Learning that connects methods to water

Baipatra VSC

Very Short-Term Courses on Hydroinformatics Engineering. A collection of learning resources connecting computational methods, spatial analysis and water-resource applications.

By Dr. Mrinmoy Majumder

Associate Professor, National Institute of Technology Agartala.

What this expanded brochure contains

Full names of techniques and abbreviations, concise topic explanations, application contexts and a guide to the learning resources identified in the publication.

Subject areas

Artificial intelligence and neural networks; optimization; multi-criteria decision-making; Geographic Information Systems and remote sensing; data science and statistics; hydrological modelling; smart water systems.

How to read this brochure

Topic descriptions explain the subject matter; they are editorial summaries, not a verified lesson-by-lesson syllabus or a promise that every subtopic is taught. Some resources are courses; others are tutorials, articles, quizzes or application announcements.

Access and intended audience

For students, researchers, educators and practising engineers. Free and paid materials are available; current access, lesson availability and subscription terms should be checked on each publication page.

Artificial intelligence & neural networks

Artificial Intelligence (AI) in Water Resources

Explores the use of computational intelligence in water-resource problems. The identified e-course introduces neural-network approaches through presentations and examples.

Artificial Neural Networks (ANNs)

Models composed of interconnected computational units that learn input-output relationships from data. The publication includes introductory material on basic concepts and developing a neural-network model.

Simple Neural Networks

Introduces elementary network structures and the relationship between input variables and model outputs. Provides a starting point for understanding network-based prediction.

Polynomial Neural Networks

Neural-network approaches using polynomial relationships to represent nonlinear dependencies. Listed alongside simple neural networks in the Artificial Intelligence and Water Resources e-course.

Artificial Intelligence and Water Resource Development

An application-oriented theme connecting AI methods with water engineering. Specific datasets, software requirements and model-assessment exercises depend on the individual resource.

Related reading: variants of neural networks

The publication also identifies comparative material on recent and widely used artificial-neural-network variants. This is related reading rather than confirmation of a separate course for each architecture.

Optimization & nature-inspired methods

Optimization: foundations, classification and constraints

Introduces the problem of selecting a solution that improves an objective while respecting restrictions. Objective functions, decision variables and constraints provide the conceptual framework.

Genetic Algorithm (GA)

An evolutionary search approach inspired by inheritance and natural selection. Candidate solutions are improved through selection and variation; included among the nature-inspired topics previously identified.

Glowworm Optimization / Glowworm Swarm Optimization (GSO)

A swarm-inspired search approach associated with glowworm signalling. The publication links glowworm optimization with hydroclimatic vulnerability analysis. Avoid confusing it with Grey Wolf Optimizer, which also sometimes appears under the abbreviation GWO.

Whale Optimization Algorithm (WOA)

A population-based optimization method inspired by humpback-whale behaviour. The publication provides an essentials-focused tutorial under its metaheuristic learning resources.

Crayfish Optimization Algorithm (COA)

A nature-inspired optimization method taught in a multi-part series. Identified lessons cover population and fitness, temperature generation using random numbers, shelter seeking, competition, pseudocode and implementation.

Comparative reading on bio-inspired algorithms

Includes an overview of recent bio-inspired optimization methods. Comparative reading helps distinguish algorithm inspiration, search behaviour and implementation choices; it does not establish a separate taught course for every algorithm mentioned.

Multi-criteria decision-making

Multi-Criteria Decision-Making (MCDM)

A family of methods for evaluating alternatives against multiple, potentially conflicting criteria. Foundational learning covers decision matrices, weighting, aggregation and ranking.

Weighted Sum Method (WSM) and Weighted Product Method (WPM)

WSM combines criterion scores using a weighted additive expression. WPM uses multiplicative aggregation, with criterion weights acting as exponents. Both introduce structured multi-criteria evaluation.

Analytic Hierarchy Process (AHP)

Structures a decision into a hierarchy and uses pairwise comparisons to derive priorities. Commonly applied to criterion weighting and alternative evaluation.

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

Ranks alternatives according to their relationship to ideal and negative-ideal solutions. The publication offers a dedicated multi-part series using real-life case studies.

Complex Proportional Assessment (COPRAS)

Evaluates alternatives using weighted beneficial and non-beneficial criteria and derives relative priorities or utility measures. Covered by a dedicated multi-part e-course.

ELECTRE I and ELECTRE II

ELECTRE expands to Elimination et Choix Traduisant la Realite, commonly rendered in English as Elimination and Choice Expressing Reality. These are outranking methods: ELECTRE I primarily supports selection; ELECTRE II develops rankings.

Evaluation of Mixed Criteria (EVAMIX)

A decision method designed to work with mixed qualitative and quantitative criteria. The publication includes an introduction and an application-oriented tutorial linking EVAMIX with optimization.

Geographic information & remote sensing

Geographic Information Systems (GIS)

Systems for managing, analysing and presenting geographically referenced information. The identified GIS course uses hands-on examples and real-life case studies.

Coordinate systems and image registration

Coordinate systems provide a spatial reference. Image registration aligns imagery with a reference; georeferencing assigns real-world coordinates. These operations support consistent mapping and analysis.

GIS digitisation

Converts mapped features into digital spatial data, commonly as points, lines and polygons. Practical workflows include tracing features and editing vector layers.

Area, length and field calculations

Uses feature geometry and attribute expressions to calculate quantities and populate data fields. Identified examples refer to MapWindow GIS.

Hydropower penstock mapping

A practical digitisation theme using site maps to represent penstock alignments. Links GIS feature creation with water-infrastructure interpretation.

Rainfall distribution mapping

Represents spatial variation in rainfall for interpretation and water-resource analysis. The exact mapping method and software depend on the individual lesson.

Remote sensing and GIS assessment

Related educational resources include multiple-choice questions on GIS and remote sensing, alongside GIS applications in water-resource management.

Data science & statistical methods

Introduction to Data Science

An introductory e-course using practical, real-world case studies. Provides a route into working with data and interpreting analytical results.

Autocorrelation

Examines how a variable relates to lagged versions of itself. Useful for understanding persistence or repeating structure in time-series observations.

Cross-correlation

Examines how two variables relate at different relative time lags. Relevant to exploring delayed relationships between environmental time series.

Mann-Kendall Test for Trend Detection

A non-parametric method for assessing monotonic trends. The publication includes an introductory tutorial on its use in trend detection.

Outlier detection in river-discharge data

Examines unusual observations and extremes. The identified practical tutorial references Pearson Type III-based analysis. Suspected outliers require investigation rather than automatic deletion.

Naming clarification: Pearson and Log-Pearson Type III

Pearson Type III and Log-Pearson Type III are related but distinct distributional approaches: the latter applies the distribution to logarithmically transformed data. The retrieved tutorial title supports Pearson Type III; the earlier brochure's Log-Pearson label should not be treated as verified.

Hydrology & connected water systems

Water Budget Equation and Water Balance Analysis

Accounts for water entering, leaving and being stored within a defined system. Provides a framework for interpreting catchment, reservoir or site-scale water movement.

Nash's Conceptual Model

A conceptual hydrological model representing catchment response using a cascade of linear reservoirs. The publication archive identifies learning material under Nash's model and flood-routing themes.

Reservoir routing methods

Studies how inflow, outflow and storage evolve over time through a reservoir. Related publication material compares reservoir-routing approaches.

Water auditing and hydroinformatics research

Related resources explore water accounting, computational approaches in water engineering, research trends and potential research opportunities.

Internet of Things (IoT) and smart water systems

Application-oriented resources connect digital monitoring with smart metering, leak detection and flood monitoring. These are related themes, not verified standalone courses.

Computational Fluid Dynamics (CFD) and flood inundation mapping

An application/internship announcement discusses integrating CFD with MCDM and GIS for flood-related mapping. This is an application resource, not confirmation of a currently available taught course or internship.

Fluid mechanics knowledge assessment

Assessment-oriented material complements the water-engineering topics. Availability, format and access should be confirmed from the publication archive.

Explore the learning collection

Publication links and scope

Publication and archive

Artificial Intelligence and Water Resources

Seven Nature Inspired Optimization Techniques

Whale Optimization Algorithm

Crayfish Optimization Algorithm

Multi-Criteria Decision-Making e-course

GIS e-course

Autocorrelation and cross-correlation

Mann-Kendall Test

EVAMIX introduction

Flood modelling application

Editorial and access notes

This expanded brochure consolidates topics identified in the publication pages and the earlier discussion. Source titles establish topic presence; explanatory descriptions provide subject context and are not verbatim course syllabi. No certification, course duration, fees, software package, learning outcome or current internship availability is guaranteed. Check original pages before enrolling.

Corrections to the earlier version

Glowworm optimization is named explicitly to avoid confusion with Grey Wolf Optimizer. Pearson Type III is retained as the verified tutorial label rather than assuming Log-Pearson Type III. Courses, related reading, assessments and application announcements are distinguished throughout.

Visit and subscribe

https://veryshorttermcourse.substack.com/