

# *Analysis and Interface for Instructional Video*

Alexander Haubold and John R. Kender  
Department of Computer Science  
Columbia University, New York  
{ah297,jrk}@columbia.edu

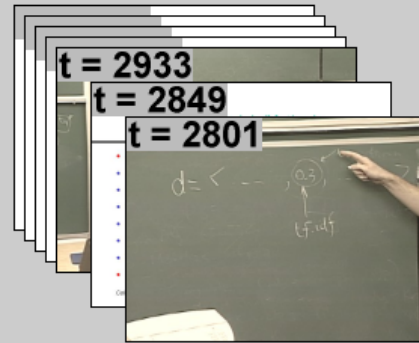
# Overview

- Motivation
- Segmentation by *Media Type*
- Clustering by *Content-based Matching*
- Visualization and Indexing of segmented data
- Demo
- Future Investigations

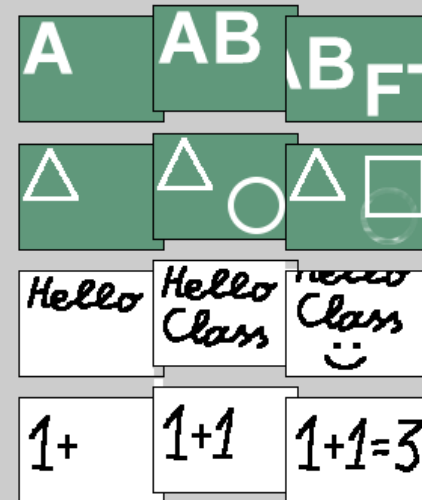
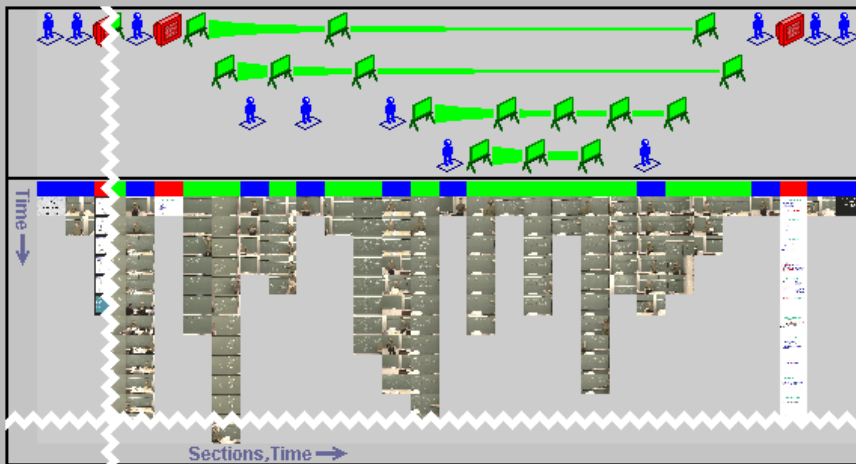
# Motivation

- Video-taped courses currently made available to students with “keyframe” index
- “Keyframe” = snapshot of video at points of substantial change every 20-25 seconds
- Typical course length: 75 min per lecture, 26 lectures per semester = 32.5 hr of video data (3.5 megaframes!) => 5000 snapshots
- Need a more compact, content-directed indexing method for keyframes

# Process Overview



1. Video → 2. "Keyframes" → 3. Segmentation by *Media Type*



5. Visualization and Interface ← 4. Clustering by Content

# Segmentation by Media Type

- Snapshots belong to six Media Types
- Media Type can be easily visualized

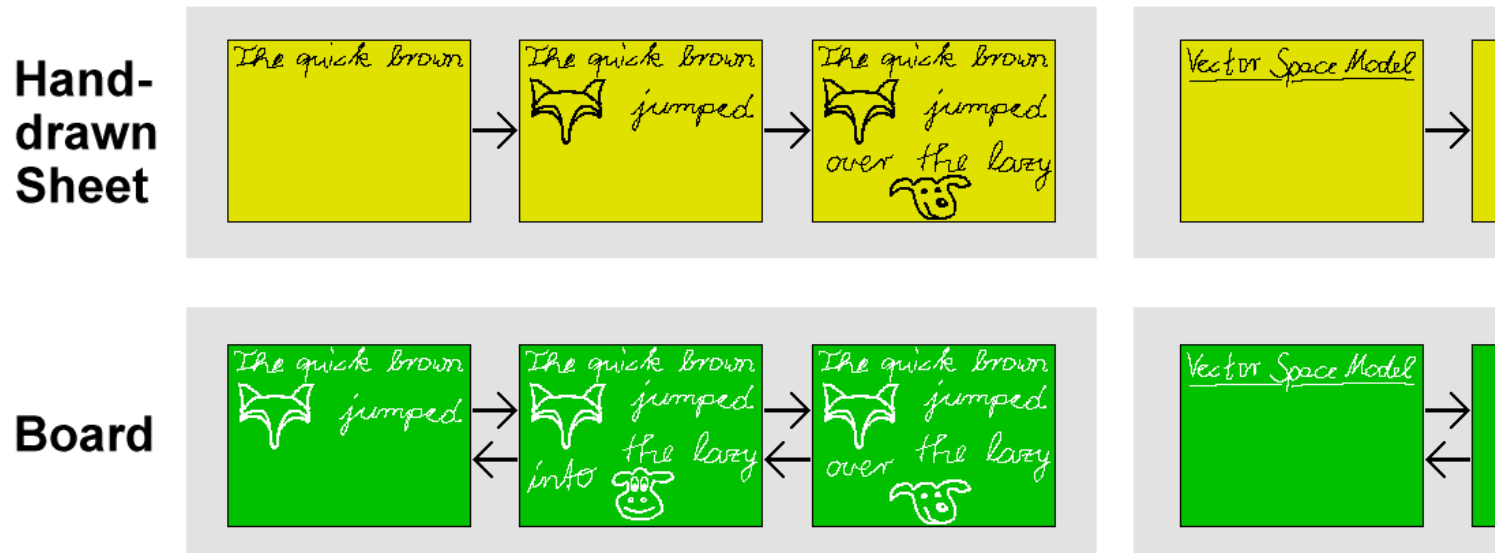


Green	Board
Blue	Podium/ Instructor
Red	Computer
Yellow	Hand-drawn Sheets
Orange	Printed Media (Illustrations)
Cyan	Class

(see paper for decision tree classifier)

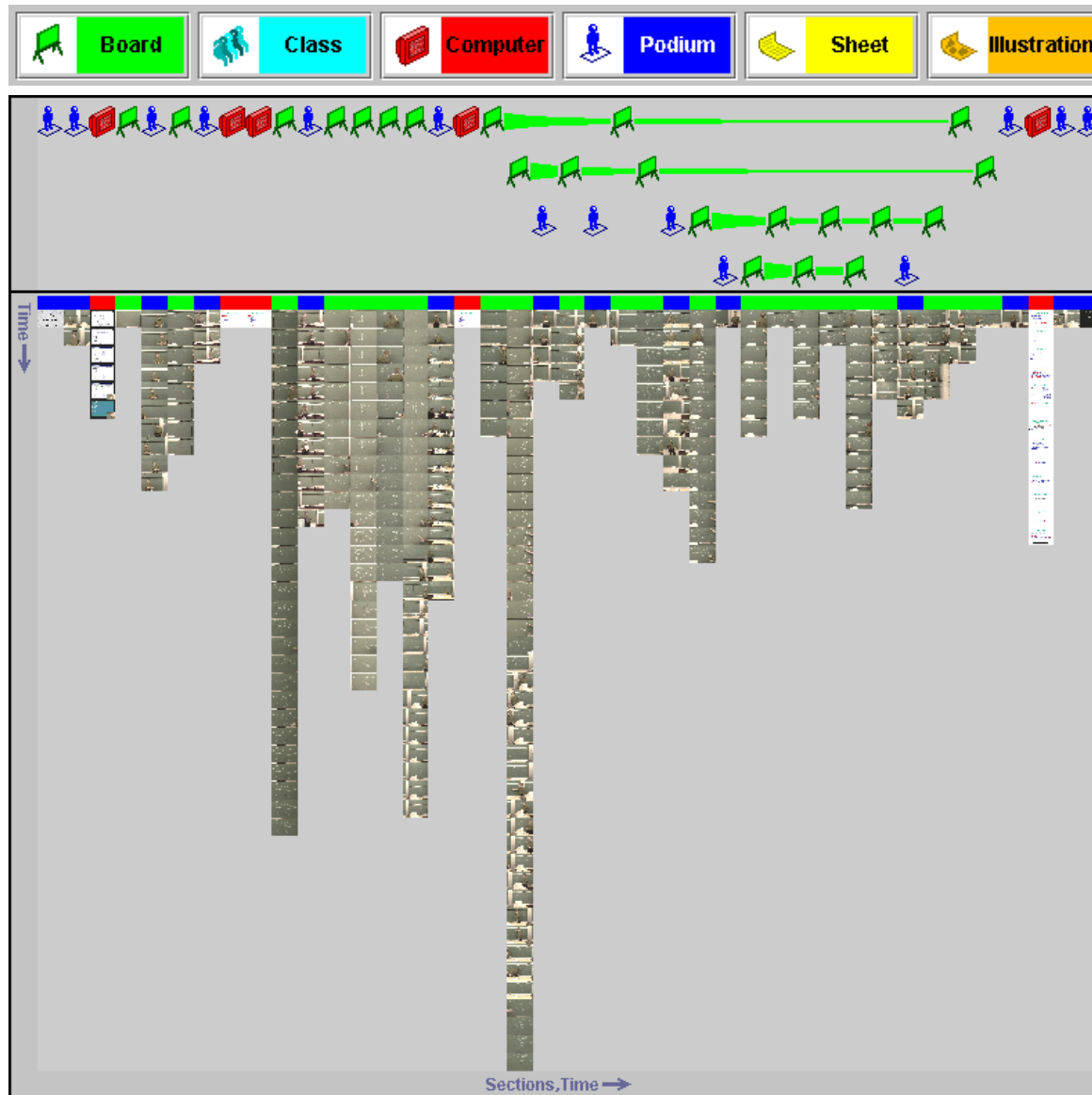
# Clustering by Content Matching

- Snapshot content evolves slowly
- Hand-drawn slides grow monotonically
- Blackboard panels varies dynamically



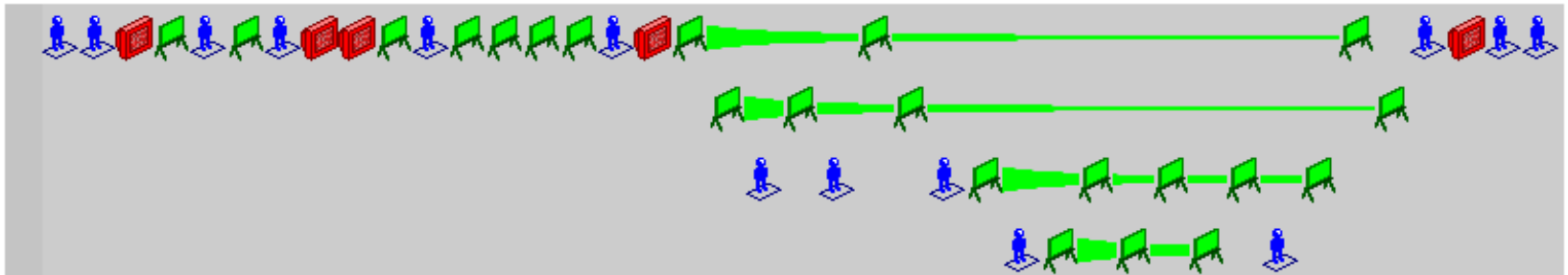
(see paper for content pixel filters, pan and zoom detectors, global match consistency heuristics)

# Interface and Visualization



# Interface and Visualization: Index

- Through analysis: temporal topic model
- Through user study: perception is topologic
- So: Topological View with relative time scale, each topic represented by media icon, interrupted topics reunited by tapered lines
- Verified: users quickly identify key concepts!





# Interface and Visualization: Details

- Through user study: need content in context
- So: Key Frame View with full index of key frames, organized by *Media Type* and *Topic*
- Verified: users quickly access full-size images and the video!



*Demo*

# *Numbers*

- First semantic clustering of extended collection of videos
- 17 videos
- 40 hours of lecture
- 4479 keyframes
- 334 content-matched topics

# *Future Investigations*

- Indexing over all videos in a course and all courses in a semester
- Automatic textual annotations for topics
- More robust segmentation and faster content matching
- User studies: patterns of retrieval -> automatic content queuing