IARE
INSTITUTE OF
AERONAUTICAL ENGINEERING

HIGH IMPACT PRACTICES (HIPS)

CORNERSTONE PROJECTS (CoPs)

INFORMATION PACKET

2025 - 2026

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AERONAUTICAL ENGINEERING
25 YEARS
2000 2025

I appreciate your interest in the Cornerstone Project (CoP), Department of CSE (Data Science) at the Institute of Aeronautical Engineering!

A **cornerstone project (CoP)** is typically introduced during the early or middle stages of an academic program at the Institute of Aeronautical Engineering. It focuses on helping students build foundational skills and understand how to apply basic concepts to real-world scenarios. These projects are usually smaller in scope, moderately complex, and designed to strengthen practical understanding of core subjects.

These projects encourage students to connect theoretical learning to data-centric applications, such as developing the data learning model, performing simple data analysis, or creating prototype engineering solutions. Emphasis is placed on learning by doing, helping students build confidence in applying methods like data preprocessing, statistical analysis, basic modeling, and reporting results. By working on these projects, students begin to understand how engineering and data science principles apply in real-world scenarios. Ultimately, cornerstone projects act as the foundation of experiential learning at IARE, transitioning students from passive learners to active problem-solvers, equipped with both technical skills and professional behaviors necessary for the challenges of advanced engineering education.

Cornerstone Project (CoP) teams are:

- Collaborative Project – This is an excellent opportunity for students who are committed to working towards social developments and emerging needs.
- Project Activity – The project coordinator listed current working areas for offering cornerstone projects with a team size of at least two students. The coordinator allotted mentors based on the work area and facilitated exclusive project laboratories for selected cornerstone project (CoP)students. This cornerstone project (CoP)bridges the gap between academic learning and real-world social applications. It helps enhance the professional development
- Short-term - Each undergraduate student may participate in a project for an assigned period.

The primary goal of cornerstone projects is to provide a level of moderate complexity, expertise, and diversity of thought in social data-centric areas that will allow them to gain hands-on experience with the cornerstone projects.

- Simulate real-world project work environments - Familiarize students with the structure, expectations, and deliverables typical of data-driven and software development projects.
- Encourage interdisciplinary thinking - Promote the application of data science methods to diverse domains such as healthcare, finance, education, environment, and smart cities.
- Promote ethical and responsible data use - Instil awareness of data ethics, privacy, security, and responsible AI practices during project planning and execution.
- Support data-driven decision making - Enable students to create data solutions that drive actionable insights, support evidence-based decisions, and add value to stakeholders.
- Foster hands-on project experience - Engage students in comprehensive, real-world data science project work that integrates the full data lifecycle from collection to insight generation and emerging technologies like AutoML, NLP, and LLMs.
- Build strong project portfolios - To enable students to create social and industry-ready project portfolios that demonstrate technical depth, innovation, and impact on careers.
- Bridge academic learning and practical application - Apply theoretical knowledge to practical challenges involving data analysis, machine learning, and visualization using real datasets.

Cornerstone Projects (CoPs) focuses on the challenges presented by the Sustainable Development Goals (SDGs)

Sustainability Development Goals (SDGs) for the Dept. of CSE (DS), IARE	
SDG 3	Ensure healthy lives and promote well-being for all at all ages
SDG 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG 12	Ensure sustainable consumption and production patterns

Themes of Cornerstone Projects (CoPs) for the CSE (Data Science):

The following project domains are recommended for cornerstone projects (CoPs), and the students should frame the problem statements from any one of the following themes:

1. Data-driven software development and implementing data analytics models for Smart Irrigation Prediction System, Weather Yield Prediction, and Crop Disease Detection **(SDG #9, SDG #12)**
2. Visual language model for data learning of real-time stereoscopic super-resolution images for traffic, fraudulent, and other surveillance applications **(SDG #9)**
3. Financial forecasting, energy consumption prediction, and sensor data analysis using statistical models and data visualization techniques. **(SDG #8, SDG #9, SDG #12)**
4. Real-time cyber-attack visualization dashboard, and cyber risk scoring framework using data-driven vulnerability assessment **(SDG #9)**
5. Social Good and Sustainable Development targeting environment monitoring, disaster response, agriculture, education, and public health **(SDG #3, SDG #4, SDG #9)**
6. Processing sensor data from IoT devices for the development of smart cities, predictive maintenance, and health monitoring **(SDG #3, SDG #9)**
7. Multi-modal data fusion for holistic analysis and decision-making. **(SDG #9, SDG #12)**
8. Behavior-based malware detection using explainable AI (XAI) techniques for cyber analytics and data visualizations **(SDG #9)**
9. Leveraging CNNs, RNNs, LSTMs, and Transformers for complex tasks related to image recognition, NLP, and sequence data modeling. **(SDG #4, SDG #9)**
10. Development of data strategies and predictive analytics for real-time streaming stock data **(SDG #8, SDG #9)**

In order to participate in cornerstone projects, you must formally apply and be accepted by the project coordinator. To proceed, please mail to the project coordinator, Dr. K Rajendra Prasad (dr.rajendraprasad@iare.ac.in), Head of CSE (Data Science & Cyber Security). This will bring up all available open positions tagged as cornerstone projects.
Please note that participation by the cornerstone project (CoP)team requires registration for the accompanying project work from any of the specified domains. More information will be provided to all selected cornerstone project (CoP)applicants who have been offered a position.

If you have any questions about a particular team, please contact the faculty mentor.
We encourage you to contemplate this fascinating new opportunity. We look forward to receiving your application submission!

Data-driven software development and implementing data analytics models for Smart Irrigation Prediction System, Weather Yield Prediction, and Crop Disease Detection

Dr. K. Rajendra Prasad, Professor & Head, CSE (Data Science) – Faculty Mentor

GOALS

To develop intelligent, data-driven software applications to address critical agricultural challenges through predictive modeling and automation. With the growing need for sustainable farming practices, this project aims to improve irrigation efficiency, yield forecasting accuracy, and early detection of crop diseases using real-time and historical data.

By integrating data from weather stations, soil sensors, and satellite imagery, the system is intended to offer predictive insights for optimal irrigation scheduling and resource management. This ensures better water usage, cost reduction, and higher agricultural productivity. Simultaneously, weather yield prediction models aim to minimize the unpredictability of seasonal outcomes by correlating meteorological and environmental variables with crop performance.

Another vital aspect of this project is to build an early warning mechanism for crop diseases using image classification and anomaly detection techniques. By employing machine learning algorithms and computer vision, the system can identify visual cues or patterns indicating potential diseases, thereby allowing timely intervention.

Overall, the project seeks to empower farmers and agricultural professionals with actionable intelligence derived from data analytics, enhancing decision-making, promoting sustainable agriculture, and improving food security outcomes through technology-driven solutions.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on core methods and technologies for Data-Driven Agricultural Intelligence.

- Foundations of data science techniques – Regression, Decision Trees, and Random Forests for irrigation and yield prediction
- Computer Vision Techniques – Image preprocessing and CNNs for crop disease classification
- Time Series Forecasting – ARIMA, Prophet, and LSTM models for weather and yield prediction
- Cloud Computing Platforms – AWS or Google Cloud for model deployment and storage scalability
- Data Visualization Tools – Tableau, Power BI, or Matplotlib for trend analysis and insights display
- GIS & Remote Sensing – Geospatial data processing for precision agriculture
- APIs and Web Frameworks – Flask/Django for deploying user-friendly dashboards and alerts

DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team interested in from the following majors or areas of interest: Challenges and Design Considerations in Building Smart Irrigation Prediction Systems

- Acquiring high-quality, real-time agricultural and environmental data across varied geographic zones
- Handling missing data and noise from sensors and weather stations
- Designing scalable architectures to support large-scale, multi-location data collection and processing
- Integrating disparate data sources such as IoT, satellite, and meteorological systems
- Ensuring interpretability of models to promote user trust and understanding among farmers
- Building mobile-friendly interfaces for accessibility in rural and remote areas
- Addressing network latency and real-time synchronization issues in remote deployments
- Ensuring data privacy, regulatory compliance, and secure communication in IoT applications

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team interested in from the following majors or areas of interest: Relevant Fields and Skills Development Through Project Execution

- Predictive analytics, supervised learning, image classification
- Agricultural Informatics – Smart irrigation, yield estimation, crop health monitoring
- Data Engineering & Visualization – ETL processes, data wrangling, interactive dashboards
- Cloud & Edge Computing – Scalable deployment of models and services
- Geospatial Analytics – Spatial analysis using satellite and GIS data
- Software Development – Full-stack implementation of intelligent applications
- Sustainable Computing – Technology for environment-friendly, efficient agriculture

MENTOR CONTACT INFORMATION

Dr.K.Rajendra Prasad
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Visual language models for data learning of real-time stereoscopic super-resolution images for traffic, fraudulent, and other surveillance applications

Dr. R. Obulakonda Reddy, Professor, Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To design a data learning system that utilizes stereoscopic super-resolution imaging to enhance real-time surveillance applications such as traffic monitoring and fraud detection. Traditional surveillance systems often suffer from low-resolution outputs and inefficiencies in extracting actionable intelligence. This project seeks to overcome these limitations by leveraging advanced image enhancement techniques and visual data learning frameworks.

By focusing on stereoscopic super-resolution, the system will process stereo image pairs to reconstruct high-resolution visualizations, improving object detection accuracy, depth estimation, and scene analysis in dynamic environments. These enhanced images will enable downstream AI models to detect anomalies such as traffic violations, unauthorized entries, or suspicious behaviors more effectively.

A key objective is to create an effective visual language that standardizes how this enhanced data is processed, interpreted, and communicated. This includes constructing robust pipelines for real-time ingestion, visualization, and classification, while maintaining the system's scalability and responsiveness.

This initiative will benefit multiple public and private sectors, particularly in smart cities, surveillance infrastructure, law enforcement, and transportation systems. By merging super-resolution techniques with deep learning and visual representation, the project aims to elevate the capability and accuracy of intelligent surveillance systems.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Advanced Imaging and Visual Learning Techniques for Surveillance

- Stereoscopic Super-Resolution – Depth-based enhancement of stereo images using GANs and CNNs
- Deep Learning Frameworks – PyTorch and TensorFlow for training detection and classification models
- Object Detection Algorithms – YOLOv8, SSD, and Faster R-CNN for tracking and event detection
- Real-Time Image Processing – OpenCV and TensorRT for optimizing latency-sensitive tasks
- Video Streaming APIs – RTSP, OpenCV VideoCapture for real-time data acquisition
- 3D Scene Reconstruction – Depth estimation from stereo vision for spatial analysis
- Visualization Libraries – Matplotlib, Seaborn, Plotly for data-driven image analytics
- Edge AI Deployment – NVIDIA Jetson or Coral TPU for deploying models in real-time environments

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Critical Design and Research Challenges in Real-Time Surveillance Visualization

- Handling synchronization and alignment errors between stereo image pairs
- Reducing computational overhead for real-time super-resolution processing
- Developing accurate depth maps under low-light or cluttered environments
- Ensuring robustness of detection models against occlusions and motion blur
- Building effective annotation pipelines for training on super-resolved images
- Designing interfaces for interpretable and scalable visual communication
- Integrating with live video streams and optimizing for bandwidth limitations
- Securing visual data in compliance with surveillance and privacy regulations

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team interested in from the following majors or areas of interest: Cornerstone Project (CoP) team interested in from the following majors or areas of interest: Key Technical Domains and Skill Development Opportunities

- Computer Vision & Deep Learning – Super-resolution, 3D scene modeling, real-time inference
- Cybersecurity & Surveillance Systems – Intelligent detection and anomaly tracking
- Data Visualization & Human-Computer Interaction – Building interpretable visual tools
- Artificial Intelligence & Edge Computing – Lightweight deployment of intelligent agents
- Image Processing & Pattern Recognition – High-resolution enhancement and object segmentation
- Transportation & Urban Analytics – Traffic monitoring, vehicle recognition, smart city surveillance
- Software Development & Optimization – Efficient pipelines and streaming workflows
- Digital Forensics – Visual evidence analysis for fraudulent and criminal behavior

MENTOR CONTACT INFORMATION

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Financial forecasting, energy consumption prediction, and sensor data analysis using statistical models and data visualization techniques

Dr. Mahammad Rafi D, Associate Professor, Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To design and implement a data-driven system that leverages statistical models and advanced visualization techniques for time-sensitive predictions in domains like finance, energy, and sensor-based environments. Accurate forecasting in these sectors enables better decision-making, risk mitigation, and operational efficiency.

In the financial domain, the project aims to predict stock prices, currency fluctuations, or financial indicators using historical data and time series modeling. These insights are crucial for investors, policy-makers, and risk managers to optimize portfolios and reduce exposure to market volatility.

Energy consumption prediction is another critical component. With the global push for smart grids and sustainable energy practices, predictive models can help optimize load distribution, reduce energy waste, and forecast consumption peaks. Incorporating data from smart meters and IoT-based monitoring systems will enhance granularity and precision in predictions.

Additionally, sensor data analysis plays a vital role in understanding patterns from distributed environments, such as temperature sensors in buildings, pressure gauges in industrial systems, or motion detectors in smart homes. The project will develop analytical models that process, visualize, and derive actionable intelligence from such sensor streams.

This project integrates statistical learning, real-time data processing, and rich visual analytics to build robust systems capable of high-stakes forecasting and data interpretation across interdisciplinary domains.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Time Series Analytics and Visualization for Multi-Domain Forecasting

- **Statistical Modeling Techniques** – ARIMA, Holt-Winters, and Seasonal Decomposition for predictive analytics
- **Time Series Forecasting Tools** – Facebook Prophet, LSTM, and Exponential Smoothing for dynamic trends
- **Data Visualization Platforms** – Tableau, Power BI, Plotly, and Seaborn for pattern discovery and insight generation
- **Sensor Data Processing** – Pandas, NumPy, and Kafka for ingesting and processing continuous sensor streams
- **Financial Analytics Libraries** – yfinance, ta-lib, and QuantLib for market data analysis and technical indicators
- **Energy Monitoring Frameworks** – Smart meter APIs and open-source energy datasets for real-world prediction models
- **Data Cleaning & Normalization** – Time-based interpolation, smoothing, and outlier detection
- **Cloud Integration** – Using AWS/GCP for large-scale data ingestion and storage pipelines

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Challenges in Designing Forecasting Systems Across Financial, Energy, and IoT Sectors.

- Managing data irregularities and missing entries in time series datasets
- Building scalable architectures to handle high-frequency sensor and market data
- Selecting and fine-tuning models for short-term vs. long-term forecasting horizons
- Evaluating the reliability and variance of different forecasting models
- Visualizing multivariate data streams and aligning insights across domains
- Handling seasonality and external events (e.g., holidays, climate) in prediction algorithms
- Dealing with real-time ingestion, windowing, and feature extraction in sensor systems

- Ensuring explainability and user trust in automated prediction pipelines

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team interested in from the following majors or areas of interest: This capstone project (CoP) team interested in from the following majors or areas of interest: Relevant Disciplines and Core Competency Development

- **Financial Data Science** – Stock prediction, trend modeling, risk analytics
- **Energy Informatics** – Load forecasting, consumption modeling, and efficiency analytics
- **Time Series Analysis** – Advanced statistical modeling and forecasting pipelines
- **IoT & Sensor Analytics** – Real-time data processing and edge-based monitoring
- **Data Visualization & BI Tools** – Insight generation through interactive dashboards
- **Software Engineering** – Building robust, scalable data analytics solutions
- **Cloud Computing & Big Data** – Streaming analytics and deployment at scale
- **Predictive Modeling** – Multidomain forecasting for decision support systems

MENTOR CONTACT INFORMATION

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Real-time cyber-attack visualization dashboard, and cyber risk scoring framework using data-driven vulnerability assessment

Dr. B Ramadevi, Professor, Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To develop an integrated platform for real-time cyber-attack monitoring and risk assessment using advanced data analytics and visualization. As cybersecurity threats grow in volume and complexity, organizations require intelligent systems to detect, interpret, and respond to attacks with minimal latency and maximum clarity.

The primary goal is to build a dynamic cyber-attack visualization dashboard that translates complex security logs and network activity into intuitive graphical representations. By incorporating real-time threat detection mechanisms and anomaly detection algorithms, the dashboard will help security teams quickly identify potential intrusions, suspicious activities, or policy violations.

Alongside visualization, the project focuses on creating a cyber risk scoring framework. This scoring model evaluates system vulnerabilities, historical threats, network behavior, and patch levels to assign a risk score that quantifies the exposure of digital assets. The framework aids in prioritizing security responses, optimizing resource allocation, and improving organizational cyber resilience.

By unifying real-time data ingestion, machine learning for threat modeling, and interactive visualization, the project empowers organizations to shift from reactive to proactive security. It also serves as a valuable educational and operational tool for SOC (Security Operations Center) analysts, IT administrators, and security auditors.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Tools and Techniques for Real-Time Cyber Threat Detection and Visualization

- **Network Traffic Analysis** – Packet sniffing using Wireshark, Zeek, or NetFlow for detecting anomalies
- **SIEM Integration** – Elastic Stack (ELK), Splunk for log correlation and real-time alerting
- **Risk Scoring Algorithms** – CVSS-based scoring, statistical models, and ML-based risk quantification
- **Data Visualization Libraries** – D3.js, Grafana, Kibana, and Plotly for real-time interactive dashboards
- **Streaming Data Pipelines** – Kafka, Apache Flink, or Spark Streaming for low-latency processing
- **Machine Learning Techniques** – Clustering, classification, and anomaly detection for threat modeling
- **Threat Intelligence Feeds** – Integration with OSINT and STIX/TAXII-based feeds for external data
- **API Integration** – REST APIs for fetching logs from firewalls, endpoints, and cloud services

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Challenges in Developing Scalable and Reliable Cyber Analytics Platforms.

- Handling high-velocity and high-volume security log data with minimal latency
- Designing flexible, responsive, and clutter-free visual dashboards for live monitoring
- Creating interpretable risk scoring models that reflect evolving attack surfaces
- Integrating disparate data sources from endpoints, servers, and cloud infrastructure
- Building alerting systems that reduce false positives while ensuring real threat detection
- Ensuring secure storage and transmission of sensitive threat intelligence data
- Calibrating models for adaptive response to zero-day and advanced persistent threats (APTs)
- Enabling scalability and fault tolerance in the data pipeline architecture

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team interested in from the following majors or areas of interest: Technical

Domains and Career-Aligned Skill Areas

- Cybersecurity Analytics – Threat modeling, risk assessment, and vulnerability analysis
- Data Engineering & Streaming Systems – Real-time data pipelines and ingestion frameworks
- Information Visualization – Interactive dashboards for SOC and security monitoring
- Machine Learning & Anomaly Detection – Behavior-based threat recognition
- Security Information & Event Management (SIEM) – Log analytics and automated alerting
- Cloud Security & DevSecOps – Secure configuration of cloud-native services
- Network Security Monitoring – Packet inspection, intrusion detection, and traffic analysis
- Secure Software Development – Designing secure, resilient, and efficient analytics tools

MENTOR CONTACT INFORMATION

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Social Good and Sustainable Development targeting environment monitoring, disaster response, agriculture, education, and public health

Dr. Sajja Suneel, Associate Professor, Dept. of CSE (Data Science)– Faculty Mentor

GOALS

To harness the power of data science for social good by addressing critical global and local challenges aligned with the United Nations Sustainable Development Goals (SDGs). This project focuses on building scalable, intelligent systems that can support sustainable practices in areas such as environmental protection, disaster response, agriculture, public education, and healthcare delivery.

In environmental monitoring, the project aims to collect and analyze real-time data from sensors, satellites, and public sources to track air quality, water contamination, deforestation, and biodiversity loss. These insights can support early interventions and environmental conservation efforts.

In the context of disaster response, the goal is to analyze spatial and temporal data to detect and predict natural hazards (e.g., floods, earthquakes, wildfires) and optimize resource allocation, evacuation planning, and rescue operations using geospatial analytics and decision support tools.

For agriculture and public health, the project will develop data models that identify disease outbreaks, optimize crop patterns, and forecast nutrition trends in underserved areas. Similarly, in education, it will apply learning analytics to measure student engagement, dropout risk, and curriculum effectiveness to support equitable access and personalized learning pathways.

The project unifies technical innovation with ethical and societal responsibility to build a data science ecosystem that directly contributes to improving human well-being and environmental resilience.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Interdisciplinary Tools for Social Good and Sustainable Analytics

- **Geospatial and Satellite Data Processing** – GIS tools and remote sensing for environmental and disaster mapping
- **Predictive Analytics** – ML models for health outbreaks, crop yield prediction, and student performance forecasting
- **Data Integration Frameworks** – Merging multi-source public data (census, health, agriculture, education)
- **IoT and Sensor Networks** – Air and water quality sensors, agricultural drones, and health monitors
- **Visualization Dashboards** – Real-time insights through Tableau, Power BI, and Mapbox
- **Natural Language Processing** – Text mining from news, reports, and citizen feedback platforms
- **Cloud Platforms for Public Services** – AWS/GCP for scalable deployment of socially impactful applications

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested the following majors or areas of interest: Key Challenges in Designing Impactful Systems for SDGs and Social Equity

- Accessing reliable and representative datasets across underrepresented or rural regions
- Ensuring data privacy, consent, and ethical usage in health, education, and citizen data
- Building scalable models that generalize well across cultural, geographic, and social contexts
- Overcoming infrastructural constraints in deploying technologies in low-resource settings
- Designing inclusive interfaces and tools for non-technical stakeholders and field workers
- Managing multilingual, unstructured data in public communication platforms
- Integrating feedback loops for continuous improvement and community-based validation
- Evaluating impact using measurable metrics aligned with SDG indicators

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Key Fields for Socially Responsible Data Science and Global Development:

- Sustainable Computing – Environmentally aware and ethical system design
- Geospatial Analytics & Remote Sensing – Spatial data modeling for monitoring and prediction
- Public Health Informatics – Epidemic forecasting, health accessibility, and diagnostics
- Educational Data Mining – Learning behavior analysis and equitable learning outcomes
- Disaster Analytics – Emergency planning, resource mapping, and resilience prediction
- Agricultural Intelligence – Smart farming, food security, and crop sustainability
- Ethics and Data Governance – Privacy, fairness, and responsible data stewardship
- Cloud & Mobile Development – Deploying accessible tools for underserved communities

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Processing sensor data from IoT devices for the development of smart cities, predictive maintenance, and health monitoring applications

Dr. M V Krishna Rao, Professor, Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To explore how data collected from Internet of Things (IoT) devices can be processed and analyzed to enhance the intelligence, efficiency, and sustainability of urban environments, industrial systems, and healthcare infrastructures. The key goal is to develop an end-to-end data pipeline that transforms raw sensor inputs into actionable insights for various smart applications.

In the context of smart cities, IoT devices embedded in transportation systems, public utilities, and infrastructure will provide real-time data to monitor traffic flow, pollution levels, energy usage, and waste management. The goal is to build dashboards and analytics models that support urban planning, dynamic traffic control, and resource optimization.

Predictive maintenance in industries and public infrastructure is another vital application. By analyzing sensor data from machinery, pipelines, or electrical grids, the project aims to detect faults or anomalies early, reducing downtime and repair costs. This proactive approach ensures higher operational reliability and cost savings.

In health monitoring, wearable and embedded IoT sensors are used to collect physiological signals such as heart rate, temperature, or oxygen levels. The project will process this continuous data stream to identify health trends, alert caregivers of abnormalities, and support telemedicine services.
Ultimately, this project will deliver intelligent systems that leverage IoT-generated data for safer, healthier, and more efficient living environments.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on IoT Data Processing and Analytics Framework for Smart Systems

- IoT Protocols & Connectivity – MQTT, CoAP, and HTTP for real-time data transmission
- Edge & Fog Computing – Localized processing of sensor data to reduce latency and bandwidth usage
- Time Series Databases – InfluxDB, TimescaleDB for storing and querying IoT data
- Predictive Maintenance Algorithms – Anomaly detection, regression models, and time series forecasting
- Health Monitoring Models – Signal processing and supervised learning on biomedical data
- Cloud IoT Platforms – AWS IoT Core, Azure IoT Hub, Google Cloud IoT for data management
- Visualization Dashboards – Grafana, Kibana, or custom web-based dashboards for live monitoring
- Data Cleaning & Synchronization – Handling noisy, missing, and asynchronous sensor inputs

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested in from the following majors or areas of interest:
Technical
Considerations in Building IoT-Driven Smart Systems

- Managing high-volume, high-frequency sensor streams with minimal latency
- Synchronizing data from heterogeneous IoT devices with different formats and time zones
- Designing fault-tolerant systems to handle hardware failures and network dropouts
- Ensuring energy-efficient data collection in battery-powered IoT deployments
- Securing IoT endpoints and communication channels against cyber threats
- Interpreting multi-modal sensor data (e.g., temperature, motion, pressure) in unified models
- Providing meaningful real-time alerts without overwhelming the user with false positives
- Balancing computation across edge, fog, and cloud layers for optimal performance

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Interdisciplinary Skillsets and Knowledge Domains for IoT-Driven Innovation

- **Internet of Things (IoT)** – Device integration, sensor networks, embedded systems
- **Smart City Technologies** – Traffic optimization, public infrastructure analytics
- **Predictive Maintenance & Industrial IoT** – Machine health diagnostics, fault prediction
- **Healthcare Analytics & Wearables** – Vital sign monitoring and early disease detection
- **Edge and Cloud Computing** – Distributed computing architecture and deployment
- **Cyber-Physical Systems** – Real-time integration of hardware and analytics software
- **Streaming Analytics & Big Data** – Real-time data pipelines, ETL, and dashboarding
- **Security & Privacy in IoT** – Authentication, encryption, and data governance for smart systems

MENTOR CONTACT INFORMATION

Dr. M V Krishna Rao
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Multi-modal data fusion for holistic analysis and decision-making

Dr. G.Ganapthi Rao, Professor, Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To develop robust models and systems that utilize multi-modal data fusion to enable more comprehensive and context-aware decision-making across various domains such as healthcare, security, autonomous systems, and social analytics. Multi-modal data refers to information collected from different sources and formats—such as text, images, audio, sensor signals, and structured tabular data—and fusing them can enhance both the depth and reliability of insights.

This project aims to integrate and align disparate data modalities using machine learning, deep learning, and statistical frameworks, ensuring that contextual cues from one modality enrich or validate the information from another. For instance, combining medical images with patient records, or fusing video and audio feeds in surveillance, provides a richer and more reliable basis for analysis than relying on a single modality.

By creating pipelines for synchronized data collection, preprocessing, representation learning, and joint modeling, the project enables holistic pattern recognition, anomaly detection, and outcome prediction. This approach improves performance in complex real-world applications where single-modal systems fall short due to ambiguity or limited information.

The project will demonstrate how unified modeling of multi-source data can drive better decision-making in domains requiring both precision and context, offering a paradigm shift from isolated analytics to interconnected intelligence.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Techniques for Multi-Modal Data Fusion and Intelligent Decision Systems

- **Data Fusion Techniques** – Early fusion, late fusion, and hybrid fusion architectures for integrating modalities
- **Deep Learning Models** – Multimodal Transformers, CNN-LSTM hybrids, and attention mechanisms
- **Feature Extraction** – NLP for text, CNNs for images, MFCC for audio, and statistical features for structured data
- **Dimensionality Reduction** – PCA, t-SNE, Autoencoders for aligning different modality representations
- **Graph-based Approaches** – Knowledge graphs and graph neural networks (GNNs) for semantic relationships
- **Data Synchronization Pipelines** – Temporal alignment of sensor streams and media inputs
- **Multimodal Datasets & APIs** – Use of datasets like MM-IMDb, CMU-MOSI, or open sensor streams
- **Visualization Tools** – Fusion heatmaps, correlation matrices, and comparative dashboards

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Challenges in Building Accurate and Scalable Multi-Modal Systems

- Aligning temporal and semantic inconsistencies across modalities
- Handling missing or incomplete modalities without degrading model performance
- Ensuring scalability when modalities involve high-dimensional data like video or audio
- Dealing with modality dominance or imbalance during fusion
- Training deep multimodal models with limited labeled datasets
- Designing interpretable models that offer reasoning for decisions across modalities
- Managing data noise and redundancy in complex fusion scenarios
- Addressing ethical and privacy concerns in using rich, diverse data sources

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Domains and Competencies Developed through Multi-Modal AI Projects

- **Artificial Intelligence & Machine Learning** – Fusion-based learning and contextual intelligence
- **Data Science & Analytics** – Multi-source data integration and correlation analysis
- **Computer Vision & Image Processing** – Visual modality extraction and classification
- **Natural Language Processing (NLP)** – Text understanding and embedding for fusion models
- **Speech & Audio Analytics** – Acoustic signal processing for voice-based insights
- **Human-Centered AI** – Multimodal interaction, explainable decisions, and behavioral analytics
- **Healthcare, Security & Smart Systems** – Domain-specific applications using multimodal fusion

MENTOR CONTACT INFORMATION

Dr. G.Ganapathi Rao
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Behavior-based malware detection using explainable AI (XAI) techniques for cyber analytics and data visualizations

Dr. S.Sreekanth, Associate Professor, Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To develop a behavior-based malware detection system that leverages **Explainable Artificial Intelligence (XAI)** to uncover, classify, and interpret malicious activities within computing environments. Unlike traditional signature-based approaches that fail to detect novel threats, behavior-based detection focuses on monitoring program execution patterns, system calls, and file/network activity to identify anomalies in real time.

This project aims to combine behavioral analysis with machine learning and deep learning models that are both accurate and interpretable. The emphasis on explainability ensures that the system can provide human-understandable justifications for each classification decision, which is critical in high-stakes domains like cybersecurity.

Explainable AI methods such as SHAP (SHapley Additive exPlanations), LIME (Local Interpretable Model-agnostic Explanations), and attention visualizations will be used to reveal which behavioral features or patterns contributed to the model's prediction. These insights support threat analysts in understanding why certain software is flagged as malicious, fostering trust and transparency in the system.

By integrating rich data visualization techniques and real-time analytics dashboards, the project also aims to present security insights in a format that's actionable for SOC (Security Operations Center) teams, reducing response time and enhancing threat mitigation efforts.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Explainable AI and Behavioral Modeling for Cyber Threat Detection

- **Behavior-based Detection Models** – Analysis of system calls, API usage, registry access, and file operations
- **Machine Learning Algorithms** – Random Forest, XGBoost, and RNNs for temporal behavior modeling
- **Explainability Frameworks** – SHAP, LIME, and Integrated Gradients to interpret ML decisions
- **Dynamic Malware Analysis Tools** – Cuckoo Sandbox, ProcMon for simulating and logging malware activity
- **Feature Engineering Techniques** – Sequence encoding, time-windowed event tracking, and behavior profiling
- **Visualization Tools** – Network graphs, behavioral heatmaps, and anomaly timelines
- **SIEM Integration** – Incorporation with platforms like Splunk or ELK for real-time threat visibility
- **Cloud Deployment** – Use of containerized environments for sandboxing and scaling malware detection systems

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team interested in from the following majors or areas of interest: Challenges in Designing Transparent and Robust Malware Detection Systems

- Extracting meaningful behavioral patterns from high-volume, noisy activity logs
- Developing accurate ML models that balance false positives and false negatives
- Ensuring interpretability without compromising model performance or scalability
- Detecting obfuscated or polymorphic malware that alters its behavior
- Designing visualization interfaces that are intuitive for security analysts
- Integrating detection engines with live enterprise networks for proactive monitoring
- Maintaining model adaptability in response to emerging zero-day threats
- Addressing data privacy concerns when analyzing user-level behavioral logs

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team interested in from the following majors or areas of interest: Key Fields and Skillsets in Cybersecurity, AI, and Interpretability

- **Cybersecurity & Ethical Hacking** – Malware analysis, threat modeling, attack surface analysis
- **Explainable AI (XAI)** – Interpretable ML, human-in-the-loop systems, trust-building
- **Behavioral Analytics** – Sequential data mining, process behavior profiling
- **Machine Learning for Security** – Pattern recognition in malware and intrusion detection
- **Security Visualization** – Communicating threats through interactive graphs and dashboards
- **Cloud & DevSecOps** – Secure deployment of threat detection models in cloud environments
- **Digital Forensics** – Reverse engineering, dynamic analysis, and system log interpretation
- **Software Engineering for Security Tools** – Building scalable, secure detection pipelines

MENTOR CONTACT INFORMATION

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Leveraging CNNs, RNNs, LSTMs, and Transformers for complex tasks related to image recognition, NLP, and sequence data modeling

Dr. K.Rajendra Prasad, Professor & Head Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To explore and apply advanced deep learning architectures—namely Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long Short-Term Memory networks (LSTMs), and Transformers—to solve real-world problems in **image classification**, **natural language processing (NLP)**, and **sequential data modeling**. These neural network models form the backbone of modern AI systems and enable automation in tasks such as face recognition, sentiment analysis, translation, speech synthesis, and time series forecasting.

Students will gain in-depth experience designing, training, tuning, and evaluating these architectures, while addressing challenges such as overfitting, data imbalance, and real-time inference. The project will span multiple domains and modalities, providing a holistic understanding of how deep learning can be adapted and fine-tuned for varying data types and prediction goals.

The project emphasizes **cross-domain learning**, encouraging experimentation with multi-input and multi-output models, transfer learning, and data augmentation. Learners will also explore how temporal dependencies are modeled by LSTMs and how self-attention in Transformers has revolutionized NLP and vision tasks.

This project, students will have built a portfolio of deep learning models capable of handling structured and unstructured data, gaining not only technical mastery but also practical insight into designing solutions that scale and generalize.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Deep Learning Architectures for Multi-Domain AI Applications:

- **CNNs for Image Processing** – Image classification, object detection, medical image segmentation
- **RNNs and LSTMs** – Modeling sequential, temporal, and time-series data
- **Transformers for NLP** – Text classification, translation, summarization, BERT and GPT fine-tuning
- **Hybrid Architectures** – Combining CNNs with LSTMs for video and spatiotemporal tasks
- **Attention Mechanisms** – Self-attention, multi-head attention for long-range dependencies
- **Model Training Platforms** – TensorFlow, PyTorch, HuggingFace Transformers
- **Transfer Learning** – Using pretrained models (ResNet, VGG, BERT, etc.) for efficient training
- **Experimentation Tools** – TensorBoard, WandB for model tracking, tuning, and performance monitoring

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest:
Challenges in Cross-Domain Model Development and Deployment

- Managing high-dimensional data and computational cost for deep models
- Preventing overfitting in small or imbalanced datasets
- Capturing long-term dependencies in sequence modeling
- Implementing attention correctly for multilingual and multimodal inputs
- Training transformers on limited hardware with memory-efficient techniques
- Hyperparameter tuning across models with different convergence rates
- Creating interpretable models using visualization and attribution techniques
- Generalizing trained models to unseen data from different domains

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest:
Interdisciplinary Domains and Technical Skills for Deep Learning Innovation

- **Deep Learning & Neural Networks** – CNNs, RNNs, LSTMs, Transformers, encoder-decoder models
- **Computer Vision** – Image recognition, segmentation, object tracking
- **Natural Language Processing (NLP)** – Text mining, question answering, sentiment analysis
- **Time Series & Sequential Modeling** – Forecasting, anomaly detection in sequential data
- **Model Optimization & Deployment** – Quantization, pruning, ONNX, TensorRT for inference
- **Human-Centered AI** – Explainability, fairness, and bias mitigation in model decisions
- **AI in Healthcare & Finance** – Applying deep models to diagnostic or risk modeling tasks
- **Cloud & GPU Computing** – Accelerated training and deployment using cloud resources

MENTOR CONTACT INFORMATION

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Development of Data Strategies and Predictive Analytics for Real-Time Streaming Stock Data

Dr. K.Rajendra Prasad, Professor, Dept. of CSE (Data Science) – Faculty Mentor

GOALS

To design and implement intelligent data strategies that process, analyze, and predict stock market movements using real-time streaming data. Financial markets are highly dynamic and volatile, requiring models that can make fast, accurate, and interpretable decisions. This project empowers students to build an end-to-end data analytics pipeline that integrates real-time ingestion, feature engineering, time-series forecasting, and visualization.

Students will engage in developing scalable solutions for financial data acquisition from APIs and message brokers such as Kafka, stream preprocessing, and storing it using time-series databases. They will explore different financial indicators, such as moving averages, RSI, MACD, Bollinger Bands, and integrate these into machine learning or deep learning models to predict stock trends and anomalies.

The project also emphasizes the importance of model latency, accuracy, and the interpretability of trading decisions. Students will evaluate models based on metrics like RMSE, MAE, Sharpe ratio, and backtesting performance. Incorporating economic news, social sentiment data, and market signals from multiple sources will enable more robust predictions.

This project, students will have mastered the data engineering and analytics pipeline required for real-time financial analytics. They will be equipped to solve complex business problems related to algorithmic trading, risk modeling, and financial decision-making using advanced data science and AI techniques.

METHODS & TECHNOLOGIES

Cornerstone Project (CoP) team will focus on Real-Time Data Engineering and Predictive Modeling in Finance

- **Streaming Frameworks** – Apache Kafka, Apache Flink, Spark Streaming for real-time data pipelines
- **Time-Series Forecasting** – ARIMA, Prophet, LSTM, GRU for stock trend prediction
- **Feature Engineering** – Technical indicators, lagged features, rolling statistics
- **Modeling Techniques** – Regression, XGBoost, LSTM, Random Forest for prediction
- **Financial Data APIs** – Alpha Vantage, Yahoo Finance, Quandl for stock and index data
- **Visualization Dashboards** – Plotly, Dash, Streamlit for live tracking and analytics
- **Database Management** – Time-series databases like InfluxDB or NoSQL (MongoDB)
- **Backtesting Tools** – Zipline, Backtrader for model evaluation in trading scenarios

RESEARCH, DESIGN, & TECHNICAL ISSUES

Cornerstone Project (CoP) team should be interested in the following majors or areas of interest: Challenges in Real-Time Financial Data Processing and Modeling

- Handling noisy and non-stationary nature of financial time-series data
- Ensuring minimal latency in model predictions for live deployment
- Integrating external news and sentiment data with price feeds
- Managing scalability and reliability in streaming architecture
- Designing appropriate trading strategies and model evaluation criteria
- Addressing overfitting and bias in predictive models
- Ensuring fault tolerance and failure recovery in real-time pipelines
- Visualizing dynamic trends, alerts, and signals in live dashboards

MAJORS & AREAS OF INTEREST

Cornerstone Project (CoP) team should be interested in from the following majors or areas of interest: Cross-Functional Expertise for Financial Data Analytics and AI

- **Financial Data Science** – Stock forecasting, volatility modeling, trading analytics
- **Machine Learning** – Regression models, time-series prediction, ensemble methods
- **Real-Time Data Engineering** – Kafka, Spark, Flink, streaming pipeline design
- **Cloud & Distributed Systems** – Scalable deployments using AWS, Azure, or GCP
- **Quantitative Finance** – Technical analysis, indicators, trading strategy design

- **Dashboards & Visualization** – Interactive visualization of KPIs and trading signals
- **AI for FinTech** – Algorithmic trading, robo-advisory, market sentiment analysis
- **DevOps for Data Science** – Model monitoring, CI/CD pipelines, and alerts

MENTOR CONTACT INFORMATION

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