

CSE 461: Programming Languages Concepts

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Homework 4: Scheme warming up **Due on Mar 6th at 6pm in Canvas.**

Submission: you should submit via Canvas a DrRacket file with Scheme code in. Please clearly mark your answers using comments so that we can tell the correspondence between your code and questions.

1. (0 points) Go through a brief tutorial about the DrRacket programming environment at <http://docs.racket-lang.org/drracket/index.html>. Be sure to change the language to R5RS.
2. (3 points) Code the Ackermann function in DrRacket, which is defined as follows:

$$A(m, n) = \begin{cases} n + 1 & \text{if } m = 0 \\ A(m - 1, 1) & \text{if } m > 0 \text{ and } n = 0 \\ A(m - 1, A(m, n - 1)) & \text{if } m > 0 \text{ and } n > 0 \end{cases}$$

To check your result, use DrRacket to compute the result of $A(3, 5)$, which should be 253. You only need to submit your Scheme code for the Ackermann function.

3. (3 points) John McCarthy is a famous computer scientist who designed LISP. He once proposed a function called the McCarthy 91 function, defined as follows:

$$\text{Mac}(n) = \begin{cases} n - 10 & \text{if } n > 100 \\ \text{Mac}(\text{Mac}(n + 11)) & \text{if } n \leq 100 \end{cases}$$

Write this function in Scheme. Try calling the function with a few numbers less than 100 and see what the results are.

4. (3 points) Some credit-card companies pay back a small portion of the charges a customer makes over a year. One company returns
 - (a) 0.5% for the first \$1000 of charges,

- (b) 0.75% for the next \$1000 (that is, the portion between \$1000 and \$2000),
- (c) 1.0% for the next \$1500 (that is, the portion between \$2000 and \$3500),
- (d) and 1.5% for everything above \$3500.

Thus, a customer who charges \$400 a year receives \$2, which is $0.5\% * 400$, and one who charges \$1,400 a year receives \$8, which is $5 = 0.5\% * 1000$ for the first \$1000 and $0.75\% * 400 = 3$ for the next \$400.

Define the function **payback**, which consumes a charge amount and computes the corresponding pay-back amount.