

# 4

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## 1 The Recursion Tree Method

- expand for  $k$  iterations to get a tree
- set  $k$  to reach base case
- sum everything

Example:  $T(n) = 5T(n/4) = \sqrt{n}$

By tree, we get:

$$n/4^k = 1$$

$$T(n) = (\sum_{i=0}^{k-1} (5/2)^i \sqrt{n}) + 5^k = \Theta(n^{\log_4 5})$$

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## 2 The Master Method

- look up answer!
- doesn't work for everything: if  $f(n) = n/\log n$ , it does not work

Let  $T(n) = aT(n/b) + n^d$

Let  $x = \log_b a$ . if:

- $d > x : T(n) = \Theta(n^d)$
  - $d = x : T(n) = \Theta(n^x \log n)$
  - $d < x : T(n) = \Theta(n^x)$
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## 3 The Guess-and-Check Method

- guess
- verify by induction proof (often the proof inducts on  $n/2$ , then prove for  $n$ )
- fill in constants
- **Remember to solve for  $c$  afterwards** - to satisfy inductive step
- this only gets you either  $O$  or  $\Omega$  with every "run" of the induction

Sometimes, we'll need to add a  $-c$  constant at the end of the guess for induction to work