Training Course on Raster Data Processing and Advanced Manipulation

Professional Development Training Course Outline

Category	GIS	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

In today's data-driven world, **Geographic Information Systems (GIS)** are indispensable for **spatial analysis** and **decision-making**. Within GIS, **raster data** stands as a fundamental data model, representing continuous phenomena like elevation, temperature, and satellite imagery through a grid of pixels. Mastering raster data processing and advanced manipulation techniques is crucial for professionals across diverse sectors, enabling them to unlock profound **geospatial insights** and drive **data-informed strategies**. This comprehensive course delves into the core principles and cutting-edge methodologies, empowering participants to effectively manage, analyze, and visualize complex raster datasets.

Training Course on Raster Data Processing and Advanced Manipulation focuses on practical, hands-on application of **geospatial tools** and **programming languages** for **raster analytics**. Participants will gain expertise in **digital image processing**, **terrain modeling**, **remote sensing data analysis**, and **spatial statistics** applied to raster formats. From foundational concepts to advanced **geoprocessing workflows** and **automation**, the curriculum is designed to equip individuals with the skills to tackle real-world challenges in fields such as **environmental monitoring**, **urban planning**, **resource management**, and **disaster response**, leveraging the power of **high-resolution imagery** and **multi-spectral data**.

Programme Curriculum

Training Course on Raster Data Processing and Advanced Manipulation

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Course Duration

5 days

Course Objectives

1. Comprehend the core **raster data model**, **pixel properties**, and various **raster formats**
2. Accurately **georeference** and **orthorectify** satellite and aerial imagery for precise spatial alignment.
3. Apply **image enhancement**, **filtering**, and **spectral analysis** for improved data interpretation.
4. Generate **Digital Elevation Models (DEMs)**, analyze **slope, aspect, and curvature**, and perform **watershed delineation**.
5. Execute complex **mathematical operations** and **conditional statements** on raster layers for suitability analysis.
6. Process **multi-spectral** and **hyper-spectral imagery** for **land cover classification** and **change detection**.
7. Implement **spatial autocorrelation**, **interpolation methods** (e.g., Kriging), and **hot spot analysis** on continuous surfaces.
8. Seamlessly **integrate raster and vector data** for comprehensive **geospatial modeling**.
9. Develop **geoprocessing scripts** using **ArcPy**, **GDAL**, **Rasterio**, or **terra** for efficient workflow automation.
10. Explore **cloud GIS platforms** (e.g., Google Earth Engine, AWS S3) for scalable **big data analytics**.
11. Differentiate and classify features based on **spectral, spatial, and contextual characteristics** for refined analysis.
12. Apply **supervised and unsupervised machine learning algorithms** (e.g., Random Forest, SVM) for **image classification**.
13. Create compelling **raster visualizations** and **interactive maps** for effective communication of spatial insights.

Organizational Benefits

- Equip teams with advanced **spatial intelligence** for more informed and strategic decisions in **resource allocation**, **risk assessment**, and **policy formulation**.
- Automate **repetitive GIS tasks** through scripting, significantly reducing processing time and **manual effort**.

- Optimize **data management** and **analysis workflows**, minimizing the need for external consultants and specialized software licenses.
- Foster deeper understanding of **environmental patterns**, **urban dynamics**, and **geological features** through sophisticated raster analysis.
- Develop in-house expertise in **cutting-edge geospatial technologies**, enabling the organization to lead in **innovation** and **solution delivery**.
- Implement best practices for **raster data validation** and **quality control**, ensuring robust and trustworthy analytical outputs.
- Empower employees with highly sought-after **geospatial skills**, increasing internal capabilities for complex **spatial projects**.

Target Audience

1. GIS Professionals & Analysts
2. Environmental Scientists & Researchers
3. Urban Planners & Developers
4. Remote Sensing Specialists
5. Hydrologists & Geologists
6. Agricultural Scientists.
7. Data Scientists & Developers.
8. Emergency Management & Disaster Response Teams

Course Outline

Module 1: Raster Data Fundamentals and Visualization

- Understanding the **raster data model**: pixels, resolution, cell values, and bands.
- Common **raster data formats** (GeoTIFF, JPEG2000, NetCDF) and their characteristics.
- Basic **raster visualization** techniques: symbology, stretching, and color ramps.
- **Georeferencing** unreferenced imagery using ground control points (GCPs).
- **Case Study**: **Mapping Historical Urban Growth** - Georeferencing scanned historical maps to modern satellite imagery to analyze urban sprawl over decades.

Module 2: Raster Pre-processing and Enhancement

- **Image rectification** and **orthorectification** for geometric correction.
- **Radiometric correction** techniques to adjust for atmospheric and sensor variations.
- **Image enhancement**: contrast stretching, histogram equalization, and spatial filtering
- **Mosaic datasets** and techniques for seamless integration of multiple raster images.
- **Case Study**: **Satellite Image Pre-processing for Agricultural Monitoring** - Correcting Sentinel-2 imagery for atmospheric effects and creating a seamless mosaic for a large farm area to prepare for vegetation index calculation.

Module 3: Raster Algebra and Spatial Analysis

- Introduction to **Map Algebra** and the **Raster Calculator**.
- **Local, focal, zonal, and global operations** on raster datasets.
- **Reclassification** and **suitability analysis** using multiple raster layers.
- Calculating **distance rasters** and **cost paths**.
- **Case Study**: **Site Suitability Analysis for a New Development** - Using raster algebra to combine layers like slope, proximity to roads, land cover, and elevation to identify optimal development sites.

Module 4: Terrain Analysis and Hydrologic Modeling

- Generating **DEMs** from various sources (LiDAR, contours).
- Deriving **slope, aspect, hillshade, and curvature** from DEMs.
- **Hydrologic functions**: fill sinks, flow direction, flow accumulation, watershed delineation, and stream network extraction.
- Creating **viewshed analysis** and **intervisibility maps**.
- **Case Study**: **Flood Risk Assessment and Mitigation Planning** - Analyzing a DEM to delineate watersheds, model potential flood inundation areas, and identify critical infrastructure at risk.

Module 5: Remote Sensing for Land Cover and Change Detection

- **Spectral signatures** and **vegetation indices** (NDVI, EVI, SAVI).
- **Supervised classification**: training data collection, algorithm selection (Maximum Likelihood, SVM, Random Forest), and accuracy assessment.
- **Unsupervised classification**: K-means, ISODATA, and cluster analysis.
- **Change detection techniques**: image differencing, image ratioing, and post-classification comparison.
- **Case Study**: **Monitoring Deforestation in a Protected Area** - Using multi-temporal Landsat imagery and supervised classification to detect and quantify forest loss over a specific period.

Module 6: Advanced Raster Manipulation and Spatial Statistics

- **Resampling methods**: nearest neighbor, bilinear interpolation, cubic convolution.
- **Raster to vector conversion** and **vector to raster conversion**.
- **Spatial autocorrelation**: Moran's I and Local Indicators of Spatial Association (LISA) for identifying spatial patterns.
- **Geostatistical interpolation**: Inverse Distance Weighting (IDW) and Kriging for creating continuous surfaces from point data.
- **Case Study**: **Mapping Air Pollution Concentration** - Interpolating air quality sensor data (point data) onto a continuous raster surface using Kriging to visualize pollution hotspots.

Module 7: Scripting and Automation for Raster Workflows

- Introduction to **Python libraries for GIS**: **GDAL**, **Rasterio**, **NumPy**, **SciPy**, **Matplotlib**.
- Automating **geoprocessing tasks** using **ArcPy** (for ArcGIS users) or custom scripts.
- Batch processing multiple raster datasets.
- Building **custom tools** and **models** for repetitive analysis.
- **Case Study**: **Automated Daily Satellite Image Processing** - Developing a Python script to automatically download, pre-process, and calculate NDVI for new satellite images as they become available.

Module 8: Cloud-Based Raster Processing and Big Data

- Concepts of **cloud computing** and **big geospatial data**.
- Introduction to **Google Earth Engine (GEE)**: accessing large archives of satellite imagery and performing on-the-fly analysis.
- **Distributed raster processing** principles.
- Utilizing **cloud storage (AWS S3)** and **compute resources** for large-scale raster operations.
- **Case Study**: **Global Land Cover Mapping with Google Earth Engine** - Leveraging GEE's computational power to classify land cover for an entire continent using years of multi-

spectral satellite data.

Training Methodology

This training course employs a highly **interactive** and **hands-on** methodology, combining theoretical concepts with practical application.

- **Instructor-Led Sessions**: Clear and concise presentations of core concepts, best practices, and advanced techniques.
- **Demonstrations**: Live demonstrations of software functionalities (QGIS, ArcGIS Pro, Python notebooks) and workflow execution.
- **Practical Exercises**: Extensive hands-on exercises and labs using real-world **geospatial datasets** to reinforce learning and build practical skills.
- **Case Studies**: In-depth analysis of industry-relevant **case studies** to illustrate the application of raster processing techniques in diverse scenarios.
- **Group Discussions**: Fostering collaborative learning and problem-solving through peer interaction.
- **Q&A Sessions**: Dedicated time for participants to ask questions and receive personalized guidance.
- **Project-Based Learning**: Opportunities for participants to work on a small project applying learned skills, with instructor feedback.
- **Resource Sharing**: Provision of course materials, datasets, scripts, and links to additional resources for continuous learning.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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