

# 15-150 Assignment 10

Jack Kasbeer

jkasbeer@andrew.cmu.edu

Section K

November 17, 2015

---

## 2: Tree Sequences

---

1.  $W_{length}(n) = c_0 + c_1 + 2 * W_{length}(n \text{ div } 2)$   
 $\Rightarrow W_{length}(n) = O(n)$   
 $S_{length}(n) = c_0 + c_1 + 2 * W_{length}(n \text{ div } 2)$   
 $\Rightarrow S_{length}(n) = c_2 + W_{length}(n \text{ div } 2)$  (parallelism)  
 $\Rightarrow S_{length}(n) = O(\log n)$
2. `nth` is implemented in `shrubseq.sml`.
3. `tabulate` is implemented in `shrubseq.sml`.
4. `length` is implemented in `sizeseq.sml`.
5. `nth` is re-implemented in `sizeseq.sml`.
6. `tabulate` is implemented in `sizeseq.sml`.
7. The work and span for both of these implementations for `tabulate` is the same. The difference between them is the cost trade-off; in `sizeseq.sml`, the `tabulate` function uses more memory because of the extra mode. The `length` function differs in the sense that it's not recursive in `shrubseq.sml`, and as a result its work is  $O(n)$  in `shrub`, but  $O(1)$  in `size`. The span is the same for both due to parallelism.

---

## 3: Just a Monoid in the Category of Endofunctors

---

1. `id = (fn x => SOME x)`
2. `(fn 0 => NONE | x => SOME ((3 mod x) + 1))`
3. `findN` is implemented in `findMany.sml`

---

## 4: Barnes-Hut

---

1. `barycenter` is implemented in `barnes-hut.sml`
2. `quadrantize` is implemented in `barnes-hut.sml`
3. `compute_tree` is implemented in `barnes-hut.sml`
4. `groupable` is implemented in `barnes-hut.sml`
5. `bh_acceleration` is implemented in `barnes-hut.sml`