

CSCI 3155 : Practice Midterm Exam 2 (applied)

Summer 2018 : Tuesday, June 27, 2017

- Please begin by acknowledging the CU Honor Code Pledge by signing in the space below the pledge

On my honor, as a University of Colorado Boulder student, I will neither give nor receive unauthorized assistance on this work.

Signature: _____

- Please then **print your name on this page** in the space provided below. Please **ALSO write your name at the top of each page** in case the pages become separated.
- You have 80 minutes for this exam.
- You may use one side of a single 8.5"x11" sheet of handwritten notes you created. Please turn in this page of notes with your exam – please make sure your name is on it if you would like it back. Otherwise, this exam is closed book, closed computer, and closed mobile device.
- Answer the Questions on your own paper. Please clearly indicate where answering each question.
- This exam has 2 pages, front only.

Name (please print): _____

Question :	1	2	3	Total	2 extra	3 extra	Raw	Reported
Points :	30	40	30	100	20	30	150	100
Score :								

We are going to extend a subset of the lab 1 javascripty with a new operator. Consider the pearl comparison operator ` \leq `. This operator is a binary operator that is called infix between its two operands (i.e. it is of the form ` $e_1 \text{ bop } e_2$ `). If the value of the left subexpression is less than the value of the right subexpression then the expression evaluates to -1. If the value of the left subexpression is greater than the value of the right subexpression then the expression evaluates to 1. If the value of the left subexpression is equal to the value of the right subexpression then the expression evaluates to 0. This should not effect your solutions, but for this practicum, the ` \leq ` operator should have a lower precedence than the `+` operator.

1. Grammars and parsing

- a. Write an ambiguous grammar over expressions that have numbers, the binary `+` operator and the ` \leq ` operator. Use the start symbol 'e' and use the meta-variable 'n' to denote numbers.
- b. State a sentence that is ambiguously defined by the grammar
- c. Demonstrate the ambiguity using parse trees.

2. Inferences

- a. Consider the operational semantic ' $e \Downarrow n$ '. Write inference rules over the language that define evaluation of an expression 'e' to a number 'n' using the standard definition of `+` and the provided explanation of ` \leq '. You may assume that ` $=+$ `, ` $<$ `, ` $>$ `, ` $==$ ` are all trivial judgment forms. You may not consider a ` $=\leq>$ ` to be a trivial judgment form.
 - i. First try writing this using 5 inference rules
 - ii. For extra credit complete this with 3 inference rules by assuming that ` $=?:$ ` is a trivial inference rule.
- b. Using your inference rules derive that ` $1 + 2 \leq 5 \Downarrow -1$

3. Coding: complete the following task in the functional subset of Scala. For extra credit, complete these in another programming language of your choosing.

- a. Creating an AST (no longer on the midterm but useful to know). Define an AST over your language. Name your AST whatever you would like. Let 'n' be represented with Doubles. Use whatever names you would like.
- b. Evaluation. Write a function that evaluates expressions in the form of your AST to a value of type Double.

