Jetson AH

The Artificial Hippocampus that enables robots to transform short term memories into long term ones to assist in future tasks.

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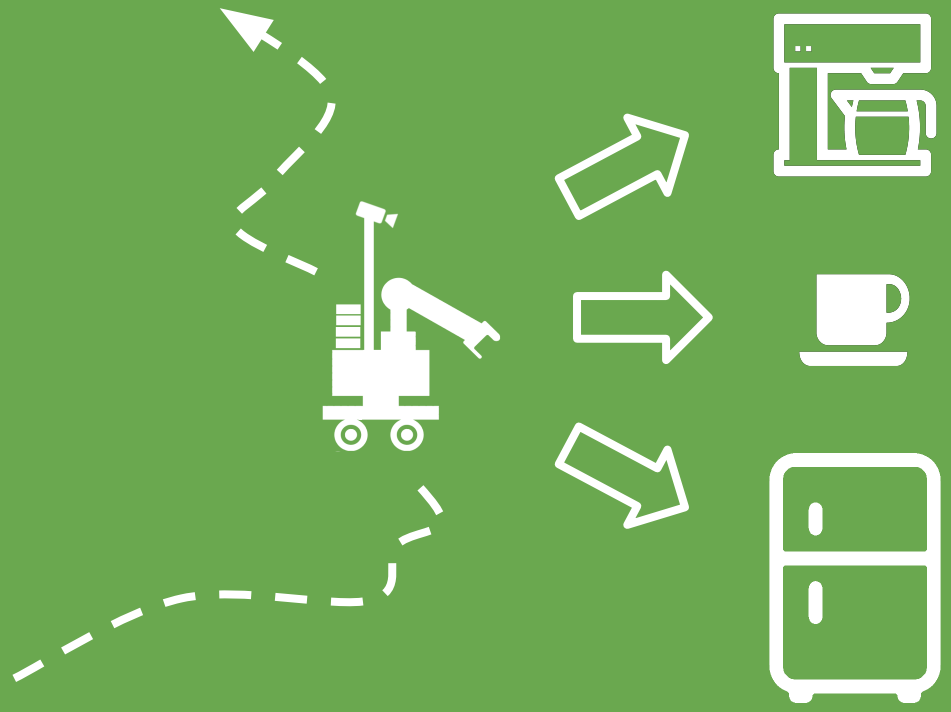
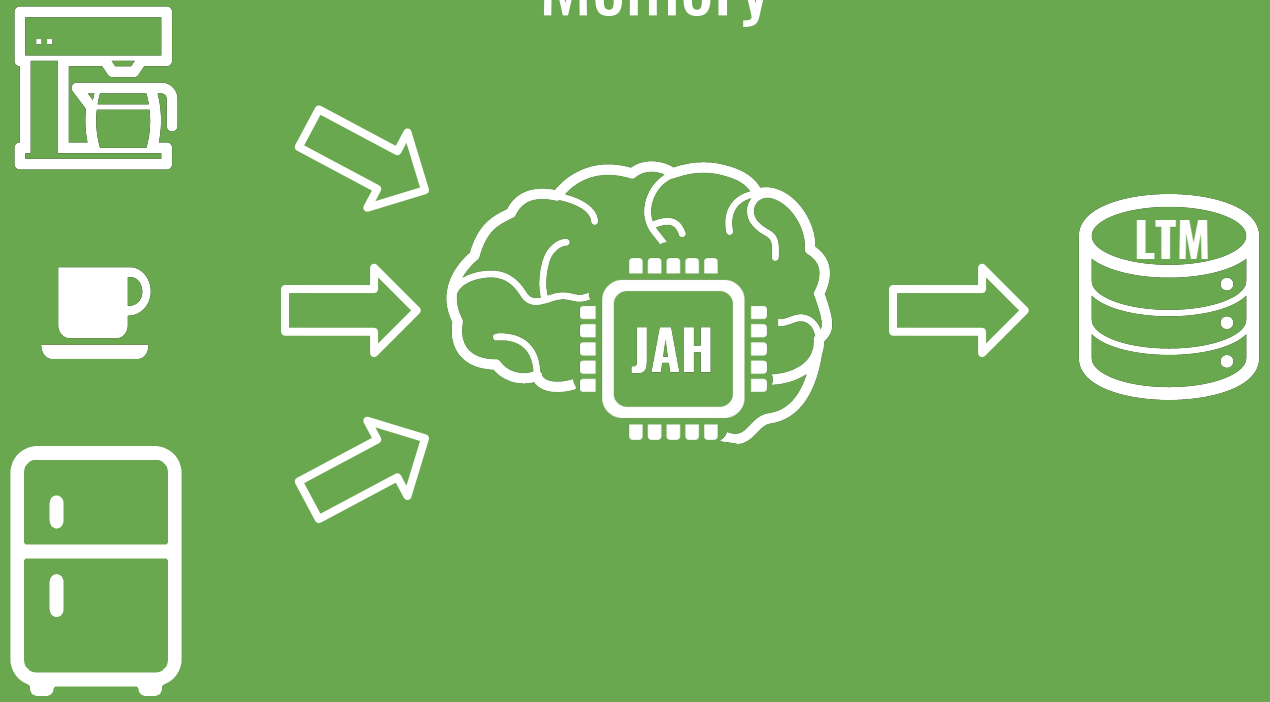
How it works

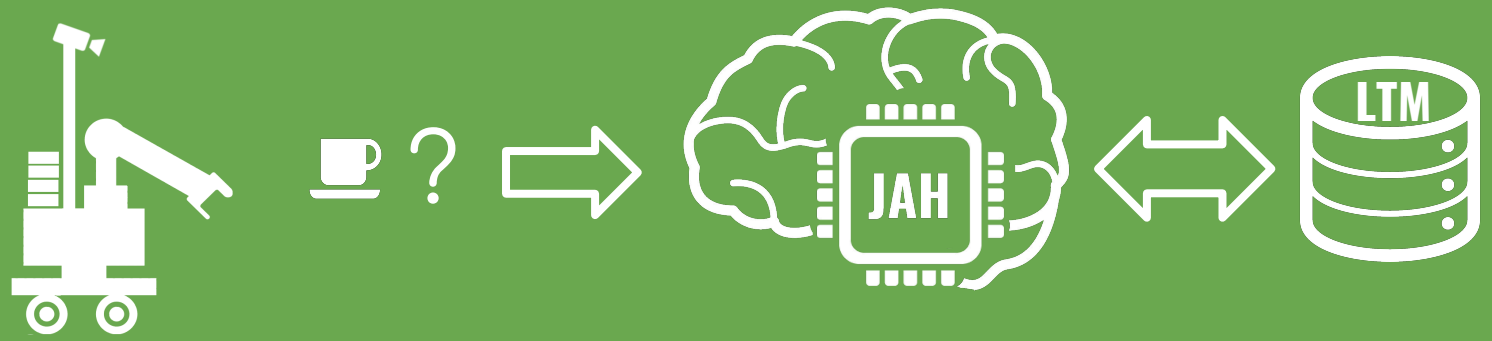
A JAH enabled robot spots objects while performing different tasks



Jetson AH, running in the background, processes and stores the most important short term information into a Long Term Memory

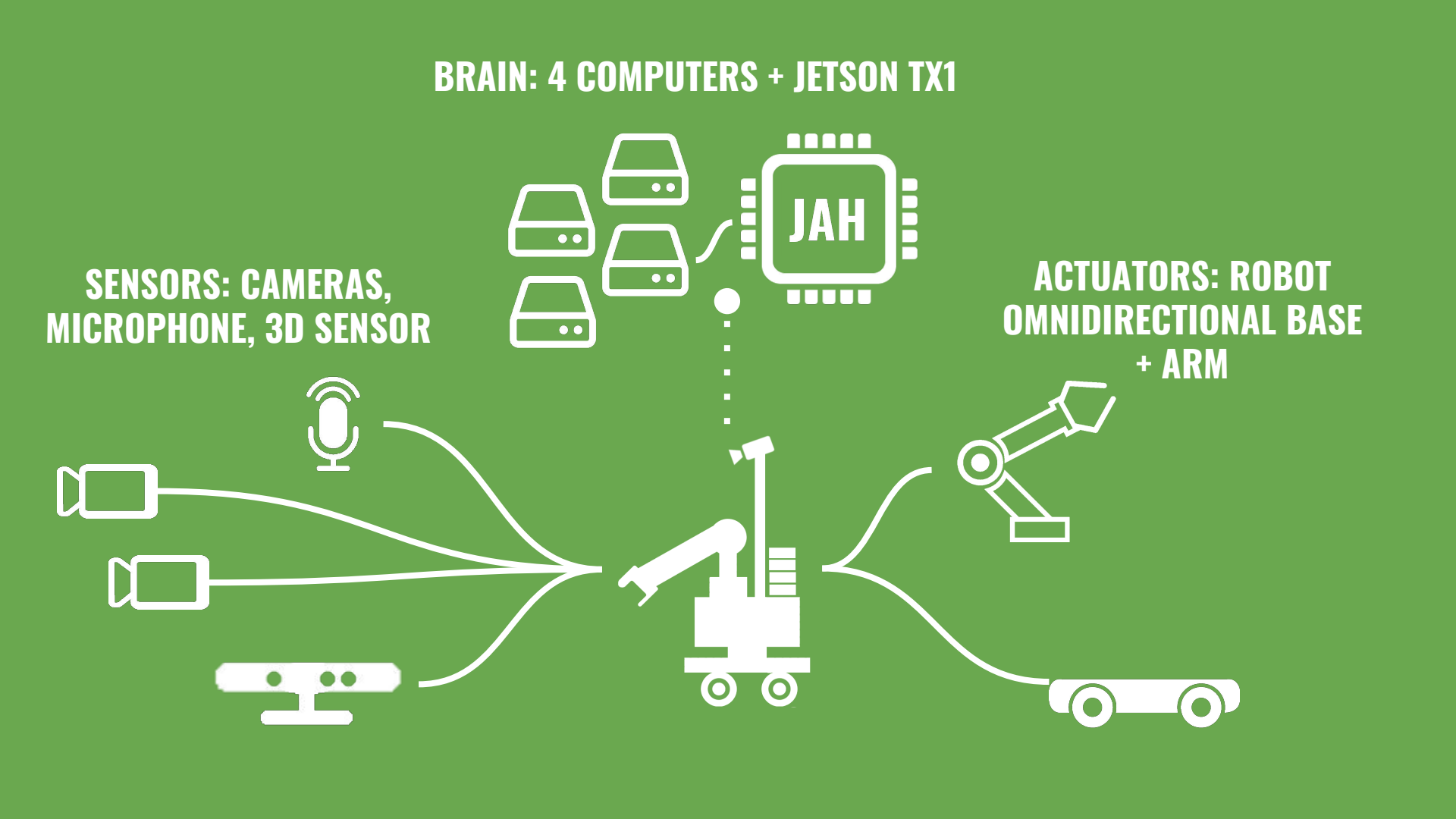


Once the robot needs to perform a new task it uses the long term memory data that was processed by Jetson AH

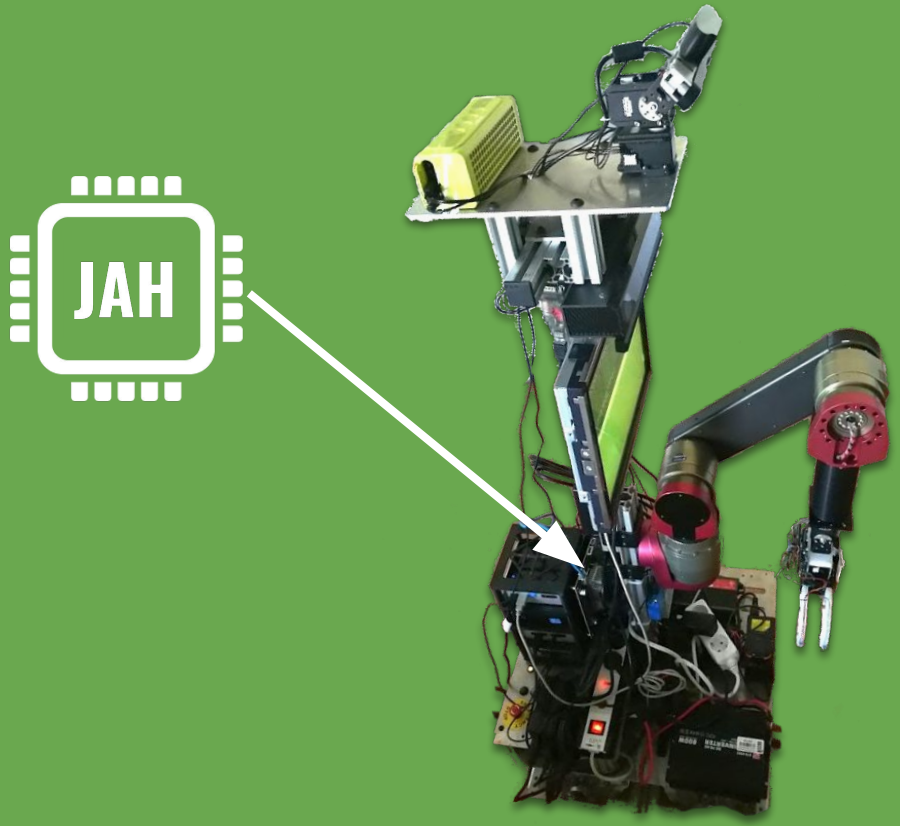


Jetson AH returns learned most possible locations of objects, speeding up the whole high level task!!

Hardware Architecture


BRAIN: 4 COMPUTERS + JETSON TX1
JAH
SENSORS: CAMERAS, MICROPHONE, 3D SENSOR
ACTUATORS: ROBOT OMNIDIRECTIONAL BASE + ARM

Real Robot Setup



Software Architecture:
Cognitive Architecture CORTEX

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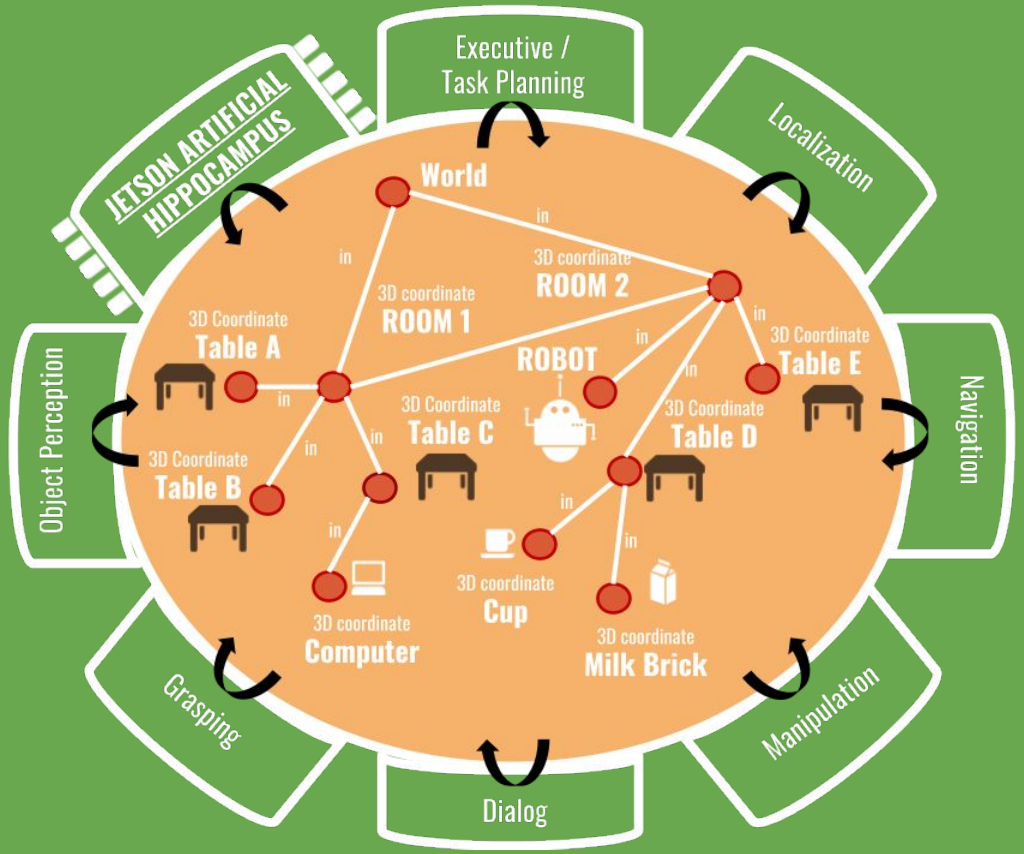
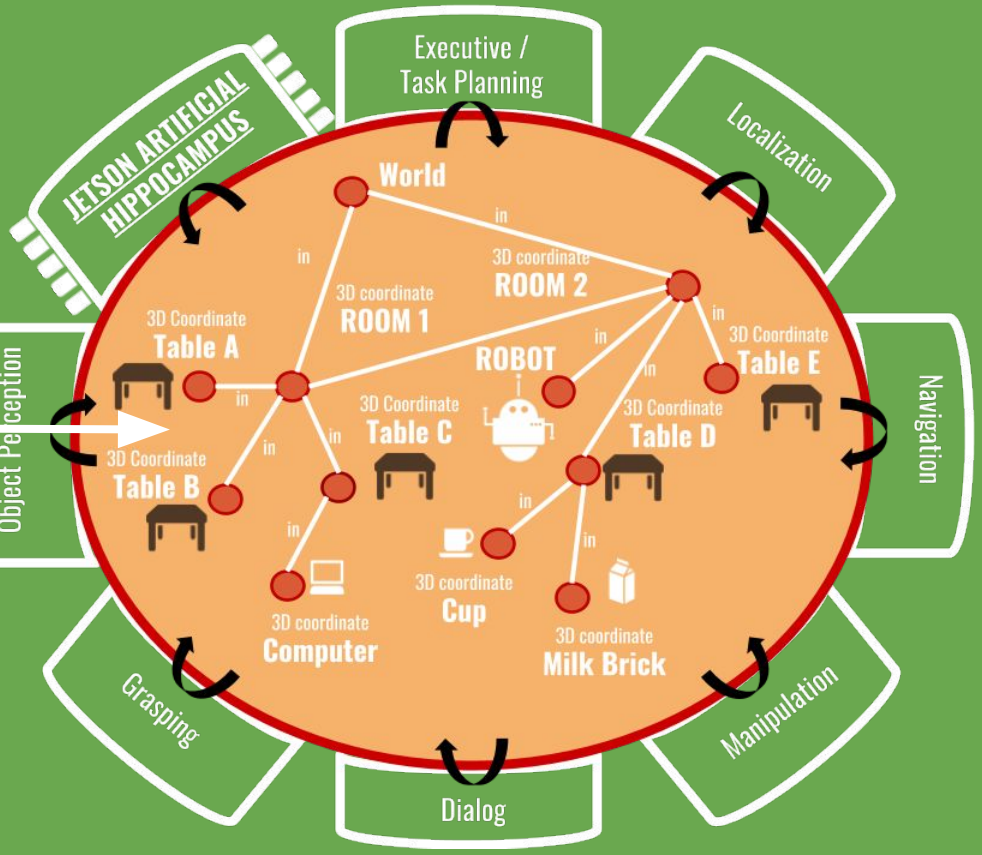
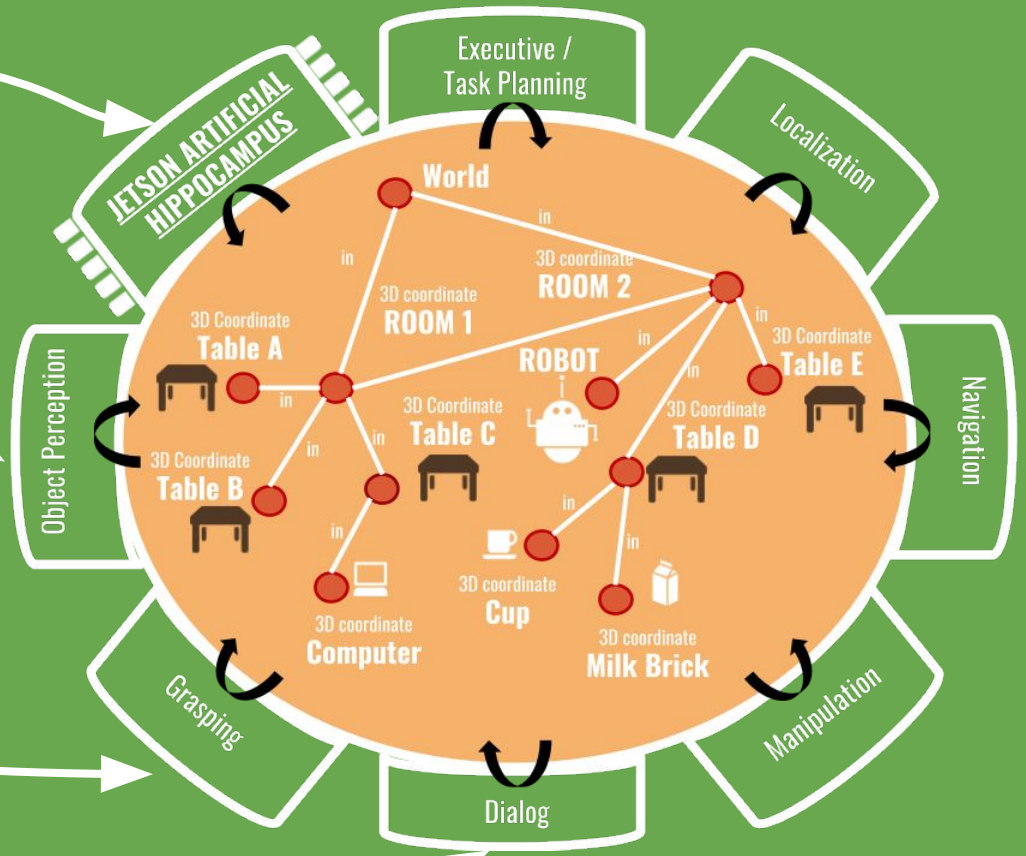


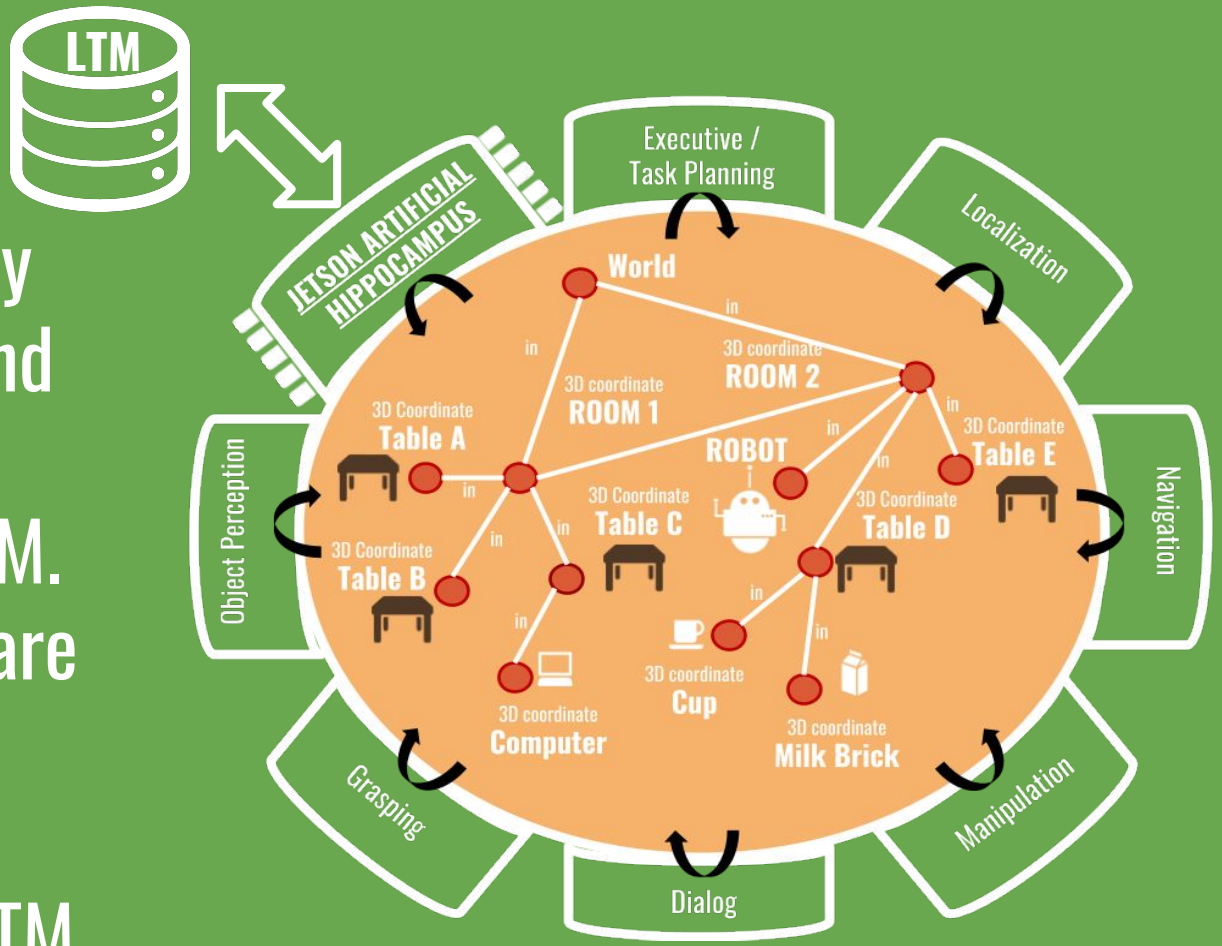
CORTEX maintains an internal model that represents the world. It is a shared hypergraph named Deep State Representation (DSR).



AGENTS read and modify the internal model as a result of the robot's actions (perceptual and others).

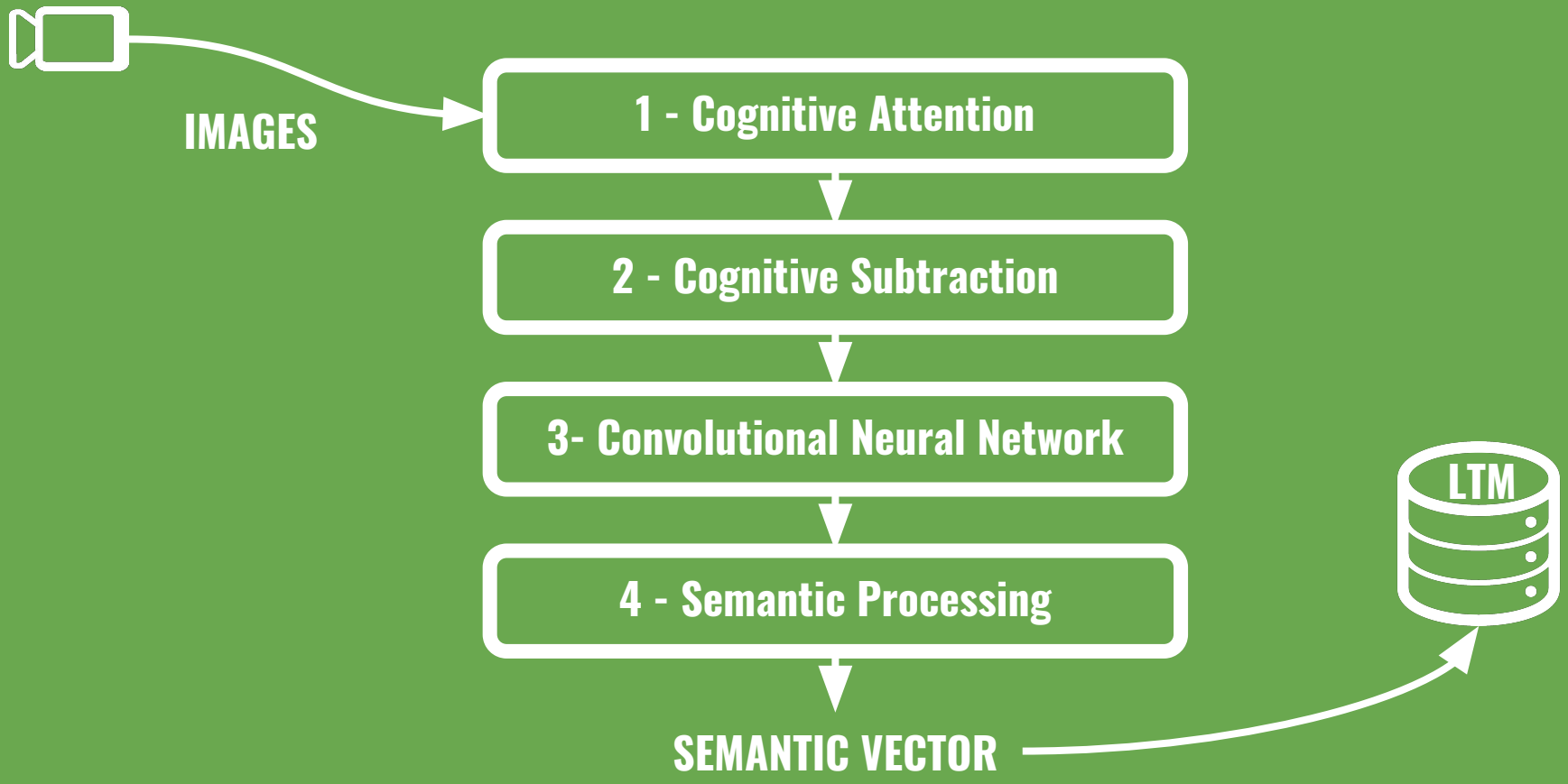


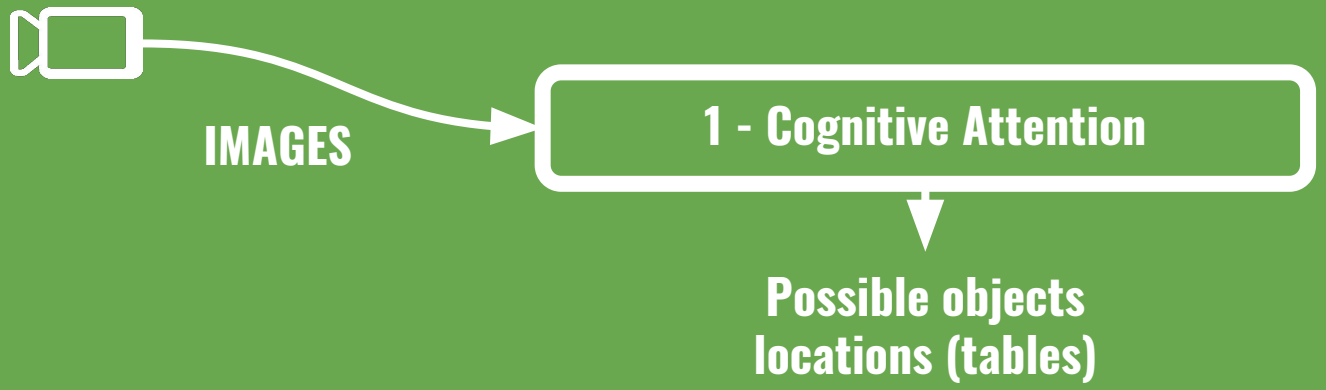
Jetson AH passively analyzes the info and stores the most important in the LTM. When search tasks are being executed it provides possible locations from the LTM.



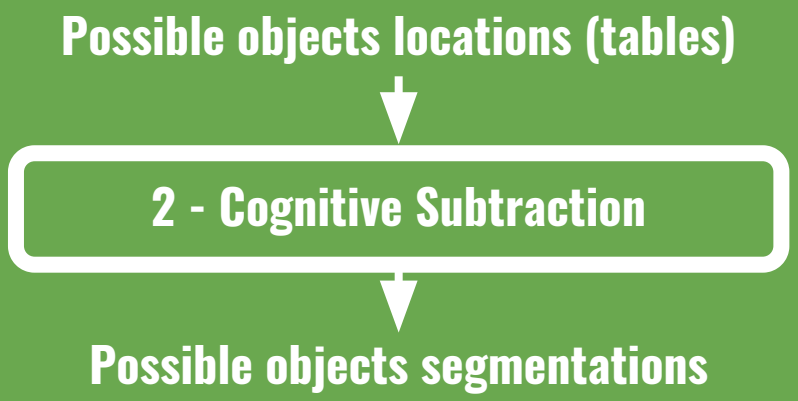
Software Architecture: Jetson AH Agent

Jetson AH: Passively Storing info in LTM

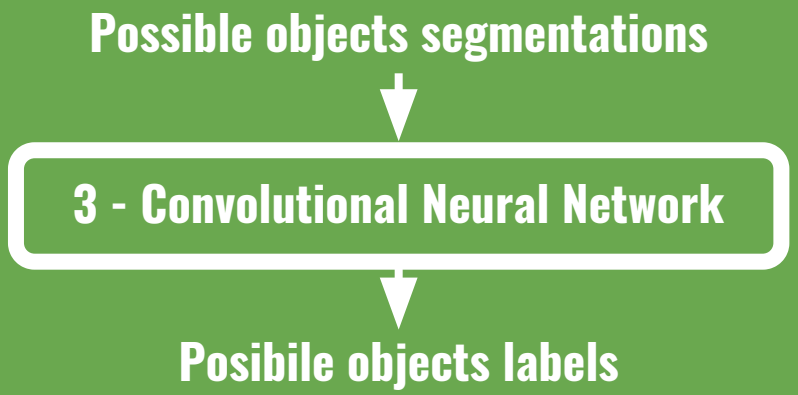




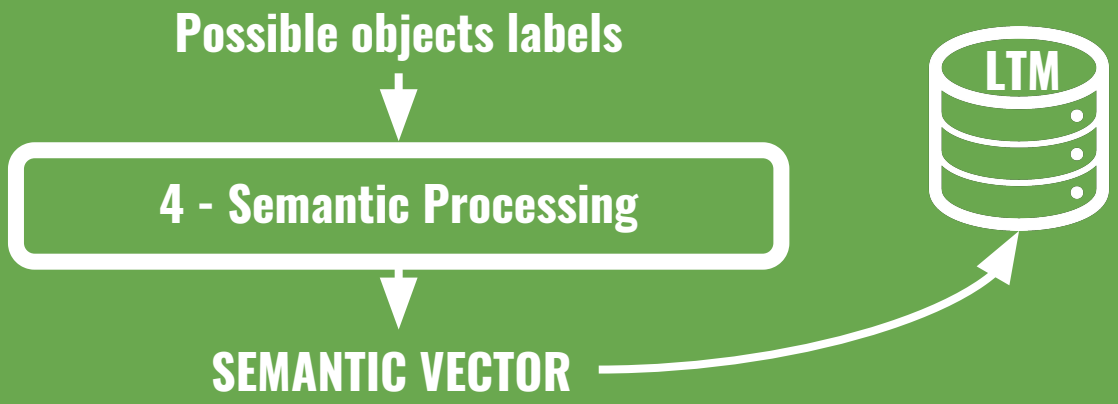
While the robot performs his tasks, RGBD Images are processed by the Cognitive Attention step that uses the world model to detect if possible tables lie in the frustum of the camera.



Images with possible objects are processed by the Cognitive Subtraction step and objects segmented following a 3D table-top segmentation

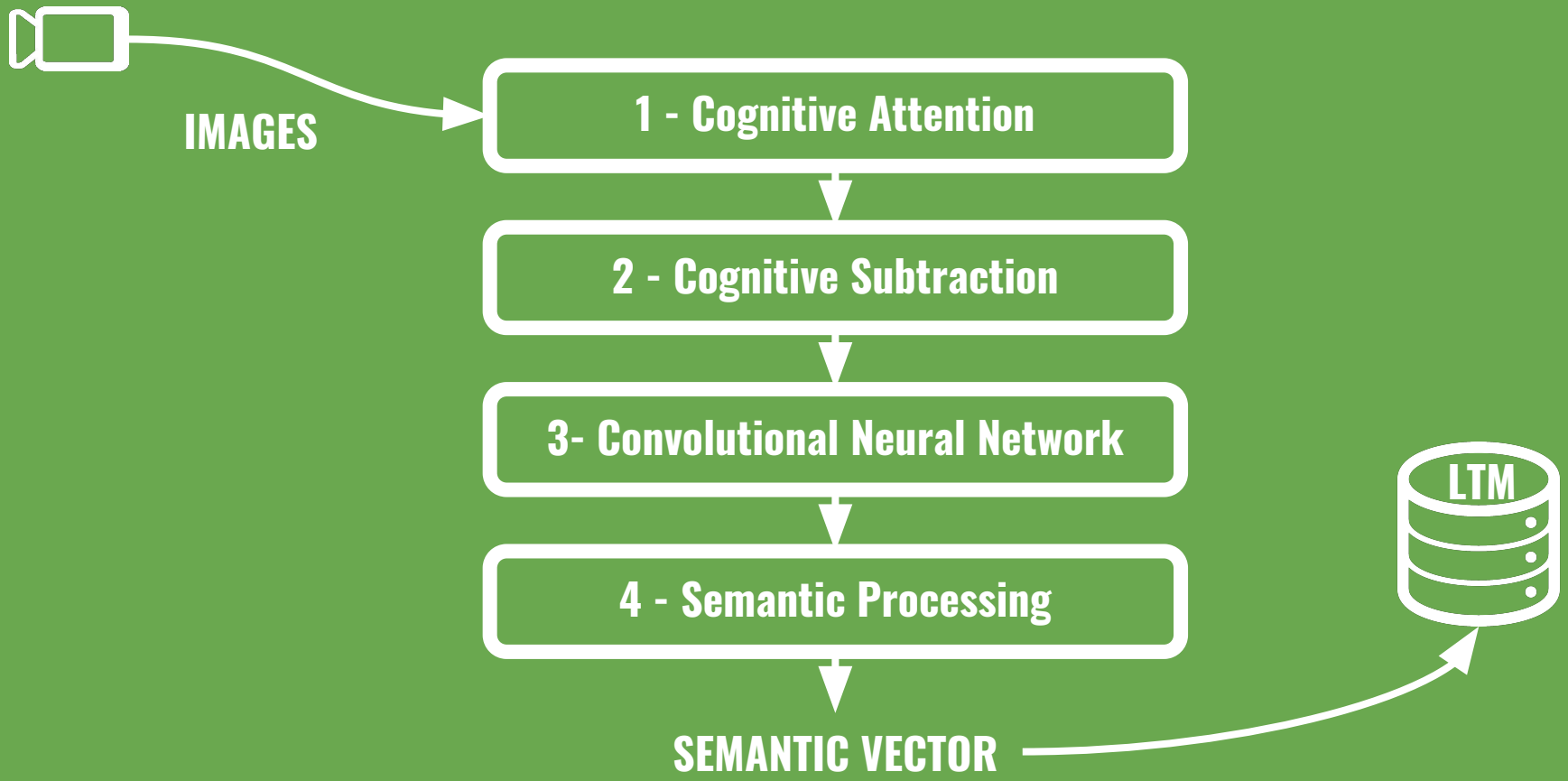


Possible objects segmentations are processed through a Deep Residual Learning Convolutional Neural Network to produce possible labels are for these segmentations



Possible objects labels are converted to vector representations using skip-gram model and a Semantic Vector representing objects in a certain location is stored in the Long Term Memory for the future.

Jetson AH: Passive Storage in LTM



Jetson AH: Using the Info in LTM

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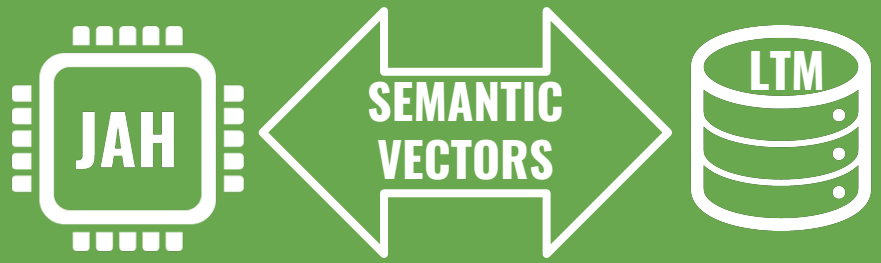
A human user asks de robot for an object (i.e., a cup).

Jetson AH: Using the Info in LTM

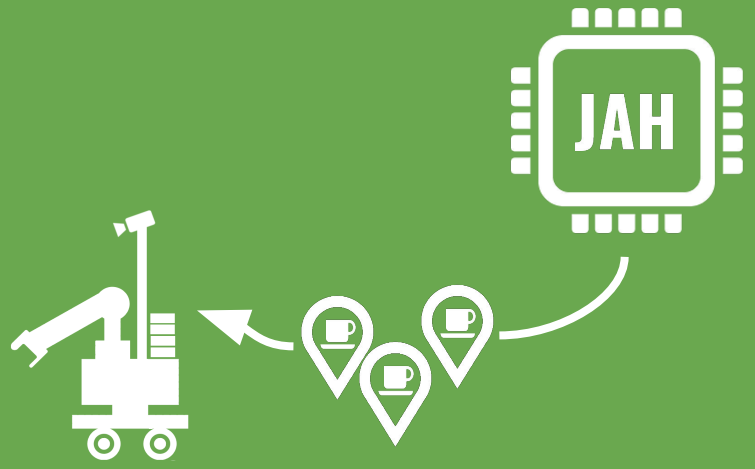
The robot uses Jetson AH to retrieve possible location that it can remember from past experiences (stored in the Long Term Memory).

Jetson AH: Using the Info in LTM



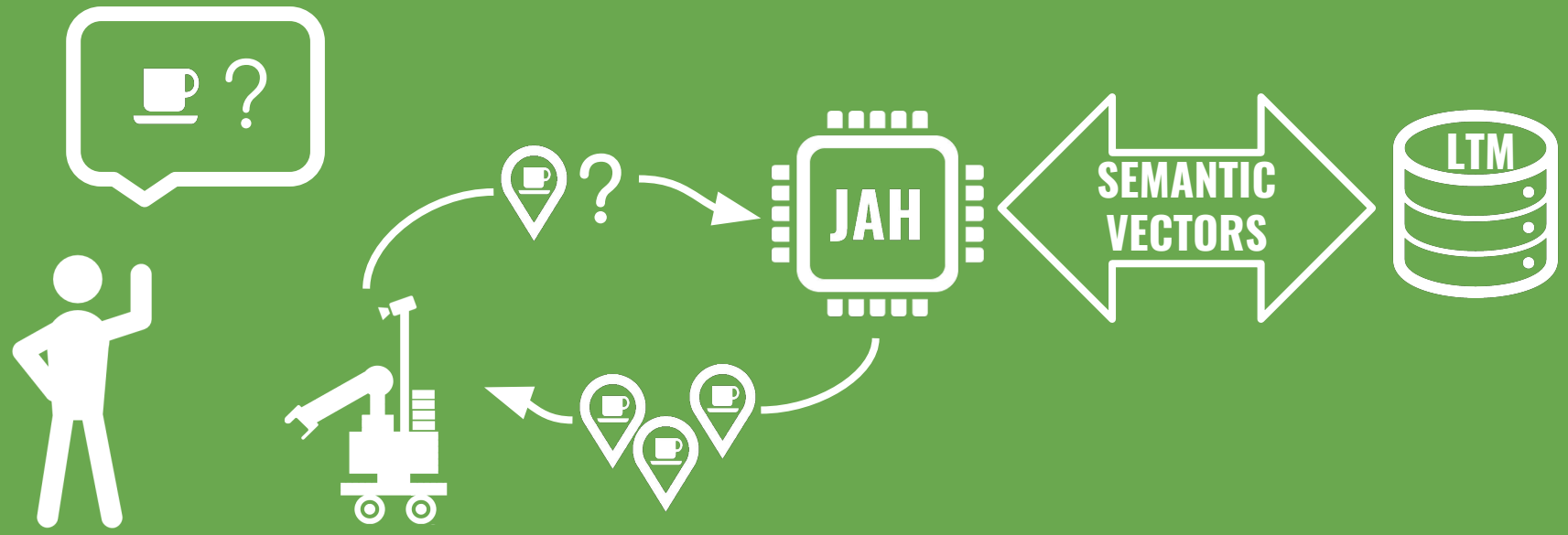
Jetson AH converts the label of the object to its semantic vector representation using the skip gram model and compares to stored vectors using the dot product.

Jetson AH: Using the Info in LTM

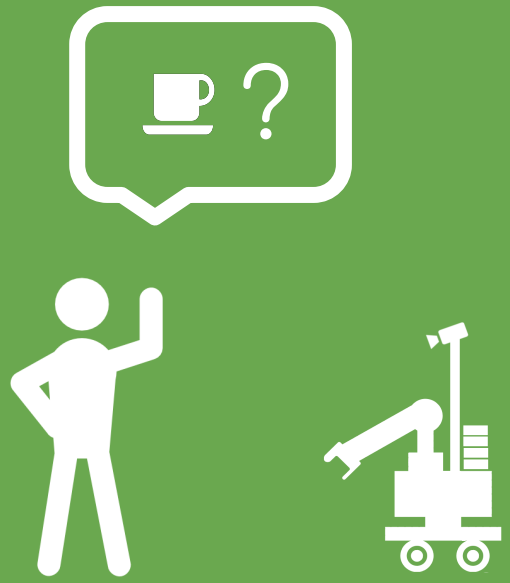


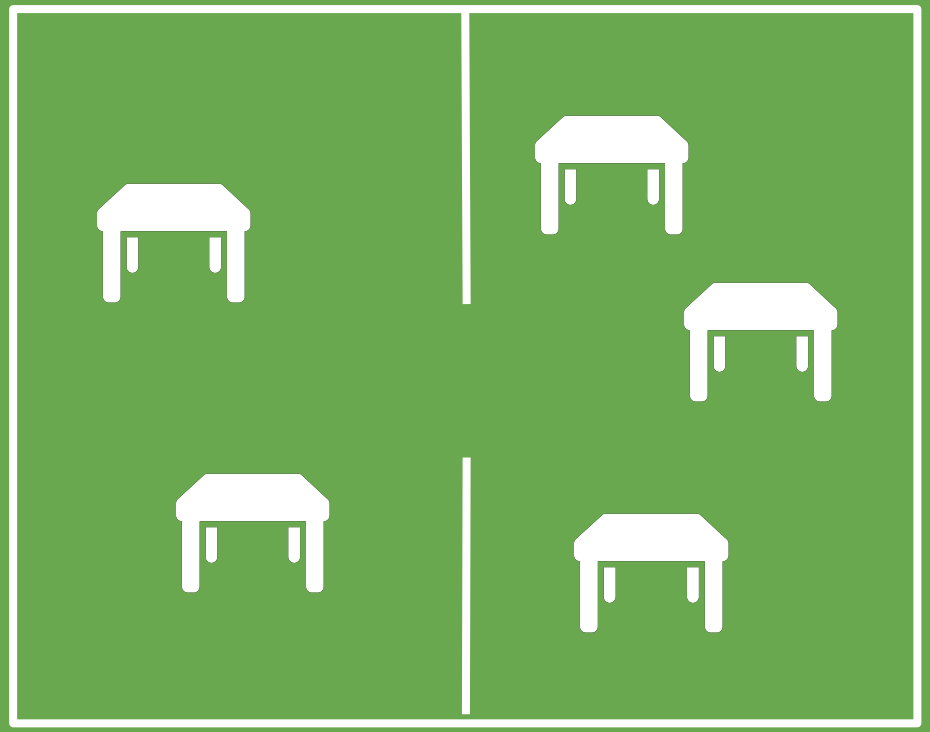
The results from the dot products are the semantic distance from the object searched to possible locations. The robot visits then those places in that order.

Jetson AH: Using the Info in LTM

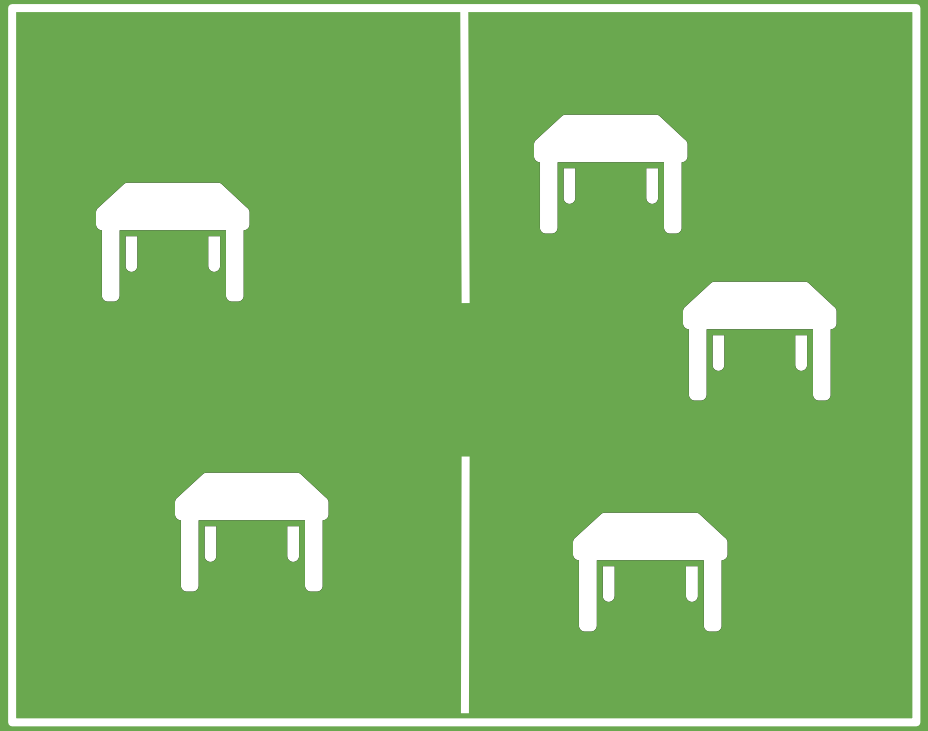


Experiments

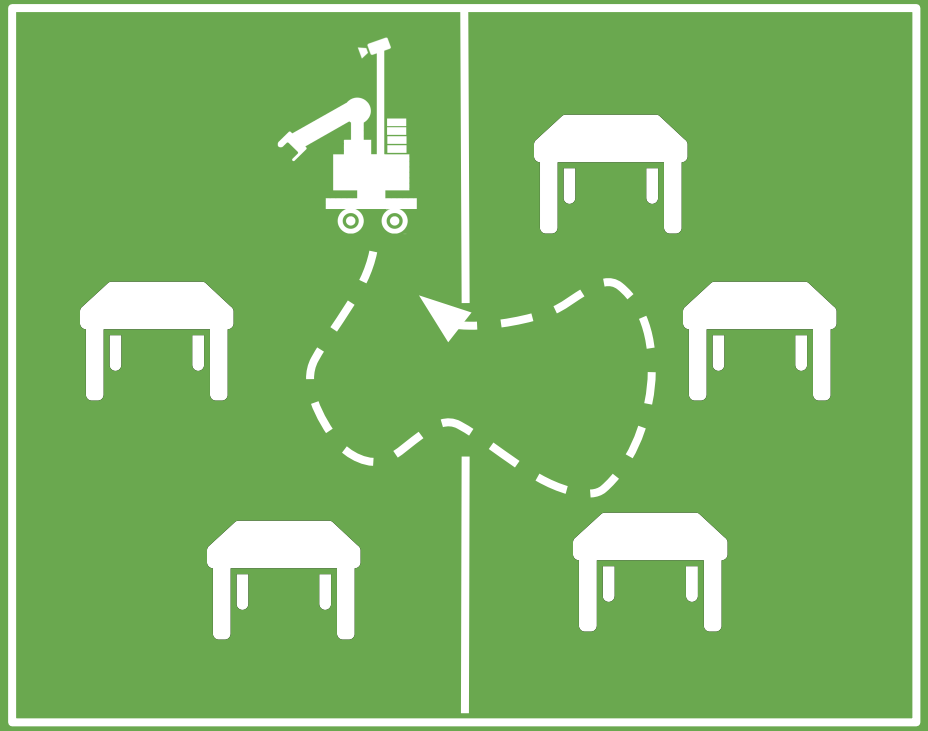


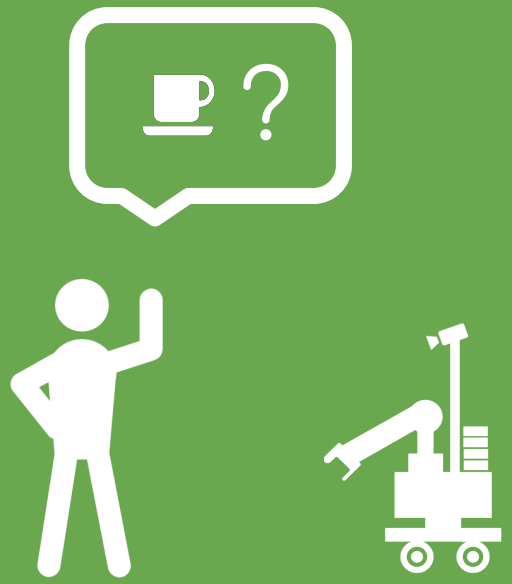


Five tables are disposed along the two rooms of the apartment containing five types of objects.



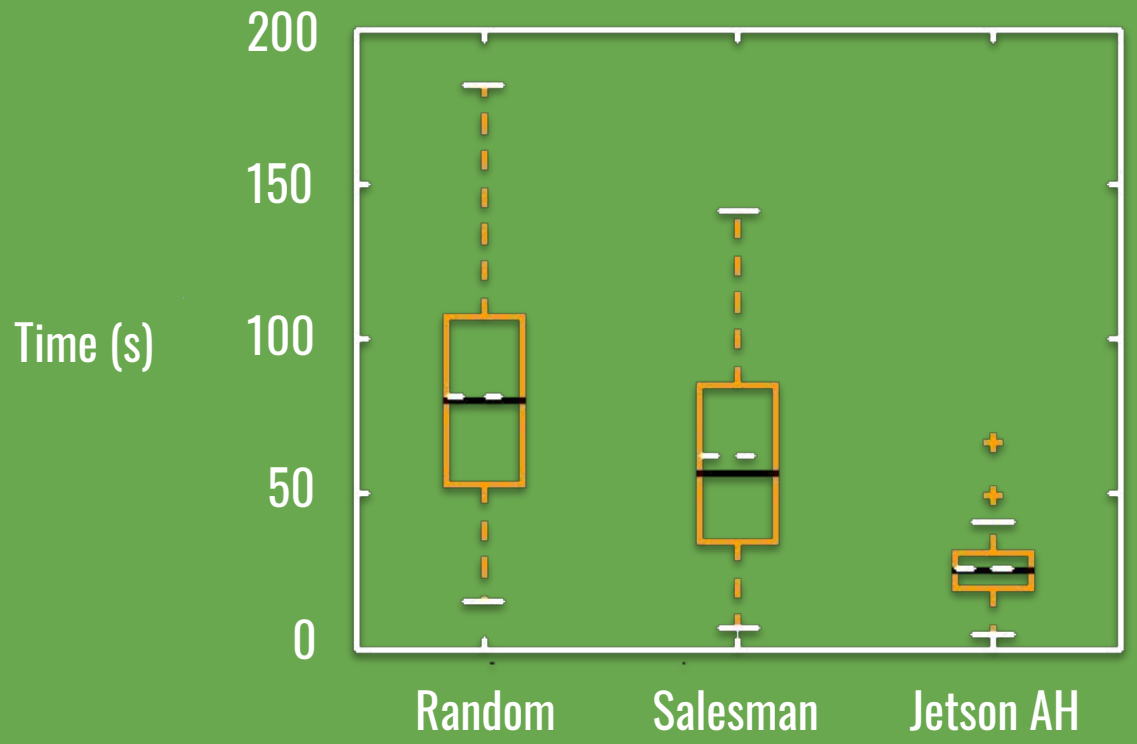
The robot wanders around the apartment in order to build the robot Long Term Memory, simulating a previous experience.



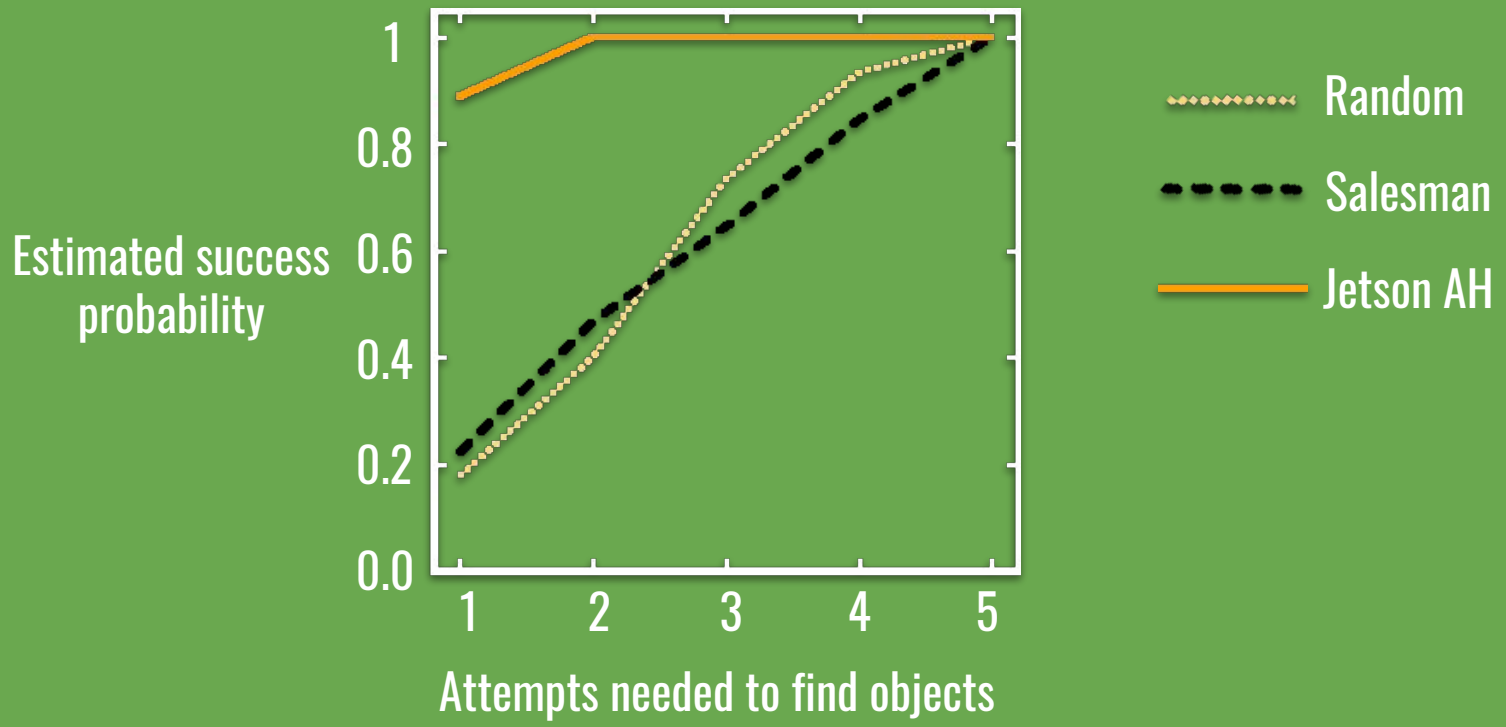


The human asks the robot to find 25 objects among the five tables. The performance of the robot with Jetson AH is compared to a random selection of tables and a traveling salesman policy.

Average success rate for each of the three methods



Box plots of average time spent by the robot finding the objects



Jetson AH: Conclusions

- Enables the robot to store Short Term Memories into Long Term Memory
  - Helps the robot learn from experiences
  - Speeds up future tasks
- Jetson TX1 as Jetson AH
  - Speeds up processing of Deep Learning algorithms needed for the Artificial Cortex
  - Enables robot onboard background processing
  - Keeps power consumption low

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