Appendix 3 – Index building

Why index building?

* Now that all data necessary to create the Local Significance (LS) and Detour Index (DI) indices is ready to use, we can start calculating the two indices for the entire city.
* The indices will be built on the city level during our index building workflow.

Index building

* In the process of index building, we want to calculate the DI for each building and the LS for each street segment.
* To facilitate the creation of the two indices, we need to find the green space entry point that is closest to the respective residential building.
* For calculating the DI for one building and the nearest green space entry, we need to measure the Euclidean distance and the network distance between the two points.
* Consequently, we calculate the average DI for all green spaces that have an entry point located in a network distance of 500 meters of less.
* The LS index also requires the network distance.
* Additionally, we need the population of the residential building and the size of the park to calculate the LS.
* We attach the LS value to each edge (i.e. each street segment) that is crossed on the way from the building entry and the green space entry.
* Similar to the DI, we calculate the LS for each green space that can be reached in a network distance of 500 meters or less.
* Finally, for each edge we sum up all LS values of all routes from each building to the respective green spaces.
* This way we end up with one cumulative LS value for each edge in a city.

Functionality

* We have integrated the process of building the LS and DI indices into the getIndices function of our index building workflow.
* The getIndices function takes as input a working directory that contains the previously created databases containing the nodes and edges data, as well as the file with the building polygons.
* All paths can be handed manually to the getIndices function or will be created automatically based on the working directory.
* By default, the output will be written to the working directory if not specified otherwise.
* The index creation workflow follows these steps: a) listing the green space identifiers, b) inputting the data, c) calculating and saving the indices and d) joining the index values back to the network and buildings:
  1. Listing the green space identifiers: Creating the indices is a computationally intensive process. Particularly the process called routing (i.e. finding the fastest route between two points in a network) can use lots of resources. To increase the speed of completing the LS and DI computation for an entire city and to speed up each computation itself, we use a number of methods. First, we use the UA identifiers that come with the UA data to facilitate parallelization of the process. During the previous steps we have kept these identifiers together with the green space entry points. By iterating through the object identifiers of the green spaces, we can distribute the computation across multiple computational cores. Similar to the snapping and blending process in the previous chapter, our function uses 75% of the available computation cores. Setting this number higher might not be recommended under certain circumstances. The green space identifiers are now used to set up the parallel processing.
  2. Inputting the data: When we set up parallel processing in R on a Windows machine, we have to account for certain limitations. If run on Windows, each task that we hand to R to compute in parallel will start a new Windows process. Unfortunately, this means that we have to input all of our data separately into each of the processes, which can take up lots of memory. Particularly loading the spatial data into each process has to be planned meticulously to not overwhelm the machines memory and cause (not so) unforeseen crashes.