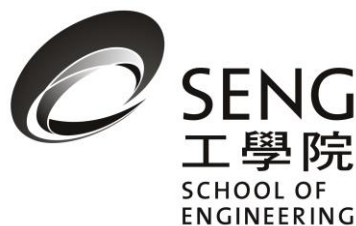


# VideoForest: Interactive Visual Summarization of Video Streams Based on Danmu Data

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- Motivation
- System
  - Architecture
  - System overview
  - Preprocessing
  - Analysis
  - Visualization
- Evaluation
- Conclusion



# Video Summarization on Youtube



Filters ▾ About 9,560,000 results

**Presidential Election 2016 LIVE | ABC News FULL BROADCAST** ← **Title**

ABC News ✓  
2 weeks ago • 4,666,494 views  
2016 Presidential Election Results | Get the latest updates and state-by-state analysis of the 2016 US Presidential Election. ← **Description**

 ← **Screenshot**

Streamed live on Nov 8, 2016  
2016 Presidential Election Results | Get the latest updates and state-by-state analysis of the 2016 US Presidential Election.

The long-awaited 2016 election day is finally here, and it could be a historic one for a number of different reasons. The United States could elect its first female president Hillary Clinton; Republicans could take back the White House with Donald Trump after two terms of Democratic control; there could be record voter turnout and the leading campaign election night parties will both be in New York. ← **Summary**

SUBSCRIBE to ABC NEWS: <https://www.youtube.com/ABCNews/>  
Watch More on <http://abcnews.go.com/>  
LIKE ABC News on FACEBOOK  
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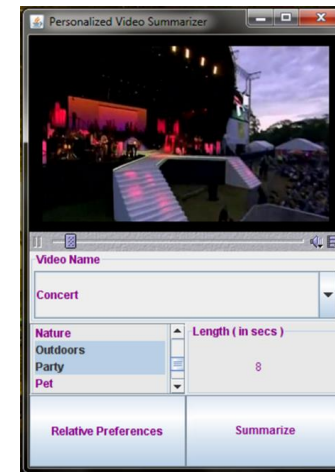
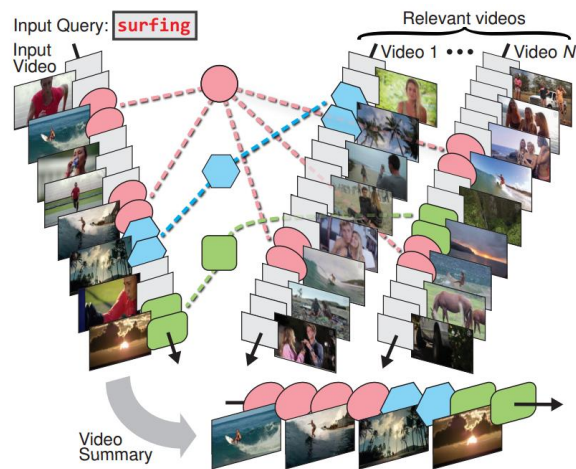
Category News & Politics ← **Category**  
License Standard YouTube License

**Song Master** 1 day ago  
At the end she says "this will test American Democracy", perhaps. Electing Hillary Clinton would have ended Democracy as we know it. Congratulations to President Trump and to the preservation of the Nation.  
Reply · 1   ← **Review**

 13:08  
Top Talkers: Donald Trump has been elected United States president, and the Morning Joe panel considers the polling data and ...

# Summarization of Video Streams

- Internal summarization techniques
  - Video, audio, linguistic features
- External summarization techniques
  - Audience's preferences and interests



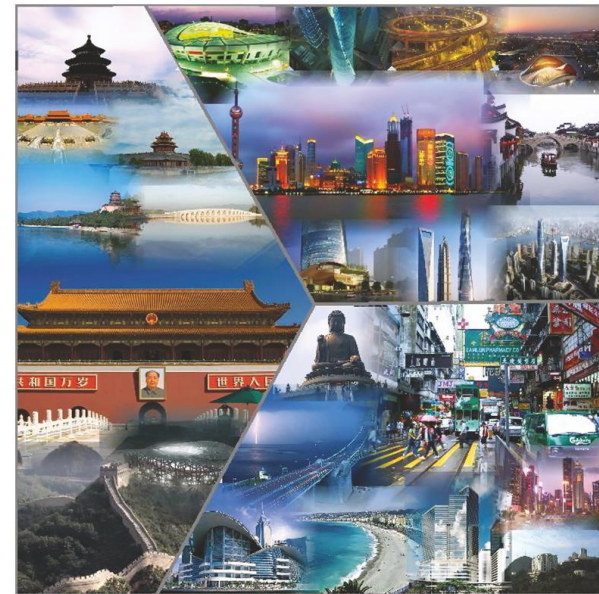
*Video co-summarization* [Chu et al. 2015]    *User preferences based* [Kannan et al. 2013]

## Summarization of Video Streams

- Summarization representation
  - Matrix form [Lu and Grauman 2013]
  - Illustration: Visual storyline & Imagehive

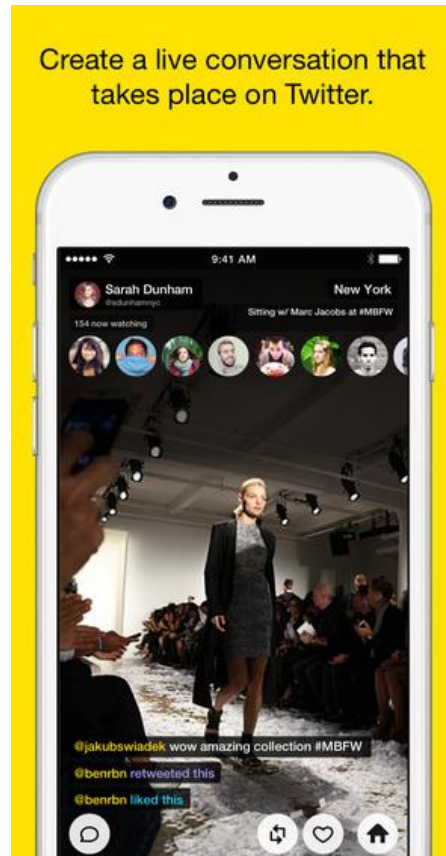
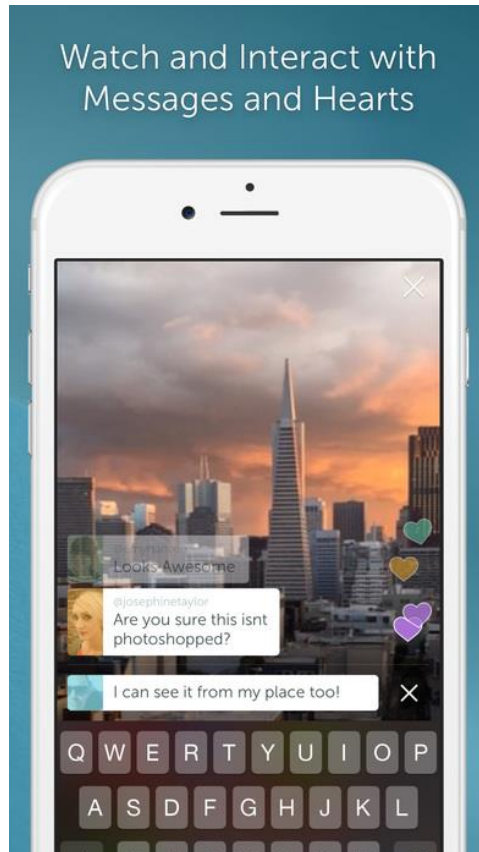


*Visual storylines* [Chen et al., 2012]



*Imagehive* [Tan et al., 2011]

# Live Streaming Platforms





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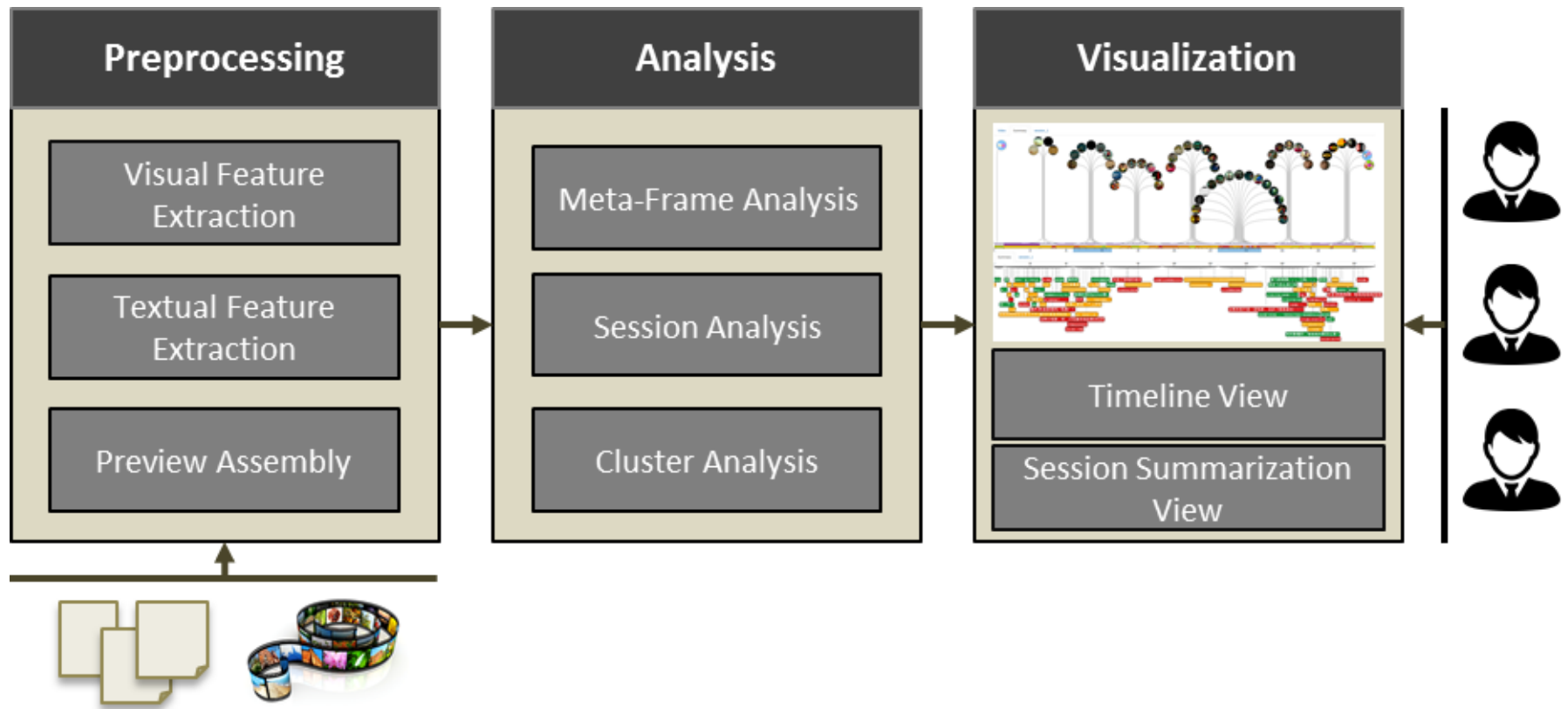
# Video Platforms with Danmu



Danmaku screenshot

# System Architecture

**Goal:** Video + Danmu + Interaction → Summarization





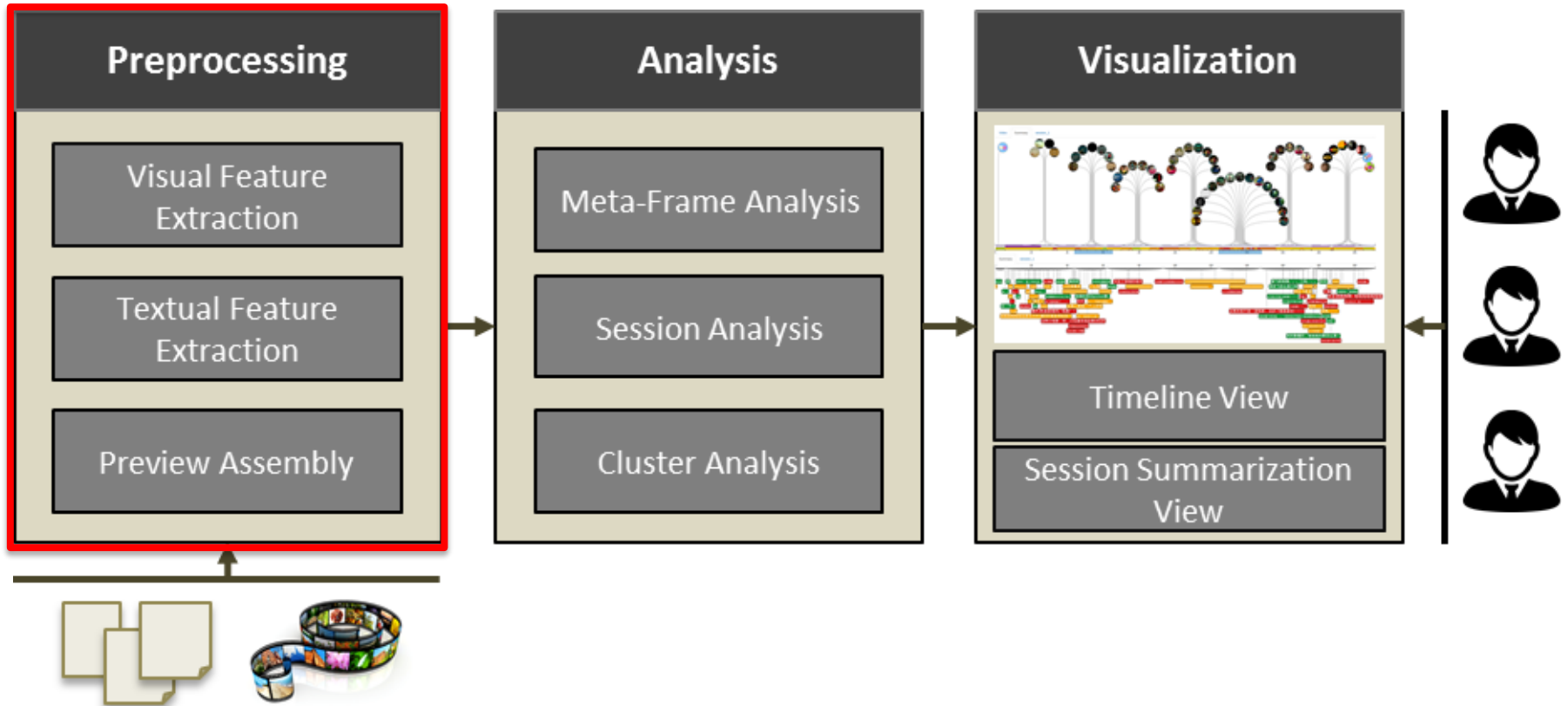


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ASIA 2016  
MACAO

# Video Demo

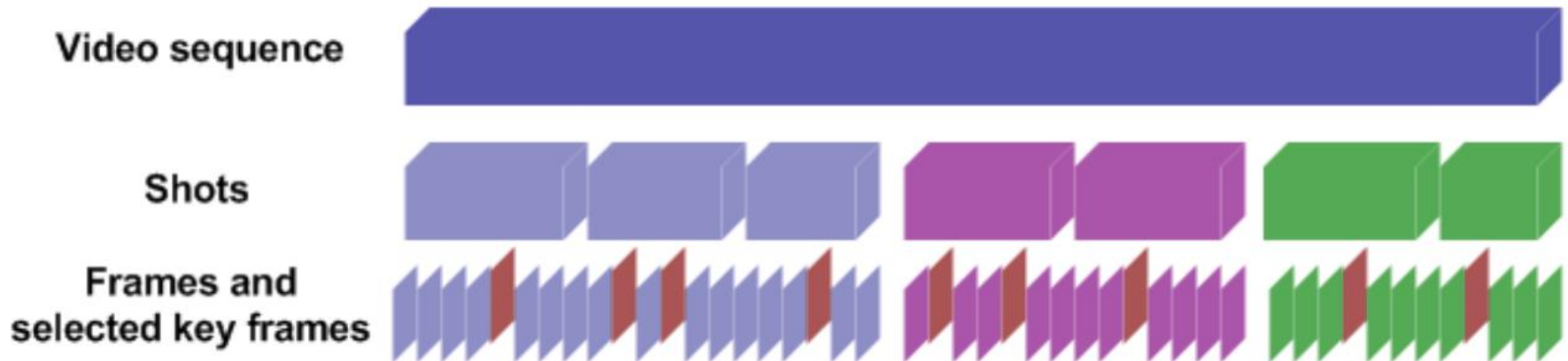


# Processing





- Visual feature extraction
  - Key frames extraction from compressed video



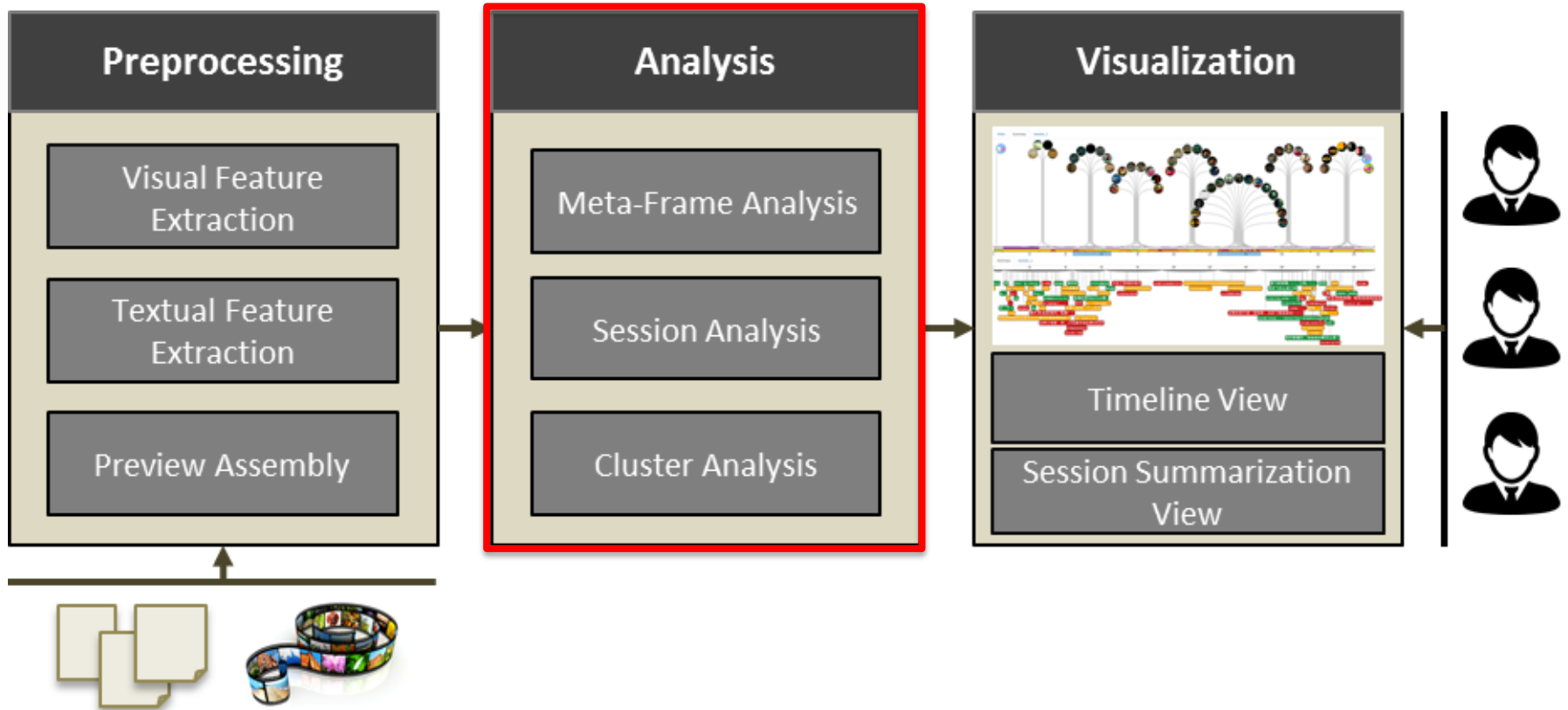
Hierarchical structure of a video sequence [Mendi and Bayrak 2010]

- Textual feature extraction
  - syntactic and semantic analysis



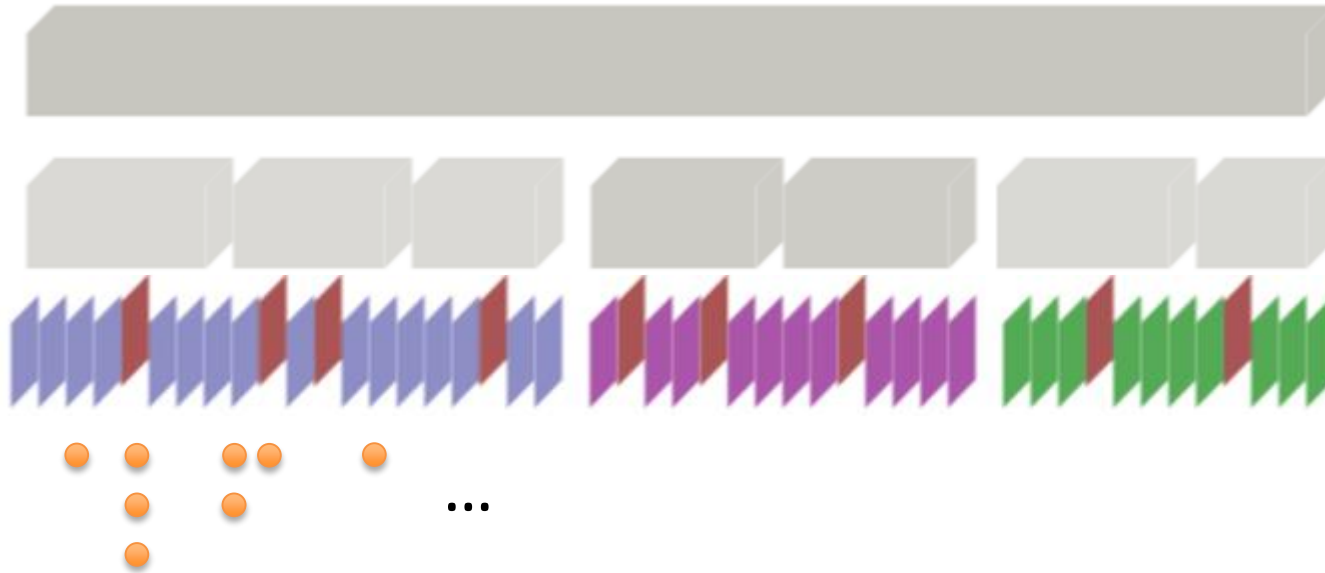
- Similarity
- Sentiment
- Topic
- Function
- Symbol
- Pattern

# Analysis





# Meta-frame, Session and Scene Cluster



## Meta-frame

- Visual attributes: image content
- Textual attributes: audience's reaction



## Meta-frame, Session and Scene Cluster



### Session

- Color palette of the entire session
- Synoptic linguistic attributes of danmu in the time range



## Meta-frame, Session and Scene Cluster

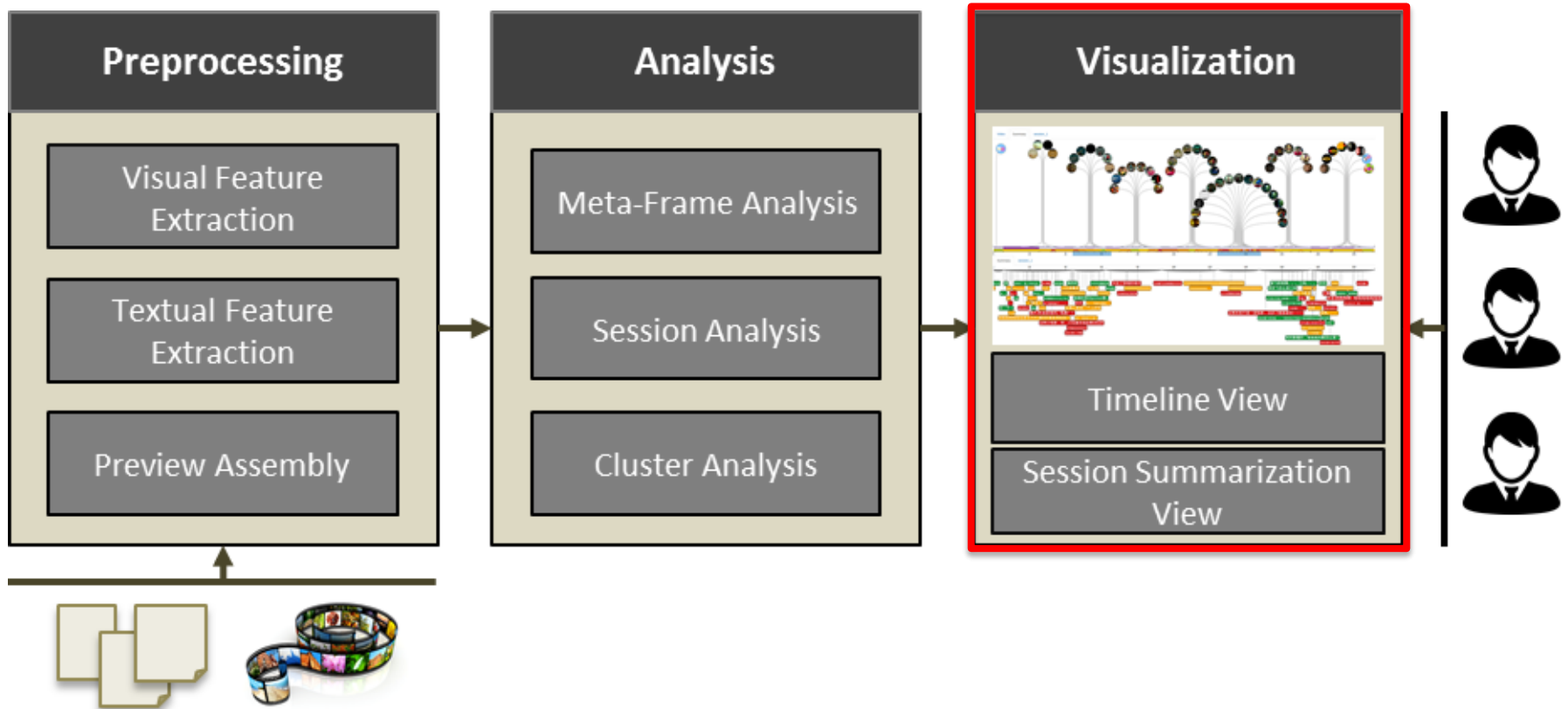


### Scene cluster

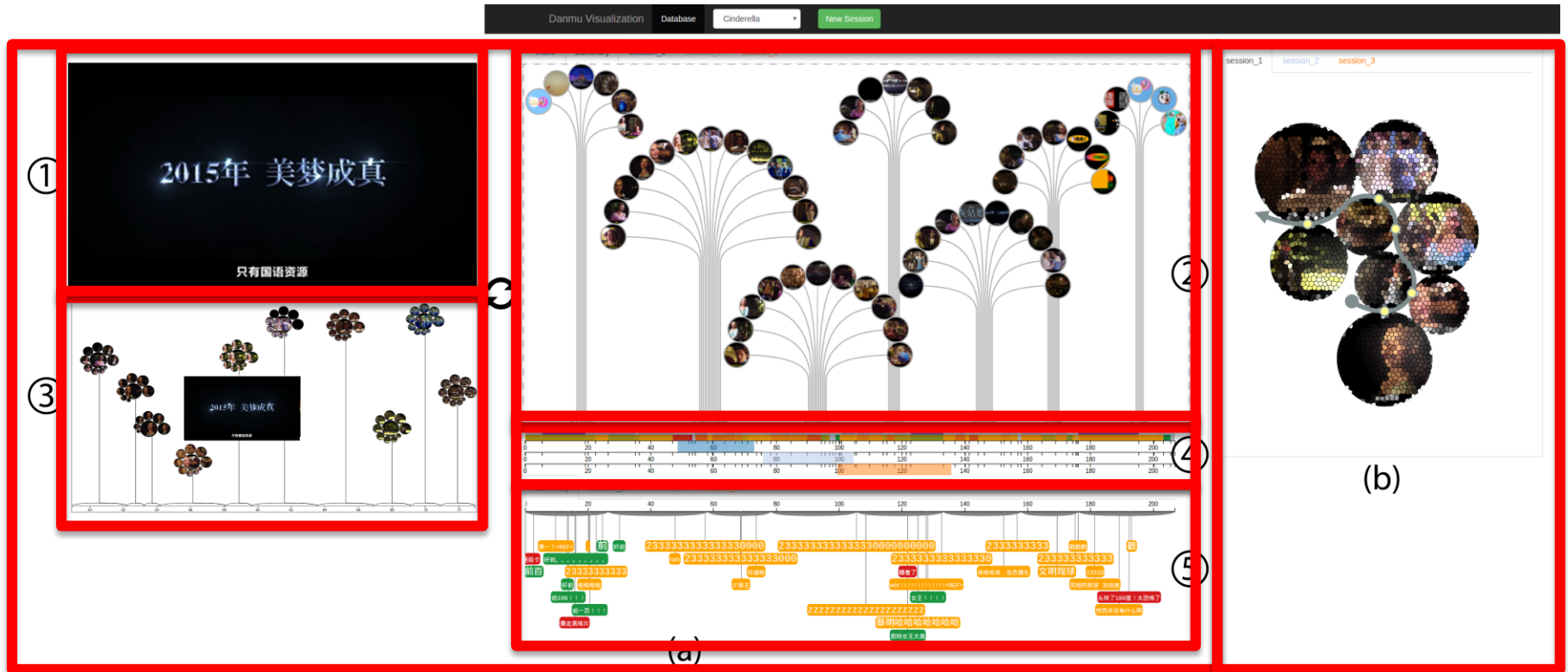
- Danmu commentary density



# Visualization



# System Interface Overview

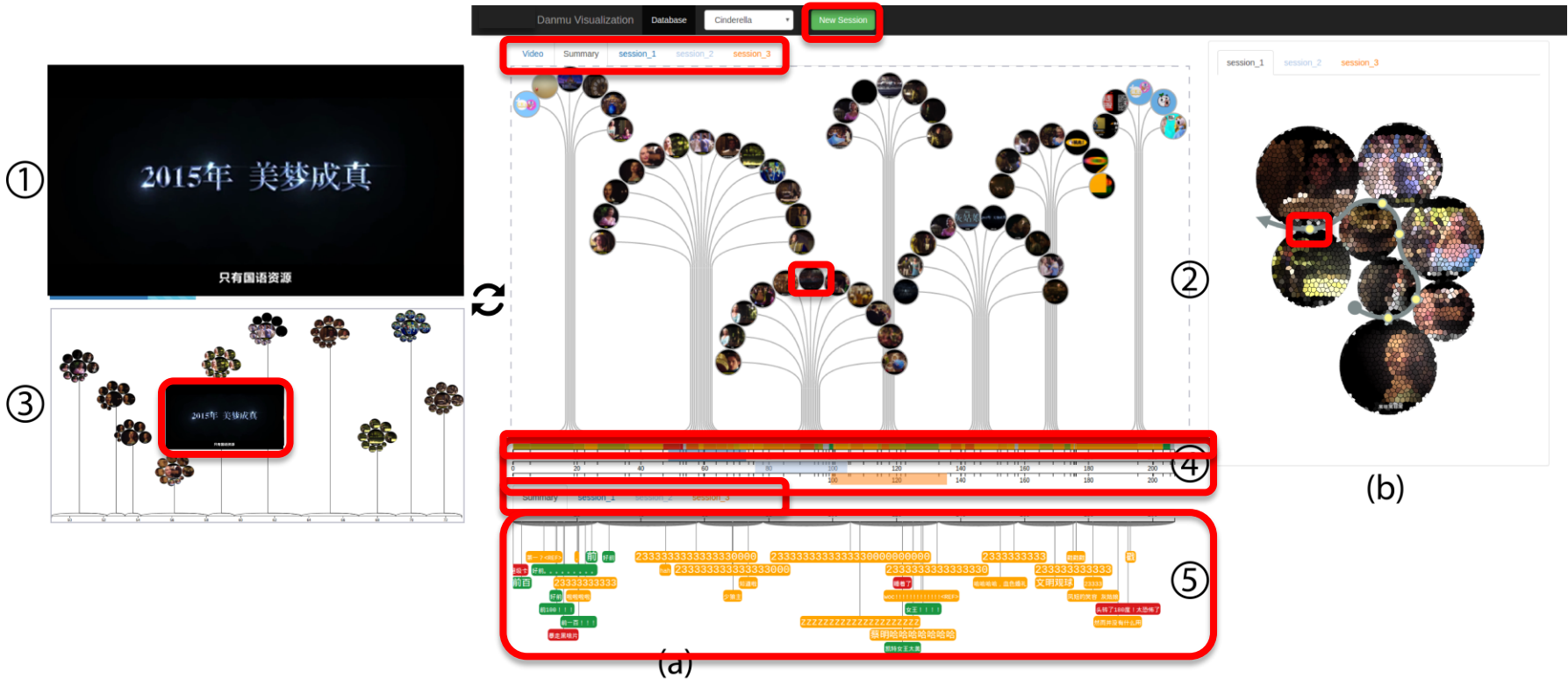


The interface is titled "Danmu Visualization" and includes a "Database" dropdown set to "Cinderella" and a "New Session" button. It is divided into three main sections:

- Panel 1 (Left):** A presentation slide titled "2015年 美梦成真" (2015 Year Dream Realized) with the subtitle "只有国语资源" (Only Mandarin Resources). Below the slide is a visualization of several stylized trees, each with a cluster of small circular nodes at its top.
- Panel 2 (Middle):** A large tree visualization with three main trunks. Each trunk branches out into many smaller trunks, each topped with a cluster of circular nodes. Below the tree is a horizontal timeline with a color-coded bar and numerical markers from 0 to 200.
- Panel 3 (Right):** A detailed view of a single node, showing a large, textured sphere composed of many smaller, multi-colored circular elements. It is labeled "session\_1 session\_2 session\_3" at the top and "(b)" at the bottom.

Panel 4 (Bottom) shows a detailed view of the timeline and node clusters, with various colored bars and text labels. It is labeled "(a)" at the bottom.

# Interactions



The screenshot shows the Danmu Visualization interface with several key features highlighted by red boxes and numbered circles:

- ①** Video player showing the title "2015年 美梦成真" (2015 Year, Dream Realized) and the text "只有国语资源" (Only Mandarin resources).
- ②** A tree visualization where nodes are video thumbnails. A red box highlights a specific node.
- ③** A smaller tree visualization with a red box highlighting a node.
- ④** A timeline bar at the bottom of the tree view.
- ⑤** A detailed view of the tree structure with various colored nodes and labels.

On the right side, a separate view labeled **(b)** shows a cluster of video thumbnails with a red box highlighting one of them.

Smart summarization

Scene preview

Highlighting

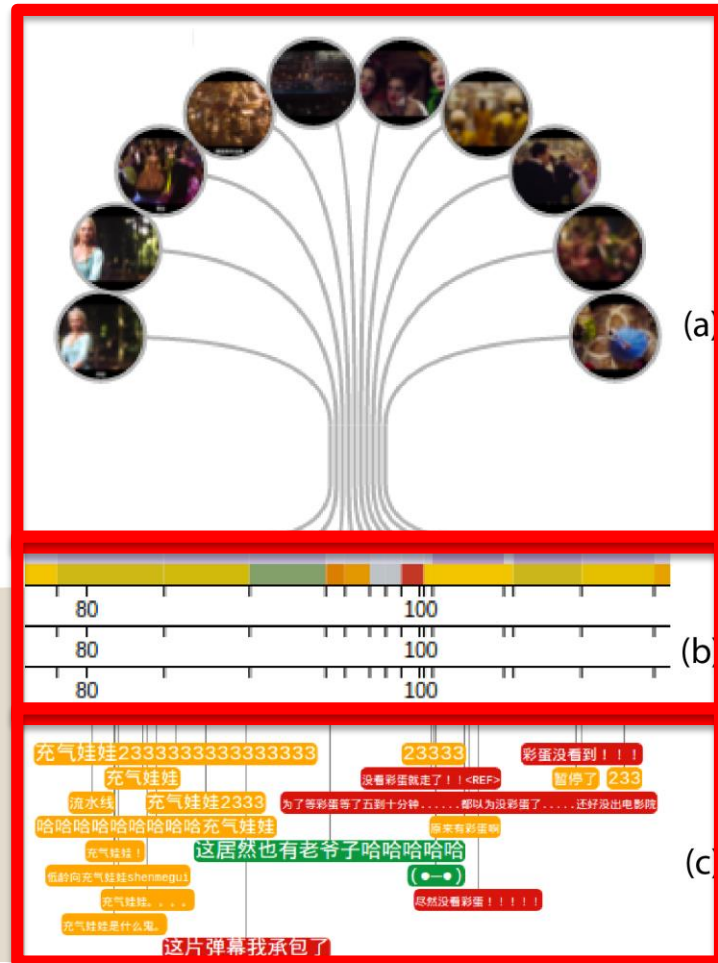
New session generating

View switching

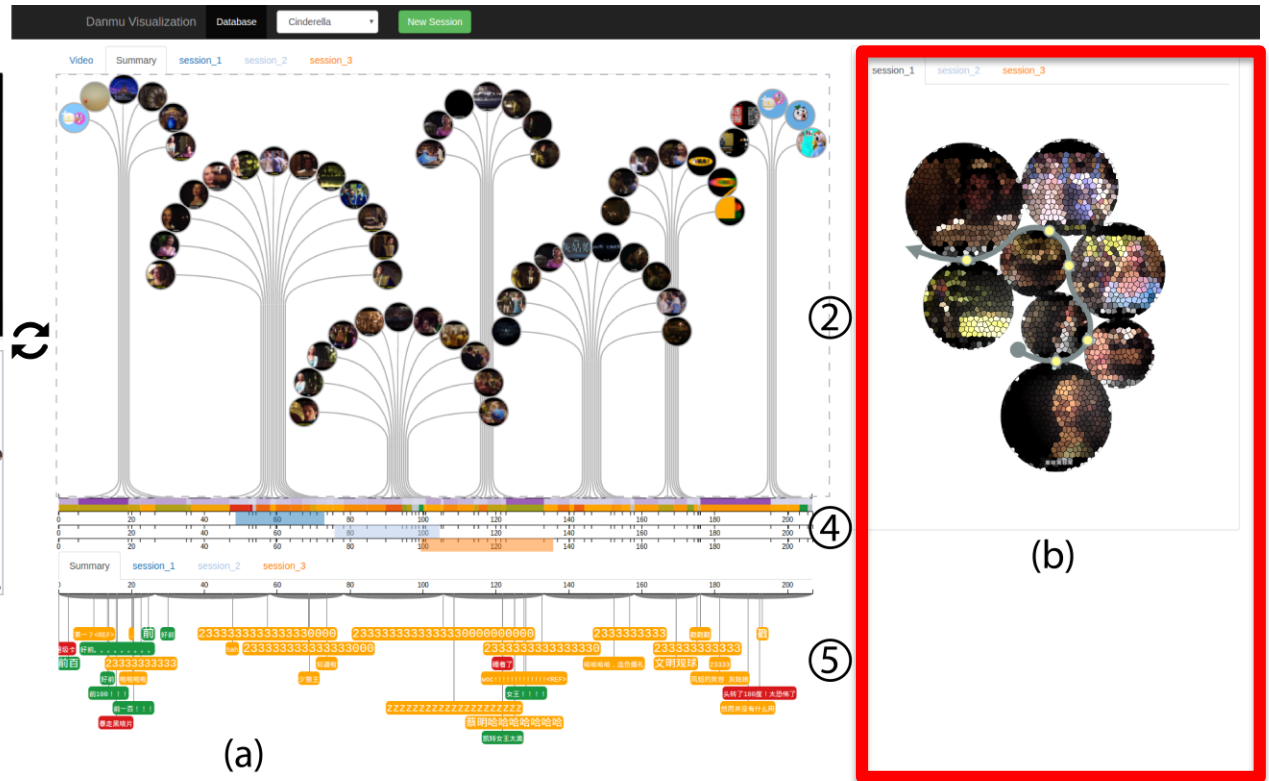
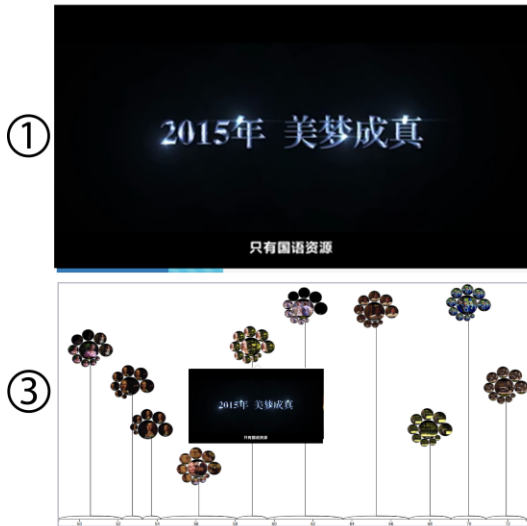


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# Visual Metaphor and Encoding

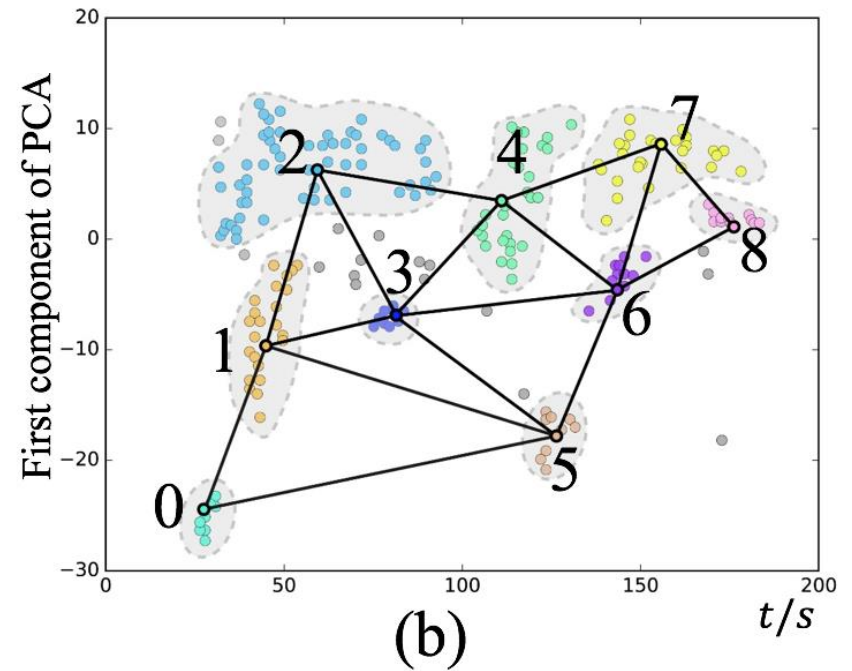
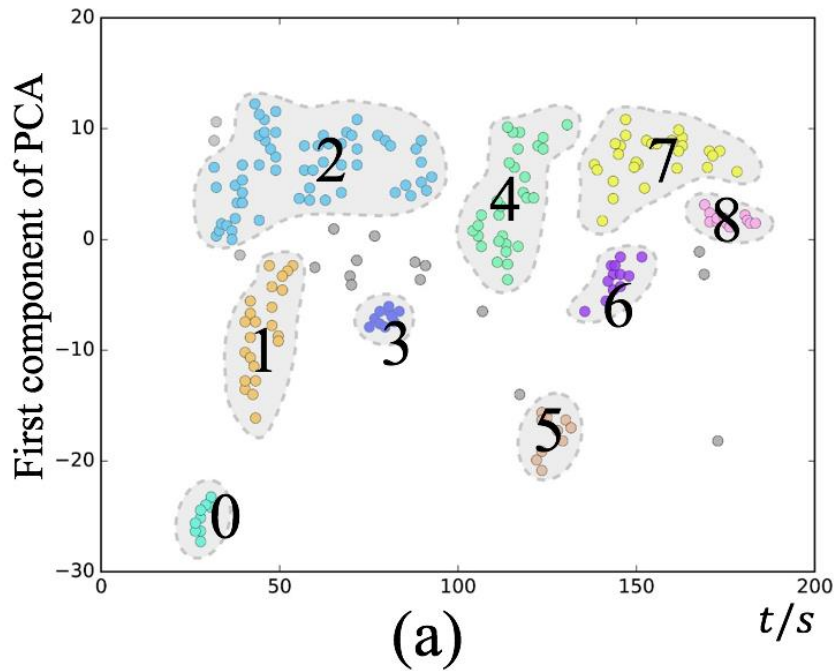


# Session Summary View





# Meta-frame aggregation

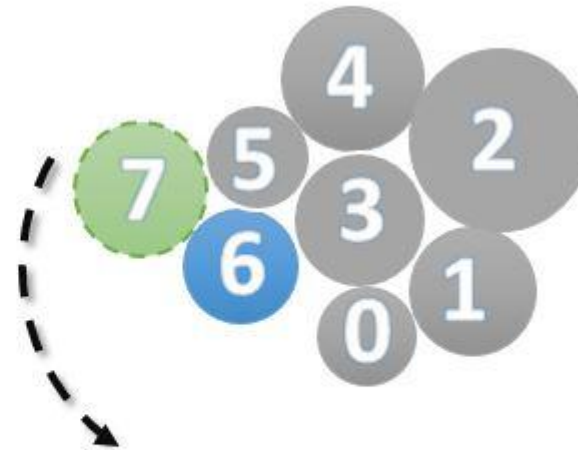




# Circle Image Packing

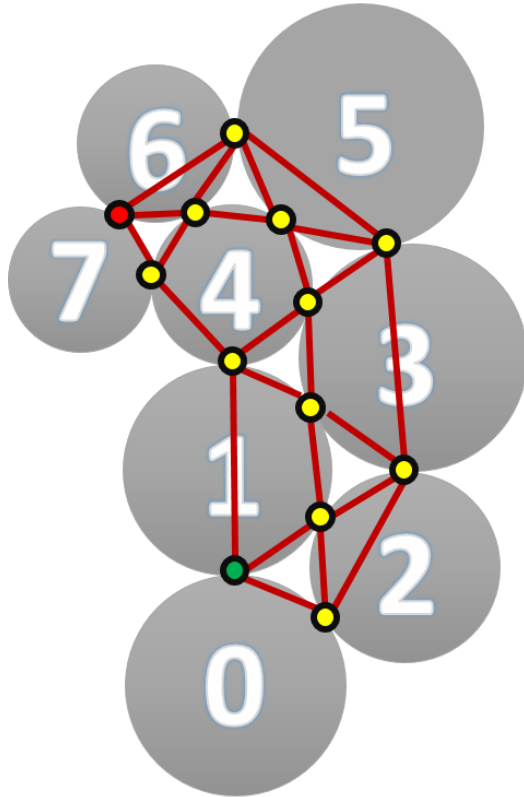


(a)

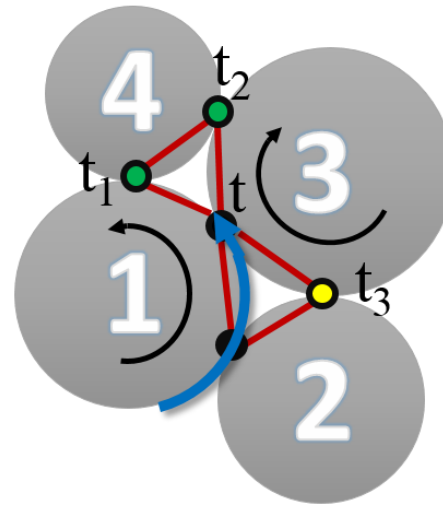


(b)

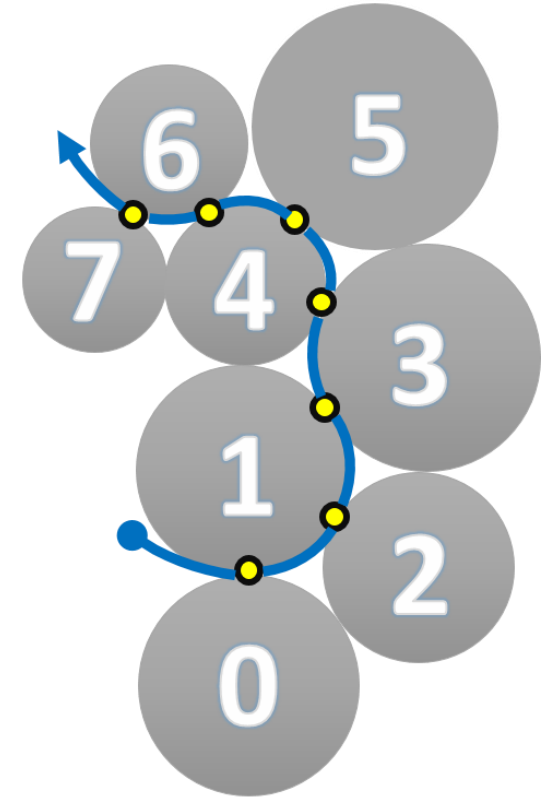
# Storyline threading



(a)

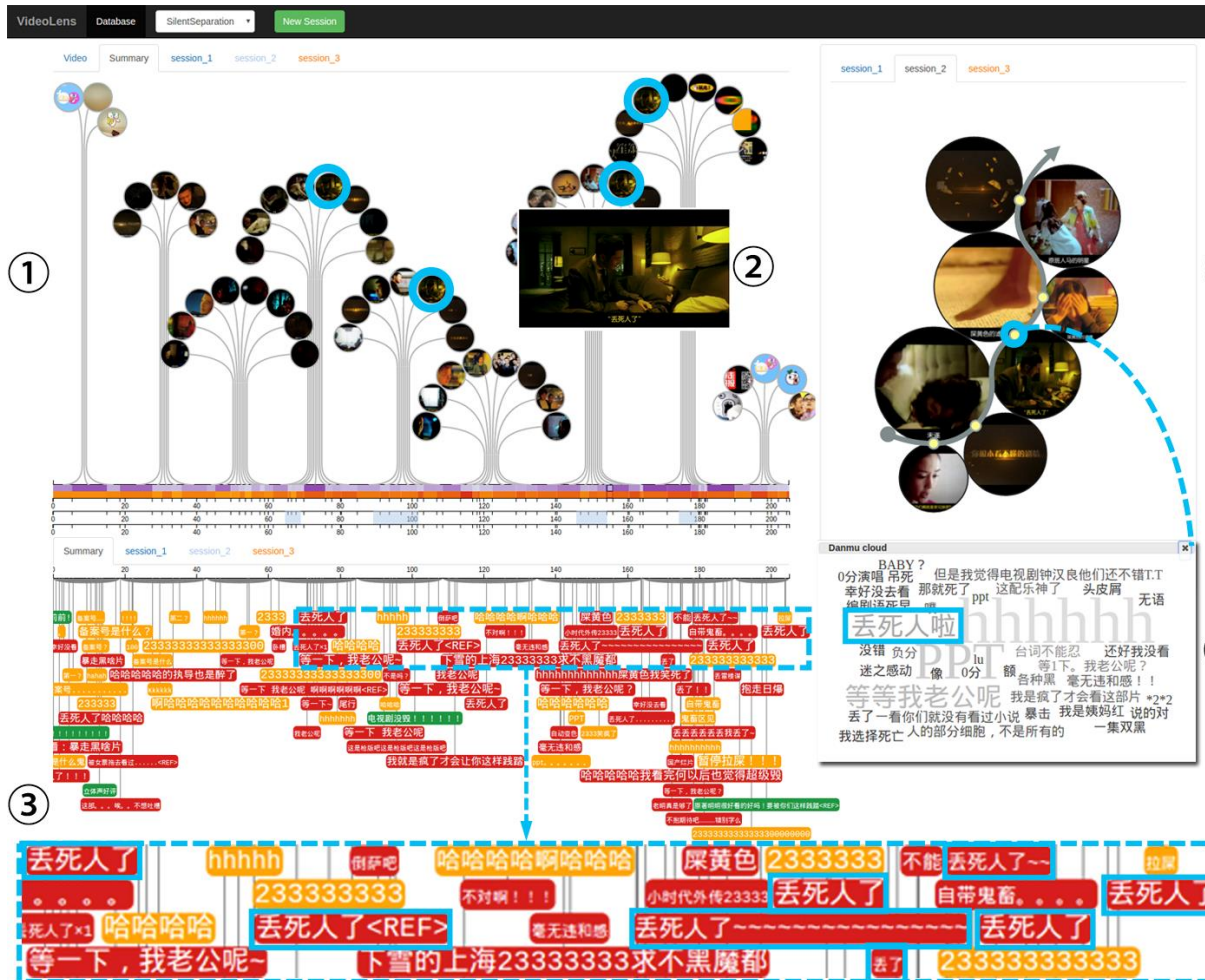


(b)



(c)





- 205 seconds long
- 2052 danmu posts
- 61 I-frames
- 1804 P-frames
- 61 sessions
- 9 scenes

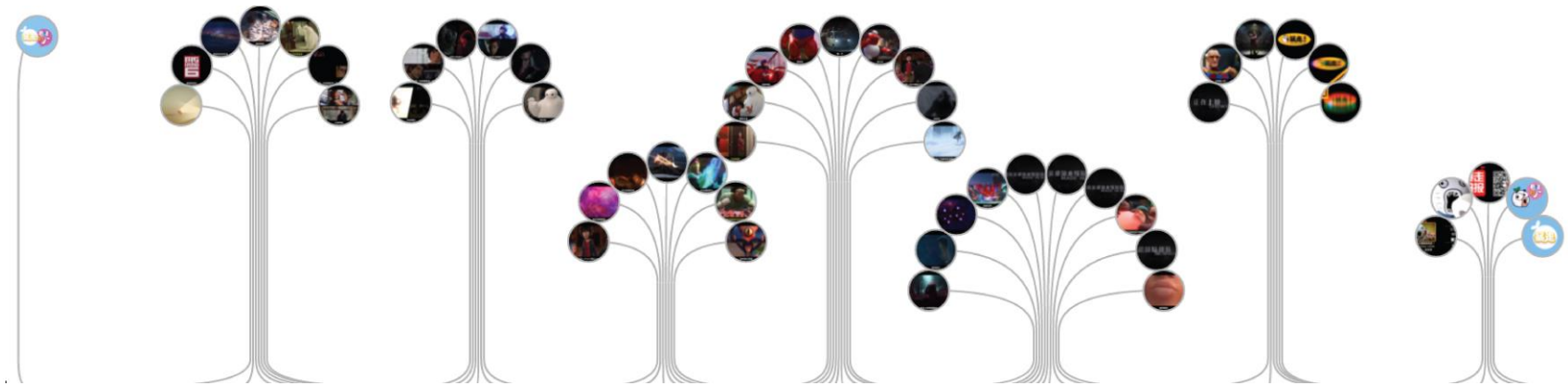
## User observation

- Thirteen experts
- Live demo
- Interview & open discussion
  - Insights
  - Applications



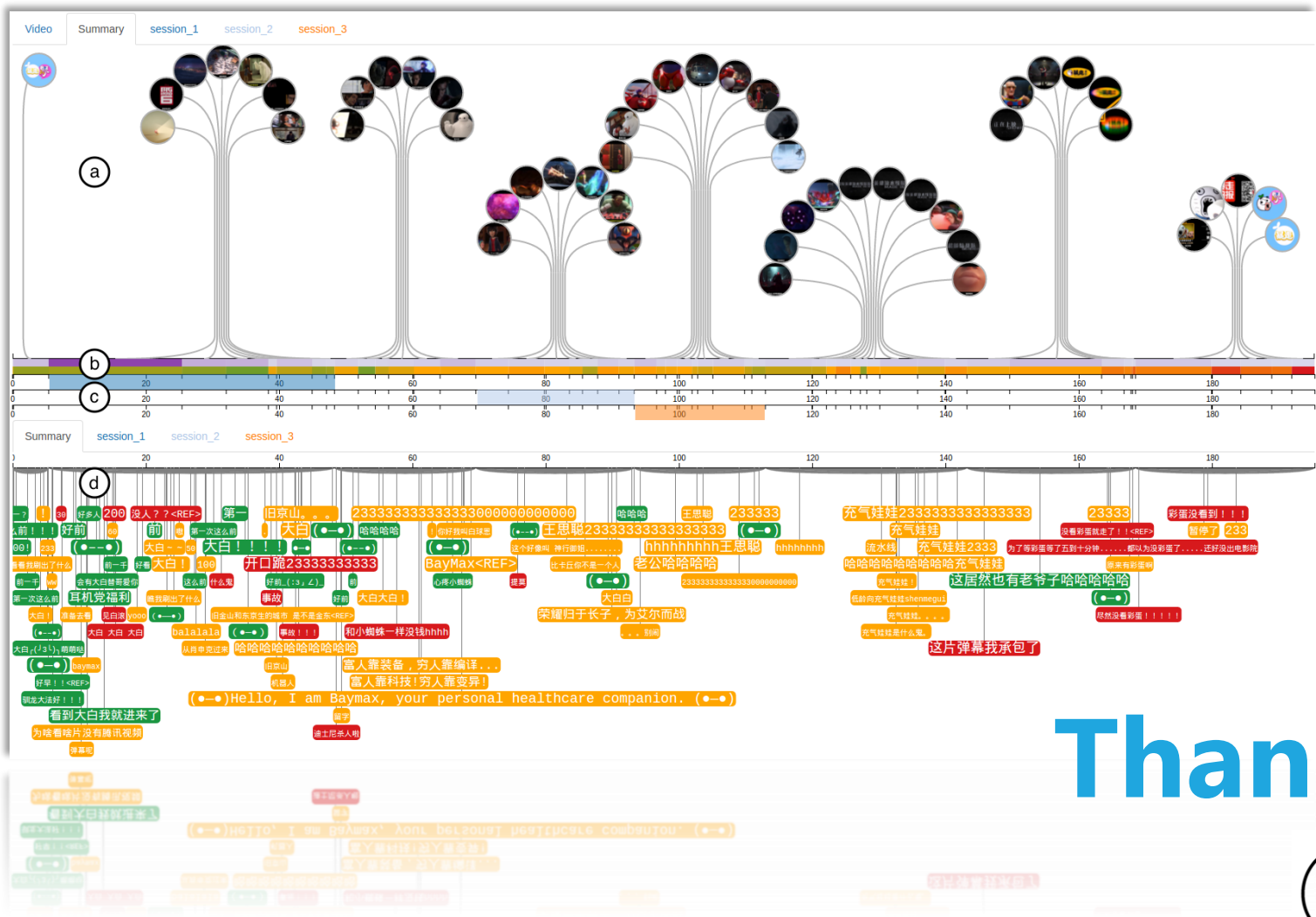
## Future Work and Conclusion

- Conclusion



- Future work

- Long video stream scalability
  - Hierarchical aggregation
- Advanced video analysis techniques



# Thank you



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