

CS 270 Lab 9 (Proving Properties of Recursive List Functions)

Week 10 - Nov 28 – Dec 1, 2017.

Name 1: _____

Drexel Username 1: _____

Name 2: _____

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Name 3: _____

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Instructions: For this exercise you are encouraged to work in groups of two or three so that you can discuss the problems, help each other when you get stuck and check your partners work. This lab provides practice using induction and equational reasoning to prove properties of recursive list functions. More precisely, the lab asks you to prove properties of the recursive reverse function.

```
(define (reverse l)
  (if (null? l)
      null
      (append (reverse (rest l)) (cons (first l) null))))
```

Prove the following 4 properties of the reverse function.

1. $(\text{list? } l) \rightarrow (\text{list? } (\text{reverse } l))$
2. $(\text{length } (\text{reverse } x)) = (\text{length } x)$
3. $(\text{reverse } (\text{append } x \ y)) = (\text{append } (\text{reverse } y) \ (\text{reverse } x))$
4. $(\text{reverse } (\text{reverse } x)) = x$

You may assume the following properties of the append function which were proved in lecture.

1. $(\text{and } (\text{list? } x) \ (\text{list? } y)) \rightarrow (\text{list? } (\text{append } x \ y))$
2. $(\text{append } \text{null } y) = y$
3. $x \neq \text{null} \rightarrow (\text{first } (\text{append } x \ y)) = (\text{first } x)$
4. $(\text{append } x \ \text{null}) = x$
5. $(\text{length } (\text{append } x \ y)) = (+ (\text{length } x) \ (\text{length } y))$
6. $(\text{append } x \ (\text{append } y \ z)) = (\text{append } (\text{append } x \ y) \ z)$

Let $(\text{nth } n \ L)$ be the function that returns the n -th element of the list L . Use nth to specify the condition that if x is a list $(\text{reverse } x)$ returns a list of length equal to the length of x that is the reverse of x .