Earth Science Mining Web Services

< Infusion of Diverse Technologies via Web Services >

Abstract To allow scientists further capabilities in the area of data mining and web services, the Goddard Earth Sciences Data and Information Services Center (GES DISC) and researchers at the University of Alabama in Huntsville (UAH) have developed a system to mine data at the source without the need of network transfers. The system has been constructed by linking together several pre-existing technologies: the Simple Scalable Script-based Science Processor for Measurements (S4PM), a processing engine at the GES DISC; the Algorithm Development and Mining (ADaM) system, a data mining toolkit from UAH that can be configured in a variety of ways to create customized mining processes; ActiveBPEL, a workflow execution engine based on BPEL (Business Process Execution Language); XBaya, a graphical workflow composer, and the EOS Clearinghouse (ECHO).

Web Services enables the infusion of diverse technologies

XBaya: mining workflow composer
- User author's workflow and deploys to ActiveBPEL engine.

ActiveBPEL: workflow orchestration engine
- Exposes a URI pointing to the WSDL for that workflow
- WSDL URI is sent to the GES DISC Data Mining Services via SOAP
- EOS Clearinghouse (ECHO)
- Discovery service for data files

Simple, Scalable, Script-Based Science Processor for Measurements (S4PM):
- Processing engine searches ECHO for data, and caches locally
- Invokes ActiveBPEL to execute ADaM via web service according to workflow
- Stages output to an FTP area for pick-up by external user.

XBaya // Web Service workflow authoring tools from University of Indiana with modifications from UAH
- Java based client-side GUI
- Compose/monitor workflows for Web Services
- Hides complexities of Business Process Execution Language (BPEL)
- Decomposes workflow execution from composition
- Deploys WSDL workflows to different BPEL workflow engines (e.g. ActiveBPEL)
- Save workflow to invoke later

ADaM // Command-line data mining algorithm from UAH wrapped as Web Services
- Data mining toolkit developed by UAH
- Includes image processing, pattern recognition and other complex algorithms
- Includes over 100 scientific utilities
- Customizable as well as traditional data mining capabilities

Pattern Recognition
- Classification Techniques
- Bayes Classifier
- Naïve Bayes Classifier
- Bayes Network Classifier
- Classifier
- And more...

Image Processing
- Arithmetic Operations (+,*)
- Collaging
- Cropping
- Image Difference
- Image Normalization
- And more...

Perl data processing engine from GES DISC triggers Web Service Workflow via ActiveBPEL engine

S4PM // DISC triggers Web Service workflow via ActiveBPEL engine

ActiveBPEL // Remotely hosted Web Service orchestration
- Open source Java based implementation of the BPEL engine
- Reads WSDL file from XBaya
- Orchestrates processes from initial stage to execution
- Manages flow control, alarms and other executions

Conclusion

Earth Science Mining Web Services, created from an infusion of well-known technologies, have shown promising results to the data mining/scientific community. With an abundance of algorithms available, users can create and execute their data mining workflows without any data transfer. In turn, this gives user control over the data they want to process at the server's source. The next phase will be the Smart Assistant for Earth Science Data Mining (SAM). SAM will provide data type/mining ontologies to aid in workflow composition, expansion of existing workflow composer tool and deployment of existing mining services in additional environments.