Cost Semantics

Guy Blelloch
Carnegie Mellon University

July 11, 2018

1 Goals

1. Sequential Semantics (Functional)
2. Cost Model and Provable Bound
3. Work Efficiency
4. Low Span (Depth)
5. As simple as sequential
6. Sequential as a side effect

2 Problem with Pure Array:

1. Persistence, ”requires” copying (if a change is made must copy the entire array)
2. Keep a history of changes

	W	S	W	S
Sub A	O(1)	-	O(lg n)	O(lg n)
Updated	O(1)	-	O(n)	O(lg n)
Inject A U	O(|U|)	O(1)	O(|U|+n)	O(lg n)

$\delta : l \to \{+, -\}$
$+$ is a leaf, $-$ is an interior node
$A :\ \alpha\ seq,\ u :\ int \times \alpha$

$$\frac{A = (a, e)\ \delta[l \to +]\ new\ l'}{\delta,\ update(A, u) \to \delta[l \to -,\ l' \to +],\ (update(a, u), l'), 1, 1}$$

3 Breadth First Search

W = O(m+n) w/ m = # Edges, n = # Vertices
S = O(d*lg n) w/ d = diameter
Repeat over levels F, P:

1. Neighbors of F
2. Filter those not already visited
3. Update P
4. Remove duplicates

```
tag(S, v) = map(λ.(x, v)) S
N = flatten(map(λv.tag(G[v], v)) F)
N' = filter(λ(u, v).P[u] = −1) N
P' = inject P N'
```