

# AI/ML Research in India

Slides Credit: Prof. B Ravindran  
IIT Madras

Narayanan C Krishnan  
IIT Palakkad

# Recent Advancements in DS/AI/ML

*(Across the globe)*

# ChatGPT

## ChatGPT: Optimizing Language Models for Dialogue

We've trained a model called ChatGPT which interacts in a conversational way. The dialogue format makes it possible for ChatGPT to answer followup questions, admit its mistakes, challenge incorrect premises, and reject inappropriate requests. ChatGPT is a sibling model to [InstructGPT](#), which is trained to follow an instruction in a prompt and provide a detailed response.

		
Examples	Capabilities	Limitations
"Explain quantum computing in simple terms" →	Remembers what user said earlier in the conversation	May occasionally generate incorrect information
"Got any creative ideas for a 10 year old's birthday?" →	Allows user to provide follow-up corrections	May occasionally produce harmful instructions or biased content
"How do I make an HTTP request in Javascript?" →	Trained to decline inappropriate requests	Limited knowledge of world and events after 2021

Source: Wikipedia



# ChatGPT

23:54 4G 35%

it.openai.com + 12 :

## Why India AI Research

AI research in India is attractive due to several reasons, including:

1. Large pool of talented engineers and researchers
2. Growing tech industry and government support for AI development
3. Increasing demand for AI solutions in various industries
4. High demand for AI talent in the job market
5. Growing interest in AI and its potential to solve local and global problems.

Like Dislike

4

00:14 4G 34%

it.openai.com + 12 :

## Why India AI Research

A PhD in AI in India may be attractive for several reasons, including:

1. Growing demand for AI expertise in industries and academia.
2. Access to cutting-edge research facilities and resources.
3. Opportunities to work on real-world AI problems affecting the local and global community.
4. Collaborations with leading AI researchers and industry experts.
5. Good job prospects and high demand for AI talent in the job market.

Like Dislike

00:02 4G 35%

it.openai.com + 12 :

## Why India AI Research

There are several reasons why someone may choose to pursue a PhD in India, including:

1. Access to top-notch institutions and research facilities.
2. Availability of funding opportunities and scholarships.
3. Rich cultural and academic diversity.
4. Opportunities to collaborate with researchers and industries.
5. Cost-effective compared to pursuing a PhD in other countries.

Like Dislike

4

# ChatGPT

FL

Hi, I'm writing an article about you and all of the cool things you can do. Could you say hello to my readers and give us a quick self-introduction? I'd like it to be friendly and casual, include a silly joke, and end with a note about how great the rest of my article is.



Hello readers! My name is Assistant, and I'm a large language model trained by OpenAI. I'm here to help answer your questions and provide you with information on a wide variety of topics. I'm a bit of a jokester, so here's a quick one for you: Why was the math book sad? Because it had too many problems! But seriously, I'm excited to be featured in your article and I hope you enjoy learning more about me and all the cool things I can do. And trust me, the rest of the article is going to be great!

Source: <https://www.springboard.com/blog/news/chatgpt-revolution/>



Find the bug with this code:

...

```
for (var i = 0; i < 5; i++) {  
  setTimeout(() => console.log(i), 1000)  
}  
...
```



The code contains a bug that will cause it to always print the number 5 to the console, rather than the expected sequence of numbers from 0 to 4. This is because the `setTimeout` function creates a closure that captures the value of the `i` variable, but the `i` variable is changed before the callback function is executed.



To fix this bug, the code can be modified to create a new variable in the loop that is passed to the `setTimeout` callback function, rather than using the loop variable directly. This will ensure that each callback function captures the correct value of the loop variable, and the expected output will be produced. Here is an example of how the code could be fixed:

```
Copy code  
  
for (var i = 0; i < 5; i++) {  
  // Create a new variable and pass its value to setTimeout  
  const value = i;  
  setTimeout(() => console.log(value), 1000)  
}
```

This code will print the numbers 0 to 4 to the console, as expected. Alternatively, the `let` keyword can be used in place of `var` to declare the loop variable, which will automatically create a new variable for each iteration of the loop and avoid the need to create a new variable manually. This is a common pattern for avoiding closure-related bugs in JavaScript.

Source: @amasad (Twitter)

## Translate natural language to code with Codex.



```
"""
Table customers, columns = [CustomerId, FirstName, LastName, Company, Address, City,
State, Country, PostalCode, Phone, Fax, Email, SupportRepId, TotalSpend]

Create a MySQL query for all customers in Texas who have spent over five thousand
dollars.

"""
query = "SELECT * FROM customers WHERE State = 'TX' AND TotalSpend > 5000"
```

Source: OpenAI

## Translate natural language to code with Codex.



```
"""
Python 3
Get the current value of a Bitcoin in US dollars using the bitcoincharts api
"""

import requests
import json

def get_bitcoin_price():
    url = 'http://api.bitcoincharts.com/v1/weighted_prices.json'
    response = requests.get(url)
    data = json.loads(response.text)
    return data['USD']['7d']

if __name__ == '__main__':
    print(get_bitcoin_price())
```

Translate natural language to code with Codex.



```
"""
Extract all the html from the string and replace the tags with ''
"""

def extract_html(text):
    return re.sub('&lt;[^&lt;]+?&gt;', '', text)
```

# Codex

# Translate natural language to code with Codex.

```
"""
Extract all the html from the string and replace
"""

def extract_html(text):
    return re.sub('&lt;[^&lt;]+&gt;', '', text)

    return data['USD']['7d']

if __name__ == '__main__':
    print(get_bitcoin_price())
```



A screenshot of the GitHub Copilot interface. At the top, it says "GitHub Copilot" with a gear icon. Below that is a "Technical preview" button. The main area features the text "Your AI pair programmer". On the right, there's a code editor window titled "JS fetch\_pic.js" showing a snippet of JavaScript code for fetching a NASA picture. The code includes imports for 'fetch' and 'Promise', and defines a function 'fetchNASAPicture' that uses 'fetch' with specific headers and a timeout. A "Copilot" watermark is visible at the bottom of the code editor. The background has a dark, grid-like pattern.

## GitHub Copilot

AI pair programmer that helps you write code faster with less work. Using Codex, GitHub Copilot applies the context in your editor and synthesizes whole lines and even entire functions of code.

Source: OpenAI

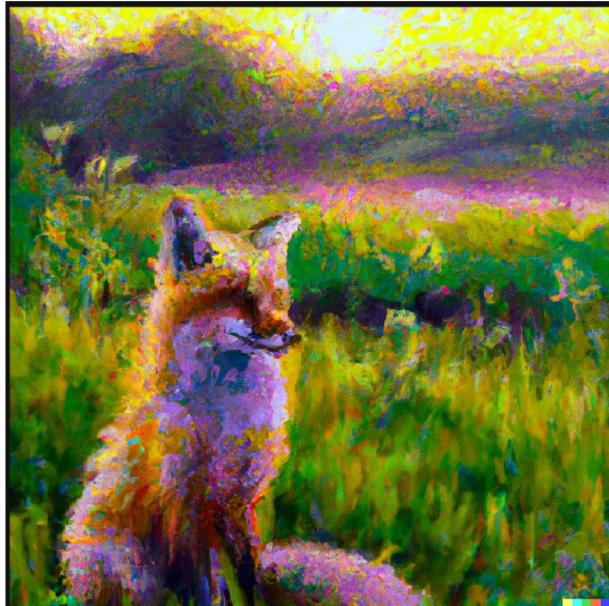


# DALL·E 2

DALL·E 2



DALL·E 2 is a new AI system that can create realistic images and art from a description in natural language.



"a painting of a fox sitting in a field at sunrise in the style of Claude Monet"



panda mad scientist mixing sparkling chemicals, artstation

Source: OpenAI

# DALL·E 2

# DALL·E 2



DALL·E 2 is a new AI system that can create realistic images and art from a description in natural language.



"a painting of a fox sitting in a field at sunrise in the style of Claude Monet"



an espresso machine that makes coffee from human souls, artstation

# DALL·E 2



## Preventing Harmful Generations

We've limited the ability for DALL·E 2 to generate violent, hate, or adult images. By removing the most explicit content from the training data, we minimized DALL·E 2's exposure to these concepts. We also used advanced techniques to prevent photorealistic generations of real individuals' faces, including those of public figures.



## Curbing Misuse

Our content policy does not allow users to generate violent, adult, or political content, among other categories. We won't generate images if our filters identify text prompts and image uploads that may violate our policies. We also have automated and human monitoring systems to guard against misuse.



## Phased Deployment Based on Learning

Learning from real-world use is an important part of developing and deploying AI responsibly. We began by previewing DALL·E 2 to a limited number of trusted users. As we learned more about the technology's capabilities and limitations, and gained confidence in our safety systems, we slowly added more users and made DALL·E available in beta in July 2022.

# AlphaFold

AlphaFold is an AI system developed by DeepMind that predicts a protein's 3D structure from its amino acid sequence. It regularly achieves accuracy competitive with experiment.

In CASP14, AlphaFold was the top-ranked protein structure prediction method by a large margin, producing predictions with high accuracy. While the system still has some limitations, the CASP results suggest AlphaFold has immediate potential to help us understand the structure of proteins and advance biological research.



A screenshot of the AlphaFold Protein Structure Database homepage. The page has a blue background with a faint protein structure model. At the top, it says "AlphaFold Protein Structure Database" and "Developed by DeepMind and EMBL-EBI". Below that is a search bar with the placeholder "Search for protein, gene, UniProt accession or organism" and a "BETA" button. Underneath the search bar are examples of search terms: "Free fatty acid receptor 2", "At1g58602", "Q5VSL9", "E. coli", "Help", and "AlphaFold DB search help". At the bottom of the search area is a link "Feedback on structure: Contact DeepMind".

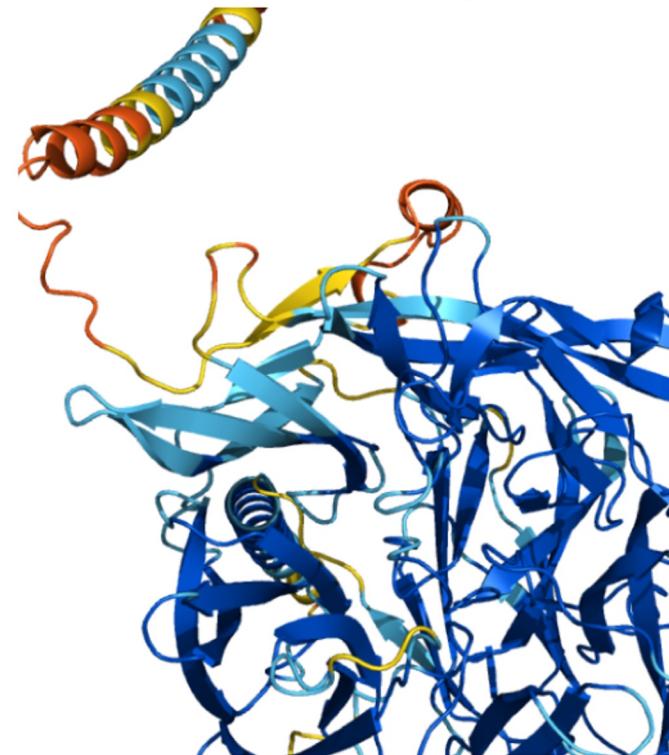
AlphaFold DB provides open access to over 200 million protein structure predictions to accelerate scientific research.

# AlphaFold



## How can AI and AlphaFold help?

Finding a way to close this rapidly expanding gap and predict the structure of millions of unknown proteins could not only help us tackle disease and more quickly find new medicines but ultimately better understand life itself. This is why biologists are turning to AI methods: the ability to predict a protein's shape computationally from its genetic code alone – as a complementary alternative to determining it through costly and time-consuming experimentation – could help dramatically accelerate research.

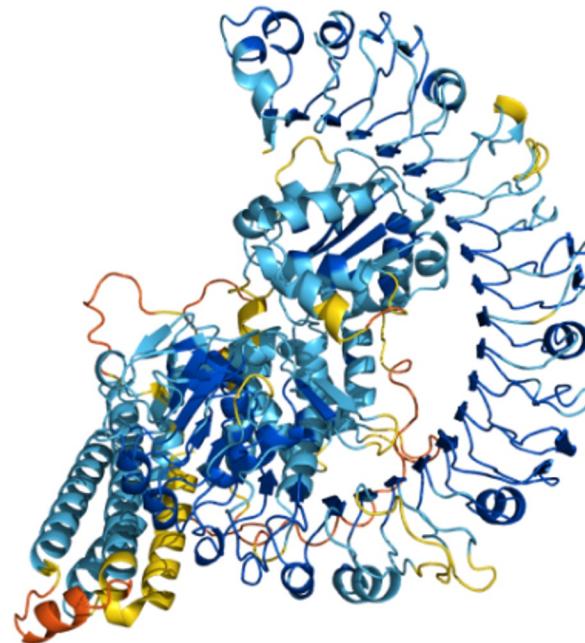


Q8I3H7: May protect the malaria parasite against attack by the immune system.  
Mean pLDDT 85.57.

# AlphaFold

## How can AI and AlphaFold help?

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Q8W3K0: A potential plant disease resistance protein. Mean pLDDT 82.24.

# Jukebox

## Jukebox

We're introducing Jukebox, a neural net that generates music, including rudimentary singing, as raw audio in a variety of genres and artist styles. We're releasing the model weights and code, along with a tool to explore the generated samples.

## Curated Samples

Provided with genre, artist, and lyrics as input, Jukebox outputs a new music sample produced from scratch. Below, we show some of our favorite samples.

 Country, in the style of Alan Jackson - Jukebox

 [SOUNDCLOUD](#)

[Link](#)

 Rock, in the style of Elvis Presley - Jukebox

 [SOUNDCLOUD](#)

[Link](#)

 Pop, in the style of Katy Perry - Jukebox

 [SOUNDCLOUD](#)

[Link](#)

 Blues Rock, in the style of Joe Bonamassa - Jukebox

 [SOUNDCLOUD](#)

[Link](#)

 Heavy Metal, in the style of Rage - Jukebox

 [SOUNDCLOUD](#)

[Link](#)

 Classic Pop, in the style of Frank Sinatra - Jukebox

 [SOUNDCLOUD](#)

[Link](#)



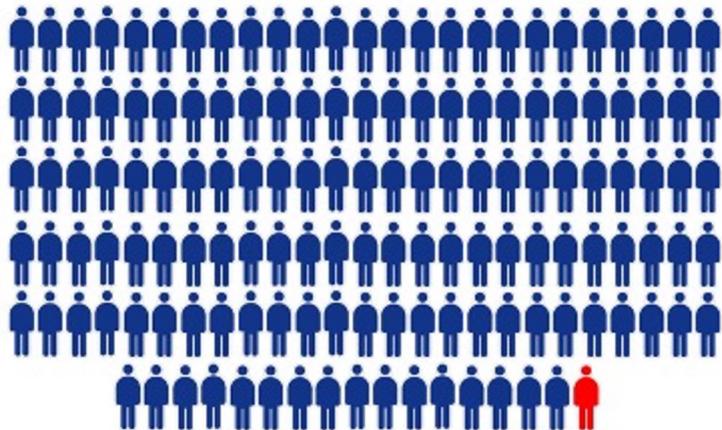
# DS/AI Institutions

# DS & AI Institutions – Global Scenario

- DS & AI centres/institutions becoming ubiquitous in academic institutions
- Centres' focus – focus research efforts and bring large teams together
- Multi-institutional DS/AI research centres in mature ecosystems
  - Alan Turing Institute in the U.K.
  - Mila in Montreal with four academic partners and numerous industry partners
  - 18 AI institutes funded by NSF – focused on specific themes
- Centers in India tend to be contained in only one institute
  - Facilitates institutions to identify DS/AI as a growth area and area of interests
  - Facilitates interdisciplinary research and inter-department participation

# Industries – Demand Supply Gap

- Out of 2.14 million STEM graduates only 10000-15000 had AI/ML in their curriculum
- Indian industry currently has a demand-supply gap of 150,000 AI/ML tech talent, with demand outstripping supply by more than 50%



# AI Research in India

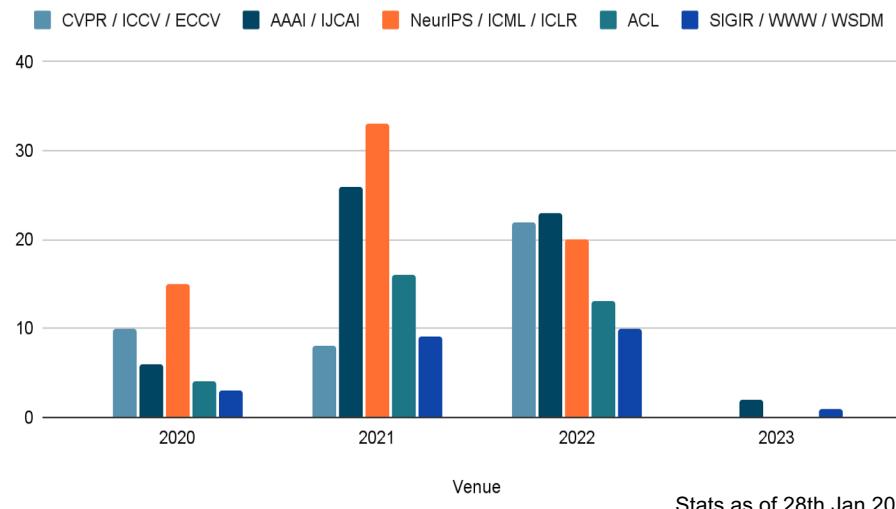
## Government Initiatives

- Organizations
  - DST, DBT, NITI Aayog, MeitY, NASSCOM
- 25 Technology Innovation Hubs across the country through National Mission on Interdisciplinary Cyber-Physical Systems
  - Boosting new and emerging technologies to power national initiatives
- Responsible AI
  - For youth
  - In schools
- International Collaborations
  - With various countries
- Startups

# Research Outcomes

Research Publications – India

Publications from India – Areas & Conferences (2020 – 2023)



Stats as of 28th Jan 2023

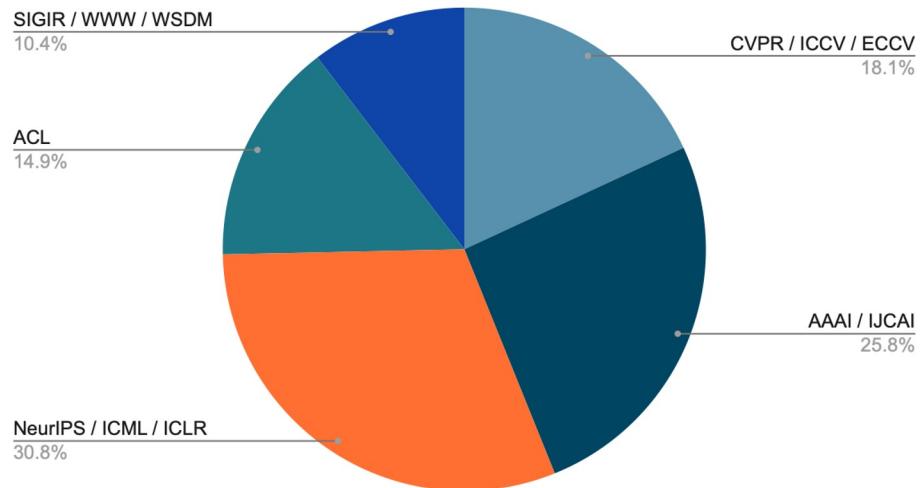
Source:

<https://ikdd.acm.org/>

# Research Outcomes

Research Publications – India

Publications from India – Areas & Conferences (2020 – 2023)



Stats as of 28th Jan 2023

Source:  
<https://ikdd.acm.org/>

# Research Centres, Schools, Departments & CoEs in India



**Yardi School of Artificial Intelligence**  
**ScAI @ IIT Delhi**

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# Yardi School of Artificial Intelligence

## ScAI @ IIT Delhi



### IITD alumnus Anant Yardi donates US\$ 10 Million to ScAI

Mr Anant Yardi, President and Founder of Yardi Systems, and an alumnus of IIT Delhi, has agreed to gift USD 10 million (Rs ~75 Cr) to IIT Delhi. Mr Yardi's gift would enable IIT Delhi to create state-of-the art laboratories and attract talented students and researchers to its newly established Yardi School of Artificial Intelligence (ScAI).

### Core Areas of Research:

- Machine Learning
- Information Retrieval
- Natural Language Processing
- Computer Vision

# Yardi School of Artificial Intelligence

ScAI @ IIT Delhi



## MULTIDISCIPLINARY APPLICATIONS

**Applications:** Healthcare, Material Science, Industry 4.0, Security, Law, Policy, Finance, Robotics,...

## BRIDGE

**Bridge:** Computer Vision, Natural Language Processing, Knowledge Graphs, Videos, Multimodal AI,...

## CORE

**Core:** Machine Learning, Deep Learning, Reinforcement Learning, Data Science, Multi-agents, Logic-based AI, ...

## BASICS

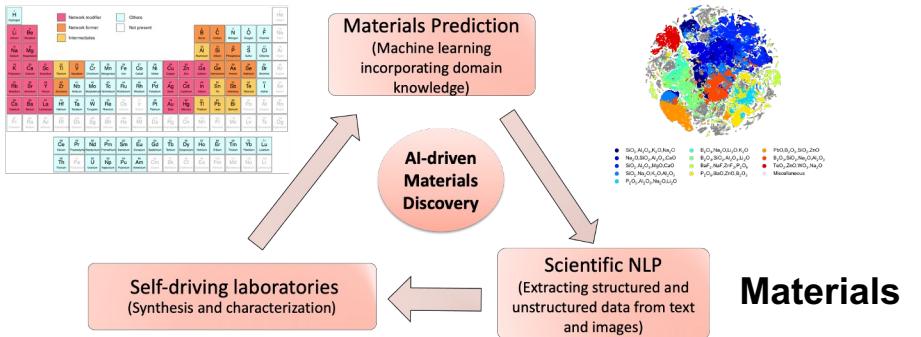
**Fundamentals:** Optimization, Linear Algebra, Probability & Statistics, Learning Theory, Hardware for AI



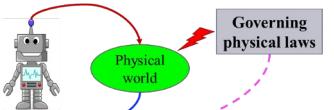
# Yardi School of Artificial Intelligence

ScAI @ IIT Delhi

## Applied Areas of Research



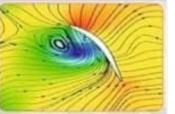
## Robotics



Intelligent systems acting & interacting with the physical world



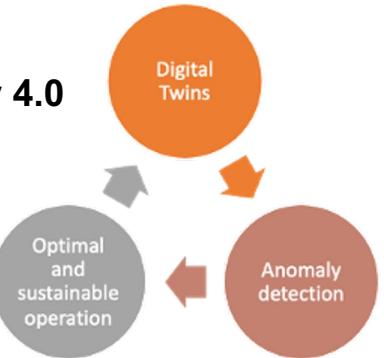
Intelligent Robotic Systems



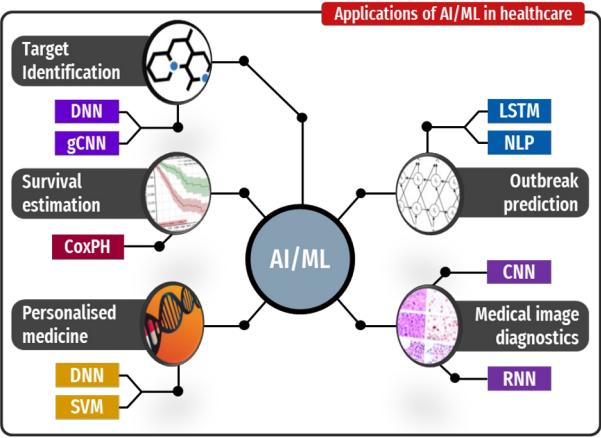
Physics-informed models

- Confluence of several AI disciplines
  - NLP (Machine Reading, Dialogue)
  - Visual scene understanding
  - Planning & common-sense.
  - Human interaction and teaching
  - Soft embodiments, tactile sensing, shape adaptation/correction,
  - Physics-informed simulation

## Industry 4.0



## Healthcare



# Yardi School of Artificial Intelligence

## ScAI @ IIT Delhi



### ScAI to Start 'M.Tech in Machine Intelligence & Data Science (MINDS)'

The Yardi School of Artificial Intelligence (ScAI) at IIT Delhi will start a new post graduate programme focused on artificial intelligence. M.Tech in MINDS will be a flagship educational programme for the school and is expected to begin in July 2022.



### IIT-Delhi launches AI school, to begin course from January

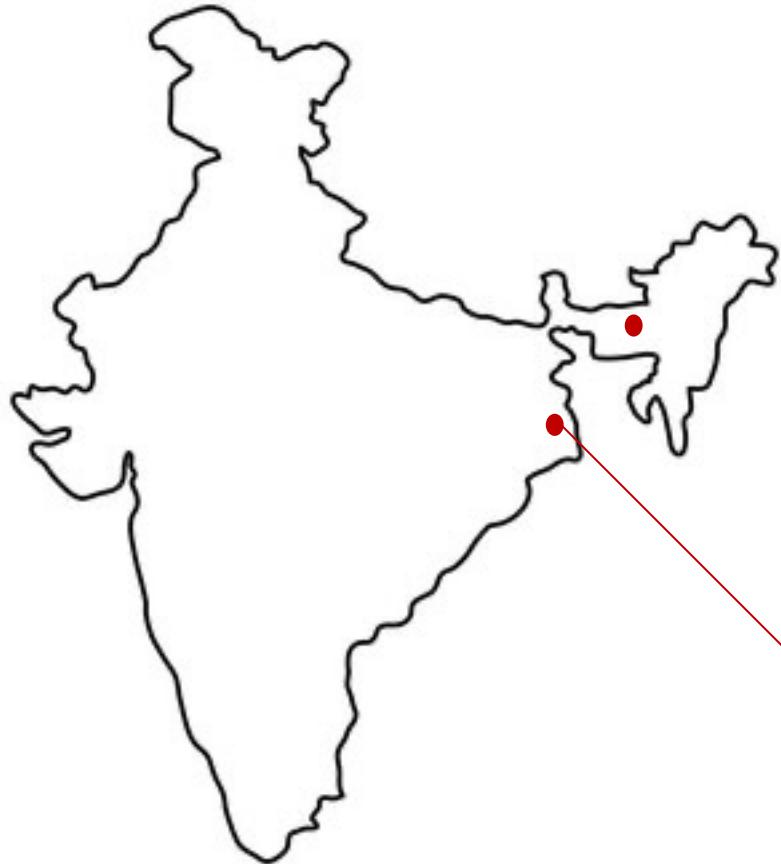
IIT-Delhi announced the establishment of School of Artificial Intelligence on its campus. The school will begin its PhD programme in January.

#### Programs:

- Multidisciplinary Ph.D.in AI
- MTech in Machine Intelligence & Data Science (MINDS)
- Dual Degree in MINDS for undergrads

#### Other Activities:

- Executive programs for professionals in industry & government
- Workshops & Summer Schools
- Outreach events



**Centre of Excellence in AI @ IITKGP**

# Centre of excellence in AI (CAI)

## @IIT Kharagpur



National  
Supercomputing  
Mission



Centre for  
Development of  
Advanced Computing

## AI Shiksha

Introduction to Machine  
Learning



IIT Kharagpur

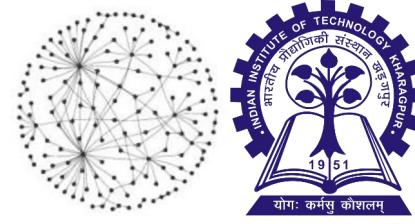
IIT Madras

IIT Goa

IIT Palakkad

# Complex Network Research Group

## CNERG @ IIT Kharagpur



SYSTEMS AND SENSING



NETWORK SCIENCE AND ML



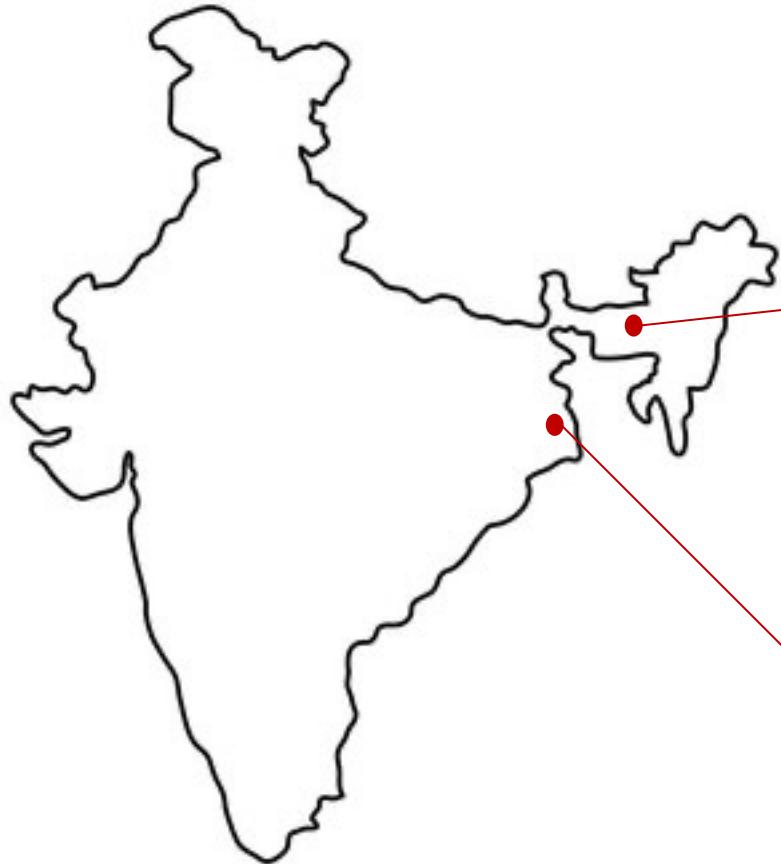
NLP AND IR



WEB AND SOCIAL

### Areas:

- Internet of Things
- Systems - Storage, Multimedia, and System Analytics.
- Network Science & Machine Learning
- Natural language processing
- Web and Social - Social Sensing, Social Computing
- Graph Mining
- Application domains



**Mehta Family School of Data Science  
and Artificial Intelligence @ IITG**

**Centre of Excellence in AI @ IITKGP**



# Mission

- To produce undergraduate and postgraduate students in data science and knowledge engineering having strong theoretical foundation, good skills in program development and exposure to research and development.
  - To produce researchers who can provide solution to different challenging research problems, both theoretical and applied, and make original contributions.
  - To be a place for innovation and technology development in frontier areas of data science and knowledge engineering.

## Programs

- BTech in Data Science and Artificial Intelligence

DS & AI Curriculum Structure				
Programming <ul style="list-style-type: none"> <li>• Computing Lab</li> <li>• Data Structures Lab</li> <li>• Python Lab</li> <li>• DBMS Lab</li> <li>• ML Lab</li> <li>• Advanced ML Lab</li> <li>• Visualization Lab</li> </ul>	AI & ML <ul style="list-style-type: none"> <li>• Machine Learning</li> <li>• Introduction to AI</li> <li>• Deep Learning</li> <li>• Multi-modal data processing &amp; learning: I &amp; II</li> <li>• Ethics, fairness, explainability &amp; verification</li> </ul>	Data Science <ul style="list-style-type: none"> <li>• Introduction to Data Science</li> <li>• Data Visualization</li> <li>• Big-data tools and techniques</li> </ul>	Mathematical <ul style="list-style-type: none"> <li>• Statistics</li> <li>• Applied Probability</li> <li>• Applied time series analysis</li> <li>• Matrix Computations</li> <li>• Data Analytics for Finance</li> </ul>	Systems <ul style="list-style-type: none"> <li>• Computer System</li> <li>• Internet of Thing</li> <li>• Control systems</li> <li>• robotics</li> </ul>
Cross disciplinary Foundation				
Signals, Systems & Networks, Bioinformatics Data analytics for finance				

- PhD (Machine learning, Deep Learning, Reinforcement Learning with applications in CV, NLP, Communications, Recommendation systems)

**Centre for Machine Learning and Data  
Science @ IITB**

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# Centre for Machine Intelligence & Data Science

C-MInDS @ IIT Bombay

## Thematic Areas



### AI/ML in Healthcare and Life sciences

- Precision diagnosis,
- Analysis in medical images



### Data analytics for financial organizations

- Trend detection
- Stock market prediction



### Indian Language and Speech Technology

- Multilingual representation learning for all Indian languages
- Automatic text and spoken translation across Indian languages

### AI/ML in Education

- Ensuring accessibility to virtual labs
- Harnessing Edu-tech and crossing language barrier in learning



### AI/ML Industry 4.0

- Smart factories and manufacturing processes
- Energy smart devices
- Fault detection
- Capability augmentation with web connectivity for large-scale machine to machine communication



### AI/ML in Transportation

- Inter-modal transportation
- Initiation of data driven design

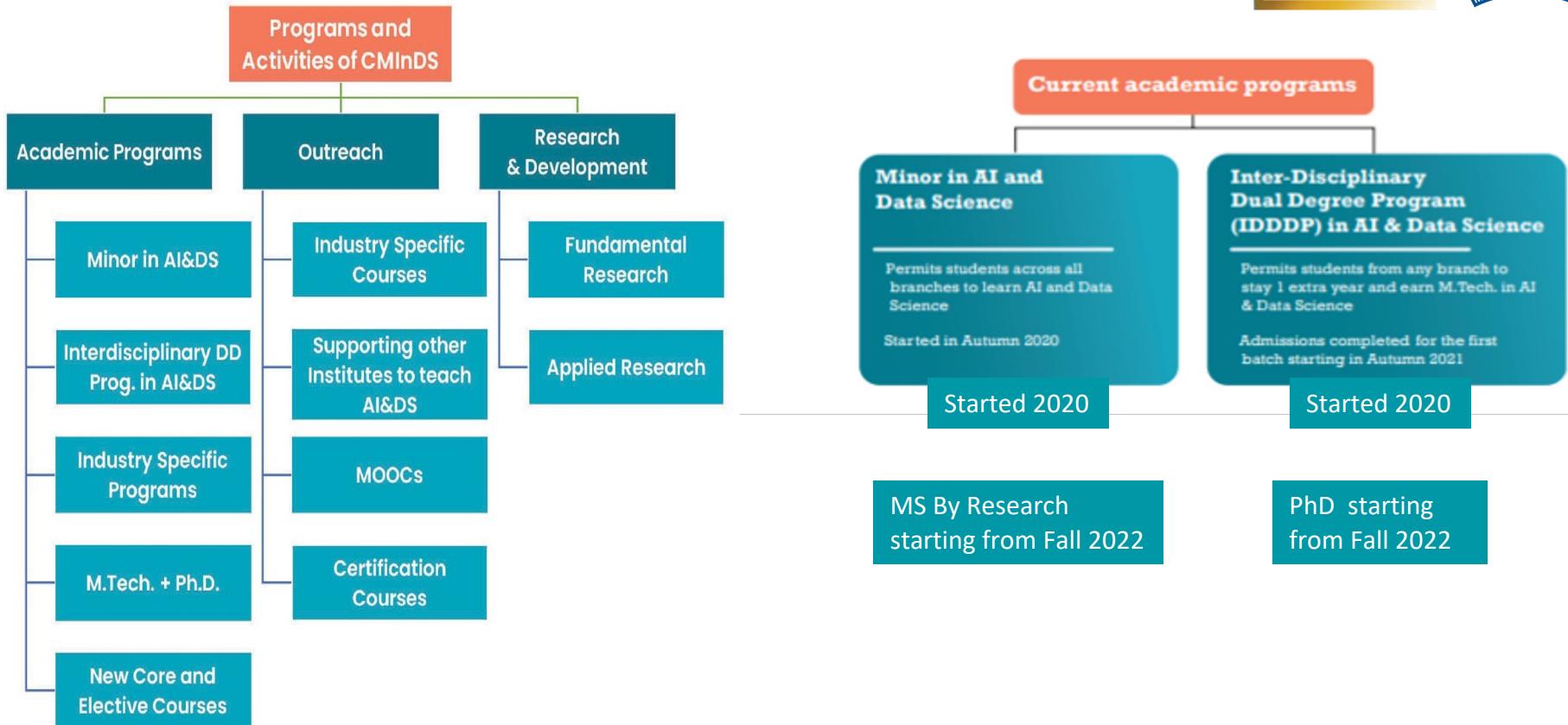


### Materials and Mechanics

- Predicting material properties
- New material discovery
- Physics Driven Machine Learning Models

# Centre for Machine Intelligence & Data Science

## C-MInDS @ IIT Bombay



# Centre for Machine Intelligence & Data Science

## C-MInDS @ IIT Bombay



DS & AI Curriculum Structure			
Programming	AI & ML	Data Science	Mathematical
<ul style="list-style-type: none"> <li>Languages, e.g., Python</li> <li>Database systems (DBMS)</li> <li>Parallel algorithms processing</li> <li>Cloud platforms</li> <li>Deep learning platforms</li> </ul>	<ul style="list-style-type: none"> <li>Introductory ML</li> <li>Knowledge representation &amp; logic</li> <li>Advanced ML (Deep Learning, Distributed learning)</li> <li>Reinforcement learning</li> <li>Theory of performance analysis and guarantees in ML</li> <li>AI</li> </ul>	<ul style="list-style-type: none"> <li>Data Analysis and interpretation</li> <li>Data Management</li> </ul>	<ul style="list-style-type: none"> <li>Statistics</li> <li>Applied Probability</li> <li>Time series analysis</li> <li>Optimization for ML</li> <li>Linear Algebra</li> <li>Simulation and modeling</li> </ul>
Domains			
Domain 1	Languages and speech	Domain 5	Civil engineering
Domain 2	Health and bio-informatics	Domain 6	Education
Domain 3	Mechanics and Manufacturing	Domain 7	Chemical engineering and climate
Domain 4	Finance and Management	Domain 8	Ethics, economics, and policy
		Domain 9	Sciences: Physics and Chemistry
Disciplines			
Computer Science	Chemical	HSS	Civil
Electrical	Mechanical	Mathematics	BSBE



Kotak-IISc AI-ML Centre @ IISc

# Kotak-IISc AI-ML Centre @IISc Bangalore

A CSR Initiative by



**Vision:** A center of excellence engaged in furthering the Theory, Practice and Pedagogy of Artificial Intelligence with emphasis on Basic Sciences and FinTech.

## Focus:

- FinTech
- Data Driven Interventions(Healthcare, Traffic, Social Systems, etc)
- CyberPhysical Systems (Robotics—Cobotics, Social Robotics)
- Creating Repository of Open Source Data for Healthcare—Teleradiology and other verticals

## Programs:

- BTech in Math and Computing
- MTech(AI)
- MTech (AI) Online – A program for Industry Professionals Certificate Programs for Industry professionals

# Kotak-IISc AI-ML Centre @IISc Bangalore

A CSR Initiative by



## Other Programs

- Postdoctoral Fellow programs
- Pre-doc Fellow programs
- PhD Students
- Outreach Programs:  
Industry, Undergraduate,  
Researchers



Prof Viraj Kumar (Kotak IISc AI-ML Centre) at IISc Challakere with Mathematics and Science high-school teachers.

**Kotak-IISc AI-ML Centre @ IISc**

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**Kohli Centre on Intelligent Systems @ IIITH**

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# Kohli Centre on Intelligent Systems

## KCIS @IIIT Hyderabad



INTERNATIONAL INSTITUTE OF  
INFORMATION TECHNOLOGY  
HYDERABAD

In 2015, IIIT Hyderabad established the Kohli Center on Intelligent Systems (KCIS) as an umbrella center to co-ordinate and accelerate the institute's activities in the Intelligent Systems or Artificial Intelligence areas.

KCIS focuses primarily on the areas of natural language processing, computer vision, speech recognition & synthesis, cognitive sciences, robotics.



# Kohli Centre on Intelligent Systems

## KCIS @IIIT Hyderabad



While there are **7 major research centers at KCIS**, multi-disciplinary and applied research also takes place between these centers and others at IIITH.

**CENTER FOR VISUAL INFORMATION TECHNOLOGY**  
<https://cvit.iiit.ac.in>

**COGNITIVE SCIENCE LAB**  
<https://csl.iiit.ac.in/>

**DATA SCIENCES AND ANALYTICS CENTER**  
<https://dsac.iiit.ac.in/>

**LANGUAGE TECHNOLOGIES RESEARCH CENTER**  
<https://ltrc.iiit.ac.in/>

**MACHINE LEARNING LAB**  
<https://mll.iiit.ac.in/>

**ROBOTICS RESEARCH CENTER**  
<https://robotics.iiit.ac.in/>

**SOCIAL AND HUMAN APPLICATIONS FOR AI**  
<https://kcis.iiit.ac.in/sahaai/>



# Kohli Centre on Intelligent Systems

## KCIS @IIIT Hyderabad



### Programs:

- Workshops and Summer Schools
- Ph.D. Fellowships

## KOHLI PhD FELLOWSHIP @ IIIT HYDERABAD

International Institute of Information Technology, Hyderabad (IIITH) invites applications for Kohli PhD Fellowship towards pursuing PhD degree at Kohli Centre on Intelligent Systems (KCIS).

**3D VISION SUMMER SCHOOL 2022**  
[in-person]

**Invited Speakers:**

- Arjun Jain, Founder, LAVIO Labs
- K. Madhava Krishna, Professor, IIT Hyderabad
- Srinath Sridhar, Assistant Professor, Brown University
- Varun Jampani, Researcher, Google Research

**22-28 May 2022**  
CVIT, IIIT Hyderabad

Workshop sessions will deep dive into Fundamentals of 3D perception, vision and deep learning techniques. Also featuring invited speakers.

Great opportunity to learn from accomplished researchers in the field.

Undergrad/3rd year, MS/PhD and industry aspirants are welcome to apply.

Venue:  
Kohli Center for Intelligent Systems  
International Institute of Information Technology, Hyderabad  
<https://kcis.iiit.ac.in/>

**NEAR TOPICS:**

- Primer on Deep Learning
- 3D Sensing, Representation and Visualization
- 3D Geometry Processing
- Learning View Regression
- Point Cloud Analysis
- Deep Learning on meshes
- Implicit Function Learning
- Neural Surface Fields
- Tools for 3D Analysis
- Labs and Hands-on Sessions using 3D processing Tools

**APPLY HERE**  
<http://cvit.iiit.ac.in/workshops/3dvision/>  
on-site food and accommodation included

**Application deadline**  
**7 May 2022**

**IIIT HYDERABAD ANNOUNCES**

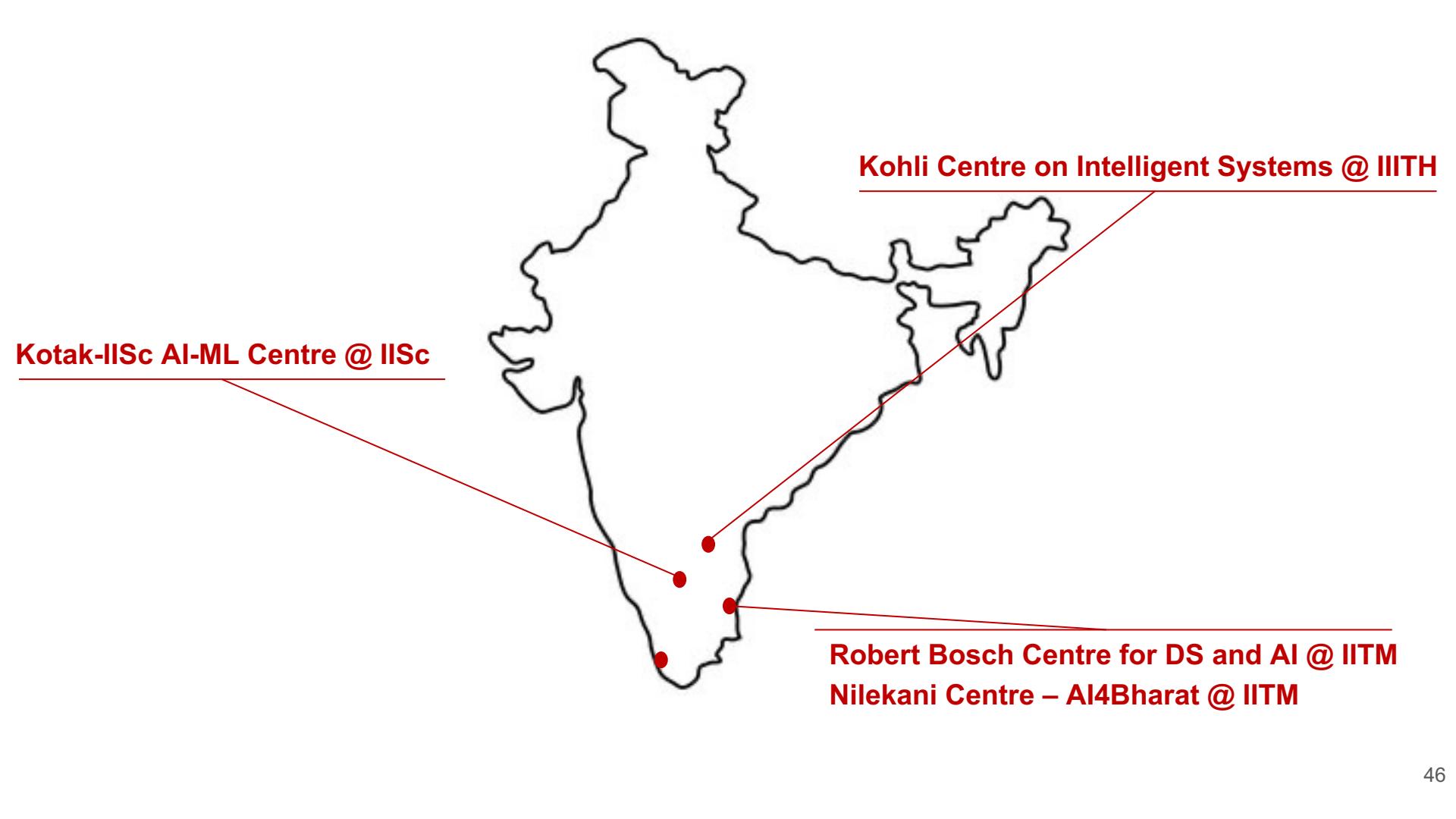
**11th IIITH Summer School on Natural Language Processing (IASNLP-2022)**

An Advanced School Focusing on Speech to Speech Machine Translation (SSMT) in Indian Languages

**Advanced Lectures on SSMT | Project Oriented**  
**20 June to 8 July**  
Registration Closes  
**28th May 2022**

**20th June 2022**  
Summer School Begins

More information at: <https://lrc.iiit.ac.in/iasnlp2022/>  
Register here: <https://forms.office.com/r/4MNRCogvyl>



**Kotak-IISc AI-ML Centre @ IISc**

**Kohli Centre on Intelligent Systems @ IIITH**

**Robert Bosch Centre for DS and AI @ IITM  
Nilekani Centre – AI4Bharat @ IITM**

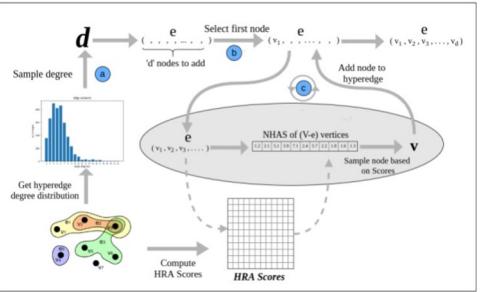
# Robert Bosch Centre for Data Science & AI RBCDSAI @ IIT Madras



ROBERT BOSCH CENTRE FOR DATA SCIENCE  
AND ARTIFICIAL INTELLIGENCE IIT MADRAS

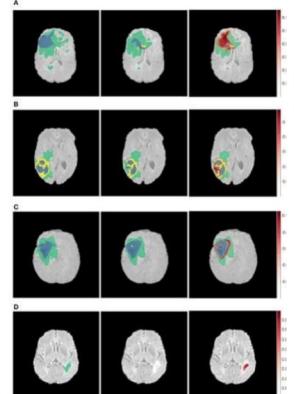
## Network Science

Faculty leads: Karthik Raman,  
Ramkrishna Pasumarthy



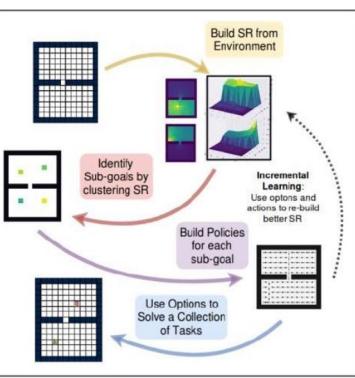
## Deep Learning

Faculty leads: Mitesh Khapra, Chandrasekhar  
Lakshminarayanan, Kaushik Mitra



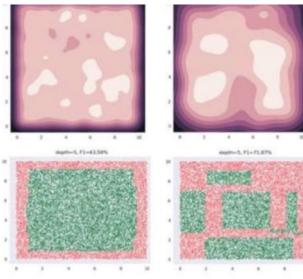
## Reinforcement Learning and Multi-arm Bandits

Faculty leads: Balaraman Ravindran, Nandan Sudarsanam



## Fair and Interpretable Machine Learning

Faculty leads: Arun Rajkumar, Harish Guruprasad



# Robert Bosch Centre for Data Science & AI

## RBCDSAI @ IIT Madras



Integrating traditional computational approaches with large-scale data analytics, hybridisation of domain knowledge and data



Manufacturing



Financial

Understanding, predicting and modelling customer behaviour; credit scoring; understanding and creating customer profiles; NPA prediction in retail banking; BFSI data analytics stack



Systems  
Biology &  
Health care

Collaborate with IBSE, for analysis of multi-omic data, development of cancer genomic data analysis pipelines, clinical data analysis, biological network analytics



Smart Cities

Collaborate with **Centre of Excellence in Urban Transportation** developing solutions for smart mobility, traffic modelling and analysis; Smart water distribution; smart power grids

Robert Bosch Centre for Data Science & AI  
RBCDSAI @ IIT Madras



# Programmes

The image is a promotional graphic for RBCDSAI Global Summer Internships 2021. It features a red banner at the top with the text "RBCDSAI Global Summer Internships 2021!" in white. To the right is a circular logo for "RBC DSAI" with a graduation cap icon. Below the banner, it says "RBCDSAI in association with e-GRIESHMA Invites international students for VIRTUAL INTERNSHIP PROGRAM". The background shows a smiling Black male student in a library setting, with other students visible in the background. A red box at the bottom left contains the text "ELIGIBILITY CRITERIA" and "Open to exceptional students, enrolled in a foreign university, who are entering the final year of their undergraduate or graduate program in 2021-2022." A red box at the bottom right lists "Hands-on experience • Work on cutting edge discoveries with some of the best minds in the field in Data Science and AI." At the very bottom, there is a footer with contact information, social media links, and a "Last date: 15/05/2021".

An advertisement for the RBCDSAI Fellowship Program. It features a circular logo with a yellow emblem and the text 'RBC DSAI'. The main title 'APPLICATIONS INVITED FOR POST BACCALAUREATE FELLOWSHIPS' is displayed prominently in red and blue. Below the title, it says 'RBCDSAI seeks exceptional graduates/post-graduates for upto TWO-YEAR research fellowship in Data Science and Artificial Intelligence'. A large red downward-pointing triangle is on the left, and a large yellow upward-pointing triangle is on the right. A man and a woman are shown smiling. The text 'Here's why RBCDSAI should be your first choice' is followed by a bulleted list of reasons. At the bottom, it says 'Exceptional graduates and postgraduates, under the age of 27 years as of 30 April 2021, are encouraged to apply.' There is a QR code and a 'SCAN TO APPLY' button.

The image is a promotional graphic for the RBCDSAI Women Post Bacc Fellowship Program. It features a woman in a dark suit and white shirt standing in front of a large yellow and red geometric background. To her left is a smaller inset image of the same woman. A flowchart diagram is overlaid on the background, showing a process from 'IDEAS' through various stages like 'RESEARCH', 'DESIGN', 'IMPLEMENTATION', and 'EVALUATION' to 'ACHIEVEMENT'. The RBCDSAI logo is in the top right corner, and the text 'APPLICATIONS INVITED FOR WOMEN POST BACCALAUREATE FELLOWSHIPS' is prominently displayed in the center.

**Together let's build  
an ecosystem for an  
innovative future**

**INVITING APPLICATIONS FOR  
RBCDSAI POSTDOCTORAL FELLOWSHIP**

From exceptional candidates with a PhD degree in research topics related to Data Science, Artificial Intelligence or allied application domains

**THE RBCDSAI EDGE**

The environment at RBCDSAI nurtures scientific leadership by encouraging fellows to develop independent research lines through supportive mentorship

**FURTHER BENEFITS**

- \* The research fellowship will include a monthly stipend that is significantly higher than typical institute post-doc fellowships + Highly interdisciplinary research projects, with some of the leading faculty in Data Science and AI+ Additional allowances for research and travel - Regular workshops and colloquia by international experts + Access to state-of-the-art high-performance computing infrastructure
- \* Opportunity to mentor bright students

**ABOUT RBCDSAI**

RBCDSAI at IITM is the leading interdisciplinary Data Science and AI center in India and one of the few centers in the world focusing on applications in various engineering disciplines. We have one of the largest groups in India looking at networked data across different disciplines & the Deep Reinforcement Learning group.

**TO APPLY**

RBCDSAI Central Centre for Data Sciences and Artificial Intelligence  
1st floor, Mehta technology block, IITM, Jyoti Bhawan, IIT Madras, Chennai - 600 036  
Phone: +91 44 22575960 | [contact@rbcdsai.org](mailto:contact@rbcdsai.org)

 [rbcdsai.iitm.ac.in](http://rbcdsai.iitm.ac.in)

# Robert Bosch Centre for Data Science & AI

## RBCDSAI @ IIT Madras



**RBCDSAI collaborates with several governmental, non-governmental, health care institutions to work on many socially relevant projects**

- **Tamil Nadu e-Governance Agency (TNeGA):** Establish the Integrated and Inclusive Public Grievance CM Helpline Management System
- **108 Ambulance:** Locate optimally and allocate emergency ambulances, and to understand the cause of road traffic accidents.
- **Dvara Trust:** An algorithm for predicting low-income households' financial distress, to draw attention to their economic well-being.
- **Kaatru:** Uses Data Science and IoT for addressing ambient air quality, by installing a network of low cost, vehicle mounted environmental monitoring devices, with 7 sensors, crisscrossing the city.
- **ARMMAN:** Predicting risk of expectant mothers dropping out of health care programs
- **GarbhINI:** Preterm risk categorisation of pregnant women
- RBCDSAI is working closely with Tamil Nadu **National Health Mission/COVID war room**



108 Ambulances



**More: [rbcdsai.iitm.ac.in/blogs/ai-for-social-good/](http://rbcdsai.iitm.ac.in/blogs/ai-for-social-good/)**

# Nilekani Center at AI4Bhārat

AI4Bharat @ IIT Madras



**Mission:** Bring parity with respect to English in AI technologies for Indian languages with open-source contributions in datasets, models, and applications and by enabling an innovation ecosystem

## Our Impact Axes



### Data

Curate and create the largest public datasets and benchmarks across various tasks and 22 Indian languages.



### Applications

Design and deploy with partners reference applications to demonstrate potential of open AI models.



### AI Models

Build state-of-the-art, open, foundational AI models across tasks and 22 Indian languages.



### Ecosystem

Enable researchers, startups, and govt. to innovate on Indian language AI tech with educational material and workshops.

**NILEKANI  
CENTER AT  
AI4BHARAT,  
IIT MADRAS**

LAUNCH  
**28**  
JULY

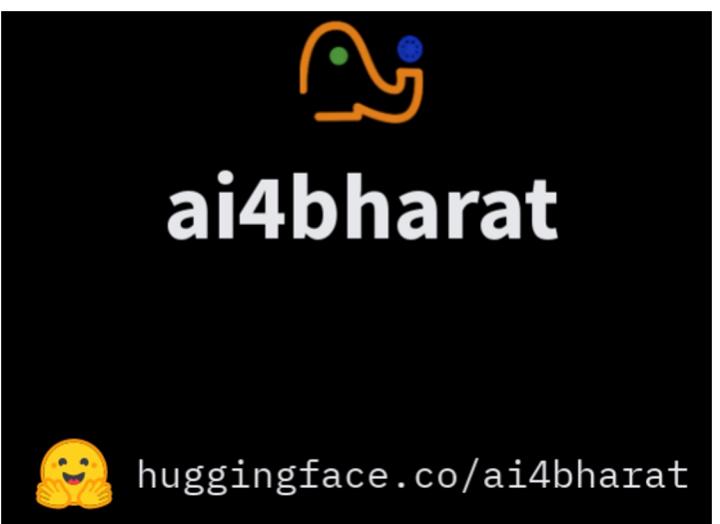


# Nilekani Center at AI4Bhārat

## AI4Bharat @ IIT Madras



### Research Areas



[huggingface.co/ai4bharat](https://huggingface.co/ai4bharat)



#### Translation

Open-source datasets (Samanantar) and models (IndicTrans) for neural machine translation between English and 12 Indic languages.



#### Speech Recognition

Open-source models (IndicWav2Vec) for speech recognition in 9 Indian languages.



#### Language Generation

Open-source language generation model (IndicBART) and benchmarks (IndicNLG Suite) for 10 Indian languages.



#### Transliteration

Open-source datasets and benchmarks (Aksharantar), models (IndicXlit), and applications for transliteration between Roman and scripts for 20+ Indic languages.



#### Language Understanding

Open-source language models (IndicBERT), benchmarks (IndicGLUE), and entity recognizers (IndicNER) for 10 Indian languages.



#### Sign Language

Open-source datasets (INCLUDE, SignCorpus) and models (OpenHands) for sign recognition for various 10 sign languages from around the world.

# Nilekani Center at AI4Bhārat

## AI4Bharat @ IIT Madras



### Programs & Positions

#### AI4Bharat Residency

⌚ 1 year     ⚽ Remote

1-year program for recent graduates to work on cutting-edge research problems in NLP, Speech, and systems-engineering for AI.

✓ Apply

#### AI4Bharat Internship

⌚ 1 semester     ⚽ Remote

1-semester program for current students to work on data and software engineering for language AI technologies

✓ Apply

#### Language Contributor

⌚ Long-term     ⚽ Remote

Long-term opportunities for experienced language translators and transcribers across Indian languages.

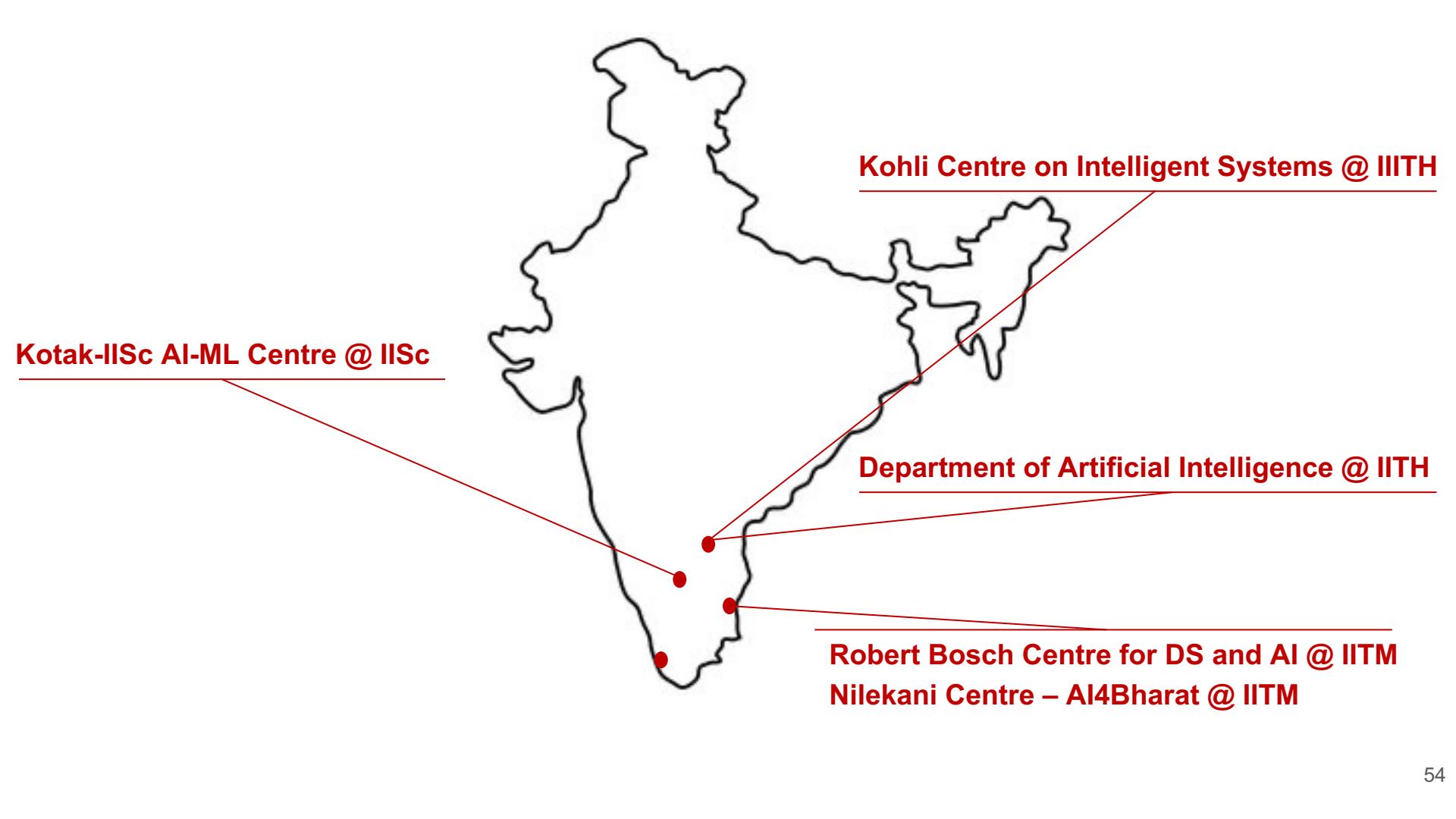
✓ Apply

#### Software Developer

⌚ Long-term     ⚽ In-person

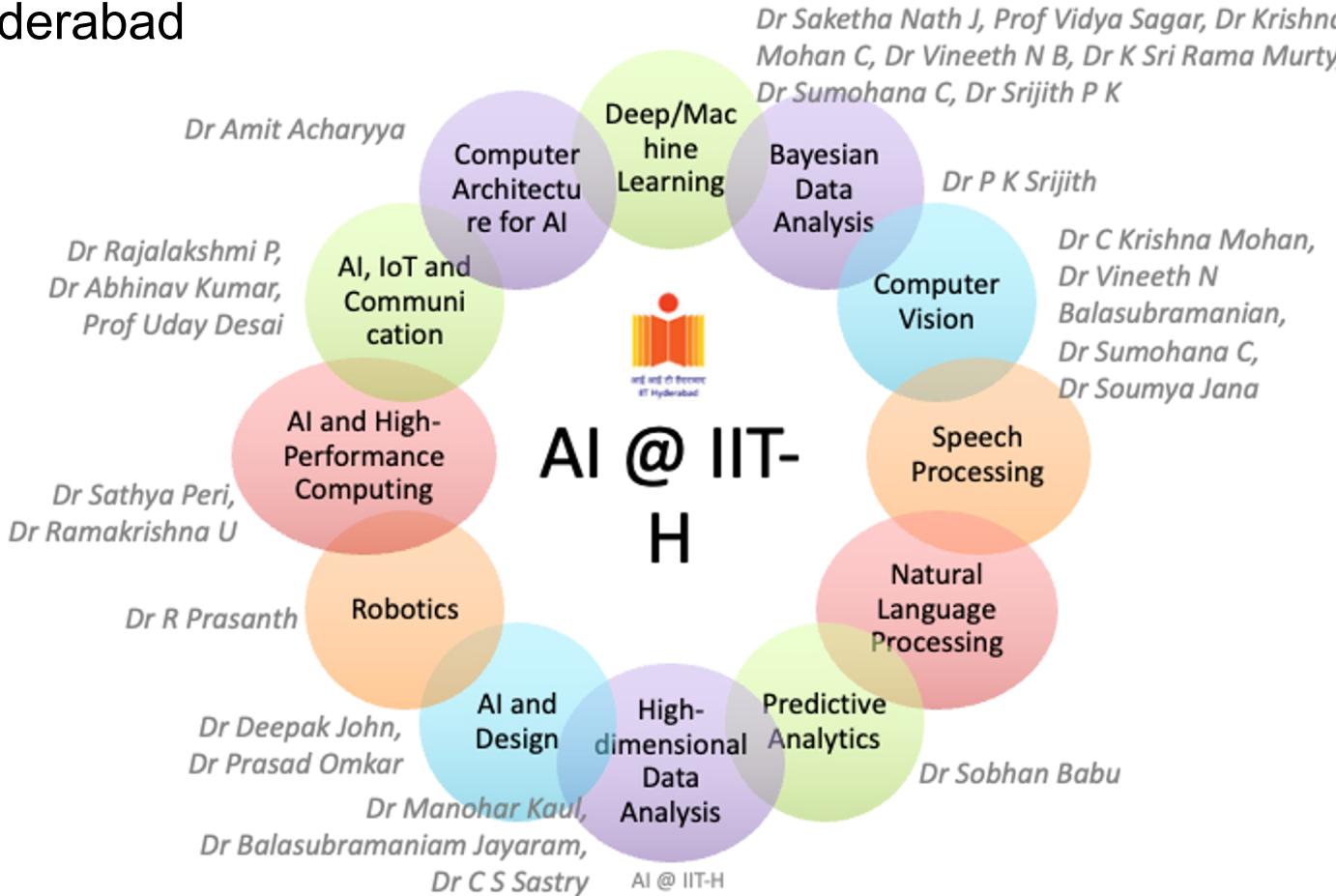
Long-term opportunities for front-end and back-end developers looking to contribute to building open-source applications for language technologies.

✓ Apply



# Department of Artificial Intelligence

## @ IIT Hyderabad



# Department of Artificial Intelligence

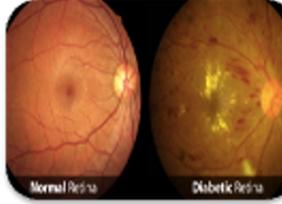
## AI @ IIT Hyderabad



Security and Surveillance



Agriculture



Healthcare



Climate Change



E-Commerce



Astronomy and Aerospace



Fraud Analytics



Smart Transport

**Research Highlights:** Publications in ICML, NeurIPS, CVPR, ICCV, ICIP, ICASSP, IEEE Transactions: Signal Processing, Image Processing, CSVT; Patents and Transfer of Technology; Large sponsored projects and Industry Consultancy

# Department of Artificial Intelligence

## AI @ IIT Hyderabad



## Programs Offered

AI @ IIITH

### BTech in AI

- First of its kind in India, 3rd in the world (to our knowledge)

### MTech in AI

- Since 2017

### PhD in AI

- Since 2019 - one of a kind allowing students from different disciplines

### Professional Program in AI and Emerging Technologies

- Summer program, open to anyone

### Masters Program in Data Science

- Real-time online program for working professionals, since 2015, offered by CSE

### Minors in AI for Bachelors students

# NVIDIA AI Technology Centre

## NVAITC @ IIT Hyderabad



### IIT-H hosts India's 1st NVIDIA AI unit

DC CORRESPONDENT  
HYDERABAD, JULY 9

The Indian Institute of Technology, Hyderabad, has collaborated with NVIDIA, a multinational technology company, to establish India's first 'NVIDIA AI Technology Centre' (NVAITC) to accelerate research on artificial intelligence (AI) and its commercial adoption. Operations started on Thursday.

The collaboration between will focus on advancing AI research in the areas of agriculture and smart cities besides language understanding. The projects that would be taken up include increasing crop yield using AI algorithms and applying AI-based solutions to support safer transportation systems and better ways of managing traffic, among others.

Prof. B.S. Murty, Director, IIT Hyderabad, said, "This combination of NVIDIA's leading edge technology for AI Compute and some of the finest minds in the country from IIT

## IIT-H, NVIDIA join hands for research

STATE BUREAU  
Sangareddy

Indian Institute of Technology-Hyderabad (IIT-H) is collaborating with NVIDIA, a multinational technology company, to establish India's first 'NVIDIA AI Technology Centre' (NVAITC) to accelerate research on Artificial Intelligence and its commercial adoption.

An event was held on Thursday to mark the commence-

ment of operations of this Centre at IIT-H that already houses two NVIDIA DGX-1 System and NVIDIA DGX-2 System. The NVAITC will accelerate research for the 220 faculty at IIT-H, which is among India's top research institutions.

Highlighting the significant benefits of the state-of-the-art facility, Prof BS Murty, Director, IIT-H, said, "As an IIT with a strong fundamental and technological research

focus, the IIT-H is very happy to join NVIDIA's NVAITC programme. This combination of NVIDIA's leading-edge technology for AI Compute and some of the finest minds in the country from IIT-H will bring synergy to help find solutions to unique Indian challenges, be it enhancing crop yield or safer cities. This will build on the strong AI capabilities IIT-H has built, including the country's first B.Tech in AI program."

This collaboration between IIT-H and NVIDIA will focus on advancing research on Artificial Intelligence in the areas of Agriculture and Smart Cities besides Language Understanding. The projects that would be taken up include increasing crop yield using AI algorithms and applying AI-based solutions to support safer transportation systems and better ways of managing traffic, among others.

### IIT-H collaborates with NVIDIA for AI research

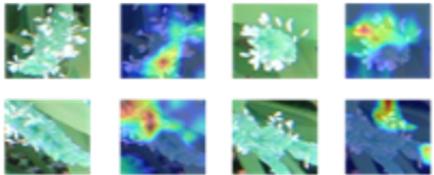
Hyderabad : The Indian Institute of Technology-Hyderabad (IIT-H) entered into a collaboration with NVIDIA to accelerate research on Artificial Intelligence and its commercial adoption. An event was held on Thursday to mark the commencement of operations of the country's first 'NVIDIA AI Technology Centre' (NVAITC). IIT Hyderabad already houses two NVIDIA DGX-1TM systems and an NVIDIA DGX-2TM system dedicated to research.



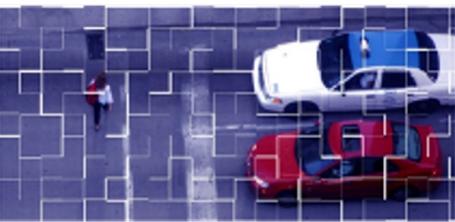
# Centre for Research and Innovation in AI (क्रिया) क्रिया @ IIT Hyderabad

## AI Collaborations with Japan

### Key Projects



DST-JST SICORP project  
on agriculture



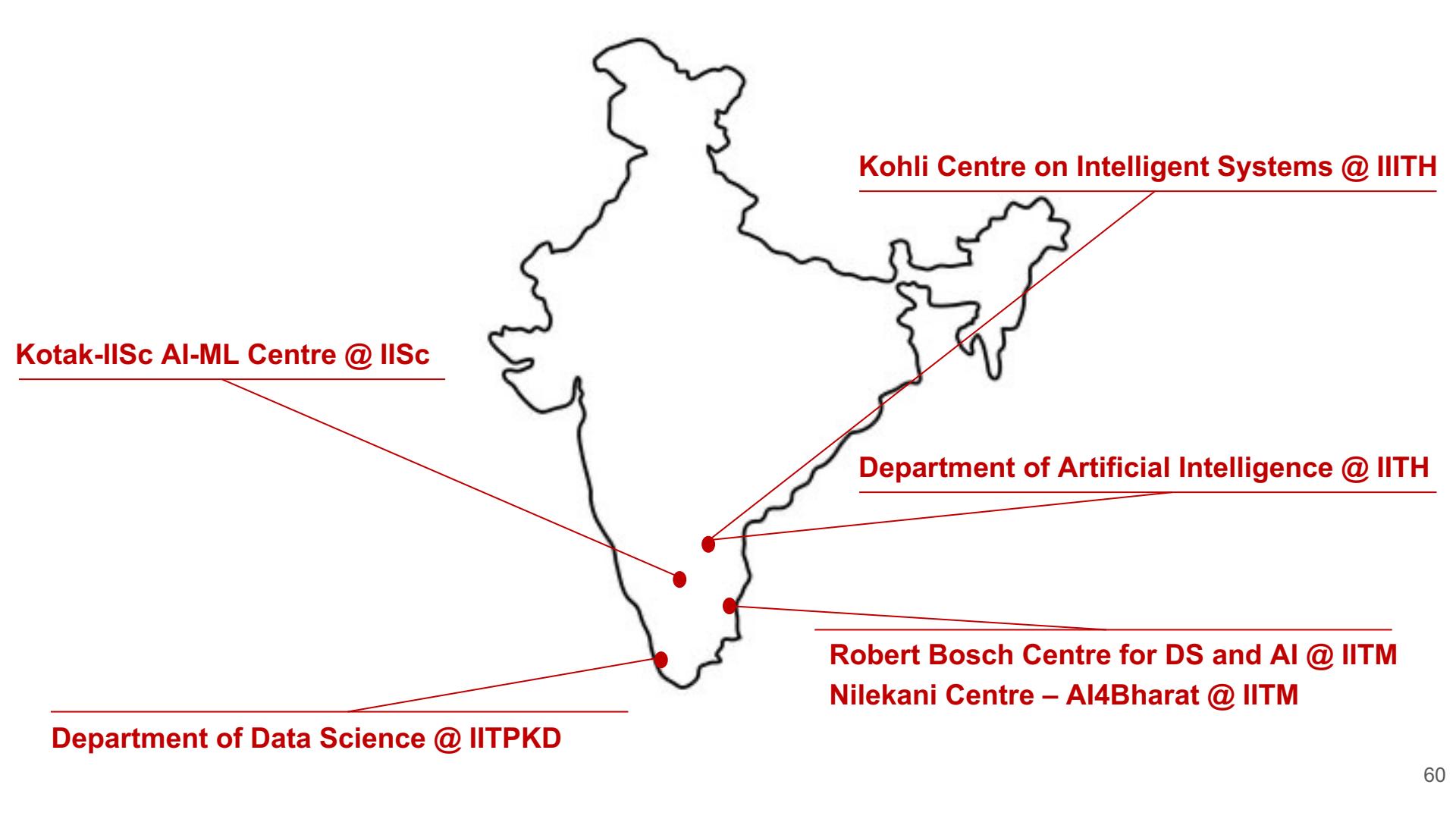
### Internships/ Collaborations

### Academic Collaborations

- University of Tokyo
- RIKEN AIP
- Nihon University

### Student Recruitment

Rakuten, Toshiba  
Research, Toyota  
Research, Bosch,  
Mercari, many more...



**Department of Data Science @ IITPKD**

**Robert Bosch Centre for DS and AI @ IITM**  
**Nilekani Centre – AI4Bharat @ IITM**

**Kohli Centre on Intelligent Systems @ IIITH**

**Department of Artificial Intelligence @ IITH**

**Kotak-IISc AI-ML Centre @ IISc**



IIT PALAKKAD

# Department of Data Science @ IITPKD

## Faculty

### Dr. Narayanan C Krishnan

#### Research

- **Theory:** Generalizable Learning – Domain Adaptation, Meta-Learning, Zero/Few-Shot Learning; XAI
- **Applications:** Computer Vision, Remote Sensing, Visual Document Analysis, Non-linear Dynamical Systems



### Dr. Sahely Bhadra

#### Research

- **Theory/Technology:** Kernel Learning, Deep Learning, Optimization, Responsible AI (Fair, Interpretability)
- **Application:** Systems Biology, Molecular Graph, Time Series Analysis



### Dr. Mrinal Das

#### Research

- **Theory/Technology:** Bayesian Models, Deep Learning, Meta Learning, Responsible AI(Privacy, Interpretability)
- **Application:** Computer Vision, Natural Language Processing



DS  
@  
IITPKD

#### Research

### Dr. Koninika Pal

- **Theory:** Locality sensitive hashing Clustering and Matrix factorization, Language modeling, Semantic web
- **Applications:** Smart indexing for Similarity Search, KB fact Extraction, Question Answering Fact Summarization Recommendation



### Dr. Satyajit Das

#### Research

- Applied AI, Architecture and compiler AI accelerator. Near sensor data analytics, Big data analytics





IIT PALAKKAD

# Department of Data Science @ IITPKD

## Academic and Student Programs Offered

DS@IITPKD

### BTech in Data Science and Engineering

- Starting Fall 2022

### MTech in Data Science

- Since Fall 2020, Unique program with students from diverse academic background

### MS and PhD Data Science

- Since 2021

### Summer Internships

- 2-3 month duration in the summer

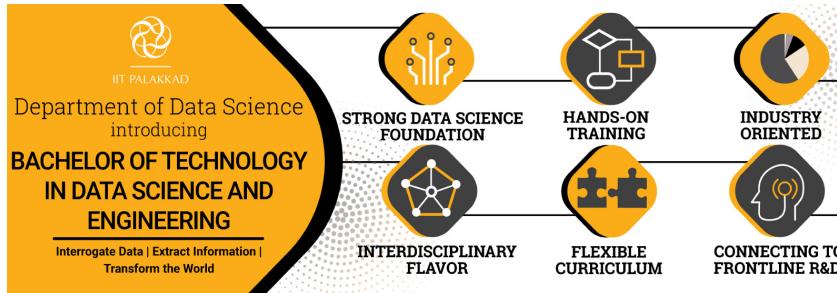
### Other Internships

- Anytime during the year, open to students from any relevant background

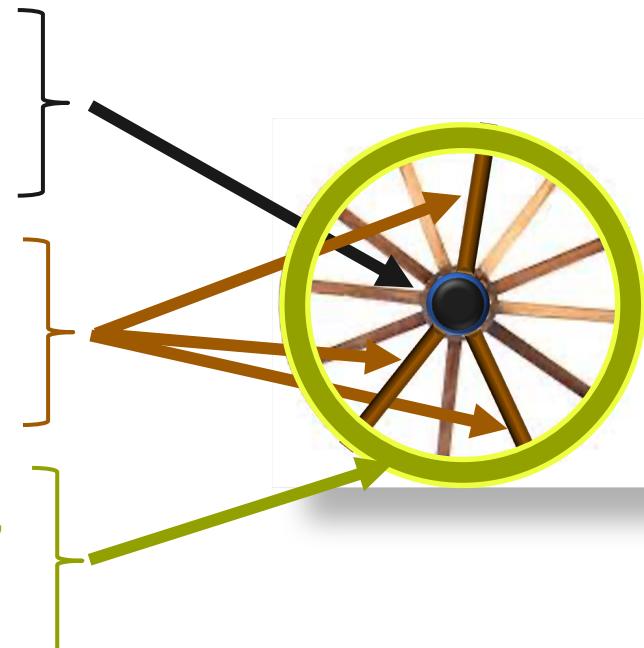


IIT PALAKKAD

# Department of Data Science @ IITPKD



- **Foundations or Core**
  - Mathematical, Computational, Statistical, Data and Software Management, Data Modeling, Ethics, Professional
- **Connections to Domains**
  - Computer vision, Business analytics, Natural Language Processing, Bioinformatics, Reinforcement Learning, Learning Theory
- **Domains**
  - Robotics, Finance, Basic Science, Pharmaceutics, Climatology, Agriculture





IIT PALAKKAD

**M.TECH DATA SCIENCE** ADMISSIONS

**COURSE HIGHLIGHT**

- Machine Learning
- Natural Language Processing
- Probability and Statistics
- Optimization
- Data Engineering
- Deep Learning
- Big Data
- Computer Vision
- Information Retrieval
- Responsible AI

**TOP RECRUITERS**

Texas Instruments, ICICI Bank, TIGER ANALYTICS, HCL, L&T Infotech, INNOPLCXUS, SIEMENS

Scan With Google Lens

The Idea of this program is to train students from various backgrounds to the fundamentals of the data science and artificial intelligence, so that graduated students become experts in interdisciplinary subjects in the intersection of their background and data science.

More Information: [www.iitpkd.ac.in](http://www.iitpkd.ac.in)

**MS/PHD DATA SCIENCE** ADMISSIONS

**RESEARCH AREAS**

- AI and Machine learning :
  - Kernel Learning
  - Multi-task Learning
  - Anomaly Detection in Time Series
  - Privacy-aware Learning
  - Bayesian Model
  - Explainable AI
- Information Retrieval and Natural Language Processing:
  - Harvesting Knowledge from Text and Web Tables
  - Knowledge Base Curation
  - Question-Answering
- Systems for AI:
  - Computer Vision
  - Architecture for Deep Learning
  - Low-power VLSI circuit implementation



IIT Palakkad has a vibrant research community in the field of data science. Researchers are working on various aspects of data science, including machine learning, data mining, big data analytics, and computer vision. Advanced algorithms and techniques are used to tackle challenging real-world problems in various domains such as healthcare, agriculture, and transportation. Researchers collaborate with industry partners and other academic institutions to bring their cutting-edge research to bear on practical applications. With a focus on high-impact research, IIT Palakkad is poised to make significant contributions to the field of data science.



Scan With Google Lens

More Information: [www.iitpkd.ac.in](http://www.iitpkd.ac.in)



IIT PALAKKAD

# Department of Data Science @ IITPKD

## Research

### Application Domains

Agriculture

Healthcare

Astronomy

### ***Research Highlights:***

Publications in well-known conferences and journals: CIKM, ICML, CVPR, ECML, IJCAI, IEEE CoolChips

Manufacturing

Systems/IoT

### ***Research Funding***

DST, SERB, NRB, IPTIF(CPS), Sansera, Multicoreware

### ***National and International Collaborations***

IITs, TIFR, Wadhwani Institute of AI, Queens University Belfast (UK), Aalto University (Finland), Ostfold University and NTNU (Norway), UBS (France)

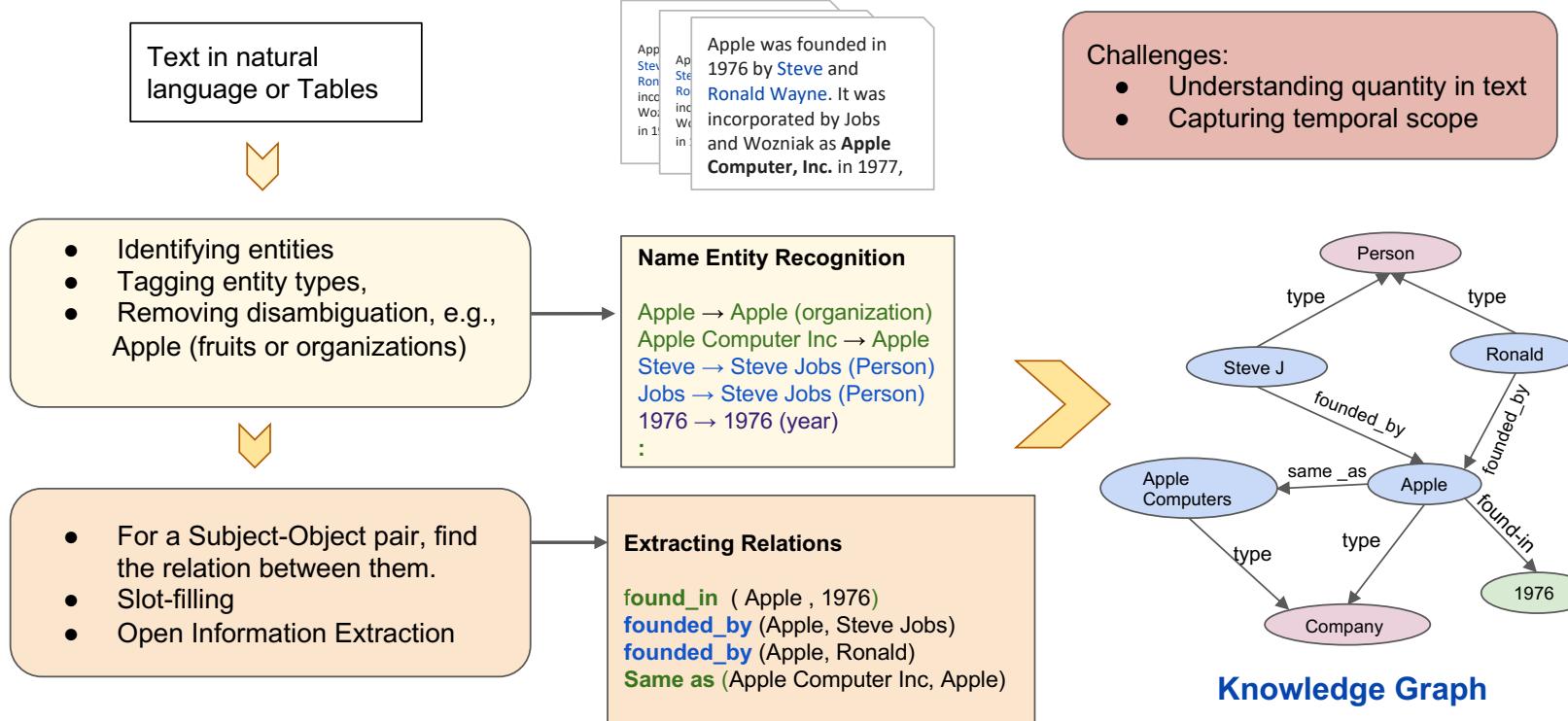
# Department of Data Science @ IITPKD

## Research - NLP and IR



IIT PALAKKAD

### Creation of Knowledge Graph by Extraction Information from Text and Tables



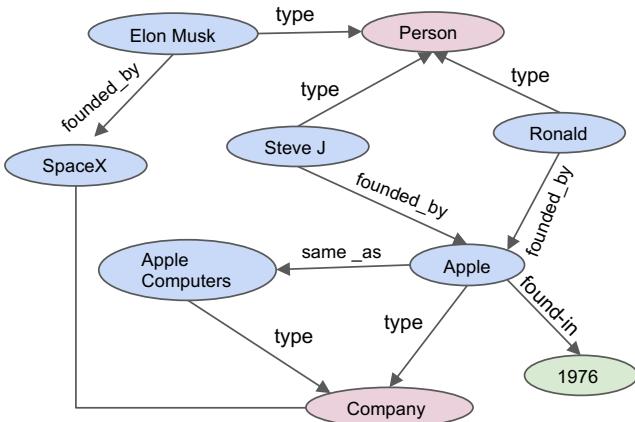


# Department of Data Science @ IITPKD

## Research - NLP and IR

### Harvesting Knowledge from Text and Tables

**Learning Graph Embedding:**  
vector representations of entities  
and edge labels



**Exploiting local connectivity between entities in Knowledge Graph :**  
shortest path, steiner tree from candidate nodes

**Exploiting Structure of Knowledge Graph :**  
Graph mining, Clustering, Random Walk



Recommendation

Steve Jobs	Apple
Elon Musk	HP
Bill Gates	Huawei
Mark Zuckerberg	



QA Systems

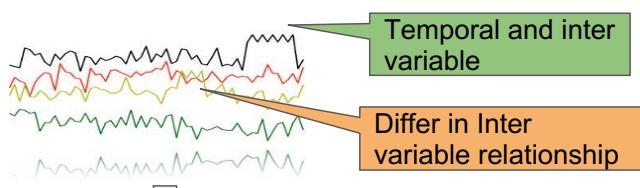
- Who were co-founder of Apple in 1977?  
What is the worth of Steve Jobs?  
Which companies are acquired by Apple during the pandemic ?

# Department of Data Science @ IITPKD

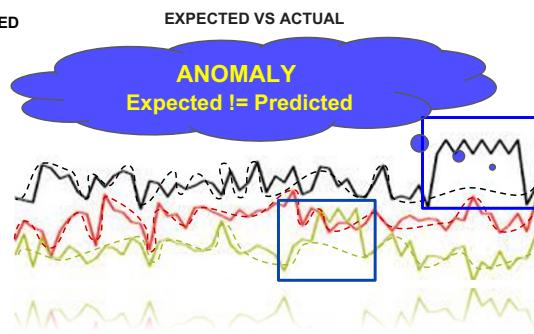
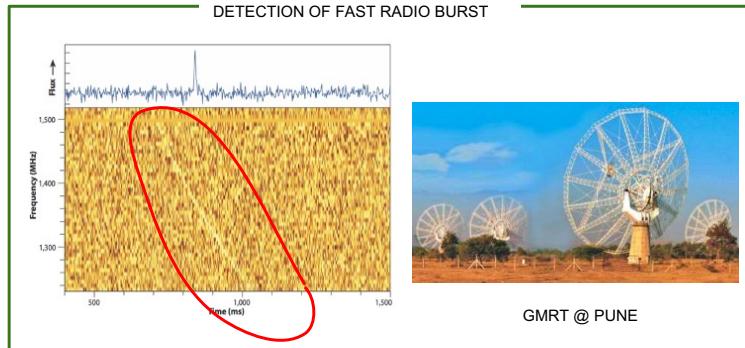
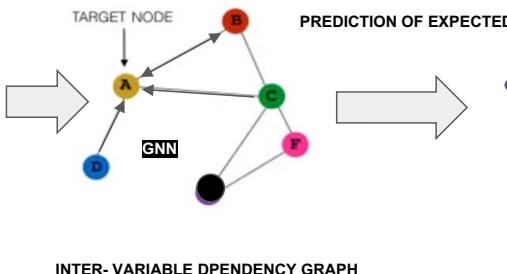
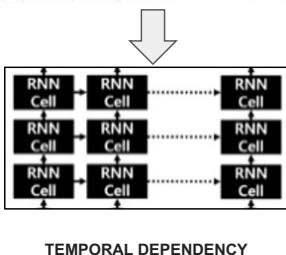
## Research - ML

### Rare Event Detection in Time series

- Temporally rare
- Rare inter variable relationship



Differ in Inter variable relationship





IIT PALAKKAD

# Department of Data Science @ IITPKD

## Research - ML

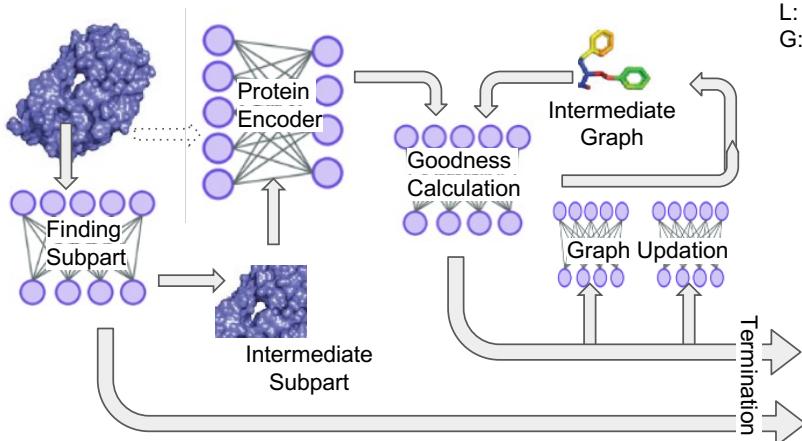
### Structural Biology and XAI

#### Graph Generation => Drug Structure Prediction

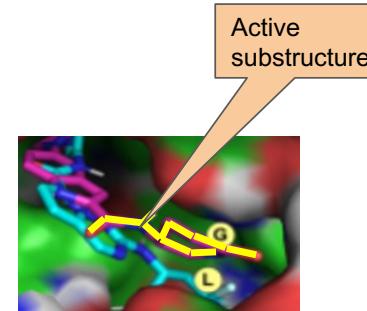
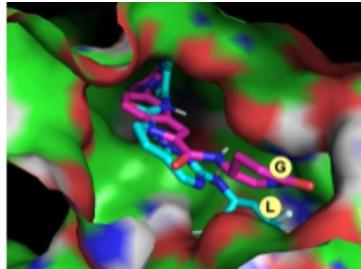
- De-novo drug for New protein
- Deep generative model
- Protein specific
- Drugs good for set of proteins

#### Explainable Graph Mining

- Explainability Through substructure

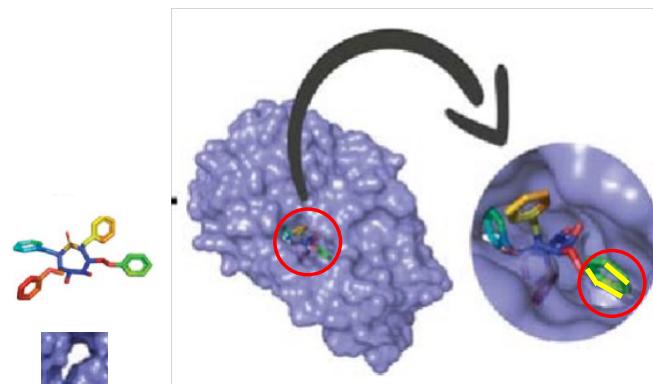


Vascular endothelial



L: known ligand with lowest binding energy -11.1 kcal/mol

G: new ligand proposed with -11.2 kcal/mol

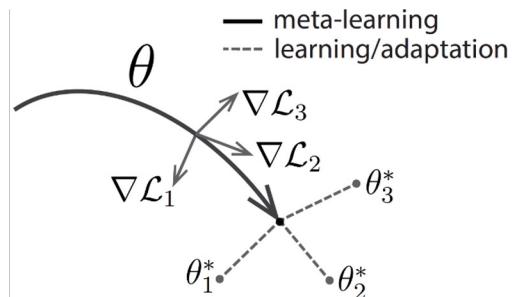


# Department of Data Science @ IITPKD

## Research - ML

### Meta Learning

- A way different paradigm than traditional Machine Learning
- Learn to solve one task – traditional ML
- What about tasks throughout lifetime ?
- Humans do not learn everything from scratch
- New tasks are appearing very frequently
- How can machine decide what to learn from and how to pass knowledge ?





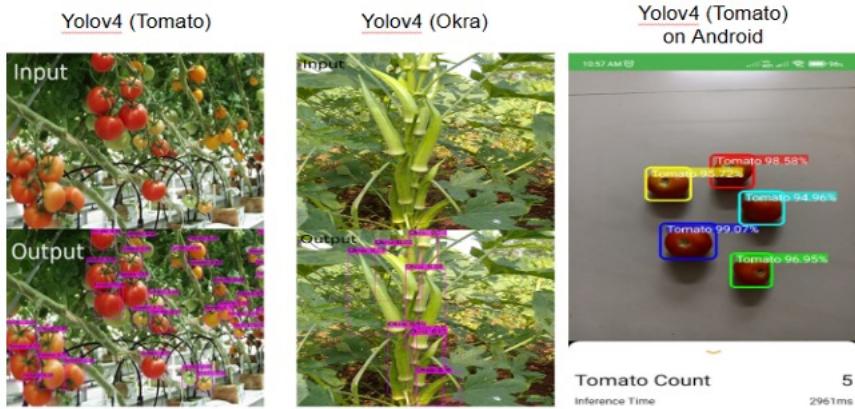
IIT PALAKKAD

# Department of Data Science @ IITPKD

## Research - Computer Vision

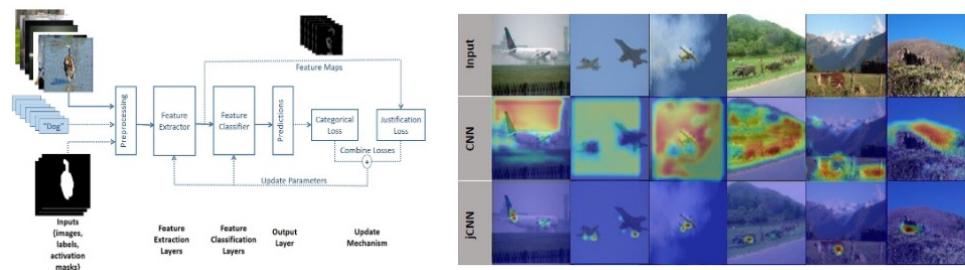
### Counting Crops

- Automatically count crops ready for harvesting
- Very easy to use: as easy as taking a photo in mobile
- Cost effective tool for farmers
- Can be scaled up to corporate farming easily



### Justifiable AI: justify the decision

- CNNs are powerful to extract features automatically
- Main extraction principle is based on correlation with labels
- Often that lead to unrelated features due to “wrong” correlation
- **Empower CNNs to extract features that are justifiable**





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# Department of Data Science @ IITPKD

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**FLORENCE NIGHTINGALE  
DATA SCIENCE TALK SERIES**

Organised by the Machine Learning Group at IIT Palakkad

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**Speaker**  
**Prof. Balaraman Ravindran**



Professor, CSE, IIT Madras  
Head, RBCDSA  
MindTree Faculty Fellow  
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**24 September 2022**  
**11 AM**  
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3rd Year Students	4 <sup>th</sup> Year Students	MTech/MSc Students	Faculty at Colleges	Working Professionals
<ul style="list-style-type: none"><li>• Internships</li><li>• Projects</li></ul>	<ul style="list-style-type: none"><li>• Internships</li><li>• Projects</li><li>• Unsure about long term commitment - Apply for MS program</li><li>• Sure about PhD - Direct PhD</li></ul>	<ul style="list-style-type: none"><li>• Internships</li><li>• Short Term Projects</li><li>• MS program</li><li>• PhD program</li></ul>	<ul style="list-style-type: none"><li>• IIT PKD is a QIP minor centre</li></ul>	<ul style="list-style-type: none"><li>• External PhD Program - Work on interesting problems from your workplace by collaborating with us</li></ul>

# Thank You!