

Kasia Kozłowska



Profession

Mathematician / Data Scientist /
Data Analyst / Python Developer

Current Position

Consultant

Joined Arup

January 2018

Years of Industry Experience

2

Nationality

Polish

Qualifications

PhD Mathematics,
University of Reading, 2017
MMath Mathematics,
University of Swansea, 2013

Affiliations

Postdoctoral Visiting Fellow
Department of Mathematics and
Statistics
University of Reading



Kasia has joined Arup in January 2018, after completing PhD in Mathematics at the University of Reading, UK. Since joining Arup, Kasia has worked on several projects involving data cleaning and processing, data visualisation and analysis as well as building predictive and prescriptive models. Kasia works predominantly in Python and uses Amazon Web Services for deployment.

Kasia's work typically involves mathematical graphs, model validation and testing and optimisation, both software and mathematical. She is particularly interested in generative and prescriptive design through optimisation.

Arup projects:

City Modelling Lab [*July 2019 - Ongoing*]

Kasia is working with an Agent-Based Model (ABM) which uses the Java-based MATSim framework to simulate travel behaviour. Kasia is part of the core technical team, working on running and developing the models. She has also worked on a novel way to validate the behaviour of the individual agents in the models using GPS data, this work was accepted to two conferences and summarised in this [blog post](#).

Kasia has also done extensive work on the process which generates networks (infrastructure and public transport available to the agents in the model) using graph representations of OSM (Open Street Map) and GTFS (General Transit Feed Specification) data. Her aim in this work is to replace the current process by a scalable and dynamic one to enable faster modelling of scenarios involving network changes as well as finding optimised networks or public transit schedules.

Energy from Waste (EfW) [*December 2019 – January 2020*]

Kasia guided a junior member of staff through the technical journey of developing a process optimising a graph representing heat pipes connecting waste plants. The process optimised the connections and spatial routes between the plants based on constraints such as construction costs and sites (giving priority to pipes being constructed under roads), profit generated and heat demand being met.

MoMo Inference, Movement Insight [*September 2018 – July 2019*]

Kasia has been working on testing methodologies and improving performance of the analysis algorithm which is used to infer details about trips and modes of individuals using GPS data collected through the Mobility Mosaic (MoMo) app. She has designed and sourced the validation data which can now be used to train machine learning models in the next phase of development. She has also designed and implemented a system of Python scripts to process the collected data and test the inference algorithm in a continuous feedback loop.

Digital Disruption [*September 2018 - Ongoing*]

Kasia is involved with the Digital Disruption group who take it upon themselves to educate colleagues across Arup in various Digital topics. Kasia was involved in the production and delivery of a workshop on computer vision which introduced various methods to process images and explained use of Tensorflow

using Keras in Python. She has also given several seminar-type talks in the Roadshow series of this initiative.

Unlocking the potential of natural flood management with machine learning - phase 2, IiA [January 2019 – March 2019]

Kasia was a part of a team working on automating processes leading to placing flood prevention solutions in a defined area. She was in charge of creating the optimisation model which, given an input of elevation and river stream data and a generated data on possible dam locations and their volumes, decided on the optimal dam placements. The optimisation model was written using a Python package called Pyomo.

Arup Data Visualisation Repository, IiA [November 2018 – March 2019]

Kasia is managing the above internal project. She is also responsible for the content design and quality of the code of the resulting Python package, which will help make visual outputs of analysis automated and standardised.

British Library User Research [September 2018 - November 2018]

Kasia helped in preparing and securing the bid for this work. She subsequently worked on discovering, gathering and scraping relevant data coming from different sources – most of which were timeseries data, e.g. Google Web page analytics data, building sensor data, events data. She collated and normalised the collected data and delivered analysis outputs using Python packages such as Pandas, Plotly and Sci-kit learn.

Google Directions API, IiA [August 2018 - October 2018]

Kasia worked on adapting and developing python scripts in a bigger process of developing a tool that makes it easier and safer for transport planners to query and extract relevant data using the Google Directions API.

TOD Forecasting, Metrolinx [June 2018 - August 2018]

Kasia worked with colleagues at the New York and Toronto offices on Transit Oriented Development (TOD) Forecasting – helping to model and implement machine learning algorithms to predict the impact of developing areas close to public transit stations using Python packages such as Sci-kit learn and Pandas.

Python Scripting for the RTM Transport modelling process, Highways England [June, 2018 – March 2019]:

Kasia is working on generalising existing Python scripts for the RTM Transport modelling process to include modelling approaches which vary across different Arup offices in the UK. She is also writing an additional script which will automate the analysis of the outputs from the RTM model.

Calculating Water Volumes with AT&R [June, 2018]:

Kasia works with AT&R using Wolfram Mathematica to calculate volume of water held behind a hypothetical dam, given a point location along a river. The aim of this project is to build an optimisation engine which will select the optimal locations and sizes of dams along the river to store as much water as possible away from cities situated further down.

C40 Data Muller [May, 2018]:

Kasia supported the C40 Data Muller work by first reviewing the literature behind the processes and recent academic publications around consumption-based modelling of carbon emissions, and consequently implementing the model in Python. This model takes into account various expenditures (household, transport, commercial etc.) of a country or city and its' import/export data to track dependencies on the countries linked to this trading. It helps quantify the global effects of imports/exports on the carbon emissions of associated countries.

Python scripting, Movement Insight (MI) [February, 2018 – June 2019]:

Kasia supports Python scripting which goes on within MI. She developed Python scripts which generate requests for Amazon AWS-based Open Trip Planner (OTP) instances given a list of travel details and saving the output isochrones or planned routes in any desired format. The script supports parallelised requests which makes the harvest of relevant data incredibly fast. On top of quickly generating a large number of isochrones/routes, this script also helps test and trouble-shoot the OTP instances.

Codifying approach to energy modelling – Calliope [February. 2018 - Ongoing]:

In this project, Kasia helped develop an energy master-planning tool which quickly models energy demand in a network of connected buildings and optimises the energy and heat supply to each of them within a given time period.

She also worked on making the python package 'Calliope' accessible to colleagues who have not used Python before. She worked with the developer to bring the newest improvements to Calliope accessible to Arup. She wrote tutorials and walk-throughs on the package and how to use it for energy modelling in the most efficient way. She also helps prepare and give workshops and presentations on the project to spread awareness and disseminate the approaches that have been developed for the tool.

Home Office Data Clustering [April, 2018]:

This is a classified project so no details can be provided here. Kasia worked on classifying different geographical sites according to usage in a bid to improve efficiency in energy supply to those sites. She used several clustering algorithms in the Scikit-learn Python package and implemented an ensemble algorithm for final classification.

Heathrow Accessibility Data Analysis [April, 2018]:

The third runway will be built in the space where there are currently several staff carparks. As part of the project, Heathrow is required to decrease the volume of staff/passengers/others driving to the airport. Kasia helped visualise and analyse the data collected by the automated car park systems.

Manchester Cycling Data Fusion Scoping Study [March. 2018 – April, 2018]:

Kasia helped scope the fusion of various data sets available or potentially available in Manchester to track the activity of cyclists in the city in a bid to improve cycling facilities throughout. The data sets come from various different sources, have been collected through different mediums and have varying granularity. Some are representative of the population and some have strong bias (e.g. Strava towards fitness-oriented individuals). Kasia described a way of

fusing the data sets in a way which would bring the best possible granularity while keeping the sample representative and free of bias.

Satellite monitoring Tool with AT&R [*March 2018*]:

This project dealt with data collected from satellite images around the time of an oil spill. The aim was to build a tool which would process satellite pictures in a bid to identify possible oil spills before they become very large. Kasia helped to fit a multivariate Gaussian model to the data using packages in Python such as Pandas and Scikit-learn.

Perception of Place [*February. 2018 – March, 2018*]:

This project involved analysing data collected from surveys performed on park and public space users. This was done in an attempt to quantify their sense of well-being and how the park/public space is contributing to it, and to identify possible areas of improvement to the public space. In this project, Kasia utilised Python packages such as Pandas to process and analyse the data and Plotly, Seaborn and Bokeh to visualise it.

Prior to Arup:

During her PhD Kasia has worked on applications of Riemann-Hilbert problems to mathematical physics. These are boundary value problems which describe many problems in fields such as statistical mechanics and random matrix theory. A relatively recent development of a powerful asymptotic technique of solving these problems has opened an avenue to rigorously solving many interesting problems. Kasia's research involved the disciplines of both pure and applied mathematics. She also utilised Wolfram Mathematica in obtaining and testing results.

During her PhD, Kasia has given many contributed and invited talks at both national and international conferences. She also spent 5 months visiting the Courant Institute of Mathematical Sciences, part of New York University, one of the leading and most prestigious mathematical schools and mathematical sciences research centres in the world.

For her master's dissertation, Kasia studied variational methods in nonlinear analysis, the centre of which formed calculus of variations.