AMRITA
VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY

Hearty Welcome to

School of Artificial Intelligence

AI and Data science(Autonomous Agents & Robotic Systems)

4-year B Tech Program @ School of Artificial Intelligence

AMRITA
VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY

BoS Members

Members from AMRITA

Prof. K P Soman, Chairman (Dean-SAI, Coimbatore)
Dr. E A Gopalakrishnan (SAI, Bengaluru)
Dr. V Sowmya (SAI, Coimbatore)
Dr. Pratiti Bhadra (SAI, Coimbatore)
Prof. Deepa Gupta (SC, Bangalore)

External members

Prof. Rajendra Acharya U(Southern Queensland, AUS)
Dr. Vivishek Sudhir (MIT, USA)
Shri. Sanjiv K R (Wipro – Global IT Business)
Dr. Sarith P Sathian (IITM)
Dr. Lakshmi Krishnan (Engender Tech. Ltd.)

Motivation - I

According to Yann LeCun:

- A New Paradigm of AI Architecture - Systems that can understand, reason, and learn from the world around them.

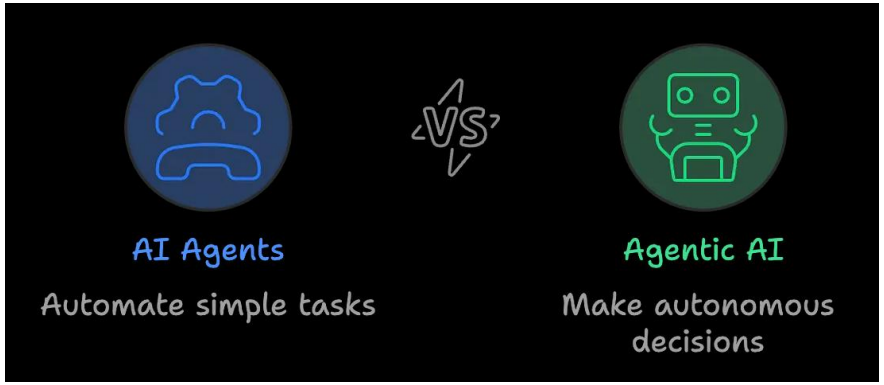
- We are entering the "decade of robotics" – AI & Robotics come together to solve problems in real world physical problems involving interacting with objects and performing physical tasks.

Yann LeCun: Meta's Chief AI Scientist

https://techcrunch.com/2025/01/23/metas-yann-lecun-predicts-a-new-ai-architectures-paradigm-within-5-years-and-decade-of-robotics/

Motivation - II

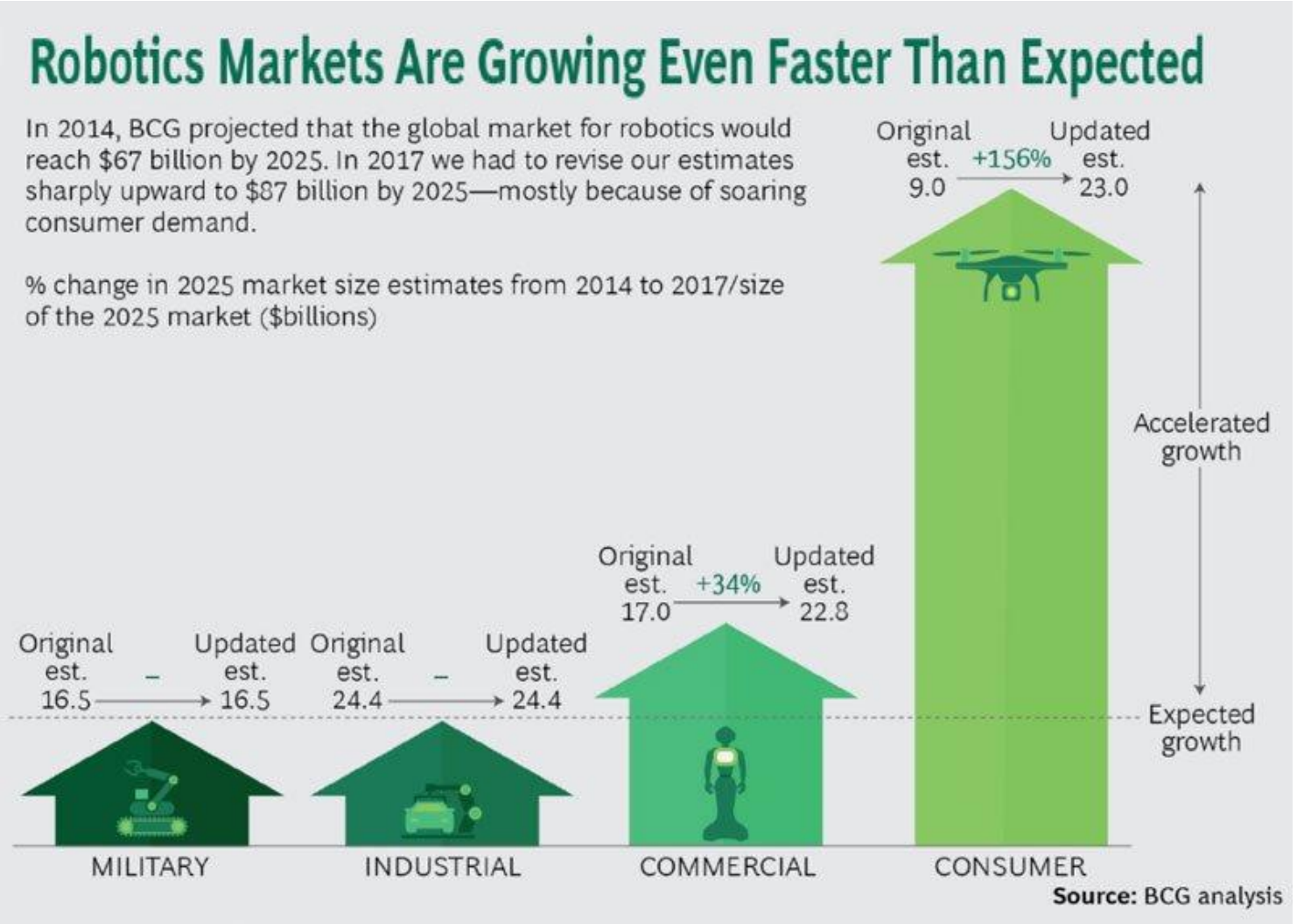
- AI agents are the next big thing in 2025!
- These are infant steps towards Agentic AI!
- We need to stay ahead of the curve to build Agentic AI systems.



https://medium.com/@elisowski/ai-agents-vs-agentic-ai-whats-the-difference-and-why-does-it-matter-03159ee8c2b4

Motivation - III

- Consumer and commercial robotics is gaining unprecedented momentum.
- AI is an inevitable part of all the robots now!
- High job prospects by upskilling in terms of AI applied to Robotics.



https://techcrunch.com/2025/01/23/metas-yann-lecun-predicts-a-new-ai-architectures-paradigm-within-5-years-and-decade-of-robotics/

Mission Protocol

**Fundamentals, specifics and practices of AI&DS(AARS) inculcated with both real and virtual "hands-on" approach, facilitating experimental, experiential and conceptual understanding.*

**Continuous and periodical assessment (using thin clients and servers) with mini-projects, practical sessions, assignments, spot-tests, and announced quizzes. (Descriptive evaluations shall be discouraged and higher-order-thinking and team-spirit methods encouraged.)*

**Teaching-learning and assessment processes would have extensive "hands-on" modalities including programming, robotics lab and AR/VR components.*

**All micro-credential courses are of 10 hours contact class duration followed by a test and assignment/mini-project (and subject to change based on demands).*

Program Objectives/Outcomes

Graduates of this program will be able to:

PSO1: Develop AI systems using a variety of algorithms and techniques, such as machine learning, natural language processing, computer vision, and robotics, to solve real-world problems and demonstrate proficiency in coding and implementing AI algorithms.

PSO2: Analyze the performance of AI & Robotic models and systems using appropriate evaluation metrics and techniques and apply optimization methods to improve the efficiency and effectiveness of AI in Robotics, while considering factors such as accuracy, speed, scalability, and resource utilization.

PSO3: Develop ethical and responsible AI & Robotic solutions by considering the ethical implications of AI & Robotic technologies, including issues related to bias, fairness, transparency, privacy, and security, and propose strategies to mitigate potential ethical concerns in the development and deployment of AI for Robotics.

A typical course (3-4 credits) evaluation format

Assessment	Internal/External	Weightage (%)
Regular tests (minimum 10)	Internal	50
Project Review 1 & 2 / Mid Semester Examination	Internal	10
Final Project Review/ End Semester Examination	External	30

SEMESTER I

Cat.	Course Code	Title	L T P	Credit
SCI	23MAT106	Mathematics for Intelligent Systems 1	2 0 2	3
ENGG	23AID101	Computational Thinking, programming and Problem Solving	2 0 2	3
ENGG	xxxxxxxx	Elements of Computing	2 0 2	3
ENGG	23EEE103	Foundations of Electrical and Electronics Engineering	2 0 2	3
SCI	23PHY104	Mechanics - Foundations for Robotics	2 0 2	3
HUM	22ADM101	Amrita Value Program I (Introduction to Traditional Indian Systems of Medicine)	1 0 0	1
HUM	22AVP103	Mastery Over Mind	1 0 2	2
HUM	19ENG111	Technical Communication	2 0 3	3
Micro Credential Course Set 1				3
TOTAL				**24**

SEMESTER II

Cat.	Course Code	Title	L T P	Credit
SCI	23MAT112	Mathematics for Intelligent Systems 2	2 0 2	3
ENGG	23AID112	Introduction to data structures and algorithms	2 0 2	3
ENGG	23AID111	Object Oriented Programming	2 0 2	3
ENGG	23AID205	Introduction to AI and ML	2 0 2	3
ENGG	23AID203	Software-Defined Communications Systems	2 0 2	3
ENGG	xxxxxxxx	Introduction to Robotics & Automation	2 0 2	3
HUM	23AID215	User Interface Design	1 0 2	2
HUM	22ADM111	Amrita Value Programme II (Insights into Indian Arts and Literature)	1 0 0	1
Micro Credential Course Set 2				3
TOTAL				**24**

SEMESTER III

Cat	Course Code	Title	L T P	Cr
SCI	23MAT204	Mathematics for Intelligent Systems 3	2 0 2	3
ENGG	23AID211	Deep Learning	2 0 2	3
ENGG	xxxxxxxx	Introduction to Control System	2 0 2	3
ENGG	23AID206	Introduction to Computer Networks	2 0 2	3
ENGG	xxxxxxxx	Introduction to ROS2 & Robot Simulation	2 0 2	3
HUM	22ADM101	Foundations of Indian Heritage	2 0 1	2
HUM	23LSE201	Life Skills for Engineers I	1 0 2	2
Micro Credential Course Set 3				3
TOTAL				**22**

SEMESTER IV

Cat	Course Code	Title	L T P	Cr
SCI	23MAT214	Mathematics for Intelligent Systems 4	2 0 2	3
ENGG	xxxxxxxx	Dynamics of Robots	2 0 2	3
ENGG	xxxxxxxx	Advanced Control systems	2 0 2	3
ENGG	23AID212	Introduction to IoT	2 0 2	3
ENGG	23AID213	Operating Systems	2 0 2	3
ENGG	23AID301	Computer Vision	2 0 2	3
HUM	22ADM111	Glimpses of Glorious India	2 0 1	2
HUM	23LSE211	Life Skills for Engineers II	1 0 2	2
Micro Credential Course Set 4				3
TOTAL				**25**

SEMESTER V

Cat	Course Code	Title	L T P	Cr
SCI	23MAT303	Mathematics for Intelligent Systems 5	2 0 2	3
ENGG	xxxxxxxxx	Natural Language Processing for Robotics	2 0 2	3
ENGG	23AID302	Big Data Analytics	2 0 2	3
ENGG		Elective - 1	2 0 2	3
ENGG	23AID201	Modelling, Simulation & Analysis	2 0 2	3
ENGG	23AID304	Signal and image processing	2 0 2	3
HUM		Free Electives (Glimpses of Indian Economy and Polity)	2 0 1	2
HUM	23LSE311	Life Skills for Engineers III	1 0 2	2
Micro Credential Course Set 5				3
TOTAL				**25**

SEMESTER VI

Cat	Course Code	Title	L T P	Cr
SCI	23MAT313	Mathematics for Intelligent Systems 6	2 0 2	3
ENGG	xxxxxxxx	AI Agents	2 0 2	3
ENGG		Elective - 2	2 0 2	3
ENGG		Elective - 3	2 0 2	3
ENGG	23AID312	Reinforcement Learning	2 0 2	3
ENGG	xxxxxxxx	Underactuated Robotics	2 0 2	3
HUM	23LSE312	Life Skills for Engineers IV	1 0 2	2
Micro Credential Course Set 6				3
TOTAL				**23**

SEMESTER VII

Cat	Course Code	Title	L T P	Cr
ENGG		Free Elective - 1	2 0 2	3
ENGG		Free Elective - 2	2 0 2	3
PRJ	23AID498	Project Phase - 1		4
ENGG	19ENV300	Environmental Science		P/F
ENGG	19LAW300	Indian Constitution		P/F
		Total		**10**

SEMESTER VIII

Cat	Course Code	Title	L T P	Cr
PRJ	23AID499	Project Phase - II		10
		Total		**10**

Total Credits	**163**

Micro Credential Courses (1 credit each):

Course code	Course Name
xxxxxxxx	3D printing
xxxxxxxx	Hands on in C, Matlab & Excel
xxxxxxxx	Reconfigurable robotic system design (hands-on based on Lego-Mindstorms kit)
xxxxxxxx	Computer aided design
xxxxxxxx	Motors and Power electronics drives
xxxxxxxx	Microprocessors and microcontrollers
xxxxxxxx	Electronic system design (hands-on)
xxxxxxxx	Hands on in Python & R
xxxxxxxx	Practical robotics with industrial robots and mobile robots
xxxxxxxx	Introduction to TinyML
xxxxxxxx	Hands on C++ and Rust
xxxxxxxx	AR & VR
xxxxxxxx	Hands on Swift & Kotlin
xxxxxxxx	MLOps
xxxxxxxx	Embedded systems for Robotics
xxxxxxxx	Analog computing and system design
xxxxxxxx	Introduction to Autonomous Vehicles
xxxxxxxx	High performance Computing
xxxxxxxx	GenAI for AI agents
xxxxxxxx	Rehabilitation robotics
xxxxxxxx	Introduction to soft and nano robotics
xxxxxxxx	Imitation learning for Robotics
xxxxxxxx	Introduction to Biomedical Informatics
xxxxxxxx	Bio-inspired Robotics

Pedagogy

Theory in Forenoon session

Computational/Practical Lab in the Afternoon

Project Oriented

Additional Micro_credential Courses in each Semester by Industry experts

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Hearty Welcome to the

Seminar on

AI & The Future

Harnessing AI for Students, Schools, and Society

Amrita School of AI

Impact of AI in Education

What is AI ?– Different Perspectives

Perspective-1**: Human-Like Reasoning**

“The theory and development of computer systems that are able to perform tasks normally requiring human intelligence such as, visual perception, speech recognition, learning, decision-making, and natural language processing.”

Perspective-2: **An Algorithm that Pursues a Goal**

“Any computational method that is made to act independently towards a goal based on inferences from theory or patterns in data

Perspective -3: **Intelligence Augmentation**

“Augmented intelligence is a design pattern for a human-centered partnership model of people and artificial intelligence (AI) working together to enhance cognitive performance, including learning, decision making, and new experiences

AI may enable achieving educational priorities in better ways, at scale, and with lower costs.

https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf

AI should be made to assist in

Personalized learning,

Project-based learning,

learning from visualizations, simulations, and virtual reality,

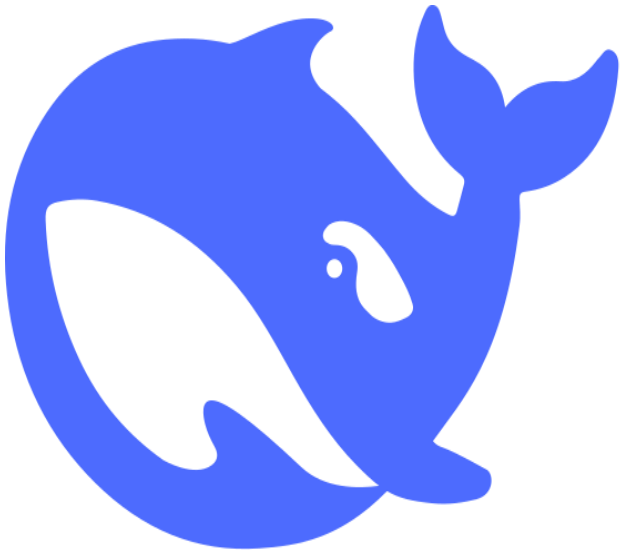
learning across school, community, and familial settings

TWO INDUSTRIES FACING IMMEDIATE DISRUPTION

Education and HealthCare

Early 2024 prediction. US will dominate

China gave
Deep_Shock to US and us



deepseek

Impact in India

AICTE to integrate AI into curricula of core engg branches

The newly launched Electrical Engineering UG curriculum would be considered a template to be followed by other core branches

Ayushi.Gupta1
@timesofindia.com

To revamp the core engineering branches and enhance their value by integrating Artificial Intelligence (AI) technology, the All India Council for Technical Education (AICTE) has planned to revise the curriculum soon. The tweaked curriculum will have AI included as interdisciplinary modules to emphasise AI applications specific to various domains, by understanding its ethical considerations and innovative practices.

To build a future-ready workforce, the AICET has dedicated 2025 as the Year of Artificial Intelligence. Prof TG Sitharam, chairman, AICTE, says, "The AICTE plans to integrate AI into the curriculum of core engineering branches as interdisciplinary modules. The AICTE has already initiated the process by incorporating

ISTOCK

AI elements into the newly launched Electrical Engineering undergraduate curriculum, considering it as a model for further integrations across other core engineering branches. The comprehensive rollout of updated curricula for all branches is expected in 2025."

Meanwhile, the council also plans to launch certain schemes to help colleges in the implementation and inclusion of Research and Development on AI into the curricula of all engineering branches, adds Prof Sitharam.

Implementation plan

The AICTE has urged institutions to submit their respective AI implementation plans, which will be reviewed by the AICTE approval bureau, and the top submissions will be featured as benchmarks for other institutions. Prof Sitharam, says, "The AICTE has suggested colleges to form 'AI Student Chapters' under the nationwide initiative titled 'AI for All: The Future Begins Here'. The formation of student-driven hubs for innovation, and hosting workshops, hackathons, and guest lectures are some of the initiatives that colleges can indulge in. The AICTE will provide guidelines and resources for establishing these initiatives at institutions, ensuring their alignment with industry trends and ethical AI practices."

B Sathiyabhama, head, Computer Science and Engineering, Sona College of Technology in Salem, Tamil Nadu, says, "Given our current resources, we are prioritising AI initiatives that leverage existing infrastructure and expertise. The institution aims to introduce short-term certification courses on AI fundamentals for all engineering disciplines, utilising online platforms and in-house expertise, establish AI labs that focus on low-cost experiments and projects, leveraging open-source AI frameworks, promote interdisciplinary AI projects that combine strengths from diverse departments, collaborate with industry partners to offer hands-on training and internships, ensuring students gain practical AI exposure, and initiate research on AI applications in niche areas including environmental monitoring in Civil Engineering and diagnostic tools in Biomedical Engineering."

Published on April 9, 2025 • In AI Features

India's Education System is About to Change Forever Thanks to AI

The traditional setup—students sitting at desks while a teacher delivers lectures using a blackboard—will soon become obsolete.

vice chairman , AICTE

"Right now, disciplines like **AI, data science, and computer science** are treated as separate verticals.

True innovation lies in cross-disciplinary integration," Jere added.

Computing
AI
DS
Common to all

Tamil Nadu to introduce AI, coding for classes 6-9 starting 2025-2026

The State Council for Educational Research and Training (SCERT) is in the final stage of preparing the syllabus with expert inputs and will soon begin training teachers.

AI and Coding

CBSE 10th std

Projects Based Learning

Experiential learning : Anything other than your experience is not knowledge , its only information

Currently what are offered as separate core Engineering (CSE,EEE,ECE,MECH) can be easily merged into one

Full spectrum Engineer

Computational Thinking	Scientific Thinking	Design Thinking
	1. Ask a Question	
1. Decomposition	2. Conduct Research	1. Empathize
2. Pattern Recognition	3. Form a Hypothesis	2. Define
3. Abstraction	4. Test the Hypothesis	3. Ideate
4. Algorithm Design	5. Record & Analyze Data	4. Prototype
5. Evaluation	6. Draw a Conclusion	5. Test
	7. Communicate Results	

Biomedical Engineering and MBBS in 4 years

HUMANITAS UNIVERSITY

6-year degree course in Medicine and Biomedical Engineering (Italy)

[JS6925] BEng in Biomedical Engineering
(jointly offered by Faculty of Engineering and LKS Faculty of Medicine)

Many IITs into Hybrid Courses

Engineer Physician

Enter the Physicianeers—How They Will Transform Health Care

Roderic Ivan Pettigrew, PhD, MD

-the convergence of engineering and medicine will cause disruptive Innovation

and will bring great hope for humanity.

Coding Assistants

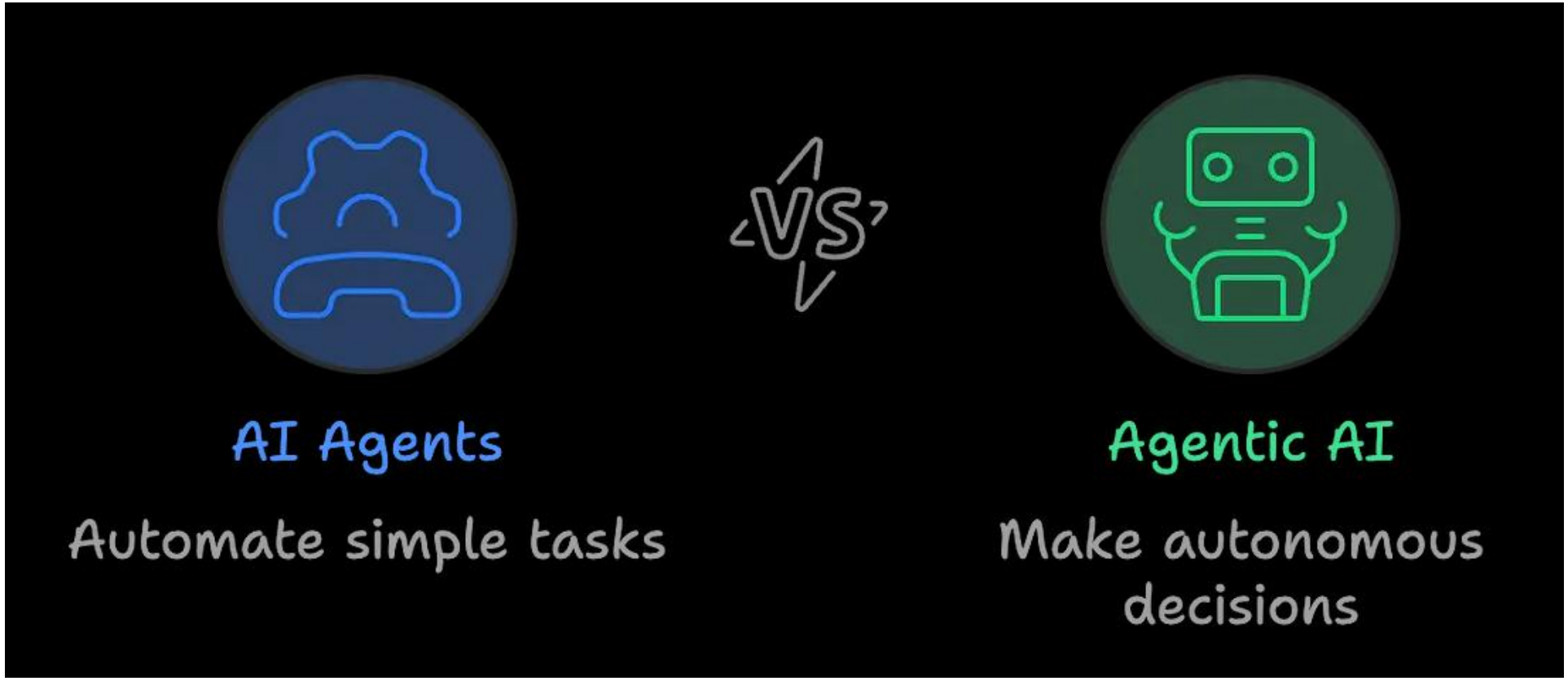
deepseek coder

Qwen2.5-Coder

Vibe Coding

This approach involves describing project requirements in plain language to AI assistants, which then generate code, troubleshoot issues, and implement features.

- AI agents and Agentic AI are the next big thing in 2025!



Coding for automation with Hardware will become a norm

https://medium.com/@elisowski/ai-agents-vs-agentic-ai-whats-the-difference-and-why-does-it-matter-03159ee8c2b4

Decade of Robotics

According to Yann LeCun:

- A New Paradigm of AI Architecture - Systems that can understand, reason, and learn from the world around them.

- We are entering the "decade of robotics" – AI & Robotics come together to solve problems in real world physical problems involving interacting with objects and performing physical tasks.

Yann LeCun: Meta's Chief AI Scientist

Robots for High Tech Farming: Robots for Health care, Robotic Tutors, Robots for manufacturing Ai in text speech and image interaction

https://techcrunch.com/2025/01/23/metas-yann-lecun-predicts-a-new-ai-architectures-paradigm-within-5-years-and-decade-of-robotics/

NVIDIA Just Changed Robotics Forever With GR00T N1

Disney Research NVIDIA Google DeepMind

Announcing NVIDIA Isaac GR00T N1 Humanoid Foundation Model

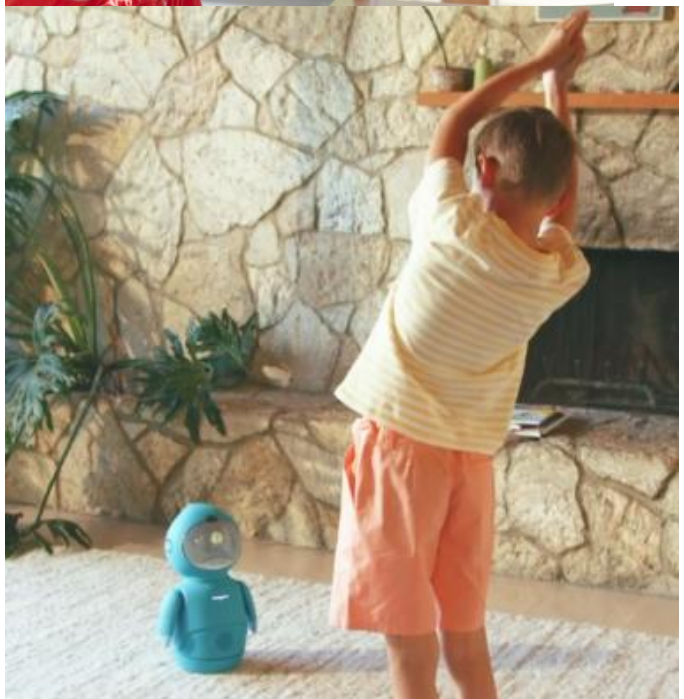
Opensource

A **foundation model** is an **artificial intelligence (AI) model** that is trained on vast datasets, enabling it to perform a wide range of tasks across various applications.

https://www.youtube.com/watch?v=BFiBZI3nqhQ

For a Bright Future of Work,
We Must Get Better at Collaborating With Machines

The Rise of Robotic Doctors and Nurses



Meet Moxie: The world’s most advanced robot that uses safe AI to boost kids' learning and emotional development.

- **Interactive Play-Based Learning:** Stories, games, and educational activities tailored to your kids' needs.
- **Emotional Support:** Empathy-driven interactions to help kids express and understand their feelings.
- **Social Skills Development:** Role-playing and conversational practice to improve real-life social interactions.
- **Parental Dashboard:** Track your child’s progress and activities with ease in the Moxie Robot App.
- **Supports Up to 4 Kids:** Create unique personalized profiles & track each kids' progress separately.

moxierobot.com/products/ai-robot

AI demand
Drastic Changes in Pedagogy

The cause of AI revolution is-

1981

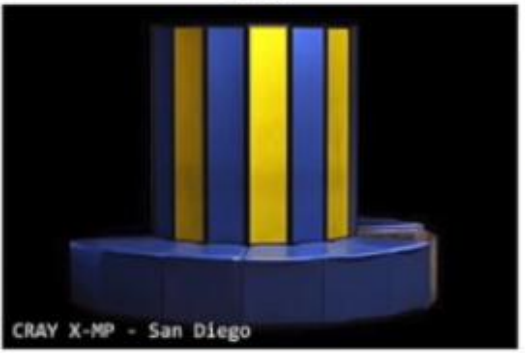
1986

1988

1990

1992

1992



1997

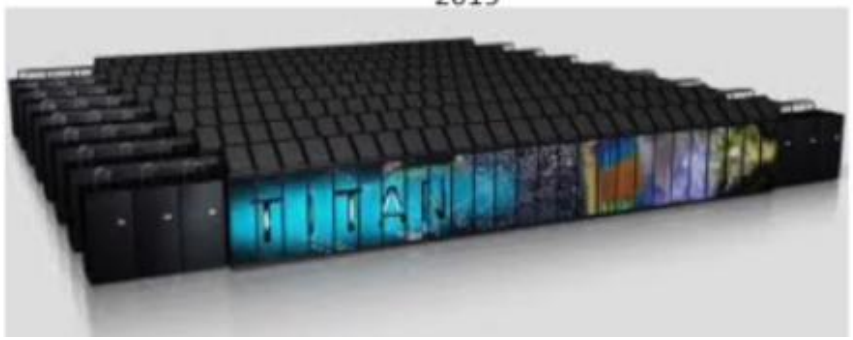
1994

1996

1997

2013

2015



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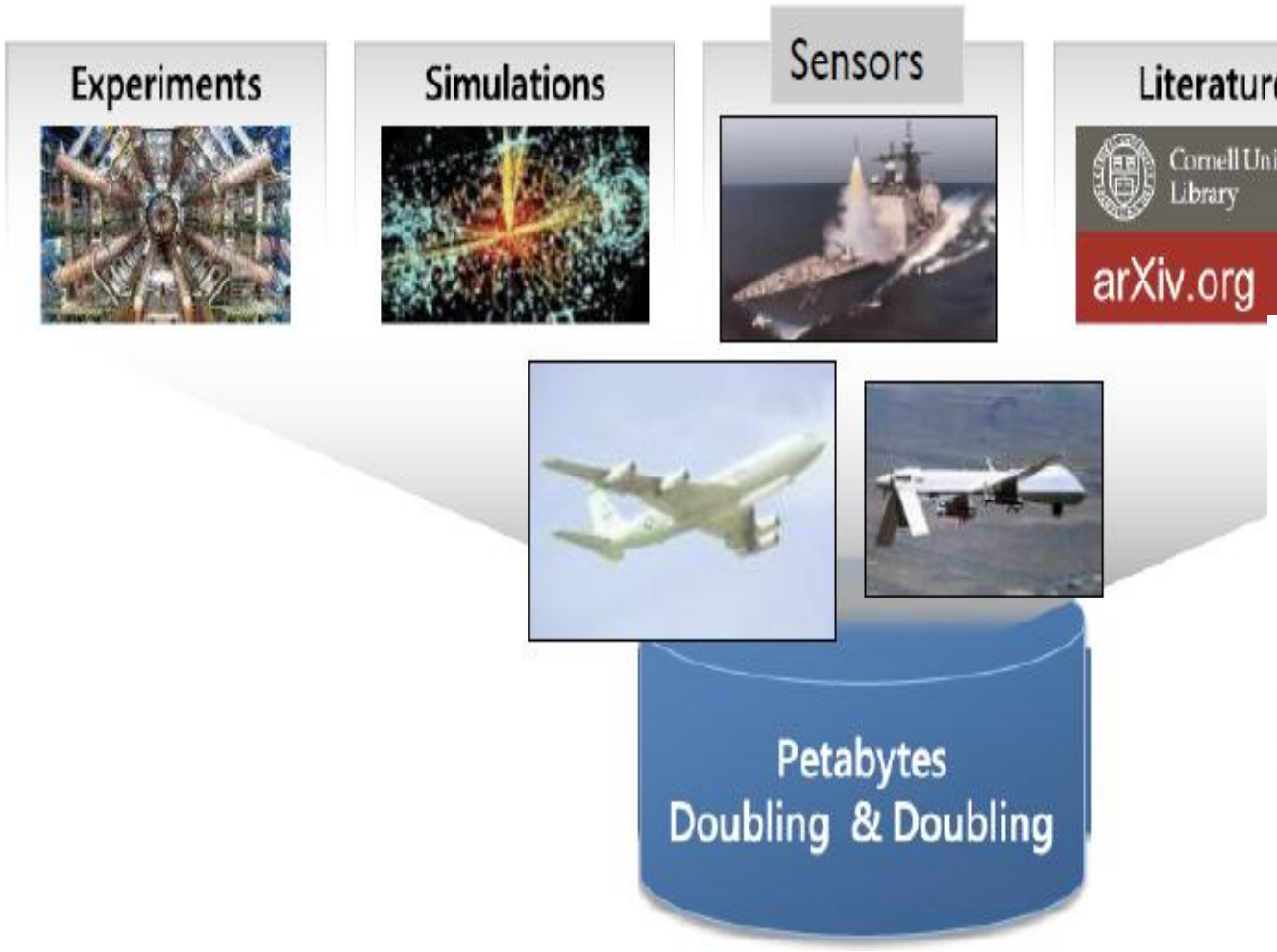
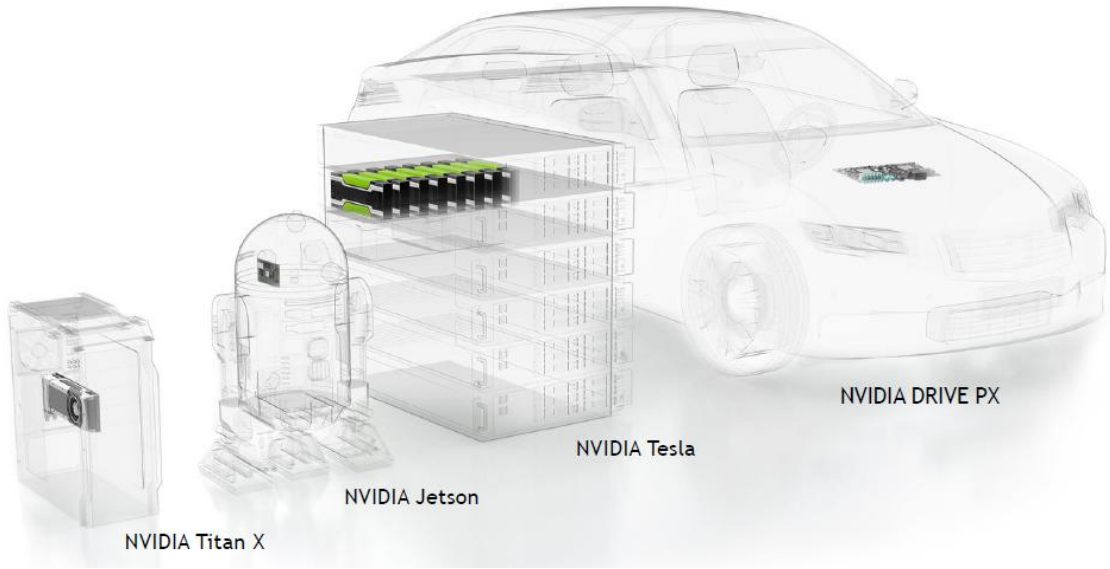
Explosion of Data Sources



DEEP LEARNING EVERYWHERE



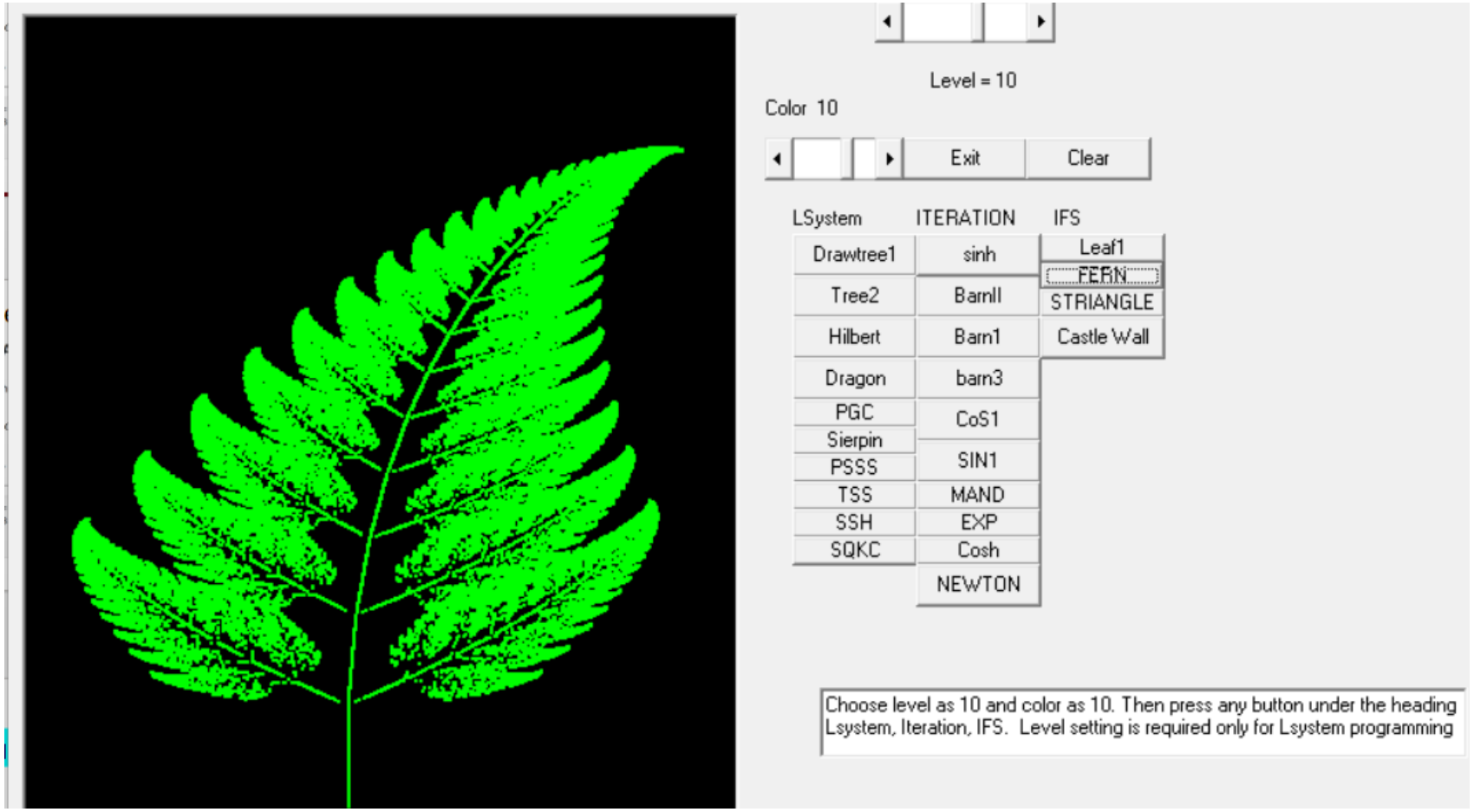
It is not at all reflected in Academics

AI is demanding a complete overhaul

The impact on students and faculty

Both faculty and students must be good at Computing and coding

Computing for Exploration in all subjects



Differentiate Sine function. Verify that it is Cosine function

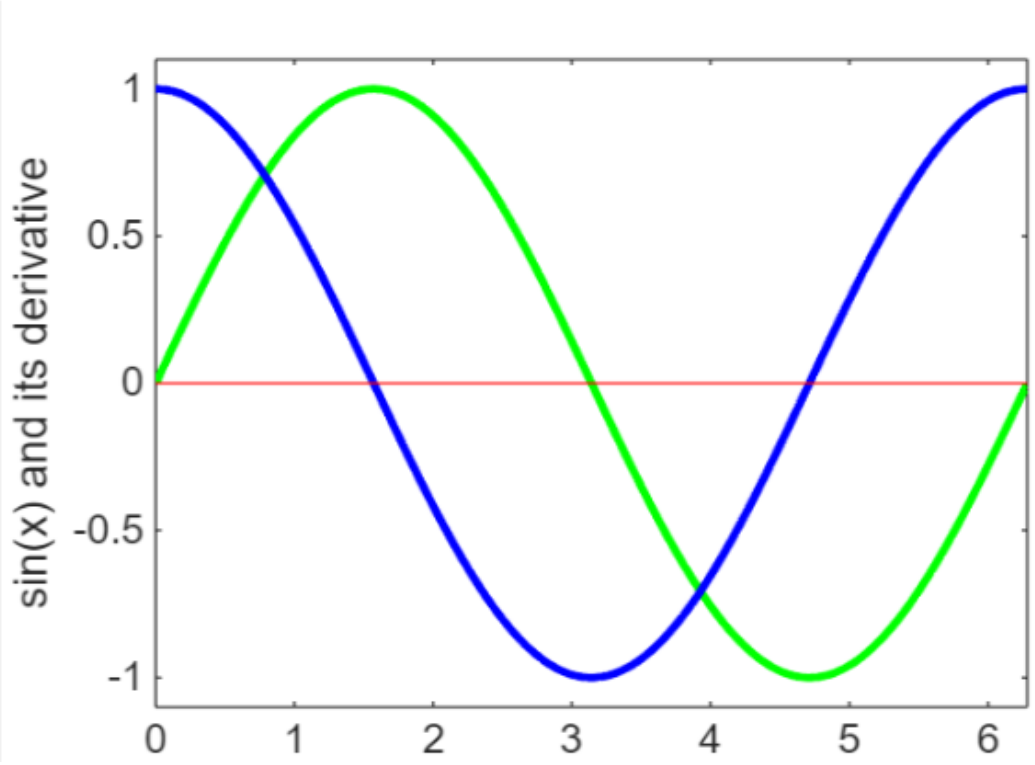
$$\frac{d}{dx}\sin(x) = \cos(x)$$

$$\frac{d}{dx}\sin(x) = \frac{\sin(x+\Delta x) - \sin(x)}{\Delta x}$$

Let us do for $0 \leq x \leq 2\pi$

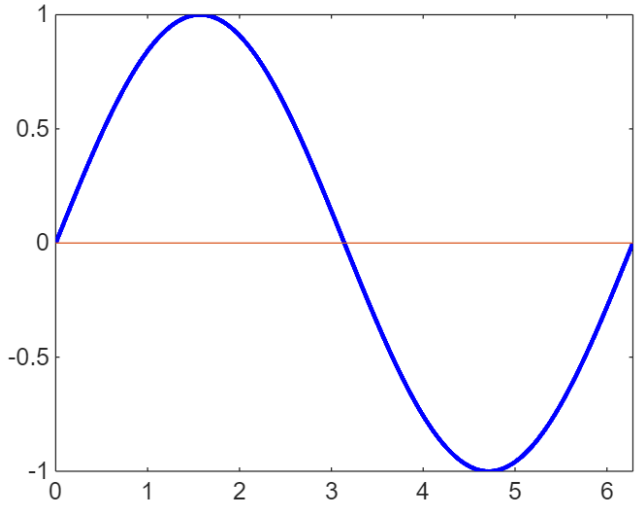
Maths faculty must be extremely good at Scientific Computing

Interactive notebooks




```
% array based programming
clf
inc=0.01;
x=0:inc:2*pi;
Deltax=0.001;
dfdx=(sin(x+Deltax)-sin(x))/Deltax;
plot(x,sin(x),"green", LineWidth=2); hold on
plot(x,dfdx,"blue", LineWidth=2) ; hold on
plot([0 2*pi], [0 0],"red")
ylim([-1.1 1.1])
xlabel('x--->')
ylabel('sin(x) and its derivative')
```

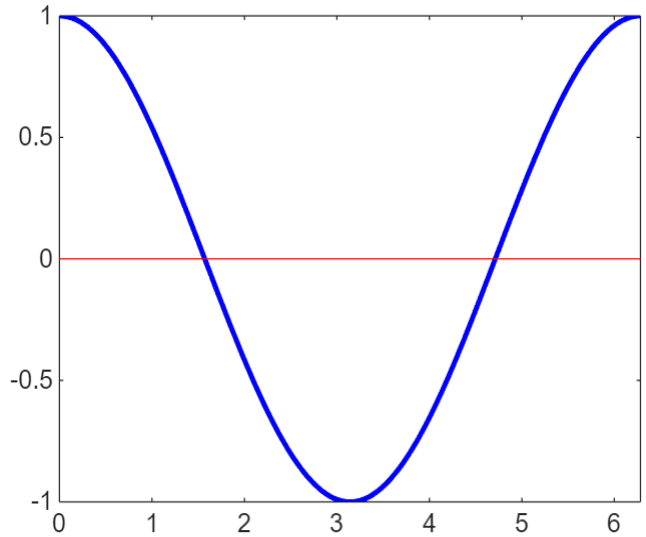
$$\int_0^{2\pi} \sin(x)dx = 0$$




```
clf
Theta=0:0.01:2*pi;
y=sin(Theta);
IS=sum(y)*0.01;
X=['Integral sum is = ' num2str(round(IS))];
disp(X)
plot(Theta,y,"blue", LineWidth=2) ; hold on
plot([0 2*pi], [0 0],"red")
hold off
```

```
Integral sum is = 0
```

$$\int_0^{2\pi} \cos(x)dx = 0$$



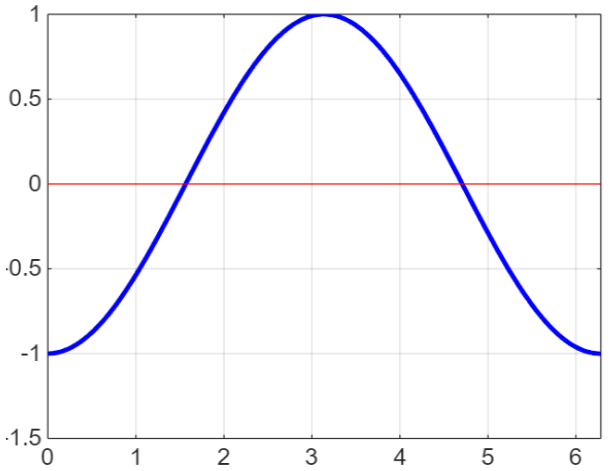

```
Theta=0:0.01:2*pi;
y=cos(Theta);
IS=sum(y)*0.01;
X=['Integral sum is = ' num2str(round(IS))];
disp(X)
plot(Theta,y,"blue", LineWidth=2) ; hold on
plot([0 2*pi], [0 0],"red")
hold off
```

```
Integral sum is = 0
```

Integration (Cumulative Integral) of Sine. Indefinite integral

$$\int \sin(x)dx = -\cos(x) + c = \int_{-\infty}^{x} \sin(t)dt$$

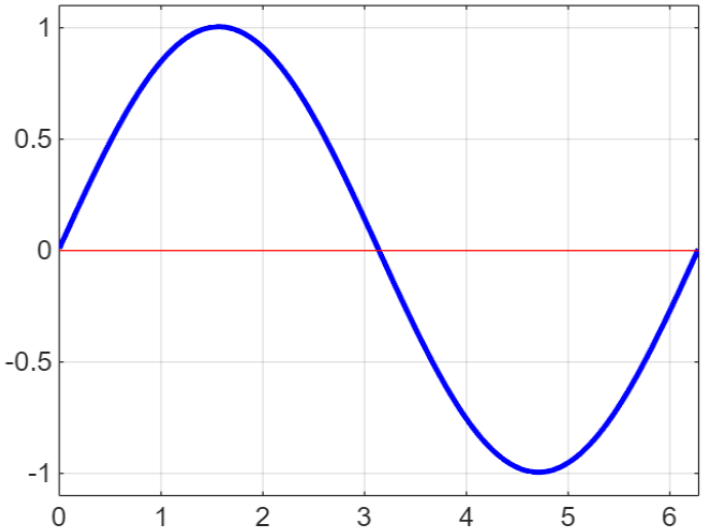
Integration from 0 to 2π.




```
delt=0.01;
Theta=0:delt:2*pi;
IS=cumsum(sin(Theta))*delt;
 Offset=(max(IS)-min(IS))/2;
% We subtract offset to vary -1 to 1
IS=IS-Offset;
plot(Theta,IS,"blue", LineWidth=2) ;
hold on
plot([0 2*pi], [0 0],"red")
```

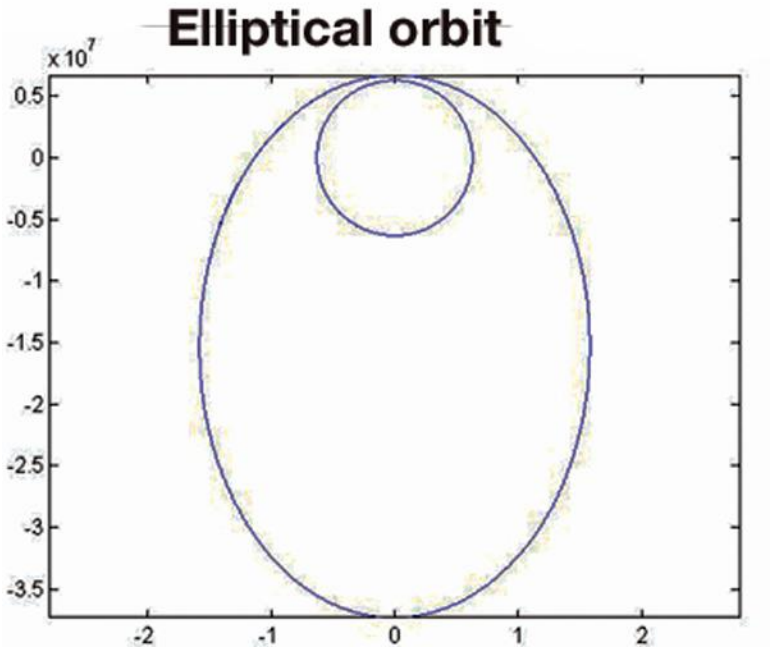
Integration (Cumulative Integral) of Cosine

$$\int \cos(x)dx = \sin(x) + c = \int_{t=-\infty}^{t=x} \cos(t)dt$$




```
delt=0.01;
Theta=0:delt:2*pi;
IS=cumsum(cos(Theta))*delt;
plot(Theta,IS,"blue", LineWidth=2) ;
hold on
plot([0 2*pi], [0 0],"red")
ylim([-1.1 1.1])
```

Space station is orbiting the earth




```
G=6.7e-11;
 mEarth = 5.9742e24;
rEarth = 6.378e6;
 dt = 0.25;
 n = (92*60 + 50) / dt;
 % paramters for orbit 402km above earth
 t(1) = 0;
 x(1) = 0;
 y(1) = rEarth + 402000;
 vx(1) = 7706;
 vy(1) = 0;
 for i=2:n+1
    t(i) = t(i-1) + dt;
    x(i) = x(i-1) + vx(i-1)*dt;
    y(i) = y(i-1) + vy(i-1)*dt;
    R = sqrt(x(i-1)^2+y(i-1)^2);
    Ag = G*mEarth/R^2;
    vx(i)= vx(i-1) - Ag*(x(i-1))/R*dt;
    vy(i)= vy(i-1) - Ag*(y(i-1))/R*dt;
 end
 plot(x,y)
```

Maths and Physics faculty must be extremely good at Scientific Computing

What happens if speed is increased?

Interactive note books- Linear Algebra

Creating integer square matrix A whose inverse is also integer valued

This is equivalent to creating an integer matrix with derterminant equals 1

$$\text{If } A=\begin{bmatrix}1 & 0 & 0\\ a & 1 & 0\\ b & c & 1\end{bmatrix}, B=\begin{bmatrix}1 & d & e\\ 0 & 1 & f\\ 0 & 0 & 1\end{bmatrix}; C=\text{AB}\text{, then } |C|=|\text{A}||B|=1\times 1=1$$

Here if the elements a,b,c,d,e,f are integers , then, C matrix is integer valued

---

```
rng(12345);  A=randi([-3 3], 3,3);  B= A-diag(diag(A));
B=B+eye(3)  ;  A1=triu(B);  A2= tril(B);
AA=A1*A2  ;
disp(det(AA))
```

Linear Algebra

Ax=b

Vector Interpretation

Vector space

$$3x + 2y = 12$$
$$4x + 3y = 17$$

$$\begin{bmatrix} 3 & 2 \\ 4 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 12 \\ 17 \end{bmatrix}$$

$$x \begin{bmatrix} 3 \\ 4 \end{bmatrix} + y \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} 12 \\ 17 \end{bmatrix}$$

Many AI tasks are solved using Linear Algebra

More stress on solving linear equations

Left Inverse and Right Inverse and pseudo inverse

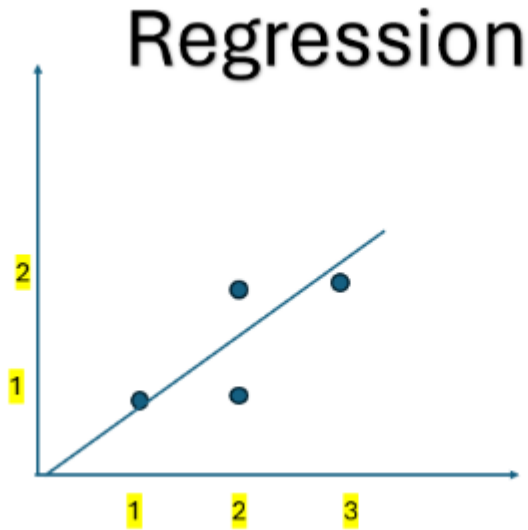
$$\begin{bmatrix} 0.25 & 0.25 & 0.25 & 0.25 \\ 0.25 & -0.25 & 0.25 & -0.25 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & -1 \\ 1 & 1 \\ 1 & -1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 1 \\ 2 & 1 \\ 2 & 1 \\ 3 & 1 \end{bmatrix} \qquad A^{\dagger} = \begin{bmatrix} -0.5 & 0 & 0 & 0.5 \\ 1.25 & 0.25 & 0.25 & -0.75 \end{bmatrix}$$

$$\begin{bmatrix} -0.5 & 0 & 0 & 0.5 \\ 1.25 & 0.25 & 0.25 & -0.75 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 2 & 1 \\ 2 & 1 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

1. Linear Regression

x	y
1	1
2	1
2	2
3	2

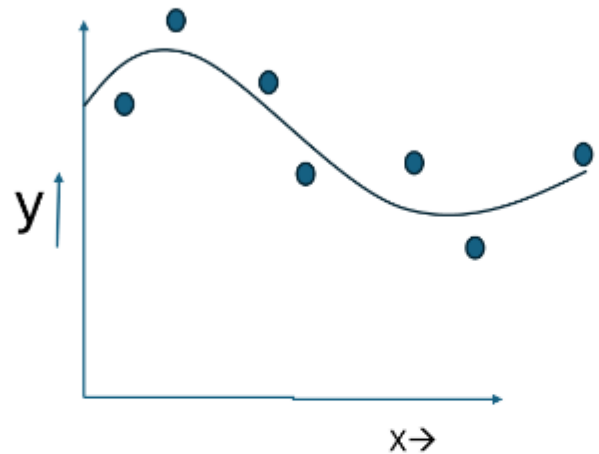


$$\begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 2 & 1 \\ 3 & 1 \end{pmatrix} \begin{pmatrix} m \\ c \end{pmatrix} \approx \begin{pmatrix} 1 \\ 1 \\ 2 \\ 2 \end{pmatrix}$$

$$\begin{pmatrix} m \\ c \end{pmatrix} = \begin{bmatrix} -0.5 & 0 & 0 & 0.5 \\ 1.25 & 0.25 & 0.25 & -0.75 \end{bmatrix} \begin{pmatrix} 1 \\ 1 \\ 2 \\ 2 \end{pmatrix} = \begin{bmatrix} 0.5 \\ 0.5 \end{bmatrix}$$

2. Non-Linear Regression

$$\begin{pmatrix} x_1 & y_1 \\ x_2 & y_2 \\ \text{-----} & \\ x_n & y_n \end{pmatrix}$$



$\Phi(x)$

$$\begin{pmatrix} x_1^3 & x_1^2 & x_1 & 1 \\ x_2^3 & x_2^2 & x_2 & 1 \\ & & & \\ x_n^3 & x_n^2 & x_n & 1 \end{pmatrix} \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{pmatrix} \approx \begin{pmatrix} y_1 \\ y_2 \\ -- \\ y_n \end{pmatrix}$$

3. Regression for Classification (linearly seperable)

Classification using Multioutput Regression

How to teach classification problem to +2 students

Consider a Binary classification problem.

Class label is changed to 1-hot representation.

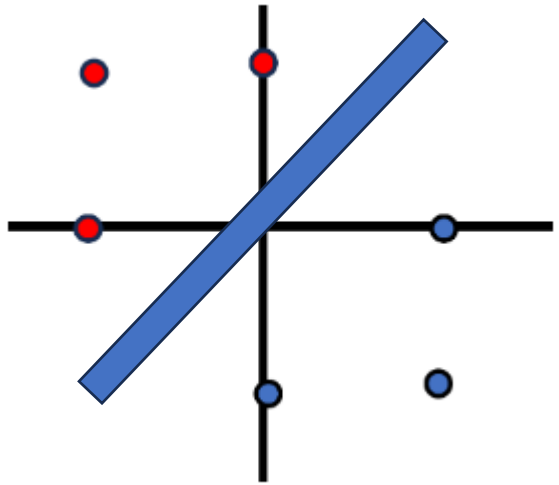
Class 1 → [1 0]

Class 2 → [0 1]

Red data points are class 1 points

Blue data points are class 2 points.

Derive a classifier

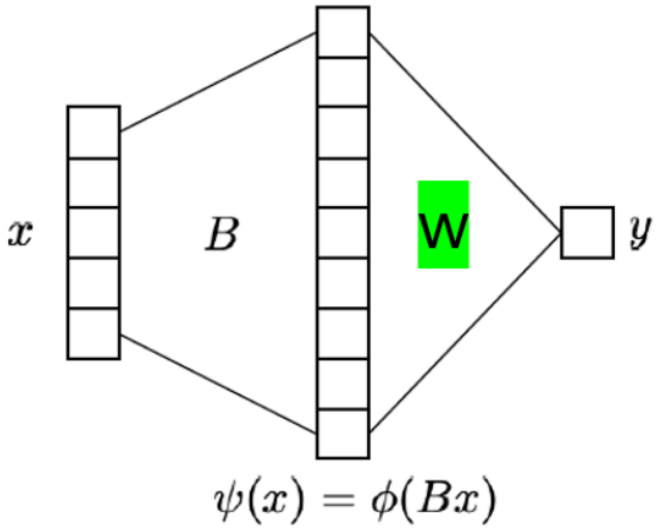


$$\underbrace{\begin{bmatrix} 0 & 1 \\ -1 & 1 \\ -1 & 0 \\ 0 & -1 \\ 1 & 0 \\ 1 & -1 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} w_{11} & w_{21} \\ w_{12} & w_{22} \end{bmatrix}}_{W} \approx \underbrace{\begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}}_{Y};$$

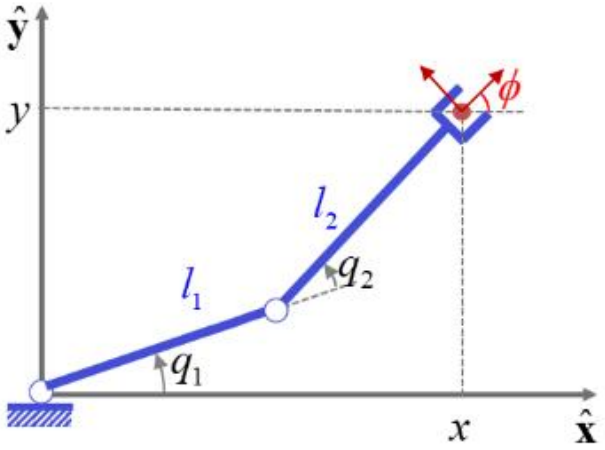
$$W = (A^T A)^{-1} A^T Y = \begin{bmatrix} -1/3 & 1/3 \\ 1/3 & -1/3 \end{bmatrix}$$

Regression for all ML tasks

Regression and Neural network



Regression and Robotics



1. Linear Regression
2. Non-linear Regression
3. Linear Classifier
4. Non-Linear Classifier (Kernel method, Indirect mapping)
5. Non-Linear Classifier (Kernel method, Explicit Mapping)
6. Finding Differential Equation
7. Frequency Estimation
8. Inverse Kinematics
9. Neural Tangent Kernel
10. Filter Design
11. CMR decomposition

Pedagogy

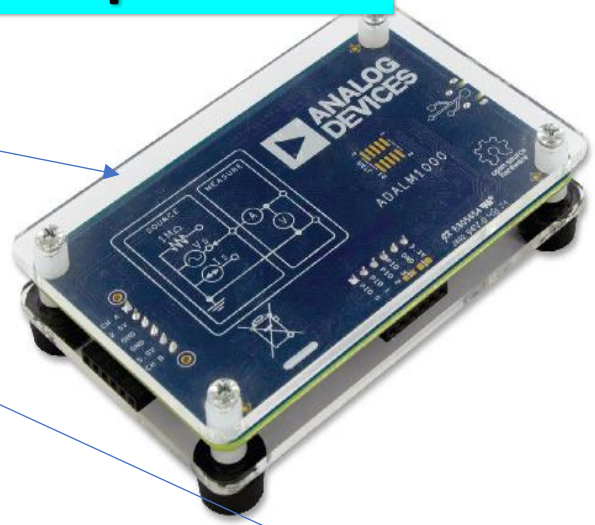
Good Morning with Theory

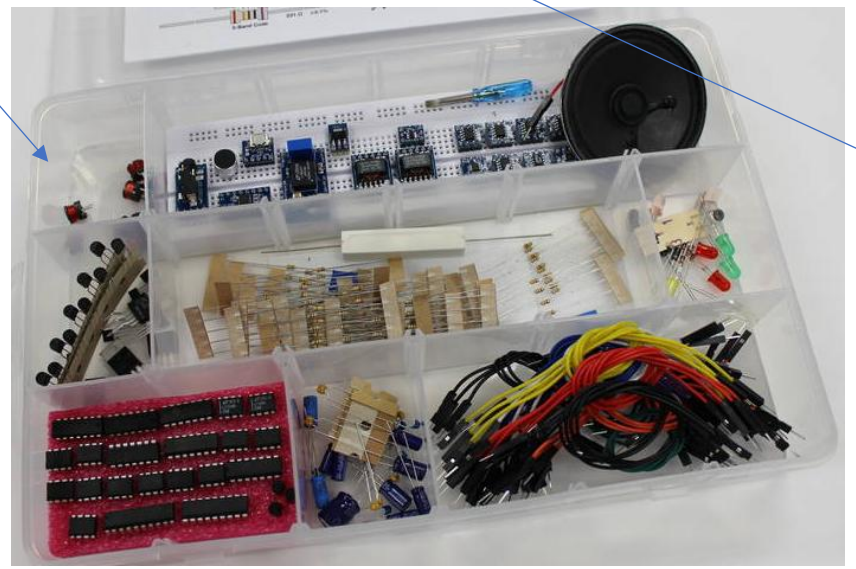
Good Afternoon with Computational lab preferably with physical devices

Maker space
Deepseek,

Carry electronics lab in your pocket

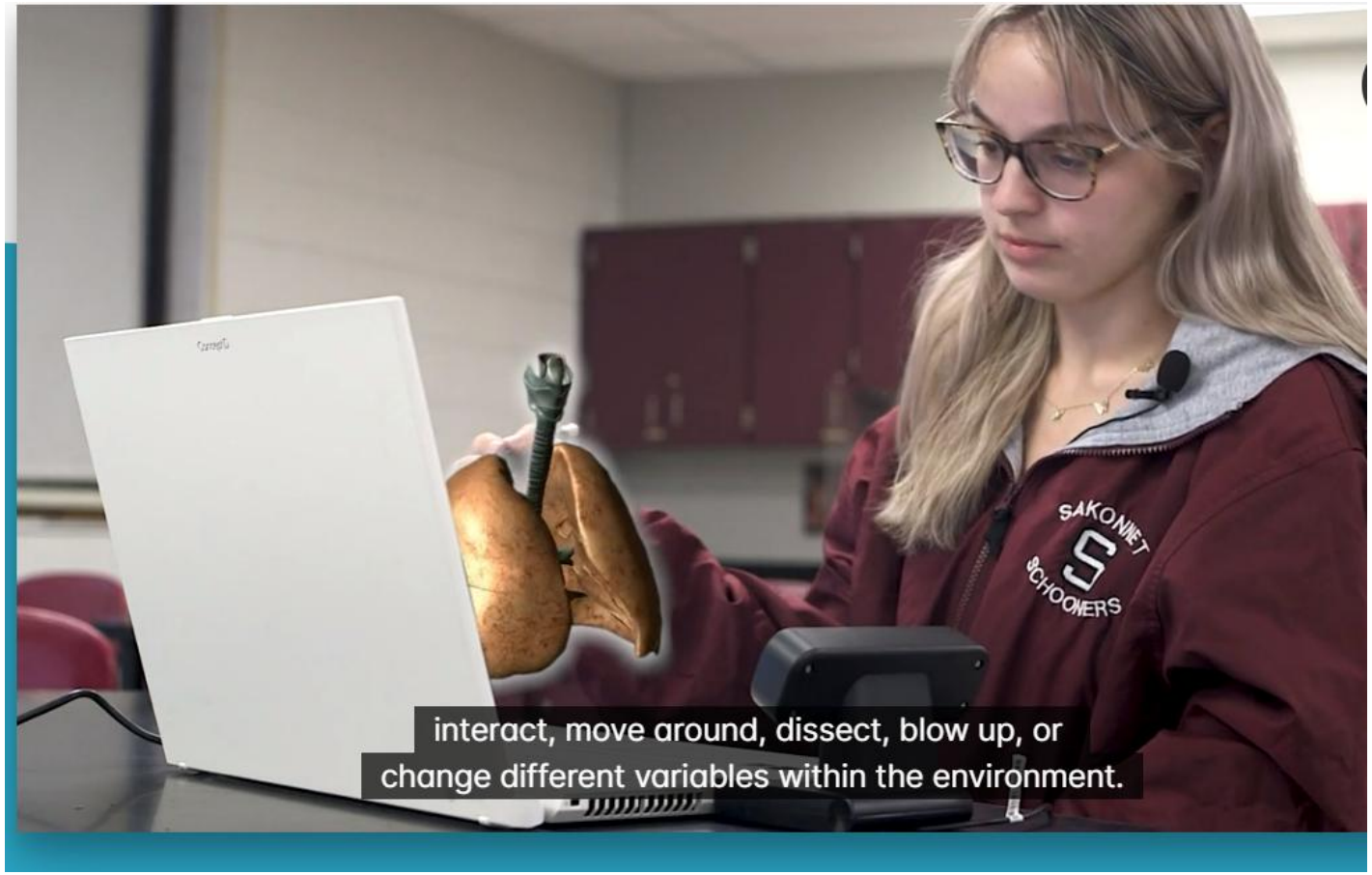
1. ADALM 1000
2. ADALM 2000
3. ADALP2000
4. ADALM PLUTO





Electronics faculty must be extremely good at Scientific Computing and hardware interfacing

https://zspace.com/



Learning subjects faster

AR-VR Lab

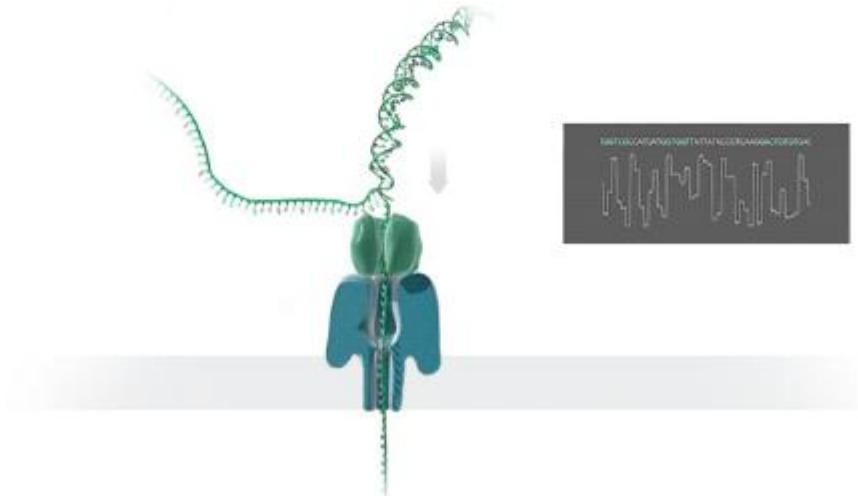
Suitable for many biological , medical and Engineering subjects

https://zspace.com/technology

Biology faculty must be extremely good at use of AR and VR + Computing

Desktop DNA/RNA Sequencer

Oxford Nanopore Sequencer



Can Large Language Models Predict Antimicrobial Resistance Gene?

Hyunwoo Yoo. Drexel University

March 2025

This study demonstrates that generative large language models can be utilized in a more flexible manner for DNA sequence analysis and classification tasks compared to traditional transformer encoder-based models

Biology faculty must be extremely good at Computing

Spiral Learning of Maths, ML,DL

Scientific Computing

AI with Hardware

Evaluation

Daily/weekly automated evaluation

50% weightage for Projects

personalized

For absorbing emerging developments

we offer
Micro-Credential Courses

Be mentally prepared for the Future:

Pure coding jobs will vanish.

Specialization is a must for getting jobs, like:

AI & DS
AI&DS(Medical Engg)
AI&DS(Cyber Physical Systems and Security)
AI&DS(Autonomous Agents and Robotics)
AI&DS(Material Science)
AI & DS(Bio-Technology)
AI & DS(Agriculture and Robotics)