

Meet your neighbors

What's your name? What year?

What has been your favorite CS class?

What's been your least favorite CS class?

What do you hope to learn (or get out of) this class?

Algorithms

"For me, great algorithms are the poetry of computation. Just like verse, they can be terse, allusive, dense and even mysterious. But once unlocked, they cast a brilliant new light on some aspect of computing." – Francis Sullivan

What is an algorithm?

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Example algorithms

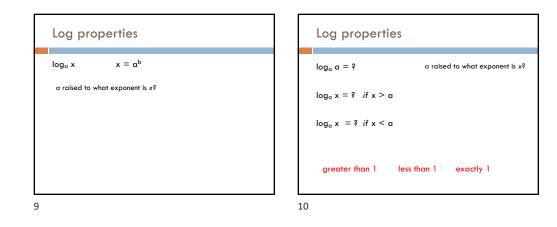
sort a list of numbers

find a route from one place to another (cars, packet routing, phone routing, ...) find the longest common substring between two strings add two numbers microchip wiring/design (VLSI) solve sudoku cryptography compression (file, audio, video) spell checking pagerank classify a web page To the course webpage...

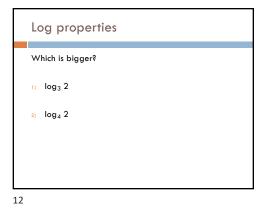
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Log properties
,

Log properties
$\mathbf{x} = \mathbf{a}_{\mathbf{p}}$
What is b?
b = log _a x
}



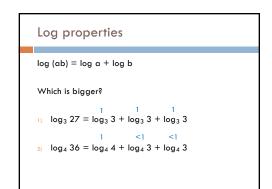
Log propertie	S
log _α α = 1	a raised to what exponent is x?
$\log_{\alpha} x > 1$ if $x > \alpha$	
$\log_{\alpha} x < 1$ if $x < \alpha$	
greater than 1	less than 1 exactly 1
11	



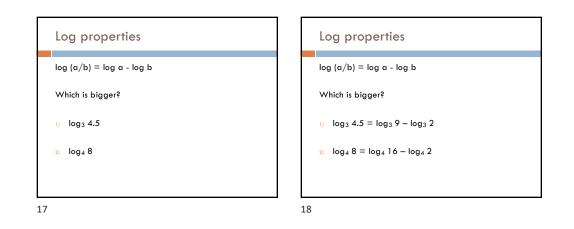


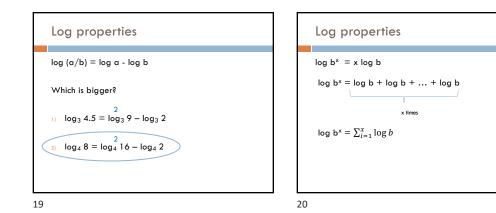


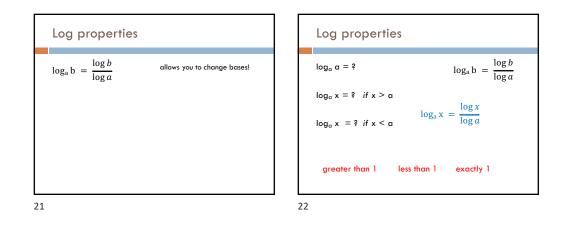
- log (ab) = log a + log b
- Which is bigger?
- $\log_3 27 = \log_3 3 + \log_3 3 + \log_3 3$
- 2) $\log_4 36 = \log_4 4 + \log_4 3 + \log_4 3$

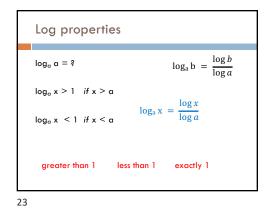


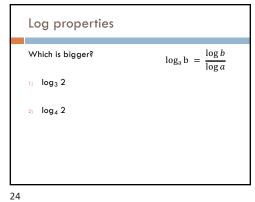
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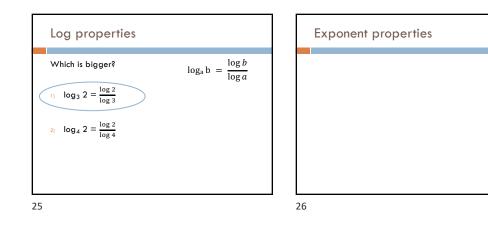


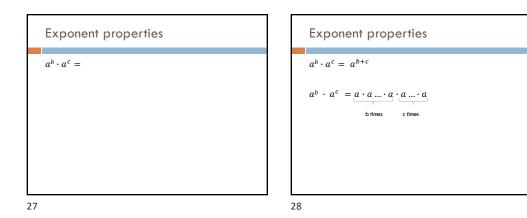


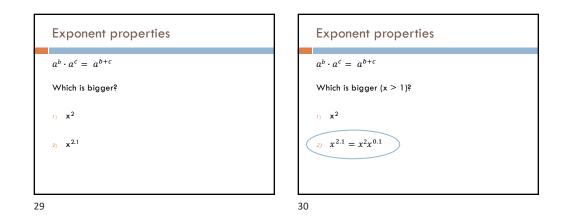


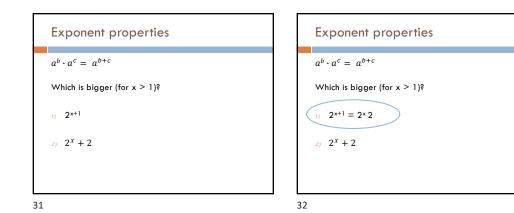


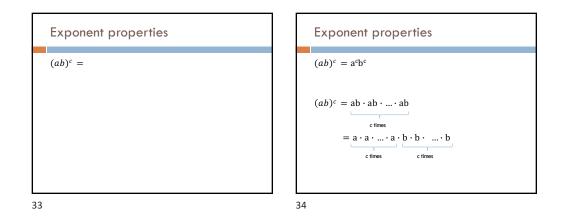


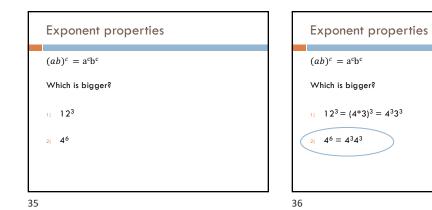




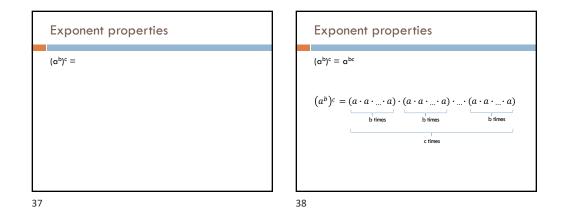


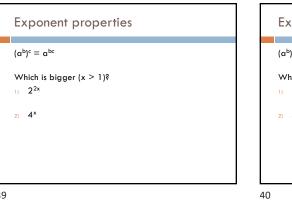












Exponent properties $(a^b)^c = a^{bc}$ Which is bigger (x > 1)? 1) $2^{2x} = (2^2)^x = 4^x$ 2) 4×

Pseudocode

A way to discuss how an algorithm works that is language agnostic and without being encumbered with actual implementation details.

Should give enough detail for a person to undersand, analyze and implement the algorithm.

5 return xMYSTERY2(A)

MYSTERY1(A)

 $1 \quad x \leftarrow -\infty$

3

4

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Pseudocode examples

2 for $i \leftarrow 1$ to length[A]if A[i] > x

1 for $i \leftarrow 1$ to $\lfloor length(A)/2 \rfloor$ 2 swap A[i] and A[length(A) - (i - 1)]

 $x \leftarrow A[i]$

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Pseudocode convections array indices start at 1 not 0 we may use notation such as ∞ , which, when translated to code, would be something like Integer.MAX VALUE use shortcuts for simple function (e.g. swap) to make pseudocode simpler

we'll often use \leftarrow instead of = to avoid ambiguity

indentation specifies scope

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Proofs

What is a proof? A deductive argument showing a statement is true based on previous knowledge (axioms)

Why are they important/useful? Allows us to be sure that something is true In algs: allow us to prove properties of algorithms

Proof techniqu	539	
example/counterexample		
enumeration		
by cases		
by inference (aka direct proof)		
trivially		
contrapositive		
contradiction		
induction (strong and weak)		