A Dharma of Video Game Science

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Technical Report LARC-2011-03

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April 2011

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April 13, 2011

Abstract

We propose a Fivefold Path for scientific research into video games and argue that it can be used to guide both the process of conducting research and that of writing it up.

1 Introduction

The academic study of video games brings together researchers from diverse fields including the computational sciences, the social sciences, the liberal arts, and the visual arts. Each of these fields has its own conventions on what constitutes a suitable publication. I propose here to give a view, albeit a personal one, from the perspective of a computer scientist. I share this in the spirit of communication, not to dispute the contrasting viewpoints from other fields, but to lead to greater understanding of what we in the computational sciences can bring to video game research[1]. My ideas are expressed here in the guise of a Buddhist[2] Dharma based on a Fivefold Path.

The remainder of this paper is comprised of three sections. Section 2 describes the Fivefold Path in some detail. Section 3 describes how research is performed and written up according to the Fivefold Path. We conclude in Section 4 with some comments and a short enumeration of the Fivefold Path for easy future reference.

2 The Fivefold Path

Like the Noble Eightfold Path of Buddhism, the Fivefold Path is not just a sequence of single steps, but a set of interdependent principles that, when put into practice, lead to a higher level of existence and ultimately to the Nirvana of publication in a refereed workshop, conference, or journal. The Fivefold Path is[3]:

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[1] And secondarily as a guide to prospective authors and referees.

[2] If nothing else, because they appear to be as fond of numbered lists as I am.

[3] Although the initial letters of the five words that describe the Fivefold Path can be rearranged to make some interesting YABA-compatible acronyms such as SCIVE and VICES, such temptation is beneath us.

1. Speculation
2. Citation
3. Implementation
4. Experimentation
5. Validation

1. Speculation: You probably think you have plenty of exciting ideas[4]. Your paper must contain at least one, and preferably three new ideas. Some of the ideas may not be completely original, but at least the combination of them must be new. Naturally you would tend to speculate that your ideas are good ones. Although there are perfectly good Liberal Arts papers that stop at this point (for example, I am particularly attracted to Gingold [5]), Computer Science papers need more. It's not enough to say "This is how to make or design or analyze or classify games", or "Designers will find this useful", or "This will improve gameplay" without some kind of supporting evidence.

2. Citation: Next, you must compare and contrast your ideas and results to prior work. The academic study of video games dates back at least as far as the last decade of the 20th Century, and has since expanded mightily. Don't make the mistake of imagining that you're the first person to think of it. Your citation list[5] should be much more than just a list of commercial games.

3. Implementation: Having ideas is actually the easy part, making them a reality is the hard part. Your ideas have to be implementable, and the best way to prove that is to implement them in code. The code can be at the prototype level, a proof of concept, not production-level code, and probably not code you would want to show in public (more on that in a moment). However, it's not enough to say say "I've written a great game, here's a screenshot", and papers that are nothing more than a user manual are usually not publishable.

4. Experimentation: Now you can experiment with your implementation. But to what aim? You need to demonstrate beyond reasonable doubt that your ideas are good ones, meaning that they are better than anybody else's ideas. The good news is that you get to define what is meant by *better*. You must define clear metrics by which your ideas can be shown to be good. *Better* can for example mean *faster*, *higher quality*, or *more controllable* than previous methods. *Faster* can mean in terms of run-time, or a faster design process. *Higher quality* can mean any number of things, including prettier pictures or a better player experience. *More controllable* could mean more control by the designer, or by the player. It's not enough to say "People who have played my game like it" without evidence.

5. Validation: Your readers must be able to judge for themselves whether your ideas are good ones according to the metrics you have laid down. This judgement can come in one of two ways. Stretching the Buddhist analogy somewhat, these could be called the Two Jewels of Validation.

5.1 Self-directed validation
5.2 Data-driven validation

5.1 Self-directed Validation: Self-directed validation[6] means that the reader must come to a subjective judgement of the quality of the ideas directly from the output of your implementation.

[4] Assuredly you are not alone in this conceit.
[5] The novice should start with a keyword search on Google Scholar, then chase citations both directions in time.
[6] This is a potentially controversial new concept. But as the Buddhists say, change is inevitable.

This can come in one of four ways, roughly in ascending order of difficulty, openness, and value. These are the Four Precepts (in Sanskrit, *Śila*) of Self-Directed Validation.

5.1.1 Screenshots in the paper (good)
5.1.2 Screenshots and videos online (better)
5.1.3 Source code online (better)
5.1.4 App online (best)

5.1.1 Screenshots in the paper: Screenshots of your implementation can be compelling for papers on graphics or rendering[7]. For example, Doran and Parberry [3] includes a selection of screenshots of generated terrain, which is appropriate since the paper is about generating terrain that looks pleasing to the eye.

5.1.2 Screenshots and videos online: Since space in a paper is limited, the screenshots in the paper can be supplemented by more or larger screenshots, or even better, videos of gameplay on a public website that is cited in the paper. Again, the paper by Doran and Parberry [3] mentioned above cites more images and a video clip at [4].

5.1.3 Source code online: Better still, you can provide complete source code online. The readers can then download the code and try it for themselves, assuming you've provided full information on the programming language and environment. If possible, your code should require only standard hardware and software. Doran and Parberry [3] also cites code available at [4].

5.1.4 App online: Best of all, you can provide an application online in the form of, for example, a Java or Flash applet that can be viewed in a standard web browser. This is the most convenient for the reader. For example, Taylor and Parberry [8] cites a Java applet at [7].

5.2 Data-driven Validation: Data is good. The more data the better, of course, but the amount of data must at least be nonzero. This can come in one of three ways, roughly in ascending order of difficulty, openness, and value. These are the Three Precepts (or *Śila*) of Data-Driven Validation.

5.2.1 Preliminary data in the paper (good)
5.2.2 Significant data in the paper (better)
5.2.3 Raw data online (best)

5.2.1 Preliminary data in the paper: You should at the very least gather some preliminary data from experiments using a small number of your students, say ten or so. This is probably enough for a paper submitted to a refereed conference or workshop. Boyce and Barnes [1] is a particularly nice example that uses data from 36 middle-school students.

5.2.2 Significant data in the paper: Significant data means *statistically significant data.* Ideally, you should perform double-blind tests on a large number of randomly selected players, and analyze the data using standard statistical tests including error bars and measures of significance. There should be a comparison of your method to some baseline, if possible including previous methods. Sadly this is seldom done, but there is the prospect of online games being used to collect large data sets (for example, the protein folding game FoldIt, see Cooper *et al.* [2]).

5.2.3 Raw data online: There will only be space in the paper for a summary of the statistical analysis of the data. Your raw datasets should be placed online for your readers to examine.

[7] This is standard for papers published by the computer graphics community.

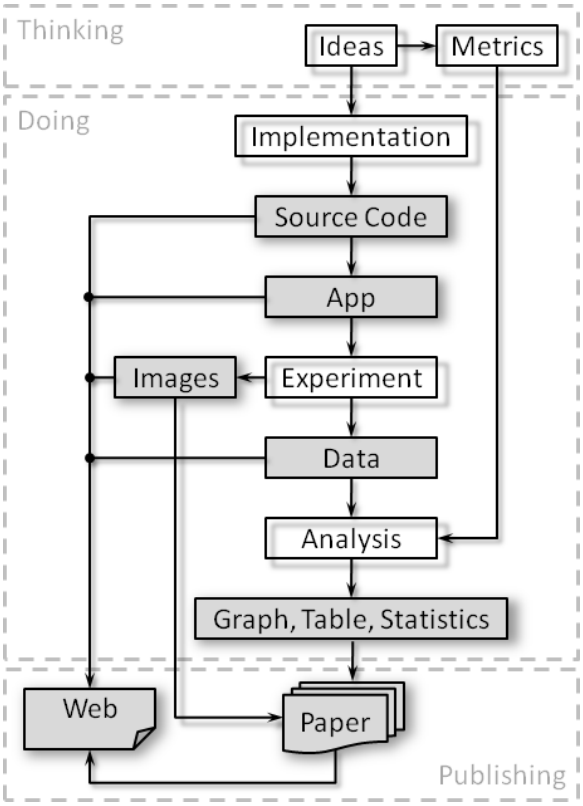

Figure 1: A flowchart for doing research using the Fivefold Path. The white boxes represent processes, gray boxes represent artifacts, and arrows show the direction of workflow.

3 The Practice of the Fivefold Path

Practioners trained in the Fivefold Path generally follow the flowchart depicted in Figure 1. Notice that it is divided into three parts, labelled *Thinking*, *Doing*, and *Publishing*. Unfortunately, while at the start of one's academic career one spends more time on the activities in the Doing box, later one finds oneself occupied more with the Thinking and perhaps some of the Publishing while promising doctoral students do the really interesting stuff[8].

It's best to keep your audience and their needs in mind when you come to write your research paper. Make sure that each of the aspects of the Fivefold Path are clearly described and appropriately visible in your paper. Don't make the reader dig for the knowledge. In particular, since the experienced reader first reads the Title and Abstract, then the Introduction, then the Conclusion, and only if they like what they see do they dig into the details, you should take some pains to ensure that your steps along the Fivefold Path are mentioned in the Abstract, foreshadowed in the Introduction, described in clearly labelled parts of the Body, and summarized in the Conclusion.

[8]This is perhaps the Prajñā of the Research Professor.

1. Speculation
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    5.1 Self-directed validation
        5.1.1 Screenshots in the paper (good)
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        5.1.4 App online (best)
    5.2 Data-driven validation
        5.2.1 Preliminary data in the paper (good)
        5.2.2 Significant data in the paper (better)
        5.2.3 Raw data online (best)

Figure 2: The Fivefold Path.

1. "I have a cool idea"
2. "It's new"
3. "I coded the idea into an app"
4. "We tested it"
5. "I was right, my idea is cool"
    5.1 "The app gets coolness from my idea"
        5.1.1 "Look at this pretty picture"
        5.1.2 "There are more online"
        5.1.3 "Look at my code"
        5.1.4 "Play with the app yourself"
    5.2 "The numbers show the app is cool"
        5.2.1 "For a few of my students"
        5.2.2 "Anything worth doing is worth overdoing"
        5.2.3 "The data supports me, see for yourself"

Figure 3: The Fivefold Path in Laconic Normal Form (LNF).

4 Summary and Conclusion

Ironically, this document itself strays far from the Fivefold Path (which is summarized briefly for your convenience in Figure 2 and in LNF in Figure 3) because it puts forward ideas with no attempt at validation. As with most didactic writing, the disclaimer "Exceptions excepted" should be assumed. Readers should therefore keep in mind the following two quotes: "Research is what I'm doing when I don't know what I'm doing" (Werner von Braun), and "A foolish consistency is the hobgoblin of little minds" (Emerson). For more information, see the webpage associated with this paper [6].

References

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