

Introduction to Distributed and Embedded Multi-agent Systems

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Nilson Mori Lazarin^{1,2}

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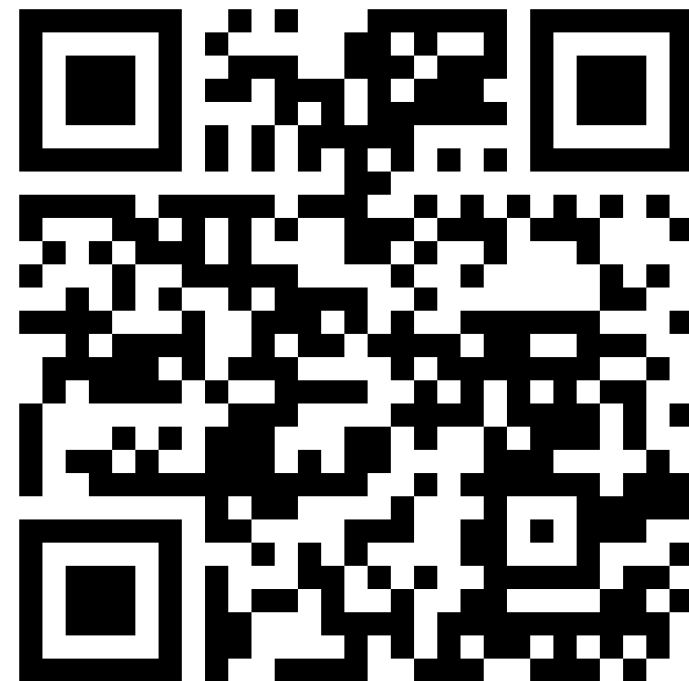
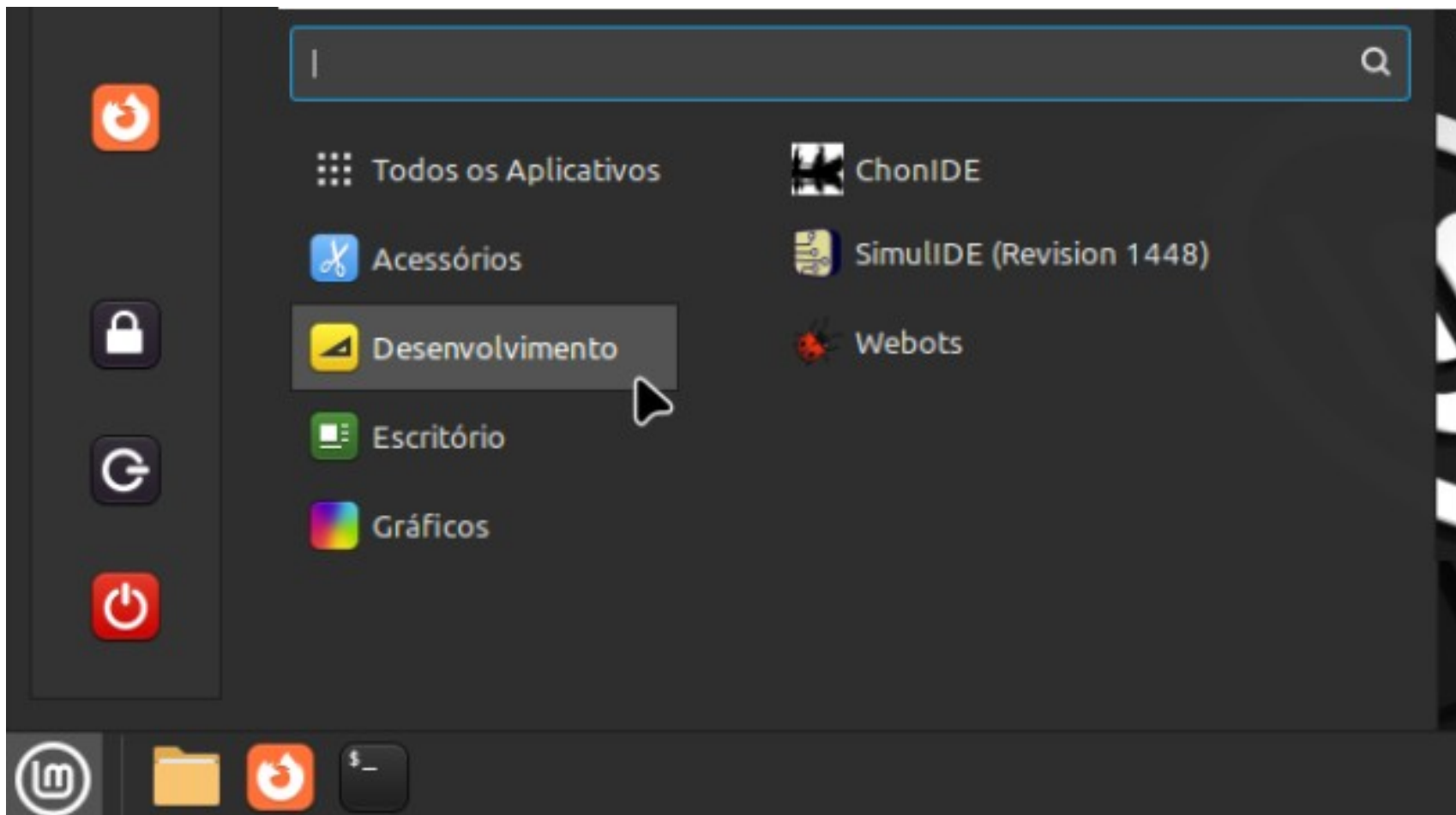


THE DEVELOPMENT TOOLS

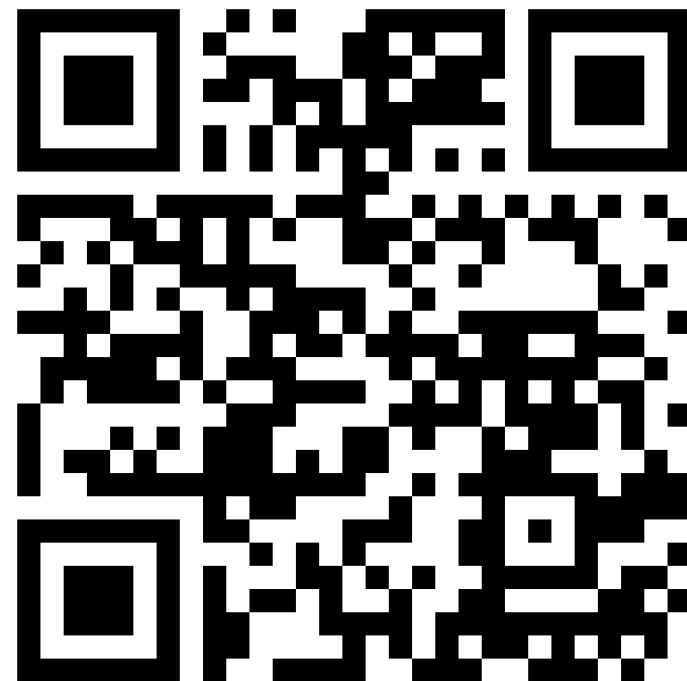
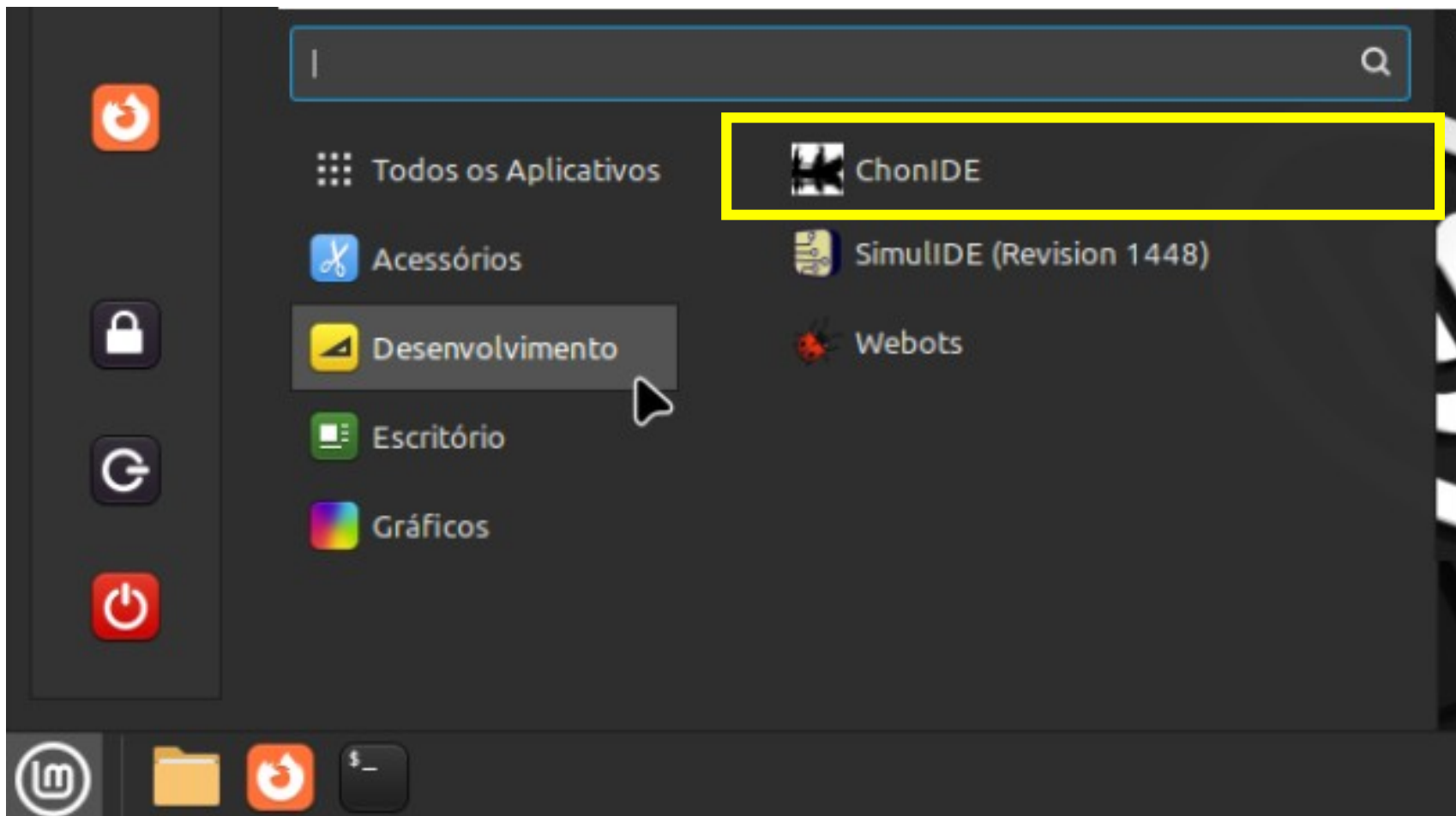




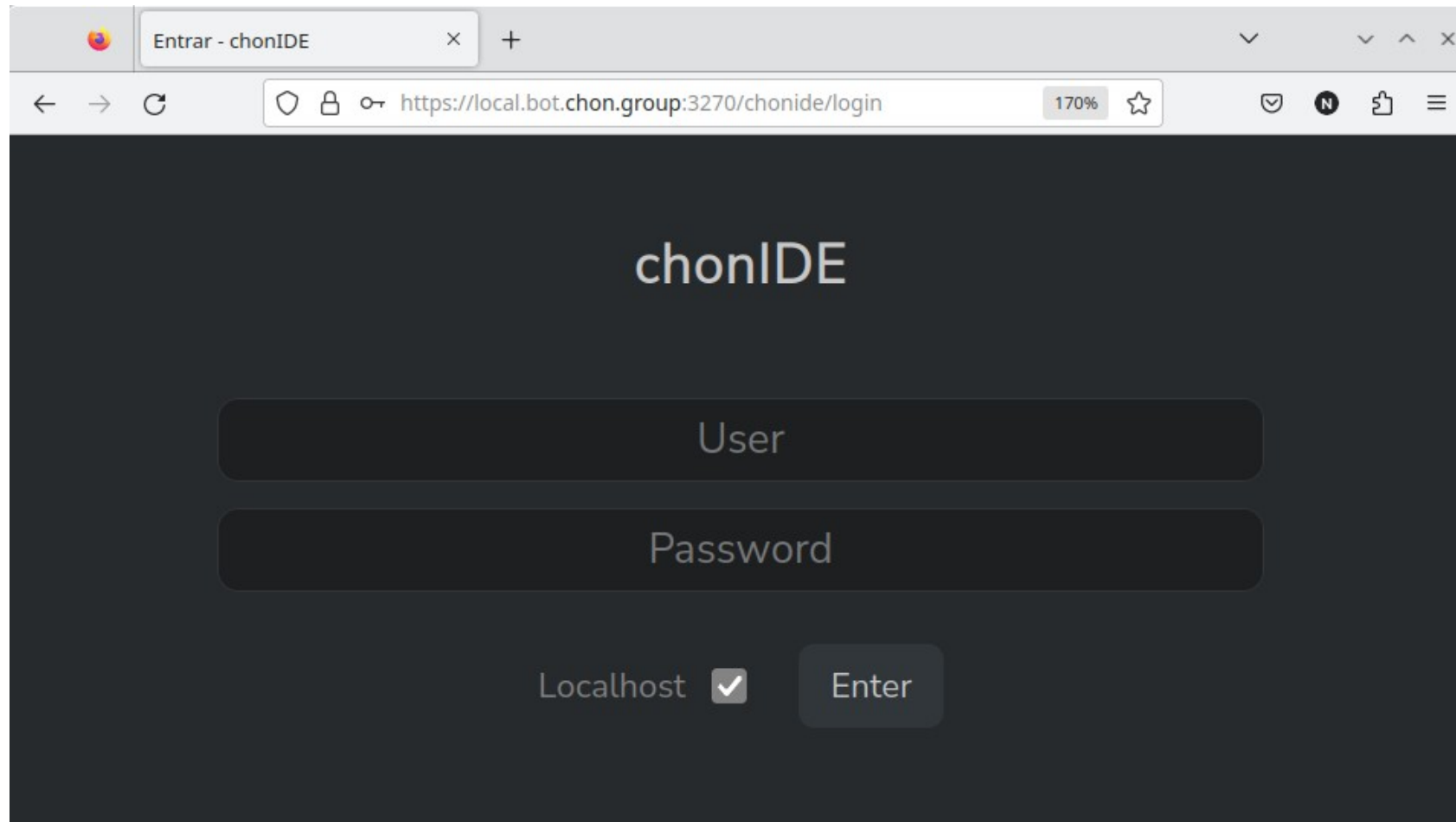
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Manual de Instalação
[https://github.com/chon-group/
chonIDE/tree/main/doc](https://github.com/chon-group/chonIDE/tree/main/doc)

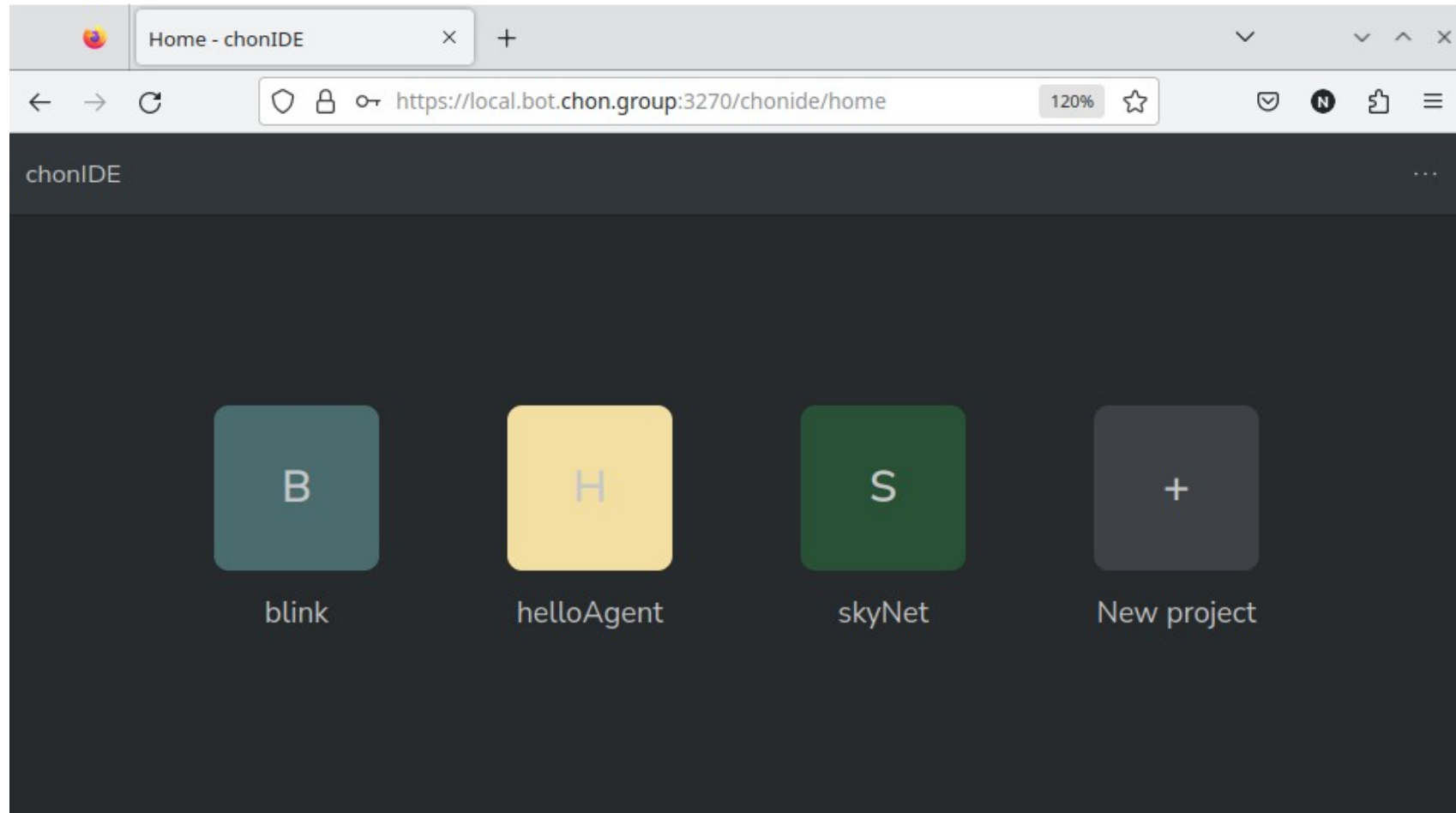


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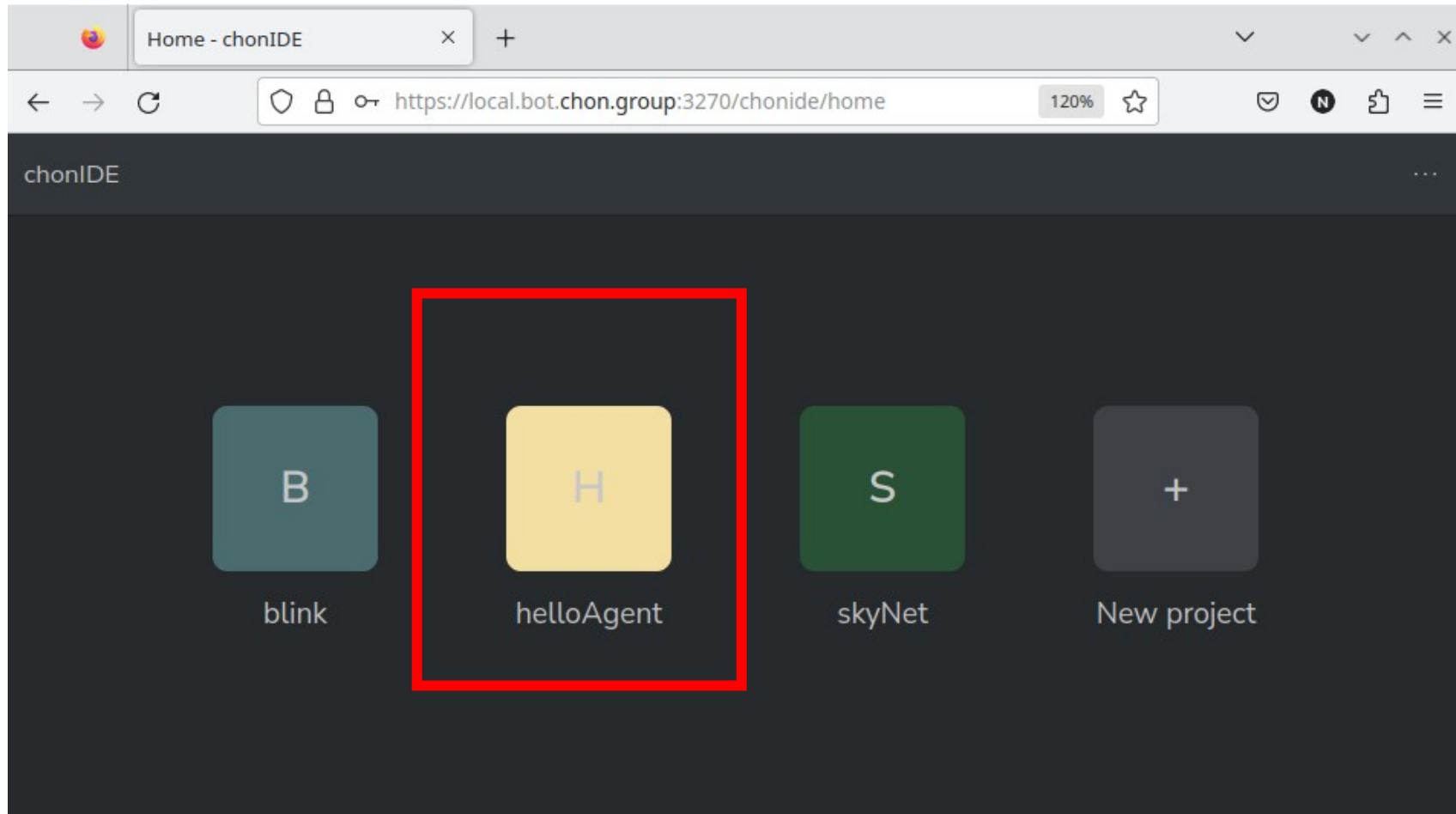
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ChonIDE: helloAgent



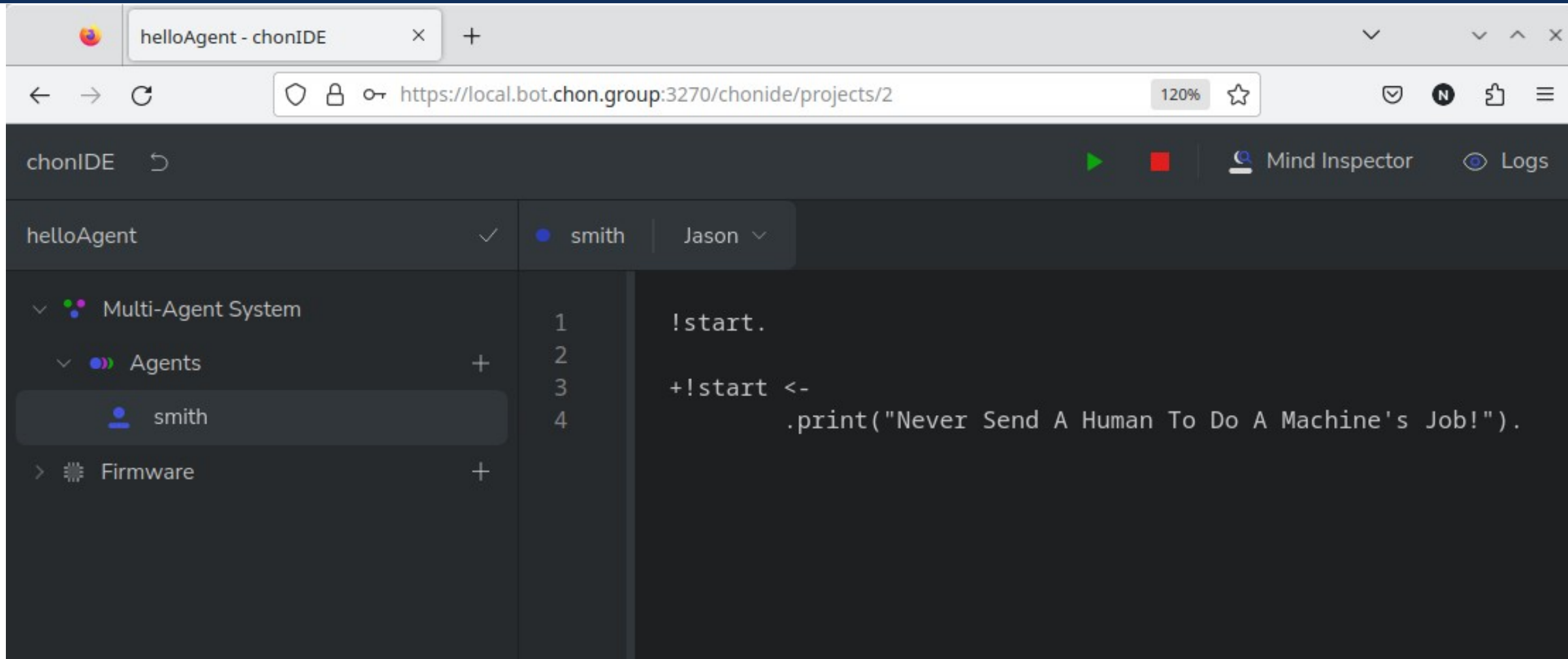
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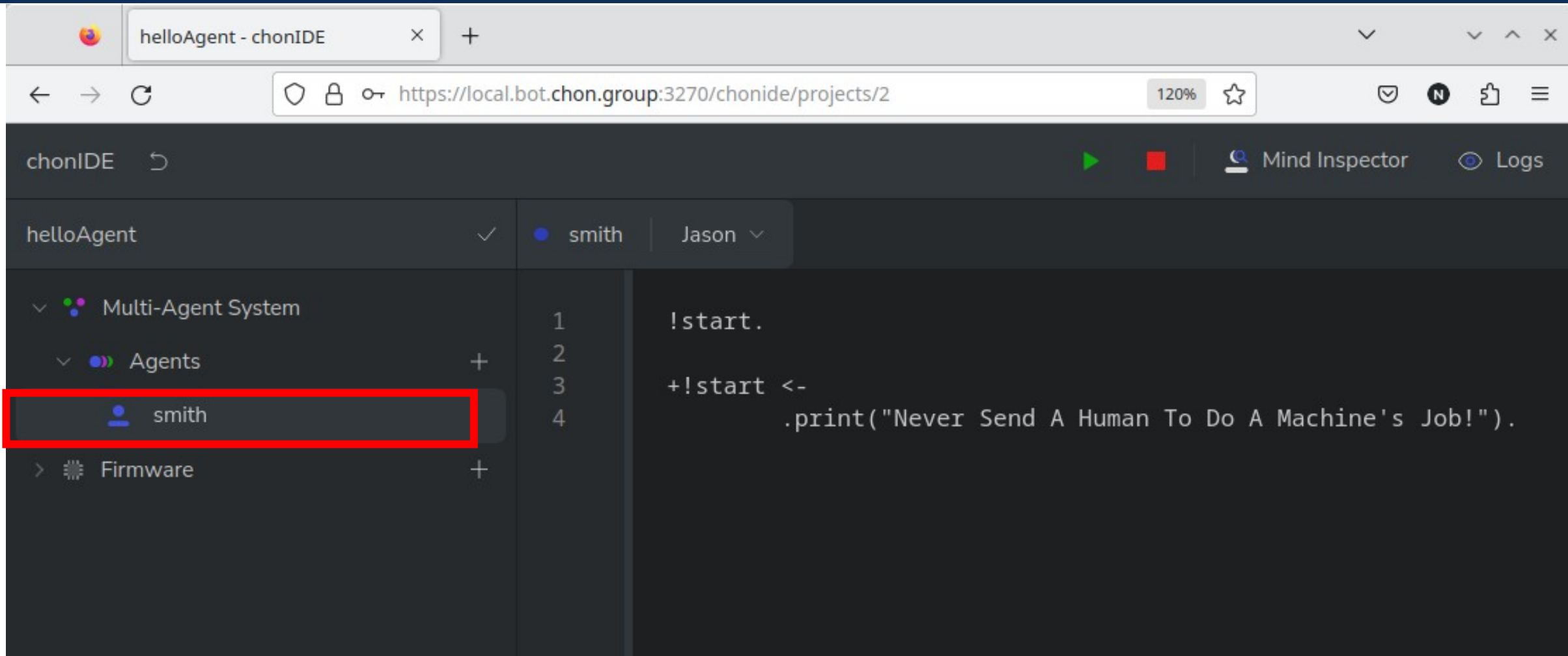
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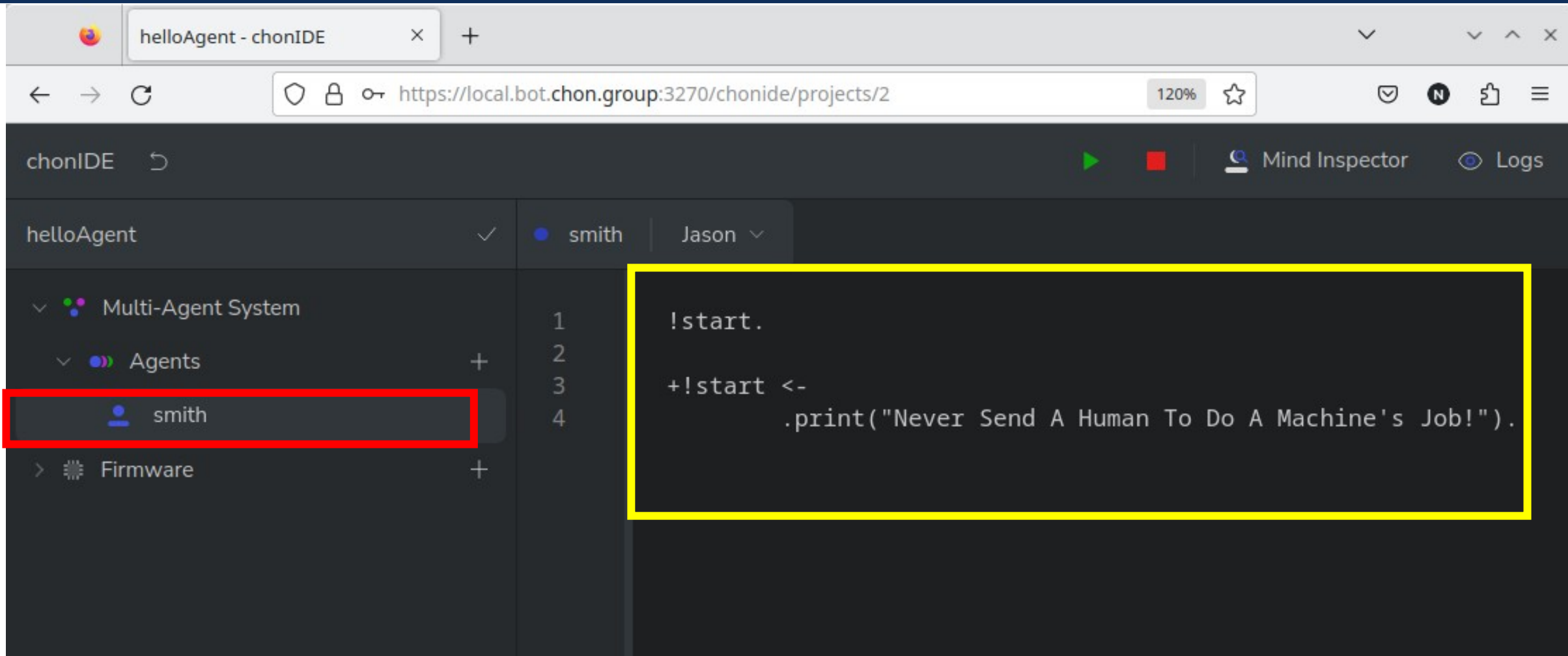
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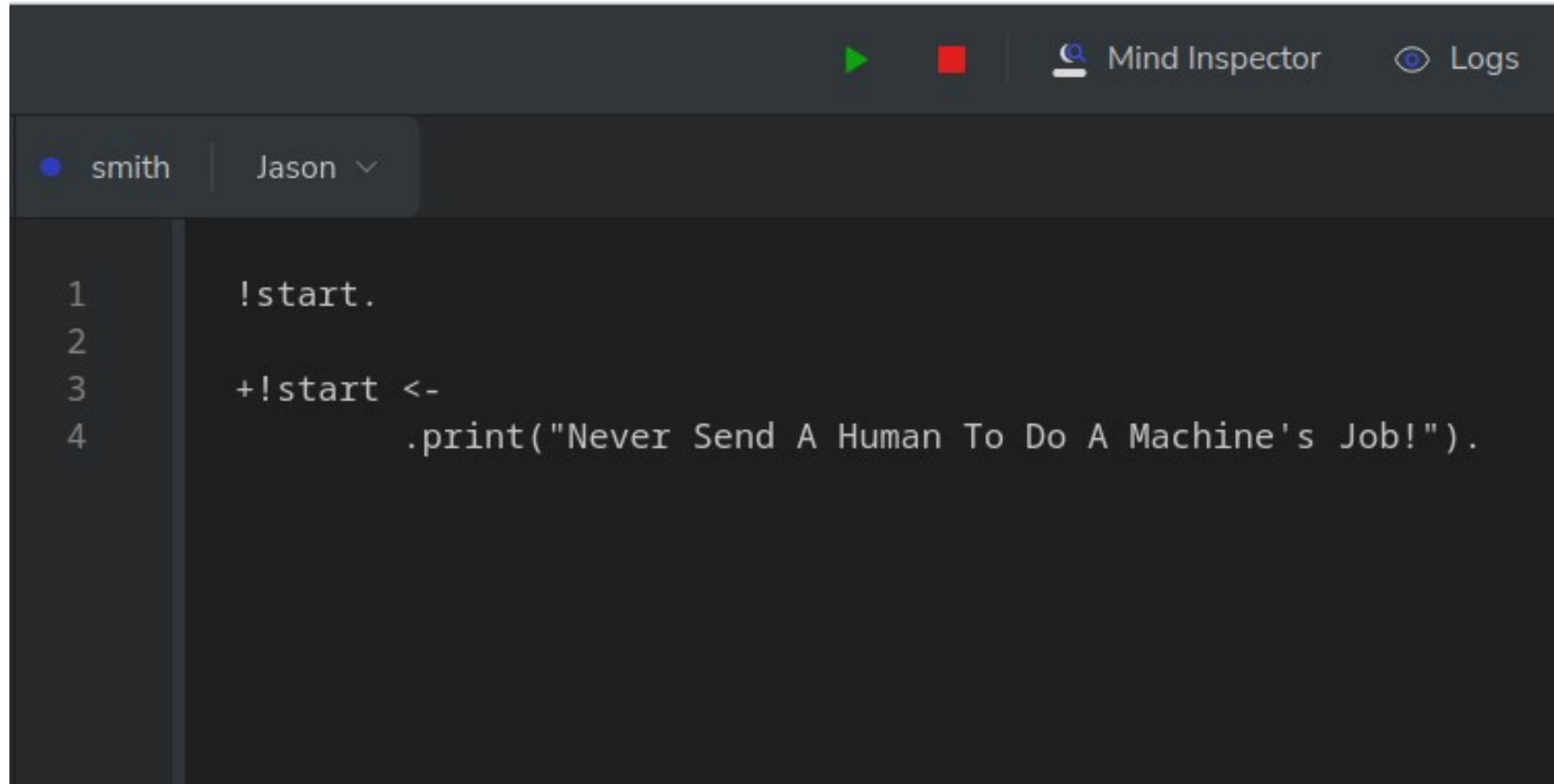
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ChonIDE: helloAgent



The screenshot shows the ChonIDE IDE interface. At the top, there are control buttons: a green play button, a red stop button, and tabs for 'Mind Inspector' and 'Logs'. Below this is a header bar with two tabs: 'smith' (selected) and 'Jason'. The main area is a code editor with a dark background and light-colored text. It contains four lines of code, numbered 1 to 4 on the left margin:

```
1      !start.  
2  
3      +!start <-  
4          .print("Never Send A Human To Do A Machine's Job!").
```

Souza de Jesus, V., Mori Lazzarin, N., Pantoja, C.E., Vaz Alves, G., Ramos Alves de Lima, G., Viterbo, J. (2023). An IDE to Support the Development of Embedded Multi-Agent Systems. In: Mathieu, P., Dignum, F., Novais, P., De la Prieta, F. (eds) Advances in Practical Applications of Agents, Multi-Agent Systems, and Cognitive Mimetics. The PAAMS Collection. PAAMS 2023. Lecture Notes in Computer Science(), vol 13955. Springer, Cham. https://doi.org/10.1007/978-3-031-37616-0_29

ChonIDE: helloAgent



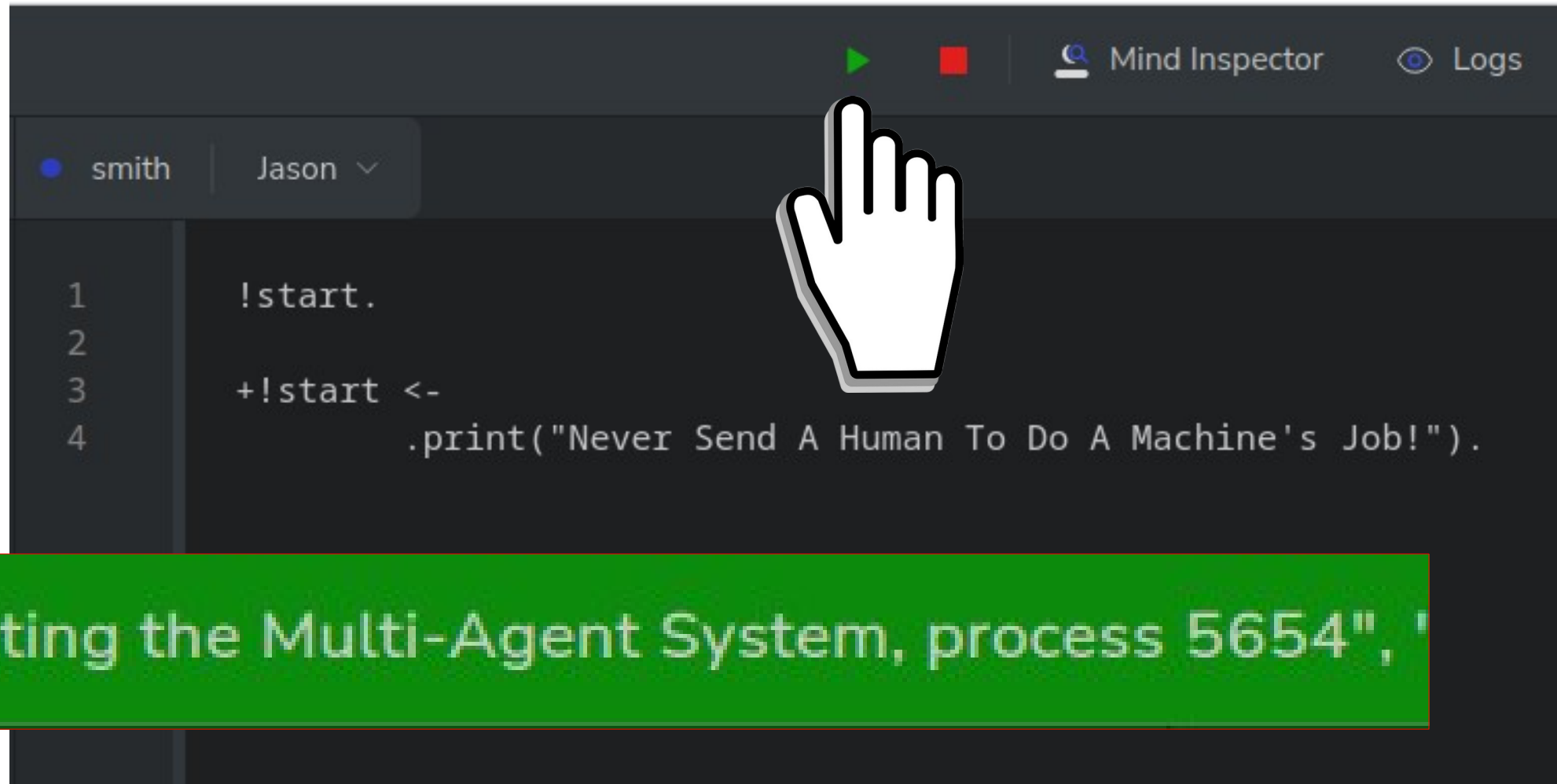
The screenshot shows the ChonIDE IDE interface. At the top, there is a toolbar with a green play button (run), a red square button (stop), and two buttons labeled 'Mind Inspector' and 'Logs'. Below the toolbar, there is a tab bar with two tabs: 'smith' (selected) and 'Jason'. The main area is a code editor with a dark background. It contains four lines of code:

```
1      !start.  
2  
3      +!start <-  
4          .print("Never Send A Human To Do A Machine's Job!").
```

A large white hand cursor with a black outline is pointing at the green play button in the toolbar.

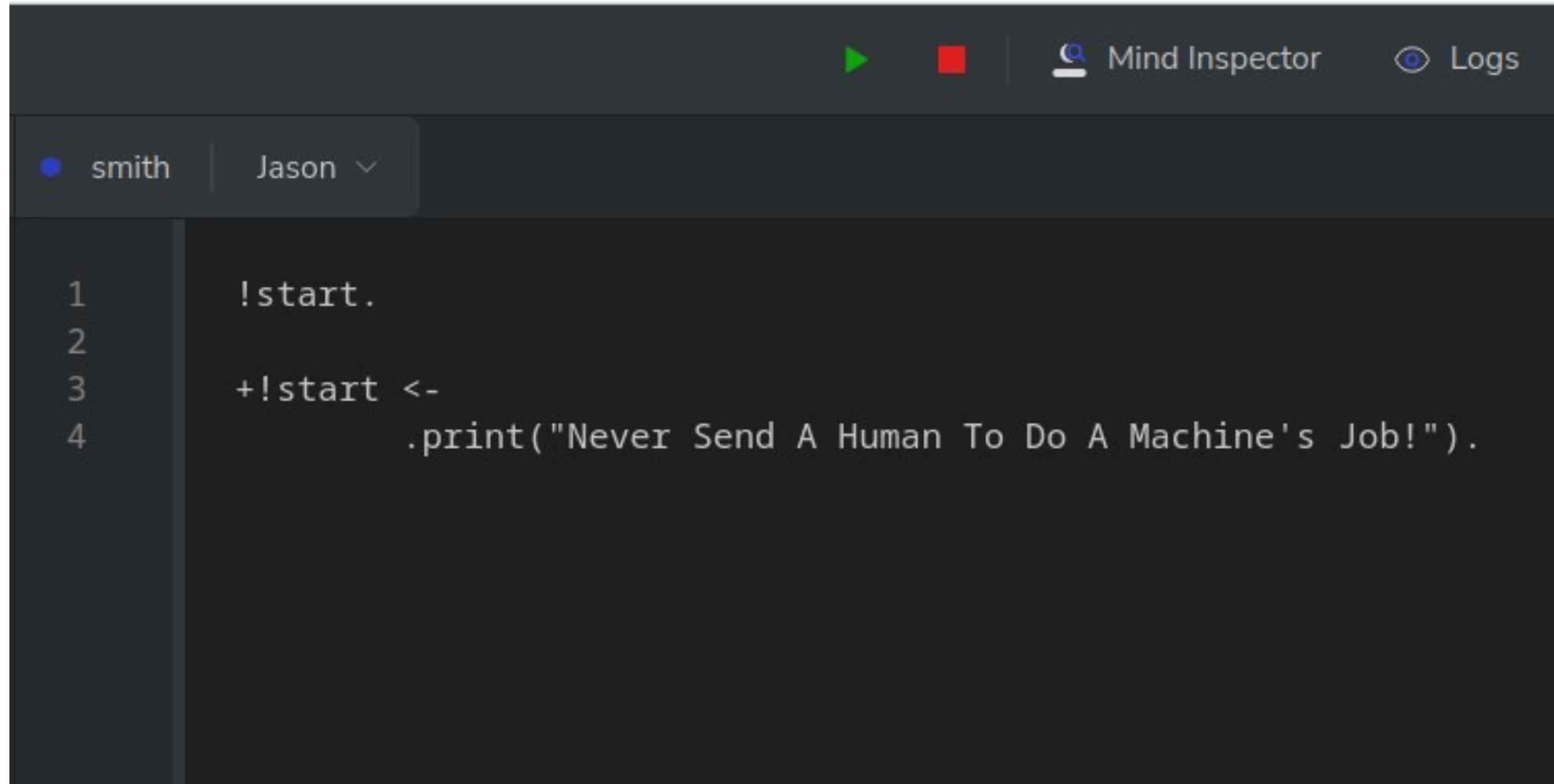
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ChonIDE: helloAgent

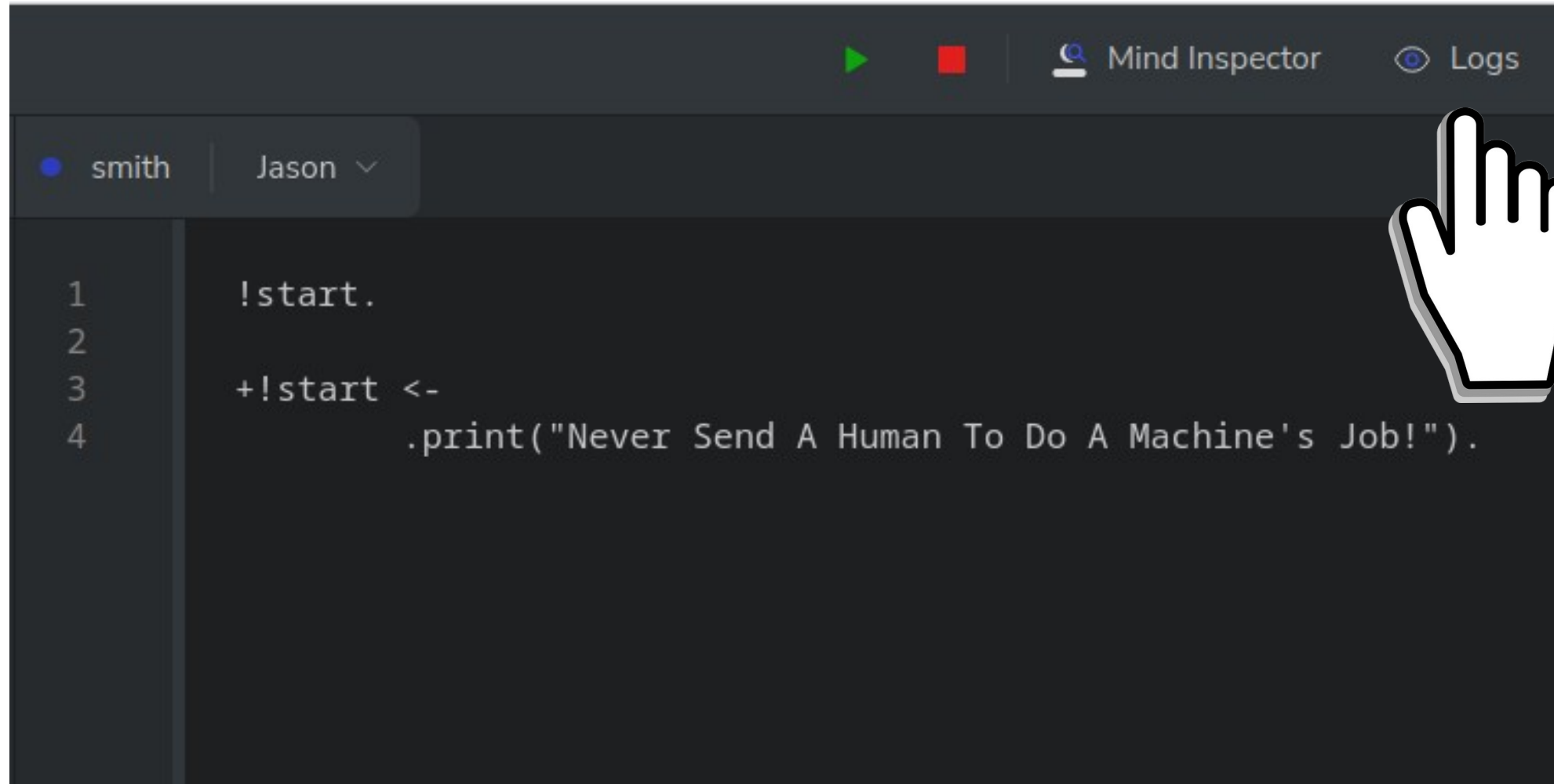


The screenshot shows the ChonIDE IDE interface. At the top, there are control buttons: a green play button, a red stop button, and tabs for 'Mind Inspector' and 'Logs'. Below this is a header bar with two agent names: 'smith' (selected with a blue dot) and 'Jason' (with a dropdown arrow). The main area is a code editor with a dark background and light-colored text. It contains a script with four lines of code, numbered 1 to 4 on the left margin:

```
1      !start.  
2  
3      +!start <-  
4          .print("Never Send A Human To Do A Machine's Job!").
```

Pantoja, C.E., Jesus, V.S.d., Lazzarin, N.M., Viterbo, J. (2023). A Spin-off Version of Jason for IoT and Embedded Multi-Agent Systems. In: Naldi, M.C., Bianchi, R.A.C. (eds) Intelligent Systems. BRACIS 2023. Lecture Notes in Computer Science(), vol 14195. Springer, Cham. https://doi.org/10.1007/978-3-031-45368-7_25

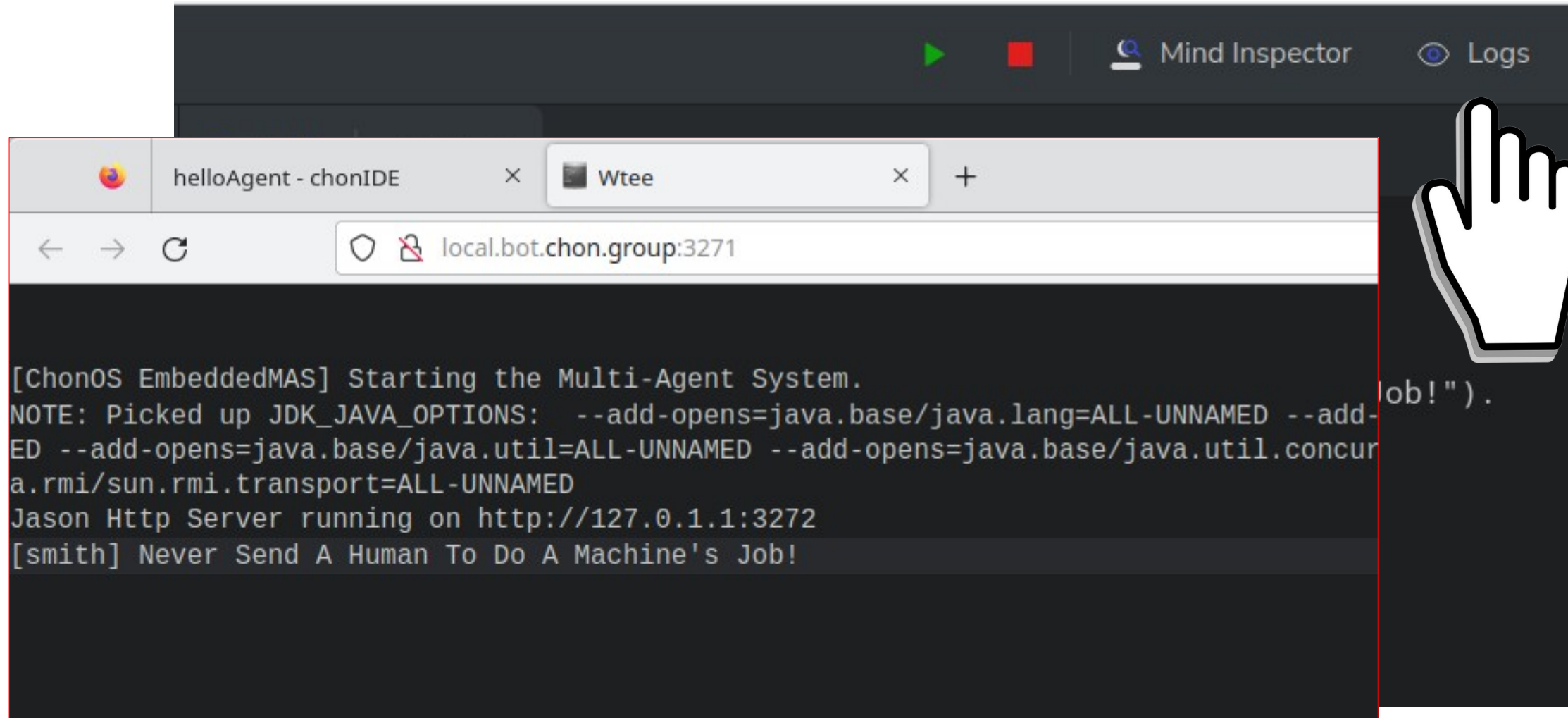
ChonIDE: helloAgent



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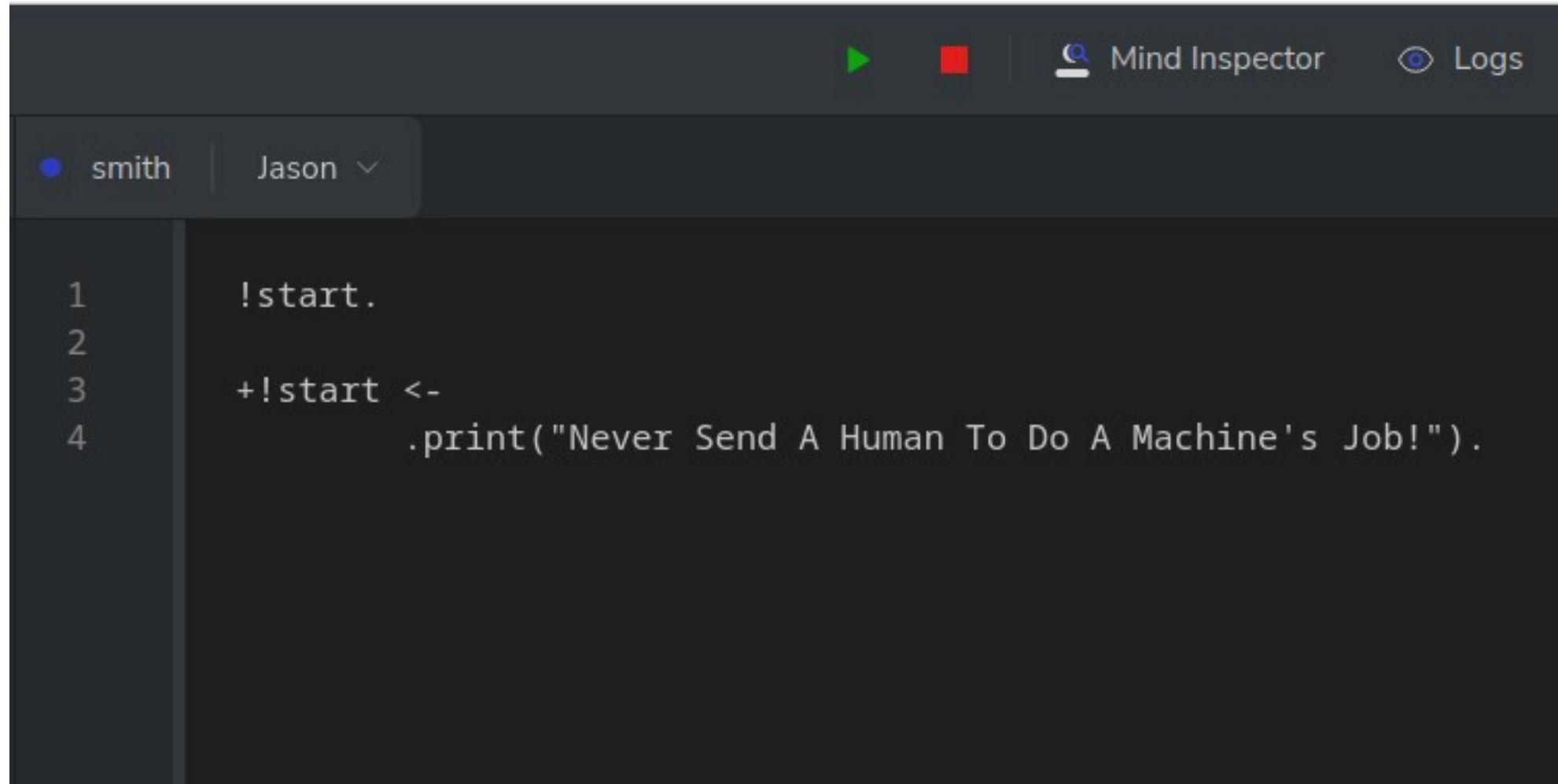
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ChonIDE: helloAgent



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ChonIDE: helloAgent

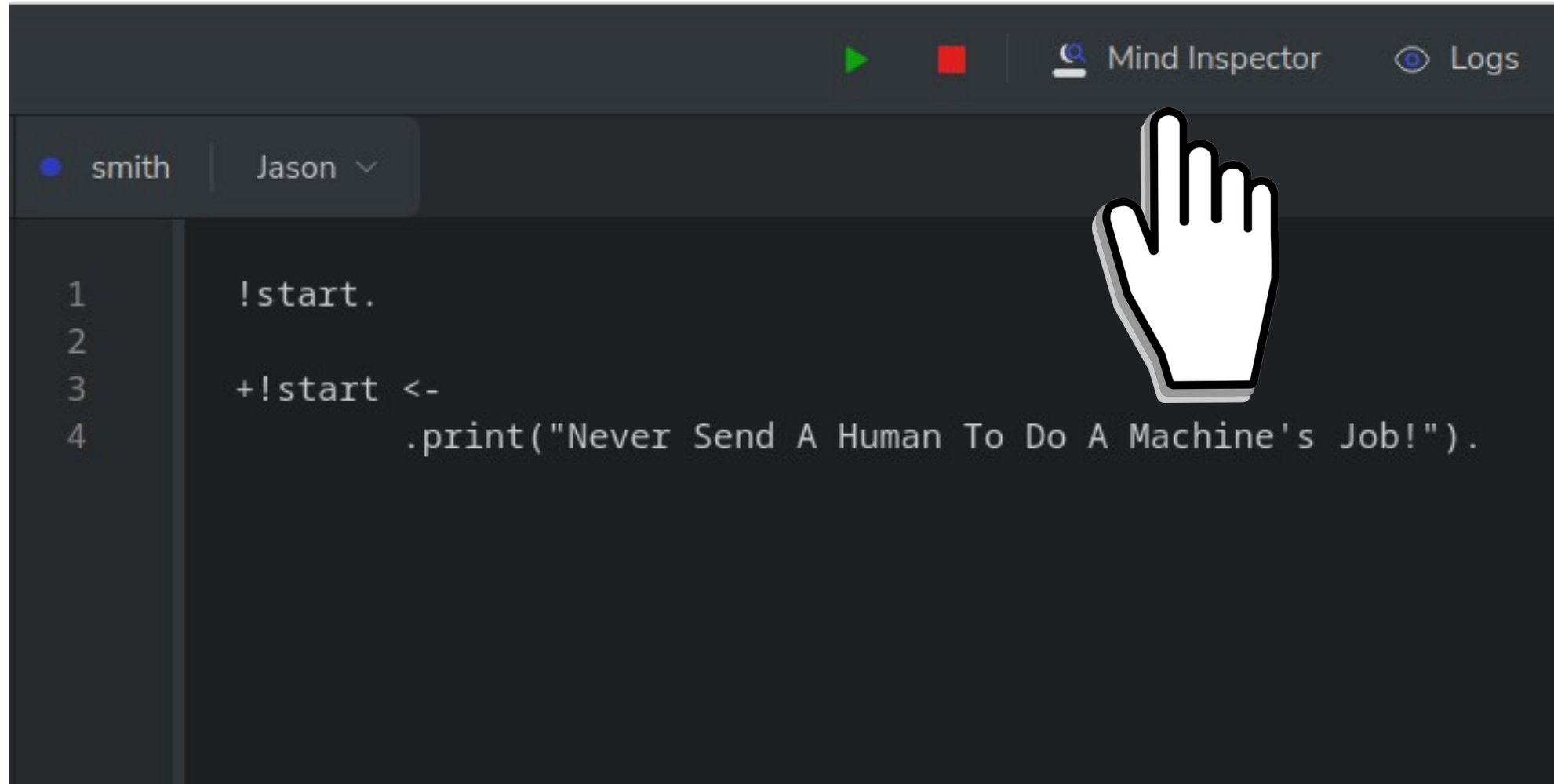


The screenshot shows the ChonIDE IDE interface. At the top, there are control buttons: a green play button, a red stop button, and tabs for 'Mind Inspector' and 'Logs'. Below this, a tab bar shows 'smith' (selected) and 'Jason'. The main code editor displays the following Jason code:

```
1      !start.  
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Bordini, R.H., Hübner, J.F. (2006). BDI Agent Programming in AgentSpeak Using Jason . In: Toni, F., Torroni, P. (eds) Computational Logic in Multi-Agent Systems. CLIMA 2005. Lecture Notes in Computer Science(), vol 3900. Springer, Berlin, Heidelberg. https://doi.org/10.1007/11750734_9

ChonIDE: helloAgent



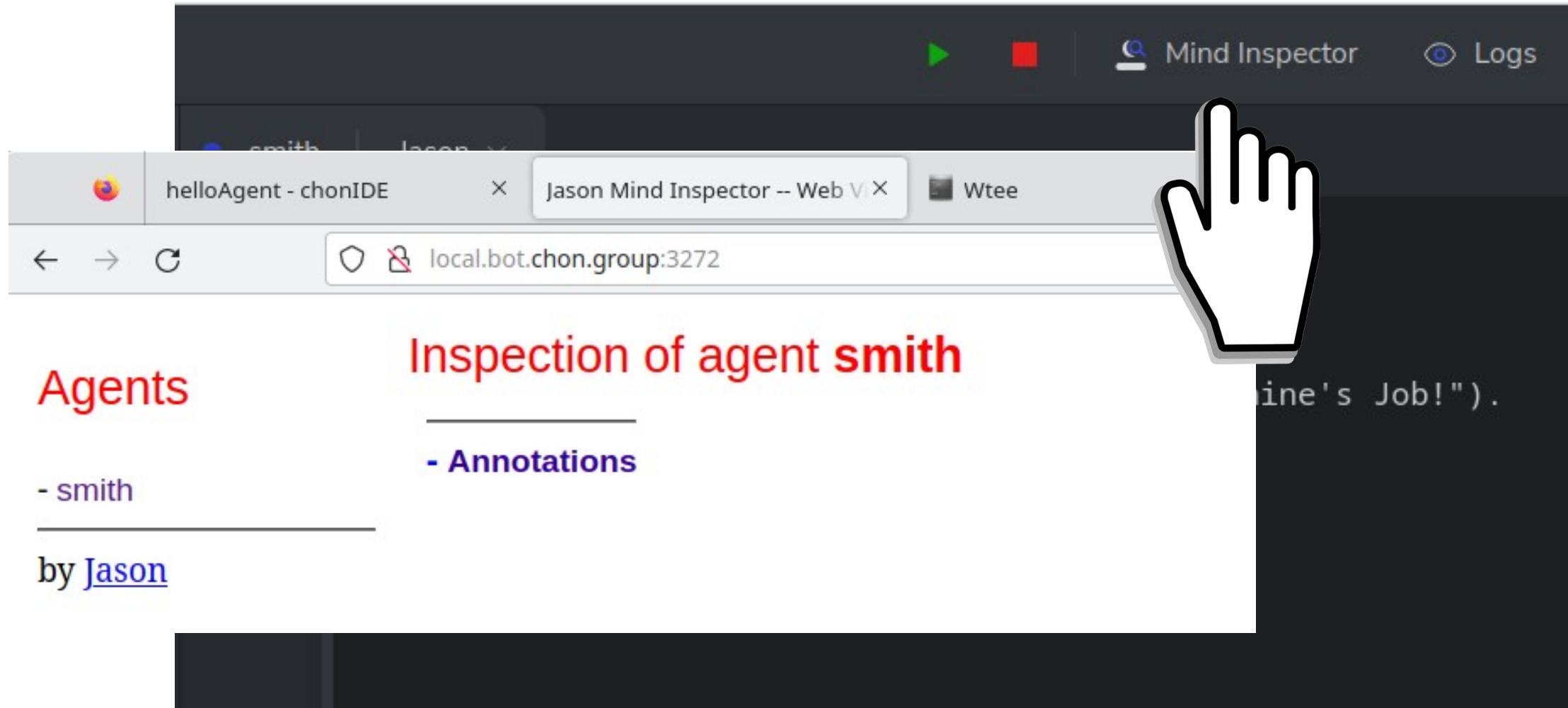
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```

A large white hand cursor with a black outline is pointing towards the code editor.

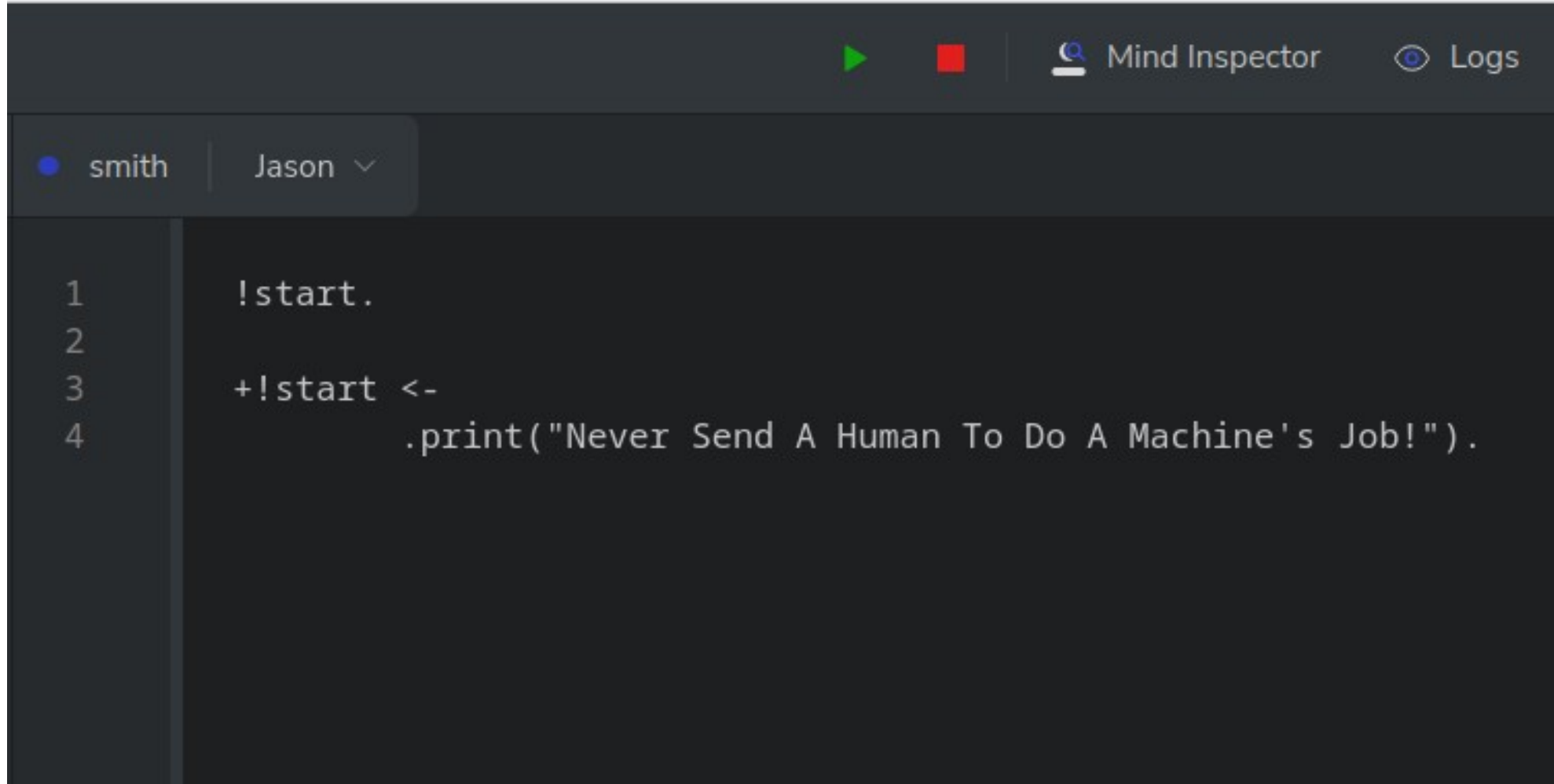
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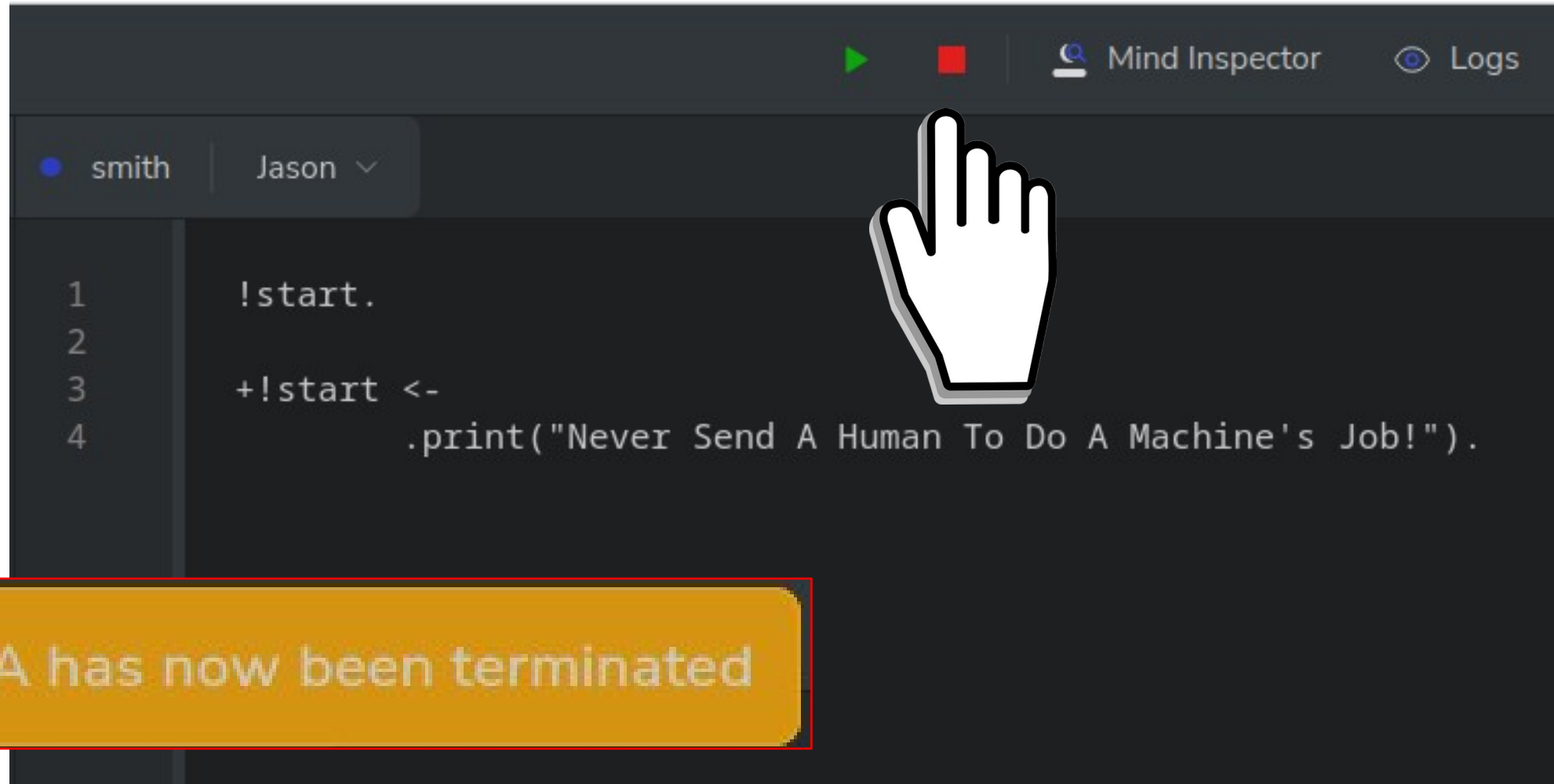
ChonIDE: helloAgent



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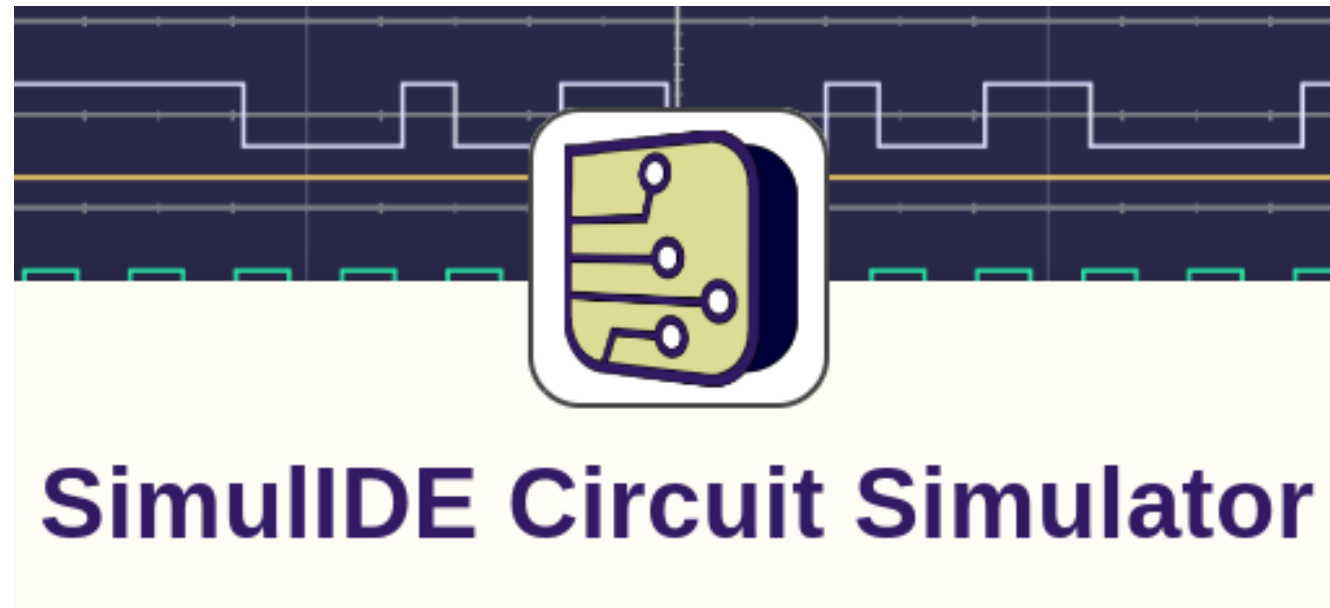
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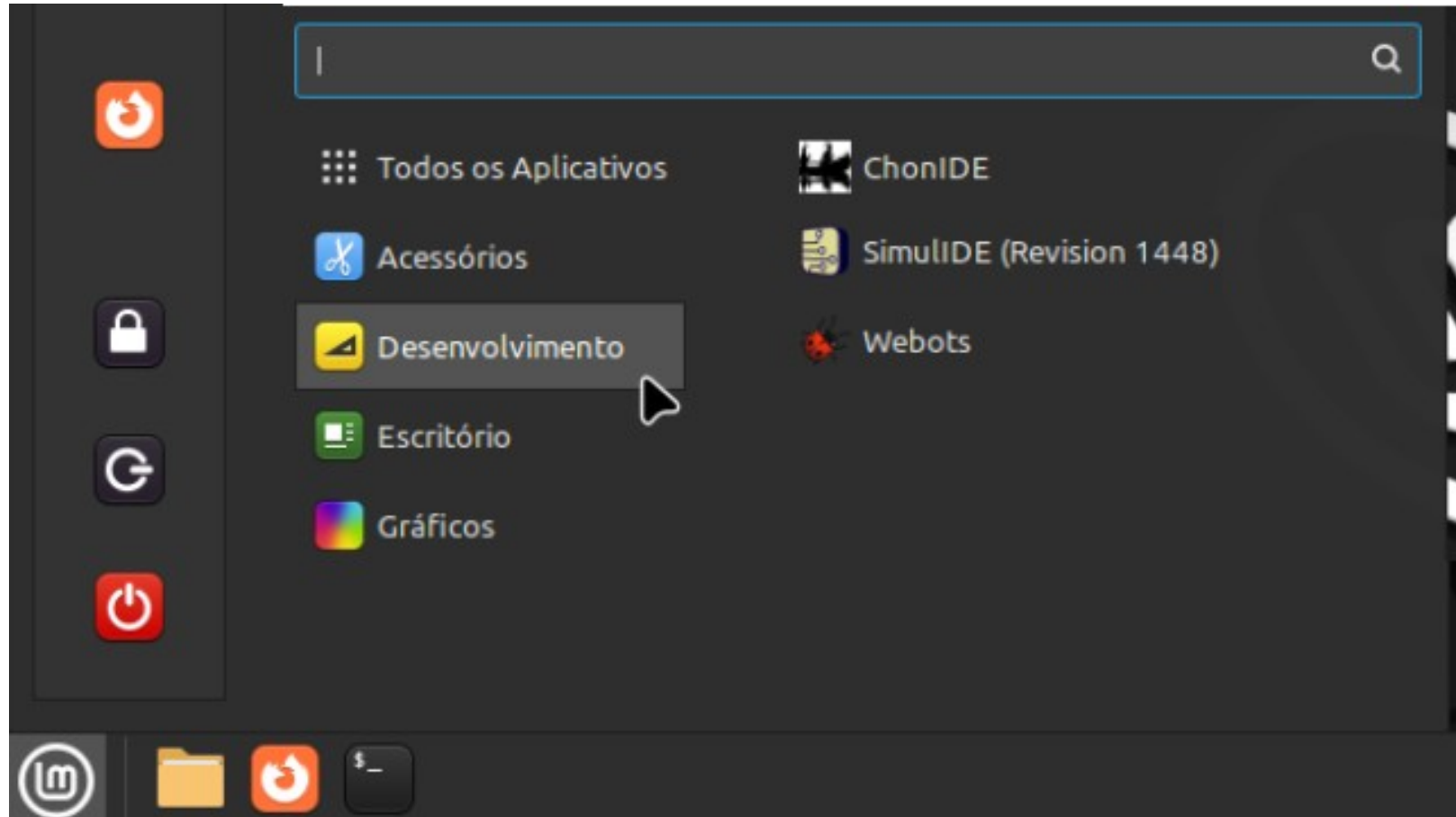
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Souza de Jesus, V., Mori Lazzarin, N., Pantoja, C.E., Vaz Alves, G., Ramos Alves de Lima, G., Viterbo, J. (2023). An IDE to Support the Development of Embedded Multi-Agent Systems. In: Mathieu, P., Dignum, F., Novais, P., De la Prieta, F. (eds) Advances in Practical Applications of Agents, Multi-Agent Systems, and Cognitive Mimetics. The PAAMS Collection. PAAMS 2023. Lecture Notes in Computer Science(), vol 13955. Springer, Cham. https://doi.org/10.1007/978-3-031-37616-0_29



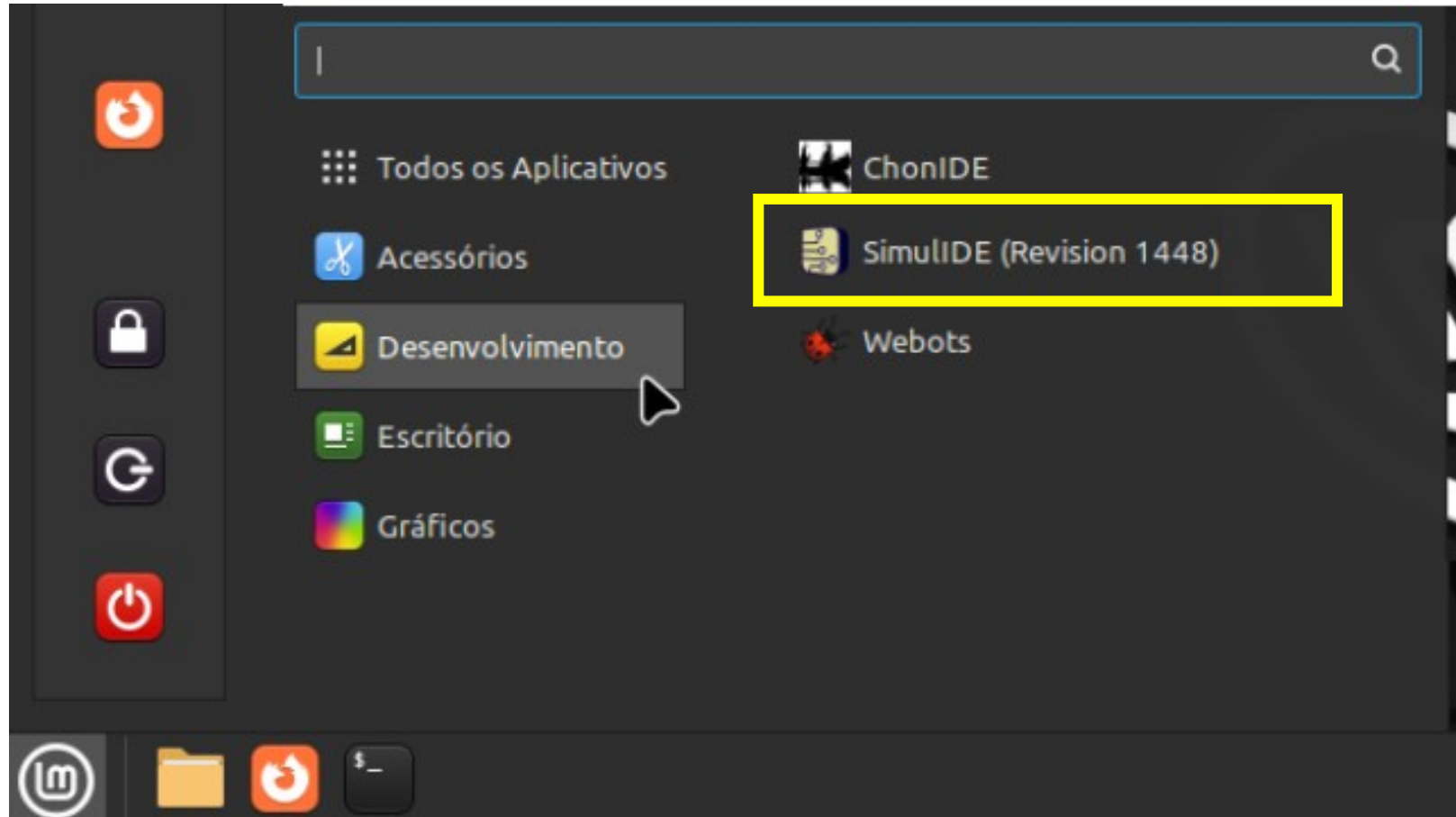
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SimulIDE



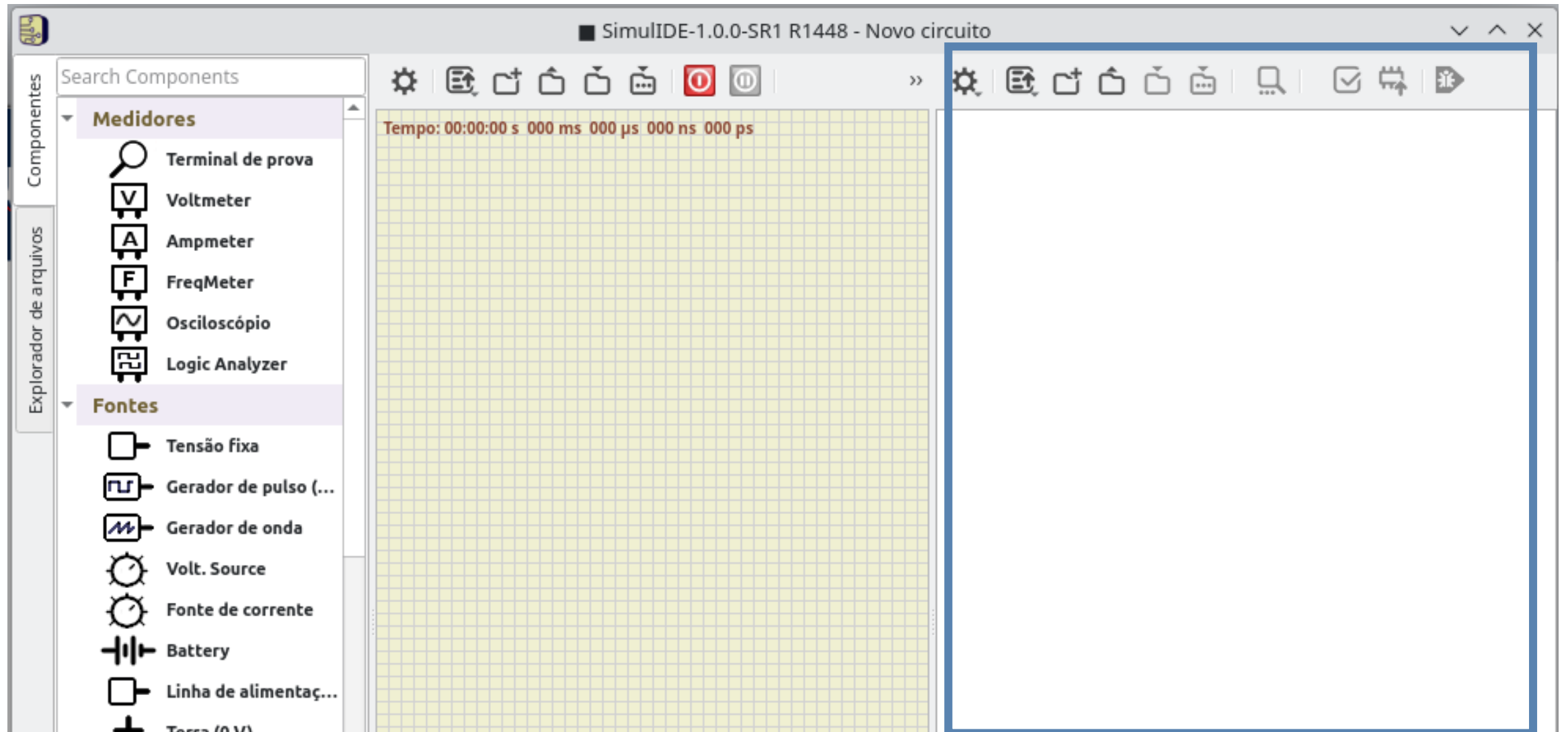
Manual de instalação
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SimulIDE

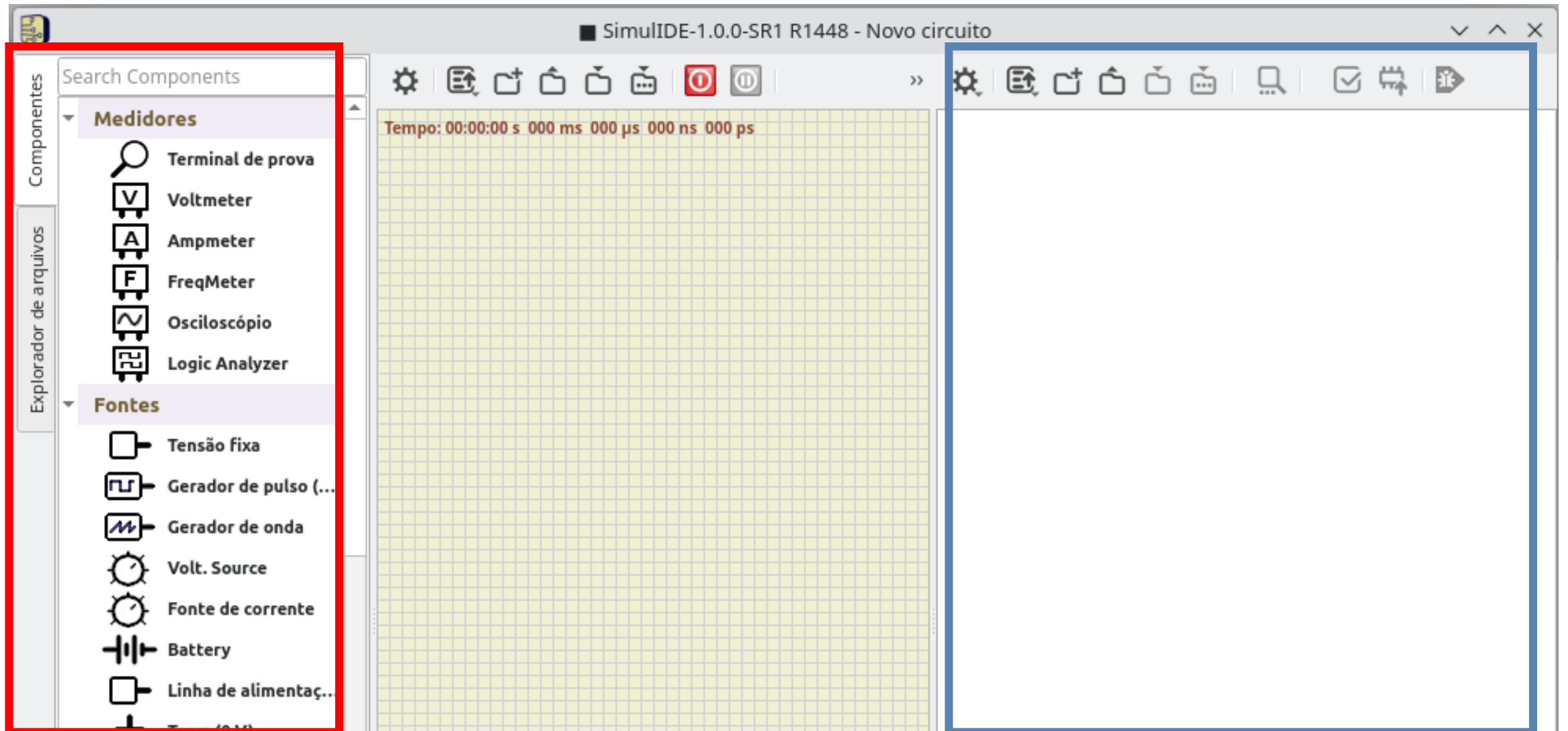


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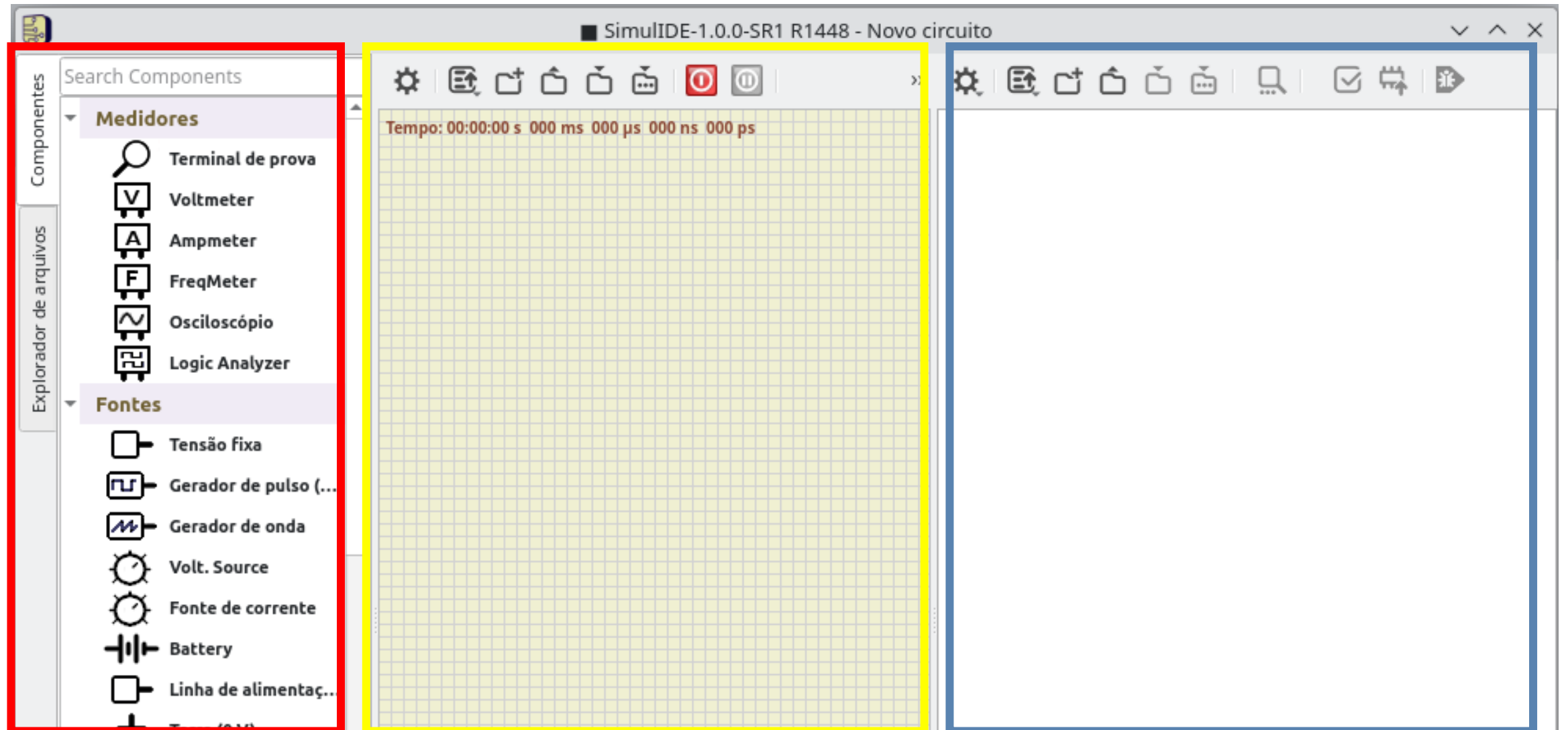
SimulIDE



SimulIDE






SimulIDE



SimulIDE: Blink

[distributedAndEmbeddedAI](#) / [course](#) / [05-TheDevelopmentTool](#) / [Examples](#) / 

 **nilsonLazarin** development tools presentation

Name	Last commit
 ..	
 Blink	developr
 Blink.zip	developr






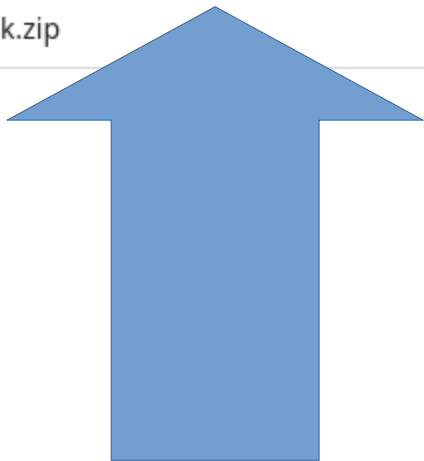
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SimulIDE: Blink

[distributedAndEmbeddedAI](#) / [course](#) / [05-TheDevelopmentTool](#) / [Examples](#) / 

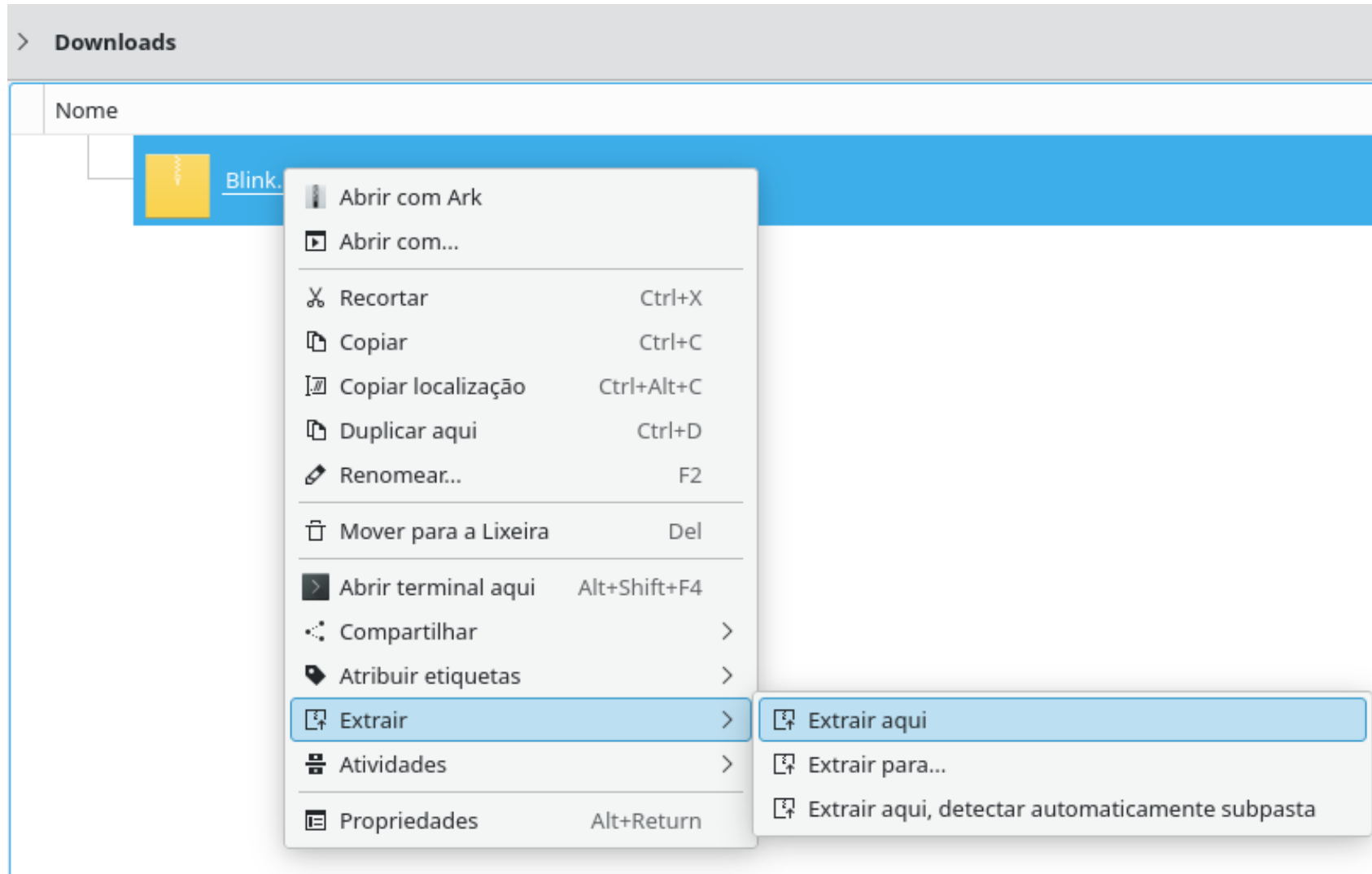
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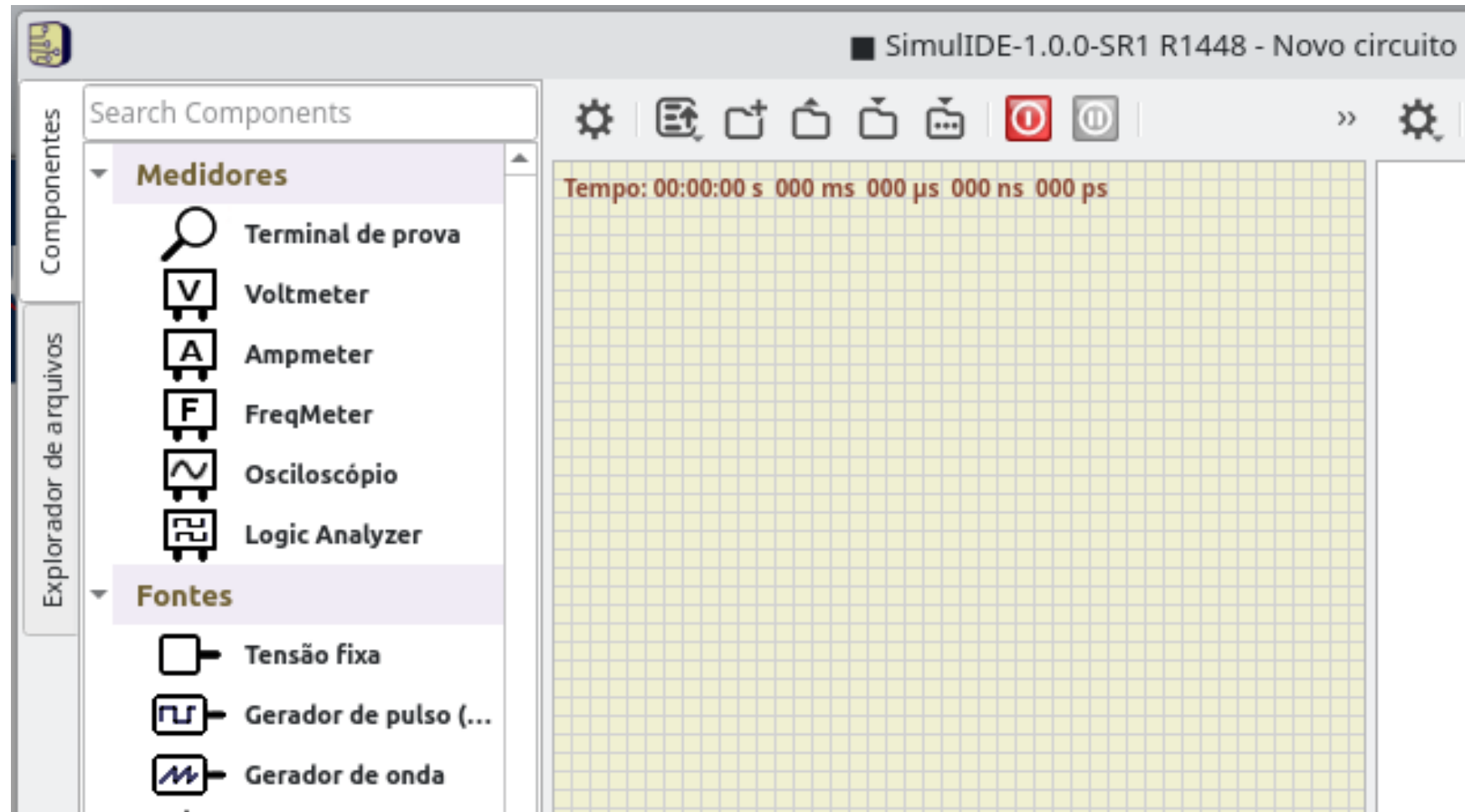


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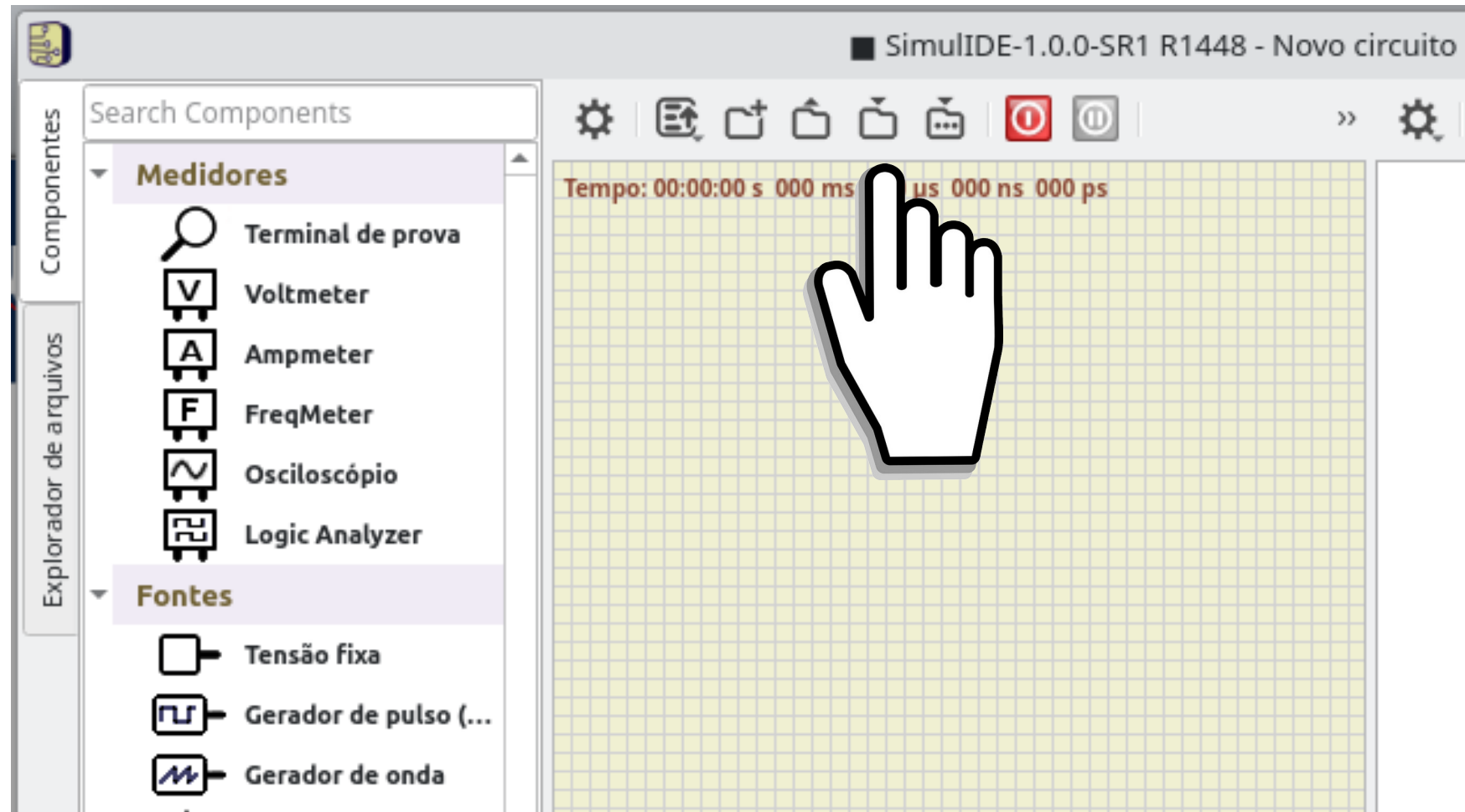
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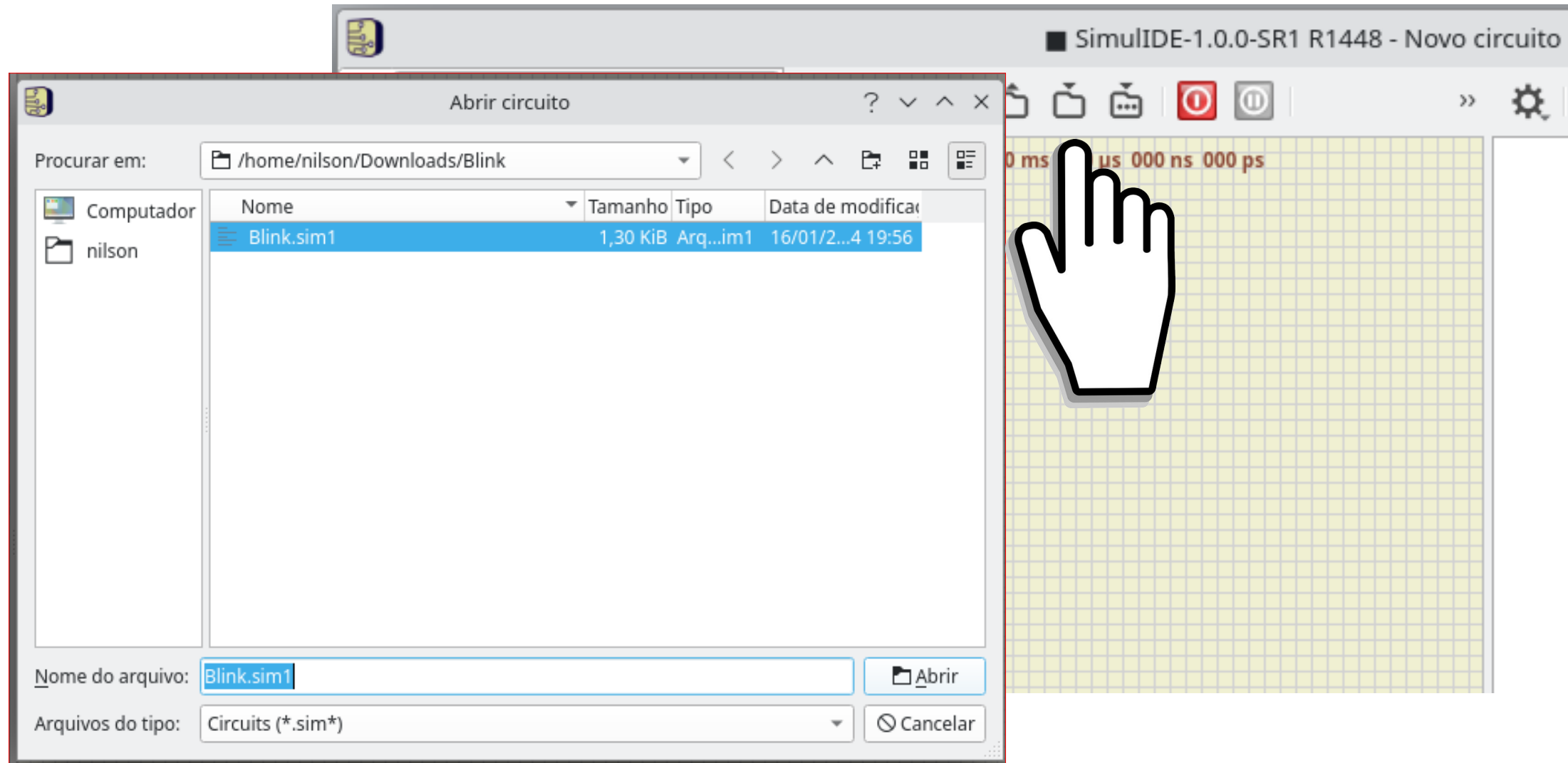
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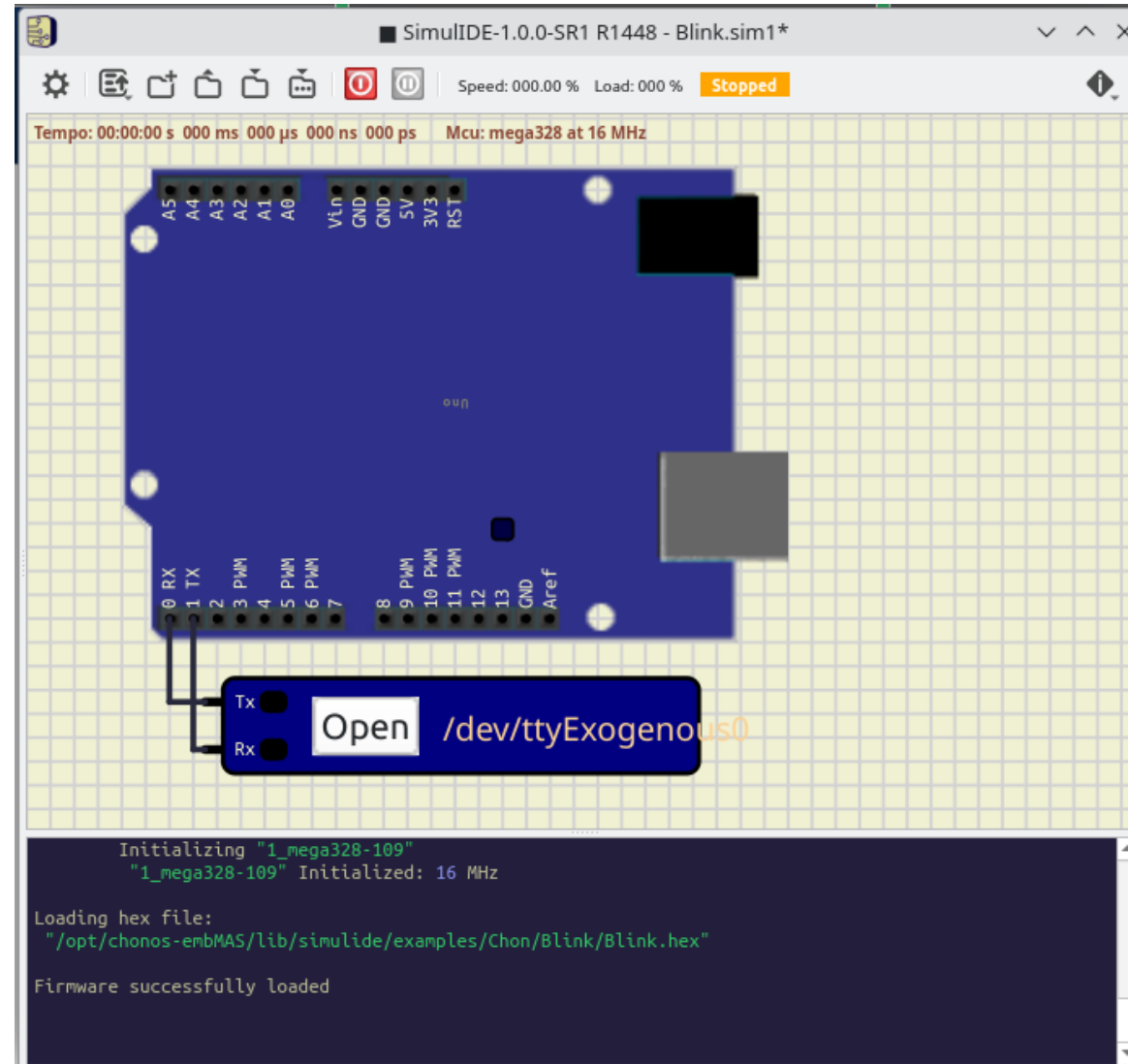
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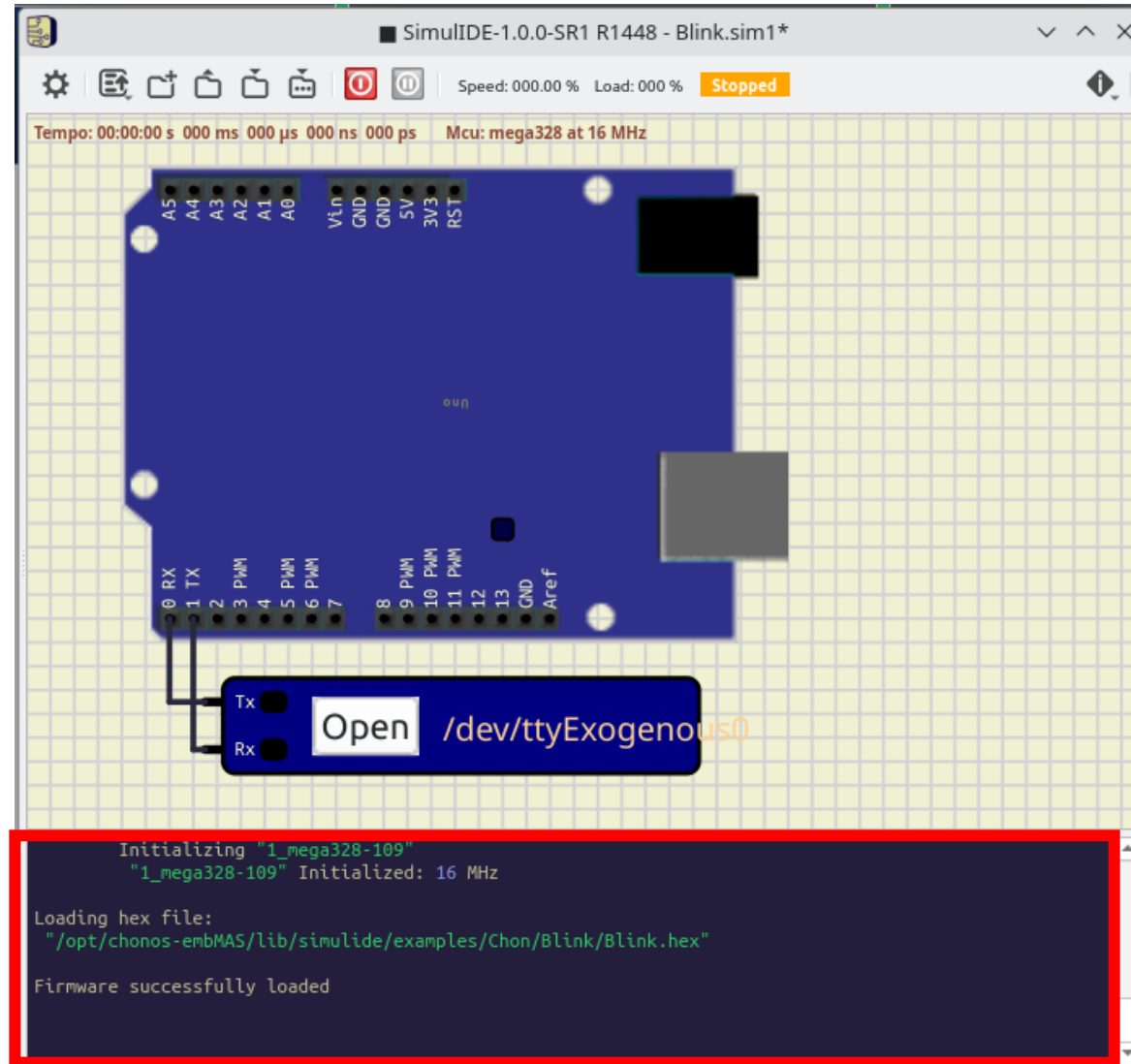
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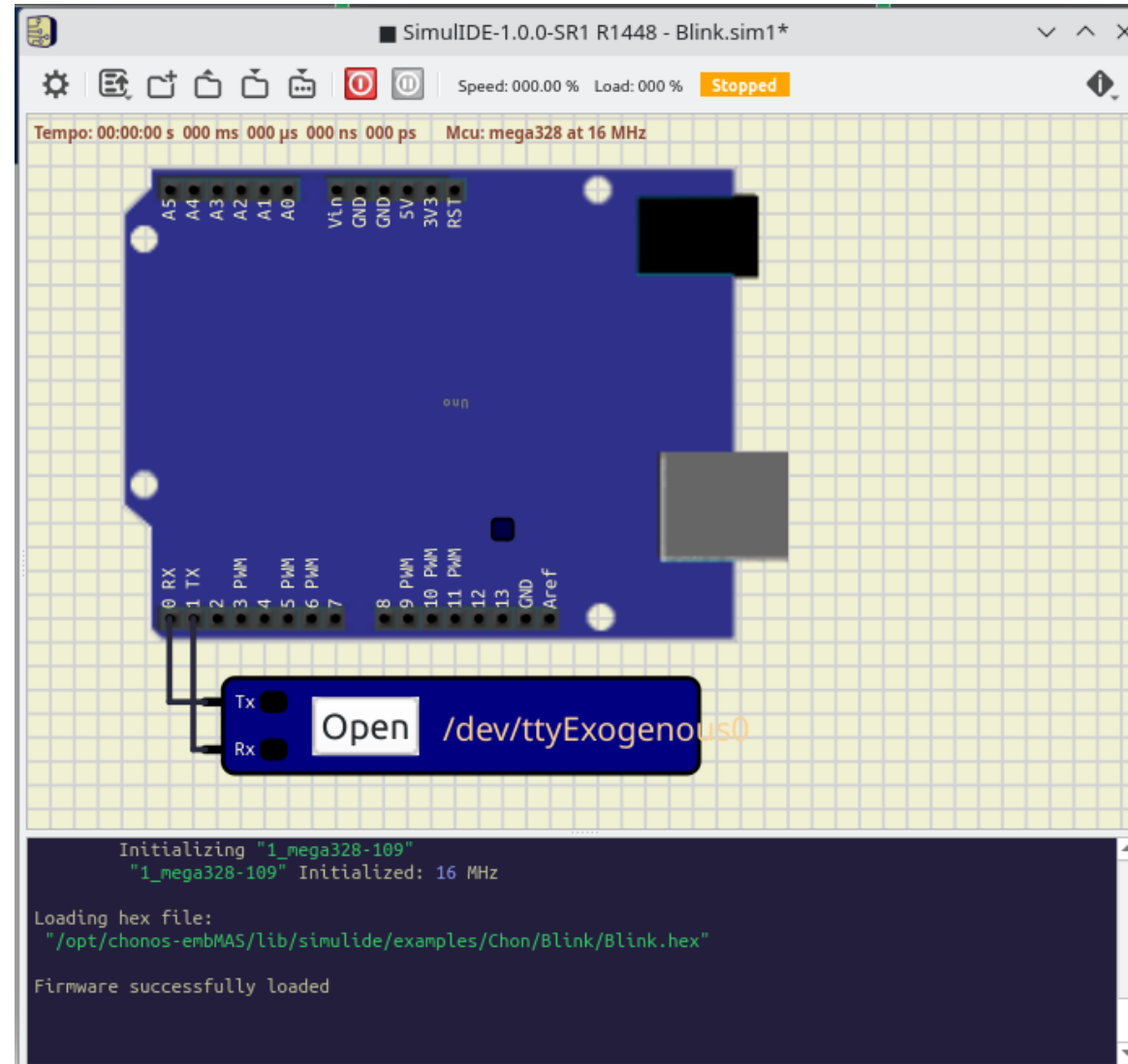
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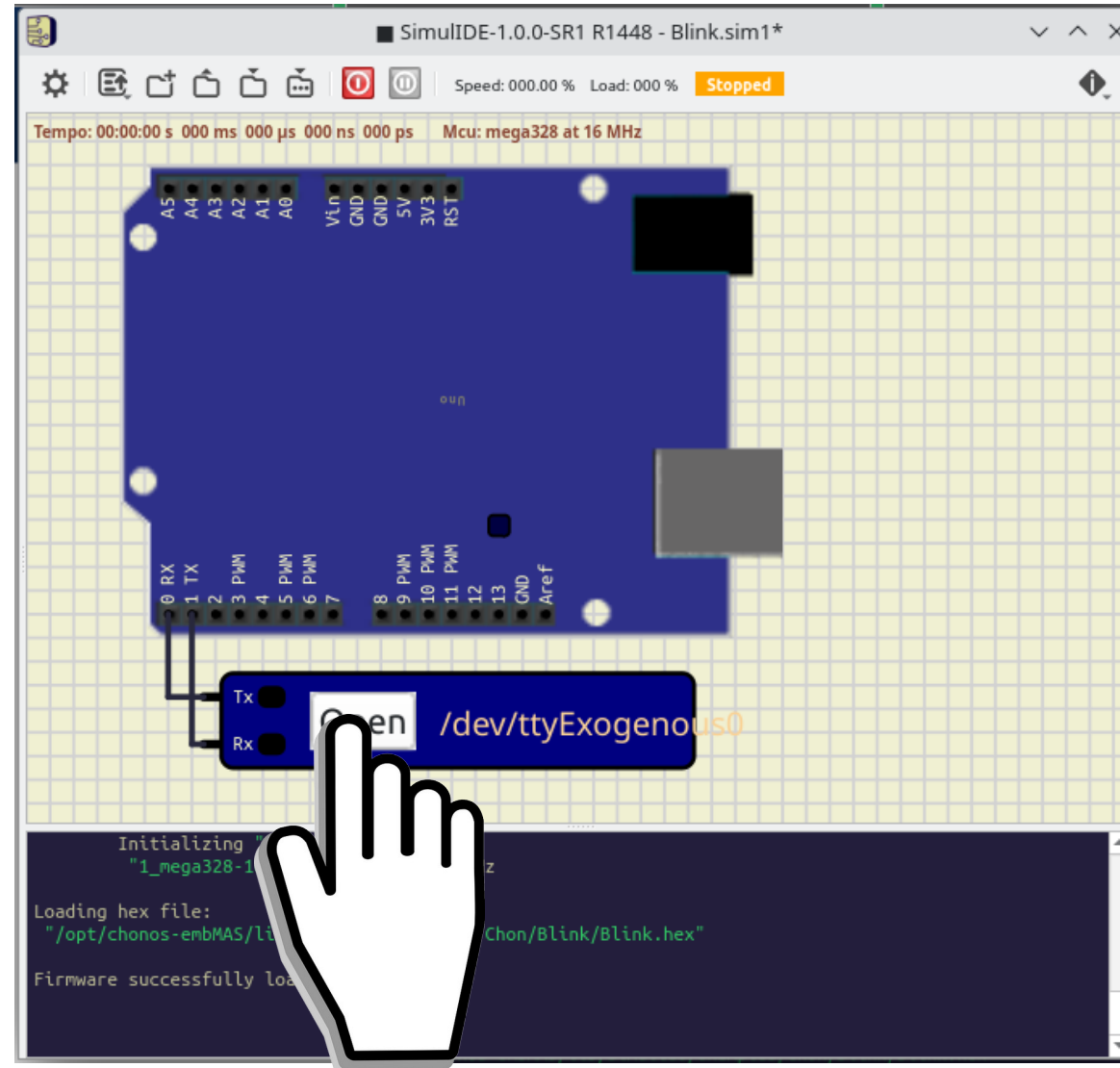
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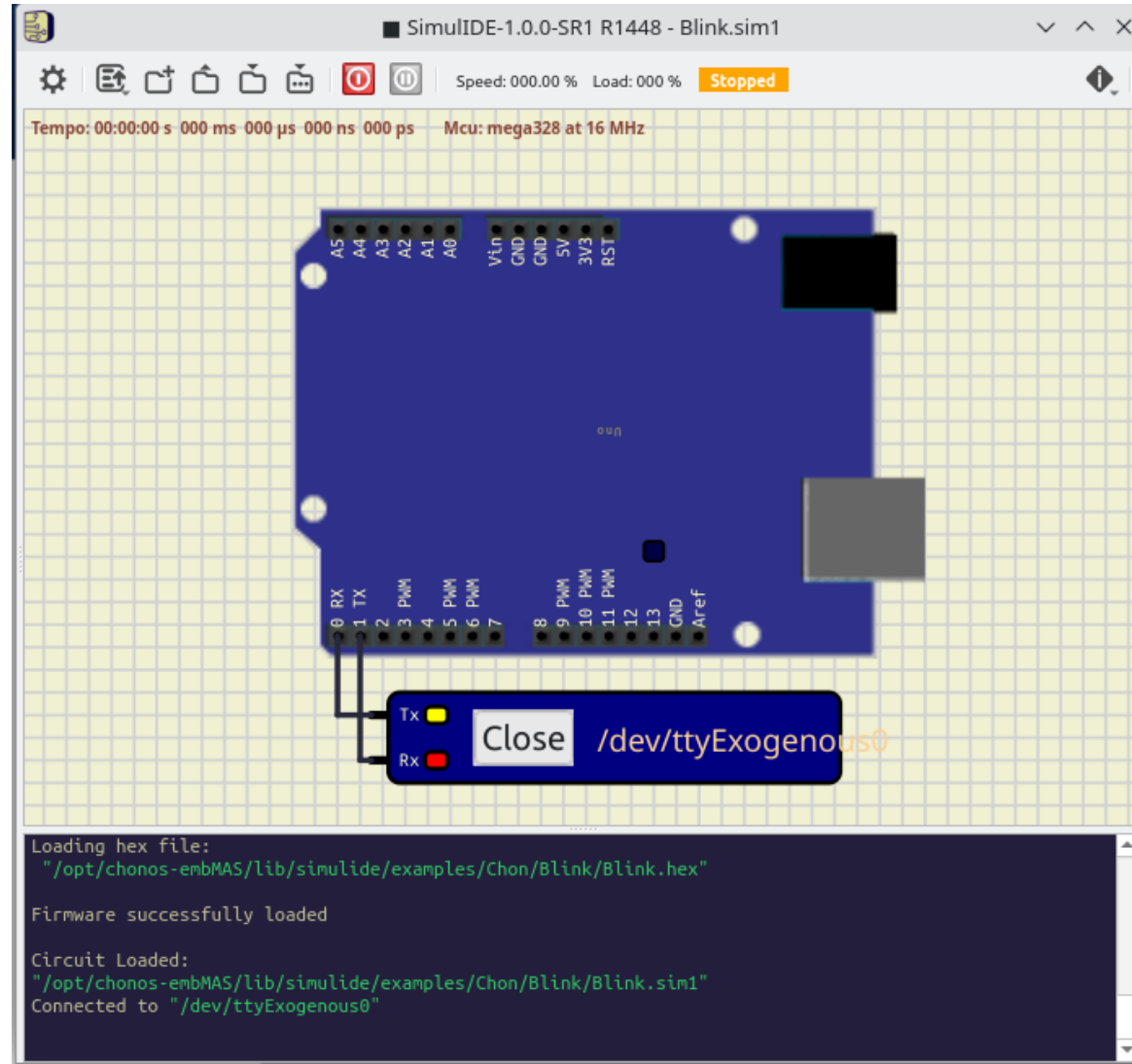
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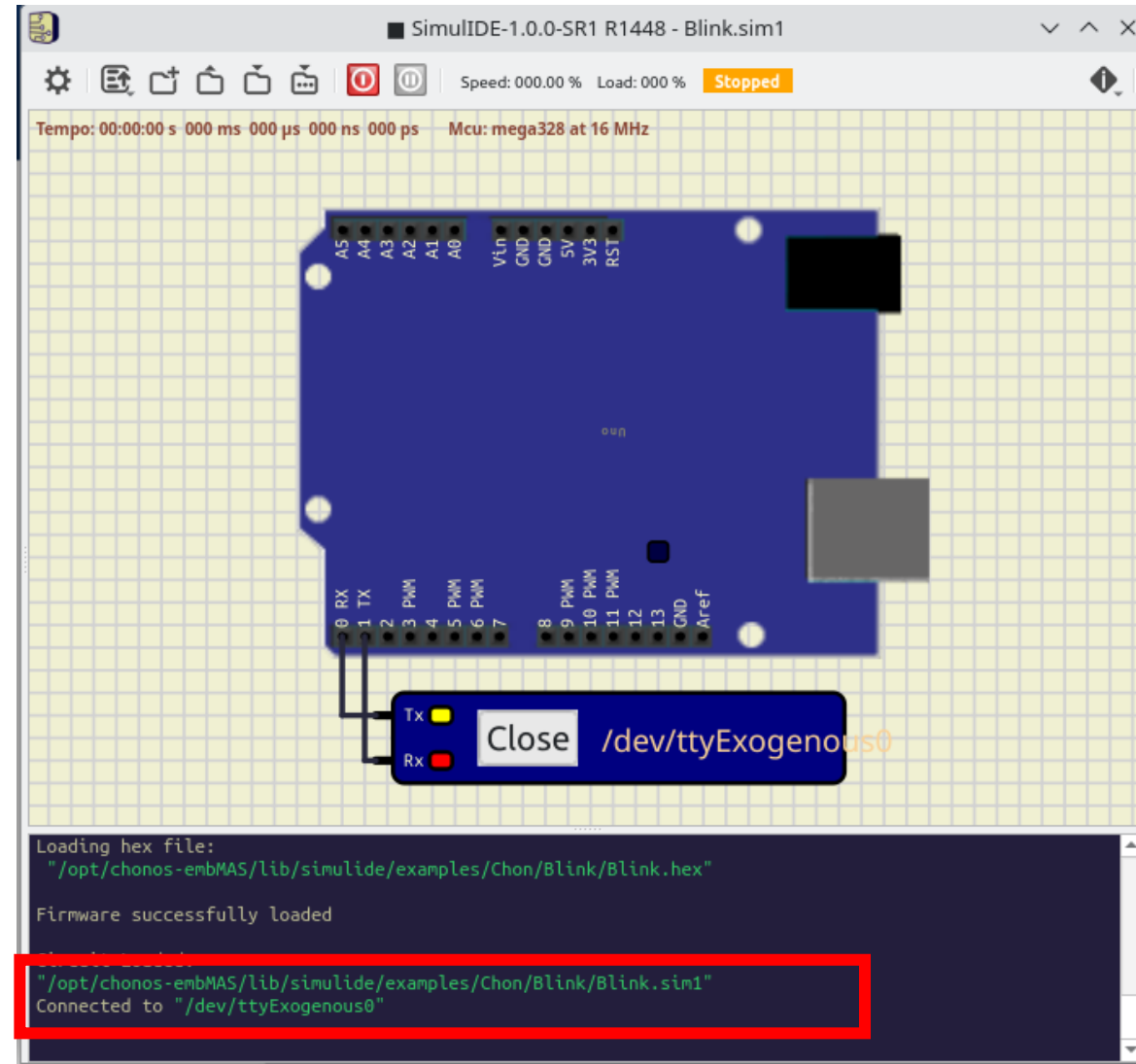
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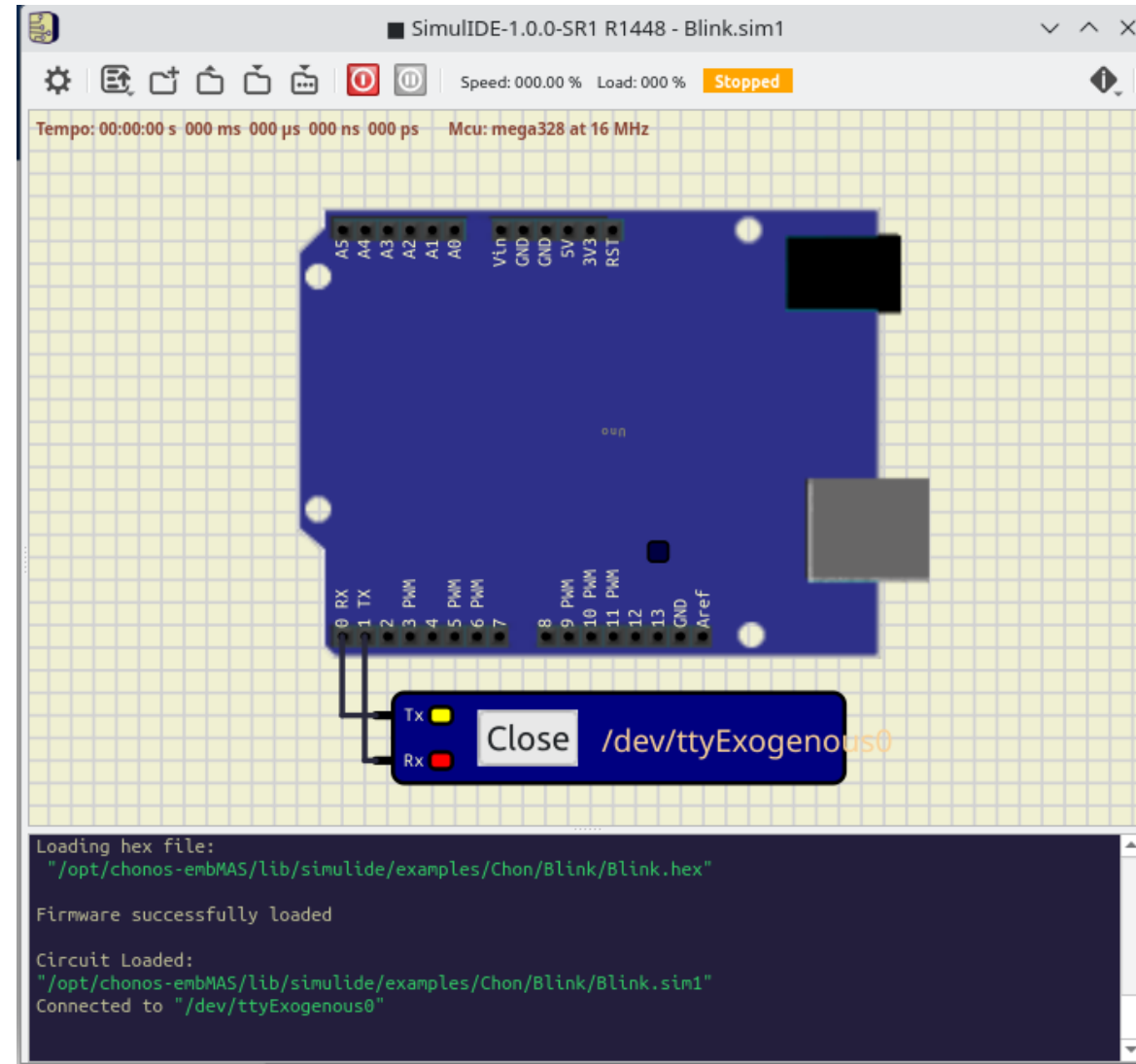
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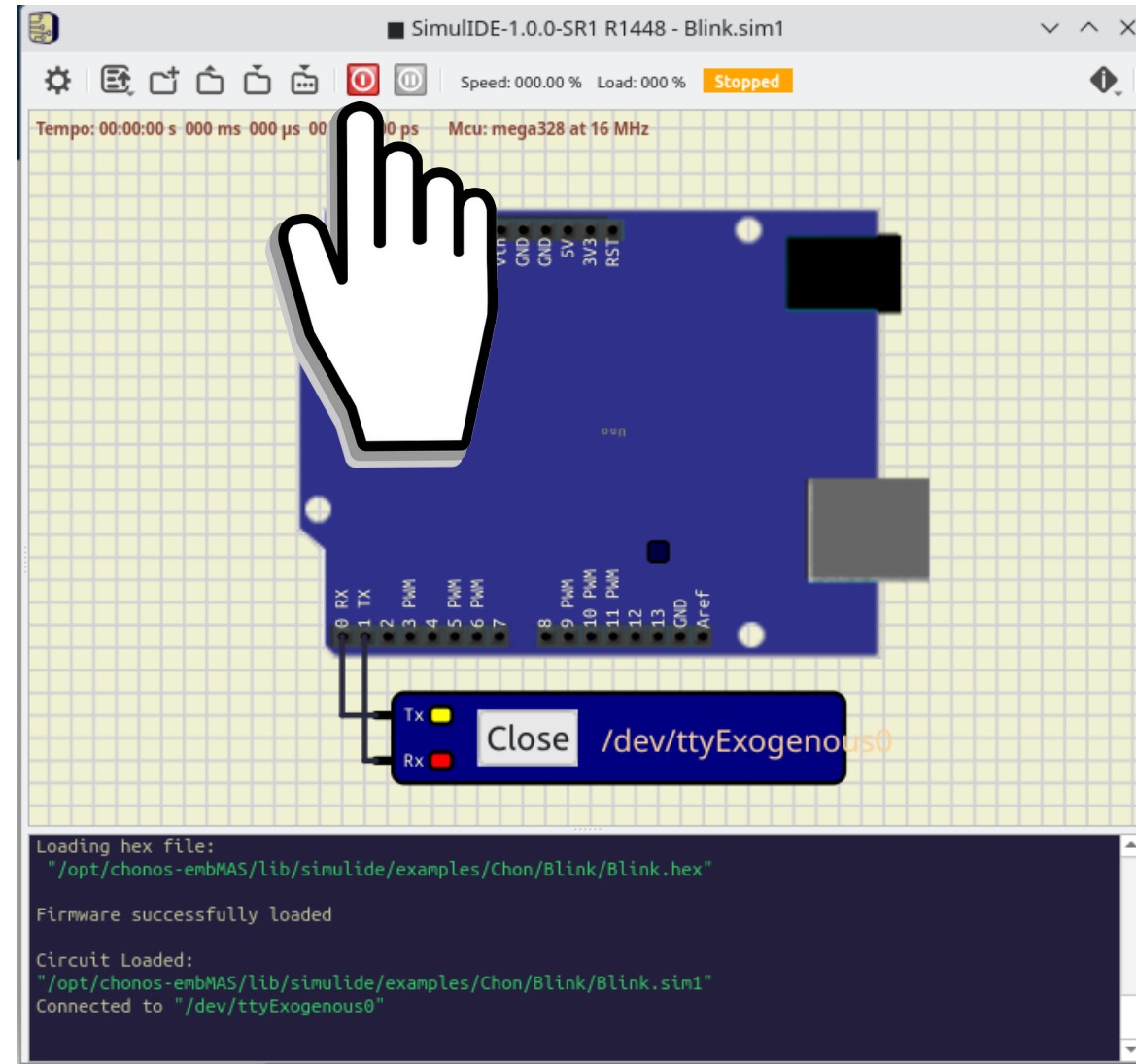
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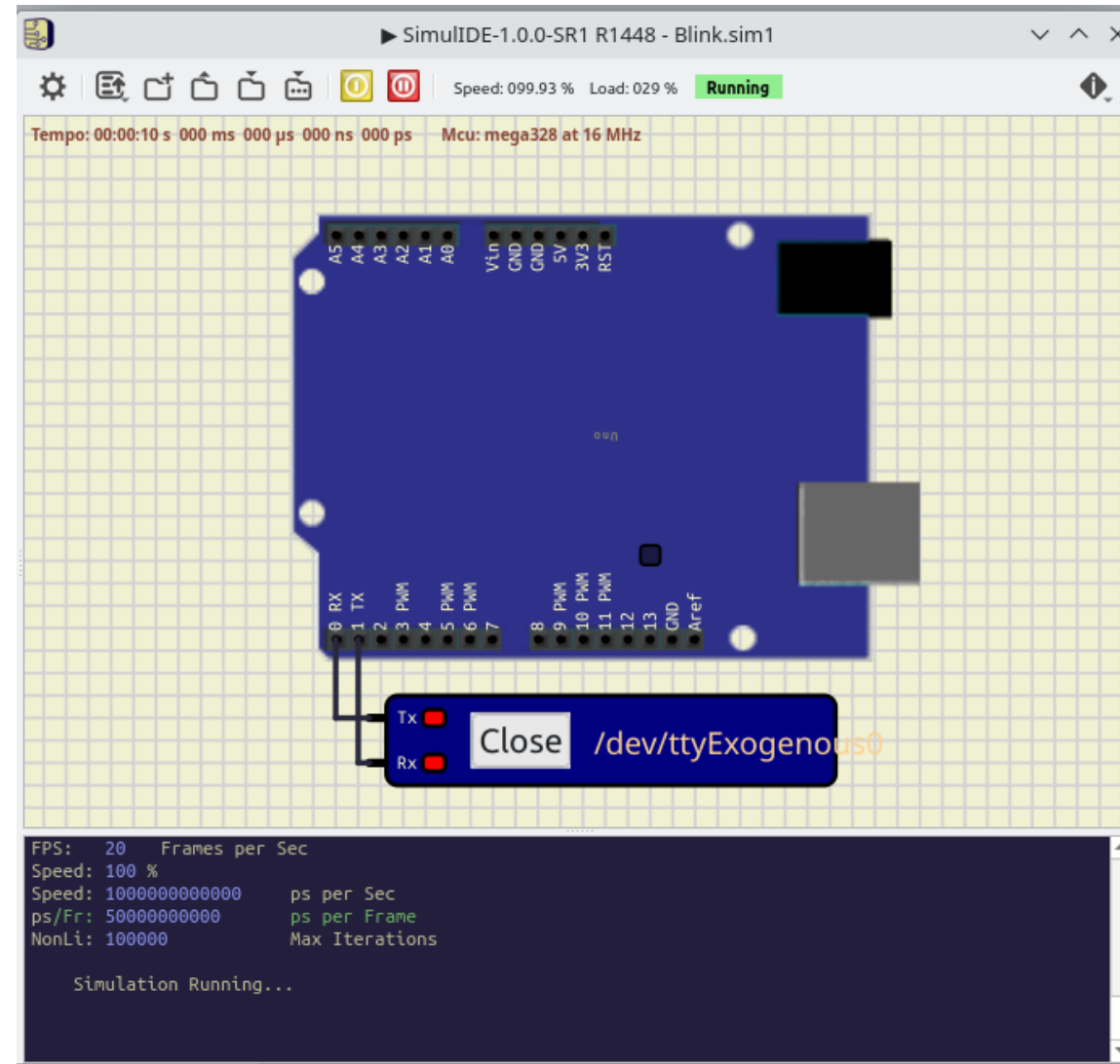
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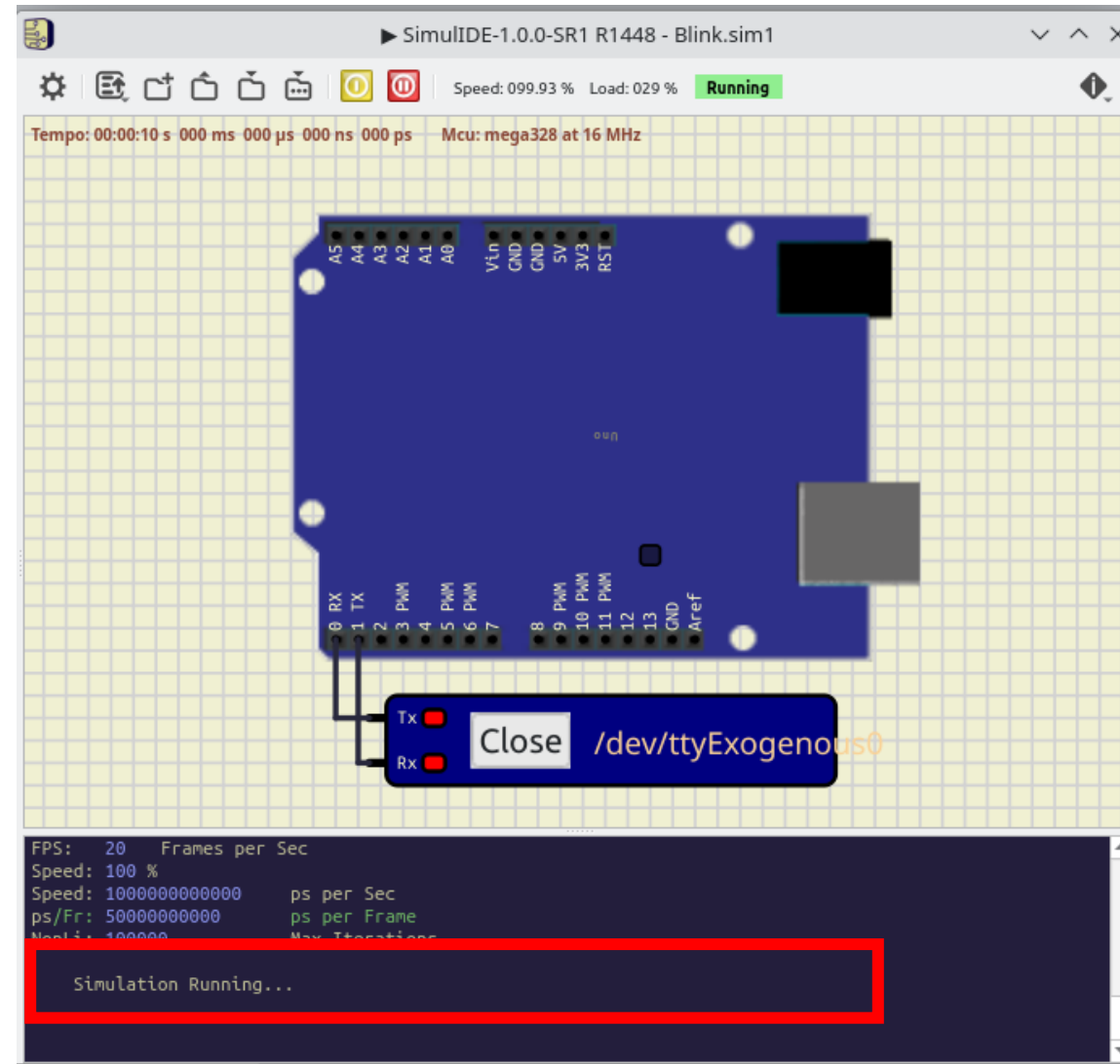
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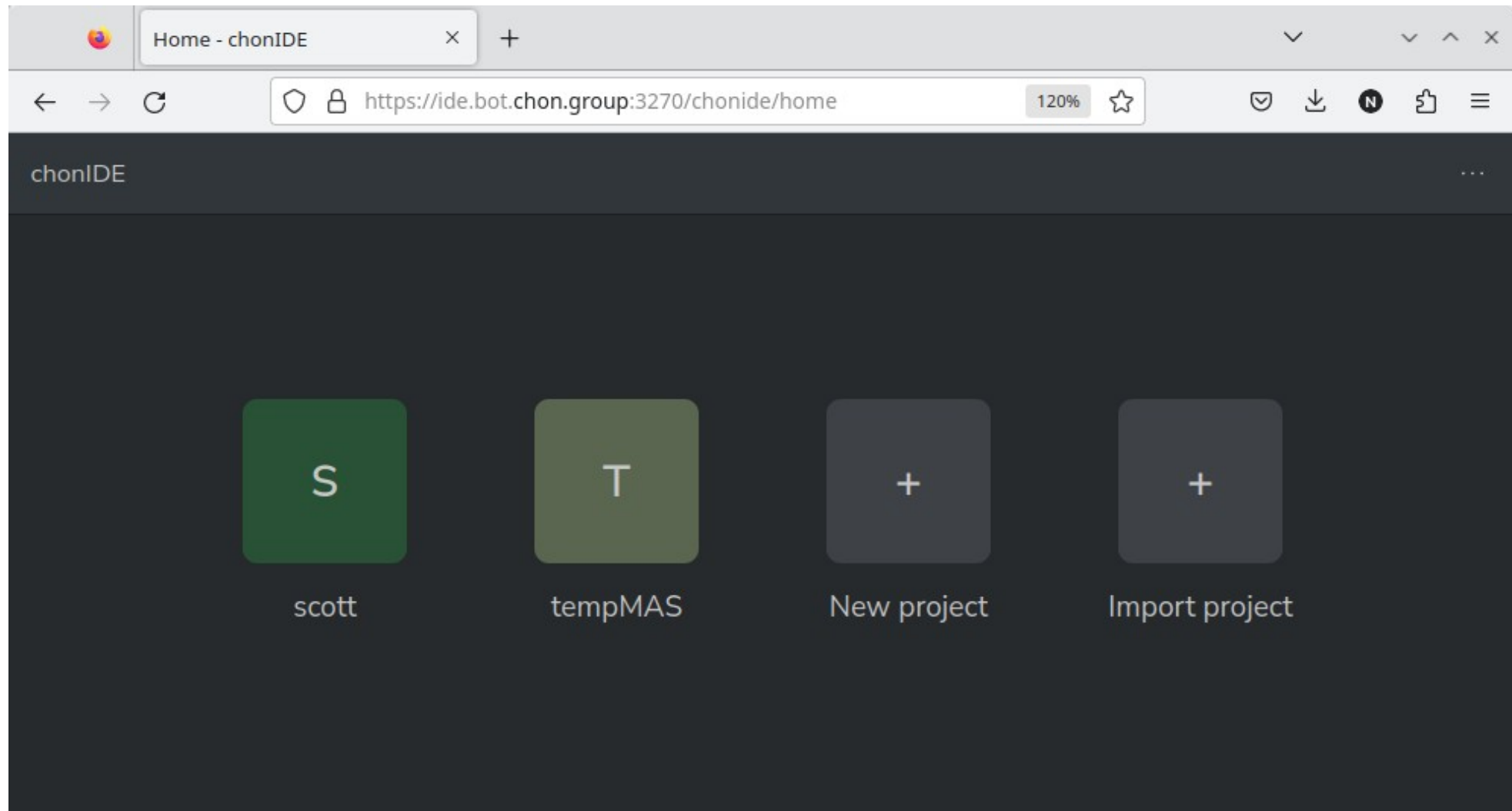
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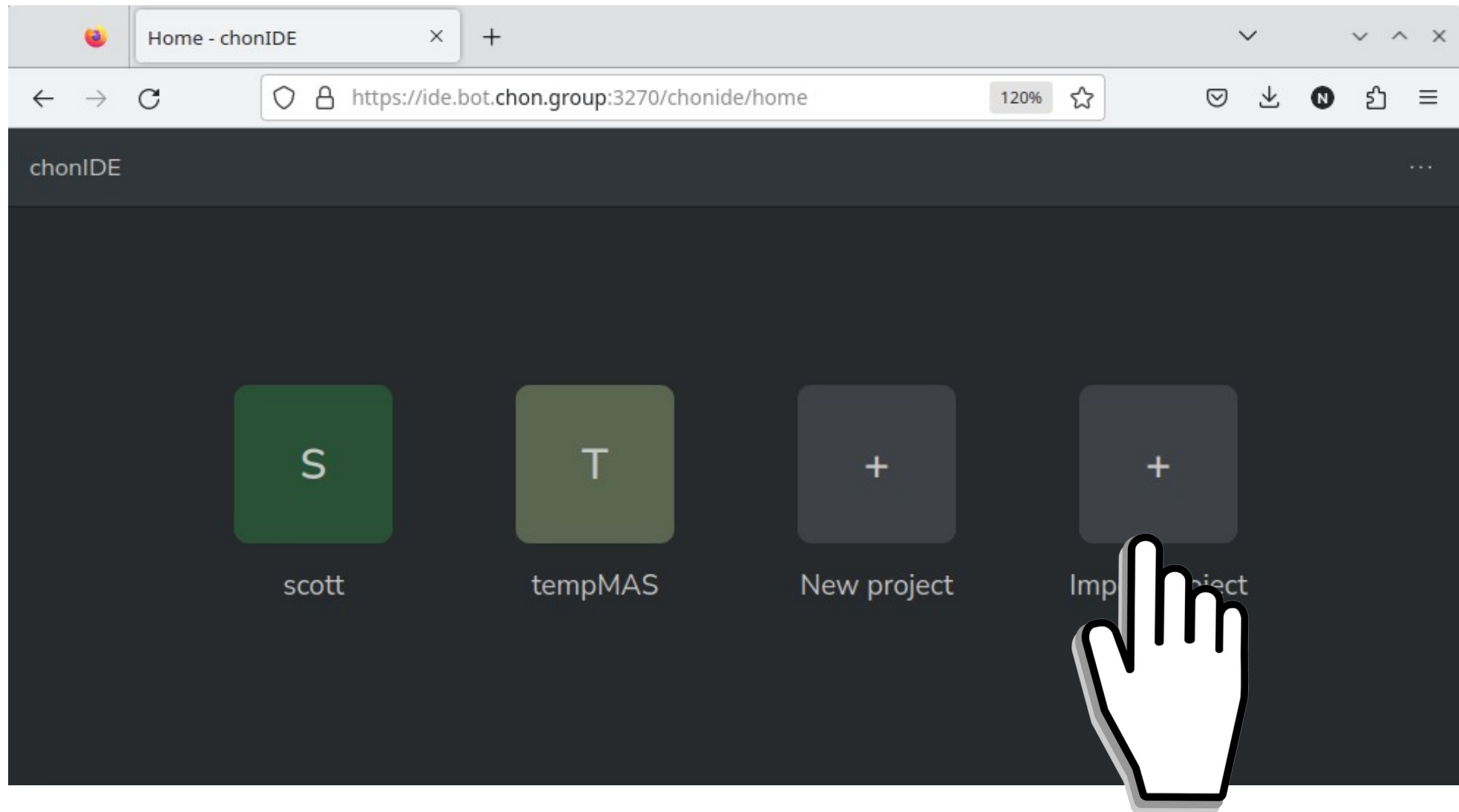
SimulIDE: Blink



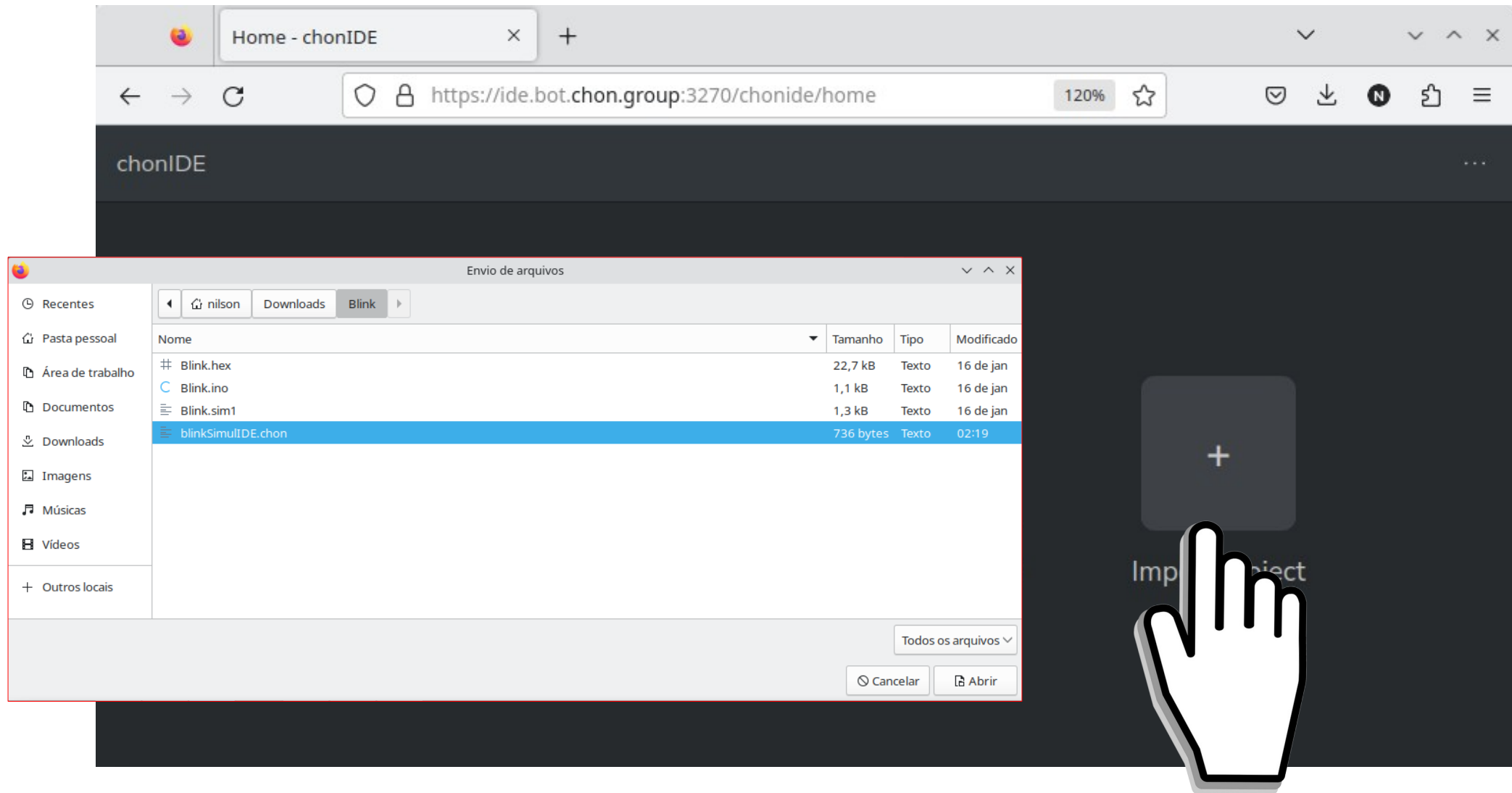
SimulIDE: Blink



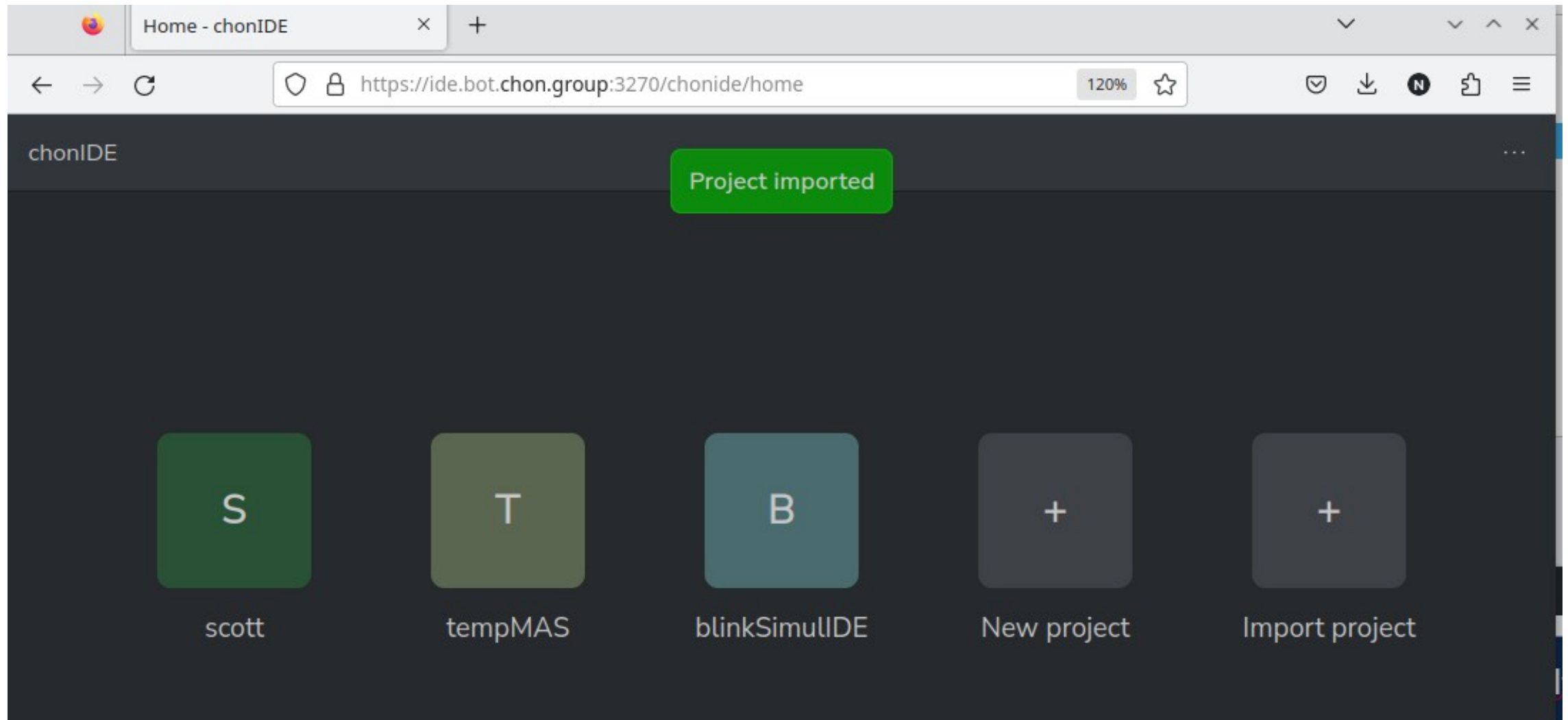
SimulIDE: Blink



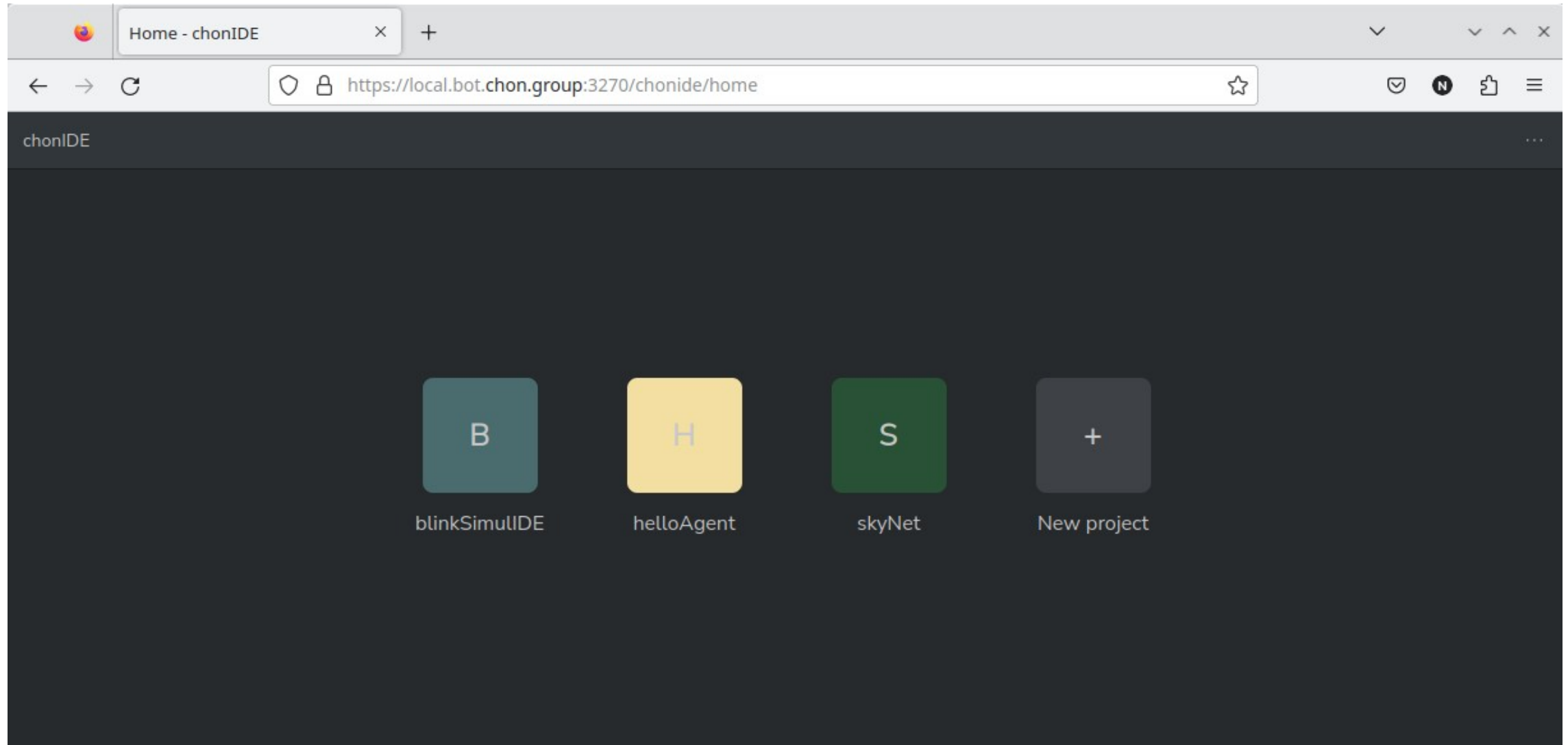
SimulIDE: Blink



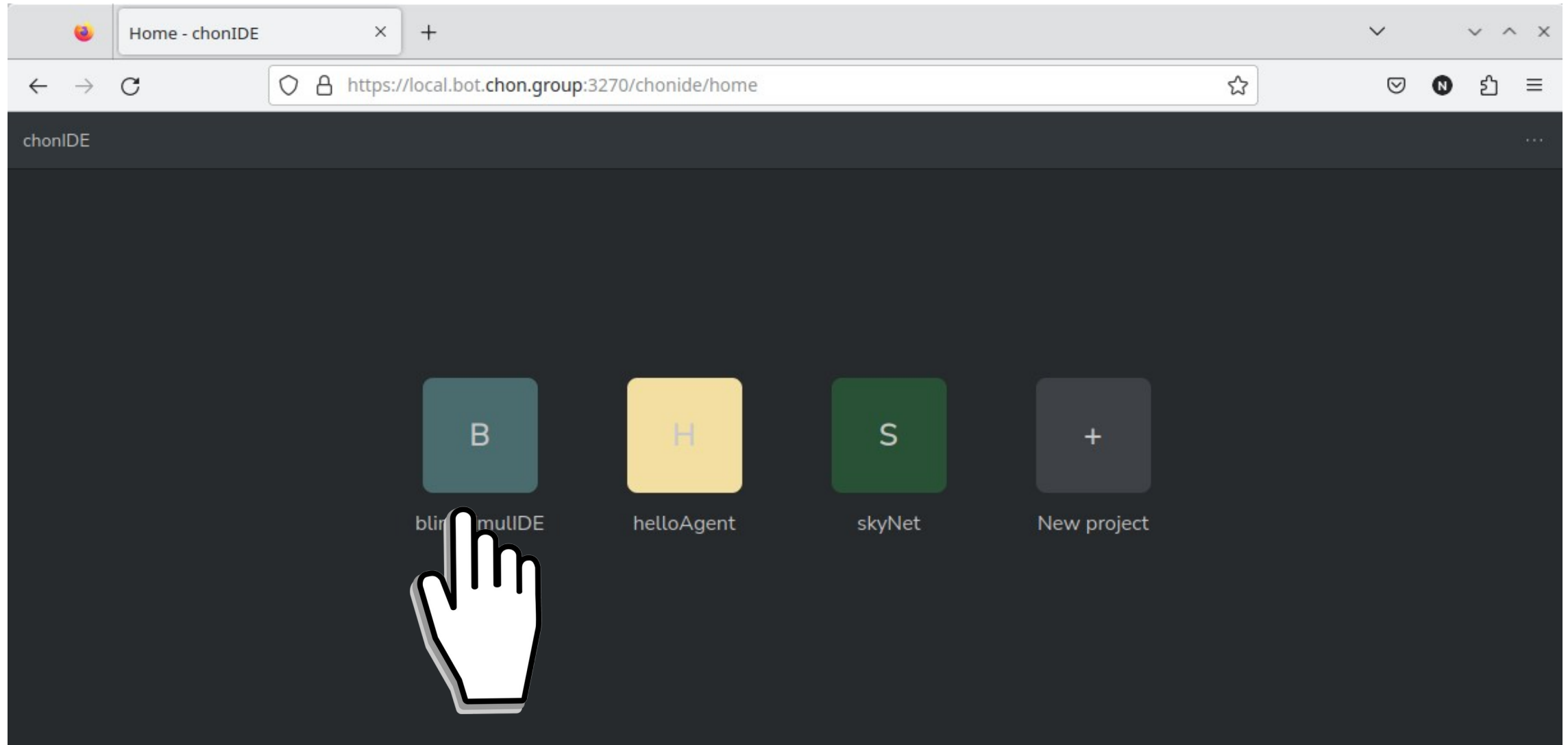
SimulIDE: Blink



SimulIDE: Blink



SimulIDE: Blink



SimulIDE: Blink

The screenshot displays the SimulIDE web interface for a project named "Blink". The interface is divided into several sections:

- Code Editor:** Shows the multi-agent system code for the "bane" agent. The code includes initial beliefs, goals, plans, and actions for controlling an LED.
- File Explorer:** Lists the project structure, including the "Multi-Agent System", "Agents" (containing "bane"), "Firmware", and "Libraries" (HCSR04, Javino, LiquidCrystal).
- Terminal:** Displays the output of the simulation, showing the initialization of the matrix and the start of the simulation.
- Visual Representation:** A blue Arduino board is shown with a terminal window connected to it. The terminal window displays the text "Close /dev/ttyExogenous0".

```
1 /* Initial beliefs and rules */
2 serialPort(ttyEmulatedPort0).
3
4 /* Initial goals */
5 !start.
6
7 /* Plans */
8 +!start:
9   serialPort(Port) <-
10     .port(Port);
11     .percepts(open);
12     .limit(500).
13
14 +ledStatus(on) <-
15   .act(ledOff);
16   .print("Turning OFF the Led in Arduino!");
17
18 +ledStatus(off) <-
19   .act(ledOn);
20   .print("Turning ON the Led in Arduino!");
```

Initializing Matrix: 28 eNodes
CircMatrix::solveMatrix 1 Circuits
CircMatrix::solveMatrix 26 Single Nodes
Circuit Matrix looks good
FPS: 20 Frames per Sec
Speed: 100 %
Speed: 1000000000000 ps per Sec
ps/Fr: 50000000000 ps per Frame
NonLi: 100000 Max Iterations
Simulation Running...

SimulIDE: Blink

The screenshot displays the SimulIDE web interface for a project named "Blink". The interface is divided into several sections:

- Code Editor:** Shows the source code for the "Blink" project. The code is written in a multi-agent system language and includes comments and function definitions for controlling an LED. A hand cursor is visible over the code.
- File Explorer:** Located on the left, it shows the project structure, including a "Multi-Agent System" folder, an "Agents" folder (containing "bane"), a "Firmware" folder, and a "Libraries" folder (containing "HCSR04", "Javino", and "LiquidCrystal").
- Terminal:** At the bottom, it displays the output of the simulation, including initialization messages and performance metrics.
- Visual Representation:** On the right, there is a visual representation of an Arduino board. A terminal window is overlaid on the board, showing the command "Close /dev/ttyExogenous0" and a "Close" button.

The terminal output includes the following text:

```
Initializing Matrix: 28 eNodes  
CircMatrix::solveMatrix 1 Circuits  
CircMatrix::solveMatrix 26 Single Nodes  
  
Circuit Matrix looks good  
  
FPS: 20 Frames per Sec  
Speed: 100 %  
Speed: 1000000000000 ps per Sec  
ps/Fr: 50000000000 ps per Frame  
NonLi: 100000 Max Iterations  
  
Simulation Running...
```

SimulIDE: Blink

The image displays the SimulIDE-1.0.0-SR1 R1448 interface, which is a multi-agent system simulation environment. The interface is divided into several panels:

- Top Panel:** Shows the project name "blinkSimulIDE - chonIDE" and the URL "https://local.bot.chon.group:3270/chonide/projects/1".
- Left Panel:** A tree view showing the project structure, including "Multi-Agent System", "Agents", "Firmware", and "Libraries". The "Agents" section is expanded, showing "bane" and "Argo".
- Center Panel:** A code editor showing the source code for the "bane" agent. The code is written in a multi-agent system language and includes comments and function definitions for controlling an LED.
- Bottom Panel:** A terminal window showing the output of the simulation. It displays messages from the "ChonOS EmbeddedMAS" and the "bane" agent, indicating the start of the simulation and the agent's actions.
- Right Panel:** A hardware circuit diagram of an Arduino Uno. The diagram shows the microcontroller, power pins, and digital pins. A "Close" button is visible, and the terminal output is displayed below the circuit.

The terminal output shows the following messages:

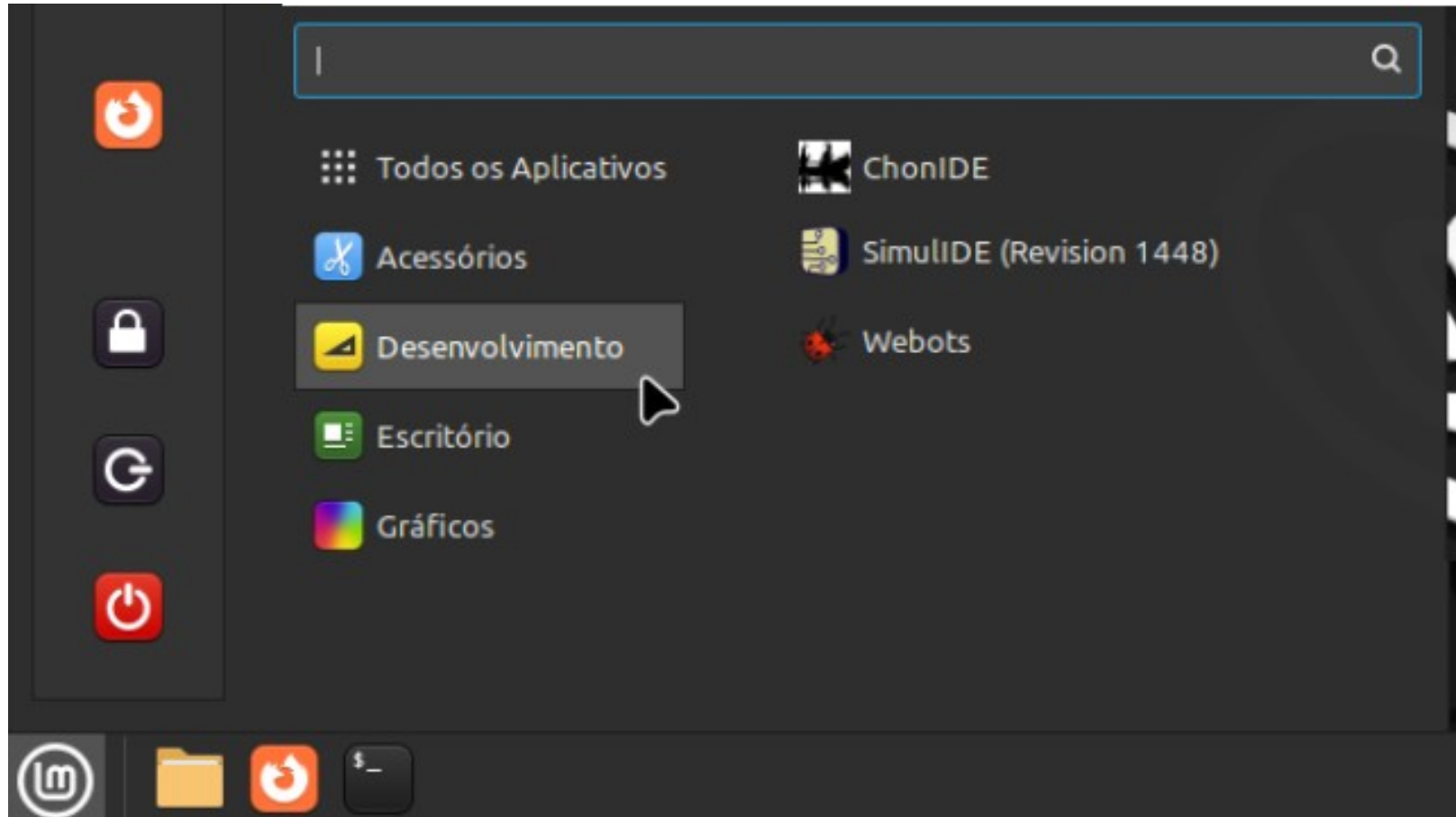
```
[ChonOS EmbeddedMAS] Starting the Multi-Agent System.  
NOTE: Picked up JDK_JAVA_OPTIONS:  --add-opens=java.base/java.lang=ALL-UNNAMED --add-opens=java.base/java.io=ALL-UNNAMED --add-opens=java.base/java.util=ALL-UNNAMED --add-opens=java.base/java.util.concurrent=ALL-UNNAMED --add-opens=java.rmi/sun.rmi.transport=ALL-UNNAMED  
Jason Http Server running on http://127.0.1.1:3272  
[JAVINO] Using version stable 1.6.0 (jSerialComm)  
[bane] Ah, Mr. Anderson, I see you are as predictable in this world as you are in the other.  
[bane] Turning ON the Led in Arduino!  
[bane] Turning OFF the Led in Arduino!  
[bane] Turning ON the Led in Arduino!  
[bane] Turning OFF the Led in Arduino!  
[bane] Turning ON the Led in Arduino!  
[bane] Turning OFF the Led in Arduino!  
[bane] Turning ON the Led in Arduino!  
[bane] Turning OFF the Led in Arduino!  
[bane] Turning ON the Led in Arduino!  
[bane] Turning OFF the Led in Arduino!  
[bane] Turning ON the Led in Arduino!
```

Webots



Michel, O. (1998). Webots: Symbiosis Between Virtual and Real Mobile Robots. In: Heudin, JC. (eds) Virtual Worlds. VW 1998. Lecture Notes in Computer Science(), vol 1434. Springer, Berlin, Heidelberg.
https://doi.org/10.1007/3-540-68686-X_24

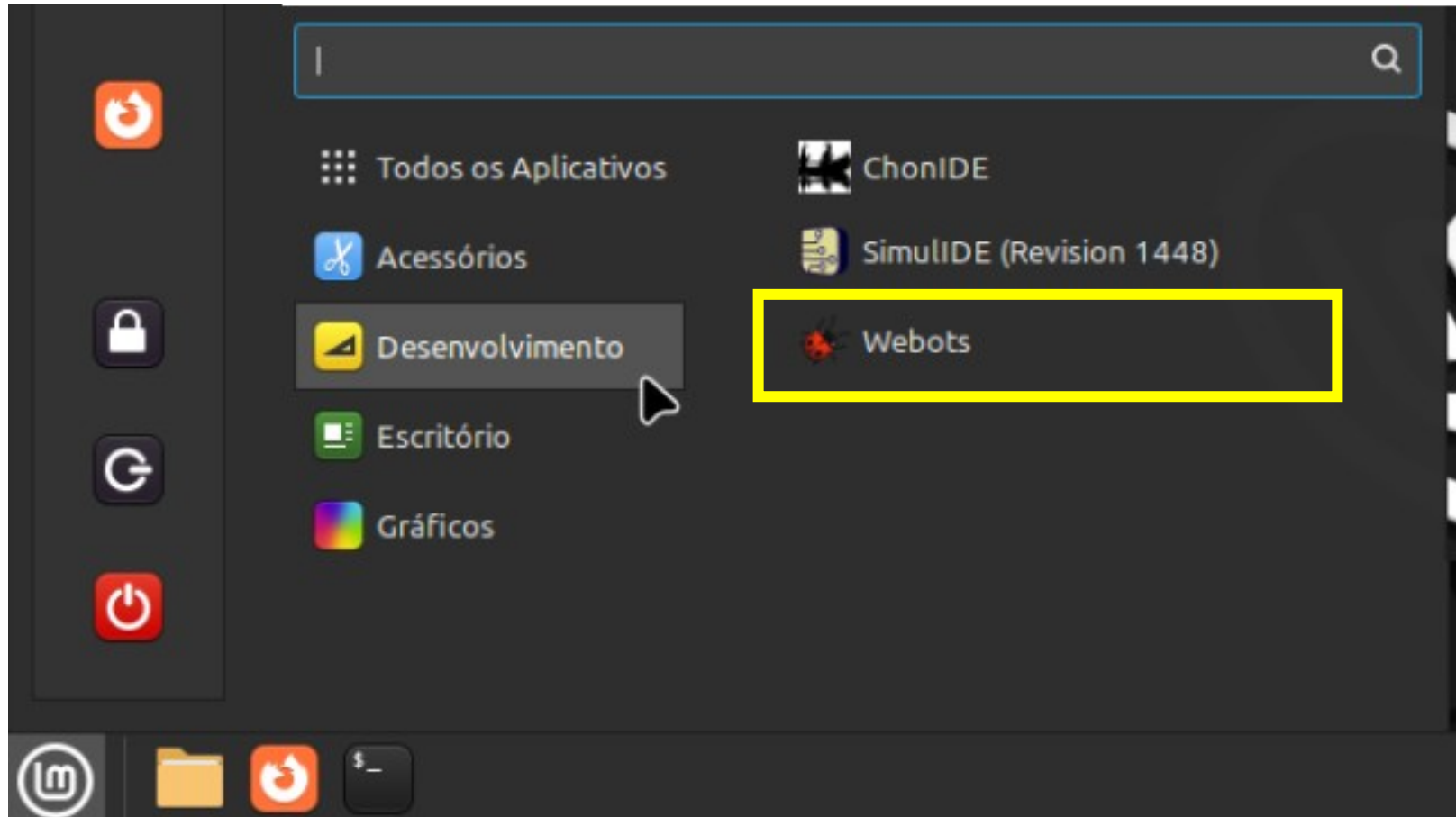
Webots



Manual de instalação

<https://cyberbotics.com/doc/guide/installation-procedure#installing-the-debian-package-with-the-advanced-packaging-tool-apt>

Webots



Manual de instalação

<https://cyberbotics.com/doc/guide/installation-procedure#installing-the-debian-package-with-the-advanced-packaging-tool-apt>

Webots

[distributedAndEmbeddedAI](#) / [course](#) / [05-TheDevelopmentTool](#) / Examples / 



nilsonLazarin Car4WD Simulated World developed by @bptfreitas

Name	Last commit
..	
Blink	developmer
Car4WD	Car4WD Sim
Blink.zip	developmer
Car4WD.zip	Car4WD Sim



<https://github.com/chon-group/distributedAndEmbeddedAI/raw/main/course/05-TheDevelopmentTool/Examples/Car4WD.zip>

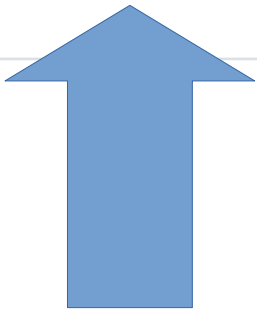
Webots

distributedAndEmbeddedAI / course / 05-TheDevelopmentTool / Examples /



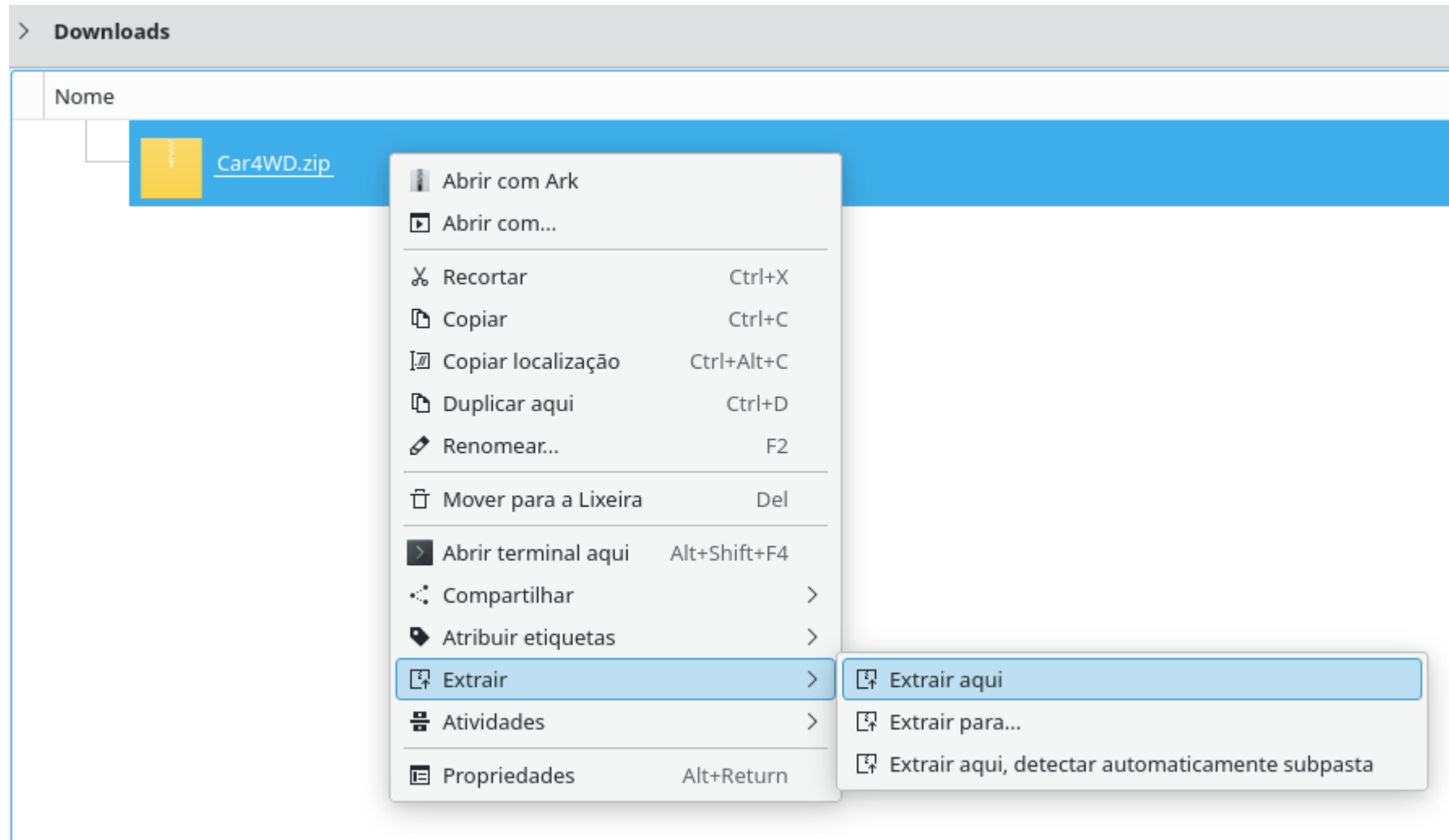
nilsonLazarin Car4WD Simulated World developed by @bptfreitas

Name	Last commit
..	
Blink	developmer
Car4WD	Car4WD Sim
Blink.zip	developmer
Car4WD.zip	Car4WD Sim

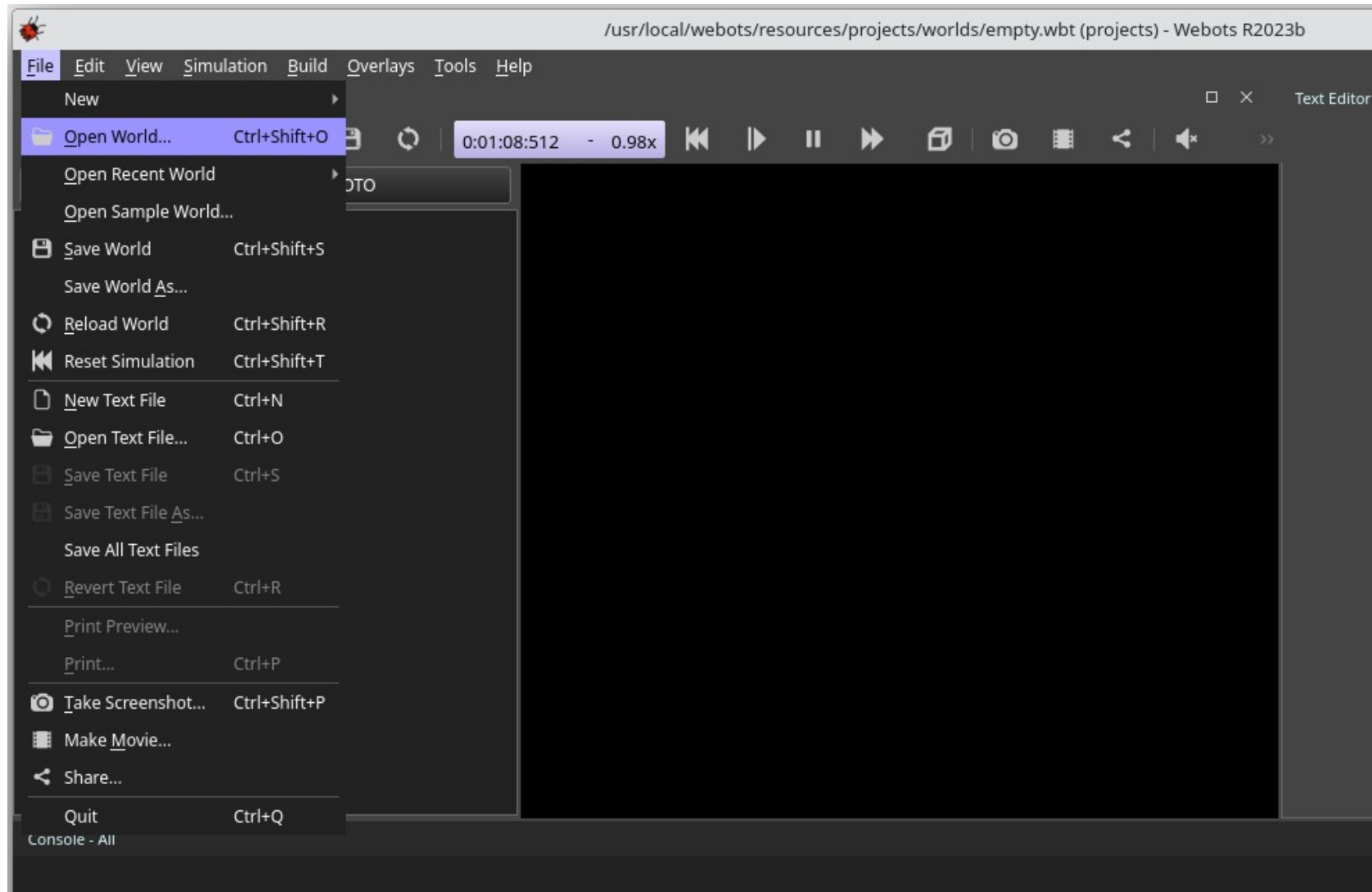


<https://github.com/chon-group/distributedAndEmbeddedAI/raw/main/course/05-TheDevelopmentTool/Examples/Car4WD.zip>

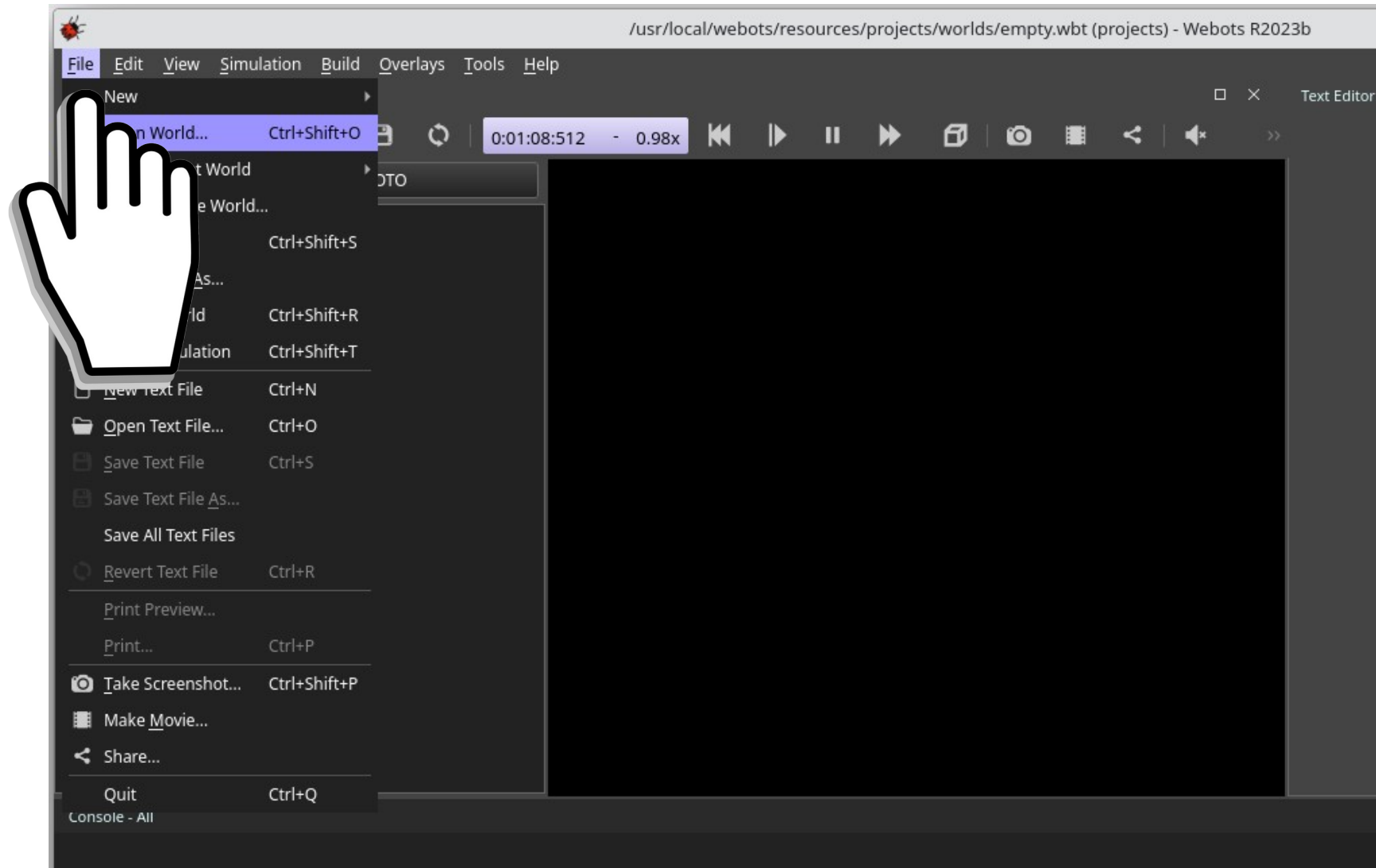
Webots



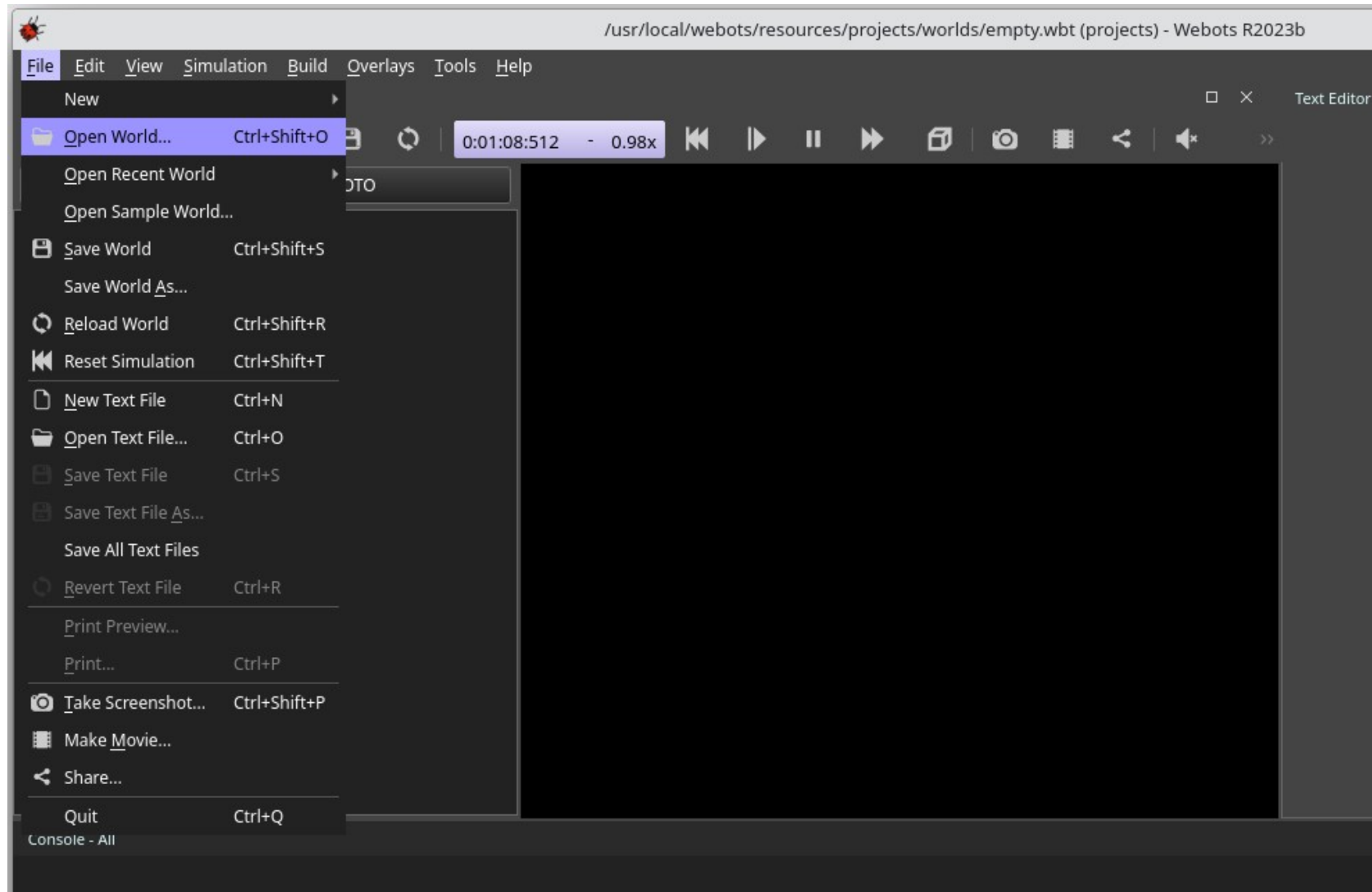
Webots



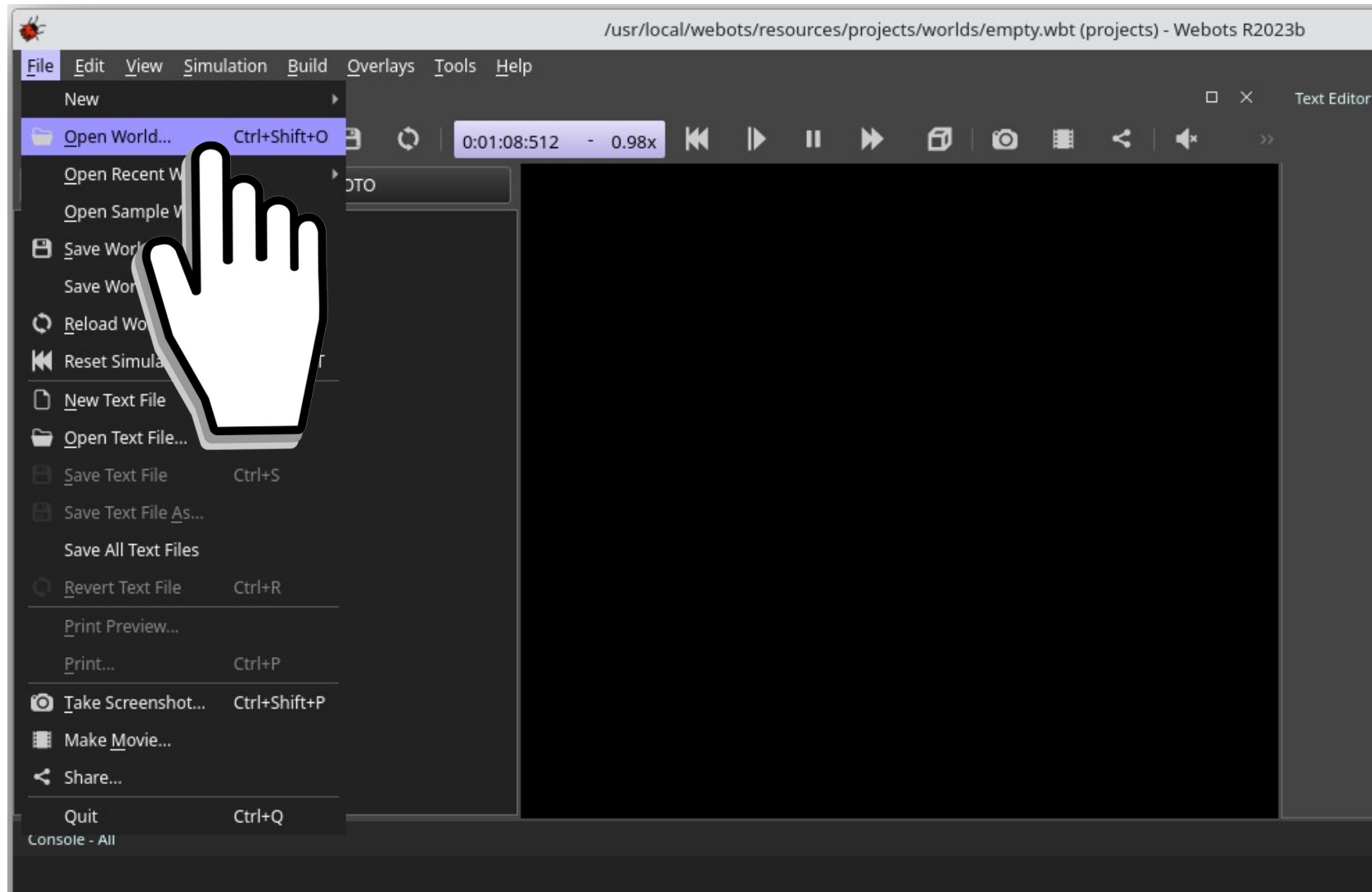
Webots



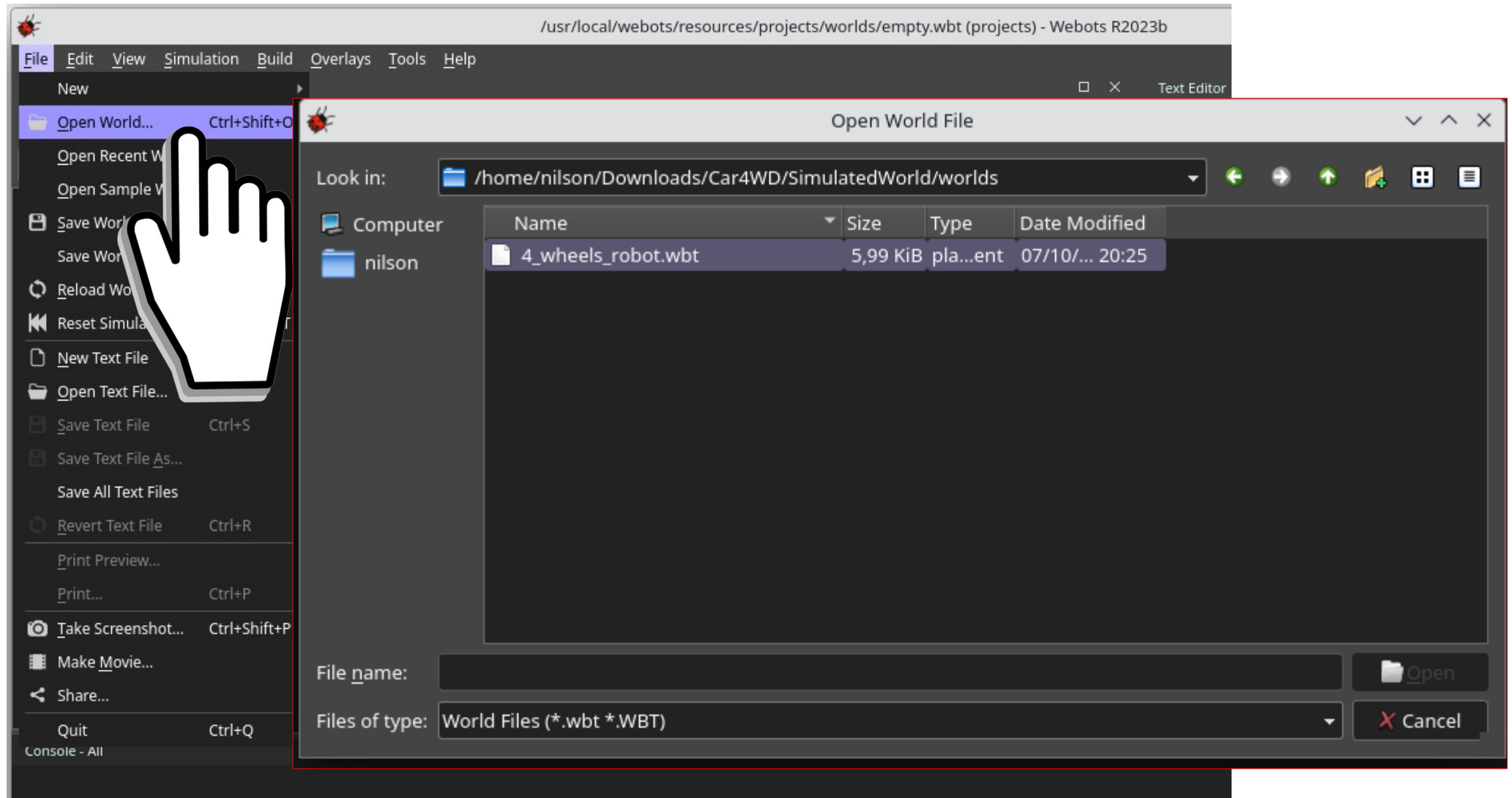
Webots



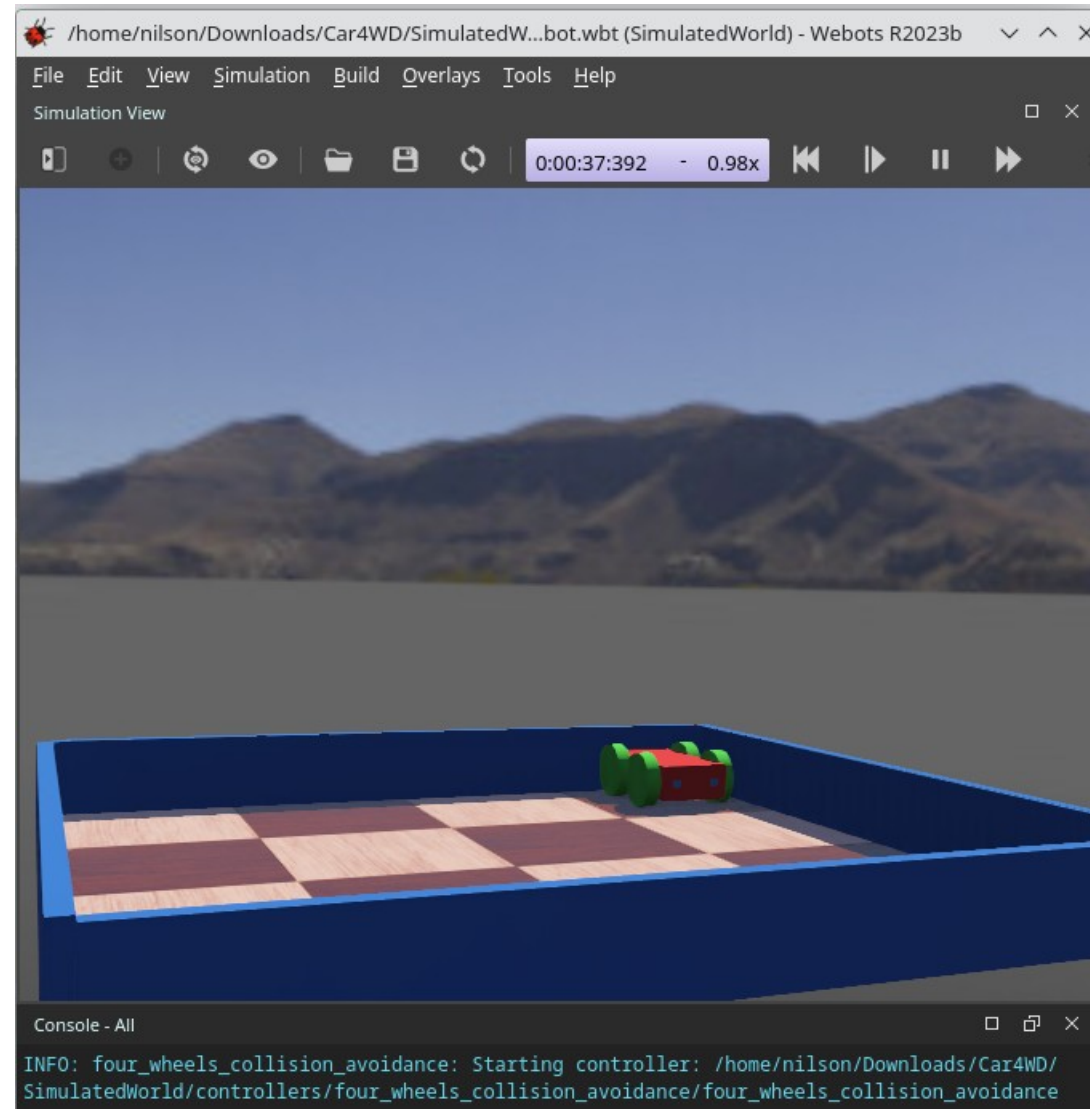
Webots



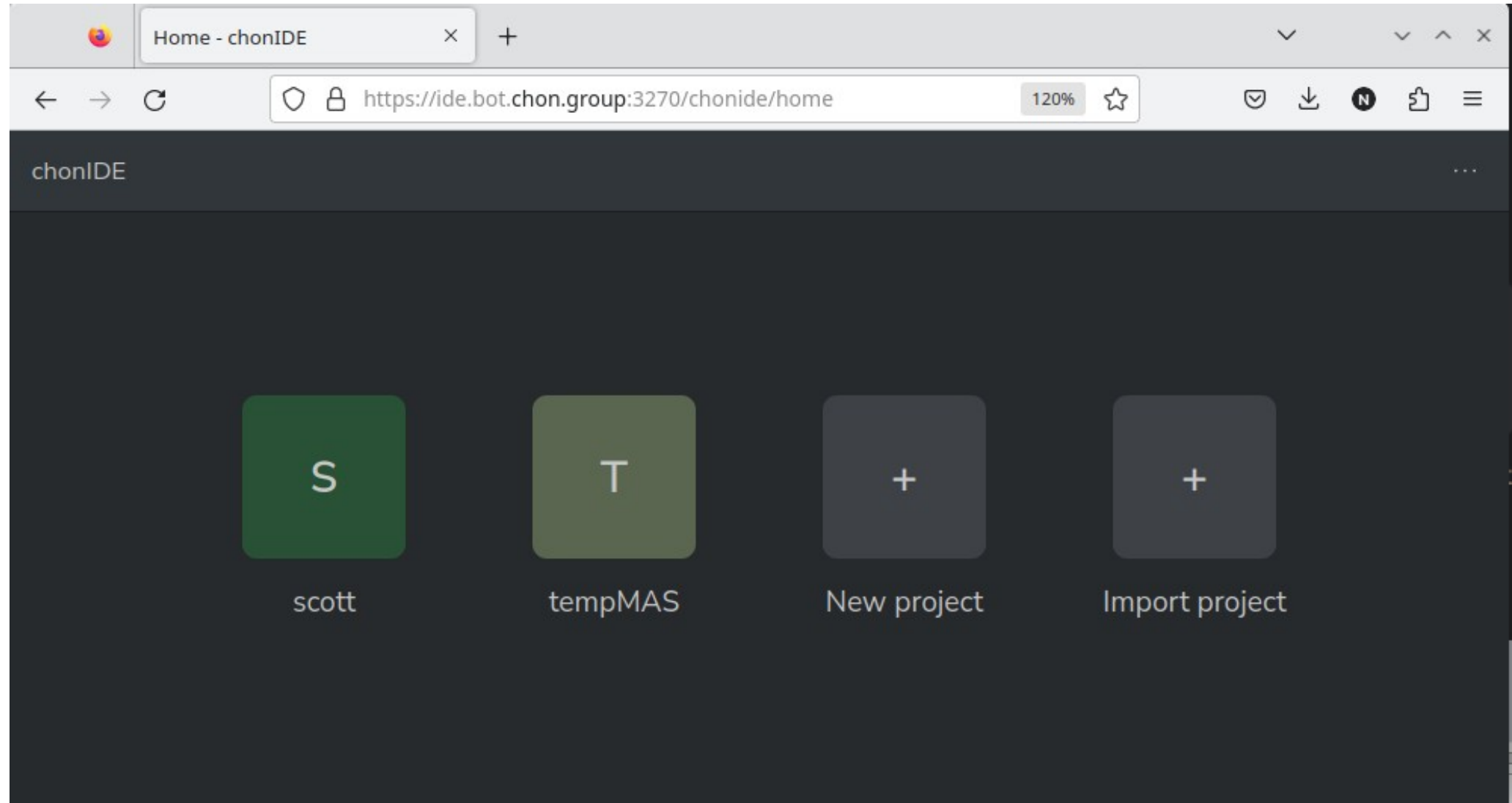
Webots



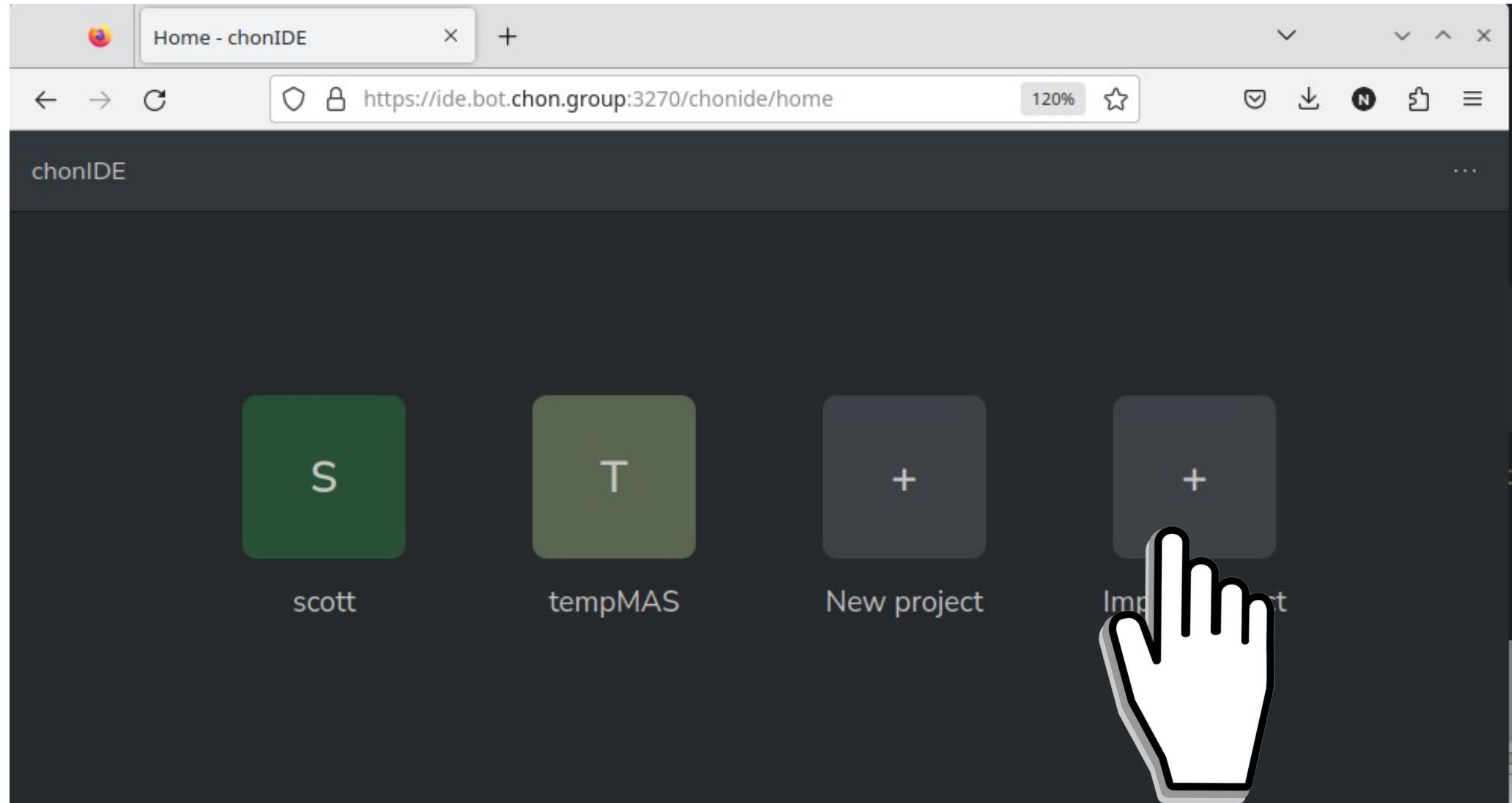
Webots



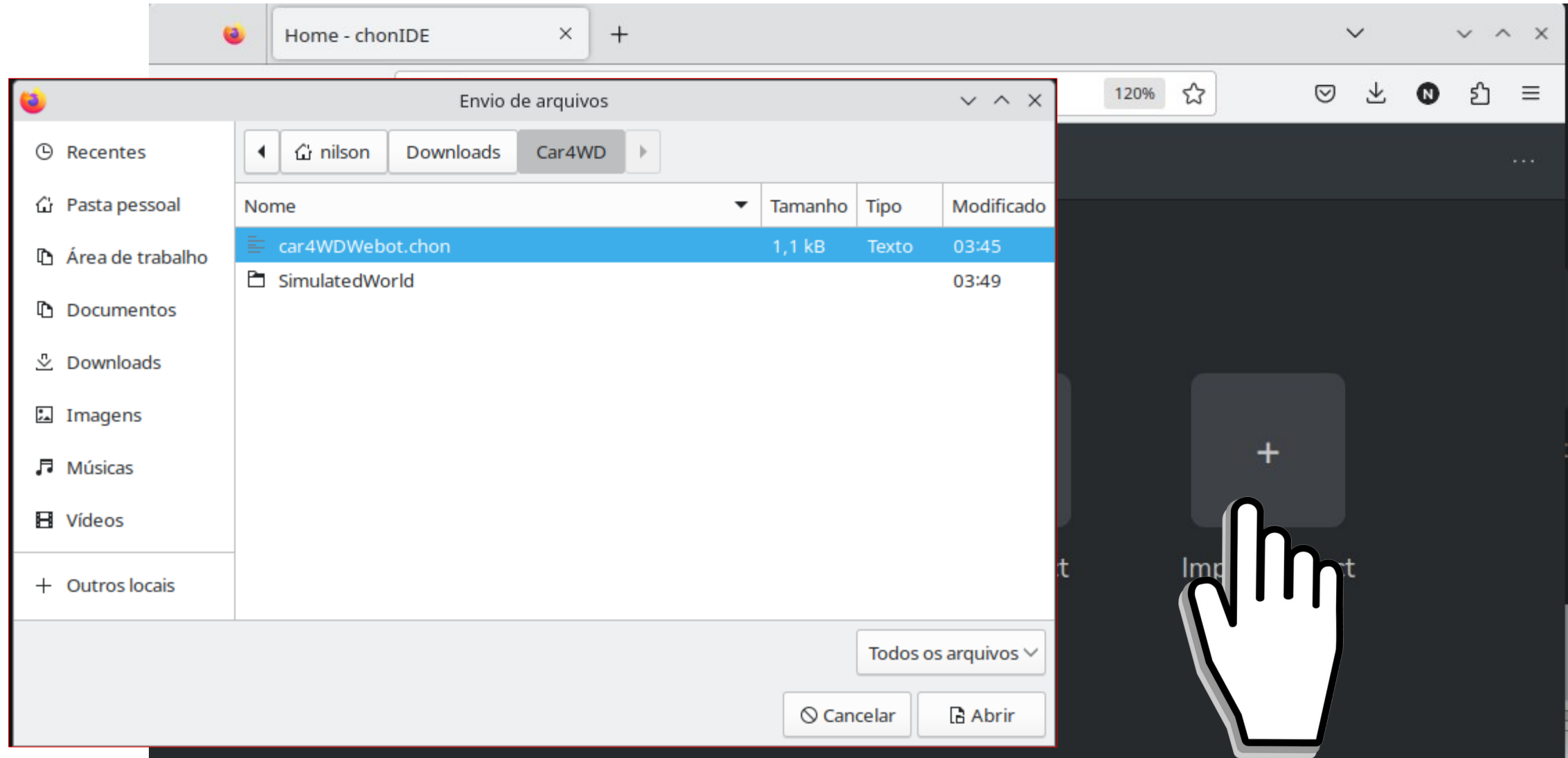
Webots



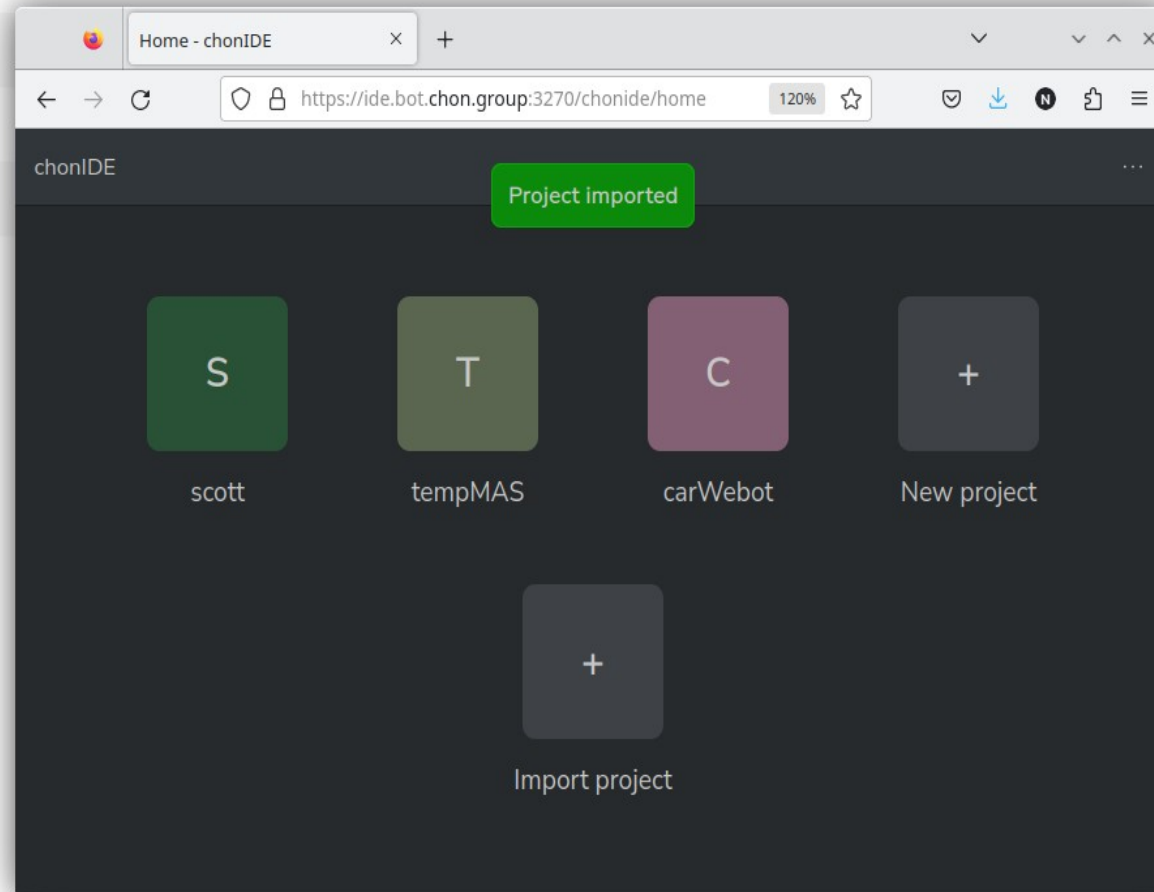
Webots



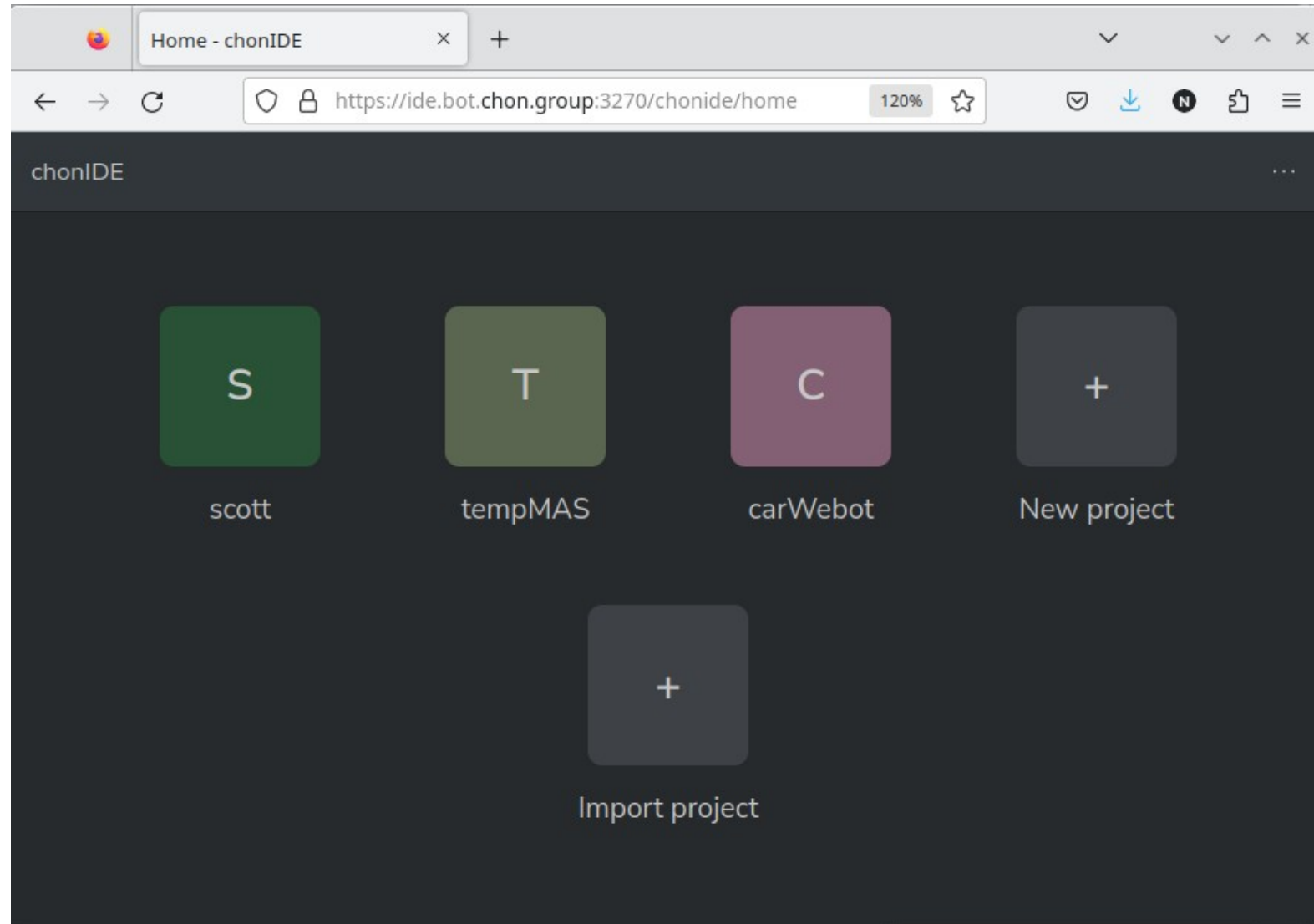
Webots



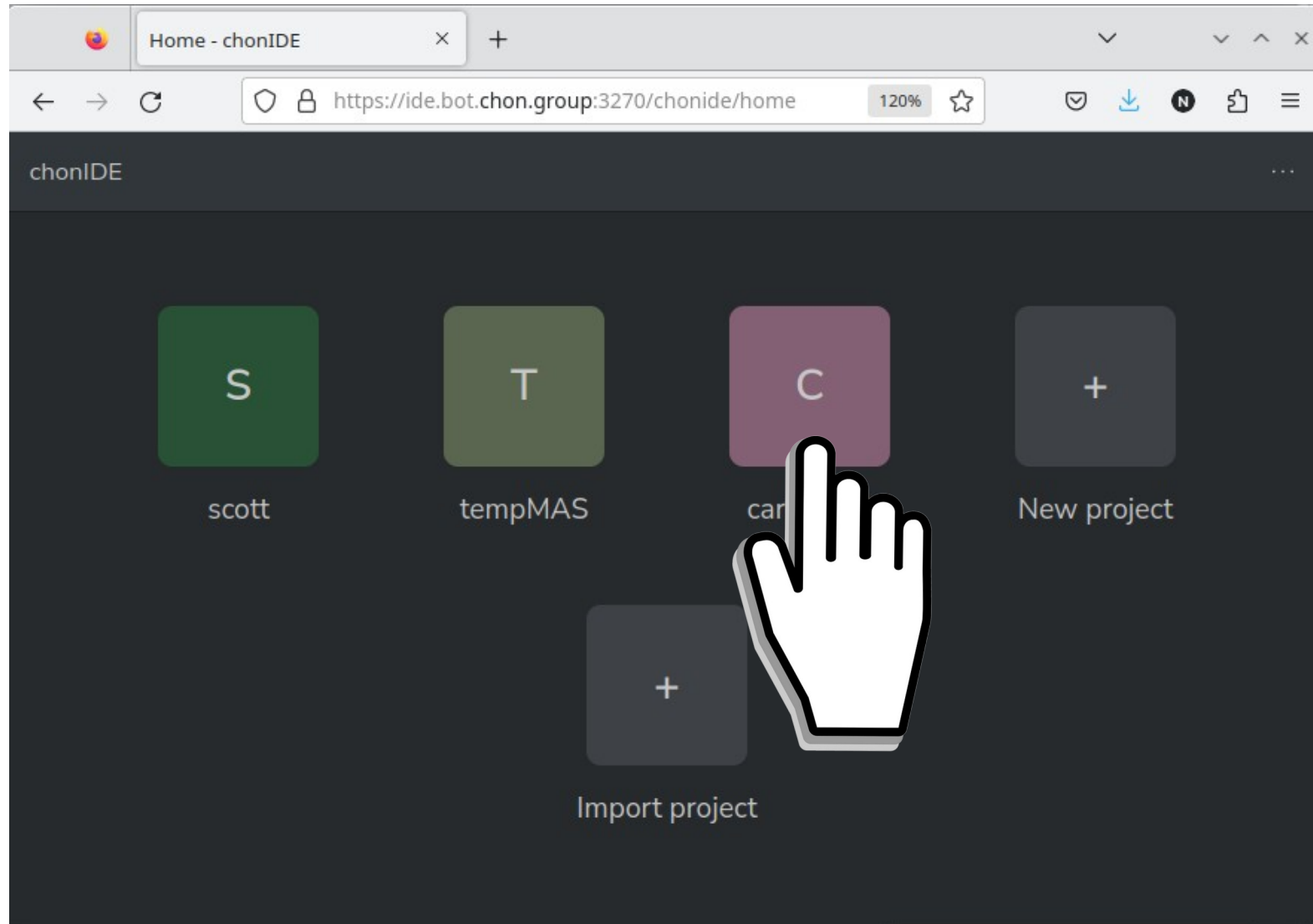
Webots



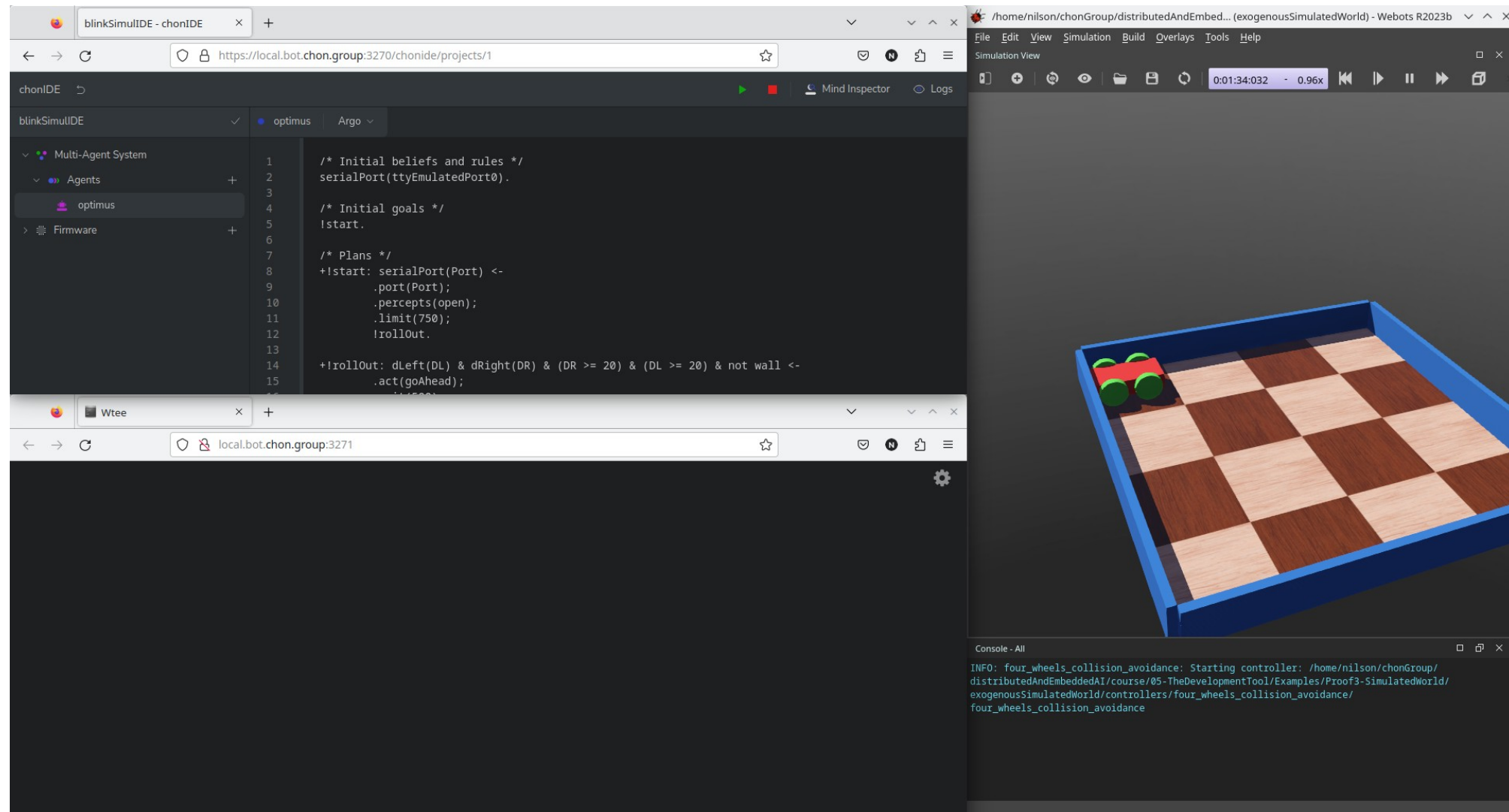
Webots



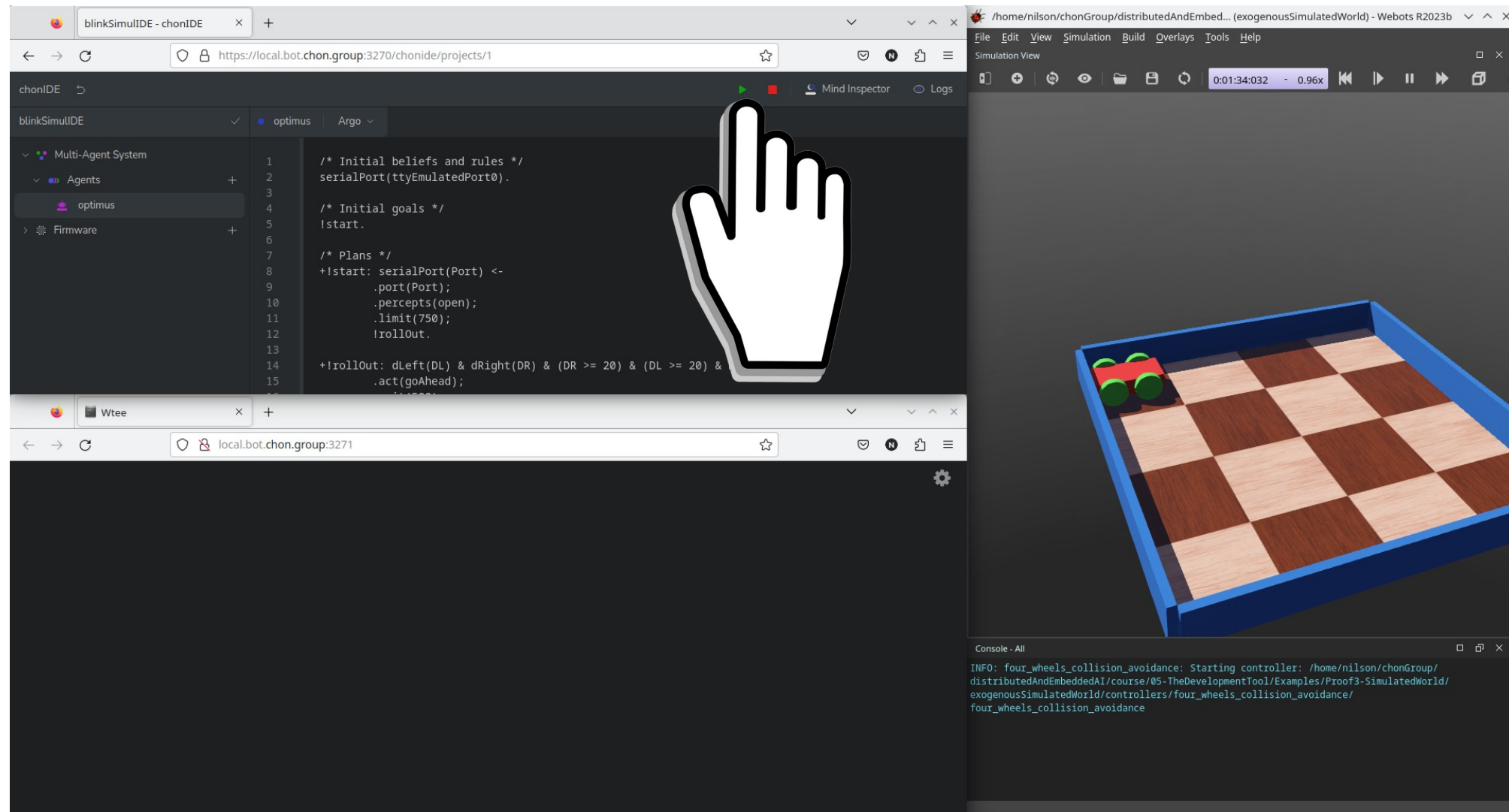
Webots



Webots



Webots



Webots

The screenshot displays the Webots R2023b environment. On the left, the blinkSimulIDE editor is open, showing a multi-agent system with an agent named 'optimus'. The code editor contains the following code:

```
1  /* Initial beliefs and rules */
2  serialPort(ttyEmulatedPort0).
3
4  /* Initial goals */
5  !start.
6
7  /* Plans */
8  +!start: serialPort(Port) <-
9      .port(Port);
10     .percepts(open);
11     .limit(750);
12     !rollOut.
13
14  +!rollOut: dLeft(DL) & dRight(DR) & (DR >= 20) & (DL >= 20) & not wall <-
15     .act(goAhead);
```

Below the code editor, a terminal window shows the startup logs for the multi-agent system, including the version of JAVINO (1.6.0) and the initial distance measurements for the 'optimus' agent.

On the right, the 3D simulation view shows a red robot with green wheels on a checkered floor. The console at the bottom right displays the following messages:

```
javino_received_msg: goAhead
Received: getPercepts (92) = dLeft(33.3);dRight(33.7);
javino_received_msg: getPercepts
Received: goAhead (93)
javino_received_msg: goAhead
Received: goAhead (94)
javino_received_msg: goAhead
Received: getPercepts (95) = dLeft(29.3);dRight(29.8);
javino_received_msg: getPercepts
Received: goAhead (96)
```

OBRIGADO!

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