INSTITUTE OF AERONAUTICAL ENGINEERING

BIG DATA ANALYTICS - PROJECT

Information Packet

Academic Year: 2024-25

Appreciate IARE students who are showing interest in the Big Data Analytics Project Program at the Institute of Aeronautical Engineering!

Big data has emerged as an important and valuable component in the decision-making process for business, healthcare, finance and many other fields. There are two key aspects of big data. First, there is an incredible volume of data presently generated and available for analysis. Second, data comes in a variety of formats and different types of data require different types of analysis. Novel techniques are being developed to analyze this variety and volume of data. Our goal at this stage is to collect and develop techniques to analyze large datasets and to analyze various types of data, and to educate interested members of the Bentley community in their use

Big data analytics team members work as part of a research group of students, research scholars, and faculty members to tackle novel research and design problems around a theme. Students who join big data analytics teams earn academic credits (RBL / PBL) for participating in design/discovery efforts that assist faculty and students with research and development issues in their areas of expertise.

Big data analytics teams are:

- Collaborative Research – This is an excellent opportunity for students who are committed to research towards social developments and emerging needs for the industry.
- Internship Activity – The project coordinator listed current research areas for offering internships to either a single student or a team size of most two students. The coordinator allotted two mentors based on the research area and facilitated exclusive research laboratories for selected big data analytics students. This BIG DATA ANALYTICS project bridges the gap between academic learning and real-world social applications. It helps for enhancing the professional development
- Long-term - Each student may participate in a project for up to three months (January to March / May to July / September to November).

The primary goal of BIG DATA ANALYTICS is to provide a level of consistency, expertise, and diversity of thought in emerging research areas that will allow them to gain hands-on experience in academic or industrial research environments through this internship project.

- Provide students with immersive exposure to empirical research, experimental design, hypothesis formulation, data acquisition, statistical analysis, and technical reporting under expert mentorship.
- Integrate student researchers into ongoing faculty-led research programs, thereby enhancing research throughput.
- Contribute to the development of a vibrant research ecosystem that aligns with the institution's strategic goals in innovation, interdisciplinary collaboration, and knowledge production.
- Equip students with domain-specific research competencies, fostering critical thinking, problem-solving, and technical communication skills that are essential for advanced academic or industrial careers.
- Promote high-impact research outcomes for social applications, climate change, water management, effective energy usage, agriculture, etc.
- Encourage translational research and innovation with potential for intellectual property generation, prototype development.
- **The research theme of this BIG DATA ANALYTICS project also focuses on the challenges**

presented by the Sustainable Development Goals (SDGs).

IARE Sustainability Development Goals (SDGs) highlighted with Blue Colour Font	
SDG #1	End poverty in all its forms everywhere
SDG #2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
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 #5	Achieve gender equality and empower all women and girls
SDG #6	Ensure availability and sustainable management of water and sanitation for all
SDG #7	Ensure access to affordable, reliable, sustainable and modern energy 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 #10	Reduce inequality within and among countries
SDG #11	Make cities and human settlements inclusive, safe, resilient and sustainable
SDG #12	Ensure sustainable consumption and production patterns
SDG #13	Take urgent action to combat climate change and its impacts
SDG #14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG #15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG #16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG #17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

The following research domains are recommended for HIPs-BIG DATA ANALYTICS Projects, and selected students should find the research gap and frame the problem statements from any one of the themes below.

1. Global Studies and Living Standards (SDG #4)
2. Social Networks Analysis (SDG #11)
3. Marketing Analytics (SDG #12)
4. Health Care (SDG #3)
5. Media Analytics (SDG #16)
6. Finance Analytics (SDG #8)
7. Predictive Analytics (SDG #11,13)
8. Prescriptive Analytics (SDG #12)
9. Augmented Analytics (SDG #9)
10. Data Governance and Ethics (SDG #16)

In order to participate in BIG DATA ANALYTICS, you must formally apply and be accepted by the project coordinator. To proceed, please mail to the project coordinator, Dr. Y Mohana Roopa (ymohanaroopa@iare.ac.in), Professor of CSE. This will bring up all available open positions tagged as BIG DATA ANALYTICS projects. When submitting a project document and an updated résumé, include a statement regarding why you are interested in working with the team to which you are applying.

Please note that participation by the BIG DATA ANALYTICS team requires registration for the accompanying research statement from any of the specified domains. More information will be provided to all selected BIG DATA ANALYTICS applicants who have been offered a position.

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

Global Studies and Living Standards

Dr. Y Mohana Roopa, Professor Dept. of CSE- Faculty Mentor

GOALS

The global studies and living standards analytics are dedicated to the use of innovative data analysis techniques applied to household living standards survey data, promoting a better understanding of how and why living standards vary across the world. The approach is strongly cross-disciplinary, joining fields such as geography, economics, sociology and statistics, as well as global studies and computer science. Past and current interests include studies related to Africa, Vietnam and Asia and investigations of the international digital divide.

METHODS & TECHNOLOGIES

The Global Studies and Living Standards Analytics project employs a multidisciplinary approach combining statistical analysis, geospatial methods, and data science to evaluate and interpret patterns in human development and well-being across different regions. Methods used include Descriptive and Inferential Statistics, Comparative and Cross-Country Analysis, Time Series and Trend Analysis, Geospatial Analysis, Survey and Field Research Methods, Index Construction and Normalization. Technologies integrated in this project include Python and R Programming languages, Tableau and Microsoft Power BI to create interactive dashboards and data visualizations for effective communication of results.

MAJORS & AREAS OF INTEREST

Global Studies and Living Standards Analytics team needs a diversity of skills:

- Examines global interconnectedness, development challenges, and international policy frameworks
- Focuses on income distribution, poverty, inequality, economic development, and macroeconomic indicators that shape living standards.
- Explores social structures, cultural factors, and community-level dynamics affecting quality of life and well-being.
- Studies access to healthcare, nutrition, sanitation, and the social determinants of health in various populations.
- Analyzes government programs, social welfare systems, and policy interventions aimed at improving living conditions.
- Investigates spatial dimensions of development, regional disparities, urban-rural divides, and the role of infrastructure.
- Provides tools for data analysis, modeling, and visualization essential to measuring and interpreting living standards.

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Social Networks Analysis

Dr. M Lakshmi Prasad, Dept. of CSE – Faculty Mentor

GOALS

The SNAP group is interested in a variety of problems related to networks, where the focus is on links between people or entities. The team has investigated the evolution of cross-departmental co-publication links, introduced methods to generate random networks from a given distribution, and has recently investigated social links between household in a village in South India.

METHODS & TECHNOLOGIES

This project (SNAP) utilizes a combination of graph theory, statistical modeling, and computational tools to analyze the structure and behavior of networks formed by individuals, organizations, or digital entities. The project focuses on uncovering hidden patterns, identifying influential actors, and understanding the flow of information or resources within a network. Below are the core methods and technologies used as Graph Theory & Network Modeling, Centrality Measures, Community Detection Algorithms, Network Metrics and Structural Analysis. Technologies integrated in this project include Python and R Programming languages, Gephi and Cystoscope, Graphistry, D3.js to create interactive dashboards and data visualizations for effective communication of results

RESEARCH, DESIGN, & TECHNICAL ISSUES

Research Issues:

- How network structure affects influence and diffusion.
- Privacy implications in analyzing personal or sensitive data.
- Evolution of social behavior over time.

Design Issues:

- Designing scalable algorithms for large-scale networks.
- Ensuring usability in visual interfaces for non-technical users.
- Handling incomplete or noisy data.

Technical Issues:

- Data preprocessing and cleaning from APIs.
- Scalability challenges with massive graphs (millions of nodes).
- Real-time processing and updating of dynamic networks.
- Integrating multi-modal data (text, image, location).

MAJORS & AREAS OF INTEREST

This is particularly relevant to the following academic majors and interest areas:

- Computer Science (Algorithms, Machine Learning, Data Mining)
- Data Science (Big Data Analytics, Predictive Modeling)
- Information Systems (Network Modeling, Social Media Analytics)
- Sociology (Social Structures, Behavioral Patterns)
- Psychology (Influence, Group Dynamics)
- Marketing (Influencer Identification, Campaign Optimization)

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PARTNERS & SPONSORS

None

Marketing Analytics

Dr. M Lakshmi Prasad, Dept. of CSE – Faculty Mentor

GOALS

The primary goals of marketing analytics are to enhance marketing effectiveness, improve customer engagement, and drive better business decisions through data. It helps businesses understand how different marketing strategies perform, by evaluating key metrics such as return on investment (ROI), customer acquisition costs, and conversion rates. By leveraging analytics, organizations aim to gain deeper insights into customer behavior, preferences, and trends, enabling them to tailor campaigns for specific audiences. Additionally, marketing analytics supports long-term strategic planning by identifying market opportunities, forecasting demand, and optimizing pricing, promotion, and product positioning strategies.

METHODS & TECHNOLOGIES

- Statistical Techniques: Regression analysis, clustering, hypothesis testing, time-series analysis.
- Data Mining & Machine Learning: Decision trees, neural networks, predictive modeling.
- Tools & Platforms:
    - Software: Excel, SPSS, R, Python (pandas, scikit-learn), SAS.
    - BI Tools: Tableau, Power BI, Google Data Studio.
    - CRM & Marketing Platforms: HubSpot, Salesforce, Adobe Analytics, Google Analytics.
    - Databases & Cloud: SQL, BigQuery, AWS, Azure for data storage and processing.
- A/B Testing: To compare campaign variants and optimize performance.

RESEARCH, DESIGN, & TECHNICAL ISSUES

Despite its benefits, marketing analytics comes with several challenges. One major issue is ensuring data quality and integrity—data may be incomplete, inconsistent, or unstructured, which can distort analysis. Ethical concerns and regulatory compliance, such as adhering to GDPR and CCPA laws, are also critical when handling consumer data. Another technical challenge involves integrating data from multiple sources, including CRM systems, web analytics, and social media platforms, into a unified analytics framework. Overfitting models, limited interpretability of complex algorithms, and the need for real-time analytics capabilities also pose design and implementation issues. Furthermore, presenting findings in an accessible and actionable manner remains a vital design consideration in analytics workflows.

MAJORS & AREAS OF INTEREST

The following majors or areas of interest are identified in this theme of research work:

- Marketing: Focuses on consumer behavior, branding, and campaign strategy.
- Data Science: Emphasizes predictive modeling, machine learning, and data engineering.
- Business Analytics: Blends business acumen with data analysis for decision-making.
- Statistics & Mathematics: Provides foundational methods for modeling and inference.
- Computer Science: Involves building data pipelines, automation tools, and custom algorithms.
- Economics & Finance: For pricing strategies, demand forecasting, and market structure analysis.

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Health Care (SDG #3)

Dr. Y Mohana Roopa, Professor, Dept. of CSE– Faculty Mentor

GOALS

To enhance public health outcomes through the application of data-driven healthcare solutions. By leveraging advanced analytics and digital technologies, the project aims to improve disease prediction, patient care management, and healthcare accessibility for vulnerable populations. It emphasizes using real-time data to guide early interventions and reduce health disparities. This initiative supports the creation of personalized medicine strategies using patient data, leading to more accurate diagnosis and treatment plans. By integrating data from wearable devices, electronic health records (EHRs), and demographic statistics, it helps in mapping population health trends and prioritizing preventive care. The project also focuses on building predictive models to detect outbreaks and high-risk cases, thereby strengthening health systems' preparedness and responsiveness. It encourages partnerships with healthcare providers, policymakers, and NGOs to implement scalable, equitable health solutions.

Ultimately, this project aims to align technological innovation with the ethical delivery of care, ensuring digital health tools uphold patient privacy, consent, and equitable access across diverse communities.

METHODS & TECHNOLOGIES

To achieve improved health outcomes and equitable care access, this project employs a wide array of innovative methods and technologies:

- Electronic Health Records (EHRs) and Health Information Systems: Centralized digital systems store and manage patients' medical histories, lab results, diagnoses, and treatment plans. EHRs enable longitudinal tracking of patient data and facilitate real-time decision-making by healthcare professionals.
- Machine Learning & Artificial Intelligence (AI): Supervised and unsupervised learning models are used for disease diagnosis (e.g., cancer detection), risk stratification, and patient outcome prediction. Deep learning, particularly convolutional neural networks (CNNs), aids in medical image analysis like radiographs, MRIs, and CT scans.
- Predictive Analytics & Epidemiological Modeling: Predictive tools leverage historical data to forecast disease outbreaks, identify vulnerable populations, and allocate resources effectively. These models assist public health agencies in planning interventions.
- Wearable Devices & IoT Integration: Smartwatches, fitness trackers, and biosensors collect physiological data (heart rate, glucose levels, oxygen saturation) in real-time. These devices sync with cloud-based platforms for continuous health monitoring and early anomaly detection.
- Telemedicine & Mobile Health Applications (mHealth): Video consultations, chatbots, and mobile health apps bridge the gap between patients and providers, especially in rural or underserved areas. These platforms allow remote diagnosis, medication adherence tracking, and virtual follow-ups.
- Natural Language Processing (NLP): NLP algorithms analyze unstructured clinical notes, extract insights from physician documentation, and automate administrative tasks like billing and reporting.
- Cloud Computing & Big Data Platforms: Scalable infrastructure enables storage and high-speed analysis of vast amounts of healthcare data. Technologies like Apache Spark, Hadoop, and cloud platforms (AWS, Azure) support batch and real-time data processing for analytics and AI models.
- Blockchain for Health Data Security: In select use cases, blockchain technology ensures tamper-proof record-keeping, secure patient data sharing, and transparent consent management in clinical trials and health data exchanges.

RESEARCH, DESIGN, & TECHNICAL ISSUES

Challenges in Building Data-Driven, Equitable Health Systems

- Ensuring patient data privacy and compliance with health regulations (HIPAA/GDPR).

- Addressing biases in health datasets affecting minority and underserved populations.
- Managing interoperability among various healthcare systems and data standards.
- Real-time data ingestion and processing from heterogeneous sources (IoT, EHRs).
- Developing explainable AI models for clinical decision-making.
- Building scalable infrastructure for national/global health deployments.
- Engaging users and caregivers through intuitive health platforms.
- Evaluating cost-effectiveness of tech-enabled health interventions.

MAJORS & AREAS OF INTEREST

These areas are listed below in this theme of work:

- Health Informatics – Electronic Health Records, Data Integration, Health IT Systems
- Data Science & AI – Predictive Modeling, Machine Learning, NLP for Clinical Data
- Biomedical Engineering – Medical Device Integration, Signal Processing
- Public Health & Epidemiology – Population Health, Health Statistics, Policy Analysis
- Cybersecurity & Ethics – Patient Privacy, Data Protection Regulations
- Software Engineering – Mobile Apps, Telemedicine Platforms, Interoperable Systems

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Media Analytics (SDG #16)

Dr. S Janardhana Rao, Professor, Dept. of CSE– Faculty Mentor

GOALS

Media Analytics plays a pivotal role in promoting transparency, accountability, and inclusiveness in governance, which are key pillars of SDG #16. By leveraging data extracted from traditional and digital media, organizations and institutions can better understand public sentiment, detect misinformation, and identify early signs of conflict or unrest. The analysis of media coverage can also help ensure that the voices of marginalized communities are heard, contributing to a more equitable public discourse. In the context of democratic engagement, media analytics helps monitor political bias, election coverage, and media fairness, thus strengthening democratic institutions. Governments and civil society organizations can utilize such insights to shape communication strategies that foster peace and reduce polarization. Furthermore, media analytics aids in combating disinformation and fake news that undermine public trust. Advanced techniques like natural language processing (NLP) and sentiment analysis enable real-time identification of misleading content and promote fact-based communication.

By encouraging media literacy and fostering a culture of responsible journalism, media analytics contributes to a safer information ecosystem. These efforts support not only peace and justice but also sustainable development by empowering communities with credible and inclusive information.

METHODS & TECHNOLOGIES

- Natural Language Processing (NLP) – Sentiment detection, topic modeling, named entity recognition, language translation, context extraction.
- Machine Learning & AI – Classification models, bias detection, misinformation prediction, model training on multilingual datasets.
- Big Data Technologies – Hadoop, Spark, cloud-based storage, distributed computing, streaming data ingestion.
- Social Network Analysis – Influencer mapping, information diffusion, network visualization, echo chamber detection.
- Data Mining & Text Analytics – Keyword extraction, clustering, pattern recognition, summarization.
- Visualization Tools – Dashboards, heatmaps, network graphs, timeline-based visual storytelling.
- Media Monitoring Platforms – API integration (e.g., Twitter, NewsAPI), automated scraping, alert systems.
- Speech & Image Recognition – Audio transcription, visual content tagging, multimodal data analysis.

RESEARCH, DESIGN, & TECHNICAL ISSUES

- Data bias in media representation and reporting.
- Real-time processing and analysis of massive media streams.
- Multi-language content analysis and translation accuracy.
- Misinformation detection and source verification.
- Context-aware sentiment analysis limitations.
- Privacy concerns in user-generated content monitoring.
- Visualization of complex media networks and narratives.
- Integration of structured and unstructured media data.

MAJORS & AREAS OF INTEREST

Interdisciplinary Skills for Analyzing Media Ecosystems

- Media Studies & Communication – Media framing, political communication, digital literacy.
- Computer Science & AI – NLP, sentiment analysis, machine learning pipelines.
- Journalism & Ethics – Fact-checking, media responsibility, freedom of expression.
- Sociology & Political Science – Public opinion, civic participation, democratic institutions.
- Data Science & Analytics – Text mining, data cleaning, data visualization.
- Cybersecurity & Policy – Misinformation detection, information integrity, digital governance.

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Finance Analytics (SDG #8)

Dr. S Janardhana Rao, Professor, Dept. of CSE– Faculty Mentor

GOALS

Finance analytics aims to leverage data-driven insights to optimize financial performance, enhance decision-making, and support sustainable economic growth. By applying analytical tools to financial data, organizations can better forecast revenue, manage risk, and identify investment opportunities that align with long-term economic objectives.

One key goal of finance analytics is to improve financial inclusion by identifying underserved populations and evaluating the impact of microfinancing and digital payment systems. This supports SDG #8 by promoting equitable access to financial resources, especially for small businesses and vulnerable communities.

Furthermore, finance analytics enhances transparency in financial operations, enabling regulators and organizations to detect fraud, monitor compliance, and ensure ethical practices in economic systems. This contributes to building resilient financial institutions and fostering trust in economic ecosystems.

Finally, the integration of real-time data analytics helps in optimizing resource allocation and streamlining financial planning. This results in improved productivity, better employment outcomes, and strategic investments that stimulate job creation and sustainable development.

METHODS & TECHNOLOGIES

Advanced Analytical Tools and Financial Intelligence Platforms

- Financial Forecasting – Time Series Analysis, ARIMA, Exponential Smoothing, Regression
- Risk Analytics – Value at Risk (VaR), Monte Carlo Simulation, Stress Testing
- Performance Measurement – KPIs, Balanced Scorecard, Benchmarking Techniques
- Data Visualization – Tableau, Power BI, Financial Dashboards
- Machine Learning Models – Classification, Clustering, Decision Trees in Credit Scoring
- Big Data Technologies – Hadoop, Spark, NoSQL for Financial Data Management
- RPA and Automation – Automating Financial Reporting, Invoice Processing
- Cloud-Based Analytics – Azure Synapse, AWS Financial Data Lakes

RESEARCH, DESIGN, & TECHNICAL ISSUES

Challenges in Leveraging Analytics for Financial Sustainability

- Ensuring data accuracy and integrity in financial datasets
- Integrating structured and unstructured data from diverse financial sources
- Managing regulatory compliance across jurisdictions
- Addressing data privacy and cybersecurity in financial transactions
- Overcoming resistance to technology adoption in traditional finance sectors
- Designing user-centric financial dashboards for non-technical stakeholders
- Adapting predictive models to rapidly changing economic conditions
- Balancing automation with human oversight in high-risk financial decisions

MAJORS & AREAS OF INTEREST

Interdisciplinary Skills Supporting Finance Analytics

- **Finance & Accounting** – Financial Modeling, Corporate Finance, Investment Analysis
- **Economics** – Economic Indicators, Development Economics, Forecasting Techniques
- **Data Science** – Machine Learning, Data Mining, Predictive Modeling
- **Business Intelligence** – KPI Tracking, Business Forecasting, Dashboard Design

- **Information Systems** – ERP Systems, Financial Databases, Cloud Platforms
- **Statistics & Mathematics** – Probability, Inferential Statistics, Quantitative Finance
- **Ethics & Governance** – Regulatory Compliance, Data Ethics, Financial Risk Management
- **Public Policy** – Financial Inclusion, Socioeconomic Impact Analysis, Digital Finance Policies

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Predictive Analytics (SDG #11)

Dr. Madhavi Devi B, Associate Professor, Dept. of CSE – Faculty Mentor

GOALS

Predictive Analytics aims to harness historical and real-time data to forecast future trends, behaviors, and events, enabling proactive decision-making in urban development and climate change mitigation. In the context of SDG #11 and SDG #13, the overarching goal is to foster smart, sustainable, and resilient cities by anticipating challenges related to urban infrastructure, transportation, and environmental risks.

The initiative seeks to empower city planners and policymakers with data-driven insights that can optimize traffic flow, reduce carbon emissions, and ensure efficient public resource distribution. For example, predictive models can forecast peak pollution hours, energy consumption patterns, or the likelihood of natural disasters such as floods or heatwaves, allowing authorities to prepare adaptive response strategies.

Another critical aspect is reducing environmental impact through sustainable transportation planning and energy-efficient building design. Predictive analytics can assess the long-term effects of current urbanization trends and simulate the outcomes of proposed policies before implementation, promoting better urban management and reducing environmental degradation.

Lastly, this project promotes collaboration between data scientists, urban planners, and environmentalists to integrate multiple datasets—ranging from satellite imagery to IoT sensor feeds—into unified models. This collaboration enables comprehensive forecasting models that help cities achieve resilience and sustainability.

METHODS & TECHNOLOGIES

Advanced Tools for Forecasting Urban and Environmental Trends

- Machine Learning Algorithms – Regression, Random Forest, and Gradient Boosting for trend analysis and event forecasting
- Time-Series Analysis – ARIMA, LSTM, and Prophet for modeling temporal changes in traffic, pollution, and energy use
- Geospatial Analytics – GIS-based tools to map and predict urban growth and climate risks
- Big Data Platforms – Hadoop and Spark for processing large-scale, heterogeneous city and climate datasets
- Data Visualization – Tableau, Power BI, and D3.js to illustrate prediction outcomes for stakeholders
- IoT Integration – Real-time data collection from urban sensors for dynamic model updates
- Cloud Computing – AWS, Azure, and Google Cloud for scalable data storage and processing
- Simulation Tools – UrbanSim and AnyLogic for modeling future urban scenarios and infrastructure demand

RESEARCH, DESIGN, & TECHNICAL ISSUES

Challenges in Designing Predictive Models for Urban and Climate Systems

- Ensuring model accuracy across diverse and non-stationary datasets
- Integrating real-time and historical data for coherent prediction models
- Addressing data quality and missing values in urban and environmental datasets
- Balancing model complexity with interpretability for public sector use
- Designing predictive models that are adaptable to rapid urban changes
- Handling ethical concerns related to data privacy in smart cities
- Building interoperable systems that combine environmental, social, and infrastructure data
- Measuring and validating the impact of predictive analytics on SDG outcomes

MAJORS & AREAS OF INTEREST

Relevant Fields and Specializations for Impactful Predictive Analytics

- Data Science & Machine Learning – Forecasting, Classification, Model Optimization, Time-Series Forecasting
- Urban Planning & Smart Cities – Urban Informatics, Infrastructure Planning, Smart Transportation

Modeling
- Environmental Science & Climate Studies – Climate Modeling, Pollution Forecasting, Environmental Risk Analysis
- Geographic Information Systems (GIS) – Spatial Analysis, Map-Based Modeling, Urban Heat Island Studies
- Computer Science & Engineering – Scalable Computing, Cloud Platforms, Sensor Integration, Software Development
- Public Policy & Sustainability – SDG Implementation Strategies, Policy Simulation, Sustainable Resource Management

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Prescriptive Analytics (SDG #12)

Dr. Madhavi Devi B, Associate Professor, Dept. of CSE – Faculty Mentor

GOALS

Prescriptive analytics plays a pivotal role in promoting sustainable consumption and production patterns, as emphasized in SDG 12. By going beyond descriptive and predictive analytics, prescriptive analytics provides actionable recommendations that enable organizations to make data-driven decisions toward optimizing resource usage, minimizing waste, and enhancing supply chain efficiency.

This project aims to utilize prescriptive analytics to support industries and governments in formulating strategies that balance economic growth with environmental sustainability. For instance, optimizing inventory and production schedules using real-time data can significantly reduce resource overuse and limit surplus generation.

Another core goal is to develop data models that recommend sustainable product design, procurement, and recycling strategies. By integrating simulation models and scenario analysis, this project seeks to guide policy and business decisions that reduce environmental footprints.

Ultimately, the goal is to empower organizations with advanced analytical tools that facilitate smarter consumption and production pathways. Through the strategic use of optimization algorithms and decision modeling, prescriptive analytics can be a key enabler in meeting SDG 12's targets for sustainable resource management.

METHODS & TECHNOLOGIES

Advanced Analytical Frameworks for Sustainable Decision-Making

- **Optimization Models** – Linear, Integer, and Non-linear Programming
- **Decision Support Systems** – Business Rules, Policy Simulation, Resource Planning
- **Scenario Analysis Tools** – Monte Carlo Simulation, What-If Analysis
- **Machine Learning Techniques** – Reinforcement Learning, Decision Trees
- **Cloud Platforms & Tools** – AWS SageMaker, Azure ML Studio
- **Prescriptive Analytics Software** – IBM Decision Optimization, FICO Xpress
- **Visualization Platforms** – Tableau, Power BI for Decision Dashboards
- **Data Integration Pipelines** – ETL Tools, Real-time Data Streaming

RESEARCH, DESIGN, & TECHNICAL ISSUES

Challenges in Applying Prescriptive Models to Resource Optimization

- Handling data heterogeneity across consumption and production systems
- Balancing model complexity with interpretability for stakeholders
- Integrating multi-objective optimization with environmental constraints
- Ensuring scalability of decision models across different industries
- Designing algorithms that adapt to dynamic and real-time inputs
- Assessing trade-offs between profitability and sustainability
- Managing uncertainty and risk in resource availability
- Ensuring compliance with environmental regulations and standards

MAJORS & AREAS OF INTEREST

Academic and Practical Fields Supporting Sustainable Prescriptive Analytics

- **Operations Research** – Optimization, Simulation, Resource Allocation
- **Data Science** – Predictive Modeling, AI-based Decision Systems
- **Industrial Engineering** – Production Planning, Supply Chain Analytics
- **Environmental Studies** – Sustainable Resource Management, Lifecycle Analysis
- **Business Analytics** – Strategic Planning, Scenario Evaluation
- **Public Policy** – Regulation Modeling, Sustainability Impact Analysis
- **Information Systems** – Decision Support Systems, System Architecture
- **Applied Mathematics** – Mathematical Optimization, Systems Modeling

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Augmented Analytics (SDG #9)

Dr. Y Mohana Roopa, Professor Dept. of CSE – Faculty Mentor

GOALS

Augmented analytics leverages artificial intelligence (AI) and machine learning (ML) to enhance data preparation, insight generation, and decision-making. In the context of SDG 9, which focuses on building resilient infrastructure, promoting inclusive industrialization, and fostering innovation, augmented analytics provides an essential platform for accelerating smart and sustainable development.

This project focuses on integrating augmented analytics tools to automate and enhance data analysis processes in industrial and infrastructure sectors. Through AI-driven data discovery and real-time trend detection, stakeholders can proactively address maintenance needs, optimize asset usage, and improve supply chain performance.

The goal is also to democratize data science across all levels of an organization, enabling non-technical users to engage with complex data through natural language processing (NLP) and guided analytics. This inclusiveness supports innovation in both established and emerging industries.

Ultimately, augmented analytics aims to reshape how industrial and infrastructure decisions are made—bringing greater accuracy, speed, and strategic foresight to planning, development, and innovation initiatives.

METHODS & TECHNOLOGIES

AI-Powered Tools for Industrial Innovation and Infrastructure Development

- **Natural Language Processing (NLP)** – Conversational Queries, Auto-Generated Insights
- **Machine Learning Models** – Anomaly Detection, Predictive Maintenance
- **Data Preparation Automation** – Smart Wrangling, Auto-Cleansing Tools
- **Embedded Analytics** – In-App Insights, Real-Time Dashboards
- **AI-Driven BI Platforms** – Qlik Sense, Tableau AI, Power BI Copilot
- **Cloud-based Analytics** – Google Cloud AI, Azure Synapse, Snowflake
- **AutoML Frameworks** – Google AutoML, H2O.ai, DataRobot
- **Augmented Data Discovery** – Pattern Recognition, Root Cause Analysis

RESEARCH, DESIGN, & TECHNICAL ISSUES

Designing Scalable and User-Friendly Augmented Analytics Systems

- Ensuring interpretability of AI-generated insights
- Managing data quality and trust in automated systems
- Integrating legacy systems with modern analytics platforms
- Scaling models across diverse infrastructure environments
- Balancing real-time performance with computational cost
- Training non-technical users to interact with AI-driven tools
- Customizing analytics workflows for domain-specific applications
- Handling bias and fairness in automated insight generation

MAJORS & AREAS OF INTEREST

Interdisciplinary Focus Areas Supporting Augmented Industrial Analytics

- **Artificial Intelligence** – Machine Learning, Cognitive Computing
- **Data Engineering** – Data Pipeline Automation, ETL Workflows
- **Human-Computer Interaction** – NLP Interfaces, UX in Analytics
- **Industrial Systems** – Infrastructure Monitoring, Process Optimization
- **Software Engineering** – API Integration, Cloud Development
- **Business Intelligence** – Insight Generation, Embedded Reporting
- **Innovation Management** – Digital Transformation, Tech Adoption
- **Statistics & Analytics** – Time-Series Analysis, Pattern Discovery

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

Data Governance and Ethics (SDG #16)

Dr. S Dr. S Janardhana Rao, Assistant Professor Dept. of CSE – Faculty Mentor

GOALS

In an era where data is a vital asset, ensuring that data is managed ethically and responsibly is essential to achieving SDG 16. This goal emphasizes building effective, accountable institutions and promoting inclusive governance. Data governance and ethics provide the framework to uphold trust, transparency, and accountability in both public and private sectors. This project aims to design data governance frameworks that align with legal, regulatory, and ethical standards. It addresses critical issues like data ownership, consent, usage rights, and cross-border data flows, particularly important for institutions involved in justice, law enforcement, and public administration.

Another goal is to create awareness and implement practices that ensure fairness, transparency, and non-discrimination in algorithmic decisions. This includes bias auditing, explainability, and ethical AI practices—key to preventing misuse or manipulation of data.

Ultimately, the project envisions a landscape where data contributes to stronger governance, ethical policy-making, and secure digital public infrastructure. By instilling trust in data systems, institutions can be more inclusive, resilient, and just.

METHODS & TECHNOLOGIES

- Satellite Remote Sensing & UAV-based Data Acquisition for high-resolution multispectral and thermal imagery.

Frameworks and Tools for Ethical Data Governance

- **Data Governance Frameworks** – DAMA-DMBOK, FAIR Principles
- **Privacy & Security Tools** – Encryption, Anonymization, GDPR Compliance
- **AI Ethics Guidelines** – IEEE, EU AI Act Standards
- **Data Auditing Systems** – Bias Detection, Fairness Audits
- **Blockchain Technologies** – Decentralized Data Integrity, Traceability
- **Metadata Management** – Data Cataloging, Lineage Tracking
- **Policy Automation Engines** – Compliance-as-Code Tools
- **Responsible AI Platforms** – Explainable AI (XAI), Model Risk Management

RESEARCH, DESIGN, & TECHNICAL ISSUES

Ethical and Legal Challenges in Data Management and Governance

- Ensuring data transparency while protecting privacy
- Handling algorithmic bias and unfair treatment
- Aligning governance frameworks with evolving regulations
- Building systems for accountability in AI decisions
- Ensuring secure data sharing across jurisdictions
- Designing user consent models for digital services
- Mitigating risks of surveillance and data misuse
- Balancing innovation with ethical constraints

MAJORS & AREAS OF INTEREST

Domains Contributing to Ethical and Responsible Data Practices

- **Information Systems** – Data Architecture, Governance Models
- **Cybersecurity** – Data Protection, Risk Management
- **Law and Public Policy** – Digital Rights, Data Regulations
- **Ethics and Philosophy** – AI Ethics, Responsible Innovation
- **Computer Science** – Secure Systems Design, AI Explainability
- **Public Administration** – Governance Frameworks, Accountability Tools
- **Sociology & Psychology** – Human-Centered Technology, Social Impact
- **Data Science** – Bias Detection, Transparent Modeling

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None