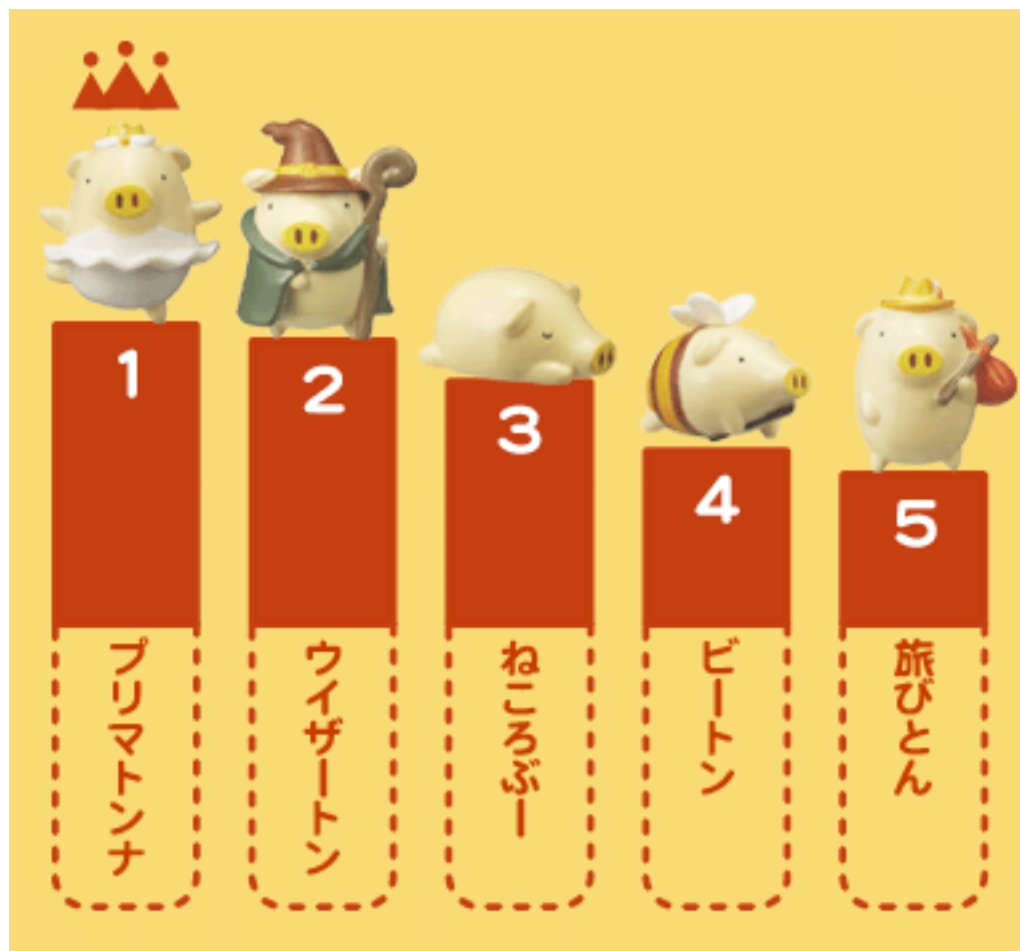


Lecture 24

CSE 331

Oct 25, 2019

Rankings



How close are two rankings?

Google [Advanced Search](#)

Web [Show options...](#) Results 1 - 10 of about 23,700,000 for compare rankings. (0.30 seconds)

Comparison Reviews Sponsored Link
[Angleslist.com](#) Your neighbors' ratings on local service companies. Award-winning.

Ranking - Wikipedia, the free encyclopedia
In competition **ranking**, items that **compare** equal receive the same **ranking** number, and then a gap is left in the **ranking** numbers. The number of **ranking** ...
[en.wikipedia.org/wiki/Ranking](#) - [Cached](#) - [Similar](#) - [Print](#) - [Share](#)

A Comparison of Ranking Methods for Classification Algorithm Selection
is based on Spearman's rank correlation coefficient. To **compare ranking** methods, a combination of Friedman's test and Dunn's multiple com- ...
[www.springerlink.com/ndex/mh87p44744x7Q258.pdf](#) - [Similar](#) - [Print](#) - [Share](#)
by PB Brazdil - 2000 - [Cited by 46](#) - [Related articles](#)

College Football Ranking Comparison
College Football **Ranking** Comparison. Sunday, November 8, 2009 (127 **Rankings**). | Last Week | Archived | FBS | FCS | Summary | CSV Data | ...
[www.masseyratings.com/cf/compare.htm](#) - [Cached](#) - [Similar](#) - [Print](#) - [Share](#)

College Basketball Ranking Comparison
Monday, April 6, 2009 (36 **Rankings**) Cor 923 810 923 898 819 868 888 777 839 899 880
243 246 245 248 241 251 247 249 248 244 **Ranking** Violation % 254 ...
[www.masseyratings.com/cb/compare.htm](#) - [Cached](#) - [Print](#) - [Share](#)

FIFA.com - Compare Teams
With FIFA.com you can **compare** the progress of up to four teams in the FIFA/Coca-Cola World **Ranking**. See how teams have risen and fallen since August 1993 ...
[www.fifa.com/.../ranking/compare/compareteams.html](#) - [Cached](#) - [Similar](#) - [Print](#) - [Share](#)

GetEducated.com | Rate, Rank & Compare Online Colleges & Degrees
GetEducated.com's directory of online degrees provides **rankings**, ratings, and comparison tools to help you choose the best online degrees from the best ...
[www.geteducated.com/](#) - [Cached](#) - [Similar](#) - [Print](#) - [Share](#)

Compare your website rankings in Google Caffeine « Advanced Web ...
Aug 18, 2009 ... To help you **compare** your website **rankings** from Google with the **rankings** from Google Caffeine we have created a quick step-by-step tutorial

Web Images Videos Shopping News Maps More MSN Hotmail

bing

ALL RESULTS ALL RESULTS 1-10 of 8,810,000 results · [Advanced](#)

FIFA.com - Compare Teams
With FIFA.com you can **compare** the progress of up to four teams in the FIFA/Coca-Cola World **Ranking**. See how teams have risen and fallen since August 1993 and pinpoint their ...
[www.fifa.com/worldfootball/ranking/compare/compareteams.html](#) · [Cached page](#)

How to Compare Graduate School Rankings | eHow.com
Choosing a graduate school can be a stressful and confusing process for any student. By comparing graduate schools and their **rankings** a student can choose which one fits her ...
By eHow Education Editor · Difficulty: Moderate · 0 posts
[www.ehow.com/how_2051516_compare-graduate-school-rankings.html](#) · [Cached page](#)

Ranking - Wikipedia, the free encyclopedia
Items that **compare** equal receive the same **ranking** number, which is the mean of what they would have under ordinal **rankings**. Equivalently, the **ranking** number of 1 plus the number of ...
[en.wikipedia.org/wiki/Ranking](#) · [Enhanced view](#)

Ranking Compare
Ask Google Yahoo Search | Web browser tool – Shows search results for a given keyword or phrase on the top three engines, Google, Yahoo and Msn.
[tools.essential-seo.com/ranking-compare](#) · [Cached page](#)

SchoolDigger.com - School Rankings, Reviews and More - Public and ...
Find the best elementary, middle, and high schools. Search for schools near any address, **compare** test scores, sort by school **ranking**, class sizes, and more using SchoolDigger.
[www.schooldigger.com](#) · [Cached page](#)

College and university rankings - Wikipedia, the free encyclopedia
The College and university **rankings** are a lists of universities and liberal arts colleges in higher education, an order determined by any combination of factors.
International ... · Regional and national ... · Criticism (North America)
[en.wikipedia.org/wiki/College_and_university_rankings](#) · [Enhanced view](#)

www.hospitalcompare.hhs.gov
[www.hospitalcompare.hhs.gov/Hospital/Search/SearchCriteria.asp?version=default&browser=IE...](#)

Rest of today's agenda

Formal problem: Counting inversions


Divide and Conquer algorithm

Solve a harder problem

Input: a_1, \dots, a_n

Output: LIST of all inversions

```
L =  $\phi$ 
for i in 1 to n-1
  for j in i+1 to n
    if  $a_i > a_j$ 
      add (i,j) to L
return L
```



Optimal for
the listing
problem

Example 1: All inversions-- $(2i-1, 2i)$

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 3 | 4 | 6 | 5 | 7 | 8 |
|---|---|---|---|---|---|---|---|

Only check $(i, i+1)$ pairs

Q1: Solve listing problem in $O(n)$ time?

Q2: Recursive divide and conquer algorithm to count the number of inversions?

CountInv (a, n)

if $n = 1$ return 0

if $n = 2$ return $a_1 > a_2$

$a_L = a_1, \dots, a_{\lfloor n/2 \rfloor}$

$a_R = a_{\lfloor n/2 \rfloor + 1}, \dots, a_n$

return CountInv($a_L, \lfloor n/2 \rfloor$) + CountInv($a_R, n - \lfloor n/2 \rfloor$)

This can be horribly wrong...

CountInv (a,n)

if $n = 1$ return 0

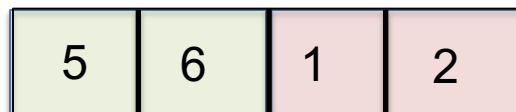
if $n = 2$ return $a_1 > a_2$

$a_L = a_1, \dots, a_{\lfloor n/2 \rfloor}$

$a_R = a_{\lfloor n/2 \rfloor + 1}, \dots, a_n$

return CountInv($a_L, \lfloor n/2 \rfloor$) + CountInv($a_R, n - \lfloor n/2 \rfloor$)

Example where instance has non-zero (can be $\Omega(n^2)$) inversions and algo returns 0?



All 4 "crossing" pairs are inversions

Bad case: “crossing inversions”

CountInv (a,n)

if $n = 1$ return 0

if $n = 2$ return $a_1 > a_2$

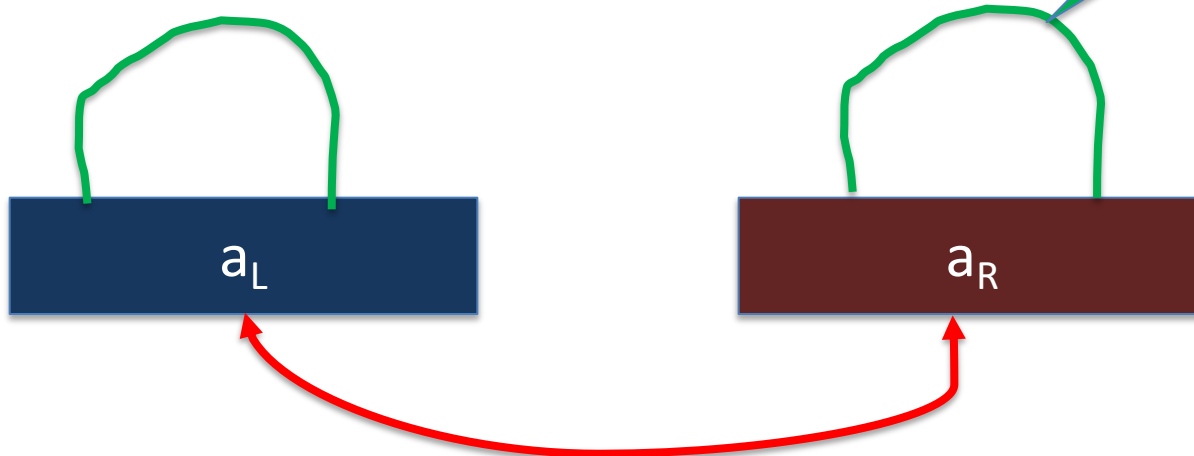
$a_L = a_1, \dots, a_{\lfloor n/2 \rfloor}$

$a_R = a_{\lfloor n/2 \rfloor + 1}, \dots, a_n$

return CountInv($a_L, \lfloor n/2 \rfloor$) + CountInv($a_R, n - \lfloor n/2 \rfloor$)

Yes!

Are a_L
and a_R
sorted?



Example 2: Solving the bad case



a_L



a_R

a_L is sorted

First element is a_L is larger than first/only element in a_R

$O(1)$ algorithm to count number of inversions?

return size of a_L

Example 3: Solving the bad case

1

a_L

5 | 6 |

a_R

a_R is sorted

First/only element is a_L is smaller than first element in a_R

$O(1)$ algorithm to count number of inversions?

return 0

Solving the bad case

First element of a_L is larger than first element of a_R



a_L



a_R

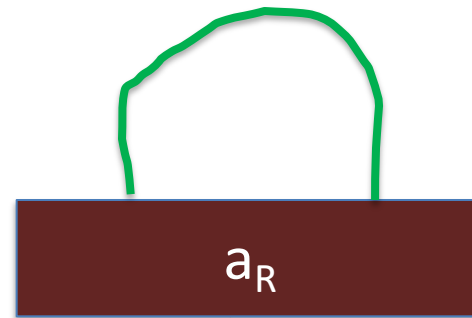
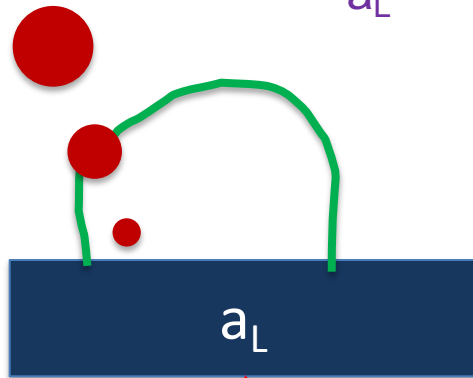
First element of a_L is smaller than first element of a_R



a_L



a_R



Try to
modify
the
MERGE
algorithm

Divide and Conquer

Divide up the problem into at least two sub-problems

Solve all sub-problems: Mergesort

Recursively solve the sub-problems

Solve stronger sub-problems: Inversions

“Patch up” the solutions to the sub-problems for the final solution

Mergesort-Count algorithm

Input: a_1, a_2, \dots, a_n

Output: Numbers in sorted order+ #inversion

```
MergeSortCount( a, n )
```

```
  If  $n = 1$  return ( 0 ,  $a_1$  )
```

```
  If  $n = 2$  return (  $a_1 > a_2$ ,  $\min(a_1, a_2)$ ;  $\max(a_1, a_2)$  )
```

```
   $a_L = a_1, \dots, a_{n/2}$      $a_R = a_{n/2+1}, \dots, a_n$ 
```

```
  (  $c_L$ ,  $a_L$  ) = MergeSortCount( $a_L$ ,  $n/2$ )
```

```
  (  $c_R$ ,  $a_R$  ) = MergeSortCount( $a_R$ ,  $n/2$ )
```

```
  (  $c$ ,  $a$  ) = MERGE-COUNT( $a_L, a_R$ )
```

```
  return (  $c + c_L + c_R$ ,  $a$  )
```

$$T(2) = c$$

$$T(n) = 2T(n/2) + cn$$

$O(n \log n)$ time

$O(n)$

Counts #crossing-inversions+
MERGE

MERGE-COUNT(a_L, a_R)

$a_L = l_1, \dots, l_{n'}$

$a_R = r_1, \dots, r_m$

```
c = 0
```

```
i, j = 1
```

```
while i ≤ n' and j ≤ m
```

```
    if  $l_i < r_j$ 
```

```
        i ++
```

```
        add  $l_i$  to output
```

```
    else
```

```
        add  $r_j$  to output
```

```
        j ++
```

```
        c += n' - i + 1
```

```
Output any remaining items
```

```
return c
```



a_L



a_R



a_L



a_R