Left-Leaning
Red-Black Trees

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Original version: Data structures seminar at Dagstuhl (Feb 2008)

- red-black trees made simpler (!)
- full delete() implementation

This version: Analysis of Algorithms meeting at Maresias (Apr 2008)

- back to balanced 4-nodes
- back to 2-3 trees (!)
- scientific analysis
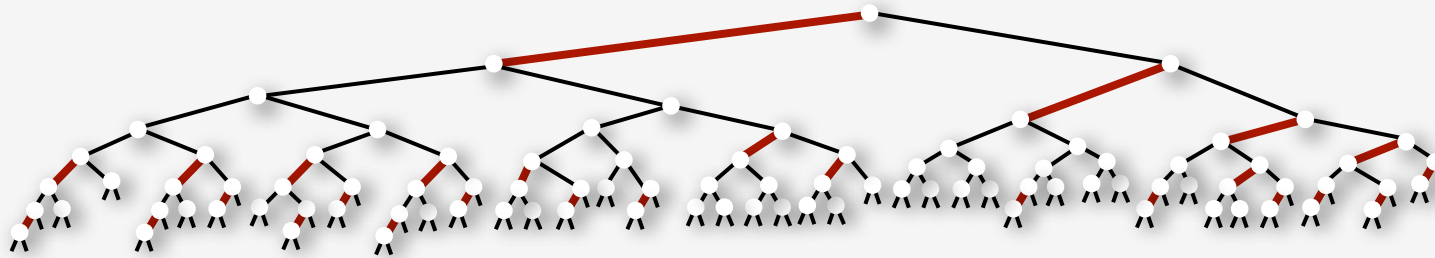
Addendum: observations developed after talk at Maresias

Java code at www.cs.princeton.edu/~rs/talks/LLRB/Java

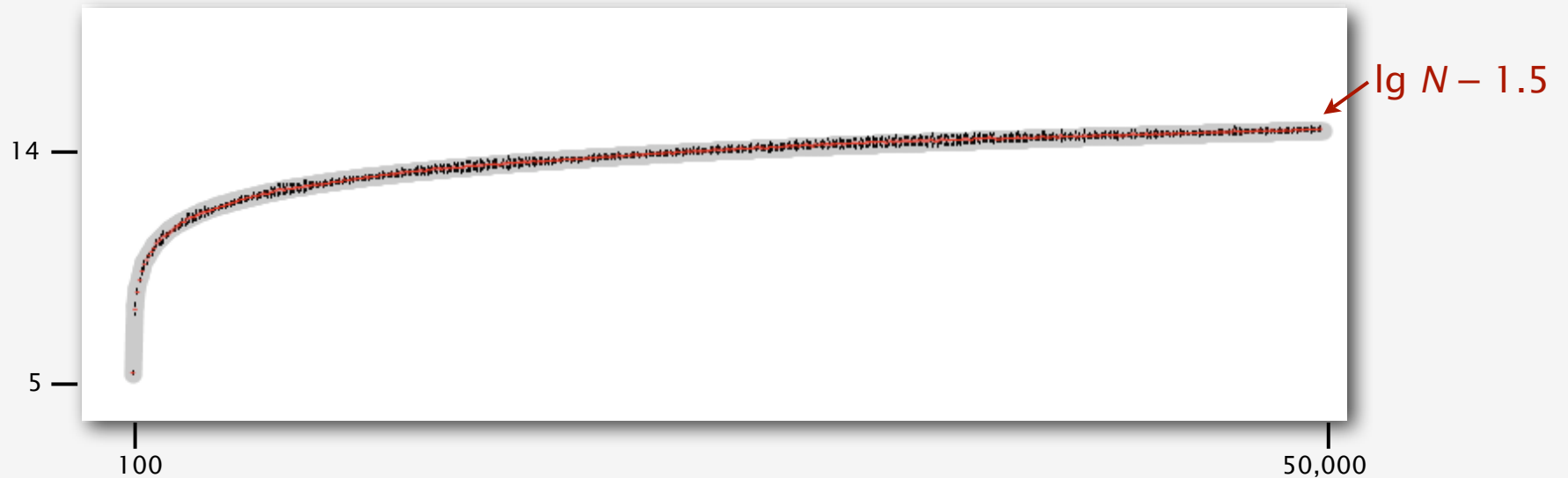Movies at www.cs.princeton.edu/~rs/talks/LLRB/movies

An exercise in the analysis of algorithms

Find a proof !

Average path length in 2-3 tree built from random keys

$\lg N - 1.5$

14

5

100

50,000

Observation 2

The height of a 2-3 tree is ~2 ln N (!!!)
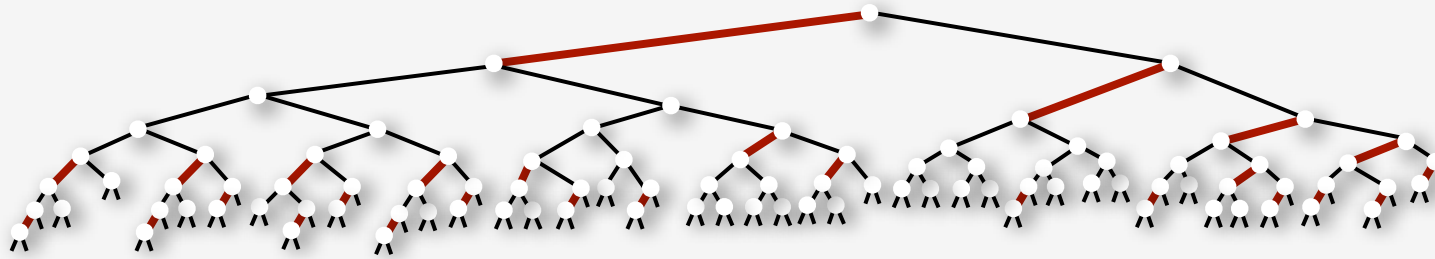
Height of a 2-3 tree built from random keys

2 ln *N*

22 —

21.66990

14 —

lg *N* - 1.5

5 —

100

50,000
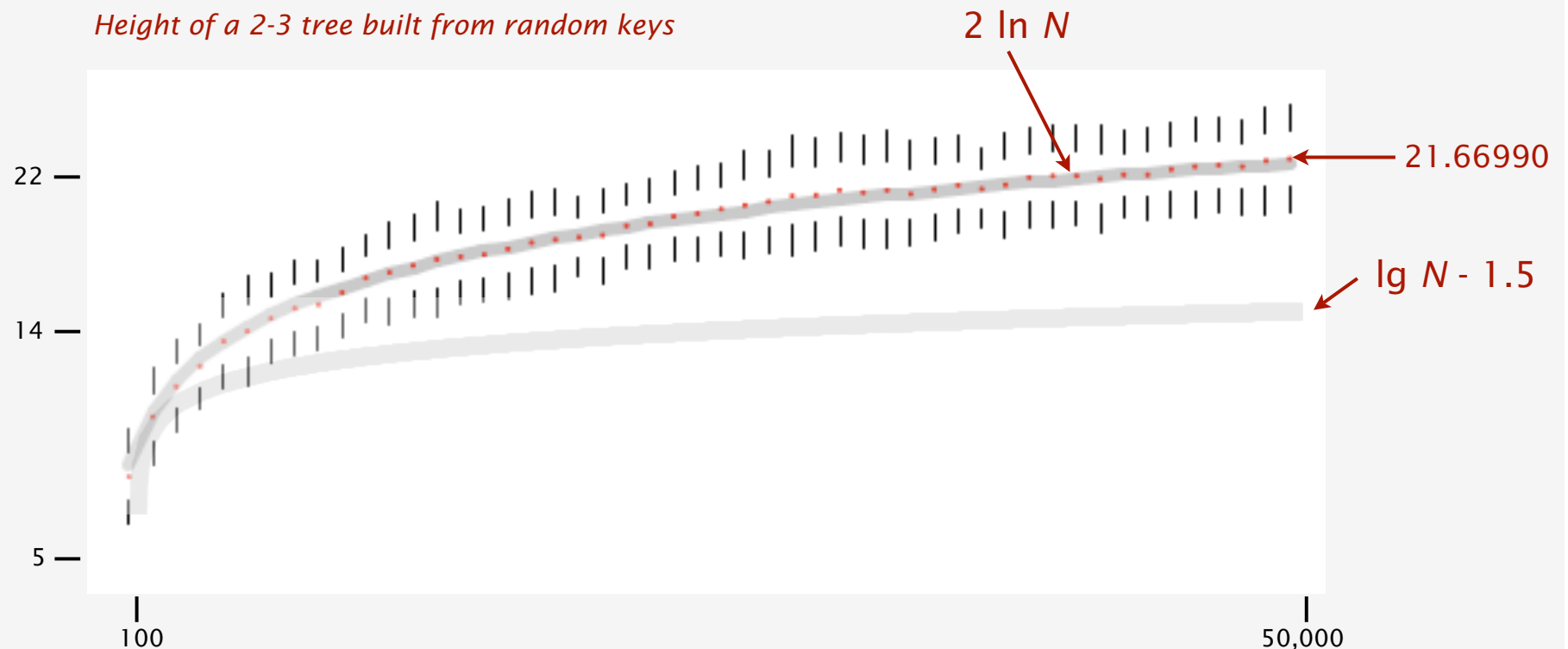
Very surprising because the average path length in an elementary BST is also ~2 ln N ≈ 1.386 lg N