

**the computer science
behind**



Ooi Wei Tsang

Department of Computer Science



School *of* Computing



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Taiwanese Lin Yu Chun Sings Whitney Houston's "I Will Always Love You" LIVE

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5,268,188 views



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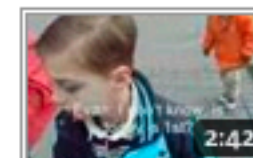


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actonish



Wow! American Boy Speaks Mandarin Chinese in China

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Taiwanese Boy Lin Yu Chun Sings Whitney Houston's 'I Will Always Love You'

1,051,170 views
clse945111



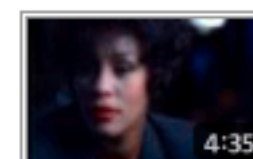
Lin Yu Chun - I Will Always Love You - Taiwanese TV Talent Show

252,346 views
ROONEYISBETTER



ORIGINAL: Taiwanese Boy Lin Yu Chun Sings 'I Will Always Love You'

283,609 views
moffalee



Whitney Houston - I Will Always Love You

16,970,894 views
bohemya1



REMIX: Taiwanese boy Lin Yu Chun and Whitney Houston's 'I Will Always Love You'

238,182 views
moffalee



Young black woman speaking Chinese on Li Jing's show

113,930 views
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Lin Yu Chun Sings 'Amazing Grace'



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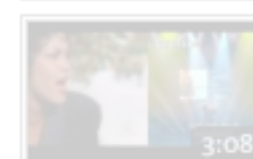
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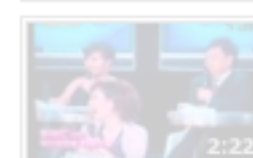
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113,930 views
steve4nlanguage



Lin Yu Chun Sings Amazing Grace

**how to make video
download or upload
more efficiently?**

24

**hours of
video uploaded
every minute
(april 2010)**

700,000

**video viewed
every minute
(october 2009)**

700,000 x 480

**seconds of video viewed
per minute**

(average length: 8 minutes)

**700,000 x 480
x 328**

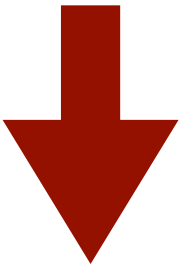
**kilobits of video served
per minute**

(average bitrate: 328 kbps)

229 TB

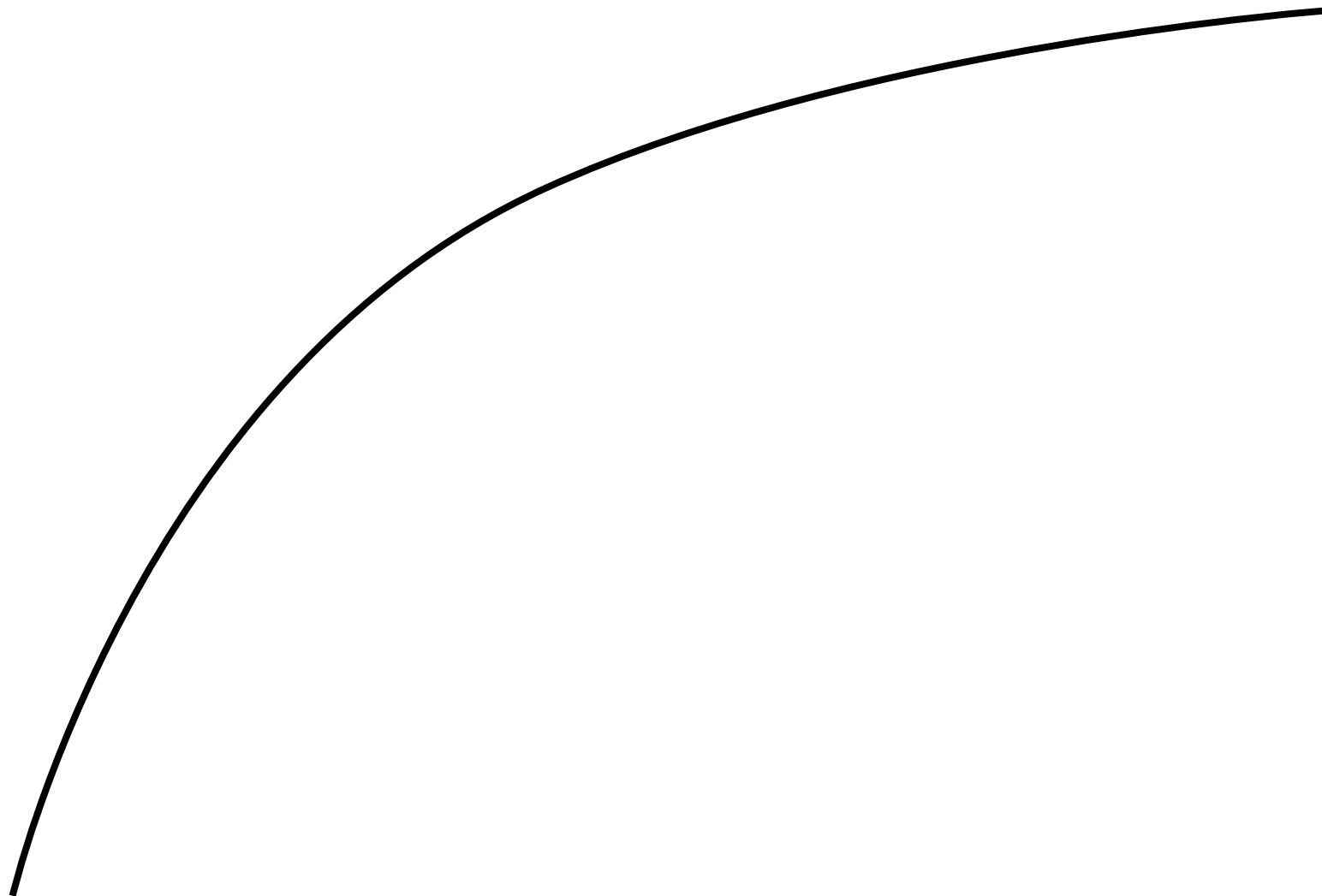
of video served
per seconds

**how to make video
download or upload
more efficiently?**

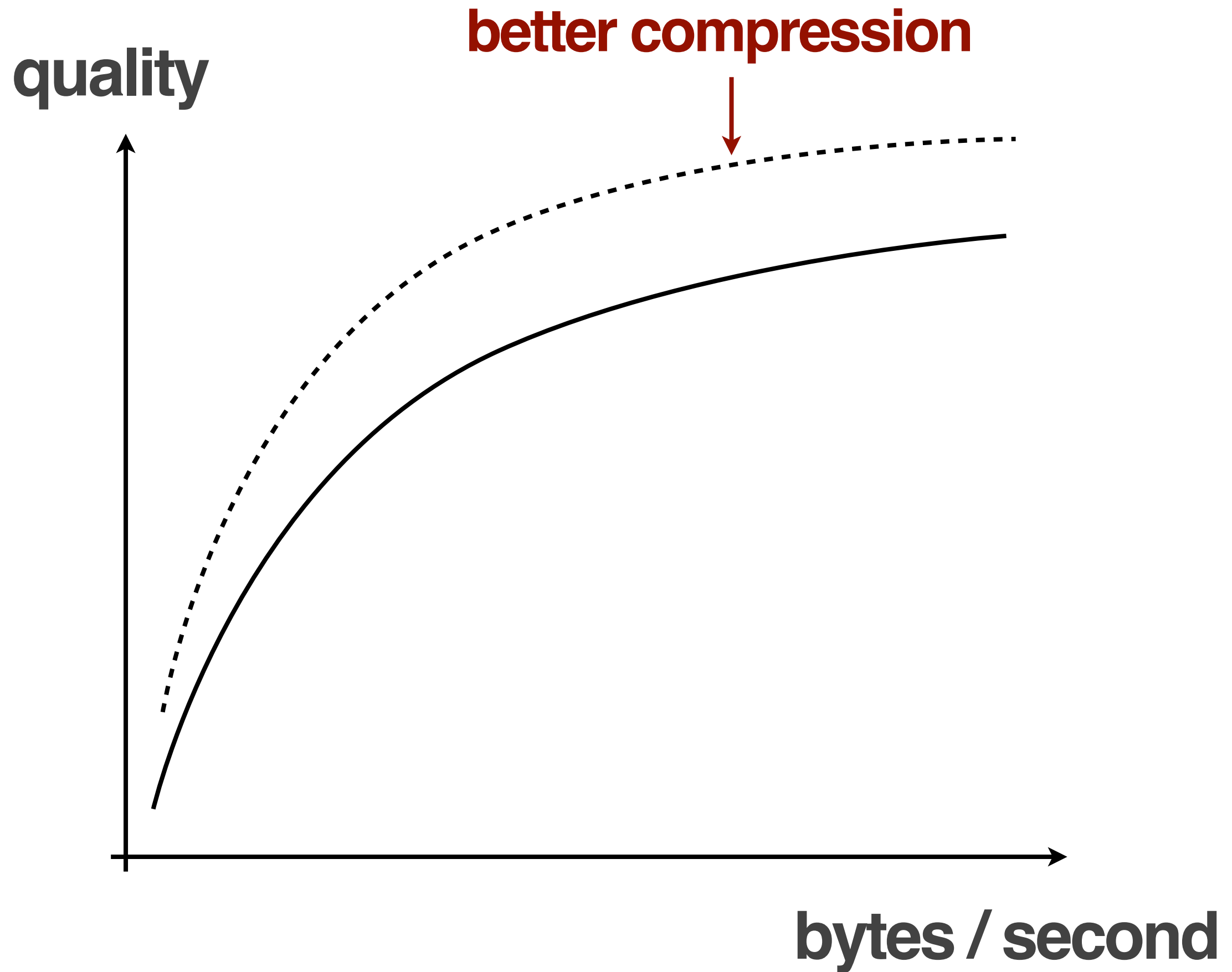

$$700,000 \times 480$$
$$\times 328$$


**kilobits of video served
per minute**

quality



bytes / second



how video compression works?

pixel:
location (150,40)
color (1,129,166)



group into 8x8 pixels



**principle: don't store details that
our eye cannot see (details)**

超級星光大道

中視



一對一踢館

Round 2

10強決定賽

超級星光大道

中視



一對一踢館

Round 2

10強決定賽

I would only be in your way
只會成為你的羈絆

principle: store differences



🔥 [TechCrunch Disrupt Is Coming May 24-26 »](#)

Google Acquires Video Compression Technology Company On2 For \$106 Million

by [Robin Wauters](#) on Aug 5, 2009

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1

Google and **On2 Technologies** jointly announced today that they have entered into a definitive agreement under which Google will acquire On2, a developer of video compression technology. The acquisition is expected to close later this year. On2 markets video compression technologies that power high-quality video in both desktop and mobile applications and devices and also holds a number of interesting **patents**.



Some of its codec designs are known as VP3, VP4, VP5, TrueMotion VP6, TrueMotion VP7 and VP8. Its customers include Adobe, Skype, Nokia, Infineon, Sun Microsystems, Mediatek, Sony, Brightcove, and Move Networks. On2, formerly known as The Duck Corporation, is headquartered in Clifton Park, NY.

Under the terms of the agreement, each outstanding share of On2 common stock will be converted into \$0.60 worth of Google class A common stock in a stock-for-stock transaction. The transaction is valued at approximately \$106.5 million.

According to the release, \$0.60 per share represents a premium of approximately 57% over the **closing price** of On2's common stock on the last trading day immediately prior to the

compression:

**how to store information in
fewest number of bits**

**how to throw away bits
without losing information**



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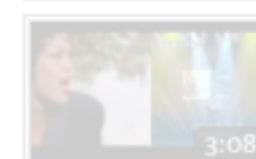
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252,346 views
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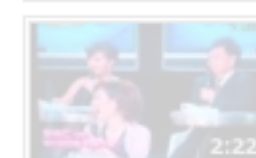
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283,609 views
moffalee



Whitney Houston - I Will Always Love You
16,970,894 views
bohemya1



REMIX: Taiwanese boy Lin Yu Chun and Whitney Houston's 'I Will Always Love You'...
238,182 views
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Young black woman speaking Chinese on Li Jing's show
113,930 views
steve4nlanguage



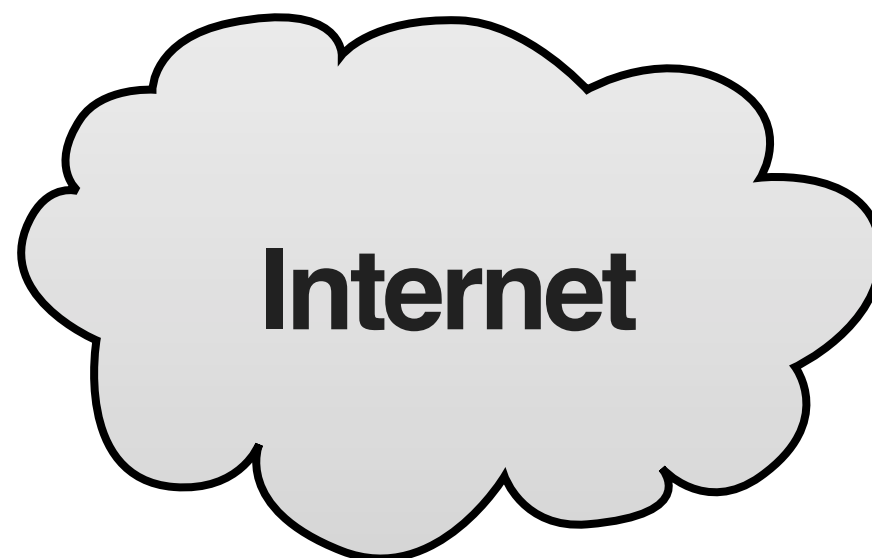
Lin Yu Chun Sings Amazing Grace

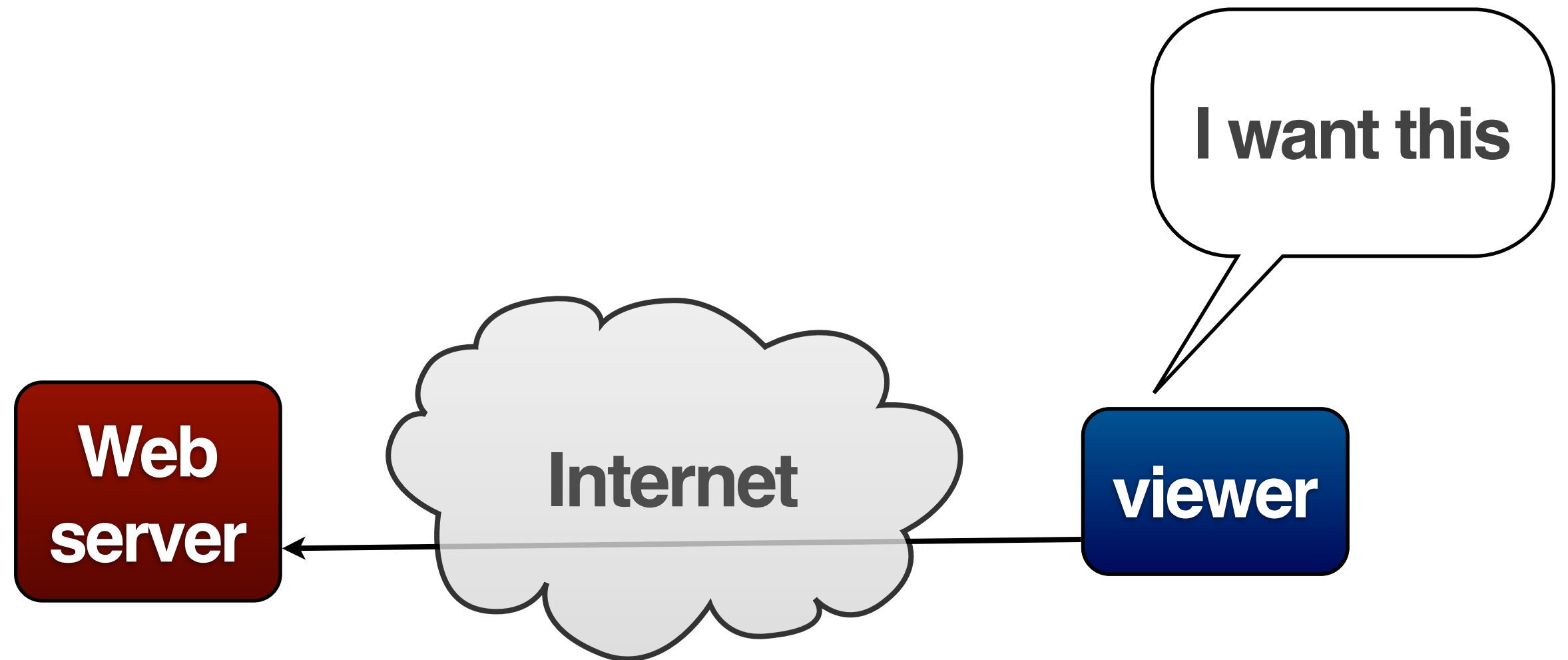
135.4 million

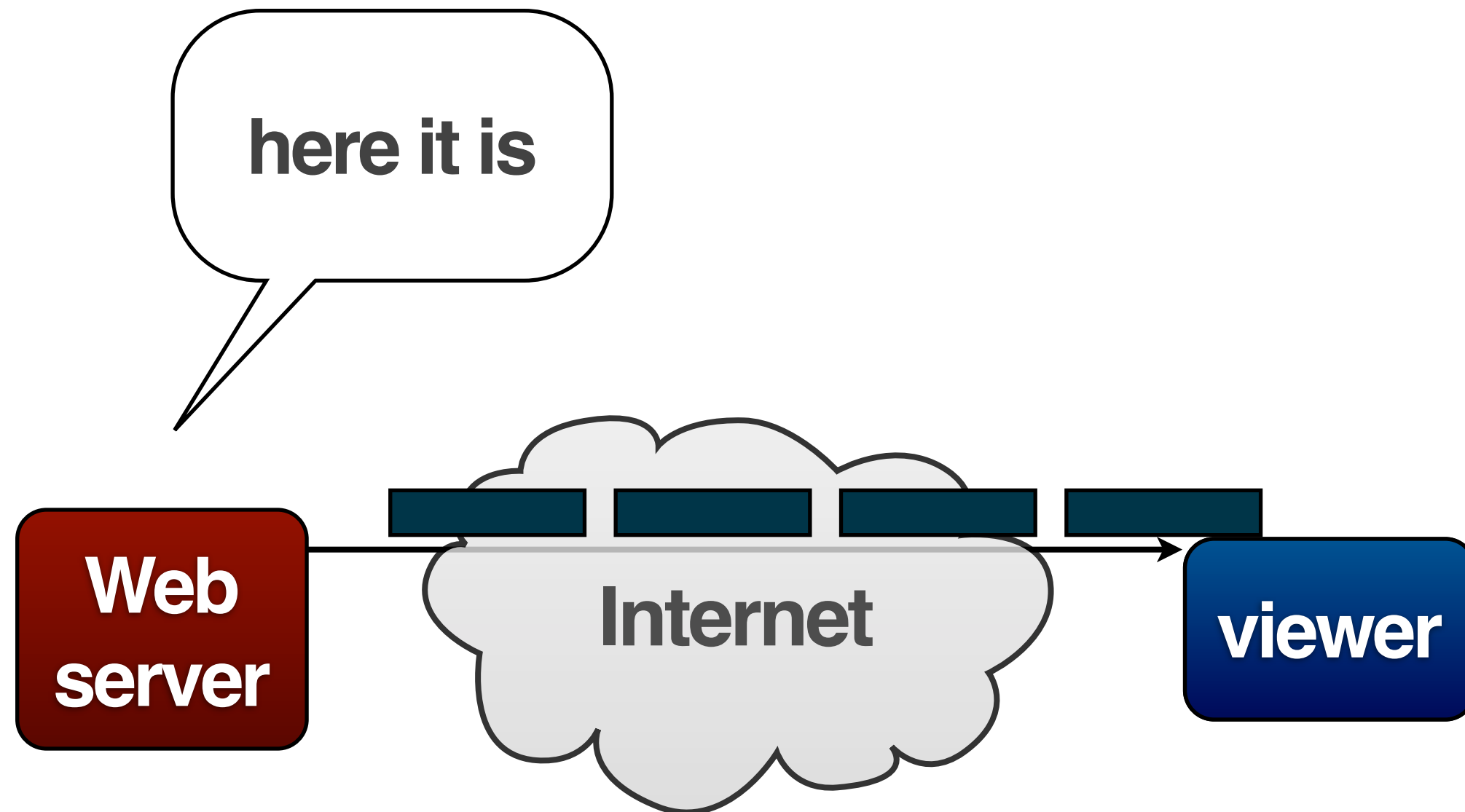
US users in January 2010

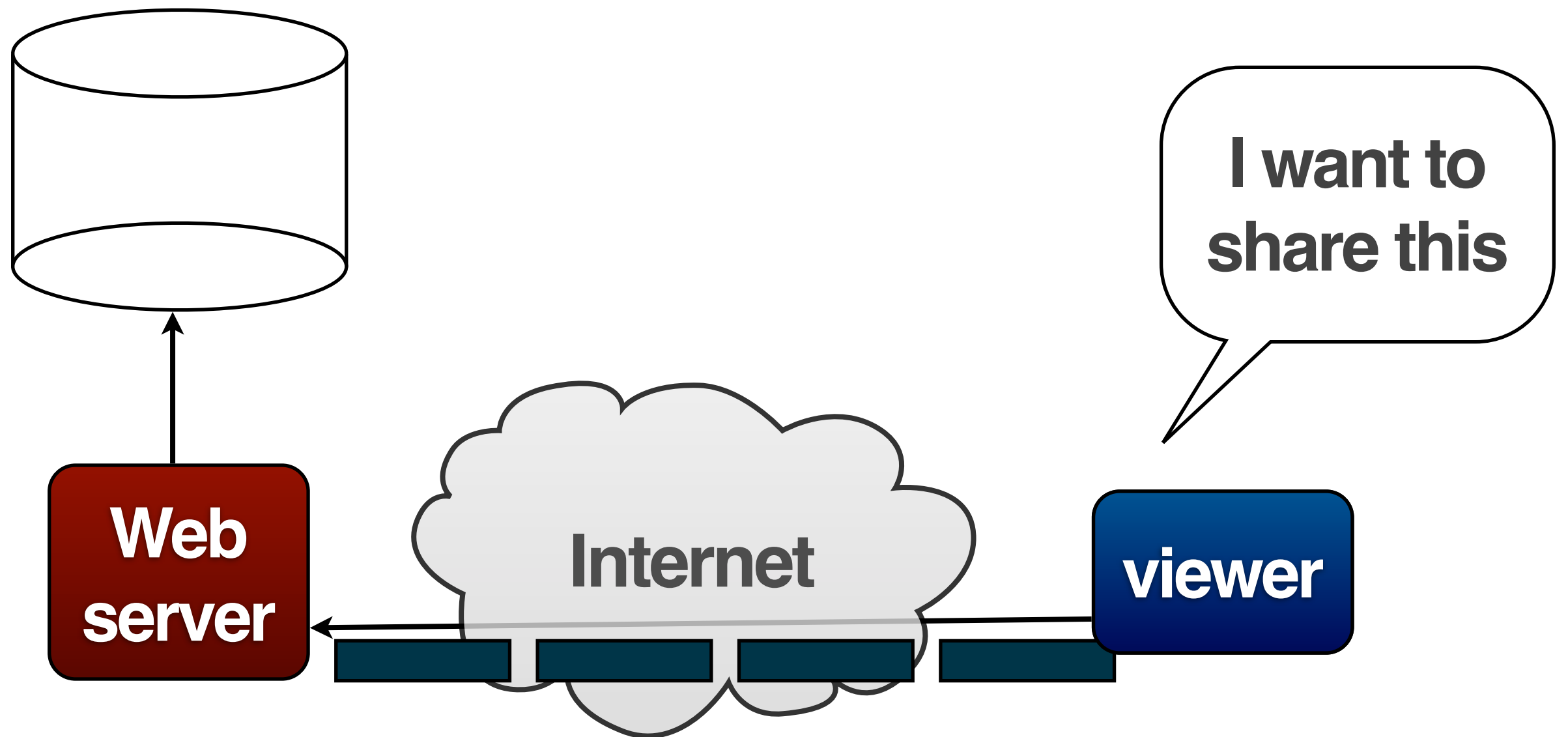
12.7 billions

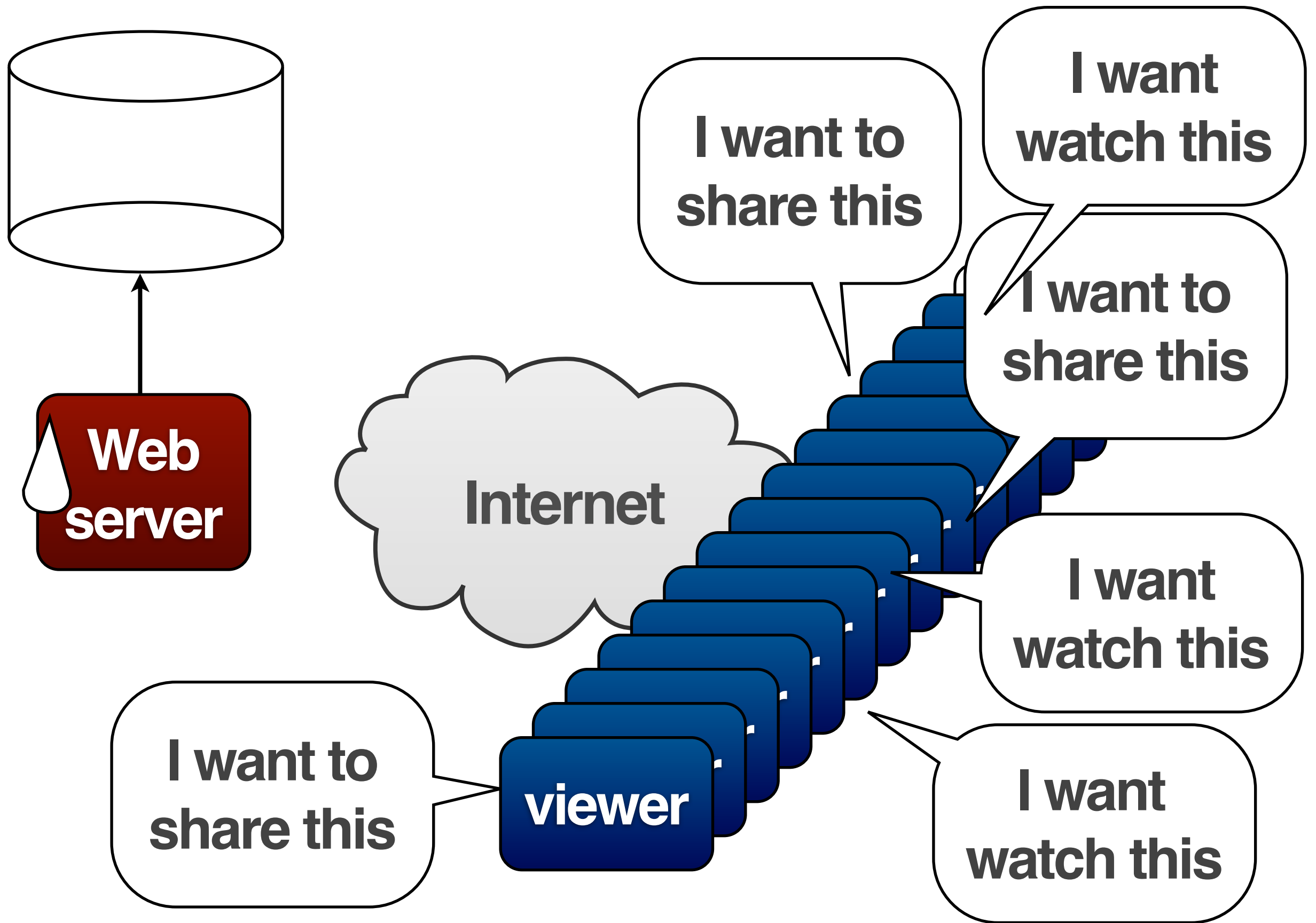
video watched in January 2010





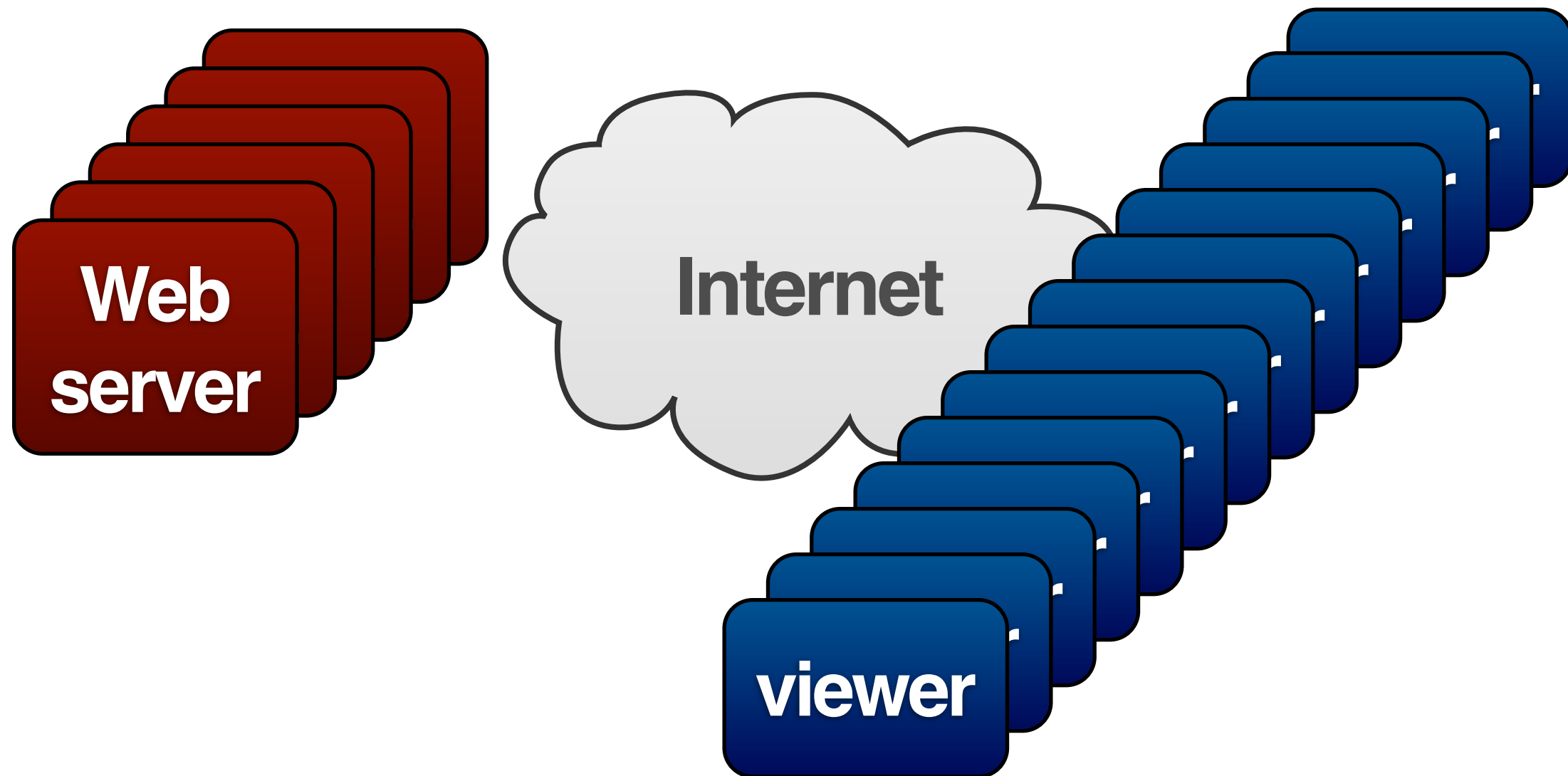




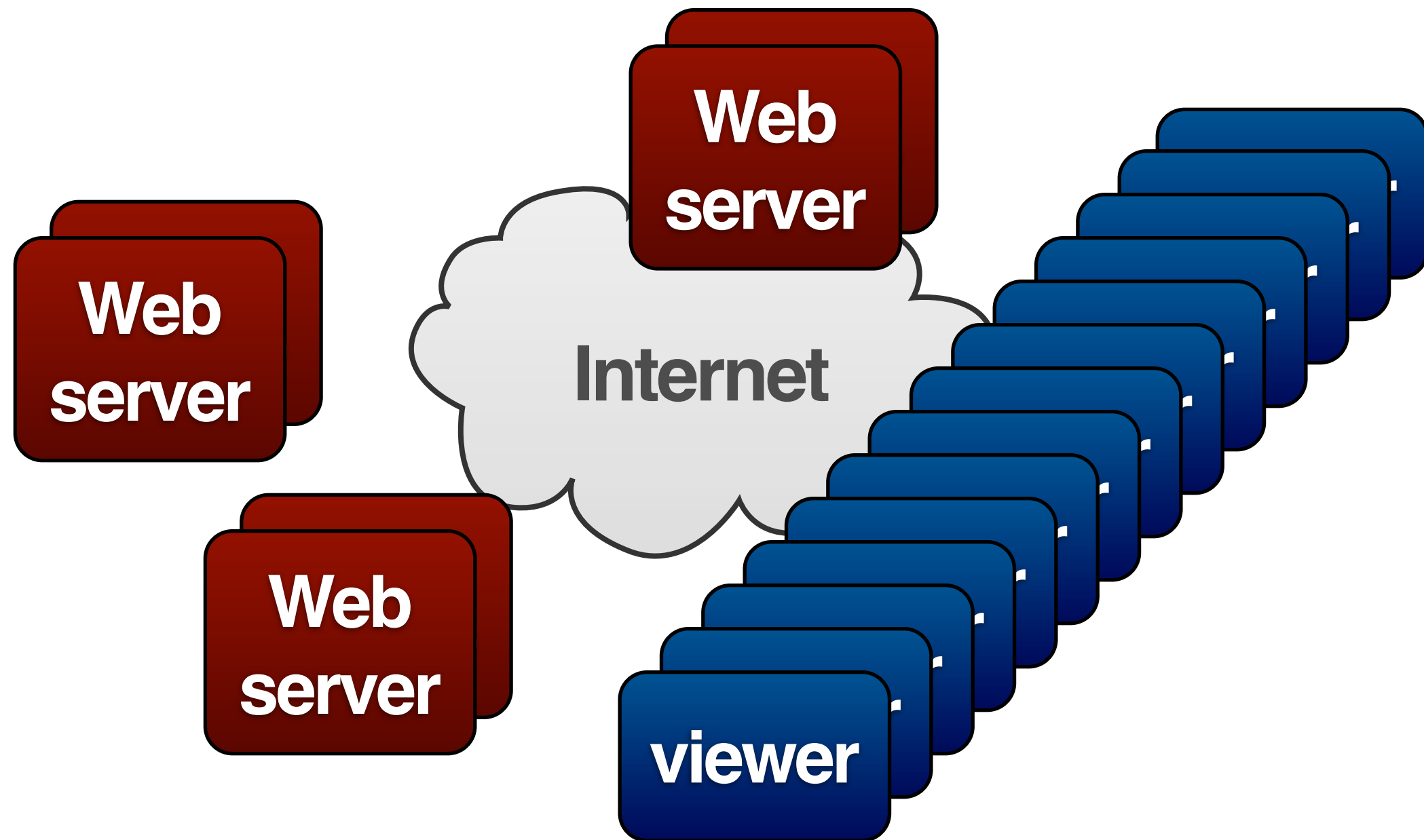


**how to support
many many viewers
and not have them
wait too long?**

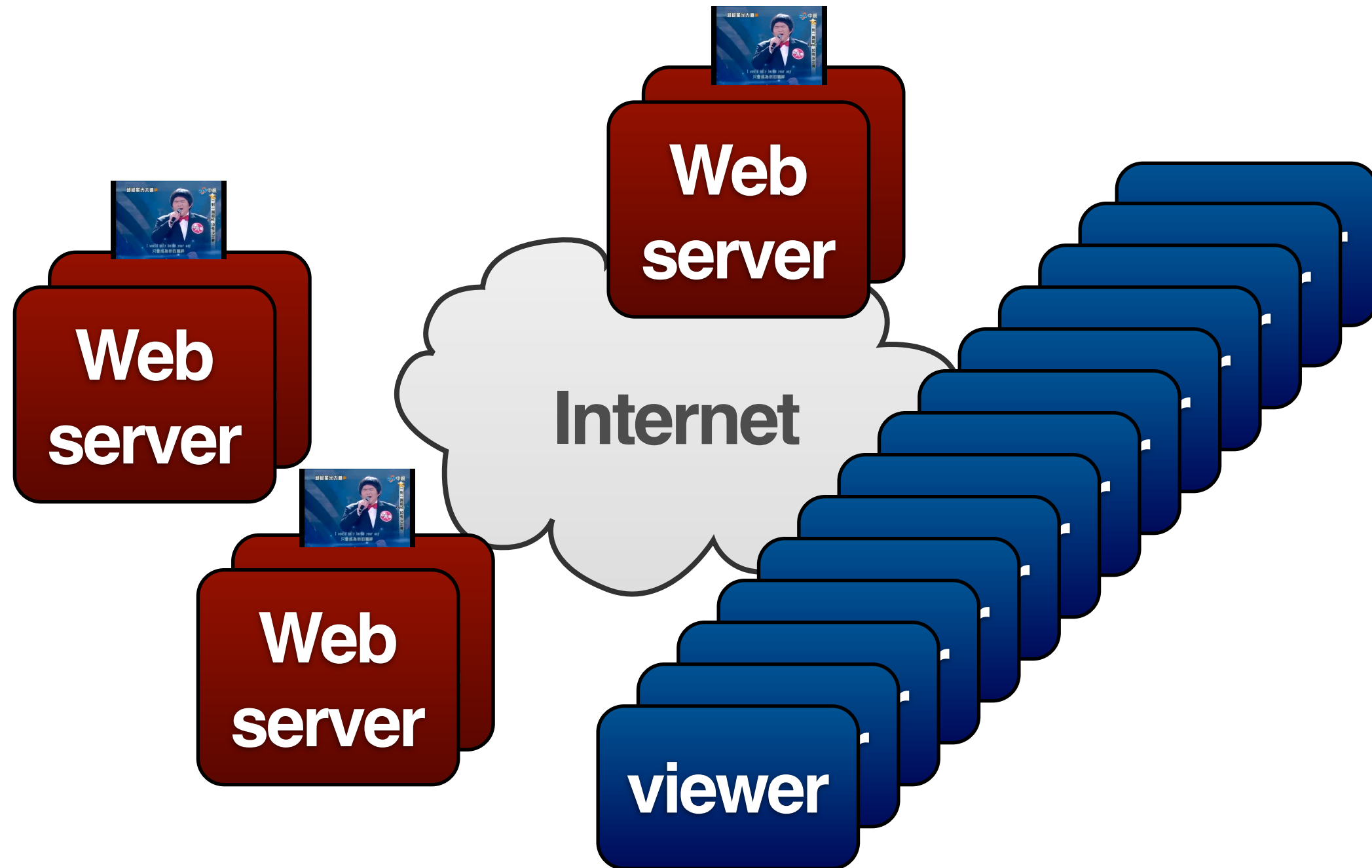
have many many servers



distributed all over the world



popular videos are duplicated



where to put video servers?

which video store where?

who has this video?

who is closest to the user?

need to adapt to:

**network condition,
popularity of videos**

distributed systems

**how multiple computers,
communicating over a network,
can achieve a common goal?**



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1,051,170 views

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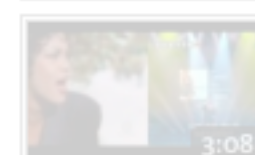
moffalee



Whitney Houston

16,970,894 views

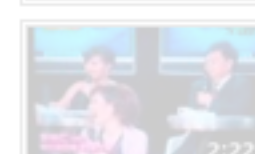
bohemya1



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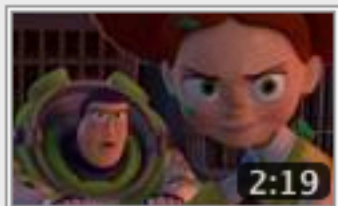
how to identify interesting and informative frame as thumbnail?



frame 1



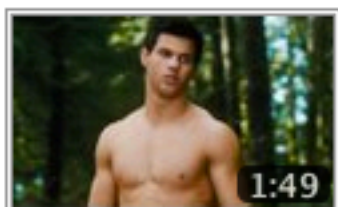
frame 900



Toy Story 3 – Official Trailer [HD]

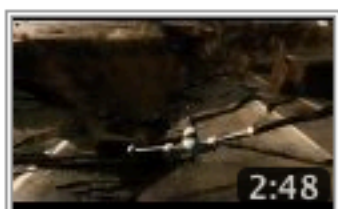
Title: Toy Story 3 Release Date: 18 June 2010 Genre: Animation Cast: Tom Hanks, Tim Allen, John Ratzenberger, Joan Cusack, Michael Keaton Director ...
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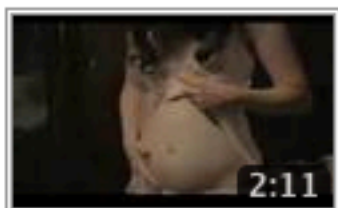
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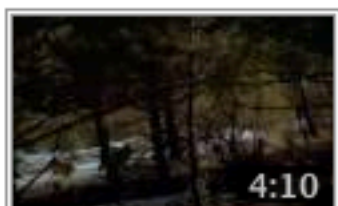
'2012' Trailer HD HD

Never before has a date in history been so significant to so many cultures, so many religions, scientists, and governments. A global
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Breaking Dawn Teaser Trailer

Stephenie´s Meyer novel Breaking Dawn **Trailer**. So I finally finished! I loved this book so much I decided to create my first
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Eclipse Trailer

BREAKING DAWN **TRAILER** : www.youtube.com This is a fanmade **trailer**. *** I wanna thank everybody for watching my video & your
1 year ago 16,060,562 views [TiteLola](#)

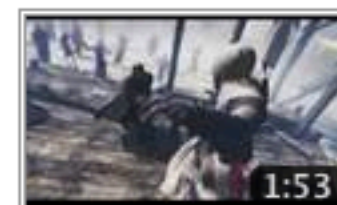


"Paranormal Activity" - Official Trailer HD

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Hannah Montana The Movie **Trailer**
Follow Us – Twitter.com The Ha...
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Nine – Official Traile...
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Stephenie´s Meyer novel Breaking Dawn **Trailer**. So I finally finished! I loved this book so much I decided to create my first
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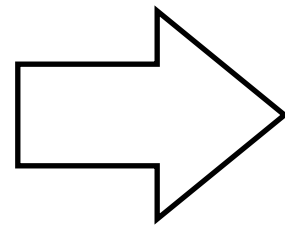
Release 25 December 2009 Genre:
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Musical 3 in theaters Oct ...
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**need to understand
the content of the video**

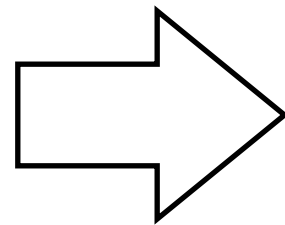
(0,0):(1,244,39)
(0,1):(1,243,38)
(0,2):(2,243,27)
(0,3):(95,34,221)
:
:
:



**is there a
variety in
the colors?**

easy

(0,0):(1,244,39)
(0,1):(1,243,38)
(0,2):(2,243,27)
(0,3):(95,34,221)
:
:

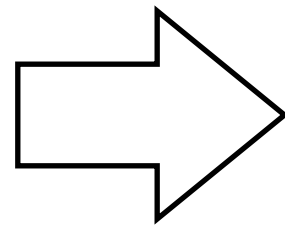


**is there a
face inside?**

**is it the
same face?**

doable

(0,0):(1,244,39)
(0,1):(1,243,38)
(0,2):(2,243,27)
(0,3):(95,34,221)
:
:



**is the scene
an important
one, based
on the text
description?**

very hard

same content

Taiwanese Lin Yu Chun Sings Whitney Houston's "I Will Always Love You" LIVE

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need to detect duplicates

**but length, size, quality,
colors, content
may change slightly**

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對一踢館
Round 2
10強決定賽

LIN YU CHUN

Joven taiwanés que deslumbró con su voz



THE PLACE FOR POLITICS



DOW 10905.23

msnbc

超級星光大道

中視

一對一踢館
Round 2
10進決賽



BOY TOP CONTENDER TO
WIN "SUPER STAR AVENUE"

TOP STORIES

MAJOR 7.7 MAGNITUDE EARTHQUAKE ROCKS INDONESIA



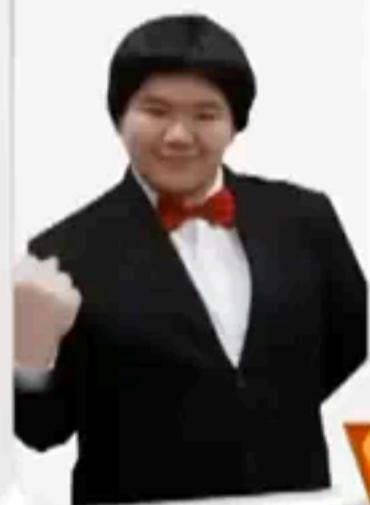
0:45 / 3:37



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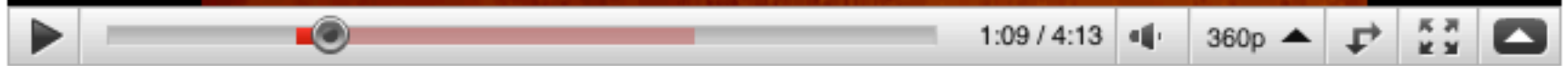


VS.

林育羣

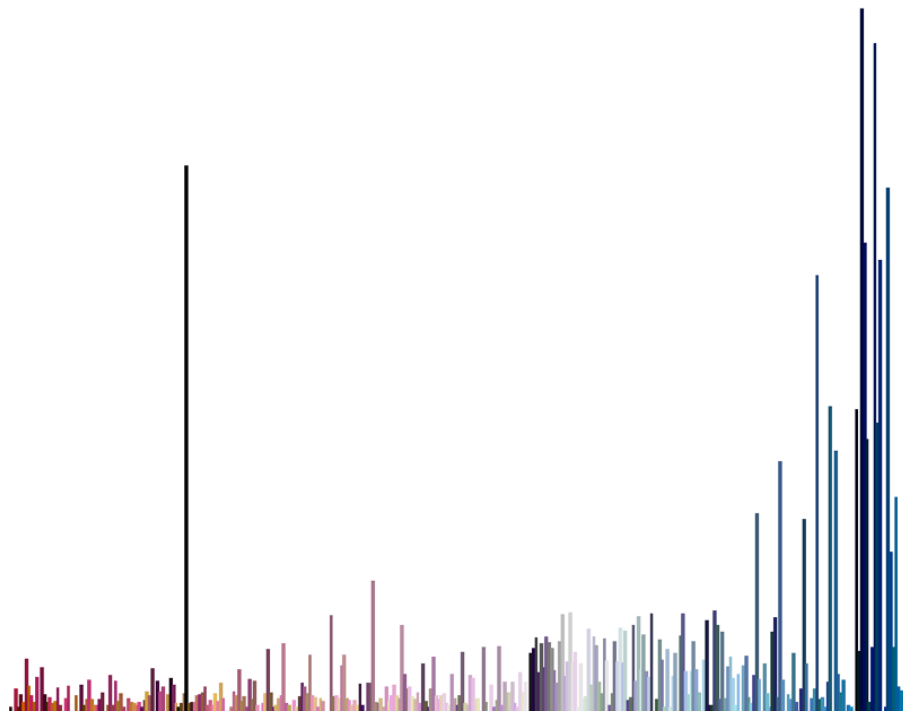
蘇正峰

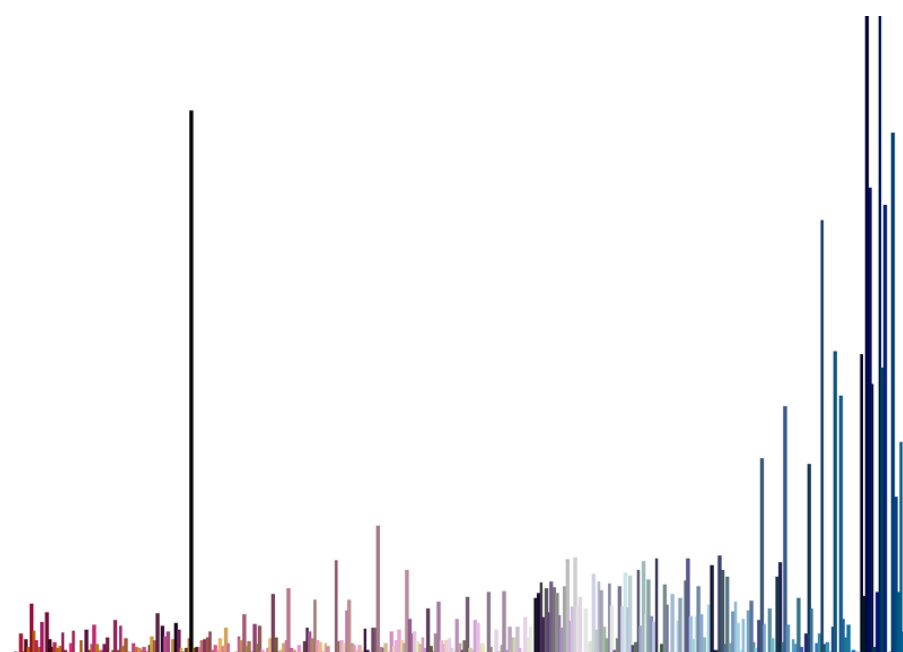
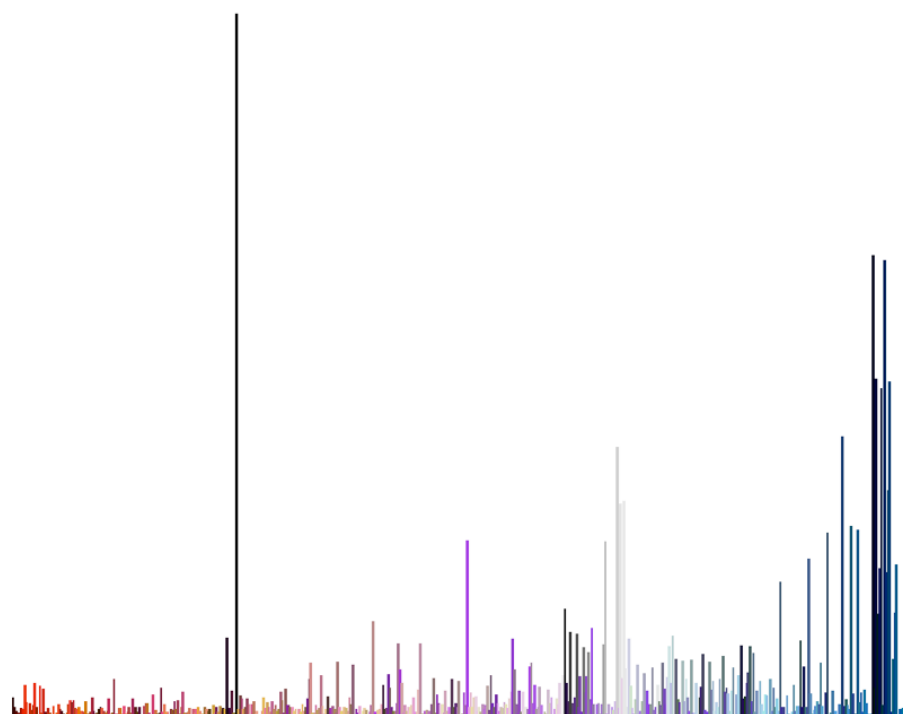
誰能拿下勝利

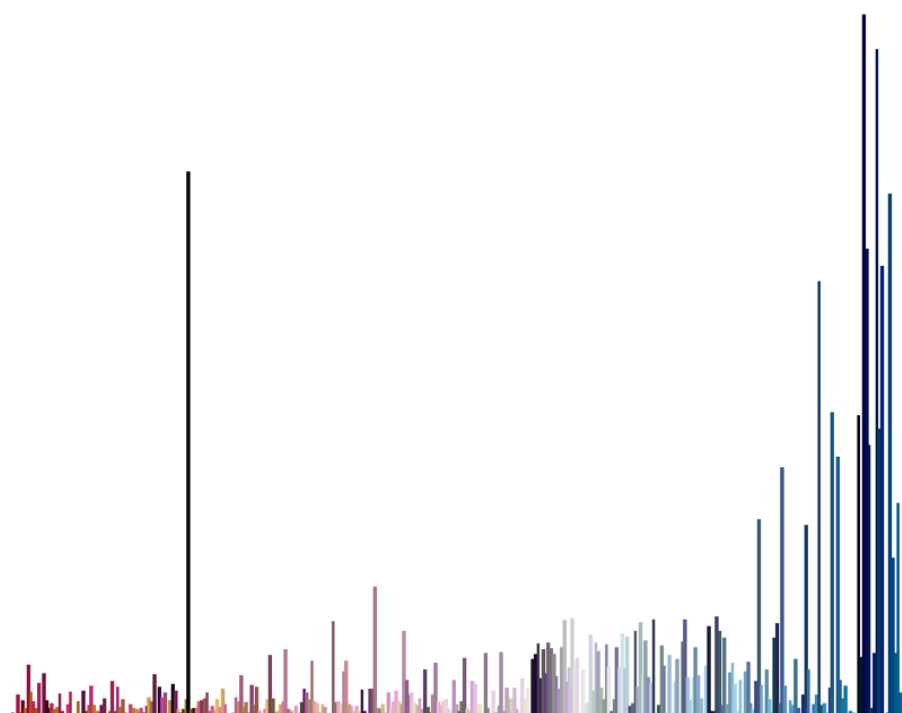
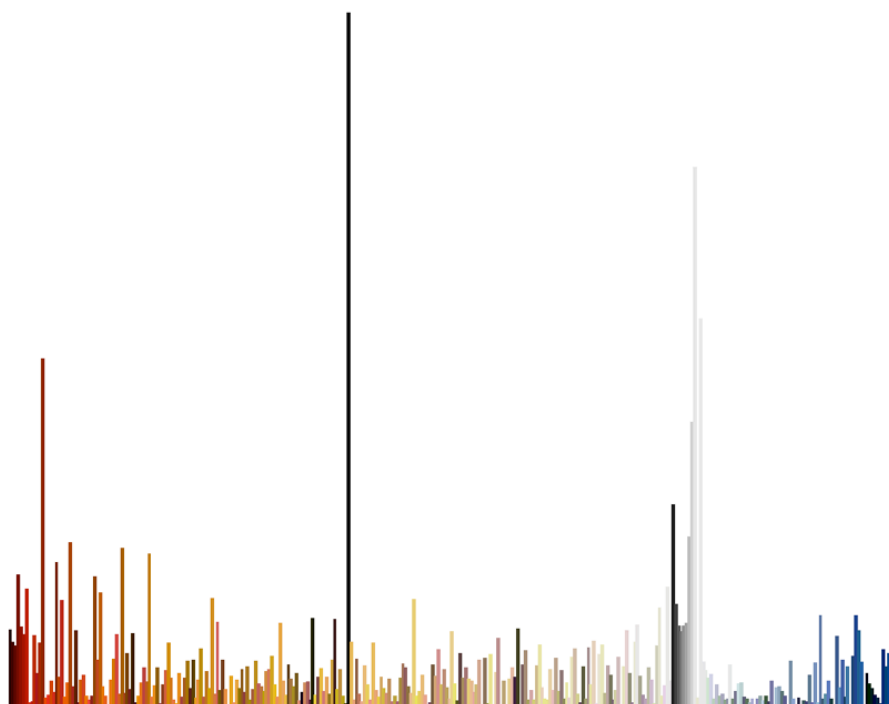


one possible method:

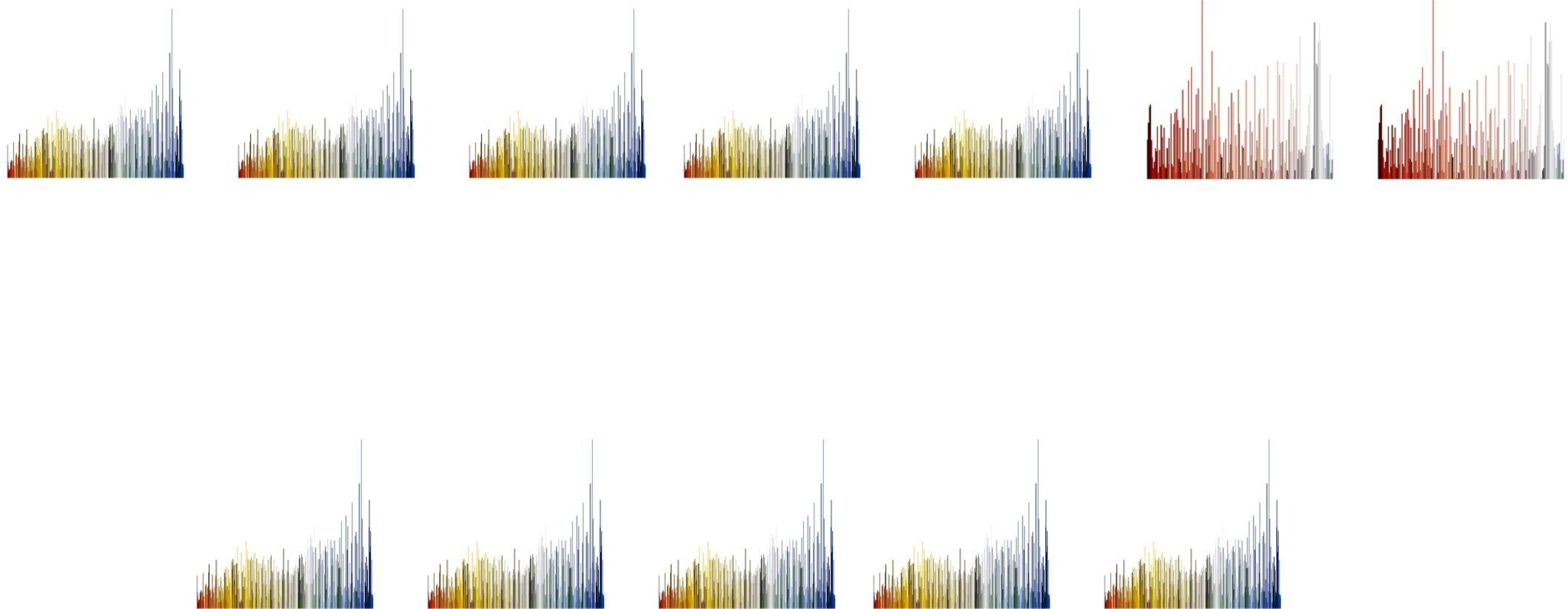
**compute color histogram for
each frame**



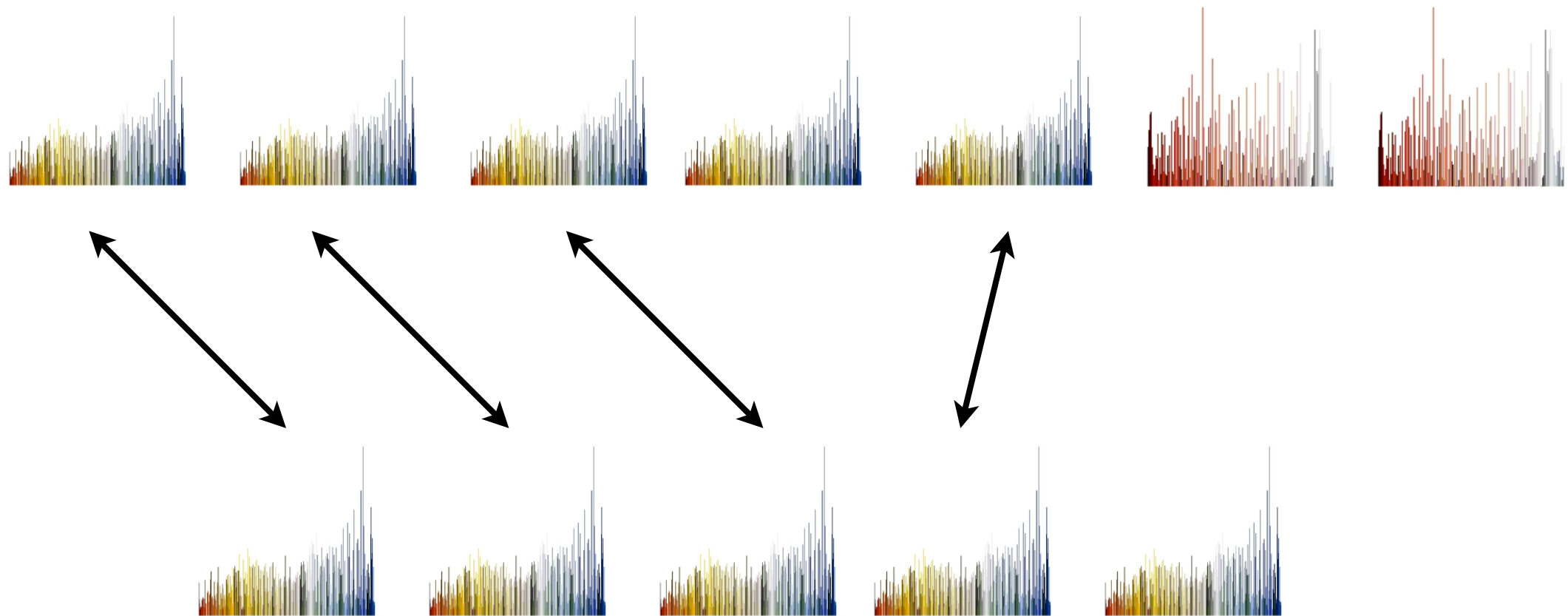




construct sequence of color histograms for videos



perform approximate matching

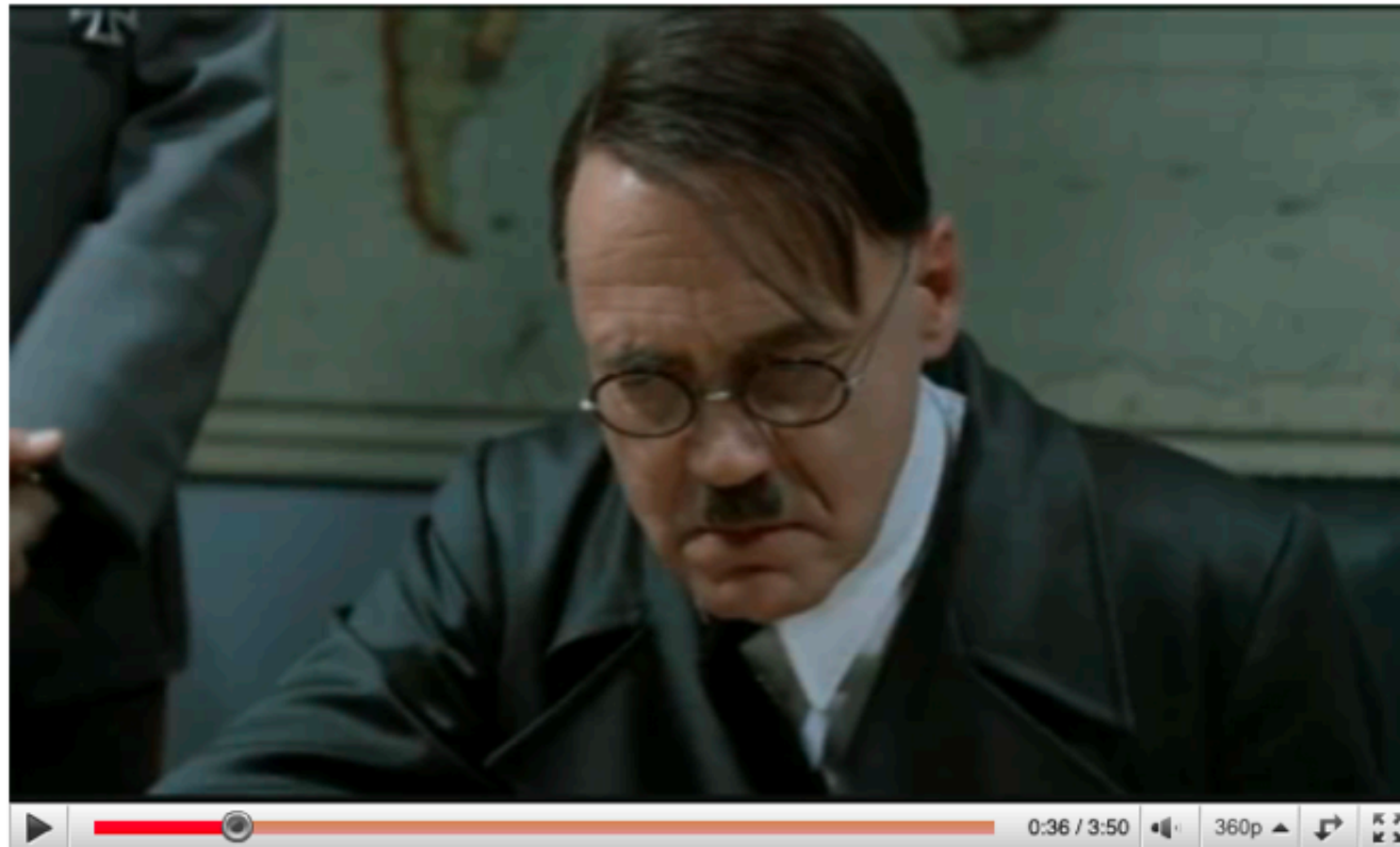


but it does not always work

different subtitles, same video

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[NeedleKiller05](#) "But Sir, I could not help but lol when watching



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[welcometo21](#)

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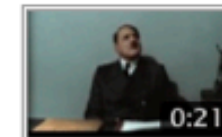
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[Hitler Reacts to Twilight the Movie](#)

116,155 views
[meeeeOW](#)



[Hitler is informed he has Swine Flu](#)

59,548 views
[hitlerrantsparodies](#)



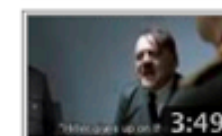
[Hitler is informed about the Apple iPad](#)

270,763 views
[hitlerrantsparodies](#)



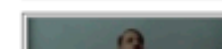
[Somebody Stole Hitlers Car](#)

1,706,000 views
[SmokeyMcPot420yee](#)



[Hitler gets banned from Xbox Live](#)

4,350,606 views
[MOTURK49](#)



[Hitler is asked "Why so](#)

**with recognition of video
content, we can also**

detect inappropriate materials

content-based search (e.g., find video of cat the musical)



Cats Musical - Memory

Cats is an award-winning **musical** composed by Andrew Lloyd Webber based on Old Possum's Book of Practical **Cats** and other

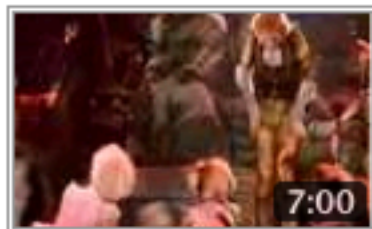
Most liked 2 years ago 4,552,666 views [UrChatNoir](#)



Cats The Musical DVD - The Rum Tum Tugger

The Rum Tum Tugger from **Cats**. ~lyrics~ The Rum Tum Tugger is a curious **cat** If you offer me pheasant I'd rather have grouse If you

Most liked 1 year ago 181,594 views [QuaxosJellicleSpoon](#)



The Best Of Cats The Musical

Hey.. This is parts of **Cats** the **musical**

3 years ago 1,270,483 views [Boq](#)



"NORA: Practice Makes Purr-fect" - Check the sequel too.

can be found at www.ravenswingstudio.com Copyright © 2007/09 by Yow!/Alexander. Nora The Piano **Cat**, LLC ... piano **music** video

3 years ago 17,342,702 views [burnellyow](#)

detect copyrighted video



Search

[Browse](#)

[Upload](#)

weitsang ▾

[Sign Out](#)

About YouTube

[Contact us](#)

[Company blog](#)

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[TestTube](#)

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[Partnerships](#)

[Developer Tools](#)

YouTube Video Identification Beta

Thanks to the continued cooperation of content owners large and small, YouTube is able to develop, test, and implement increasingly effective content management tools. Today, we are proud to launch, in beta form, our latest innovation in online video: YouTube Video Identification.

Like our other content policies and tools, YouTube Video Identification goes well above and beyond our legal responsibilities. And like those other tools and policies, Video Identification aims for three main goals: accurate identification, choice for copyright holders, and a great user experience.

Identification

YouTube Video Identification will help copyright holders identify their works on YouTube. We have worked with Google to develop one-of-a-kind technology that can recognize videos based on a variety of factors. As its Beta status indicates, our Video Identification is brand-new, cutting-edge stuff, so we will be constantly refining and improving it. Early tests with content companies have shown very promising results. As we scale and refine our system, YouTube Video Identification will be available to all kinds of copyright holders all over the world, whether they want their content to appear on YouTube or not.

No matter how accurate the tools get, it is important to remember that no technology can tell legal from infringing material without the cooperation of the content owners themselves. This means that copyright holders who want to use and help us refine our Video ID system will be providing the necessary information to help us recognize their work. We aim to make that process as convenient as possible.

more relevant video



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Taiwanese Lin Yu Chun Sings Whitney Houston's "I Will Always Love You" LIVE

1music4all 1 videos ▾ | Subscribe

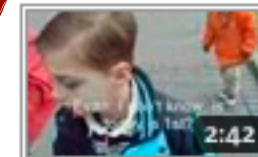


1music4all — April 07, 2010 — Lin sings Dolly Parton classic on Taiwanese tv talent show

5,268,188 ▾



Lin Yu Chun Sings Whitney Houston's 'I Will Alw...
1,764,888 views
actonish



Wow! American Boy Speaks Mandarin Chinese in China
228,717 views
weirdchina



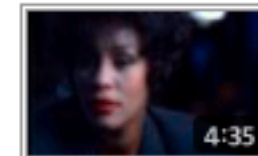
Taiwanese Boy Lin Yu Chun Sings Whitney Houston...
1,051,170 views
clse945111



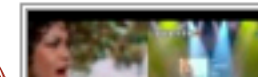
Lin Yu Chun - I Will Always Love You - Taiwane...
252,346 views
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ORIGINAL: Taiwanese Boy Lin Yu Chun Sings I Wil...
283,609 views
moffalee



Whitney Houston
16,970,894 views
bohemya1



REMIX: Taiwanese boy Lin Yu Chun and Whitney Ho...

multimedia content analysis

**how to reason about the content
of image, video, and audio?**

Recommended for You

Edit   

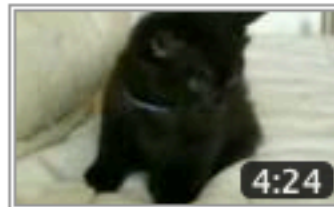


Confessions of an Area 51 Employee...

2 years ago

58,078 views

Because you watched Agent Cooper Ente...

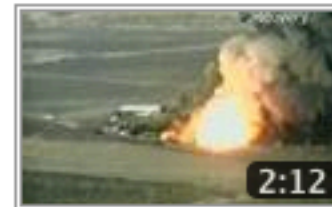


THE BEST CAT VIDEO YOU'LL EVER

3 years ago

25,640,211 views

Because you watched The Internet Is M...



Destroyed in Seconds- Chemical

1 year ago

1,468,097 views

Because you watched Qwirkle

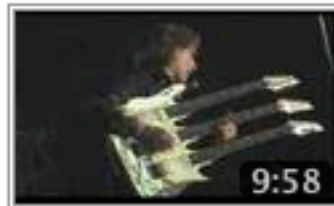


Twin Peaks - "Bob"

3 years ago

117,200 views

Because you watched Albert's speech -...



Steve Vai - "I Know You're Here"

1 year ago

3,696,800 views

Because you watched Prefab: What if ...



Happy Birthday

3 years ago

7,824,002 views

Because you watched corgis singing ha...

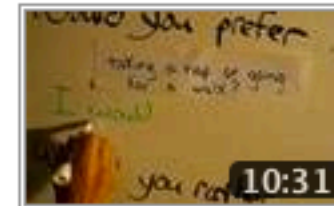


David Letterman - Rudolph The Re...

4 months ago

24,833 views

Because you watched David Letterman -...



Lesson 1 - Preferences -

2 years ago

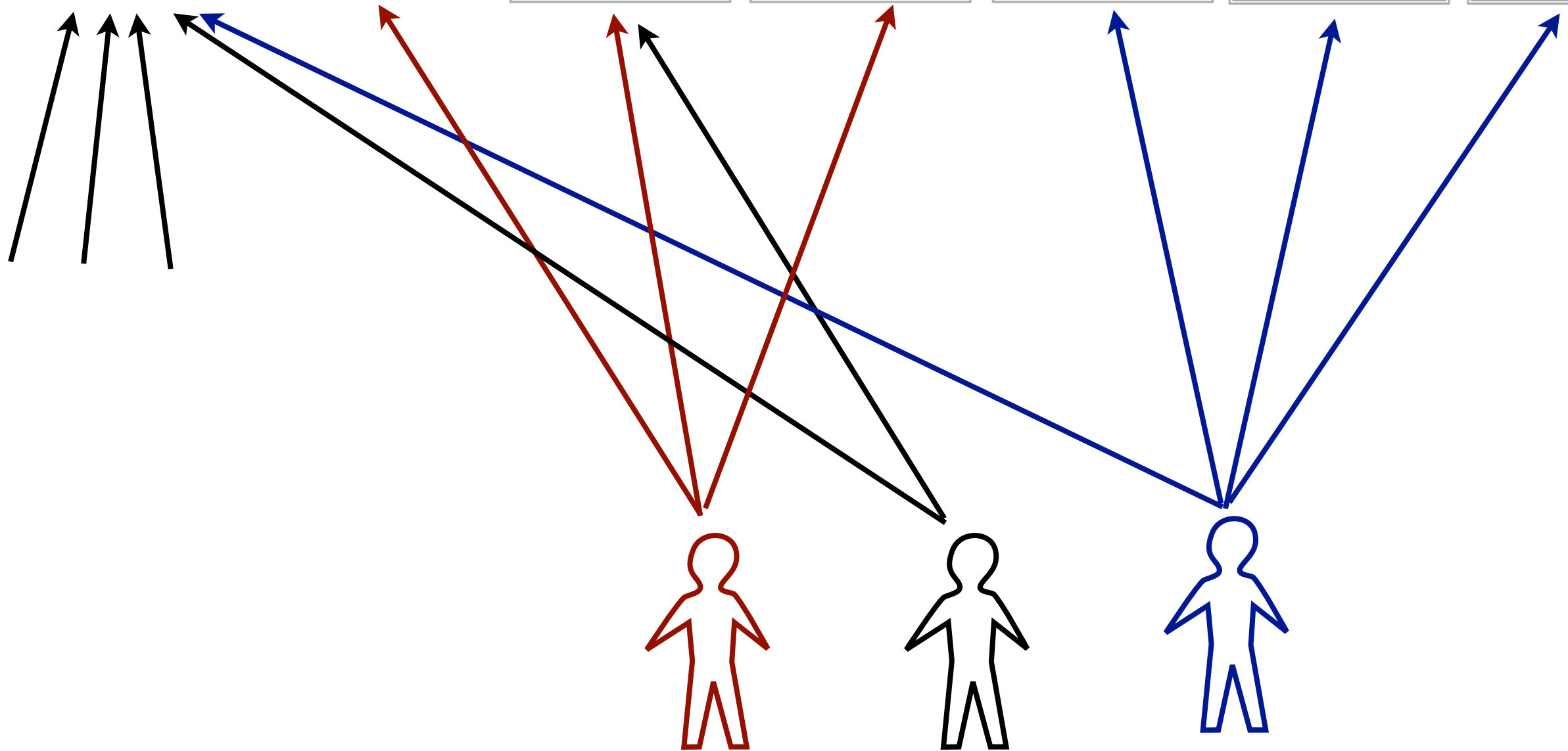
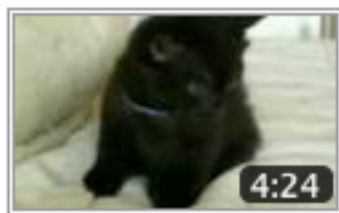
500,096 views

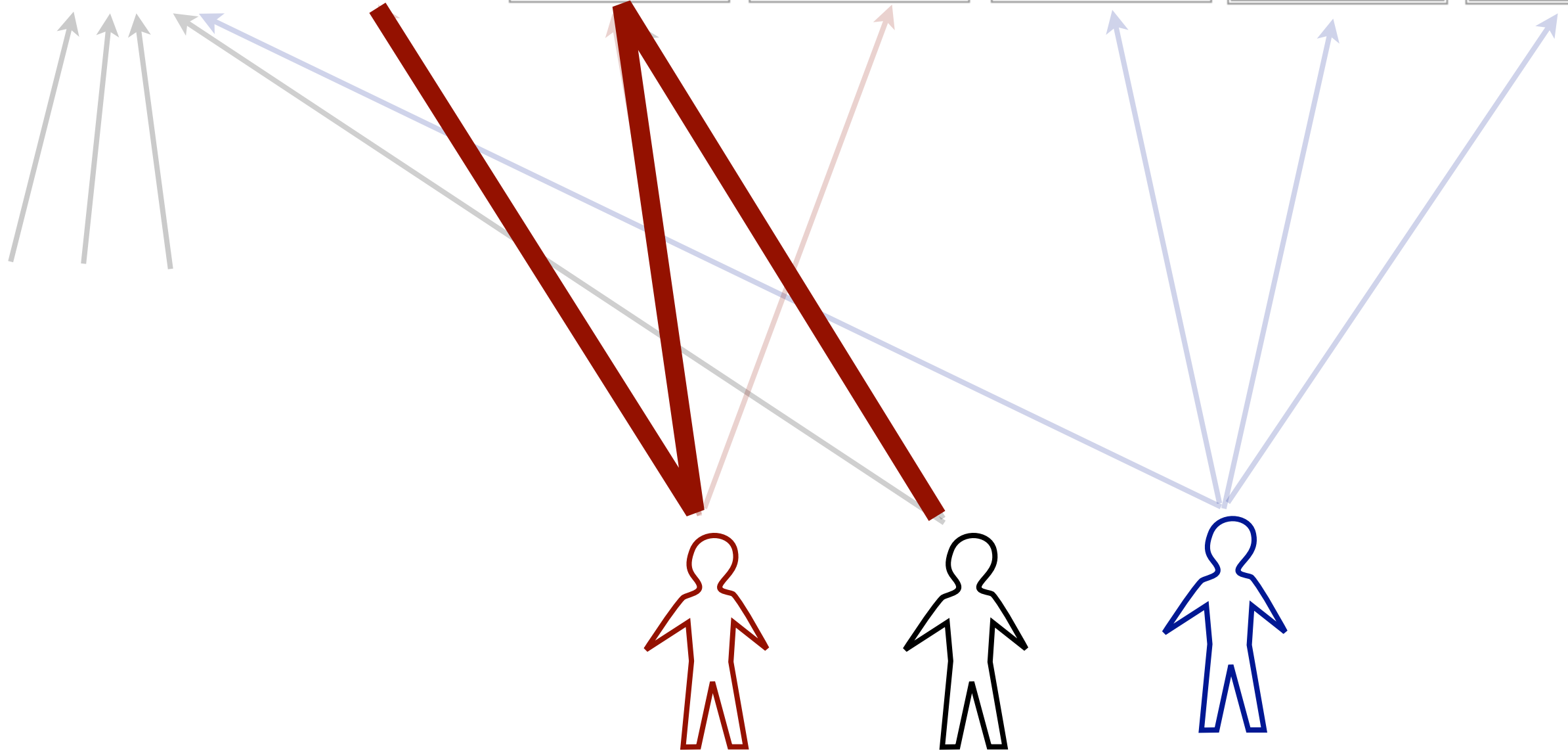
Because you watched English Grammar L...

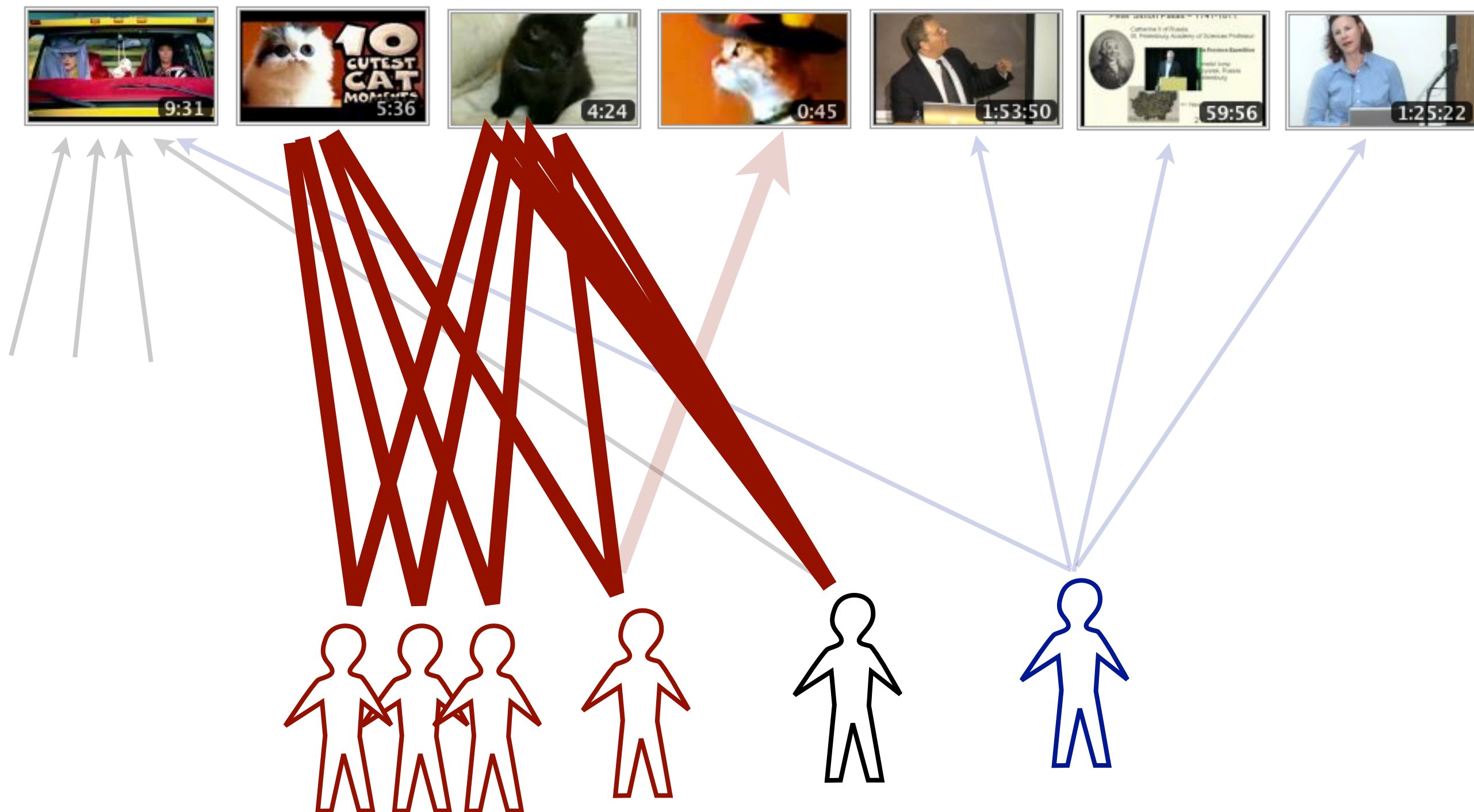
**need to predict what
a user likes to watch**

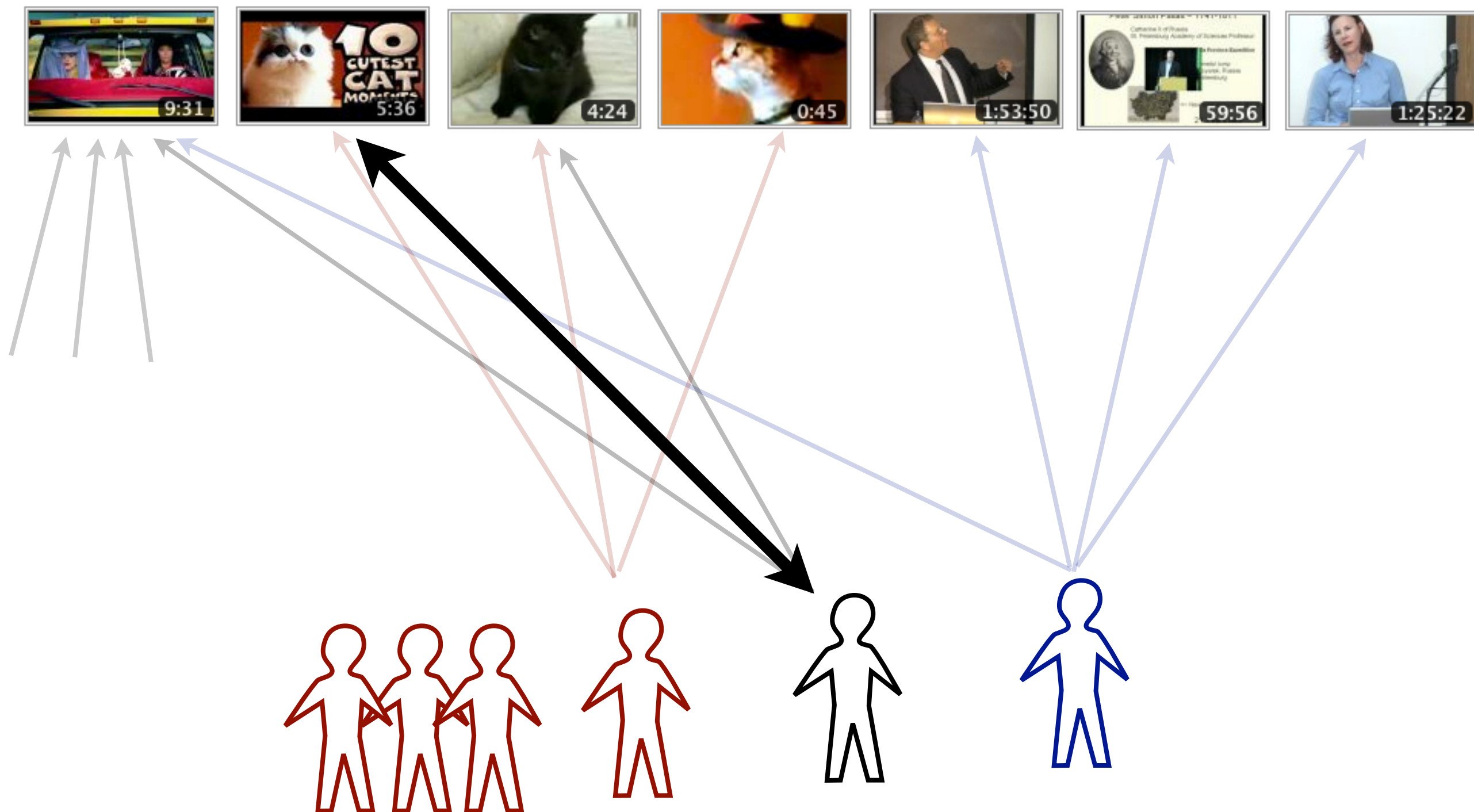
**Observe pattern: many users
who viewed X, also viewed Y**

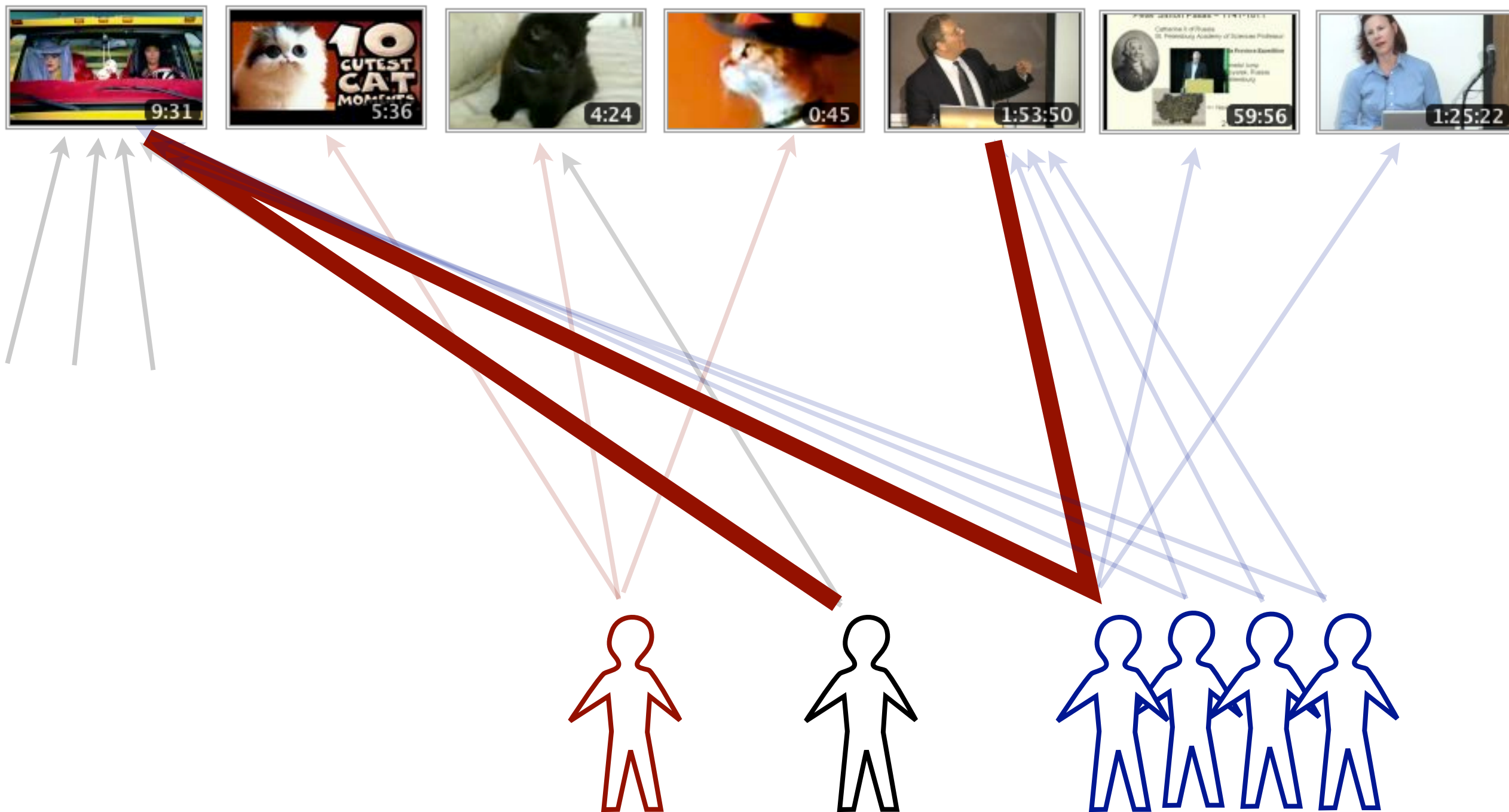
**if a user is viewing X, the user
might like Y too.**











User U may like video V if

**there is a short path between U and V
there are many paths between U and V
not going through popular videos**

Netflix Prize

COMPLETED

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Movies For You

Randy, the following movies were chosen based on your interest in:
[Bowling for Columbine](#)
[Carnivale: Season 1](#)
[Fahrenheit 9/11](#)

The Big One

★★★★★
A more subversive
comedy from

All Discs
guaranteed!You really
liked it...

Now only for just \$5.99

[Shop](#)
as low as

Original art

Congratulations!

The Netflix Prize sought to substantially improve the accuracy of predictions about how much someone is going to enjoy a movie based on their movie preferences.

On September 21, 2009 we awarded the \$1M Grand Prize to team "BellKor's Pragmatic Chaos". Read about [their algorithm](#), checkout team scores on the [Leaderboard](#), and join the discussions on the [Forum](#).

We applaud all the contributors to this quest, which improves our ability to connect people to the movies they love.

Netflix gave out \$1M to
improve their
recommendation

machine learning

**how to recognize pattern and
learn information from data**

Taiwanese Lin Yu Chun Sings Whitney Houston's "I Will Always Love You" LIVE

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1music4all — April 07, 2010 — Lin sings Dolly Parton classic on Taiwanese tv talent show competition. (Parton wrote and first recorded the so...

5,268,188 ▾ views



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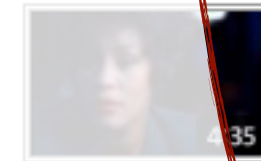
Taiwanese Boy Lin Yu Chun Sings Whitney Houston's 'I Will Always Love You' 1,051,170 views clse945111



Lin Yu Chun - I Will Always Love You - Taiwanese version 252,346 views ROONEYISBETTER



ORIGINAL: Taiwanese Boy Lin Yu Chun Sings I Will Always Love You 283,609 views moffalee



Whitney Houston 16,970,894 views bohemya1



REMIX: Taiwanese boy Lin Yu Chun and Whitney Houston's 'I Will Always Love You' 238,182 views moffalee



Young black woman speaking Chinese on Li Jing's show 115,930 views stevenlanguage



Lin Yu Chun Sings American Song

each video has many properties:

who has viewed it

who likes it

who commented what about it

who tags it with what

:

(and when, where ..)

how to find:

**top 10 most viewed video in
Singapore**

how to find:

**all videos tagged with “cat”
“favorited” by me**

**top 10 most watched videos liked
by viewers who also liked video X**

~250,000,000

**videos on YouTube
(my estimate)**

700,000

**video viewed
every minute
(october 2009)**

**need to store, search, retrieve, and
update metadata about video
efficiently and consistently**

database

**how to manage large amount of
data**

compression
distributed systems
media content analysis
machine learning
database

computational methods to
store
retrieve
transmit
process
display
interact with
information

computer science

**the computer science
behind**



Thank You



School *of* Computing