Example Design Documentation

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1   Introduction

In this course, you'll be required to write design documents for several of your projects. It's very important that you put time and effort into this! The students who put time and effort into their design documents almost always end up getting better grades and having an easier time with their projects in this course. At this point, you've probably had to do some medium-sized coding projects for your coursework; so you should realize that it is often difficult to go back and redisign when you run into a problem in the middle of your project. The design document provides you with a way to think about the problems you'll be coming up against while doing your initial design.

While the structure of a design document may seem constraining in its structure, it is designed to do two things: first, it requires you to use an organized thought process while designing your project; second, it requires you to write out the results of this thought process in a way that is communicable, in this case, with us, the TAs, but also with your teammates.

Provide an overview of the entire document:

- Describe the purpose of the document

- Describe the scope of the document

- Describe this document's intended audience

- Provide references for any other documents, such as textbook, reference manual, etc.

- Define any important terms, acronyms, or abbreviations.

- Summarize the content of the document

2   Overview

Provides an general overview of the functionality of the system and matters related to its design (including a discussion of the basic design approach and organization). You could split this up to multiple subsections.

3   The Fetch Stage

3.1   Circuit Diagram

Top level schematic and description

3.1.1   Submodule A

Submodule A schematic and description

3.1.2   Submodule B

Submodule B schematic and description

3.2   Correctness Constraints

State the functional requirement of this module.

- item 1
- item 2
- item 3

3.3   Testing

State the approach to verify the functional correctness of this module.

4   ...

5   Summary

...

6   Guidelines

The purpose of this document is for you to outline the design of your MIPS processor and provide an overview of your proposed implementation.

It serves to:

- Help you to start early and understand the requirements.

- Facilitate communication between you and your TA to get feedback on your design.

- Clarify any part of your circuit that we may find confusing.

As with any high level design, you should update and refine this document as you work on the implementation. You will need to turn an initial design document a week after the project is released and turn in a final design document when you are done with the project.

6.1   Modularity

Modularity is the single most important concept to understand when writing a design document (and possibly in digital design in general). Section 1.2 in this book[1] gives a good overview of what exactly modularity means in this context, and it is highly suggested that you read it. Make sure when you are designing your system that you are primarily thinking in terms of the modules you need and the interfaces between them. If any single module in your system is so complex that you cannot easily reason about its behavior, then it should be split up into multiple modules.

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[1]Digital design and computer architecture by David Money Harris and Sarah L. Harris. A free ebook version is available from Cornell library at cornell.worldcat.org

6.2 A picture is worth a ~~1,000~~ million words

Trying to write an entirely textual description of a circuit quickly becomes unmanageable for a design of any significant size. Well organized diagrams should always come first, and then small textual blurbs should be added for any piece of the diagram which may not be immediately clear to the viewer. When creating diagrams, it is important to organize blocks in some logical fashion. A typical strategy is to have inputs on the left and outputs on the right, and then to have data "flow" through your module from left to right.

6.3 Know Your Audience

You can assume that anybody looking at your design will know everything from lecture, but not that they have any prior knowledge about how your design is organized. Therefore it is perfectly acceptable to use primitive blocks such as the various boolean gates and flipflops without showing their transistor level implementation. In fact, it will actively hurt the clarity of your document if you decide to show implementation at such a low level. It is even fine to use high level blocks such as adders that we have covered in class without further elaboration. If you have a block that is a combinational function, it is best to give a truth table or boolean expression for the function rather than showing a harder to understand gate-level implementation of the function. It is not, however, okay to give a high level description of a block such as "Control Logic" and never give any further elaboration.

6.4 Approach

We recommend the following process for making your document:

- Draw a top level schematic for your circuit, using the coarsest blocks you can think of as your building blocks.

- For each block on the top level, draw a new diagram showing the implementation of that block. Again, use modules to implement any non-trivial functionality in this model.

- Recursively apply this process everywhere until you only have primitive blocks (see Know Your Audience).

- If there are any places where your solution is not made immediately obvious by the diagram, add text annotations to explain what is happening.

6.5 Miscellaneous

The required submission file format for the design document is PDF. You can, for example, create a PDF file using Microsoft Word or Google Docs. However, we recommend you to generate your PDF version of the design document using LaTeX. You could take this tex file and the associated Makefile as a starting point for your design document. For a quick reference on LaTeX, please refer to the wikibook at http://en.wikibooks.org/wiki/LaTeX