

The objective of this thesis is to develop a fast memory-efficient representation of some graphs that occur in real-world applications.

We consider separable graph classes (e.g. planar graphs or graphs of bounded genus) and show how to represent them in a way that (1) makes accessing vertices in a walk cache-efficient on average and (2) is highly memory-efficient. In particular, we show a compact representation of separable graph classes with the I/O cost of a random walk of length k being $\mathcal{O}(K/(Bw)^{1-c})$ w.h.p.

In the second part of the thesis, we consider layout of trees with optimal worst-case I/O cost for root-to-leaf traversal, show an additive (+1)-approximation of I/O optimal compact layout and contrast this with a proof of **NP**-hardness of exact solution.

In this thesis, we also prove generalisations of the recursive separator theorem. The first one generalises the theorem for weighted graphs and the second one replaces minimum region size by average region size in the bound.