A NEW GENETIC TOURIST TRIP DESIGN ALGORITHM FOR A HIGHLY PERSONALIZED GLOBE-TROT TRAVELING EXPERIENCE

LINAS STRIPINIS, REMIGIJUS PAULAVIČIUS AND ERNESTAS FILATOVAS
INSTITUTE OF DATA SCIENCE AND DIGITAL TECHNOLOGIES, VILNIUS UNIVERSITY

THE NATURE OF THE PRACTICAL PROBLEM

Our study examines the problem of designing tourist trips, with a particular focus on personalization. This problem can be summarized as follows:
TTDP: *A tourist starts from a given point, visits the most appropriate attractions exactly once within a certain period of time, and returns to the same point. The objective is to maximize overall tourist satisfaction by visiting as many* ***P****oint* ***O****f* ***I****nterests (POI) as possible within a predefined time frame.*
Constraints:

- The duration of the tour does not exceed a predefined time limit.
- There is a maximum allowable time specified for each **tier of objects** (*Landmarks*(50%), *Historic Sights*(20%), *Minor Sights*(15%), *Hidden Gems*(15%)).
- A set of POIs may correspond to a single given location, but only one POI from this set can be included in the trip plan.
- Visits are made to all attractions on the mandatory list.

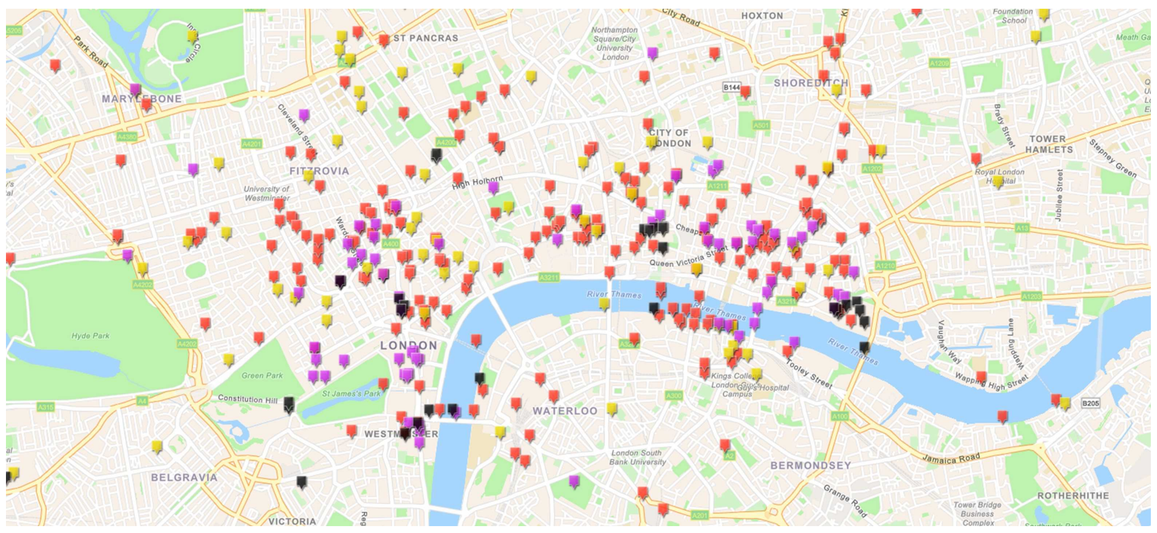

Figure 1. A representative network of attractions in central London

Object tier - describes the overall importance of the object. Currently we have 4 tiers: *Landmark* (e.g. Big Ben, Tower of London), *Historic Sight* (e.g. London Wall), *Minor Sight* (e.g. streets, parks) and *Hidden Gem* (e.g. various museums).

GENETIC ALGORITHM

TTDP is solved by adapting the well-known stochastic meta-heuristic Genetic Algorithm (GA) [1]. The GA is based on ideas from evolutionary theory, which states that only the strongest individuals survive. The main concept of the GA is that **good solutions will survive** in the population and will continue to be reproduced to become better, while bad solutions will eventually disappear. The flowchart of the GA is illustrated in **Fig. 2**.

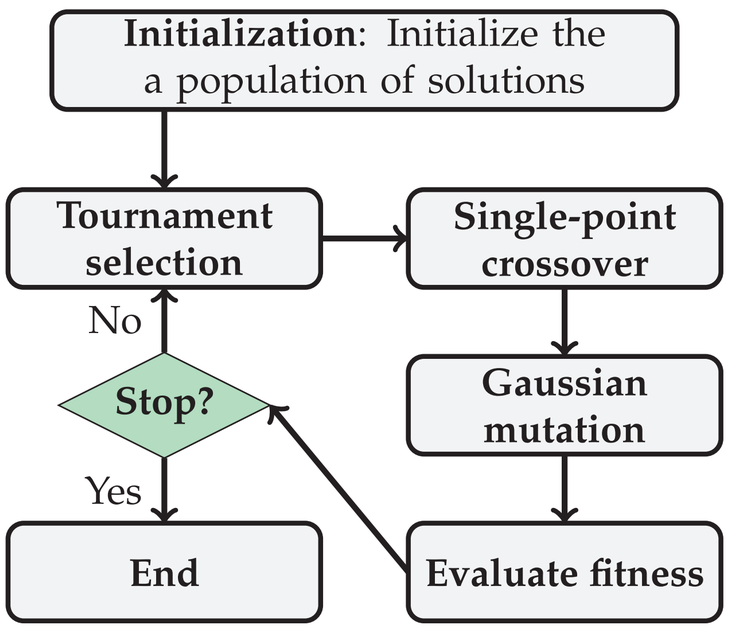

Figure 2. Flowchart of the GA

An example of a data fragment from the POI database is provided in the **Table 1**.

ID	Time	Obj. ID	Latit.	Long.	Obj. Tier	Rating
21	222	21	51.4966	−0.1765	Landmark	11.1575
22	114	22	51.5225	−0.1326	Hidden G.	2.3400
23	77	23	51.5063	−0.0149	Minor S.	3.7850
26	218	27	51.5131	−0.1103	Historic S.	4.9350

Table 1. POI data fragment needed for the GA

References

[1] J.H. Holland (1975) *Adaptation in Natural and Artificial Systems*. The University of Michigan Press, Ann Arbor.

ACKNOWLEDGEMENTS

This research has received funding from the Research Council of Lithuania (LMTLT), agreement No. S-MIP-21-53.

PERFORMANCE TESTS USING DIFFERENT USER PROFILES

An experimental dataset consisting of POIs in the **City of London** was used for the study. This testing included **519 popular tourist attractions** divided into four tiers. The map of these attractions is illustrated in **Fig. 1**. Investigation purposes include **different personalized profiles** for POIs in the **four categories**. For all **four cases**, the same starting and ending points are selected (*Milennium Bridge* and *Soho Square*), the time limit is set to **120 minutes**, and no mandatory points were required.
For each test instance, 10 independent runs are performed, and the best worst and average solutions are reported. The performance of GA on all test instances is presented in **Table 2.**

User Profile	Fitness Value			Number of POIs	Duration			Distribution of POIs			
	Avg.	Best	Worst		POIs	Walking	Total	Landmark	Historic S.	Minor S.	Hidden G.
Arts	165.74	166.78	161.25	25	47.53	68.01	115.54	10(49.89%)	4(18.61%)	8(14.98%)	3(12.80%)
Culture	138.96	142.59	135.65	25	49.92	67.06	116.98	6(48.81%)	5(19.62%)	10(14.97%)	4(14.09%)
Politics	129.70	132.01	126.66	22	48.98	70.15	119.13	7(49.94%)	7(19.92%)	5(14.94%)	3(14.47%)
Growth	142.63	145.37	135.45	24	49.17	69.48	118.65	8(49.67%)	6(19.68%)	7(14.76%)	3(14.76%)

Table 2. Constructed routes for four practical test instances

ILIUSTRATION OF THE ROUTE

Fig. 3 shows the best rated route graphically.

- A solid **blue** line shows the tour route.
- The markers indicate the locations of POIs:
  - **Green** indicates the **start** and **end points**.
  - **Blue** indicates **selected points** of the GA.

The POIs should be visited in alphabetical order during the tour.

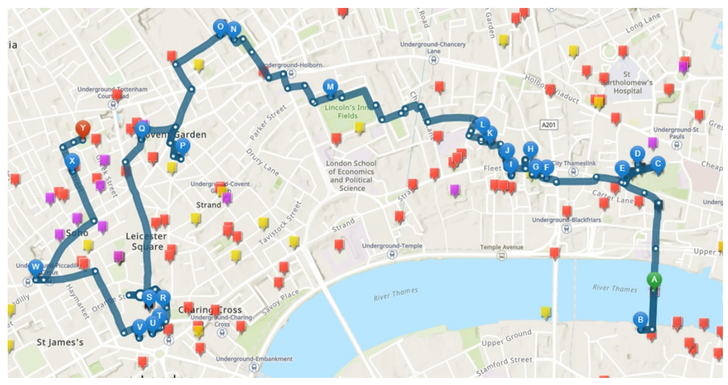

Figure 3. Illustration of the best rated route

CONCLUSION AND FUTURE WORK

During the literature review, it was determined that no fully compliant model for the design of personalized tourist trips existed in the literature. This project has made the following contributions:

- As a result of practical requirements, this study proposed a new design for categorical constraints.
- Personalized tourist trip planning is designed for use in real-world applications.
- A new genetic algorithm has been developed to solve the designed problem and is already applied in the GlobeTrott Travel mobile app, see **Fig. 4**.
- The performance of the proposed algorithm is evalueted using the collected real-world dataset containing the main POIs of the City of London.

Future work. A high-performance version of the algorithm will be developed in order to accelerate its runtime and investigate it on other real-world datasets.

Figure 4. Mobile app