Distributed Multimedia Systems Exams

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2018 - 2019

1.

(a)

$$\mathbf{A}\mathbf{A}^{\mathrm{T}} = \begin{bmatrix} 35 & 17 \\ 17 & 9 \end{bmatrix}$$

$$\lambda = 22 \pm \sqrt{458}$$

$$\sigma_i = \sqrt{\lambda_i}$$

$$\mathbf{\Sigma} = \begin{bmatrix} 6.588 & 0 & 0 \\ 0 & 0.774 & 0 \end{bmatrix}$$

(b)

$$\mathbf{A}\mathbf{A}^{\mathrm{T}} = \begin{bmatrix} 35 & 17 \\ 17 & 9 \end{bmatrix}$$

$$\lambda_1 = 43.401,\ v_1 = [\ 0.897 \quad 0.443\ ]^{\mathrm{T}}$$

$$\lambda_2 = 0.599,\ v_2 = [\ -0.443 \quad 0.897\ ]^{\mathrm{T}}$$

$$U = \begin{bmatrix} 0.897 & -0.443 \\ 0.443 & 0.897 \end{bmatrix}$$

(c)

Yes, $\sigma_1 \gg \sigma_2$

(d)

$B = U\Sigma V^{\mathrm{T}}$

$$= \begin{bmatrix} -0.589 & -0.694 & -0.414 & 0 \\ -0.507 & -0.023 & 0.759 & 0.408 \\ -0.466 & 0.312 & 0.138 & -0.816 \\ -0.425 & 0.648 & -0.483 & 0.408 \end{bmatrix} \begin{bmatrix} 48.351 & 0 & 0 \\ 0 & 13.68 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} -0.821 & -0.411 & -0.396 \\ 0.355 & 0.177 & -0.918 \\ -0.447 & 0.894 & 0 \end{bmatrix}$$

rank 1:

$$\hat{B} = \sigma_1 u_1 v_1^T = \begin{bmatrix} 23.381 & 11.705 & 11.278 \\ 20.126 & 10.075 & 9.708 \\ 18.498 & 9.26 & 8.923 \\ 16.871 & 8.446 & 8.137 \end{bmatrix}$$

$e = 187.139$

rank 2:

$$\hat{B} = \sigma_1 u_1 v_1^T + \sigma_2 u_2 v_2^T = \begin{bmatrix} 20.011 & 10.024 & 19.993 \\ 20.014 & 10.02 & 9.996 \\ 20.014 & 10.016 & 5.004 \\ 20.018 & 10.015 & 0 \end{bmatrix}$$

$e = 0.000$

2.

(a)

Setting 1:

uncompressed bitrate $= 30 \times (720 \times 480 \times 8 + 720 \times \frac{1}{2} \times 480 \times 8 \times 2) =$ 165.888 Mbps

average compression ratio $= \frac{1}{9} \times \frac{1}{10} + \frac{2}{9} \times \frac{1}{20} + \frac{6}{9} \times \frac{1}{50} = 0.036$

bitrate = 5.898 Mbps

Setting 2:

uncompressed bitrate $= 30 \times (720 \times 480 \times 8 + 720 \times \frac{1}{2} \times 480 \times \frac{1}{2} \times 8 \times 2) = 124.416$ Mbps

average compression ratio $= \frac{1}{9} \times \frac{1}{10} + \frac{2}{9} \times \frac{1}{20} + \frac{6}{9} \times \frac{1}{50} = 0.036$

bitrate = 4.424 Mbps

Setting 3:

uncompressed bitrate $= 30 \times (720 \times 480 \times 8 + 720 \times \frac{1}{2} \times 480 \times \frac{1}{2} \times 8 \times 2) = 124.416$ Mbps

average compression ratio $= \frac{1}{12} \times \frac{1}{10} + \frac{2}{12} \times \frac{1}{20} + \frac{9}{12} \times \frac{1}{50} = 0.032$

bitrate = 3.940 Mbps

Setting 2 is most suitable.

(b)

Spatial redundancy : JPEG-based compression in I-frame

Temporal redundancy : motion estimation and compensation in B, P- frame

Psycho-visual redundancy : Chroma subsampling

(c)

computational complexity and compression ratio

2D Logarithmic Search

3.

(c)

polynomial dataword = $x^7 + x^5 + x^2 + x + 1$

augemnted polynomial dataword = $x^{11} + x^9 + x^6 + x^5 + x^4$

remainder = 1

codeword = $x^{11} + x^9 + x^6 + x^5 + x^4 + 1$

decoded dataword = $x^7 + x^5 + x^2 + x + 1$

5.

(b)

Low packet Loss

High throughput

Low packet duplication

2020 - 2021

1.

(a)

(i)

A 0

B 10

C 111

D 110

(ii)

$8000 \times (0.36 \times 1 + 0.30 \times 2 + 0.34 \times 3) \div 8 = 1980$ bytes

(b)

$$\begin{cases} p + q = 0.25 \\ 2p + (0.18 + 0.16 + 0.14 + 0.12 + 0.10) \times 3 + (0.05 + q) \times 4 = 1 \end{cases}$$

$$\begin{cases} p = 0.175 \\ p = 0.075 \end{cases}$$

Not optimal

2.

(a)

in s1.pdf

3.

(a)

(i)

The average compression factor $= \frac{1}{9} \times \frac{1}{10} + \frac{2}{9} \times \frac{1}{20} + \frac{6}{9} \times \frac{1}{40} = 0.0389$

$720 \times 480 \times (1 + \frac{1}{2} + \frac{1}{2}) \times 8 \times 30 \times 60 \times 50 \times 0.0389 \div 8 = 2.4192 \times 10^9$ bytes

2021 - 2022

1.

(a)

$\lambda_1 = 10.0089,\ \lambda_2 = 7.9959$

(b)

$\lambda_{3,4}$ are far from real values.

2.

(b)

(iii)

$$\text{A} \rightarrow \begin{bmatrix} 60 & 0 & 0 & 0 \\ 0 & 2.929 & 0 & 7.071 \\ 0 & 0 & 0 & 0 \\ 0 & 7.071 & 0 & 17.071 \end{bmatrix} \rightarrow \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 2.929 & 0 & 7.071 \\ 0 & 0 & 0 & 0 \\ 0 & 7.071 & 0 & 17.071 \end{bmatrix}$$

$$\text{B} \rightarrow \begin{bmatrix} 60 & 0 & 0 & 0 \\ 18.478 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -7.653 & 0 & 0 & 0 \end{bmatrix} \rightarrow \begin{bmatrix} 0 & 0 & 0 & 0 \\ 18.478 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 7.653 & 0 & 0 & 0 \end{bmatrix}$$

A has more distortion.

4.

(a)

(i)

$a = 1$