

Rational OpenCog Controlled Agent

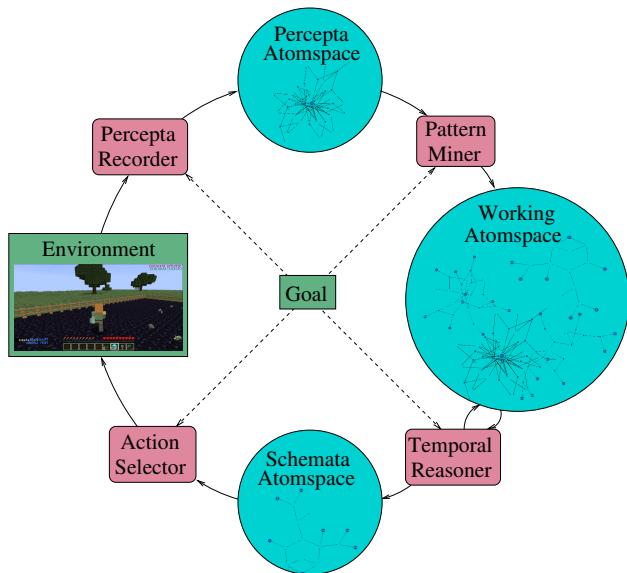
Nil Geisweiller, Hedra Yusuf

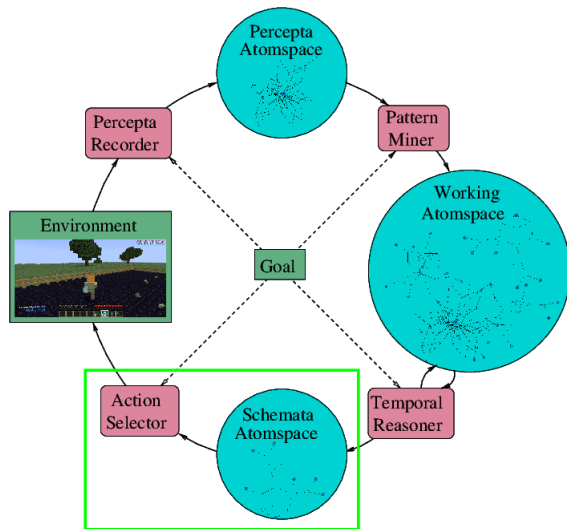
Artificial General Intelligence 2023 (AGI-23)



SingularityNET



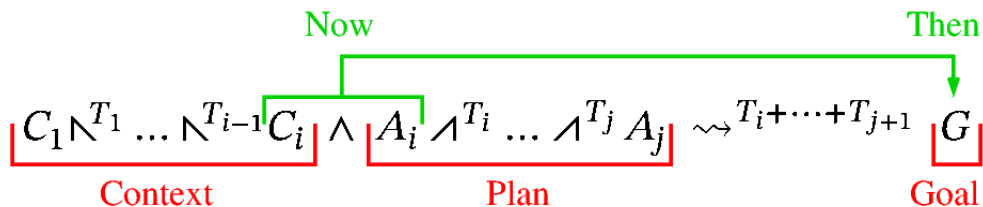


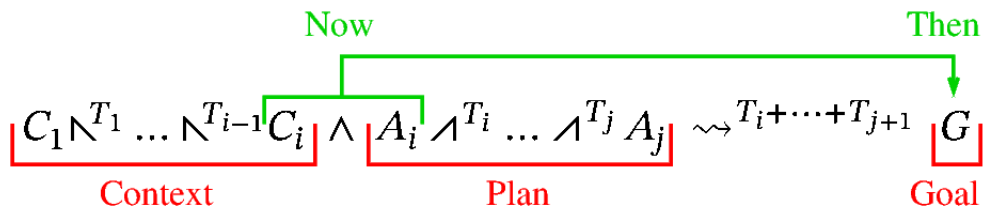


Cognitive Schematic

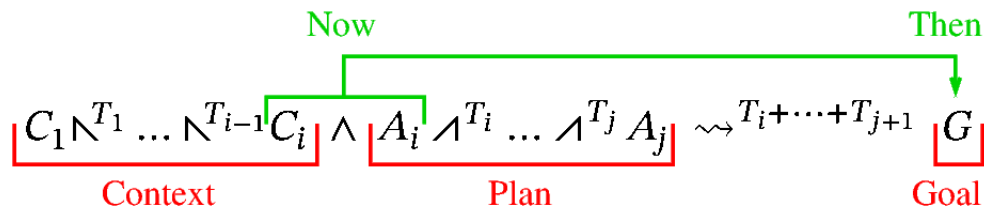
● Context \wedge Action \rightsquigarrow^T Goal

$$C_1 \mathbin{\smash{\mathrel{\mathcal{N}}}}^{T_1} \dots \mathbin{\smash{\mathrel{\mathcal{N}}}}^{T_{i-1}} C_i \wedge A_i \mathbin{\smash{\mathrel{\mathcal{A}}}}^{T_i} \dots \mathbin{\smash{\mathrel{\mathcal{A}}}}^{T_j} A_j \rightsquigarrow^{T_i + \dots + T_{j+1}} G$$



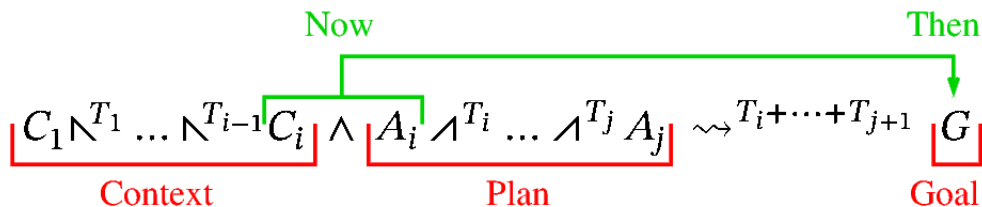


$$[C_1 \wedge N^{T_1} \dots \wedge N^{T_{i-1}} C_i](t) = \text{True} \mid \text{False}$$

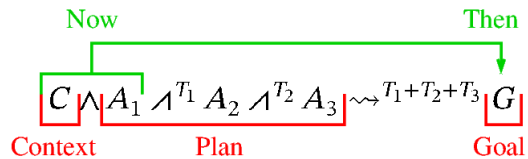


$$[C_1 \wedge N^{T_1} \dots \wedge N^{T_{i-1}} C_i](t) = \text{True} \mid \text{False}$$

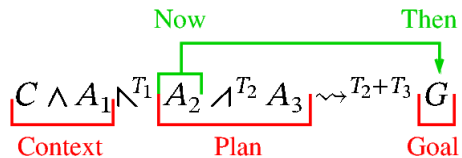
$$\mapsto \text{Dist}(\text{Bool})$$



$$\begin{aligned}
 [C_1 \wedge N^{T_1} \dots \wedge N^{T_{i-1}} C_i](t) &= \text{True} \mid \text{False} \\
 &\mapsto \text{Dist}(\text{Bool}) \\
 &\mapsto \text{Dist}(\text{Dist}(\text{Bool}))
 \end{aligned}$$

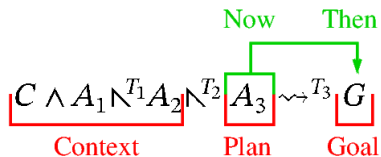


$$C \wedge A_1 \nearrow^{T_1} A_2 \nearrow^{T_2} A_3 \rightsquigarrow^{T_1+T_2+T_3} G$$

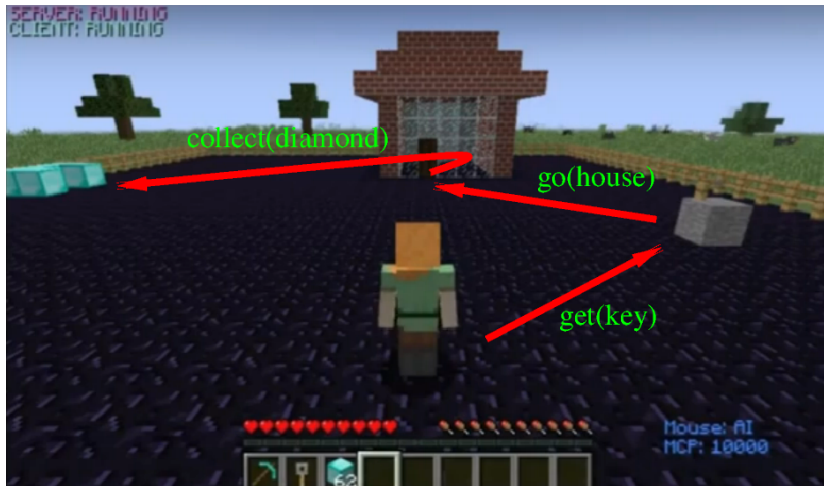


$$C \wedge A_1 \wedge^{T_1} A_2 \wedge^{T_2} A_3 \rightsquigarrow^{T_1+T_2+T_3} G$$

$$C \wedge A_1 \wedge^{T_1} A_2 \wedge^{T_2} A_3 \rightsquigarrow^{T_2+T_3} G$$



Example: Collect Diamonds



Actions

- get(key)
- go(house)
- collect(diamond)

Percepts

- outside(house)
- inside(house)
- hold(key)
- next(door)
- reward(1)
- reward(0)

Example: Collect Diamonds



Example: Collect Diamonds

$\text{outside}(\text{house}) \wedge \text{get}(\text{key}) \nearrow^1 \text{go}(\text{house}) \nearrow^1 \text{collect}(\text{diamond}) \rightsquigarrow^3 \text{reward}(1)$



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$\text{hold}(\text{key}) \wedge \text{go}(\text{house}) \nearrow^1 \text{collect}(\text{diamond}) \rightsquigarrow^2 \text{reward}(1)$



Example: Collect Diamonds

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$\text{hold}(\text{key}) \wedge \text{go}(\text{house}) \nearrow^1 \text{collect}(\text{diamond}) \rightsquigarrow^2 \text{reward}(1)$

$\text{inside}(\text{house}) \wedge \text{collect}(\text{diamond}) \rightsquigarrow^1 \text{reward}(1)$



Example: Collect Diamonds

$\text{outside}(\text{house}) \wedge \text{get}(\text{key}) \nearrow^1 \text{go}(\text{house}) \nearrow^1 \text{collect}(\text{diamond}) \rightsquigarrow^3 \text{reward}(1)$

$\text{hold}(\text{key}) \wedge \text{go}(\text{house}) \nearrow^1 \text{collect}(\text{diamond}) \rightsquigarrow^2 \text{reward}(1)$

$\text{inside}(\text{house}) \wedge \text{collect}(\text{diamond}) \rightsquigarrow^1 \text{reward}(1)$



The Paradox of Choice

Many applicable schemata

$$\begin{array}{ccc}
 C_1 \wedge A_1 \rightsquigarrow^{T_1} G & \stackrel{m}{=} & TV_1 \\
 \vdots & & \\
 C_{9999} \wedge A_{9999} \rightsquigarrow^{T_{9999}} G & \stackrel{m}{=} & TV_{9999}
 \end{array}$$

The Paradox of Choice

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 \end{array}$$

Some contradicting each other

$$\begin{array}{ccc}
 C_1 \wedge A \rightsquigarrow^{T_1} G & \stackrel{m}{=} & <0.9 \ 0.5> \\
 C_2 \wedge A \rightsquigarrow^{T_1} G & \stackrel{m}{=} & <0.1 \ 0.5>
 \end{array}$$

The Paradox of Choice

Many applicable schemata

$$\begin{array}{ccc}
 C_1 \wedge A_1 \rightsquigarrow^{T_1} G & \stackrel{m}{=} & TV_1 \\
 \vdots & & \\
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 \end{array}$$

Some contradicting each other

$$\begin{array}{ccc}
 C_1 \wedge A \rightsquigarrow^{T_1} G & \stackrel{m}{=} & \langle 0.9 \ 0.5 \rangle \\
 C_2 \wedge A \rightsquigarrow^{T_1} G & \stackrel{m}{=} & \langle 0.1 \ 0.5 \rangle
 \end{array}$$

With different risk/reward profiles

$$\begin{array}{ccc}
 C_1 \wedge A_1 \rightsquigarrow^{T_1} G & \stackrel{m}{=} & \langle 0.9 \ 0.1 \rangle \\
 C_2 \wedge A_2 \rightsquigarrow^{T_2} G & \stackrel{m}{=} & \langle 0.6 \ 0.9 \rangle
 \end{array}$$

Balancing exploitation and exploration

Solomonoff-ish Induction
+
Thompson Sampling

Balancing exploitation and exploration

Solomonoff-ish Induction ↘

+

Thompson Sampling ↙

Second Order Mixture

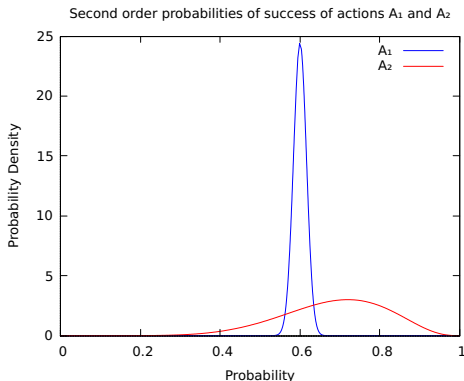
Balancing exploitation and exploration

Solomonoff-ish Induction ↘

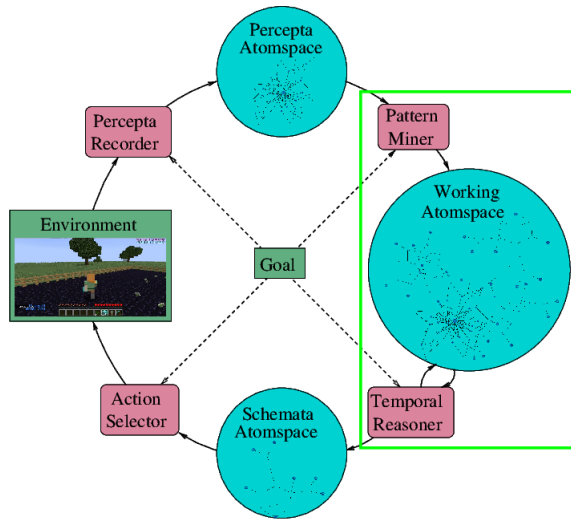
+

Thompson Sampling ↙

Second Order Mixture



Learning Schemata



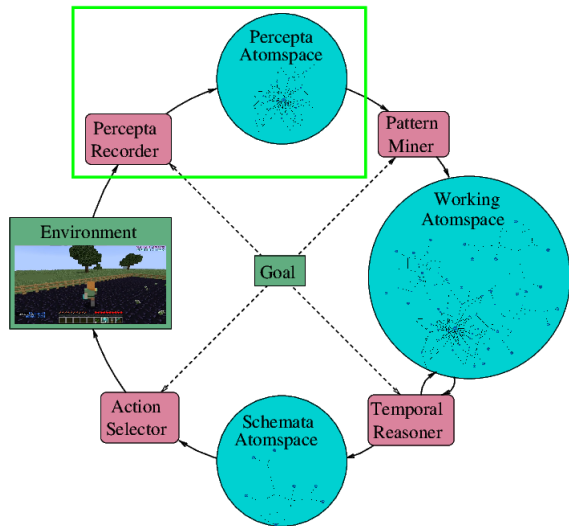
Pattern Mining
+
Temporal Reasoning

Pattern Mining Schemata

<i>Time</i>	<i>Event</i>
⋮	⋮
10	<i>Reward(0)</i>
10	<i>outside(house)</i>
10	<i>hold(key)</i>
10	<i>go(house)</i>
11	<i>inside(house)</i>
11	<i>go(diamond)</i>
11	<i>Reward(0)</i>
12	<i>Reward(1)</i>
⋮	⋮

$$hold(key) \wedge go(house) \rightsquigarrow^1 inside(house) \stackrel{m}{=} \langle 0.833, 0.007 \rangle$$

Reasoning Schemata



Events
Timestamped
Recorded