Training Course on AI for Environmental Monitoring and Anomaly Detection

Professional Development Training Course Outline

Category	GIS	**Duration**	10 Days
Base Fee	$3,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

This comprehensive training course explores the transformative power of **Artificial Intelligence (AI)** and **Geographic Information Systems (GIS)** in revolutionizing **environmental monitoring** and **anomaly detection**. Participants will gain cutting-edge skills in leveraging **geospatial AI** for **sustainable development** and **climate action**. The curriculum emphasizes hands-on application of **machine learning** and **deep learning** techniques to analyze **remote sensing data**, identify **environmental changes**, and proactively detect **anomalies** across diverse ecosystems. Training Course on AI for Environmental Monitoring and Anomaly Detection is designed to equip professionals with the tools and knowledge necessary to address pressing **environmental challenges** through **data-driven insights** and **predictive analytics**.

The integration of AI with GIS offers unprecedented capabilities for understanding, managing, and protecting our planet. From tracking **deforestation** and **water quality** to monitoring **biodiversity** and predicting **natural disasters**, **GeoAI** provides a powerful framework for real-time analysis and informed decision-making. This course delves into practical methodologies for deploying AI models on **large-scale geospatial datasets**, enabling participants to develop solutions for **pollution detection**, **land-use change analysis**, and the early identification of **environmental risks**. By mastering these advanced techniques, learners will contribute to more effective **environmental stewardship** and enhance **resilience** against global environmental threats.

Programme Curriculum

Training Course on AI for Environmental Monitoring and Anomaly Detection

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Course Duration

10 days

Course Objectives

1. Understand the core concepts of Artificial Intelligence, Machine Learning, Deep Learning, and their integration with Geographic Information Systems for **environmental applications**.
2. Proficiently handle and preprocess various types of **remote sensing data** for AI model input.
3. Implement supervised and unsupervised machine learning algorithms for **land cover classification**, **habitat mapping**, and **environmental pattern recognition**.
4. Build and deploy AI models to **detect unusual patterns** and **outliers** in environmental datasets, such as pollution events or illegal activities.
5. Apply **Convolutional Neural Networks (CNNs)** for advanced **image classification**, **object detection**, and **change detection** in environmental contexts.
6. Analyze **temporal geospatial data** to identify trends, forecast environmental changes, and detect **spatio-temporal anomalies**.
7. Seamlessly integrate developed AI models with popular GIS software for visualization, further analysis, and reporting.
8. Evaluate the accuracy and reliability of AI models using appropriate metrics for **geospatial data**.
9. Design and implement automated pipelines for continuous **environmental data processing** and **real-time anomaly alerts**.
10. Apply AI and GIS to solve real-world **environmental problems**, including **deforestation monitoring**, **water quality assessment**, and **disaster management**.
11. Effectively interpret and communicate the results of AI analyses to inform **environmental policy** and **conservation strategies**.
12. Understand the ethical considerations and best practices for responsible deployment of AI in **environmental data analysis**.
13. Recognize emerging technologies and future directions in **geospatial AI** for **environmental sustainability**.

Organizational Benefits

- Automate complex environmental data analysis, saving significant time and resources.
- Leverage AI for more precise detection of environmental changes and anomalies, leading to better decision-making.

- Identify potential environmental issues and threats earlier, enabling timely interventions and reducing impacts.
- Empower staff with the skills to extract actionable insights from vast environmental datasets.
- Direct resources more effectively to areas requiring immediate environmental attention.
- Improve compliance with environmental regulations through robust and transparent monitoring systems.
- Stay at the forefront of environmental technology by integrating cutting-edge AI and GIS capabilities.
- Contribute to broader sustainability goals by employing advanced tools for environmental stewardship.

Target Audience

1. Environmental Scientists and Researchers.
2. GIS Professionals and Analysts
3. Data Scientists and AI Engineers datasets.
4. Conservation Biologists and Ecologists.
5. Urban Planners and Policy Makers.
6. Resource Managers.
7. Remote Sensing Specialists
8. Consultants in Environmental and Geospatial Sectors

Course Outline

Module 1: Introduction to AI, GIS, and Environmental Monitoring

- Foundations of AI and Machine Learning
- GIS for Environmental Applications.
- Synergy of AI and GIS (GeoAI).
- Big Data in Environmental Science
- Ethical Considerations in GeoAI
- **Case Study**: Analyzing historical satellite imagery of the Amazon rainforest to identify early signs of deforestation patterns before the widespread adoption of AI.

Module 2: Geospatial Data Acquisition and Preprocessing

- Sources of Environmental Geospatial Data
- Data Formats and Structures
- Data Cleaning and Transformation.
- Feature Engineering for AI Models.
- Cloud Platforms for Geospatial Data.
- **Case Study**: Preprocessing a time-series dataset of water quality parameters from IoT sensors in a river basin, including outlier removal and normalization, to prepare for anomaly detection.

Module 3: Fundamentals of Machine Learning for Geospatial Data

- Supervised Learning Algorithms
- Unsupervised Learning Algorithms.
- Model Training and Validation
- Feature Selection and Importance
- Introduction to Python Libraries
- **Case Study**: Training a Random Forest classifier to categorize different land cover types (forest, urban, water) from multispectral satellite imagery of a region affected by

urbanization.

Module 4: Spatial Statistics and Geostatistics

- Understanding Spatial Autocorrelation.
- Spatial Interpolation Techniques.
- Hotspot Analysis.
- Geographically Weighted Regression (GWR).
- Integrating Spatial Statistics with ML.
- **Case Study**: Using Kriging to map predicted air pollutant concentrations across a city based on sparse sensor data and identifying high-pollution hotspots.

Module 5: Anomaly Detection Techniques

- Definition and Types of Anomalies data.
- Statistical Methods for Anomaly Detection.
- Proximity-Based Anomaly Detection.
- Density-Based Anomaly Detection.
- Time-Series Anomaly Detection.
- **Case Study**: Detecting unusual increases in chlorophyll-a levels in a lake using statistical anomaly detection methods, potentially indicating an algal bloom.

Module 6: Deep Learning for Remote Sensing Imagery

- Introduction to Neural Networks.
- Convolutional Neural Networks (CNNs).
- Image Classification with CNNs.
- Object Detection in Satellite Imagery).
- Semantic Segmentation).
- **Case Study**: Developing a CNN model to classify different types of agricultural crops from high-resolution drone imagery, supporting precision agriculture.

Module 7: Advanced Anomaly Detection with Deep Learning

- Autoencoders for Anomaly Detection.
- Recurrent Neural Networks (RNNs) for Time-Series Anomalies.
- Generative Adversarial Networks (GANs) for Anomaly Detection.
- One-Class SVM for Novelty Detection.
- Deep Learning Frameworks.
- **Case Study**: Using an Autoencoder to detect anomalies in satellite-derived vegetation index (NDVI) time-series data, indicating unexpected vegetation stress or decline.

Module 8: Spatio-Temporal Anomaly Detection

- Concepts of Spatio-Temporal Data.
- Spatio-Temporal Clustering.
- Change Detection with AI.
- Predictive Anomaly Detection.
- Visualizing Spatio-Temporal Anomalies
- **Case Study**: Detecting sudden changes in urban footprint from multi-temporal satellite imagery, indicating rapid and potentially unauthorized urban sprawl.

Module 9: Integrating AI Models with GIS Software

- **GIS Software for AI Integration**.

- Scripting for GIS Automation
- Geoprocessing with AI Outputs
- Web GIS for Environmental Monitoring.
- Data Visualization and Storytelling.
- **Case Study**: Integrating a developed pollution hotspot detection model into ArcGIS Pro to visualize real-time pollution alerts on an interactive map.

Module 10: Environmental Monitoring Applications

- Air Quality Monitoring and Prediction.
- Water Resource Management.
- Forestry and Land Use Change.
- Wildlife Conservation.
- Disaster Management and Response.
- **Case Study**: Applying AI models to satellite imagery to monitor deforestation in a protected area and automatically generate alerts for illegal logging activities.

Module 11: Climate Change Monitoring and Resilience

- AI for Climate Impact Assessment.
- Carbon Sequestration Monitoring.
- Climate Change Adaptation Strategies.
- Greenhouse Gas Emission Monitoring.
- Climate Risk Assessment.
- **Case Study**: Utilizing AI to analyze historical climate data and satellite imagery to identify regions most vulnerable to drought, aiding in agricultural planning and water resource management.

Module 12: Urban Environmental Monitoring and Smart Cities

- Urban Heat Island Effect Mapping.
- Urban Green Space Monitoring.
- Waste Management Optimization.
- Noise Pollution Mapping.
- Sustainable Urban Planning
- **Case Study**: Mapping urban heat island intensity using satellite thermal imagery and AI to identify areas needing green infrastructure development

Module 13: IoT, Drones, and Real-Time Environmental Monitoring

- IoT Sensors for Environmental Data.
- Drone-Based Environmental Monitoring
- Real-time Data Streams and Processing
- Edge Computing for Environmental AI.
- Automated Alert SystemsUpcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

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