Programming as a Vital Skill to a Visual Analytics Graduate Program

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ABSTRACT

This paper is a position piece on why an introductory class in a programming language is important for a Visual Analytics Graduate student's success in the future. Four key elements will be discussed as to why it important and a brief case study will highlight how it can be applied. This is in response to discussions as to whether a programming course should be included in a joint Visual Analytic's program with the Faculty of Business.

INTRODUCTION

There has typically been a difference between undergraduate and graduate studies. Where graduates have been more focused on research and undergrads have been focused on learning and application, though at research universities, this is slowly changing, as undergraduates are seeking to learn more. [1]

Applying this idea to Simon Fraser University's (SFU) proposed Visual Analytics (VA) Program, an argument can be made that undergraduate students should be learning concepts, theory, doing some research and learning key software packages. And graduate students should be focused on doing more detailed research in their field of study. By removing an introductory programming course from the curriculum a problem could arise. In

Illuminating the Path, a research agenda is set out for the development of Visual Analytics in the context of Homeland Security. [2] It highlights the need for a concerted effort to develop better systems to disseminate the vast amount of data that is being generated and stored. Undoubtedly this will require some conception of how computer systems function in order to achieve this goal. Thomas Davenport sees this vast amount of information as one of the last potential competitive advantages for an organization and yet, very few have realized it. [3]

Visual Analytics is "*the science of analytical reasoning facilitated by interactive interfaces.*"[4] The existing VA tools have been found to be insufficient and more effective systems will need to be developed. It is here where Graduate students can make their mark, simply learning existing systems, such as Minitab, tableau, excel, or SPSS, will likely prove to be insufficient, as it is taking what is already existing. Learning these systems at the undergraduate level is appropriate, as students can recognize the limitations and through their masters research they can potentially develop a method of overcoming these limitations.

It is during the master's level research program, where the importance of learning some basic programming becomes evident. While many students will not be top level programmers, by the end of their course, they should be able to build a basic proof of concept model and demonstrate their idea. At this point, if necessary, the proof of concept can be passed off to a more experienced programmer to develop further. Though the creator can still be

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[1] González, C. (2001, August 31). Undergraduate Research, Graduate Mentoring, and the University's Mission.

[2] *Illuminating the Path: the research and development agenda for Visual Analytics*. (2005).
[3] Davenport, T. H. & Harris, J.G. (2007). *Competing on Analytics: the New Science of Winning*.
[4] *Illuminating the Path: the research and development agenda for Visual Analytics*. (2005). pg. 5.

involved, as they are capable of having a somewhat intelligent conversation with the system developers to ensure the full vision or potential of the program is met.

WHY PROGRAMMING IS IMPORTANT

At a basic level, a master's student should be able to speak intelligently with most members in his/her organization. Suppose a student's thesis revolves around a new method of interpreting and interacting with data. While the student may not be able to create a full production model of the program, he/she could create a proof of concept model before passing it off to more experienced programmers. A VA master's student should be able to do the following 4 steps after taking an introductory programming course.

Understanding
The first step is to learn the language. A student should be able to develop an idea of what a class is, how a program executes itself and some of the basic commands for making a program function.

New Tools of Analysis
The second step involves the master's student gaining a conceptual of idea of what it is he/she wishes to build, essentially a use case. It will spell out what the student hopes to accomplish and the steps necessary to do so.

Prototypes
The third step involves building a prototype of the program using the use case as a guide. It will be a roughly functioning model of the desired tool, where it can then be tested, checked and improved upon.

Presentation
The final step is for the student to present their program and solicit feedback from other students and faculty. This could be the final product which a master's thesis is based upon.

Summary
Davenport said that the application VA has the potential to be one of the last areas of competitive advantage.[5] By being able to perform these 4 steps, the student will be able to speak somewhat intelligently to the developers, develop a concept for new analysis tools from a user perspective, be able to build a prototype of it and finally, present the findings before passing it off to stronger developers. These will be important factors in the student's future success, as it takes him/her beyond being a simple user of a system, but someone who is capable of improving the system.

CASE STUDY: IAT 800

For me personally, IAT 800 was an enabling class. I learned the four steps previously outlined and feel relatively confident that I can overcome some of the basic issues in designing analysis tools. While further experience is needed, the foundation that was built in this class will help me towards my thesis and at work.
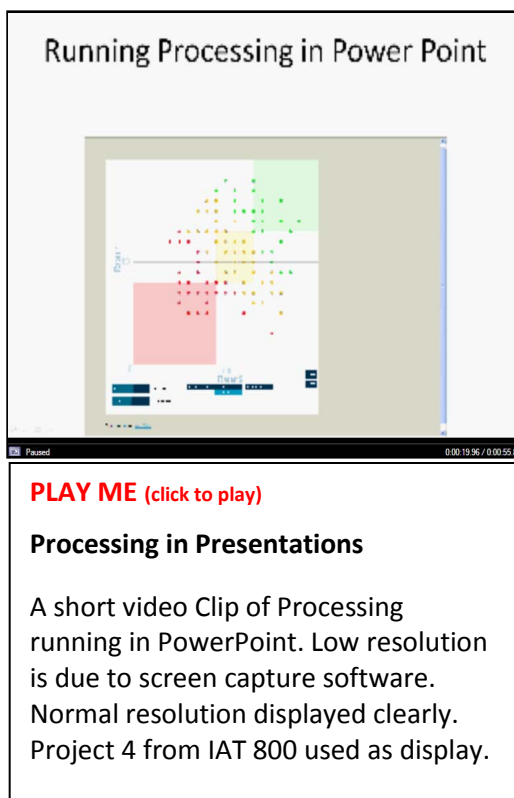
Using Processing
I have directly applied the projects in IAT 800 towards my work as a business analyst, by building a prototype for better understanding information in scatter plot diagrams. A second project involves examining all the possible permutations in determining an ordinal rank for a multi attribute decision system. This will be a ground up project and I am currently in Step 3, where I am designing the data model for running simulations.

The following video is a very simple example of how some basic programming skills could be used to develop a different method of conducting presentations and meetings. In the video, assignment 4 from IAT 800 is executed within PowerPoint, rather than running in a

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[5] Davenport, T. H. & Harris, J.G. (2007). *Competing on Analytics: the New Science of Winning*.

separate system (browser or processing). This type of application has the potential to eliminate switching in and out of programs, which can confuse the audience, or having multiple scenarios in back up slides. It comes to the heart of visual analytics, which is to display information visually and interactively.

This example does have some drawbacks, the first one being system resources. While trying to run the PowerPoint presentation and the capture program, my computer was using all of its resources, which resulted in slow response times in PowerPoint, though when I ran it without the capture program, performance was greatly improved. Secondly, the image quality was quite poor from the capture program, which is not reflective of the actual quality.

PLAY ME (click to play)

Processing in Presentations

A short video Clip of Processing running in PowerPoint. Low resolution is due to screen capture software. Normal resolution displayed clearly. Project 4 from IAT 800 used as display.

FURTHER STUDY

An experiment could be run where you test audience comprehension using an interactive presentation from processing, versus a presentation that switch's between programs and one that has numerous scenarios loaded into various backup slides. I would hypothesis that the interactive processing presentation would be more effective, though I could see this being context dependant. An excellent to attempt this experiment would be using marketing or financial data, both of which can be highly quantitative and perhaps better understood visually.

KEY ASSUMPTIONS

- New tools for VA are required
- A Masters program is not learning to use a statistical package
- A Masters program is about research with potential to do some development

CONCLUSION

A masters program in Visual Analytic's is difficult and it will challenge students to learn new things. If Davenport is correct and VA is one of the last competitive advantages, any student who can extend this knowledge by going beyond the basics of the system, will already have that competitive advantage.

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