Some Sample Project Topics

Sample Project Topics

STEP-L Web Redesign Project

Project Title: “STEP-L Web” Environmental Sensitivity Model Redesign

Project Background and Motivation: The ABE department created a web-based version of an EPA Excel Spreadsheet some years ago. It has been “upgraded” several times. This has resulted in 4 different versions built in order to handle multiple input data types (GUI, JSON, SOAP URL’s). All 4 are in current use, one is strictly a human interface and the other 3 accept some form of dynamic input from the web, the API is public but not documented.

The original design has a complex architecture where a set of Fortran programs are executed with text files as parameter files. The text files are built by a human using a JavaScript GUI and Python backend (JSON becomes “rows” in the calculations). The existing interface code is crude, is not object-oriented and has a few known interface bugs. The Fortran programs can remain as it is unless there exists a better replacement (e.g. Java).

There is an intricate system of temporary files and folders for calculations and output. The temp directories are difficult to manage and should be replaced with some new system that allows a user to save the current progress and continue work later from the same state. A small lite database (e.g. Google or Tableau table, and let Google handle login, logout etc.) with minimum amount of required maintenance would be appropriate.

Project Deliverables: Our ultimate goal is to replace the 4 versions with a new single object-oriented redesign.

1. Accept JSON input from the web as a service (with a documented API)
2. Intuitive GUI for humans to use
3. Allows a user to save the current progress (user inputs) and continue work later from the same state with a small lite database
4. GUI works in multiple browsers and is mobile-aware (compatibility)
5. Upgrade some of the behind-the-scenes input data sets
6. Well documented code with the names for the 200 input environmental variables rather than calling them “input 001”, “input099” ...
7. The output can be save and loaded as well. (Note that the output currently is a set of graphs. Contact the project stakeholders for details and suggestions.)

System Requirements: We need the final product to function on either one of our departmental platforms – 1) a highly managed ECN Linux/ Apache/ Tomcat web server, or 2) an ITAP virtual Windows 2012 / Apache/ web server managed by us, where we can install anything but must be vigilant on security. Both systems have Python-based models currently. We have had extensive security issues with poorly installed and poorly secured PHP and I do not want any more code using PHP. I would welcome some true security scanning of the final product, since we are accepting multiple JavaScript input streams, currently have writeable temp directory and are executing a lot of small scripts- we are somewhat vulnerable.

The current version runs on the Linux box and I would prefer that, but we cannot be root, can only
install things that run for the user (as opposed to root). This Linux box is equipped with 12 core CPU and good for computations. (Side note: the department does not buy AWS or other cloud-based things that require monthly subscriptions, or pay companies to duplicate what we get on campus.)

**Current version:** https://engineering.purdue.edu/mapserve/ldctest/STEPL/ (probably needs some explanation if you try to run it)

**Project Stakeholder:** Larry Theller, Agricultural and Biological Engineering, theller@purdue.edu

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**L-THIA LID Redesign Project**

**Project Title:** The L-THIA LID Spreadsheet Replacement and Redesign

**Project Background and Motivation:** L-THIA LID (Long-Term Hydrologic Impact Analysis : Low Impact Development) is an online spreadsheet calculator, where a user enters inputs describing an area, makes selections of alternatives using radio buttons and sliders, thus creating a before and after scenario; the program fetches appropriate precipitation data from a database, and performs calculations that estimate the impact on the environment of the user’s selected alternatives. Results are presented as tables and graphs.

The existing web site has undergone several renovations. As a result it is overly complex. The human GUI functions well in Chrome but often has issues in other browsers. There is also a PHP script that listens for JSON inputs from a web client. The incoming JSON is parsed and populates a web form as if the human entered it.

There is an intricate system of temporary files and folders for calculations and output. The temp directories are difficult to manage and should be replaced with some new system that allows a user to save the current progress and continue work later from the same state. A small lite database (e.g. Google or Tableau table, and let Google handle login, logout etc.) with minimum amount of required maintenance would be appropriate.

Also we would like to remove the database calls to ECN’s tightly managed Oracle server with some other method of input or a database more accessible than ECN’s Oracle (note that the precipitation data could be seen as 3500 text files, one for each county in the US.) We want to continue to support both input types (human GUI and posted JSON).

At this time the structure is based on core compiled routines in C which get inputs from Perl scripts. The Perl is now driven by PHP scripts that are triggered from HTML and JavaScript web forms. (There is known to be a unresolved, subtle error in some calculations probably due to the complex GUI.)

**Project Deliverables:** Our conclusion is that it would be faster to design and build a new version with modern tools, as opposed to trying to fathom the complex structure to fix the bug and make incremental improvements.

1. Improved ways of building the inputs
2. Redesign of the system around the existing C source code or the Excel spreadsheet (the set of trusted equations) in some other fashion (see System Requirements).
3. GUI needs to be robust and simple or intuitive to use. (The core user is a watershed coordinator with a BS in wildlife science trained by US Corps of Engineers to use the model, during a 4 hour
4. The new one ought to be mobile-aware, ought to be HTML 5.
5. The main part of the GUI is the sliders and radio button choices (look for the section “Lot Level LID Screening”. New version should replicate these in some fashion.
6. Allows a user to save the current progress (user inputs) and continue work later from the same state, and review her past work with a small lite database
7. The output can be save and loaded as well. (Note that the output currently is a set of tables and graphs. Contact the project stakeholders for details and suggestions.)
8. Enhanced output (focus groups have asked for better presentation than data-dense tables – what data in the graph is good, what is bad, why is nothing highlighted or popped out for consideration.)

We want to get away from Perl, as the admins are slowing removing all the old libraries we compile against. I would prefer Python as the scripting language as we have many other web models in Python, so we will continue to keep some staff around trained to use that.

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The current version runs on the Linux box and I would prefer that, but we cannot be root, can only install things that run for the user (as opposed to root). This Linux box is equipped with 12 core CPU and good for computations. (Side note: the department does not buy AWS or other cloud-based things that require monthly subscriptions, or pay companies to duplicate what we get on campus.)


**Project Stakeholder:** Larry Theller, Agricultural and Biological Engineering, theller@purdue.edu

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**Transforming Drainage Project**

http://transformingdrainage.org/

**Project Title:** Reservoir Planning Tool for Water Quality and Irrigation Benefits

**Project Background and Motivation:** The goal is to develop a web-based tool for calculating and displaying the potential benefits of various sizes of irrigation reservoir across the entire Midwest. These reservoirs will store water during wet periods for use during dry periods, and will be part of a system to provide a sustainable food supply under future climate conditions. Students in Spring 2017 created the tool for input and calculation at a single point, at https://drainage.agriculture.purdue.edu/ (Click on “Select a location and use 30-year model estimates”, then submit to see the current grid.) The goal for this semester is to develop an automated way to calculate the outputs at all the grid locations (approximately 10,000), and to create online maps that display outputs for the entire region. The same Google map-based platform can be used, or the outputs could be displayed in an alternate way.
mapping tool.

**Project Deliverables:**
1. Calculation of the reservoir benefits for 10,000+ grid cells using an existing algorithm.
2. A map website that allows the user to view the outputs over the entire region, and select what maps to display (turning them on or off)
3. Charts that provide more information (for example displaying maximum/minimum rather than only the average for any location), .csv download capability, and other output enhancements.

**Project Stakeholders:** Jane Frankenberger, Professor, is the Principle Investigator for the Transforming Drainage Project, and will oversee the project along with Larry Theller, GIS Specialist, and Ben Reinhart, Project Manager. The tool will be used across the Midwest to plan possible water storage.

### Purdue Autism Cluster

**Project Title:** Heart rate deceleration analysis software to help researchers in autism, speech, and nutritional studies

**Project Background and Motivation:** A unique experimental technique on heart rate deceleration analysis has been used in identifying early risk factors for autism in infants along with concurrent behavioral attention data. The same technique has been adopted in the research areas of speech (i.e., analyzing how infants process language) and analysis of drug response to nutritional supplements. Despite the fact that this is a well-established technique with multiple applications, there is no software to help researchers perform this analysis in an efficient way. Today, if a researcher needs to use this technique for her/his study, she/he needs to get it implemented by a programmer in a customized way that caters to their requirements or needs to do manual analysis of the data recorded in an excel spread sheet, which is time-consuming and prone to error. Some researchers also do this through SAS software, which requires SAS expertise.

If there was a generic software product that implements the heart rate deceleration analysis algorithm (which will be provided) along with a user friendly UI that helps researchers perform their analysis with customized options, it will help accelerate the research in the aforementioned fields and will make a unique clinical impact in multiple research fields. Also, the software engineering team will get the opportunity to experience the complete software development life-cycle by working closely with real world stake holders.

**Project Objectives and Deliverables:** A software product that provides the following features:
1. Preprocessing of heart rate data combined with other data streams used for the study (e.g., behavioral attention data).
2. Implementation of the heart rate deceleration analysis algorithm.
3. User friendly UI to help researchers to customize their analysis.
4. Provide both graphical and numeric output (e.g., a CSV file that specifies the algorithm output for each heart beat) to facilitate further analyses.

Details of the algorithm, user inputs, and the formats of the graphs will be provided.

**Project Stakeholder:** Bridgette L. Tonnsen, Ph.D. Assistant Professor of Psychological Sciences, Purdue University, btonnsen@purdue.edu
Purdue Sports Performance

**Project Title:** Health & Wellness Questionnaire App

**Project Description:** A daily health & wellness questionnaire application for Purdue student athletes. The application would be both iPhone and Android user friendly. The possibility of multiple questionnaires would be filled out on the application daily and all data stored, saved, and accessible via excel or another platform to be analyzed. The app would have the ability to send information out as notifications/reminders to individual student athletes or full teams. Below are examples of current technology already in use:

https://coachmeplus.com
https://coachmeplus.com/portfolio-posts/canisius-college-case-study

**Project Owner:** Christopher Giacchino, Sports Performance Associate, Purdue University, 781-854-6317, cgiacchi@purdue.edu

Knowledge Engineering Laboratories

**Project Title:** The Unit Modeler Technology

**Project Description:** Purdue University has partnered with Knowledge Engineering Laboratories (Ke Labs) to make the Unit Modeler Technology available for student projects. The Unit Modeler Intelligent Software Development Environment (ISDE) is a comprehensive technology for building smart, feature rich, enterprise-ready applications. The Unit Modeler ISDE has the unique ability to work with complex information in a very natural and easy way. You can do more in less time and do not need a programming background to get started.

**Project Owner:** Knowledge Engineering Laboratories (Ke Labs). Click here for details.

Nielsen's Research Methods Center of Excellence

**Digitization of Retail Establishment Surveys**

**Completed Projects and Projects in Progress**

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