Computational Photography

Dr. Irfan Essa
Professor
School of Interactive Computing

Study the basics of computation and its impact on the entire workflow of photography, from capturing, manipulating and collaborating on, and sharing photographs.

Video Textures: (Part 1 of 2) How to Make a Video Texture?

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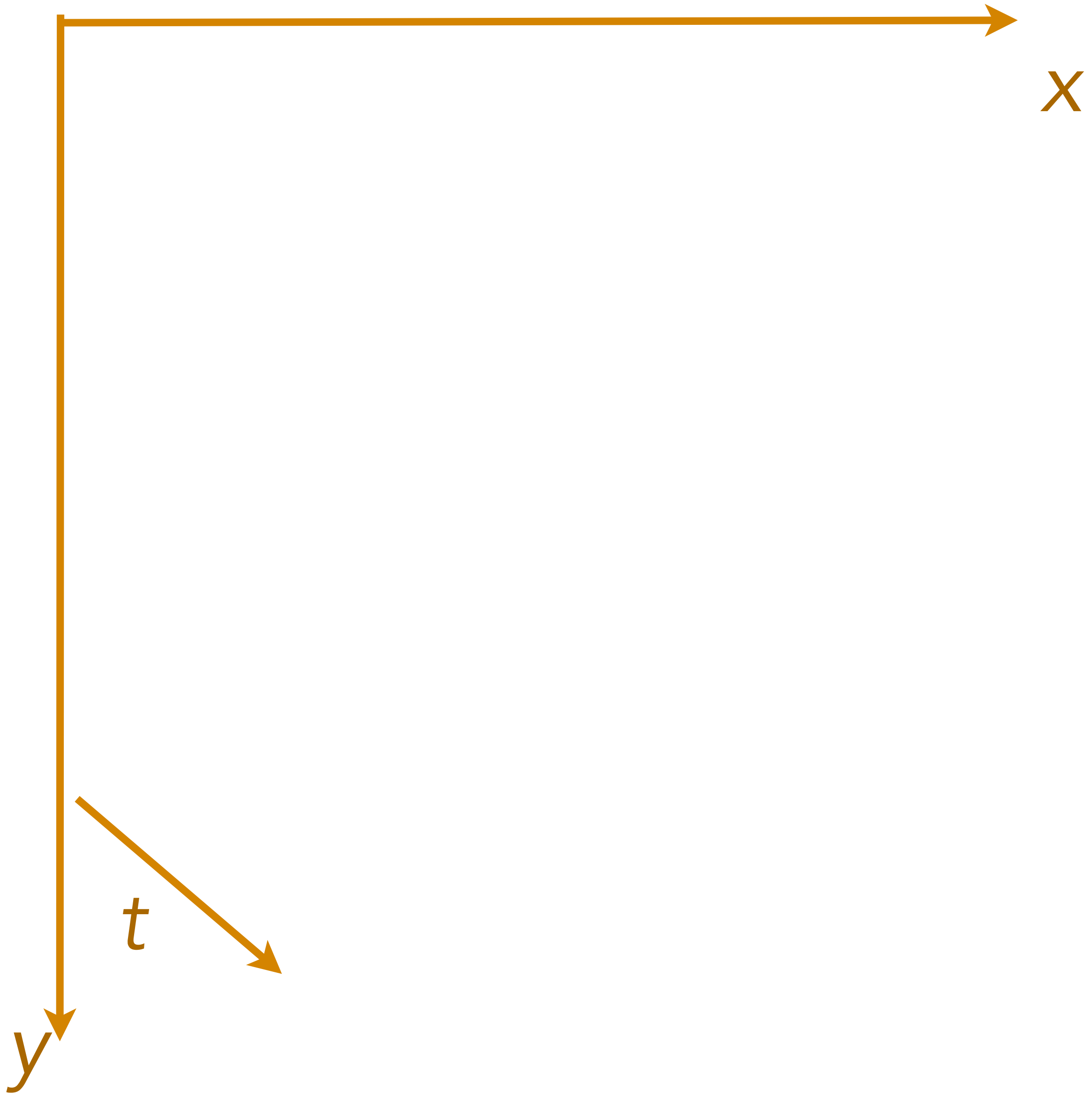
How can we find similar frames in a Video Volume to generate longer Videos?

Lesson Objectives

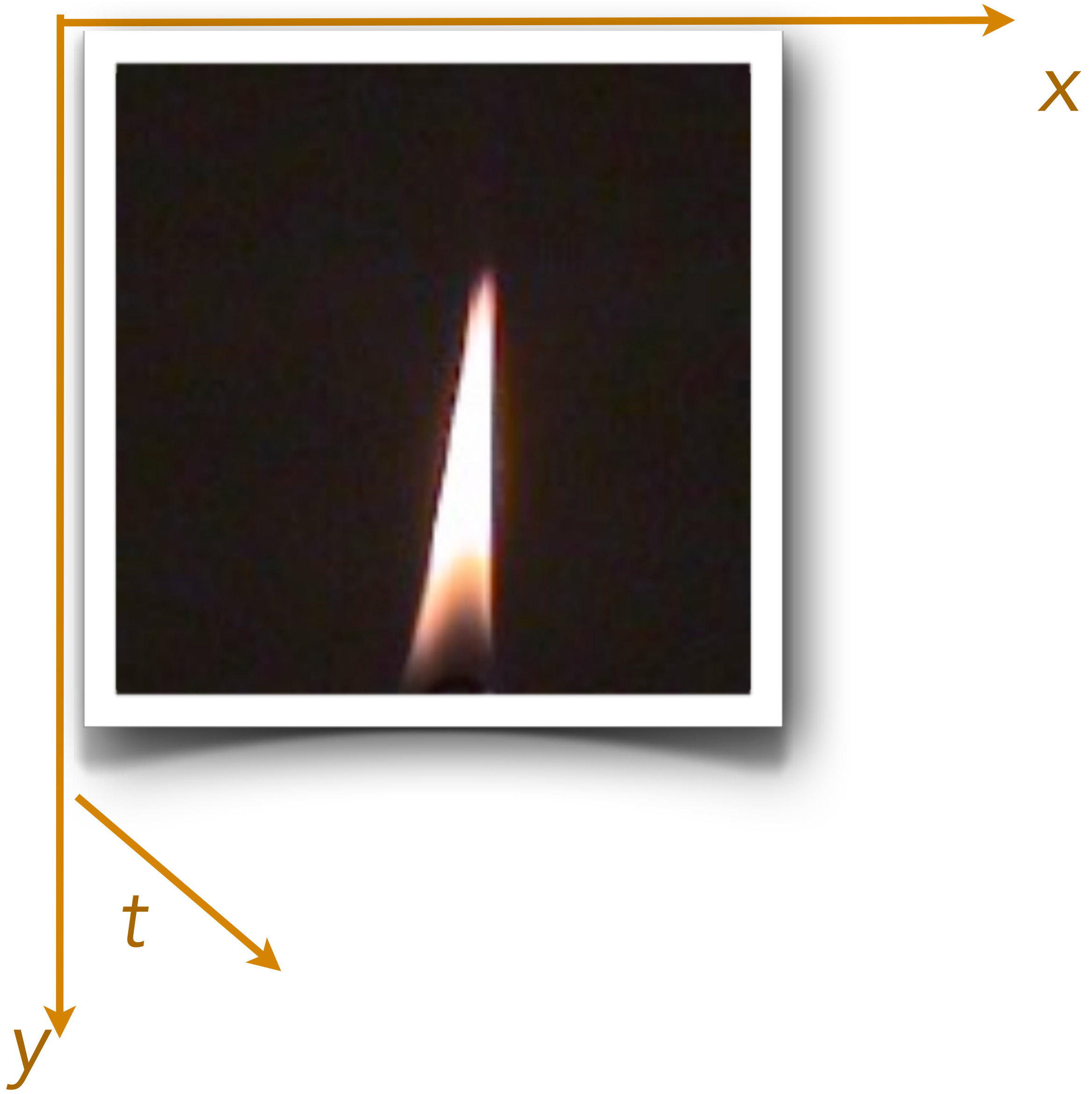
- ★ Explain in your own words the concept of a Video Texture.
- ★ Describe in your own words the two (2) methods used to compute similarity between frames.
- ★ Describe in your own words how similar frames are used to find transitions to generate Video Textures.

Review: VIDEO



- ★ "Digital" Video:
  - numeric representation in two-dimensions (*x* and *y*), stacked in time, *t*
  - referred to as *I(x,y,t)* in continuous function form, *I (i,j,t)* in discrete

Review: VIDEO



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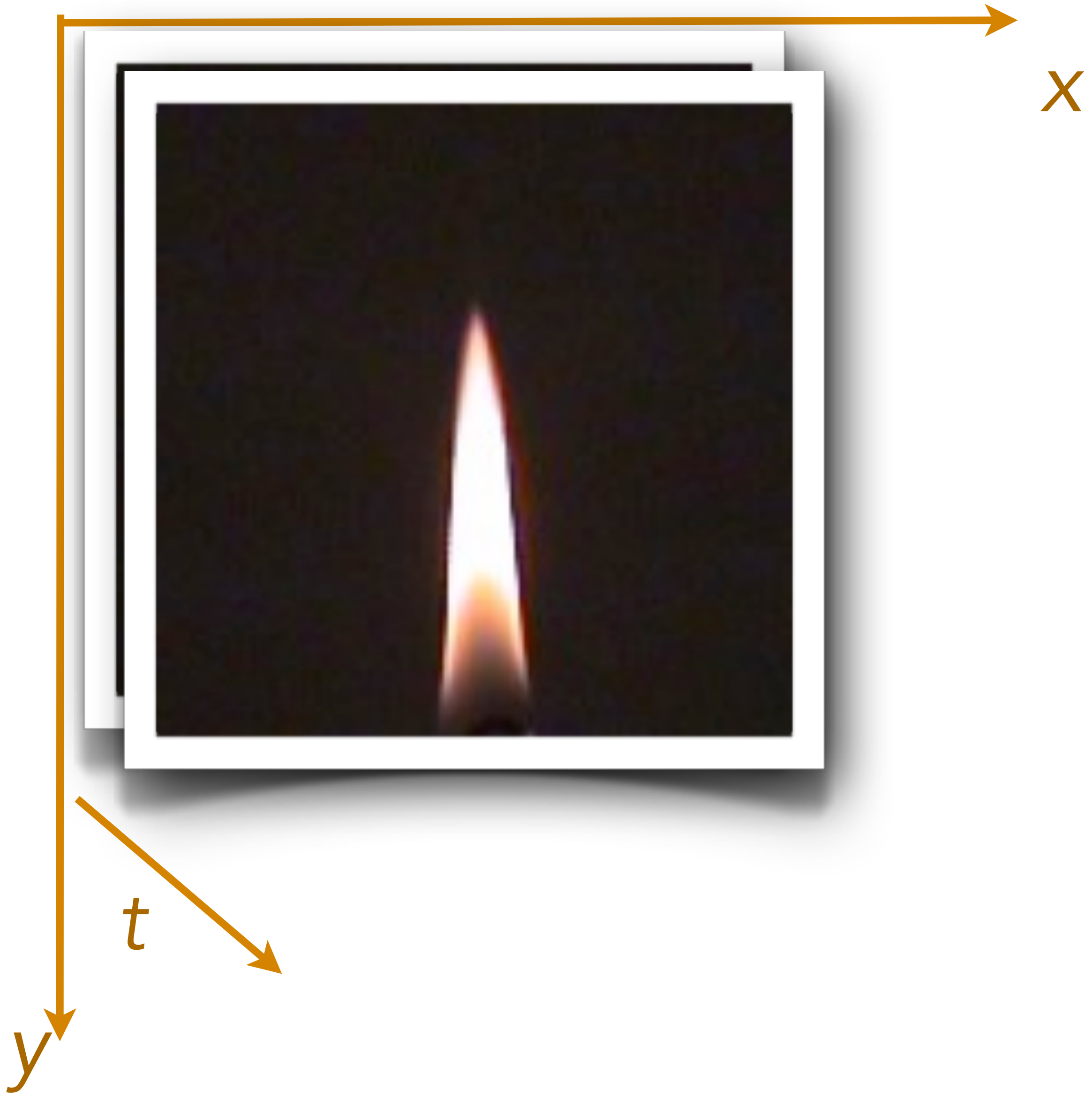

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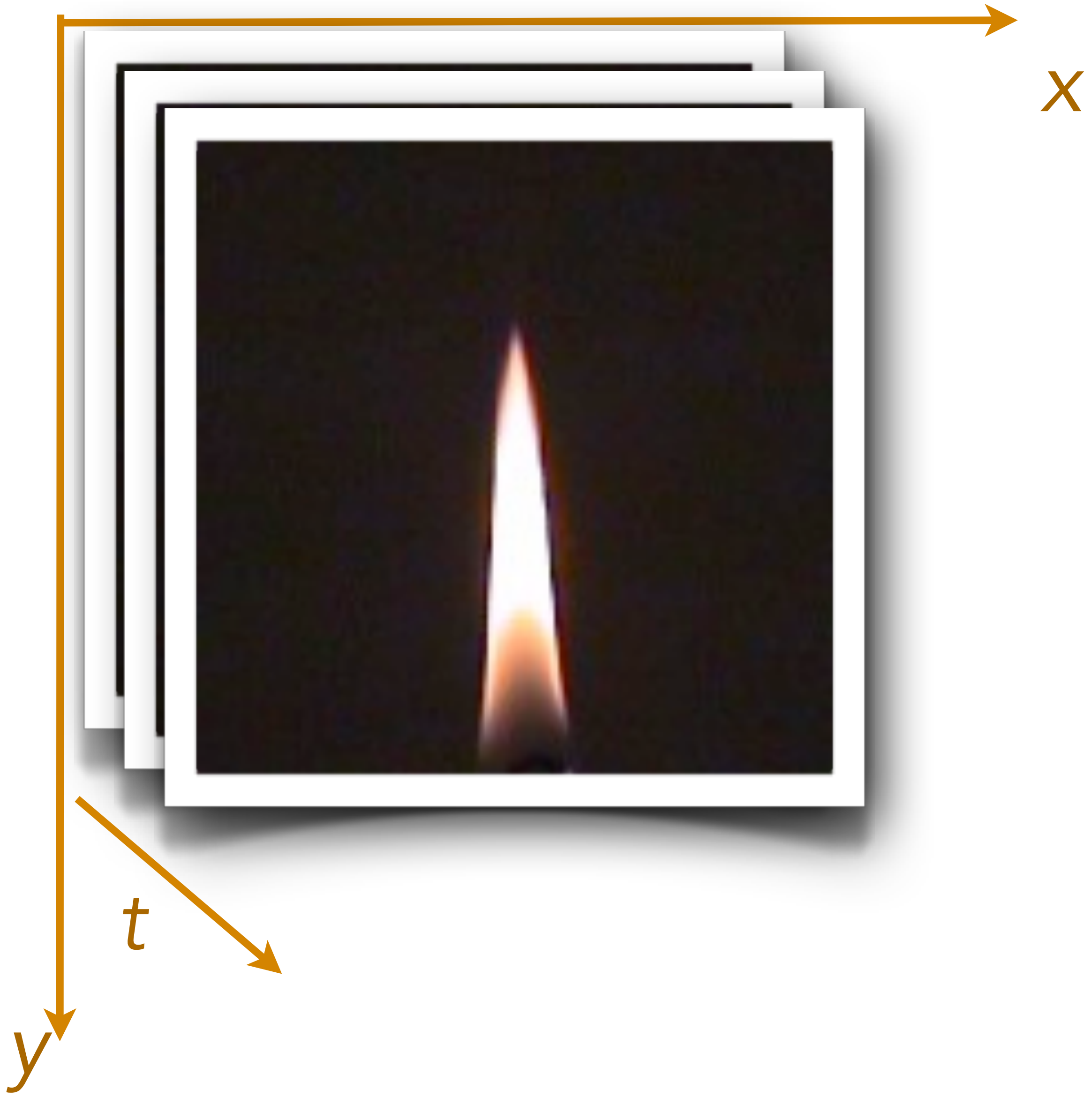

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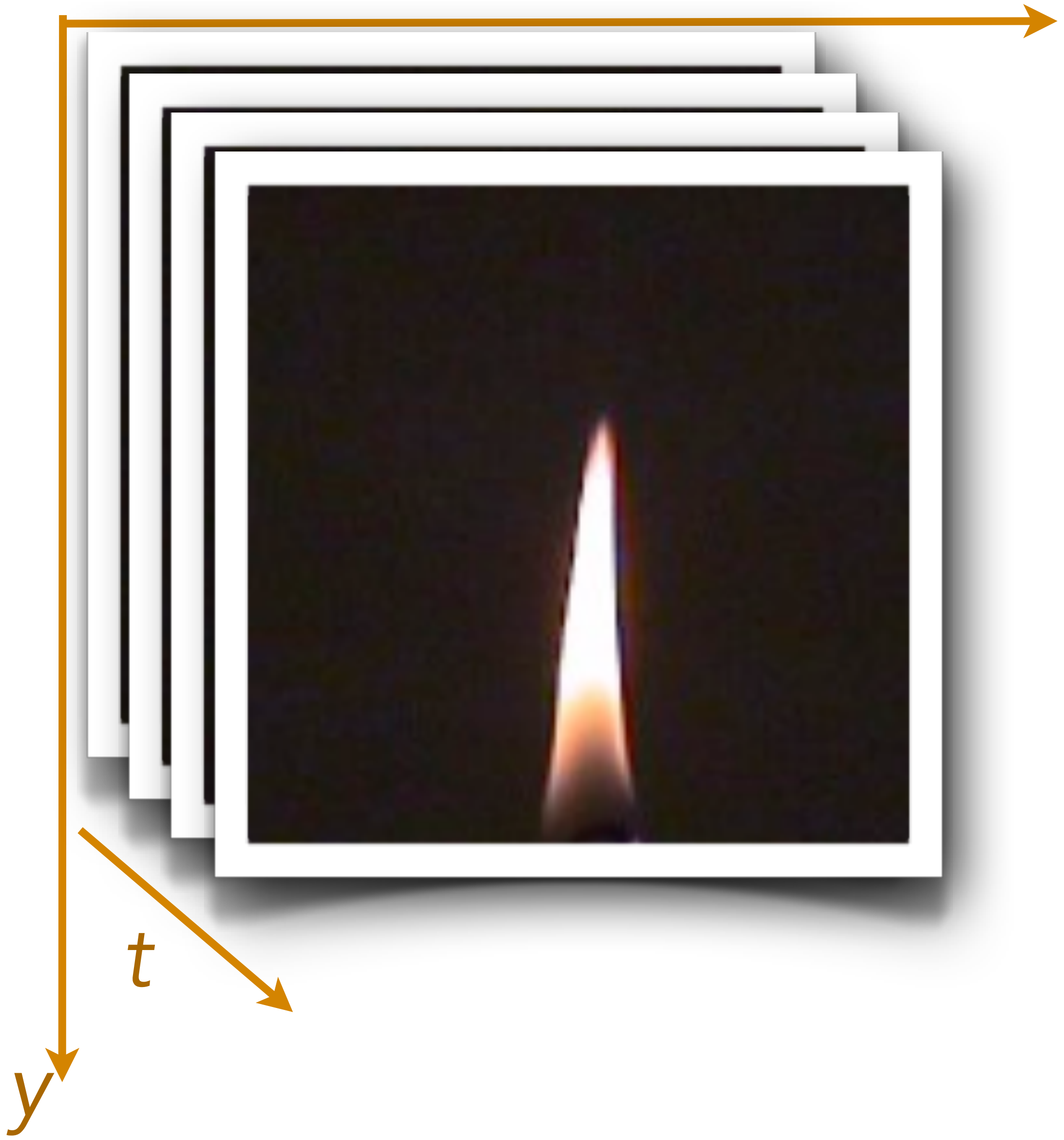

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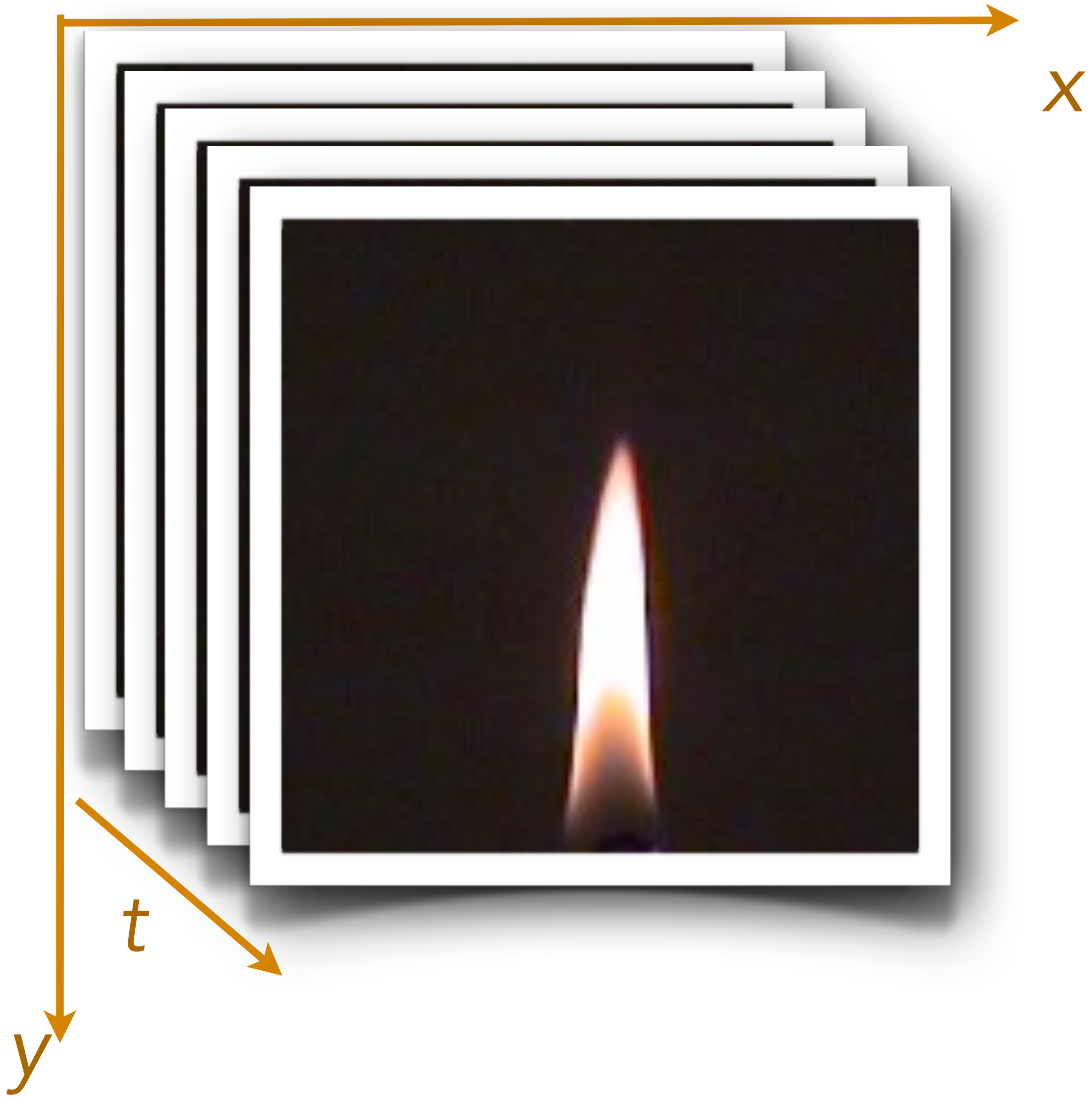

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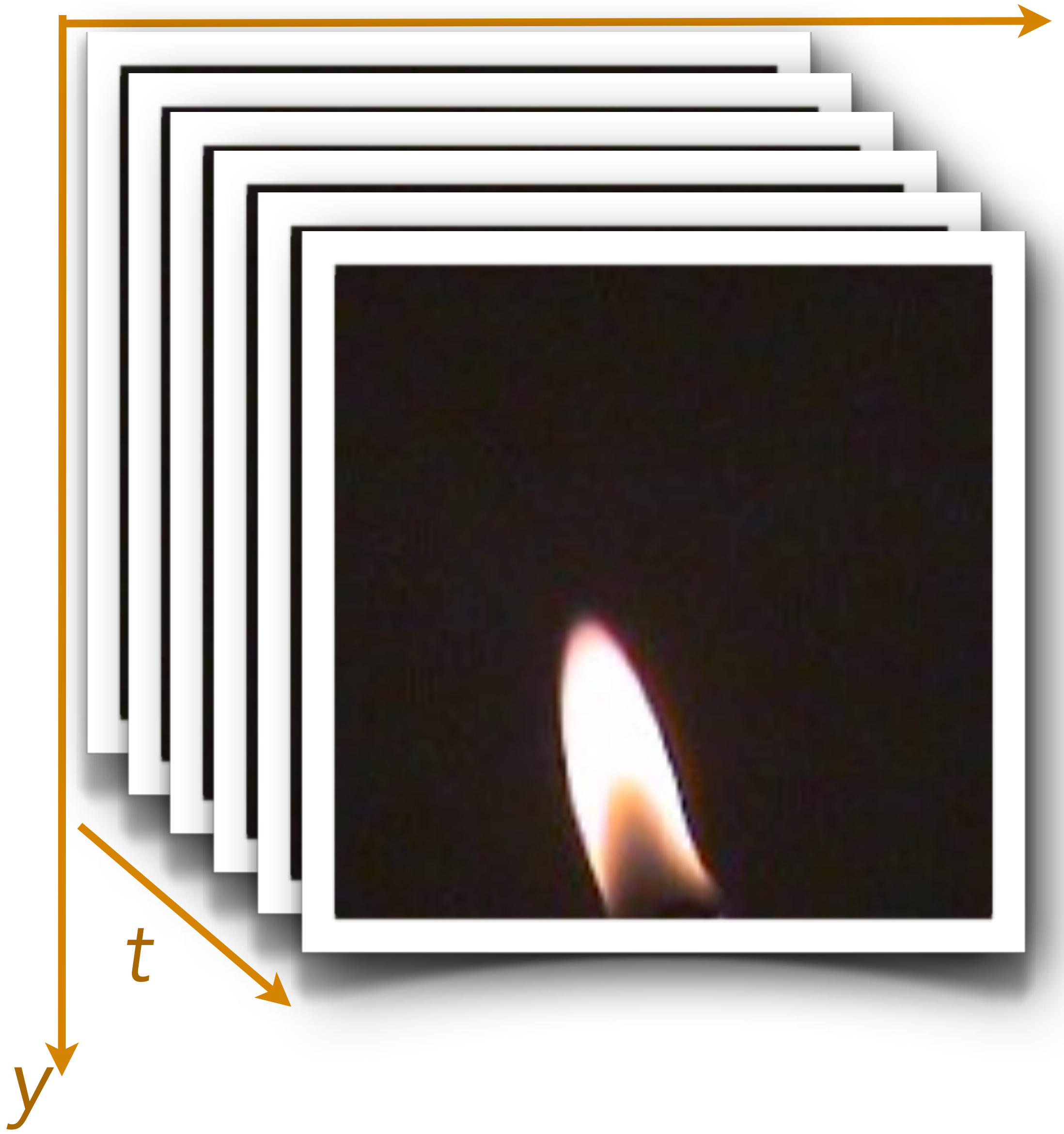

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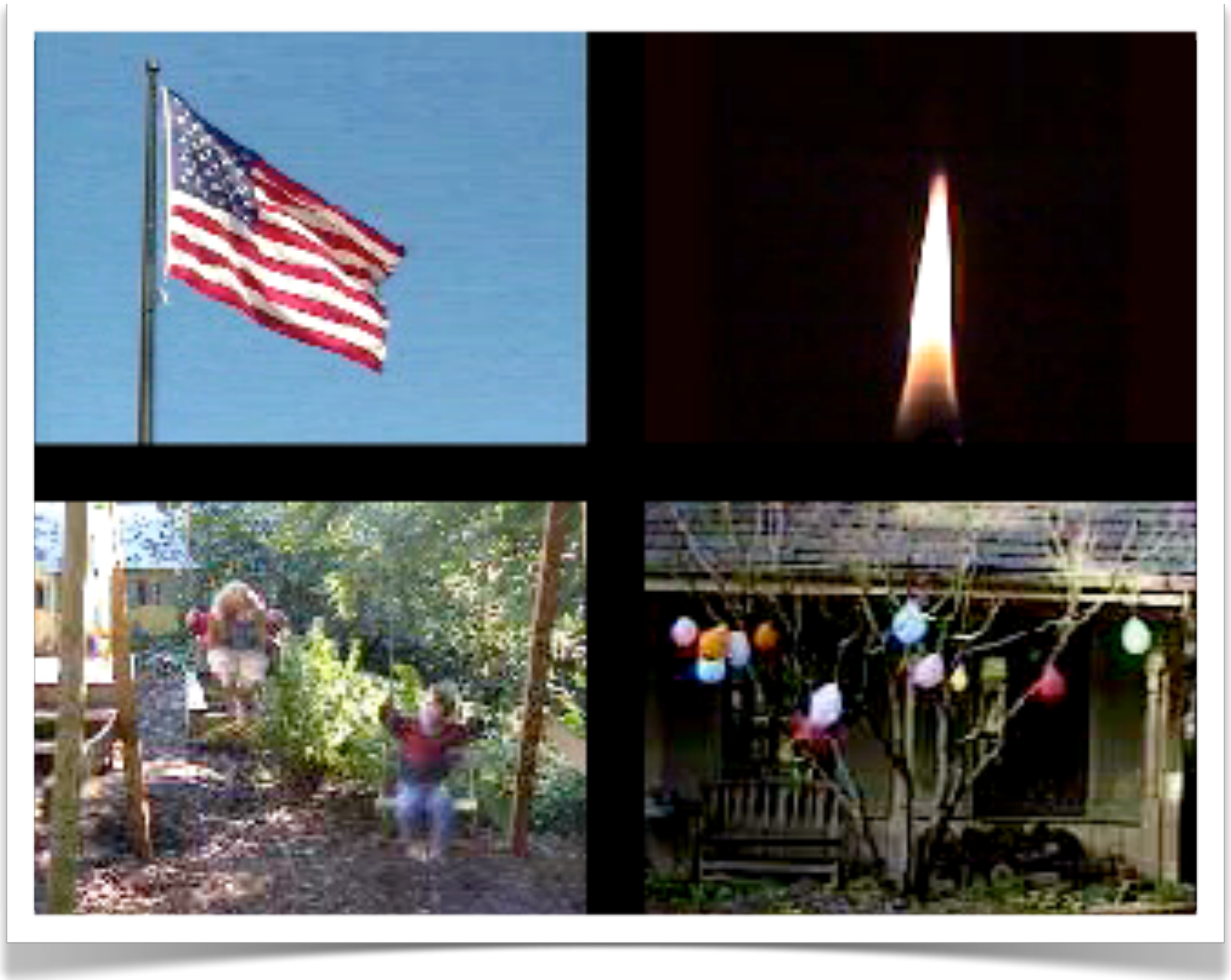
Video Textures

Still Pictures

Video Textures

Video Textures

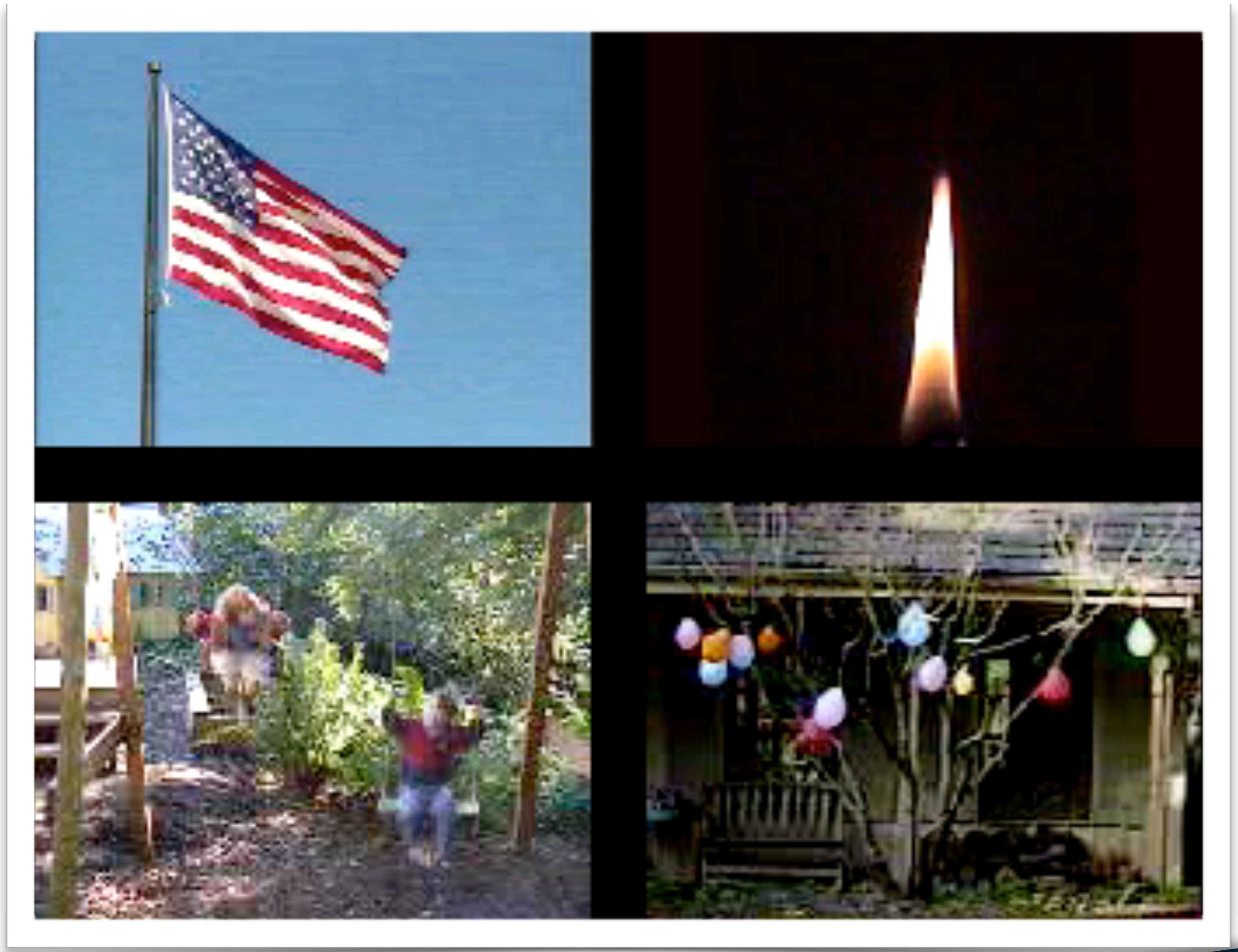
Looping Video



Video Textures

Schödl, Szeliski, Salesin, and Essa (2000)

Video Textures



Video Clip

Video Texture

Video Clip to Video Textures

Video Clip

Video Texture

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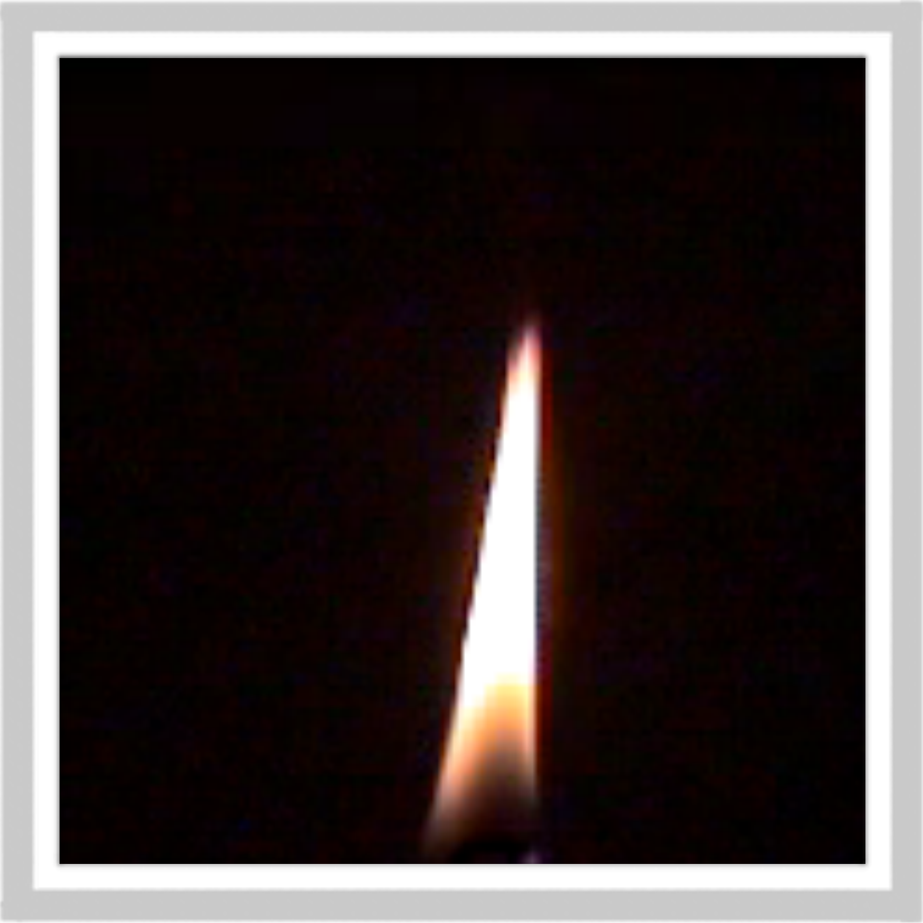
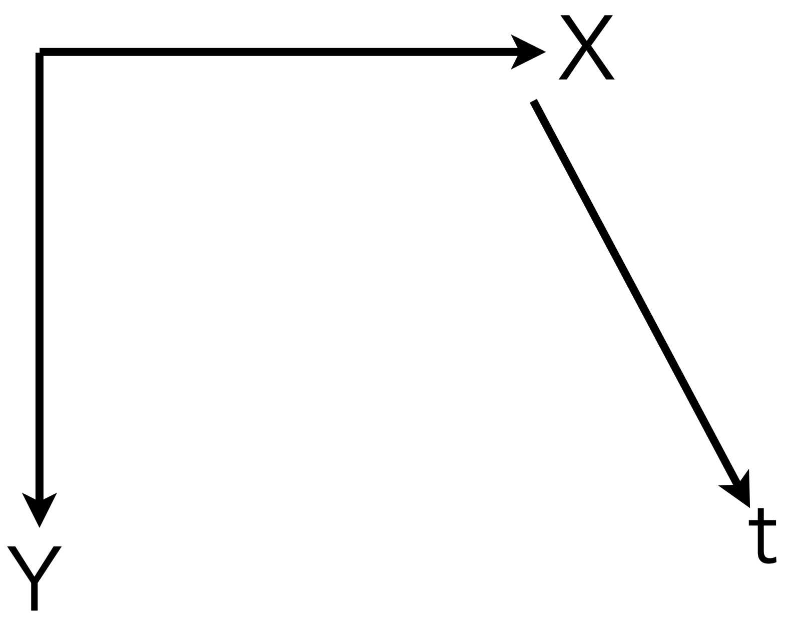
Video Clip



90 frames



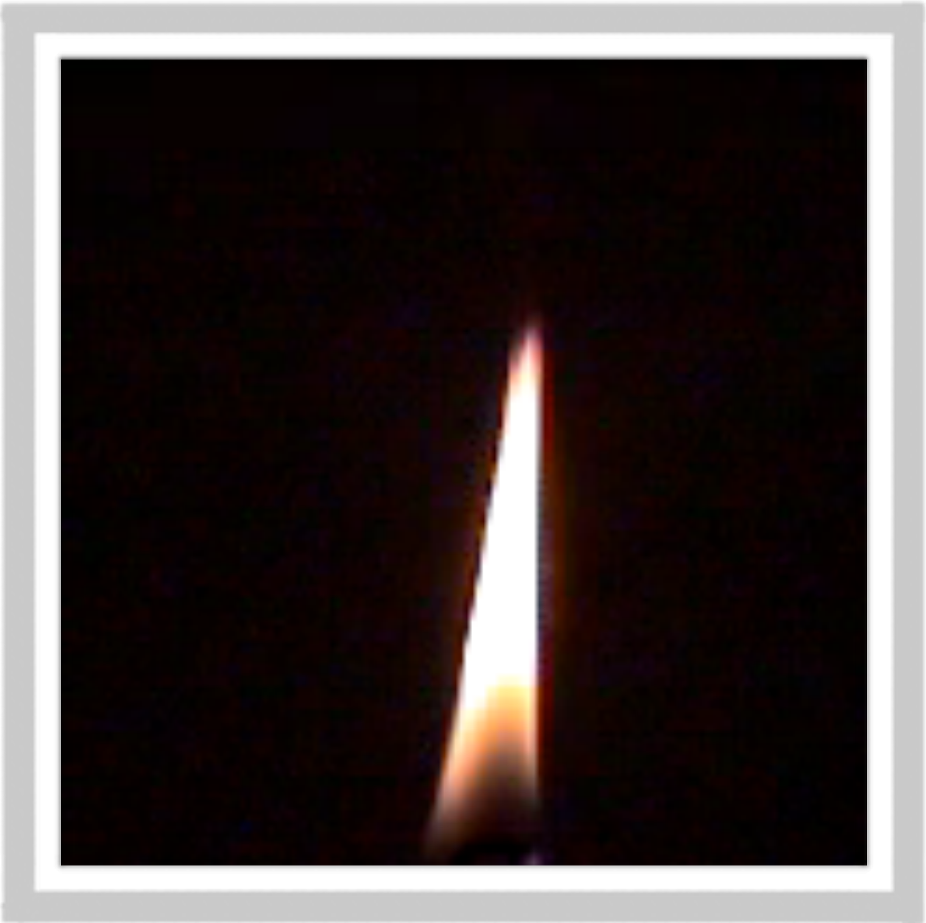
90 frames: f_1, f_2, f_3, ..., f_{90}

f_1

Compute how similar f_1 is to all frames: f_1, f_2, f_3, ..., f_{90}

Do this for all f_1, f_2, f_3, ..., f_{90}

Video Clip



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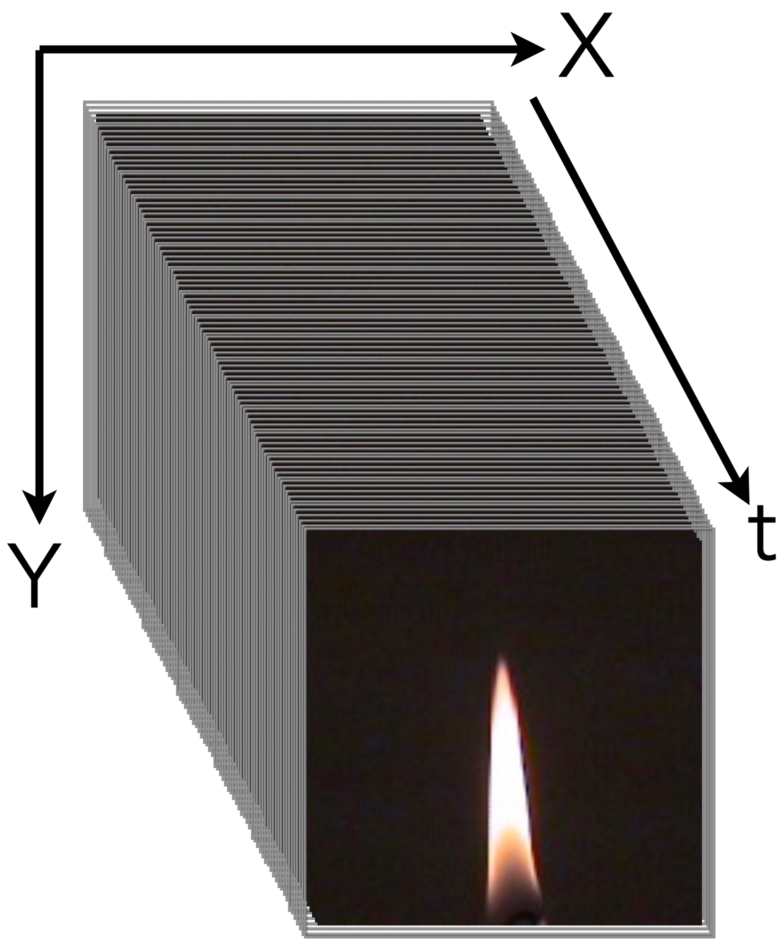

90 frames: f_1, f_2, f_3, ..., f_{90}

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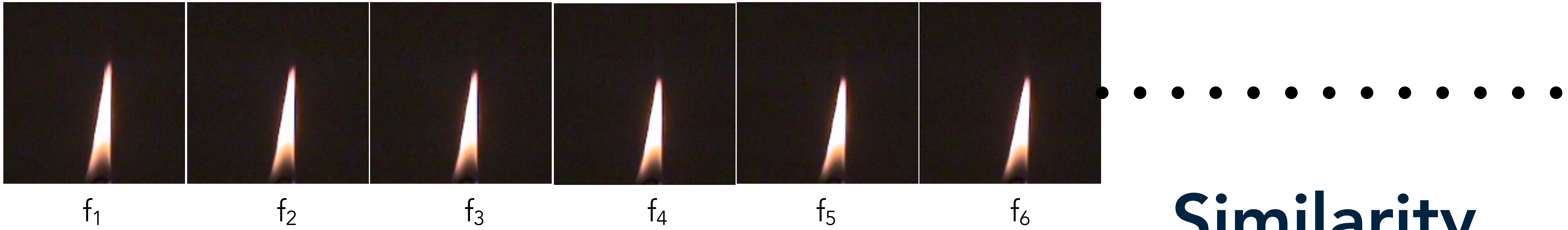
Video Clip to Video Textures

Similarity Metric (1)

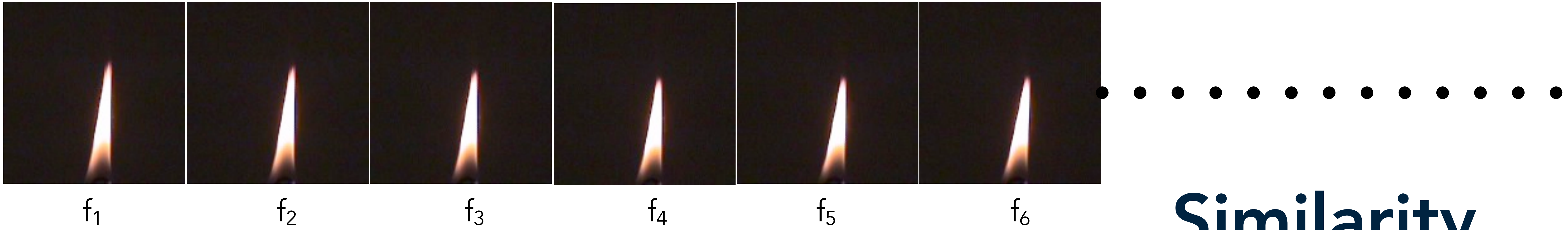


- ★ One method to compute similarity is to compute the Euclidean Distance between two Frames.
- ★ Consider two frames, $p = \{p_1, p_2, \ldots p_N\}$ and $q = \{q_1, q_2, \ldots q_N\}$

$$d_2(p, q) = \sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2 + \cdots + (p_n - q_n)^2}$$

$$d_2(p, q) = \sqrt{\sum_{i=1}^{N} (p_i - q_i)^2}$$

This distance metric is referred to as L^2 norm



Similarity Metric (2)

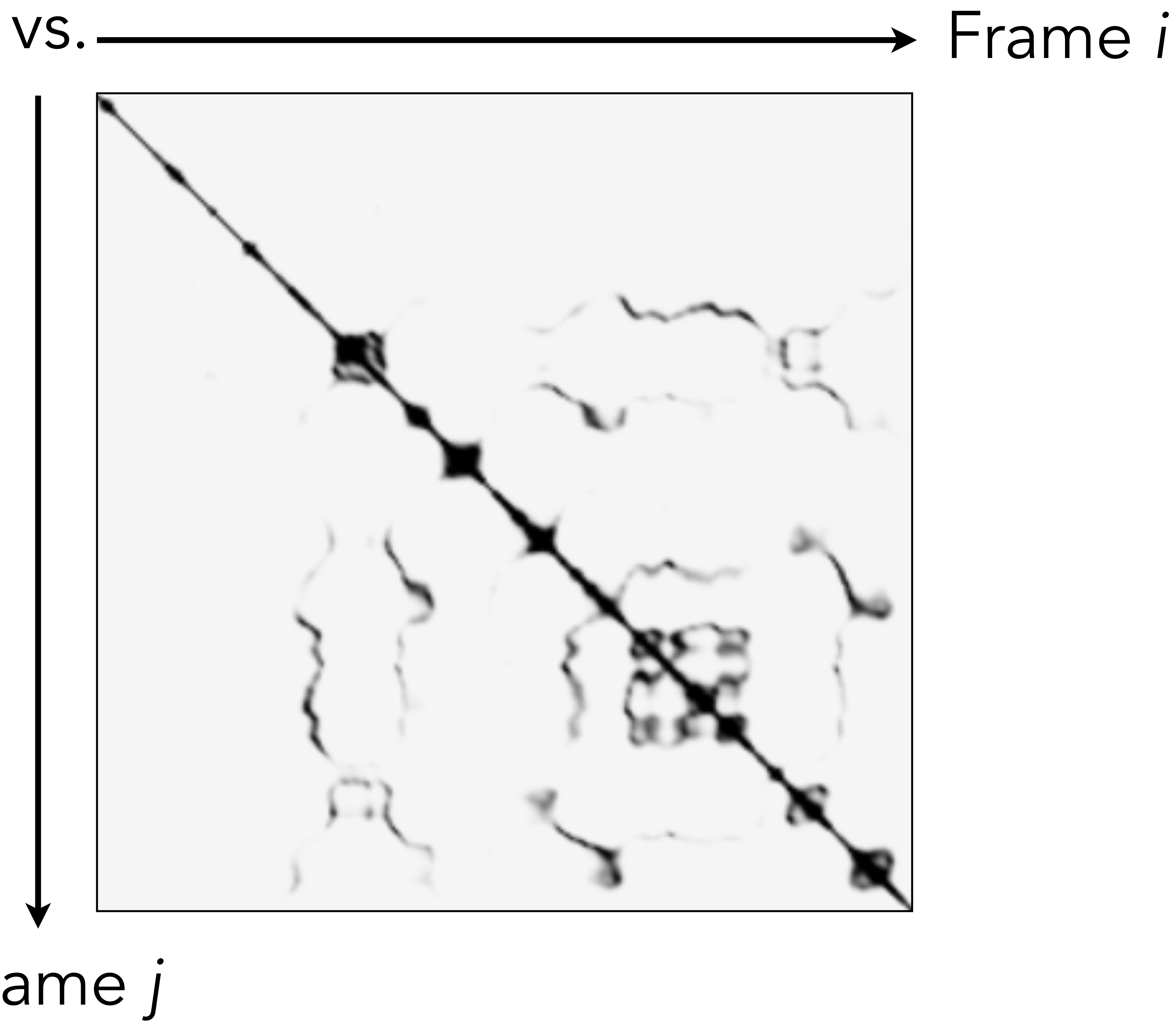
- ★ Another method to compute similarity is to compute the Manhattan Distance between two Frames.
- ★ Consider two frames, $p = \{p_1, p_2, \ldots p_N\}$ and $q = \{q_1, q_2, \ldots q_N\}$

$$d_1(p,q) = (p_1 - q_1) + (p_2 - q_2) + \cdots + (p_n - q_n)$$

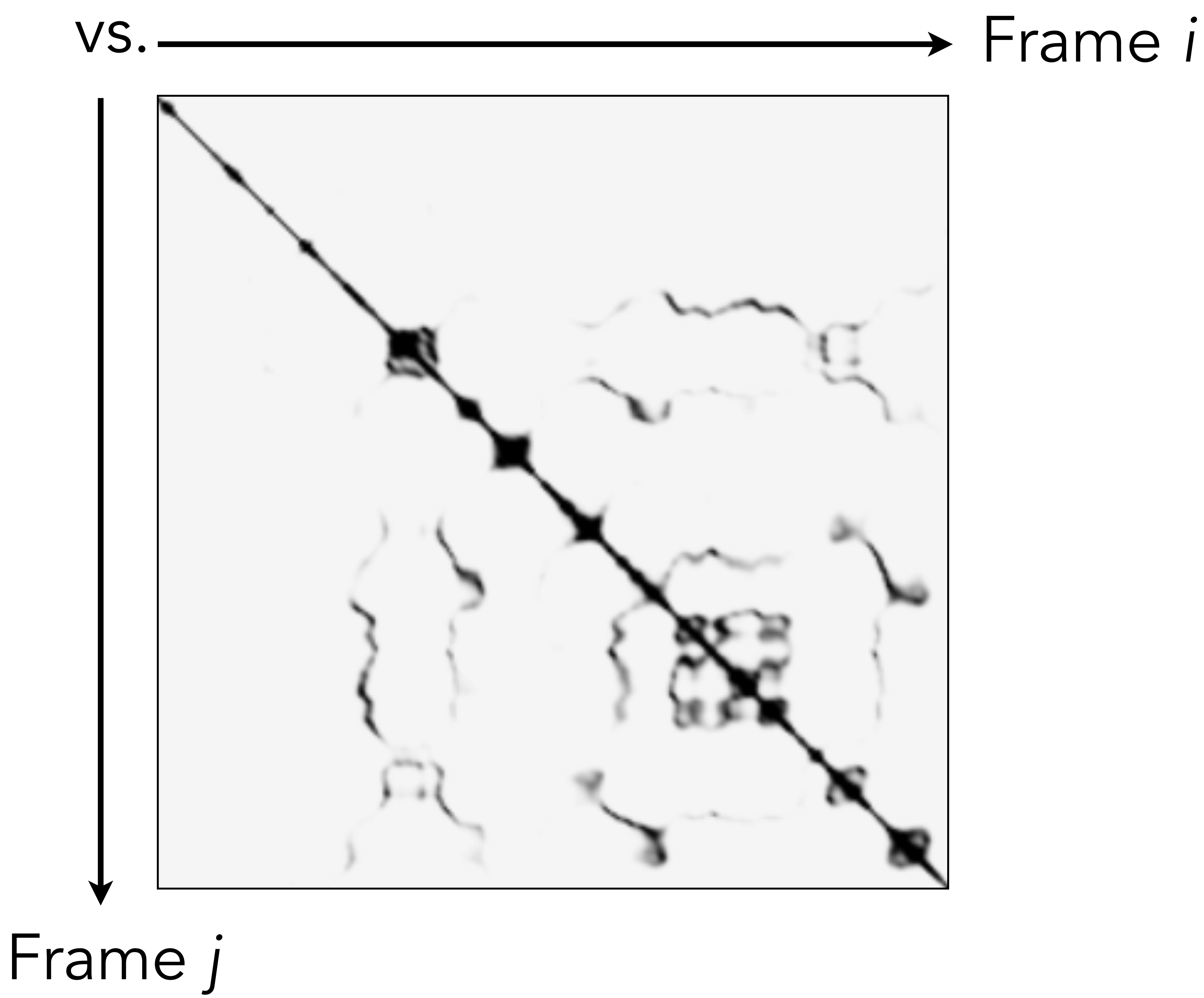
$$d_1(p,q) = \sum_{i=1}^{N} |p_i - q_i|$$

This distance metric is referred to as L^1 norm. (| .. | implies Absolute)

Finding Similar Frames

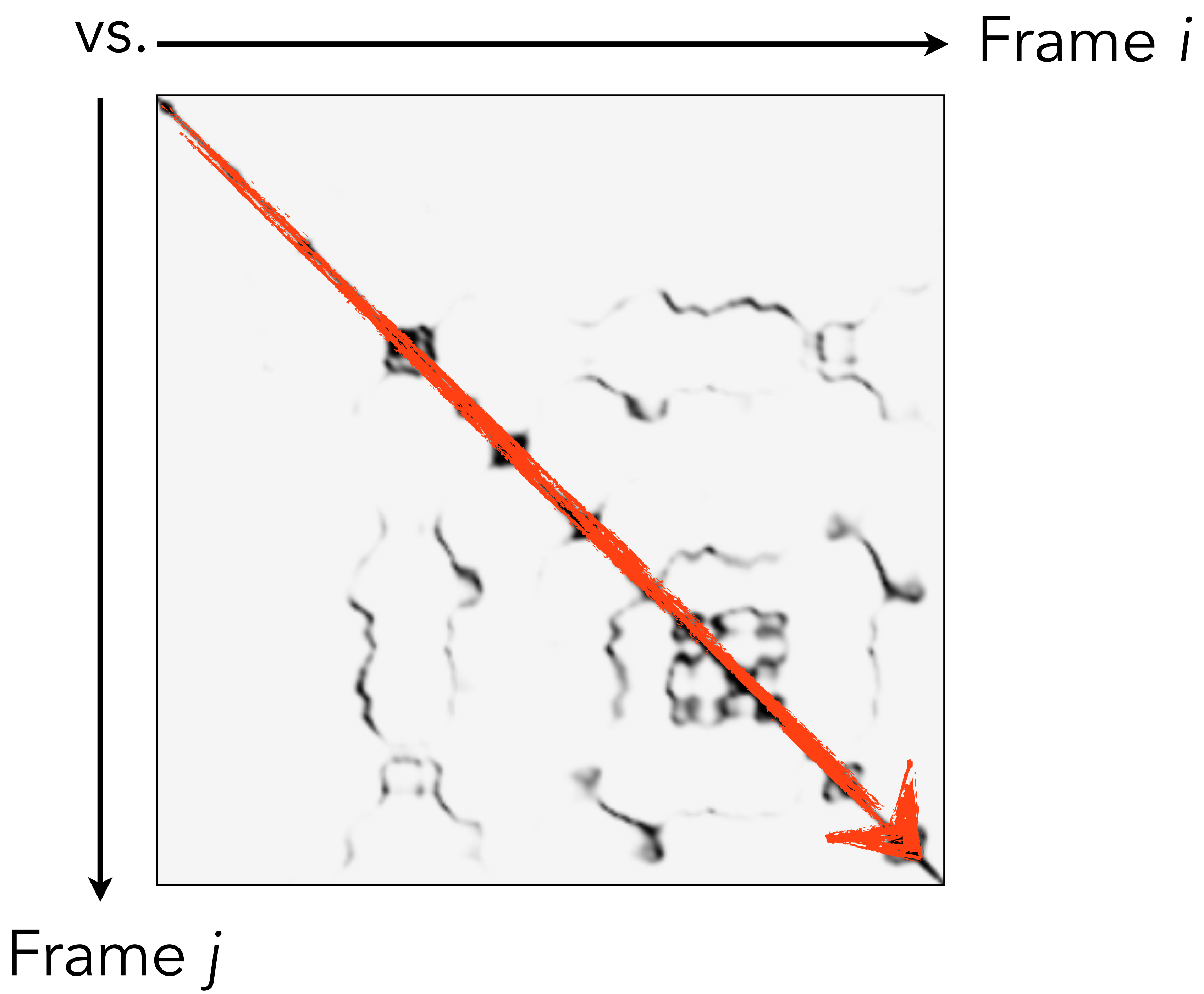


Finding Similar Frames



- Compute Euclidean Distance d_{ij} between all N Frames

Finding Similar Frames



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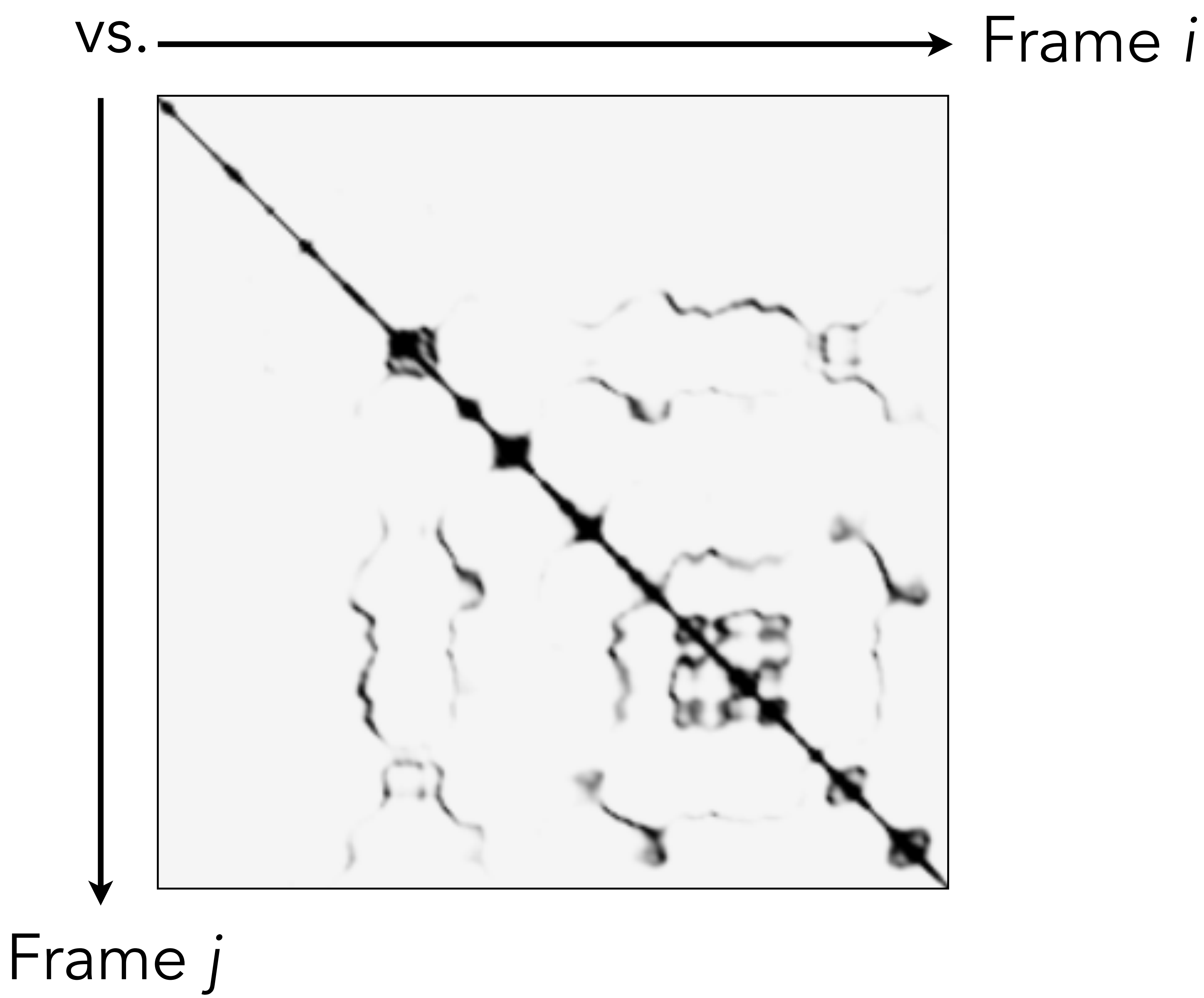

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Finding Similar Frames

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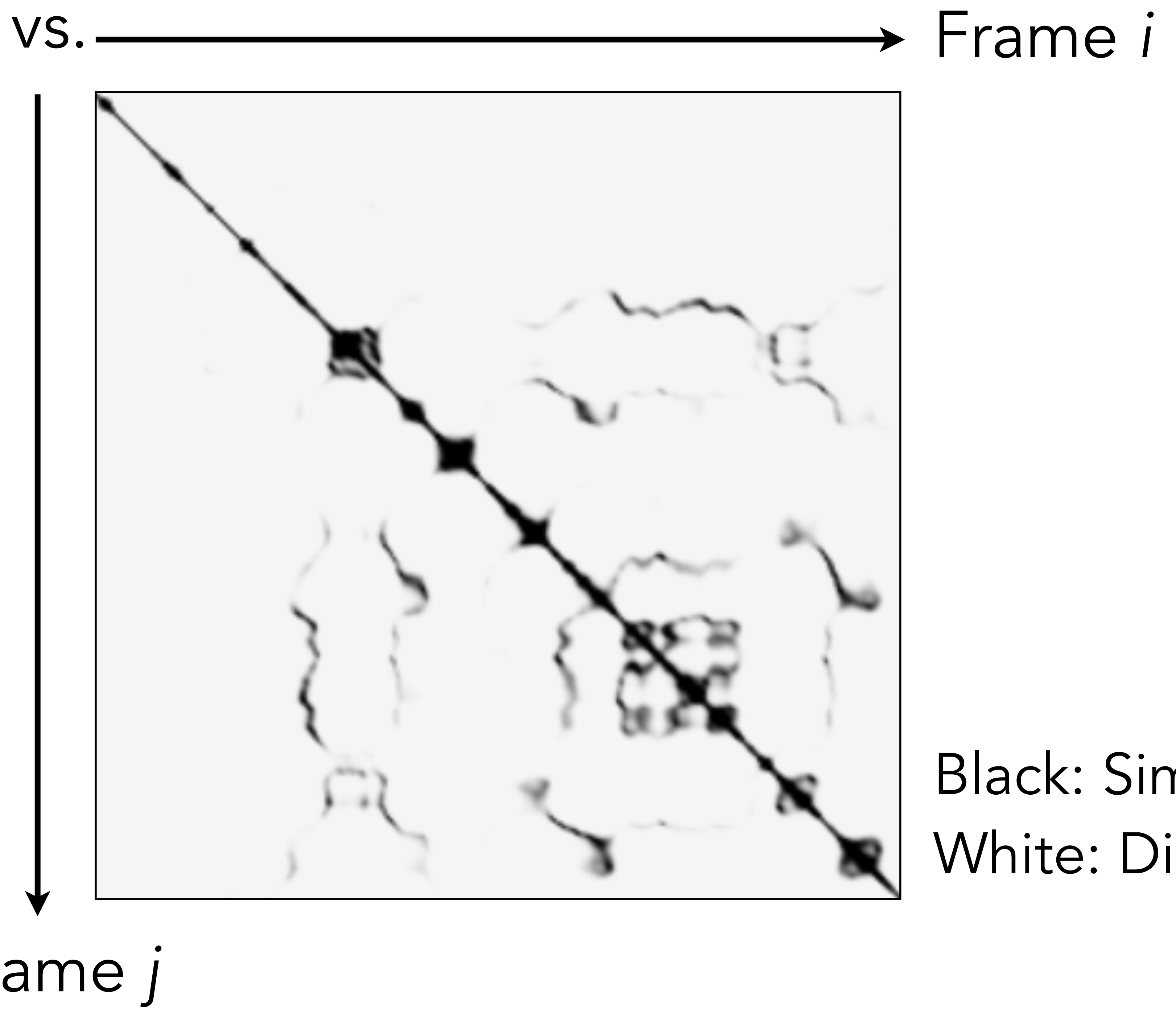
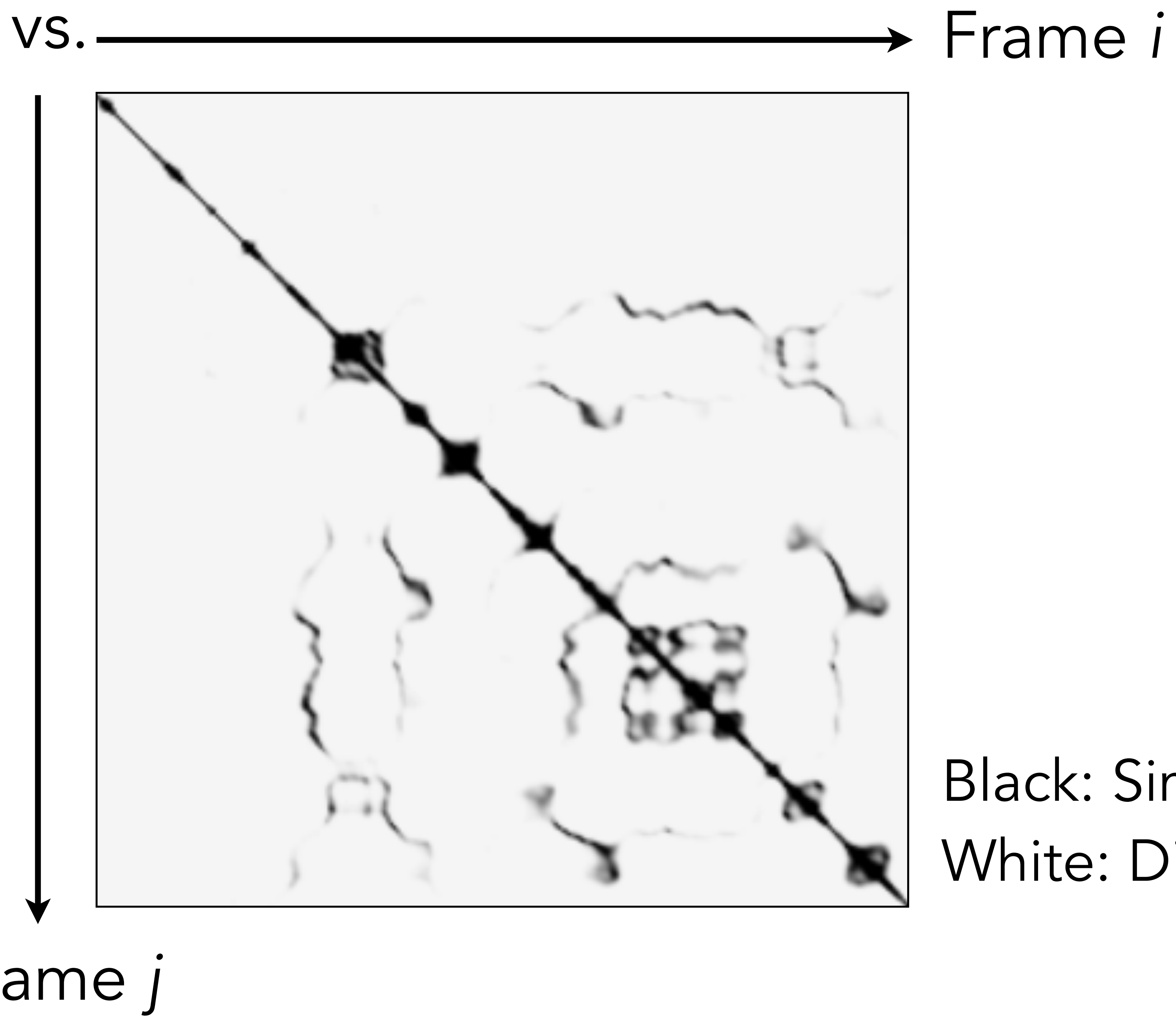


Black: Similar Frames

White: Dissimilar Frames

Finding Similar Frames

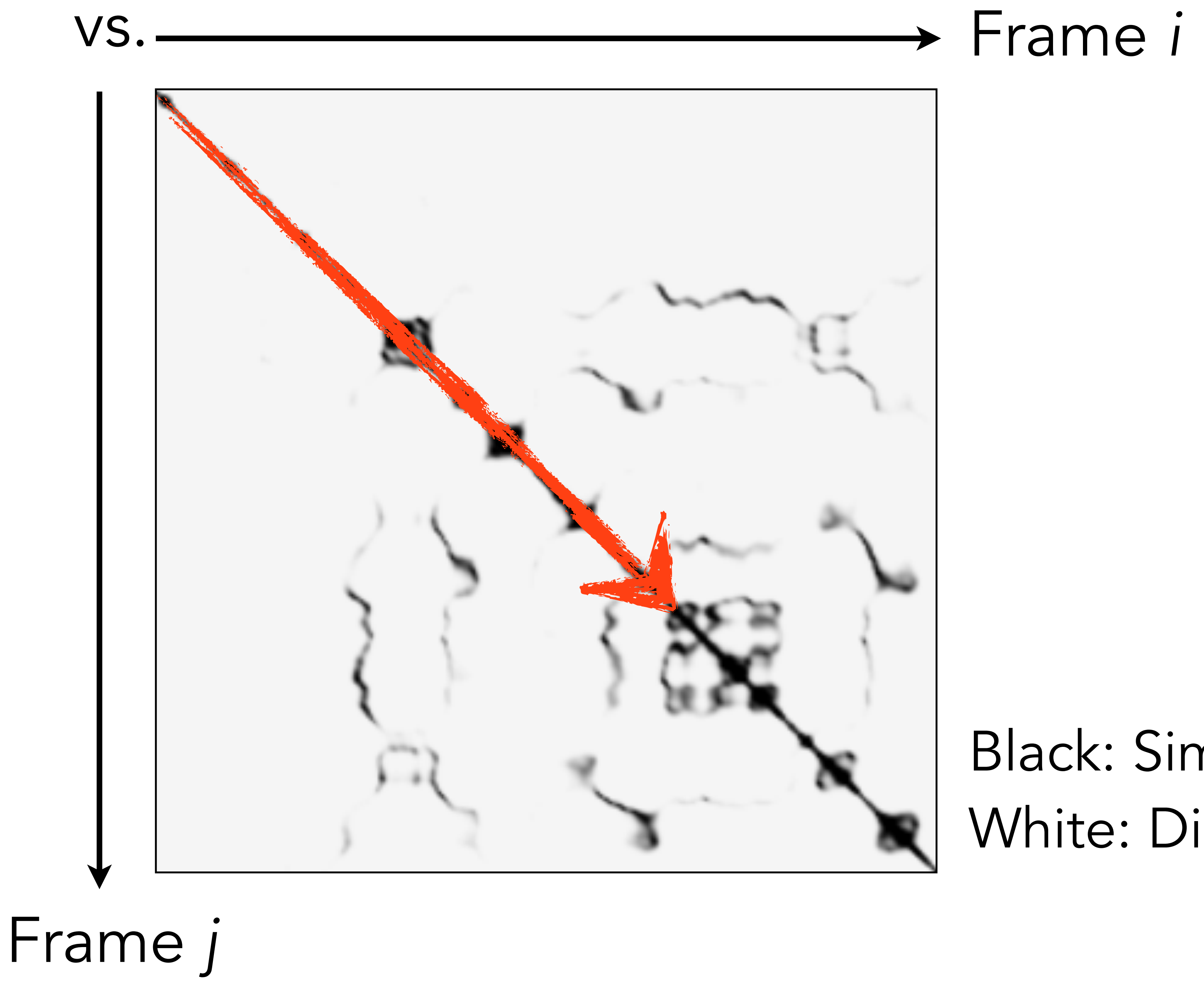


Black: Similar Frames

White: Dissimilar Frames

- ★ Compute Euclidean Distance d_{ij} between all N Frames
- ★ Similar frames are the ones that would be best to Jump to

Finding Similar Frames



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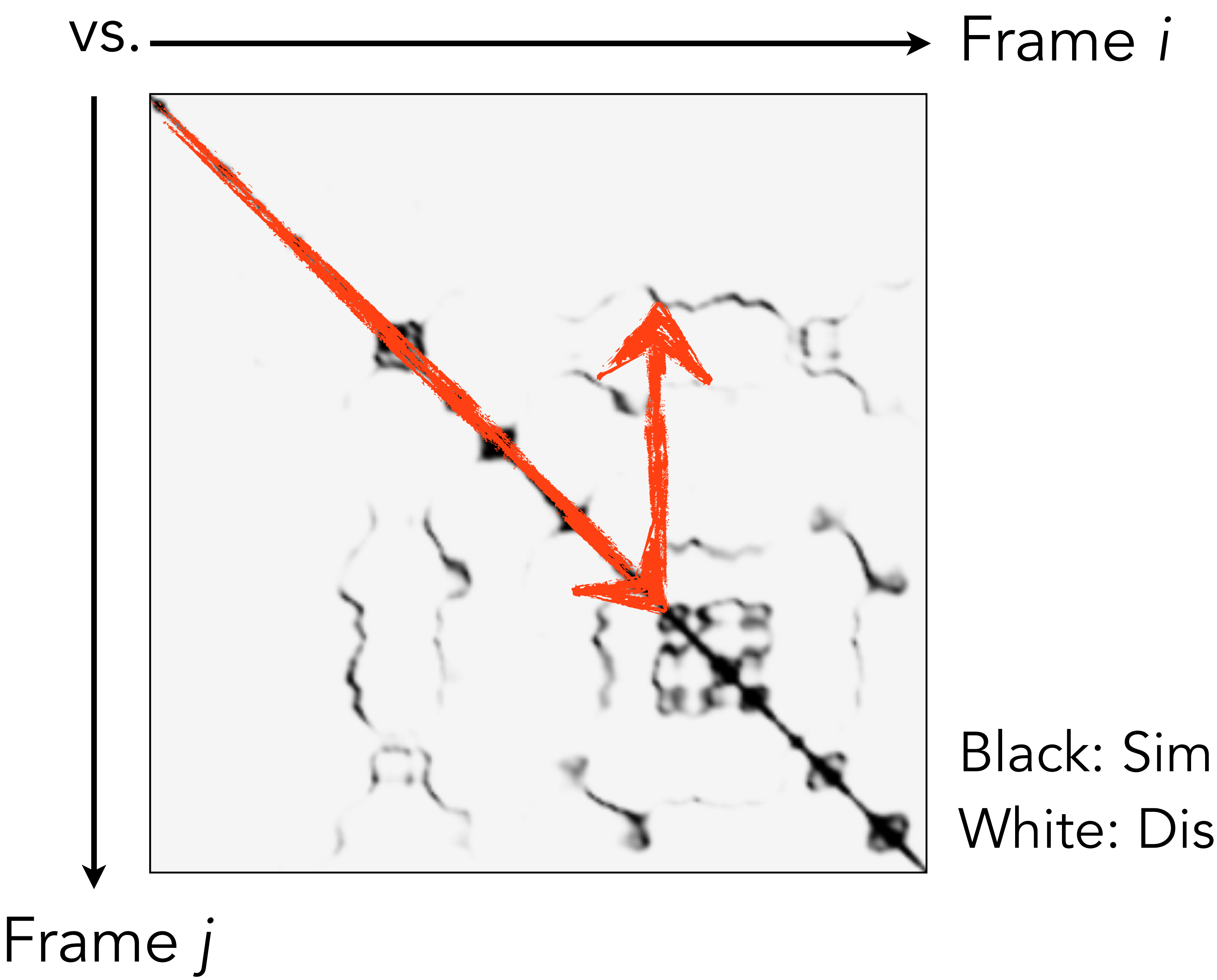

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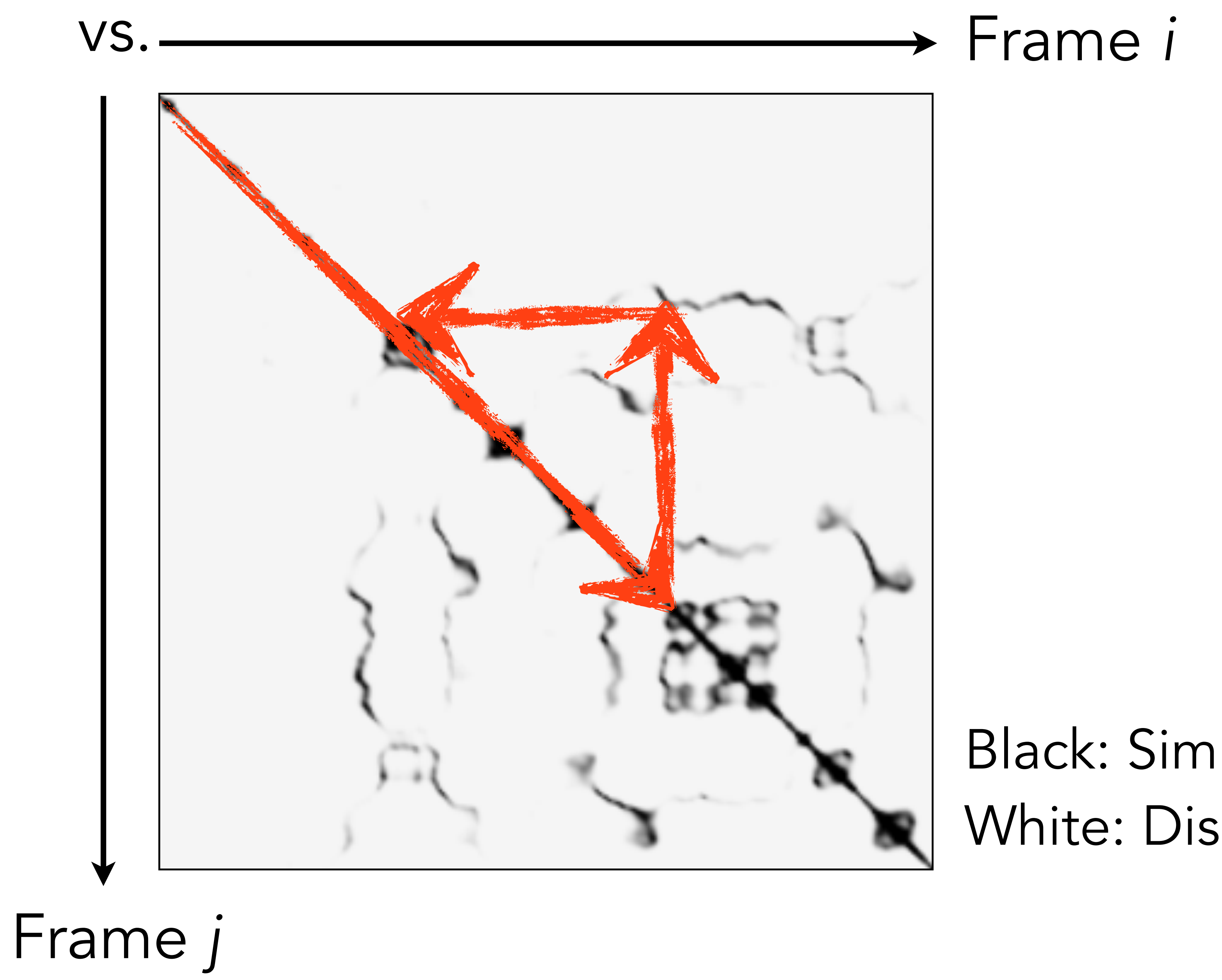

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Infinitely long Video Texture

Infinitely long Video Texture

Summary

- Introduced the concept of a Video Texture.
- Discussed the two (2) methods used to compute similarity between frames.
- Showcased the use of similar frames to generate Video Textures by finding similar points to transition to.

https://commons.wikimedia.org

Further Information

- ★ Schödl, Szeliski, Salesin, and Essa (2000), “Video textures,” in SIGGRAPH 2000 [Website].
- ★ Kwatra, Schödl, Essa, Turk, Bobick (2003), “Graphcut textures: image and video synthesis using graph cuts” in SIGGRAPH 2003, (DOI, PDF, Video, Website).

commons.wikimedia.org/

Next Class

- ★ More on Video Textures: Types, Control, Blending, and Applications.

Credits

- ★ For more information, see
  - Richard Szeliski (2010) Computer Vision: Algorithms and Applications, Springer.
- ★ Some videos retrieved from
  - YouTube Creative Commons.
  - From Professors Essa's Lab.
  - List will be available on website.

www.flickr.com/photos/neneonline/231886965/

Georgia Institute of Technology

Computational Photography

Dr. Irfan Essa
Professor
School of Interactive Computing

Study the basics of computation and its impact on the entire workflow of photography, from capturing, manipulating and collaborating on, and sharing photographs.