

Scheme Warmup Exercises

Write the Scheme procedures described below. Each procedure can call the procedures defined earlier in these exercises. Use only our “basic Scheme vocabulary”.¹ Answers will be available on the web site (don’t peek).

1. Write a function that computes the area of a triangle with given height and base.
2. Write a procedure that computes the approximation to $\sin x$ given by $x - x^3/6 + x^5/120$.
3. Write the factorial function.
4. Write a predicate that checks if something is a list with exactly one element.
5. Write a predicate that checks if something is a list with exactly two elements.
6. Write a function that computes the average of a list of numbers.
7. Write a function that computes the variance of a list of numbers. (Here, the variance is the average of the squared difference between each element and the overall average).
8. Write a function that takes a list and tells us whether all its elements are equal.
9. Write a function that generates a list of integers (0 1 2 .. $n-1$) given n .
10. Write a function that duplicates each entry in a list. For example, (a b c) becomes (a a b b c c).
11. Write a function that counts the number of atoms in a list. For example, ((a b) c ((c a))) gives 5.
12. Write a function that replaces all atoms in the list with the symbol ‘?. For example, ((a b) c ((c a))) gives ((? ?) ? ((? ?))).
13. Write a function that takes two (numerical) functions and returns the one that yields the largest value when applied to 0.
14. Write a function that takes a list of one or more boolean functions and produces the new boolean function that results from OR-ing their results together.
15. Write a function that take a function f and a number n and generates a function that takes x and returns a list of the form (x f(x) f(f(x)) $f^{(n \text{ times})}(x)$).

¹ Ok, one more is useful: x^n is (**expt** x n).