

RESTful Web Services in Science

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November 5, 2015

CGI Programs

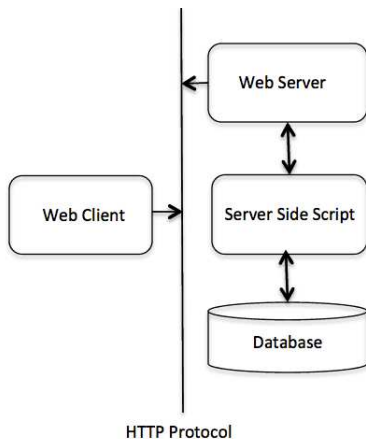


Figure: Perl/Python web program back in the good old days of CGI

Example:

`http://bar.utoronto.ca/efp_arabidopsis/cgi-bin/efpWeb.cgi`

Source: <http://www.tutorialspoint.com/perl/perl CGI.htm>

Web 2.0

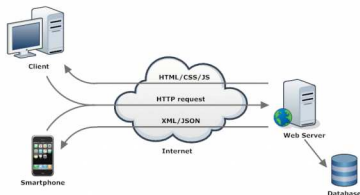
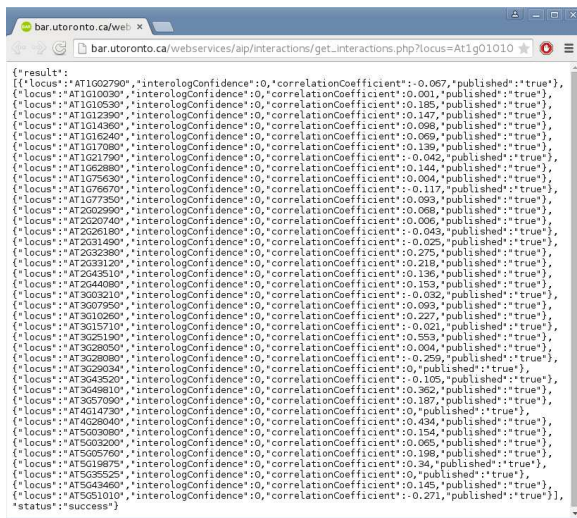


Figure: Modern REpresentational State Transfer

- ▶ Input: HTTP GET request
- ▶ Output: XML, JSON, SVG, png

Source: <http://di-side.com/di-side/services/web-solutions/rest-webservice-symfony/>

AIV: Database and webservice



The screenshot shows a web browser window with the address bar displaying `bar.utoronto.ca/web` and the URL `bar.utoronto.ca/webservices/aip/interactions/get_interactions.php?locus=At1g01010`. The main content area displays a JSON response from the webservice. The response is a list of interactions for the specified locus, each containing fields for locus, interologConfidence, correlationCoefficient, and published status. The status is consistently "success".

```
{
  "result": [
    {
      "locus": "AT1G02790",
      "interologConfidence": 0,
      "correlationCoefficient": -0.067,
      "published": "true"
    },
    {
      "locus": "AT1G10030",
      "interologConfidence": 0,
      "correlationCoefficient": 0.001,
      "published": "true"
    },
    {
      "locus": "AT1G10530",
      "interologConfidence": 0,
      "correlationCoefficient": 0.185,
      "published": "true"
    },
    {
      "locus": "AT1G12390",
      "interologConfidence": 0,
      "correlationCoefficient": 0.147,
      "published": "true"
    },
    {
      "locus": "AT1G14360",
      "interologConfidence": 0,
      "correlationCoefficient": 0.098,
      "published": "true"
    },
    {
      "locus": "AT1G16240",
      "interologConfidence": 0,
      "correlationCoefficient": 0.069,
      "published": "true"
    },
    {
      "locus": "AT1G17080",
      "interologConfidence": 0,
      "correlationCoefficient": 0.139,
      "published": "true"
    },
    {
      "locus": "AT1G21790",
      "interologConfidence": 0,
      "correlationCoefficient": -0.042,
      "published": "true"
    },
    {
      "locus": "AT1G62880",
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      "correlationCoefficient": 0.144,
      "published": "true"
    },
    {
      "locus": "AT1G75630",
      "interologConfidence": 0,
      "correlationCoefficient": 0.004,
      "published": "true"
    },
    {
      "locus": "AT1G76670",
      "interologConfidence": 0,
      "correlationCoefficient": -0.117,
      "published": "true"
    },
    {
      "locus": "AT1G77350",
      "interologConfidence": 0,
      "correlationCoefficient": 0.093,
      "published": "true"
    },
    {
      "locus": "AT2G02990",
      "interologConfidence": 0,
      "correlationCoefficient": 0.068,
      "published": "true"
    },
    {
      "locus": "AT2G20740",
      "interologConfidence": 0,
      "correlationCoefficient": 0.006,
      "published": "true"
    },
    {
      "locus": "AT2G26180",
      "interologConfidence": 0,
      "correlationCoefficient": -0.043,
      "published": "true"
    },
    {
      "locus": "AT2G31490",
      "interologConfidence": 0,
      "correlationCoefficient": -0.025,
      "published": "true"
    },
    {
      "locus": "AT2G32380",
      "interologConfidence": 0,
      "correlationCoefficient": 0.275,
      "published": "true"
    },
    {
      "locus": "AT2G33120",
      "interologConfidence": 0,
      "correlationCoefficient": 0.218,
      "published": "true"
    },
    {
      "locus": "AT2G43510",
      "interologConfidence": 0,
      "correlationCoefficient": 0.136,
      "published": "true"
    },
    {
      "locus": "AT2G44080",
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    {
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    {
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      "correlationCoefficient": 0.004,
      "published": "true"
    },
    {
      "locus": "AT3G28090",
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      "published": "true"
    },
    {
      "locus": "AT3G29034",
      "interologConfidence": 0,
      "correlationCoefficient": 0,
      "published": "true"
    },
    {
      "locus": "AT3G43520",
      "interologConfidence": 0,
      "correlationCoefficient": -0.105,
      "published": "true"
    },
    {
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      "correlationCoefficient": 0.352,
      "published": "true"
    },
    {
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      "interologConfidence": 0,
      "correlationCoefficient": 0.187,
      "published": "true"
    },
    {
      "locus": "AT4G14730",
      "interologConfidence": 0,
      "correlationCoefficient": 0,
      "published": "true"
    },
    {
      "locus": "AT4G28040",
      "interologConfidence": 0,
      "correlationCoefficient": 0.434,
      "published": "true"
    },
    {
      "locus": "AT5G03080",
      "interologConfidence": 0,
      "correlationCoefficient": 0.154,
      "published": "true"
    },
    {
      "locus": "AT5G03200",
      "interologConfidence": 0,
      "correlationCoefficient": 0.065,
      "published": "true"
    },
    {
      "locus": "AT5G05760",
      "interologConfidence": 0,
      "correlationCoefficient": 0.198,
      "published": "true"
    },
    {
      "locus": "AT5G19875",
      "interologConfidence": 0,
      "correlationCoefficient": 0.34,
      "published": "true"
    },
    {
      "locus": "AT5G35525",
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      "correlationCoefficient": 0,
      "published": "true"
    },
    {
      "locus": "AT5G43460",
      "interologConfidence": 0,
      "correlationCoefficient": 0.145,
      "published": "true"
    },
    {
      "locus": "AT5G51010",
      "interologConfidence": 0,
      "correlationCoefficient": -0.271,
      "published": "true"
    }
  ],
  "status": "success"
}
```

Figure: The Web Service called for At1g01010

Toy Example of REST

- ▶ All `http://services.groupkt.com/country/get/all`
- ▶ CA
`http://services.groupkt.com/country/get/iso2code/CA`
- ▶ CAD
`http://services.groupkt.com/country/get/iso3code/CAN`

Python Code Demo

RESTful Web Services

Some service providers in Biology

- ▶ Reactome
<http://reactomews.oicr.on.ca:8080/ReactomeRESTfulAPI/Re>
- ▶ ATTED-II <http://atted.jp/help/API.shtml>
- ▶ BAR <http://bar.utoronto.ca/webservices/>

Searching and demystifying output

- ▶ JSON Lint: <http://jsonlint.com/>
- ▶ Most database websites have REST web services described in API documentation section

Working example

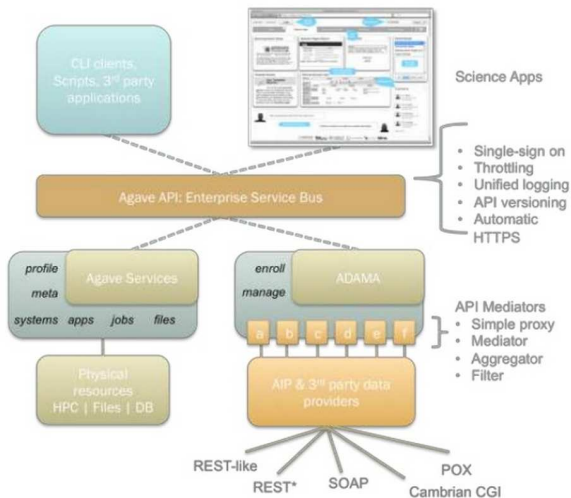
- ▶ TAIR for Plant Biology
- ▶ Araport being made by The J. Craig Venter Institute, Texas Advanced Computing Center, and University of Cambridge
- ▶ <https://www.araport.org/>
- ▶ Community extensible Science Apps
- ▶ We (BAR at University of Toronto) are also working on Science Apps

Science Apps On Araport

- ▶ Web Apps must be written in HTML5/CSS/JavaScript
- ▶ Araport allows developers to develop fully functional apps in their local development environment and test them on Araport site
- ▶ Developers can also develop Araport Data Mediator API (ADAMA) adaptors to access web services on 3rd party websites
- ▶ The ADAMA adaptors (Python clients for RESTful web services) can be called by using Agave API from web apps

(Krishnakumar V. *et al.*, 2015)

Araport Architecture



Source: Araport workshop tutorial

Web Application Development Stack

The following are used to develop Araport webapps

- ▶ Yeoman application generator
- ▶ Grunt task runner
- ▶ Bower package manager
- ▶ npm (node package manager)
- ▶ OAuth 2.0 for Agave API access
- ▶ HTML5/CSS/JavaScript
- ▶ Swagger-js for API documentation

Arabidopsis Interactions Viewer

An interactions Viewer was developed for Araport

- ▶ Interactions database is on the BAR
- ▶ RESTful web service gets data from database on the BAR
- ▶ ADAMA mediator (in Python 2.7 and YAML) on Araport workspace to access the web service from Araport
- ▶ Interactions displayed using Cytoscape JS plugin
- ▶ Developed using HTML5/CSS/JavaScript
- ▶ Hosted on GitHub
- ▶ Backend:
https://github.com/asherpasha/AIP_interactions_webservice
- ▶ Frontend:
https://github.com/asherpasha/AIP_interactions_viewer

(Geisler-Lee J. *et al.*, 2007)

AIV: Screenshot

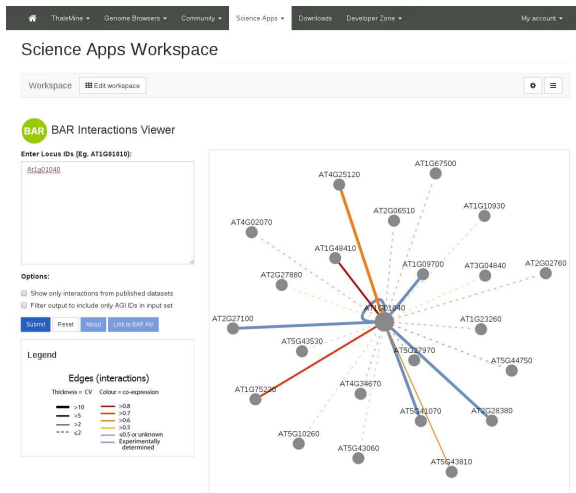


Figure: Interactions viewer running on Araport

Acknowledgements

Provart Lab and CAGEF

- ▶ Prof. Provart
- ▶ Prof. Guttman
- ▶ Jamie Waese
- ▶ Sylva Donaldson
- ▶ Yunchen Gong
- ▶ Ryan Austin
- ▶ Hardeep Nahal
- ▶ Anna van Weringh
- ▶ Michael Dong
- ▶ Matthew Ierullo
- ▶ Rohan Patel
- ▶ Nina Wang
- ▶ Richard Song

Araport/JCVI/TACC

- ▶ Prof. Chris Town
- ▶ Prof. Jason Miller
- ▶ Matt Vaughn
- ▶ Vivek Krishnakumar
- ▶ Matt Hanlon

Others

- ▶ U of T Scientific Coders
- ▶ Joshua Heimbach (Araport workshop team)

Funding

- ▶ Genome Canada
- ▶ CAGEF
- ▶ University of Toronto