CPSC 121: Models of Computation Lab #7: Circuit Design: Coding Theory

Objectives

Coding theory is the study of methods used in determining the correctness of transmitted data. Think about the game of telephone in which one person whispers a message to another, who then passes that message on to the next person and so on and so forth. The "fun" in the game arises when the message makes it around the room and back to the original sender, now changed in some (humorous) way from the actual message, presumably having been altered somewhere along the way. Messages such as emails or phone conversations, which are sent on computer networks are subject to these kinds of transmission errors. In this lab, you will be designing and implementing an error-checking circuit that catches mistakes made when data is relayed.

1 Prelab: Coding Theory

The two biggest categories of transmission errors are *substitution errors* and *transposition errors*. **TODO** (prelab): Define these two terms and give an example of each. Also define a *checksum*.

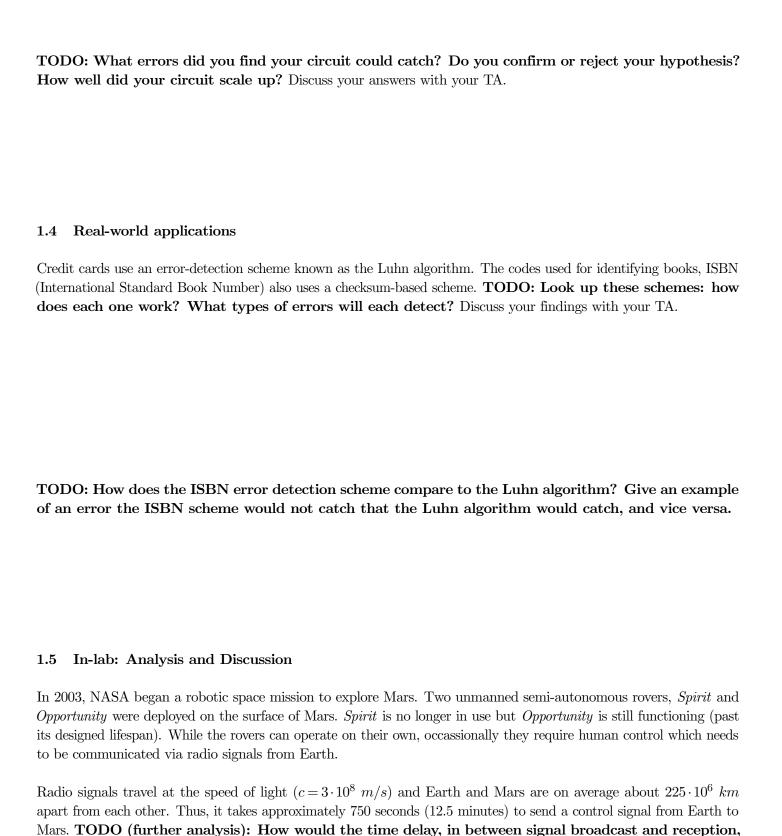
1.1 Prelab: design

TODO (prelab): Research and design an error-checking circuit that can identify substitution errors or transposition errors. Provide a circuit diagram for your design and cite any sources you use. To help you get started, consider parity checking and repetition codes. You are welcome to use any of these for your circuit. If you use the parity check your circuit must be able to identify errors in a message of at least four parallel bits, where one of the bits is the checksum. For all other designs, aim for a circuit that can handle three serial bits.

Please do not design an overly complex circuit that will take you too long to implement or test.

TODO (prelab): Determine or describe a method to test each of the following:
 Will this circuit catch substitution errors? Will this circuit catch transposition errors?
1.3 In-lab: Your circuit
TODO: Implement your circuit on Logisim, and then test it using your methods from the prelab Record your results/observations.
TODO: Scale your circuit up: modify your circuit so that it can detect errors on messages one bit larger than your current implementation. Then test your circuit again using your own methods. Record your results/observations. Show your circuit to your TA.

1.2 Prelab: methods



influence our design of how data is transmitted to the rovers on Mars?

2 End of Lab Survey

TODO: To help us improve these labs both this term and for future offerings, complete the survey at http://www.tinyurl.com/cs121labs.

3 Challenge problem

TODO (challenge): Implement a small circuit that corrects errors upon detecting them. You may want to first read up on forward error correction (FEC).

4 Marking scheme

All labs are out of ten marks, with two marks for prelabs, and eight marks for in-lab work. In more detail:

- Two marks Prelab questions
- Five marks In-lab questions. It is one mark for your results, one for scaling up, one for your findings; and two for the real world applications.
- Two marks Further analysis questions
- One mark End of lab survey.

TAs may at their discretion award one bonus mark, such as for completing a challenge problem. It is expected that most students will achieve 6-8. If you feel you're heading for 0-5, **get immediate help from the TAs!**