

# **Fields of the Future**

## **-Robotics and Automation**

**-Shylean Keshwani**

# Agenda

- **Introduction to Robotics-**

- What, Why and Types
- 3 laws of robotics

- **Discuss the Cambrian Explosion of Robots-**

- Collaborative Robots

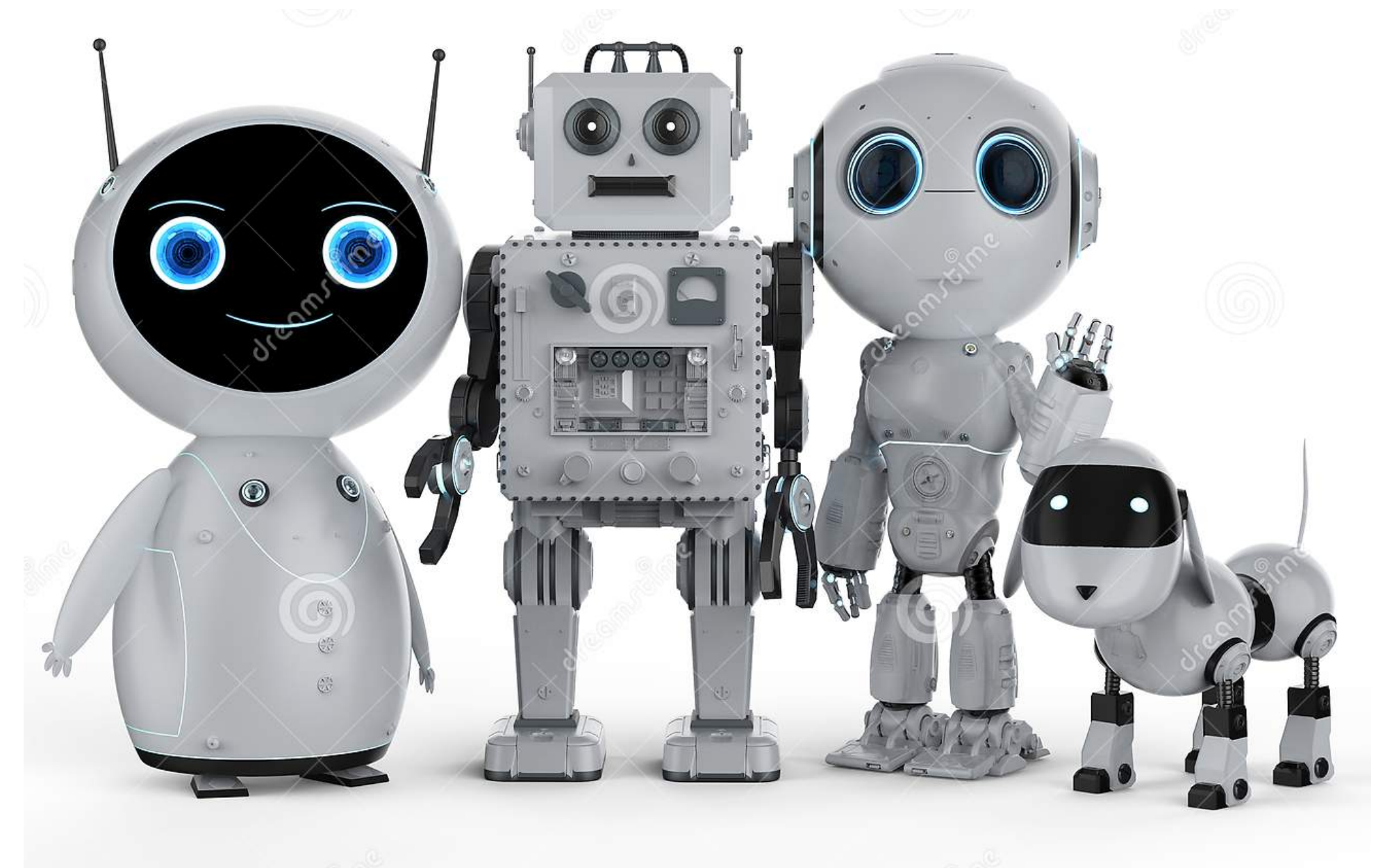
- **Adaptive Robots-**

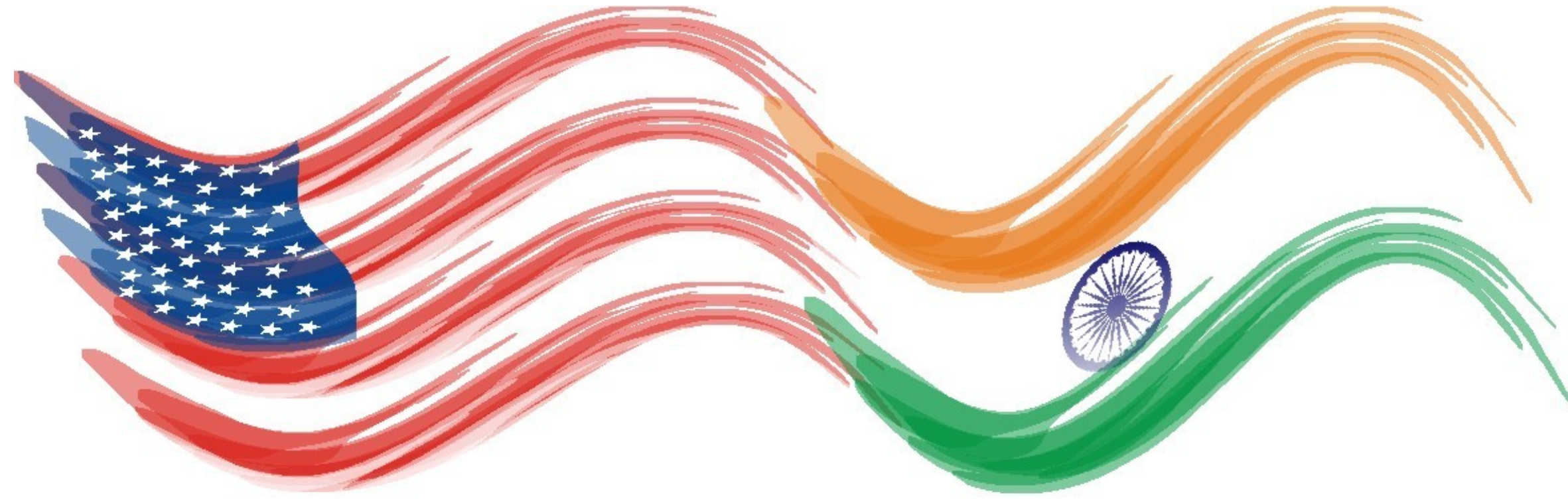
- Intelligence based on Sensors and Vision (Machine Learning)
- Simulation Tools
- Programming Languages

- **Desirable Skills and Traits of Robotics and Automation Engineer-**

- Typical Work Day
- Course-work and Major
- Desirable traits and skills
- Challenges in Implementing Robotics
- Field of Future:- Growing Industries

- **Additional Resources and Contact**

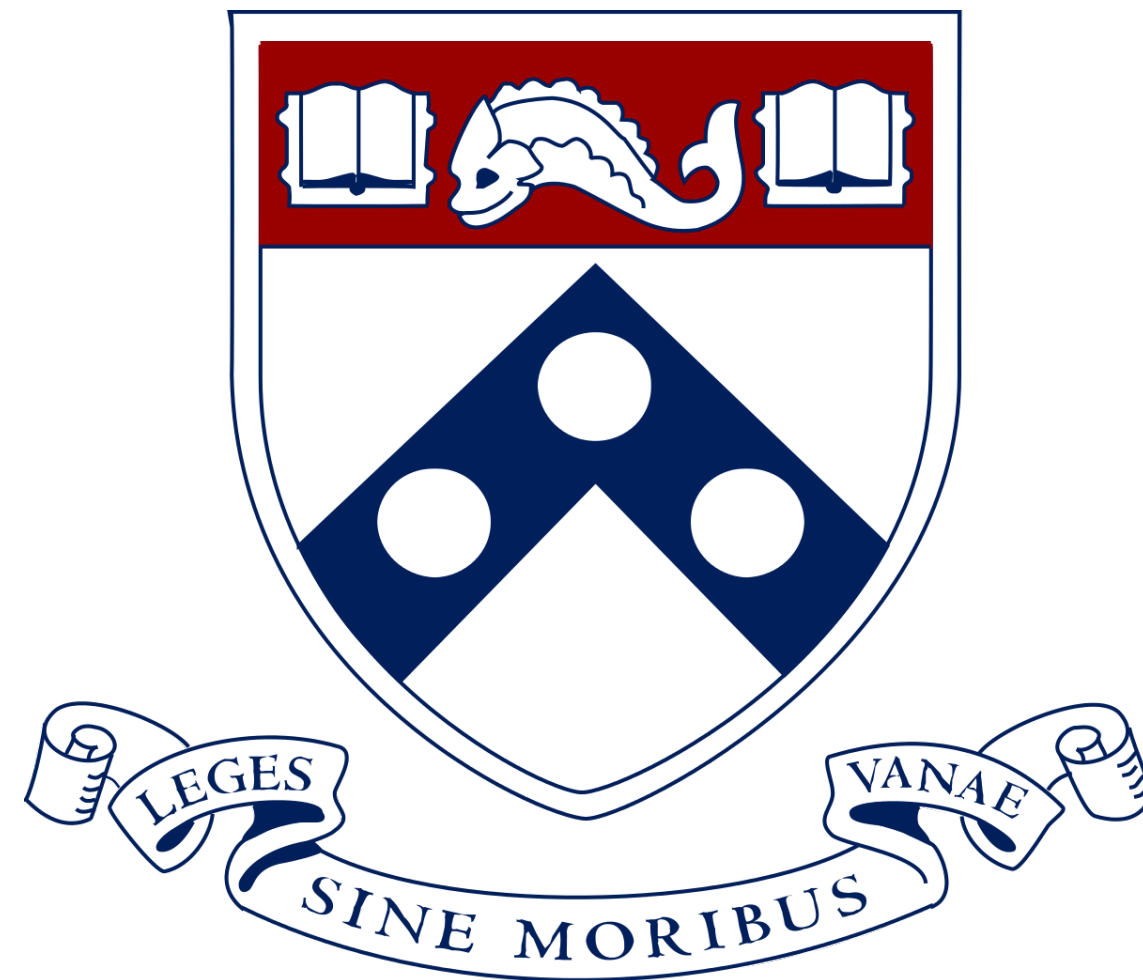




AGA KHAN FOUNDATION  
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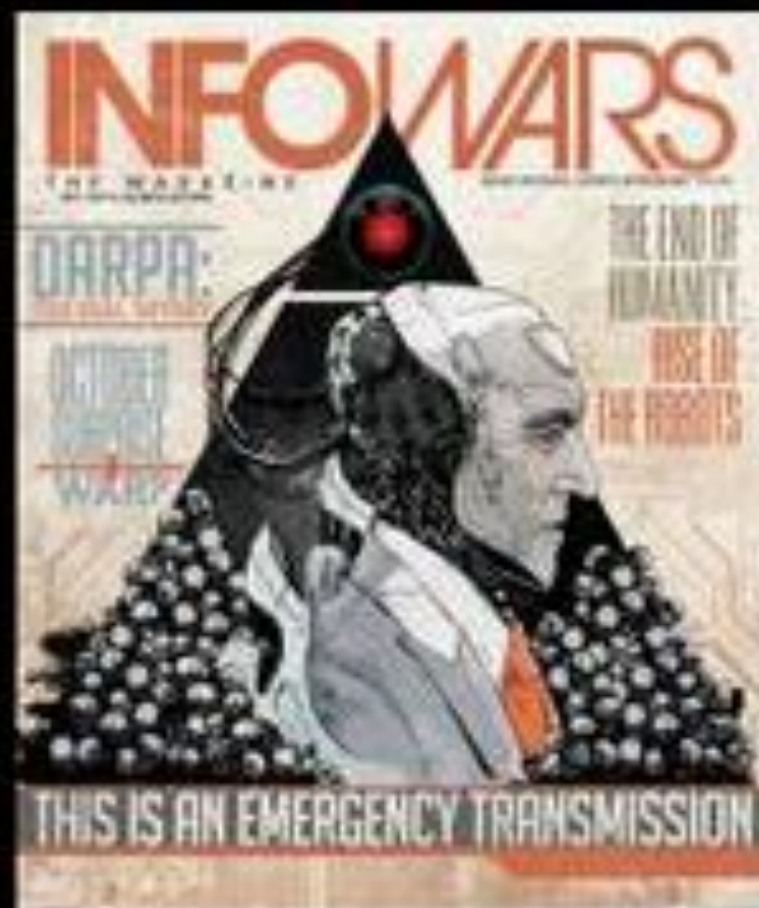


FLEXTRONICS X

flex



# Robotics Engineer



what the media says I  
do



what my friends think  
I do



what the customer  
wants me to do



what my boss thinks I  
do



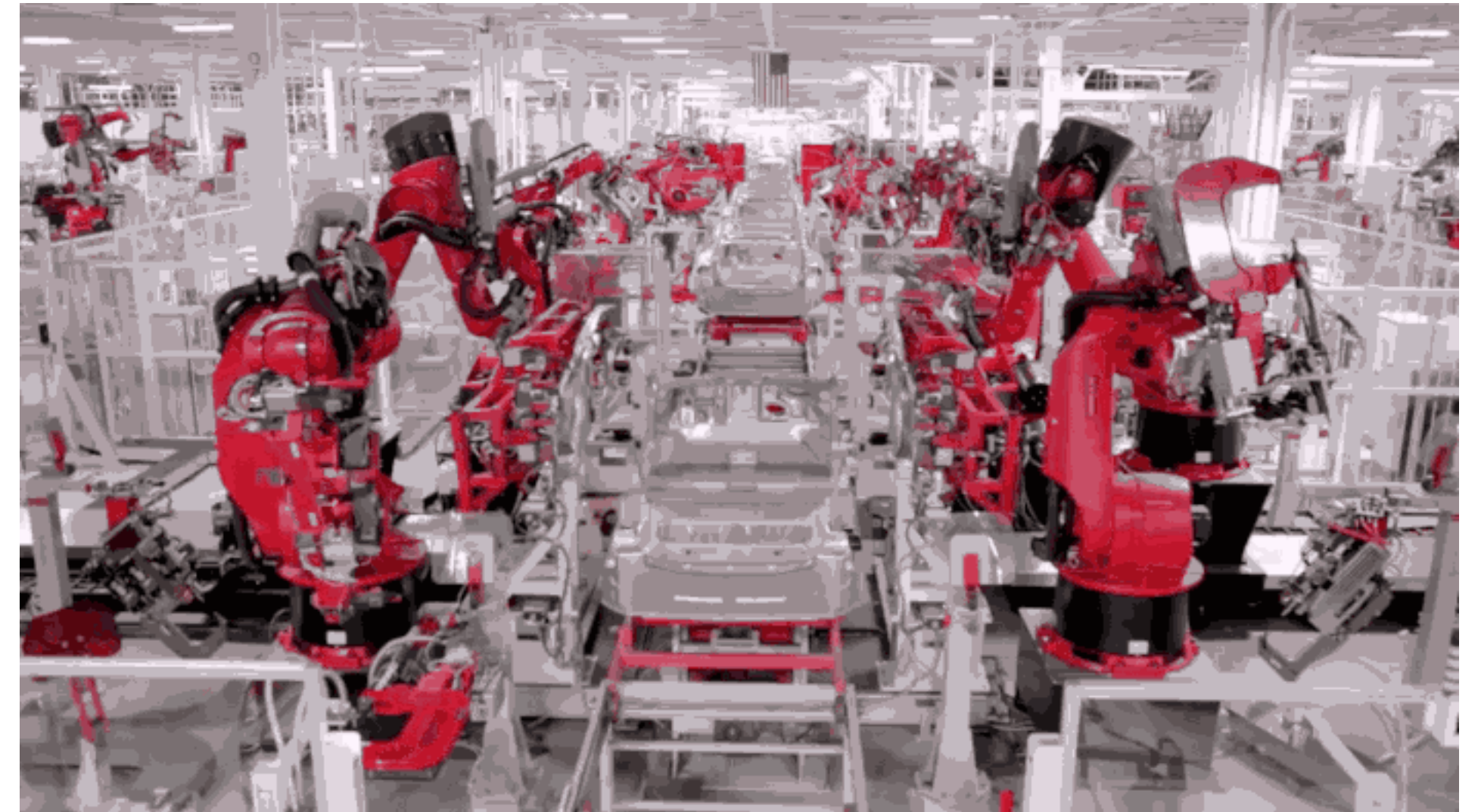
what I think I do



what I really do

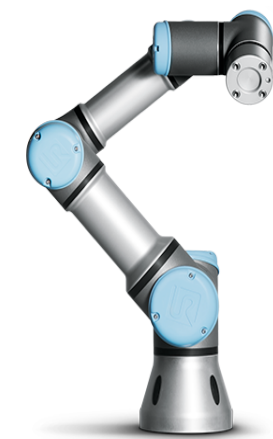
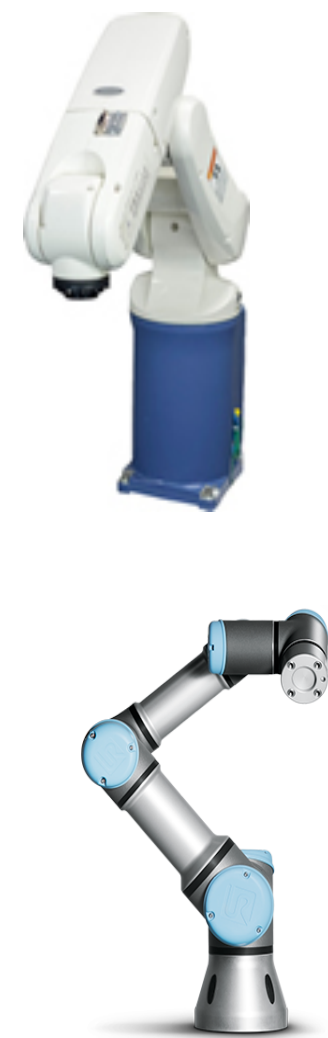
# What are Robots?

A re-programmable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of variety of tasks with a high degree of accuracy



## Why Robots

- Repeatability
- Human Fatigue
- High Accuracy
- Human Safety
- High Volume

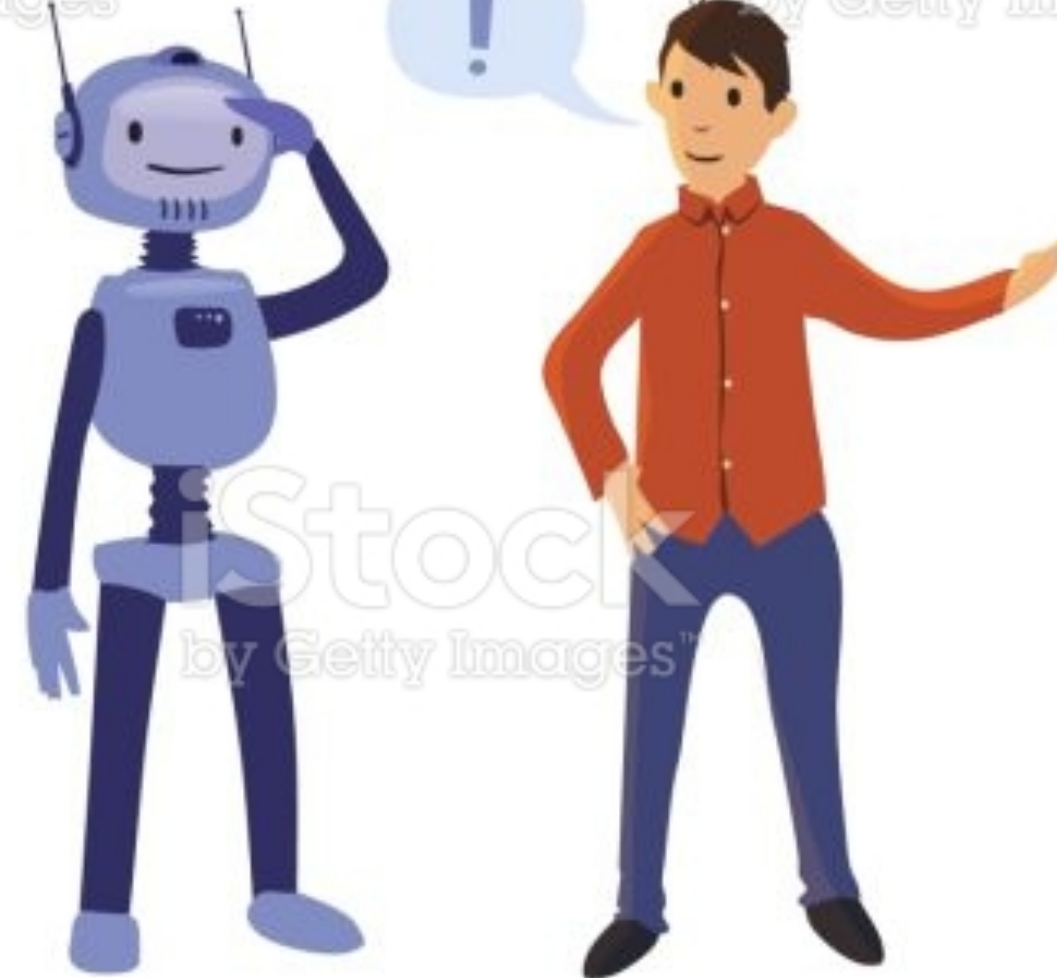


# Three Laws of Robotics



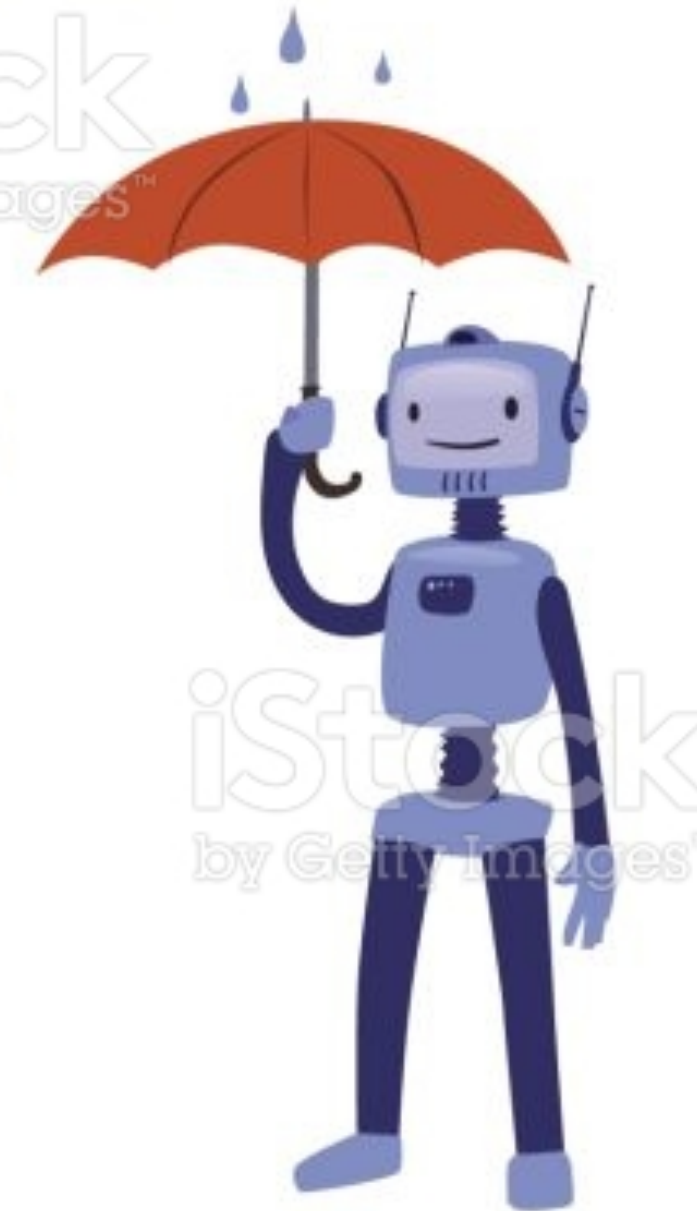
1

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 it by human beings except where such orders would conflict with the First Law.








3

A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

The Three Laws of Robotics are a set of rules devised by the science fiction author Isaac Asimov.

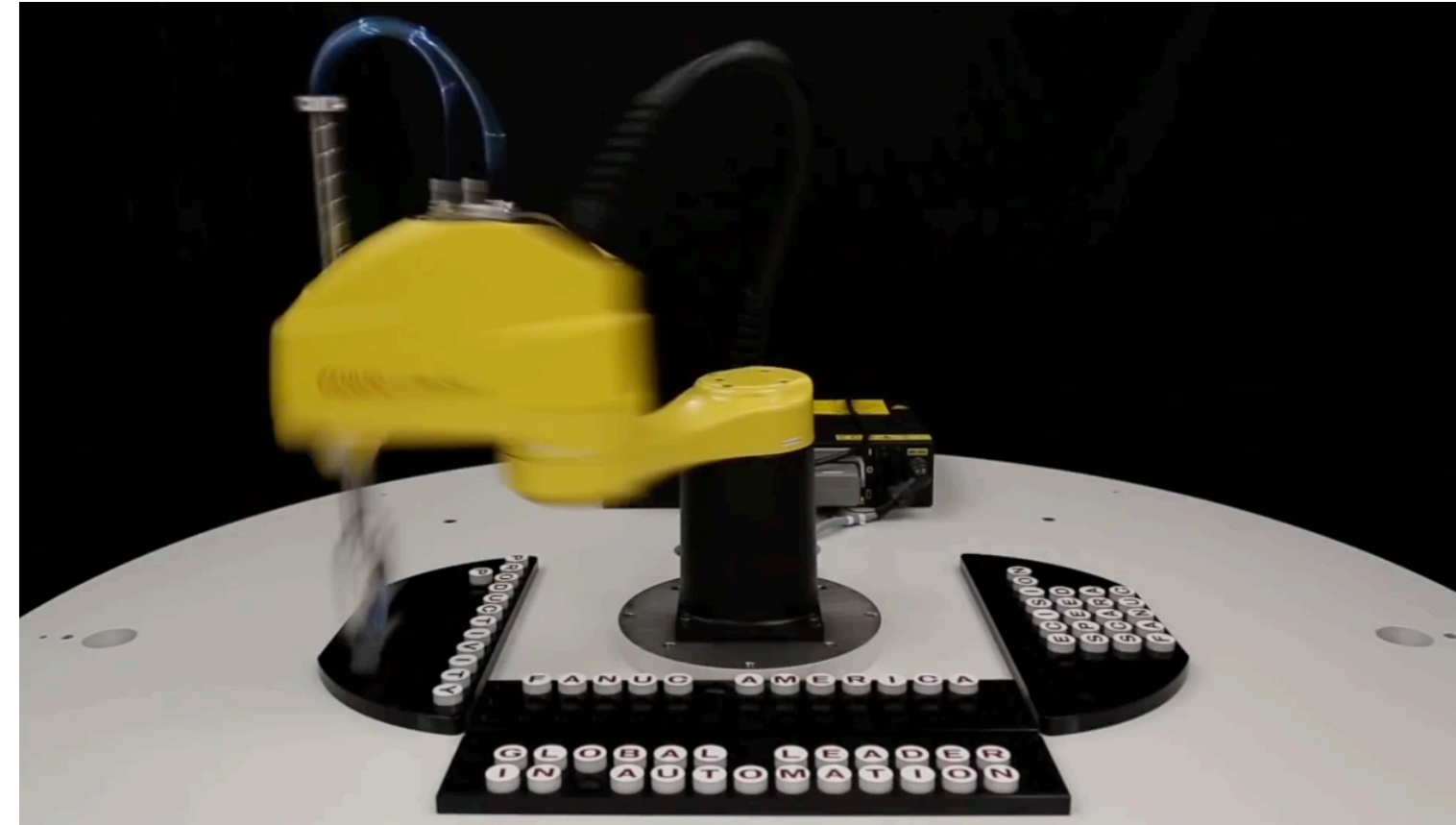
# Type of Robots

Type	Cartesian	SCARA	Articulated	Delta	Cobot
Picture					
Number of Axis	3	3 to 4	6 to 8	3 to 6	3 to 6
Accuracy	+/-0.02mm	+/-0.03mm	Medium - High	+/-0.02mm	+/-0.05mm
Speed Range	Medium	High	High	High	Low
Load Range	5-15 kgs	5-7kgs	3-100kgs	1-3kgs	3-16kg
Applications	<ul style="list-style-type: none"> <li>Polishing</li> <li>Palletizing</li> <li>Sealing and Dispensing,</li> <li>Assembler &amp; tester base machine</li> </ul>	<ul style="list-style-type: none"> <li>Product Inspection</li> <li>Assembly cell</li> <li>Handling unit</li> </ul>	<ul style="list-style-type: none"> <li>Handling</li> <li>Assembling</li> <li>Spot welding</li> <li>Cutting, deburring, grinding, polishing</li> </ul>	<ul style="list-style-type: none"> <li>High precision assembly operations in a clean room for electronic components</li> <li>High speed pick &amp; place</li> </ul>	<ul style="list-style-type: none"> <li>Visual inspection</li> <li>Assembly aid</li> </ul>

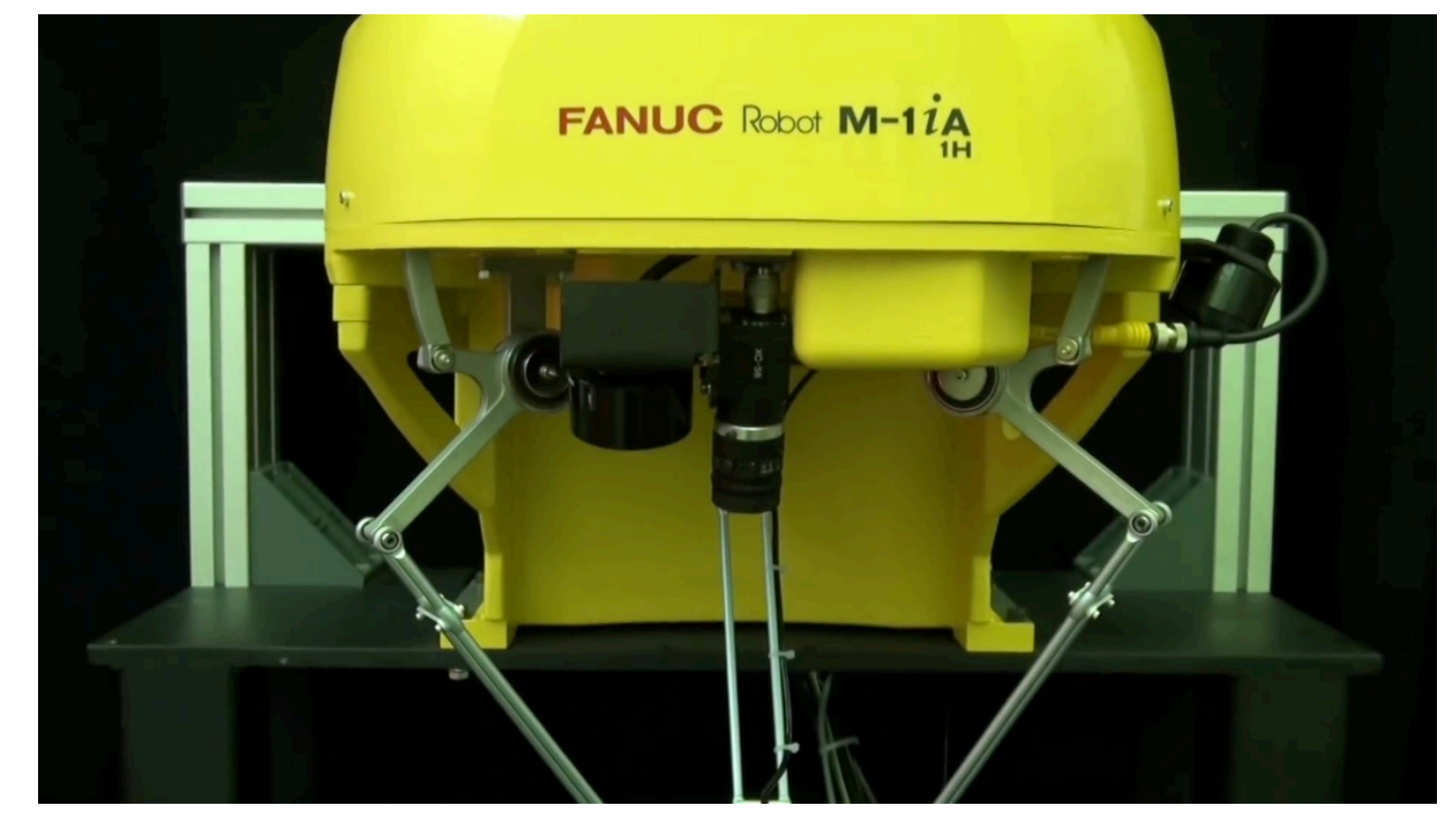
# Type of Robots



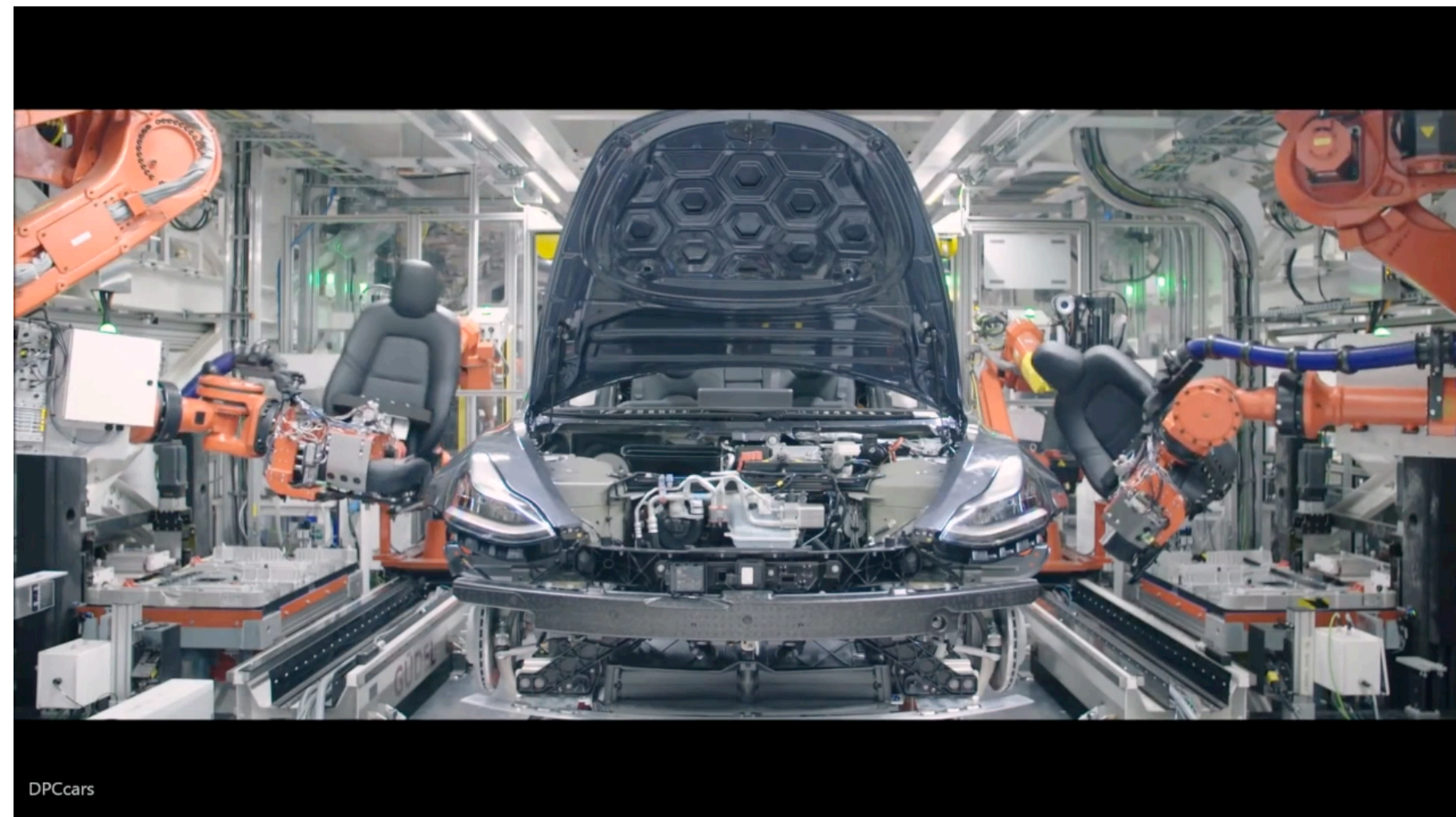
Cartesian



SCARA



Delta



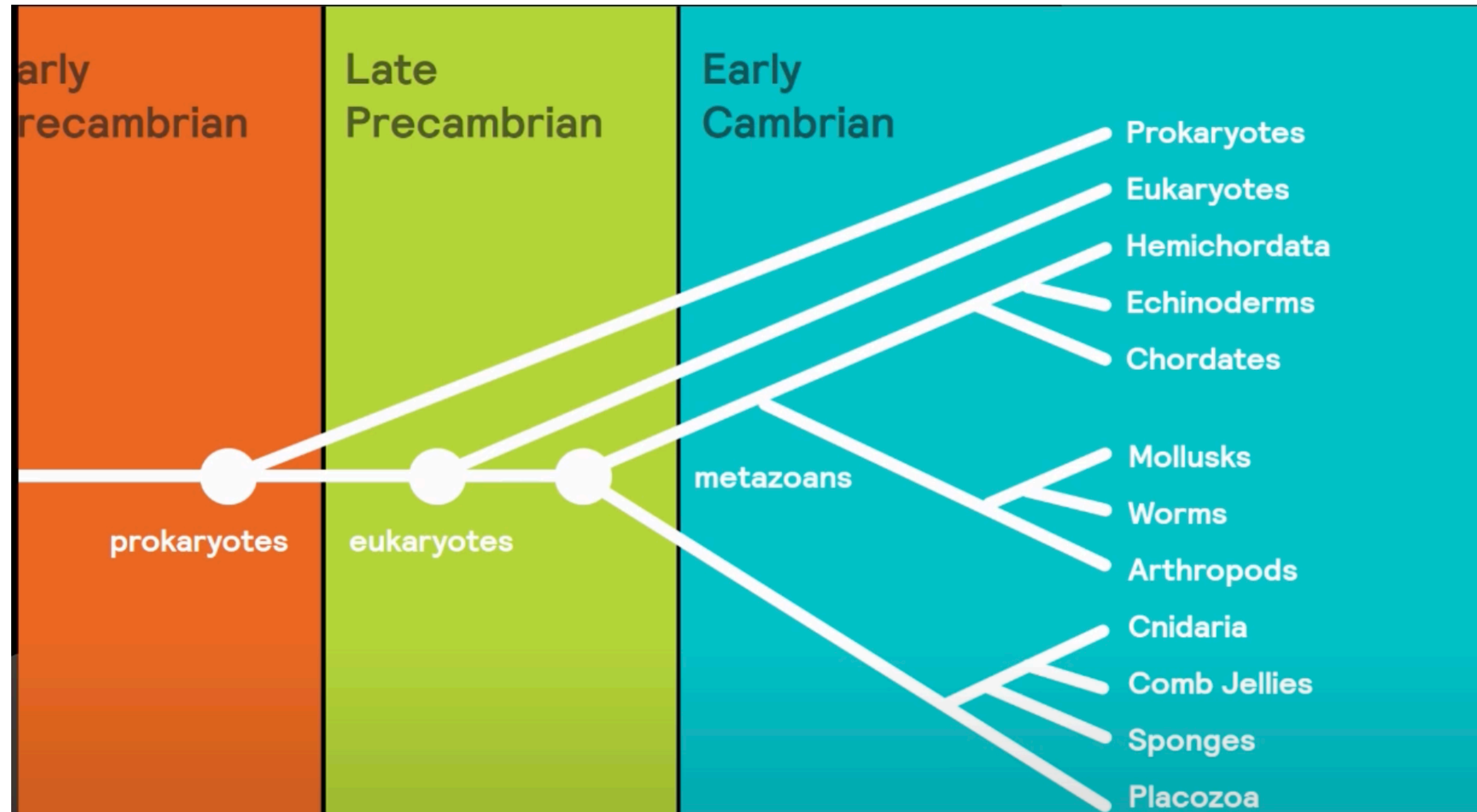
Articulated



Collaborative (Cobot)



# Cambrian Explosion



Buddy Robot/ Companion



Hair Transplant



Education Purpose

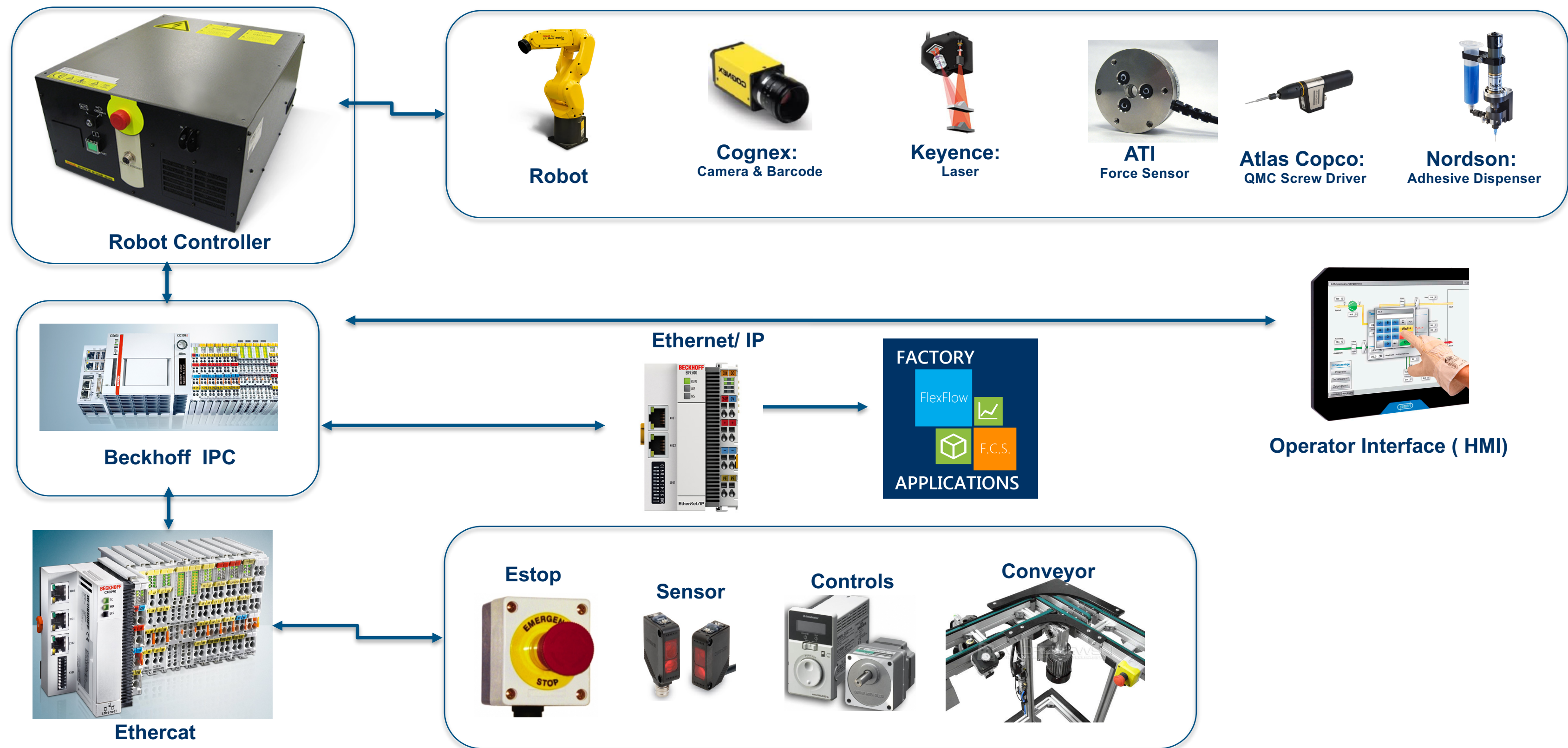


Making Pizza

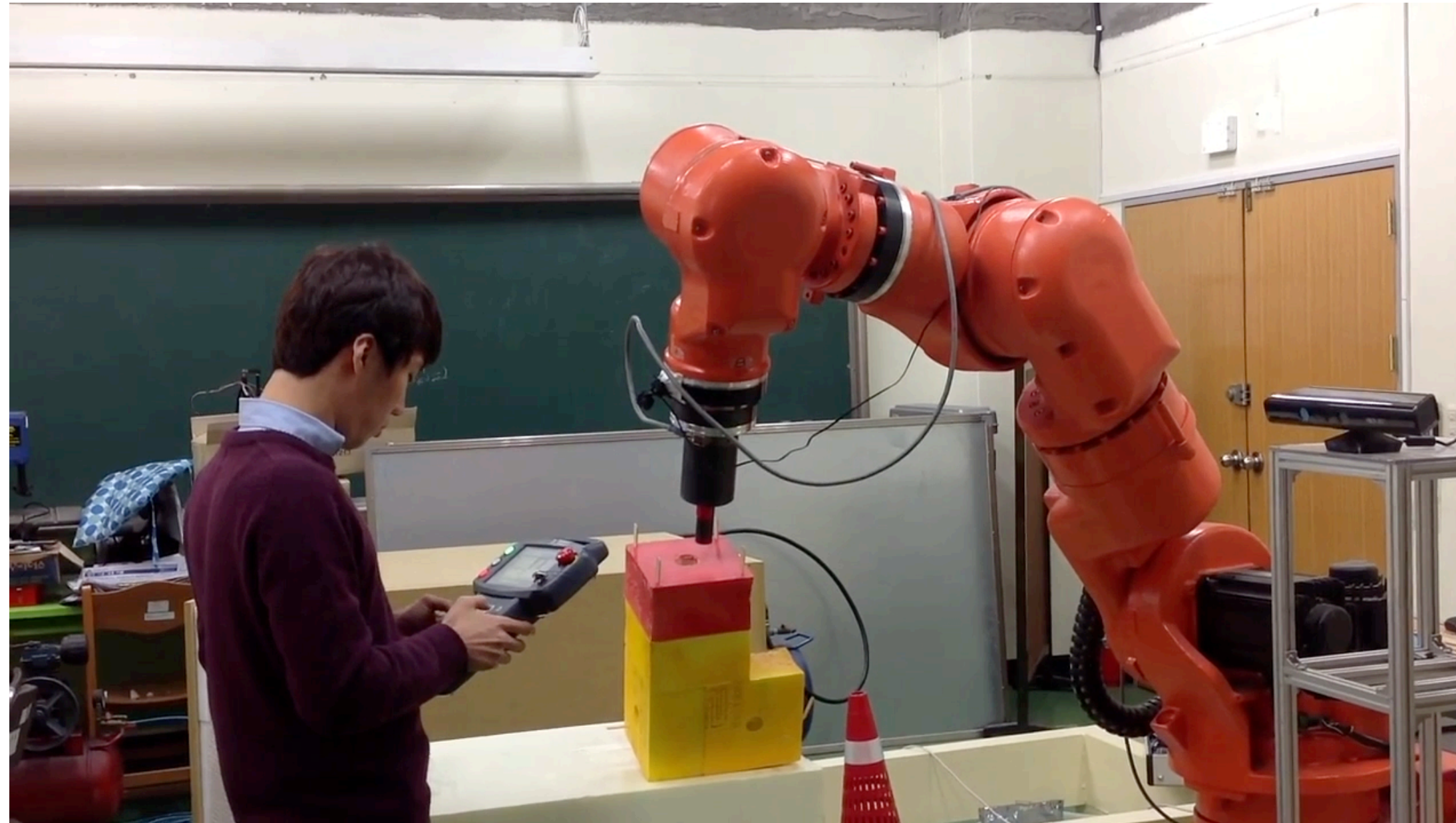


Grilling Burgers

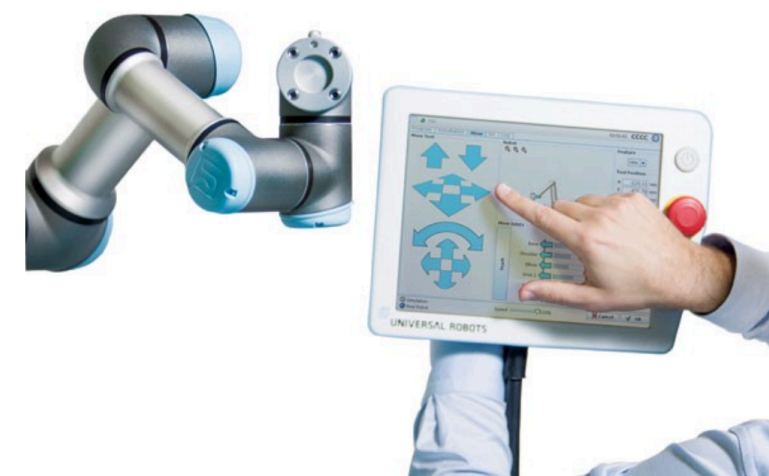
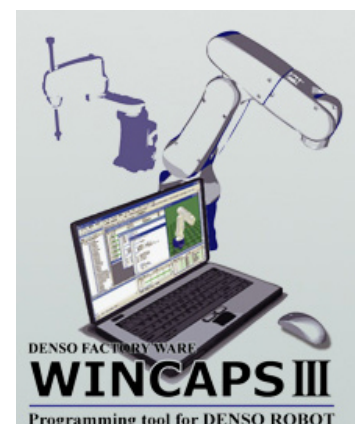
# Adaptive Robots



# Programming and Simulation Tools

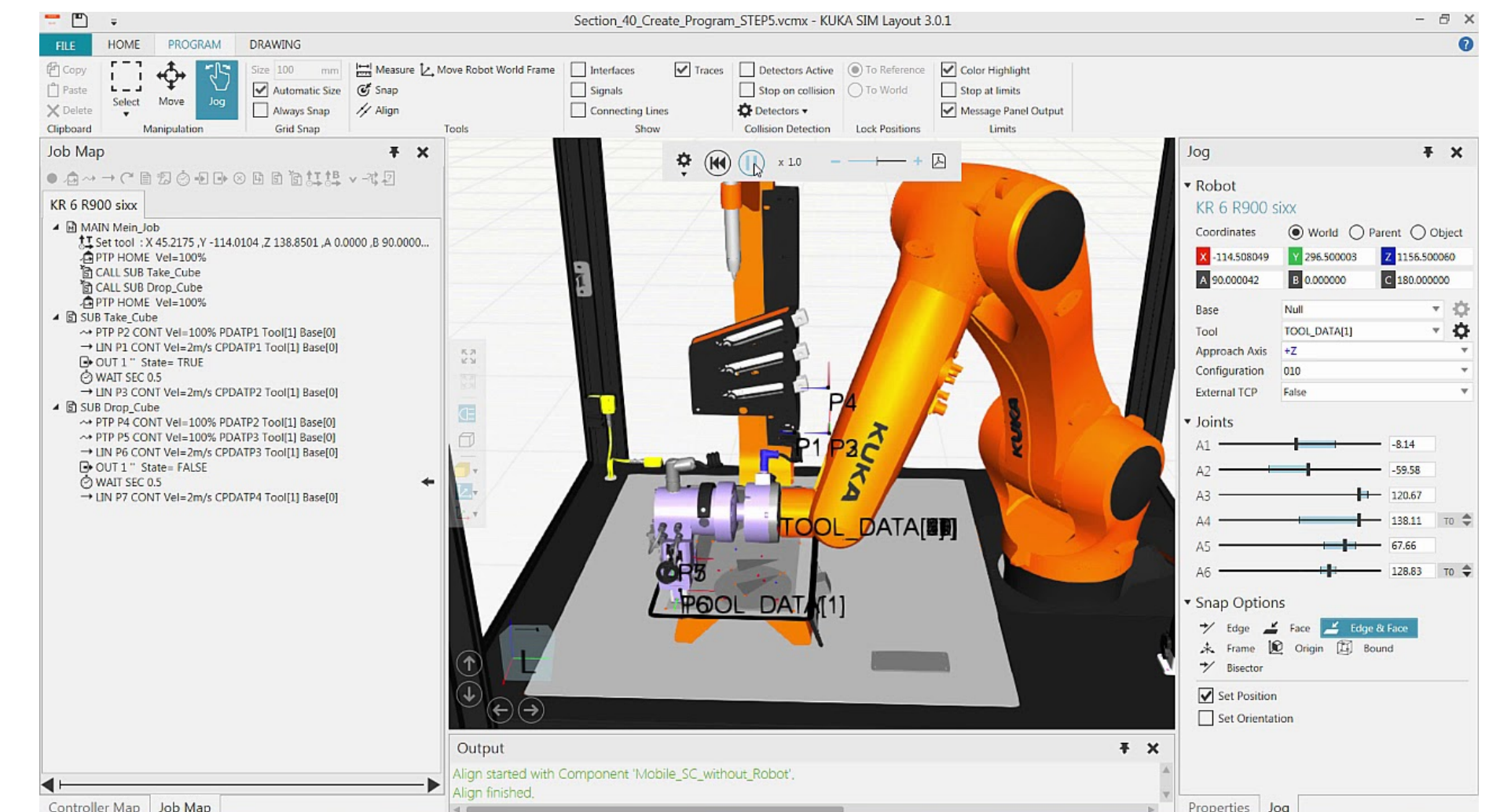


SIMULATION TOOL	
Tool Name	Notes
Visual Components	Entire manufacturing processes can be simulated and analyzed, including robotics equipment
RoboDK	Programming tool for industrial robots which allows for scripting using Python with integrated 3D simulation
V-REP	3D simulator compatible with Windows, Mac and Linux
RobotStudio	Created by ABB and is focused on industrial robot simulation and offline programming
Workspace	3D simulation environment supporting a long list of languages used by industrial robot manufacturers such as ABB G-Code, ABB Rapid, Adept V-Plus, Fanuc Karel 5, Fanuc TP, Mitsubishi PA10, Mitsubishi Melfa Basic, Motoman Inform II, Kawasaki AS, Kuka KRL, Nachi Slim, Panasonic Pres and Siemens G-Code.
WorkcellSimulator	It is mainly used for applications which involve handling, sorting or machinery for laser cutting and similar applications.
Roboguide	developed by FANUC Robotics consisting of four components, HandlingPRO, PaintPRO, PalletPRO and PalletTool and WeldPRO



The robot UR5. Image courtesy of Universal Robots.

“You don't need to type or calculate anything to get the robot to work. You just need to show it the movements”. Universal Robots.



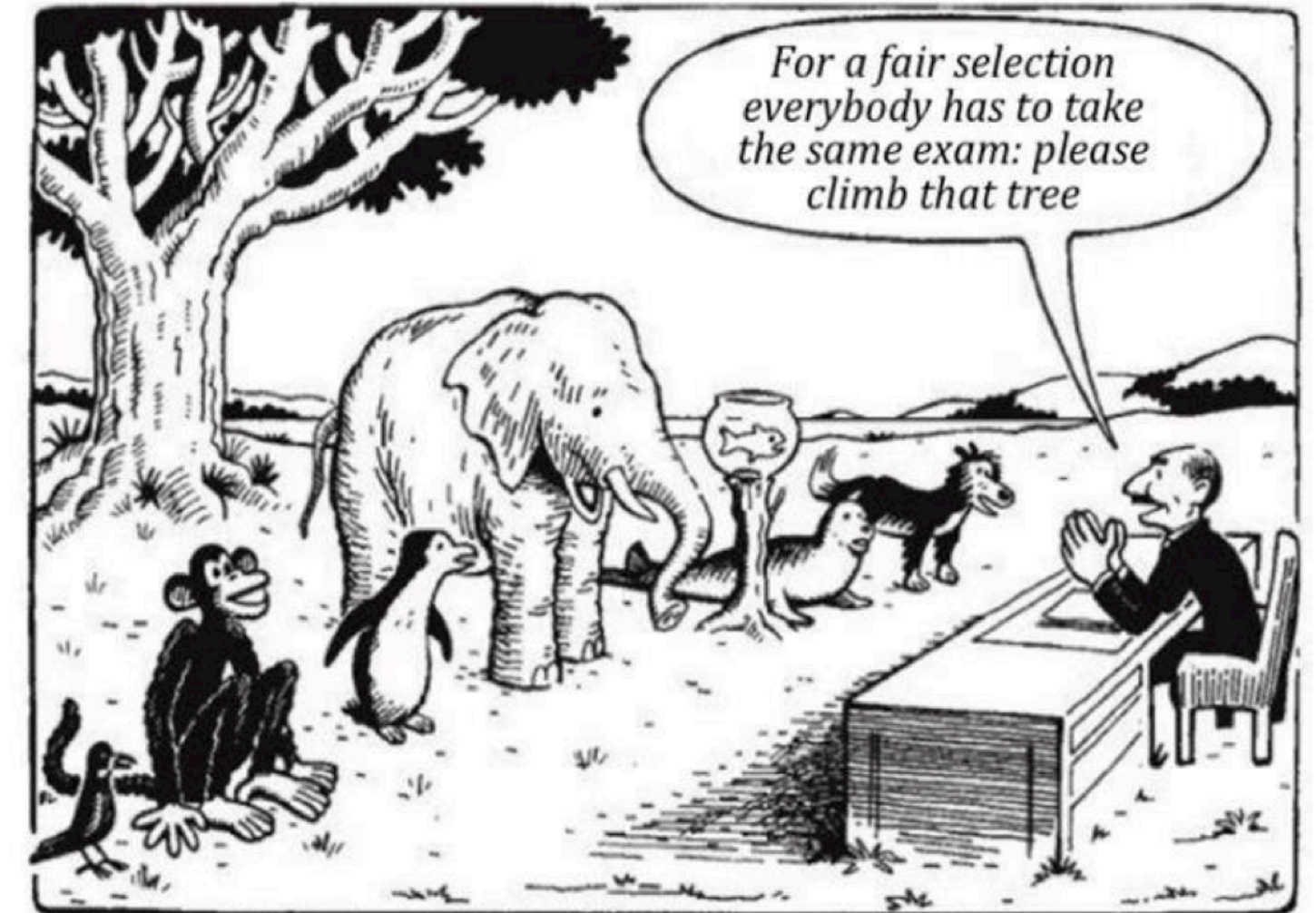
Nachi SLIM



# Education

- You want to be a doctor? Study medicine.
  - You want to build bridges? Study civil engineering.
  - You want to work with robots? Well... you could study electronics, computer science, biotechnology, manufacturing, cognitive science...truly inter-disciplinary
  - ... there are loads of routes to a job in robotics!
- 
- Pick a relevant major- STEM
    - Engineering (Mechanical, Computer Science, Electrical, etc)
    - Mathematics
    - Physics
  - Co-op/Internship
    - While schooling is a crucial aspect of becoming a robotics engineer, internships and jobs are other essential steps. Without having the opportunity to put your knowledge into practice, throwing yourself into the robotics field will give you the first hand experience
    - Experience doesn't have to just come from professional internships or jobs. Many high schools and colleges offer the opportunity to enter robotics competitions or join robotics clubs.
  - Continued Learning
    - Annual Conferences- RIA, Automate, etc.
    - Online learning-edX, Coursera
    - Robotics Competition (Mentor- FIRST)

**Few Potential Career Path- Automation Engineer, Manufacturing Engineer, Controls Engineer, Robotics Engineer, Robotics Integrator, Technical Program Manager, Automation Design Lead, Engineering Manager, Technical Operations.....**



## Our Education System

*“Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid.”*

*- Albert Einstein*



# Desirable Skill and Traits: Robotics & Automation

- **First Principle Thinking**

- What are we absolutely sure is true? What has been proven?

- **Programming Mindset**

- Although you don't need to learn all of them, a good roboticist will be comfortable outlining the flow and learning any new language if and when it is required

- **Continued Learning**

- Every time I began a new project, I needed to learn one or two new skills.

- **Technology and Design**

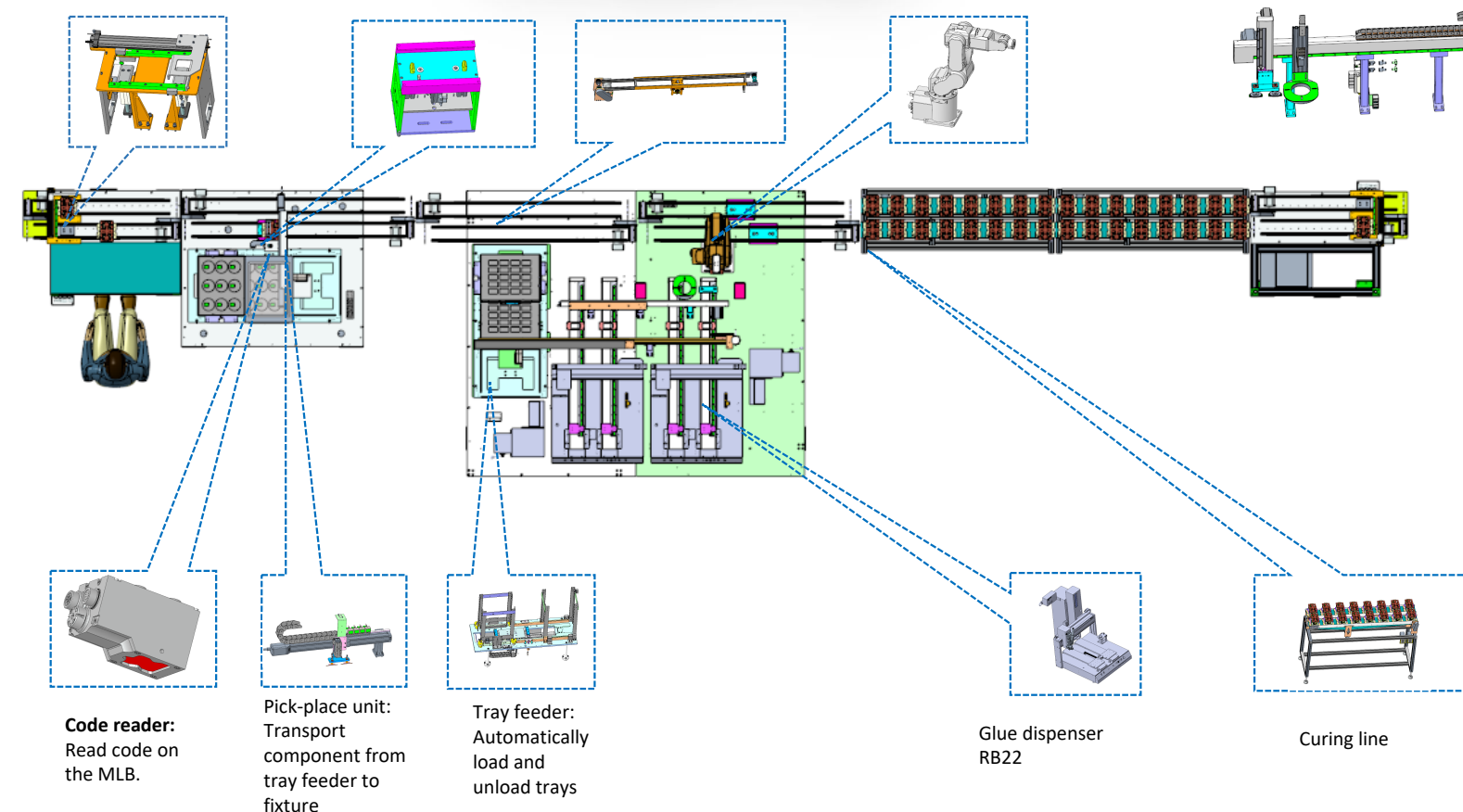
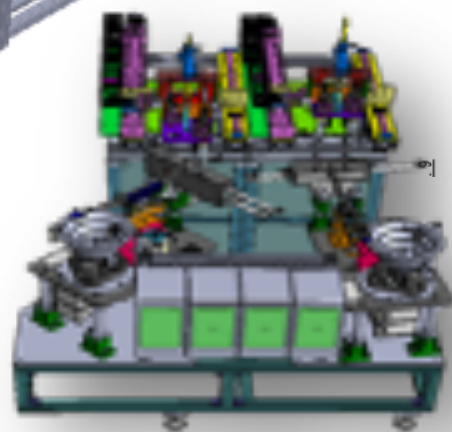
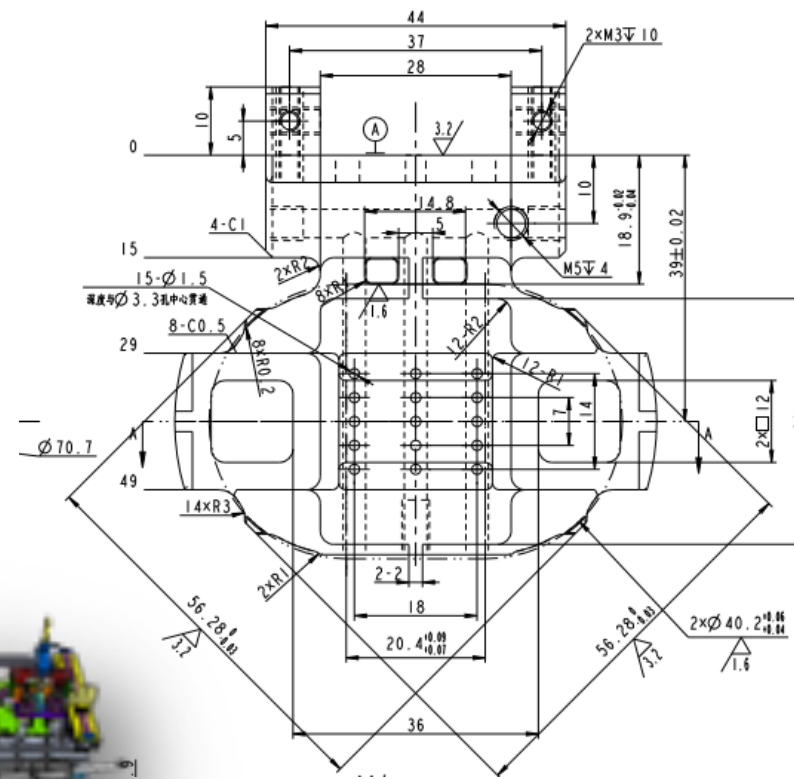
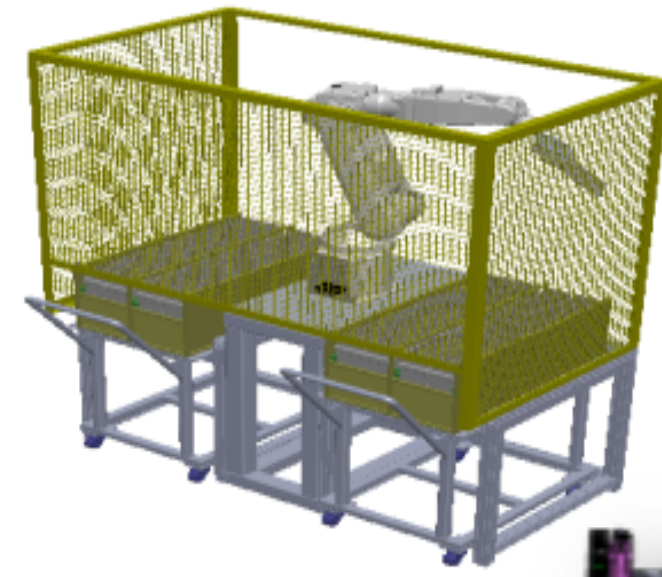
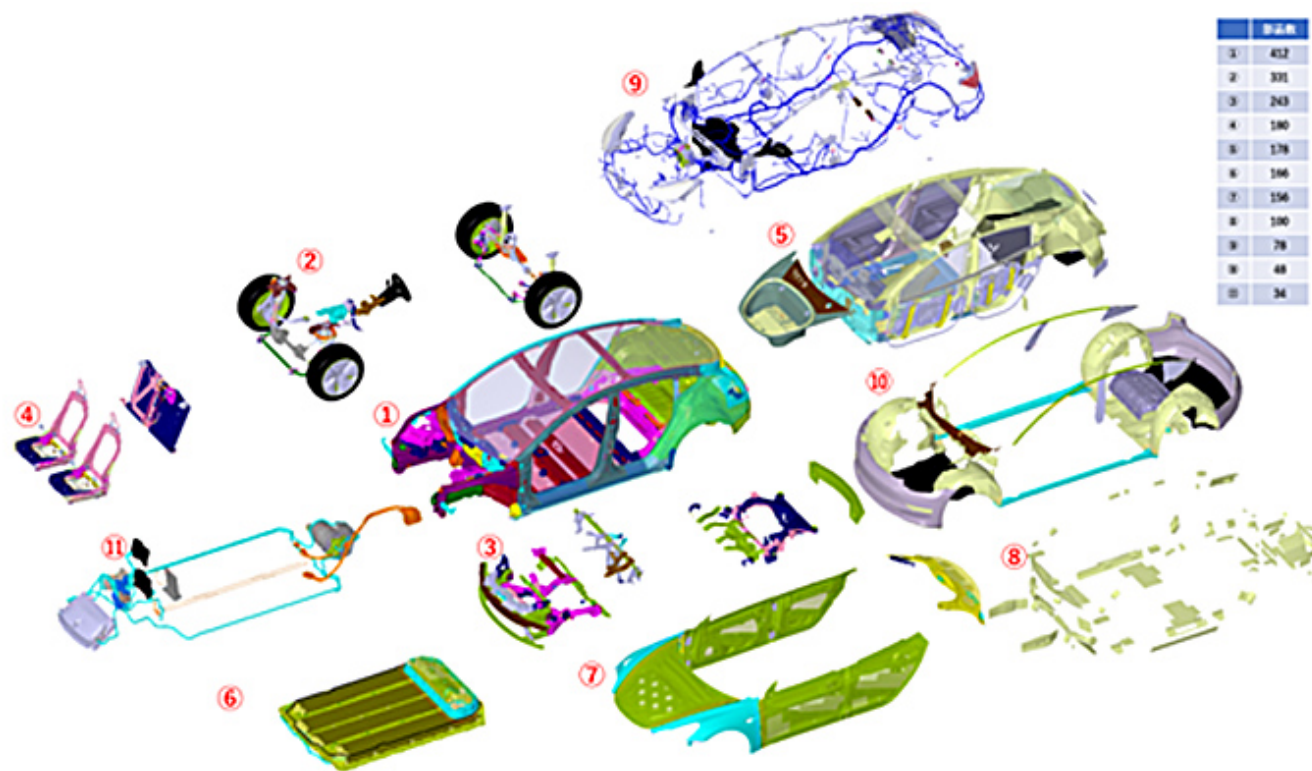
- Robotics involves a wide range of technologies so skills in technology design mean you can effectively isolate the source of problems and propose effective solutions.

- **Persistence**

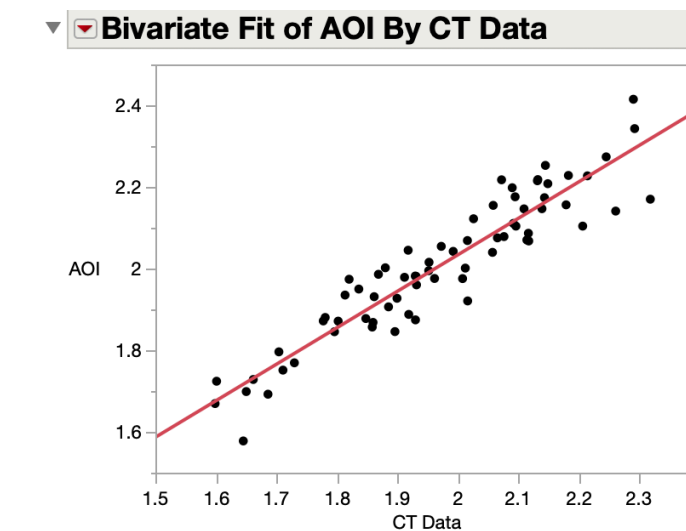
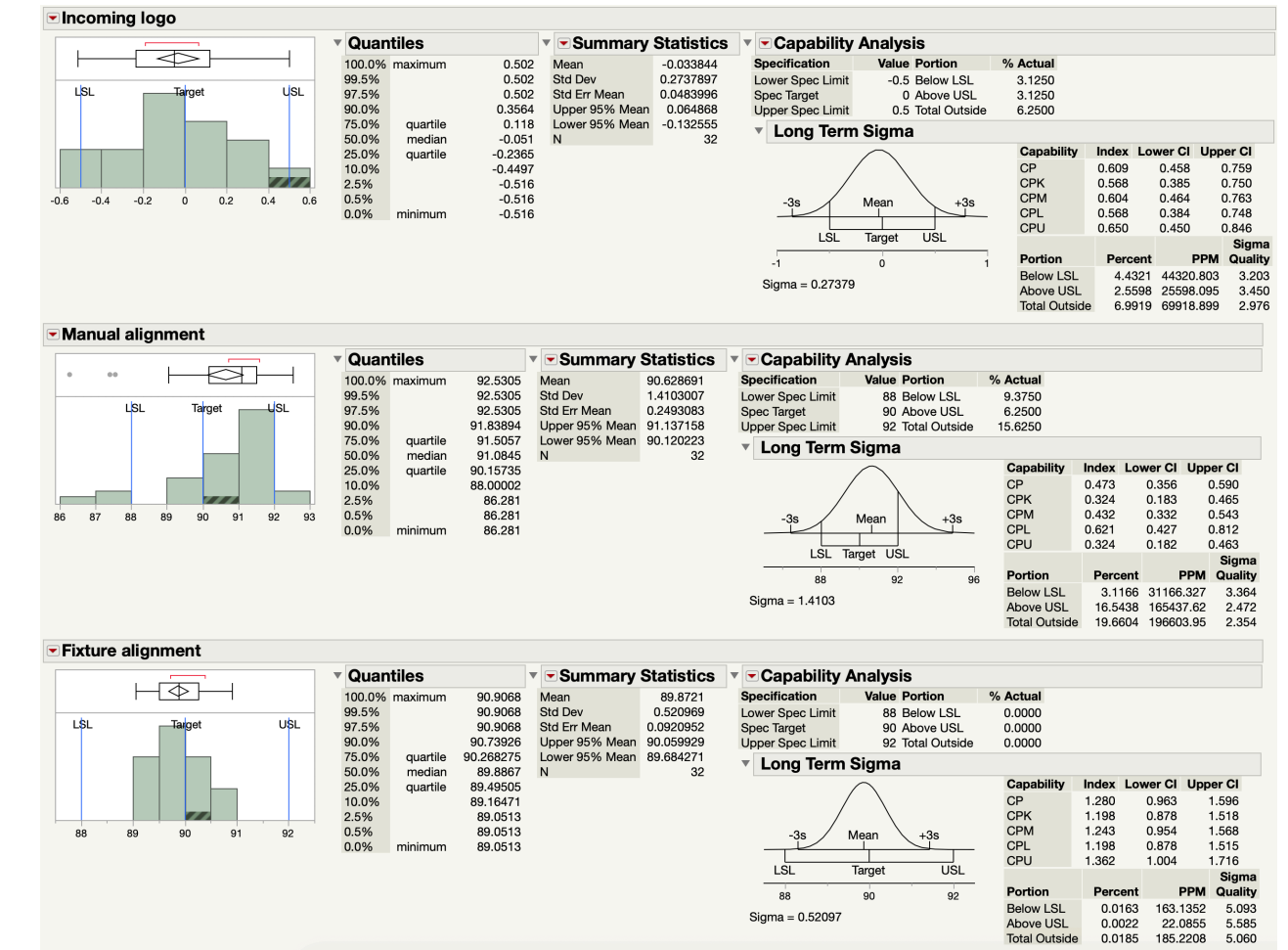
- Given the complex nature of robotics, Persistence is an essential skill. It might be persistence in trying to find the solution to a particularly difficult problem or persistence in trying to explain a complex topic to others.



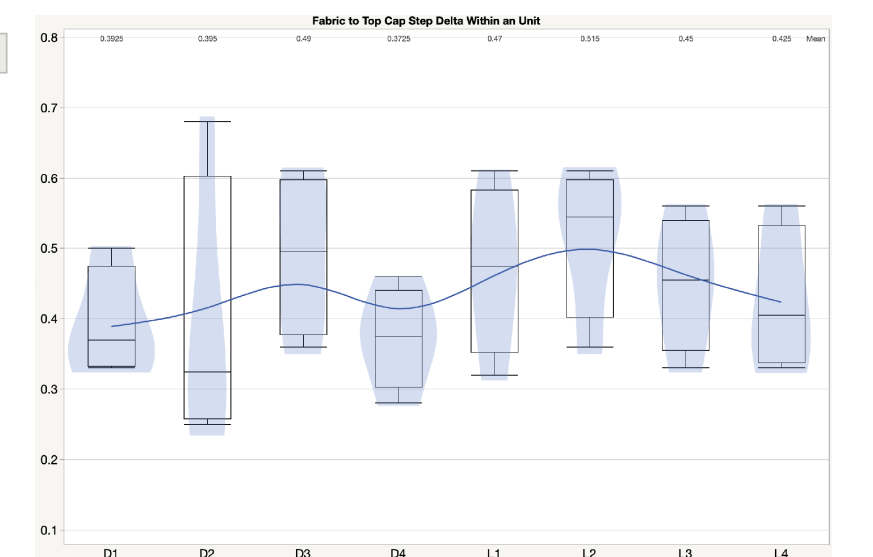
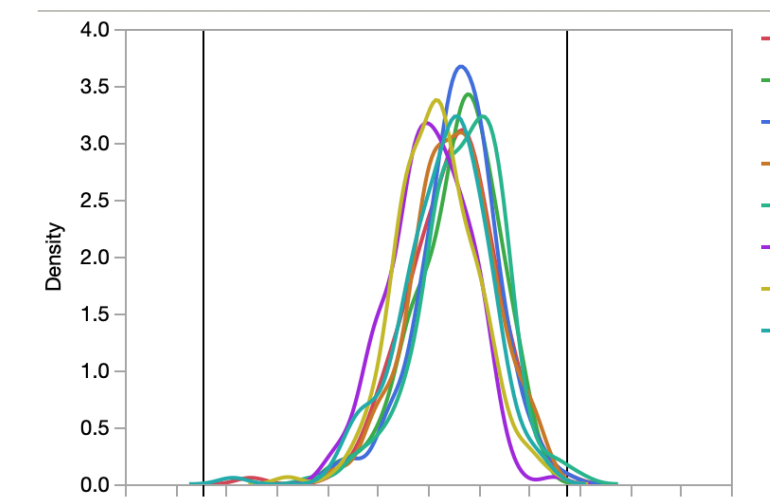
# Typical Work Day (NOT)



Product Transfer Mechanism, where 6-axis pick PR



Linear Fit  
 Linear Fit  
 AOI = 0.244894 + 0.894588\*CT Data  
 Summary of Fit  
 RSquare 0.871038  
 RSquare Adj 0.869141  
 Root Mean Square Error 0.062123  
 Mean of Response 2.008673



Product Design Review and assembly process

Automation Design Simulation, Review and Deploy

Data Review for Capability Analysis

# Challenges and Potential Solutions to Implementing Robotic

## • Skillset and Experience

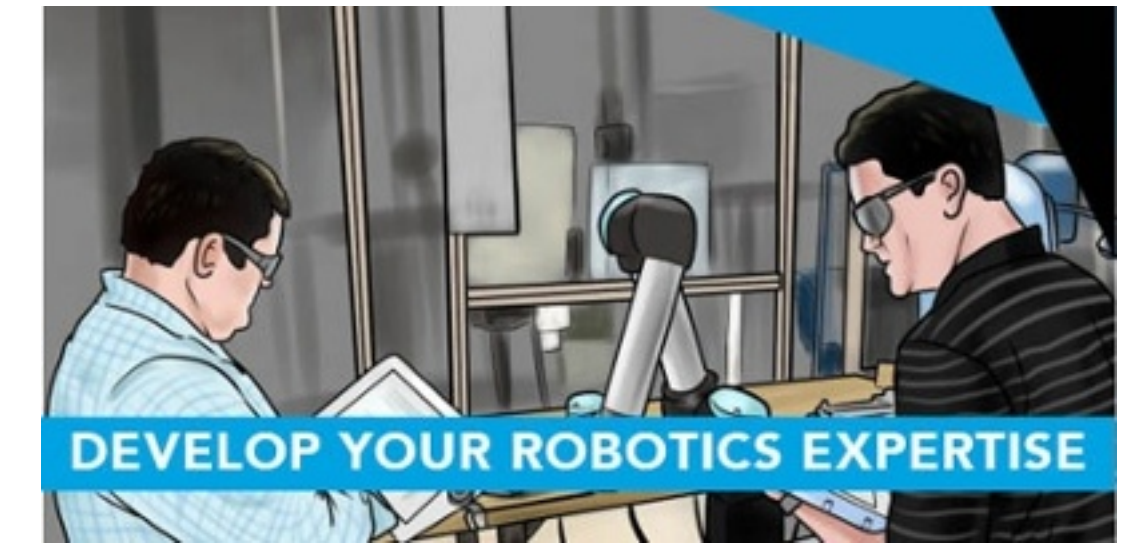
- In a study done by Accenture, it was found that 75% of manufacturing companies reported a shortage of skilled workers
- Dedicated website- robots.job
- 14% YOY projected growth

## • Cost of Technology

- Purchasing robots outright can be an expensive venture for large manufacturing companies. Even small ones may not be able to sustain the cost. To combat this, a new wave of companies are offering robotics as a service.

## • Safety

- Fenced robotics are usually isolated from human workers for this very reason. Thankfully, the robotics industry is answering the call once again with collaborative robots that are equipped with a wide range of safety features.



# Field of Future: Growing Industries

1. **Medical and Health Care-** Intuitive Surgery, Material delivery, assembly automation
2. **Farming and Agriculture-** Milking Cows, Precision seeding, irrigation, indoor farming , assembly automation
3. **Consumer and Household-** Smart Vacuums, Robot assisted cooking and cleaning, assembly automation
4. **Automotive/Transportation/ Logistic-** Testing and manufacturing next generation vehicles , warehouse mobile robots, warehouse automation
5. **Emergency and First Response-** Mobile robots can be used in place of human first responders to sift through the wreckage after a hurricane, tornado, or other disaster.
6. **Military and Law Reinforcement-** Military Grade Robots, ground robots, and some exoskeletons is to relieve personnel of certain burdens while enhancing their safety.



Proud Member:



ROBOTS. COUS  
PEOPLE. POWER. ROBOTS.



# Additional Resources and Contact

- **Why do we need robotics in schools?**

- [robotics-https://blog.robotiq.com/7-reasons-to-teach-robotics-at-school](https://blog.robotiq.com/7-reasons-to-teach-robotics-at-school)

- **Robotics Online**

- <https://www.robotics.org>

- **Robotics Online Courses**

- <https://www.edx.org/learn/robotics>

- **Robotics E-book**

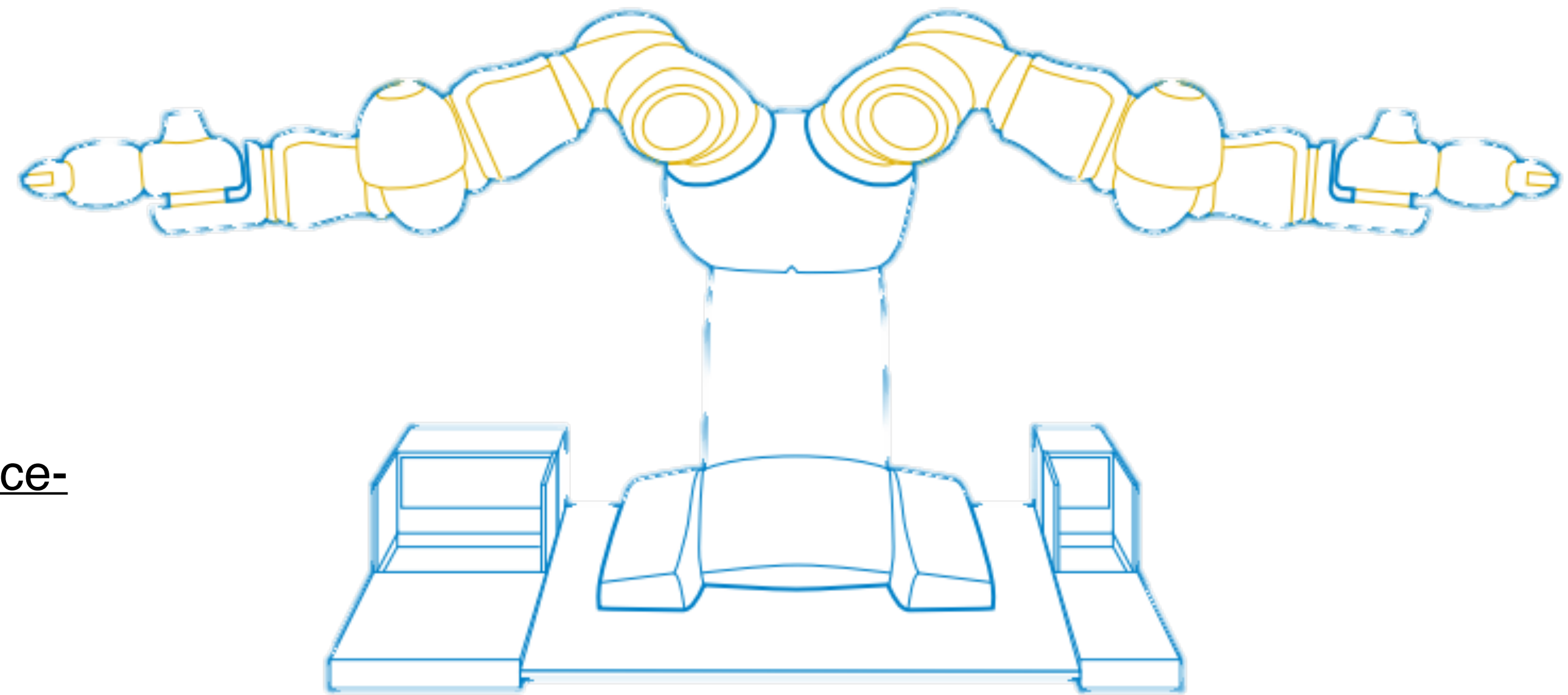
- <https://robotiq.com/resource-center/ebooks?301=%2Fresource-center%2Febooks%2F>

- **Robotics Job- Dedicated website**

- <https://www.robots.jobs>

## Contact

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Stay Hungry. Stay Foolish.

-Steve Jobs