

A green chalkboard with two pieces of pink chalk and faint white chalk drawings. The chalkboard is the background for the entire slide. Two pieces of pink chalk are lying on the left side. Faint white chalk drawings, including a large 'V' and some curved lines, are visible on the board. A small white dot is located at the top center of the slide.

# Writing Technical Research Papers

# Why do you need to write Technical Papers?

- It is obvious that every research needs good and proper documentation.
- To attend conferences.
- To share research results with other researchers.
- To get views for improvement of your research.
- To obtain some form of degree.
- To get recognition and promotion

# Scope of Presentation

- What is Research?
- Activities in EE Research
- Writing Technical Research Reports
- Writing Technical Research Papers
- Strategies in Writing Good Papers

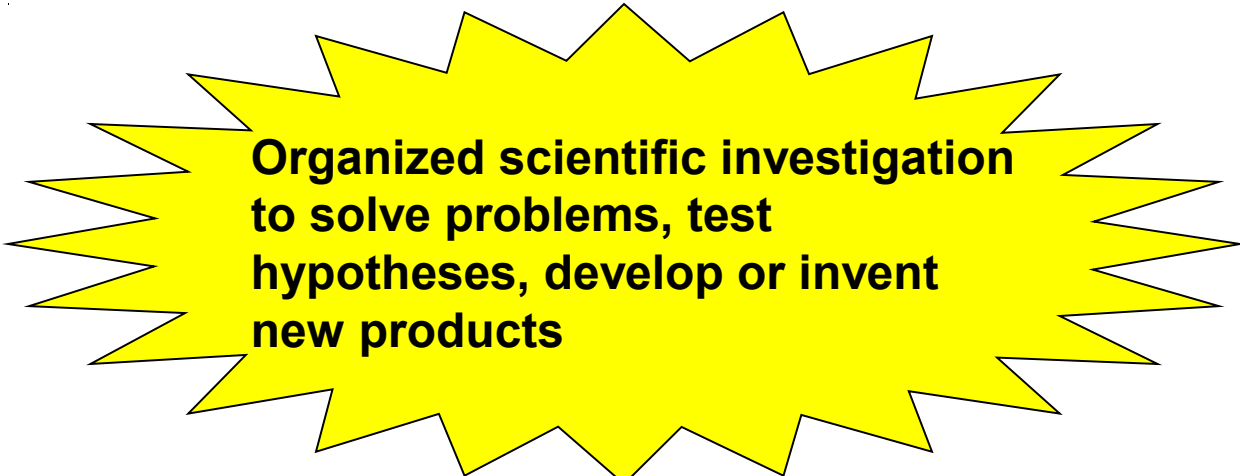


# What is Research?

# Definition of Research



Hunting for facts or  
truth about a subject



**Organized scientific investigation  
to solve problems, test  
hypotheses, develop or invent  
new products**

# High Quality Research!

- It is based on the work of others.
- It can be replicated (duplicated).
- It is generalizable to other settings.
- It is based on some logical rationale and tied to theory.
- It is doable!
- It generates new questions or is cyclical in nature.
- It is incremental.
- It is apolitical activity that should be undertaken for the betterment of society.





# Then, what is bad research?

- The opposites of what have been discussed.
- Looking for something when it simply is not to be found.
- Plagiarizing other people's work.
- Falsifying data to prove a point.
- Misrepresenting information and misleading participants.

# What is Research?

Research must be systematic - It follows certain steps that are logical in order. These steps are:

- Understanding the nature of problem to be studied and identifying the related area of knowledge.
- Reviewing literature to understand how others have approached or dealt with the problem.
- Collecting data in an organized and controlled manner so as to arrive at valid decisions.
- Analyzing data appropriate to the problem.
- Drawing conclusions and making generalizations.



# Why do we need research?

- To get PhDs, Masters and Bachelors??
- To provide solutions to complex problems
- To investigate laws of nature
- To make new discoveries
- To develop new products
- To save costs
- To improve our life
- Human desires

Asking the  
Question

1

2

Identifying the  
important  
factors/problem  
statement

3

Formulating  
hypotheses

4

Collecting  
relevant  
information

5

Testing the  
hypotheses

6

Working  
with the  
hypotheses

7

Interpreting  
the Results

8

Asking new  
Questions

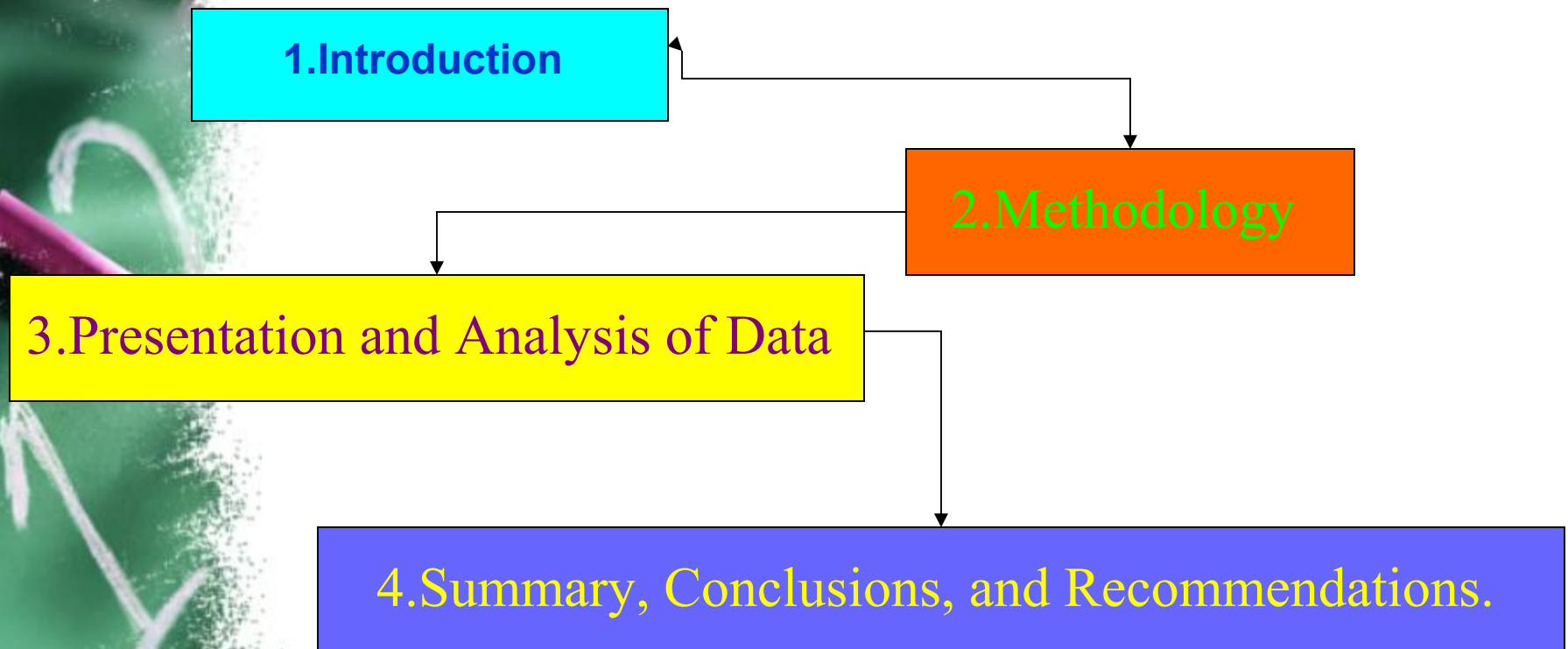
# STEPS IN CONDUCTING RESEARCH



# WRITING TECHNICAL RESEARCH REPORTS AND RESEARCH PAPERS

# CONTENTS OF A RESEARCH REPORT

- The body of the report follows the preliminary information. The body of the research report contains four logical divisions :



# A TYPICAL RESEARCH REPORT

## 1. INTRODUCTION

- Statement of the Problem
- Review of Related Literature
- Statement of Hypotheses of Research Questions
- Limitations
- Definition of Terms



## 2. METHODOLOGY

- Procedures for Collection and Treatment of Data

## 3. PRESENTATION AND ANALYSIS OF DATA

- Presentation of Data
- Analysis of Data





## 4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

- Summary
- Conclusions
- Recommendations



# TECHNICAL RESEARCH PAPERS

- Contents of a Research Paper
- The Art of Writing a Research Paper

# Factors Affecting Writing Good Papers

- Good Research Results
- Time
- Need to be 'focus'
- Careful Planning and Need to be 'Creative'
- Organization of the Paper
- Writing Styles
- Language






# ORGANIZATION

## Contents of a Technical Research Paper

- Title (followed by names and affiliations)
- Abstract (followed by Key Words)
- Introduction (include Literature Review)
- Your Proposed Technique/Method
- Hardware or Software Development
- Application of the Technique
- Results and Discussions (usually include Comparisons)
- Conclusion (and Future Work)
- References
- Appendices (if any)

# Title

- Make it short but meaningful and reflective of the research work
- TITLE PAGE
  - Choice of Title
    - Short
    - Description of major conclusion
  - Authors' Names
    - Check instructions/format
  - Footnotes/Symbols
  - Author for correspondence
  - Key words



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**TUNING OF A NEURO-FUZZY CONTROLLER  
BY GENETIC ALGORITHM**

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# Abstract

- It is a brief account of the paper's relevant points – it is a summary of the research
- Length and format are usually specified for a particular journal
- It must stand alone without reference to text body
- Should include some information on the results obtained

# Example of an Abstract (1)

Due to their powerful optimization property, genetic algorithms (GAs) are currently being investigated for the development of adaptive or self-tuning fuzzy logic control systems. This paper presents a neuro-fuzzy logic controller (NFLC) where all of its parameters can be tuned simultaneously by GA. The structure of the controller is based on the Radial Basis Function neural network (RBF) with Gaussian membership functions. The NFLC tuned by GA can somewhat eliminate laborious design steps such as manual tuning of the membership functions and selection of the fuzzy rules. The GA implementation incorporates dynamic crossover and mutation probabilistic rates for faster convergence. A flexible position coding strategy of the NFLC parameters is also implemented to obtain near optimal solutions. The performance of the proposed controller is compared with a conventional fuzzy controller and a PID controller tuned by GA. Simulation results show that the proposed controller offers encouraging advantages and has better performance.

# Example (2)

- **Abstract** - The Fractal dimension technique is widely used nowadays in various wakes of engineering analysis. The aim of the paper is to demonstrate that the technique of fractal dimensions can be applied to fingerprint analysis. In this paper we propose an algorithm to quantify the fingerprint to a single number on the basis of Fractal theory. The algorithm was implemented using MATLAB and the results are reproduced. The algorithm will greatly reduce processing time as compared to conventional techniques. The paper presents a preliminary idea illustrating this concept and an example as to how it can be applied practically. We propose that the algorithm can be used to screen the number of possible matches for a fingerprint followed by pattern matching techniques to obtain the best match.

# Example (3)

**Abstract**— In general regression neural networks (GRNN), one drawback is that the number of training vectors is proportional to the number of hidden nodes, thus a large number of training vectors will produce a larger architecture, which is a major disadvantage for many applications. In this paper we proposed an efficient clustering technique referred to as ‘similarity index fuzzy c-means clustering’. This technique uses the conventional fuzzy c-means clustering preceded by a technique based on similarity indexing to optimally cluster input data which are relevant to the system. The technique employs a one-pass similarity measures on the data to calculate the similarity index. This index indicates the degree of similarity in which data will be clustered. Similar data then undergoes fuzzy c-means iterative process to determine their cluster centers. We applied the technique on GRNN for dynamic system identification and modeling. It was observed that the identification and modeling results are far better than GRNN based on conventionally used clustering techniques.

# Introduction

- Write a brief account on the current state of the problems – Answer the why?
- Provide a literature review of similar research in the field- you can start of by giving a general literature review of similar research, then focus on those that more related to your research work – references are very much required here
- Identify and Highlight their limitations (as much as possible)
- If there is not so much limitation –then you need to be creative
- Write a brief account of your proposed technique and how the limitations as identified can be overcome
- End your Introduction by writing a brief information on how your paper is organized



# Your Proposed Technique and Method

- Can be divided into several sub-sections
- Provide a general description of the technique or method you proposed (use block diagrams where appropriate)
- In another section, start with the general theory first then followed by your own formulations
- Write down your algorithms (equations)/strategy and provide explanation on them
- Figures may be required where necessary





# Hardware/Software Development

- As a result of your proposed algorithm, you might have developed a software to test its viability through simulation
- Provide a description of how the software is developed (Computer specs, Programming Languages used, Flowcharts, Block diagrams, etc.)
- Sometimes hardware are designed to test the proposed technique/algorithm
- Provide sufficient description of the hardware setup/ designed (technical specifications, block diagrams, saturations, sensor limitations, components used, photos of the hardware, etc.)
- Highlight the uniqueness of your hardware compared to similar products (if any)

# Application of the technique/algorithm

- Usually new techniques/algorithms are tested using programs – simulations
- Test-beds are usually bench-marked problems in the form of equations
- Provide a write-up on how the simulation is carried up (including all assumptions used, how important parameters are chosen/selected, etc.)
- Similarly for hardware application, describe how the experiments have been carried out
- Only discuss experiments which are relevant to show the effectiveness or superiority of the proposed technique

# Results and Discussions

- Results can be tabulated in several forms (use graphical form where applicable)
- Usually comparisons with existing techniques (conventional or otherwise) are required to show the effectiveness of the proposed technique
- Provide merit discussions – correct analyses of your experimental results show the quality of the paper. Always provide answers to why the experiments went such a way.
- Every figure shown in the paper must be addressed in the text. Figures must be legible enough.
- What conclusion can you draw from your experiments?



(From Barry Zaret..)

## DISCUSSIONS

“Reviewers rarely complain a discussion is too brief”

- Provide summary of results and how results led to conclusion
- Place results in context of current knowledge
- Impact of data (present and future)
- Unanswered questions
- Limitations of study
- Don't overemphasize your own work



(From Barry Zaret..)

## FIGURES/LEGENDS

- Focus on key points
- Don't clutter Illustrations
- Define symbols/abbreviations in legends
- Label axes
- Use same units as in text
- Photo authenticity
- Obtain permission for use of previously published material



# Conclusion

- In the conclusion part, highlight the major advantages of the technique/method proposed when compared with other techniques or conventional techniques
- Re-emphasize by writing down (in a few sentences where appropriate) the novelty of the research work
- You may also write down the limitations of your research work such that reviewers cannot 'attack' the weaknesses of your technique when you submit your paper for review
- Write suggestions to improve the problems or limitations of the proposed technique (such as in future work)



# Format of a paper


- Almost all journals provide a format or template before papers can be published
- References are always required to be written in a certain format






# Strategies in Writing Good Technical Papers

- Identify the novelty of your research work
  - This can be done from the literature review, by comparing your research results with others
  - Identify and highlight the problems and limitations of current techniques already proposed by others
  - Write down how your research (proposed technique) can overcome the above limitations or problems

- 
- List down the strengths and weaknesses of your proposed technique
    - If your proposed technique can only be applied to a certain class of problems, then try to be ‘creative’ and write to focus only towards these problems
    - Do not allow reviewers to attack your weaknesses, it would be good to mention the weaknesses of your proposed technique in the paper, again try to be ‘creative’ in writing such as “perhaps this is to demonstrate on certain applications...”

- 
- Provide a good analysis on the research results
    - Do not just write down what has been observed from your experiments
    - Explain why these observations are ‘so and so’
    - Provide a summary of results and how results led to conclusion

# Publishing your Paper

- Types of Journals (Tier-1, Tier-2, etc...?)
- How review is being done?
- What reviewers look for in a paper?
- How selection of reviewers are done?
- Acceptance and Revision
- How to answer reviewer's questions?
- Format of a Journal
- How to get on the Editorial Board of a Journal?

Is the material publishable in Trans.?

YES

Plan an appropriate title

List author/co-authors  
(Show IEEE membership)

Collect all relevant references

Plan figures with titles

Plan sections and subsections

Collect material for each  
section/subsection

Write draft paper

Finalize all the figures

Prepare final paper  
(Iterate – iterate – iterate)

