Homework Assignment 7

Any automatically graded answer may be manually graded by the instructor. Submissions are expected to only use functions taught in the course. If a submission uses a disallowed function, that exercise can get zero points. Excluding promises, *all functions that mutate values are disallowed* (mutable functions usually have a `!` in their name).

Memory management

1. Implement function `frame-refs` that returns the set of all handles contained in the given frame, according to the notion of *contains* introduced in class.

   - *Hint:* Consider using function `frame-values`.
   - *Hint:* Suppose you have a list `l` of `d:values`. You can keep just the elements of a given type, say you want to only keep the `d:numbers` of `l`, with `filter` and a type predicate. That is `(filter d:number? l)` returns all of the numbers in `l` and has type `(Listof d:number)`.

2. Implement function `(mem-mark contained mem ref)` that returns the set of all reachable handles from handle `ref`, and takes: `contained` a function that takes an element of the heap and returns a set of handles contained in that element, `mem` is a heap, and `ref` is the initial handle, according to the memory sweep algorithm discussed in class. **This is effectively a graph traversal algorithm.** An example of a `contained` function is function `frames-refs` for a heap of frames. Notice that function `mem-mark` expects a heap of any data.

3. Implement function `(mem-sweep mem to-keep)` that given a heap `mem` and a set of handles to keep (parameter `to-keep`) returns a new heap of frames that only contains the handles in the given set. *Hint:* Peruse `hw7-util.rkt` for heap-related functions. The solution should be a single function call.

Monads

Recall the list operations we have implemented in class.

4. Implement `map` for lists of effectful operations.

5. Implement `exists?` for lists of effectful operations.

Manually graded questions

6. **Manually graded.** Consider memory management via reference counting and the increment count operation. Suppose that the reference count algorithm is faulty and the reference count overflows resetting back to zero. *Discuss if overflowing the reference count affects soundness or completeness of memory management.*