

# How does Google search for everything? Computer Science at Work

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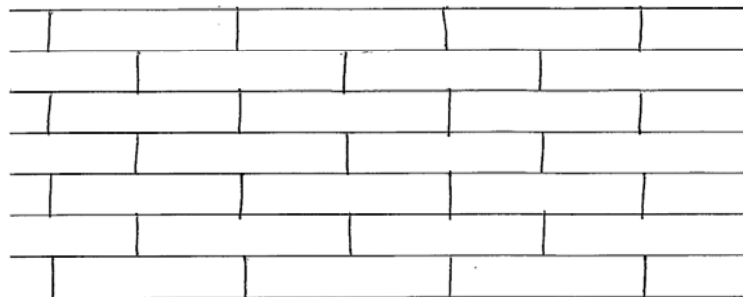


[Advanced Search](#)  
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# How does one search for an item?

- Data must be organized in some way
- Sorting alphabetically (or numerically) is one way
  - Sorting by height – compare the two ways we sorted
  - Demo several sorting algorithms
    - Selection sort
    - Insertion sort
    - Shell sort
- There are other ways to organize data!

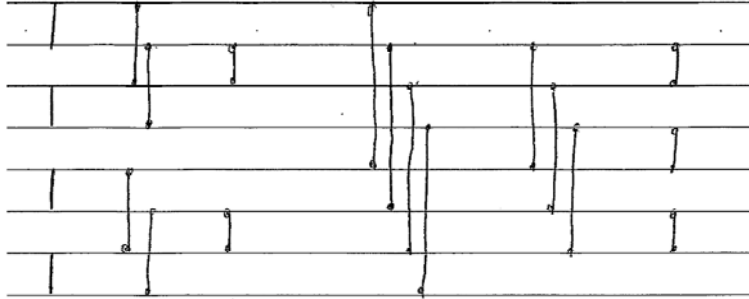
# Sorting Network



# Sort numbers (largest at bottom) using comparators in parallel

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

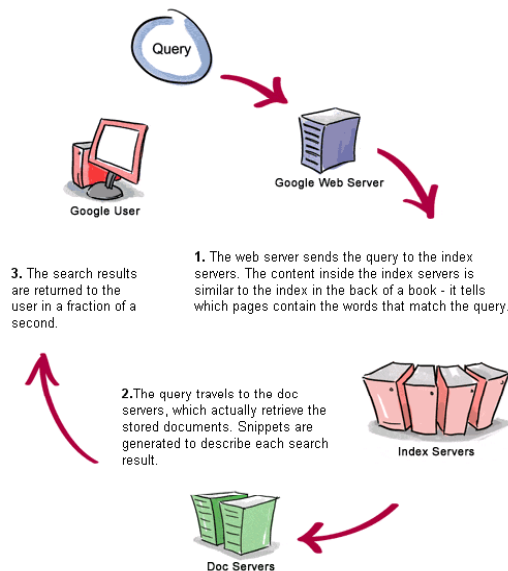
## Sorting Network different setup for comparators



## Sort numbers (largest at bottom)

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

## Google Search Query



## Computer Science at work behind the scenes!

- Googlebot web crawler
  - Finds and retrieves pages
  - Gives pages to google indexer

# “how” “google” “search” “works”

Google how google search works Search [Advanced Search](#)

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[How Google Works - Google Guide](#)  
Feb 2, 2007 ... **Google** gives more priority to pages that have **search** terms near each other ... For more information on **how Google works**, take a look at the ...  
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[Corporate Information - Technology Overview](#)  
The software behind our **search** technology conducts a series of simultaneous ... The life span of a **Google** query normally lasts less than half a second, ...  
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[computer.howstuffworks.com/search-engine1.htm](#) - [Cached](#) - [Similar](#)

[The Anatomy of a Search Engine](#)  
The **Google search** engine has two important features that help it produce high ..... That **works** out to be about 850 terabytes. Also assume that indexing a ...  
[infolab.stanford.edu/~backrub/google.html](#) - [Cached](#) - [Similar](#)

# Page Rank Algorithm

Google miley cyrus Search [Advanced Search](#)

Web [Show options...](#) Results 1 - 10 of about 1,000,000

[News results for miley cyrus](#)

[Billy Ray Cyrus Raps for Miley's Twitterers](#) - 11 hours ago  
**Miley Cyrus** rapped about leaving Twitter, so why shouldn't Billy Ray **Cyrus** rap about stickin' around? Anything Miles can do, dad can do better, right? ...  
[El Online - 275 related articles >](#)  
[Times LIVE](#) [Miley Cyrus raps about why she left Twitter](#) - CTV.ca - [914 related articles >](#)  
[Are Miley Cyrus & Penelope Cruz filming with the Ladies of Sex ...](#) - Examiner.com - [56 related articles >](#)

[MileyCyrus.com - Step Into... a Miley State of Mind](#)  
Features news, pictures, audio, video, biography, events, and information on her fan club.  
[www.mileycyrus.com/](#) - [Cached](#) - [Similar](#)

[Miley Cyrus - Wikipedia, the free encyclopedia](#)  
**Miley Ray Cyrus** (born Destiny Hope **Cyrus**; November 23, 1992) is an American pop-rock singer and television and film actress. **Cyrus** is best known for ...  
[Early life](#) · [Career](#) · [Entrepreneurship](#) · [Philanthropy](#)  
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John Mayer Endorses **Miley Cyrus'** Exit From 'The Hate-rix': The MTV News Quote Of The Day .... Find where **Miley Cyrus** is credited alongside another name ...  
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# Correction Algorithms

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Did you mean: [computer science](#)

Google is all about problem solving and writing algorithms

- Algorithms must happen fast!
- Compare the two sorting algorithms we did
- Want efficient, fast algorithms!
  
- No one wants to wait on a search query!

## Computer Science Research at Duke

- Microscopic robots
  - assembling self organized structures
- Smart Phone surround sense App
  - Using algorithms to figure out your exact location
  - Better than GPS
- Building networks for the future
  - Large scale experimental network
- Virtual World (Classroom) with students from Duke and China

My research - Making theoretical concepts come alive – visualize and interact with!

