Problem statement 1:

AI/ML for Networking
Category: Network Security
Pre-requisites:

- Computer Systems Basics – CPU/Memory/Storage/NIC
- Good Hands-on Experience on Linux
- Programming Skills in Python and/or C
- Basics of AI/ML

Problem Statement

Description:
Modern networks face increasing challenges in monitoring and securing traffic due to the exponential growth of data, encrypted communication, and sophisticated cyber threats. Traditional rule-based security measures and deep packet inspection (DPI) techniques are becoming less effective in detecting and classifying threats, especially in encrypted traffic. Manual intervention in network traffic classification is inefficient, leading to delayed threat detection and security vulnerabilities. To address these issues, AI-driven solutions can analyze traffic patterns, detect anomalies, classify applications, and enhance security in real-time, ensuring adaptive and intelligent network defense.

Expected Outcome:

- **Automated Network Traffic Analysis** using AI/ML models to detect and classify traffic in real time.
- **Improved Threat Detection & Security**, identifying anomalies, malware, and encrypted attacks with higher accuracy.
- **Reduced False Positives & False Negatives**, enhancing the efficiency of network security operations.
- **Scalability & Performance Optimization**, ensuring AI models can handle high-traffic environments with minimal latency.
- **Privacy-Preserving Traffic Analysis**, leveraging AI for encrypted traffic analysis without decryption.

Deliverables:

1. **AI-Powered Traffic Classification Model** – A system that categorizes network traffic (e.g., APP ID detection) based on behavior and patterns.
2. **Threat Detection & Anomaly Identification Framework** – AI-driven security mechanism to detect suspicious or malicious activity.

Problem statement 2:

Image Sharpening using knowledge distillation

Prerequisites:

Concepts in Machine Learning
Programming Skills (Python)
Deep Learning / CNN - Train/Validate/Test with Data

Objective:

Develop a model to enhance image sharpness during video conferencing, addressing issues like reduced clarity due to low bandwidth or poor internet connections.

Approach:

Utilize a Teacher-Student model technique for knowledge distillation:

Teacher Model: Select a high-performing pre-trained image sharpness model.

Student Model: Design and develop an ultra-lightweight AI/ML model that mimics the teacher model's performance.

Requirements:

The final model should operate at 30-60 frames per second (fps) or higher, maintaining high accuracy.

During training, use high-resolution images cropped to lower resolutions to reduce computational complexity. However, the model must be capable of processing 1920x1080 resolution images at the target fps.

Training Dataset:

Downscale and upscale ground truth images using bicubic/bilinear methods to simulate video conferencing conditions.

Performance Evaluation:

Use Structural Similarity Index (SSIM) as the performance metric.

Achieve an SSIM score above 90%.

Test the model on a benchmark dataset of over 100 images, including diverse categories such as text, nature, people, animals, and games.

Conduct an extensive subjective study to obtain a Mean Opinion Score (MOS) on the model's ability to produce sharpened images.

Expected Outcome:

A robust image sharpness model that enhances video conferencing quality, providing clear and sharp visuals even under challenging network conditions.

Report Submission Format :

Create a report citing data sources, detailed model(both teacher and student) description, performance analysis process and result, and working source code.

Problem statement 3:

Create pipeline (detect, decode and classification) using DL Streamer, define system scalability for Intel HW

Pre-requisites:

- Concepts in machine learning
- Programming skills (Python)
- OS (Linux)
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Category: AI, machine learning, System scalability

Description:
As deployment of Edge and AI are growing, City and transportation are adopting new use-cases where more and more visual cameras are deploying across cites. It is very hard to manual scan all the cameras' feeds. AI is helping to decode, detect and classify those cameras feeds and providing analytics. Those cameras are used every where like Mahakumbh or Cricket.

Example :
https://www.livemint.com/news/mahakumbh-2025-how-ai-powered-facial-recognition-is-assisting-law-enforcement-agencies-surveillance-security-cctv-11737512022231.html
https://www.icc-cricket.com/media-releases/icc-tv-to-deliver-comprehensive-coverage-with-ai-powered-innovations-and-star-studded-commentary-team-for-icc-men-s-t20-world-cup-2024

Those AI cameras needs compute, storage and networking. Intel HWs are the capable to handle those AI cameras.
DL streamer (https://dlstreamer.github.io/dev_guide/dev_guide_index.html) optimized to run at Intel HWs.
Create pipeline (decode, Detect and classify) on Intel HW (CPU and GPU) run pipeline on CPU, GPU. Figure out how many cameras streams are supported, what is optimum FPS which model best on Intel HW.

Outcomes:

- Maximum number of streams, FPS and Model on CPU
- Maximum number of streams, FPS and Model on GPU
- Bottleneck CPU, GPU, or IO
- Create a 3-page report on the chosen problem, Pipeline, and results of each model

Problem statement 4:

AI-Powered Interactive Learning Assistant for Classrooms

Objective: Build a Multimodal AI assistant for classrooms to dynamically answer queries using text, voice, and visuals while improving student engagement with personalized responses.

Prerequisites:

- Familiarity with natural language processing (NLP) and multimodal AI concepts.
- Knowledge of speech-to-text frameworks and computer vision techniques.
- Programming skills in Python, with experience in libraries like Hugging Face Transformers and OpenCV.

Problem Description:
Modern classrooms lack real-time, interactive tools to address diverse student needs and keep them engaged. The objective is to create a multimodal AI assistant that:

1. Accepts and processes text, voice, and visual queries from students in real-time.
2. Provides contextual responses, including textual explanations, charts, and visual aids.
3. Detects disengagement or confusion using facial expression analysis and suggests interventions.

Expected Outcomes:

- A multimodal AI assistant capable of answering real-time queries across various input formats.
- Integration of visual aids (e.g., diagrams, charts) for better understanding.
- A feature to monitor student engagement and adapt teaching methods dynamically.

Challenges Involved:

- Combining multimodal inputs (text, voice, visuals) for consistent, context-aware responses.
- Ensuring low-latency processing to maintain real-time interactions.
- Handling diverse accents, noisy environments, and variations in facial expressions.

Tools & Resources:

- **Hardware**: Intel AI PC with GPU and NPU for real-time processing / any Intel Hardware.
- **Software**: Hugging Face Transformers (NLP), OpenCV (visual analysis), PyTorch/TensorFlow.
- **Datasets**: Public multimodal datasets like AVA-Kinetics (for behavior analysis) and LibriSpeech (for speech-to-text).

Problem Statement 5:

Design and implement a smart, automated system for product labeling and traceability, capable of verifying product quality parameters and applying or validating labels that include:

- Device ID
- Batch ID
- Manufacturing Date
- RoHS Compliance
- Serial Number (QR or barcode)
- The system will leverage:
- Mechatronic systems for sensor-based inspection, actuation, and real-time control.
- AI models for dynamic verification and validation of label data and product compliance.
- Automated labeling or data printing mechanisms (simulated or real).
- Data logging for traceability and audit purposes.

Background:

- In modern manufacturing, especially in electronics, medical devices, and automotive components, every product must be individually labeled with traceable information to

comply with regulatory, logistical, and quality standards. This metadata allows tracking through production, warehousing, and customer delivery.

- Currently, many factories use semi-automated labeling systems that are error-prone or disconnected from quality checks. Your project simulates the design of a smart labeling system that not only labels the product but verifies critical parameters and ensures compliance using sensor data and intelligent logic

Problem Description:
You are building a Smart Product Traceability Station in a manufacturing line for small electronic devices.
System Requirements:

- Each unit arrives on a conveyor for inspection and labeling.
- The system must perform the following steps:
- Identify the product using a camera or sensor (or simulated input).

Verify compliance:

- Check RoHS status using part metadata or sensor flags.
- Confirm Batch ID from production input.
- Match Device ID and Manufacturing Date via database or simulation logic.
- Apply or validate a label (with QR code, barcode, or digital record).

Use actuators to:

- Mark or print the label (real or simulated).
- Reject units with missing or mismatched data.

AI Integration:

- Use OCR (optical character recognition) or image recognition to validate label print quality or content.
- Use machine learning to classify valid/invalid products or spot faulty labels.
- Store all data into a simulated or real-time traceability log/database.

Deliverables:

- System Architecture Design:
- Block diagram, flowchart, and hardware/software mapping.

Label Inspection Simulation or Hardware:

- Simulated camera or sensor readings for product verification.
- Logic for generating and applying labels.

AI Module:

- OCR for label verification, or ML model for visual defect detection.
- Accuracy and performance report.

Control System Implementation:

- Embedded logic for sensor-actuator interaction and data validation.
- Label printing/rejecting mechanism.
- Traceability Database or File Logging:
- Store details like DeviceID, BatchID, timestamps, inspection result.

Final Demonstration and Report:

- Functional demo (video or live).
- Documentation covering design, implementation, dataset used, AI training, and results.

Free Tools & Simulators for Students:

Tool	Purpose	Link
Tinkercad Circuits	Simulate microcontroller and sensor logic	Tinkercad
Google Colab + OpenCV + EasyOCR	Label inspection using AI/OCR in Python	Colab
LabelImg + YOLOv5 in Colab	Train object detection model for label check	YOLOv5
Python + SQLite/CSV	Simulate traceability database logging	Python Docs
Proteus or Fritzing	Simulate control logic and label activation	Proteus
MATLAB + Simulink	Advanced modeling of label print systems	MATLAB Student

Evaluation Criteria:

Criteria	Description	Score
1. Mechatronics System Design	Application of sensors, actuators, mechanical setup, and control logic for automated labeling and inspection. System layout, design clarity, and real-time execution quality.	20

2. Electronics & Embedded Systems	Circuit design, microcontroller programming, interfacing (sensors/actuators), communication protocols (I2C/SPI/UART), and power management.	15
3. AI and Machine Learning Integration	Implementation and training of an OCR/ML model for label verification or defect detection. Evaluation metrics, model integration, and performance.	20
4. Data Logging & Traceability Logic	Accuracy and completeness of logging product metadata (Device ID, Batch ID, etc.), use of databases or structured files, and traceability relevance.	10
5. System Functionality & Testing	Overall operation of the system, including labeling accuracy, real-time rejection, product tracking, and system stability during testing/demo.	10
6. Innovation & Problem-Solving	Creativity in design, optimization techniques, edge computing, use of cloud or dashboard integration, or other features extending the baseline.	10
7. Documentation & Technical Report	Quality of written report (clarity, structure, diagrams), inclusion of results, challenges, and learning outcomes.	5
8. Presentation & Demonstration	Clarity, professionalism, teamwork, and effectiveness of communication during the final presentation/demo.	5
9. Project Management & Teamwork	Effective collaboration, distribution of tasks, timeline adherence, and group coordination.	5

Dataset Recommendation for Defect Images

- For defect detection, especially in a real-world industrial scenario like product labeling or quality control, using a relevant dataset will help students train AI models effectively. Here are some datasets that can be used for defect detection or quality inspection:
- The PCB Defect Detection Dataset on Kaggle:

- This dataset contains images of PCBs (Printed Circuit Boards) with defects. It is perfect for students to apply computer vision techniques for defect detection.
- Students can use OpenCV, TensorFlow, or PyTorch to implement machine learning models for detecting defects in the products.
- Fruits and Vegetables Defect Dataset:
- This dataset includes images of fruits and vegetables with various defects such as bruises, rot, etc. It's a good fit for students to apply defect detection models in food industry quality control systems.
- Steel Defect Dataset:
- This dataset contains images of steel sheets with different types of surface defects (e.g., pits, cracks, etc.). It can be used for defect detection in metal manufacturing processes.
- MVTec Anomaly Detection Dataset:
- MVTec provides a comprehensive dataset for industrial object recognition and anomaly detection, with defects such as scratches, dents, and missing parts on industrial objects. This dataset is especially useful for students working with industrial automation in visual inspection tasks.

Problem Statement 6:

Product Category Creation for Healthcare Kiosks in India

Category: Artificial Intelligence, Machine Learning, Computer Vision, Federated Learning, Healthcare, Electronic Health Records (EHRs), Telemedicine,

Participants: Engineering Students or MBA Students with Engineering background

Prerequisites:

- Understanding of Artificial Intelligence, Machine Learning, Computer Vision, Federated Learning
- Understanding of Govt. of India policies and initiatives to transform Indian healthcare industry, Digital India Mission, Ayushman Bharat Digital Mission, National Health Database, Digital Public Infrastructure, Digital Health Incentive Scheme (DHIS)
- Understanding of Product management to guide Intel on features required through every step of a product's lifecycle — from development to positioning, competition mapping, market requirements document and pricing — by focusing on the product and its customers first and foremost.

Background – Healthcare Sector in India

The healthcare sector in India is one of the largest employers in the country with 7.5 million people employed as of FY24. The Indian healthcare market is currently valued at around US$ 638 billion.

The demand for Indian healthcare professionals is expected to double nationally and globally by FY30 due to a shortage of healthcare workers in India. India has 1.7 nurses per 1,000 people and a doctor-to-patient ratio of 1:1500 nationwide which is worse than WHO standard recommendation of doctor-to- patient ratio of 1:1000. India's health expenditure increased from 1.4% to 1.9% of the GDP from 2017-18 to 2023-24 which is still below the target of 2.5% set by National Health Policy 2017. In actual terms, the Indian government has allocated Rs. 99,858 crore (US$ 11.50 billion) to the healthcare sector in the Union Budget 2025-26 for the development, maintenance, and enhancement of the country's healthcare system.

India's healthcare landscape is undergoing a digital transformation, driven by government initiatives, policy reforms, and technological advancements. With a rapidly growing population and increasing demand for quality healthcare, digital health solutions are playing a crucial role in enhancing accessibility, affordability, and efficiency.

Digital healthcare infrastructure in India is evolving to bridge the gap between urban and rural healthcare services, leveraging telemedicine, electronic health records (EHRs), and artificial intelligence (AI)-driven diagnostics. Govt. of India's healthcare initiatives, such as the Ayushman Bharat Digital Mission (ABDM) and the Digital Health Incentive Scheme (DHIS), have the potential to set a global benchmark for digital healthcare transformation. India is focusing on achieving the largest digitization drive in the World by following basic principles like:

1. Interoperability and Standardization: Ensuring seamless data exchange between key stakeholders
2. Data Management at Scale: Using the efforts put on creating the India Stack which is a digital public infrastructure platform designed to facilitate presence-less, paperless, and cashless services in India.
3. Public-Private Partnerships (PPP): Encouraging PPP model for quick innovation, deployment and scale.
4. Focus on Affordability and Accessibility: Leveraging Govt. initiatives like Digital India, Ayushman Bharat Digital Mission (ABDM), Digital Health Incentive Scheme (DHIS), National Health Database (NHDB), Ayushman Bharat Health Account (ABHA) and Pradhan Mantri Ayushman Bharat Health Infrastructure Mission (PM-ABHIM) to bridge the gap between Urban and Rural India in terms of accessibility to quality health services while keeping affordability as the focus.
5. Create differentiated delivery models: Indian Govt. is also creating a comprehensive health service delivery mechanism spanning preventive, promotive, curative, rehabilitative and palliative care. There are two complementary components – Comprehensive Primary Healthcare Units (Ayushman Arogya Mandirs) and Comprehensive Health Insurance for poor populations (PM-JAY: Pradhan Mantri Jan Arogya Yojana). Ayushman Arogya Mandirs are envisaged to deliver expanded range services that go beyond Maternal and child health care services to include care for non -communicable diseases, palliative and rehabilitative care, Oral, Eye and ENT care, mental health and first level care for emergencies and trauma, including free essential drugs and diagnostic services. PM-JAY is the largest insurance scheme to

cover more than 10 crore Indian poor with a INR 5 lakh insurance cover to provide access to secondary and tertiary care.

6. Vishwa Guru: India's digital health models, with focus on leveraging Artificial Intelligence, Machine Learning, Federated Learning and Telemedicine, could serve as template for other developing nations in the World to adopt and use for large scale Digital Public Infrastructure in Healthcare.

Introduction – Healthcare Kiosk

A self-service kiosk has become a regular fixture in many businesses irrespective of its size. Whether at an airport or in a supermarket or in the hospitality, banking, or healthcare sectors, this system makes things easier for both customers and businesses.

The ability of healthcare kiosks to simplify processes for patients and administrators offers great potential to the healthcare industry. A healthcare kiosk is an interactive device placed at a fixed spot in the hospital or Ayushman Arogya Mandir, designed to accomplish multiple tasks that reward patients and administrations alike.

A healthcare kiosk gives patients the control to find the information themselves (wayfinding) which ensures that the patients are actively engaged, as they can interact with the system in a meaningful way.

Current Features of the Healthcare Kiosk:

- Helps in booking walk in appointments.
- Expedite Patient Payments by integration of QR code-based payments (UPI) or card payments
- Server as a ready reckoner for Indoor Patient Status
- Accurately measures BMI and patient vitals which are needed for each patient before a doctor can access them during OPD visits
- Reduce Personnel and Material Costs

Technical Specification of the Healthcare Kiosk:

- Intel 12th Gen i3 / i5 / i7 based computing unit
- Touch Screen size 18.5”/22”/24”
- Ram 8gb/16gb
- Storage SSD 512gb

Problem Description

While a product on Intel Architecture exists, the off take is poor as it solves certain market needs while ignoring many others.

Can the Healthcare Kiosk be improved to include certain workloads that support the ABDM or DHIS or help by creating an innovative healthcare delivery model or bring in AI, Machine learning and Federated learning to bridge the urban-rural accessibility gap in India?

What features will unlock the potential to position the product as the right product to solve the grassroot issues of India and create a product that becomes synonymous with the principles of National Digital Health Mission (NDHM) which aims to offer universal health coverage to all Indians which unlocks a structured approach to interoperability, cybersecurity, and data exchange mechanisms to ensure a robust digital healthcare ecosystem creating a healthcare coverage that is efficient, accessible, inclusive, affordable, timely and safe.

Can the Healthcare Kiosk be linked to the India Stack which is India's Digital Public Infrastructure platform comprises of various digital public goods like UIDAI, eKYC, eSign, Digilocker, Unified Payments Interface, The Account Aggregator framework, ONDC, Open Credit Enablement Network (OCEN) and bring in Intel's inherent secure assets like OneAPI, OpenVINO, Open Edge Platform and Intel Product Security Assurance practices to build a solution that consumers can inherently trust while sharing confidential data under the NDHM?

Can technologies like face ID recognition be brought in with advanced authorization from the patient, as seen in Digi Yatri Kiosks, to fasten the registration and check-in process? If yes, what support is needed from the ecosystem? Should we think of creating a foundation/body who will decide on the features and its implications as well as implementation?

Can the Healthcare Kiosk serve as a federated learning platform across a variety of machine learning model pipelines, a quality-preserving database, an open benchmarking platform for comparing & validating AI models to support diagnosis of non-communicable diseases, and a consent management system for research of common cases under ABDM thereby unlocking the immense potential of AI for improving health outcomes?

Can the Healthcare Kiosk deployed at remote locations serve as a remote consultations' hub (tele-consultation), where patients can come in and consult a doctor of choice located anywhere in the country thereby reducing the burden on physical healthcare facilities? Can this be then linked to the eSanjeevani (National Telemedicine Service) platform of Govt. of India to serve as a system that immediately monitors patient's vitals, sends a report along with medical history data with any relevant lab or imaging results for the case being discussed by using AI and LLMs (large language models) that too for Indians in various Indian Languages and Dialects?

Can the Healthcare Kiosk self-propose a preliminary diagnosis and develop an appropriate treatment plan which can then be taken to a doctor for a second opinion before acting on the AI generated diagnosis and treatment plan?

Can the Healthcare Kiosk be used to Connecting Health and Wellness Centers (HWCs) or other hospitals with specialist doctors from anywhere in the Country for tele-consultation for better healthcare accessibility in remote areas or for sharing the tacit knowledge database? This Kiosk can share the patient's vitals report along with medical history data with any relevant lab or imaging results to the doctor located thousands of kms away so that the doctor understands the history and recommends the right treatment plan.

While all the above themes look interesting, we need to think about the features that can be developed in todays' World across the product lifecycle, affordability in Indian context, funding sources to tap into, Go-to-Market motions, the potential challenges in implementing a solution like this in terms of regulations, product certifications, ground level deployment and overall patient journey.

Expected Outcome:

- Mapping of current features and future features along with HW requirements (current and future), SKUs, etc. based on the feature introduction for the Healthcare Kiosk keeping in mind the 5 stages of Product Management - (1) product development, (2) introduction, (3) growth, (4) maturity, and (5) decline.
- Go-to-Market Blueprint for reaching target customers, building demand, and gaining a competitive advantage keeping in mind the various stakeholders like HW OEM, Independent Software Vendors (ISVs) and System Integrators (SIs) as well as the customer support mechanisms.
- Market requirements Document (MRD) to help define the market's requirements or demand for a specific product, typically containing information on the product's vision, the competitive landscape, business analysis, and revenue opportunity, as well as a list of features