

# Artificial Intelligence

*THE MOST EXCITING DISCIPLINE in*

*Today's World*

# Artificial Intelligence: Not merely a humanoid robot

- AI, as often portrayed, in science fiction is NOT only robots or other humanoid beings
  - **who are friendly and serve humans or,**
  - **turn evil and want to kill all humans to take control of our planet**

*Fei-Fei Li, Director of Stanford AI lab, claims that the myth of the **terminator** coming next door is, in fact, a real crisis for the development of the AI field as it highlights the public misreading of the technology but also reveals the fear of what are the intentions of the people behind the technology (2018)*

- AI is, in fact, an ever-evolving term which is one of the reasons that it means very different things to different people
- Artificial Intelligence is hard to define because the field has been redefined continuously with the advances of technology and the ambiguity of what we consider as “intelligent”

***A better understanding of AI is crucial to its future development and progress***

# Artificial Intelligence: *Facts & Figures*

- According to Statista, revenue from the artificial intelligence (AI) software market worldwide is expected to reach **126 billion dollars by 2025**
- As per Gartner, 37% of organizations have implemented AI in some form. The percentage of enterprises employing AI grew **270% over the past four years**
- According to Servion Global Solutions, by 2025, **95% of customer interactions will be powered by AI**

# What is AI?

<p>“The exciting new effort to make computers think . . . <i>machines with minds</i>, in the full and literal sense” (Haugeland, 1985)</p> <p>“[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . . ” (Bellman, 1978)</p>	<p>“The study of mental faculties through the use of computational models” (Charniak and McDermott, 1985)</p> <p>“The study of the computations that make it possible to perceive, reason, and act” (Winston, 1992)</p>
<p>“The art of creating machines that perform functions that require intelligence when performed by people” (Kurzweil, 1990)</p> <p>“The study of how to make computers do things at which, at the moment, people are better” (Rich and Knight, 1991)</p>	<p>“A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes” (Schalkoff, 1990)</p> <p>“The branch of computer science that is concerned with the automation of intelligent behavior” (Luger and Stubblefield, 1993)</p>

**Figure 1.1** Some definitions of AI. They are organized into four categories:

Systems that think like humans.	Systems that think rationally.
Systems that act like humans.	Systems that act rationally.

# From Wikipedia

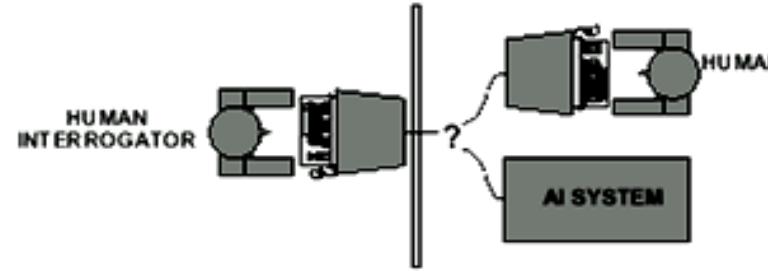
**Artificial intelligence (AI)** is the intelligence of machines and the branch of computer science that aims to create it. Textbooks define the field as "the study and design of intelligent agents"<sup>[1]</sup> where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.<sup>[2]</sup> John McCarthy, who coined the term in 1956,<sup>[3]</sup> defines it as "the science and engineering of making intelligent machines."<sup>[4]</sup>

The field was founded on the claim that a central property of humans, intelligence—the sapience of *Homo sapiens*—can be so precisely described that it can be simulated by a machine.<sup>[5]</sup> This raises philosophical issues about the nature of the mind and limits of scientific hubris, issues which have been addressed by myth, fiction and philosophy since antiquity.<sup>[6]</sup> Artificial intelligence has been the subject of optimism,<sup>[7]</sup> but has also suffered setbacks<sup>[8]</sup> and, today, has become an essential part of the technology industry, providing the heavy lifting for many of the most difficult problems in computer science.<sup>[9]</sup>

AI research is highly technical and specialized, deeply divided into subfields that often fail to communicate with each other.<sup>[10]</sup> Subfields have grown up around particular institutions, the work of individual researchers, the solution of specific problems, longstanding differences of opinion about how AI should be done and the application of widely differing tools. The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects.<sup>[11]</sup> General intelligence (or

# Acting Humanly: The Full Turing Test

- Alan Turing's 1950 article *Computing Machinery and Intelligence* discussed conditions for considering a machine to be intelligent
  - “Can machines think?” ↔ “Can machines behave intelligently?”
  - The Turing test (The Imitation Game): Operational definition of intelligence

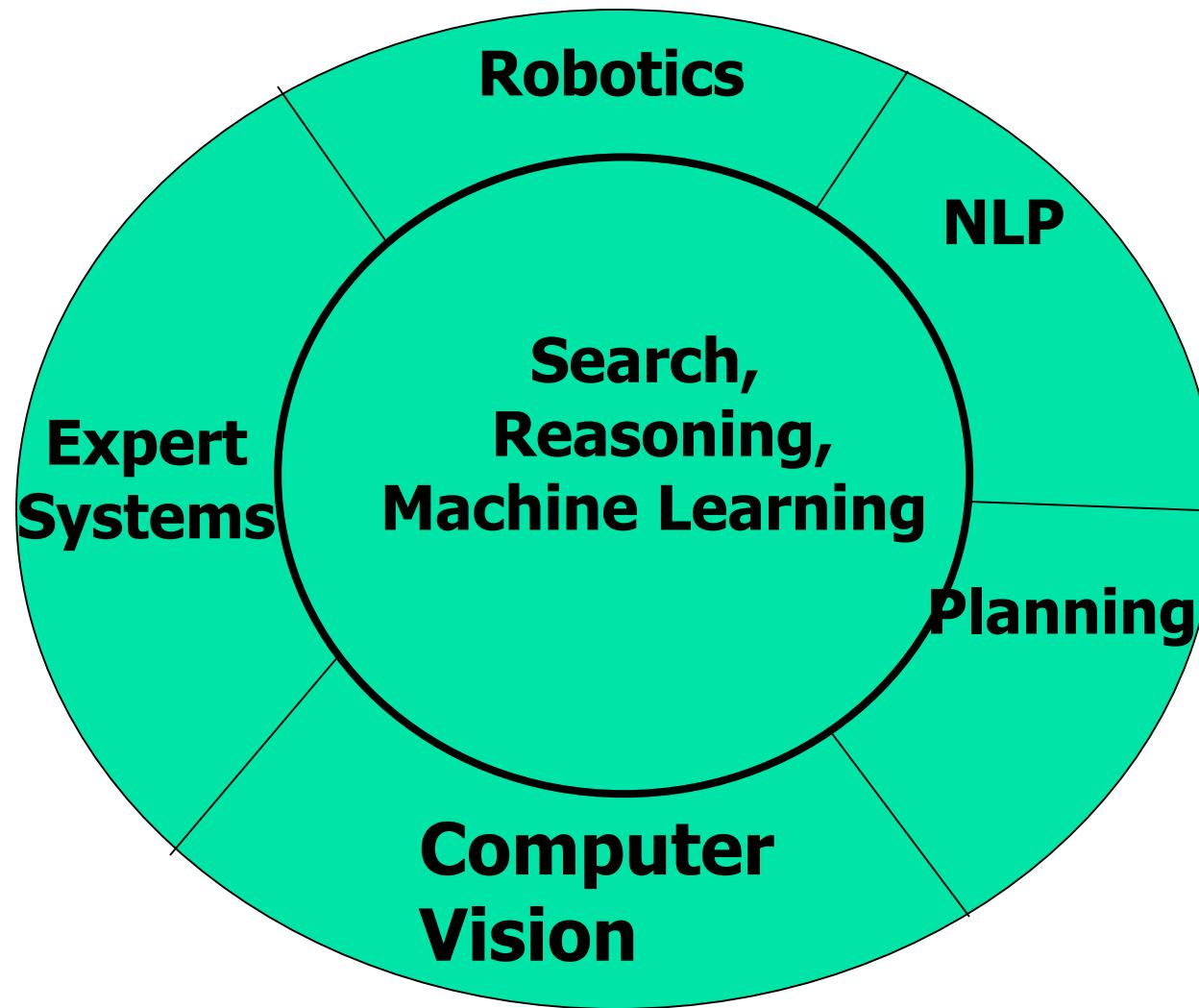


- Computer needs to posses: Natural language processing, Knowledge representation, Automated reasoning, and Machine learning
- Problem: 1) Turing test is not reproducible, constructive, and amenable to mathematic analysis. 2) What about physical interaction with interrogator and environment?
- Total Turing Test: Requires physical interaction and needs perception and actuation.

# What would a computer need to pass the Turing test?

- **Natural language processing:** to communicate with examiner
- **Knowledge representation:** to store and retrieve information provided before or during interrogation
- **Automated reasoning:** to use the stored information to answer questions and to draw new conclusions
- **Machine learning:** to adapt to new circumstances and to detect and extrapolate patterns
- **Vision :** to recognize the examiner's actions and various objects presented by the examiner
- **Motor control:** to act upon objects as requested
- **Other senses:** such as audition, smell, touch, etc.

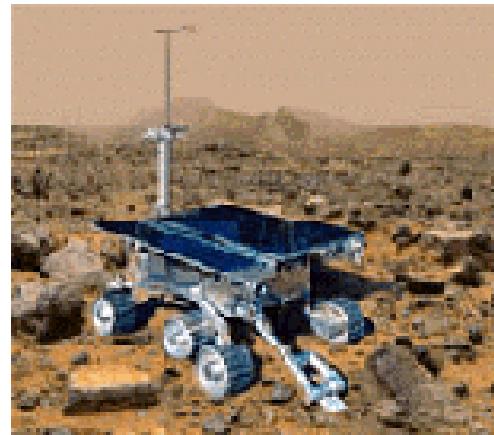
**Disciplines which form the core of AI- inner circle  
Fields which draw from these disciplines- outer circle**



# Why study AI?



Labor



Science



Appliances



Search engines



Medicine/  
Diagnosis

**What else?**

# Natural Language Question Answering

The screenshot shows a web-based interface for an AI movie. At the top, there's a decorative film strip banner. Below it is a video player window displaying a blurry image of a person's face. To the right of the video is a sidebar with a vertical list of menu items under the heading "A.I. NOW PLAYING". The menu includes sections for A.I. Message Center, Love & Machines, Robots, The Art of A.I., Play, and A.I. Today, each with sub-options like Timeline, Robot Resources, Sketches, Storyboards, Photos, Multimedia, Turing Test, More Games, and A.I. Puzzler. At the bottom, there's a chatbot interaction area. The "CHATBOT" section contains the text "Hello, my name is Chatbot. What's your name?". The "YOU" section has an empty input field and an "ENTER" button.

- 0.0 A.I. MESSAGE CENTER
- 1.0 LOVE & MACHINES
- 2.0 ROBOTS
  - 2.1 TIMELINE
  - 2.2 ROBOT RESOURCES
- 3.0 THE ART OF A.I.
  - 3.1 MODELS & MODEL MAKERS
  - 3.2 SKETCHES
  - 3.3 STORYBOARDS
  - 3.4 PHOTOS
- 4.0 PLAY
  - 4.1 MULTIMEDIA
  - 4.2 TURING TEST
  - 4.3 MORE GAMES
  - 4.4 A.I. PUZZLER
- 5.0 A.I. TODAY
- 6.0 A.I. NEWS

<http://aimovie.warnerbros.com>

8/16/2025

<http://www.ai.mit.edu/projects/infolab/>

# Examples: AI at Google

# Finding Canonical Images

Web Images Maps News Shopping Gmail more ▾ Sign in

Google™ mona lisa Strict SafeSearch is on Search Images Search the Web Advanced Image Search Preferences New! Google Image Labeler

Images Showing: All image sizes ▾ Results 1 - 21 of about 343,000 for mona lisa with Safesearch on. (0.04 seconds)

Word has it that **Mona Lisa** wasn't a ...  
320 x 366 - 21k - jpg  
uk.gizmodo.com

da Vinci: **Mona Lisa**  
340 x 472 - 10k - gif  
www.enchantedlearning.com

**Mona Lisa** We have examined the topic ...  
379 x 589 - 63k - jpg  
thesituationist.wordpress.com

**Mona Lisa** right  
282 x 795 - 59k - jpg  
www.museumldv.com

**Mona Lisa** made from train tickets --  
468 x 296 - 67k - jpg  
www.pinktentacle.com

Image:**MonaLisa** sfumato.jpg  
350 x 400 - 26k - jpeg  
commons.wikimedia.org

Image:**Mona Lisa**.jpg  
743 x 1155 - 156k - jpg  
commons.wikimedia.org

**MonaLisa**.jpg  
435 x 644 - 43k - jpg  
www.mentalfloss.com

Study Page: **Mona Lisa** in Book Cover ...  
360 x 595 - 85k - gif  
www.studiolo.org

**Mona Lisa**  
406 x 302 - 46k - jpg  
www.sunrise-divers.com

**mona lisa**  
400 x 612 - 48k - jpg  
www.whyleavelofrance.com

**Mona Lisa** cartoon 3 - catalog ...  
400 x 395 - 51k - jpg  
www.cartoonstock.com

**Mona Lisa** cartoon 4 - catalog ...  
400 x 400 - 51k - jpg  
www.cartoonstock.com

**Mona Lisa**  
800 x 600 - 97k - jpg  
www.vladstudio.com

**Mona Lisa** - Joint Poster  
299 x 450 - 42k - jpg  
www.allposters.com

"**Mona Lisa**"  
507 x 694 - 22k - jpg  
www.oregoncoastradio.com

**Mona Lisa** is Lisa Gherardini  
334 x 520 - 17k - jpg  
yedda.com

Click here if your browser does not ...  
605 x 790 - 187k - jpg  
www.paris.org

Sir Joshua's **Mona Lisa**  
502 x 502 - 50k - jpg  
www.moviespring.com

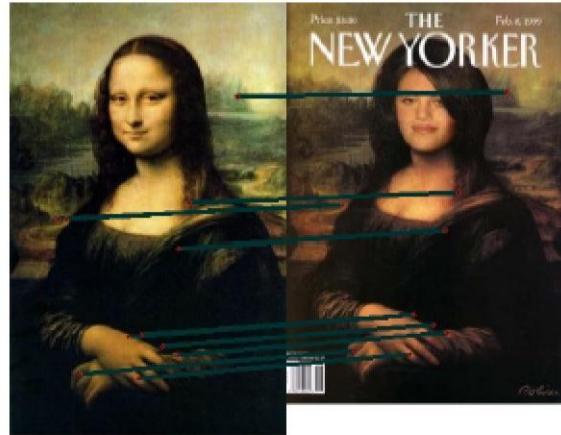
Complete history of **Mona Lisa**  
450 x 328 - 22k - jpg  
www.simplonpc.co.uk

**Mona Lisa** Magnet by Leonardo da ...  
348 x 450 - 29k - jpg  
www.allposters.com

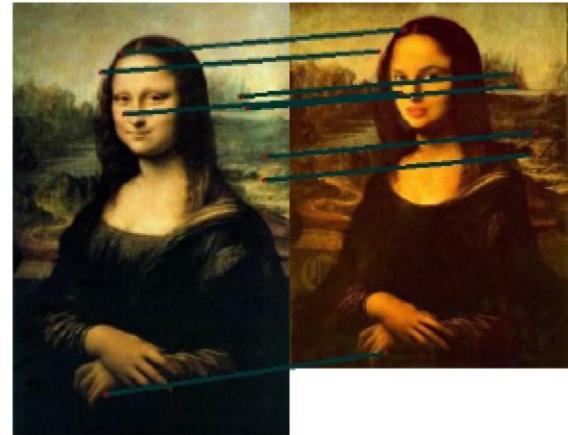
Goooooooooooooogle ►  
1 2 3 4 5 6 7 8 9 10 [Next](#)

New! Want to help improve Google Image Search? Try [Google Image Labeler](#).

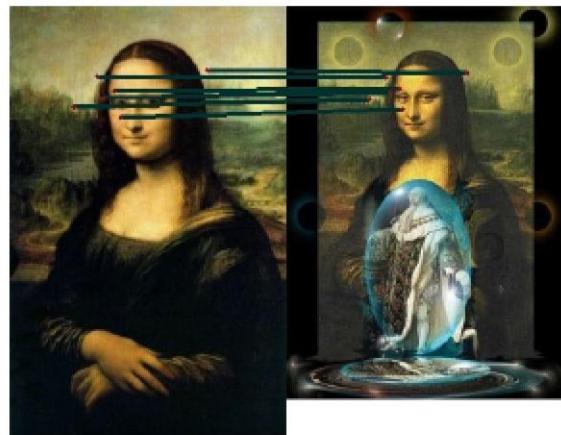
# Compare low-level features



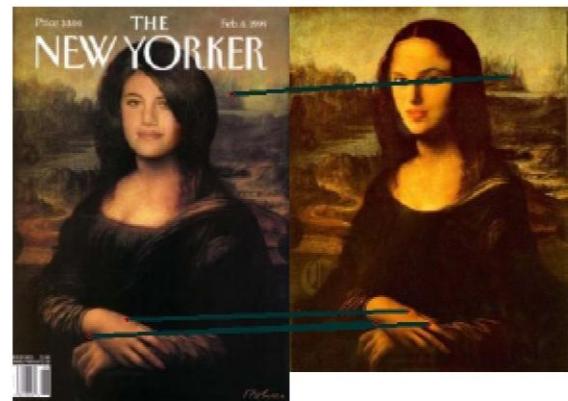
(a) A v.s. B



(b) A v.s. C

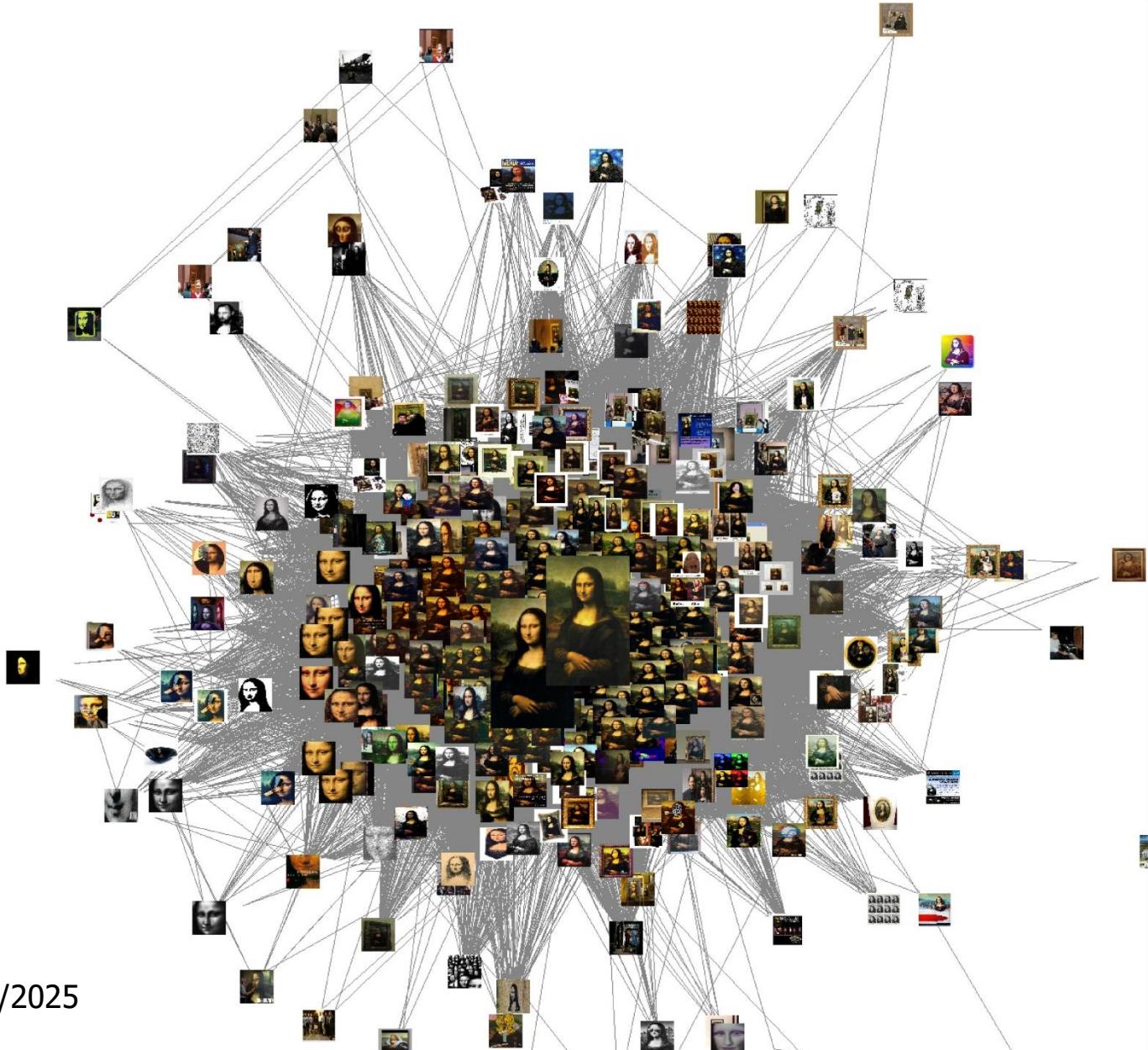


(c) A v.s. D



(d) B v.s. C

# Induced Graph



# Route Finding

1. Turn left

210m

2. At the roundabout, take the 2nd exit onto IIT Main Rd

250m

Take NH922 to Anisabad Post Office Rd/Dhira Chak Main Rd/Khagaul Rd/Mithapur - Anisabad - Khagaul Rd in Anisabad, Patna

53 min (28.8 km)

3. Take NH922 to Anisabad Post Office Rd/Dhira Chak Main Rd/Khagaul Rd/Mithapur - Anisabad - Khagaul Rd in Anisabad, Patna

210m

4. Turn left at Singh Da Dhaba onto Bihta Kanpa Rd

Pass by SURAJ Hotel (on the right in 450 m)

1.4 km

5. At Pradip Communication, continue onto Bihta Rd/Bikram - Bihta Rd

Continue to follow Bikram - Bihta Rd

Pass by Hanuman Mandir (on the left)

2.3 km

Take IIT Main Rd to Bihta Kanpa Rd

2 min (550 m)

6. Head northeast

Pass by SBI ATM (on the left)

88 m

7. Turn left

210m

8. At the roundabout, take the 2nd exit onto IIT Main Rd

250m

Take NH922 to Anisabad Post Office Rd/Dhira Chak Main Rd/Khagaul Rd/Mithapur - Anisabad - Khagaul Rd in Anisabad, Patna

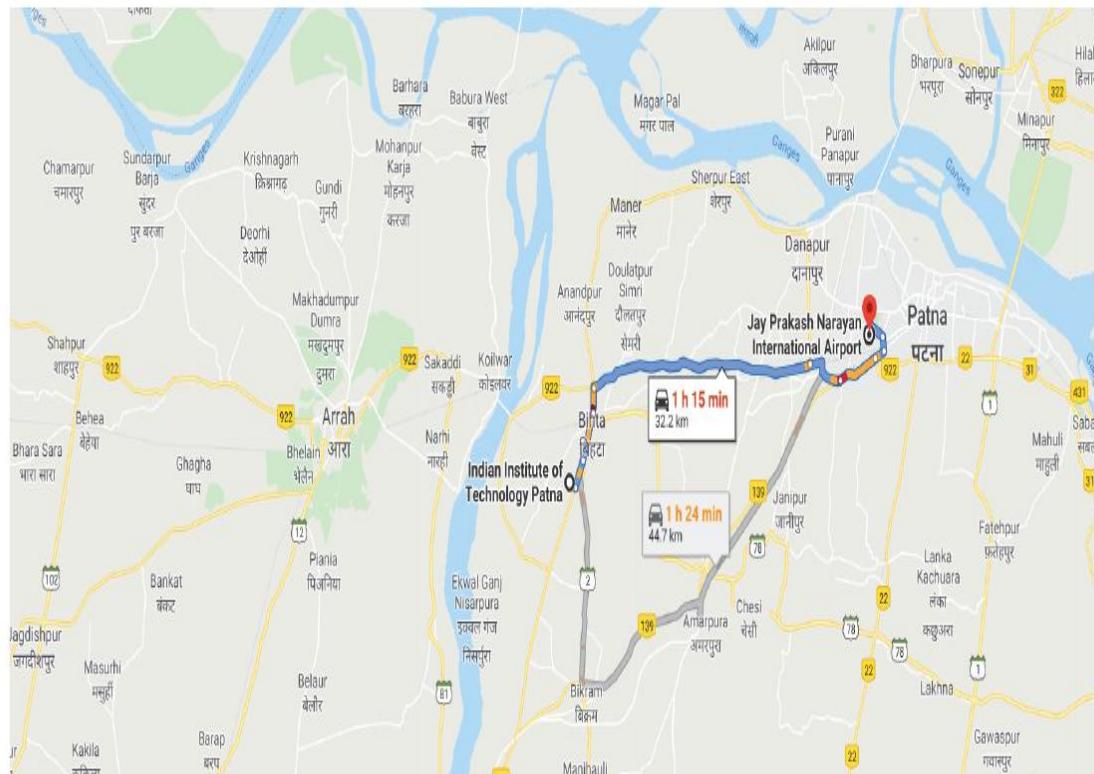
8/24/2020

Indian Institute of Technology Patna to Jay Prakash Narayan International Airport - Google Maps

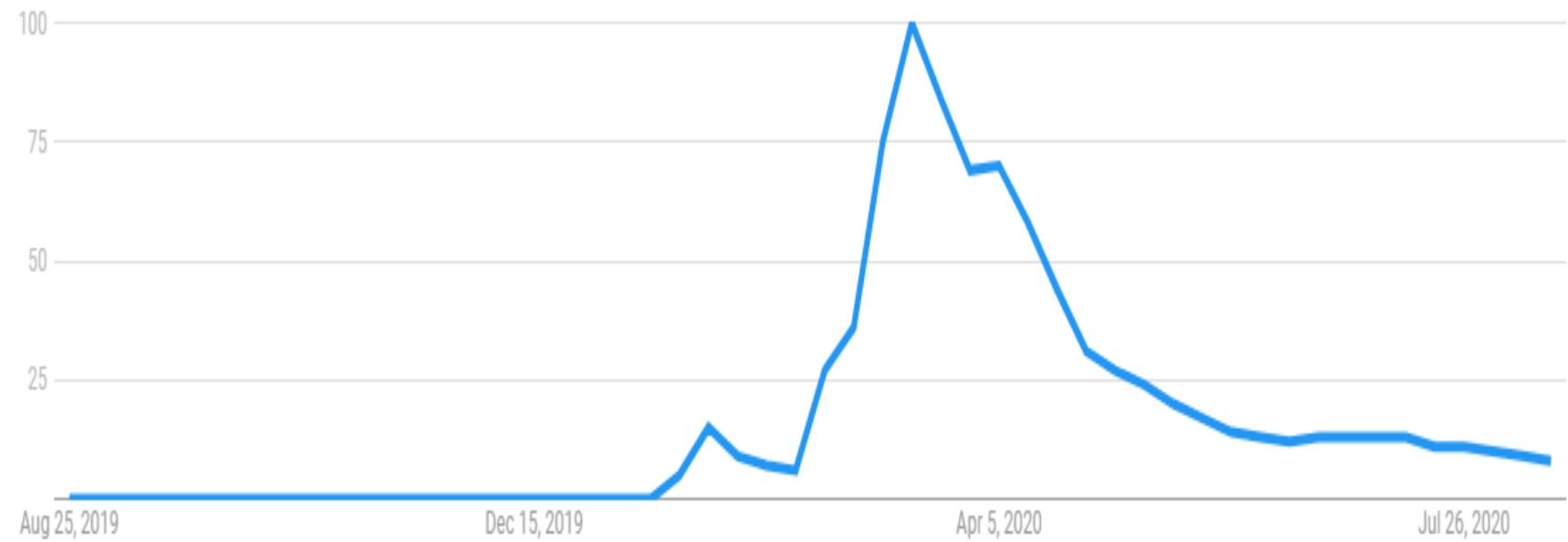


Indian Institute of Technology Patna to Jay Prakash Narayan International Airport

Drive 32.2 km, 1 h 15 min



# COVID-19 Trend



# Making sense of data



<http://youtu.be/kb7RL6b-mHE>

# Big data: Blessing or curse?

Information is the main treasure of humankind

Without efficient management, such a treasure becomes useless:  
the more we have, the less we can use!

Web is Enormous

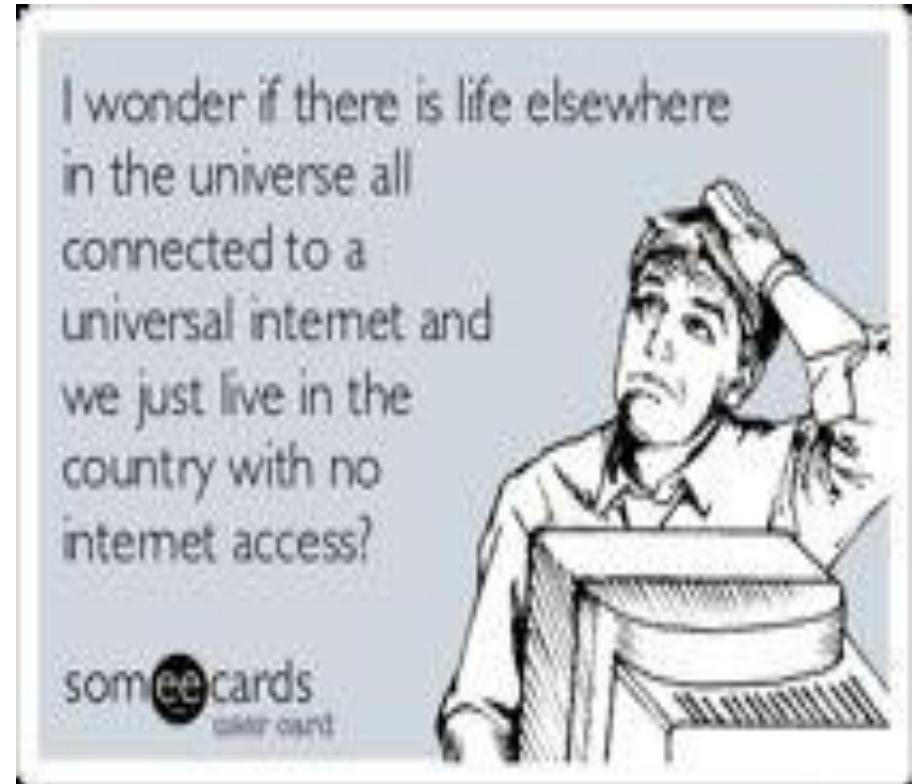
# Web: connecting people

- The potential for Knowledge sharing today is unmatched in history
- Never before have so many knowledgeable people been connected

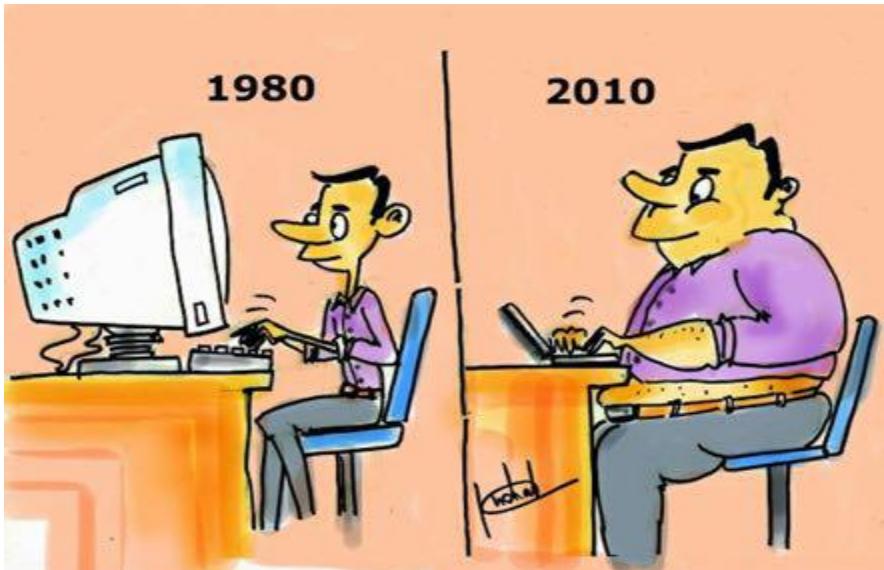


# To be or not to be connected?

***Being connected is good  
but being disconnected for  
the past millions years was  
the main reason behind our  
cultural diversity***



# Being disconnected!



# Artificial Intelligence: *Application*

## ***All-inclusive Digital India***

- 635 million internet users
- **Multilingual information access** to the low-income citizens is very important
- Differently abled and visually challenged people should be part of this digital revolution

# Artificial Intelligence: *Application*

- **AI in Life Styles**

- Autonomous Vehicles
- Spam Filters
- Facial Recognition
- Recommendation System

- **AI in Navigation**

- GPS technology can provide users with accurate, timely, and detailed information to improve safety

# Artificial Intelligence: *Application*

- **AI in E-commerce**

- Personalized Shopping
- AI powered Assistants
- Fraud Prevention

- **AI in Education**

- Automated Administrative tasks
- Personalized learning
- Automated question and assignment generation
- Help in evaluation
- Creating smart contents
- Voice Assistants

# Artificial Intelligence: *Application*

- **AI in Robotics**

- Carrying goods in hospitals, factories, and warehouses
- Cleaning offices and large equipment
- Inventory management

- **AI in Human Resources**

- AI and ML to hire right people for a specific position
- Scanning of profiles and resumes

# Artificial Intelligence: *Application*

## ■ **AI in Healthcare**

- **Bot** to assist patients with the queries of their symptoms, access the health records, medicines to take, information about the hospitals, precautions to be taken etc.
- **Multilingual report generation** from clinical records and radiology examinations
- Useful **information extraction** from clinical records
- Detecting diseases and identify cancer cells

## ■ **AI in Agriculture**

- Backbone of India
- Identify defects and nutrient deficiencies in the soil
- **Multilingual Chatbot** for the farmers
- Could provide information on crops, soil condition, weather condition, fertilizers, pesticides, market condition, price etc

# Artificial Intelligence: *Application*

- **AI in Gaming**

- Creating smart, human-like NPCs to interact with the players
- Predicting human behaviors through game design

- **AI in Automobiles**

- To build self-driving vehicles
- Improve in-vehicle experience
- Provide additional supports like emergency braking, blind-spot monitoring and driver-assist steering

# Artificial Intelligence: *Application*

- **AI in Social Media**

- Instagram
- Facebook
- Twitter

- **AI in Marketing**

- Using AI, marketers can deliver highly targeted and personalized ads with the help of behavioral analysis, pattern recognition, etc.
- AI can help with content marketing in a way that matches the brand's style and voice
- Chatbots to interact with the users

# Artificial Intelligence: *Application*

## ■ **AI in Finance**

- AI can help to significantly improve a wide range of financial services
- Customers looking for wealth management solutions can get information through SMS, Online Chat etc
- Fraud detection
- Detecting transaction patterns

# Artificial Intelligence: *Application*

## Law & Judiciary

- **Machine Translation** of judgments and proceedings from English to Indic and Indic to English languages
- **Multilingual Interactive System** to provide legal advice to the clients, common citizens; assisting lawyers and judges with specific details about a case, and its precedences
- **Automated Contract Review:** very routine NDAs, complex such as Real-estate deals, Corporate deals etc.
- **Text Simplification:** Simplifying legal documents (*corporate laws, taxation, civil etc*) to make the common people understand easily

## Tourism & Travel

- **Conversational Assistant** with personalization feature to assist the users in choosing travel destinations, booking hotels, selecting tourist spots etc
- **Sentiment Analysis** of the user written reviews of the places, services etc
- **Machine Translation** of descriptions (hotels, restaurants, tourist places) and reviews into Indian languages

- **Aviation:** Analysis of information from aircraft manuals; find meaning in the descriptions of problems reported verbally or handwritten from pilots and other humans; determine the event sequences that caused aircraft accidents

- **Digitization of ancient and archaeological manuscripts and texts**

○ Knowledge extraction

# AI is Real Fun!

# What is AI?

<p>“The exciting new effort to make computers think . . . <i>machines with minds</i>, in the full and literal sense” (Haugeland, 1985)</p> <p>“[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . . ” (Bellman, 1978)</p>	<p>“The study of mental faculties through the use of computational models” (Charniak and McDermott, 1985)</p> <p>“The study of the computations that make it possible to perceive, reason, and act” (Winston, 1992)</p>
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**Figure 1.1** Some definitions of AI. They are organized into four categories:

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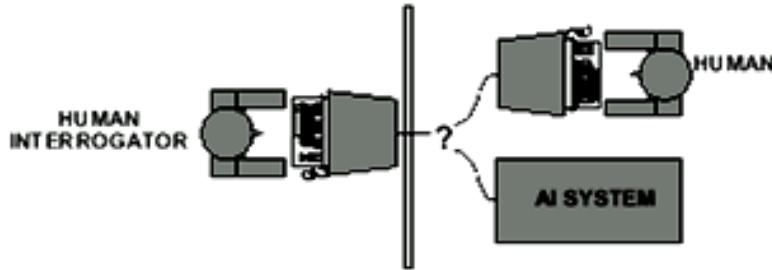
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# Acting Humanly: The Full Turing Test

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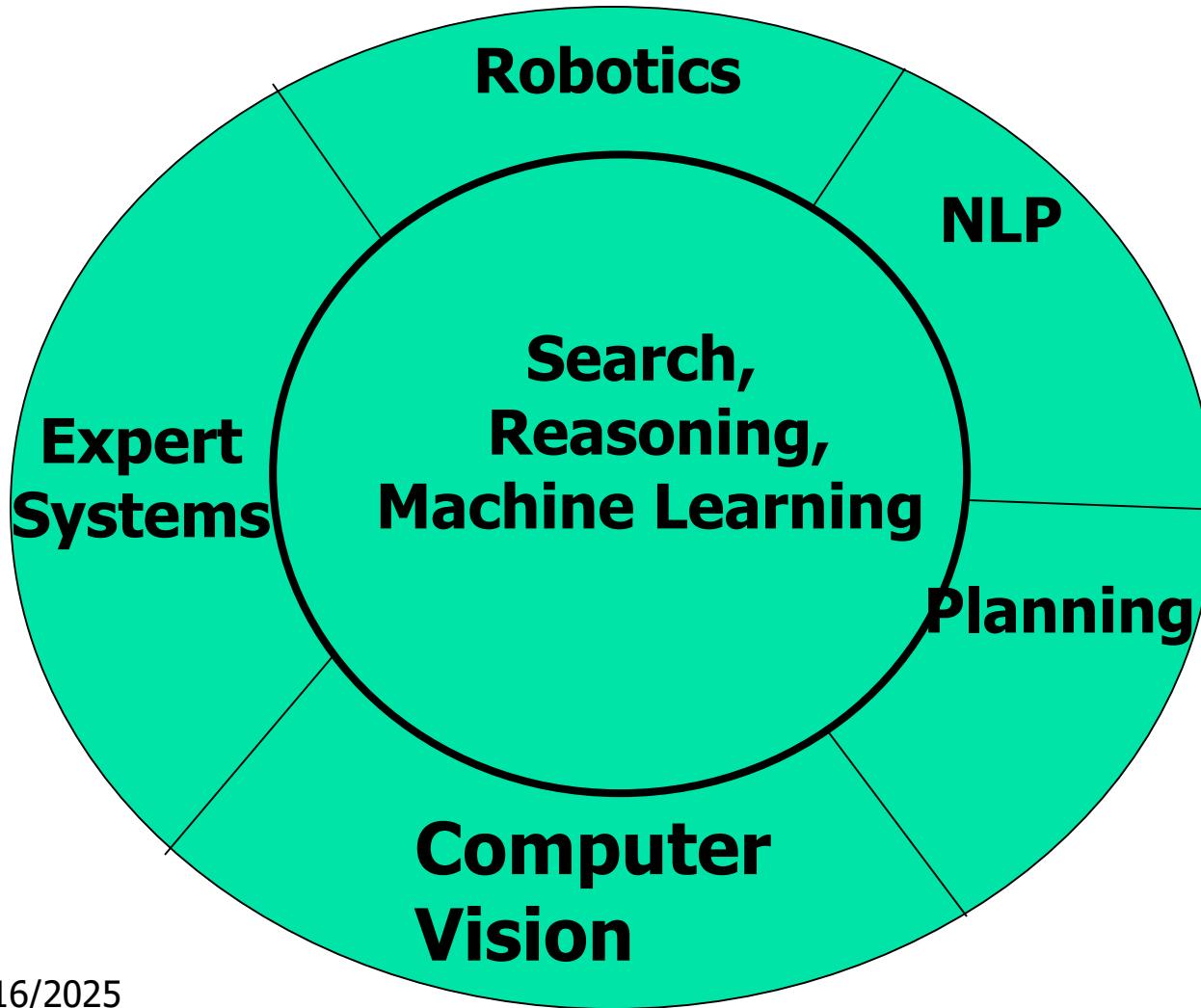
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- **Other senses:** such as audition, smell, touch, etc.

**Disciplines which form the core of AI- inner circle**

**Fields which draw from these disciplines- outer circle**



# Allied Disciplines

Philosophy	Knowledge Rep., Logic, Foundation of AI (is AI possible?)
Maths	Search, Analysis of search algos, logic
Economics	Expert Systems, Decision Theory, Principles of Rational Behavior
Psychology	Behavioristic insights into AI programs
Brain Science	Learning, cognitive science, Neural Nets
Physics	Learning, Information Theory & AI, Entropy, Robotics
Computer Sc. & Engg.	Systems for AI

# AI History

- 1943** McCulloch & Pitts: Boolean circuit model of brain
- 1950** Turing's "Computing Machinery and Intelligence"
- 1952–69** Look, Ma, no hands!
- 1950s** Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1956** Dartmouth meeting: "Artificial Intelligence" adopted
- 1965** Robinson's complete algorithm for logical reasoning
- 1966–74** AI discovers computational complexity Neural network research almost disappears
- 1969–79** Early development of knowledge-based systems
- 1980–88** Expert systems industry booms
- 1988–93** Expert systems industry busts: "AI Winter"
- 1985–95** Neural networks return to popularity
- 1988** – Resurgence of probability; general increase in technical depth  
"Nouvelle AI": ALife, GAs, soft computing
- 1995** – Agents, agents, everywhere . . . Machine learning comes to age, web intelligence, smart machines
- 2003** – Human-level AI back on the agenda

# AI State-of-the-art

- Have the following been achieved by AI?
  - World-class chess playing
  - Playing table tennis
  - Solving mathematical problems
  - Discover and prove mathematical theories
  - Engage in a meaningful conversation
  - Understand spoken language
  - Observe and understand human emotions
  - Express emotions
  - ...

# AI: From Past to Present

- AI/NLP based systems have enabled wide-range of applications
  - Google's powerful search engines
  - Alexa, Google's MT
  - Several systems related to healthcare, mental health, processing social media texts etc.
  - Fake news detector and so on
  - Chess playing
- Shallow ML algorithms (corresponds to Statistical NLP)
  - Used extensively (HMM, MaxEnt, CRF, SVM, Logistic Regression etc.)
  - Requires handcrafting of features
  - Time-consuming
  - Curse of dimensionality (because of joint modeling of language models)

# AI: From Past to Present

- Deep Learning algorithms
  - No feature engineering
  - Success of distributed representations (Neural language models)
- Some recent developments
  - The rise of distributed representations (e.g., Word2vec, GLOVE, ELMO, BERT etc)
  - Convolutional, recurrent, recursive neural networks, Transformer, Reinforcement learning
  - Unsupervised sentence representation learning
  - Combining deep learning models with memory-augmenting strategies
- Explainable AI
  - **ChatGPT**
  - **GPT-4**

# AI: Future

- Artificial General Intelligence :  
**able to exhibit human intelligence**
- Artificial Super Intelligence :  
**surpasses human intelligence in many aspects**

from creativity to general wisdom to problem-solving —  
will require machines to experience consciousness

# News: March 27, 2019

*Yoshua Bengio, Geoffrey Hinton, and Yann LeCun received the*

*Turing Award-2018 (equivalent to Nobel Prize of Computing)*

- *for Modern AI (specifically for deep learning research)*

Bengio- University of Toronto and Google

Hinton- University of Montreal

LeCun- Facebook's chief AI scientist and a professor at NYU

# Topics to be covered (1/2)

- **Search**
  - General Graph Search, Uninformed search, informed search and local search
- **Logic**
  - Propositional Calculus and Predicate Calculus
- **Planning**
- **Machine Learning**
  - Basic Ideas, Decision Trees, Bayes Networks, Text Classification, Neural Networks
- **Deep Learning**
  - CNN, RNN, LSTM

# Topics to be covered (2/2)

- **Evolutionary Computation**
  - Genetic Algorithm, Multiobjective Optimization, Differential Evolution, Particle Swarm Optimization
- **Probabilistic Methods**
  - Hidden Markov Model, Maximum Entropy Markov Model
- Introduction to NLP

# Goal of Teaching the course

- **Concept building:** firm grip on foundations, clear ideas
- **Coverage:** grasp of good amount of material, advances
- **Inspiration:** get the spirit of AI, motivation to take up further work

# Resources

- Main Text:
  - Artificial Intelligence: A Modern Approach by Russell & Norvig, Pearson, 2003.
- Other Main References:
  - Principles of AI - Nilsson
  - AI - Rich & Knight
  - Knowledge Based Systems – Mark Stefik
- Journals
  - AI, IEEE Expert, TPMII, IEE TKDE etc..
  - Area Specific Journals e.g, Computational Linguistics etc.
- Conferences
  - IJCAI, AAAI, ACL etc.

# Evaluation

- Assignments: 35
- Midterm Exam: 25
- ESE Exam: 40

**Thank you for your attention!**