

RESEARCH TALK

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Research Directions (if any)

- Something Interesting
 - Else let industry take care of it
- Something Useful
- Something Fundable
 - Graduate students expect stipends to do research!
- Something I know something about
 - *Or nobody knows anything about*



Research Areas

- **Parallel and Distributed Systems**

Volpex: Reliable execution when failure/errors are routine (MTBF in minutes) [*with Dr. Gabriel*]

- Very large scale systems (1000s of nodes)
- Volunteer computing – 100s of ordinary PCs distributed around the world solving scientific problems

- **Educational Technologies**

- *Indexed Captioned Searchable (ICS) Videos*



Background

- Video medium is ubiquitous and growing for coursework
 - MOOCS, iTunes U, MIT Courseware, UH...
 - Supplement or replace lectures
- Key shortcoming of video format is the inability to quickly access content of interest
 - Loud and clear in surveys and interviews
 - Students wants answers to questions for review, not watch an hour long video



ICS Videos in a Nutshell

- **Custom video player that allows quick access to video content of interest**
 - **Indexing:** Video divided into logical segments with clickable index points
 - **Search:** Keyword search in video
 - **Captioning:** Scrolling captions for audio.

ICS Videos in a Nutshell

The screenshot displays a video player interface. The main video area shows a desktop environment with a rocky landscape background and a large play button overlay. The desktop has a title bar that reads "Computer Science - Introduction to Computing - COSC 1300 Lecture 21" and a "Help" button. Various application icons are visible, including Recycle Bin, Command Prompt, Microsoft PowerPoint, Run, iTunes, Google Chrome, COSC 1300 Fall 2012, COSC 1300 HW1-12, Adobe Reader 9, Dropbox, Microsoft Word 2010, Shipping Tool, QSoft, QuickTime Player, cosc1300, Mozilla Firefox, Math Input Panel, Notepad, WordPad, WinZip, GIMP 2.0, Calculator, Microsoft Access 2010, Paint, Classroom Presenter 3, Internet Explorer, Free Music Downloads, Camtasia Recorder, Microsoft Excel 2010, nutty, DeckBuilder 3, XnView, and GIMP 2.

On the right side, there is a "Transcript" panel with a search bar and a list of video segments:

- 0:05** Okay so I need 3 more volunteers for today to give your powerpoint.
- 0:10** presentation. Let's see you are Shannon, are you Shannon?
- 0:38** Jasmine, okay so you're in the third. Jasmine Scott.
- 0:57** Whats your name now? Your last name is?
- 1:35** okay I got 2, I need one more? We'll go with these two okay. First one is going to be Jasmine Scott here.
- 2:38** So Jasminen is going to talk to us about TranSwitch: Engines for Global Connectivity. Hello everybody I'm Jasmine. The company I chose was TranSwitch.
- 2:56** Basically its a company, they make integrated circuits and intellectual property solutions.

Below the video player, there is a control bar with a "Speed 1x" button, a search bar containing "quiz", and a timeline with markers at 00:01, 04:05, 06:33, 15:55, 23:05, 25:51, 31:01, and 35:31. Three thumbnail images are shown below the timeline, each with a red border and a label: "quiz(1)", "quiz(1)", and "quiz(9)".

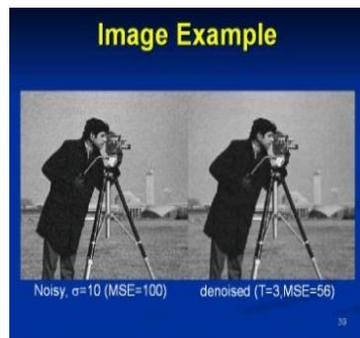
Text Search

User types a *keyword* -- all segments of the video that match are presented

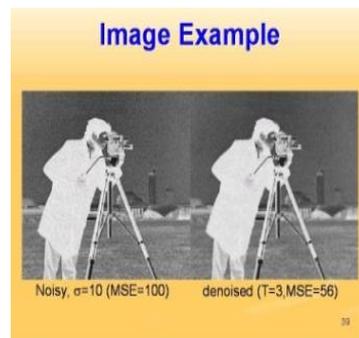
Challenges:

- Recognize text on video frame: OCR enhanced with custom image transformations for text recognition
- Semantic search ?

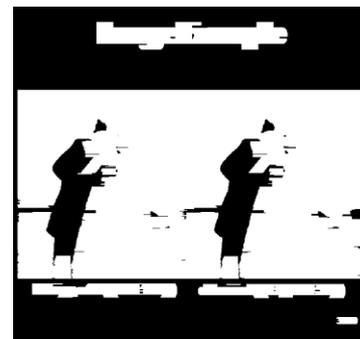
Original Image



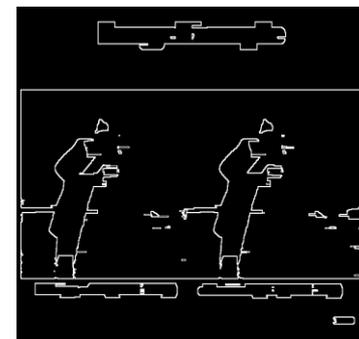
Inversion



Dilation



Edge Detection

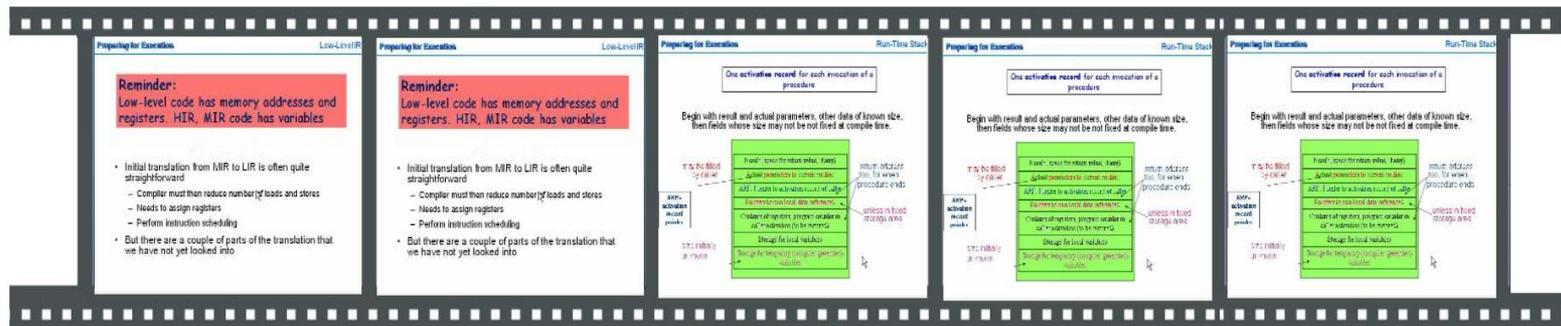


Automatic Indexing

The video is presented as a series of clickable segments, each with a visual index frame

Challenges:

- Identify *Topic Changes*, beyond scene changes. Based on recognition and analysis of text patterns
- Combined with semantic and audio input ?



Text Captions

Video player supports captions:

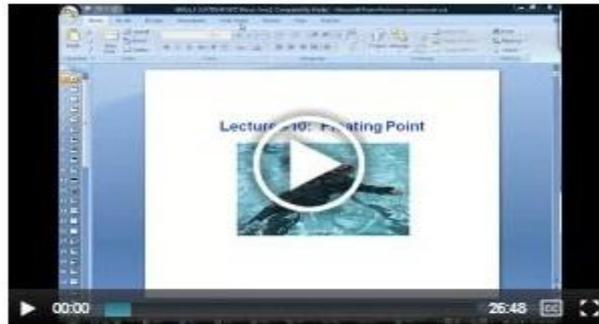
- Semi-automatic caption generation employing speech recognition (YouTube)
- ICS Caption Editor for correcting captions manually
 - “Crowdsourcing” option

Text Captions

Welcome rucha! [Logout](#)

ICS Caption Editor

[Help](#) | [Watch Video](#)



Legend

- Section currently being edited
- Caption is Complete
- Caption Needs a Review

PlaySpeed: ▾

0 Completed!, 0 Requested for Review, 14 remaining.

Section No.	Start Time (mm:ss)	Caption Text	Save my Changes	Status	Review Count
Edit Section 1	0:05	Lets talk about floating point today.We have seen the ways of representing numbers in binary so far	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	0:13	the largest we've gotten with the unsigned integers we preferred edited by Rucha	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	0:18	two to the n minus one ending number in bits you have represent and with sign integer the two complement we have negative two to the n minus one	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	0:26	two to the n minus one minus one because one less positive number than the negative number. So the question you might	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	0:37	represents a very large numbers or even decimal number, rational number like pi or the natural number e. The way we do this	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
Edit Section 2	0:50	to go back and look at scientific notation base tenth	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	0:56	things to note the number before the decimal point were call the mentissa	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	1:04	the radix or the base that you're in so we're are talking about base 2 that would be 2 and an exponent number	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	1:15	multiple ways to represent this number, of course, like we have point 1 and ten to the negative ten. However, to make sense you want to have stuffs in normalize form	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	
	1:27	based ten that just means you have one number before the decimal point and that is also true with binary	<input type="button" value="Save"/>	<input type="button" value="Mark as Complete"/>	

Diverse Research Challenges

- Enhancing text from video frames by enhancing OCR accurately [Image processing]
- Identifying Index Points [Text processing, Machine Learning]
- User Interface Design
- Learning Methodologies [Education, Psychology]
 - Measurement of Enhancement of Learning
 - Inverted Classrooms

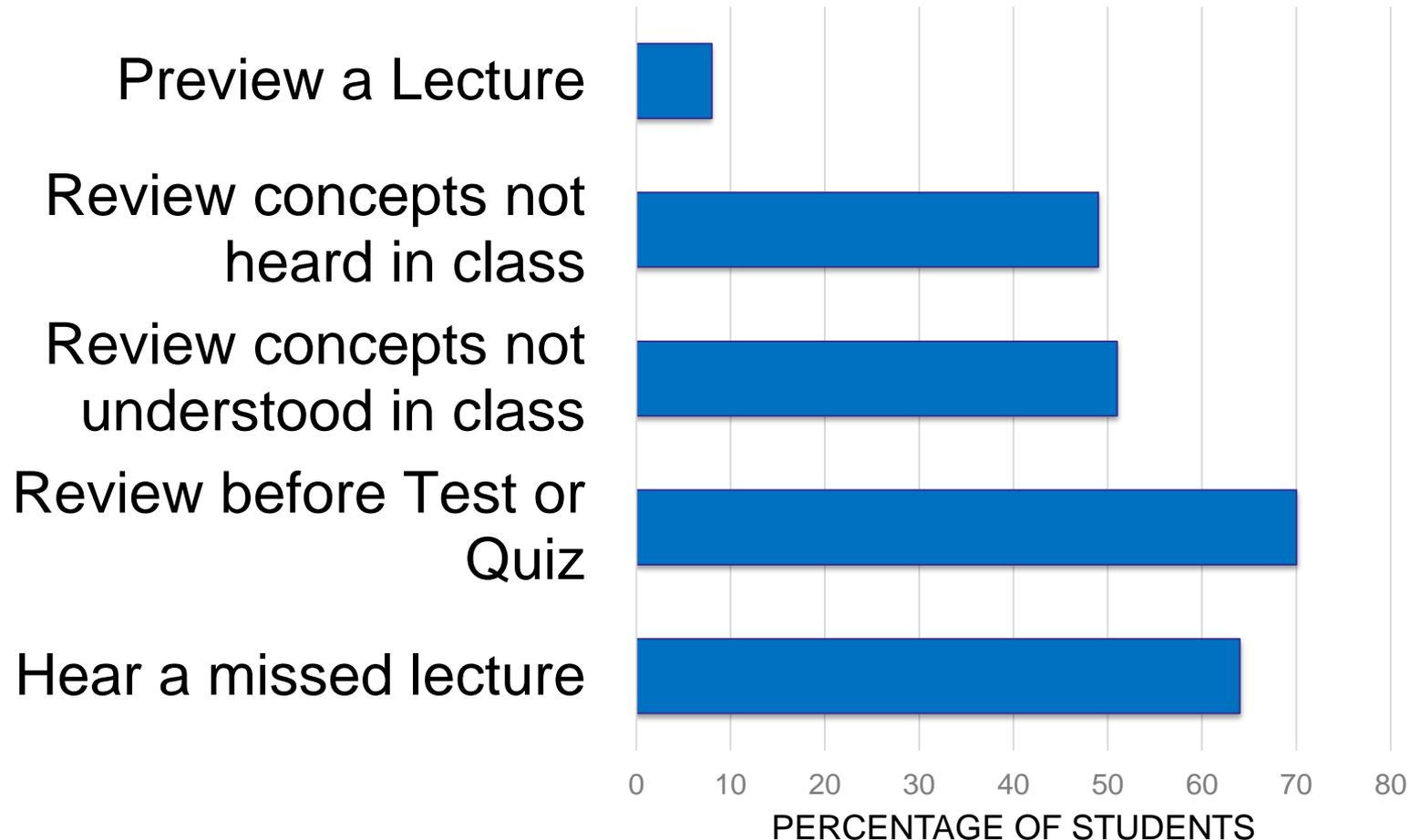
Deployment and Experience

- Widely used at University of Houston in the Departments of Biology, Chemistry, Computer Science, Geology, Mathematics

Estimate ~10,000 student users in past 3 years
in ~70 courses in 6 STEM fields at UH

~3000 participated in surveys

Reasons For Using Videos



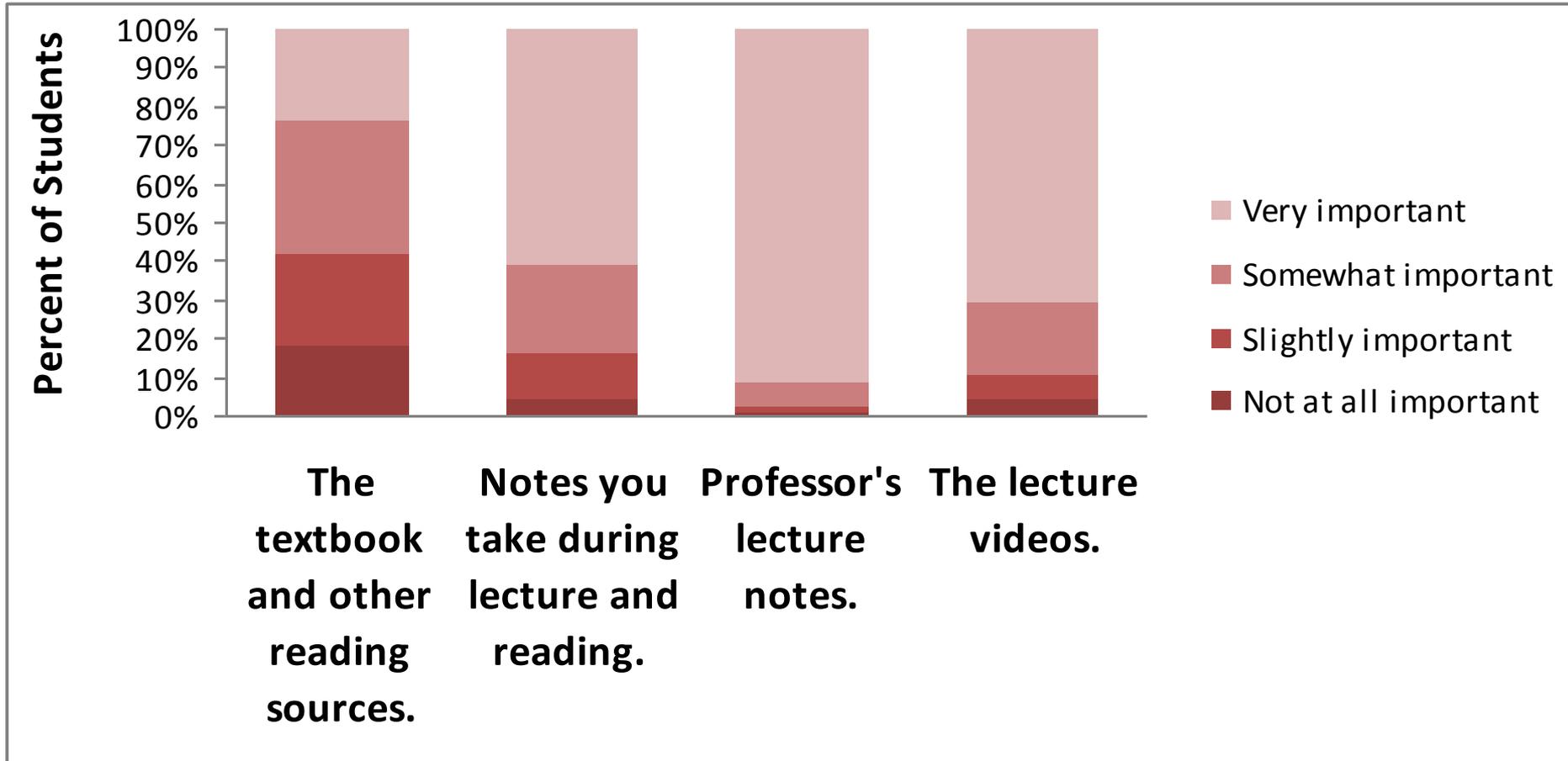
Student Evaluation of Videos

Evaluation Item	Mean
Lecture videos help <u>clarify material</u> that was not clear in class.	5.45
Lecture videos are useful for <u>reviewing</u> .	5.63
Having <u>access</u> to video lectures for this class is important to me.	5.61
The lecture videos helped me to study for <u>quizzes or tests</u> .	5.51

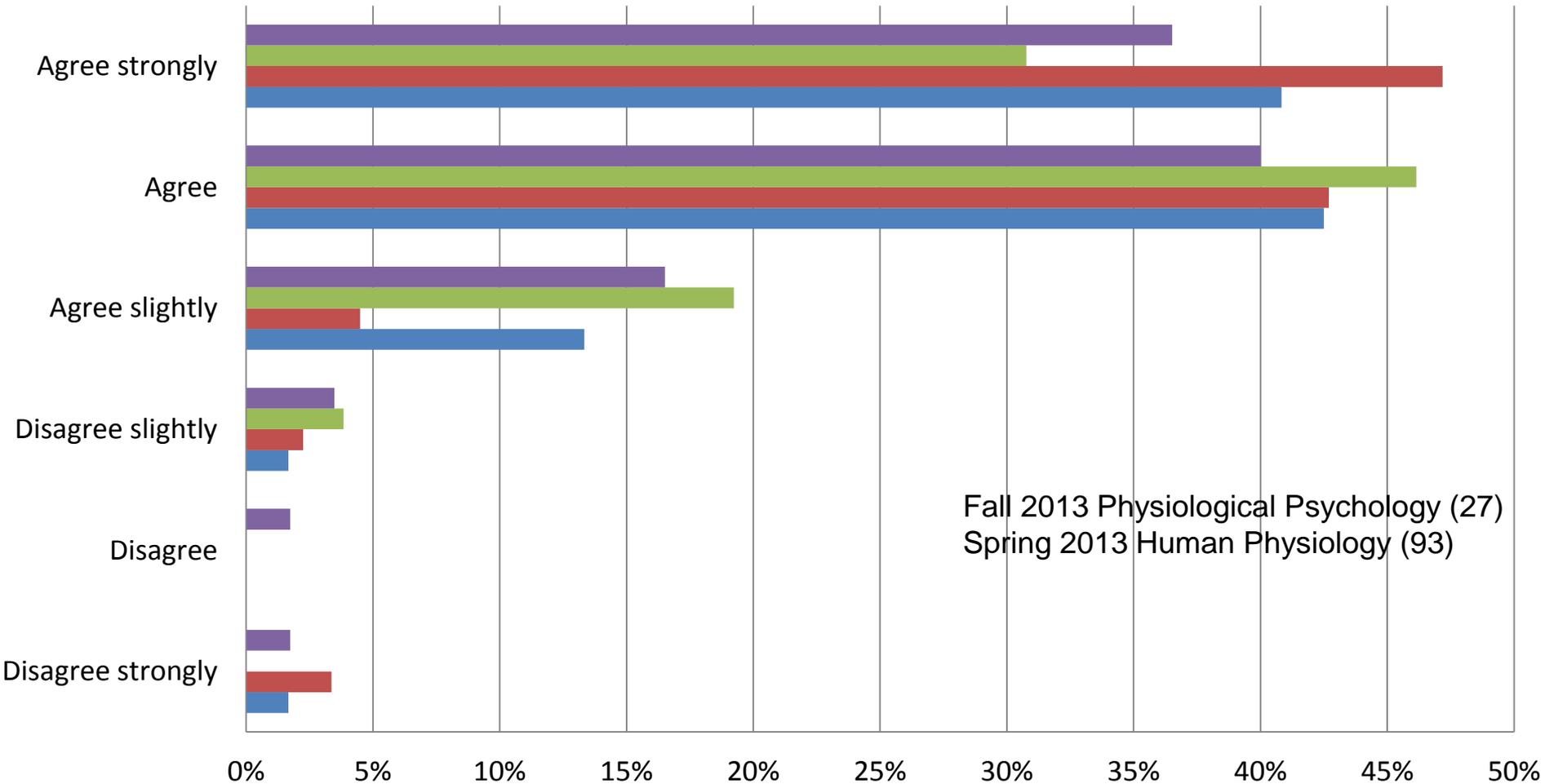
Scale: 1 = Disagree Strongly , 6 = Agree Strongly



Videos as a Resource



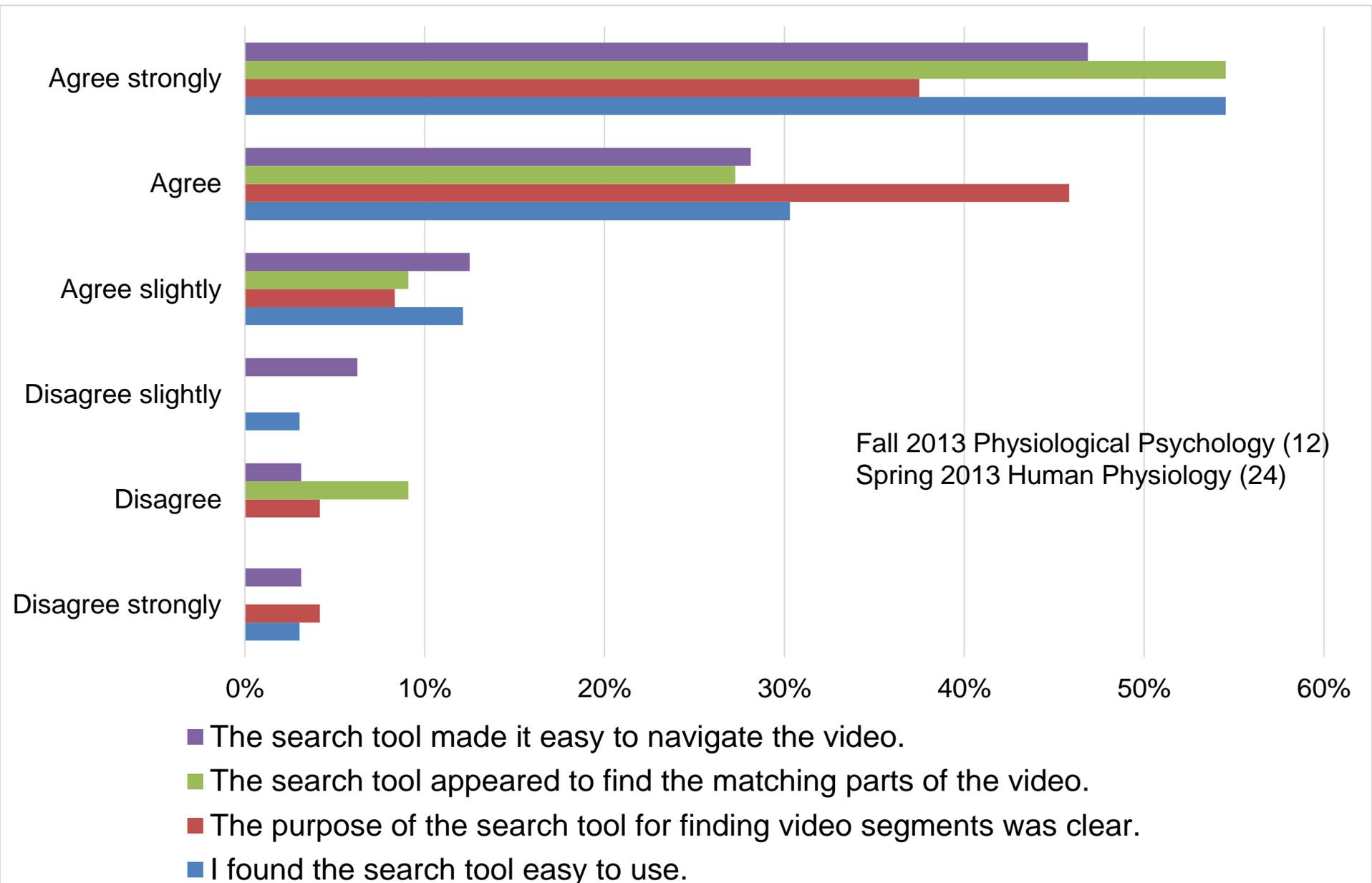
Student response: Indexing



Fall 2013 Physiological Psychology (27)
Spring 2013 Human Physiology (93)

- The index points separated a lecture into logical segments.
- The index points were appropriately placed in the video timeline.
- The placement of index images on the screen made the index easy to use.
- The indexing was helpful.

Student response: Search



Project Team

CS Faculty: Zhigang Deng, Olin Johnson, Shishir Shah, **J. Subhlok**

Students: Tayfun Tuna, Varun Varghese, Rucha Borgaonkar, Mahima Joshi

X-Students: J. Li, C. Yun, G. Bhatt, T. Tuna. A. Verma, R. Kushalnagar

NSMIT Staff: **S. Baez-Franseschi**, Pradeep Krishnan, Andrea Arias

Assessment: **Lecia Barker (UT Austin)**, Yumei Liu, Erin Hodges (UH)

Deployment, usage and assessment

UH Computer Science, UH Geosciences, UH Biology and Biochemistry

*UH Downtown (**Richard Alo**), Texas School for the Deaf (**David Coco**)*

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Many small and large projects for BS, MS or PhD students!



Contact Info

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