Chapter 6
AI Applications

A. Introduction to NLP- Language models, Grammars, Parsing

B. Robotics - Robots, Robot hardware, Problems Robotics can solve

C. AI applications in Healthcare, Retail, Banking

Natural Language Processing

- - NLP bridges human language and computers.
- - Combines linguistics, computer science & AI.
- - Enables machines to understand, interpret, and generate human language.
- - Examples: Chatbots, Google Translate, Siri.

- A language can be defined as a set of strings
- set of rules called a grammar.
- rules that define the meaning or semantics of a program

Applications of NLP

- - Text Classification (Spam Detection)
- - Machine Translation (Google Translate)
- - Speech Recognition (Alexa, Siri)
- - Sentiment Analysis (Twitter, Reviews)
- - Question Answering (ChatGPT)
- **Challenges in NLP**
- - Ambiguity: Lexical, Syntactic, Semantic
- - Understanding context and tone
- - Handling informal/slang language
- - Dealing with multilingual and low-resource languages

Language Models

- **A language model** is the core component of modern Natural Language Processing (NLP). It's a statistical tool that analyzes the pattern of human language for the prediction of words. i.e. A language model predicts the probability of word sequences.

- NLP-based applications use language models for a **variety of tasks**, such as audio to text conversion, speech recognition, sentiment analysis, summarization, spell correction, etc.

Types of language model

- **1. Statistical Language Models**
- • Unigram, Bigram, Trigram models
- • Neural Language Models
- **2. Neural Language Models**
- RNNs, Transformers like BERT, GPT

- **1. Statistical Language Models**
- Statistical models include the development of probabilistic models that are able to predict the next word in the sequence, given the words that precede it
- **N-Gram**: This is one of the simplest approaches to language modelling. Here, a probability distribution for a sequence of 'n' is created, where 'n' can be any number and defines the size of the gram (or sequence of words being assigned a probability).
- If n=4, a gram may look like: "can you help me". Basically, 'n' is the amount of context that the model is trained to consider.
- There are different types of N-Gram models such as unigrams, bigrams, trigrams, etc.

N-gram Language Models

- - Predicts word based on the previous N-1 words.
- - Example:
-   Sentence: 'I love NLP'
-   Bigram: P(love | I), P(NLP | love)
- - Need smoothing to handle unseen word combinations

Example: Bigram Model (n = 2)

Training Corpus:

"I love NLP. I love AI.“

From this corpus, we can **extract bigrams** (2-word sequences):

("I", "love")

("love", "NLP")

("NLP", ".")

("love", "AI")

("AI", ".")

Bigram Probabilities (frequency-based):Assuming we calculate frequency counts:

Bigram	**Count**	**Probability (P)**
("I", "love")	2	2/2 = 1.0
("love", "NLP")	1	1/2 = 0.5
("love", "AI")	1	1/2 = 0.5

So, if the model sees "I", it predicts the next word is "love" with probability 1.0.If it sees "love", it might predict "AI" or "NLP" with equal probability (0.5 each).

- **Example Sentence Generation** (Using bigrams):Start with "I":

"I ⟶ love“

"love ⟶ NLP" or "love ⟶ AI" (random choice)

Add "." at end

So you might generate:"I love AI." or "I love NLP."

- **Unigram**: The unigram is the simplest type of language model. It doesn't look at any conditioning context in its calculations**. It evaluates each word or term independently**. Unigram models commonly handle language processing tasks such **as information retrieval**. The unigram is the foundation of a more specific model variant called the query likelihood model, which uses information retrieval to **examine a pool of documents and match the most relevant one to a specific query.**

- **Bidirectional**: Unlike n-gram models, which analyze text in one direction (backwards), bidirectional models **analyze text in both directions, backwards and forwards**. These models can predict any word in a sentence or body of text by using every other word in the text. **Examining text bidirectionally increases result accuracy.** This type is often utilized in machine learning and speech generation applications. For example, Google (BERT) uses a bidirectional model to process **search queries**.

- **2. Neural Language Models**
- These language **models are based on neural networks** and are often considered as an **advanced approach to execute NLP tasks**. Neural language models overcome the shortcomings of classical models such as n-gram and are used for complex tasks such as speech recognition or machine translation.
- trained using deep neural networks on massive text datasets
- **Language is significantly complex and keeps on evolving. Therefore, the more complex the language model is, the better it would be at performing NLP tasks.**
- RNNs, Transformers like BERT, GPT`

Real world applications of Language Models

1. Speech Recognition

- Voice assistants such as Siri and Alexa are examples of how language models help machines in processing speech audio.

2. Machine Translation

- Google Translator and Microsoft Translate are examples of how NLP models can help in translating one language to another.

3. Sentiment Analysis

- This helps in analyzing the sentiments behind a phrase. This use case of NLP models is used in products that allow businesses to understand a customer's intent behind opinions or attitudes expressed in the text.

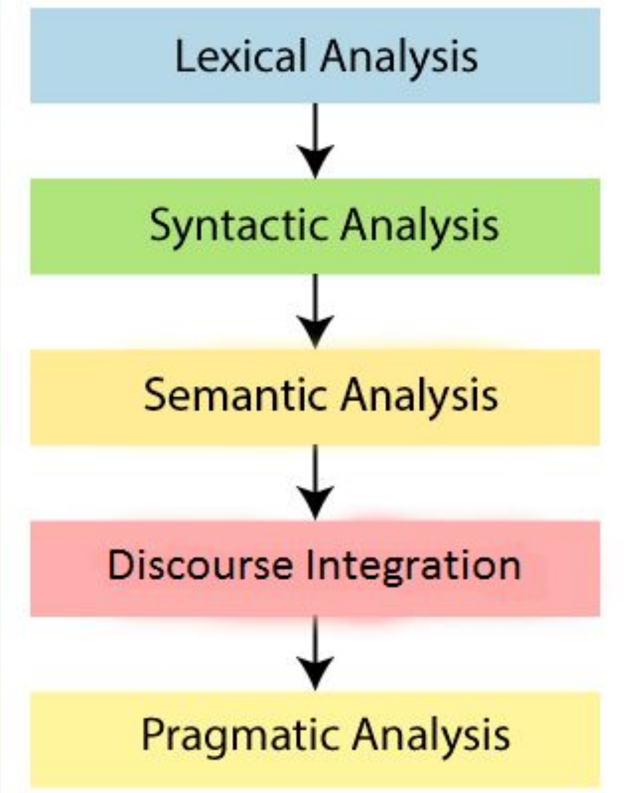
- **4. Text Suggestions**

- Google services such as Gmail or Google Docs use language models to help users get text suggestions while they compose an email or create long text documents, respectively.

5. Parsing Tools

- Parsing involves analyzing sentences or words that comply with syntax or grammar rules. Spell checking tools are perfect examples of language modelling and parsing.

Steps (Phases) of NLP



1. Lexical Analysis and Morphological

- The first phase of NLP is the Lexical Analysis. This phase scans the source code as a stream of characters and converts it into meaningful lexemes. It divides the whole text into paragraphs, sentences, and words.

2. Syntactic Analysis (Parsing)

- Syntactic Analysis is used to check grammar, word arrangements, and shows the relationship among the words.
- **Example:** Agra goes to the John.
- In the real world, Agra goes to the John, does not make any sense, so this sentence is rejected by the Syntactic analyzer.

3. Semantic Analysis

- Semantic analysis is concerned with the meaning representation. It mainly focuses on the literal meaning of words, phrases, and sentences.

4. Discourse Integration

- The meaning of any sentence depends upon the meaning of the sentence just before it. In addition, it also brings about the meaning of immediately succeeding sentence.

5. Pragmatic Analysis

- Pragmatic is the fifth and last phase of NLP. It helps you to discover the intended effect by applying a set of rules that characterize cooperative dialogues. It involves deriving those aspects of language which require real world knowledge. It understands that how people communicate with each other, in which context they are talking and so many aspects.
- **For Example:** "Open the door" is interpreted as a request instead of an order.

Example Sentence:

"She gave her dog a bath."

1. Lexical Analysis
Break the sentence into **words (tokens)** and identify their parts of speech.

Output:
"She" ⟶ Pronoun
"gave" ⟶ Verb
"her" ⟶ Pronoun
"dog" ⟶ Noun
"a" ⟶ Article
"bath" ⟶ Noun

2. Syntactic Analysis (Parsing)
Check if the sentence follows correct **grammar rules**.
Build a **parse tree** (subject-verb-object structure).

Output:
Subject: "She"
Verb: "gave"
Indirect Object: "her dog"
Direct Object: "a bath"
✔ Grammar is correct.

3. Semantic Analysis

Understand the **actual meaning** of words and the sentence.
Output:
- "She gave her dog a bath" = A woman cleaned her dog.
- Understands "gave" in this case means **performed an action**, not “gifted”.

4. Discourse Integration

Connect the sentence to the **previous sentence or context**.
Example Context: Earlier sentence:
"It was dirty after playing in the mud."
Now we understand **why** "she gave her dog a bath".

5. Pragmatic Analysis
Figure out **what the speaker actually means** based on intent or situation.
Output:
- Even if not stated, we understand that **"bath"** means **washing** the dog — not putting it in a bathtub for fun.
- Also implies **care/love** for the dog.

Why NLP is difficult?

- NLP is difficult because **Ambiguity and Uncertainty** exist in the language.
- There are the following three ambiguity -

Lexical Ambiguity

- Lexical Ambiguity exists in the presence of two or more possible meanings of the sentence within a single word.
- **Example:**
- Manya is looking for a **match**.
- In the above example, the word match refers to that either Manya is looking for a partner or Manya is looking for a match. (Cricket or other match)

Syntactic Ambiguity

- Syntactic Ambiguity exists in the presence of two or more possible meanings within the sentence.
- **Example:**
- I saw the girl with the binocular.
- In the above example, did I have the binoculars? Or did the girl have the binoculars?

Referential Ambiguity

- Referential Ambiguity exists when you are **referring to something using the pronoun**.
- **Example:** Kiran went to Sunita. She said, "I am hungry."
- In the above sentence, you do not know that who is hungry, either Kiran or Sunita.

Concept of Grammar

- Grammar is very essential and important to describe the syntactic structure of well-formed programs. In the literary sense, they denote syntactical rules for conversation in natural languages. Linguistics have attempted to define grammars since the inception of natural languages like English, Hindi, etc.
- The theory of formal languages is also applicable in the fields of Computer Science mainly in programming languages and data structure.
- A mathematical model of grammar was given by **Noam Chomsky** in 1956, which is effective for writing computer languages.
- Mathematically, a grammar G can be formally written as a 4-tuple (N, T, S, P) where −
- **N** or $\mathbf{V_N}$ = set of non-terminal symbols, i.e., variables.
- **T** or $\sum$ = set of terminal symbols.
- **S** = Start symbol where $S \in N$
- **P** denotes the Production rules for Terminals as well as Non-terminals. It has the form $\alpha \rightarrow \beta$, where α and β are strings on $V_N \cup \sum$ and least one symbol of α belongs to V_N

Context free grammar

- **A *context-free grammar (CFG)* is a list of rules that define the set of all well-formed sentences in a language.**
- Each rule has a left-hand side, which identifies a syntactic category, and a right-hand side, which defines its alternative component parts, reading from left to right.
- E.g., the rule s --> np vp
- means **that "a sentence is defined as a noun phrase followed by a verb phrase”**

Parsing in NLP

- Method of analyzing a sentence to determine its structure according to the grammar to get the meaning out of the sentence

- With the help of the grammar it will generate the parse tree of the string
- Top down parsing (start from start symbol)
- Bottom up parsing (Start from non terminals)

- Concept of Parse Tree
- It may be defined as the graphical depiction of a derivation. The start symbol of derivation serves as the root of the parse tree. In every parse tree, the leaf nodes are terminals and interior nodes are non-terminals.

Syntactic categories (common denotations) in NLP

- np - noun phrase (**is a group of two or more words that functions like a noun when put together**. Exa.The cars)
- vp - verb phrase (**consists of a verb, or of a main verb following a modal or one or more auxiliaries**. Examples are `walked,' `can see,' and `had been waiting.)
- s - sentence
- det - determiner (article) (a,an,the)
- n - noun
- tv - transitive verb requires a direct object to complete its meaning.

  “She gave a book.”

  “gave” is a transitive verb.

  “a book” is the object (what she gave).
- iv - intransitive verb does not take a direct object.

  “He yawned.”

  “yawned” is complete without an object.
- prep – preposition (in ,at)
- pp - prepositional phrase (ontime)
- adj - adjective

Common CFG Rules for English Parsing

Sentence Level

- S ⟶ NP VP(A sentence is made of a noun phrase followed by a verb phrase)

Noun Phrase (NP) Rules

- NP ⟶ Det Noun(e.g., "the cat")
- NP ⟶ Det Adj Noun(e.g., "the black dog")
- NP ⟶ ProperNoun(e.g., "Alice")
- NP ⟶ Pronoun(e.g., "she", "he")

Verb Phrase (VP) Rules

- VP ⟶ Verb(e.g., "sleeps")
- VP ⟶ Verb NP(e.g., "eats fish")
- VP ⟶ Verb NP PP(e.g., "put the book on the table")

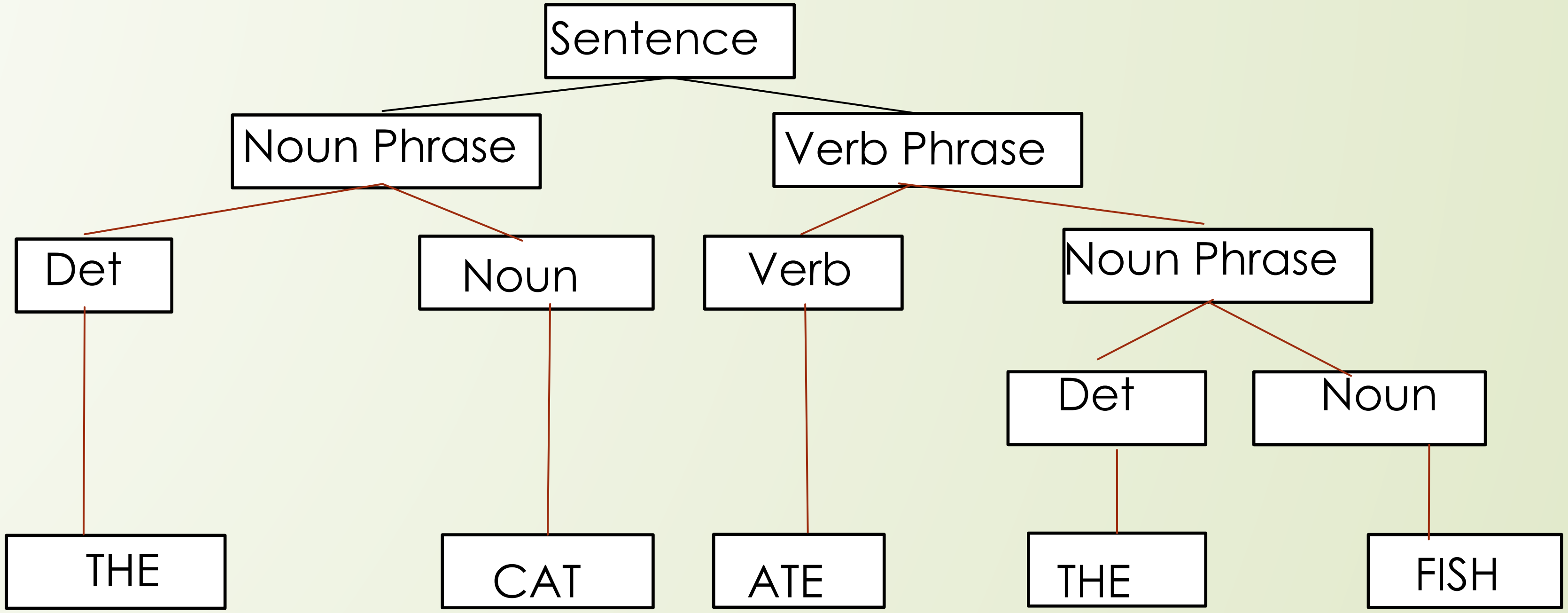
Prepositional Phrase (PP) Rules

- PP ⟶ Preposition NP
- (e.g., "on the table")

Determinants and Others

- Det ⟶ the | a | an | some | my
- Noun ⟶ cat | dog | book | fish
- Verb ⟶ sleeps | eats | put | chased
- Adj ⟶ black | big | red
- Preposition ⟶ on | in | under | over

- S-> NP VP
- NP-> Det Noun
- |Noun
- |Det Noun
- VP-> Verb
- | VP NP
- | Verb NP



Robot

- **Robots** are physical agents that perform tasks by manipulating the physical world
- **Effectors** such as legs, wheels, joints, and grippers.
- **Sensors**, which allow them to perceive their environment.
- Most of today's robots fall into one of **three primary categories**

  Manipulators, Mobile robots, Mobile manipulators

Categories of robots

- **Manipulators**, or robot arms
- These are **physically anchored** to their workplace,
- **for example** in a factory assembly line or on the International Space Station.
- Manipulator motion usually involves a **chain of controllable joints**, enabling such robots to place their effectors in any position within the workplace.
- Manipulators are by far the most common type of **industrial robots**, with approximately one million units installed worldwide.
- Some mobile manipulators are used in **hospitals** to assist surgeons.

- The second category is the **mobile robot.**
- Mobile robots **move about their environment** using wheels, legs, or similar mechanisms.
- They have been put to use **delivering food in hospitals, moving containers at loading docks,** and similar tasks.
- Unmanned ground vehicles, or UGVs, drive autonomously on streets, highways, and off-road.
- The **planetary rover** explored Mars for a period of 3 months in 1997. Subsequent NASA robots, which landed in 2003
- Other types of mobile robots UAV include **unmanned air vehicles** (UAVs), commonly used for surveillance, crop-spraying,
- Autonomous underwater vehicles **(AUVs)** are used in deep sea exploration. Mobile robots deliver packages in the workplace and vacuum the floors at home

- The third type of robot combines mobility with manipulation, and is often called a **mobile manipulator.**
- Humanoid robots mimic the human torso. Early **humanoid robots**, both manufactured by Honda Corp. in Japan.
- The field of robotics also includes **prosthetic devices** (artificial limbs, ears, and eyes for humans), intelligent environments (such as an entire house that is equipped with sensors and effectors), and multibody systems, wherein robotic action is achieved through swarms of small cooperating robots

Real robots….

- **must cope with environments that are partially observable, stochastic, dynamic, and continuous**.
- Many robot environments are sequential and multiagent as well. **Partial observability and stochasticity** are the result of dealing with a large, complex world.
- Robot cameras cannot see around corners, and motion commands are subject to uncertainty due to gears slipping, friction, etc.
- **real crashes** really hurt, unlike simulated ones. Practical robotic systems need to embody prior knowledge about the robot, its physical environment, and the tasks that the robot will perform so that the robot can **learn quickly and perform safely.**
- Robotics brings together many of the concepts we have seen earlier in the book, **including probabilistic state estimation, perception, planning, unsupervised learning, and reinforcement learning**

Robot hardware

- **Sensors:** Sensors are the perceptual interface between robot and environment
- Sensors are the perceptual interface between robot and environment.
- **Passive sensors,** such as cameras, are true observers of the environment: they capture signals that are generated by other sources in the environment.
- **Active sensors**, such as sonar, send energy into the environment.
- Active sensors tend to provide more information than passive sensors, but at the **expense of increased power consumption** and with a danger **of interference** when multiple active sensors are used at the same time.
- Whether active or passive, sensors can be divided into **three types**, depending on whether they **sense the environment, the robot's location, or the robot's internal configuration**

First category of sensors based on **they sense the environment**

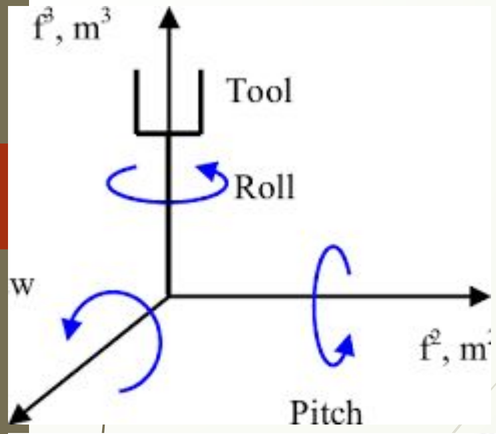
- **Range finders** are sensors that measure the distance to nearby objects.
- **Sonar sensors** emit directional sound waves, which are reflected by objects, with some of the sound making it back into the sensor
- **optical range sensors** emit active signals (light) and measure the time until a reflection of this signal arrives back at the sensor.
- **Scanning lidars** (short for light detection and ranging)tend to provide longer ranges than time of flight cameras, and tend to perform better in bright daylight
- Common range sensors include **radar,** which is often the sensor of choice for UAVs. Radar sensors can measure distances of multiple kilometers.
- **Tactile sensors** such as whiskers, bump panels, and touch-sensitive skin. These sensors measure range based on physical contact, and can be deployed only for sensing objects very close to the robot

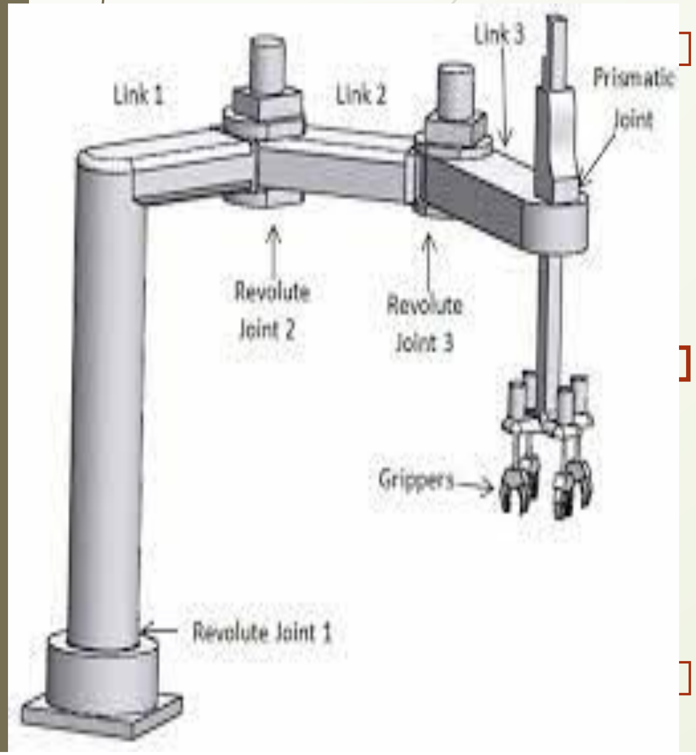
A second important class of sensors is **location sensors**

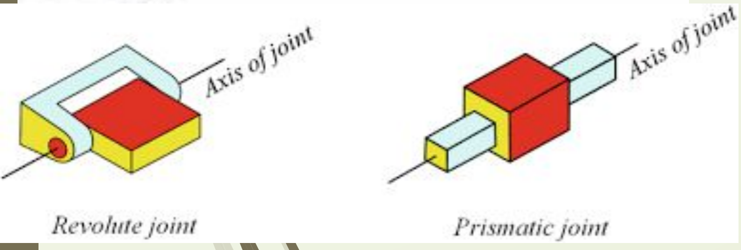
- The **Global Positioning System** (GPS) is the most common solution to the localization problem. GPS measures the distance to satellites that emit pulsed signals
- At present, there are **31 satellites in orbit**, transmitting signals on multiple frequencies. **GPS receivers** can recover the distance to these satellites by analyzing phase shifts.
- By triangulating signals from multiple satellites, GPS receivers can determine their **absolute location on Earth to within a few meters**.
- Differential GPS involves a second ground receiver with known location, providing **millimeter accuracy** under ideal conditions.
- Unfortunately, GPS **does not work indoors or underwater**. Indoors, localization is often achieved by attaching beacons in the environment at known locations.
- Many indoor environments are full of wireless base stations, which can help robots localize through the analysis of the wireless signal.

The third important class is proprioceptive sensors, which inform the **robot of its internal configuration**

- To measure the exact configuration of a robotic joint, motors are often equipped with **shaft decoders** that count the revolution of motors in small increments. On robot arms, shaft decoders can provide accurate information over any period of time. On mobile robots, shaft decoders that report wheel revolutions can be used for **odometry**—the measurement of distance traveled
- External forces, such as the current for AUVs and the wind for UAVs**, INERTIAL SENSOR** increase positional uncertainty. Inertial sensors, such as **gyroscopes**, rely on the resistance of mass to the change of velocity. They can help reduce uncertainty
- **force sensors and torque sensors**. These are indispensable when robots handle fragile objects or objects whose exact shape and location is unknown.
- Force sensors allow the robot to sense how hard it is gripping the bulb, and torque sensors allow it to sense how hard it is turning.
- Good sensors can measure forces in all three translational and three rotational directions



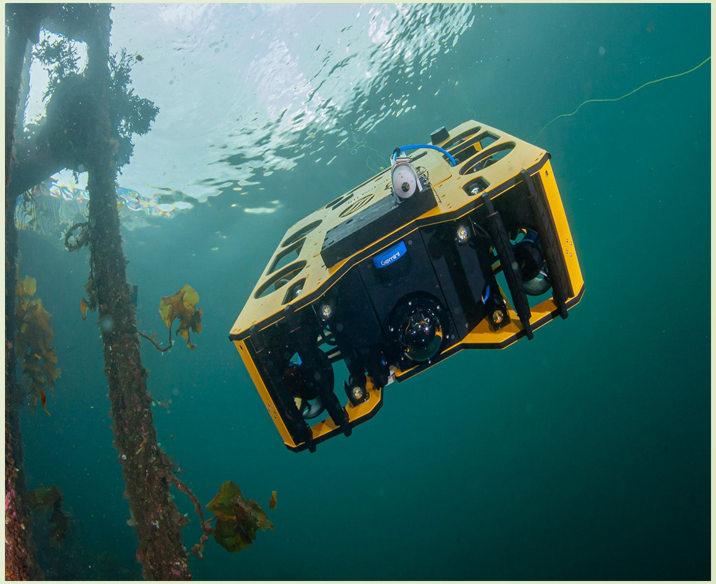




Effectors

- **Effectors** are the means by which robots move and change the shape of their bodies
- the concept of a **degree of freedom (DOF)** We count one degree of freedom for each independent direction in which a robot, or one of its effectors, can move.
- For example, a rigid mobile robot such as an **AUV has six degrees of freedom**, three for its (x, y, z) location in space and three for its angular orientation, known as yaw, roll, and pitch. These six degrees define the kinematic state2 or pose of the robot. The dynamic state of a robot includes these six plus an additional six dimensions for the rate of change of each kinematic dimension, that is, their velocities.
- **For example, the elbow of a human arm possesses two degree of freedom**. It can flex the upper arm towards or away, and can rotate right or left. The wrist has three degrees of freedom. It can move up and down, side to side, and can also rotate. Robot joints also have one, two, or three degrees of freedom each. Six degrees of freedom are required to place an object, such as a hand, at a particular point in a particular orientation
- Revolute joints that generate rotational motion and one prismatic joint that generates sliding motion.

- **Differential drive robots** possess two independently actuated wheels (or tracks), one on each side, as on a military tank. If both wheels move at the same velocity, the robot moves on a straight line
- Some mobile robots possess arms. This robot’s arms use springs to compensate for gravity, and they provide minimal resistance to external forces
- **Legs, unlike wheels, can handle rough terrain**.
- Other methods of movement are possible: air vehicles **use propellers or turbines;** underwater vehicles use **propellers or thrusters,** similar to those used on submarines. **Robotic blimps** rely on thermal effects to keep themselves aloft.



Source of power for a robot

- Sensors and effectors alone do not make a robot.
- A complete robot also needs a **source of power** to drive its effectors.
- The **electric motor** is the most popular mechanism for both manipulator actuation and locomotion, but pneumatic actuation using compressed gas and hydraulic actuation using pressurized fluids also have their application niches

Problems that Robotics can solve: Applications

- **Industry and Agriculture.** Traditionally, robots have been fielded in areas that require difficult human labor, yet are structured enough to be amenable to robotic automation. The best example is the assembly line, where manipulators routinely perform tasks such as assembly, part placement, material handling, welding, and painting
- **Transportation.** Robotic transportation has many facets: from autonomous helicopters that deliver payloads to hard-to-reach locations, to automatic wheelchairs that transport people who are unable to control wheelchairs by themselves, to autonomous straddle carriers that outperform skilled human drivers when transporting containers from ships to trucks on loading docks. In factory settings, autonomous vehicles are now routinely deployed to transport goods in warehouses and between production lines.

- **Robotic cars.** Many of us make cell phone calls while driving. Some of us even text. The sad result: more than a million people die every year in traffic accidents. Robotic cars like BOSS and STANLEY offer hope: Not only will they make driving much safer, but they will also free us from the need to pay attention to the road during our daily commute.
- **Health care.** Robots are increasingly used to **assist surgeons with instrument placement** when operating on organs as intricate as brains, eyes, and hearts.. Robots have become indispensable tools in a range of **surgical procedures**, such as hip replacements, thanks to their high precision. In pilot studies, robotic devices have been found to reduce the danger of lesions when performing colonoscopy.
- Outside the operating room, researchers have begun to develop **robotic aides** for elderly and handicapped people, such as intelligent robotic walkers and intelligent toys that provide reminders to take medication and provide comfort
- **Hazardous environments.** Robots have assisted people in cleaning up nuclear waste, most notably in Chernobyl and Three Mile Island. Robots were present after the collapse of the World Trade Center, where they entered structures deemed too dangerous for human search and rescue crews. Some countries have used robots to transport ammunition and to defuse bombs. A number of research projects are presently developing prototype robots for clearing minefields, on land and at sea.

- **Exploration**. Robots have gone where no one has gone before, including the surface of Mars . Robotic arms assist astronauts in deploying and retrieving satellites and in building the International Space Station. Robots also help explore under the sea. They are routinely used to acquire maps of sunken ships. A robot mapping an abandoned coal mine, Unmanned air vehicles known as **drones** are used in military operations. Robots are becoming very effective tools for gathering information in domains that are difficult (or dangerous) for people to access.
- **Personal Services**. Service is an up-and-coming application domain of robotics. Service robots assist individuals in performing daily tasks. Commercially available domestic service robots include **autonomous vacuum cleaners, lawn mowers, and golf caddies.** The world's most popular mobile robot is a personal service robot: the robotic vacuum cleaner Roomba.
- **Entertainment.** Robots have begun to conquer the entertainment and toy industry. **Robotic soccer**, a competitive game very much like human soccer, but played with autonomous mobile robots. Robot soccer provides great opportunities for research in AI, since it raises a range of problems relevant to many other, more serious robot applications

- **Human augmentation.** A final application domain of robotic technology is that of human augmentation. Researchers have developed **legged walking machines that can carry people around**, very much like a wheelchair. Several research efforts presently focus on the development of devices that make it easier for people to walk or move their arms by providing additional forces through extraskeletal attachments. If such devices are attached permanently,. Robotics they can be thought of as **artificial robotic limbs. A robotic hand** that may serve as a prosthetic device in the future. **Robotic teleoperation**, or telepresence, is another form of human augmentation.
- Underwater vehicles are often **teleoperated;** the vehicles can go to a depth that would be dangerous for humans but can still be guided by the human operator. All these systems augment people's ability to interact with their environments. Some projects go as far as replicating humans, at least at a very superficial level. **Humanoid robots** are now available commercially through several companies in Japan

(a)

(b)

Figure 26.1 (a) An industrial robotic arm with a custom end-effector. Image credit: Macor/123RF. (b) A Kinova® JACO® Assistive Robot arm mounted on a wheelchair. Kinova and JACO are trademarks of Kinova, Inc.

(a) (b)

Figure 26.2 (a) NASA's Curiosity rover taking a selfie on Mars. Image courtesy of NASA. (b) A Skydio drone accompanying a family on a bike ride. Image courtesy of Skydio.

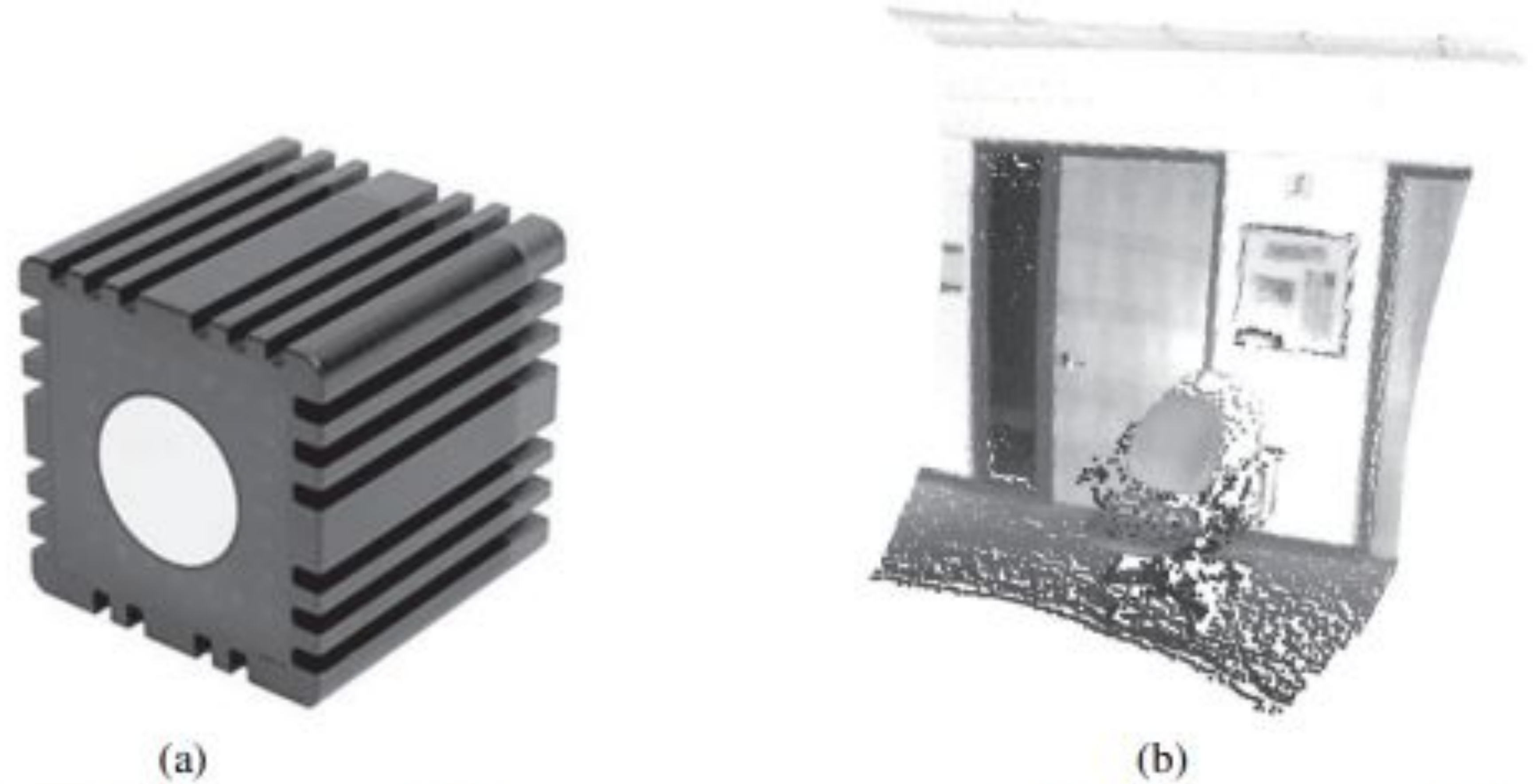
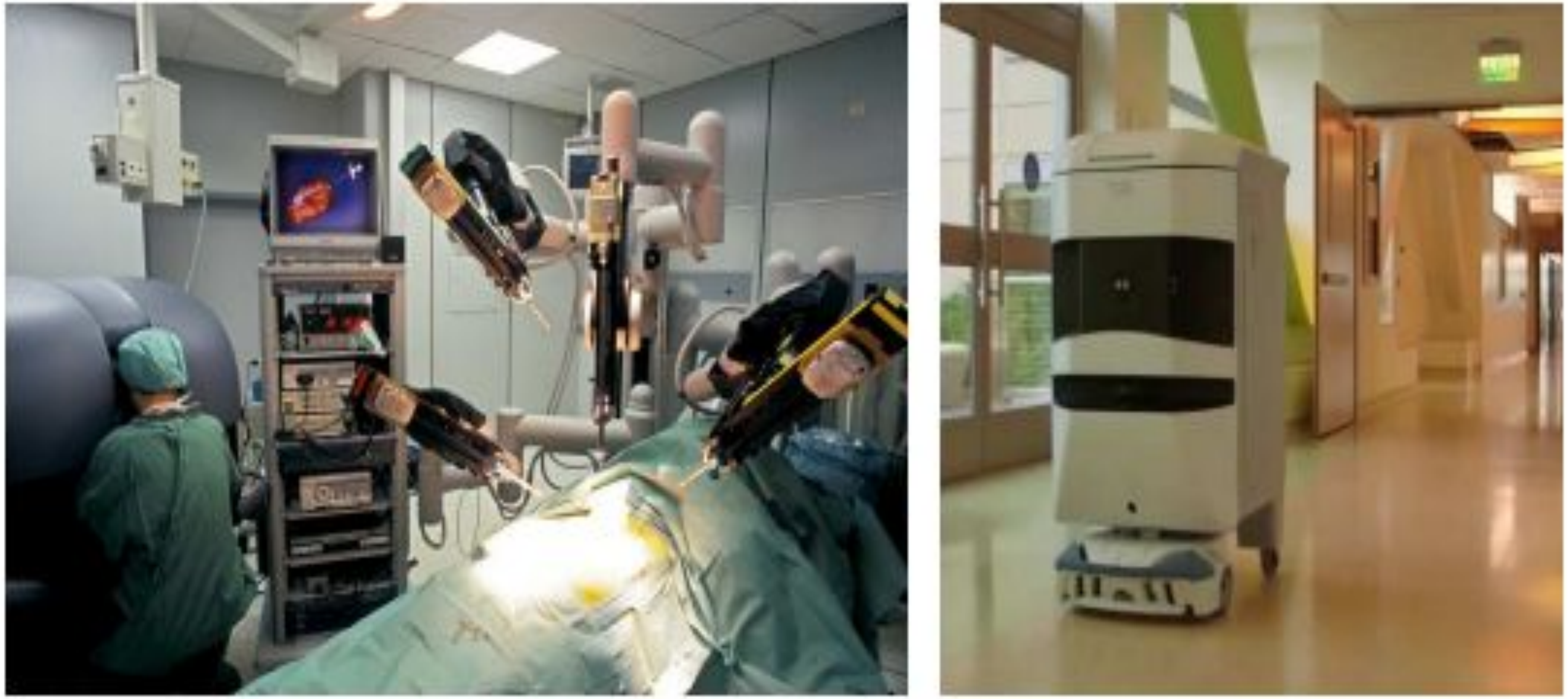


Figure 26.3 (a) Time-of-flight camera; image courtesy of Mesa Imaging GmbH. (b) 3D range image obtained with this camera. The range image makes it possible to detect obstacles and objects in a robot's vicinity. Image courtesy of Willow Garage, LLC.

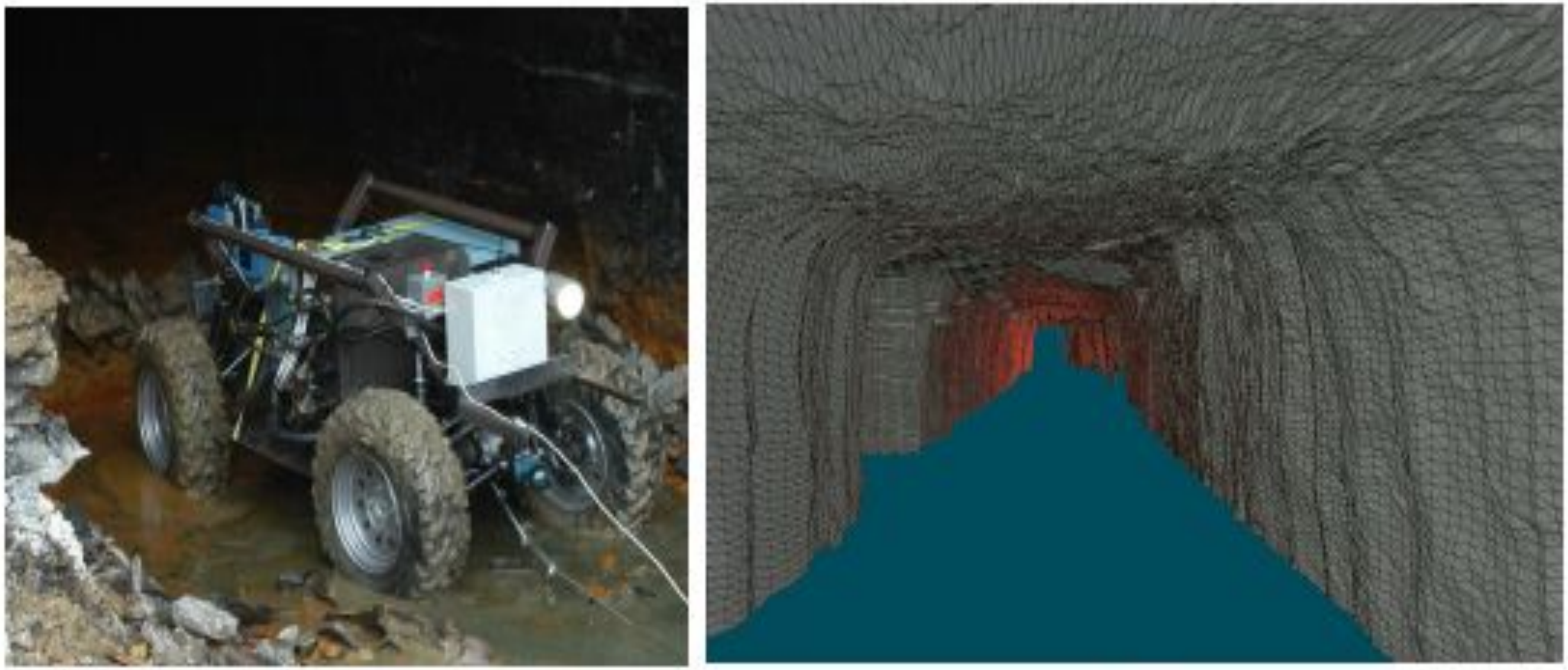
(a) (b)

Figure 26.33 (a) A patient with a brain–machine interface controlling a robot arm to grab a drink. Image courtesy of Brown University. (b) Roomba, the robot vacuum cleaner. Photo by HANDOUT/KRT/Newscom.



(a) (b)

Figure 26.34 (a) Surgical robot in the operating room. Photo by Patrick Landmann/Science Source. (b) Hospital delivery robot. Photo by Wired.



(a) (b)

Figure 26.36 (a) A robot mapping an abandoned coal mine. (b) A 3D map of the mine acquired by the robot. Courtesy of Sebastian Thrun.

AI applications

- **Retail**
- **Healthcare**
- **Banking**

AI applications in the retail industry

1. **Personalized Marketing**: AI algorithms can analyze customer data to predict buying behavior and personalize marketing campaigns to target individual customers.

2. **Inventory Management:** AI can help retailers optimize inventory management by analyzing sales data and predicting future demand.

3. **Chatbots:** Retailers are using AI-powered chatbots to offer customer service support, answer frequently asked questions, and even process orders.

4. **Visual Search:** AI-powered visual search technology allows customers to take a photo of an item and find similar products in a retailer's inventory.

5. **Price Optimization**: AI can analyze pricing data and competitor information to suggest optimal prices for products, maximizing profits while staying competitive.

6. **Fraud Detection**: AI algorithms can detect fraudulent transactions and prevent them from occurring in the future, protecting both the retailer and the customer.

7. **Predictive Analytics**: AI can analyze data from various sources such as social media, weather forecasts, and economic indicators to predict future buying patterns and trends.

AI applications in Healthcare

1. **Medical Imaging Analysis**: AI algorithms can analyze medical images such as X-rays, MRI scans, and CT scans to assist with diagnosis and treatment planning.
2. **Predictive Analytics**: AI can analyze large amounts of patient data to identify patterns and predict potential health risks or complications.
3. **Personalized Medicine:** AI algorithms can analyze patient data to develop personalized treatment plans based on individual characteristics, such as genetics and medical history.
4. **Virtual Nursing Assistants:** AI-powered virtual nursing assistants can provide basic care and support to patients, such as answering questions and monitoring vital signs.
5. **Drug Discovery:** AI can analyze vast amounts of data to identify potential drug candidates and accelerate the drug discovery process.
6. **Telemedicine:** AI-powered telemedicine systems can facilitate remote consultations between patients and healthcare providers, improving access to care and reducing healthcare costs.
7. **Disease Diagnosis:** AI algorithms can analyze patient symptoms and medical history to assist with disease diagnosis, providing more accurate and timely diagnoses.

AI applications in banking

1. **Fraud Detection:** AI algorithms can analyze transaction data and identify patterns of fraudulent behavior, helping banks prevent financial fraud.
2. **Chatbots:** Banks are using AI-powered chatbots to provide customer service support, answer frequently asked questions, and even process transactions.
3. **Customer Analytics:** AI can analyze customer data to predict buying behavior, identify customer preferences, and personalize marketing campaigns.
4. **Credit Scoring:** AI can analyze credit data to assess creditworthiness, helping banks make more accurate lending decisions.
5. **Risk Management:** AI can analyze vast amounts of data to identify potential risks and suggest strategies to mitigate them.
6. **Investment Analysis**: AI algorithms can analyze market data to identify potential investment opportunities and suggest investment strategies.
7. **Anti-Money Laundering (AML) Compliance**: AI can analyze transaction data to detect suspicious activity and help banks comply with AML regulations.