6.851	Students III.	May 13, 2010

David Charlton: Dynamic Shadows THEORY

- 3D ambigrams / trip-lets: 3D shape with desired three orthogonal projections
- example of n^3 complexity for 3 shadows of complexity n (previous example didn't have proper shadows) ... for maximal shape with those projections
- but if 3D shape is connected then $O(n^2)$ complexity (as previously conjectured) & can be computed in $O(n^2)$ time
  - sweep plane + amortization
  - output-sensitive
- OPEN: can any 3 shadows be achieved by some (nonmaximal) 3D shape of $O(n^2)$ complexity? (disconnected)
- OPEN: faster existence check?

Paul Christiano & Shaunak Kishore:

resiliant DSs (memory errors)

- RAM, adversary corrupts $\leq \delta$ words @ any time
- want correctness with prob. $\geq 2/3$
- error correcting codes: $O(\delta)$ space to store δ words, $\leq \delta$ errors, $O(\delta)$ en/decode

$\Rightarrow$ array with $O(n\delta)$ space
- linked list with $O(n+\delta)$ space } $O(\delta)$/op.
- search trees with $O(n+\delta)$ space, $O(\lg n+\delta)$/op.
- predecessor with $O(n+\delta)$ space, $O(OPT+\delta)$/op.
- interval tree with $O(n+\delta)$ space, $O(\lg n+k+\delta \lg \delta)$/op.
  - scapegoat trees for dynamization [Galperin & Rivest]
  - $\boxed{\text{OPEN}}$: $O(\delta \lg \delta) \to O(\delta)$?
- $\boxed{\text{OPEN}}$: derandomize?
  other range queries?

Sarah Eisenstat:

THEORY

kinetic minimum spanning circle

- relation to farthest-point Delaunay Δ^n?
  - FPDT contains $\leq$ one acute Δ
  - if one exists, then it's the min. spanning $\bigcirc$
  - else min spanning $\bigcirc$ has longest edge as diameter

(case missing in [Guibas])

$\Rightarrow$ need kinetic DS for longest edge & acute Δ in FPDT

- $O(n^{2+\varepsilon})$ for convex hull
- $O(n^{3+\varepsilon})$ for FPDT
- $O(\#$ external events$)$ for acuteness
- $O(n^{2+\varepsilon})$ for diameter

- $\Omega(n^2)$ external events for linear motion based on lower bound for diameter [AGHV 1997] (but doesn't work as is ~ substantial care)

$\Rightarrow O(n^{1+\varepsilon})$ efficiency (same as FPDT)

- OPEN: higher dimensions?

David Stein:

THEORY

partitioning distributed assembly tasks

- motivation: automated assembly @ Boeing using robots
- DAG of dependencies
- directed graph of reachability (geometry)
- operations:
  - deliver part to needed task
  - place part
  - ...
- heuristic scoring function
- NP-hard partitioning problem
- problem: $O(n)$ space in every robot
  not local broadcasts

David Wilson:

THEORY

maintaining recency (Move To Front)

- one op.: MTF(x) returns # distinct items since last MTF(x)
  (or recency query + MTF update)
- motivation: cache modeling
- reduction to partial sums on bit vector via slow growth in # 0's & amortized rebuild & can be de-amortized
  $\Rightarrow O(\log_w n)$ DS [Pătrașcu & Demaine 2004]
  & $O(n)$ space
- also works for dynamic set (insert & delete) via amortized rebuilding
  or modification to partial sums to support grow/shrink at the ends $\Rightarrow$ worst case
- OPEN: $\Omega(\log_w n)$ lower bound?
  - partial sums LB doesn't seem to apply ~ less "communication"
- OPEN: partial retroactivity?
  - cleanups an issue