

UN SDG

Unit 1: Introduction to AI in Tourism

Course: AI and Tourism – MIT-AI @ Gandaki University

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SUSTAINABLE DEVELOPMENT GOALS



The 2030 Agenda for Sustainable Development, adopted by all United Nations members in 2015, created 17 world Sustainable Development Goals.

The aim of these global goals is "peace and prosperity for people and the planet" – while tackling climate change and working to preserve oceans and forests

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SDG TOurism



SDG Tourism (Sustainable Development Goals Tourism) refers to aligning the global tourism industry with the UN's 17 SDGs to foster inclusive growth, reduce poverty, protect the planet, and ensure prosperity for all

Learning Objectives (Unit 1)

- **Define** Artificial Intelligence (AI) and its core applications in the tourism industry
- **Identify** major AI technologies, current trends, challenges, and opportunities in tourism
- **Recognize** the interdisciplinary nature of applying AI to tourism problems
- **Analyze** real-world case studies of AI implementation across hospitality, travel agencies, and destination management

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Overview: AI and Tourism (Course Context)

AI in Tourism: Core Concepts

This course focuses on applying AI to transform the tourism sector through:

- Tourist behavior analysis
- Recommendation systems
- Geospatial analytics
- Smart destination planning
- AI-enabled sustainability monitoring

The course prepares students to evaluate AI's impact on sustainable tourism practices and the SDGs.

What is Artificial Intelligence?

Artificial Intelligence (AI) is the study and development of computer systems capable of:

- Learning
- Reasoning
- Self-correction
- Performing human-like cognitive tasks

AI is an umbrella term covering multiple technological concepts and subfields.

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What is AI in Tourism?

AI in Tourism = application of AI technologies to:

- Improve tourism experiences
- Optimize operations
- Support destination planning

It integrates multiple technologies:

- Machine Learning (ML)
- Natural Language Processing (NLP)
- Geospatial Analytics
- Recommender Systems
- Data Mining

"AI technologies are poised to revolutionize tourism by enabling hyper-personalization, optimizing operations, and fostering sustainable practices." [Chiwaridzo, 2024]

Core Areas of AI Research

- **Rule-Based Reasoning** – if-then rules for decisions
- **Machine Learning (ML)** – learning patterns from data
- **Deep Learning (DL)** – multi-layer neural networks for images/text
- **Natural Language Processing (NLP)** – chatbots, review/text analysis
- **Computer Vision** – recognizing attractions, crowds, facial expressions
- **Speech Analytics** – voice assistants, spoken queries
- **Robotics** – hotel service robots, airport assistants

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AI, Data Science & ML in Tourism Context

Although AI is the broad concept, tourism applications usually refer to:

- **Data Science (DS)** – data collection, cleaning, modeling, visualization
- **Machine Learning (ML)** – predictive models & classification
- **Deep Learning (DL)** – complex pattern recognition

Data Science is a significant part of AI and is essential for tourism analytics.

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Why AI Matters in Tourism

The tourism industry is:

- **Highly complex:** many providers, intermediaries, and customers
- **Information-rich:** bookings, reviews, GPS, sensors, social media
- **Coordination-intensive:** many touchpoints across the travel chain

Therefore, AI becomes a key driver of:

- Innovation
- Personalization
- Operational efficiency

Value of AI in Tourism

AI's benefits across tourism sectors:

- **Improved Decision-Making** – Better strategic planning and policy-making
- **Service Optimization** – Automation + individualized services
- **Competitive Advantage** – Better guest experience → loyalty & market differentiation
- **Real-Time Insights** – Immediate detection of patterns, correlations, and anomalies
- **Prediction Capability** – Answers questions like arrival forecasts and destination popularity

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Examples of AI/DS Use in Tourism

- **Route Optimization** – best travel paths, crowd-free alternatives
- **Predictive Analytics & Forecasting** – tourist demand, pricing, staffing
- **Personalization & Recommendation** – tailored itineraries & packages
- **Opinion Mining & Sentiment Analysis** – TripAdvisor, Google, TikTok reviews
- **Alerting & Monitoring Systems** – overcrowding alerts, weather/safety warnings

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AI and Smart Tourism

AI + Big Data form the backbone of Smart Tourism, enabling:

- Sustainability
- Personalization
- Co-value creation
- Enhanced well-being

Smart tourism emerges from integrating digital technology into all layers of:

- Visitor experience
- Destination management

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Three Levels of Smart Tourism & AI Integration

1. Intelligent Technology as Infrastructure

- Sensors & IoT as the backbone
- Continuous data collection (flows, environment, usage)
- Bridges physical and digital world → “OuterNet”

2. Smart Experiences

- AI adapts experiences based on context and preferences

3. Dynamic Ecosystem

- Data shared among hotels, airlines, destinations, Destination Marketing Organization (DMO), Online Travel Agency (OTA)
- AI harmonizes and processes information ecosystem-wide

Growth of AI in Tourism Research

- Early research and applications of AI in tourism date back to the 1990s, its use has grown significantly since the mid-2010s, particularly after 2018, with a major acceleration during and after the COVID-19 pandemic.
- Since 2018, ML usage in tourism research has increased sharply
- Initially, AI was used for simpler marketing and operational tasks, but it now impacts nearly every aspect of the industry, from customer service and personalization to back-end revenue management.
- Key linked areas:
 - Big data
 - Sentiment analysis
 - Forecasting
 - Recommender systems
 - Smart tourism studies

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Applying AI Subfields in Tourism

AI Subfield	Tourism Application Example
ML & DL	Forecast tourist arrivals, classify visitor types
NLP	Analyze reviews, chatbots, multilingual translation
Computer Vision	Detect crowds, identify landmarks, automate check-in
Speech Analytics	Voice-based hotel check-in, voice search in booking apps
Robotics	Autonomous luggage handling, room service robots

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Competencies Needed for AI & DS in Tourism

Successful AI/DS implementation requires expertise in:

- **Computer Science** – Algorithms, data structures, software systems, cloud
- **Mathematics & Statistics** – Prediction, regression, time-series, probabilistic modeling
- **Tourism Domain Knowledge** – Customer experience, satisfaction drivers, cultural context

Tourism data is complex, intangible, and emotional, making analytics challenging.

Challenges in Tourism AI Implementation

- Measuring intangible experiences (emotion, satisfaction)
- Fragmented data across many stakeholders
- Ethical concerns: privacy, surveillance, tracking
- Lack of standardized data-sharing mechanisms
- Need for real-time, high-quality data

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AI as the Foundation of Digital Transformation

- AI is the umbrella concept enabling digital transformation across tourism
- AI = systems capable of learning, reasoning, and self-correction
- In tourism research, emphasis often focuses on DS and ML as operational engines

Tourism is an ideal AI domain because it is:

- Data-rich
- Coordination-heavy
- Customer experience driven

Major Trends in AI Adoption in Tourism

1. Rise of Advanced Analytics

- Rapid digitalization
- Faster computing, large storage
- Development of powerful algorithms

2. Analytical Focus Areas

- Sentiment analysis
- Big data analytics
- Machine learning
- Forecasting

3. Predictive Power – AI supports forecasting of arrivals, prices, demand, and flows

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Key AI Applications (Trends + Examples)

AI-driven systems enable:

- **Route Optimization** (avoid crowds; design efficient itineraries)
- **Predictive Analysis & Forecasting** (demand, pricing, staffing, cancellations)
- **Personalization & Recommendations** (custom itineraries and bundles)
- **Opinion Mining** (analyzing thousands of online reviews)
- **Real-Time Monitoring Systems** (alerts for congestion, safety, environment)

Example: Google Maps & TripAdvisor "Popular Times" using real-time location data

Opportunities for Value Creation

Personalization & Smart Experiences

- Context-aware recommendations (weather, time, trip purpose, budget)

- Automated concierge systems adapting to guest preferences

Industry Optimization

- Airlines: Passenger forecasting, predictive maintenance, yield optimization
- Hotels: Digital marketing, customer segmentation, revenue management

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Smart Tourism Ecosystems (Revisited)

AI + Big Data enable Smart Tourism, with:

- Enhanced sustainability
- New forms of co-value creation
- Higher visitor well-being

Three Levels:

- Infrastructure (sensors/IoT, "Outernet")
- Smart experiences (personalized, adaptive services)
- Dynamic ecosystem (shared, synchronized data among stakeholders)

Emerging Methodological Opportunities

1. Natural Language Processing (NLP)

- Currently underused in tourism: mostly review & sentiment analysis
- Emerging uses: Automated assistants, voice-based travel planning

2. Deep Learning (DL)

- Powerful for personalization, image & text analysis
- Still rare but growing in tourism research & applications

3. Democratization of Data Science

- AutoML tools (RapidMiner, KNIME, Google AutoML)
- Lower technical barrier for small tourism businesses

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Challenges: Data & Technical Limitations

- **Data Quality Issues** – “Garbage in – garbage out”
- **Model Complexity** – Many ML models are black boxes, difficult to interpret
- **Production Deployment** – Models may misbehave with new, inconsistent real-world data
- **Risk** of unexpected or unwanted behavior in production

Challenges: Industry & Organizational Resistance

- **Intangible Tourism Product** – Experiences are emotional & ephemeral → hard to measure
- **Fragmented Market Structure** – Many small SMEs → limited time, budget, AI awareness
- **Inter-Sector Friction** – Historic tension between hotels and OTAs
- **DMOs** must prove their impact with sparse data

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Challenges: Skills & Interdisciplinarity

Successful tourism AI needs:

- Computer Science
- Math & Statistics
- Tourism Domain Knowledge

Gaps:

- Few individuals excel in all three fields
- AI practitioner and Data scientists must be strong communicators who can explain complex problems

Challenges: Ethical & Regulatory Issues

Ethical Requirements

- Data privacy & consent
- Transparency and explainability
- Accountability for decisions

Regulatory Concerns

- Strictly regulated sectors must certify ML models
- “Human-in-the-loop” often needed for safety-critical decisions

Bias & Fairness – Overfitting and biased data can cause unfair recommendations

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AI in Tourism as an Interdisciplinary Field

AI in tourism blends knowledge from:

- **Computer Science:** ML models, NLP, AI systems
- **Geography:** GIS, mobility data, VGI
- **Economics:** Forecasting, pricing, market analysis
- **Social Sciences:** Tourist behavior, motivations, satisfaction
- **Sustainability Sciences:** SDG assessment, environmental monitoring

"The interdisciplinary nature of tourism requires an integrated approach where data science methods are informed by domain knowledge." [Egger, 2023]

Skills & Team Structures for AI in Tourism

- Rare to find one person expert in CS + Statistics + Tourism
- Often solved via interdisciplinary teams:

- Data engineers
- ML researchers
- Tourism/domain experts
- Policy & ethics specialists

Ideal Data Scientist Profile in Tourism

- Technically strong, but also business-oriented and communicative
- Able to bridge data, models, and real-world policy questions

Case Studies & Applications Overview

This unit introduces AI through case studies in:

- Hospitality (hotels, Airbnb, reviews)
- Travel Agencies & Airlines
- Destination Management (DMOs, regional planning, marketing)

Preview of applications:

- Opinion mining & sentiment analysis on tourism reviews
- Tracking tourist movements with GPS & mobile data
- AI applications in sustainable tourism

Case Study 1: AI in Hospitality

Application: Personalized Guest Experience & Operational Efficiency

- **Chatbots & Virtual Concierges** – Handle bookings, FAQs, and guest requests 24/7
- **Robotic Assistance** – Service & delivery robots for room service
- **Demand Forecasting & Dynamic Pricing** – ML adjusts room rates in real time
- **Personalized Recommendations** – Suggests rooms, amenities, add-on services

Citations: [Chiwaridzo, 2024], [IGI Global, 2024]

Case Study 2: AI in Travel Agencies & OTAs

Application: Intelligent Recommendation & Market Intelligence

- **Automated Itinerary Generation** – Tailored travel plans using preferences & history
- **NLP-Driven Review Analysis** – Summarizes thousands of reviews for decision support [Lahagun et al., 2024]
- **AI-Based Travel Risk Alerts** – Monitors disruptions (weather, strikes, health alerts)
- **Dynamic Packaging** – Bundles flights, hotels, and activities based on user behavior

Citations: [Shrestha et al., 2024], [Lahagun et al., 2024]

Case Study 3: AI in Destination Management

Application: Smart Planning & Tourist Flow Management

- **Tourist Flow Tracking** – GPS & mobile data to understand movement patterns
- **Identifying Areas of Interest (AOI)** – VGI & social media density to map hotspots [Devkota et al., 2019]
- **Crowd Detection** – Image analysis to monitor congestion at attractions
- **Route Optimization** – AI suggests itineraries to disperse traffic & reduce overcrowding

Citations: [Devkota et al., 2019], [Yu et al., 2025]

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Case Study 4: AI for Sustainable Tourism

Application: Supporting Sustainable Development Goals (SDGs)

- **Monitoring Ecological Impact** – Track energy/water use & crowd levels
- **Emissions Forecasting** – Predict carbon footprint from tourism flows
- **Promoting Eco-Friendly Choices** – AI recommenders highlight eco-friendly operators & itineraries

"AI presents significant opportunities for mitigating climate change impacts in tourism, though it also carries risks that must be managed." [Gössling et al., 2025], [Peeters et al., 2024]

Unit 1 Summary & Look Ahead

Unit 1 Review

- Defined AI and its relevance to tourism
- Explored AI technologies, trends, opportunities, and challenges
- Understood the interdisciplinary nature of AI in tourism
- Reviewed case studies in hospitality, travel/OTAs, and destination management

Looking Ahead – Unit 2: Tourism Data & EDA

- Data Sources & APIs: VGI, TripAdvisor, Booking.com, Google Maps
- Data preprocessing & feature engineering
- Case study: Identifying trends, seasonality, and outliers in tourist arrivals & spending

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Discussion Questions (Class Interaction)

- ① Considering the interdisciplinary nature of AI in tourism, which discipline (e.g., CS, geography, economics) do you think is most critical, and why?
 - ② Can you recall a recent travel experience where AI was involved, either visibly (e.g., recommendations) or behind the scenes (e.g., dynamic pricing)?
 - ③ What ethical concern regarding AI in tourism (privacy, bias, job loss, surveillance) worries you most, and how might it be addressed?

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References I

-  Chiwaridzo, T. (2024). *AI Technologies for Personalized and Sustainable Tourism*.
 -  Devkota, B. et al. (2019). Using Volunteered Geographic Information and Nighttime Light Remote Sensing Data to Identify Tourism Areas of Interest. *Sustainability*, MDPI.
 -  Egger, R. (2023). *Applied Data Science in Tourism: Interdisciplinary Approaches, Methodologies, and Applications*. Springer.
 -  Gössling, S. et al. (2025). AI and sustainable tourism: Risks and opportunities. *Taylor & Francis*.
 -  IGI Global. (2024). *AI Innovations for Travel and Tourism*.
 -  Lahagun, J. et al. (2024). Machine Learning-Based Social Media Review Analysis for Recommending Tourist Spots.
 -  Peeters, P. et al. (2024). Current issues in tourism: Mitigating climate change. *Elsevier*.
 -  Shrestha, Y. et al. (2024). Personalized Tourist Recommender System. *MDPI*.

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References II

-  Yu, Z. et al. (2025). An AI-driven social media recommender system leveraging smartphone and IoT data. *Springer*.

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