PC512

Technical Writing and Communication Skills

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Varieties of Communication

- Written/Printed
- Oral
- Visual
- Electronic
- Body Gestures

- One to One
- One to Many

Examples of Communication Varieties

- Class lecture
- Email to a student
- Conference Paper

- Oral+visual+one-to-many
- Written+electronic+one-to-one
- Written+one-to-many

Written Communication

- Technical
  - Simple English Language
  - Theorems and Proofs
  - Examples
  - Equations
  - Figures
  - Tables
  - References
- Creative
  - Language
  - Words
  - Verbal Images
  - Sound pattern

Format of a Technical Document

- Shown in the next three slides

Technical Writing Example

An investigation of partitioning of images with respect to compressibility and spatial complexity

Descriptive Title

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ABSTRACT

Analysis of two-dimensional spatial data is important for aerial surveys of crops and soils, reconnaissance, medical diagnosis, geographical information systems, and many other domains. Partitioning of images is helpful in the processing and analysis of spatial data. Investigations have shown that splitting an image into sub-images and compressing each sub-image using fewer calculations leads to a faster and more efficient method for the compression of the main image. The relationship between partitioning, spatial information, and the ease of compressing is explored in this paper.

Short Abstract

Keywords: Image Processing, image complexity, image segmentation, image compression

Keywords

1. INTRODUCTION

When an image is partitioned into smaller images, we often find that operations such as compression can be performed on the smaller images with less number of computational steps. In this paper, we investigate the relation between the partitioning, compressibility, and spatial information of images.

Sections With Numbers

2. IMAGE COMPRESSION USING SINGULAR-VALUE-DECOMPOSITION (SVD)

In using the technique of singular value decomposition we decompose a matrix in terms unitary or orthogonal matrices and set of non-negative singular values. Thus, we consider an image A as a $n \times n$ matrix and express

$$A = U\Sigma V^* \quad (1)$$

where U and V are $n \times n$ unitary matrices and Σ is a $n \times n$ diagonal matrix with the singular values (SVs) $\sigma_1, \sigma_2, \cdots, \sigma_n$ greater than or equal to zero. Some of the SVs may be small. If we neglect the small Svs and consider the first few SVs we can create an approximation of the image A. It can be approximated by another $n \times n$ matrix

$$A' = \sigma_1 u_1 v_1^* + \sigma_2 u_2 v_2^* + \cdots + \sigma_r u_r v_r^* \quad (2)$$

Equations With Numbers

where $r < n$, u_i, and v_i^* are the i-th columns of U and V^*, the conjugate transpose of V, respectively ($i = 1, 2, \ldots, r < n$); none of the singular values used are zero or insignificant[1-3].

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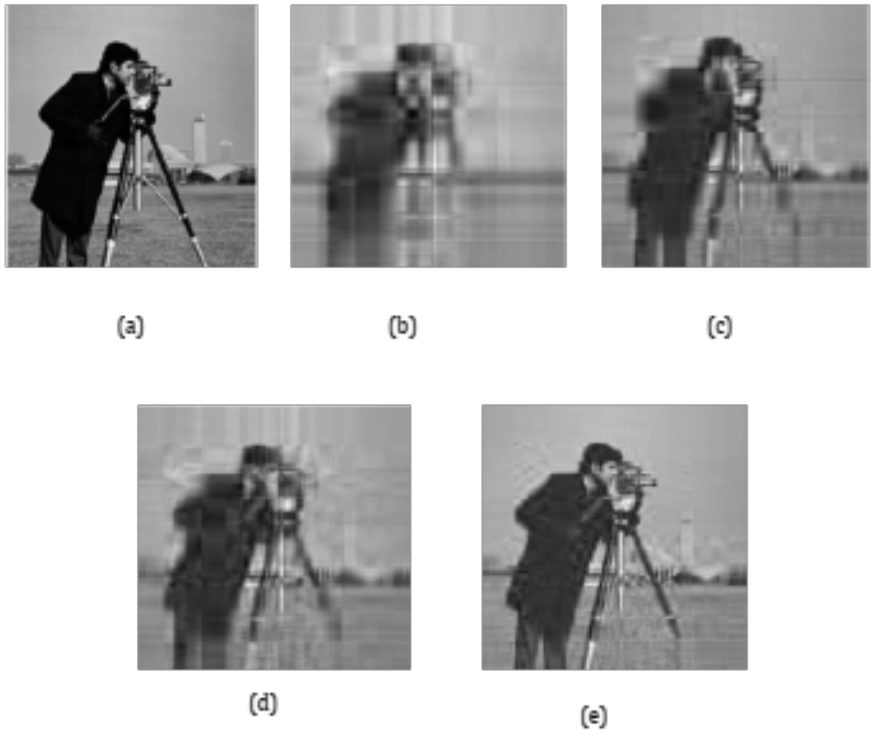

Figures & Diagrams & Charts

Figure Captions With Numbers

Fig.1. (a) Original Image, (b) Approximated Image using SVD with 5 SVs, (c) Approximated image using 4 sub-images each compressed with 5 SVs, (d) Approximated Image considering only 10 SVs, (e) Approximated image using 9 sub-images each compressed with 5

Table Captions With Numbers

TABLE 1. A comparison of SVD versus MSVD for the test image 'CAMERAMAN.BMP'.

Image Name	Method applied	Value of r or r' i.e. number of singular values used	Number of segments d^2	MSE
Cameraman.bmp Size: 512x512	SVD	5	1	784.78
	MSVD	5	4	455.84
	SVD	10	1	482.17
	MSVD	5	9	225.97

Table With Data

In another experiment, we took the image of "Lena" for testing. In Table 2 all the findings from the experiments are displayed. The image has been partitioned into different numbers of modules. For each case operational time and number

TABLE 3a. The effect of segmentation on the test image "LENA.BMP"

	Par titions	Spatial Information	No. of SV needed for approximation w.r.t. error threshold value(10^x)
Lena. jpg	1	66.36	14
	4 (2x2)	$\begin{matrix} 50.58 & 73.96 \\ 68.41 & 68.53 \end{matrix}$	$\begin{matrix} 3 & 7 \\ 3 & 6 \end{matrix}$
	16 (4x4)	$\begin{bmatrix} 34.36 & 34.44 & 68.61 & 79.44 \\ 73.59 & 44.21 & 68.39 & 74.31 \\ 61.45 & 84.86 & 70.46 & 48.45 \\ 55.04 & 66.73 & 73.17 & 66.53 \end{bmatrix}$	$\begin{bmatrix} 1 & 1 & 2 & 2 \\ 1 & 2 & 2 & 2 \\ 1 & 1 & 1 & 2 \\ 1 & 1 & 3 & 3 \end{bmatrix}$
	36 (6x6)	$\begin{bmatrix} 21.18 & 19.54 & 34.74 & 67.36 & 17.66 & 77.98 \\ 22.94 & 72.33 & 37.3 & 70.02 & 87.32 & 87.84 \\ 27.47 & 86.32 & 53.43 & 64.84 & 97.73 & 38.17 \\ 54.19 & 73.48 & 88.14 & 76.25 & 76.35 & 28.24 \\ 59.12 & 85.79 & 32.33 & 70.98 & 66.75 & 56.91 \\ 50.17 & 72.03 & 42.78 & 8.59 & 101.09 & 66.54 \end{bmatrix}$	$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 2 \\ 1 & 1 & 1 & 1 & 2 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 2 & 2 \end{bmatrix}$

5. CONCLUSION

Summary
Or
Conclusion

Partitioning several standard images into smaller sub-images, we have shown that SVD based compression can be performed with a less number of computational steps in a shorter time. Spatial complexity of the sub-images remains mostly in the same order as that of the main image. Thus, the advantages in computation and storage of data mostly come from the smaller dimensions of the sub-images.

REFERENCES

References

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Oral Communication

- Technical
  - Visual aids
    - Charts
    - Slides
    - Posters
    - Handouts
- Non-Technical
  - Podium
    - Handouts

A Typical Slide For a Technical Presentation

Title of the Slide

Image Compression with SVD

- Total storage for A_K will be $k(m+n+1)$, where m x n is the size of the original image.
- Compression ratio $(C_R)=\dfrac{m\times n}{k\times(m+n+1)}$
- To measure the quality of the compressed image w.r.t. the original image we have calculated the error.

$$\frac{\|A-\tilde{A}_k\|_F}{\|A\|_F}$$

Plain Background Without Decorations

$$\|A-\tilde{A}_k\|_F = \sqrt{\sigma_{k+1}^2+\ldots+\sigma_r^2}.$$

Text with Charts or Figures and Equations

Technical Communication

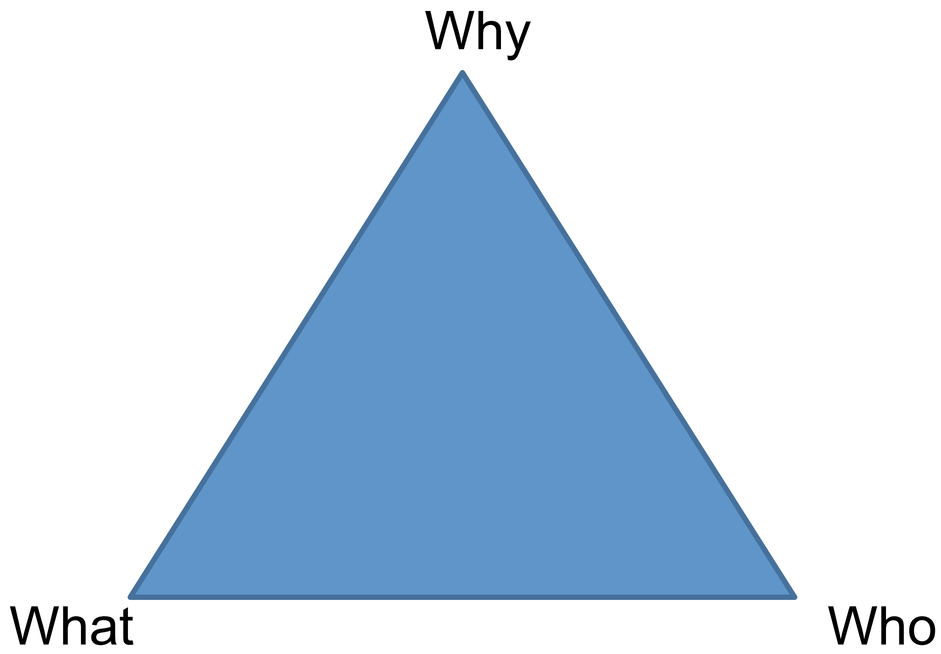
Technical Writing

- Thesis
- Paper
- Report
- Memo
- Proposal
- Minutes of meetings
- Briefs
- Cases
- Patent applications

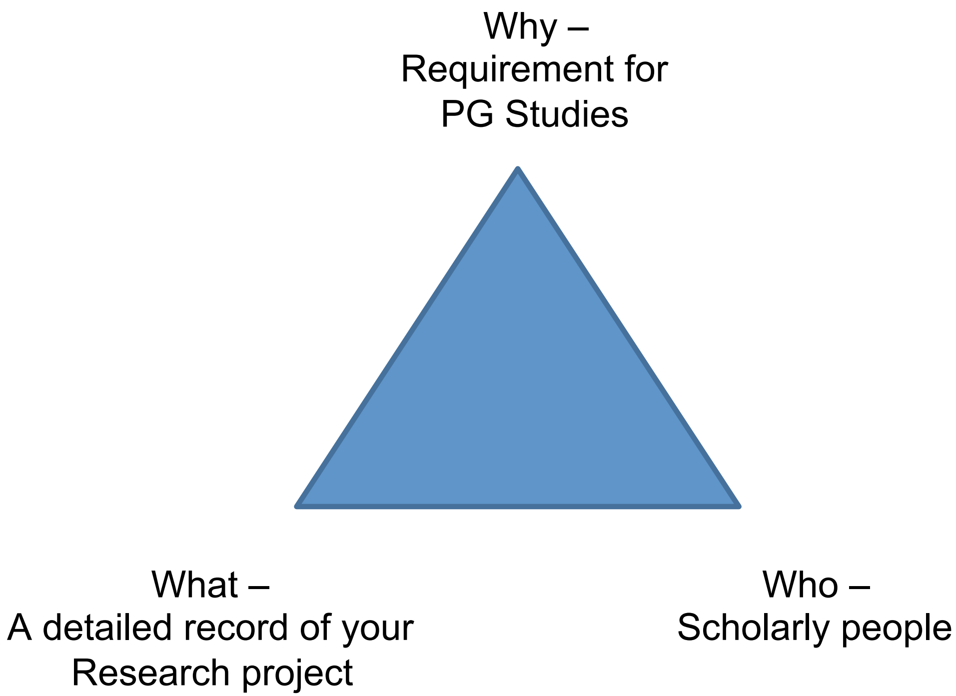
Tech. Presentation

- Progress report
- Viva
- Project review
- Seminar
- Lecture

Technical Communication Triangle



Triangle for A Thesis (example)



General Guidelines

Fact 1

Technical Communication is an *ART*

(creativity, care, beauty, …)

Fact 2

Supervised Practice makes you BETTER

Fact 3

Tech Writing and Presentation are for OTHER PERSONS – not for yourself (Who)

Fact 4

Technical Writing or Presentation is for some GAIN (Why)

Gain = MTech, PhD, Job, Project Money, Promotion, Fame, Recognition, Award, …

Fact 5

Know / Understand the SUBJECT THOROUGHLY before Writing / Presentation

Fact 6

NO CHEATING

Fact 7

Be Diplomatic

Free Software for Writing/ Presentation

- Use
  - LibreOffice Suite (equivalent to Microsoft Office)
  - **Zotero** or Mendely for Reference Management
  - LaTeX packages (pdfLaTeX)
    - MikTeX in Windows
    - MacTeX for MacOSX
    - Texlive for Linux
    - LyX or TeXmacs for wyswyg and easy equation editing
    - Texmaker, Notepad++, VSCode, Vim, … editors
    - **Overleaf**, Papeeria, … for Online LaTeX

Quick Tutorials on LaTeX

- https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes
- https://www.bu.edu/math/files/2013/08/ShortTeX3.pdf

Summary

Basic and general facts and rules about technical writing and presentations