

# DynamicSlide: Reference-based Interaction Techniques for Slide-based Lecture Videos

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# MOOC and video

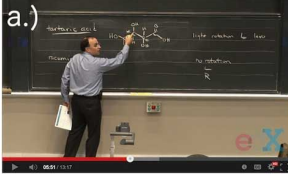
CLASS CENTRAL


  
**78M**  
Students

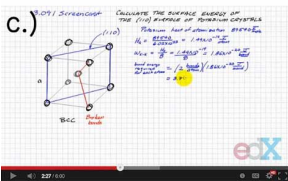
  
**800+**  
Universities

  
**9.4k**  
Courses

By the Numbers: MOOCs in 2017

a.) 

b.) 

c.) 

d.) **Matched Analysis**  
Basic principle: Perform analysis within each matched group and then pool to obtain a summary average  
Typical format for results from a case control study involving 1-1 matching on a single factor

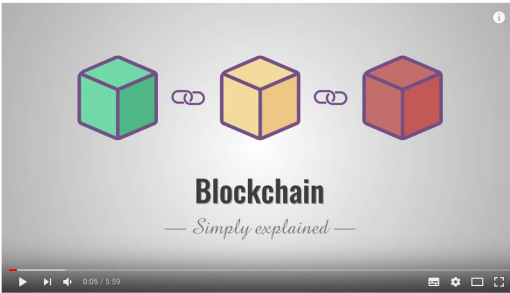
Exposure Status of Case	Exposure Status of Control	
	+	-
+	A	B
-	C	D

# Slides are widely used in lecture videos

Motivation 1: Practical Relevance

- Interest in improving economic welfare → interest in public economics
- Almost every economic intervention occurs through government policy (i.e. involves public economics) via two channels:
  - Price intervention: taxes, welfare, social insurance, public goods
  - Regulation: min wages, FDA regulations (25% of products consumed), zoning, labor laws, min education laws, environment
- Government directly employs one sixth of U.S. workforce

2:02 / 57:18  
Public Economics Lectures Part 1: Introduction



Blockchain  
— Simply explained —

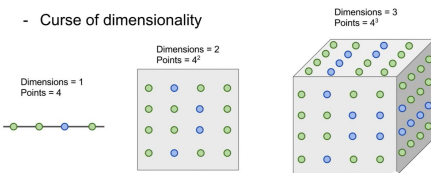
How does a blockchain work - Simply Explained

5월 10일 679,959회

Savjee 2월 11, 13.

What is a blockchain and how do they work? I'll explain why blockchains are so special in simple and plain English!

k-Nearest Neighbor on images **never used**.



Fei-Fei Li & Justin Johnson & Serena Yeung Lecture 2 - 44 Stanford University, 2017

Stanford University CS231n, Spring 2017

Anders Feder - 2 / 16

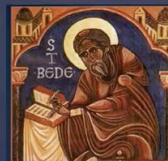
Lecture 2 | Image Classification

Stanford University School of Engineering

## Early Medieval Grammarians and Encyclopedists

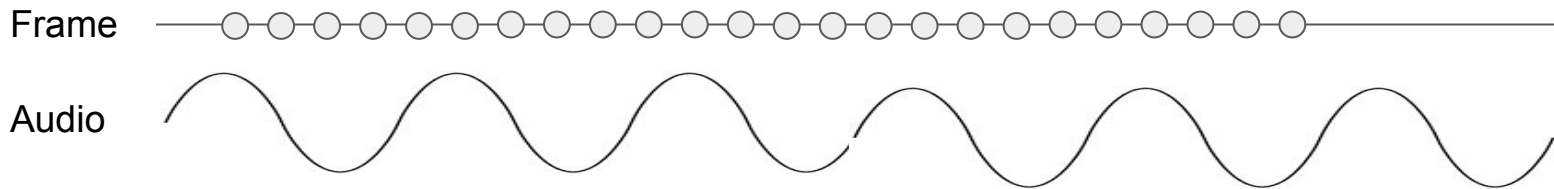
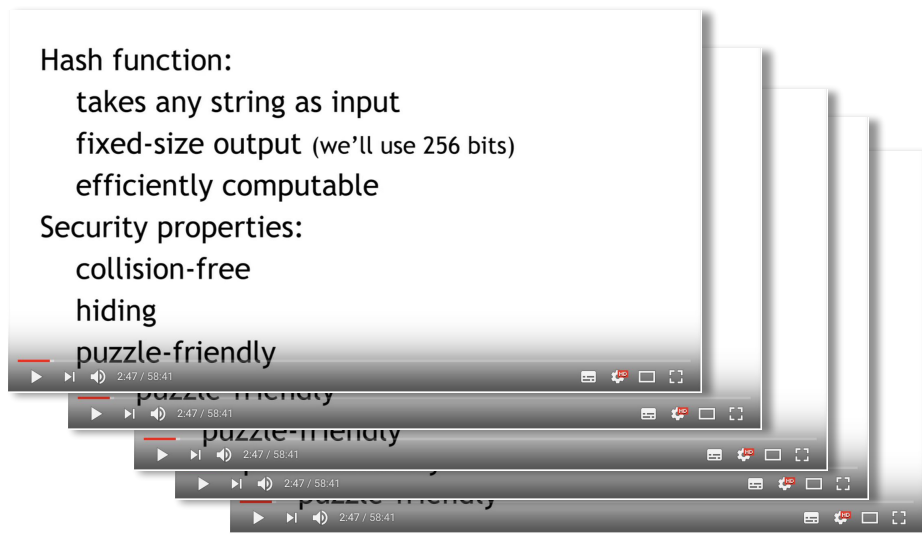
### Encyclopedists and Compilers

**Isidore of Seville:** Note how it functions more as a set of notes or like an encyclopedia. Rhetoric handbook as reference tool. It compiles and synthesizes. Groups rhetoric and dialectic together. He still thinks of R as primarily a secular and legal tool, not just an ecclesiastical tool.



**Venerable Bede:** English. From Augustine, best example of figures and tropes are from scripture. First treatise on rhetorical style in England. Peculiarly English tendency (until the Ren.) to equate rhetoric with style.

# Decomposing Slide-based Video



# Decomposing Slide-based Video

Hash function:

- takes any string as input

- fixed-size output (we'll use 256 bits)

- efficiently computable

Security properties:

- collision-free

- hiding

- puzzle-friendly



Collisions do exist ...



possible inputs



possible outputs



Slide



Audio



# Decomposing Slide-based Video

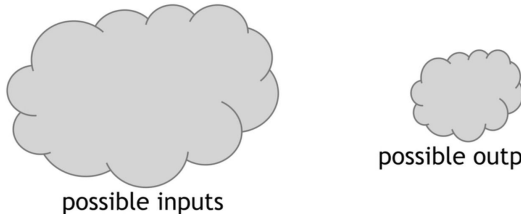
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possible inputs

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Hash function:

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efficiently computable

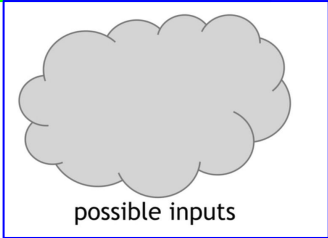
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collision-free

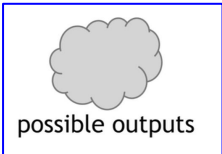
hiding

puzzle-friendly

Collisions do exist ...



possible inputs



possible outputs

timeframe

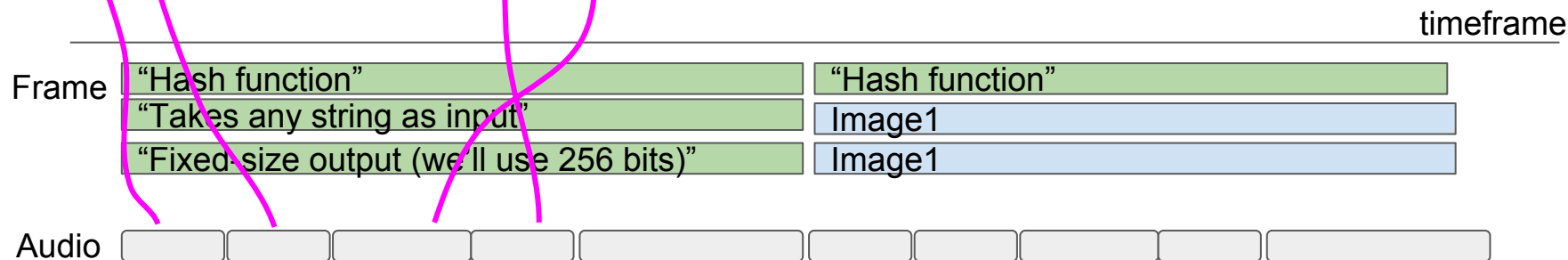
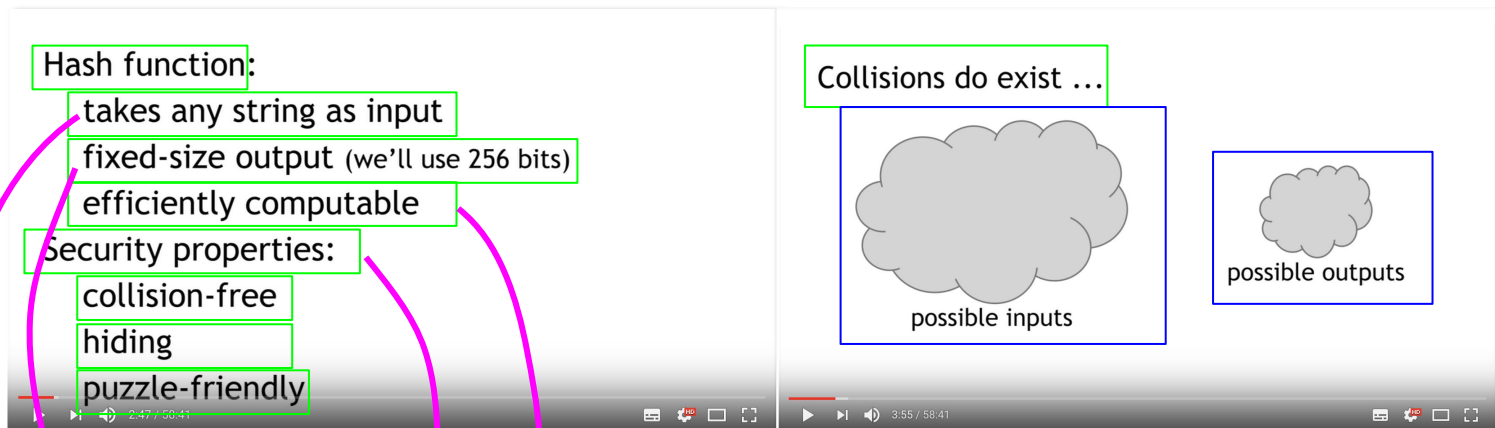
Slide

"Hash function"	"Hash function"
"Takes any string as input"	Image1
"Fixed-size output (we'll use 256 bits)"	Image1

Audio

--	--	--	--	--	--	--	--	--	--

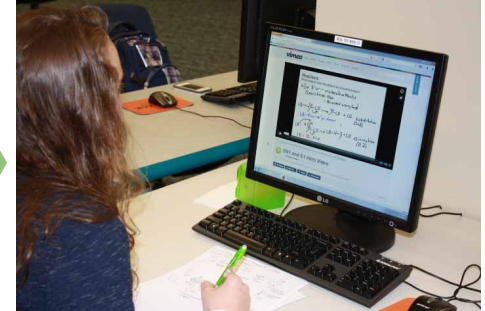
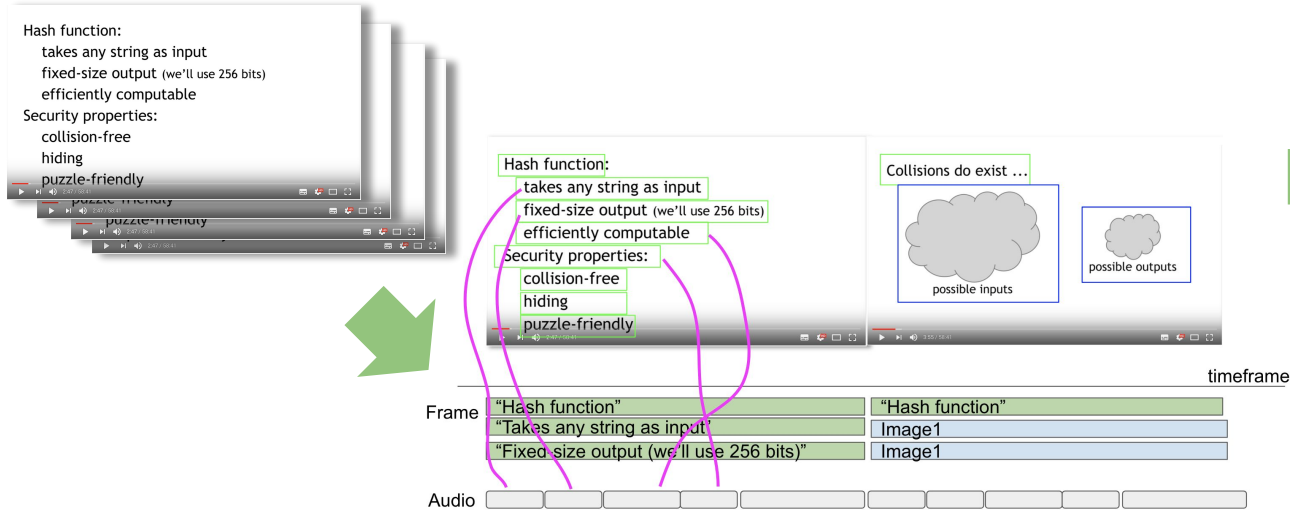
# Decomposing Slide-based Video





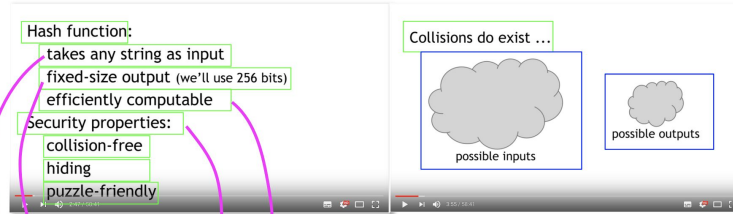
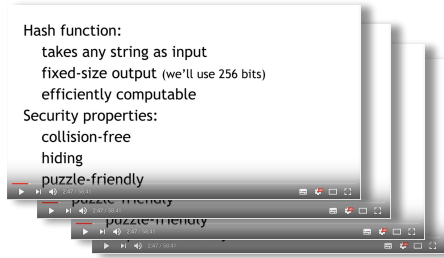
# Object-oriented tools for both learners & instructors

For Learners (Player)

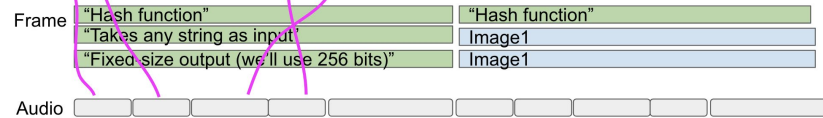


For Instructors  
(Lightweight editor)

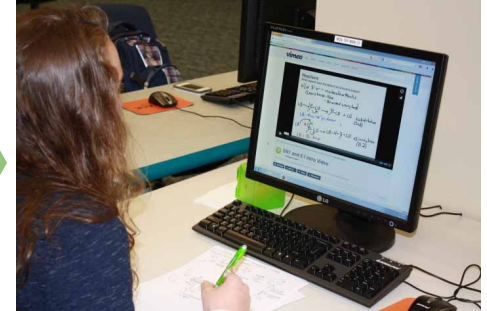
# Object-oriented tools for both learners & instructors



timeframe



For Learners (Player)



For Instructors  
(Lightweight editor)

# Link between slide and narration

**Attribute Values**

- Each attribute has a set of values objects draw from.
- The same attribute can be mapped to different attribute values  
Example: height can be measured in feet or meters
- Different attributes can be mapped to the same set of values  
Example: Attribute values for ID and age are integers

0:17 So each attribute, each object is defined by a set of attribute values.

0:25 And each attribute we can think of as being defined by the set of values that it can hold.

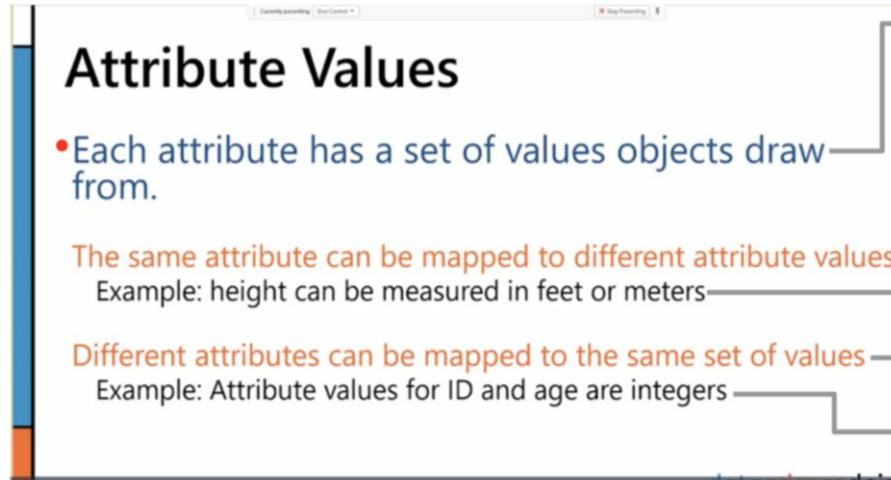
0:32 So we can have the same attribute mapped to different attribute values.

0:36 Height can be measured in meters or feet, temperature can be measured in Celsius, Kelvin, or Fahrenheit, lots of other sorts of things like that.

0:46 And different attributes will often be mapped to the same set of values.

0:51 ID numbers and age are both usually given as integer values.

# Link between slide and narration



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visual  
information hierarchy

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visual  
information hierarchy

auditory  
detailed explanation

# Link between slide and narration

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**How can we find leverage links  
between slides and narration for watching video?**

# Interaction techniques powered by links between slides and narration

The screenshot shows a presentation slide titled "Attribute Classification". The slide content is as follows:

**Discrete Attribute**  
Has a finite or countably infinite set of values  
**Examples:** zip codes, click counts, set of words in a collection of documents  
Often represented as integer variables  
• Binary attributes are a special case of discrete attributes

**Continuous Attribute**  
Has real numbers as attribute values  
**Examples:** temperature, height, or weight  
Continuous attributes are typically represented as floating-point variables

The slide is part of a video player interface. A red arrow points from the "POINTER" menu item to the slide content. The video player shows a timeline from 3:24 to 4:01. A subtitle track on the right shows the following text:

3:09 There's a countably infinite set, but there are always going to be integers.  
3:13 So we have a countably infinite set of values there.  
3:16 Usually we represent these as integer variables.  
3:20 And binary attributes are a pretty special case of discrete attributes that we end up having to handle differently in some cases.  
3:28 Binary attributes have only two values.  
3:31 And we might call those yes or no, dead or alive, 1 or 0.  
3:36 And those kinds of columns are sort of a special case.  
3:40 In some contexts, we really like them, they make things easier.

The video player interface includes a "POINTER" menu with options: NONE, HIDE, BLUR, and POINTER. The "POINTER" option is selected. The video player also shows a "Subtitle" button and a "data science dojo" logo.

At the bottom of the video player, there is a timeline and a list of interaction techniques:

- 3:53 Has real numbers as attribute values
- What about imaginary numbers?

1. Automatic Highlighting
2. Item-based Navigation
3. In-video Bookmarking

# Interaction techniques powered by links between slides and narration

The screenshot shows a presentation slide titled "Attribute Values" within a video player. The slide content includes:

- Each attribute has a set of values objects draw from.
- The same attribute can be mapped to different attribute values
  - Example: height can be measured in feet or meters
- Different attributes can be mapped to the same set of values
  - Example: Attribute values for ID and age are integers

The video player interface includes a progress bar, a "PONTER" dropdown menu, and a "Slides" / "Notes" tab. A timeline of narration is visible on the right side of the slide, with timestamps and corresponding text:

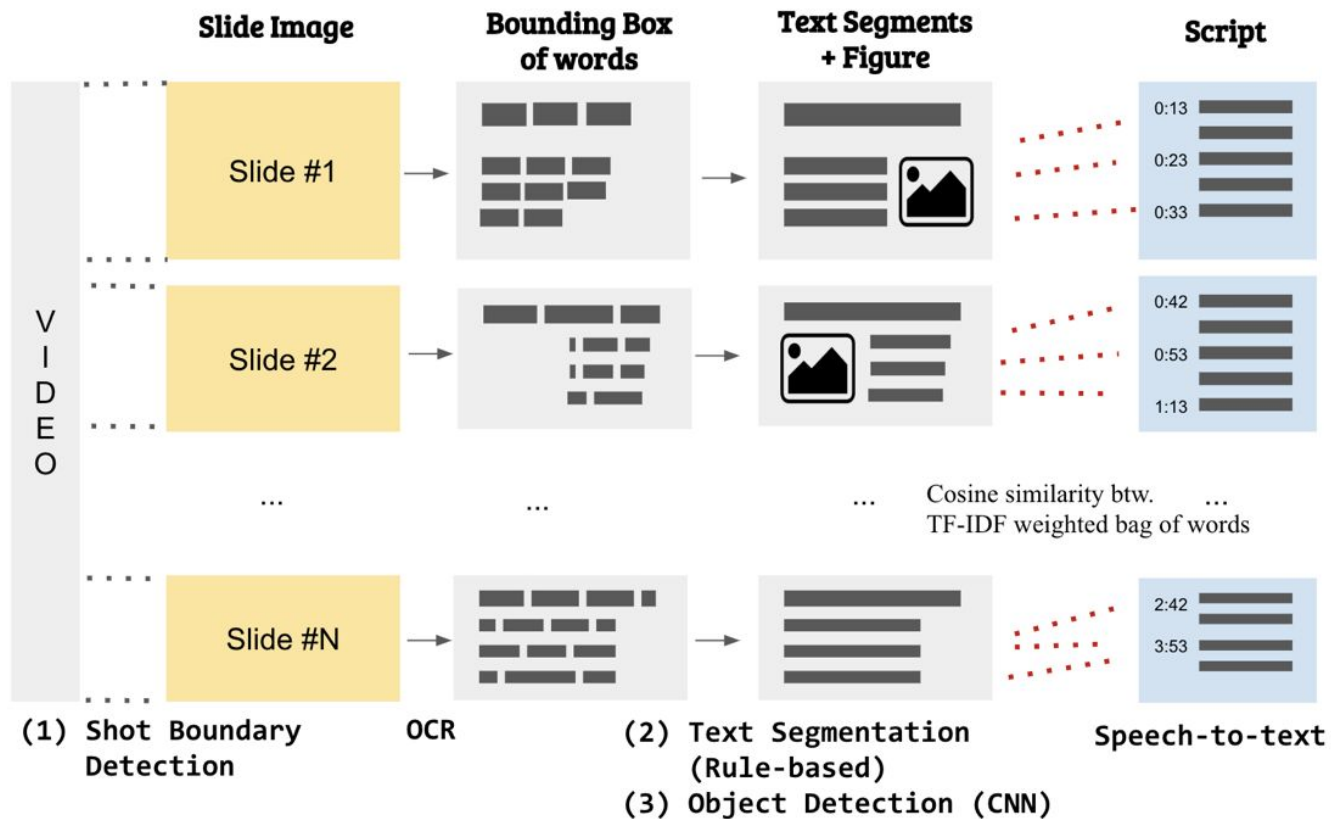
- 0:32 So we can have the same attribute mapped to different attribute values.
- 0:38 Height can be measured in meters or feet, temperature can be measured in Celsius, Kelvin, or Fahrenheit, lots of other sorts of things like that.
- 0:48 And different attributes will often be mapped to the same set of values.
- 0:51 ID numbers and age are both usually given as integer values.
- 0:58 Temperature and height are both often given as floating point values, as decimal values.
- 1:05 So the properties of our attributes can also be different.

At the bottom of the video player, a timestamp "0:51" is shown next to the example "Example: Attribute values for ID and age are integers".

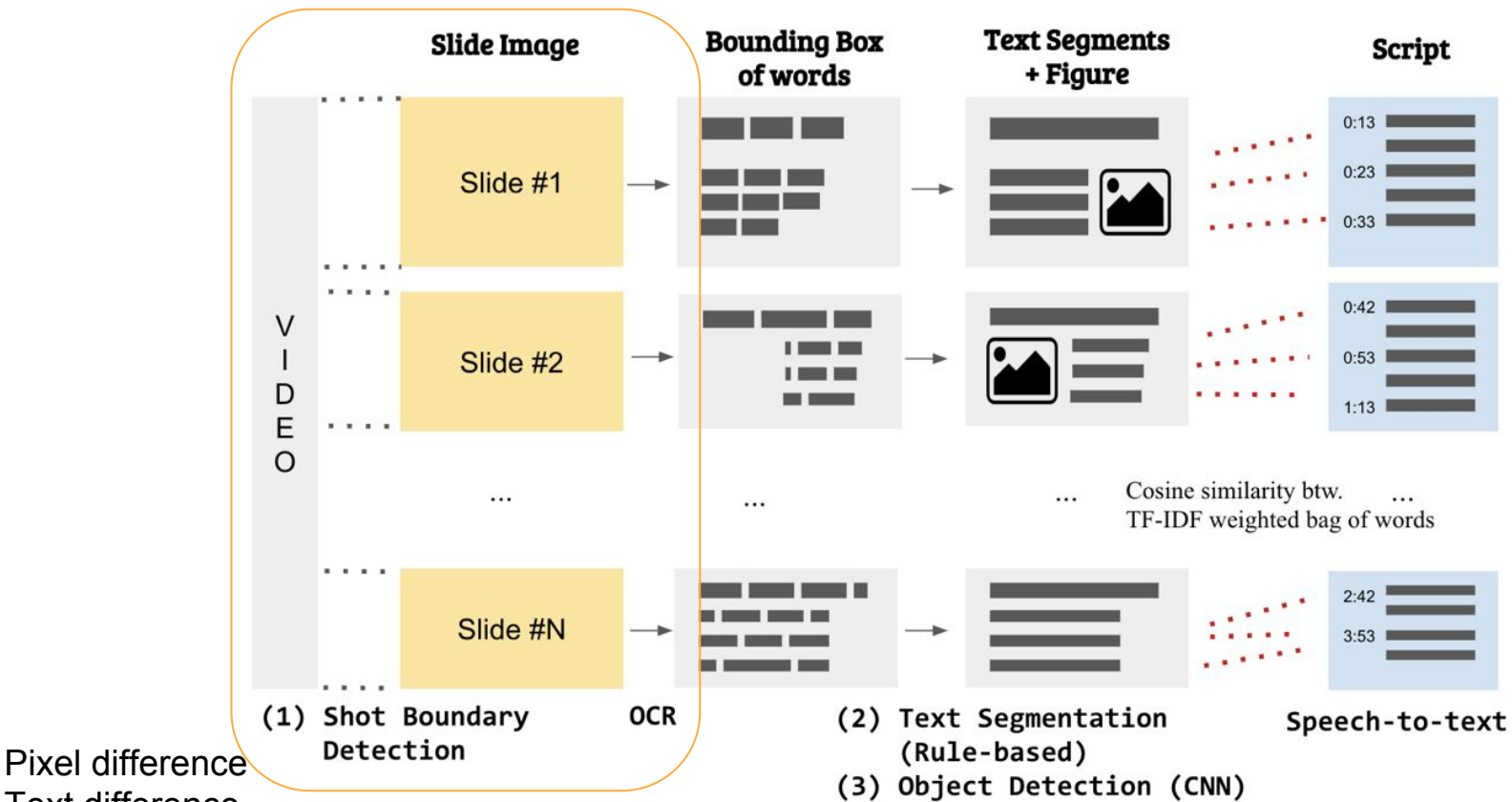
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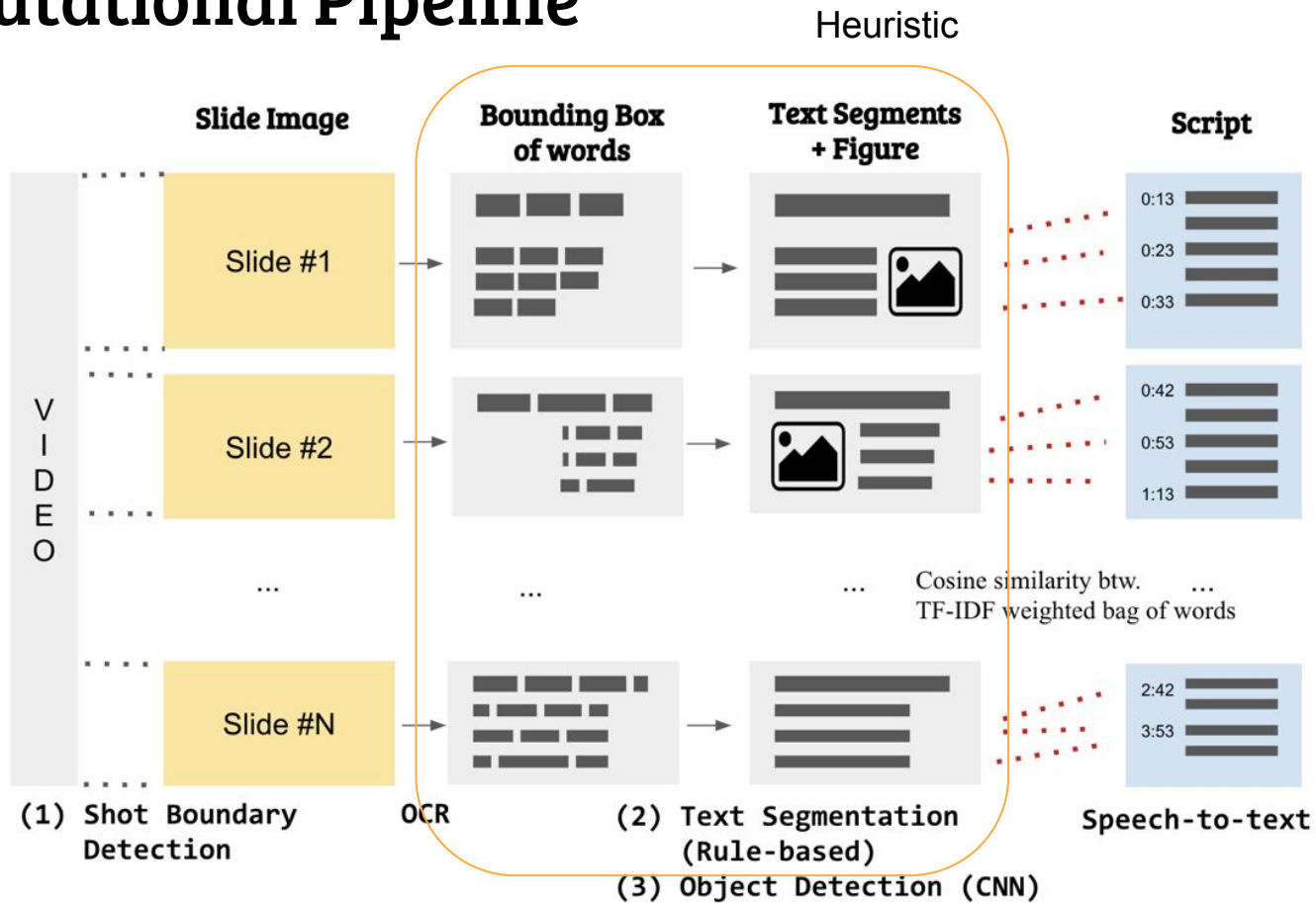
# Computational Pipeline



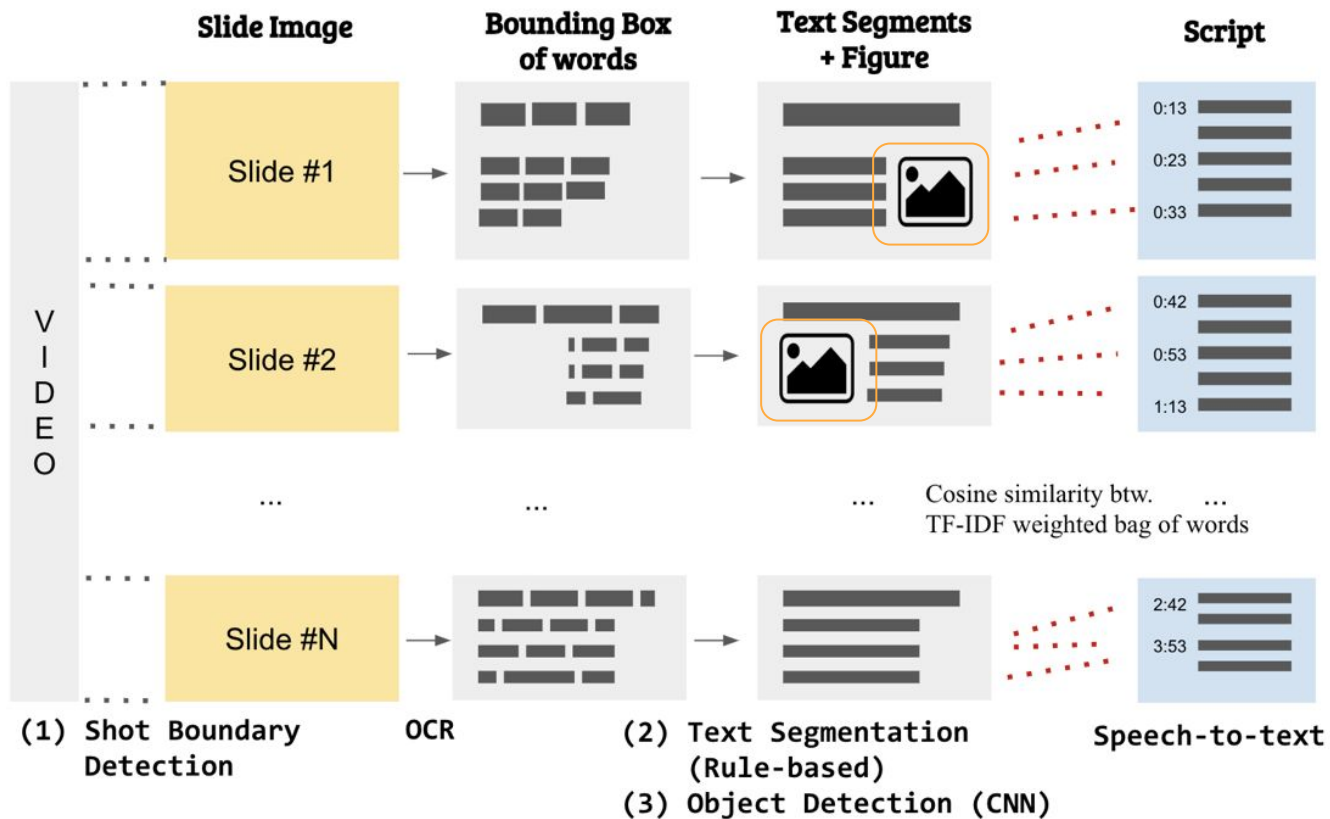
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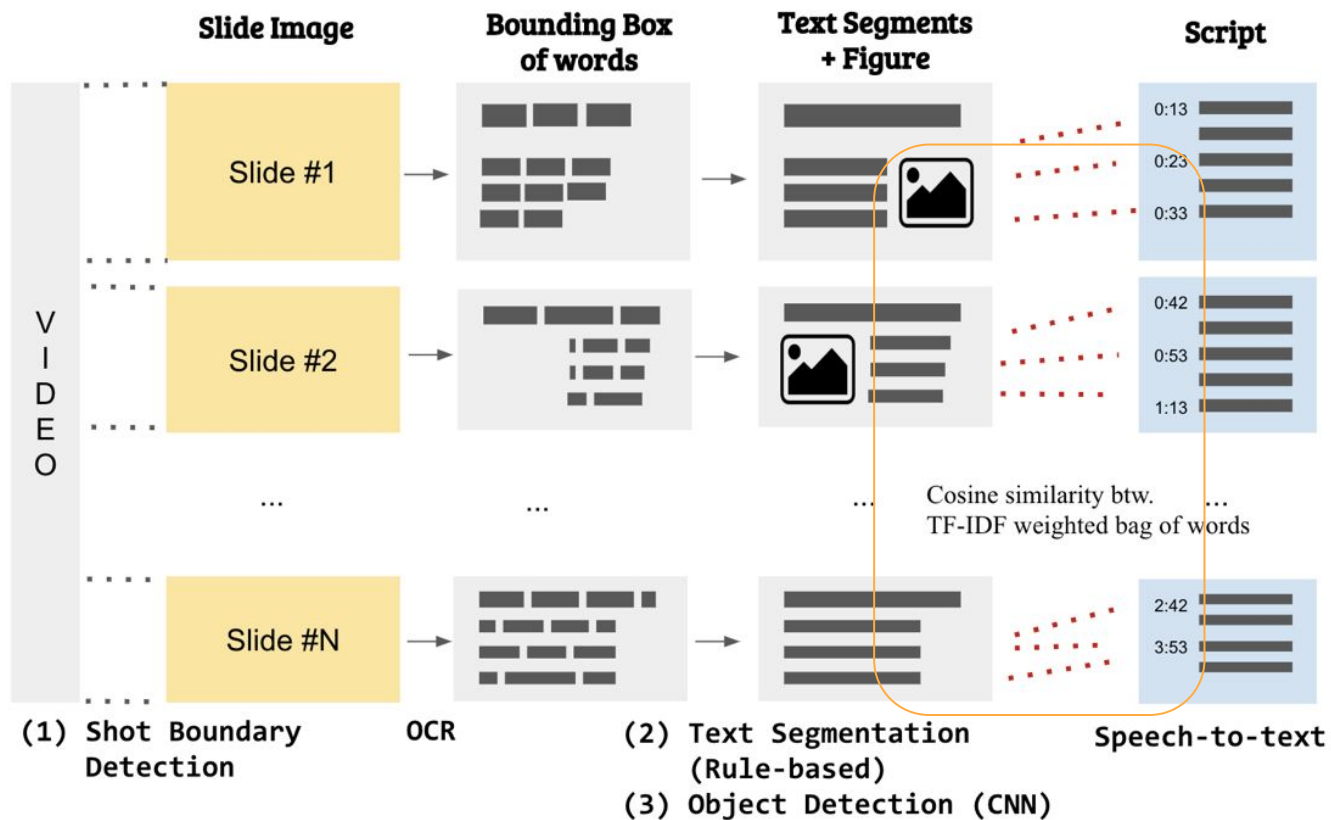
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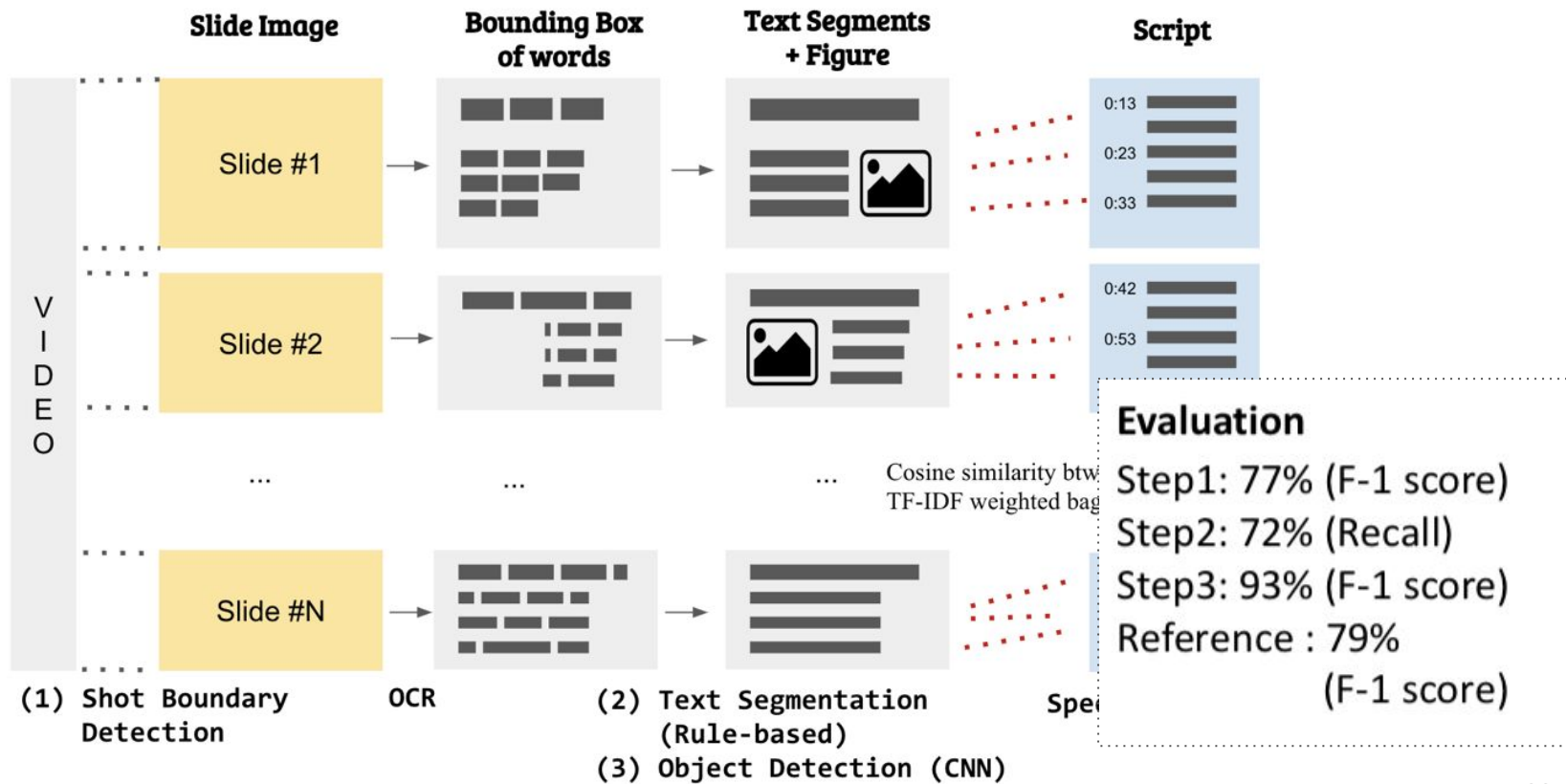
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# Computational Pipeline



# User Study (n=12)

**Attribute Values**

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0:58 Temperature and height are both often given as floating point values, as decimal values.

1:05 So the properties of our attributes can also be different.

1:11 Height, for instance, has a pretty practical maximum and minimum value, as does something like

Slides

#10366 4 - 6 #10371 7 - 12 #10377 13 - 145 #11093 146 - 288 #11253 289 - 1

Baseline

**Attribute Classification**

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POINTER

NONE  
HIDE  
BLUR  
POINTER

Slides Notes

3:53 Has real numbers as attribute values  
What about imaginary numbers?

DynamicSlide

1. Navigation -> Searching relevant part of the question
2. Cognitive load -> NASA-TLX

# User Study (n=12)

## Navigation task

(Time taken, seconds, shorter the better)

		Baseline	Ours
Answer is in the slide	Q1	26.3	15.9
	Q2	14.7	14.7
Answer is NOT in the slide	Q3	26.1	49.2
	Q4	29.5	16

## Cognitive Load

(NASA-TLX, 1~5, smaller the better)

	Baseline	Ours
Overall	3.2	3.1
Mental	3.5	3.2
Performance	3.0	3.0
Effort	3.5	3.2
Frustration	3.1	2.6



# Discussion

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The video player interface includes a progress bar at the bottom of the slide area, a "POINTER" dropdown menu with options "NONE", "HIDE", "BLUR", and "POINTER" (selected), and a "Subtitles" button. A timeline of subtitles is visible on the right side of the video player.

**Subtitles:**

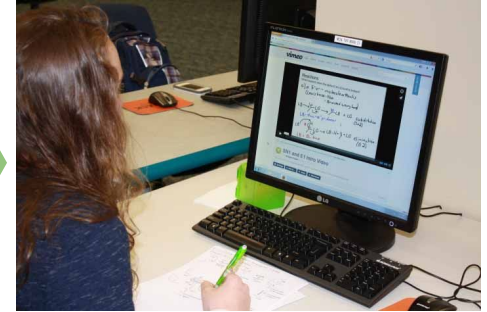
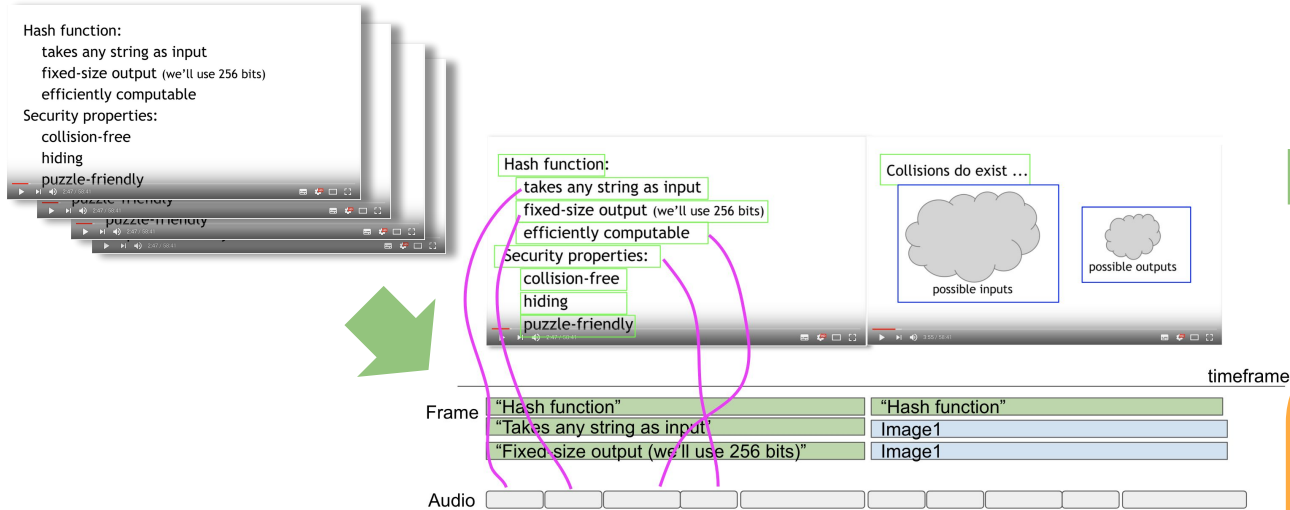
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- 3:36 And those kinds of columns are sort of a special case.
- 3:40 In some contexts, we really like them, they make things easier.

At the bottom of the video player, a subtitle is displayed: "3:53 Has real numbers as attribute values. What about imaginary numbers?"

- How to robustly find link between slides and narrations?
- Do links commonly exist in lecture videos?
- The effect of finding and leveraging wrong link

# Object-oriented tools for both learners & instructors

For Students (Player)



For Instructors  
(Lightweight editor)

# Lifespan of a lecture



t

# Lifespan of a lecture



- Update the content of slide
- Try different versions of explanation



# Lifespan of a lecture



- Update the content of slide
- Try different versions of explanation

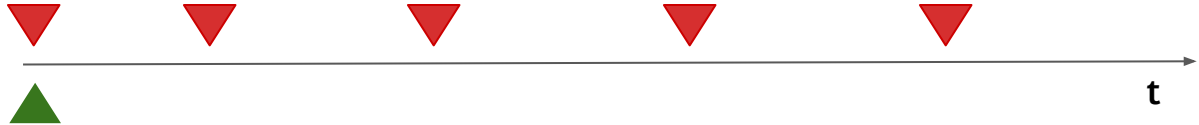


- Hard to update the published video

# Lifespan of a lecture



- Update the content of slide
- Try different versions of explanation



- Hard to update the published video

**How can we build a tool to help instructors directly update their video without having to patch and re-publish?**

# Formative study

Interviews with

7 **Instructors** who made lecture video  
(Professors + Part time)

3 **Video editors**  
(Content team at the university)

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1. Instructors want to edit the videos before and after publications
2. Editing cost is prohibitive
3. Editing often involves substituting the original (slide) contents



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Before

- Add supplementary content
- Highlight the text
- Cut part with mistakes

After

- Fix typo
- Fix figure

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Changing text (ABC -> CBA)



ABC

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Create patch

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Changing text (ABC -> CBA)



ABC

CBA

Create patch

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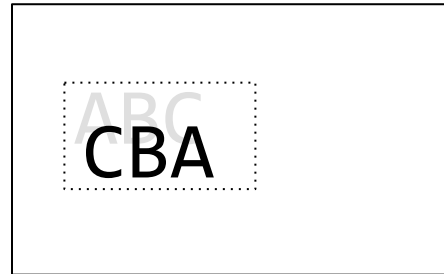
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Changing text (ABC -> CBA)



Overwrite + Adjust timing

# Design Goals

1. Provide an intuitive interface for instructors to directly edit their lecture videos
2. Enable users to update elements of the lecture slide within the video
3. Facilitate synchronization of visual and audio events in the video



# DynamicLecture

Editing interface for video #1 Save Load

Thumbnail 1: Lecture Title Slide

Thumbnail 2: Lecture Content Slide

Thumbnail 3: Lecture Content Slide

Thumbnail 4: Lecture Content Slide

Thumbnail 5: Lecture Content Slide

Thumbnail 6: Lecture Content Slide

Thumbnail 7: Lecture Content Slide

Thumbnail 8: Lecture Content Slide

Thumbnail 9: Lecture Content Slide

Thumbnail 10: Lecture Content Slide

## What is Public Economics?

- Public economics focuses on answering two types of questions
  - How do government policies affect the economy?
  - How should policies be designed to maximize welfare?
- Three motivations for studying these questions:
  - Practical Relevance
  - Academic Interest
  - Methodology

Please modify the text

Academic Taste

Public Economics Lectures

Part 1: Introduction

2 / 56

0:26 / 57:17

Play Pause

Add Content Add Animation

Add Image Add text

Size 15 | Font Color Palette | Background Color Palette

### Transcripts

0:25 So for instance if we have the Romney tax plan instead of the Obama tax plan at a very broad level.

0:30 What are the impacts going to be on the economy in terms of the number of people who are working the distribution of income and so forth.

0:39 How should we optimally design policies in order to maximize welfare?

0:44 So if we have our choice of different social welfare programs or education Finance policies are tax policies, which of these policies should we actually pick in practice in order to maximize economic

# DynamicLecture



# DynamicLecture

Editing interface for video #1

Save Load



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Public Economics Lectures Part 1: Introduction 2 / 56

Play Pause

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Add Content

Add Animation

Add Image

Add text

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## Transcripts

0:25 So for instance if we have the Romney tax plan instead of the Obama tax plan at a very broad level.



0:30 What are the impacts going to be on the economy in terms of the number of people who are working the distribution of income and so forth.



0:36 Second is a normative question.



0:39 How should we optimally design policies in order to maximize welfare?



0:44 So if we have our choice of different social welfare programs or education Finance policies are tax policies, which of these policies should we actually pick in practice in order to maximize economic

# DynamicLecture

Editing interface for video #1

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## What is Public Economics?

- Public economics focuses on answering two types of questions

- 1 How do government policies affect the economy?
- 2 How should policies be designed to maximize welfare?

- Three motivations for studying these questions:

- 1 Practical Relevance
- 2 Academic Interest
- 3 Methodology



Public Economics Lectures

Part 1: Introduction

2 / 56

Play Pause

0:26 / 57:17

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## Record Audio

Please press the stop button after recording your voice.

Start Recording

0:00

Second is a normative question.

this is new text

Fix

How should we optimally design policies in order to maximize welfare?

Save

Cancel

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What is Public Economics?

Transcripts

Animation Timings

Animation Type

☒ HIGHLIGHT ☐ MAGNIFY ☐ APPEAR

Please select when the animation start and ends by clicking buttons between words

Save Cancel

1:47

so there you have a clause.  
I am hungry now **START** phrase  
it's just a group of words  
that does not contain a  
subject or a verb that  
compliment each other **END** for  
example.

Clauses and Phrases

- A clause is a group of words that contains both a subject and a verb that complement each other.
- A phrase is a group of words that does not contain a subject or a verb that complement each other.

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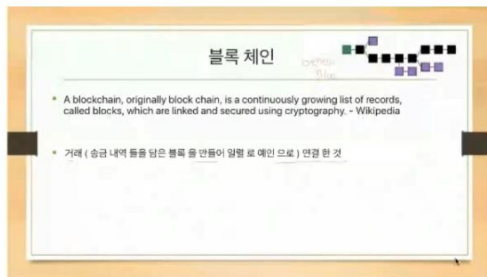
# Evaluation

1. Instructors review their lecture videos, then list up improvement items
2. Inststructors fix their video using the system



# Result

1. Instructors review their lecture videos, then list up improvement items
2. Inststructors fix their video using the system



return vs. print

```
# 태어난 연도를 받아 나이를 리턴
def calculate_age(year_of_birth):
    this_year = 2018
    return this_year - year_of_birth + 1

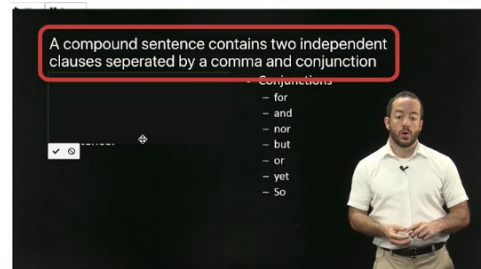
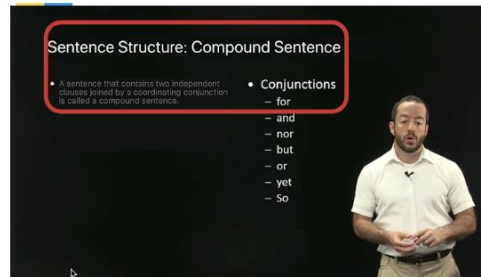
age = calculate_age(1988) 인자
```

return vs. print

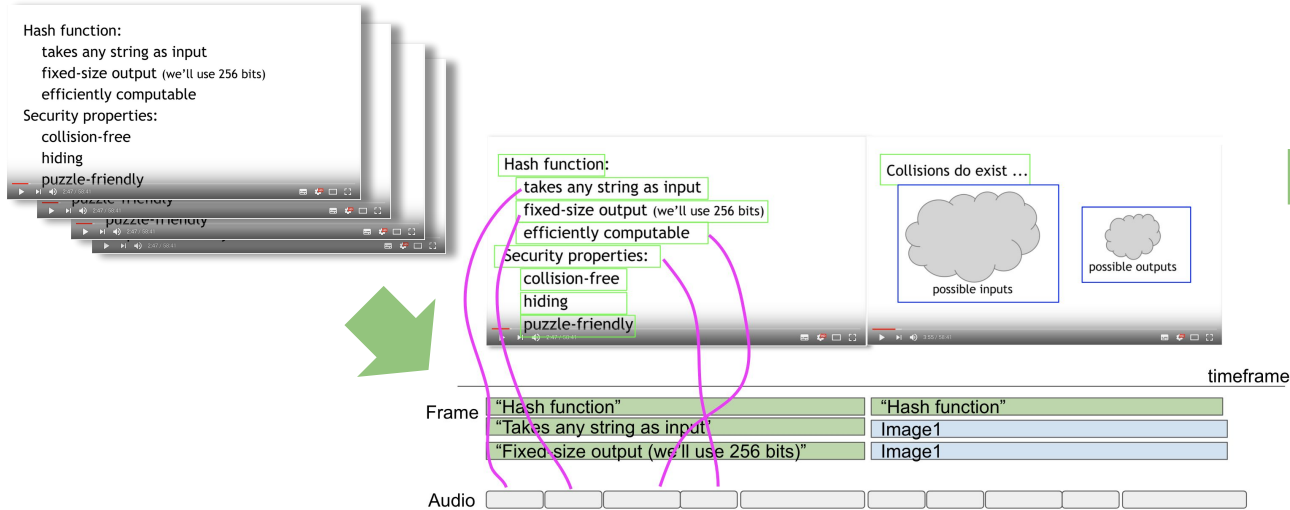
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```

2018 - 1988 + 1 = 31

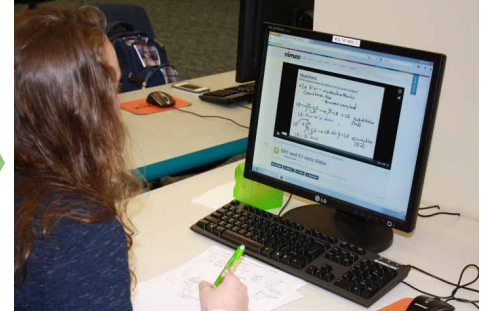


# Conclusion



1. *Parsing* videos into objects can improve the way we interact, consume, & create lecture videos.
2. We need to explore novel object-based video interaction techniques. ( e.g., participatory video improvement by learners)

For Students (Player)



For Instructors  
(Lightweight editor)