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String  $a =$  "Kunal"  
 String  $b =$  "Apoorv Kunal Rahul"  
 (n) (m)

Linear time?  $O(n+m)$

Karp - Rabin algorithm

Quad time complexity.  
 $O(n \times m)$

	0	1	2	3	4
$a =$	K	U	N	A	L
$b =$	A	P	O	O	R
	0	1	2	3	4
	5	6	7	8	9
	10	11	12	13	14

Diagram showing string matching between 'KUNAL' and 'Apoorv Kunal Rahul'. Blue brackets connect 'KUNAL' to the 'KUNAL' in the second string. A red bracket connects 'Rahul' to 'Rahul' in the second string. A blue arrow points from the matching 'KUNAL' to the text 'Quad time complexity.'

$$h(a) = hb[i : i + \text{len}(a)]$$

① If  $h(a) = hb[i : i + \text{len}(a)]$

\* maybe  $\rightarrow$  found a match

\* check every character  $O(a)$   
if all char = , answer  $\checkmark$

$\rightarrow$  \* not all chars are equal

$$h(a) = h(\text{substring})$$

but  $a \neq \text{substring}$

$$p = \frac{1}{\text{len}(a)}$$

$\rightarrow$  (Universal  
hashing  
prev lecture)

$\Rightarrow$  expected cost per  $i$  (index) =  $d(i)$

Time =  $O(\text{len}(a) + \text{len}(b) * \underbrace{\text{cost of hash function}})$

$\rightarrow O(\text{len}(a) * \text{len}(b))$  a test of collisions.

Extra:

\* Monte Carlo variant

\* Las Vegas variant

