

Exercise Sheet 10

Assignment 10.1 Traits in Lua

Trait composition $+$ is defined as a symmetric join \sqcup between two maps c_1, c_2 :

$$(c_1 + c_2)(n) = b_1 \sqcup b_2 = \begin{cases} b_2 & \text{if } b_1 = \perp \vee n \notin \text{pre}(c_1) \\ b_1 & \text{if } b_2 = \perp \vee n \notin \text{pre}(c_2) \\ b_2 & \text{if } b_1 = b_2 \\ \top & \text{otherwise} \end{cases} \quad \text{with } b_i = c_i(n)$$

The following Lua function dispatches lookups for key k from map `receiver` to the two maps `m1, m2` in an ordered fashion with priority on `m1`:

```
function asymmetricDispatch (receiver, k)
  local v = receiver.m1[k]
  if not v then return receiver.m2[k] end
  return v
end
```

1. Provide a Lua implementation of the function `symmetricDispatch(receiver, k)`, which implements dispatching of key k based on the symmetric join \sqcup .
2. Use this function to implement a function `composeTraits(trait1, trait2)`, which takes a pair of trait maps as input and creates an object-like map as output, that delegates its lookups to the traits in symmetric join fashion.

Assignment 10.2 Delegation & Prototypes

A Lua interpreter, implemented in Java, uses the following two Java data types to represent Lua tables and closures (anonymous functions):

```
interface Table {
  Object get(String key);           // key's value in the internal hashmap
  void put(String key, Object val); // bind key to value
  Table getMetatable();           // null if no metatable
}

interface Closure {
  Object execute(Object... params); // interprets this closure
}
```

The interpreter works on a Lua program's syntax tree. Implement a Java method

```
static Object eval(Table table, String key)
```

for the interpreter, which evaluates a Lua sub-expression of the form `<table>.key` as occurring e.g. in the following Lua code in line 12:

```

1 Account = { accountcounter=0 }
2 function Account:new()
3     template = { balance=0 }
4     setmetatable(template,self)
5     self.__index = self
6     self.accountcounter = self.accountcounter+1
7     return template
8 end
9
10 myaccount = Account:new()
11 print(
12     myaccount.accountcounter
13 )

```

Assignment 10.3 Stream Wrapper Mixin with Prototypes

Consider the following Lua code:

```

Stream = {}
Stream.__index = Stream
function Stream:write(character) ... end
function Stream:new(object)
    setmetatable(object,self)
    return object
end
Mutex = {}
Mutex.__index = Mutex
function Mutex:lock() ... end
function Mutex:unlock() ... end
function Mutex:new()
    object = {}
    setmetatable(object,self)
    return object
end

```

1. Create a memory diagram after execution of the code above together with:

```
mystream = Stream:new({ mutex = Mutex:new() })
```

2. Extend the program by a **creator** function. This function should produce a *wrapper table* for tables, that were created with **Stream:new**. More specifically, this *wrapper table* should delegate every lookup to the wrapped table, with one exception: in case, the function **write** is called, the new table should establish a **Mutex**-locked area around a call to the wrapped table's original **write** function.

Assignment 10.4 Prototype Based Design

Plan and implement the datastructures to represent symbolical arithmetical expressions, composed of the operators +, -, ·, /, constants and variables in Lua. Don't forget to include nice ways to specify and evaluate them!