TEST 1: next class (June 6)

Materials: Upto (inclusive) today's lecture.

Office Hour: Monday June 5, 4–6pm and Tue June 6, 3–4pm (as usual) in CSEB 2015

Quicksort (A, p, r)

1. If $p < r$ do
2. $\quad q \leftarrow \text{Partition}(A, p, r)$
3. $\quad \text{Quicksort}(A, p, q-1)$
4. $\quad \text{Quicksort}(A, q+1, r)$
5. End If

Partition(A, p, r)

1. $x \leftarrow A[r]$ % The "pivot" element
2. $i \leftarrow p - 1$
3. For $j = p \ldots (r-1)$ do
4. If $A[j] \leq x$ then do
5. $i \leftarrow i + 1$
6. exchange $A[i]$ and $A[j]$
7. End If
8. End For
9. exchange $A[i+1]$ and $A[r]$
10. return $(i+1)$

- In place
- Worst-case running time: $\mathcal{O}(n^2)$
- If the partitions are "balanced", then runs in $\mathcal{O}(n \log n)$
- Can be randomized

  randomly choosing the pivot element

Strassen's Matrix Multiplication Algorithm

- Divide the input matrices into 4 quarters
- Clever formulas for calculating the quarters of the product:

$$T(n) = 7T(n/2) + \Theta(n^2)$$

- So $T(n) = \mathcal{O}(n^{\log_2 7})$

The Closest Pair Algorithm

Input: a set P of points $p_i = \langle x_i, y_i \rangle$

- Sort P in increasing order of x-coordinates $\Longrightarrow$ X
- Sort P in increasing order of y-coordinates $\Longrightarrow$ Y
- Return Closest-Pair-Rec(P,X,Y)

Closest-Pair-Rec(P,X,Y)

1. If $|P| \leq 3$ then *brute-force*
2. Else

3. Compute line ℓ dividing P into P_L, P_R
4. Compute X_L, Y_L and X_R, Y_R
5. $\langle q_0, q_1 \rangle$ = Closest-Pair-Rec(P_L, X_L, Y_L)
6. $\langle r_0, r_1 \rangle$ = Closest-Pair-Rec(P_R, X_R, Y_R)
7. $\delta = min\{d(q_0, q_1), d(r_0, r_1)\}$
8. S = points in P within distance δ to ℓ

in increasing order of y-coordinates

9. For each s in S,
10. Compute distances to the next 7 points
11. Let $\langle s_0, s_1 \rangle$ be the closest pairs in S
12. End For
13. return the closest of $\langle q_0, q_1 \rangle$, $\langle r_0, r_1 \rangle$ and $\langle s_0, s_1 \rangle$