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Add- 21/B, Om Swati Manor Chs, J.K. Sawant Marg, Opp. Shivaji Natyamandir, Behind Cambridge Showroom, Dadar (West) Mumbai – 400028
Con.- 09820971345, 9619071345, 9223209699
G-mail-lakshyaacademymumbai@gmail.com

Page 03 : Prelims Exam

In a significant move for global digital diplomacy, Swiss President Guy Parmelin announced that Geneva will host the 2027 AI Impact Summit. This announcement, made during the 2026 AI Impact Summit in New Delhi, underlines Switzerland's ambition to become a central hub for artificial intelligence (AI) governance. The summit aims to prevent the concentration of AI power within a few "big powers" (the U.S. and China) and focuses on establishing international legal frameworks for AI.

Switzerland's President announces Geneva as host of 2027 AI Impact Summit

The Hindu Bureau
NEW DELHI

The Artificial Intelligence (AI) Impact Summit in 2027 will be held in Geneva, Switzerland's President Guy Parmelin said here on Thursday, making a pitch for smaller countries to "come together" to ensure good governance of AI development, so it is not held in the hands of a few "big powers".

Mr. Parmelin, who also met with Prime Minister Narendra Modi for bilateral talks on Thursday on the sidelines of the AI summit here, said they had discussed cooperating in innovation on artificial intelligence, multilateral cooperation, and trade ties after the conclusion of the India-EFTA trade agreement in 2024.

"Switzerland is looking forward to hosting the 2027 AI Summit in Geneva – and to working with the subsequent incoming host of the 2028 AI Summit, the United Arab Emirates, as partner for the Geneva Summit," Mr. Parmelin told presspersons at Switzerland's "Country Pavilion" at the Bharat Mandapam complex after the plenary session. "It will also consolidate our role as a leading centre for innovation and research in AI," he said adding the next summit would focus on international law aspects of AI.


Guy Parmelin

Asked about the domination of the two big AI players, U.S. and China, who together account for more than 70% of the global AI industry, Mr. Parmelin said smaller countries should "organise" together and build infrastructure, while recognising specific technological breakthroughs in many of the other countries.

"It is very important that we work together so that the [technological future of the world] is not just in a few hands of big powers," Mr. Parmelin said in response to a question from *The Hindu*. "We know some countries have taken a way forward, and it's very important that good governance is brought to everyone. Notably, countries like South Korea, France, Switzerland, need to work together to bring good governance to other countries," he added.

In a statement after his meeting with Mr. Modi, the Ministry of External Affairs said both leaders had discussed the benefits of the Trade and Economic Partnership Agreement (TEPA) between India and the four-nation European Free Trade association (EFTA) for bilateral trade.

"Both sides agreed to further strengthen collaboration in innovation-led growth, joint research, sharing of best practices, and capacity building through training and skill development initiatives," the MEA statement said.

Mr. Modi welcomed plans to hold the Fifth Summit in Switzerland.

Key Highlights of the Announcement

1. Geopolitical Balancing

The "Small Powers" Strategy: President Parmelin emphasized that smaller, technologically advanced nations like Switzerland, South Korea, and France must collaborate to ensure **good governance**.

Decentralizing AI Control: With the U.S. and China currently controlling over **70% of the global AI industry**, Switzerland is positioning itself as a neutral ground to prevent a digital duopoly.

2. Focus on Governance and Law

The 2027 Summit will specifically prioritize **international law** and **fundamental rights** regarding the deployment of AI.

Human-Centric Approach: The objective is to move beyond purely economic interests toward a rules-based international order for digital technologies.

3. India-Switzerland Strategic Synergy

Trade and Innovation: The talks between PM Modi and President Parmelin highlighted the **India-EFTA Trade and Economic Partnership Agreement (TEPA)**, which became operational in late 2025.

Collaborative Research: Both nations agreed to strengthen joint research, capacity building, and skill development, leveraging Switzerland's innovation and India's vast digital talent pool.

Conclusion

The selection of Geneva for the 2027 AI Impact Summit represents a shift toward the **multilateralization of technology**. For India, this partnership with Switzerland (and the EFTA) provides a strategic hedge against tech-monopolies while securing long-term investments through the TEPA. By focusing on international law, the 2027 summit will likely set the stage for a "Global Code of Conduct" for AI, ensuring that the benefits of the Fourth Industrial Revolution are shared equitably across the globe.

UPSC Prelims Exam Practice Question

Ques: Which of the following best describes the term "International Geneva"?

A) A military alliance led by Switzerland

B) A cluster of international organizations and UN agencies headquartered in Geneva

C) A free trade bloc in Europe

D) A global financial regulatory mechanism

Ans : B

Page 07 : GS II : Social Justice / Prelims Exam

The "begin-early" mantra in dentistry represents a fundamental shift from reactive to **preventive healthcare**. For a country like India, where dental caries (tooth decay) remains the most common chronic childhood disease, this strategy is not just a medical choice but a vital public health necessity.

Why begin-early mantra is a key prevention strategy in dentistry

Tooth decay is still the most common chronic disease in children worldwide. It's preventable, yet it causes missed school days, pain, and infections; early, simple actions that prevent oral health issues can spare children from trauma, save families money, and build a foundation for lifelong health

Catch them young: In a diverse country like India, some simple, early steps can bridge gaps that fancy clinics can not always reach. GETTY IMAGES

THE GIST

- Tooth decay does not have to be a normal part of childhood. Most of the time, if we get ahead of the problem, cavities do not stand a chance
- Research also keeps finding links between chronic mouth inflammation and other, later, health issues. The mouth is the front door to the body's health. That is why this is about equity, education, and access
- By focusing on prevention, we're not just fixing problems — we're preventing the fear and the financial strain that comes with them

Sowjanya Gumukula

I used to break my heart a little, when parents would bring in their child for the first time to a dentist, usually because of an emergency – a swollen cheek, a visible hole in a tooth, tears of pain. The child's first memory of a dental clinic, therefore, was fear, bright lights, and the sound of a drill. It is how a lot of us grew up thinking dentistry worked: you wait until it hurts, then you fix it. Thankfully, that script is being rewritten.

Getting ahead

In paediatric dentistry today, a quiet revolution is underway. We're realising that waiting for disease to announce itself is a losing battle. Tooth decay doesn't have to be a normal part of childhood. Most of the time, if we get ahead of it, cavities don't stand a chance. We're shifting our energy from repair to prevention, and, honestly, it feels like a win for everyone: from fix it to fit-in.

Remember your first dental visit? Mine was at five, and I had three cavities. That was pretty standard back then. But by five, a lot of damage can already be done. The advice now is to see a child by their first birthday. I know – it sounds wild. What are we going to do, check gums? Talk about baby food? Exactly. That first visit is a "well-baby check-up" for the mouth. We look at those few new teeth, chat about feeding that bedtime bottle can be tricky), show parents how to clean tiny gums, and demystify fluoride. It's not scary – it's a conversation. We might suggest swapping out sticky dried fruit for cheese, or perfecting the angle of a toothbrush. These tiny tweaks? They build a fortress against future problems. This changes the whole story. Dentistry stops being the "scary place you go to when things go wrong" and becomes part of regular health maintenance, like a vaccination.

It's about building trust from the ground up. These gentle, early visits create a powerful new memory: the dentist's office is a normal place. That alone can prevent a lifetime of white-knuckling in the dental chair.

Low tech tools

Our best tools are surprisingly low-tech. The most effective parts of prevention aren't fancy. They're simple, almost humble. Take Silver Diamine Fluoride (SDF). It's a liquid we paint on a soft, early cavity. No needle, no drill. It stops the decay in its tracks. Does it stain the spot? Yes, it turns it dark. But for a terrified toddler, or for a family in a rural community without easy clinic access, it's a miracle. It's a pause button that prevents immense pain.

Fluoride varnish is another superstar. It's a quick paint-on treatment at check-ups that strengthens enamel. School programmes love it because it reaches children who might not see a dentist otherwise. And then there's the toothbrush. It sounds obvious, but it's the

Gentle, early visits create a powerful new memory for children: the dentist's office is a normal place. That alone can prevent a lifetime of white-knuckling in the dental chair

MVP. Using a rice-grain smear of fluoride toothpaste for toddlers, and actually watching them brush (not just hearing the water run) until they're about eight, cuts cavity risk dramatically. This daily, sometimes messy, two-minute habit is the real foundation.

Why this matters

Tooth decay is still the most common chronic disease in children worldwide. It's preventable, yet it causes missed school days, pain, and infections. Where prevention programmes are in place, cavity rates drop. It's that simple.

The money angle is simple, too. Preventing a cavity costs a fraction of fixing one. It saves families from emergency costs, lost work days, and the emotional toll of seeing their child in pain. But it's bigger than teeth. A child with a toothache can't eat well, sleep well, or focus in school. Their whole world shrinks.

Research also keeps finding links between chronic mouth inflammation and other, later, health issues. The mouth is the front door to the body's health.

That is why this is about equity, education, and access. School nurses and community health workers are crucial partners. In a diverse country like India, these simple, early steps can bridge gaps that fancy clinics can't always reach.

This shift is changing my job description. I spend more time teaching and coaching than drilling. I collaborate with paediatricians – because if a child is at the doctor for a checkup, why not quickly check their mouth, too? We're teaming up with teachers and local leaders to make oral health a normal part of the conversation about a child's well-being.

A hopeful look forward

The bottom line is getting clearer: we can prevent most oral health problems. Early, simple actions can spare children from trauma, save families money, and build a foundation for lifelong health. By focusing on prevention, we're not just fixing problems – we're preventing the fear and the financial strain that comes with them. We're giving children the gift of a confident smile and a healthier start.

In the end, it's not just about saving teeth. It's about saving children from ever needing us to fix them in the first place. And that's a future worth smiling about.

Dr. Sowjanya Gunkula is a U.S.-licensed dentist with international training who focuses on preventive and evidence-based oral healthcare and contributes to advancing community and public health dentistry. sowji.gunkula@gmail.com)

Why "Begin-Early" is a Critical Prevention Strategy

1. Breaking the "Cycle of Fear" (Psychological Impact)

Traditionally, a child's first dental visit occurs during an emergency (pain or swelling). This associates the dentist with trauma and pain.

The Shift: Early visits (by age one) are "well-baby checks" that focus on conversation and simple cleaning.

Result: Building trust early prevents **dental anxiety**, ensuring the child maintains oral hygiene habits into adulthood.

2. High-Impact, Low-Tech Interventions

Preventive dentistry utilizes cost-effective tools that are highly suitable for India's diverse socio-economic landscape:

Silver Diamine Fluoride (SDF): A "miracle liquid" that stops decay without needles or drills. While it stains the decay black, it acts as a "pause button" for families with limited access to advanced clinics.

Fluoride Varnishes: Simple paint-on treatments that strengthen enamel, ideal for large-scale school health programs.

The "Rice-Grain" Rule: Using a tiny smear of fluoride toothpaste from infancy builds a foundation for enamel health at near-zero cost.

3. Socio-Economic Significance

Untreated dental issues are a "silent epidemic" that hampers national productivity:

Educational Impact: Toothaches are a leading cause of school absenteeism and poor concentration.

Economic Equity: Prevention costs a fraction of restorative treatment (fillings, root canals). For low-income families, early intervention prevents catastrophic out-of-pocket expenditure.

The "Front Door" Theory: Research links chronic oral inflammation to systemic issues like diabetes and heart disease later in life.

India's Policy Framework & Challenges

In the Indian context, the "begin-early" mantra aligns with several government initiatives:

National Oral Health Programme (NOHP): Aimed at reducing the morbidity from oral diseases through integrated preventive services.

Rashtriya Bal Swasthya Karyakram (RBSK): Includes screening for dental conditions among children (0–18 years) to ensure early intervention through District Early Intervention Centres (DEICs).

The Challenge of Access: While "fancy clinics" are limited to urban hubs, preventive strategies can be executed by **ASHAs, ANMs, and school nurses**, bridging the rural-urban healthcare gap.

Conclusion

The shift from "repair" to "prevention" is a hallmark of an evolving healthcare system. By adopting the "begin-early" approach, India can transform oral health from a luxury service into a basic right. This strategy reduces the disease burden, saves family resources, and ensures that a child's first memory of healthcare is one of care, not pain.

UPSC Prelims Exam Practice Question

Ques: The "Rice-Grain Rule" in preventive dentistry refers to:

A) Daily consumption of calcium-rich rice varieties

B) Application of fluoride gel once a year

C) Using a smear of fluoride toothpaste for infants

D) Restricting sugar intake in early childhood

Ans: c)

UPSC Mains Exam Practice Question

Ques: Oral health inequalities reflect broader socio-economic disparities in India. Examine how early preventive strategies can promote health equity. (**150 Words)**

Page 08 : GS II : Governance / Prelims Exam

In February 2026, the Supreme Court of India referred petitions challenging the Digital Personal Data Protection (DPDP) Act, 2023 to a Constitution Bench. The central issue is the amendment to Section 8(1)(j) of the RTI Act, 2005, which critics argue effectively converts the "Right to Information" into a "Right to Deny Information."

1. The Core Legal Shift

The DPDP Act, via Section 44(3), has fundamentally altered the criteria for withholding "personal information":

Feature	Original RTI Act (2005)	Amended RTI Act (DPDP 2023)
Scope of Denial	Only if information has no relation to public activity OR causes unwarranted invasion of privacy.	Blanket ban on any information that "relates to personal information."
Public Interest Override	PIOs could disclose data if the larger public interest justified it.	Removed. No override exists for personal information anymore.
The "Acid Test"	Information that cannot be denied to Parliament cannot be denied to a citizen.	This safeguard has been effectively bypassed.

2. Major Concerns for Governance and Democracy

The amendment creates several systemic risks that the Constitution Bench will likely examine:

- **Information Asymmetry:** While Section 7 of the DPDP Act allows the State to process citizen data without consent for "legitimate uses," the RTI amendment prevents citizens from accessing data about state officials. This creates a one-way mirror where the state monitors citizens, but citizens cannot scrutinize the state.

Privacy, transparency

There must be no information asymmetry between state and citizens

On Monday, the Supreme Court of India referred a series of petitions challenging the amendment to Section 8(1)(j) of the Right to Information (RTI) Act by Section 44(3) of the Digital Personal Data Protection (DPDP) Act, 2023, to a Constitution Bench, recognising its "constitutional sensitivity". The Chief Justice of India even remarked that the Court might "have to lay down what is meant by 'personal information'". The RTI Act, 2005 was enacted to create an informed citizenry and ensure state accountability, which is vital for a democracy. Over two decades later, the DPDP Act has delivered a body blow by diluting one of its foundational sections. Section 8(1)(j) originally allowed the withholding of personal information only if it had no relationship to any public activity or interest, or if its disclosure resulted in an unwarranted invasion of privacy. Crucially, the section included a "public interest override" as an integral feature of the 2005 Act, permitting disclosure if a Public Information Officer was satisfied that the larger public interest justified it. The DPDP amendment removes this override and prohibits the disclosure of "any information which relates to personal information", amounting to a blanket ban. This enables rejecting requests concerning officials, procurement records, audit reports or public spending. In its campaign for the RTI, the Internet Freedom Foundation has highlighted a "legitimate uses" paradox here: while Section 7 of the DPDP Act allows the state to process personal data without consent, the RTI amendment prevents citizens from using similar principles to seek transparency from the state. Thus, while the government can monitor the citizen, the citizen is denied the ability to scrutinise the government.

This amendment also creates a severe "chilling effect" on the press. As argued in one of the writ petitions by The Reporters' Collective, journalists could be classified as "data fiduciaries" under the DPDP Act and its Rules when collecting information for investigative reports. Non-compliance with the Act can attract fines up to ₹250 crore. Such a legal framework threatens reducing journalism to just publishing government releases. It is ironic that the DPDP Act provides exemptions to startups but omits similar protections for journalism. This is in sharp contrast with the European Union's General Data Protection Regulation (GDPR), which balances privacy and transparency to ensure accountability. The Constitution Bench must refer to the judgment, *Central Public Information Officer* (2019), which held that personal information should remain private unless disclosure is necessary for the larger public interest. It is known that the RTI has significantly reduced state-citizen (this includes the poor) information asymmetry over two decades. Ensuring its survival is essential for a responsive government.

Shielding Corruption: Previously, RTI was used to verify the educational qualifications, assets, and service records of public officials. Under the new "blanket ban," such requests can be rejected as "personal," potentially shielding nepotism and financial irregularities.

Chilling Effect on the Press: Journalists, classified as "data fiduciaries," face fines up to **₹250 crore** for processing personal data without consent. Without a "journalistic exemption" (similar to the EU's GDPR), investigative reporting on public figures becomes legally hazardous.

3. Judicial Precedents and the Proportionality Test

The Constitution Bench will evaluate the amendment against the **Puttaswamy (2017)** judgment, which established privacy as a fundamental right but insisted on a **Three-Pronged Test** for any restriction:

Legality: The restriction must be backed by law.

Need: It must serve a legitimate state aim.

Proportionality: There must be a rational nexus between the objects and the means adopted, ensuring the least restrictive measures are used.

The Court will also revisit the **CPIO, Supreme Court v. Subhash Chandra Agarwal (2019)** ruling, which held that transparency and privacy are not in opposition but are both facets of public interest that must be balanced.

Conclusion

The referral to a Constitution Bench signifies that the "constitutional sensitivity" of this clash cannot be resolved by mere statutory interpretation. The final verdict will define the character of Indian democracy in the digital age—determining whether privacy will be used as a shield for state opacity or if the "informed citizenry" envisioned in 2005 remains the ultimate check on power.

UPSC Prelims Exam Practice Question

Ques: The "Acid Test" principle under the RTI framework implies that:

A) Information affecting national security can never be disclosed.

B) Information denied to Parliament can also be denied to citizens.

C) Information that cannot be denied to Parliament cannot be denied to a citizen.

D) All personal information of public officials must be disclosed.

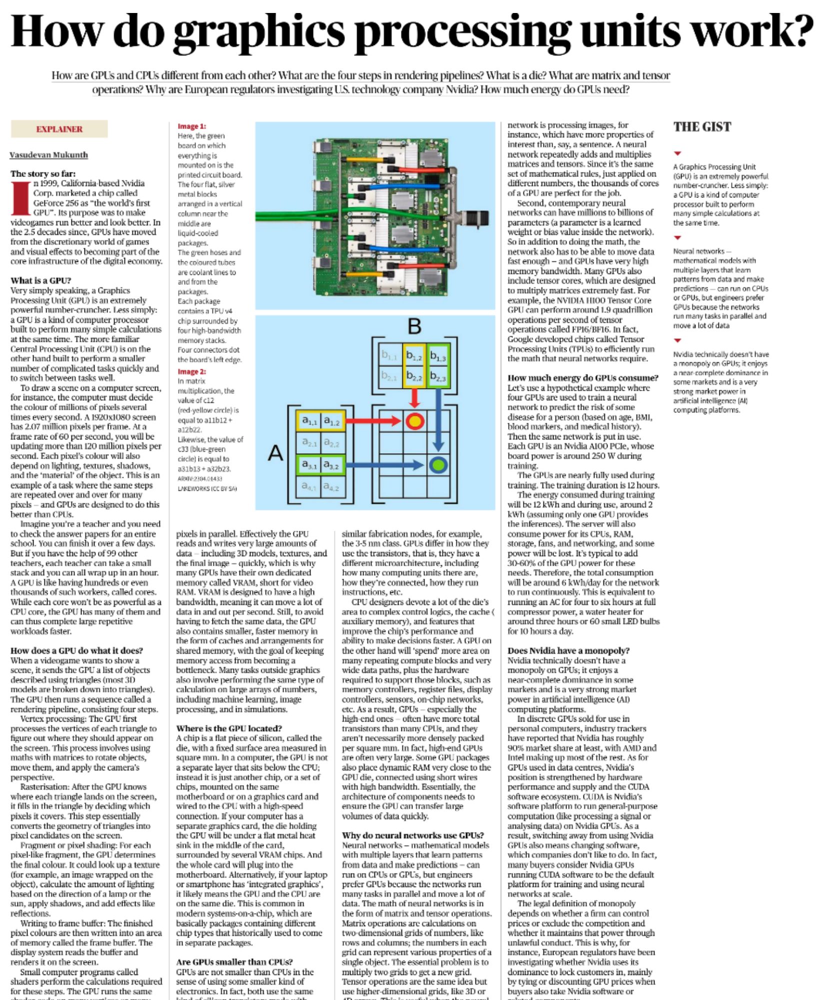
Ans: C)

UPSC Mains Exam Practice Question

Ques: The amendment to Section 8(1)(j) of the RTI Act through the DPDP Act, 2023 has reignited the debate between transparency and privacy. Critically examine. **(150 Words)**

Page 10 : GS III : Science and Tech / Prelims Exam

Since the launch of the Nvidia GeForce 256 in 1999, Graphics Processing Units (GPUs) have evolved from gaming accelerators to the backbone of artificial intelligence (AI), high-performance computing, and the digital economy. Today, Nvidia dominates the global AI hardware ecosystem. However, its growing market power has attracted scrutiny from European regulators, raising questions about competition, energy use, and technological sovereignty.



How do graphics processing units work?

How are GPUs and CPUs different from each other? What are the four steps in rendering pipelines? What is a die? What are matrix and tensor operations? Why are European regulators investigating U.S. technology company Nvidia? How much energy do GPUs need?

EXPLAINER

Vasudevan Mukunth

The story so far:

In 1999, California-based Nvidia Corp. marketed a chip called GeForce 256 as "the world's first GPU". Its purpose was to make videogames run better and look better. In the 2.5 decades since, GPUs have moved from the discretionary world of games and visual effects to becoming part of the core infrastructure of the digital economy.

What is a GPU?

Very simply speaking, a Graphics Processing Unit (GPU) is an extremely powerful number-cruncher. Less simply: a GPU is a kind of computer processor built to perform many simple calculations at the same time. The more familiar Central Processing Unit (CPU) is on the other hand built to perform a smaller number of complicated tasks quickly and to switch between tasks well.

To draw a scene on a computer screen, for instance, the computer must decide the colour of millions of pixels several times every second. A 1920x1080 screen has 2.07 million pixels per frame. At a frame rate of 60 per second, you will be updating more than 120 million pixels per second. Each pixel's colour will also depend on lighting, textures, shadows, and the 'material' of the object. This is an example of a task where the same steps are repeated over and over for many pixels – and GPUs are designed to do this better than CPUs.

Imagine you're a teacher and you need to check the answer papers for an entire school. You can finish it over a few days. But if you have the help of 99 other teachers, each teacher can take a small stack and you can all wrap up in an hour. A GPU is like having hundreds or even thousands of such workers, called cores. While each core won't be as powerful as a CPU core, the GPU has many of them and can thus complete large repetitive workloads faster.

How does a GPU do what it does?

When a videogame wants to show a scene, it sends the GPU a list of objects described using triangles (most 3D models are broken down into triangles). The GPU then runs a sequence called a rendering pipeline, consisting four steps.

Vertex processing: The GPU first processes the vertices of each triangle to figure out where they should appear on the screen. This process involves using maths with matrices to rotate objects, move them, and apply the camera's perspective.

Rasterisation: After the GPU knows where each triangle lands on the screen, it fills in the triangle by deciding which pixels it covers. This step essentially converts the geometry of triangles into pixel candidates on the screen.

Fragment or pixel shading: For each pixel-like fragment, the GPU determines the final colour. It could look up a texture (for example, an image wrapped on the object), calculate the amount of lighting based on the direction of a lamp or the sun, apply shadows, and add effects like reflections.

Writing to frame buffer: The finished pixel colours are then written into an area of memory called the frame buffer. The display system reads the buffer and renders it on the screen.

Small computer programs called shaders perform the calculations required for these steps. The GPU runs the same shader code on many vertices or many pixels in parallel. Effectively the GPU reads and writes very large amounts of data – including 3D models, textures, and the final image – quickly, which is why many GPUs have their own dedicated memory called VRAM, short for video RAM. VRAM is designed to have a high bandwidth, meaning it can move a lot of data in and out per second. Still, to avoid having to fetch the same data, the GPU also contains smaller, faster memory in the form of caches and arrangements for shared memory, with the goal of keeping memory access from becoming a bottleneck. Many tasks outside graphics also involve performing the same type of calculation on large arrays of numbers, including machine learning, image processing, and in simulations.

Image 1: Here, the green board on which everything is mounted on is the printed circuit board. The four flat, silver metal blocks arranged in a vertical column near the middle are liquid-cooled packages. The green hoses and the coloured tubes are coolant lines to and from the packages. Each package contains a TPU v4 chip surrounded by four high-bandwidth memory stacks. Four connectors dot the board's left edge.

Image 2: In matrix multiplication, the value of c12 (red-yellow circle) is equal to a11b12 + a12b22. Likewise, the value of c33 (blue-green circle) is equal to a31b13 + a32b23. ARXIV:2304.01433 LAKEWORKS (CC BY SA)

Where is the GPU located?

A chip is a flat piece of silicon, called the die, with a fixed surface area measured in square mm. In a computer, the GPU is not a separate layer that sits below the CPU; instead it is just another chip, or a set of chips, mounted on the same motherboard or on a graphics card and wired to the CPU with a high-speed connection. If your computer has a separate graphics card, the die holding the GPU will be under a flat metal heat sink in the middle of the card, surrounded by several VRAM chips. And the whole card will plug into the motherboard. Alternatively, if your laptop or smartphone has 'integrated graphics', it likely means the GPU and the CPU are on the same die. This is common in modern systems-on-a-chip, which are basically packages containing different chip types that historically used to come in separate packages.

Are GPUs smaller than CPUs?

GPUs are not smaller than CPUs in the sense of using some smaller kind of electronics. In fact, both use the same kind of silicon transistors made with similar fabrication nodes, for example, the 3-5 nm class. GPUs differ in how they use the transistors, that is, they have a different microarchitecture, including how many computing units there are, how they're connected, how they run instructions, etc.

CPU designers devote a lot of the die's area to complex control logics, the cache (auxiliary memory), and features that improve the chip's performance and ability to make decisions faster. A GPU on the other hand will 'spend' more area on many repeating compute blocks and very wide data paths, plus the hardware required to support those blocks, such as memory controllers, register files, display controllers, sensors, on-chip networks, etc. As a result, GPUs – especially the high-end ones – often have more total transistors than many CPUs, and they aren't necessarily more densely packed per square mm. In fact, high-end GPUs are often very large. Some GPU packages also place dynamic RAM very close to the GPU die, connected using short wires with high bandwidth. Essentially, the architecture of components needs to ensure the GPU can transfer large volumes of data quickly.

Why do neural networks use GPUs?

Neural networks – mathematical models with multiple layers that learn patterns from data and make predictions – can run on CPUs or GPUs, but engineers prefer GPUs because the networks run many tasks in parallel and move a lot of data. The math of neural networks is in the form of matrix and tensor operations. Matrix operations are calculations on two-dimensional grids of numbers, like rows and columns; the numbers in each grid can represent various properties of a single object. The essential problem is to multiply two grids to get a new grid. Tensor operations are the same idea but use higher-dimensional grids, like 3D or 4D arrays. This is useful when the neural network is processing images, for instance, which have more properties of interest than, say, a sentence. A neural network repeatedly adds and multiplies matrices and tensors. Since it's the same set of mathematical rules, just applied on different numbers, the thousands of cores of a GPU are perfect for the job.

Second, contemporary neural networks can have millions to billions of parameters (a parameter is a learned weight or bias value inside the network). So in addition to doing the math, the network also has to be able to move data fast enough – and GPUs have very high memory bandwidth. Many GPUs also include tensor cores, which are designed to multiply matrices extremely fast. For example, the NVIDIA H100 Tensor Core GPU can perform around 1.9 quadrillion operations per second of tensor operations called FP16/BF16. In fact, Google developed chips called Tensor Processing Units (TPUs) to efficiently run the math that neural networks require.

How much energy do GPUs consume?

Let's use a hypothetical example where four GPUs are used to train a neural network to predict the risk of some disease for a person (based on age, BMI, blood markers, and medical history). Then the same network is put in use. Each GPU is an Nvidia A100 PCIe, whose board power is around 250 W during training.

The GPUs are nearly fully used during training. The training duration is 12 hours.

The energy consumed during training will be 12 kWh and during use, around 2 kWh (assuming only one GPU provides the inferences). The server will also consume power for its CPUs, RAM, storage, fans, and networking, and some power will be lost. It's typical to add 30-60% of the GPU power for these needs. Therefore, the total consumption will be around 6 kWh/day for the network to run continuously. This is equivalent to running an AC for four to six hours at full compressor power, a water heater for around three hours or 60 small LED bulbs for 10 hours a day.

Does Nvidia have a monopoly?

Nvidia technically doesn't have a monopoly on GPUs; it enjoys a near-complete dominance in some markets and is a very strong market power in artificial intelligence (AI) computing platforms.

In discrete GPUs sold for use in personal computers, industry trackers have reported that Nvidia has roughly 90% market share at least, with AMD and Intel making up most of the rest. As for GPUs used in data centres, Nvidia's position is strengthened by hardware performance and supply and the CUDA software ecosystem. CUDA is Nvidia's software platform to run general-purpose computation (like processing a signal or analysing data) on Nvidia GPUs. As a result, switching away from using Nvidia GPUs also means changing software, which companies don't like to do. In fact, many buyers consider Nvidia GPUs running CUDA software to be the default platform for training and using neural networks at scale.

The legal definition of monopoly depends on whether a firm can control prices or exclude the competition and whether it maintains that power through unlawful conduct. This is why, for instance, European regulators have been investigating whether Nvidia uses its dominance to lock customers in, mainly by tying or discounting GPU prices when buyers also take Nvidia software or related components.

THE GIST

- A Graphics Processing Unit (GPU) is an extremely powerful number-cruncher. Less simply: a GPU is a kind of computer processor built to perform many simple calculations at the same time.
- Neural networks — mathematical models with multiple layers that learn patterns from data and make predictions — can run on CPUs or GPUs, but engineers prefer GPUs because the networks run many tasks in parallel and move a lot of data
- Nvidia technically doesn't have a monopoly on GPUs; it enjoys a near-complete dominance in some markets and is a very strong market power in artificial intelligence (AI) computing platforms.

GPU vs. CPU: The Core Logic

While both are processors, they are built for fundamentally different tasks.

CPU (Central Processing Unit): Designed for **sequential processing** and complex logic. It acts as the "manager" of the computer, handling a few complicated tasks at once and switching between them quickly (low latency).

GPU (Graphics Processing Unit): Designed for **parallel processing**. It is an extremely powerful "number-cruncher" with thousands of smaller, simpler cores that handle many repetitive calculations simultaneously (high throughput).

Analogy: A CPU is like a highly skilled professor who can solve a complex calculus problem. A GPU is like a stadium full of students who can each do one simple multiplication at the same time. The stadium of students will finish a massive 1,000-page math sheet much faster than the professor.

The 4 Steps of the Rendering Pipeline

When a GPU draws a 3D scene, it follows a sequence called the **rendering pipeline**:

Vertex Processing: The GPU calculates the 3D position of the "corners" (vertices) of objects. It uses matrix math to rotate, scale, and move objects according to the camera's view.

Rasterization: The 3D shapes are converted into 2D "fragments" or potential pixels. The GPU determines which pixels on your screen are covered by which triangles.

Fragment (Pixel) Shading: This is where the visual magic happens. The GPU calculates the final color of each pixel by applying textures (images), lighting, shadows, and reflections.

Writing to Frame Buffer: The finished pixel data is stored in memory (the frame buffer) and sent to your display to be shown on screen.

Key Terms: Die, Matrices, and Tensors

What is a Die? A **die** is the actual piece of silicon inside a computer chip. It is a flat, tiny rectangle where billions of transistors are etched. If you open a processor, the die is the "brain" under the metal heat spreader.

Matrix and Tensor Operations: In AI and graphics, data is stored in grids:

Matrix: A 2D grid of numbers (rows and columns). **Matrix multiplication** is the primary math used to move objects in games or process data in AI.

Tensor: A generalization of a matrix into **higher dimensions** (3D, 4D, etc.). For example, a color image is a 3D tensor: height, width, and three color channels (Red, Green, Blue).

Why are European Regulators Investigating Nvidia?

European (and French) regulators are investigating Nvidia for potential **antitrust violations** and anti-competitive practices. The main concerns are:

Abuse of Dominance: Nvidia holds a near-monopoly in AI chips (80-90% market share). Regulators are checking if they use this power to "lock in" customers.

Bundling: Investigating whether Nvidia forces customers to buy their networking equipment or software (CUDA) to get access to their highly sought-after GPUs.

Preferential Treatment: Checking if Nvidia penalizes customers who try to use chips from competitors like AMD or Intel.

How Much Energy Do GPUs Need?

Modern high-end GPUs are extremely power-hungry due to the sheer number of calculations they perform.

Nvidia A100: Uses about **250–400 Watts**.

Nvidia H100: Can draw up to **700 Watts**—nearly double its predecessor.

Context: Training a large AI model on thousands of these GPUs can consume as much electricity as a small city. For a single high-end server running 24/7, the energy use can be equivalent to running several home air conditioners simultaneously.

Conclusion

GPUs have evolved from simple "game enhancers" to the backbone of the global digital economy and AI. While their parallel architecture makes them incredibly efficient for math-heavy tasks, their massive energy consumption and Nvidia's market dominance have turned them into a focal point for environmental and regulatory scrutiny.

UPSC Prelims Exam Practice Question

Ques: Why are European regulators investigating Nvidia?

A) For environmental violations in semiconductor fabrication

B) For alleged anti-competitive practices linked to bundling hardware and software
C) For violating data protection regulations
D) For export control violations
Ans: c)

UPSC Mains Exam Practice Question

Ques: Discuss the implications of Nvidia's dominance in AI hardware for global competition law and technological sovereignty. **(250 words)**

In response to the protectionist "America First" policies and significant tariff pressures from the Trump administration, Beijing has launched a sophisticated, long-term strategy to "reverse-engineer" U.S. trade containment. By pursuing approximately 20 new free-trade agreements (FTAs) and deepening its integration into global supply chains, China aims to transition from a target of U.S. pressure to the indispensable hub of a new, multilateral trade order.

How China plans to dominate global trade long after Trump leaves office

Beijing pursues 20 free-trade agreements amid U.S. tariffs; China aims to embed more deeply in global trade to counter U.S. pressure; *Reuters* review of Chinese policy papers shows systematic bid to neutralise U.S. containment; China's huge trade surplus complicates its global ambitions

INSIGHT

Reuters
BEIJING

China sees an opening to turn President Donald Trump's tariffs to its advantage by reshaping global trade in ways that would insulate its $19 trillion economy from U.S. pressure far into the future. Beijing is exploiting the uncertainty created by Trump to try to stitch China's vast manufacturing base into the world's biggest economic blocs, including the European Union, Gulf States and a trans-Pacific trade pact, a *Reuters* examination found. The push involves accelerating efforts to clinch some 20 trade deals in total, many years in the making, despite widespread concerns about China's overproduction, uneven market access and soft domestic demand.

A *Reuters* review of 100 Chinese-language articles by state-backed trade scholars written since 2017 reveals a systematic push by China's policy advisers to reverse-engineer U.S. trade policy and neutralise Washington's containment strategy. China is now putting that blueprint into action. The deal reached with Canada during Prime Minister Mark Carney's January visit to Beijing – which slashes tariffs on Chinese electric vehicles – was the first of many aimed at breaking U.S. leverage, according to interviews with 10 people, including Chinese officials and trade diplomats.

"Don't interrupt your opponent when he is making a mistake," said one Chinese official of Trump's disruptive trade agenda.

No sparks: U.S. President Donald Trump and Chinese President Xi Jinping. REUTERS FILE

Trade strategy papers

The review, drawn from over 2,000 trade-strategy papers endorsed by the Chinese Academy of Social Sciences (CASS) and Peking University, which advise top leaders, shows policy insiders broadly accept that painful structural change is a price worth paying for China's long-term dominance of global commerce. The papers' contents are reported here for the first time.

> A *Reuters* review of 100 Chinese-language articles by state-backed trade scholars shows a systematic push by China's policy advisers to neutralise Washington's containment strategy

Upend trade policy

If successful, Beijing could upend more than a decade of U.S. trade policy by placing itself at the heart of a new, China-shaped multilateral order, two Western diplomats said.

"The Chinese have a golden opportunity now," said Alicia Garcia Herrero, senior fellow at the Bruegel think tank.

China's commerce ministry didn't respond to a request for comment about Beijing's strategy.

Asked about China's approach, a U.S. official told *Reuters* it was no surprise that countries with large trade surpluses sought to maintain globalisation.

"President Trump is fixing the problems globalisation caused for the U.S. while other countries are trying to double down on globalisation as free market access to the U.S. goes away," the official said.

Building blocs

The shift in China's tone reflects its calculations. A year ago, Beijing was invoking Mao Zedong and its ability to fend off the West in the Korean War with martial propaganda.

Now, as China prepares to welcome Trump in April, its diplomats are touring the world urging trading partners to join it in defending multilateralism and open trade. In January, China dispatched its top diplomat to tiny Lesotho – which Trump initially hit with a 50% tariff – to pledge development cooperation.

On Saturday, state media said China would implement zero tariffs on imports from 53 African countries. Meanwhile, China is pitching AI-powered customs systems to neighbours and working to retool digital infrastructure that underpin commerce.

The moves underline a goal identified in the policy papers: to embed China so deeply in global trade that partners can't afford to decouple under U.S. pressure. "In countering U.S. strategic competition with China,' anti-decoupling' should become China's primary focus," wrote Ni Feng, fellow at CASS's Institute of American Studies, in 2024. Since 2017, China has been negotiating with countries, including Honduras, Panama, Peru, South Korea and Switzerland.

"We are willing to negotiate bilateral and regional trade and investment agreements with interested countries and regions," commerce ministry spokesperson He Yongqian told *Reuters*. China's foreign minister Wang Yi surprised European negotiators in November by raising the prospect of a free-trade agreement with Brussels during talks with his Estonian counterpart. A month later, Wang pressed the Gulf Cooperation Council to conclude long-running talks on a free-trade agreement. In January, British Prime Minister Keir Starmer agreed with Chinese leader Xi Jinping to launch a feasibility study into a trade-in-services agreement that could reduce barriers for British firms. German Chancellor Friedrich Merz has said he will seek "strategic partnerships" with China during a trip next week.

China's commerce minister Wang Wentao has made joining the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) a priority. The pact has its roots in the U.S.-backed Trans-Pacific Partnership, developed in part to counter China before Washington withdrew in 2017.

But China's huge trade surplus complicates the pitch. Some member countries worry Chinese manufacturers may use improved market access to funnel excess low-cost goods abroad, while China's domestic demand remains sluggish.

Key Pillars of China's Strategy

1. The "Anti-Decoupling" Blueprint

A review of over 2,000 policy papers from institutions like the **Chinese Academy of Social Sciences (CASS)** reveals a shift toward **"anti-decoupling."** The goal is to embed China's $19 trillion economy so deeply into global trade that any U.S.-led effort to isolate Beijing would be too economically painful for partners to follow.

- **Case Study:** The **January 2026 deal with Canada** (under PM Mark Carney), which slashed tariffs on Chinese electric vehicles (EVs), serves as a template for breaking U.S. leverage over traditional allies.

2. Aggressive Multi-Regional Engagement

Beijing is exploiting the vacuum left by U.S. withdrawal from multilateralism:

- **CPTPP Accession:** China is prioritizing entry into the Comprehensive and Progressive Agreement for Trans-Pacific Partnership—a pact originally designed by the U.S. to contain China.

Expanding "Global South" Ties: China has implemented **zero tariffs** on imports from 53 African nations and pledged development cooperation with smaller states like Lesotho to counter U.S. influence.

European & Gulf Outreach: Renewed pushes for FTAs with the **European Union** (strategic partnerships sought by Germany's Friedrich Merz) and the **Gulf Cooperation Council (GCC)**.

3. Technological & Institutional Standards

China is moving beyond mere manufacturing to dominate the "plumbing" of global trade:

AI-Powered Logistics: Piloting AI customs systems (e.g., the "Friendship Port" on the Vietnam border) to slash transit times.

Digital Infrastructure: Retooling digital trade rules through the **Regional Comprehensive Economic Partnership (RCEP)** to set global standards for the 21st century.

Major Challenges & Frictions

Challenge	Impact on Global Trade
Record Trade Surplus	China's **$1.2 trillion surplus (2025)** fuels fears of industrial overcapacity flooding markets with low-cost goods.
Weak Domestic Demand	Trading partners demand China pivot to a **consumption-led economy** to ensure reciprocal trade.
Geopolitical Skepticism	Western nations remain wary of "coercive measures" and the use of trade as a political tool.

Strategic Implications for India

As China embeds itself further into RCEP and CPTPP, India faces a dual challenge:

Manufacturing Competition: Increased Chinese exports to Southeast Asia and Africa may crowd out Indian exports.

Supply Chain Dependence: If China successfully sets global digital and AI trade standards, India may find it harder to negotiate independent terms in the Indo-Pacific.

Conclusion

China's current maneuver is a calculated "long game" that views Trump's disruptive tariffs as a transient obstacle but a "golden opportunity" to rewire global commerce. By fast-tracking 20 trade deals and anchoring itself through digital infrastructure, Beijing seeks to render U.S. containment strategies obsolete. However, its success hinges on whether it can manage its massive trade imbalances and convince a skeptical world that a China-centric order is truly "mutually beneficial."

UPSC Mains Exam Practice Question

Ques: "China's response to U.S. protectionism reflects a structural shift in global trade geopolitics." Examine the key features of China's 'anti-decoupling' strategy and analyse its implications for the global trade order and India.

From Washington to Delhi, the shadow of Epstein

Brinda Karat

is a senior leader of the CPI(M)

The release of documents from the Epstein files has done more than expose the depravity of one man. The documents illuminate the dark truths of a new model of "bonding" between political power, corporates, financial institutions, the wealthy and the influential. Structural class-based bonding is hardly new, nor are criminality and impunity treated as entitlement. But the files show how deep the rot is – the elimination of even the semblance of morality as a reference point in systems devoted to private profit.

Jeffrey Epstein was a paedophile and convicted sex offender, among his many other "qualifications". One would have thought that in any civilised society, such a man would be punished and socially isolated. But in America – a country that seeks to preach democracy to the world – it was precisely these attributes that enabled him to innovate a globalised model of developing business relations that included the sexual exploitation of young women and children. Rich white men in America, Presidents and former Presidents, bankers in Russia and Europe, sheikhs in West Asia, and links in India are all named in the files. It is not that all those named necessarily participated in "bonding" based on sexual criminality. The services offered by Epstein were many and varied, not all sexual. Their crime is that, being in positions of power, their closeness to Epstein normalised his model of bonding.

Complicity and depravity

For many of those named, it involved shared experiences in spaces where minors were trafficked and abused. Participation created mutual dependency, the glue of which was secrecy and complicity. Even a cursory reading of the mail exchanges now flooding the Internet shows the striking intertwining of coded language for sexual depravity with references to business deals, financial transactions, with banks ignoring warning signals, and the gaining of access to political and financial contacts – with Epstein as broker and facilitator. The sexual use of women and children was transactional – building blocks for networks, profit and power. The Epstein files open a window into the ethically bankrupt operations of capitalism.

There may be degrees of culpability. Legal frameworks differentiate between direct participation in crime and abetment. Abetment too has degrees. But for anyone who engaged with Epstein after 2008, a defence based on lack of knowledge simply does not hold. The first complaints against him were made in 2005, when a mother in Palm Beach, Florida, U.S., filed a complaint that he had abused her 14-year-old daughter. Police investigations identified at least a dozen more victims. Instead of decisive action, the Federal government under President Bush accepted a sweetheart non-prosecution deal pushed by Epstein's powerful lawyers. Epstein pleaded guilty to lesser charges of "soliciting a prostitute and a minor" and received a sentence of 13 months, during which he was allowed to leave jail daily to attend his office and return at night. Successive governments, regardless of party, ignored the voices of victims. Epstein continued his activities with impunity.

It was only because of the courage and sustained struggle of the survivors that in July 2019, Epstein was arrested on charges not covered by the 2008 agreement. He died, reportedly by suicide, in August before trial. The emails and documents now released, dating from around 2002 to 2019, provide evidence of those involved. Yet, by redacting names, the Department of Justice under U.S. President Donald Trump has protected the identities of powerful men. Survivors have repeatedly stated that the Trump administration mounted one of the biggest cover-ups in history.

India cannot ignore some of the implications of the Epstein connections

The India angle

It is for the American people to address their institutions. From India, we extend solidarity to the courageous survivors demanding justice and accountability.

But it does not end there.

Two Indian names have surfaced in the mails. The first is industrialist Anil Ambani, known to be close to the leadership of the ruling regime, as evidenced by the official recommendation to have him as the Indian partner in the Rafale deal. The second is Hardeep Puri.

The correspondence between Mr. Ambani and Epstein reflects familiarity and sexualised, demeaning language regarding women. The more consequential exchange concerns political access. Ahead of a proposed visit by India's Prime Minister to Washington, Mr. Ambani wrote: "Leadership would like ur help for me to meet Jared (Mr. Trump's son-in-law) and Bannon asap... likely visit to DC by PM in May to meet Donald... Also assistance on that."

Mr. Ambani represented himself as acting in relation to a prime ministerial visit and sought Epstein's help to arrange meetings with senior U.S. political figures. If authentic – and they have not been denied as fabricated – these emails raise serious governance questions. Why was an Indian businessman invoking "Leadership" in communications with a convicted sex offender? Was he authorised to speak in this manner? Is there any inquiry about these claims?

India's Ministry of External Affairs dismissed references to the Prime Minister in these emails as "trashy ruminations of a convicted criminal". But the issue is not Epstein's credibility. It is Mr. Ambani's words. Why has no action been taken against him? Or is it because he was indeed acting on behalf of the government? The government must answer.

Mr. Puri is now a Union Minister in the Narendra Modi government. The Government strained every nerve to shield him in Parliament, shutting down discussion of the Epstein files. In a press conference, Mr. Puri claimed lack of knowledge of Epstein's activities to justify his mails dating from 2014. Apart from evidence that he met Epstein several times, consider this exchange: "Dear Jeff, seasons greetings. Please let me know when you are back from your exotic island. I would like to come across for a chat..."

And later: "Give me a shout when you are back. And, have fun. Not that you require encouragement from others for that."

Does this signify ignorance?

A questionable defence

In the same press conference, Mr. Puri trivialised Epstein's crimes, stating: "He was convicted for soliciting a prostitute and a woman who was underage. And that's it." Really, Mr. Puri? A woman who was underage? Do you mean a child? And for you that is not reason enough to shun association?

He went further, recounting that "a lady MP" told him others were jealous, to which he replied that if something had happened he would speak. Who was this lady Member of Parliament, party to such misogynism which passes as humour? What does it say about the standards of our Members of Parliament? By his own words, for the Minister, participation in acts on an "exotic island", the notorious site of sexual exploitation, is framed as something to be jealous of. His defence is that he had not done anything to excite such jealousy. These are not semantic slips. They are an example of how rape cultures are strengthened.

It brings disgrace to India to have a Cabinet Minister who wilfully maintained contact with a convicted sex offender and then defends that association. Does his continuation in office signify approval from the Prime Minister?

Parliament was not allowed to discuss the Epstein files. There is no such prohibition on the people of India.

GS Paper II : International Relations

UPSC Mains Practice Question: "The Epstein disclosures highlight the nexus between political power, corporate elites and financial networks in the age of global capitalism." Discuss the governance, ethical and institutional challenges arising from such networks. What lessons can India draw? **(250 Words)**

Context :

The release of the "Epstein Files"—a massive archive of over 3.5 million pages made public by the U.S. Department of Justice in early 2026—has reignited global scrutiny over the intersection of wealth, sex trafficking, and political power. In India, the controversy has taken a sharp political turn following the mention of industrialist Anil Ambani and Union Minister Hardeep Singh Puri in the documents. Brinda Karat, a senior CPI(M) leader, argues that these files expose an "ethically bankrupt" model of capitalist "bonding" that transcends borders, reaching from Washington to Delhi.

Key Highlights of the Analysis

1. The Nature of "Structural Bonding"

Karat highlights that the Epstein case is not merely about individual depravity but a systemic "innovation" in business relations.

- Transactional Power: The files suggest that sexual exploitation was used as a "building block" for elite networks.
- Normalization: By 2008, Epstein's status as a convicted sex offender was public knowledge. Karat argues that any high-profile individual who engaged with him after this point cannot claim ignorance.

2. The "India Angle": Allegations and Evidence

The article focuses on two prominent Indian names found in the email exchanges:

- Anil Ambani: The correspondence allegedly shows Ambani seeking Epstein's help to facilitate meetings with U.S. officials (like Jared Kushner and Steve Bannon) ahead of Prime Minister Modi's 2017 visit. Karat questions why a private businessman was invoking "Leadership" in talks with a convicted criminal.
- Hardeep Singh Puri: The files include emails from Puri (dating back to 2014) where he reportedly used familiar language, such as asking Epstein for a "chat" after his return from his "exotic island."

3. The Government's Defense and Political Fallout

The Indian government and the named individuals have issued strong rebuttals:

- The "Trashy Ruminations" Defense: The Ministry of External Affairs (MEA) dismissed the mentions as the "trashy ruminations of a convicted criminal," arguing that the documents hold no credibility.
- Ministerial Clarification: Hardeep Singh Puri stated his interactions were strictly professional, occurring during his tenure as India's Ambassador to the UN, and were part of institutional delegations (like the IPI).
- Opposition Pressure: The Congress party and other opposition leaders have demanded a formal inquiry, alleging a "cover-up" and questioning if national interests were compromised for personal reputations.

4. Systemic Critiques

From a governance and ethics perspective the issue raises several critical themes:

Lobbying vs. Diplomacy: The role of private industrialists in mediating state-to-state relations.

Corporate Ethics: The moral responsibility of corporations to vet their global associates.

Accountability: The limits of executive privilege when international criminal records are involved.

Conclusion

The "Epstein Files" controversy serves as a stark reminder of the complexities of global elite networks. While the Indian government maintains that the references are baseless fabrications by a criminal, the debate sparked by leaders like Brinda Karat underscores a deeper demand for transparency. The core of the issue is not just the legality of these interactions, but the moral and ethical standards expected of those representing the Indian state on the world stage.