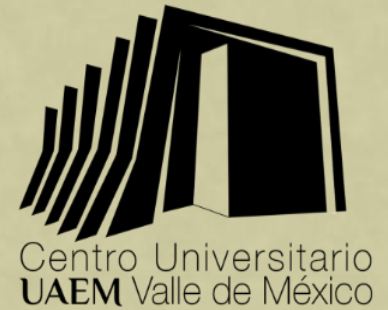




FUNDAMENTALS OF ROBOTICS



Ingeniería en Computación

UDA: FUNDAMENTOS DE ROBÓTICA

TEMA: INTRODUCCIÓN A LA ROBÓTICA

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CU UAEM VM**



PROGRAMA DE ESTUDIO POR COMPETENCIAS
FUNDAMENTOS DE ROBOTICA

I. IDENTIFICACIÓN DEL CURSO

Espacio Educativo: Facultad de Ingeniería						
Licenciatura: Licenciatura de Ingeniería en Computación				Área de docencia: Interacción Hombre-Máquina		
Año de aprobación por el Consejo Universitario:						
Aprobación por los H.H. Consejos Académico y de Gobierno		Fecha:		Programa elaborado por: Adriana H. Vilchis González		Programa revisado por:
				Fecha de elaboración : 20 Septiembre del 2009		
Clave	Horas de teoría	Horas de práctica	Total de horas	Créditos	Tipo de curso	Núcleo de formación
L41067	2	1	3	5	Curso	Sustantivo
Unidad de Aprendizaje Antecedente Ninguna				Unidad de Aprendizaje Consecuente Ninguna		
Programas educativos o espacios académicos en los que se imparte: Licenciatura en Ingeniería en Computación (Facultad. de Ingeniería, Centros Universitarios: Atlacomulco, Ecatepec, Texcoco, Valle de Chalco, Valle de México, Valle de Teotihuacán, Zumpango)						

FUNDAMENTALS OF ROBOTICS

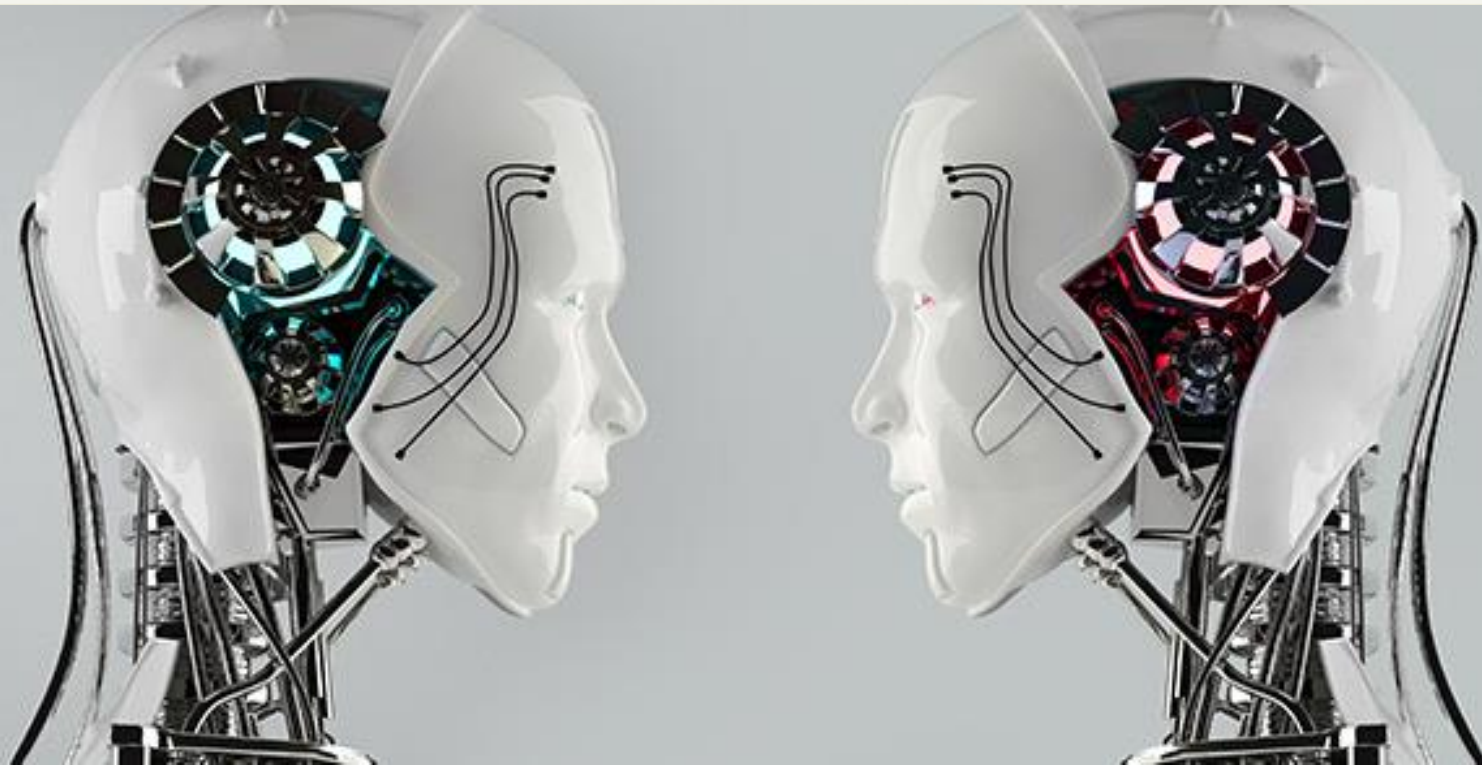


Image taken from <http://www.cra.org/ccc/visioning/visioning-activities/robotics>

ROBOTICS FIRST TIMELINE

- 1922 Czech author Karel Capek wrote a story called Rossum's Universal Robots and introduced the word "Robota" (meaning worker, labor doing compulsory manual works without receiving any remuneration).
- 1954 George Devol developed the first programmable Robot.
- 1955 Denavit and Hartenberg developed the homogenous transformation matrices
- 1962 Unimation was formed, first industrial Robots appeared.

WHAT IS A ROBOT?

- *Random House Dictionary* A machine that resembles a human being and does mechanical routine tasks on command.
- *Robotics Association of America* An industrial robot is a re-programmable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.

WHAT IS A ROBOT?

- *Oxford dictionary* A machine resembling a human being and able to replicate certain human movements and functions automatically.
- Today's robots are a combination of manipulative, perceptive, communicative, and cognitive abilities. Today's robots are capable of so many tasks. Yet, there is so much more on the horizon.

WHAT IS A ROBOT ?

- A manipulator (or an industrial robot) is composed of a series of links connected to each other via joints. Each joint usually has an actuator (a motor for eg.) connected to it.
- These actuators are used to cause relative motion between successive links. One end of the manipulator is usually connected to a stable base and the other end is used to deploy a tool.

TO QUALIFY AS A ROBOT

- A machine must be able to:
 - Sensing and perception: get information from its surroundings.
 - Carry out different tasks: Locomotion or manipulation, do something physical—such as move or manipulate objects.
 - Re-programmable: can do different things in different ways.
 - Function autonomously and/or interact with human beings.

ROBOTS ARE HARD TO DEFINE

- As the field of robotics rapidly progresses it is not necessarily a bad thing that everyone has not agreed on a universal definition for a robot:
 - Robots are likely to outgrow any definition placed upon them.
 - Perhaps Joseph Engelberger, father of the industrial robot, summed it up best when he said: "I may not be able to define one, but I know one when I see one."

HOLLYWOOD'S ROBOTS



LAWS OF ROBOTICS

- Isaac Asimov proposed the following three Laws of Robotics:
 - Law 1: A robot may not injure a human being or through inaction, allow a human being to come to harm.
 - Law 2: A robot must obey orders given to it by human beings, except where such orders would conflict with a higher order law.
 - Law 3: A robot must protect its own existence as long as such protection does not conflict with a higher order law.

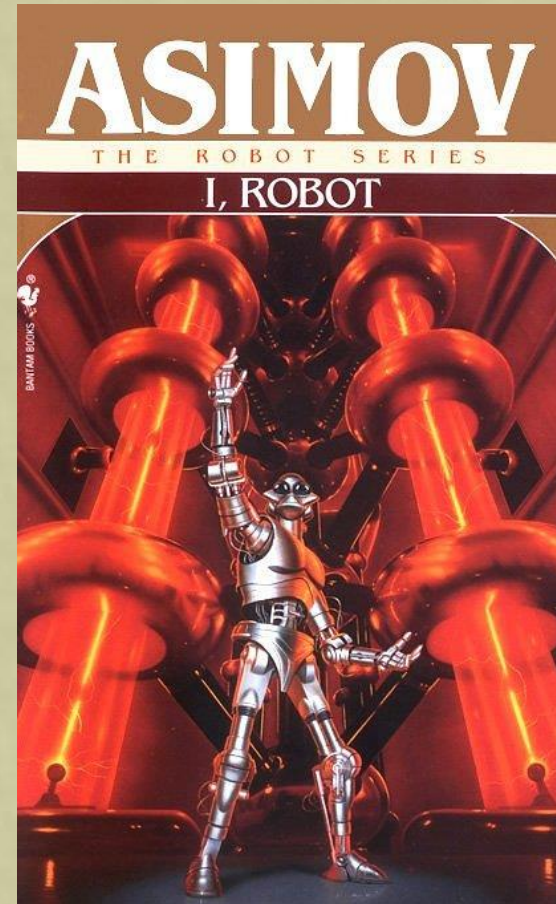


Image taken from <http://www.therobotspajamas.com/book-report-i-robot/>

Go to http://www.asimovonline.com/asimov_home_page.html

CLASSIFICATION OF ROBOTS

- **JIRA** (**J**apanese **I**ndustrial **R**obot **A**ssociation):
 - Class1: Manual-Handling Device
 - Class2: Fixed Sequence Robot
 - Class3: Variable Sequence Robot
 - Class4: Playback Robot
 - Class5: Numerical Control Robot
 - Class6: Intelligent Robot

CLASSIFICATION OF ROBOTS

- **RIA (Robotics Institute of America):**
 - Variable Sequence Robot (Class3): A device that performs the successive stages of a task according to a predetermined method easy to modify.
 - Playback Robot (Class4): A human operator performs the task manually by leading the Robot.
 - Numerical Control Robot (Class5): The operator supplies the movement program rather than teaching it the task manually.
 - Intelligent Robot (Class6): A robot with the means to understand its environment and the ability to successfully complete a task despite changes to the environment.

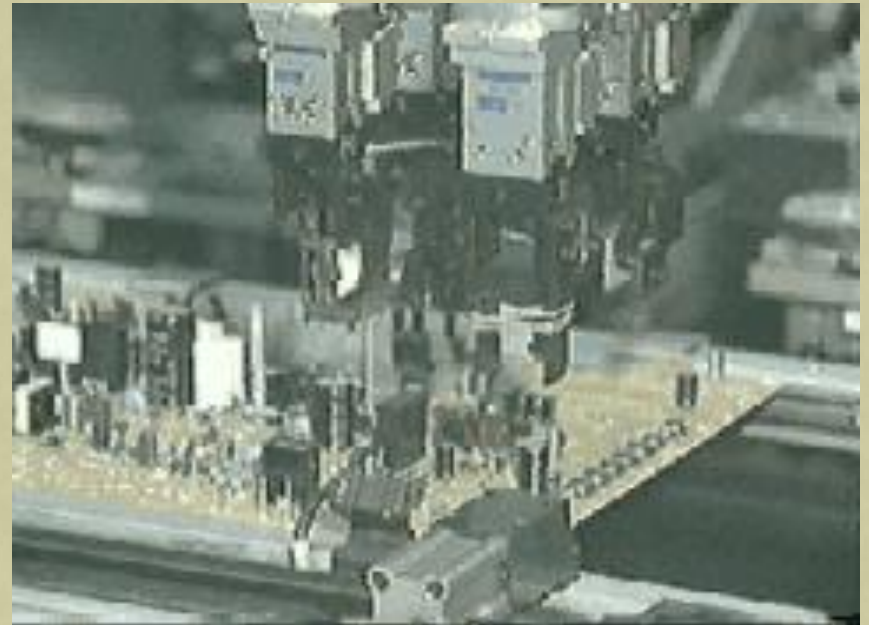
CLASSIFICATION OF ROBOTS

- **AFR** (**A**ssociation **F**rançaise de **R**obotique):
 - Type A: Manual Handling Devices/ telerobotics
 - Type B: Automatic Handling Devices/ predetermined cycles
 - Type C: Programmable, Servo controlled robot, continuous point-to-point trajectories
 - Type D: Same type with C, but it can acquire information

ROBOTS IN THE WORLD

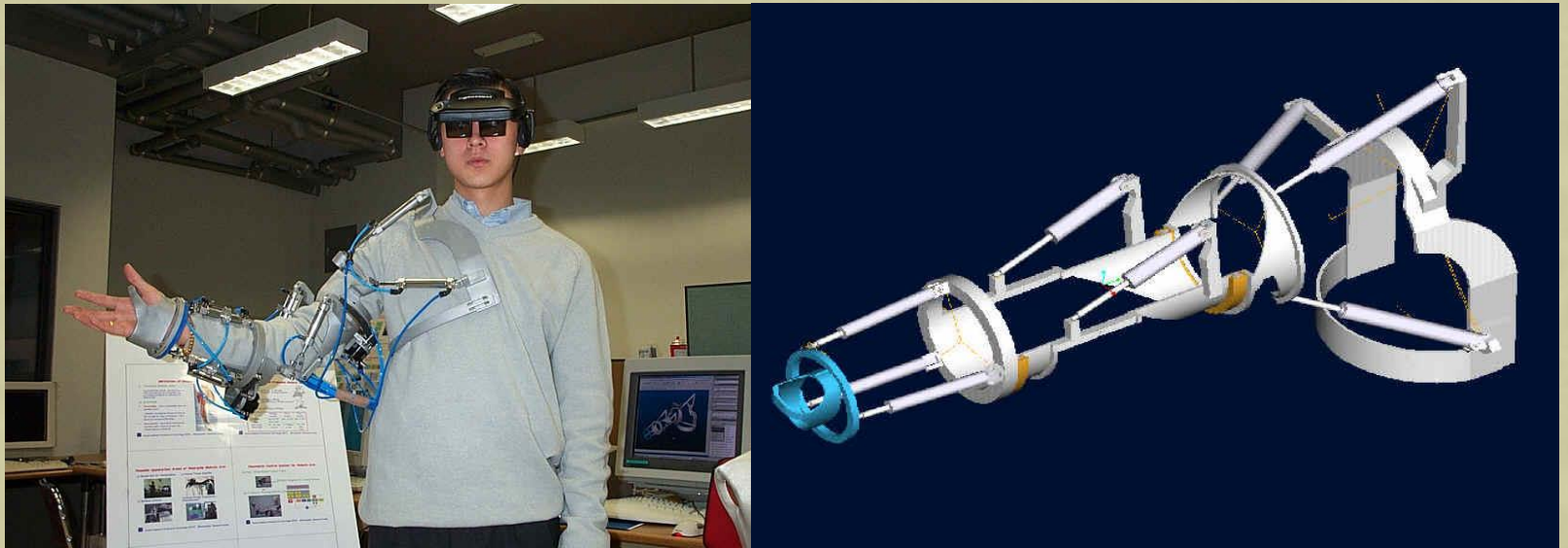


Painting Robot in Motor Company



Assembly Robot in Electronic Company

ROBOTS IN THE WORLD

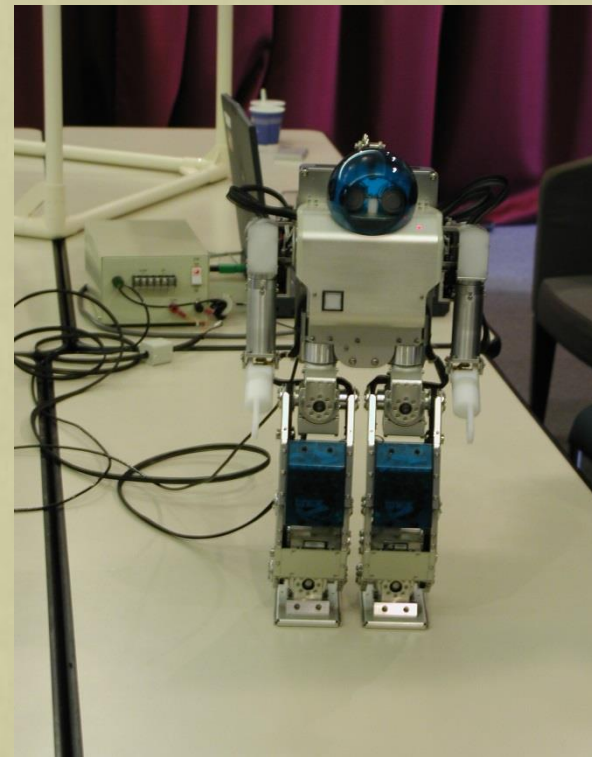


Wearable Robotic Arm and Tele-Operated Robot (KIST)

ROBOTS IN THE WORLD



HONDA (ASIMO) – Biped Robot



Fujitsu – Biped Robot (Laptop Size)

ROBOTS IN THE WORLD



Sony (AIBO) – Toy robot

ROBOT CHARACTERISTICS

- Robots are:
 - Machines - mechanical devices designed for doing work.
 - Automatic - operations which are executed without external help.
 - Reprogrammable - multifunctional and flexible: not restricted to one job but can be programmed to perform many jobs (nearly all robot systems contain a reprogrammable computer).
 - Responsive - must be able to react based on their sensory input.

WHAT IS ROBOTICS?

- Robotics is the art, knowledge base, and the know-how of designing, applying, and using robots in human endeavors.
- Robotics is an interdisciplinary subject that benefits from mechanical engineering, electrical and electronic engineering, computer science, biology, and many other disciplines.

WHAT IS ROBOTICS

- History of Robotics:
 - 1922: Karel Čapek's novel, Rossum's Universal Robots, word "Robota" (worker)
 - 1952: NC machine (MIT)
 - 1955: Denavit-Hartenberg Homogeneous Transformation
 - 1967: Mark II (Unimation Inc.)
 - 1968: Shakey (SRI) - intelligent robot
 - 1973: T3 (Cincinnati Milacron Inc.)
 - 1978: PUMA (Unimation Inc.)
 - 1983: Robotics Courses
 - 21C: Walking Robots, Mobile Robots, Humanoid Robots

ADVANTAGES VS. DISADVANTAGES OF ROBOTS

- Robots increase productivity, safety, efficiency, quality, and consistency of products.
- Robots can work in hazardous environments without the need.
- Robots need no environmental comfort.
- Robots work continuously without experiencing fatigue of problem.

ADVANTAGES VS. DISADVANTAGES OF ROBOTS

- Robots have repeatable precision at all times.
- Robots can be much more accurate than human.
- Robots replace human workers creating economic problems.
- Robots can process multiple stimuli or tasks simultaneously.

ADVANTAGES VS. DISADVANTAGES OF ROBOTS

- Robots lack capability to respond in emergencies.
- Robots, although superior in certain senses, have limited capabilities in Degree of freedom, Dexterity, Sensors, Vision system, real time response.
- Robots are costly, due to Initial cost of equipment, Installation costs, Need for Peripherals, Need for training, Need for programming.

WHY USE ROBOTS?

- Application in 4D environments
 - Dangerous
 - Dirty
 - Dull
 - Difficult
- 4A tasks
 - Automation
 - Augmentation
 - Assistance
 - Autonomous

WHY USE ROBOTS?

- Increase product quality:
 - Superior Accuracies (thousands of an inch, wafer-handling: microinch)
 - Repeatable precision
 - Consistency of products
- Increase efficiency:
 - Work continuously without fatigue
 - Need no vacation

WHY USE ROBOTS?

- Increase safety:
 - Operate in dangerous environment
 - Need no environmental comfort:
 - Air conditioning, noise protection, etc.
- Reduce Cost:
 - Reduce scrap rate
 - Lower in-process inventory
 - Lower labor cost

WHY USE ROBOTS?

- Reduce manufacturing lead time:
 - Rapid response to changes in design
- Increase productivity:
 - Value of output per person per hour increases

TYPES OF ROBOTS

- Robots can be classified according to six different characteristics:
 - Use
 - Mobility
 - Motion control
 - Capability
 - Arm configuration
 - End effector

TYPES OF ROBOTS

- Use:
 - Industrial robots vs Non industrial robots.
- Mobility:
 - Mobile robots vs Fixed robots.
- Motion control:
 - Servo-controlled robots vs Non-Servo Control

TYPES OF ROBOTS

- Capability:
 - First Generation Robots include both playback and numerically controlled (NC) robots.
 - Second generation robots incorporate basic sensory systems to feedback information to the computer controller and can respond to their environment (adaptive robots).
 - Third generation robots use artificial intelligence (AI) computers.

TYPES OF ROBOTS

- Arm Configuration (Robots that have arms):
 - Rectangular Coordinate Robot vs Cylindrical Coordinate Robot vs Spherical Coordinate Robot.
 - Jointed Arm Robot vs Spine Robot.
- End effector:
 - End effectors are the type of tool attached to the end of the robot arm.
 - ability of end effectors to be automatically changed to a different tool is a major factor in robot flexibility.

ROBOTICS FOR ALL

- Robot Manipulators:
 - Assembly
 - Automation
 - Field robots:
 - Military applications
 - Space exploration
 - Service robots:
 - Cleaning robots
 - Medical robots
 - Biotechnology:
 - Micro/Nano manipulation
 - Sample Handling
 - Automated Analysis
 - Urban challenge:
 - Fire Fighting
 - Search and Rescue
 - Entertainment robots:
 - Toys
- There are over 4 million robots in use in society of which, about 1 million are industrial robots:

• 50% in Asia, 32% in Europe, 16% in North America

WHAT CAN ROBOTS DO?

- Jobs that are dangerous for humans.
- Repetitive jobs that are boring, stressful, or labor-intensive for humans.
- Menial tasks that human do not want to do.
- Chances are, something you eat, wear, or was made by a robot.
- Even much more: When robots enter the public domain, the robot revolution will demand that information age people be “robot literate.”
- The future uses and applications are very promising: Future robots will be able to relieve man of many types of physical work.

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GUIÓN EXPLICATIVO

- Esta presentación tiene como fin lo siguiente:
 - ¿Qué es un robot?, sus tipos, características y clasificación.
 - Leyes de la robótica y ¿Qué es la robótica?
 - Qué pueden hacer los robots, sus ventajas y desventajas.

GUIÓN EXPLICATIVO

- El contenido de esta presentación contiene temas de interés contenidos en la Unidad de Aprendizaje Fundamentos de Robótica.
- El material va en Inglés para reforzar la práctica de esta lengua y fomentar el uso de la misma en UDAs avanzadas y especializadas.
- Las diapositivas deben explicarse en orden, y deben revisarse aproximadamente en 24 horas, además de realizar preguntas a la clase sobre el contenido mostrado.