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# Intro to Robotics

By Morokot Sakal



# Bio: Morokot Sakal

## Education (2012 - 2020):

- A.Eng in Mechanical Engineering, Ibaraki College, Japan
- B.Eng in Mechanical Engineering, Tohoku University, Japan
- M.Eng in Aerospace Engineering, Tohoku University, Japan

**Position:** Lecturer & Researcher of IT faculty

**Email:** m.sakal@aupp.edu.kh

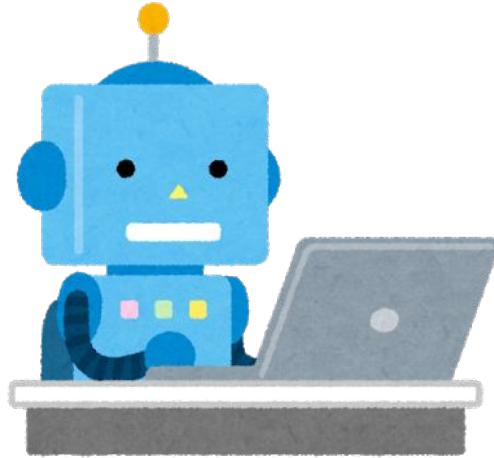
**Interests:** Satellite and STEM Education



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# Course Motivation

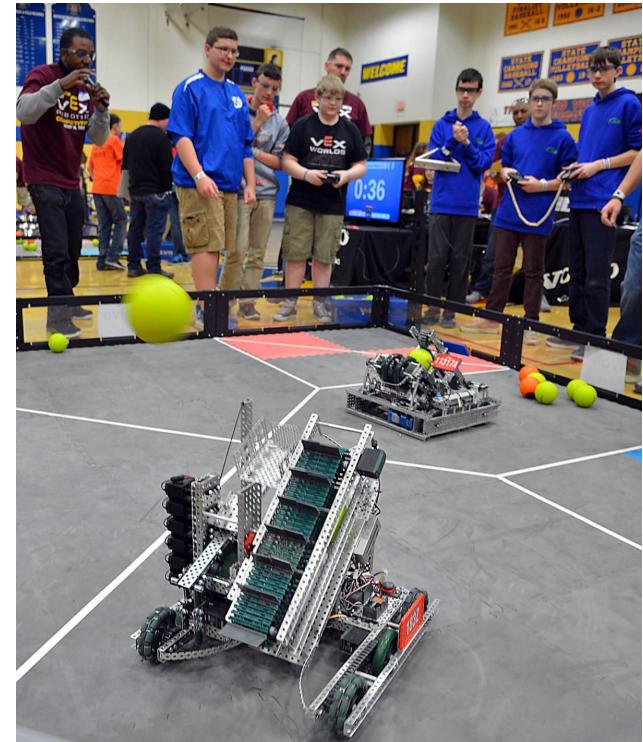
To introduce the field of **Robotics** and provide guidance to where to get started with Robotics



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# Intended Audience

- High school student
- People who interested in robotics in general
- No prior experience is required



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# What you will learn

## Morning session:

What is a Robot?

Types of Robot

Components of a Robot

Pathway to learning Robotics

Q&A session

## Afternoon session:

Intro to VEXcode VR platform

Driving around

Using sensors

Final coding challenge

Q&A session



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What is a Robot?

# Example of robotics in science-fiction



BB-8 from Star War



Doraemon



Jarvis of Iron Man



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# Example of recent robot



autonomous vehicles  
[Google]



Commercial drones  
[DJI]

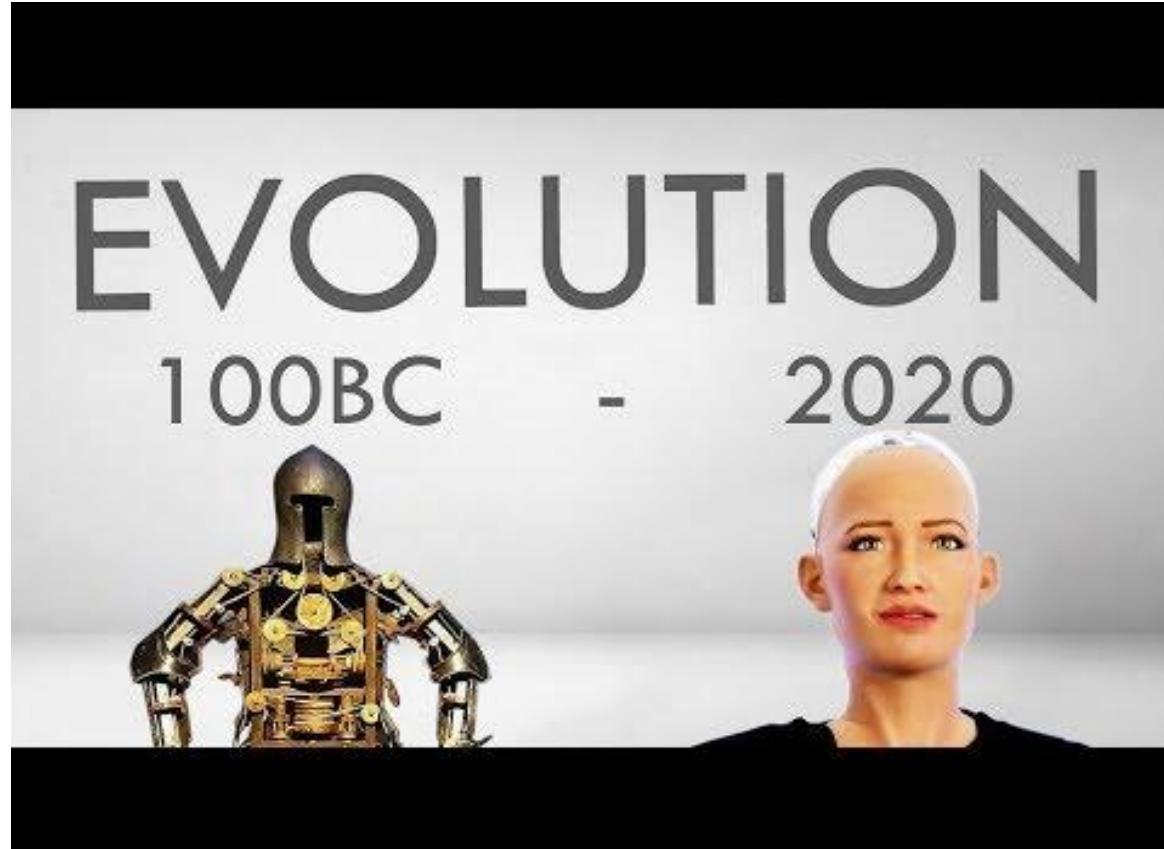


Mars Rover  
[NASA JPL]



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# Robots evolution



# What is your favorite robot?



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# Definition

**Old:** Robota (Czech word) = Forced labor or a worker

**New:** A robot is an **autonomous** system which exists in the physical world, can **sense** its environment, and can **act** on it to achieve some goals

Since the field of Robotics is evolving, its definition is erratic



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# Definition based on characteristic

**Working long duration:** If one system can **work in longer duration** without **supervision**, that system can be considered as robot

Example: a system which has autonomous charging capability



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# Definition based on characteristic (cont.)

**Ease of operation:** the easier it is to operate, the more it tends to be a robot



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# Definition based on characteristic (cont.)

**Autonomy:** the more the system is able to operate automatically without supervision, the more likely is a robot



Autonomous Mobile Robot [Amazon]

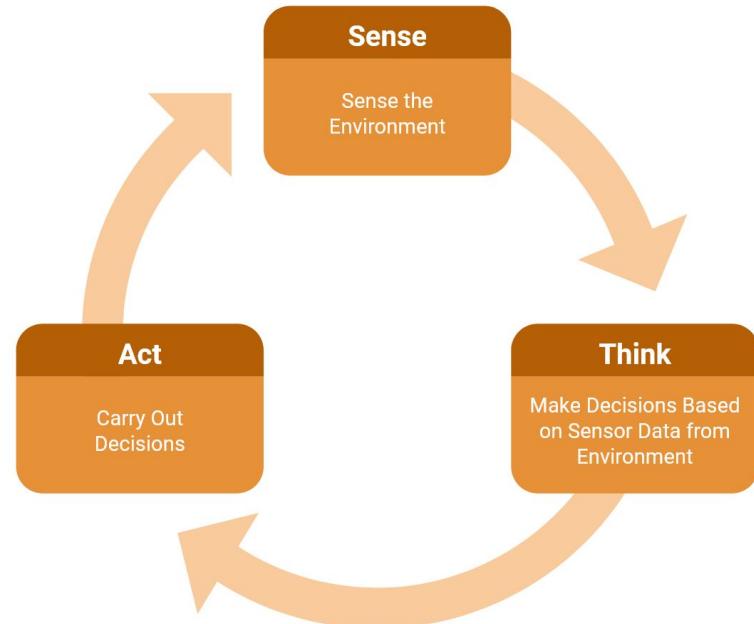


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# Definition based on actions

## **SENSE, THINK and ACT:**

If a system is able to do the three actions above, it is considered a robot



# Is a smart washing machine a robot?

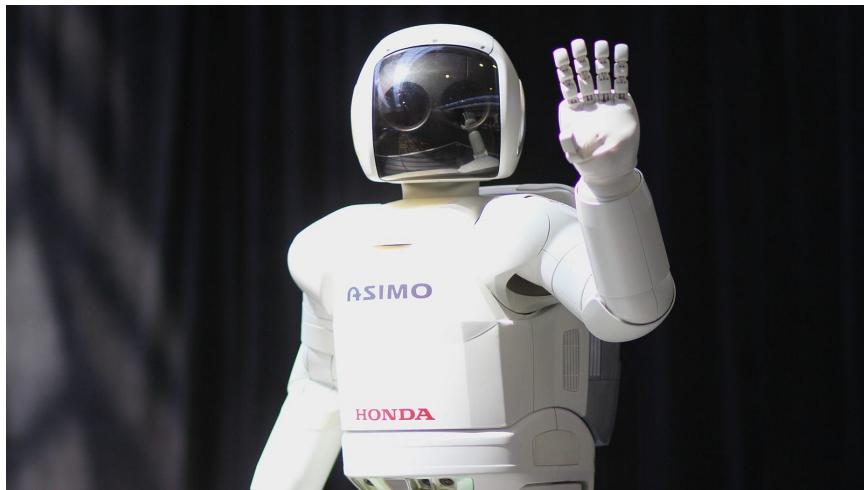
Smart washing machine is not considered as a robot because it is not

**REPROGRAMMABLE**



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# Summary



AUTONOMY  
= SENSE, THINK and ACT

REPROGRAMMABLE



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# Types of Robot

# Classification of Robots

There are many different ways to classify a robot, based on

- Period of its development
- Budget
- Tasks
- Applications

In this course, we will classify the robot based on **Tasks** and **Applications**



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# Why do we create Robot?

4D

Dirty

Dangerous

Dull

Difficult



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# Task: Dirty

Refer to the tasks which there's a risk of contamination or is harmful to the human body, a robot should be used to perform such task



Pipe inspection crawler robot



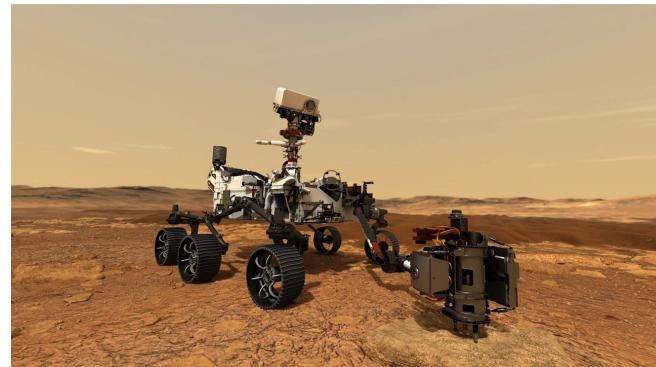
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# Task: Dangerous

Refer to the tasks that are too dangerous or a risk to one's life



Skyscraper window cleaning robot



Mars exploration rover



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# Task: Dull (repetitive)

Refer to the tasks that are repetitive and boring, frequently seen in the manufacturing process



Charlie Chaplin, Modern Time (1930s)



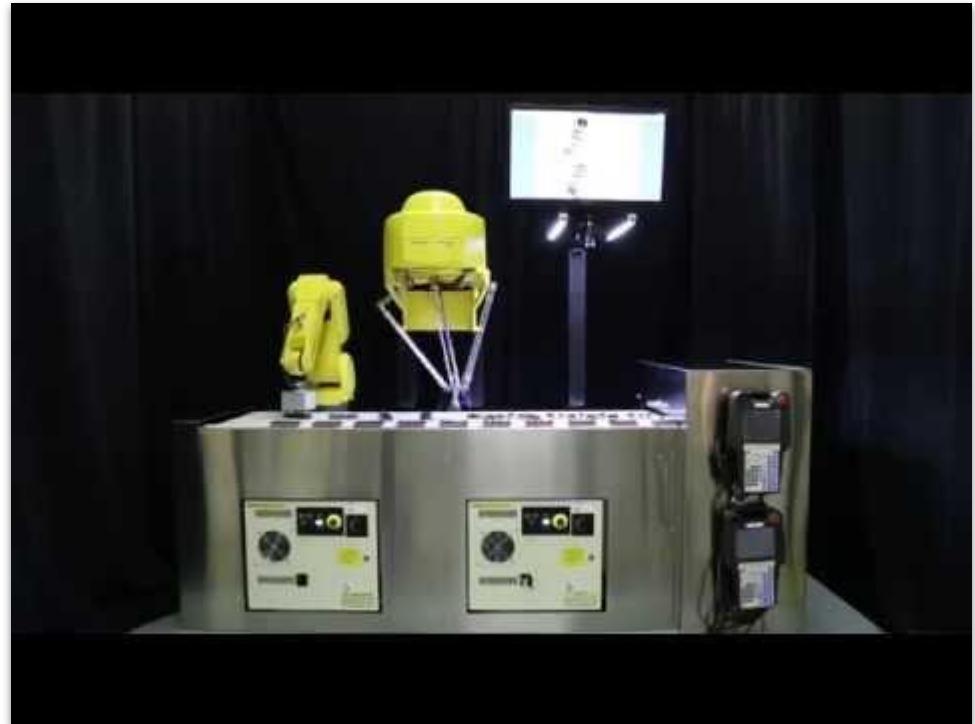
Assembly robot



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# Task: Difficult

Refer to the tasks that are impossible for human to use one's hands or brain and hands together to perform



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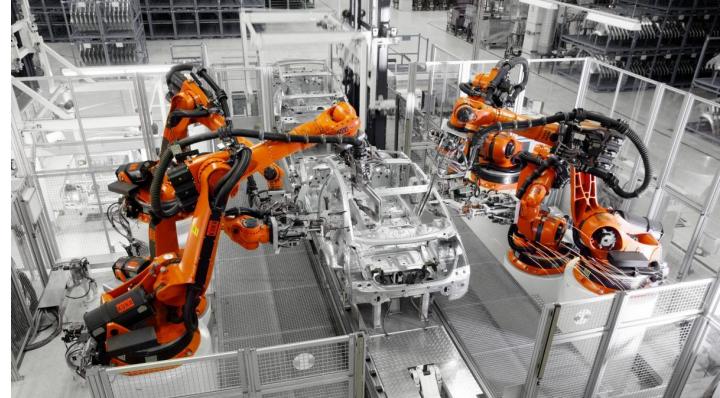
# Application: Manufacturing

- standardized result
- repetitive
- produce in huge quantity

Certain process:

- high temperature
- dangerous chemical substances

These tasks are Dull & Dangerous



Kuka Robot



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# Application: Logistic

Transport products in warehouses, hospital, etc.

Recent technology: Drone

- Pickup package
- Detect barcode for inventory checking



Autonomous Mobile Robot [Amazon]



Delivery drone [DHL]



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# Application: Transportation

Transport human

- Example: autonomous driving, buses, taxis

Advantages

- Help with traffic congestion
- Reduce traffic accidents



[Google]



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# Application: Exploration

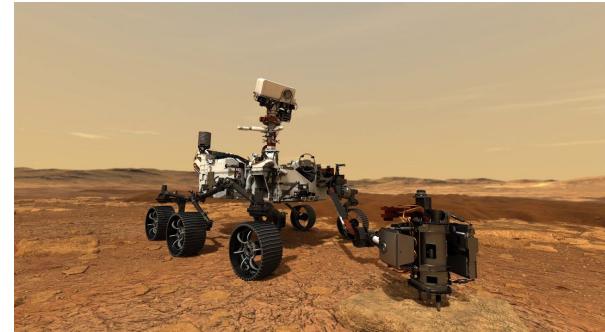
We explore:

- Natural resources
- Inaccessible by human (sea, sky, outerspace, etc)

Using a robot to perform such task is more efficient than human

It can also be used for:

- Security checking
- Rescuing disaster victims



Mars Rover [NASA JPL]



Searching & Rescue Robot [Tohoku Uni.]



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# Application: Medical

1. Provide assistance (Telemedicine)

Example: Surgical operation, diagnosis



2. Assist patient with disability

Example: Helping out with therapy  
(physical & mental)



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## Application: Entertainments

Various advertisements and filming:  
create interesting camera angle by  
using robot



Commercial drones  
[DJI]



Stuntronics [Disney]

Stuntman is replaced by robot to  
perform dangerous tasks



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# Other applications

## Service & Social Relation

- Help out with household chores (vacuuming)
- Welcoming guests at a shop or hotel



Roomba (Vacuum Cleaner)



Pepper [Softbank]



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# Morning Session: Scan for Presence

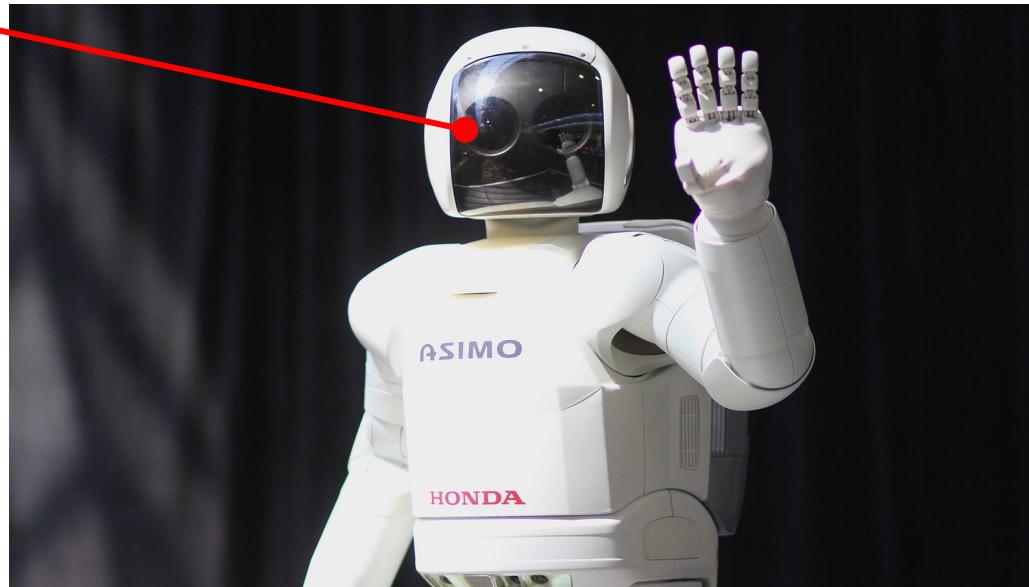


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# Components of a Robot

# Five basic components of a Robot

Sensor



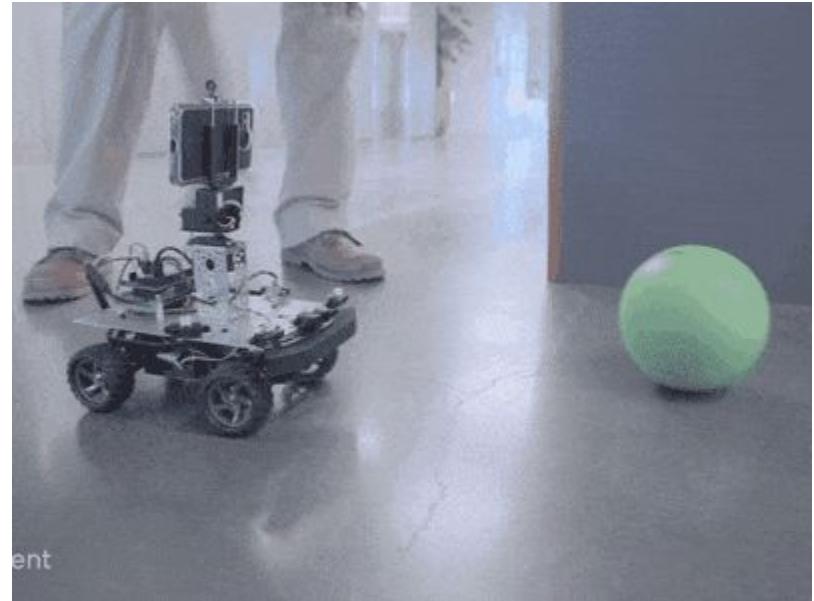
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# Sensor

Vision: light, color sensor, camera

Touch: bump sensor

Sound, etc

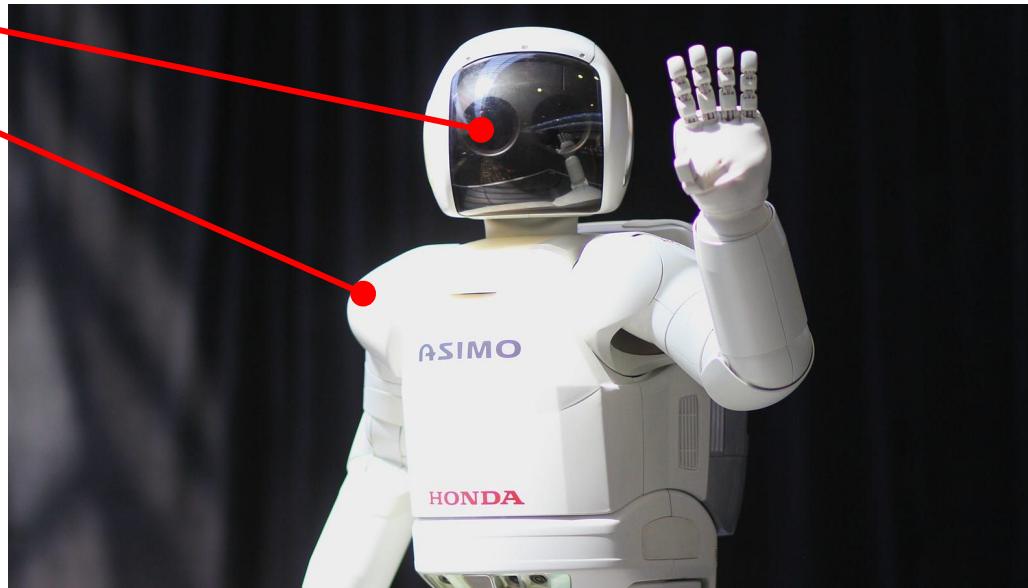


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# Five basic components of a Robot

Sensor

Actuator



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# Actuator

Wheels

Propellers/Wings

Arm

Legs

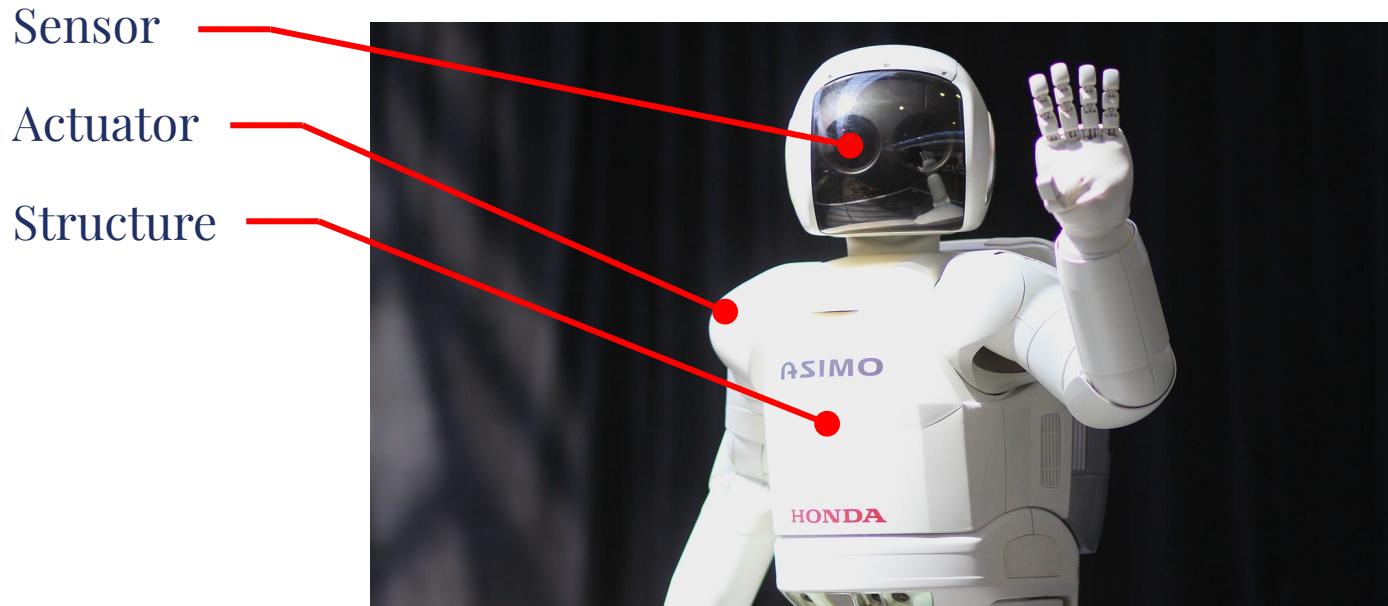
In a form of

- electrical motors
- hydraulics



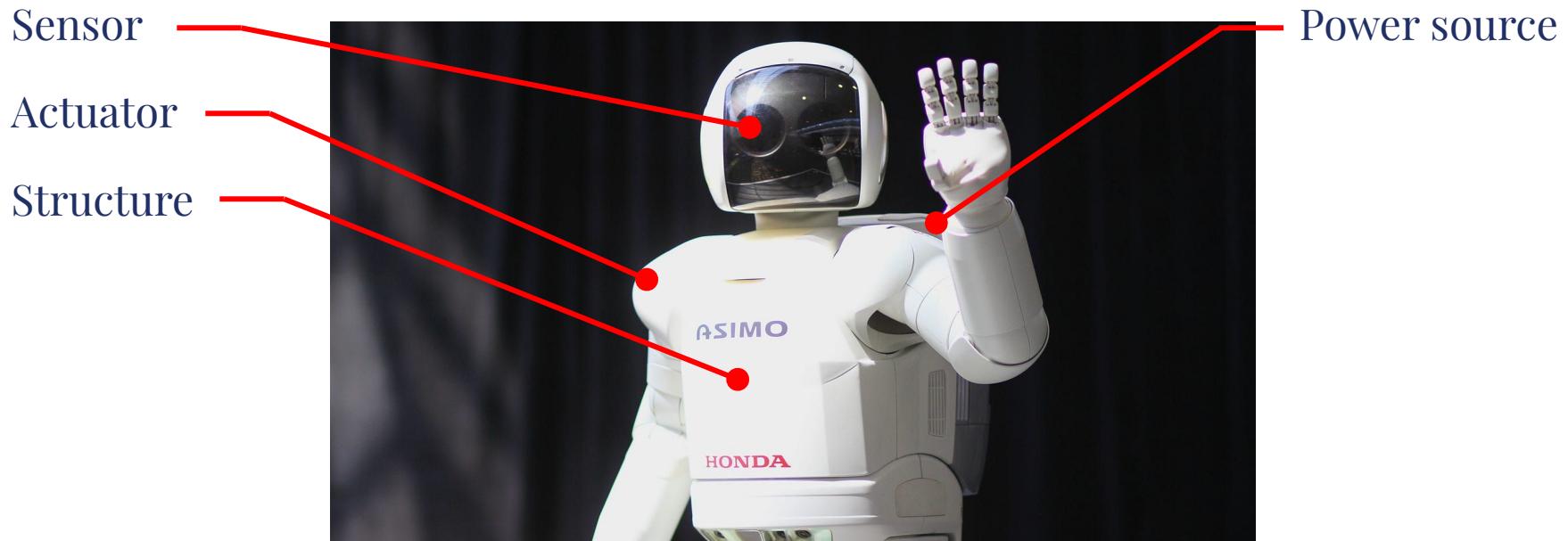
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# Five basic components of a Robot



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# Five basic components of a Robot



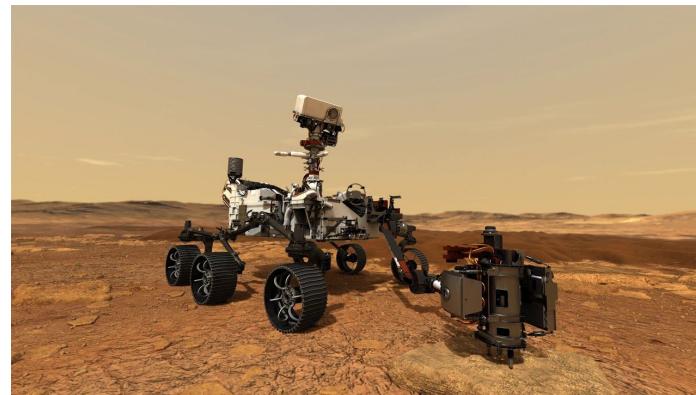
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# Power

- Battery
- Solar
- Internal Combustion
- Radioisotope Thermoelectric Generator (RTG)

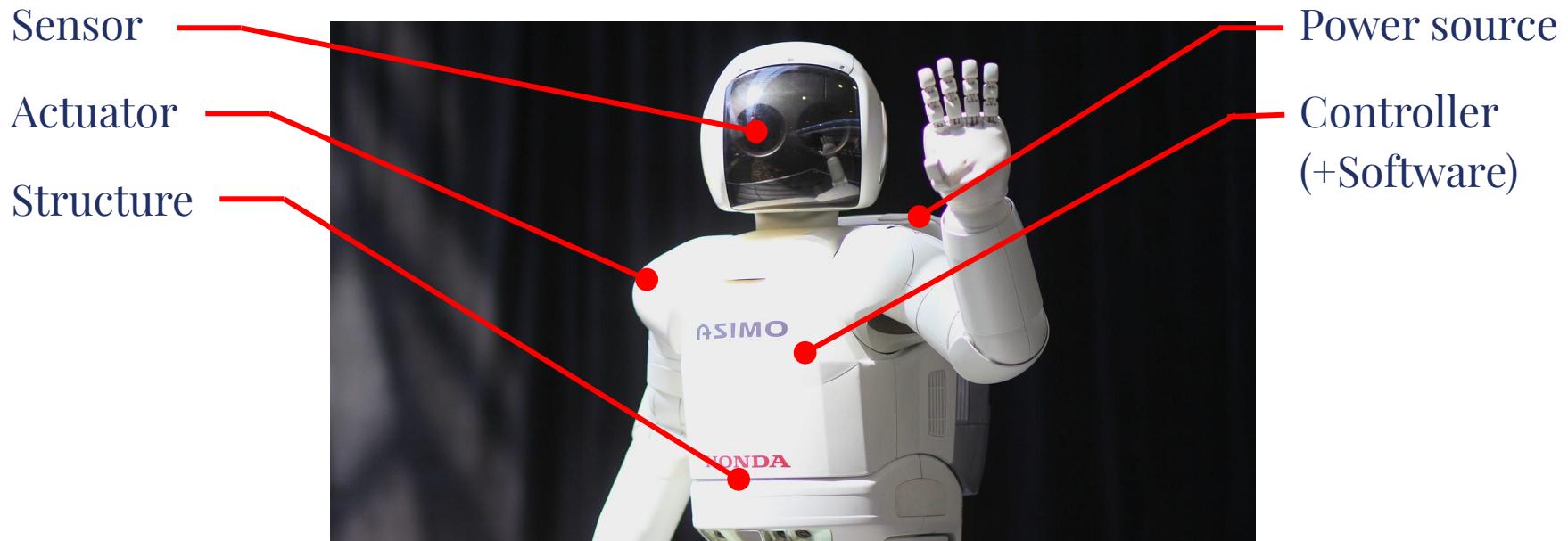


Boston Dynamics



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# Five basic components of a Robot

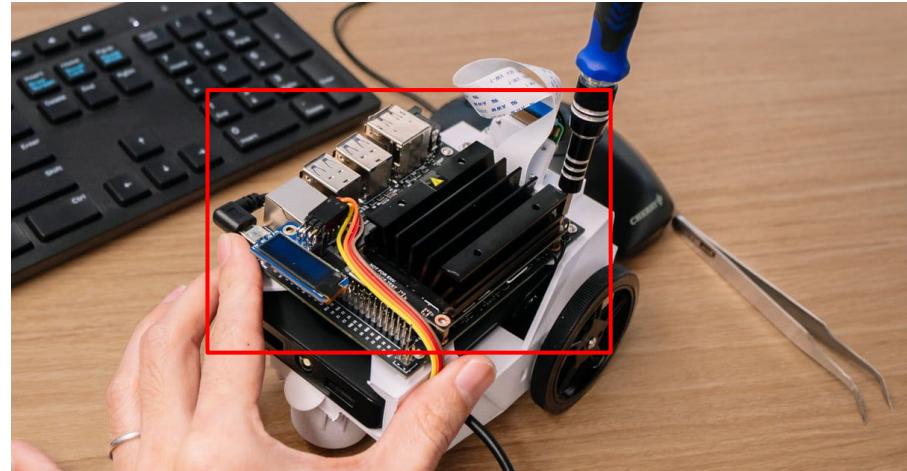


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# Controller (+Software)

An electrical circuit

- Brain of robot
- Sensor data processing
- Control the movement/actions of a robot
- Power management



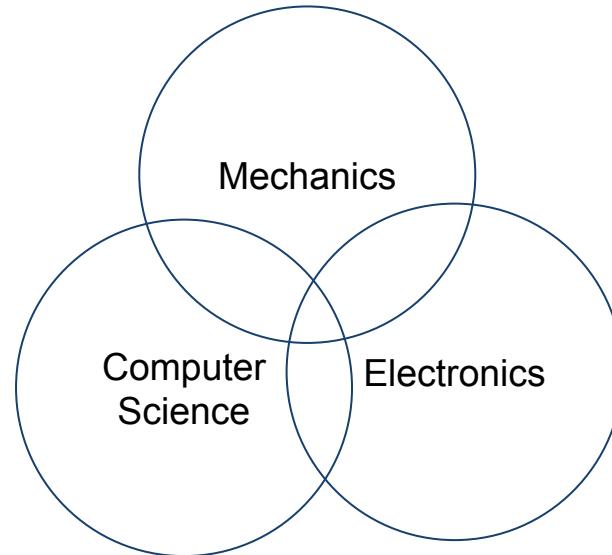
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# Pathway to learn robotics

# Skills needed

# Robotics

=



Physics

Mathematics



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# How to become a roboticist

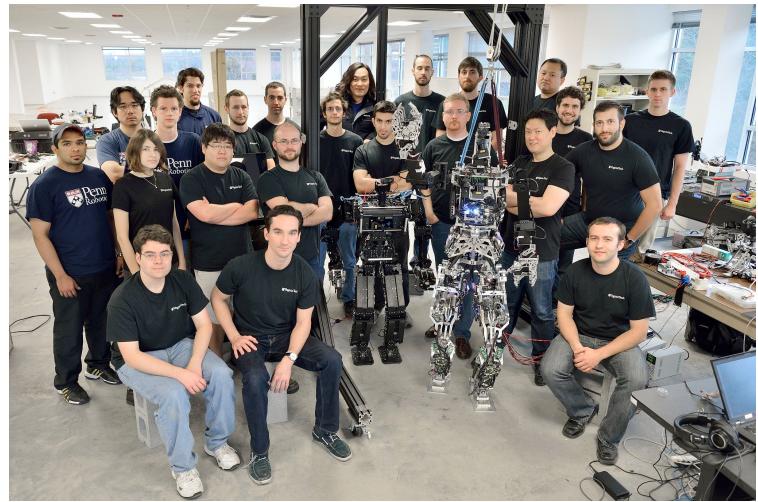
Fiction



Iron Man [Marvel]

He is working alone :))

Reality



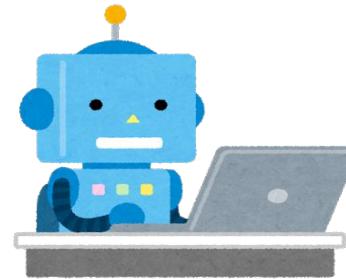
An University Robotics team

You need a team to build a robot

# Approaches to learn Robotics



1. Build your **first robot** using a kit or on your own



2. Take **robotics course online** to strengthen your skills



3. Join a **robotics club** to share your passion with others and receive advices



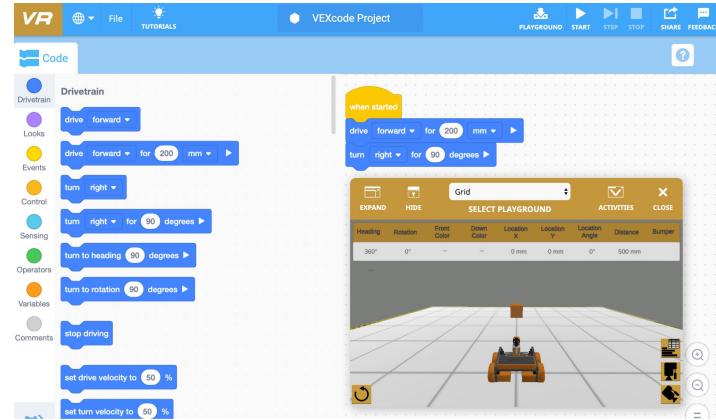
4. Enter **robotics competitions** when you're ready to showcase your projects.

# 1: Build your own first robot

- Start with simple robots, and as you gain experience, move on to complex models over time.
- Using online platform to learn robotics coding.



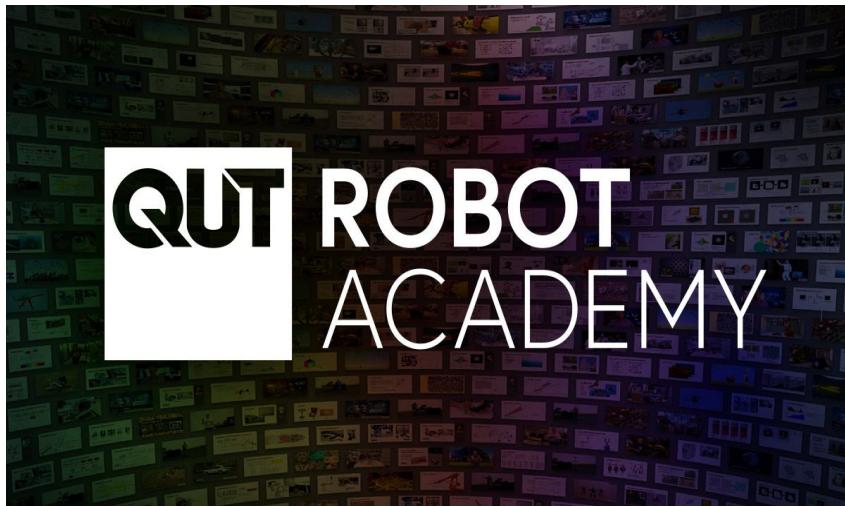
Hardware-based [makeBlock]



Simulator [VEX Robotics]

## 2: Take robotics course online (Coursera, Udacity, Edx, etc)

Robotics course that can teach you advanced techniques



ETH zürich

A screenshot of a course slide from ETH Zurich's "Programming for Robotics" series. The slide has a blue header with the ETH Zurich logo. Below the header is a photograph of a large, classical-style building with a prominent dome and multiple levels of arched windows. The title "Programming for Robotics" and subtitle "Introduction to ROS" are displayed in white text on the left side of the slide. The names of the instructors, Péter Fankhauser, Dominic Jud, Martin Wermelinger, and Marco Hutter, are listed at the bottom. In the bottom right corner, there is a large ROS logo consisting of a 4x4 grid of dots followed by the letters "ROS".

Programming for Robotics  
Introduction to ROS

Péter Fankhauser, Dominic Jud, Martin Wermelinger, Marco Hutter

RSL  
Robotic Systems Lab

Péter Fankhauser | 20.02.2017 | 1

<https://www.wikihow.com/Learn-Robotics>



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## 2: Take robotics course online (Coursera, Udacity, Edx, etc)

Robotics course that can teach you advanced techniques

The screenshot shows the landing page for the "Robotics Software Engineer" Nanodegree program. At the top left, it says "NANODEGREE PROGRAM". Below that is the title "Robotics Software Engineer". A brief description follows: "Build five hands-on projects to acquire core robotics software engineering skills: ROS, Gazebo, Localization, Mapping, SLAM, Navigation, and Path Planning." Two buttons are present: "DOWNLOAD SYLLABUS" and "START LEARNING". At the bottom, it shows "ENROLLMENT CLOSING IN" with a timer: "19 09 45 13 DAYS HRS MIN SEC". On the right side, there's a box titled "SKILL COVERED" listing "C++ . ROS . Localization . Mapping . SL... + MORE". It also specifies "CLASSROOM OPENS 01 May 2019" and "DURATION 4 Months". A note below states: "Classroom opens 7 days after enrollment closes" and "We recommend 10 hrs / week".

Robotics course [Udacity]

<https://www.wikihow.com/Learn-Robotics>

The screenshot shows the landing page for the "Robotics Specialization" offered by the University of Pennsylvania. At the top right, it says "Offered By" and shows the Penn logo with "Penn UNIVERSITY OF PENNSYLVANIA". The specialization title is "Robotics Specialization". A brief description follows: "Learn the Building Blocks for a Career in Robotics. Gain experience programming robots to perform in situations and for use in crisis management". Below that is a rating section with "4.3 2,671 ratings". A师资力量 profile for "Vijay Kumar" is shown, along with "+6 more instructors". A large red button at the bottom left says "Enroll for Free Starts Jul 27". To its right, it says "Financial aid available". At the bottom, it shows "34,720 already enrolled".

Robotics course [Coursera]



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### 3: Join a Robotics club

Join a **robotics club** at your school or friends who share the same passion, to share your hobby with other people and learn new ways to build robots.

Note: If you can't find any robotics clubs in your area, consider starting your own instead.

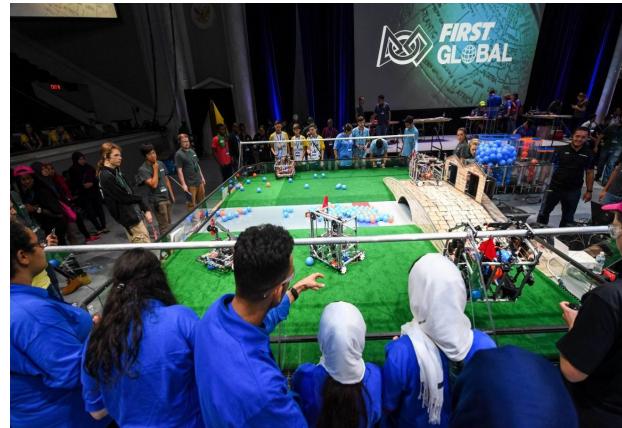


## 4: Enter robotics competition

No matter how you do, robotics competitions can be a great way to test your robots and learn ways to make them better.



National competition

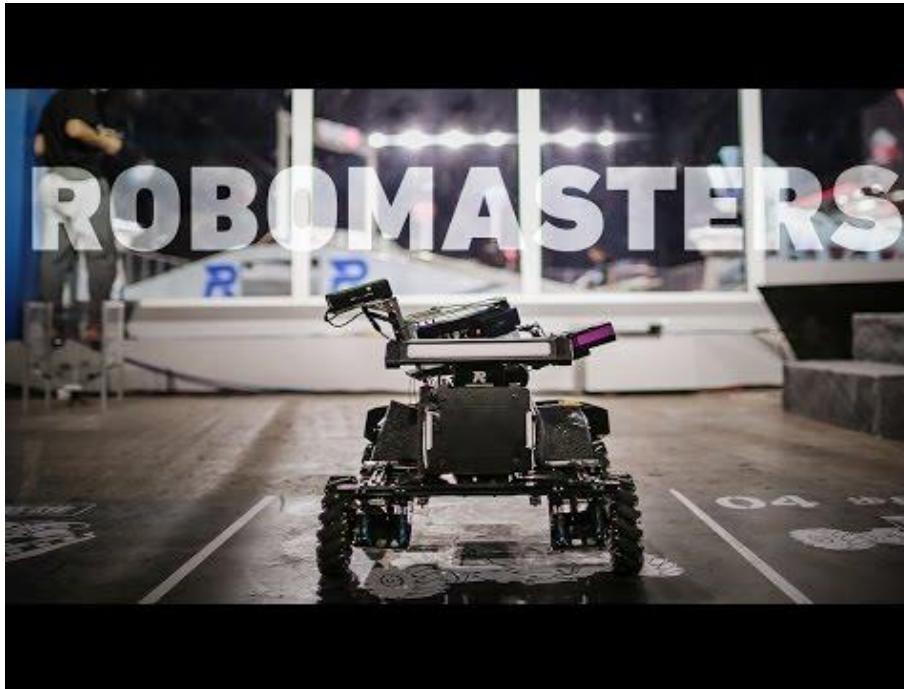


International competition

# Competition: RoboMasters

Similar to Dota or  
Mobile Legend

Engineer = Superstar



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# Advanced your study in the university

Currently, there is no existing university in Cambodia that offers major in Robotics.

Choose amongst the following:

- Information and Communications Technology
- Electrical and Electronics Engineering
- Mechanical Engineering



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Thank you!



gifs.com

[Boston Dynamics]



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