AMRITA
VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY

Hearty Welcome to

School of Artificial Intelligence

AI and Data science(Quantum Technologies)

4-year B Tech Program @ School of Artificial Intelligence

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.)

Quantum Technologies are
Covered through 18 micro_credential courses.
3 courses in a semester

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	20
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	Introduction to Classical Computing
xxxxxxxx	Mathematical Postulates of Quantum Mechanics
xxxxxxxx	Elements of Quantum Computing
xxxxxxxx	Linear algebra and Quantum Gates
xxxxxxxx	Elements of Quantum Programming
xxxxxxxx	Quantum Programming Frameworks
xxxxxxxx	Conceptual ideas in Quantum mechanics
xxxxxxxx	Quantum Operator Mechanics
xxxxxxxx	Basic Laboratory Course for Quantum Technologies-1
xxxxxxxx	Quantum Machine Learning
xxxxxxxx	Basic Laboratory Course for Quantum Technologies-2
xxxxxxxx	Quantum Protocols and algorithms
xxxxxxxx	Basic Laboratory Course for Quantum Technologies-3
xxxxxxxx	Introduction to Quantum Communication
xxxxxxxx	Introduction to Quantum Sensing-1
xxxxxxxx	Introduction to Quantum Sensing -2
xxxxxxxx	Introduction to Quantum Materials -1
xxxxxxxx	Introduction to Quantum Materials-2
xxxxxxxx	Quantum Measurements and Classical limits
xxxxxxxx	Quantum States of light
xxxxxxxx	Quantum Enhanced sensing and Metrology
xxxxxxxx	Fundamentals of Photonics for Quantum Communication
xxxxxxxx	Foundations of Quantum Communication
xxxxxxxx	Advanced Concepts in Quantum Communication
xxxxxxxxx	Foundations of Quantum Materials
xxxxxxxxx	Collective Phenomenon in Quantum Materials
xxxxxxxxx	Advanced Topics in Quantum Materials
xxxxxxxxx	Foundations of Quantum Information

Quantum computing

What is it and how does it work?

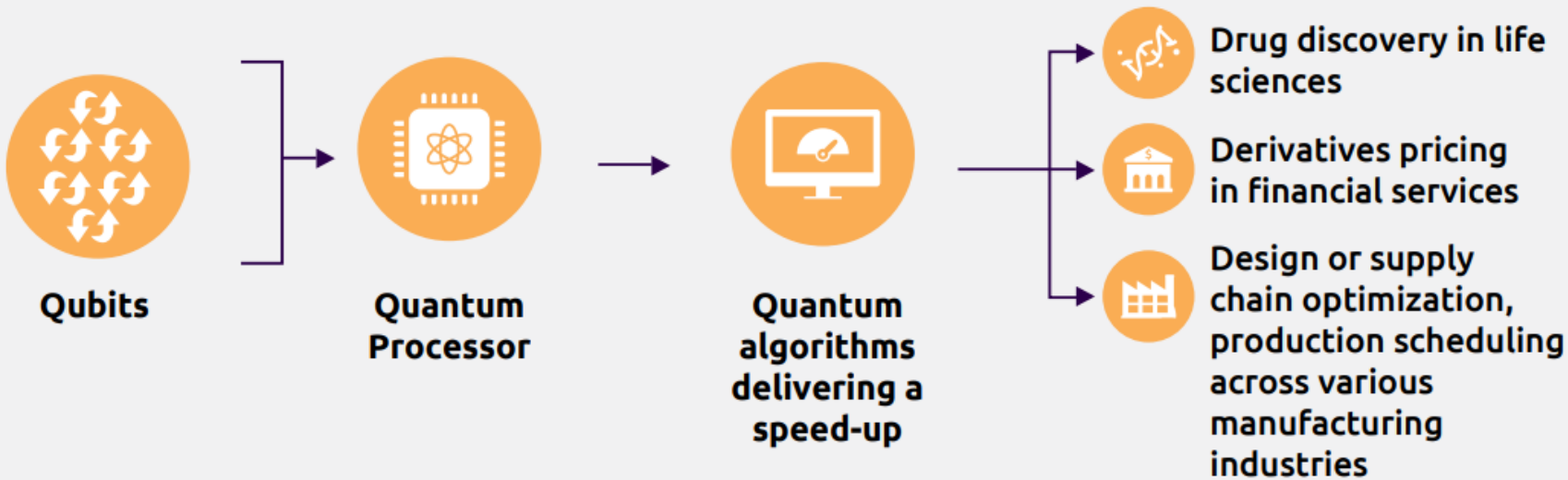
Use of quantum properties to perform computations. The most basic unit of quantum computation is called a **qubit**. Qubits can acquire any value between 0 and 1 at the same time. Quantum computing, in some cases, provides an **exponential speed-up in computing power**.

Individual qubits represent many possible states simultaneously…

…making it possible to carry out complex calculations in parallel…

This allows writing quantum algorithms which can run orders of magnitude faster, saving computing resources…

…while also enabling solution or simplification of problems that are difficult for classical computers, e.g.,

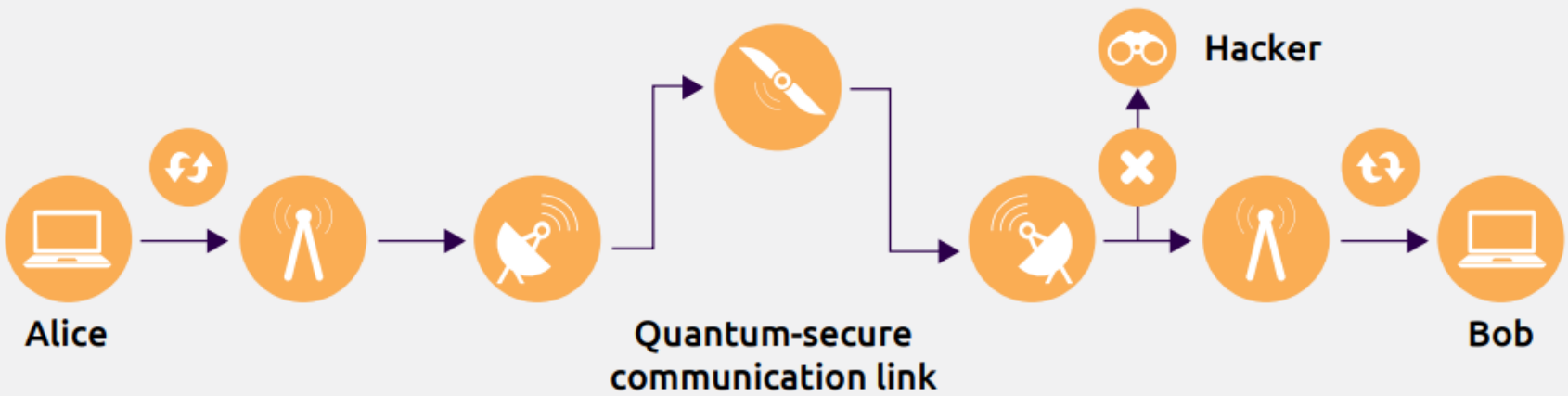


Quantum communication and security

What is it and how does it work?

Transmitting and controlling information using the laws of quantum mechanics i.e. by using qubits as opposed to bits. Quantum security involves securing information transfer using quantum theory. **Quantum-key distribution** (QKD) is a key distribution protocol to generate "quantum" keys that can be used for secure information exchange over a classical channel with classical cryptography techniques. The keys are distributed using rules of quantum mechanics where any act of listening in leaves a detectable sign of snooping.

1. **Alice and Bob generate and share quantum keys using QKD**
2. **Alice then encrypts her message using this quantum key and any classical encryption algorithm**
3. **Only Bob, who has access to quantum keys, can access this message.**
4. **When used in a provably secure encryption like one time pad, the quantum keys guarantee that the message cannot be hacked.**



Quantum sensing

What is it and how does it work?

Use of quantum properties or phenomena to measure a physical quantity with high precision

Using quantum effects to measure:

- Timing
- Acceleration and rotation
- Gravitation
- Electric or magnetic field

Quantum sensors provide unprecedented precision in measurement. These sensors are already deployed in areas such as biomedical imaging, timing synchronization of satellites, and detection of gas leakages.


Towards Bio-Enabled Quantum Sensing
Quantum Sensing
Neuronal Circuits and Clinical Testing with Subcellular Precision
Microscale Structure Determination to Temperature Probing in Living Systems with NV Centre-based Diamond Technology

Pedagogy

Theory in Forenoon session

Computational/Practical Lab in the Afternoon

Project Oriented

Additional Micro_credential Courses in each Semester by Industry experts

AMRITA
VISHWA VIDYAPEETHAM
श्रद्धावान् लभते ज्ञानम्
DEEMED TO BE UNIVERSITY

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,

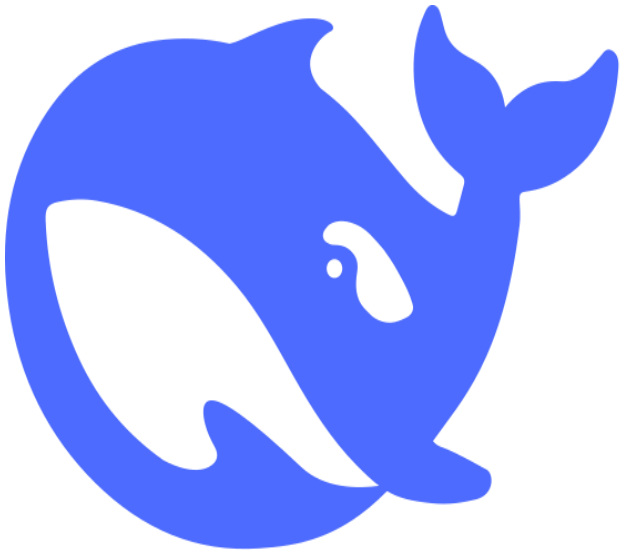
learning across school, community, and familial settings

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

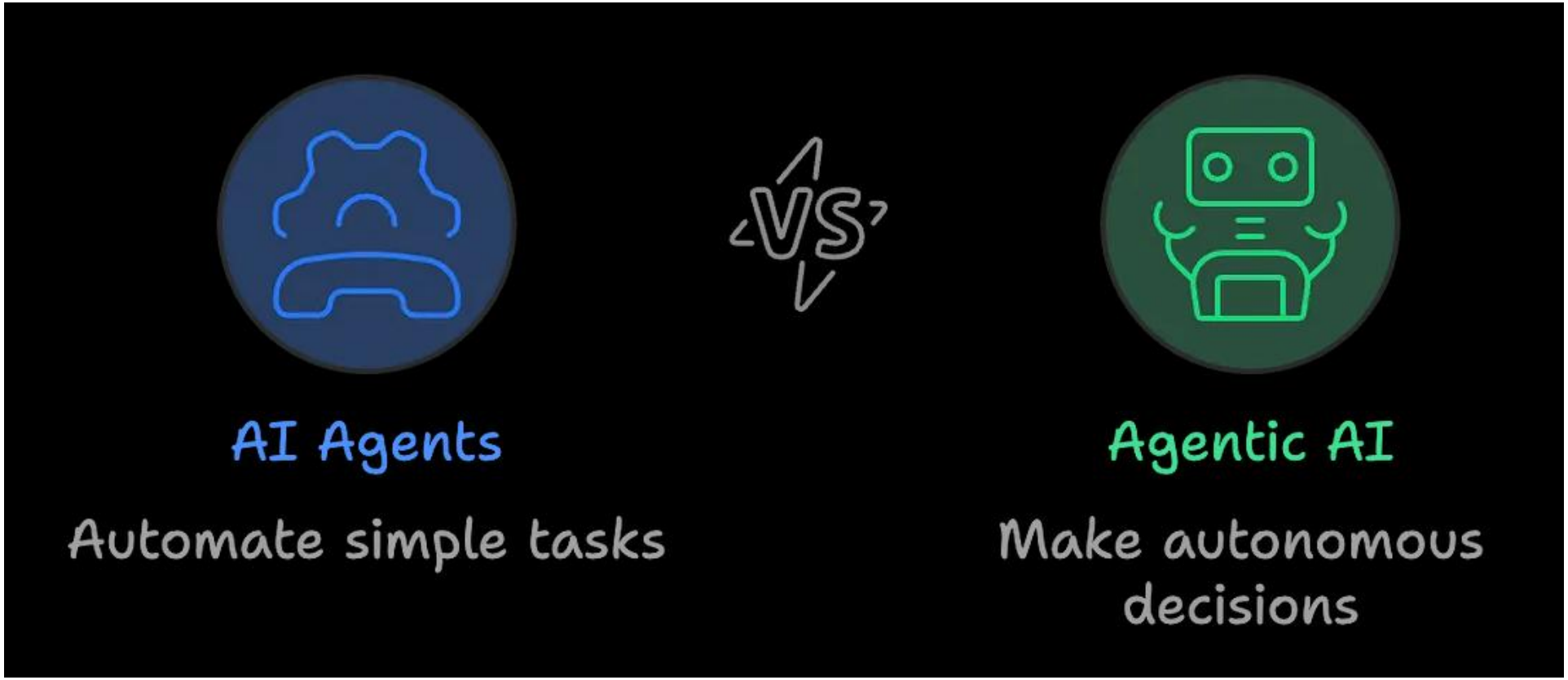
deepseek coder

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

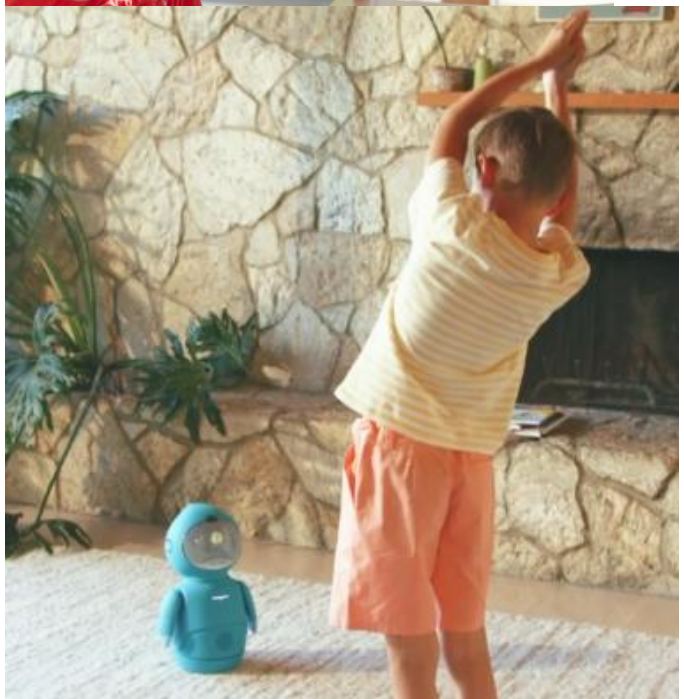
Opensource

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

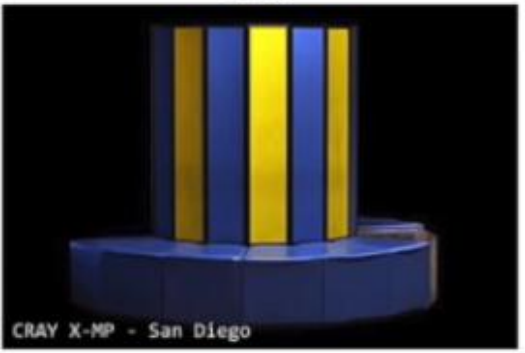
1986

1988

1990

1992

1992



1997

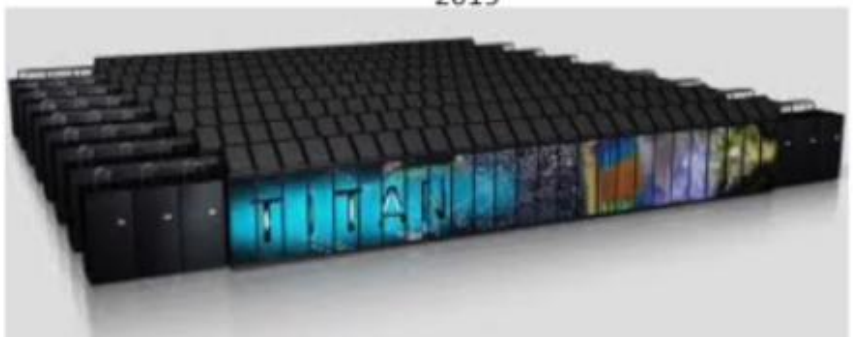
1994

1996

1997

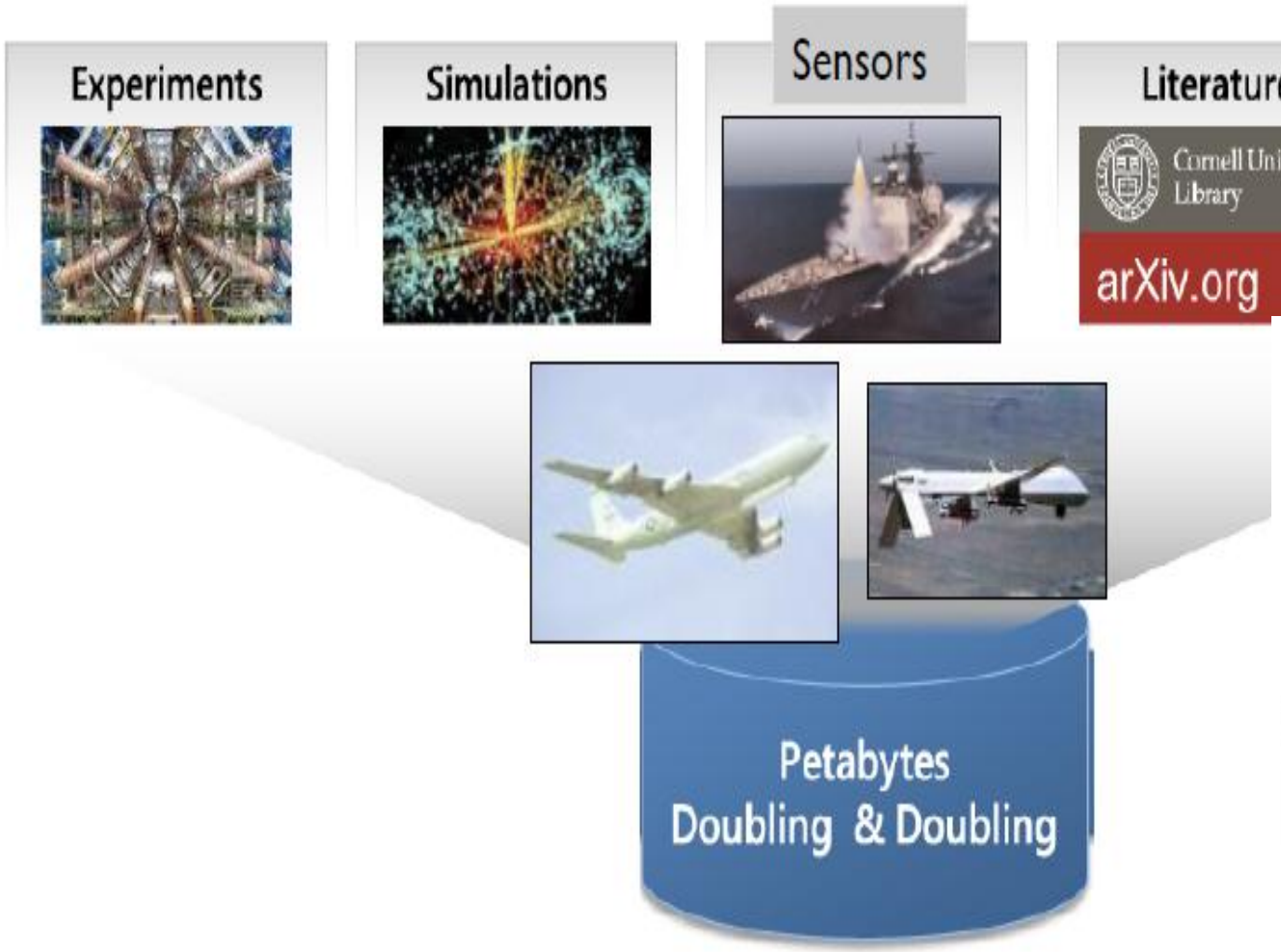
2013

2015

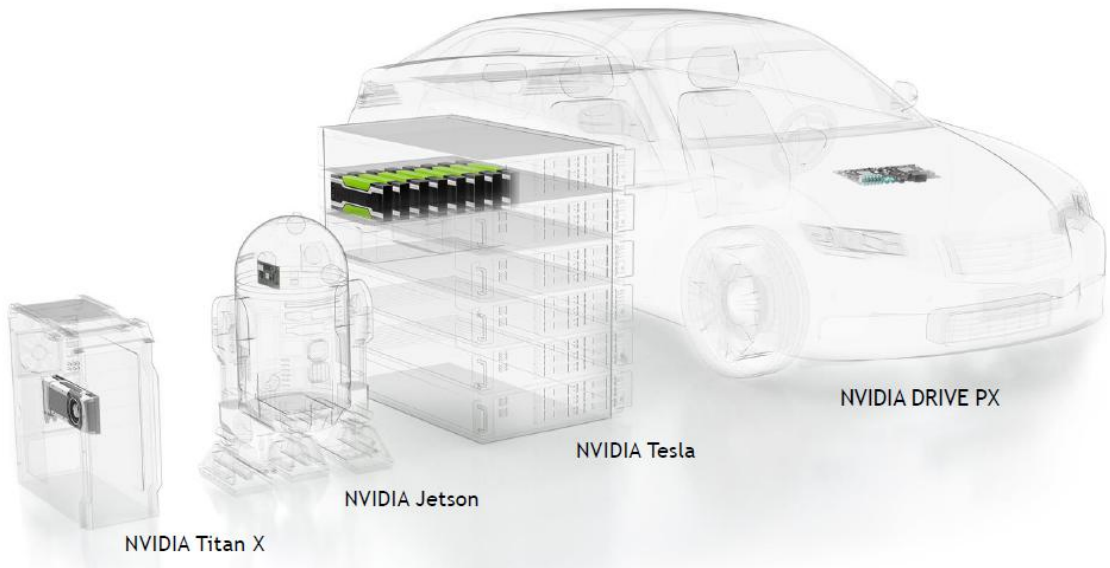


20’000’000 X

Explosion of Data Sources



DEEP LEARNING EVERYWHERE



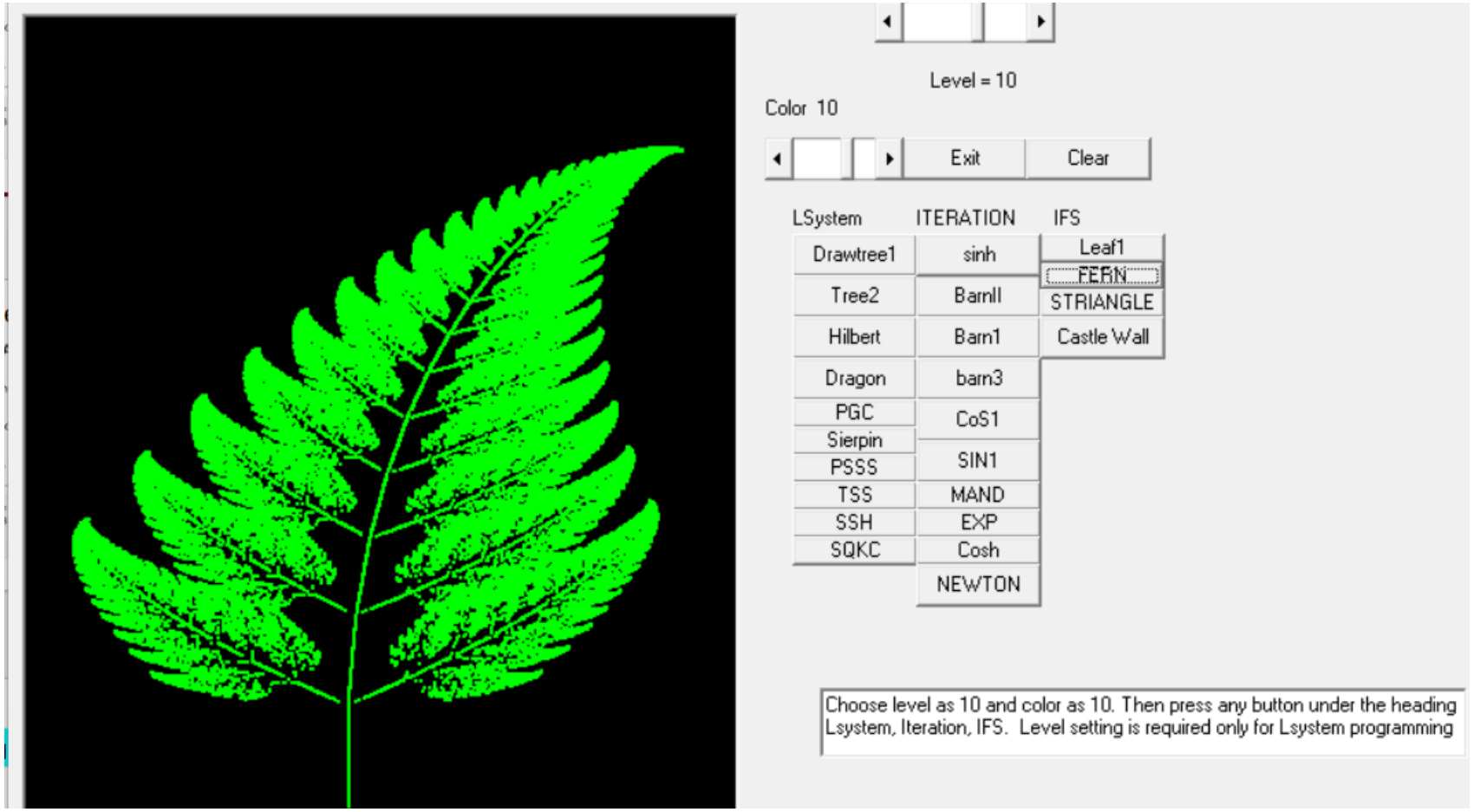
It is not at all reflected in Academics

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

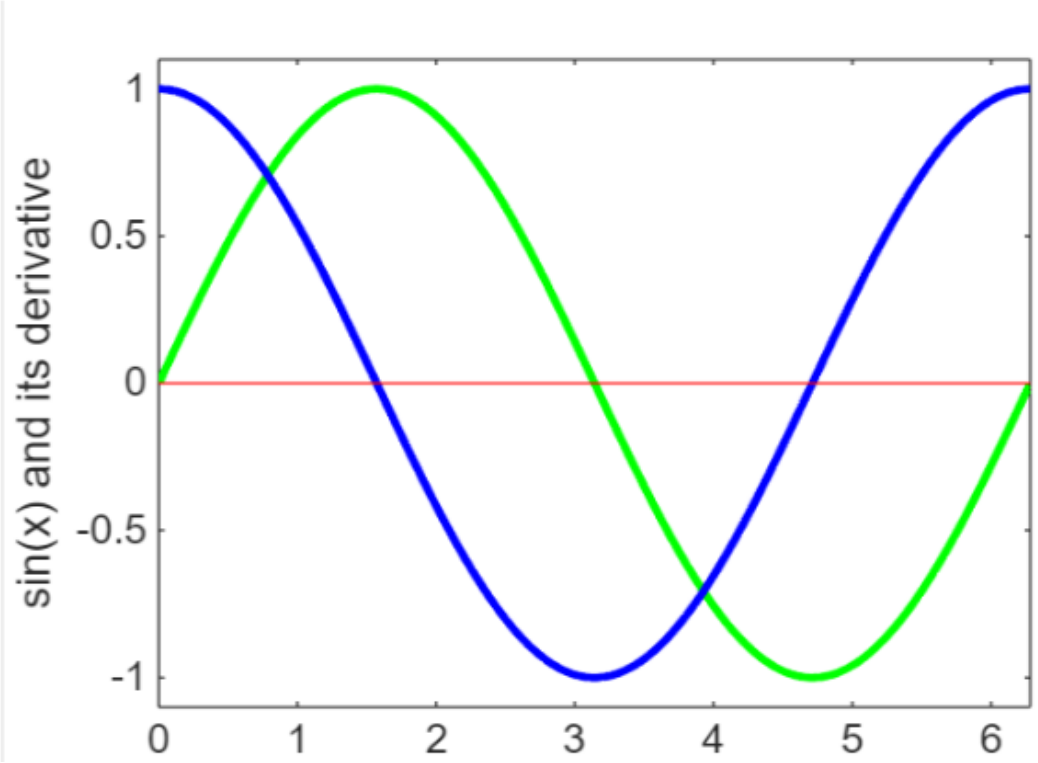
$$\frac{d}{dx}\sin(x) = \cos(x)$$

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

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

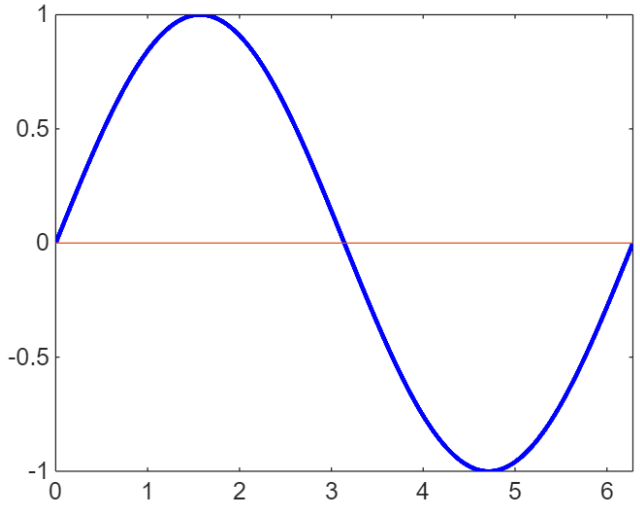
Maths faculty must be extremely good at Scientific Computing

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')
```

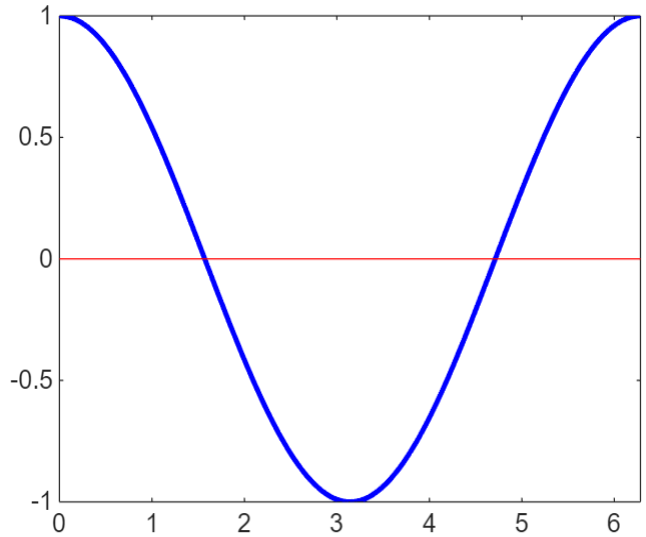
$$\int_0^{2\pi} \sin(x)dx = 0$$




```
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
```

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



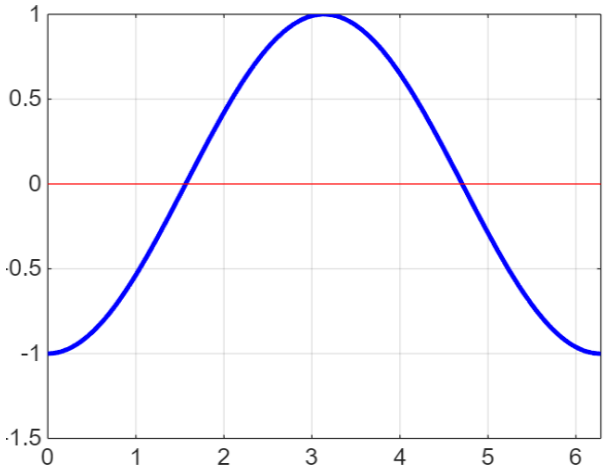

```
Theta=0:0.01:2*pi;
y=cos(Theta);
IS=sum(y)*0.01;
X=['Integral sum is = ' num2str(round(IS))];
disp(X)
plot(Theta,y,"blue", LineWidth=2) ; hold on
plot([0 2*pi], [0 0],"red")
hold off
```

```
Integral sum is = 0
```

Integration (Cumulative Integral) of Sine. Indefinite integral

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

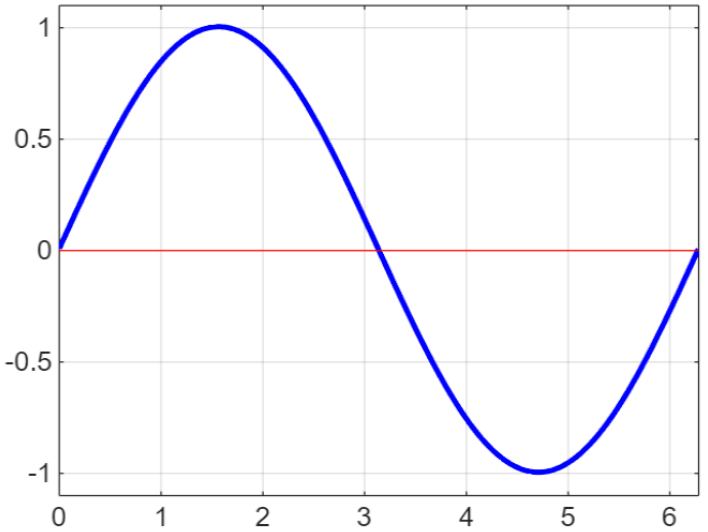
Integration from 0 to 2π.




```
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")
```

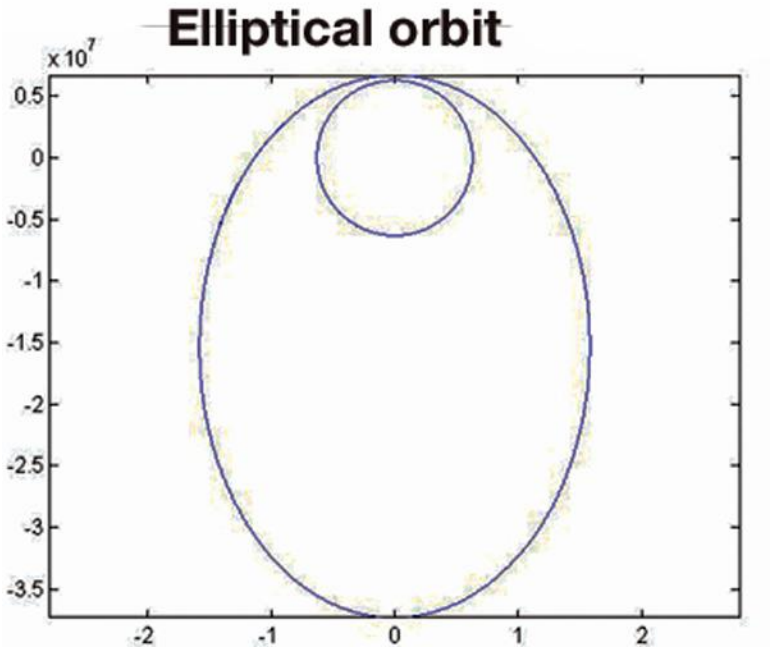
Integration (Cumulative Integral) of Cosine

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




```
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

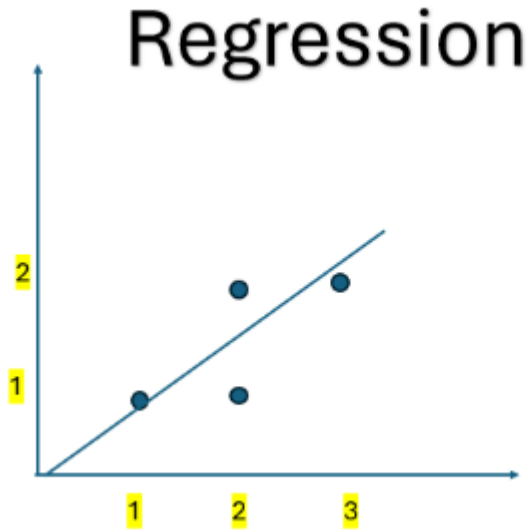
$$\begin{bmatrix} 0.25 & 0.25 & 0.25 & 0.25 \\ 0.25 & -0.25 & 0.25 & -0.25 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & -1 \\ 1 & 1 \\ 1 & -1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

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

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

1. Linear Regression

x	y
1	1
2	1
2	2
3	2

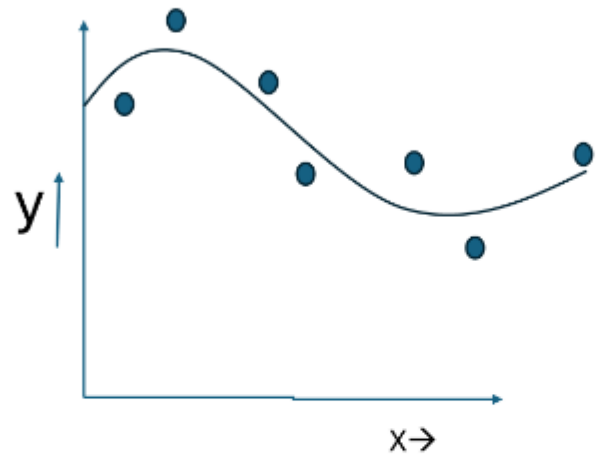


$$\begin{pmatrix} 1 & 1 \\ 2 & 1 \\ 2 & 1 \\ 3 & 1 \end{pmatrix} \begin{pmatrix} m \\ c \end{pmatrix} \approx \begin{pmatrix} 1 \\ 1 \\ 2 \\ 2 \end{pmatrix}$$

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

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.

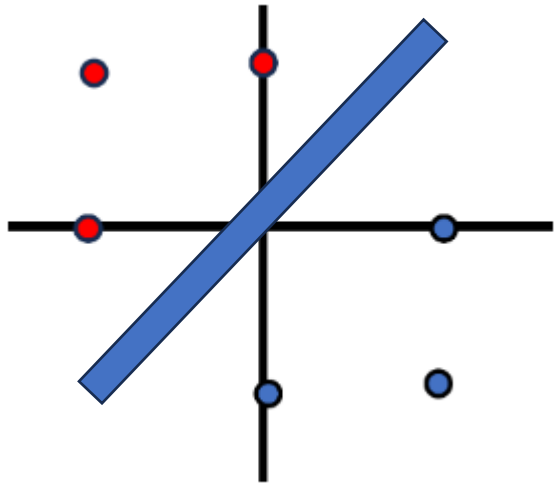
Class 1 → [1 0]

Class 2 → [0 1]

Red data points are class 1 points

Blue data points are class 2 points.

Derive a classifier

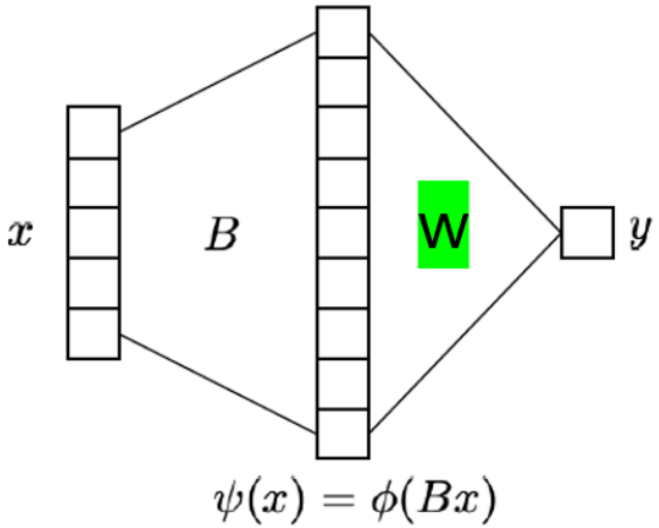


$$\underbrace{\begin{bmatrix} 0 & 1 \\ -1 & 1 \\ -1 & 0 \\ 0 & -1 \\ 1 & 0 \\ 1 & -1 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} w_{11} & w_{21} \\ w_{12} & w_{22} \end{bmatrix}}_{W} \approx \underbrace{\begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}}_{Y};$$

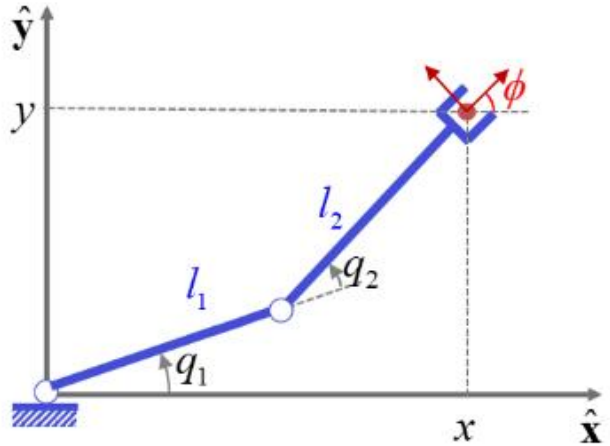
$$W = (A^T A)^{-1} A^T Y = \begin{bmatrix} -1/3 & 1/3 \\ 1/3 & -1/3 \end{bmatrix}$$

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

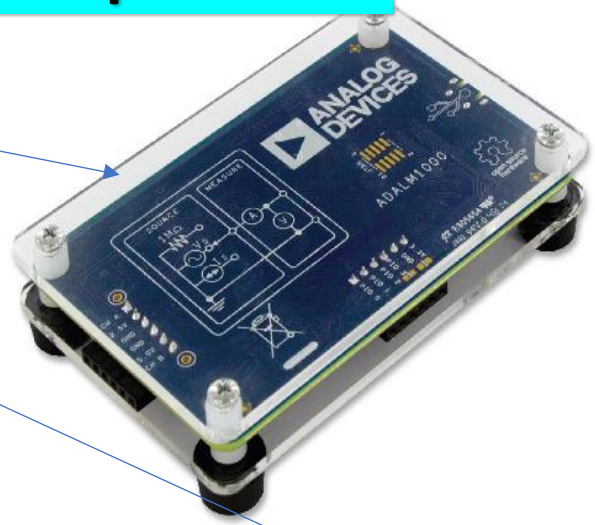
Good Morning with Theory

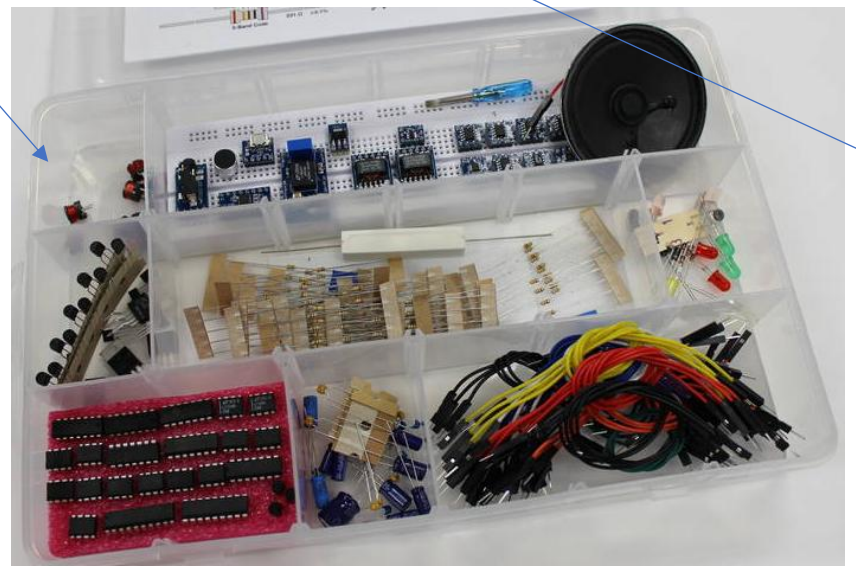
Good Afternoon with Computational lab preferably with physical devices

Maker space
Deepseek,

Carry electronics lab in your pocket

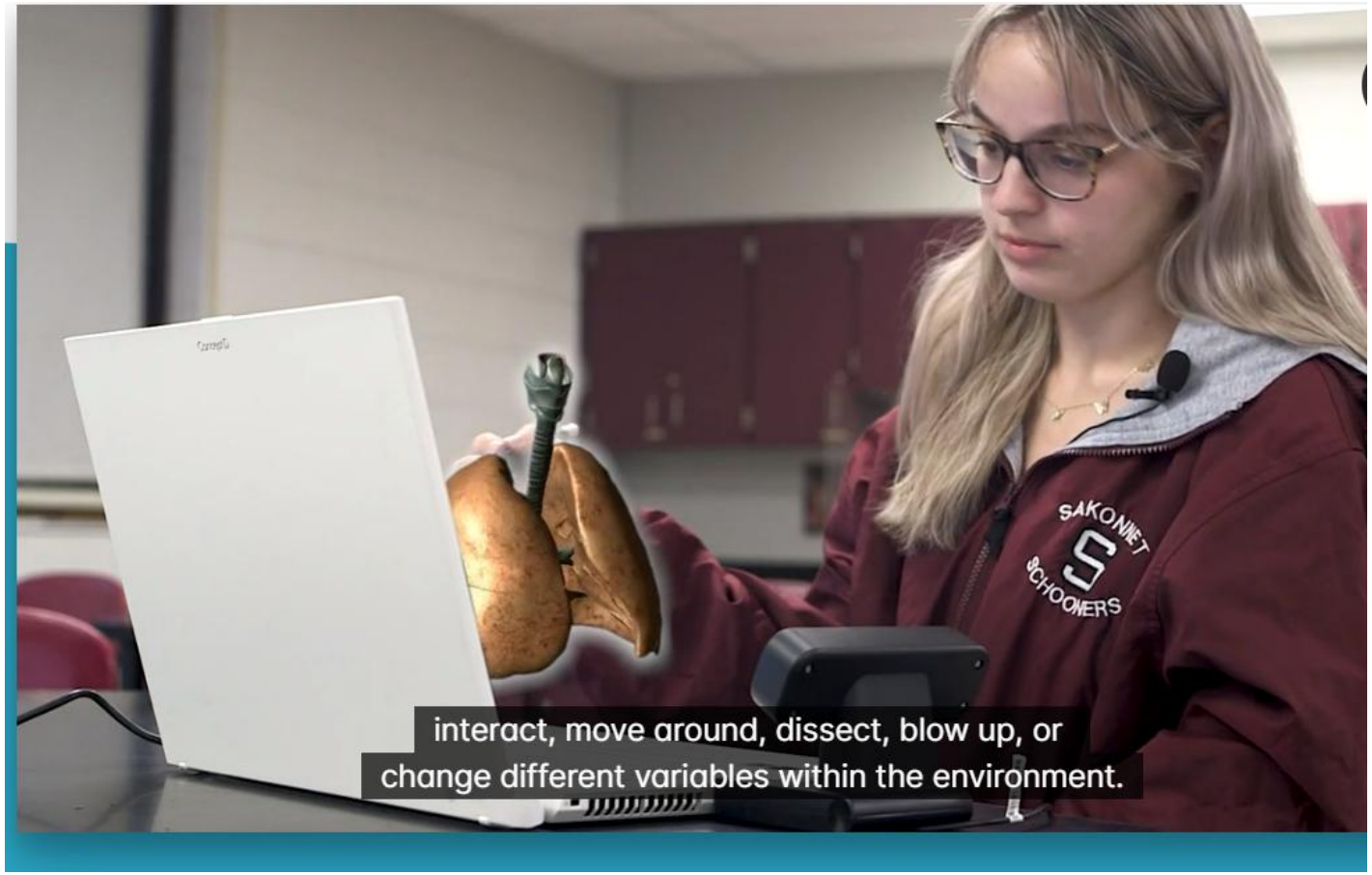
1. ADALM 1000
2. ADALM 2000
3. ADALP2000
4. ADALM PLUTO





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

https://zspace.com/



Learning subjects faster

AR-VR Lab

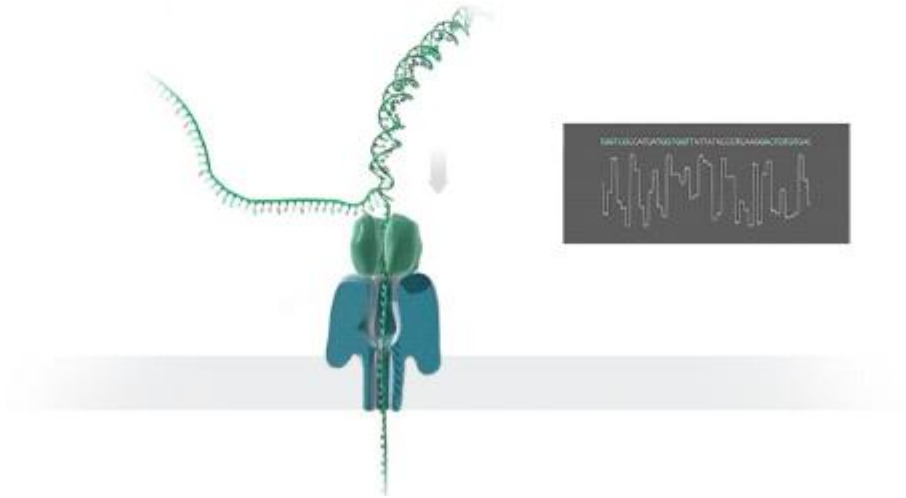
Suitable for many biological , medical and Engineering subjects

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(Quantum Technologies)
AI & DS(Bio-Technology)
AI & DS(Agriculture and Robotics)