iPad Application for the Interactive Exploration of Brain Data (iOS)

Keywords: Scientific Data Management, Spatial Indexes, iOS (iPad)

Context: Scientists in all kinds of disciplines like biology, chemistry, physics etc. produce vast amounts of data through experimentation and simulation. The amounts of data produced are already so big that they can barely be managed. And the problem is certain to get worse as the volume of scientific data doubles every year. In the DIAS laboratory we are working on next generation data management tools and techniques able to manage tomorrow’s scientific data.

We work with neuroscientists in the Blue Brain Project (http://bluebrain.epfl.ch) to manage the vast amounts of data they produce. Their research, modeling and simulating a fraction of the rat brain, already produces gigabytes of data. With the recent upgrade of their computing infrastructure (IBM Blue Gene/P), the volume of data will soon be in the order of terabytes.

Current solutions are inadequate to manage this data volume and we are thus investigating new methods to index and store it in order to provide efficient access.

Project: To efficiently analyze spatial data sets in the neurosciences, we have developed indexes/spatial access methods (FLAT[1], SCOUT[2] and TOUCH[3]). The neuroscientists currently use the indexes we have developed on their desktop machines as well as on the supercomputer. To support them in the quick, efficient ad-hoc analysis of their brain models, we have also started to develop an iPad application. The latest version of the app allows neuroscientists to define a range query on a small representation of the brain model and to visualize the results as a 3D model that can be panned, rotated, zoomed with the known iOS gestures.

The goal of this projects is to extend the iPad app we have developed so far. The student will therefore fully port FLAT, an index used to execute spatial range queries on the neuroscience data, onto the iPad. Furthermore, the student will test if it is feasible to port TOUCH, a novel spatial join for the detection of neuron intersections, on the iPad. The iPad’s limited CPU as well as memory capacity may make it impossible to run TOUCH efficiently.

Milestones: 1. Get acquainted with the spatial join methods developed.
2. Understand the visualization code on the iPad (already developed and available) & get acquainted with VTK OpenGL ES Rendering Toolkit (http://www.vtk.org/Wiki/VES).
3. Port FLAT [1] on the iPad. FLAT is written in C++ and has few dependencies. The following steps need to be done:
   a. Update indexing code to write index data in an iOS compatible format (float representation and byte order)
   b. Port query execution code on the iPad (remove dependencies)
   c. Ensure proper memory management; test with Valgrind and XCode instrumentation

4. Port TOUCH [3] on the iPad:
   a. port TOUCH on iOS
   b. perform extensive performance measurements to understand if the iPad’s CPU is powerful enough to run TOUCH

Knowledge: C/C++, ideally Objective C

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Duration: 2 months

References