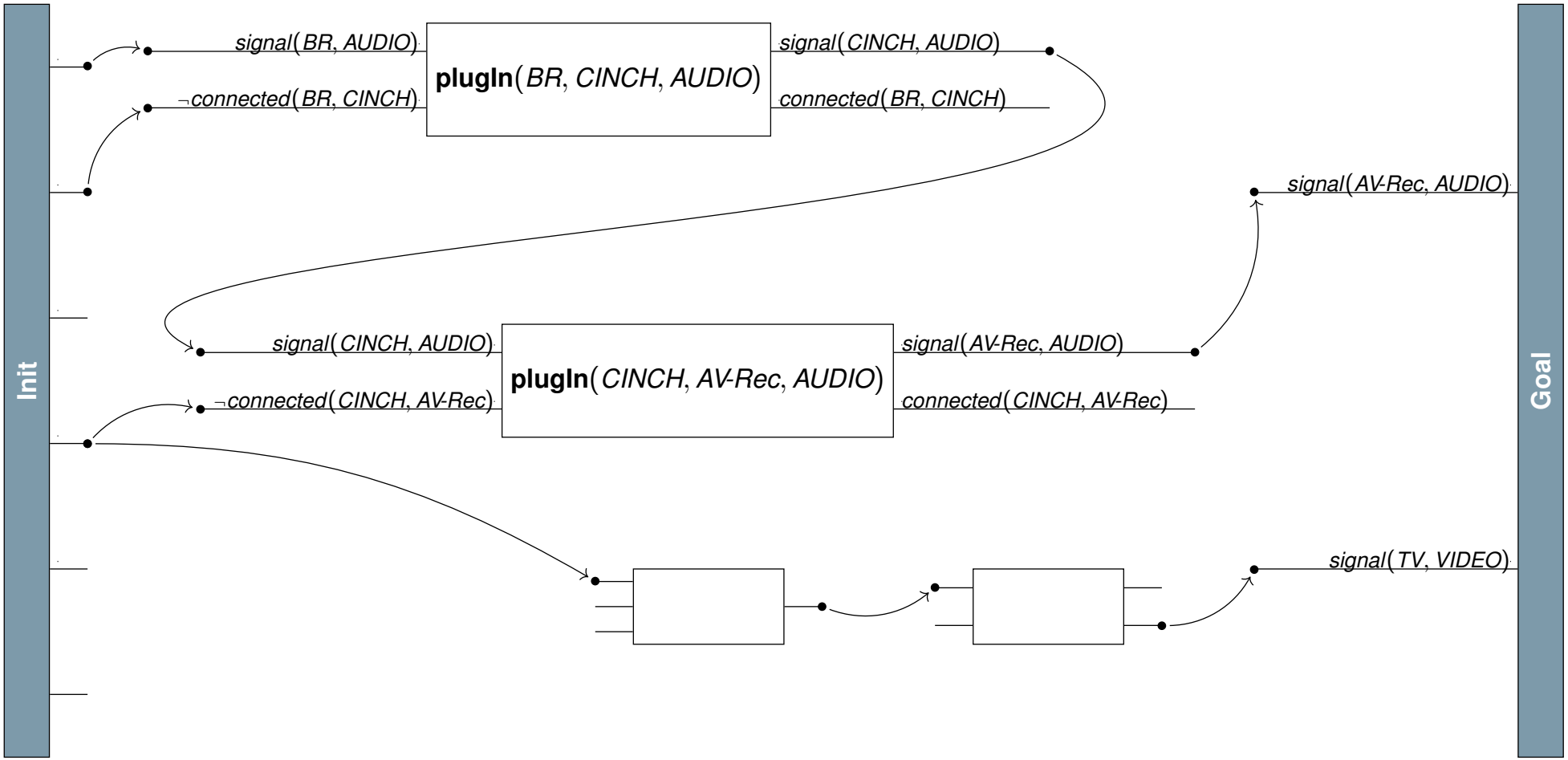

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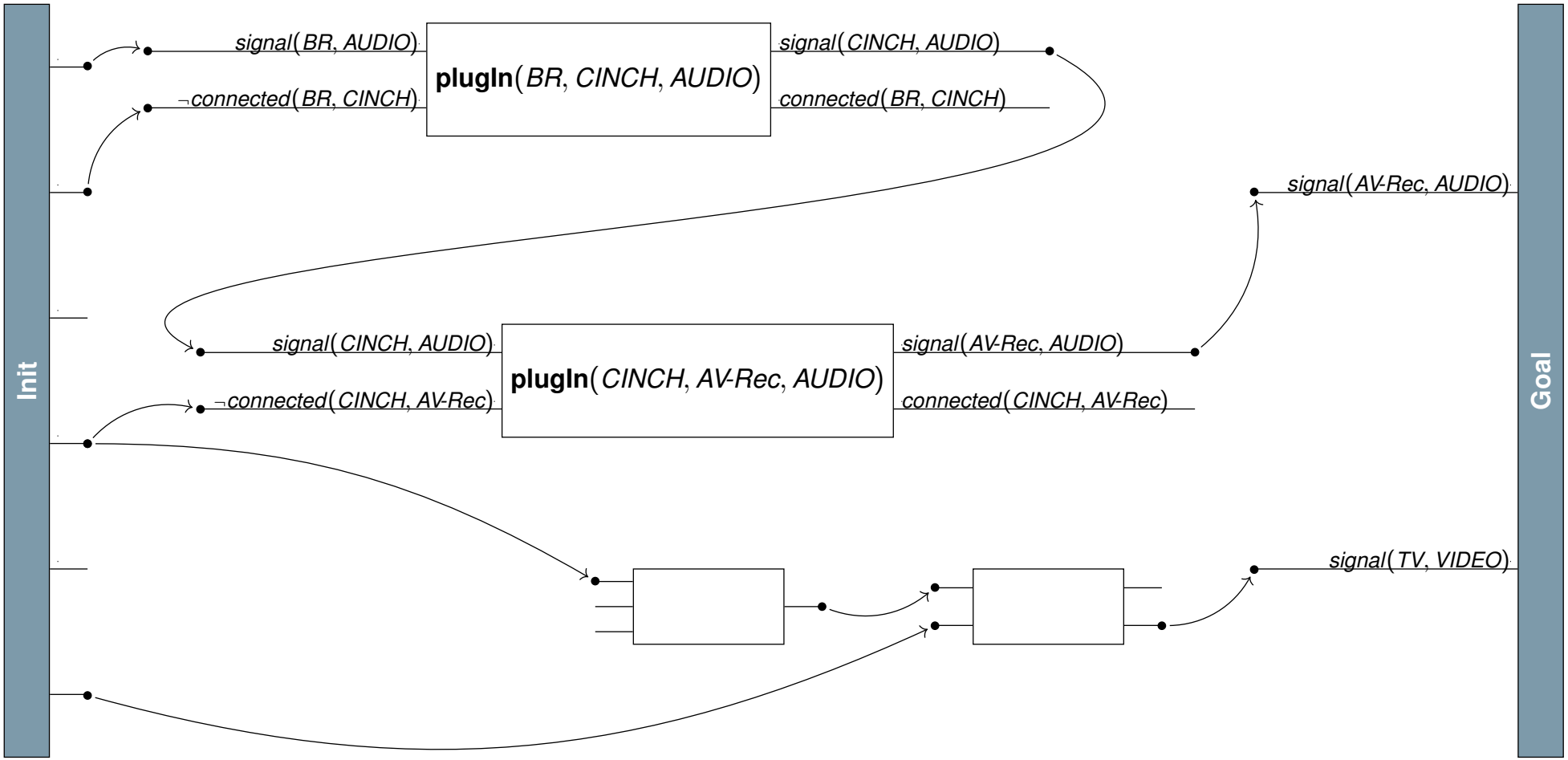

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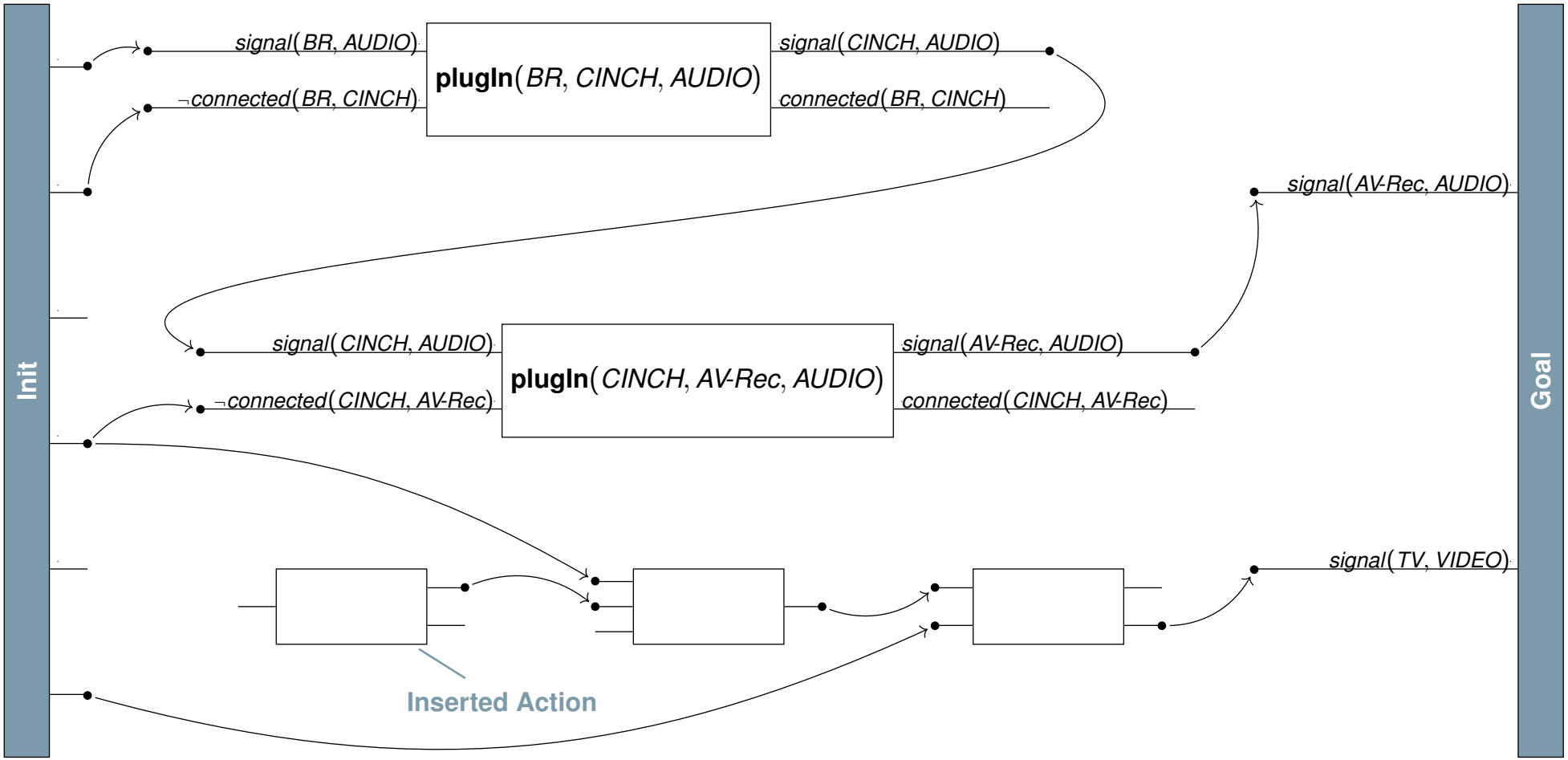

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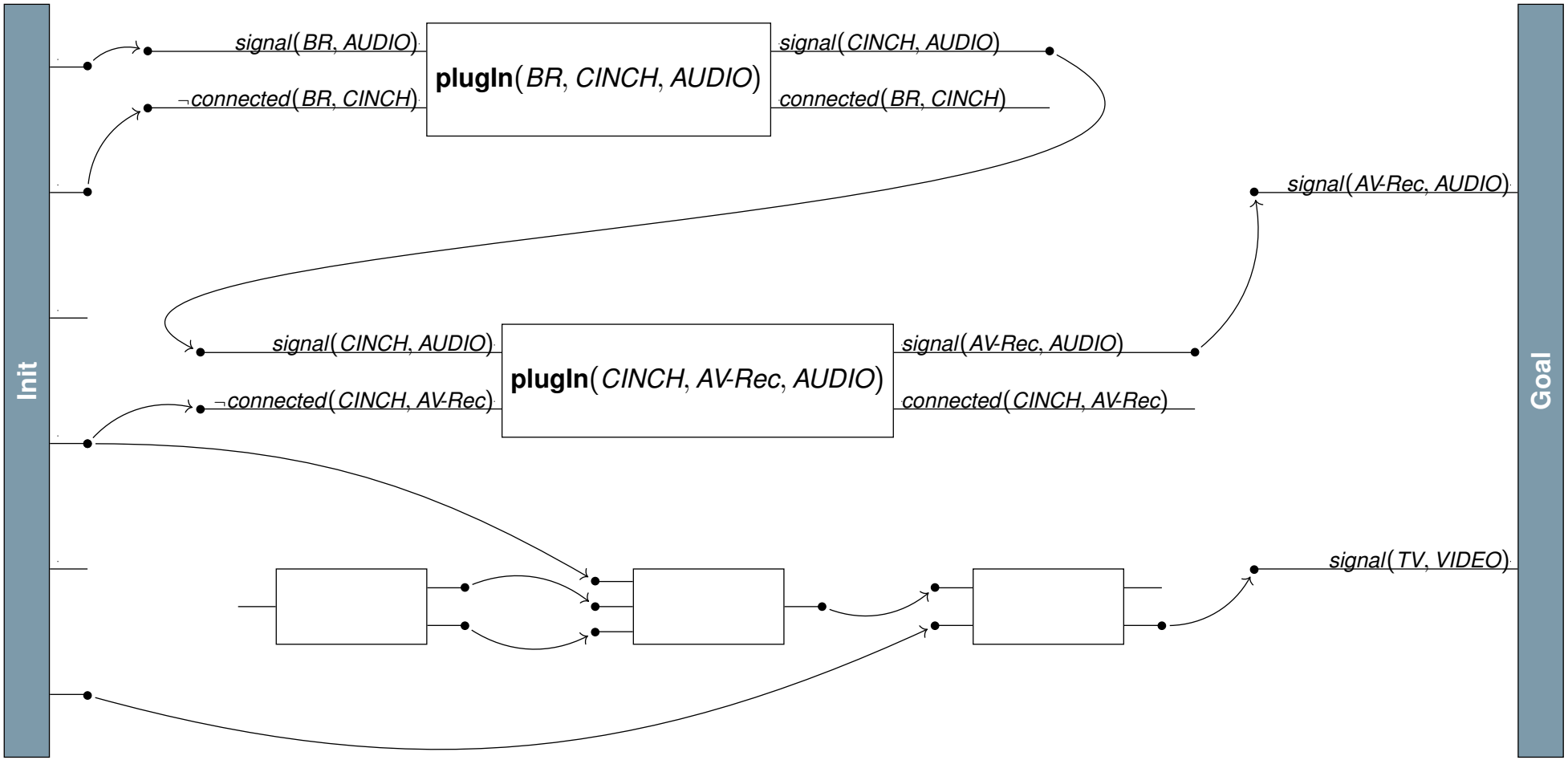

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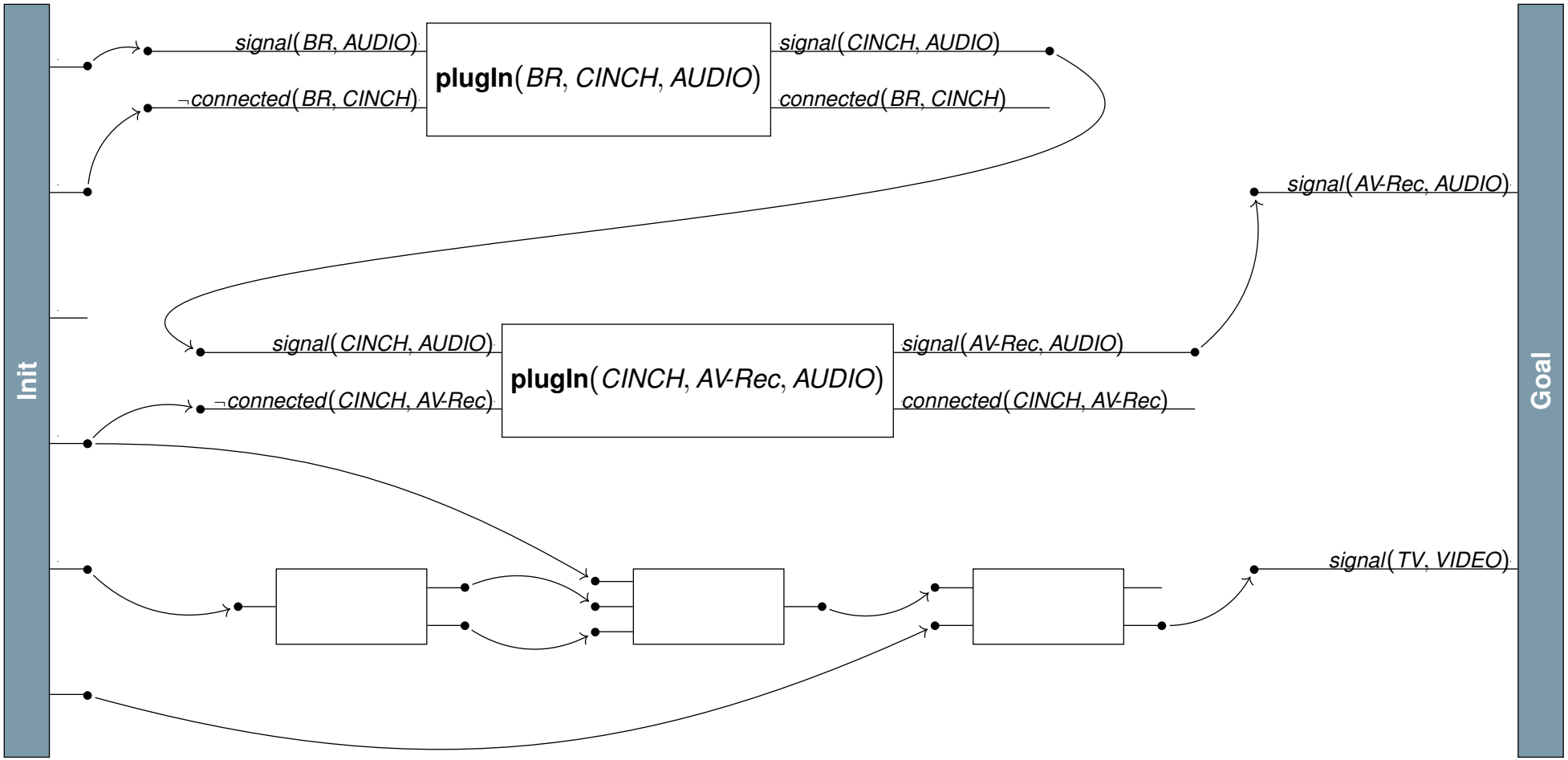

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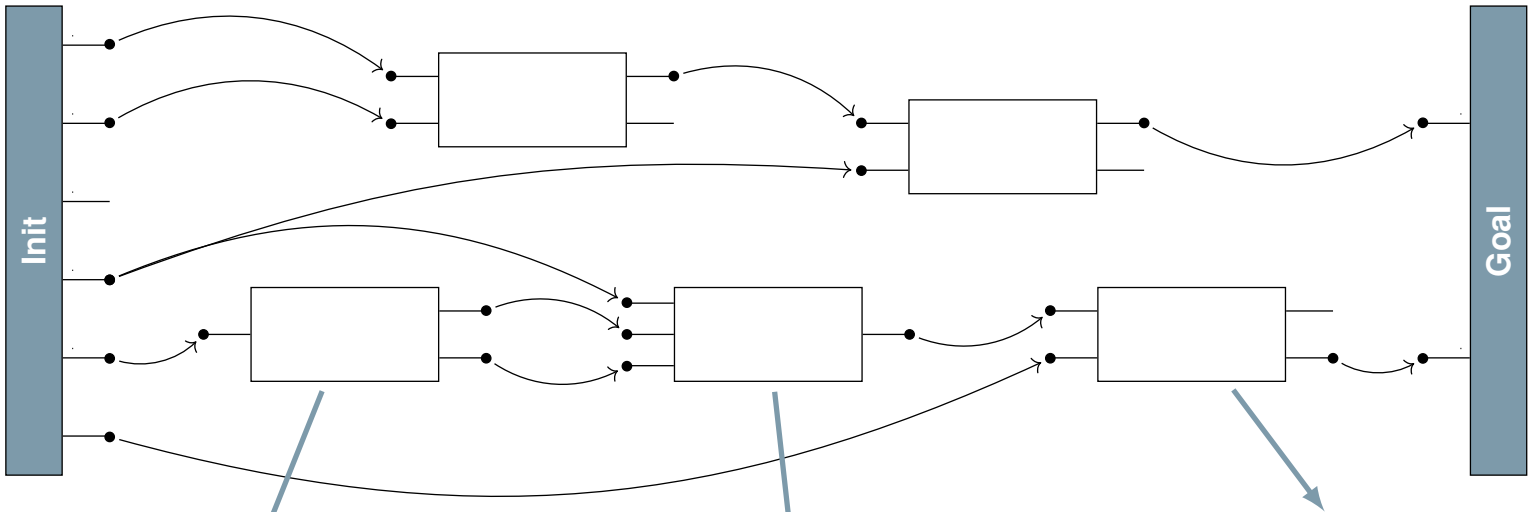

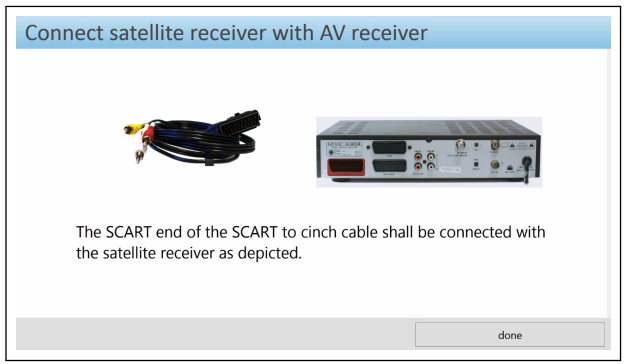

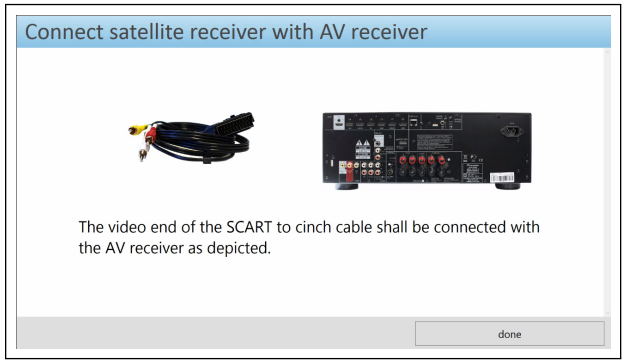

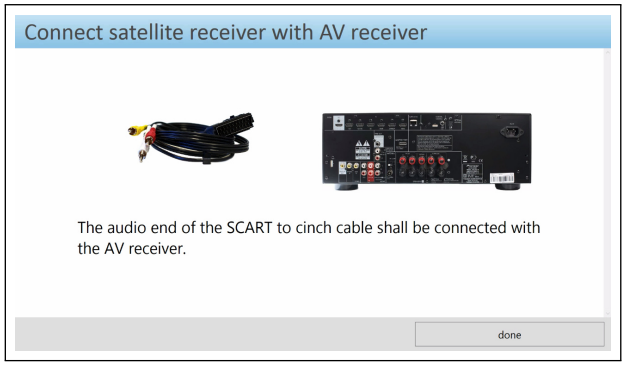

The Role of AI Planning for Companion-Systems

With AI Planning, we can:

- Generate plans automatically that are executed:
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- Repair plans if execution errors occur
- Recognize users' goals and plans to react accordingly

Assembly a Home Theater – Problem Setting

Four devices:

- Television (requires video)
- Blu-ray player
- Satellite receiver
- audio/video receiver (requires audio)

System Capabilities

Required data and information:

- A planning and dialog model of all involved hardware
- Pictures and videos

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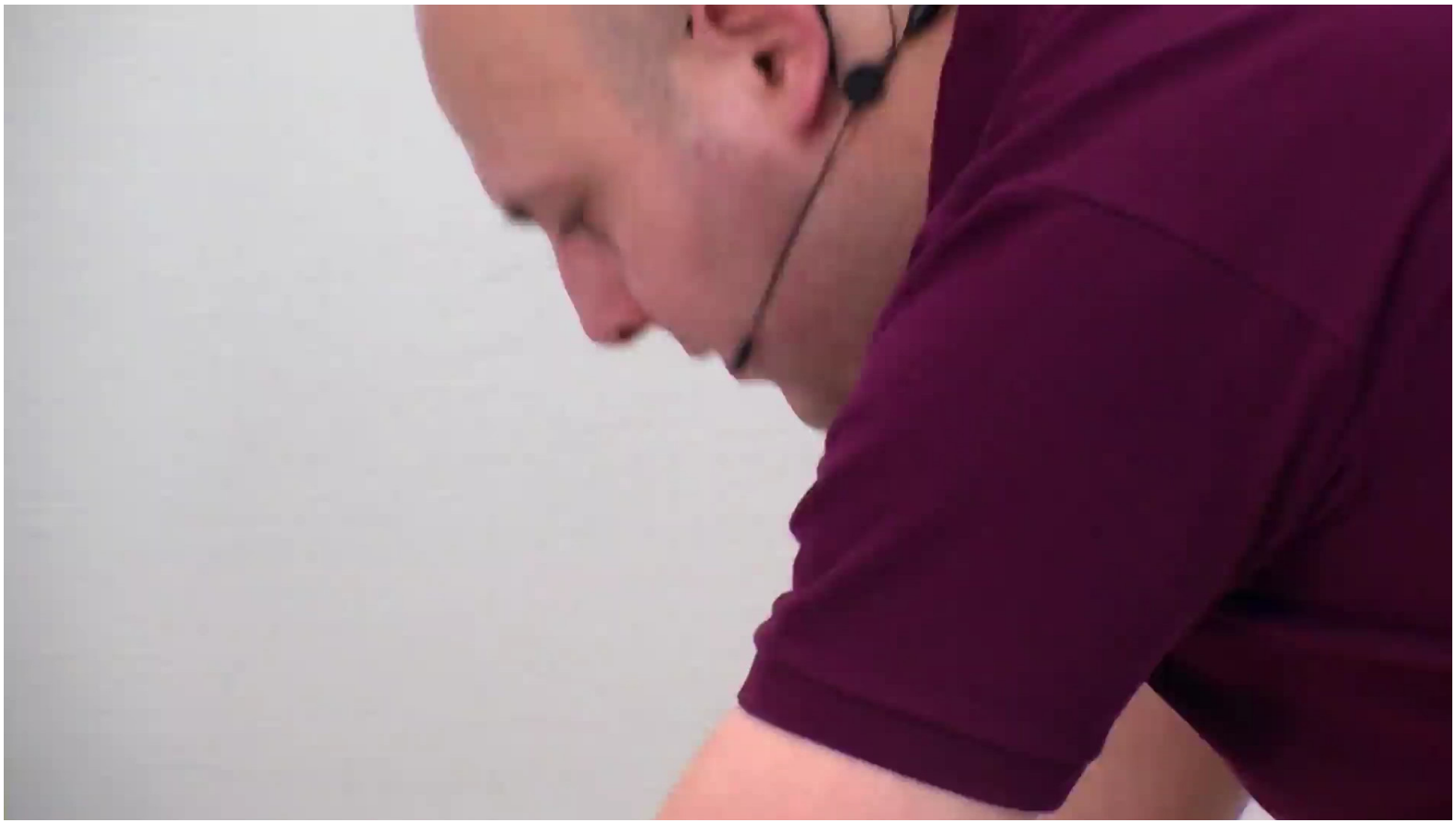
- Repair failed plans

Illustration of the System – Step-by-Step Instructions

Illustration of the System – Explanation Capabilities



More Information

For more information, see:

- A ***video*** about the assistant and its underlying technology:
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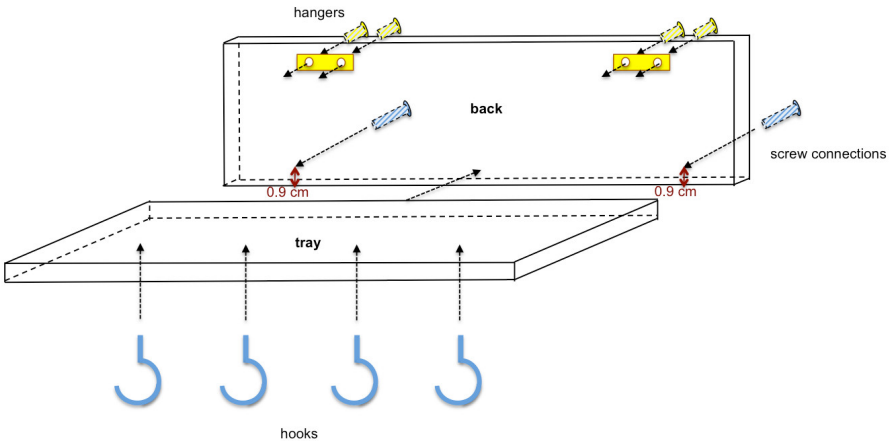
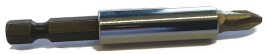
- A ***video*** about the assistant and its underlying technology: `sfb-trr-62.de` → Research → Demonstration Systems
- An overview about all (approx. 10) papers that were written in the context of the assistant, see:

  P. Bercher et al. “Advanced User Assistance for Setting Up a Home Theater”. In: *Companion Technology – A Paradigm Shift in Human-Technology Interaction*. Cognitive Technologies. Springer, 2017. Chap. 24, pp. 485–491

The DIY Assistant – Problem Setting





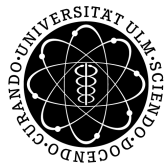
The material:

- Boards (need to be cut first)
- Electrical devices like drills and saws
- Attachments like drill bits and materials like nails

System Capabilities

Required data and information:

- A planning, dialog, and ontology model of the project (the required steps and material) and the tools and attachments
- Pictures and videos



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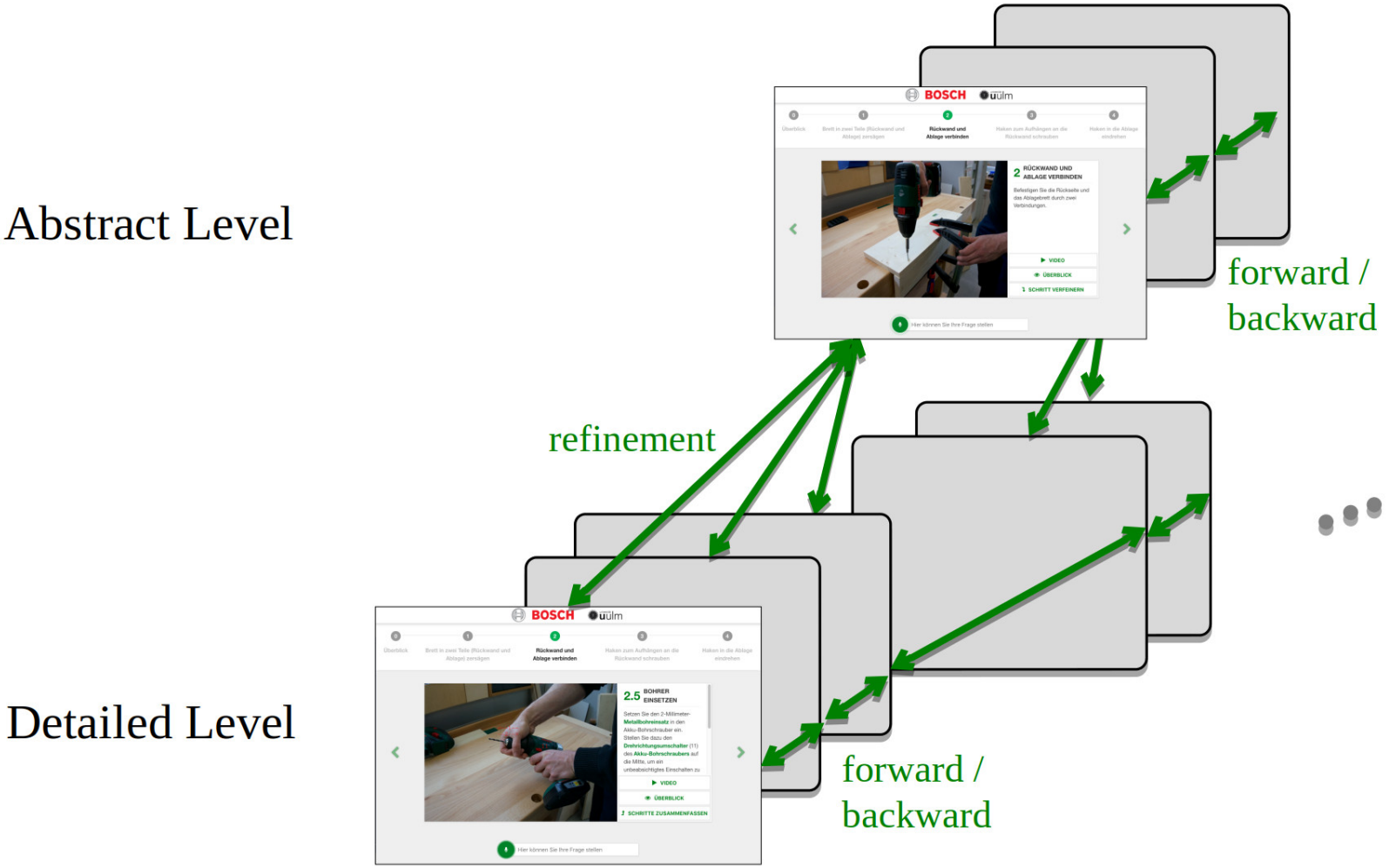
- Illustrate the instructions on different levels of abstraction

System Capabilities (Cont'd)

Presentation of instructions on different levels of abstraction:



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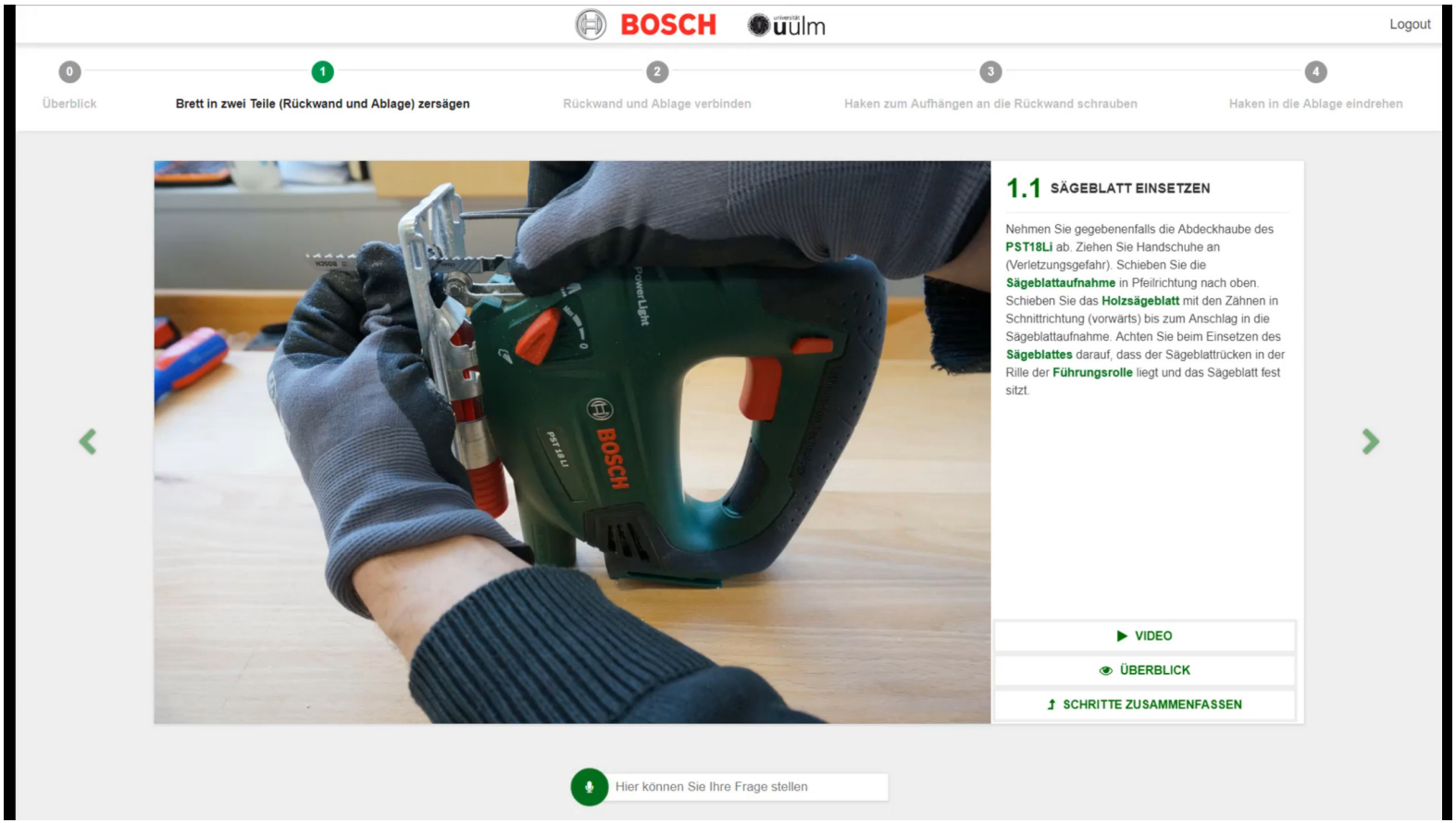
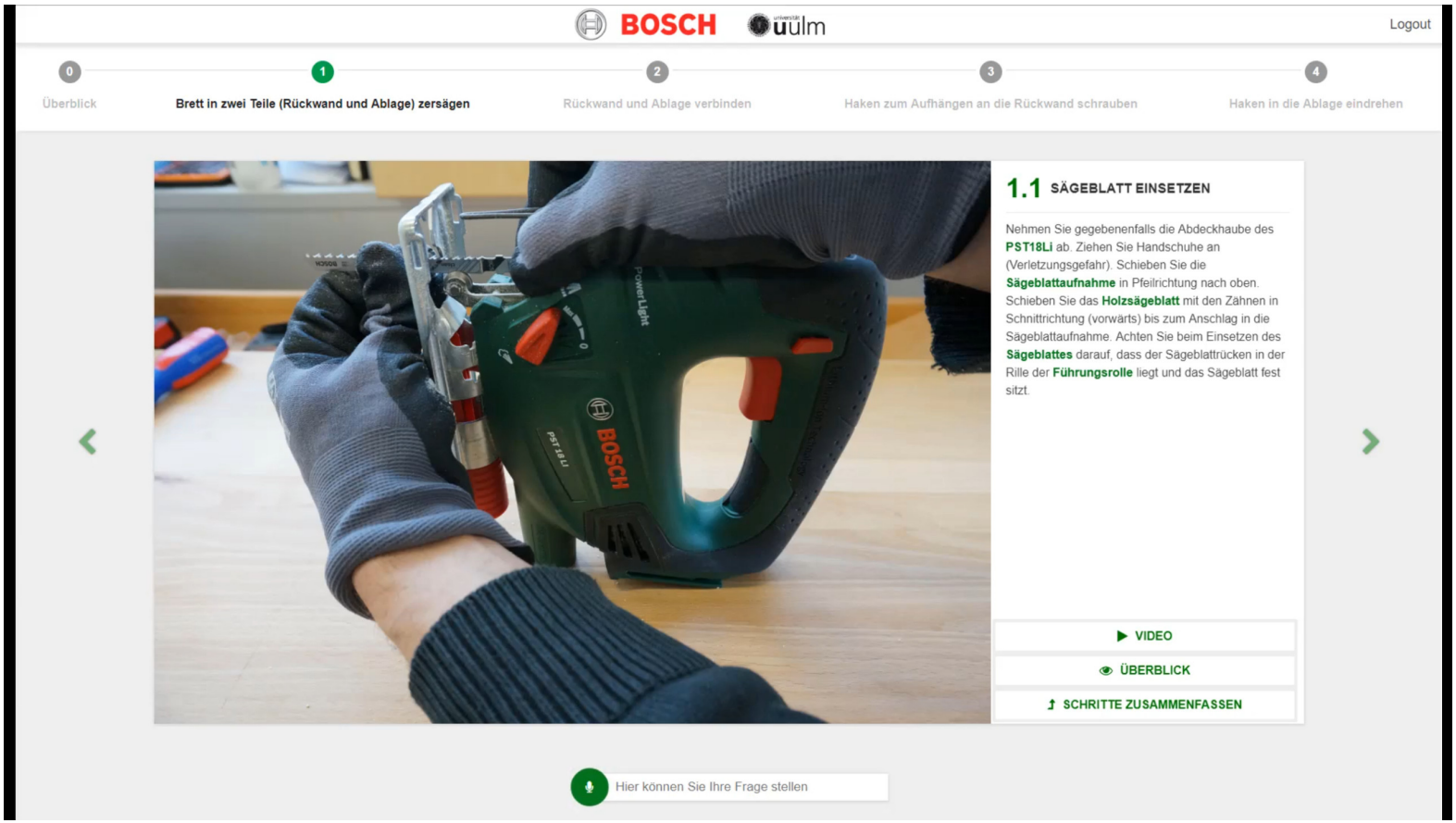


Illustration of the System – Explanation Capabilities



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More Information

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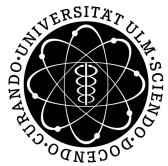
- See also the next talk by Marvin Schiller (which focuses on a user study with the assistant)



Thank You!

Thank you for your attention!