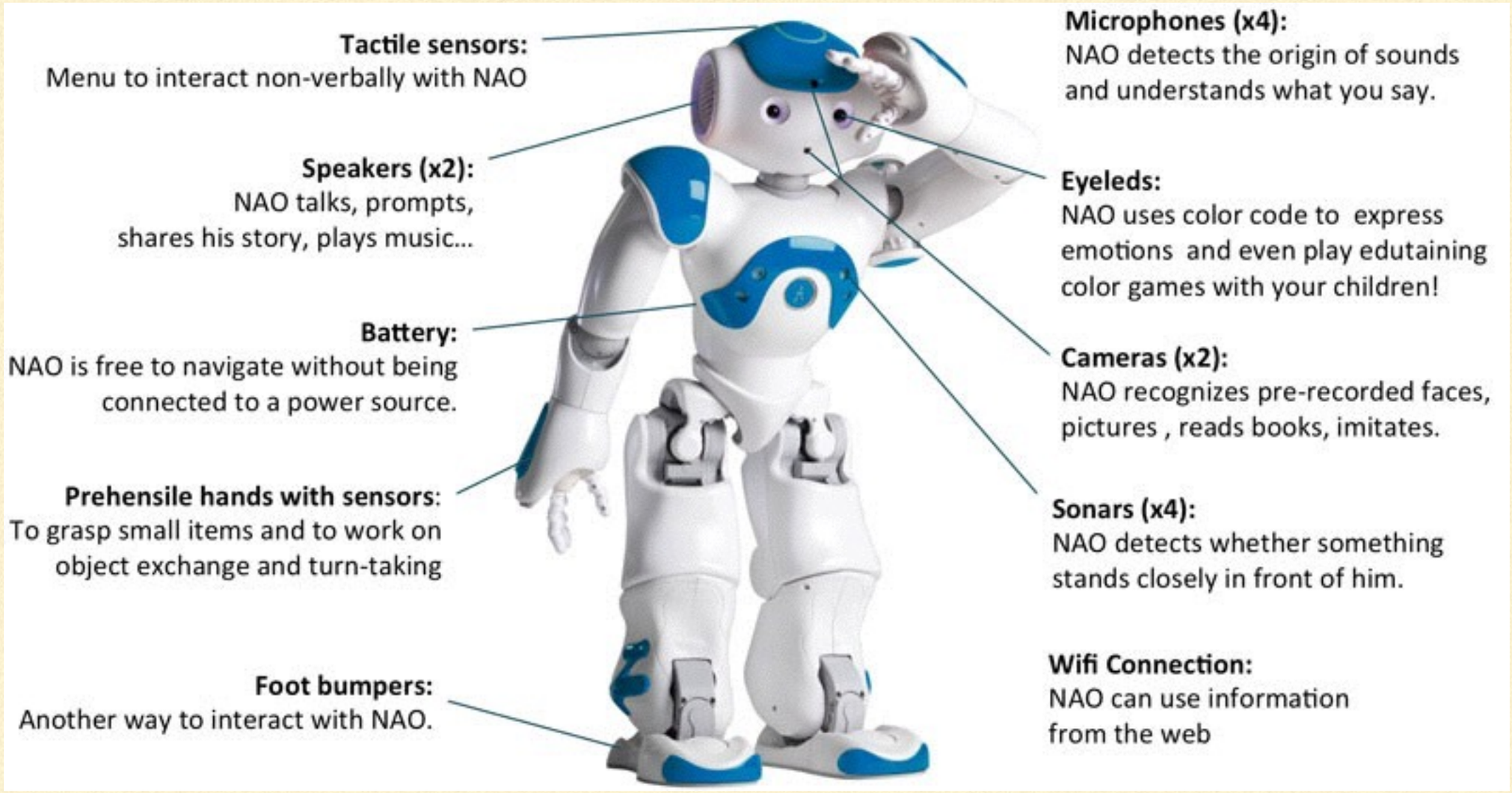

ROBOT DEMO


Tactile sensors:
Menu to interact non-verbally with NAO
Speakers (x2):
NAO talks, prompts,
shares his story, plays music…
Battery:
NAO is free to navigate without being
connected to a power source.
Prehensile hands with sensors:
To grasp small items and to work on
object exchange and turn-taking
Foot bumpers:
Another way to interact with NAO.
Microphones (x4):
NAO detects the origin of sounds
and understands what you say.
Eyeleds:
NAO uses color code to express
emotions and even play edutaining
color games with your children!
Cameras (x2):
NAO recognizes pre-recorded faces,
pictures , reads books, imitates.
Sonars (x4):
NAO detects whether something
stands closely in front of him.
Wifi Connection:
NAO can use information
from the web

# ROBOT DEMO

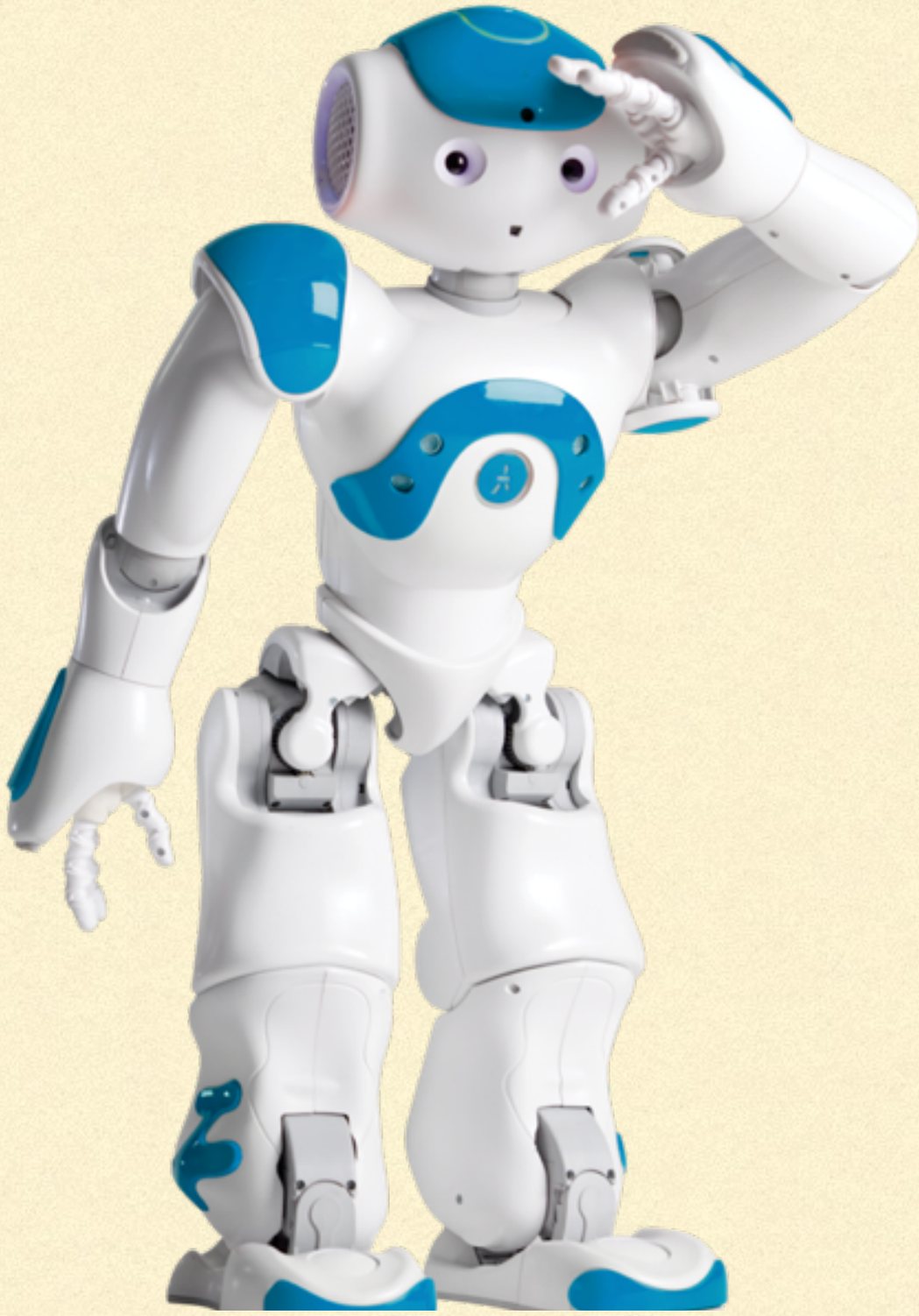
# IBM WATSON ROBOTICS

Ali Unwala

Robotics Lead at the Watson Innovation Labs

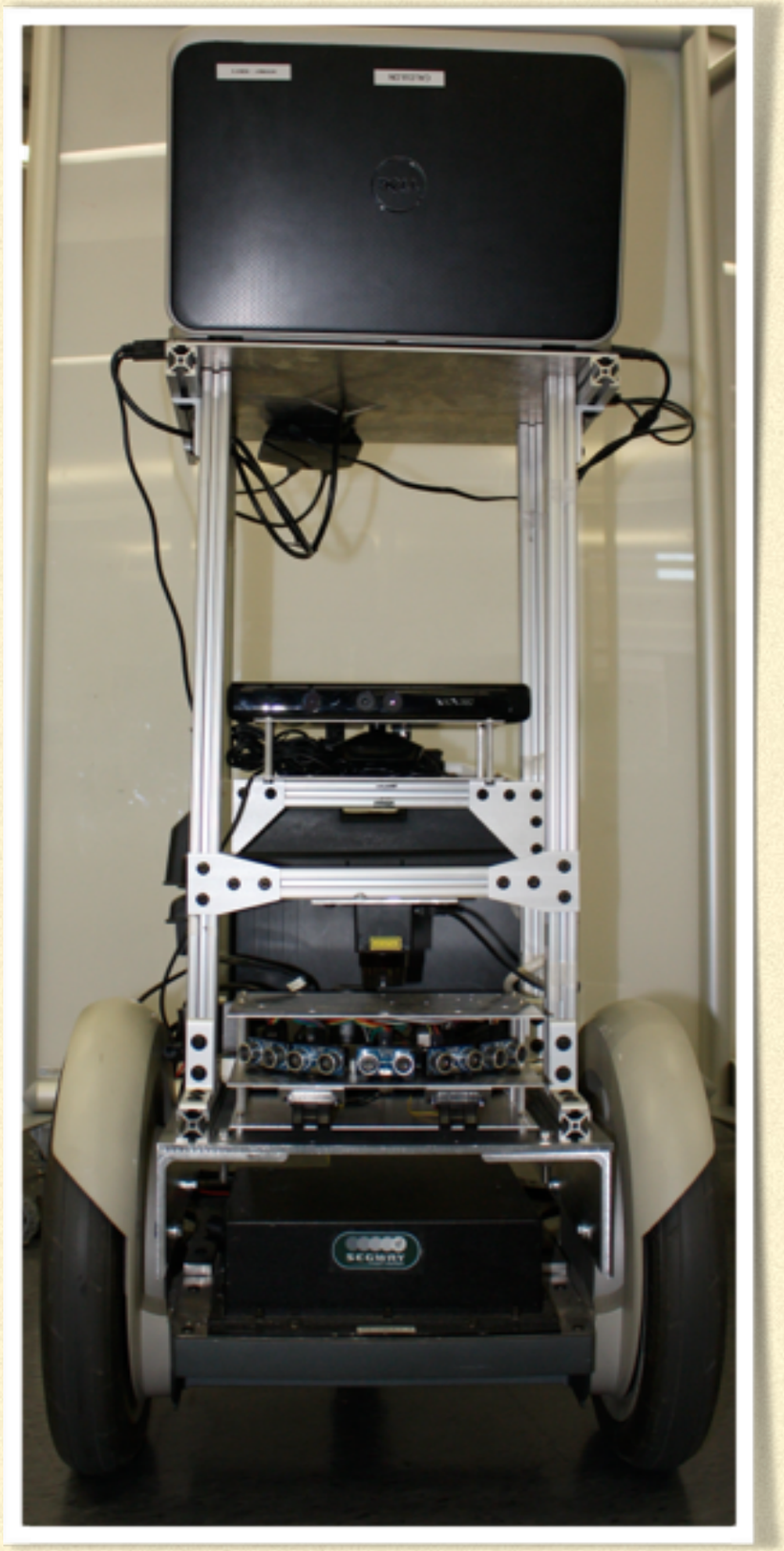
## Overview

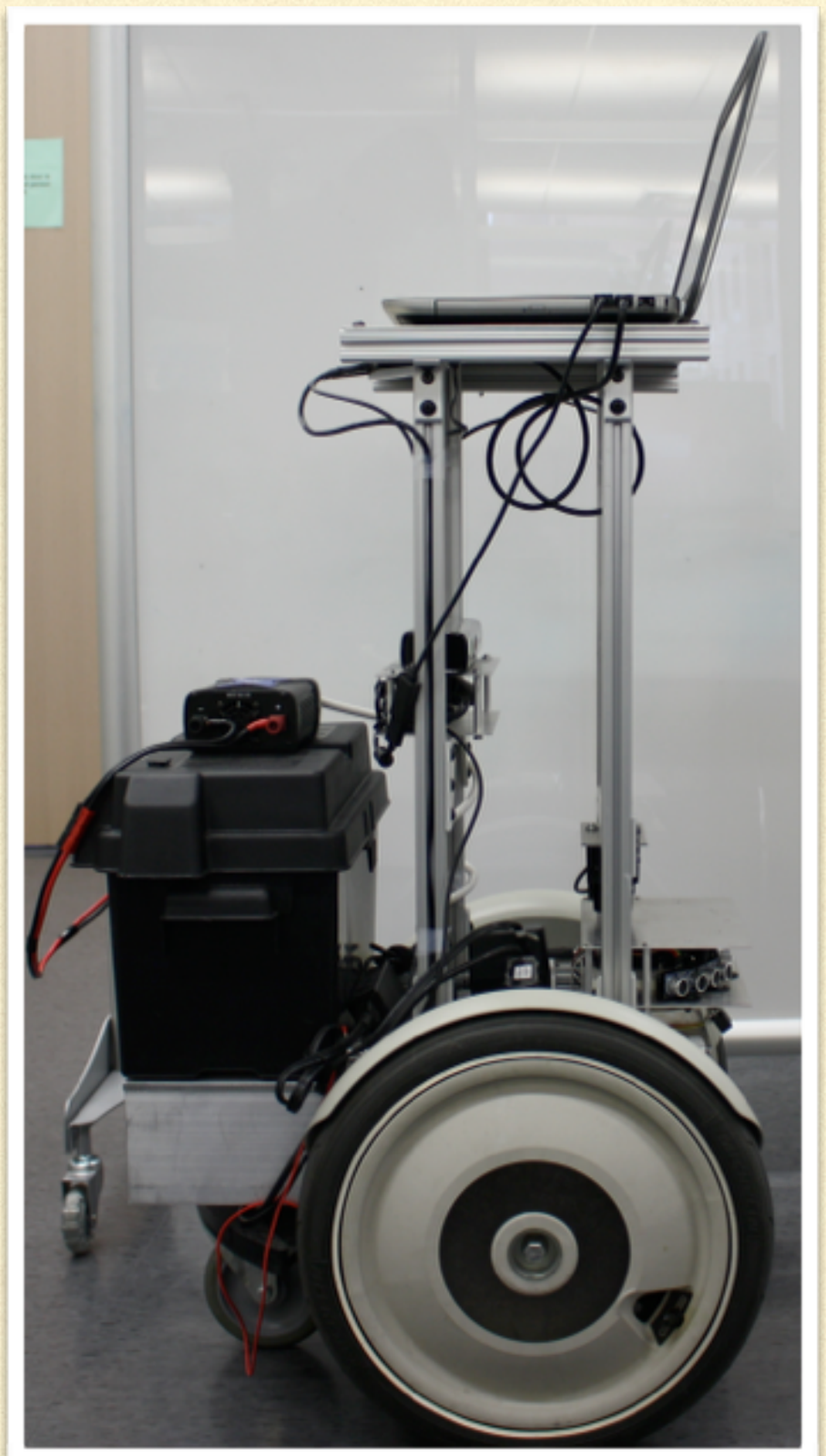
- PRELIMINARIES
- WHY IBM?
- WHAT WE ARE DOING WITH ROBOTS?
- PAST WORK
- CURRENT WORK
- CHALLENGES
- ROBOTICS OPERATING SYSTEM



# WHO AM I?

- Ali Unwala
- UT Austin Undergraduate + Graduate
- Started by doing something else
- Graduate work





# WHAT IS YOUR DEFINITION OF A ROBOT?

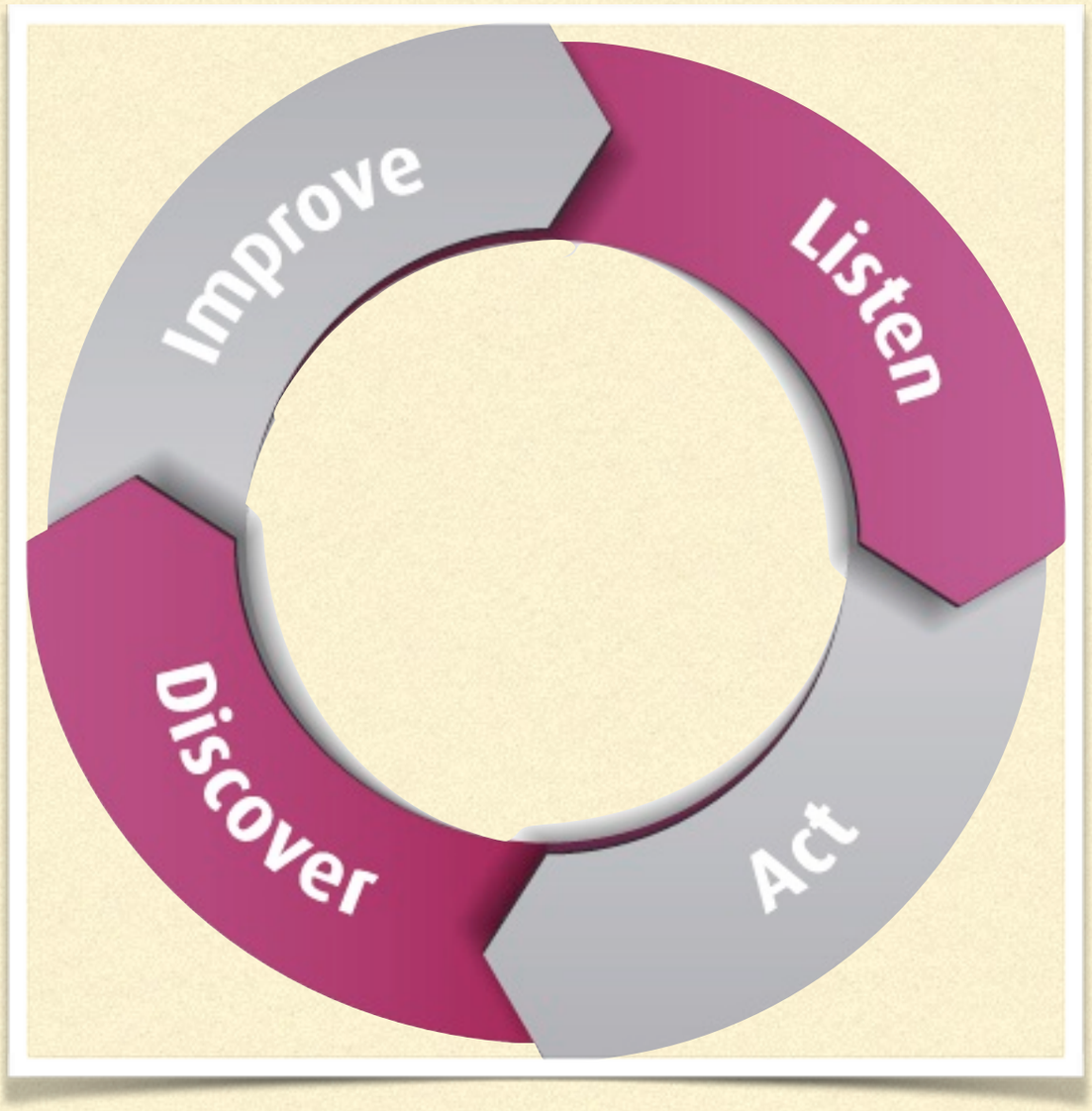
# WHAT IS A ROBOT?

- From Wikipedia:
  - A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robots can be autonomous or semi-autonomous and [have a variety of forms]



# WHAT IS A ROBOT?

- My opinion:
  - A robot is any computer system that has multiple sensors. Which has closed loop feed back with sensor data from the real world.



# THE THREE LAWS OF ROBOTICS

- (Isaac Asimov, The caves of steel , Galaxy No. 13, 1950.)

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.

2. A robot must obey the orders given to it by human beings except where such orders would contradict with the First Law.

3. A robot must protect its own existence, except where such protection would contradict with the First and Second Laws

# WHERE DOES IBM FIT INTO ROBOTICS?

- Within the Watson group we offer many SAAS based services.
  - TTS, STT, Personality Insights, Q/A, Dialouge, NLC…
- Great way to test all the services on one platform at the same time.

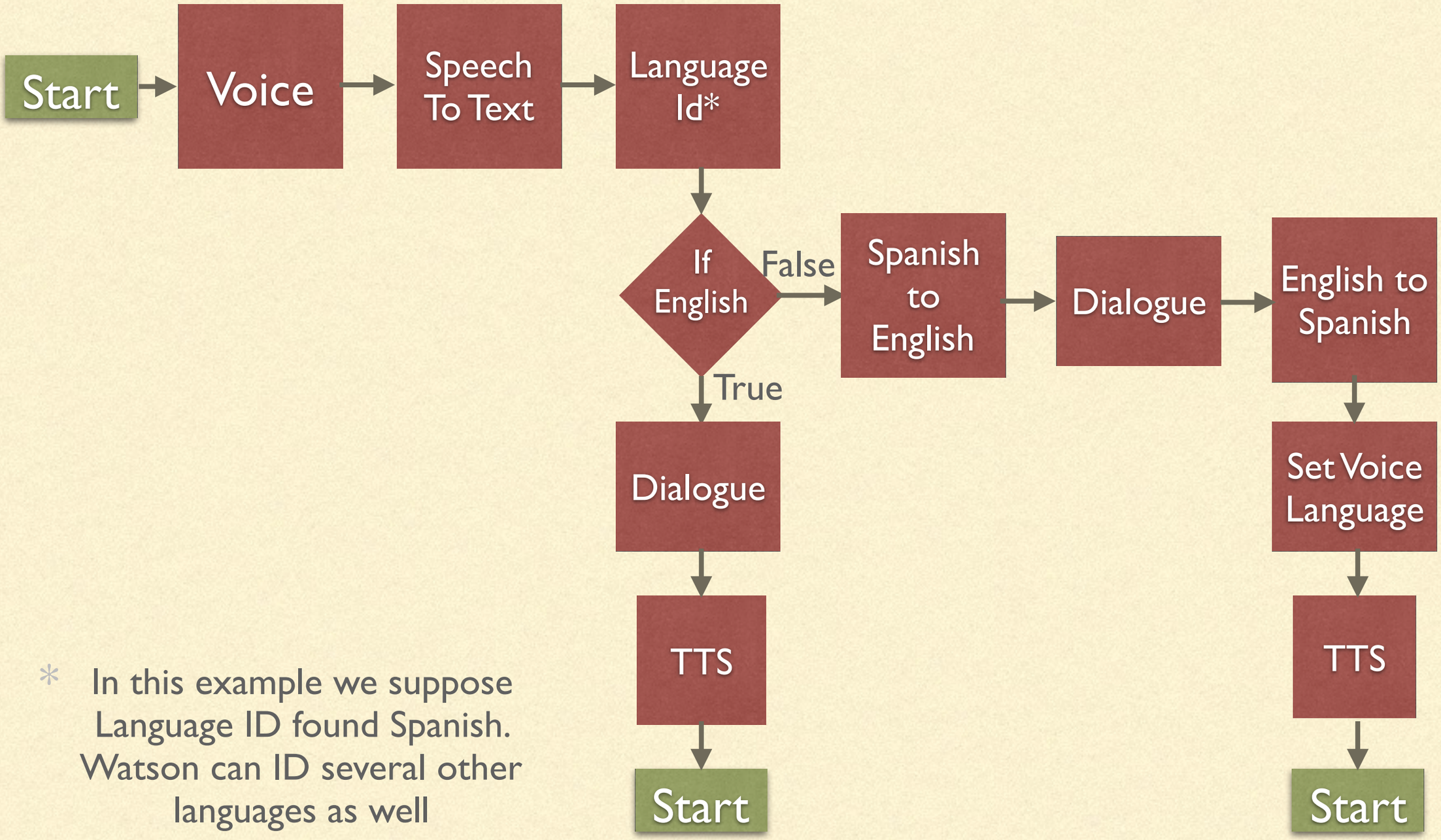

# WHERE DOES IBM FIT INTO ROBOTICS?

- We also are focused on the brain over lower level control problems.



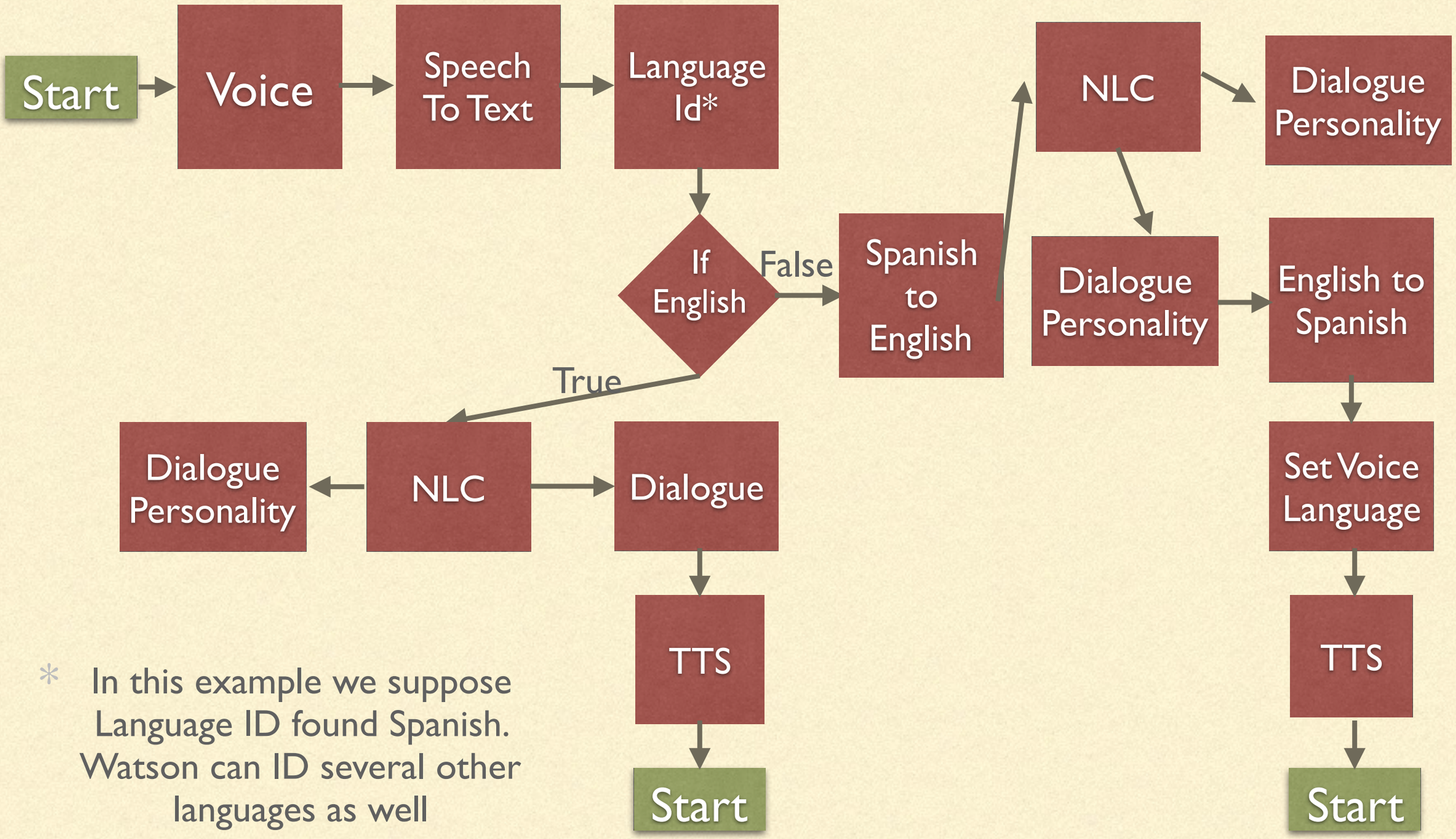
AlchemyAPI
IBM
Concept Expansion
IBM BETA
Concept Insights
IBM
Dialog
IBM BETA
Language Translation
IBM
Natural Language Classifier
IBM
Personality Insights
IBM
Question and Answer
IBM BETA
Relationship Extraction
IBM BETA
Speech To Text
IBM
Text to Speech
IBM
Tradeoff Analytics
IBM
Visual Recognition
IBM BETA
Cognitive Commerce™
Third Party
Cognitive Graph
Third Party
Cognitive Insights™
Third Party

# SIMPLE USE CASE - THE MULTILINGUAL GREETER




* In this example we suppose Language ID found Spanish. Watson can ID several other languages as well

# SIMPLE USE CASE - THE MULTILINGUAL GREETER




* In this example we suppose Language ID found Spanish. Watson can ID several other languages as well

# OTHER USE CASES - WITHOUT ARMS

- Toys for learning and talking to
- Inventorying shelves
- Hotel concierge
- Park avatars
- Home buddy
- Cataloging information
- With arms
- The possibilities become endless!

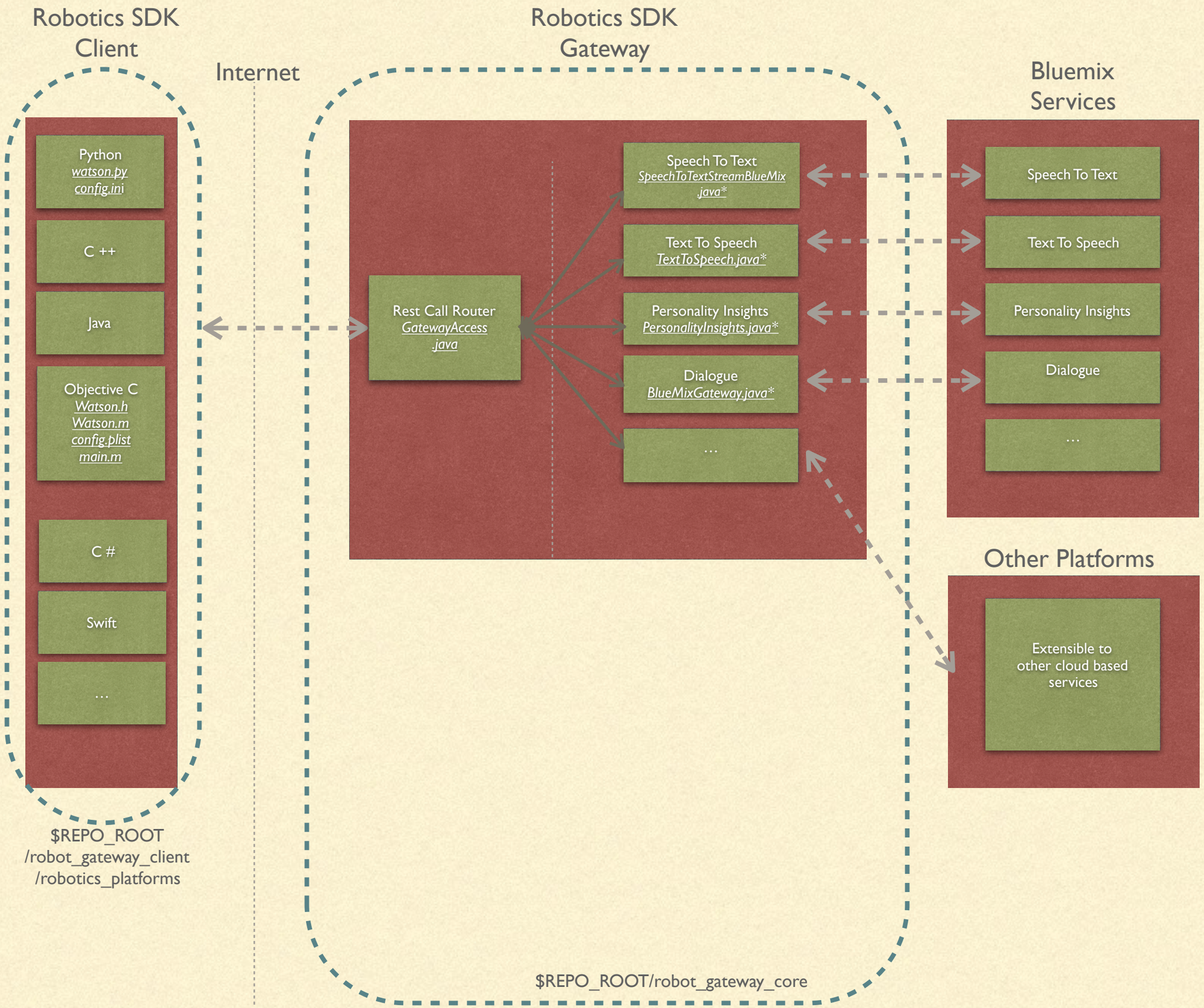
# PAST WORK

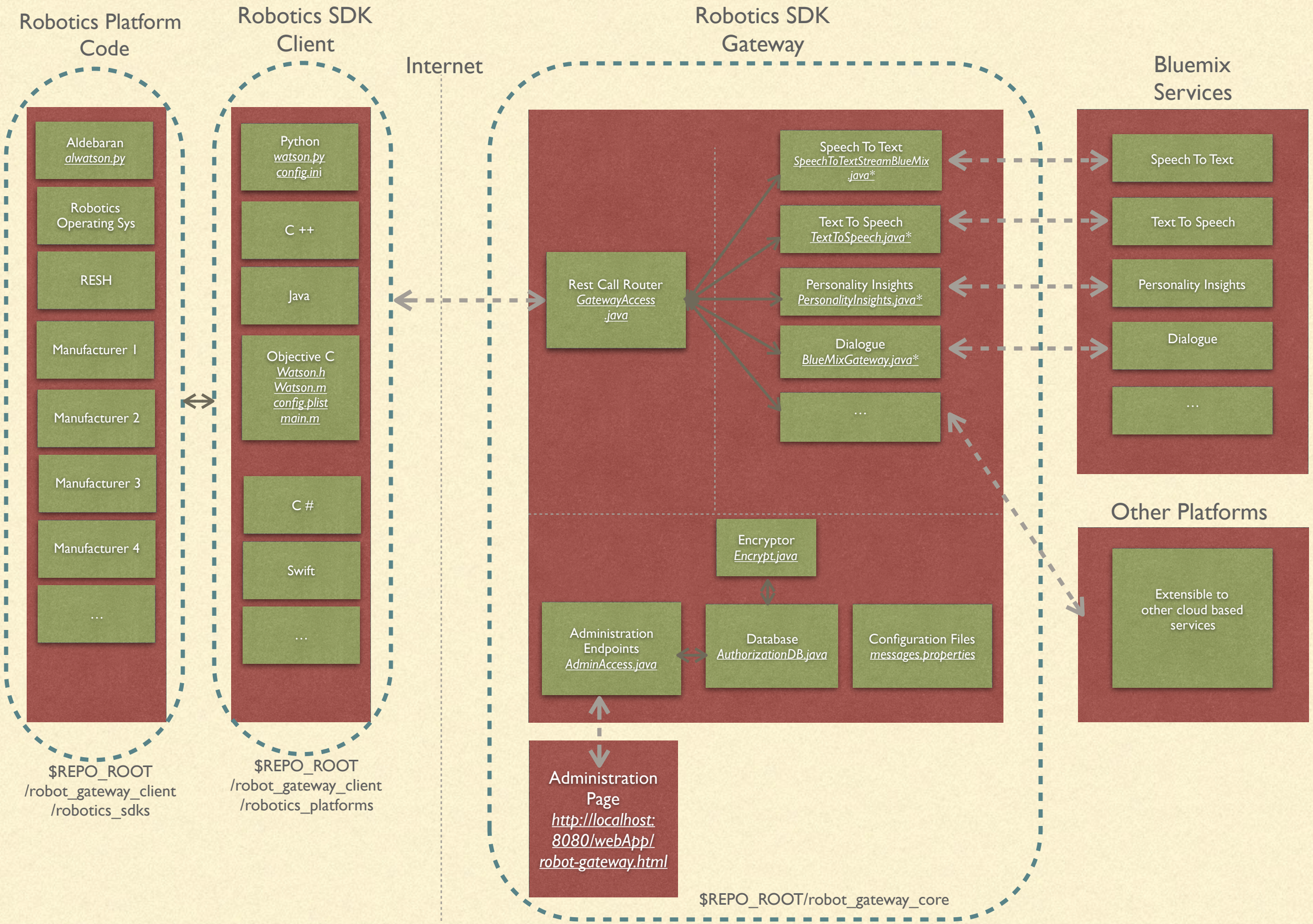
- Chef Watson Task
- Watson Trivia Game
- Dances/Offline Scripts
- On Stage Demos

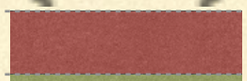
# ROBOTICS SDK

- Right now Watson is lacking true sensor based services. (Alchemy API now has a few)
- Lots of powerful services are on Bluemix
- Bluemix AI services are not “Necessary” they are merely useful
  - At least today
- How to get this to a user fast and efficiently

# Robotics SDK Overview


Robotics SDK
Client
Internet
Robotics SDK
Gateway
Bluemix
Services
Python
watson.py
config.ini
C ++
Java
Objective C
Watson.h
Watson.m
config.plist
main.m
C #
Swift
…
Rest Call Router
GatewayAccess
.java
Speech To Text
SpeechToTextStreamBlueMix
.java*
Text To Speech
TextToSpeech.java*
Personality Insights
PersonalityInsights.java*
Dialogue
BlueMixGateway.java*
…
Speech To Text
Text To Speech
Personality Insights
Dialogue
…
Other Platforms
Extensible to
other cloud based
services
$REPO_ROOT
/robot_gateway_client
/robotics_platforms
$REPO_ROOT/robot_gateway_core


Robotics Platform Code
Robotics SDK Client
Internet
Robotics SDK Gateway
Bluemix Services
Aldebaran
alwatson.py
Robotics Operating Sys
RESH
Manufacturer 1
Manufacturer 2
Manufacturer 3
Manufacturer 4
…
$REPO_ROOT
/robot_gateway_client
/robotics_sdks
Python
watson.py
config.ini
C ++
Java
Objective C
Watson.h
Watson.m
config.plist
main.m
C #
Swift
…
$REPO_ROOT
/robot_gateway_client
/robotics_platforms
Rest Call Router
GatewayAccess
.java
Speech To Text
SpeechToTextStreamBlueMix
.java*
Text To Speech
TextToSpeech.java*
Personality Insights
PersonalityInsights.java*
Dialogue
BlueMixGateway.java*
…
Encryptor
Encrypt.java
Administration
Endpoints
AdminAccess.java
Database
AuthorizationDB.java
Configuration Files
messages.properties
Administration
Page
http://localhost:
8080/webApp/
robot-gateway.html
$REPO_ROOT/robot_gateway_core
Speech To Text
Text To Speech
Personality Insights
Dialogue
…
Other Platforms
Extensible to
other cloud based
services

| Legend | |
|---|---|
| Rest Call |  |
| Function Call |  |
| Logical Component |  |
| Subcomponent | |
| Extends BlueMixGateway.java | * |
| File that implements functionality | *filename.ext* |

# ROBOTS SDK END GOAL

```
import watson
w = watson.Watson()
s = w.translate( p , ‘English' , ‘French' , None , None )
```

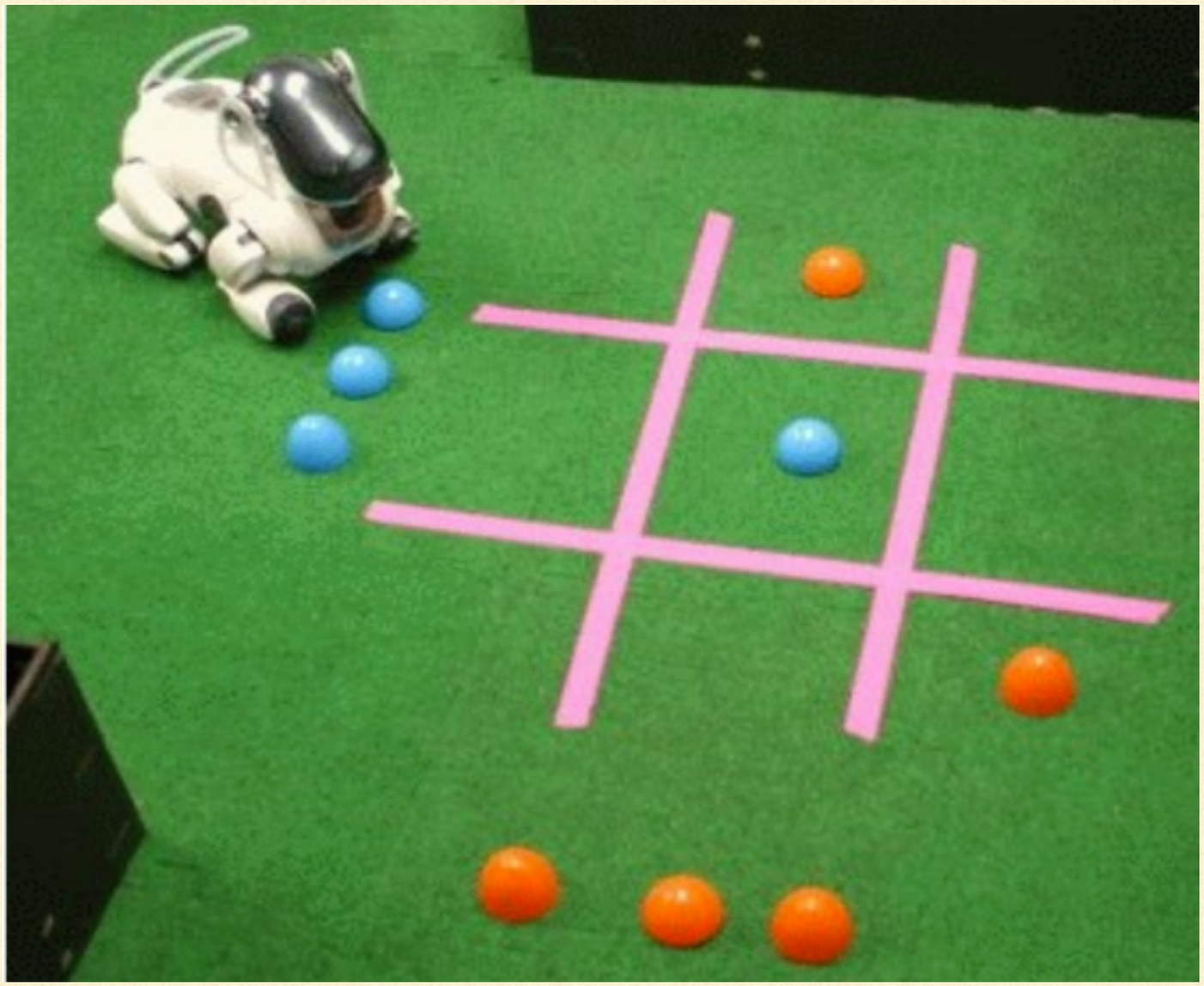
# RESH ARCHITECTURE

- The SDKs goal is for enablement to use AI services on a Robot
- RESH is a new on-going research area by TRL that is looking into how to build an on-robot code architecture

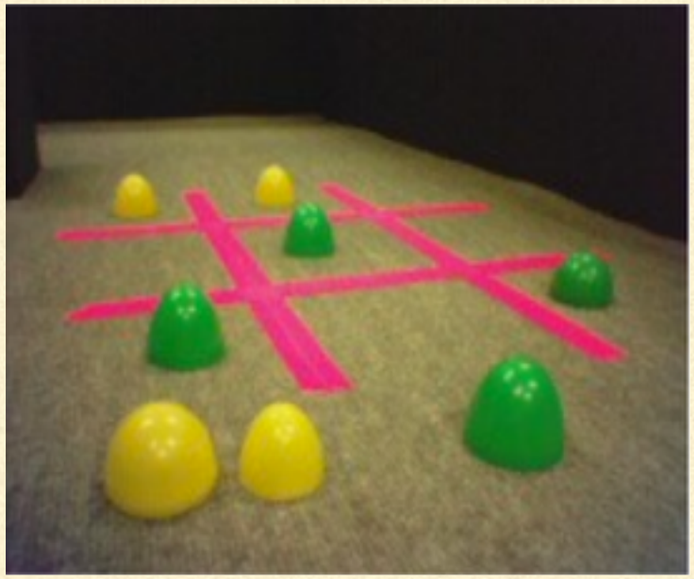
# CHALLENGES

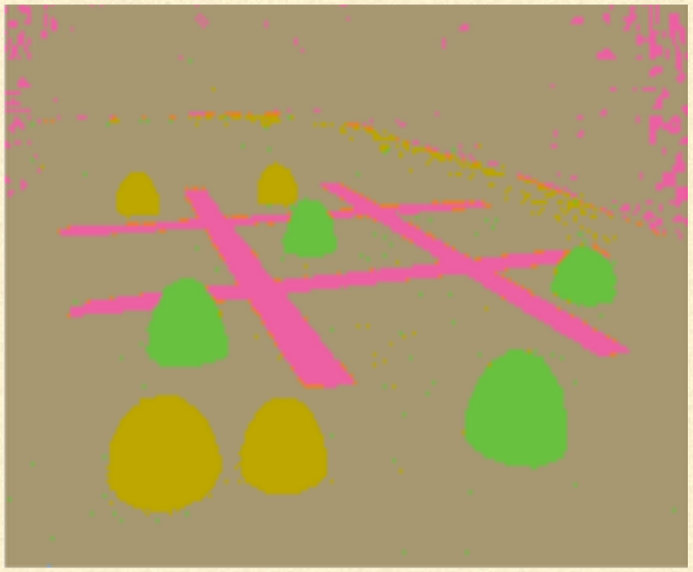
- Vision
- Navigation
- Reasoning
- Actuator Kinematics (Arms)

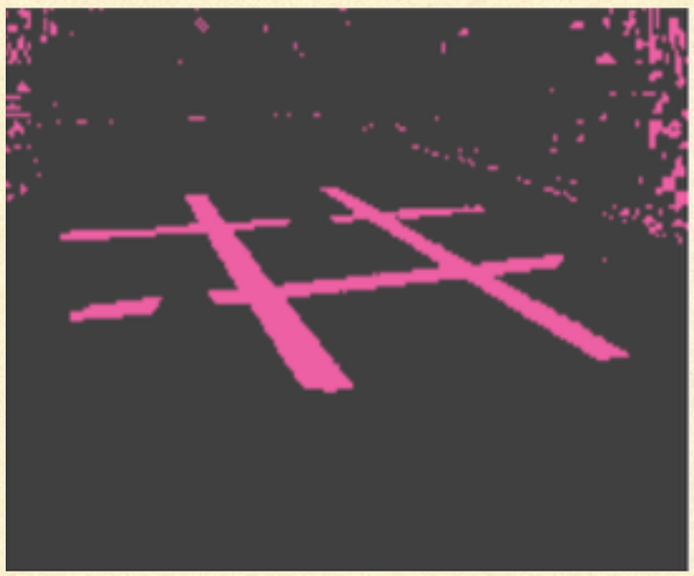
# VISION

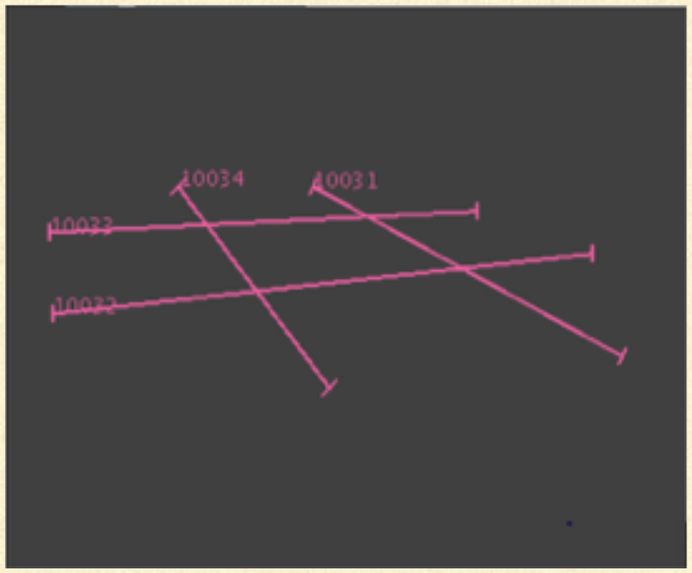


# VISION

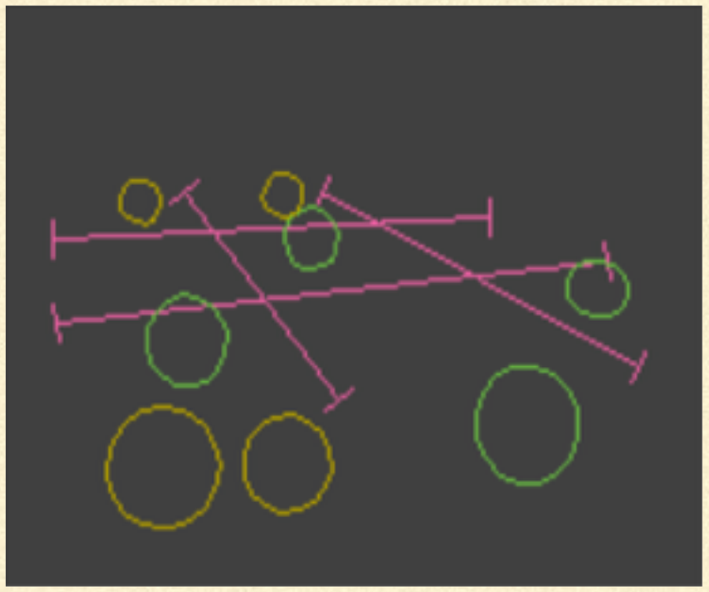


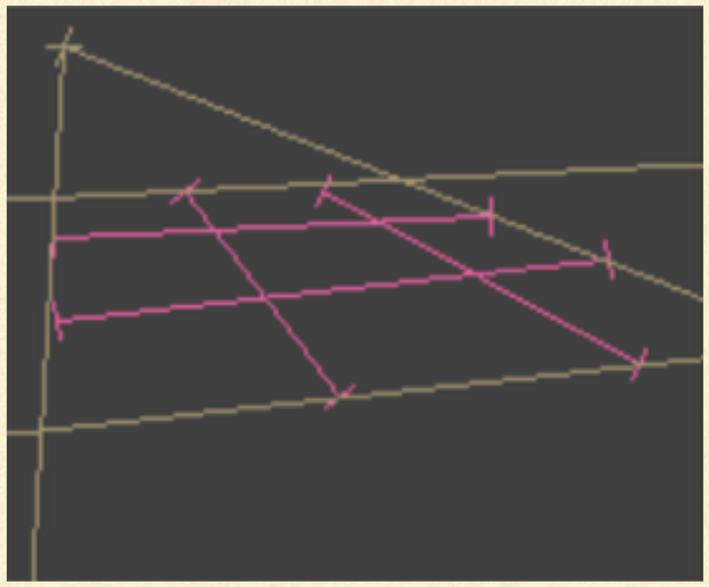


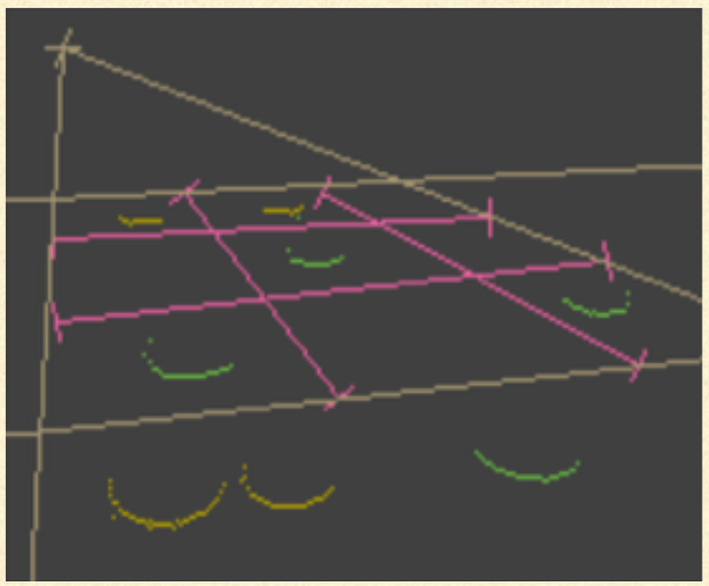


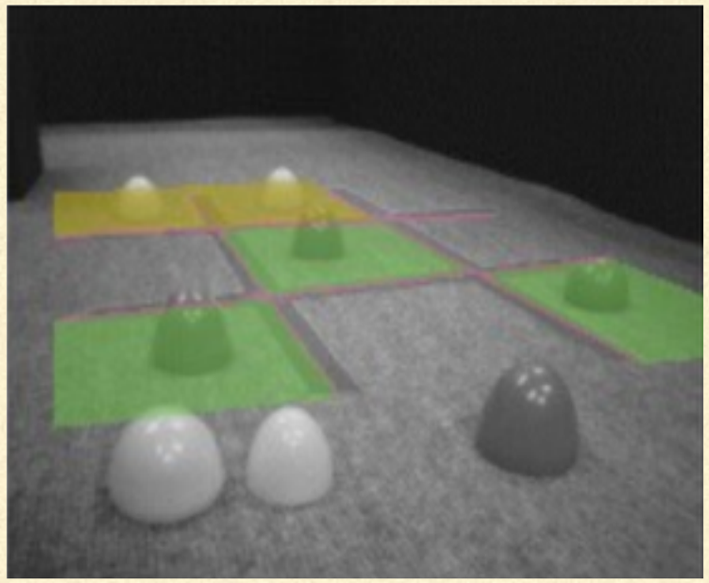


# VISION

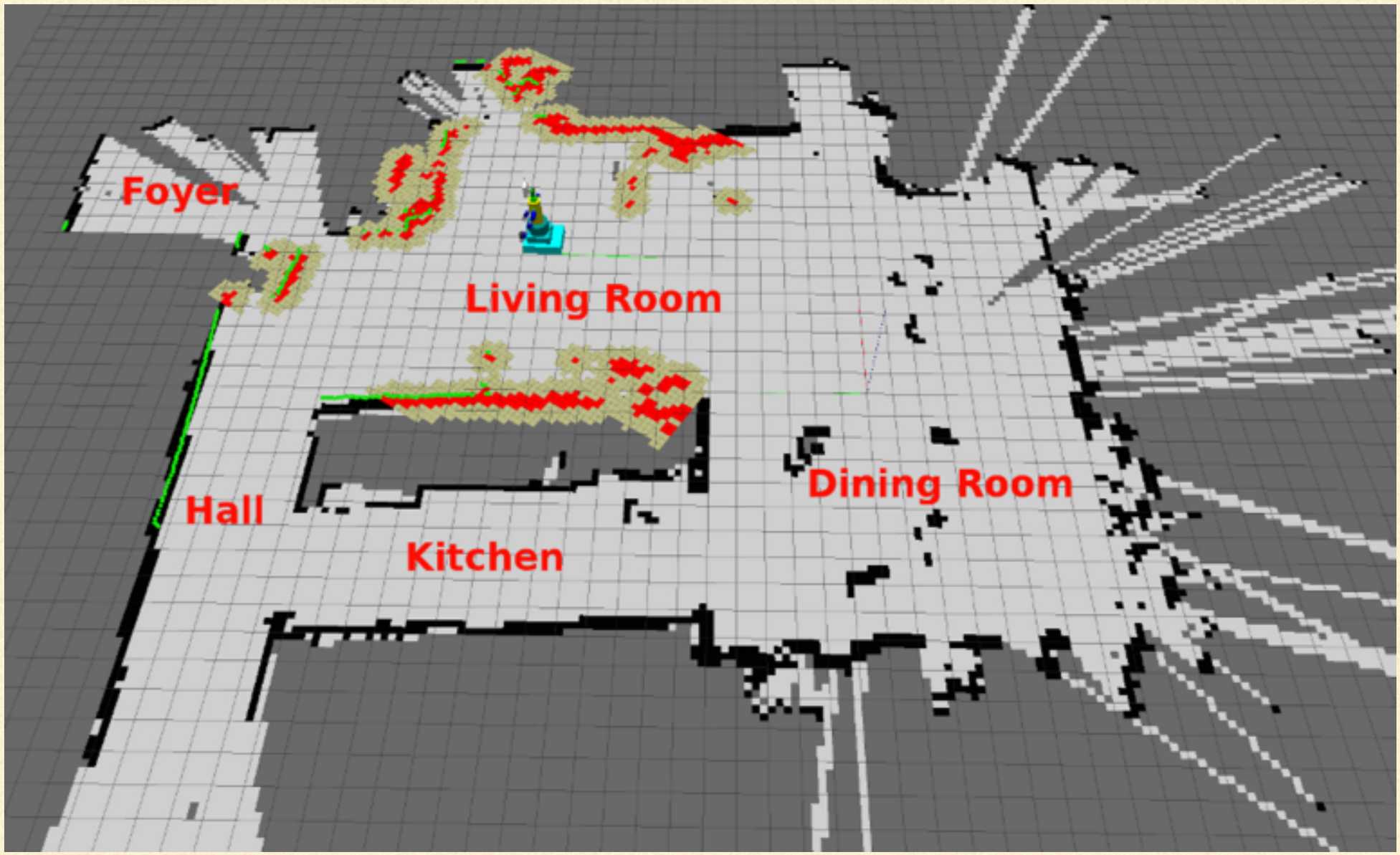








# NAVIGATION



# REASONING

- Very tricky area
- No good way to merge knowledge bases
- Very hard to represent partial things - spork
- Need a true learning & continuously retraining approach here

# BUILDING YOUR OWN ROBOT

- Robotics Operating System (ROS)
- Starting with Consumer Parts
- Sensor Placement
- Software Stack

# ROBOTICS OPERATING SYSTEM

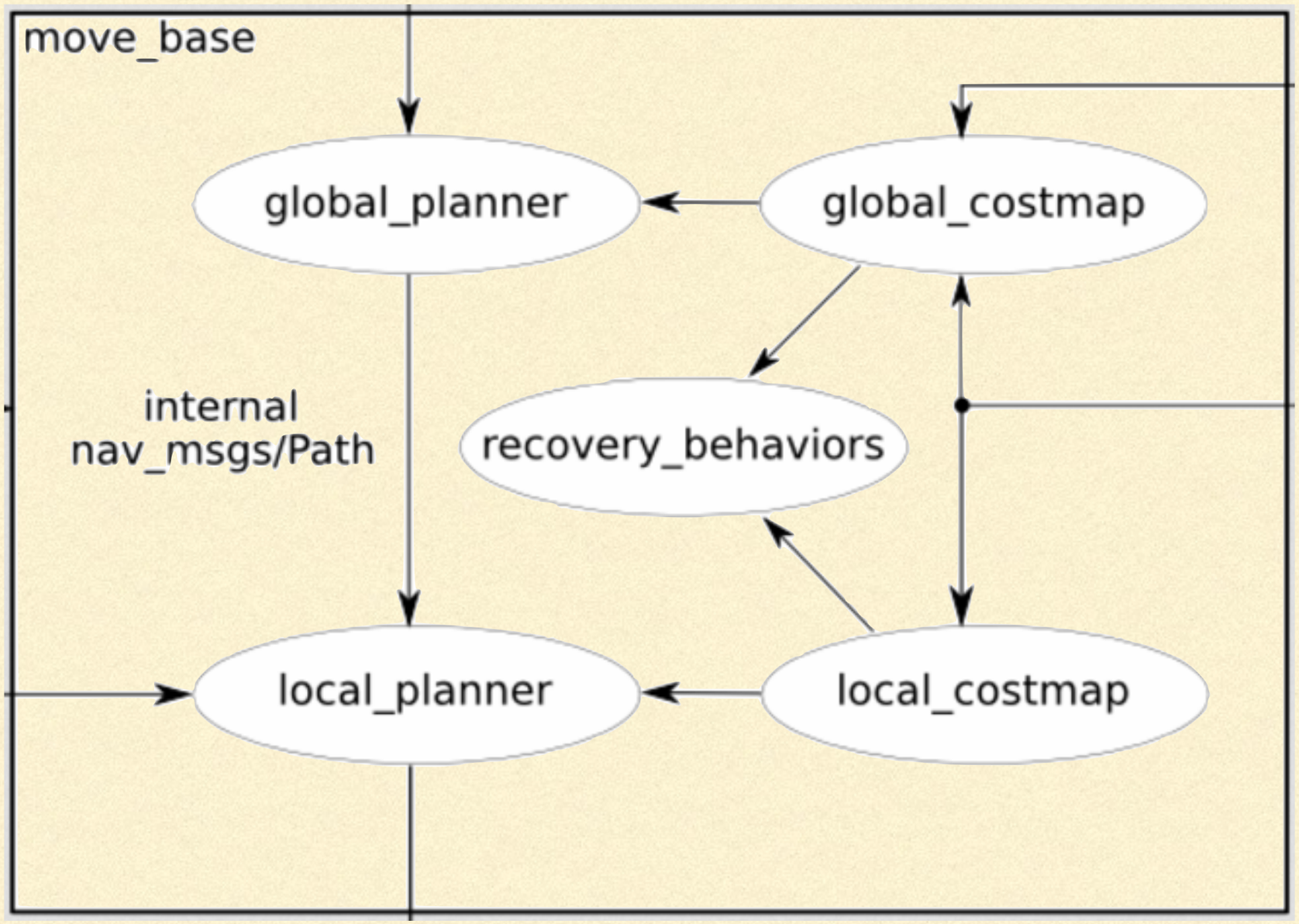
## Definition:

- ROS is an open-source, meta-operating system. It provides hardware abstraction, low-level device control, message passing.

- Code within ROS is a loosely confederated system of nodes that are dynamically able to grow. Each node has forced interface conditions.

http://wiki.ros.org/ROS/Introduction

# ROS CODE CONCEPT




http://wiki.ros.org/move_base?distro=jade

# HARDWARE AND ROS

- If you buy ROS-supported consumer parts you can prototype fast!
- Driver Level Code
- ROS Wrapper Code

# SOME SUPPORTED SENSORS


http://wiki.ros.org/Sensors

# THATS ALL FOLK'S

## Any questions?

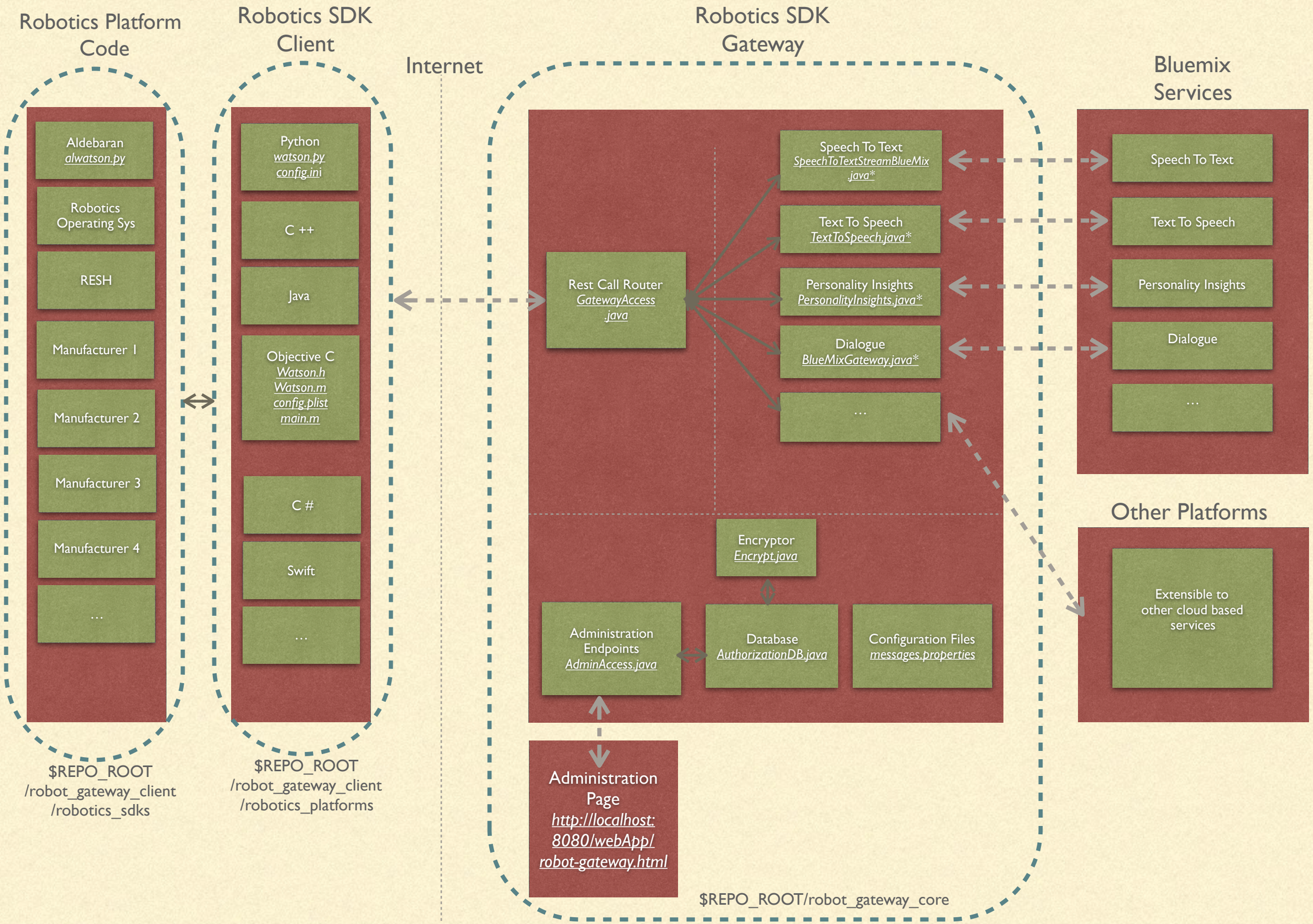
- References


1. https://www.youtube.com/watch?v=NOhcQCy1Kxs

2. http://www.cs.cmu.edu/afs/cs/academic/class/15494-s12/Lectures.html

3. http://www.princeton.edu/~stengel/MAE345Lecture1.pdf

4. http://ipvs.informatik.uni-stuttgart.de/mlr/marc/teaching/13-Robotics/


Robotics Platform Code
Robotics SDK Client
Internet
Robotics SDK Gateway
Bluemix Services
Aldebaran
alwatson.py
Robotics Operating Sys
RESH
Manufacturer 1
Manufacturer 2
Manufacturer 3
Manufacturer 4
…
$REPO_ROOT
/robot_gateway_client
/robotics_sdks
Python
watson.py
config.ini
C ++
Java
Objective C
Watson.h
Watson.m
config.plist
main.m
C #
Swift
…
$REPO_ROOT
/robot_gateway_client
/robotics_platforms
Rest Call Router
GatewayAccess
.java
Speech To Text
SpeechToTextStreamBlueMix
.java*
Text To Speech
TextToSpeech.java*
Personality Insights
PersonalityInsights.java*
Dialogue
BlueMixGateway.java*
…
Encryptor
Encrypt.java
Administration
Endpoints
AdminAccess.java
Database
AuthorizationDB.java
Configuration Files
messages.properties
Administration
Page
http://localhost:
8080/webApp/
robot-gateway.html
$REPO_ROOT/robot_gateway_core
Speech To Text
Text To Speech
Personality Insights
Dialogue
…
Other Platforms
Extensible to
other cloud based
services

## Legend:

Rest Call

Logical Component

Subcomponent

* extends BlueMixGateway.java