Choose 1 of the given problem statements and prepare the presentation as mentioned in the instructions of the event description.

Structure of Presentation to Submit:

Your submission should include:

1. **Title Slide:** Team name, problem statement, and proposed solution title.
2. **Problem Analysis:** In-depth understanding of the problem and its impact.
3. **Proposed Solution:** Detailed explanation of your idea, including innovation, feasibility, and scalability.
4. **Implementation Plan:** Step-by-step approach to executing your solution.
5. **Impact Assessment:** Expected outcomes, benefits, and potential challenges.
6. **Conclusion:** Summary of your solution and why it's the best approach.
7. **References:** Cite all sources used in your research.

Industry: Agriculture in India

Problem Statement 1:
India loses **16-20% of its perishable produce**, equivalent to ₹92,000 crores annually, due to the lack of proper cold storage infrastructure. According to the National Centre for Cold-Chain Development (NCCD), the country has a shortfall of **over 10 million metric tons of cold storage capacity**, especially for fruits, vegetables, and dairy products. This inefficiency not only results in massive economic losses but also impacts food security and farmer incomes.

Challenges Due to the Problem:

1. **Inadequate Cold Storage Infrastructure:**
    - Most of the existing cold storage facilities are concentrated in a few states like Uttar Pradesh, West Bengal, and Maharashtra, leaving many regions underserved.
    - Over 60% of cold storage units are outdated, resulting in frequent breakdowns and high energy consumption.
2. **High Cost of Establishing Cold Chains:**
    - Setting up a cold storage unit costs between ₹5–₹8 crores per 5,000 metric tons, making it inaccessible to small and marginal farmers.
    - Lack of access to affordable financing and subsidies further discourages investment in cold storage infrastructure.
3. **Post-Harvest Losses and Farmer Distress:**

- Due to the absence of storage facilities, farmers are forced to sell their produce immediately after harvest, often at prices 30-50% below market value.
- Post-harvest losses for perishable crops like tomatoes, onions, and potatoes can reach up to **30% of total production**.

Industry: Cryptography

Problem Statement 2:
With the advent of **quantum computing**, many widely used cryptographic algorithms like RSA, ECC, and Diffie-Hellman are at risk of being rendered obsolete. A study by NIST estimated that a sufficiently powerful quantum computer could break RSA-2048 encryption in **8 hours** using Shor's algorithm. The race for **quantum-resistant cryptographic algorithms** is critical, but adoption remains slow due to technical, operational, and compatibility challenges.

Challenges Due to the Problem:

1. **Lack of Readiness for Quantum-Safe Algorithms:**
   - Many organizations still rely on legacy systems that are not compatible with quantum-resistant cryptographic standards.
   - Transitioning to post-quantum algorithms involves redesigning security protocols, which is both time-consuming and resource-intensive.
2. **Uncertainty in Standardization:**
   - While NIST is in the process of standardizing post-quantum cryptographic algorithms, the lack of finalized standards creates confusion for organizations.
   - Companies face a dilemma between adopting early solutions or waiting for official standards, risking potential security breaches.
3. **Performance Trade-offs:**
   - Quantum-resistant algorithms like lattice-based cryptography require significantly more computational power and memory.
   - These trade-offs can degrade system performance, particularly for low-power devices like IoT sensors or mobile devices.
4. **Economic Barriers to Transition:**
   - The cost of upgrading cryptographic systems to quantum-safe standards is prohibitive for smaller enterprises.
   - Many organizations are hesitant to invest in post-quantum security without immediate threats from quantum computers.

Industry: AI/ML

Problem Statement 3:
Bias in AI models is a critical issue, with **over 65% of AI systems** showing evidence of

discriminatory behavior in tasks like hiring, credit scoring, and facial recognition. A 2021 MIT study found that some facial recognition algorithms had an **error rate of 34.7%** for darker-skinned females compared to 0.8% for lighter-skinned males. These biases arise from unbalanced training datasets, leading to inequitable outcomes and loss of trust in AI systems.

Challenges Due to the Problem:

1. **Data Imbalance in Training Datasets:**
    - Most datasets used to train AI models are skewed towards certain demographics, such as being predominantly white, male, or from urban areas.
    - This results in AI models that fail to generalize across diverse populations, reinforcing systemic inequities.
2. **Lack of Explainability in AI Models:**
    - Many ML models, especially deep learning systems, function as "black boxes," making it difficult to understand why a biased decision was made.
    - The absence of interpretability complicates efforts to diagnose and address the root cause of bias.
3. **Inadequate Testing for Fairness Metrics:**
    - Organizations often prioritize accuracy over fairness during model evaluation.
    - Standard benchmarks do not account for real-world implications of bias, leading to unintentional harm in deployment.
4. **Regulatory and Ethical Challenges:**
    - There is no universal standard for ensuring fairness in AI, and existing laws like GDPR are not comprehensive in addressing algorithmic bias.
    - Companies face legal and reputational risks when biased AI models are deployed, as seen in cases like **Amazon's biased hiring algorithm**.

Industry: EduTech

Problem Statement 4:
In India, **over 50% of students in rural schools** face learning gaps due to a lack of personalized educational content. A 2022 ASER report revealed that **only 20% of students in Grade 5 could read a Grade 2-level text** in rural areas. While EduTech platforms have proliferated, most are designed for students with consistent internet access and devices, excluding those in low-resource settings.

Challenges Due to the Problem:

1. **Digital Divide in Rural Areas:**
    - Around **40% of rural households** lack reliable internet connectivity, limiting access to EduTech platforms.
    - Shared or no access to devices like smartphones or tablets further alienates students from digital learning.

2. **Language and Cultural Barriers:**
    - Most EduTech content is in English or Hindi, while **22 major languages and hundreds of dialects** are spoken in India.
    - Students from regional or tribal communities struggle to grasp content not available in their native language.
3. **One-Size-Fits-All Approach:**
    - Current platforms primarily cater to urban, tech-savvy students and fail to address diverse learning needs.
    - Lack of adaptive learning tools results in slower students being left behind and advanced students remaining unchallenged.

Industry: Healthcare

Problem Statement 5:
India faces a growing burden of **chronic kidney disease (CKD)**, which affects **1 in 10 adults**, with over **200,000 patients requiring dialysis annually**. However, only **10% of these patients have access to regular dialysis** due to high treatment costs, limited dialysis centers (especially in rural areas), and a shortage of trained nephrologists. This gap significantly impacts survival rates and quality of life for CKD patients.

Challenges Due to the Problem:

1. **Limited Dialysis Centers in Rural Areas:**
    - Over **70% of India's population** lives in rural areas, but **80% of dialysis centers** are concentrated in urban regions.
    - This forces patients in rural areas to travel long distances, increasing costs and physical strain, leading to poor treatment adherence.
2. **High Treatment Costs:**
    - Dialysis costs range between **₹2,500–₹5,000 per session**, and patients typically require three sessions a week.
    - For low-income families, this becomes unsustainable, as annual dialysis expenses can exceed **₹5–₹7 lakhs**, excluding other medical costs.
3. **Shortage of Trained Nephrologists and Technicians:**
    - India has only **1 nephrologist per 1.5 lakh population**, far below the global average.
    - Lack of trained technicians for operating dialysis machines results in frequent service disruptions and long wait times.
4. **Inadequate Preventive Care and Early Diagnosis:**
    - CKD often progresses silently, with symptoms becoming noticeable only in advanced stages.
    - A lack of awareness and preventive screening programs means most patients are diagnosed too late to benefit from lifestyle interventions or early treatment.

Industry: FinTech

Problem Statement 6:
High Fraud Rates in Buy Now, Pay Later (BNPL) Services

The **Buy Now, Pay Later (BNPL) market** in India is expected to reach **$40 billion by 2026**, with over **10 million users**already relying on it. However, BNPL services face a growing **fraud problem**, with reports indicating that **20-30% of BNPL defaults** are due to identity theft, synthetic fraud, and first-party fraud. Fraudsters exploit loopholes in digital KYC (Know Your Customer) processes, use stolen credentials, or create fake identities to access credit without repayment. This results in heavy financial losses for BNPL providers and increased risks for merchants.

Challenges Due to the Problem:

1. **Inadequate Identity Verification & KYC Fraud:**
    - Fraudsters use fake or stolen Aadhaar/PAN details to open BNPL accounts.
    - Weak verification methods allow synthetic identities (fake profiles with real credentials) to bypass security.
2. **First-Party Fraud & Friendly Fraud:**
    - Customers intentionally take credit without the intent to repay (first-party fraud).
    - Some users falsely claim they never made a purchase (friendly fraud), leading to disputes and revenue loss.
3. **High Default Rates Affecting BNPL Profitability:**
    - Unlike traditional credit, BNPL has relaxed credit checks, leading to **higher default rates** (BNPL default rates can be 2-3x higher than credit cards).
    - Unpaid loans increase operational costs and risk for FinTech lenders.

Industry: FMCG (Fast-Moving Consumer Goods)

Problem Statement 7:
Inefficient Last-Mile Distribution Leading to Stockouts and Wastage

India's FMCG sector, valued at **$110 billion**, faces significant **last-mile distribution inefficiencies**, leading to **15-20% stockouts** and **10-12% product wastage** annually. Due to unpredictable demand, fragmented retail networks, and poor real-time inventory tracking, retailers often run out of high-demand products while perishable items expire before reaching consumers. These inefficiencies cause **revenue losses of over ₹35,000 crores ($4.2 billion) per year** and weaken brand loyalty.

Challenges Due to the Problem:

1. **Stockouts Causing Revenue Loss & Consumer Dissatisfaction:**
    - Popular products (e.g., packaged snacks, beverages, and personal care items) frequently go out of stock.
    - Retailers lose sales, and consumers switch to competitor brands, reducing brand loyalty.
2. **Wastage of Perishable Goods Due to Poor Inventory Management:**
    - Products with shorter shelf lives (e.g., dairy, bakery, and fresh foods) often expire before reaching customers.
    - Inefficient demand forecasting leads to overstocking, forcing companies to dispose of unsold inventory.
3. **Lack of Real-Time Visibility in the Supply Chain:**
    - Small retailers rely on manual tracking, leading to delays in restocking decisions.
    - Brands struggle to gather real-time sales data, affecting production and distribution planning.
4. **High Distribution Costs & Inefficient Route Planning:**
    - Unoptimized delivery routes increase transportation costs and fuel consumption.
    - Frequent stockouts force retailers to place emergency orders, leading to **higher logistics costs**.

Industry: Chemical Industry

Problem Statement 8:
Hazardous Waste Management & Disposal in Chemical Manufacturing

India's chemical industry, valued at **$220 billion**, generates **7.2 million metric tons** of hazardous waste annually. Improper disposal methods, including unregulated dumping and inadequate treatment facilities, lead to **soil and water contamination**, posing severe environmental and health risks. Studies indicate that **60% of chemical waste** from small and medium enterprises (SMEs) is **either untreated or improperly disposed of**, leading to **groundwater pollution, respiratory diseases, and long-term ecological damage**.

Challenges Due to the Problem:

1. **Lack of Proper Waste Treatment Infrastructure:**
    - Many chemical plants, especially SMEs, lack in-house treatment facilities.
    - Existing hazardous waste processing plants are inadequate or overburdened.
2. **High Costs & Limited Adoption of Sustainable Waste Disposal:**
    - Advanced waste treatment technologies (e.g., incineration, bioremediation) are expensive.
    - Many industries opt for cost-cutting measures, leading to non-compliance with regulations.
3. **Severe Environmental & Health Hazards:**

    - Toxic waste leaks contaminate **rivers and groundwater**, affecting agriculture and drinking water.
    - **Workers and nearby communities** face increased risks of cancer, lung diseases, and neurological disorders.
4. **Regulatory Gaps & Inefficient Monitoring:**
    - Existing environmental laws (e.g., Hazardous Waste Rules, 2016) are difficult to enforce uniformly.
    - Many chemical plants operate without proper audits or monitoring, leading to unchecked pollution.
5. **Recycling & Circular Economy Barriers:**
    - Only **30% of chemical waste** is recovered or recycled due to technological and logistical challenges.
    - Lack of incentives and awareness discourages industries from adopting **waste-to-value** solutions.

Industry: Internet of Things (IoT)

Problem Statement 9:
Security Vulnerabilities in IoT Devices Leading to Cyber Threats

With over **2 billion IoT devices** deployed in India across smart homes, healthcare, manufacturing, and transportation, security threats have escalated. Studies show that **98% of IoT traffic is unencrypted**, making devices vulnerable to cyberattacks like **DDoS (Distributed Denial of Service), ransomware, and data breaches**. Weak authentication, outdated firmware, and insecure communication protocols allow hackers to exploit IoT networks, leading to **financial losses, privacy breaches, and operational disruptions**.

Challenges Due to the Problem:

1. **Lack of Standardized Security Protocols:**
    - Many IoT devices have **weak encryption** or lack security updates.
    - No universal security framework exists, making it hard to enforce industry-wide protection.
2. **Device Hijacking & Botnet Attacks:**
    - Hackers take control of unsecured devices to launch large-scale **DDoS attacks** (e.g., Mirai botnet).
    - Compromised devices can be used for **spying, data theft, or unauthorized remote control**.
3. **Data Privacy Risks & Unauthorized Access:**
    - IoT devices collect massive amounts of **sensitive user data** (e.g., health records, security footage).
    - Poor access controls can lead to **data leaks, identity theft, or surveillance risks**.

4. **Firmware & Software Update Challenges:**
    - Many IoT devices are deployed **without regular security patches**, making them vulnerable over time.
    - Users often neglect firmware updates, leading to outdated and exploitable systems.

Industry: Electric Automobiles

Problem Statement 10:
Battery Degradation & Thermal Management Issues in EVs

India's EV market is projected to reach **$150 billion by 2030**, but **battery degradation** remains a major challenge. Lithium-ion batteries, which power **90% of electric vehicles (EVs)**, degrade over time due to **temperature fluctuations, frequent fast charging, and deep discharge cycles**. Studies show that EV batteries lose **up to 20% capacity within five years**, leading to **reduced driving range, higher replacement costs, and increased e-waste**. Inefficient **thermal management systems** further accelerate degradation, posing **safety risks such as overheating and fire hazards**.

Challenges Due to the Problem:

1. **Reduced Battery Lifespan & Performance Decline:**
    - High temperatures and excessive charging cycles cause **faster battery wear**, reducing range and efficiency.
    - Degraded batteries impact **acceleration, regenerative braking, and overall vehicle reliability**.
2. **Safety Risks Due to Overheating & Fire Hazards:**
    - Poor thermal management can lead to **thermal runaway**, where battery cells overheat uncontrollably.
    - Cases of **EV fires** have been reported in India due to faulty cooling systems and extreme weather conditions.
3. **High Replacement Costs & Lack of Recycling Infrastructure:**
    - EV battery replacements can cost **30-50% of the vehicle price**, making ownership expensive.
    - India lacks a **strong battery recycling ecosystem**, leading to increased **e-waste and environmental hazards**.
4. **Inefficiencies in Fast Charging & Battery Swapping:**
    - Frequent fast charging accelerates battery degradation by causing **lithium plating**, reducing battery life.
    - Battery swapping stations face compatibility issues due to **lack of standardized battery designs**.