



Technical Challenges for Searching Premium Content at Hulu.com

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Agenda

- Introduction to Hulu
- Core Problems at Hulu
 - Search/Browse
 - Recommendation
 - Ad targeting
- Lessons Learnt



The online video business is up: us market

| | Unique viewers | Streams/user |
|--------|----------------|--------------|
| 9-Mar | 149,410,000 | 96.8 |
| 10-May | 182,918,000 | 185.6 |
| | 22% | 92% |

Source: comscore video metrix

The Mission

“To help people find and enjoy the world’s premium content when, where, and how they want it.”

Premium is the way that I define it is, it’s done by people who do this for a living. Which doesn’t necessarily mean that it has to be on television.

— JASON KILAR



The Product

hulu™ TV Movies
Welcome Jason | Profile | Queue (33) | Sign Out
Channels Popular Episodes Popular Clips Popular Shows Browse search

Orientation / Jump Push Fall

Hulu Desktop

Heroes
Season 4 :
The ringmas
Tracy resurr
to disrupt N

The Tonight Show
Mon, Sep 21, 2009
Season 1 : Episode 7

facebook Home Profile Friends Inbox

12:22 PM

Jason Nellis Settings Logout

hulu Watch Now
Fall Premieres



+ Add 'Watch Now' to my profile Share

next video ▶
Heroes: 1
Season 3:

Buffer Full
02:34

hulu

facebook Privacy Logout



Update your status about this event

Share with everyone watching this event

Everyone Watching Friends

Andrei Murashov and what shall we do with it?
1:39am

Miranda Mattingly Grim ♥'s Hulu.
6:06pm - Louisville, KY

Jesus Hernandez i hope this app is cool.

This is a sample of what everyone watching is saying

hulu



00:00:00 / 00:00:00

Dancing With T ...
Night 1, Part 1
Season 9:
Episode 1

The Product

- Statistics:

- 1.2 billion video streams in May, 2010
- 43 million + unique users each month
- 2th ranked video site for overall streams
- 5.4 million + embedded players across 161,000+ sites

Source: comScore Video Matrix May 2010

- Content

- More than 1,700 shows and movie titles
- Over 11,000 hours
- From More than 200 Content Providers

- With 40+ Distribution Partners:

- MSN, Yahoo, Myspace, IMDb, AOL, Comcast, Sling...

- Recently added Labs :

- Hulu Desktop, time based search and caption search



Hulu Plus

- Hulu Plus is a ad-supported subscription product that is incremental and complementary to the existing Hulu service.
- For almost all of the current broadcast shows on our service, Hulu Plus offers the full season.
- You can enjoy Hulu with the following devices: iPhone, iPad, iPod touch, Internet-enabled TVs, Blu-ray devices, game consoles and set-top boxes.



The People



Over 200 employees in Santa Monica, New York,
Chicago, and Beijing
People with both start-up and enterprise
experience

Beijing Office (R&D)



Exterior



Lounge Hall



Interior



The Projects

- Front End
 - Develop and maintain site features
- Player: Site, Distribution Partner, Embedded
- Video Coding
- Video Search
 - Celebrity Annotation
- Recommendation
- Ad Targeting

Core Problems

- To help people find and enjoy the world's premium content
 - Find their favorite contents, explore new ones and watch easily
 - Provide search, browse and recommendation functionalities
- While keeping CP and Advertisers happy
 - Serving relevant ads
- Large scale challenges of serving billions of streams per month

The spectrum of video consumption

Time Span of Interest

Video Game

Lecture Talks

Home video

How to DIY

Company Event

TV Show

Viral video

Talk Show

Variety Show

Documentary

News

Sports

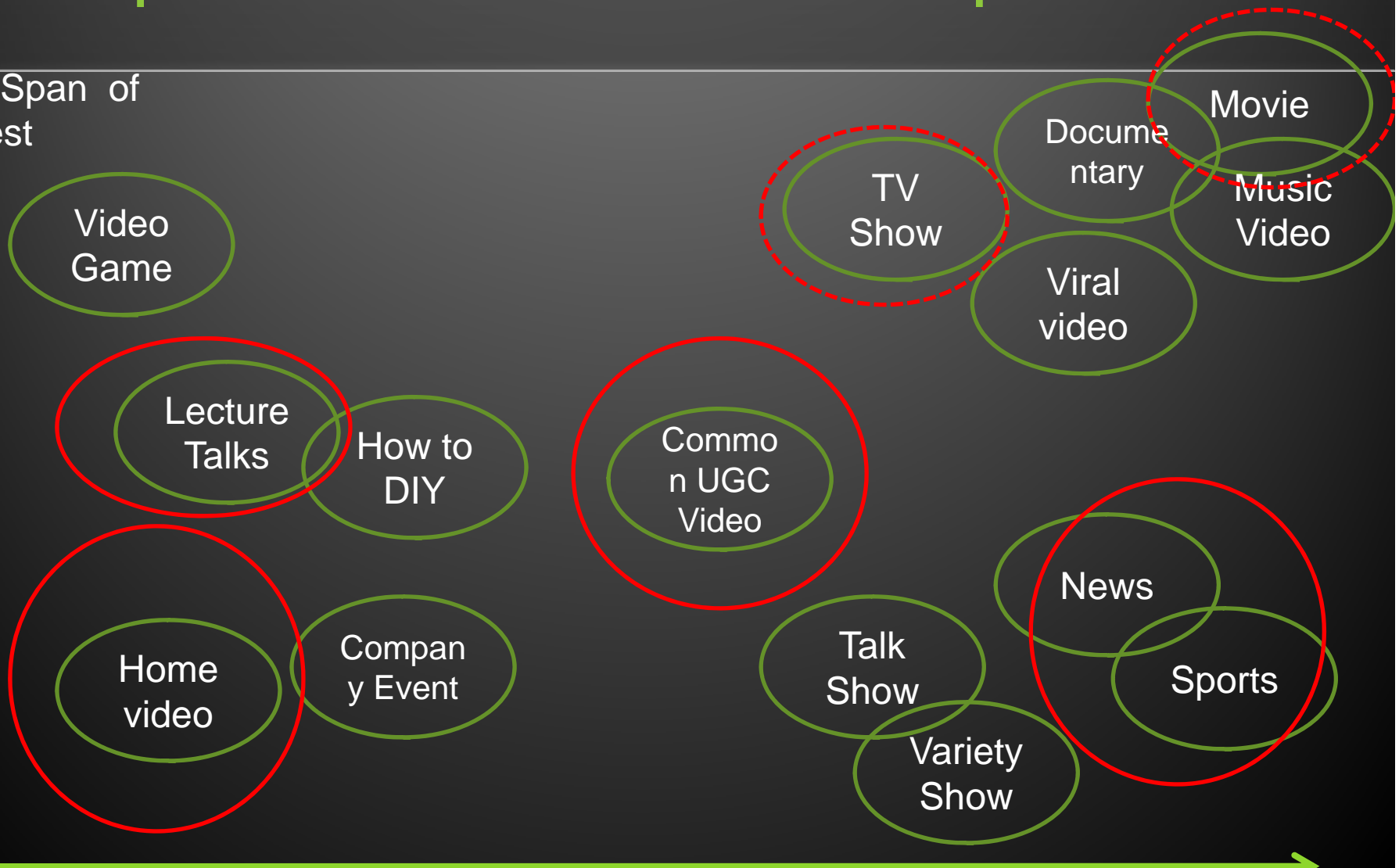
Movie

Music Video

Viewer #

The spectrum of video consumption

Time Span of Interest



Previous Research I

- News/Sports video analysis and summary
 - Structure analysis
 - Highlight extraction
 - Thus, enables efficient browsing
 - However, other genres are not well structured
- Audiovisual Archive retrieval
 - Reuse the recorded contents
 - On fine granularity of shot
 - Thus, general concepts as the middle layer
 - But, is this of interest to common users?

Previous Research II

- Recently, largely influenced by User Generated Contents (UGC) under web 2.0
 - Lack of meta data, description
 - May have copy right problems
 - Thus, content analysis is more favorable
- Google Research focus in multimedia
 - Large scale annotation
 - Image/Audio/Video Representation
 - Localization of image-/video-level labels to spatial/temporal portions of the content
 - Large scale matching / Hashing

Core Problems at Hulu: Search

- The premium video search challenge
 - content and user intent understanding
- Structured data, with rich meta data
 - Show, scene, episodes, clips, trailers
 - Role list, description, keywords
- Content representation
 - Meta data is easier to obtain and better than visual features



Alice's Adventures in Wonderland

The book has inspired numerous film and television adaptations. This list comprises *only* direct and complete adaptations of the original books. Sequels and works otherwise inspired by - but not actually based on - those books (such as Tim Burton's 2010 film *Alice in Wonderland*), appear in [Works influenced by Alice in Wonderland](#).

- *Alice in Wonderland* (1903 film), silent film, directed by Cecil Hepworth and Percy Stow.
- *Alice's Adventures in Wonderland* (1910 film), silent film, directed by Edwin Stanton Porter
- *Alice in Wonderland* (1915 film), silent film, directed by W. W. Young.
- *Alice in Wonderland* (1931 film), directed by Bud Pollard.
- *Alice in Wonderland* (1933 film) directed by Norman Z. McLeod
- *Alice in Wonderland* (1949 film), live-action/stop motion film with animation directed by Lou Bunin
- *Alice in Wonderland* (1951 film), Walt Disney Animation Studios traditional animation film
- *Alice of Wonderland in Paris*, 1966 animated film
- *Alice in Wonderland (or What's a Nice Kid Like You Doing in a Place Like This?)*, 1966 Hanna-Barbera animated television movie
- *Alice in Wonderland* (1966 film), BBC television movie directed by Jonathan Miller
- *Alice's Adventures in Wonderland* (1972 film), British musical film
- *Alice in Wonderland* (1976 film), pornographic film
- *Alice* (1981 film)
- *Alisa v Strane Chudes*, 1981 Kievnauchfilm traditional/cutout animation serial film directed by Yefrem Fruzhanskiy^[19]
- *Alice at the Palace*, filmed performance of Elizabeth Swados' 1981 production *Alice in Concert*
- *Alice in Wonderland (1983 film)*, filmed performance based on the 1982 Broadway revival
- *Fushigi no Kuni no Alice*, 1983 Nippon Animation anime television series
- *Alice in Wonderland* (1985 film), television movie
- *Alice in Wonderland* (1986 TV serial), 4×30 minute BBC TV adaptation written and directed by Barry Letts
- *Alice in Wonderland* (1988 film), a 51-minute direct-to-video animated film from Burbank Films Australia
- *Něco z Alenky* (1988 film), surrealist live-action/stop motion film directed by Jan Švankmajer; released on DVD in English as *Alice* by First Run Features
- *Adventures in Wonderland* (1991-1995 TV Series), Disney Channel series where Alice can go through her bedroom mirror to Wonderland
- *Alice in Wonderland* (1999 film), television movie
- *Abby in Wonderland* (2008 film), made as a Sesame Street Special; released directly to DVD

The *Alice in Wonderland* (2010 film) Disney film directed by Tim Burton is a sequel to the two Alice stories, making it a derivative work, instead of a proper adaptation.

Comics Adaptations

[\[edit\]](#)

The book has inspired numerous comics adaptations.

- *Walt Disney's Alice in Wonderland* (Dell Comics, 1951)
- *Walt Disney's Alice in Wonderland* (Gold Key Comics, 1965)
- *Walt Disney's Alice in Wonderland* (Whitman, 1984)
- *Alice in Wonderland* (Antarctic Press, 2006, four issues)
- *Wonderland* (Slave Labor Graphics, 2006, six issues)
- *Heart no Kuni no Alice* (manga series, 2008, Hoshino Soumei)
- *Pandora Hearts* (manga series, 2006, Jun Mochizuki)
- *Alice in Verse: The Lost Rhymes of Wonderland* (Candleshoe Books, 2010, J.T. Holden)
- *Are You Alice?* a gothic manga retelling of Alice in Wonderland.



Alice, the March Hare, and the Mad Hatter at the "Mad Tea-Party" in the first film adaptation directed by Cecil Hepworth in 1903.



Alice in Disney's animated version

Saturday Night Live



- Genres
 - Full, clips, shorts, commercials, news and politics, weekend update Thursday
- Roles
 - Hosts, guests, writers,
- It is no easy to tell user intent directly

Howcast



Recreation (235)

Sort by: **Recently Added** [Most Popular Today](#) [Most Popular All Time](#) [User Rating](#)

1 of 47



How to Get a Hotel Upgrade

Video Clip (02:08)



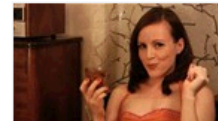
How to Dry Flowers

Video Clip (01:15)



How to Make a 4th of July Hat

Video Clip (01:52)



How to Tie a Cherry Stem in a Knot ...

Video Clip (02:32)



How to Find Out if Your Toys Are Alive

Video Clip (01:29)

Health & Beauty (252)

Sort by: **Recently Added** [Most Popular Today](#) [Most Popular All Time](#) [User Rating](#)

1 of 51



How to Highlight Your Own Hair

Video Clip (01:52)



How to Change Your Makeup for Summer

Video Clip (02:18)



How to Choose the Best Clothes for ...

Video Clip (01:21)



How to Choose Colors to Flatter You...

Video Clip (02:29)



How to Find a Summer Dress

Video Clip (02:06)

Food & Drink (207)

Sort by: **Recently Added** [Most Popular Today](#) [Most Popular All Time](#) [User Rating](#)

1 of 42



How to Make a 5-Minute Microwave Ch...

Video Clip (01:27)



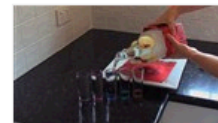
How to Bake a Statue of Liberty Cake

Video Clip (02:02)



Quick Tips: How to Slow Down Banana...

Video Clip (00:14)



How to Keep Vodka Cold

Video Clip (01:40)



Quick Tips: How to Core Iceberg Let...

Video Clip (00:18)

Home & Family (281)



Ranking function

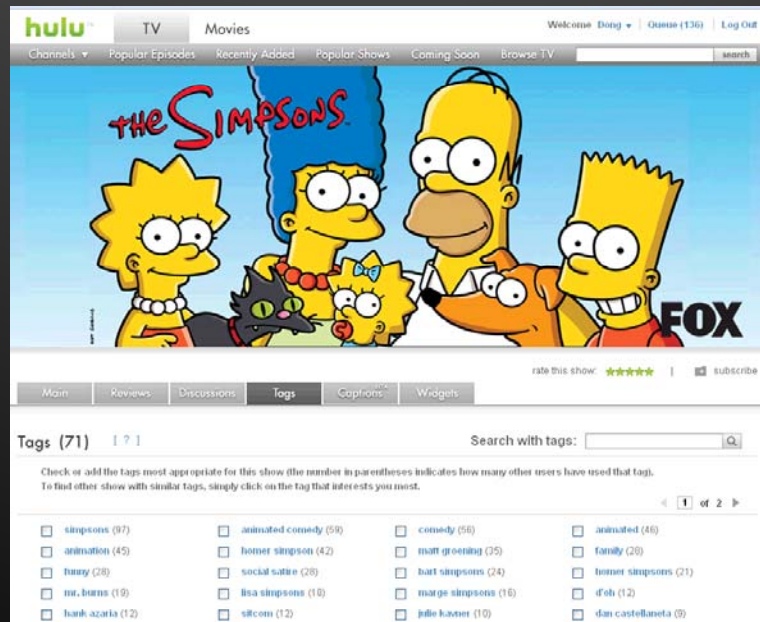
- Relevance
- Content quality
- Freshness
- Query log analysis
 - Click through as Implicit feedback

UI Design

- UI may be more important than algorithms!
- Easy to access drop down search with auto suggestion
 - Emphasis on show and recent episodes
 - Navigates to the show / watch page efficiently
- Promoted search to hit most relevant shows
- Clustering search result by shows, channels sources and genres
 - Context sensitive clustering options

Tagging is great, but what to tag, for premium contents?

- Users have less incentive for tagging, auto tagging is necessary
- Auto categorization?
- General TRECVID like concepts?



The screenshot shows the Hulu website interface for the TV show 'The Simpsons'. The page features a large banner image of the Simpson family and the show's title. Below the banner, there are navigation tabs for 'Main', 'Reviews', 'Discussions', 'Tags', 'Captions', and 'Widgets'. The 'Tags' tab is selected, displaying a list of 71 tags. The tags are organized into a grid, with each tag including a checkbox and the number of users who have used that tag. The tags include 'simpsons (97)', 'animation (45)', 'hugh (28)', 'm. burns (19)', 'hank azaria (12)', 'animated comedy (50)', 'homer simpson (42)', 'social satire (28)', 'lisa simpsons (10)', 'sitcom (12)', 'comedy (58)', 'matt groening (25)', 'bart simpsons (24)', 'marge simpsons (16)', 'julia kaxner (10)', 'animated (46)', 'family (20)', 'homer simpsons (21)', 'd'oh (12)', and 'dan castellaneta (0)'. There is also a search bar for tags and a 'rate this show' section with a star rating and a 'subscribe' button.

Celebrity receives lots of attraction

- Contents specially for gossiping celebrities
- A lot of

The image shows a screenshot of a YouTube channel page for 'E! News Now'. The main content area displays a grid of related channels, each with a thumbnail image, the channel name, and a '+ subscribe' button. The channels include:

- E! News Now**: Thumbnail with 'E! NEWS NOW' text.
- Access Hollywood**: Thumbnail with 'access hollywood' logo.
- Chelsea Lately**: Thumbnail featuring a woman in a blue dress.
- Sinbad: Son Of A Preacher Man**: Thumbnail with 'SINBAD SON OF A PREACHER MAN' text.
- Celebrity Interviews**: Thumbnail with 'celebrity INTERVIEWS' and 'Dish With The Stars' text.
- Pretty Wild**: Thumbnail with 'PRETTY WILD' text.
- Elton John: Tantrums and Tiaras**: Thumbnail with 'Elton John TANTRUMS AND TIARAS' text.
- Hollywood News**: Thumbnail with 'HOLLYWOOD NEWS' text.
- Dearly Departed**: Thumbnail with 'DEARLY DEPARTED' text.

On the left side, there is a sidebar with a search bar and a list of search results. The search bar contains the text 'Search'. Below it, there is a 'Results' section with a 'Video Type' dropdown menu set to 'All'. The search results list includes:

- urday Night Live
- go to show page(5 episodes)
- sical SNL Digital Shorts
- lor Lautner Hosts SNL
- lor Swift Hosts SNL
- h Galifianakis Hosts SNL
- └: Best of Justin Timberlake
- is Farley SNL Moments
- r-Musical SNL Digital Ghorts
- sical snl digital shorts
- with betty white
- ther lover
- at day

At the bottom right, there is a 'hulu' logo.

Caption search

Channels ▾ Most Popular Recently Added Collections Labs Spotlight Plus search


Search Results [All](#) | Captions


Search currently available closed captioning transcripts in **English** ▾ [\[Learn More \]](#)


Captions Search


Results 1-10 of 44 for **bart**


Video Type: ▾ Show: ▾ Sort by: ▾

 **The Simpsons: Stealing First Base** Season 21 : Ep. 15 (21:37)
13:29 Oh! I finally caught one of **Bart's** school plays.
That's not **Bart**.
It's Principal Skinner.
[7 more results](#) in this video

 **The Simpsons Anniversary Special: In 3-D! On Ice!** Season 1 : Ep. 1 (42:26)
05:02 hired me on the spot. [SNAPS FINGERS]
[AS **BART**]: Behold! Neanderthal man!
Fox Approached Jim Brooks about doing these little, short simpsonscartoons
[5 more results](#) in this video

 **Dead Like Me: Business Unfinished** Season 1 : Ep. 10 (44:14)
28:14 Coulda, shoulda, didn't.
We kept a boat at St. **Bart's**. You know St. **Bart's**?
I suppose that's an island.
[3 more results](#) in this video

 **The Simpsons: Boy Meets Curl** Season 21 : Ep. 12 (22:01)
17:32 and we'll go get some coffee.
It's not that easy, **Bart**.
I...
[2 more results](#) in this video

 **The Simpsons: Meeting the Family Excerpt** (01:37)
01:19 But what could be more important than your best friend?

Query aware Thumbnail













hulu™ TV Movies Welcome Dong ▾ | Queue (130) | Log Out

Channels ▾ Most Popular Recently Added Collections Labs Spotlight Plus

Search Results [Advanced Search](#)

Results 1-20 of 333 for **tina fey**. Related Searches: [saturday night live](#) [great day](#) [musical snl digital shorts](#) [mother lover](#) [snl with betty white](#) [andy samberg](#)

Video Type: Show: View: only Sort by:

| | | | |
|--|---|--|---|
|  Saturday Night Live: Tina Fey Monologue Excerpt (04:43) More: Saturday Night Live Channel: Comedy |  Saturday Night Live: Teacher Excerpt (05:54) More: Saturday Night Live Channel: Comedy |  Saturday Night Live: Palin / Hillary Open Excerpt (05:33) More: Saturday Night Live Channel: Comedy |  Saturday Night Live: Masters Excerpt (04:24) More: Saturday Night Live Channel: Comedy |
|  Saturday Night Live: Tina Fey on Update Excerpt (03:35) More: Saturday Night Live Channel: Comedy |  Saturday Night Live: Sarah Palin Network Excerpt (05:01) More: Saturday Night Live Channel: Comedy |  Saturday Night Live: School Dance Excerpt (04:20) More: Saturday Night Live Channel: Comedy |  Golden Globes: Tina Fey Web Exclusive (01:09) More: Golden Globes Channel: News and Information |
|  Saturday Night Live: Weekend Update: Alito's |  Saturday Night Live: Lolene |  Saturday Night Live: SNL Promo: Tina Fey |  Saturday Night Live: Brownie Husband |

Core Problems at Hulu: Browse

- Help user to navigate inside video and give them more control
- Thumbnail based preview
- Trade off between easy of use and feasibility

Thumbnail based preview

The screenshot displays the Hulu interface for a TV show. At the top, the Hulu logo is on the left, and navigation links for 'TV' and 'Movies' are in the center. On the right, there is a user profile 'Welcome Dong', a queue of 130 items, and a 'Log Out' link. Below this is a secondary navigation bar with options like 'Channels', 'Popular Episodes', 'Recently Added', 'Popular Shows', 'Coming Soon', and 'Browse TV', along with a search bar.

The main content area shows a video player for a FOX TV show. The video title is '11:00 AM - 12:00 PM' with a '24' rating. It is identified as 'Season 8 : Ep. 19' with a duration of '42:57' and a star rating of four stars. A 'View Description' link is provided. An advertisement for Sprint is visible on the right side of the player area.

The video player itself shows a close-up of a man's face. Below the video is a control bar with a play/pause button, a progress bar showing '06:41 / 42:58', and an 'Autoplay is on' indicator. A small thumbnail preview of the video is shown in the bottom right corner of the player area, with a timestamp of '32:46'. To the right of the video player are several interactive icons: 'pop out', 'share', 'embed', and 'lower lights'.

Below the video player is a popularity graph. The y-axis is labeled 'Popularity' and the x-axis shows time in minutes, with markers at 5, 10, 15, 20, 25, 30, 35, and 40. The graph consists of many vertical bars representing popularity over time. A single bar at approximately 32:46 is highlighted in green, corresponding to the thumbnail preview shown in the player.








The Hulu logo is visible in the bottom right corner of the page.

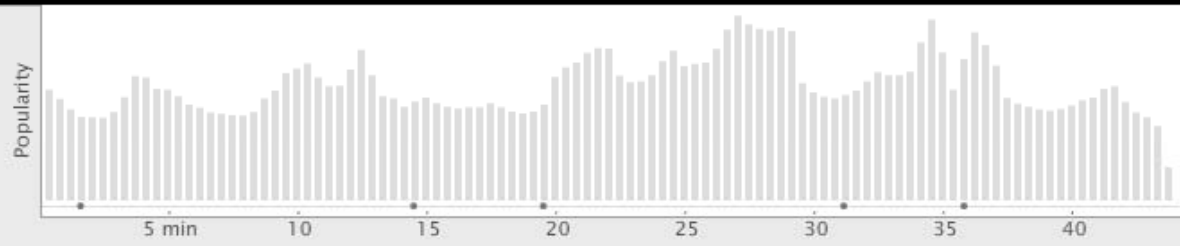
Heatmap

FOX **Glee**
Season 1 : Ep. 2 | 44:15 | ★★★★★ | 
[View Description](#)



-  pop out
-  share
-  embed
-  lower lights

Video player controls:   Autoplay is off     
00:46 / 44:16



Heat Map [What's this?]



Core Problems at Hulu: Recommendation

- Popular items (The Harry Potter problem)
- Rating vs. Top k
- Precision vs. Diversity
- Explanation
- Content based vs. Behavior based

Popular items occurs too many times

- Traditional Method:



- Our Approach



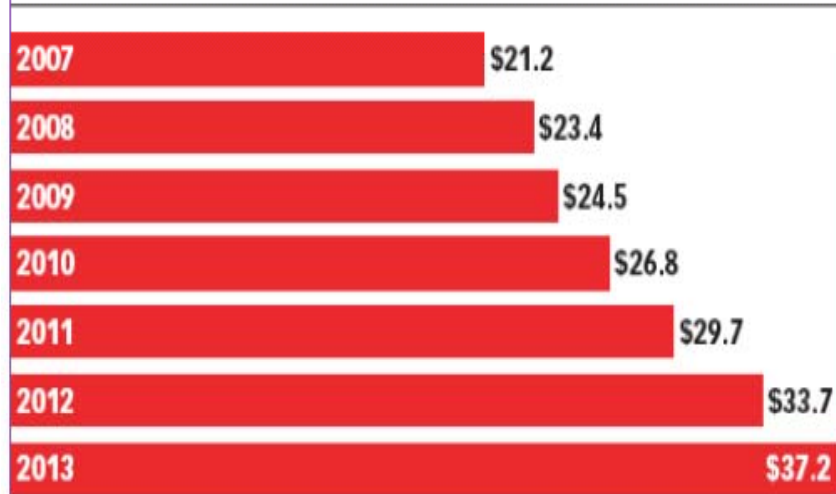
Core Problems at Hulu: Video Ads

- Designing effective ad-targeting methods
- Matching ads with the right user
- Tracking ad performance
- Our attempts
 - The Hulu ad selector model
 - Demo prediction

The Advertising



US Online Advertising Spending, 2007-2013 (billions)



Source: eMarketer, April 2009

- Traditional TV ads
 - Mass media, measured by CPM
- Online ads increases
 - Banner and context ads
 - Video ads are more persuasive
 - We should be cautious
- Combining both
 - Segment the mass into different clusters and show different ads
 - Pre-roll, mid roll and end card
 - Still, measured by CPM

Advertising Cost per Thousand Impressions by Medium, 2009 / 2010



Source: Morgan Stanley



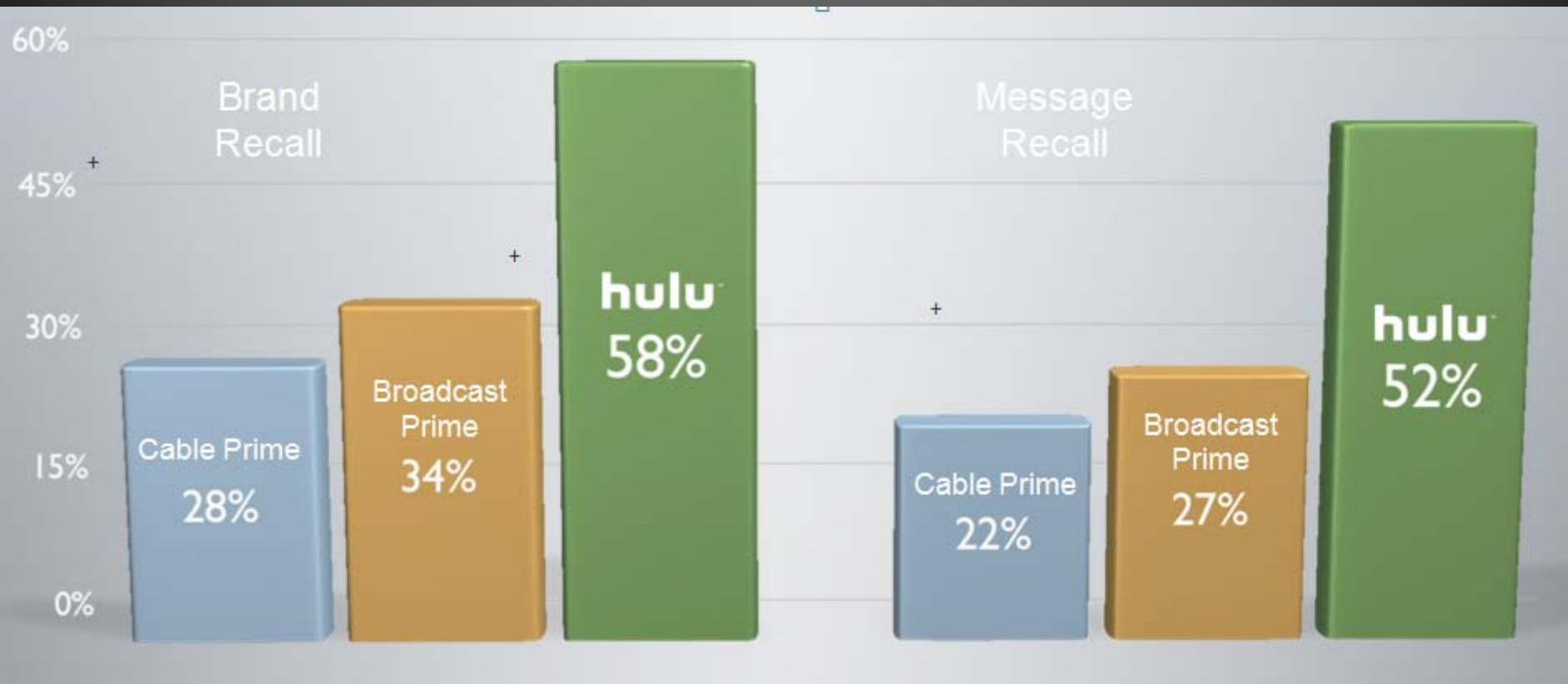
The Innovation

Ad experience

- Standard Ad Formats: Instream Video ad, Branded Slate
- Premium Ad Formats: Branded Player slate, Premium Slate

The screenshot displays the Hulu website's advertising solutions interface. At the top, the text "hulu™ advertising solutions" is on the left and "ad selector" is on the right. Below this is a navigation bar with "hulu™", "TV", and "Movies" tabs, along with links for "Login", "Forgot Password?", and "Sign Up". A search bar is also present. The main content area shows a video player for "The Eclipse, Part 1" from the show "Heroes". The video player includes a TRESemmé advertisement overlay. The ad features the TRESemmé logo and the text "LOOKS LIKE A SPLURGE. FEELS LIKE A STEAL." and "CLICK HERE FOR SALON GORGEOUS HAIR". Below the video player, there is a "Choose the style you prefer:" section with three options: "Flawless Curls", "Sleek and Shiny Hair", and "Full-bodied Blowout". Each option has a "Choose" button. At the bottom of the ad, it says "Your video will automatically start in 11 seconds." The Hulu logo is visible in the bottom right corner.

Ad Performance(Same Brand)



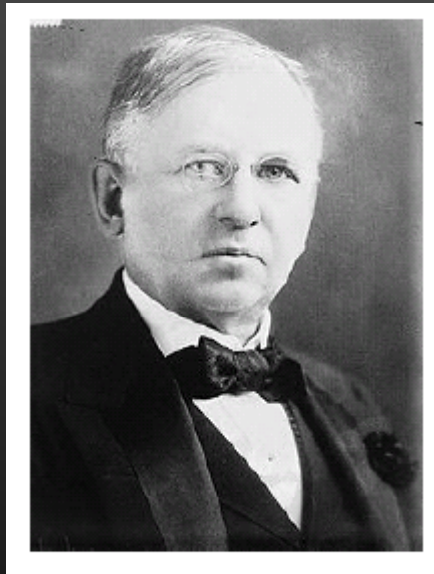
Source: Nielsen IAG 2008



Ad targeting by demographics

- Gender, age and household

*"Half the money I spend on advertising is wasted; the trouble is I don't know which half."
John Wanamaker, ~ 1875*



Shows vs. Gender

- Men are from mars:
 - Men's top 5 shows(sports, political, ...)



- Women are from Venus:
 - Women's top 5 shows(lifestyle and fashion, ...)



Shows vs. Age

- 18~20 users most preferred 5 shows (high school or college life, ...)



- 30~34 users most preferred 5 shows (classical animation, ...)



Shows vs. Household

- Users with children most preferred 5 shows (family and kids, ...)



- User without children preferred 5 shows (global top shows, ...)



Lessons learnt

- Premium videos are different from UGC videos
 - # of viewers and time span of interest
 - User behavior is important for browse and search ranking
 - Celebrity is of more value for annotation
- Content based video recommendation is worth exploring
- Precaution needed while advertising
 - Better targeting ability
 - Better recall and brand image

Any Questions?



huluTM
Hulu