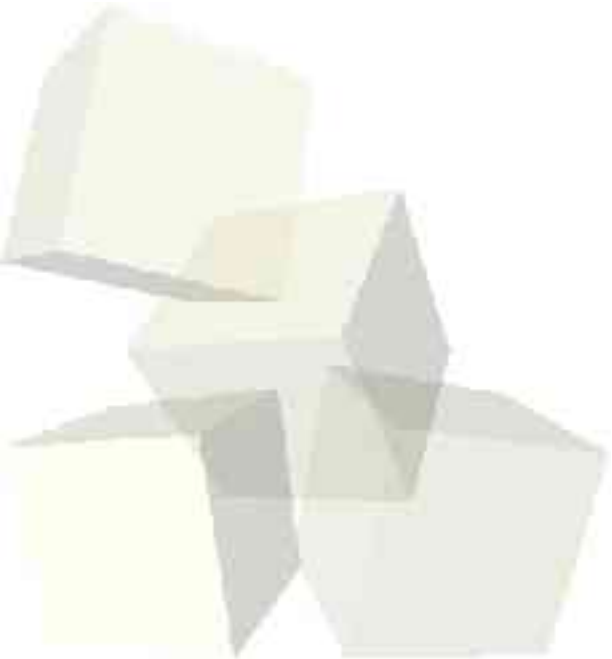
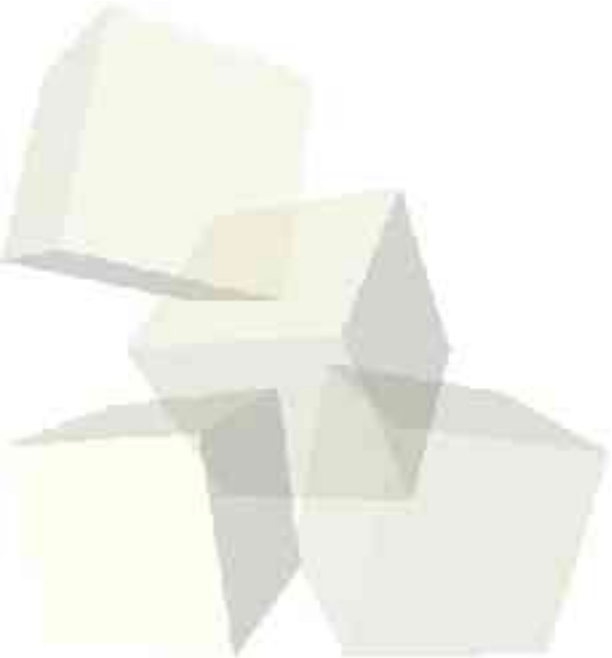
Higher Order Functions

10-27-2004



Opening Discussion

- What are the three times we can use a match in ML? What does each of them do? What operators restrict polymorphism? Which ones allow it?

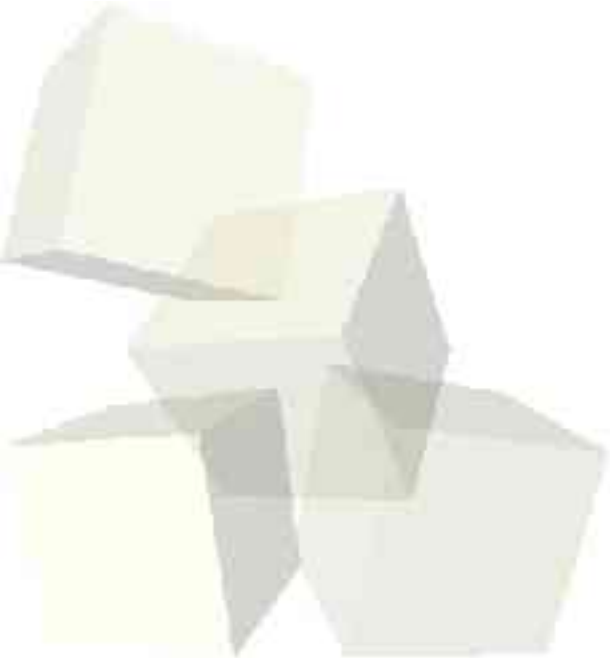


Higher Order Functions

- Being a functional language, ML lets us do the fun things we functions we got to do in Scheme. That means we can pass functions to functions and have functions return functions.
- The order of a function is one higher than the highest order of any function it accepts or returns.
- Note in the types that -> binds right to left.

Common Higher Order Functions

- Some common higher order functions are map, reduce, and filter. Let's write map and filter.
- Note the syntax not only of writing these functions, but also of calling them.

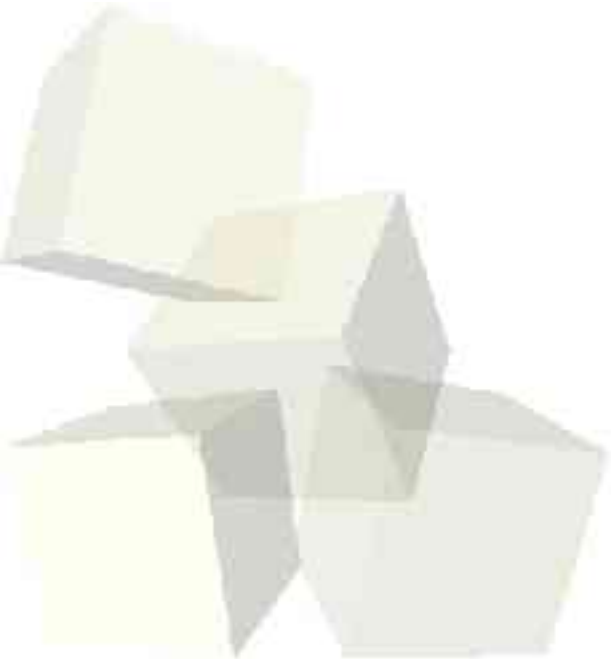


Curried Functions

- Just like in Scheme, we can take a function of multiple variables, and Curry it. That means it takes one argument at a time and returns functions until it gets the last argument.
- This is even easier to do in ML than in Scheme. We simply write the function and leave out the parentheses and commas for the argument list.
- In ML curried functions truly take multiple arguments, others just take a tuple.

Currying Scheme Style

- Of course, you could also curry functions in ML the way we did in Scheme by writing the internal function in a let and returning it.



When to include parentheses

- The fact that curried functions don't include the parentheses or commas in calls either can cause issues. This is because function calls bind higher than other operators so “foo y-1” gets bound as “(foo y)-1”. If you want “foo (y-1)” then you have to include those parentheses.
- This is also an issue in the function definition if you specify the types of arguments or have patterns in arguments. Just put parentheses around each argument.

Built-In Higher-Order Functions

- ML provides an infix operator for composition: o.
- ML also provides a map function that is curried. The type of this function is interesting to look at.
- ML also provides functions foldr and foldl that do a “fold” operation. These repeatedly apply a function to elements of a list moving through the list either right to left or left to right.

Minute Essay

- Assume you have you tnp1 function from assignment #5 and filter from earlier today. Also assume we have defined some list of ints, lst. Write the line of code that will return a list of all the even values from applying tnp1 to the elements of lst.
- Remember that assignment #6 is due on Friday.