Advanced Programming Languages
Homework Assignment 0

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Logistics. Turn in your assignment as a single PDF document via the University of Michigan Canvas website. You may work alone or in pairs of your own choosing.

Exercise 1: Grading Contract. Indicate whether you will be using the default grading (in which you complete all of the assignments) or the *alternate* grading contract (in which you do not complete the homework assignments but your final grade is reduced by one letter; see the course webpage for details). If you choose the alternate grading contract, do not complete any other exercises in this homework.

Exercise 2: Bookkeeping. First, indicate one thing you like about the class and one thing you would change about it. Second, give me an interesting piece of computer science trivia. If you are working in pairs, each student must give separate answers to these two queries. (Bonus points: give an English word other than "bookkeeping" that contains three adjacent doubled letters. Hint: one approach is to use an "extended" regular expression on a file like `/usr/dict/words`.)

Exercise 3: Set Theory. This exercise is meant to help you refresh your knowledge of set theory and functions. Let X and Y be sets. Let $\mathcal{P}(X)$ denote the powerset of X (the set of all subsets of X). There is a 1-1 correspondence (i.e., a bijection) bewteen the sets A and B, where $A = X \to \mathcal{P}(Y)$ and $B = \mathcal{P}(X \times Y)$. Note that A is a set of functions and B is a (or can be viewed as a) set of relations. This correspondence will allow us to use functional notation for certain sets in class. This is Exercise 1.4 from page 8 of Winskel's textbook. *Do one of the following:*

- Demonstrate the correspondence between A and B by presenting an appropriate function and proving that it is a bijection. For example, you might construct a function $f : B \to A$ and prove that f is an injection and a surjection.

- Write "I understand this background material" but do not do the problem. You will receive full credit for this question.

Exercise 4: Model Checking Experiments. Download the CPAChecker software model-checking tool using the instructions on the homework webpage. Read through enough of the manual to run the tool on the `tcas.i` testcase provided on the homework webpage. Check the two properties given. For each command, copy down the last ten non-empty lines of output from CPAChecker and include them as part of your answer to this question.

It is your responsibility to find a machine on which CPAChecker works properly (but feel free to check the forums if you are getting stuck).

Hint: if your output when checking `Property1a` does not indicate "No property violation found by chosen configuration" then you have not set things up correctly.

Exercise 5: Model Checking Analysis. What is going on when you run CPAChecker using the commands listed? In at most three paragraphs, summarize your experience with the CPAChecker tool. What does `Property1a` mean? Is `tcas.i` a reasonable test suite? What has been proved? Did you find CPAChecker to be a usable tool? You may find the graphical reporting option of CPAChecker to be helpful here. For full credit, do not restate my lecture on counter-example guided abstraction refinement; instead, discuss your thoughts and experience using this tool. Focus on threats to validity (e.g., imagine that you were writing a paper and using this as an experiment) over usability.

Both your ideas and also the clarity with which they are expressed (i.e., your English prose) matter. I should be able to identify your main claim, the arguments you are making, and your conclusion.