SSP 100 - 10
How Computers See

11 / 10 / 2026

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Today's Topics

- Questions/Comments?
- Let's get clarity on converting images to other bases. Let me introduce the idea, and have you work on a worksheet. I will give some time for you to work on the worksheet.
- Then I will show examples with JPEG compression using DCT basis.
- I will also show examples of face images converted to eigenface space.

Learning Goals

- Understand the idea of bases for images, how to compute the coefficients and how the coefficients can be used as a summary of the image.
- Understand how to hand compute with 2x2 Haar bases and Frei-Chen 3x3 bases.
- Understand how conversion to another base is lossless.
- Understand that if we discard small, non-zero coefficients and only keep the larger coefficients and reconstruct the image it is lossy (that is, we do not get the exact original image back), but in many cases is close
- The coefficients of the basis images are then used as a compact representation of the original image

Worksheet

- Let me introduce what you will be doing on the worksheet.

Worksheet answers

- Let’s hear your answers to the worksheet

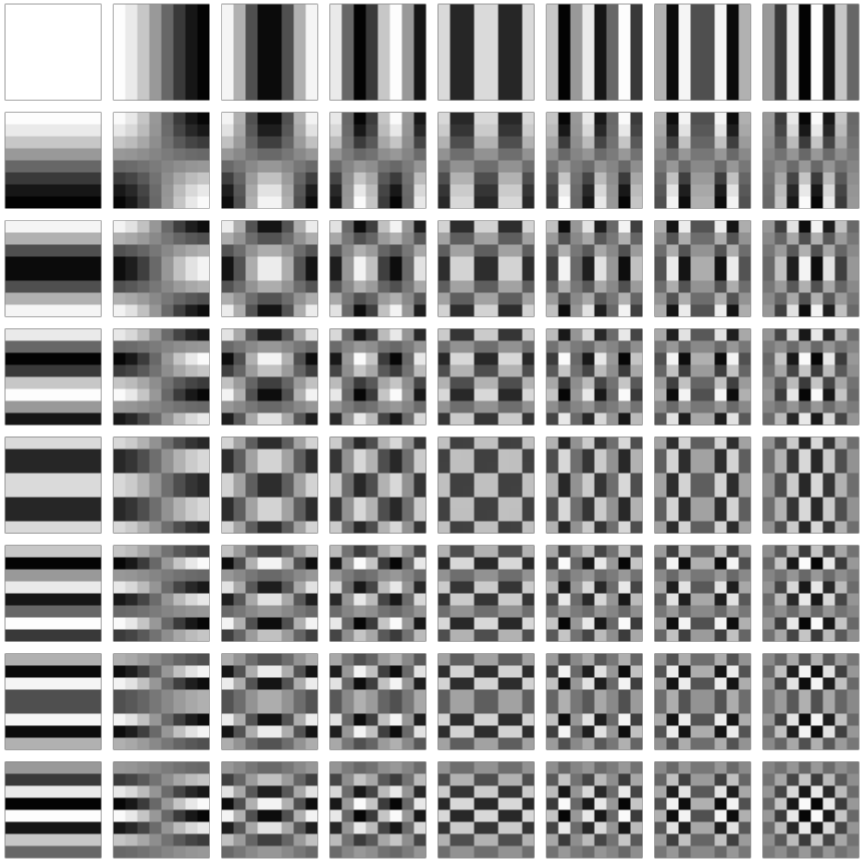
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Use of DCT in JPEG compression

- JPEG compression uses as part of its compression algorithm, the DCT.
- Image is broken into 8x8 blocks of pixels (a total of 64 pixel values) and coefficients of the 64 DCT basis images are computed.
- 64 coefficients would be computed.

Use of DCT in JPEG compression



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Use of DCT in JPEG compression

- The good thing is for many natural images, coefficients of many of the more complex basis images are 0 or very low. And roughly speaking, we can discard these coefficients of the more complex basis images which allows for a more compact representation (that is 64 values now represented by fewer than 64 values).
- Hence this more compact representation results in compressing the size of the original data.

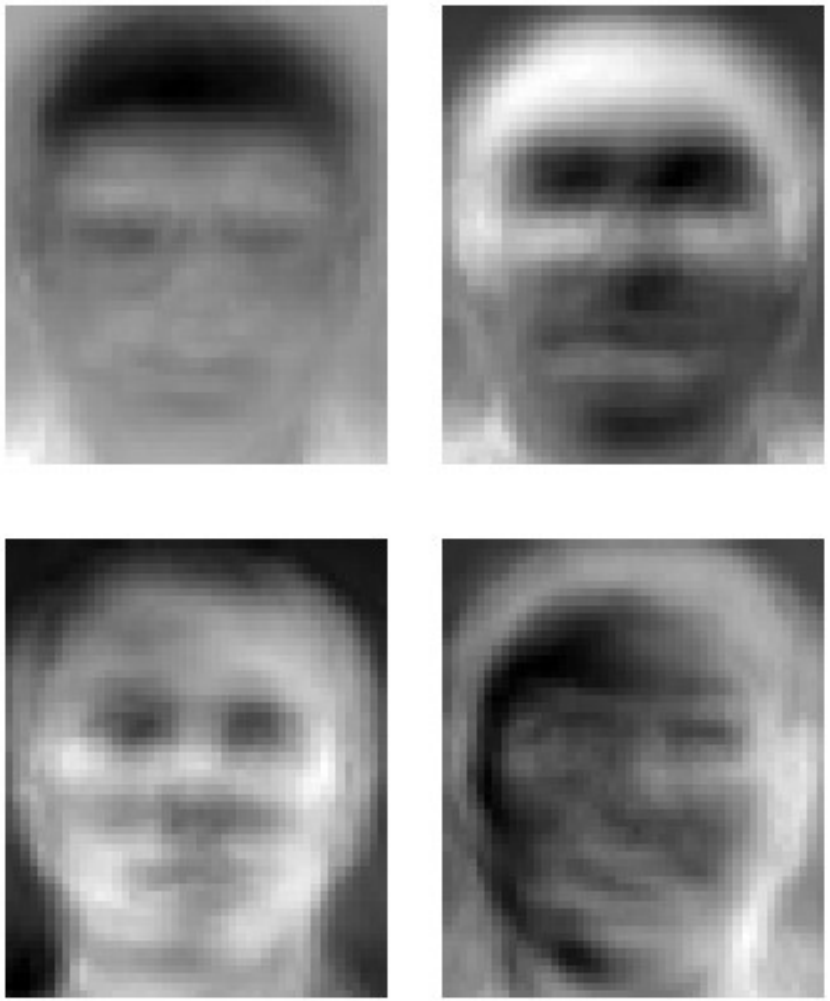
Use of DCT in JPEG compression

- Let me show you what the effect of discarding more coefficients (lower quality) vs. discarding fewer (higher quality) on a few images.

Basis of faces

- Late 1980s to late 1990s, researchers represented faces with a linear combination of the most significant basis faces.
- Early 1990s attempts had trouble with lighting changes, shadows, etc.
- Later solutions were more robust to lighting changes, etc.

Some eigenfaces from AT&T Laboratories Cambridge



Revisit Learning Goals

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- Understand how conversion to another base is lossless.
- Understand that if we discard small, non-zero coefficients and only keep the larger coefficients and reconstruct the image it is lossy (that is, we do not get the exact original image back), but in many cases is close
- The coefficients of the basis images are then used as a compact representation of the original image