6.897
L 8.5
Mar. 10, 2003

Add $x \to T_i$ with same parent as y

Case 1: if x is within $2 \cdot 2^{i+1}$ of parent(y) then we can add it directly:

insert:
- insert $x \to T_i$, enqueue $x \to Q_i$
- link $x \leftrightarrow$ parent(y), maybe remove parent(y) $\leftarrow Q_{i+1}$

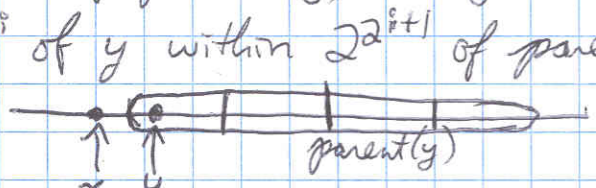
balance:
- dequeue z from Q_i, delete $z \leftarrow T_i$
- unlink $z \leftrightarrow$ parent(z), maybe enqueue parent(z) $\to Q_{i+1}$

$O(2^i)$ time.

L 9.1

Case 2: x not within $2 \cdot 2^{i+1}$ of parent(y); say $x \ll$ parent(y)

but: x is within $2 \times 2^{2^i}$ of y within $2 \cdot 2^{2^{i+1}}$ of parent(y).



- Add $z =$ parent(y) $- 2 \cdot 2^{2^{i+1}}$ (extreme of parent(y)'s range) $\to T_{i+1}$ with same parent as parent(y) (recursive)
- move left 1/4 of parent(y)'s children to third 1/4 of z's children (& remove z from Q_{i+1}, maybe enqueue parent(y) $\to Q_{i+1}$)
- Add $x \to T_i$ with parent $= w$ ~ Case 1 $\Rightarrow$ cheap.