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Dear Prof. Keating,

Attached is our final report on the state of our semester project, Explain Shell for Chrome. The members of the team working on this project were Ted Li, Justin Gallagher, Jacob Zimmerman, and Howard Chen.

Sincerely,

Jacob Zimmerman,
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Explain Shell for Chrome & ExplainShell Trends

Final Report

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Submitted to

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Abstract

Purpose Methodology **Results** **Conclusions** There are many snippets of shell code on the web that pose threats to unsuspecting web users, who may accidentally run malicious or insecure commands. Documentation for such commands exists, but is unwieldy and intimidating. Written in Javascript, CSS, and HTML, the ExplainShell Chrome extension provides information in a user-friendly and convenient manner. When a user clicks on a shell command on a webpage, the extension opens an iframe containing an explanation of the command. Although certain features of the extension were unable to be completed, this extension is fully functional and significantly reduces the hassle required to look up shell commands found online.

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1 Introduction

We discuss the circumstances warranting the need for our project and give an overview of our project and discuss its solutions to problems we outlined. We also analyze the effectiveness of our Literature Review, as well as how well our final accomplishments compare with our original goals.

1.1 Background

For those who work in a command line environment, it's hard to find references that are both accurate and accessible when trying to run particular commands. Manual pages certainly satisfy the “accurate” stipulation, as they're often the most definitive source of information on a command. On the other hand, Google has made vast amounts of information accessible to users, but at the cost of quality.

By and large, users favor accessibility over accuracy, meaning that commands and lines of code found online are copied and pasted from online with almost the same level of trust as that of a `man` page. This poses a grave threat to users, as people run the risk of running malicious or insecure commands unknowingly.

Luckily, there exist sites like ExplainShell.com which aim to rectify this situation to some extent. By copying and pasting commands into ExplainShell.com, users can at a glance see usage information for a particular command, giving credibility to the correctness of particular commands. ExplainShell works well, but it provides one additional step on top of the simple copy/paste operation that users would otherwise perform. Unfortunately, this step is oftentimes one operation too many.

1.2 Project Overview

The primary goal of our project, ExplainShell for Chrome, was to reduce the invasiveness of this step in people's normal workflow. Using a Chrome Extension, that user's could install with a single click, we would be able to provide the access to the same information that ExplainShell provided, but directly in the context of the page.

This manifests itself in the extension in one of two forms, chosen at the discretion of the user. With the first option enabled, all lines of code that look like shell commands are turned into links. Instead of having to copy, change tabs, and paste, users can have one-click access to the information. The alternative option is to merely hover over the relevant lines and have

an inline popup display the relevant information.

A secondary goal of our project was to provide a sort of community for people learning and using shell commands. We wanted to take advantage of the information we would have access to given a sizable install base of our Chrome Extension. This project, called ExplainShell Trends, would tap into the clicks or hovers sent to our Chrome extension, and send them off to a centralized analytics site. This analytics site would be able to display trends such as most popular command, most popular site, most viewed articles, etc.

By aggregating data from all installations of our Chrome extension, we created a collective learning grounds that was both accessible and accurate (backed by ExplainShell.com). Even people who don't have the ExplainShell for Chrome extension installed would be able to see what sorts of commands people view most commonly and learn new things.

1.3 Analysis of Literature Review

The literature on this sort of subject was nearly non-existent. What documentation there is on shell scripting is usually of poor quality and widely varied. Additionally, it is normally a topic that is learned in the process of doing something else; shell scripting is generally a means to an end rather than a pursuit in and of itself. This vicious cycle means that finding literature for our topic was a struggle.

We did manage to find value in sites like BashOneliners.com and LinuxCommand.org. BashOneliners.com is a site dedicated to the collection and explanation of single-line Bash snippets. LinuxCommand.org is a tutorial for explaining the shell to first-time users. Both of these sites possessed an element of what we wanted to encapsulate in our project. Using them as a reference point, we were able to refine our product and aim to fill a gap in the current app ecosystem.

Apart from these sites, we used various walkthroughs and tutorials to guide our development process, with varying effectiveness. Some notable references we used were this guide¹ by Christopher Buecheler, and the Chrome extension sample code². These sites helped in the sense that they guided our technical implementation, but did little as far as providing insight or ideas into what could be accomplished or tweaked to solve our problem.

¹<http://cwbuecheler.com/web/tutorials/2013/node-express-mongo/>

²<https://developer.chrome.com/extensions/samples#search:contextmenus>

1.4 Successes

Considering the product that we were able to produce in the end, I would say that we were successful at achieving both of these goals. We have a working Chrome extension that puts ExplainShell's information as close as possible to the user's workflow. Our trends site is able to aggregate many pieces of information collected by our Chrome extension. While we don't have a huge number of people using the app presently, with a little bit of marketing, there is no reason why it couldn't be a practical solution for people in the large.

It is interesting to note that the way the Chrome extension works now is different from the way any of us planned it initially. Along the way, we realized that the time required to implement certain features would be prohibitively high, so we dropped them, but because of the way we planned the development of the extension (see Approach), nothing that we ended up having to drop significantly affected our progress towards our original goals. We discuss the difference between our original plans and final outcomes in more detail in Approach and Results.

2 Approach

In this section, we outline the various phases of our development cycle. We make special note of the technologies used to implement the extension and the site.

2.1 Phase 1

We planned Phase 1 of our project as the minimum viable product that could add value on top of ExplainShell.com. For this phase, we implemented a Chrome extension that allowed the user to select text, right click and be presented with a context menu item directing the user directly to ExplainShell.com in a new tab. We implemented this very shortly after our planning session to have a working product.

While there was certainly room for improvement at this step, Phase 1 was important for initializing the infrastructure of our project. Without having to get too heavily invested into the brunt of the projects work, we were able to do things like initialize a Git repository for the project, lay out the core files to the Chrome extension (written in JavaScript), and push a working app all the way through the Chrome Web Store.

2.2 Phase 2

For Phase 2, we implemented the first of the two options for how to interact with our Chrome extension: finding bash command lines in the page and turning them into clickable links. This turned out to be somewhat tricky, as without doing a significant amount of text processing, it's hard to figure out what is a line of bash code and what isn't.

To combat this, we looked for certain classes that tend to be present on blocks of bash code, including the CSS class “`lang-sh`”, which is added by the Google PrettyPrint processor, a common library for adding color to code snippets. In addition, we also interpreted code blocks whose line started with the text `$`, as it is a common practice online to preface bash oneliners in this way. Obviously, this can't possibly cover all cases, but in our experience it is able to identify a large number of bash commands within web pages.

2.3 Phase 3

The principal goal of this phase was to implement the other major option: displaying a popup when the user hovers over a line of bash code. This end result of phase diverged the most from our original intentions of all the phases.

Originally, we had planned to provide a new interface around the information collected and returned by the underlying ExplainShell application. This interface was to be more mobile friendly and also suitable to a light-weight popup. This would have required modifying the actual ExplainShell backend (written in Flask) and submitting a Pull Request to the original ExplainShell project. Due to our teams' limited knowledge of Flask and the complexities involved with getting acquainted to a foreign code base, this turned out to not be a viable path.

Instead, we implemented a popup that displayed the actual ExplainShell.com page for that line of code. As it turned out, this aligned more or less equally with our original goal for the popup. It remains accessible, and is only slightly more clunky than we initially intended. For users looking to have the least resistance possible, it provides a quick way of bring up the relevant ExplainShell.com information. The popup used Bootstrap to provide the popup skeleton and animations, which was chosen for its ease of use and widespread documentation.

2.4 Phase 4

“Phase 4” was the term that we used to refer to the ExplainShell Trends site during project planning and development. Since this phase actually was a project own its own for the most part, we were able to proceed on development in this phase alongside development of the Chrome extension.

We implemented the Trends site as a Node.js application with a MongoDB backend. This was the best option because as a team, we were most familiar with Node.js, and MongoDB’s schema-less approach to data storage allowed our models to develop rapidly as we adjusted the trends site and added features to it. The visible portion of the trends site was implemented again using Bootstrap with a library for incorporating JSON-based tables into the page.

The trends site is capable of querying information based on most recently clicked items, top sites, and top articles. The trends site frontend is capable of taking any of these returned datasets and sorting them by any field. All in all, these endpoints provide a wide perspective of what sort of commands are popular or potentially interesting to command line users.

3 Results

Our ExplainShell for Chrome and ExplainShell Trends projects are both successful when evaluated in terms of our proposed evaluation criteria. Both ExplainShell for Chrome and ExplainShell Trends are user-friendly and informative, bridging the gap between accessibility and accuracy of information. Each embodies a solution that helps people learn new things about command line shell code, improving on the solutions that already exist. Additionally, the Chrome extension lowers the barriers to looking up information about a command before running it, meaning that users are safer from malicious attacks.

At the end of our project, we were able to implement all but three of the milestones on our revised Gantt chart, all of which related to the public ExplainShell API. As discussed earlier in the subsection on Phase 3, even though we were not able to successfully contribute to ExplainShell’s Flask backend, progress towards our original goals and design for the extension didn’t entirely falter.

We had initially allocated time for contributing a public API to ExplainShell for the purpose of making a responsive inline popup for when a user would hover over or tap on a line of shell code. However, realizing that the time required to implement this feature was prohibitively high, we managed

to find a different solution to provide the user with a simple popup by just embedding the relevant ExplainShell page itself in the popup.

We have included our project’s Gantt chart and revised Gantt chart in Figure 3 for reference (rotated for space considerations). The second, third, and fourth items of the revised Gantt chart correspond to the items we dropped.

4 Discussions

4.1 Lessons Learned

Our team learned a great deal from working on this project. Early on, we fell embarrassingly behind schedule. Very little work had been contributed to the project, and we were having trouble communicating between group members. Why this ended up being the case is still somewhat mysterious, but we all recognized that the lack of communication was hindering us.

Around the time we had to start doing weekly progress reports, we realized that not nearly enough work was being accomplished. Jake had managed to pull together a working implementation of Phase 1, but no other work had been done. The turning point was that we had a meeting where we sat down and addressed the lack of ownership and communication between team members—basically, we needed to get our acts together and we all knew it.

Coming out of this meeting, we started to get some actual work done. We worked diligently to make up time lost, checking items off our Gantt chart with renewed vigor. It was a really powerful experience, seeing what can be accomplished with just a little bit of discussion and understanding, and is what we all agree is the most impactful lesson learned from the project.

As a team, we also learned many individual, technical lessons. For example, Howard took the opportunity to learn how to use Git effectively to collaborate on a programming project. Each member had the chance to learn new things about web development and software engineering along the way.

4.2 Recommendations

If we were to do it over again, the principal recommendation we would adhere to is to start earlier. Procrastinating on deadlines was one of the biggest

detriments to our productivity, and is ultimately what held us back from contributing a public ExplainShell API back to the original project. Had we managed our time effectively, we could have gotten ahead of the planned schedule, ultimately yielding the necessary extra time to implement all the features we had originally intended.

Another recommendation that we have is to understand the importance of bottlenecks. When working on this project, we didn't accurately recognize which steps of our project would require the most work. With two days of planning compared with 2 hours of planning to come up with our Gantt chart, we could have more adequately recognized these gaps in our planning and compensated for them up front.

References

- [1] ExplainShell, <http://explainshell.com/>
- [2] Bash Oneliners, <http://www.bashoneliners.com/>
- [3] Linux Command, <http://linuxcommand.org/>
- [4] Chrome extension context menu sample code, <https://developer.chrome.com/extensions/samples#search:contextmenus>
- [5] Tutorial - Getting Started With Node.js, Express, MongoDB, <http://cwbuecheler.com/web/tutorials/2013/node-express-mongo/>

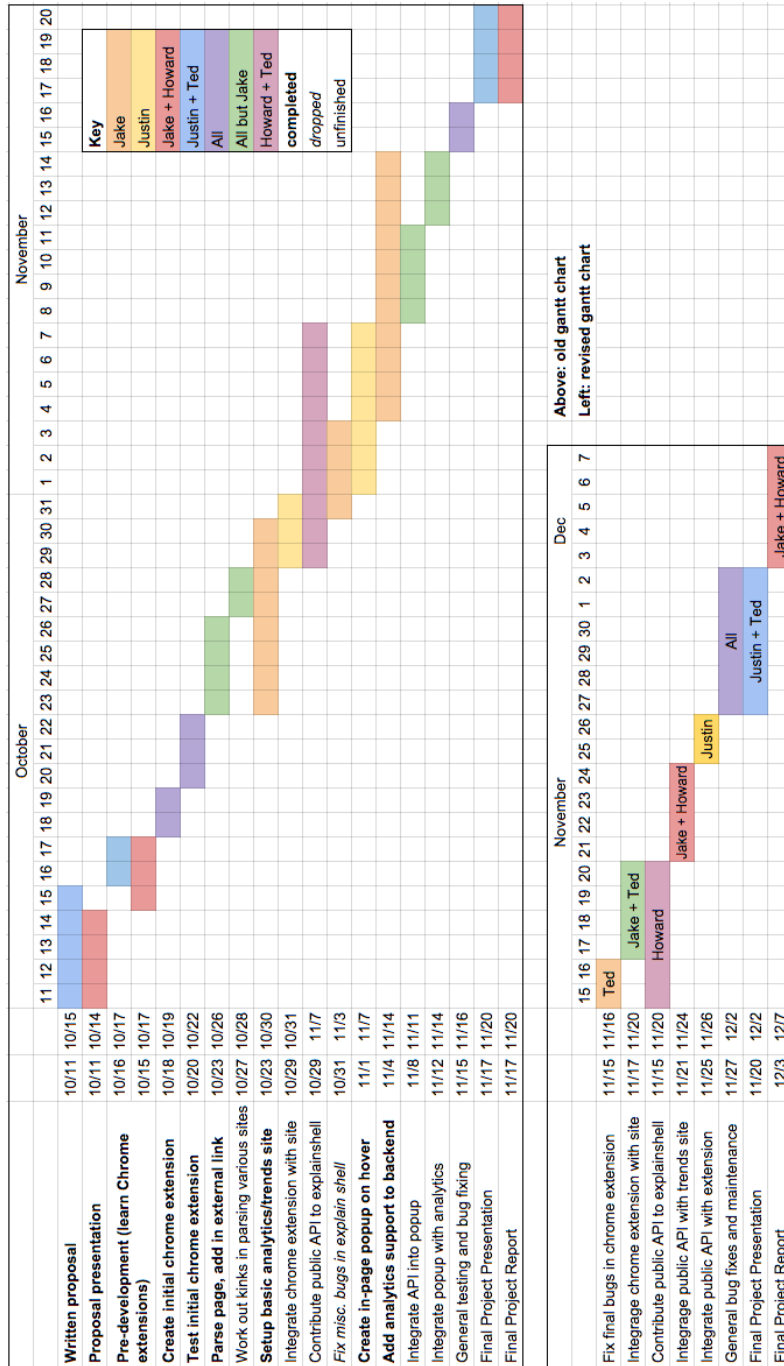


Figure 1: Revised Gantt chart, in context with progress on old Gantt chart