Advanced Course

Applications of artificial intelligence in the agrifood sector

Zaragoza (Spain)・29 September-3 October 2025

Programme

0. Opening session and programme presentation (1 hour)

1. Artificial Intelligence: Overview in the Agrifood System (5.5 hours)

- 1.1 Introduction to a digital Agrifood 4.0 system
  - 1.1.1 Digitalisation of the agrifood system
  - 1.1.2 Opportunities
  - 1.1.3 Barriers and challenges for the application of AI in the agrifood sector
  - 1.1.4 Sustainability, environmental impact and climate resilience across the agrifood sector
  - 1.1.5 Ethics & legislation
- 1.2 Fundaments of Artificial Intelligence
- 1.3 Artificial Intelligence methods
  - 1.3.1 Supervised learning
  - 1.3.2 Unsupervised learning
  - 1.3.3 Reinforcement learning
- 1.4 Application of Artificial Intelligence
  - 1.4.1 Tabular data
  - 1.4.2 Time series prediction
  - 1.4.3 Machine vision
  - 1.4.4 Natural language processing
- 1.5 Practical work 1: A data-driven project: CRISP-DM

2. Artificial Intelligence in Agriculture (7 h)

- 2.1 Precision agriculture
  - 2.1.1 Robotics, drones, self-driven vehicles for crop management
  - 2.1.2 Crop and soil analysis
  - 2.1.3 Irrigation requirements
  - 2.1.4 Prediction of the impact of climate change on agrifood sectors
- 2.2 Plant breeding
  - 2.2.1 Phenotyping
  - 2.2.2 Genetic information
- 2.3 Crop disease and pest detection
  - 2.3.1 Early detection of disease and pests
  - 2.3.2 Harvest detection
  - 2.3.3 Post harvest detection
- 2.4 Optimisation of irrigation and fertilisation
  - 2.4.1 Irrigation schedule
  - 2.4.2 Identifying irrigation needs
  - 2.4.3 Nutrient management and precision fertilisation
  - 2.4.4 Water conservation strategies
- 2.5 Practical work 2: A decision support system for agriculture management

3. Artificial Intelligence in Livestock Farming (7 h)

- 3.1 Smart livestock monitoring
  - 3.1.1 Animal identification
  - 3.1.2 Behaviour tracking
- 3.2 Disease management and traceability
  - 3.2.1 Animal health monitoring
  - 3.2.2 Prediction and early detection
  - 3.2.3 Disease traceability
- 3.3 Feed and production optimisation

- 3.3.1 Feed formulation for optimal nutrition
- 3.3.2 Prediction of animal growth
- 3.3.3 Prediction of by-products: quantity, quality

3.4 AI in aquaculture
- 3.4.1 Feed optimisation. Animal welfare
- 3.4.2 Early detection of diseases
- 3.4.3 Fish prediction for a more sustainable fishery

3.5 Practical work 3: Animal welfare assessment with sensors

4. Artificial Intelligence in the Agrifood Industry (5 h)

4.1 Food processing: Quality and safety
- 4.1.1 Quality inspection
- 4.1.2 Food fraud detection

4.2 Food processing: Automation in production lines
- 4.2.1 Optimisation in energy and water
- 4.2.2 Machine maintenance
- 4.2.3 Production control and OEE
- 4.2.4 Production scheduling

4.3 Demand forecasting and logistics management
- 4.3.1 Demand prediction
- 4.3.2 Inventory and storage management
- 4.3.3 Supply chain optimisation
- 4.3.4 Optimal food distribution

4.4 Practical work 4: Computer Vision for Assessing Ripeness and Maturity Levels from UAV Data in Horticultural Crops

5. Artificial Intelligence in Retail (2 h)

5.1 Consumer behaviour analysis. Customer segmentation

5.2 Efficiency in inventory management

5.3 Reduction of food waste

6. Artificial Intelligence in the Agrifood System Governance (2h)

6.1 Policy-making and decision support

6.2 AI in risk management and crisis response

6.3 Sustainability and environmental governance

7. Case Studies (5 h)

7.1 Case Study 1 – GeoAgro: An AI-powered digital extension system for small holder farmers in the Global South

7.2 Case Study 2 – Using AI to predict fungal problems in corn and barley: the Fruspredic project

7.3 Case Study 3 – AI in livestock monitoring

7.4 Case Study 4 –Applications of AI in the agrifood industry: Alimente 21 project

7.5 Case Study 5 – AI in product prices prediction

8. Next Wave of AI in the Agrifood System (1 h)

8.1 Agrifood 5.0

8.2 Ethics & legislation in AI

8.3 Synthetic data and modelling reality

8.4 Digital Twins in agriculture

8.5 GenAI: LLMs for developing advisory systems

8.6 Autonomous agriculture beyond autonomous equipment