

Extending Apex with Open Source JavaScript Libraries: Dynamic Chart Generation, Large Image Zooming, and Interactive Graph Visualization

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Apex, Java Script, Dynamic Chart, Image Zooming, Graph Visualization.

Introduction

Aside from PL/SQL, JavaScript is one of the two kernel technologies naturally integrated in Apex. Nowadays a large number of JavaScript libraries in the market, most of which are open source, provide us with various possibilities to improve user experience in Apex. In this presentation, we take Raphaël (<http://raphaeljs.com/>), OpenLayers (<http://openlayers.org/>), and Graphviz (<http://www.graphviz.org/>) as three examples to demonstrate rich user interactivity design and implementation in Apex for dealing with biological images and biological data at Roche Diagnostics GmbH. With increasing complexity, we show three demos:

1. Dynamic chart generation of the pharmaceutical project portfolio leveraging the Raphaël library.
2. Google-Map alike, real-time large biomedical image zooming through the OpenLayers library.
3. Dynamic generation of interactive genealogy graph for biological entities by means of the Graphviz library.

All three applications are currently used in production at Roche Diagnostics GmbH in Penzberg.

Raphaël : Dynamic Chart Generation

Raphaël is an open source JavaScript library for creating vector graphics for the Web. It is easy to use thus well suited to create custom charts which are not yet available in Apex. As shown in Figure 1, at Roche we use Raphaël to dynamically generate the project portfolio chart.

Portfolio charts are frequently used in the pharmaceutical industry to give an overview of the project status in terms of drug development milestones. The charts are similar to swim lane charts. On the top the milestones are displayed, e.g. new medicine proposal, target identification, lead identification, entry into human, etc. Below each milestone, the corresponding projects are listed together with respective dates.

For the purpose of reusability, the portfolio chart is packaged as a plugin, which can pull the data from any table and display it accordingly

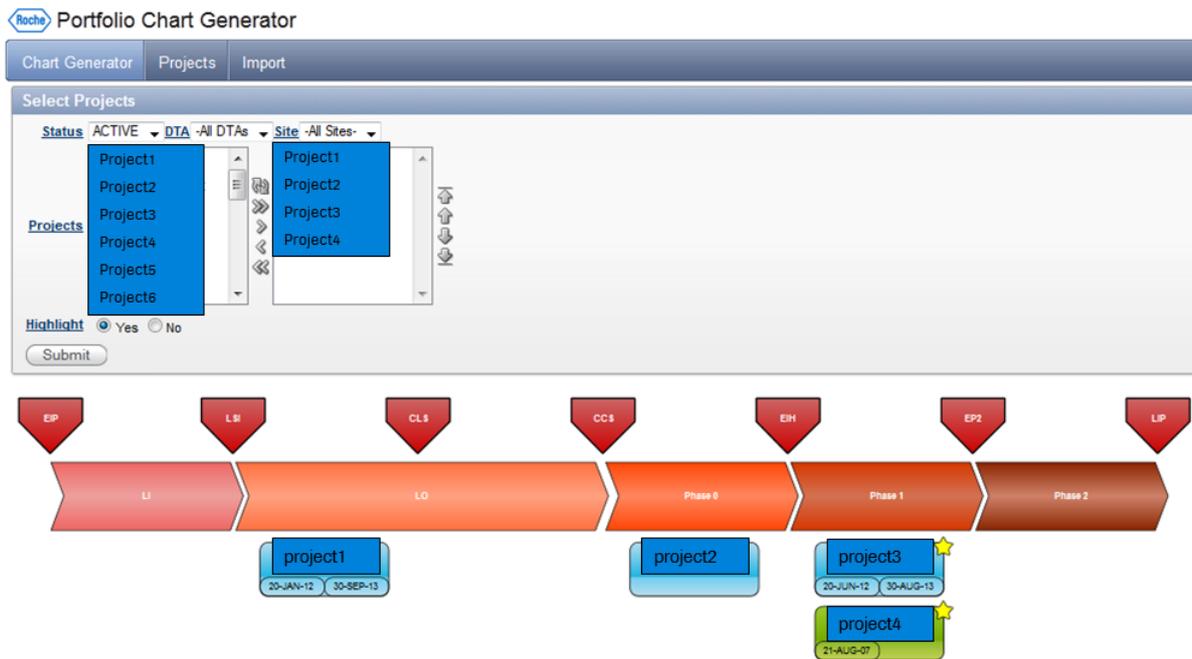


Figure 1: Project portfolio chart dynamically generated in Apex.

OpenLayers: Real-time Large Image Zooming

In the pharmaceutical industry we often need to deal with very large biomedical images with Giga-bit sizes. For the image analysis directly in Web browsers, the large image zooming with good response time is a basic requirement. In a multiplex tissue imaging project at Roche, we leverage OpenLayers to implement real-time large image zooming in Apex. In Figure 2 we illustrate the system architecture of the Apex application.

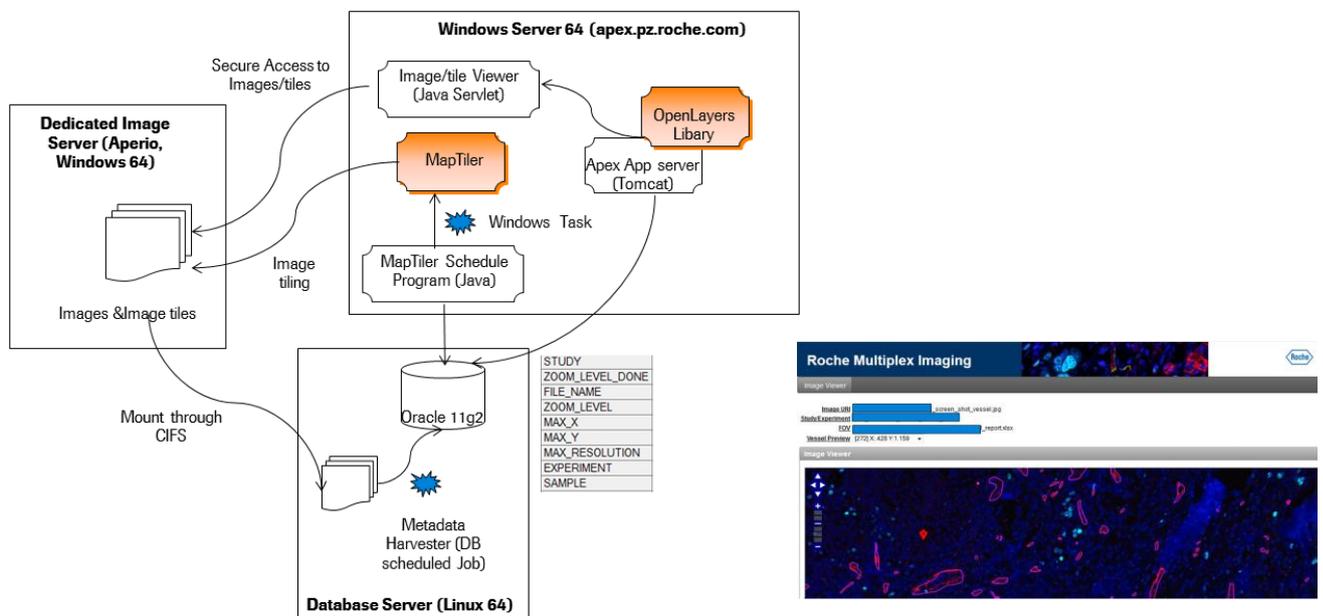


Figure 2: System architecture of the Apex application.

OpenLayers is a JavaScript library for displaying map data in Web browsers. In contrast to many other similar dynamic map APIs like the Google Maps API, the MSN Virtual Earth APIs, and the Yahoo! Maps API, OpenLayers is a free software with the FreeBSD license. It can be directly installed on the Apex application server as shown in Figure 2.

While using OpenLayers, an important process is the off-line image tiling, i.e., preparing image tiles (raster data) in advance and also caching the tiles in browsers or proxy servers. This is done in our project through an open source software MapTiler/GDAL2Tiles, which is part of the GDAL Open Source Project (Geospatial Data Abstraction Layer, <http://www.gdal.org/>). Controlled by a Java program, the map tiler conducts the image tiling directly on the dedicated image server, and also harvest the image metadata, in particular the image zoom level, into the database. The user can adjust the zoom level later according to the analysis requirements, and after each change, the Java program will redo the image tiling process.

For the dynamic image zooming, the OpenLayers APIs need other image metadata like the URL of image tiles, the image size (max X, max Y), and the maximal image resolution. The API also supports the layer-based POI (Point of Interest) marking. From the Apex application, the user can select “Field of Views” and get them marked on images. Besides the security control over the Apex Web application, a specific image viewer is further implemented as a Java servlet to avoid unauthorized access to image tiles on the dedicated image server from the Web interface.

Graphviz: Interactive Graph Visualization

Graphviz is a wide spread tool for layouting network data. In the pharmaceutical research we track each processing step of a sample, yielding various genealogy data. These genealogies are of interest to scientists as they provide a quick overview of the history of a sample. In Figure 3 we show a typical sample genealogy generated in Apex.

As Apex has no means to display graphs, we implement an extension to dynamically generate the sample genealogy. The input format for Graphviz, i.e. the dot file, is generated by a PL/SQL package. The rendering of the SVG is done by a C library, which is called from the PL/SQL code. Our approach is rather generic. The queries for entering new graph types can be generated on the fly. We also use a SVG (Scalable Vector Graphics) to flash library for the compatibility with some Web browsers like Internet Explorer 8, which do not support SVG. Furthermore, the client is also extended with JavaScript functionalities to support event handling.

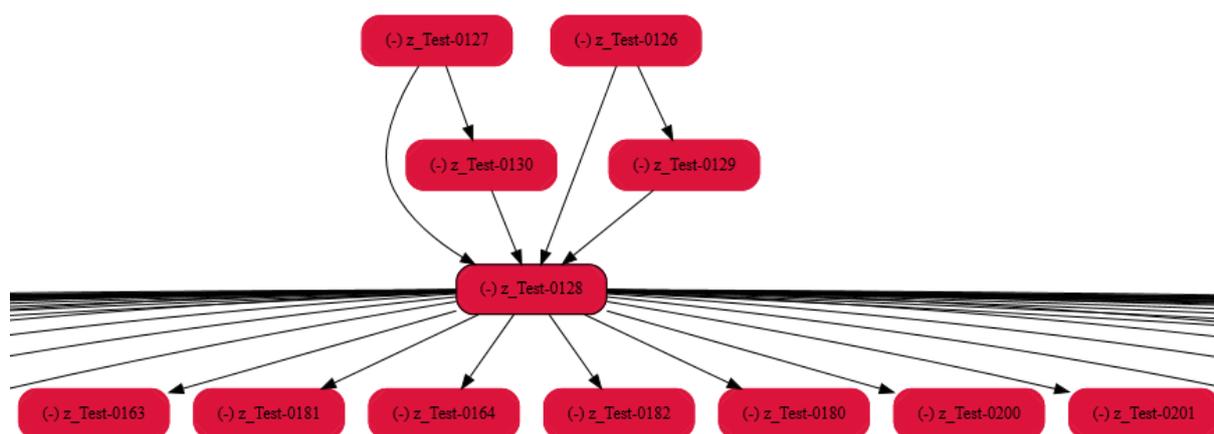


Figure 3: Sample genealogy dynamically generated in Apex

Summary

Apex provides a rather straightforward approach to integrating various JavaScript libraries. Enhanced by powerful PL/SQL and Ajax technologies, we have now lots of possibilities to realize rich user experience in Apex.

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