

CompSci 6

Introduction to Computer Science

December 8, 2011

Prof. Rodger

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Announcements

- Final Exam
- APT due tonight!
- Last late assignments with penalty Dec 10!
 - Cannot turn in anything late after this date
- Grades on assignments are coming!
- Today
 - More sorting, timings
 - Classwork
 - A CS story

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Final Exam

- Friday, Dec 16, 2-5pm
- Closed Book, Closed Notes, Closed neighbor
- Python Resource Sheet
- Covers all topics through today
- Best way to study is practice writing code!

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Final Exam (cont)

- Test format
 - Multiple choice
 - Writing code
- Topics include:
 - if, loops, lists, sets, maps, files, functions
 - recursion and regular expressions – reading level

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Look at mergesort again

- Is there another way to do mergesort?

Timings

N	$\log_2 N$	N^2	N^3	2^N
10	3.3	100	1000	1024
20	4.3	400	8000	1048576
40	5.3	1600	64000	1.1×10^{12}
80	6.3	6400	512000	1.2×10^{24}
160	7.3	25600	4096000	1.4×10^{48}

Growth of functions

- As the size of the data increases, how many steps are there for an algorithm/method?

Timings

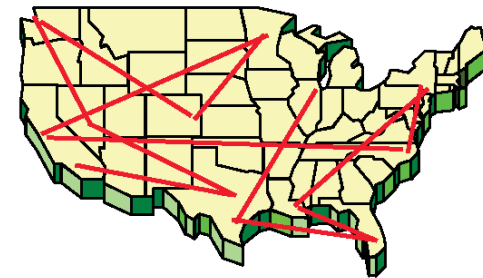
N	$\log_2 N$	N^2	N^3	2^N
250	7.9	62,500	1.56×10^7	1.8×10^{75}
500	8.9	250,000	1.25×10^8	3.2×10^{150}
1000	9.9	1×10^6	1×10^9	
2000	10.9	4×10^6	4×10^6	
4000	11.9	1.6×10^7	8×10^9	

Look at the timings of the sorts

- How do the sorts compare?
 - With size as they grow
 - With different types of data
 - Random
 - Reverse
 - Almost sorted

Problem: Traveling Band

- Band wants you to schedule their concerts.
- They don't like to travel. Minimize the time they are on the bus!
- Given N cities, what is the best schedule (shortest distance) to visit all N cities once?



How do you calculate the best path?

- Try all paths
 - Atlanta, Raleigh, Dallas, Reno, Chicago
 - Dallas, Atlanta, Raleigh, Reno, Chicago
 - Etc.
- Would you agree to code this up?

How long?

Number of Cities	All paths – N!	Time to solve - 10 ⁹ Instructions per second
10	3 million	
15	10 ¹²	
18	10 ¹⁵	
20	10 ¹⁸	
25	10 ²⁵	

How long?

Number of Cities	All paths – N!	Time to solve - 10^9 Instructions per second
10	3 million	< sec
15	10^{12}	
18	10^{15}	
20	10^{18}	
25	10^{25}	

How long?

Number of Cities	All paths – N!	Time to solve - 10^9 Instructions per second
10	3 million	< sec
15	10^{12}	16 min
18	10^{15}	
20	10^{18}	
25	10^{25}	

How long?

Number of Cities	All paths – N!	Time to solve - 10^9 Instructions per second
10	3 million	< sec
15	10^{12}	16 min
18	10^{15}	11 days
20	10^{18}	
25	10^{25}	

How long?

Number of Cities	All paths – N!	Time to solve - 10^9 Instructions per second
10	3 million	< sec
15	10^{12}	16 min
18	10^{15}	11 days
20	10^{18}	31 years
25	10^{25}	

How long?

Number of Cities	All paths – $N!$	Time to solve - 10^9 Instructions per second
10	3 million	< sec
15	10^{12}	16 min
18	10^{15}	11 days
20	10^{18}	31 years
25	10^{25}	10^8 years

Does $P = NP$?

- Famous CS question
- If yes, a whole class of difficult problems can be solve efficiently, one problem is reducible to another
- If no, none of the hard problems can be solved efficiently

$P = NP$?

- P: Problems with polynomial time solutions
 - N, N^2
 - Example: Selection sort
 - Easy to solve
- NP: problems with not polynomial time solutions
 - $2^n, N!$
 - Hard to solve

A CS Story