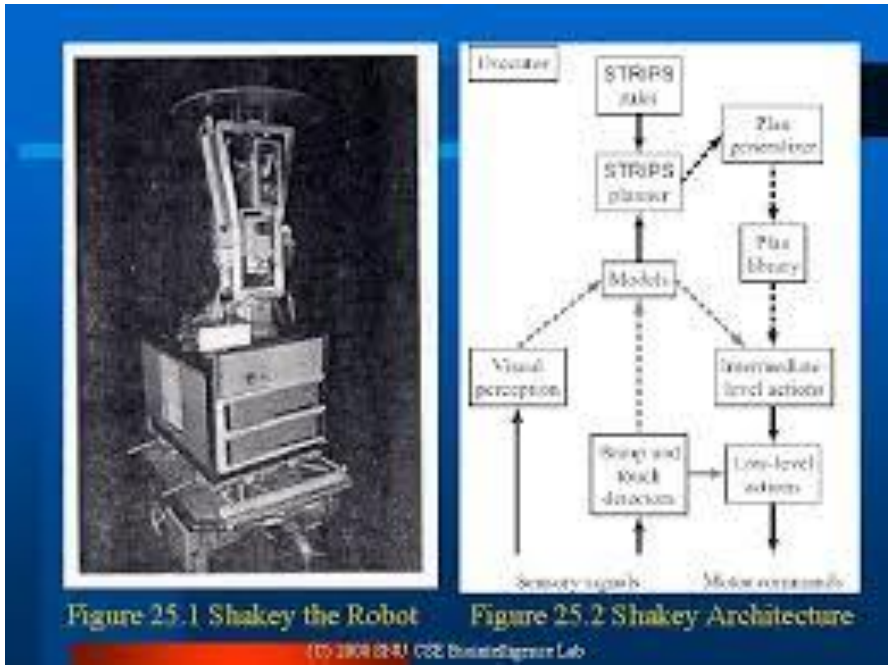
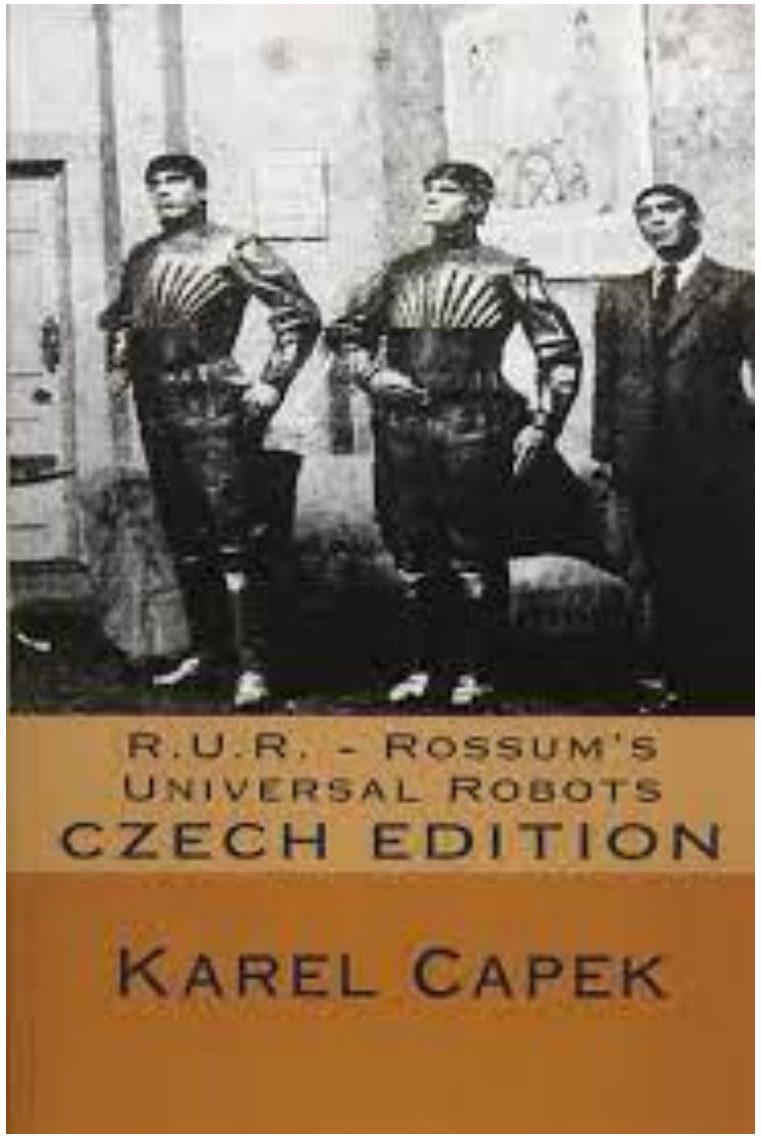
FROM RUR TO ROS 2022

CENG 5435/4391

A BIT OF HISTORY OF ROBOTS





ROBOTS ARE BORN AND REVOLT !

METROPOLIS 1927 SILENT FILM

The **robot** Maria is designed Rotwang initially with his dead wife, Hel, as a model. However, Jon Fredersen convinces him to create the robot to replicate Maria in order to cause chaos and to undermine Maria's influence over the workers.
The robot Maria is a model of "the workers of the future," who would be mechanical slaves.
In addition to being a prototype of an ideal proletarian automaton, the robot Maria is highly sexualized.
She functions to seduce, corrupt and destroy.

HIS BOOKS

ISAAC ASIMOV

First Law

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

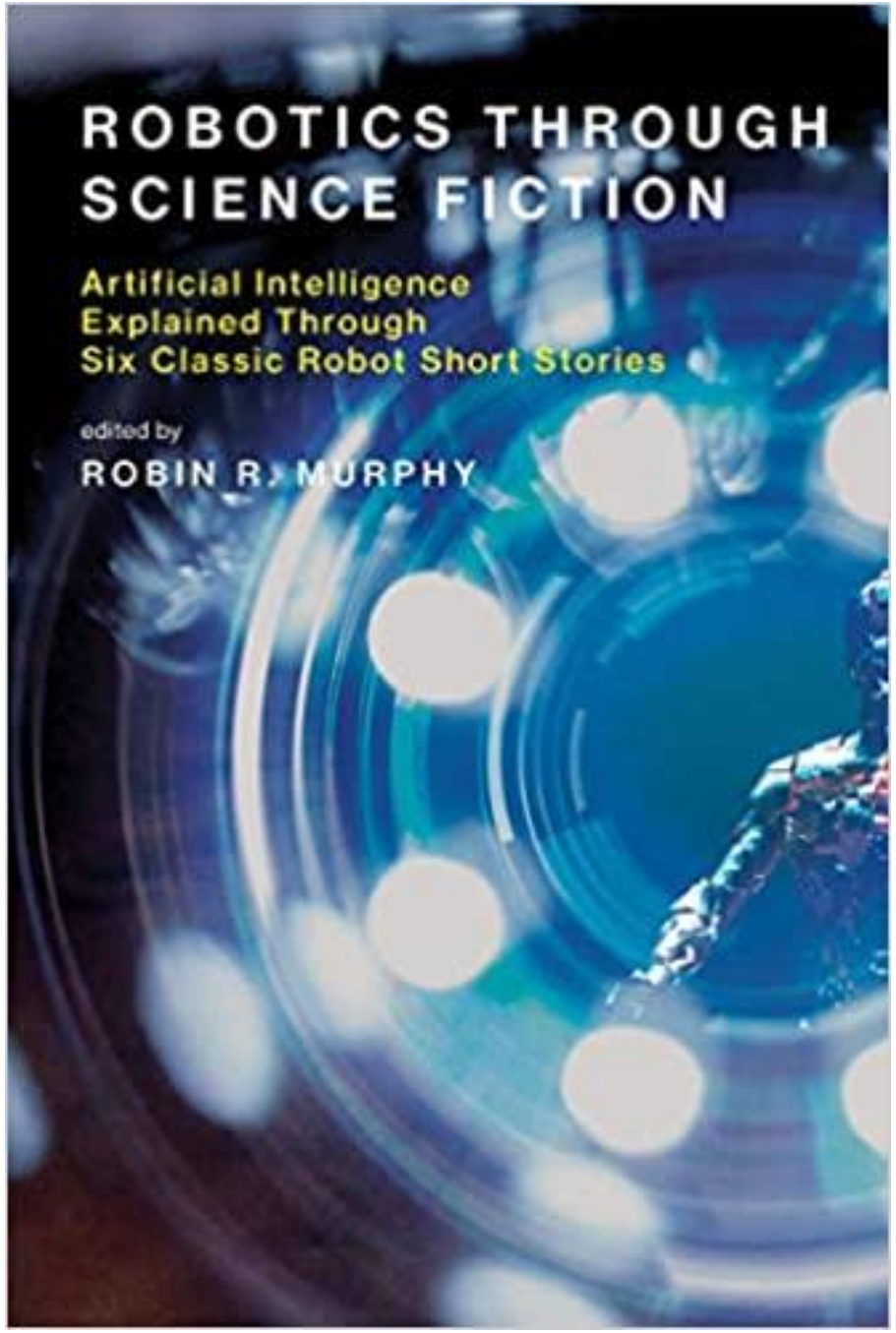
Second Law

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

Third Law

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

HELPFUL ROBOTS



Murphy's primary research is in artificial intelligence for mobile robots as applied to disaster robotics.

Unimate was conceived in 1956 at a meeting between inventors George Devol and Joseph Engelberger, where they discussed the writings of science fiction. Together they made a serious commitment to develop a real, working robot.

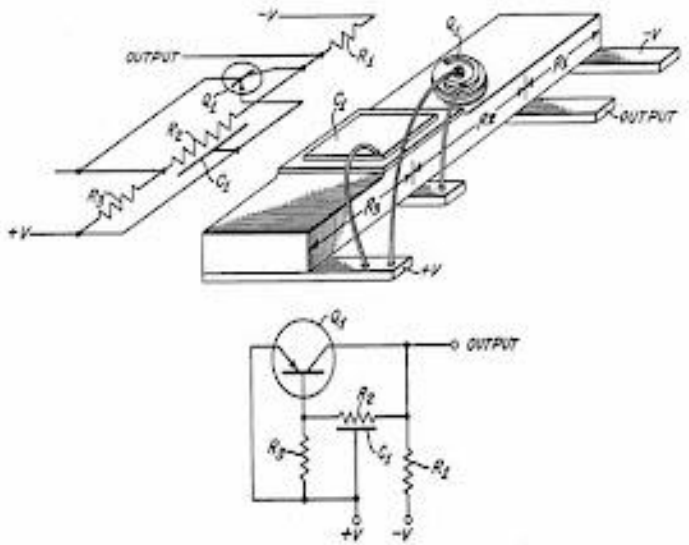
In 1961 the first industrial robot, Unimate, joined the assembly line at a General Motors plant to work with heated die-casting machines.

OFFSITE LARGE COMPUTER

The subject of SRI's Artificial Intelligence Center research from 1966 to 1972, Shakey could perform tasks that required planning, route-finding, and the rearranging of simple objects. The robot greatly influenced modern robotics and AI techniques; today, it resides in the Computer History Museum.

The First (2D) Integrated Circuit
Jack Kilby, Texas Instruments, 1958

- Transistor, Resistors and Capacitors on the same piece of semiconductor
- Interconnects between components not integrated
  → Low connectivity between components



Motorola 68000 (16/32-bit, 32-bit registers, 16-bit ALU)	Transistors: 68,000

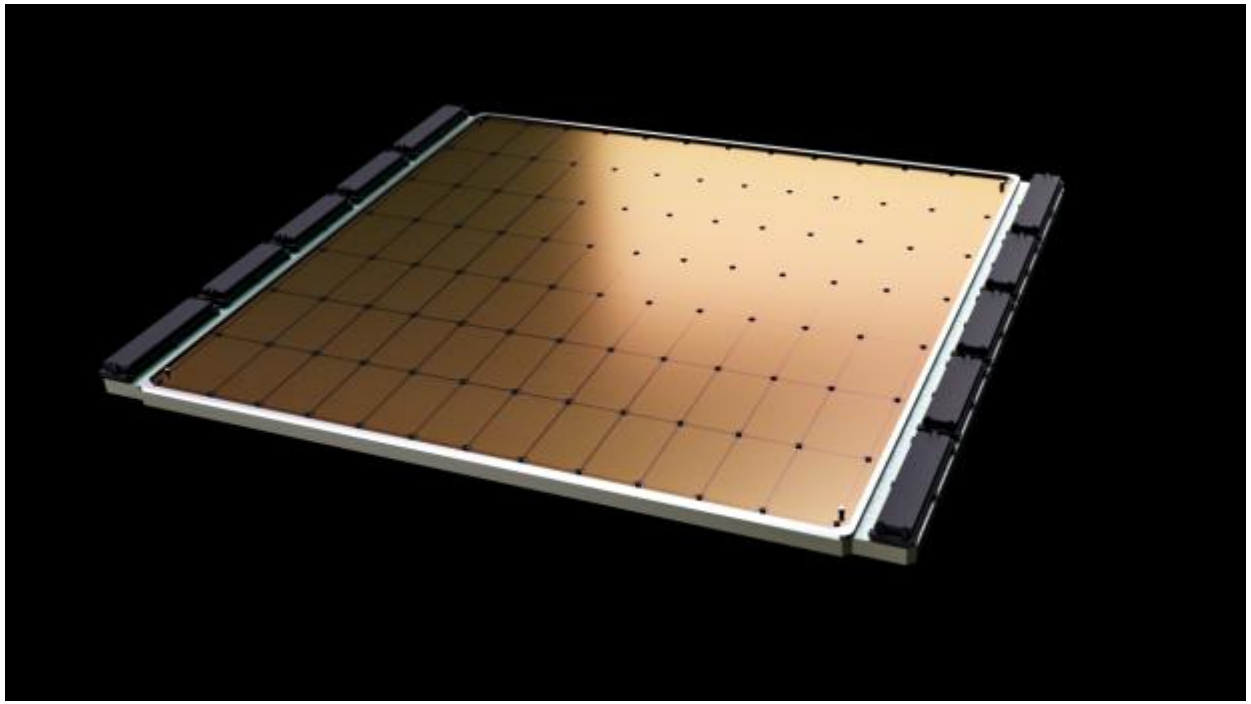
GPU

Versal VP1802	92,000,000,000	2021 ?[f]	Xilinx

The world's largest chip: 2.6 trillion transistors and 850,000 cores. Cerebras has the world's largest chip: 2.6 trillion transistors -- that's 2,600,000,000,000 -- with 850,000 cores on TSMC 7nm.Read more: https://www.tweaktown.com/news/74601/the-worlds-largest-chip-2-6-trillion-transistors-and-850-000-cores/index.html

5 kW of Power

re millimeters of silicon,
f on-chip memory

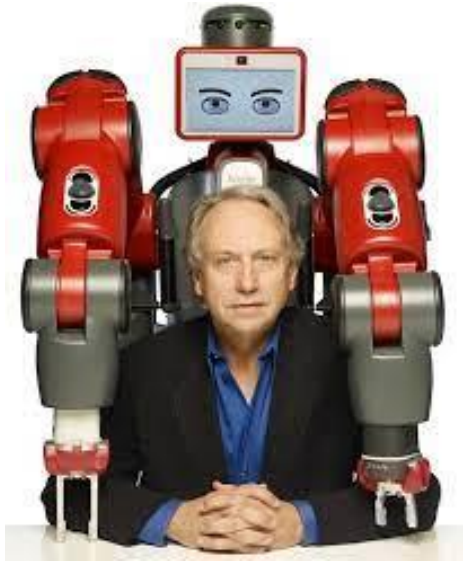


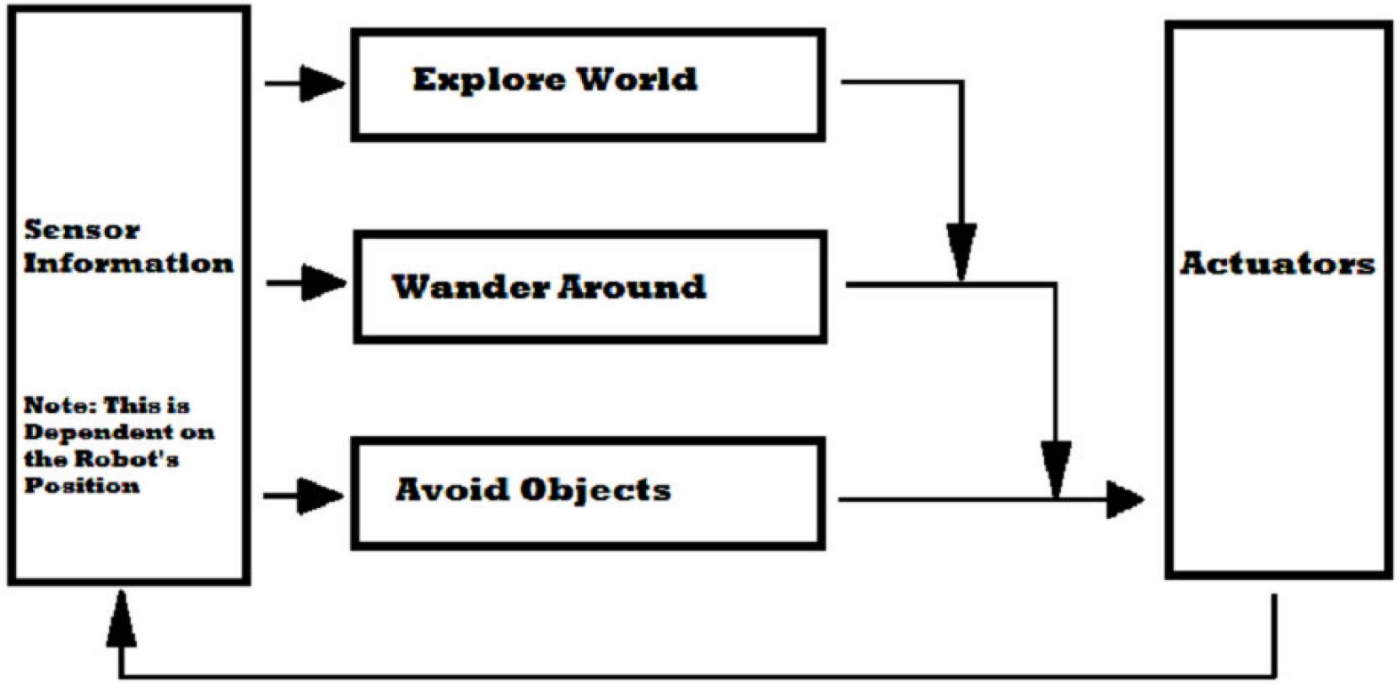
My Integrated circuits used a 1 inch wafer

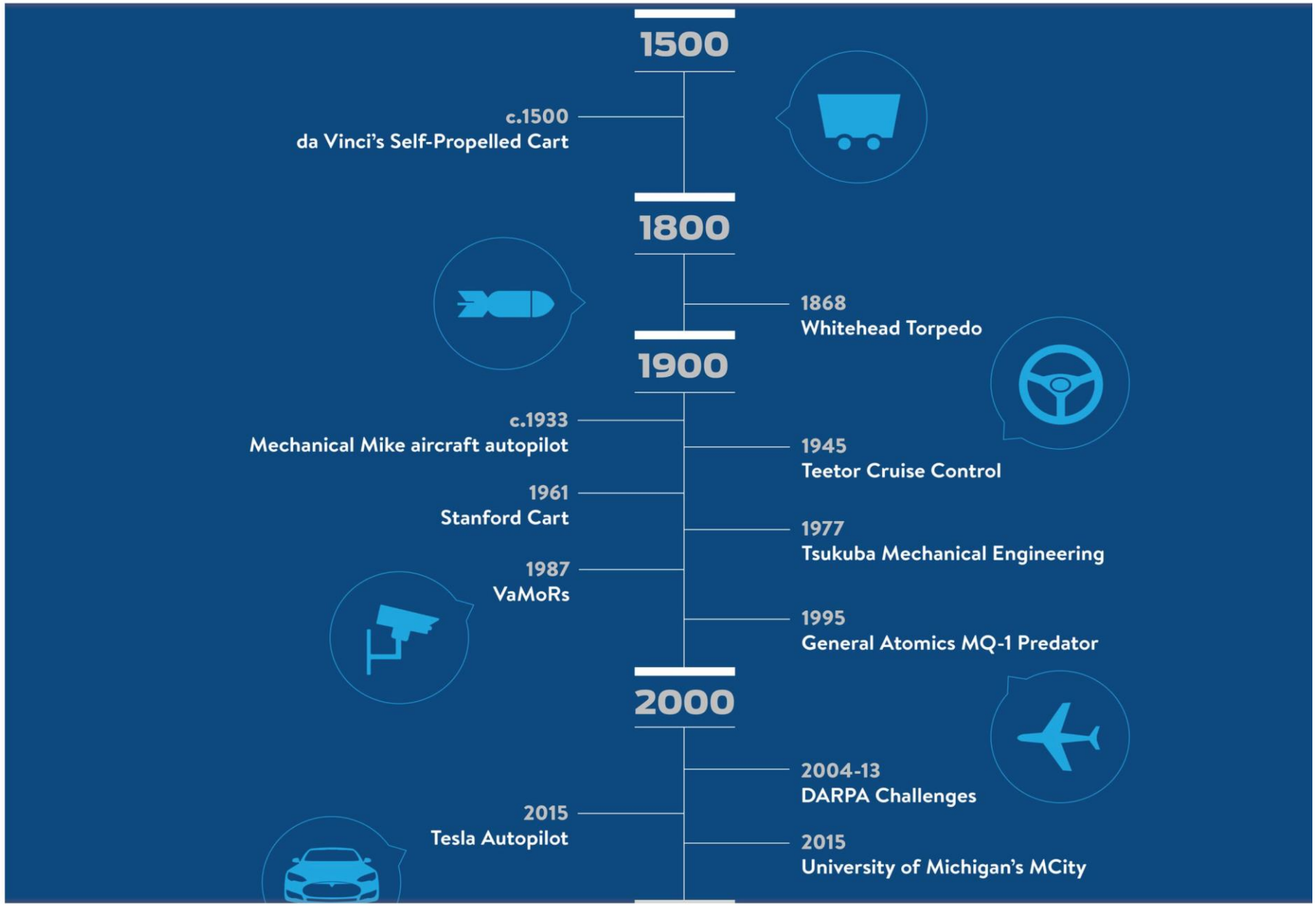
WOW !

Subsumption architecture is a reactive robotic architecture heavily associated with behavior-based robotics which was very popular in the 1980s and 90s. The term was introduced by Rodney Brooks and colleagues in 1986. Subsumption has been widely influential in autonomous robotics and elsewhere in real-time AI.

Subsumption architecture is a control architecture that was proposed in opposition to traditional AI, or GOFAI. Instead of guiding behavior by symbolic mental representations of the world, subsumption architecture couples sensory information to action selection in an intimate and bottom-up fashion.







https://www.wired.com/brandlab/2016/03/a-brief-history-of-autonomous-vehicle-technology/

The hands are great
ROS BASED

ER4
Robotic Systems
Technology Branch

Darby Magruder, Deputy Branch Chief

- **PARADIGM SHIFT**
- **PROCESSOR**
- **HARDWARE**
- **SENSOR**
- **ALGORITHMS**

AI ?

Rodney Brooks "The Future of Innovation in Artificial Intelligence and Robotics"
17,849 views Jan 16, 2019 1:48:04

https://www.youtube.com/watch?v=4P_ZhwvA8kA

Rodney Brooks
At About 46:40

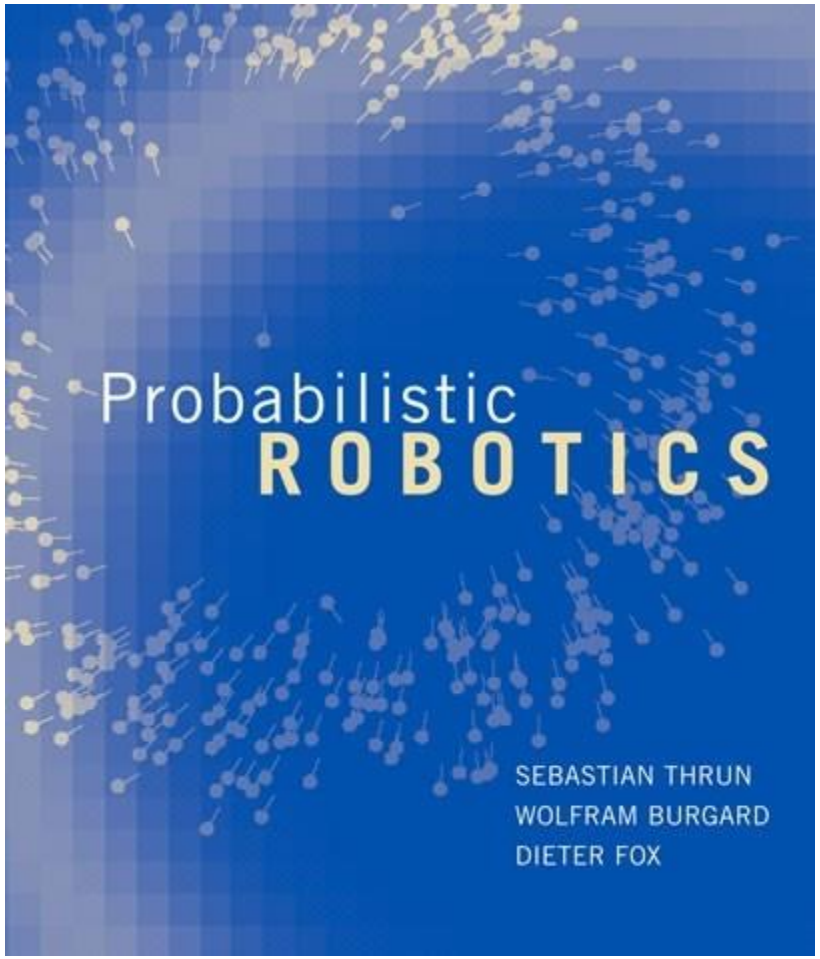
STOP OR SPEED UP – THAT IS THE QUESTION?

Open the Pod bay doors, please, HAL. 4,529 views Mar 1, 2018 1:18

https://www.youtube.com/watch?v=OpFIW9WoH3E

OR

2005 DARPA Grand Challenge



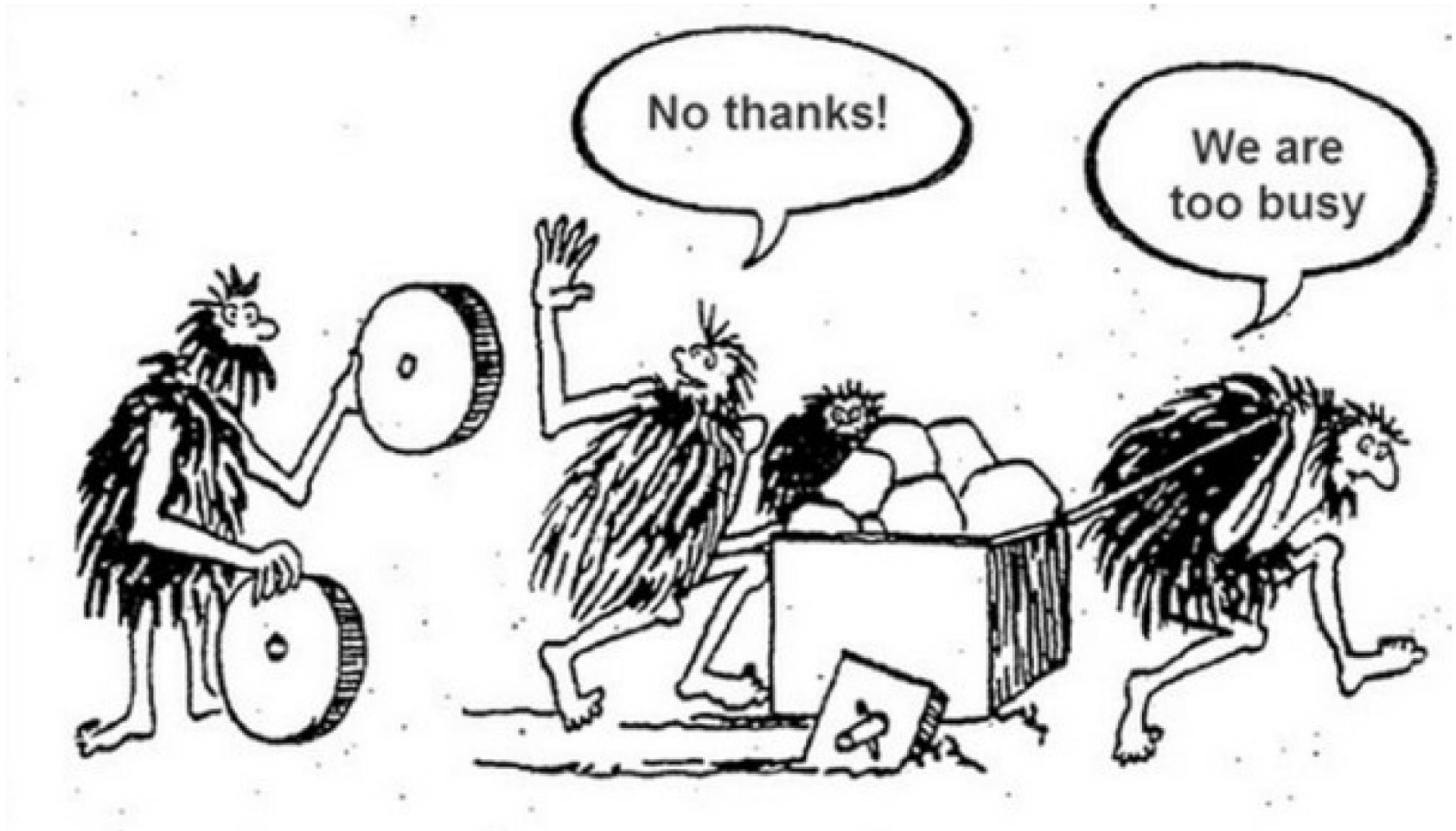
Sebastian Thrun: Flying Cars, Autonomous Vehicles, and Education | Lex Fridman Podcast #59
59,959 views Dec 21, 2019

https://www.youtube.com/watch?v=ZPPAOakITeQ

17:33 - What does it take to be a good leader?

A VERY INFORMATIVE LECTURE

THE RACE WILL BE WON BY SOFTWARE!!



The ROS goal is to provide a **standard for robotics software development, that you can use on any robot**.

Consider this image before saying "don't reinvent the wheel"

THERE IS ALWAYS A WISE GUY!

Start About 2007

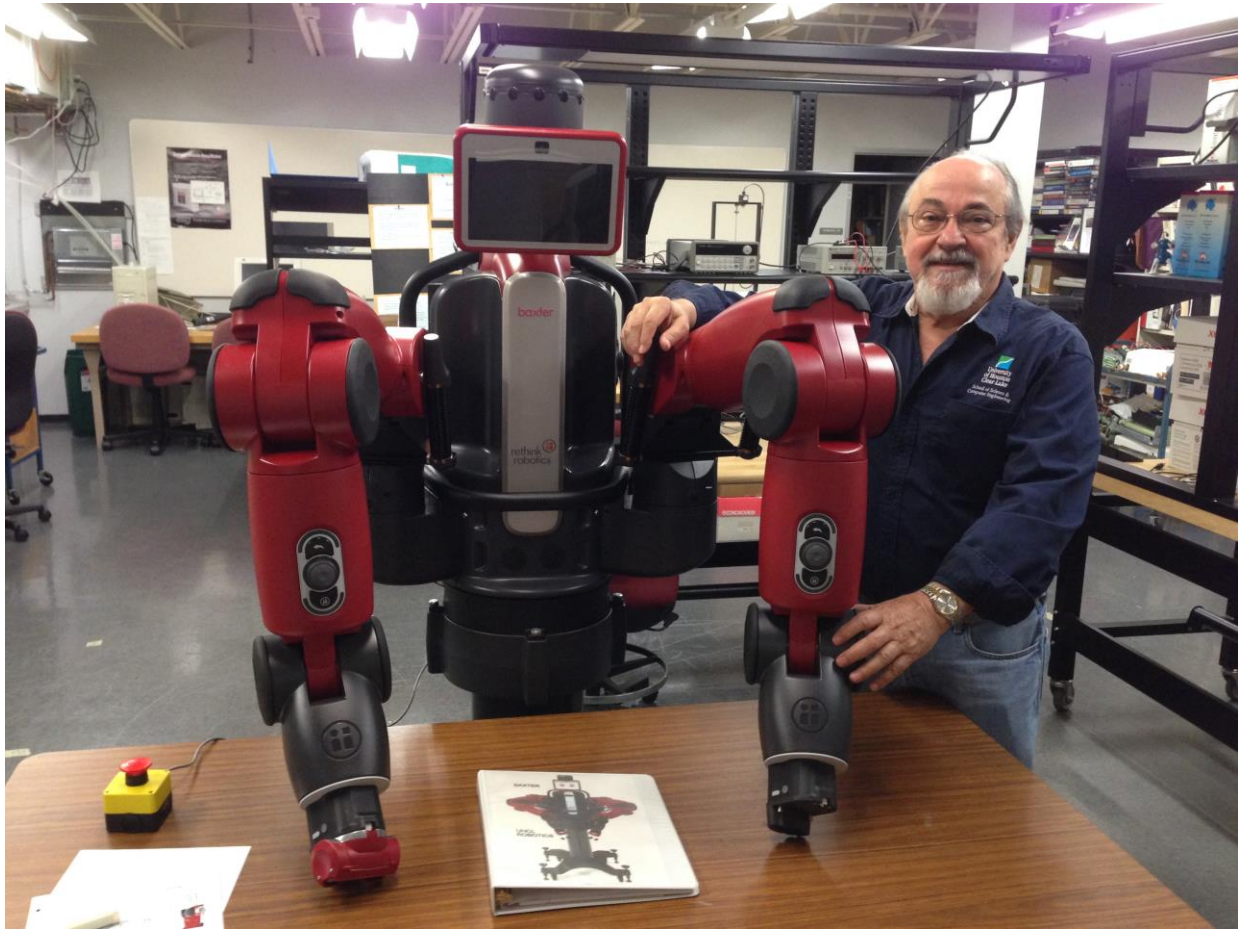
ROS: an open-source Robot Operating System

Morgan Quigley*, Brian Gerkey†, Ken Conley†, Josh Faust†, Tully Foote†,
Jeremy Leibs‡, Eric Berger†, Rob Wheeler†, Andrew Ng*

*Computer Science Department, Stanford University, Stanford, CA
†Willow Garage, Menlo Park, CA
‡Computer Science Department, University of Southern California

RODNEY'S COMPANIES

http://wiki.ros.org/Robots/Roomba



Main Floor

ROOMBA aka. JEEVES CLEANS THE FLOORS AND RUGS

10 ft

Room dividers Room labels Keep Out Zones

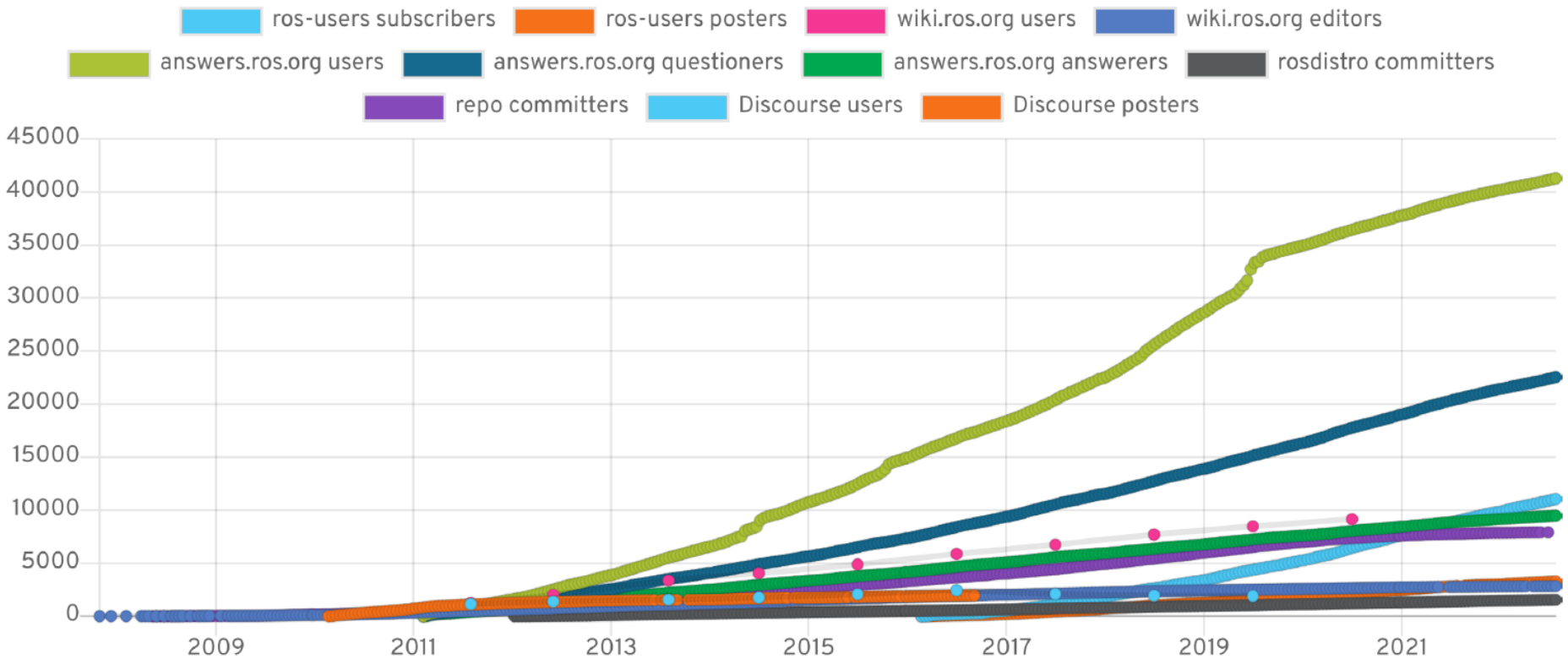
https://robots.ros.org/

ROS 10 Year Montage 2,082 views Dec 31, 2017

https://www.youtube.com/watch?v=mDwZ21Zia8s

ROS Metrics

Users | Packages | ROS Distro | Repos | Answers | Analytics | Wiki | Misc



A collection of different metrics for measuring the number of users in the ROS community.

ROS Community Metrics

Brian Gerkey, Ken Conley, Tully Foote August 2011 (reporting on July 2011)

Binary downloads - July 2011

Total unique IP addresses of binary .deb downloaders: **4,517**

Total downloads of binary .debs: **290,102**

Top 30 most-downloaded binary .debs:

ros-diamondback-visualization
ros-diamondback-visualization-common
ros-diamondback-desktop-full
ros-diamondback-simulator-gazebo
ros-diamondback-visualization-tutorials
ros-diamondback-slam-gmapping
ros-diamondback-executive-smach-visualization
ros-diamondback-executive-smach
ros-diamondback-ros-comm
ros-diamondback-rx
ros-diamondback-perception-pcl
ros-diamondback-common
ros-diamondback-common-msgs
ros-diamondback-geometry
ros-diamondback-diagnostics-monitors
ros-diamondback-robot-model
ros-diamondback-diagnostics
ros-diamondback-image-common
ros-diamondback-laser-pipeline
ros-diamondback-driver-common
ros-diamondback-vision-opencv
ros-diamondback-ros-tutorials
ros-diamondback-common-tutorials
ros-diamondback-image-pipeline
ros-diamondback-geometry-tutorials
ros-diamondback-navigation
ros-diamondback-documentation
ros-diamondback-image-transport-plugins
ros-diamondback-simulator-stage
ros-diamondback-ros

	208,563 % of Total: 100.00% (208,563)
1. China	**53,629** (24.77%)
2. United States	**29,584** (13.66%)
3. Japan	**17,528** (8.09%)
4. South Korea	**13,851** (6.40%)
5. Germany	**13,519** (6.24%)
6. India	**13,082** (6.04%)
7. Taiwan	**5,462** (2.52%)
8. Singapore	**4,431** (2.05%)
9. Hong Kong	**4,065** (1.88%)
10. United Kingdom	**4,028** (1.86%)
11. France	**3,756** (1.73%)
12. Canada	**3,555** (1.64%)
13. Italy	**3,384** (1.56%)
14. Russia	**2,970** (1.37%)
15. Turkey	**2,908** (1.34%)
16. Spain	**2,827** (1.31%)
17. Australia	**2,529** (1.17%)
18. Brazil	**2,078** (0.96%)
19. Thailand	**2,034** (0.94%)
20. Vietnam	**1,701** (0.79%)
21. Netherlands	**1,684** (0.78%)
22. Philippines	**1,586** (0.73%)
23. Indonesia	**1,393** (0.64%)

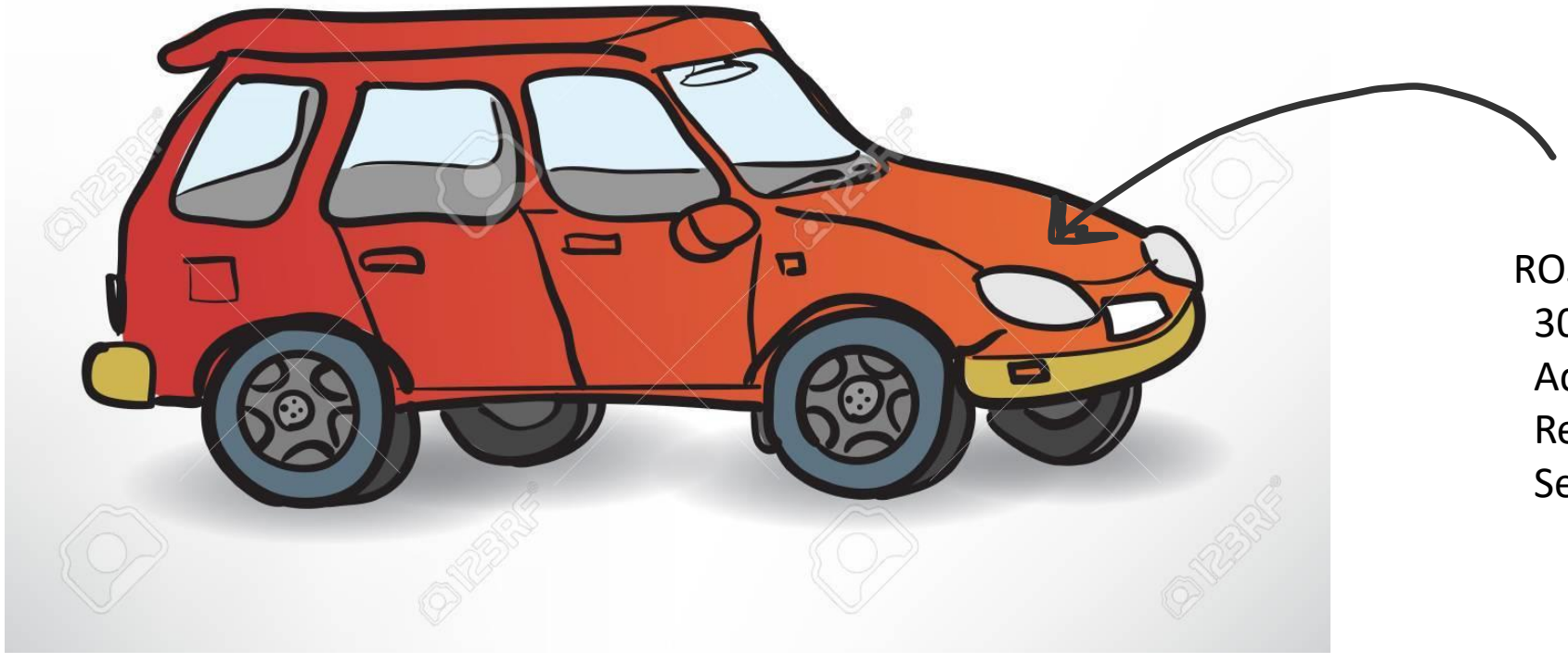
Source: Google Analytics
Site: wiki.ros.org in July 2021

Binary Downloads

	July 2020	July 2021	YoY Change
Total Pkgs	86128	89144	3.50%
Diff Pkgs	16044	19197	19.65%
Deb Downloads	38554145	35036199	-9.12%

120x

ROS1 Under The Hood 150hp



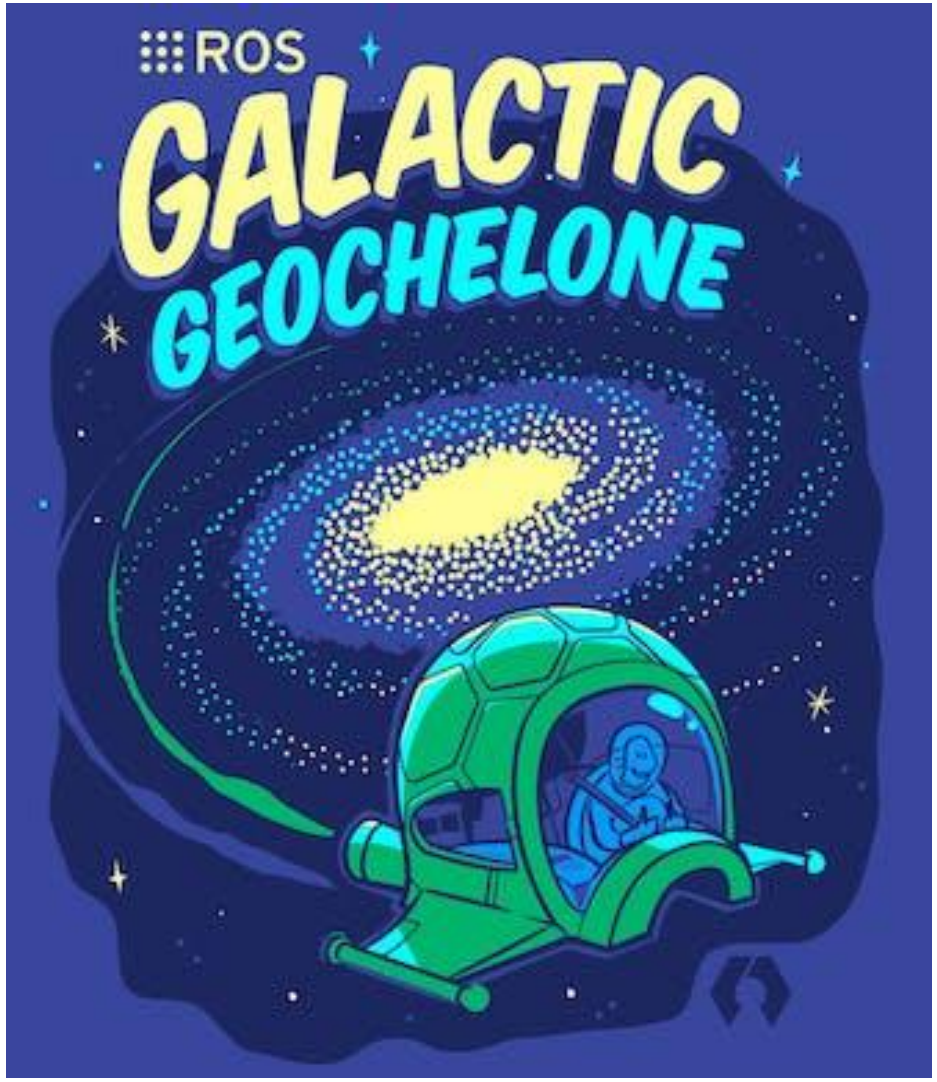
ROS2 **Under the Hood**

- 300hp
- Advanced Communications
- Real-time
- Security

ROS 1

- ONE ROBOT
- LIMITED SECURITY
- LIMITED REAL-TIME

- Teams of multiple robots
- Small embedded platforms
- Real-time systems
- Non-ideal networks
- Production environments


ROS
GALACTIC
GEOCHELONE