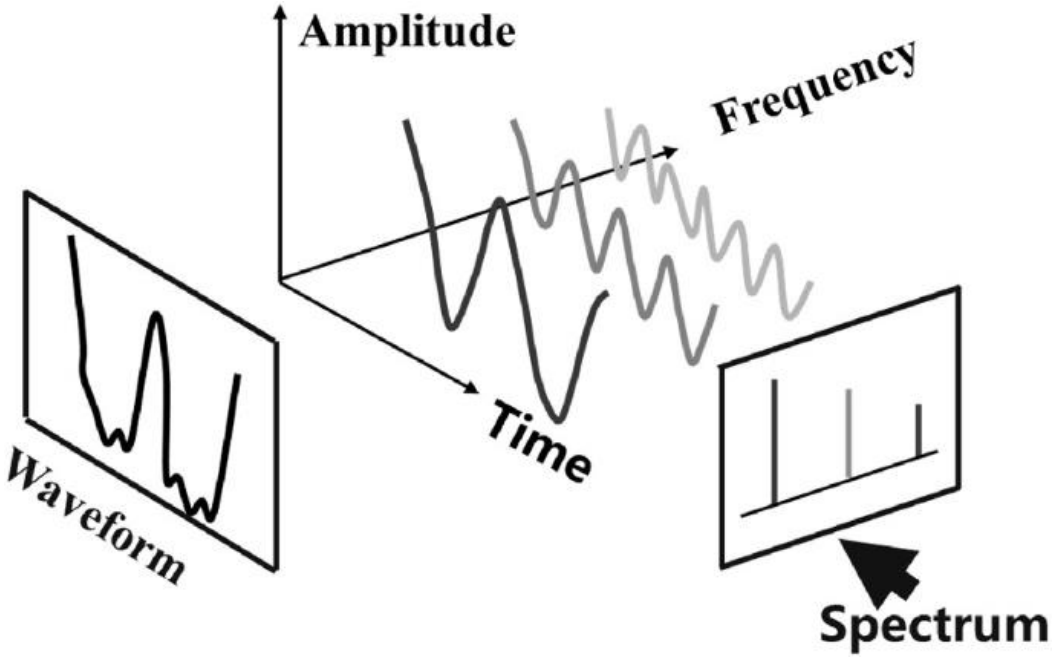
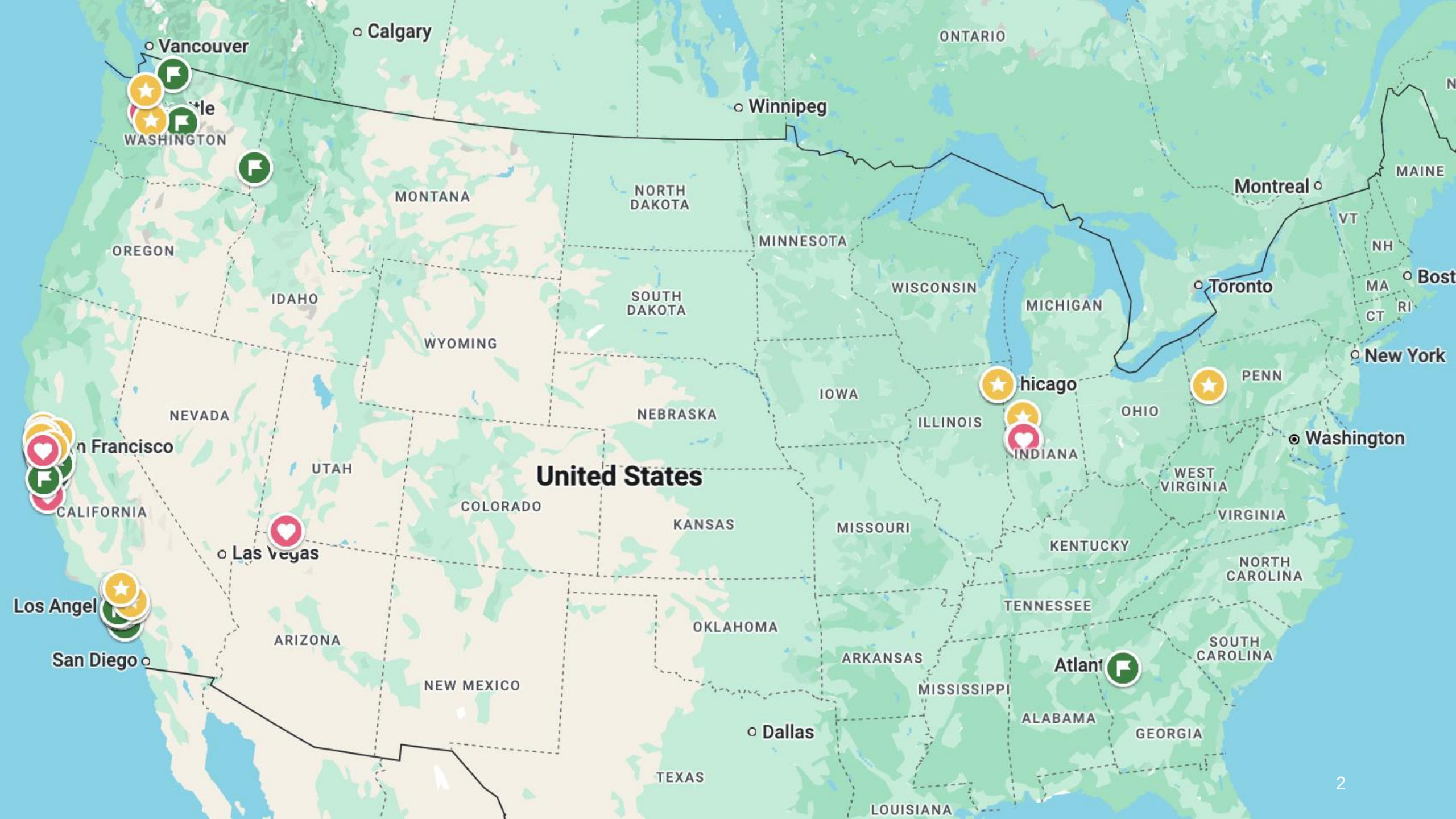


Frequency-domain Operators

Fall 2024

Yi-Ting Chen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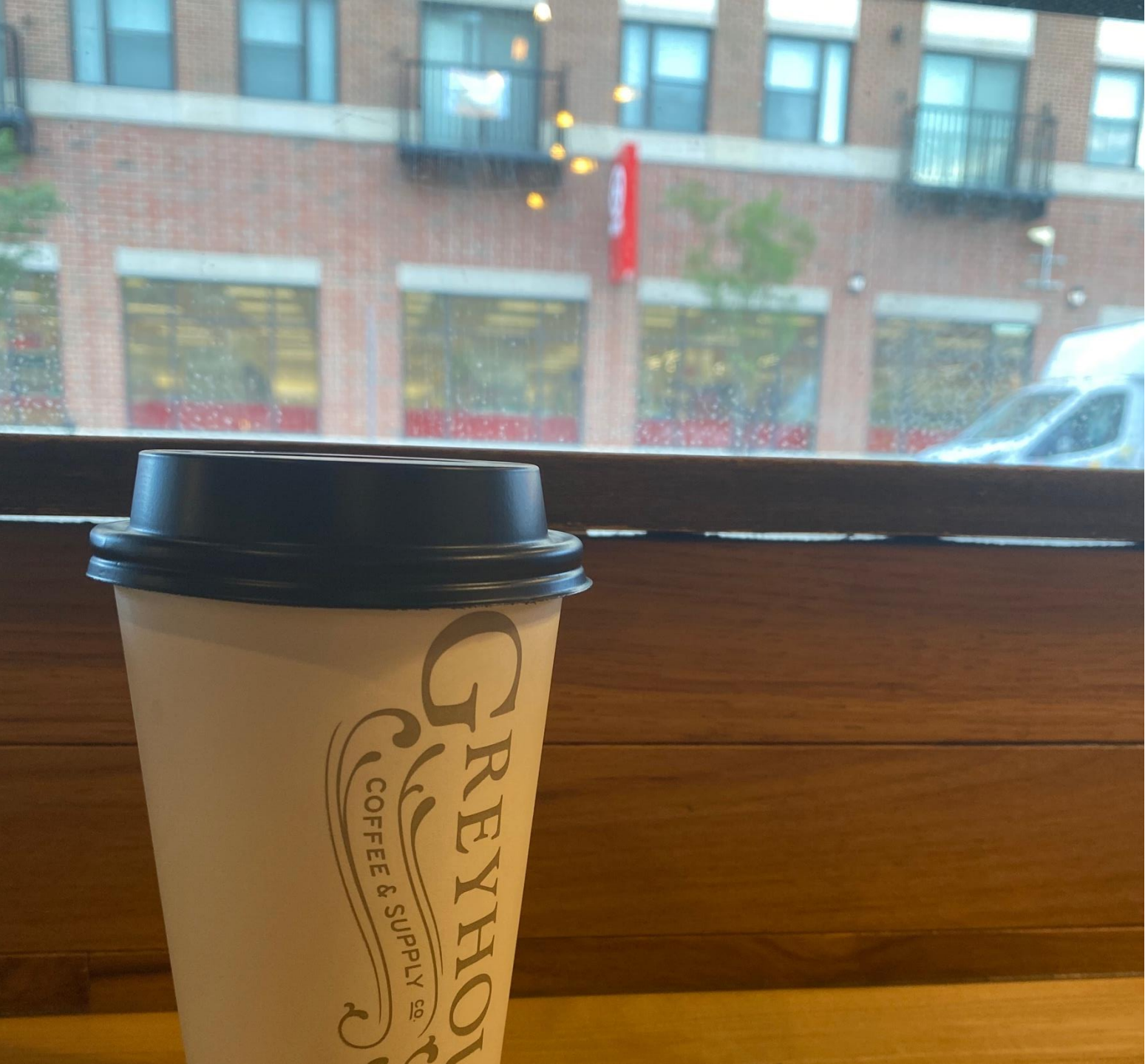
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PURDUE UNIVERSITY

https://youtu.be/bzfT16k6HEM?si=e0jhnHlTQKeigGHk

Take It With A Grain of Salt

Apple Podcast 預覽

186 集

The American English Podcast teaches the language and culture of the United States. Through common expressions, pronunciation tips and interesting cultural snippets or stories, I hope to keep this fun, useful and interesting! All bon更多

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2024年5月29日

Expression: To Take It With A Grain Of Salt

In today's episode, we'll begin by going through the commentary you guys made on Culture Shock in the United States. Afterwards, I'll tell you a joke, we'll go over the expression "to take it with a grain of salt," and we'll do a pronunciation exercise. Premium Content for this episode is available with...

▶ 播放 25 分鐘

2024年5月18日

Chats with Shana: Culture Shock in the U.S. (Everyday Life)

In this Chats with Shana episode, I'm going to reflect on various aspects of US culture. Although I talk about culture all the time on here, it's not often we talk about some basic things, like everyday life things that can cause culture shock. The truth is, I don't often think about the topics I'm going ...

▶ 播放 30 分鐘

1-D Linear Time Invariant System

Linear System

Additivity: $T\{x_1(t) + x_2(t)\} = T\{x_1(t)\} + T\{x_2(t)\} = y_1(t) + y_2(t)$

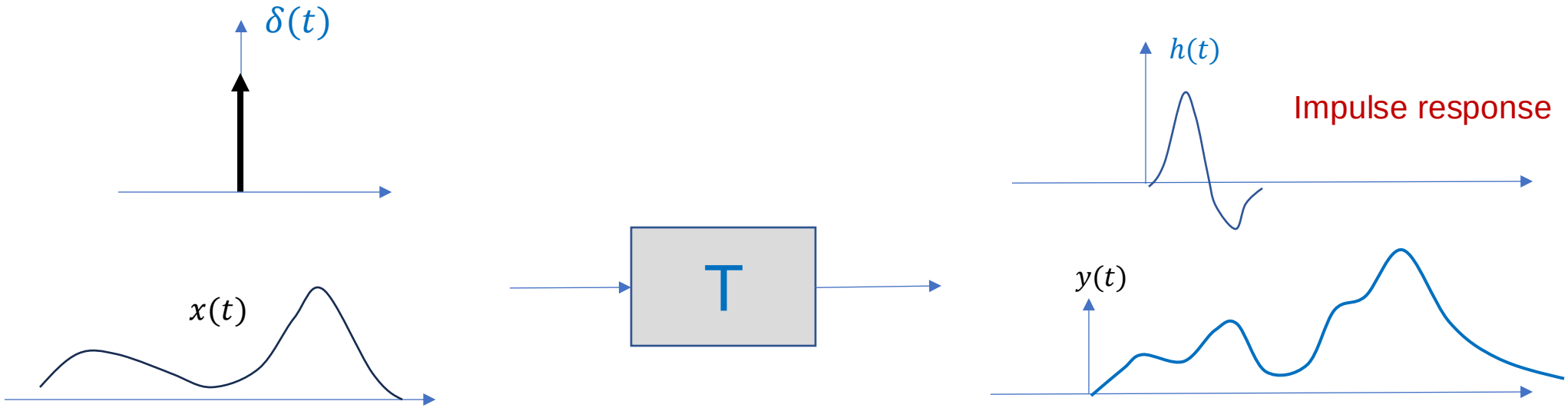
Homogeneity: $T\{ax(t)\} = aT\{x(t)\} = ay(t)$

Time-Invariant System

If $y(t) = T\{x(t)\}$, then $y(t - t_0) = T\{x(t - t_0)\}$.

Summary

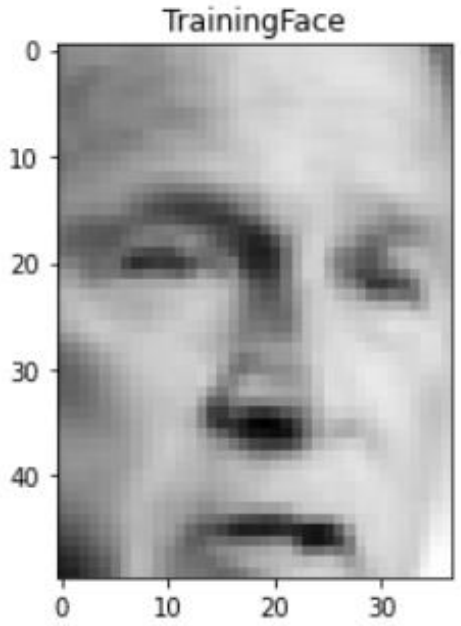
$$h(t) = T\{\delta(t)\}$$



$$x(t) = \int_{-\infty}^{\infty} x(\tau)\delta(t-\tau)d\tau$$

$$y(t) = \int_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau$$ Convolution

Eigenfaces



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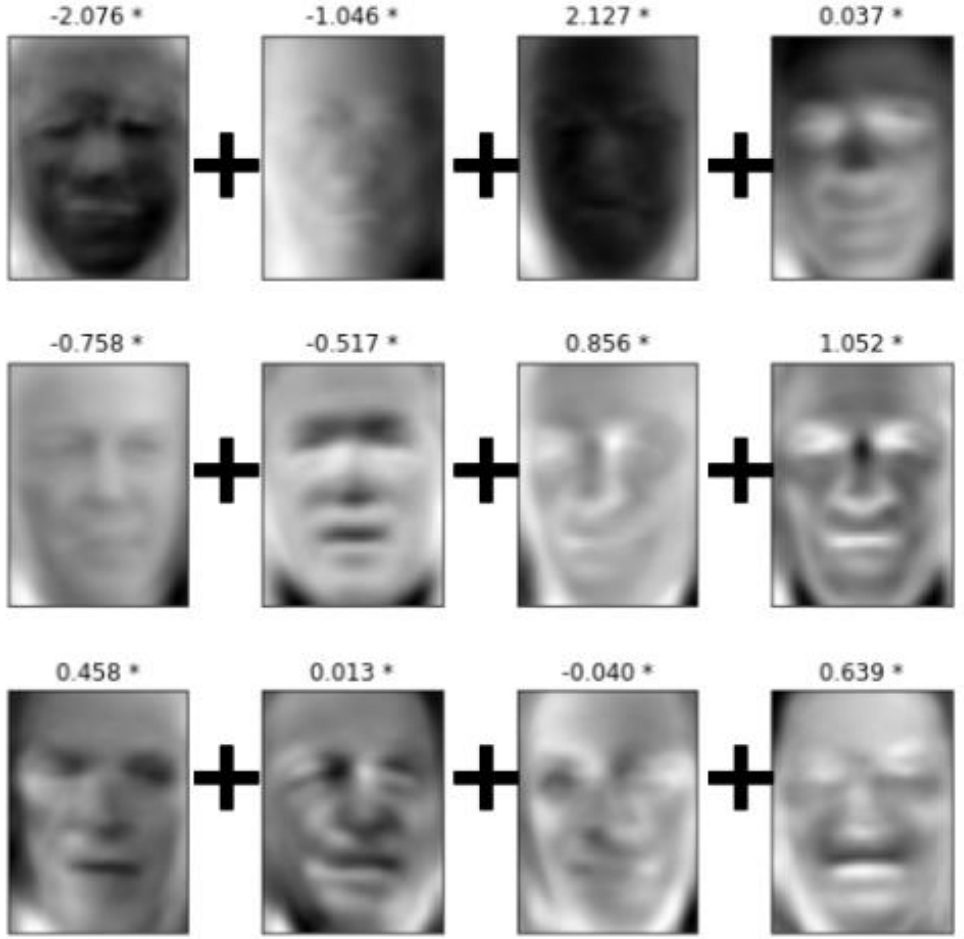
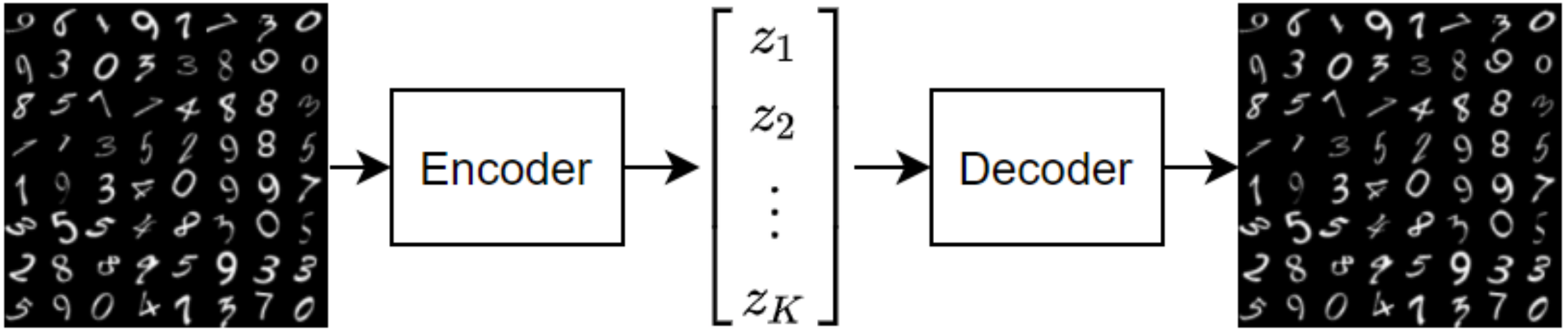


https://en.wikipedia.org/wiki/Eigenface#:~:text=An%20eigenface%20(%2F%CB%88a%C9%AA%C9%A1,Alex%20Pentland%20in%20face%20classification.

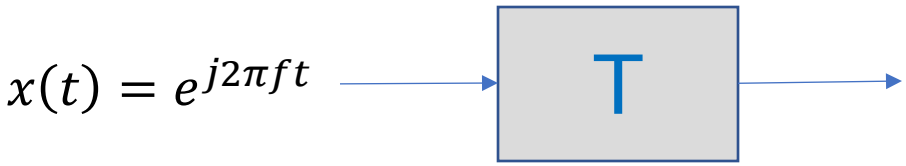
Variational Autoencoder (VAE)



https://en.wikipedia.org/wiki/Variational_autoencoder

Frequency-Domain Analysis (1/3)

$$e^{j2\pi ft} = \cos(2\pi ft) + jsin(2\pi ft)$$



$$\begin{aligned} y(t) &= \int_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau \\ &= \int_{-\infty}^{\infty} x(t-\tau)h(\tau)d\tau \\ &= \int_{-\infty}^{\infty} e^{j2\pi f(t-\tau)}h(\tau)d\tau \\ &= e^{j2\pi ft}\int_{-\infty}^{\infty} e^{-j2\pi f\tau}h(\tau)d\tau \\ &\equiv H(f)e^{j2\pi ft} \end{aligned}$$

H(f): Frequency Response

This is a complex-valued function that characterizes how the system responds to a sinusoid of frequency f . It typically includes both a gain (magnitude) and a phase shift.

$$y(t) = |H(f)|e^{j(2\pi ft+\arg(H(f)))}$$

Frequency-Domain Analysis (2/3)

Fourier Transform Pair

$$X(f) = \int_{-\infty}^{\infty} x(t) e^{-j2\pi ft} dt$$

where $e^{-j2\pi ft} = \cos(2\pi ft) - jsin(2\pi ft)$

$$x(t) = \int_{-\infty}^{\infty} X(f) e^{j2\pi ft} df$$

where $e^{j2\pi ft} = \cos(2\pi ft) + jsin(2\pi ft)$

$$X(f) = Re\{X(f)\} + jIm\{X(f)\} = |X(f)| e^{j\angle X(f)}$$

$|X(f)|$ Magnitude

$\angle X(f)$ Phase

Frequency-Domain Analysis (3/3)

$$x(t) = \int_{-\infty}^{\infty} X(f) e^{j2\pi f t} df$$

$$y(t) = \int_{-\infty}^{\infty} X(f) T\{e^{j2\pi f t}\} df$$

$$= \int_{-\infty}^{\infty} X(f) H(f) e^{j2\pi f t} df$$

$$\Rightarrow \quad Y(f) = X(f) H(f)$$

We will not have classes next week!

BRNO UNIVERSITY OF TECHNOLOGY

We will not have lecture on 10/8, but I will record an offline lecture and upload to E3.

https://developmental-robotics.jp/en/members/yukie_nagai/

https://homes.luddy.indiana.edu/djcran