Research & Innovation Information Technologies / ATHENA

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Explainable Visitor Profiling for Adaptive Cultural Heritage Experiences

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Motivations

- Visitors have **different** motivations, interests, constraints, and preferred exploration ways
- **One-size-fits-all** experiences **cannot** provide the right content depth, format, and interaction style
- An initial motivation profile gives a starting point for **personalisation**

Challenges

- **Limited data**
- **Strong imbalance**
- Visitor **motivations overlap**
- Predictions must be **understandable**
- The service must be **multilingual**

Key Objectives

- ✓ Define **visitor motivation profiles**
- ✓ **Train and compare ML models**
- ✓ **Validate model behaviour** on real data
- ✓ **Provide explanations** for each prediction
- ✓ **Generate multilingual explanations**

Visitor Profiling & Motivation Explainer Service



Initial state
The questionnaire is used to predict a starting profile

Five visitor profiles

StorySeeker: Curious, narrative-driven, discovery-oriented
SocialVisitor: Social, emotional, interactive
Fast-trackVisitor: Efficient, highlight-focused, time-concsious
In-depthExplorer: Analytical, detail-oriented
Recharger: Relaxed, visual, low-stimulation

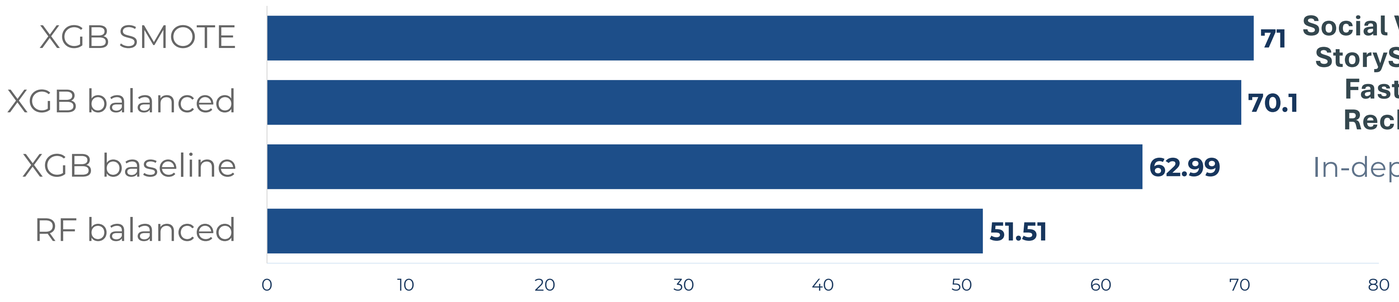


Prediction remains separate from explanation

Questionnaire 19 behavioural features → **ML model with profile probabilities** → **Local SHAP supporting and opposing evidence** → **Language model for plain language explanation**

The classifier determines the result. The language model verbalises supplied probabilities and local evidence.

Model Evaluation



Social Visitor 88.9%
StorySeeker 68.3%
Fast-track 64.3%
Recharger 62.5%

In-depthExplorer: no ground-truth yet

71.00%
balanced accuracy XGBoost with SMOTE

70.37%
Overall accuracy XGBoost, class-balanced

Balanced accuracy covers the four profiles present in the empirical data. In-depthExplorer requires real-world validation.

Integration & Profile Evolution

The questionnaire result becomes the first state in an evolving visitor model.

FastAPI | **Ollama & LangChain** | **8 tested languages** | **Streaming via SSE**

Initial profile questionnaire → **Visit evidence choices, dwell time, questions** → **Updated state confirm or revise** → **Adapted interaction content and follow-up**

Impact

- ✓ **Identifies** visitor motivations from the start
- ✓ **Provides** transparent, explainable predictions
- ✓ **Supports** multilingual and accessible experiences.
- ✓ **Lays the foundation** for adaptive visitor experiences



Next Steps

- **Integrate a Motivation State** Agent into the environment
- **Dynamically update visitor profiles** using behavioural signals and feedback
- **Personalise** experiences through adaptive content, storytelling, and recommendations.
- **Resolve profile uncertainty** through targeted clarification questions.
- **Evaluate and improve personalisation** using real-world visitor data

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