

Advanced Functional Programming

Software Engineering Chair and Programming Systems Lab

Small-group work

Divide into groups and discuss the following questions. You don't have to answer the questions in the given order, so pick your favorite questions.

1. What formal definitions of *monad* are given in the paper? What would be an intuitive description? To answer that question, try to find commonalities between the different monads introduced in the paper.
2. What do you need to define a monad as a programming abstraction? Does the “triple” suffice?
3. You are given the following signature for a monadic random generator:

```
type 'a m                                (* generator producing 'a *)
val unit : 'a -> 'a m
val (>=>): 'a m -> ('a -> 'b m) -> 'b m    (* infix bind *)
val choose: float -> 'a m -> 'a m -> 'a m (* prob. choice *)
val run: 'a m -> 'a                        (* run the generator *)

val flip: int m
val uniform: int -> int m
val demo: int m
```

Function `choose p m m'` takes a probability p ($0 \leq p \leq 1$) and selects generator `m` with probability p and generator `m'` with probability $1 - p$. Give implementations for the functions `flip`, `uniform`, and `demo`:

- (a) `flip` returns 0 or 1, each with probability $1/2$. (1 line)
 - (b) `uniform n` returns a number $1, \dots, n$, each with equal probability. Use this function to simulate throwing a die. (3 lines)
 - (c) `demo` throws a 6-sided fair die. If this yields a number not greater than 3 the result is obtained by throwing an 8-sided fair die, or an 20-sided die otherwise. (3 lines)
4. The paper mentions *purity* a lot. Try to give a definition. How are monads related to purity, and to laziness? Haskell relies on monads for state and I/O, can you explain why?
 5. The paper demonstrates several applications of monads. Which cannot easily be simulated with conventional language features? Can you think of other applications not in the paper?
 6. What is the general contribution of monads, as a tool in the programming toolbox? What are possible disadvantages in using monads?

Homework Assignment

Congratulations! You were elected as a member for the program committee of the next seminar on advanced topics in functional programming. Please review the three anonymous submissions.

1. Write any comments you have into the margins, on the back of the paper, or on an extra paper that you staple to the submission.
2. For each paper provide a list of 8 points that you like or that you would like to see improved. You can also provide additional comments.
3. We ask you to handle your reviews with strict confidentiality. In particular, you are *not* allowed to discuss them with your colleagues.
4. Put your name and student ID on your reviews and drop them off at the program chair's office (room 326/45) until Monday, November 28th at noon (12am). If the door is closed, slide your printout under the door. No Emails.