

Research of Command Line Interface User Experience

of CSC318 Group 3

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Executive Summary

The following research report provides insight towards our methods for gathering data relevant to our enhanced command line interface (CLI) project. Previous research was conducted through the study of published journals concerning CLI's and the relationships they have with computer users. Our findings from these articles are located in the Background Research section, and were used to identify key issues with current command lines, and possible improvements. Our research plan, as described in the appropriate section, consists of observing user performance on a hands-on command line test and then asking users to fill out a follow-up questionnaire aimed at identifying usage trends and possible usability improvements of the CLI. We will also gather information from some participants with a short one-on-one interview which will help us understand user's experiences with CLI's, or what could encourage non-users to adopt the technology. Participants will be gathered mainly from the University of Toronto.

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Who Did What

For this assignment, we split up work evenly. A rough division of work is as follows: Rui worked on interview questions, Ben worked on the questionnaire questions, Maxwell worked on adding to the questionnaire and the live test cheat sheet, and Philip and Dawing worked on the Phase 2 document, including the Research Protocol, summaries, etc. However, we generally brainstormed together to create the questions for our research instruments, and group members jumped from section to section, contributing content when they thought of appropriate ideas to add.

BACKGROUND RESEARCH

Problem Space

The problem space we intend to study is the initial learning experience of shell Command Line Interfaces (CLIs). Though shell CLIs are powerful, they suffer from a steep initial learning curve. Users are expected to know a large repertoire of commands, arguments, options, and command composition techniques.

This problem stems mainly from the design of CLI interfaces. The primary use case where a Command Line Interface is more effective than a simple Graphical User Interface (GUI), is interfacing with complex systems that require many configuration options. CLI interfaces also have the benefit of being faster than GUIs in many cases, as all interfacing is done through one focal point; thus, one's attention does not need to be drawn around a changing UI.

These traits make shell CLIs effective tools for systems administration. As a result, they are perceived and treated more as a tool, rather than an interactive program. Users are expected to read large manuals before trying to use a CLI, and something will inevitably go wrong. The debug/error messages that get displayed are targeted more to people with an existing understanding of the underlying systems, as opposed to new users just getting started with shells.

Despite being unfairly relegated to systems administration, many Command Line Tools are well suited to an average user's daytoday operations. Many CLI specific tools are faster, simpler ways of accomplishing common tasks such as file globbing and permissions management. Furthermore, many debug tools for common systems are usable only from a CLI (networks, etc).

Knowledge of a CLI is one of the main barriers between end users and developers / administrators. Moreover, most CLI tools operate on a small, shared design language that should not, in principle, be difficult to learn. Therefore, identifying and combating the main barriers to the initial learning and adoption of shells is a worthwhile task to pursue.

And through our background research, we found out that:

- Predictive next command / macro formation in shells is a lot of effort for non guaranteed return for the user. (e.g. ~50% effectiveness in guessing next full command after given a log of the users interactions).
- Application contexted enhanced search queries are dependent on the source and is quite a bit of effort for often little return.

Target Audience

The main target audience of our research are students who just start learning CLI and those new users who are struggling with it. We are also looking for feedback from experienced users, who may or may not have issues with working with the CLI.

RESEARCH PLAN

We will be targeting different people based on questionnaire/test and interview. Using our research instruments, we will be able to probe our target audience, and understand their response towards CLIs.

Our three research instruments are divided into two sets. The first is comprised of the tasks/observation followed by the questionnaire while the other is the interview itself. Each set of research instruments is to be conducted independently of each other and be mutually exclusive on a per person basis.

To recruit participants, we will look to find whoever we can, throughout various locations of campus. Focusing only Bahen Center will give a skewed sample, so we will also try to set up in other locations, based on our predicted level of computer experience. This includes: Sidney Smith, around Victoria College, Engineering, CSC207 classes, etc. We will also give out doughnuts and other snacks to motivate people to participate our research.

RESEARCH INSTRUMENTS

Interview Script

[Introduction]

Good morning/afternoon/evening, sir/madam! My name is ... and I'm conducting an interview for CSC318 Design of Interactive Computational Media, and our group is working on Command Line Interfaces. Would you like to help us with it? It wouldn't take too long.

(If the answer is negative, politely say thanks and find others; if the answer is positive, move on to the following questions.)

[Background Information]

- ☐ Ask for permission to record the interview.
- ☐ Which program are you in at the moment?
- ☐ Which year are you in? (It's more polite to ask so instead of asking for age.)
- ☐ (If the interviewee is not a student) Then what is your occupation?

[CLI-Oriented]

- ☐ Do you know what a command line interface is (CLI)?
 - If YES, go to [YES] questions.
 - If NO, go to [NO] questions.
- **[YES]** So, you've heard of it, and you are capable to do some cool stuff with it?
 - ☐ (If NO) So have you have to tried to learn it before? (If yes, why stopped learning? If no, go to [NO] part.)
 - (if YES)
 - ☐ What was the hardest part about using the CLIs?
 - ☐ What is your general idea toward CLIs?
 - ☐ *Which tasks in particular do you find the most difficult or annoying to accomplish using a CLI? (What would you change about it?)
 - ☐ Now if I'm a newbie student and I want to learn CLIs, would you please give me some secret advice?
 - ☐ In which cases would you choose to use a CLI over a GUI given the option to in your day-to-day life?
 - ☐ Are there specific use-cases which you would recommend learning a CLI over another?
 - ☐ What do you think the benefits of using a CLI are?
- **[NO]**
 - ☐ (Briefly introduce what CLI is and what it does, if necessary, perform some basic actions with CLI as an example)

- (If the interviewee is in CSC-related program, can tell him/her that CLI will be taught in CSC207 and CSC209)
- ☐ Do you think you would benefit from learning to use a CLI?
- ☐ Which one do you prefer, CLI or GUI (what you do on a daily basis, like moving folders and files around in the system)?

[Closing]

So that's all for our interview, we really appreciate your participation, and here's a doughnut (or some other rewards), please take it. And have a nice day, goodbye!

Remark: The questions above are just the outlines of our interview, so researchers need to be flexible while asking questions. Accuracy, correctness and politeness always come the first.

Terminal / CLI Usage Questionnaire

(Follow up to the interactive trial)

Education

High School / Below	Undergraduate	Graduate	Working
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Gender _____

What is your area of specialization / program of study? _____

Do you know what a Command Line Interface is? Yes / No

Have you ever used one? If yes:

How many years have you been using a CLI? _____

Which CLI do you have the most experience with? _____

Otherwise,

Have you ever considered learning a CLI in the past? for what?

Overall Reaction

Terrible					Wonderful
Difficult					Easy
Frustrating					Satisfying
Inadequate Power					Adequate Power
Dull					Stimulating

Screen and Appearance

<i>Reading the Screen</i>	Hard					Easy
<i>Organization of Information</i>	Confusing					Simple

Terminology and system information

<i>Use of terms in the system</i>	Inconsistent					Consistent
<i>Is terminology related to task?</i>	Never					Always
<i>Position of message on screen</i>	Inconsistent					Consistent
<i>Prompts for input</i>	Confusing					Clear
<i>Error Messages</i>	Unhelpful					Helpful

Learning

<i>Exploring new features by trial and error</i>	Difficult					Easy
<i>Learning to operate the system</i>	Difficult					Easy
<i>Remembering names and use of commands</i>	Difficult					Easy
<i>Performing tasks is straightforward</i>	Agree					Disagree

Interface Capabilities

<i>Speed</i>	Slow					Fast
<i>Reliability</i>	Unreliable					Reliable
<i>Mistake Correction</i>	Difficult					Easy
<i>Designed for all levels of users</i>	Disagree					Agree

What is your general impression of Command Line Interfaces?

What are the most negative things you have to say about this Command Line Interface?

What are the most positive things you have to say about this Command Line Interface?

Tasks on Terminal (Observation)

- Put the test subject in front of terminal with no explanation (no access to Google).
- After a minute or two of observing their initial actions, give them the cheat-sheet.
- Standardized Terminal Settings:
 - Colors: (the defaults from <http://terminal.sexy/>).
 - Font: Deja Vu Sans Mono (http://dejavu-fonts.org/wiki/Main_Page).
 - Font size 13.

Tasks (do as many of these in 5 minutes as you can)

- find your current working directory
- navigate to your desktop directory
- make a new file `newfile.txt` (on the desktop)
- make a new directory `newdir` (on the desktop)
- move the new file to the new directory
- navigate inside the new directory
- delete the file `newfile.txt` inside the new directory
- change the permissions of a read-only file
- make a file with the text "I am a new file"
- display the contents of that file
- wget an image off imgur (<http://i.imgur.com/83vlenA.jpg>)
- access CDF remotely
- list all processes of user `root` (or any of us, we just need to set up some processes)
- write to a file: all users on redwolf with the prefix "g3" in their username
- (Challenging) Find the name of the user with the most processes
 - requires reading the man page of grep

● Bash help sheet

● (to be given 2 minutes into the interactive trial)

- The bash shell works by moving around the filesystem of the computer and executing various commands. Commands are executed by typing them on the prompt and pressing enter/return, and can accept any number of arguments. Multiple arguments are written with spaces between them.
- You can also redirect the text displayed by one command to the input of another by using the 'pipe' character (|, on the \ key). redirection is done like this:
 - **command_1 | command_2**
- I/O can also be redirected to a file by using the 'greater than' character (>). I/O redirection can be accomplished like this:
 - **command_1 > filename**
- On this helpsheet, arguments are specified with <carat brackets>, and should be replaced with the value you want to pass to the command.

pwd

displays the "current working directory" of the shell
(this is the location in the filesystem that the shell is looking at)

ls

short for 'list'
:displays the contents of the current working directory of the shell

cd <directory>

short for 'change directory'
changes the current working directory to the one specified in the argument
<directory>

mv <file> <destination>

short for 'move'
moves a file to the destination specified.
it can also be used to rename files. For example,
mv x.txt y.txt
renames the files "x.txt" to "y.txt"

cp <file> <destination>

short for 'copy'
copies a file from the source file to a given path.

mkdir <dirname>

makes an empty directory

touch <filename>

makes an empty file

rm <path>

removes the file at a given path

echo <text>

displays the text specified in the argument <text>

man <command_name>

displays a long helptext for a given command
(press 'q' to escape the helptext viewer, and use the arrow keys to navigate around the helptext)

Other commands of interest:

chmod, ps, touch, cat, ssh, grep, finger, wget

Research Protocol

1. **Project Title:** Interviews and Observations of Command Line Interface User Experience.
2. **Investigators:**
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3. **Purpose:** The purpose of our research is to understand the learning curve and usability of CLIs for all computer users, to help us derive requirements for the design of novel interactive computational media that are intended to be useful to users of all levels. A brief description of our design concept is a CLI assistance software which provides visual cues and intuitive features to help usability.
4. **Process to be followed:** We will brief the participants about the purpose of the study, explain the consent form to them, and ensure that they sign the consent form. We will then engage the participants in observed command line usage tests, short follow-up questionnaires, and opinion based interview questions. We will also, with their permission, make observations as follows: observe participant performance during use of the command line and note down things such as requests for help, number of mistakes made, etc. The workspace will vary, but will be in generally quieter locations to allow participants to concentrate. The terminal they will work in will be controlled using our standardized terminal settings.
5. **Participant selection:** Participants will be chosen from students around U of T campus. They will be identified via observation, and students who have finished class and are on break will be requested to participate. The location we hold the study in will influence the likelihood of whether or not they use computers on a regular basis. In general, they will be characterized by age, program of study, and level of previous experience with command line interfaces.
6. **Relationships:** Our relationship to the participants may be described as follows: No relationship.
7. **Risk and benefit:** There will be minimal risk to the participants, for example that they will only feel that they have wasted their time. The only benefit will be to contribute to the education of the investigators. Participants are free to withdraw before or at any time during the study without the need to give any explanation.
8. **Consent details:** We will brief the participants about the purpose of the study, and explain the attached consent form to them, and ensure that they consent to participate and sign the consent form.

9. **Compensation:** Participants will receive no compensation or a small snack food.
10. **Information sought:** The information to be sought is described in the attached questionnaire, interview script, or observation protocol.
11. **Confidentiality:** Information will be kept confidential by the investigators. Names or other identifying or identified information will not be kept with the data. The only other use will be to include excerpts or copies in the assignment submitted, but names and other identifying or identified information will not be submitted.

Consent Form: Command Line Interface User Experience

I hereby consent to participate in a research study conducted by B.Hu, D.Cho, R.Qiu, P.Bilodeau and M.Huang-Hobbs for an assignment in *University of Toronto Computer Science 318, Design of Interactive Computational Media*.

I agree to participate in this study the purpose of which is to understand the learning curve and usability of CLIs for all computer users.

I understand that

- The procedures to be used are: observation, questionnaire and interview.
- I will receive snacks or no compensation for my participation.
- I am free to withdraw before or any time during the study without the need to give any explanation.
- All materials and results will be kept confidential, and, in particular, that my name and any identifying or identified information will not be associated with the data.

PARTICIPANT

Name (please print) _____

Signature _____

Toronto, Date _____

INVESTIGATOR(s) Name _____ Signature _____

References

- Durham, A., & Emurian, H. (1998). Learning and retention with a menu and a command line interface. *Computers in Human Behaviour*, 14(4), 597-620.
- Westerman, S. (1997). Individual Differences in the Use of Command Line and Menu Computer Interfaces. *International Journal of Human-Computer Interaction*, 9(2), 183-183.
- Herrera, D. A. (2004). Using guided interaction to support learning a command language (Order No. EP10787).
- Davison, B. D., & Hirsh, H. (1997). Toward an adaptive command line interface. *HCI* (2), 505-508.
- Davison, B. D., & Hirsh, H. (1998, July). Predicting sequences of user actions. In *Notes of the AAAI/ICML 1998 Workshop on Predicting the Future: AI Approaches to Time-Series Analysis* (pp. 5-12).
- Hirsh, H., Basu, C., & Davison, B. D. (2000). Learning to personalize. *Communications of the ACM*, 43(8), 102-106.
- Korvemaker, B., & Greiner, R. (2000, August). Predicting Unix command lines: adjusting to user patterns. In *AAAI/IAAI* (pp. 230-235).
- Jacobs, N., & Blockeel, H. (2001). The learning shell: Automated macro construction. In *User Modeling 2001* (pp. 34-43). Springer Berlin Heidelberg.
- Ekstrand, M., Li, W., Grossman, T., Matejka, J., & Fitzmaurice, G. (2011, October). Searching for software learning resources using application context. In *Proceedings of the 24th annual ACM symposium on User interface software and technology* (pp. 195-204). ACM.
- R. Eberts , L. Villegas , C. Phillips & C. Eberts (1992) Using neural net modeling for user assistance in HCI tasks, *International Journal of Human-Computer Interaction*, 4:1, 59-77, DOI: 10.1080/10447319209526028
- K. R. Mahach , D. Boehm-Davis & R. Holt (1995) The effects of mice and pull-down menus versus command-driven interfaces on writing, *International Journal of Human-Computer Interaction*, 7:3, 213-234, DOI: 10.1080/10447319509526122
- D. M. Lane , H. Albert Napier , S. Camille Peres & A. Sandor (2005) Hidden Costs of Graphical User Interfaces: Failure to Make the Transition from Menus and Icon Toolbars to Keyboard Shortcuts, *International Journal of Human-Computer Interaction*, 18:2, 133-144, DOI: 10.1207/s15327590ijhc1802_1
- Morgan, K., Morris, R. L., & Gibbs, S. (1991). When does a mouse become a rat? or... comparing performance and preferences in direct manipulation and command line environment. *The Computer Journal*, 34(3), 265-271.
- Chen, J.-W., & Zhang, J. (2007). Comparing Text-based and Graphic User Interfaces for Novice and Expert Users. *AMIA Annual Symposium Proceedings*, 2007, 125-129.
- Dillon, E. C., Jr. (2009). Which environment is more suitable for novice programmers: Editor/command line/console environment vs. integrated development environment?(Order No. 1468008). Available from ProQuest Dissertations & Theses Global. (304830577). Retrieved from <http://search.proquest.com/docview/304830577?accountid=14771>