技術英語

Technical English

CUTURI, 中澤, 吉井

Source for today's slides: *Science research writing for non-native speakers of English* by Hilary Glasman-Deal, an **excellent book that I recommend.**

Writing a Scientific Paper

Dynamic Programming Algorithm Optimization for Spoken Word Recognition

HIROAKI SAKOE and SEIBI CHIBA

Abstract—This paper reports on an optimum dynamic programming (DP) based time-normalization algorithm for spoken word recognition. First, a general principle of time-normalization is given using time-warping function. Then, two time-normalized distance definitions, called symmetric and asymmetric forms, are derived from the principle. These two forms are compared with each other through theoretical discussions and experimental studies. The symmetric form algorithm superiority is established. A new technique, called slope constraint, is successfully introduced, in which the warping function slope is restricted so as to improve discrimination between words in different categories. The effective slope constraint characteristic is qualitatively analyzed, and the optimum slope constraint condition is determined through experiments. The optimized algorithm is then extensively subjected to experimental comparison with various DP-algorithms, previously applied to spoken word recognition by different research groups. The experiment shows that the present algorithm gives no more than about two-thirds errors, even compared to the best conventional algorithm.

I. INTRODUCTION

IT is well known that speaking rate variation causes nonlinear fluctuation in a speech pattern time axis. Elimination of this fluctuation, or time-normalization, has been one of the central problems in spoken word recognition research. At an early stage, some linear normalization techniques were examined, in which timing differences between speech patterns were eliminated by linear transformation of the time axis. Reports on these efforts indicated that any linear transformation is inherently insufficient for dealing with highly complicated fluctuation nonlinearity as well as that time-normalization significantly improves recognition accuracy.

DP-matching, discussed in this paper, is a pattern matching algorithm with a nonlinear time-normalization effect. In this algorithm, the time-axis fluctuation is approximately modeled with a nonlinear warping function of some carefully specified properties. Timing differences between two speech patterns are eliminated by warping the time axis of one so that the maximum coincidence is attained with the other. Then, the time-normalized distance is calculated as the minimized residual distance between them. This minimization process is very efficiently carried out by use of the dynamic programming (DP) technique. The basic idea of DP-matching has been reported in several publications [1]–[3], where it has been shown by preliminary experiment on Japanese digit words that a recognition accuracy as high as 99.8 percent has been achieved, indicating the DP-matching effectiveness.

This paper reports an optimum algorithm for DP-matching through theoretical discussions and experimental studies. In-

vestigations were made, based on the assumption that speech patterns are time-sampled with a common and uniform sampling period, as in most general cases. One of the problems discussed in this paper involves the relative superiority of either a symmetric form of DP-matching or an asymmetric one. In the asymmetric form, time-normalization is achieved by transforming the time axis of a speech pattern onto that of the other. In the symmetric form, on the other hand, both time axes are transformed onto a temporally defined common axis. Theoretical and experimental comparisons show that the symmetric form gives better recognition than the asymmetric one. Another problem discussed concerns slope constraint technique. Since too much of the warping function flexibility sometimes results in poor discrimination between words in different categories, a constraint is newly introduced on the warping function slope. Detailed slope constraint condition is optimized through experimental studies. As a further investigation, the optimized algorithm is experimentally compared with several varieties of the DP-algorithm, which have been applied to spoken word recognition by some research groups [3]–[6]. The optimized algorithm superiority is established, indicating the validity of this investigation.

II. DP-MATCHING PRINCIPLE

A. General Time-Normalized Distance Definition

Speech can be expressed by appropriate feature extraction as a sequence of feature vectors.

$$A = a_1, a_2, \cdots, a_i, \cdots, a_I$$
$$B = b_1, b_2, \cdots, b_j, \cdots, b_J. \qquad (1)$$

Consider the problem of eliminating timing differences between these two speech patterns. In order to clarify the nature of time-axis fluctuation or timing differences, let us consider an i-j plane, shown in Fig. 1, where patterns A and B are developed along the i-axis and j-axis, respectively. Where these speech patterns are of the same category, the timing differences between them can be depicted by a sequence of points $c = (i, j)$:

$$F = c(1), c(2), \cdots, c(k), \cdots, c(K), \qquad (2)$$

where

$$c(k) = (i(k), j(k)).$$

This sequence can be considered to represent a function which approximately realizes a mapping from the time axis of pattern A onto that of pattern B. Hereafter, it is called a warping function. When there is no timing difference between these
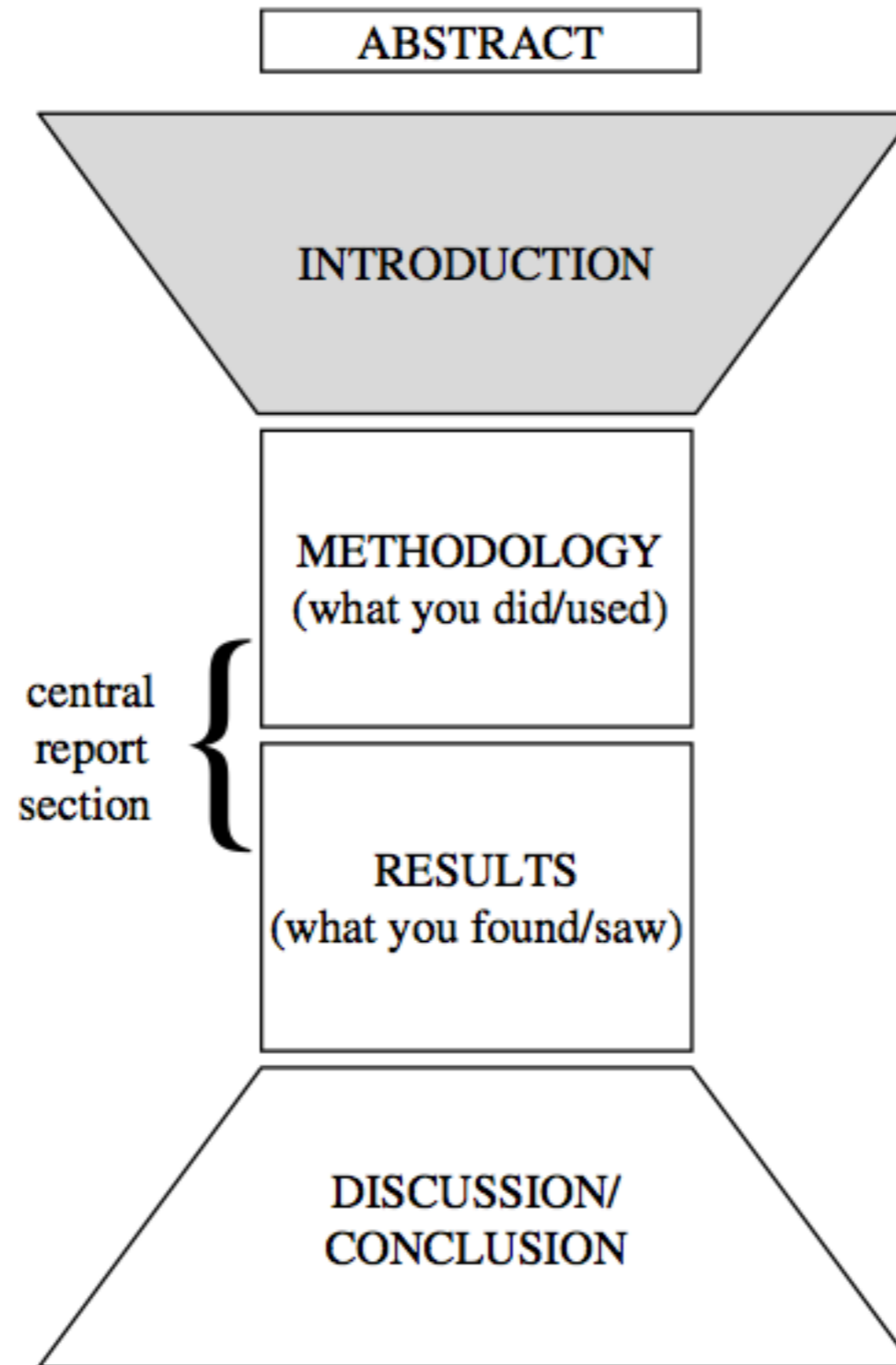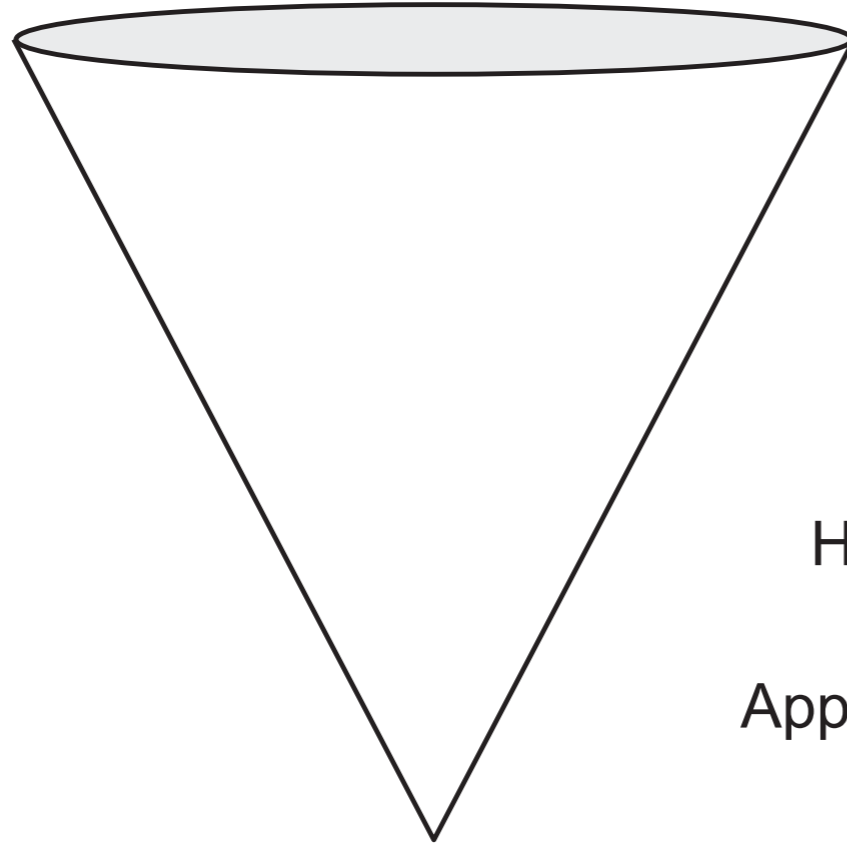
Writing a Scientific Paper

Fig. 1. The shape of a research article or thesis.

Structure

Background, known information

Knowledge gap, unknown information

Hypothesis, question, purpose statement

Approach, plan of attack, proposed solution

Fig. 1. The introduction: a cone or funnel.

"It was a cold and rainy night":
Set the Scene with a Good Introduction Thomas M. Annesley

Using Paragraphs

- What is a **paragraph**? a unit of text. Usually a few sentences.

- **Why use paragraphs?** make it easier for your reader to parse your text.

- **Extra function**: allow readers to read your article very quickly

Quick Paper Reading

1. READ THE TITLE

   and try to predict the type of information you expect to see

2. LOOK AT THE NAME OF THE AUTHOR

   What you know about the writer will help you predict and evaluate the content.

3. CHECK THE DATE

   and use it to help you assess the content.

4. READ THE ABSTRACT

   to find out what the researchers did and/or what they found

5. LOOK QUICKLY AT THE FIRST PARAGRAPH

   without trying to understand all the words.

6. LOOK QUICKLY AT THE FIRST SENTENCE OF EACH PARAGRAPH

   without trying to understand all the words

7. LOOK QUICKLY AT EACH FIGURE/TABLE AND READ ITS TITLE

   to try and find out what type of visual data is included

8. READ THE LAST PARAGRAPH

   especially if it has a subtitle like 'Summary' or 'Conclusion'

The Crime Novel Analogy

- *Suppose someone gives you a crime novel*

- *Suppose you read **first** the **final chapter***

  - *You know who did the crime, why, how*

- *Start reading the novel from the start now*

- **Will you read the novel faster?**

Structure

- *What types of information should be in my introduction?*

Building A Model

The synthesis of flexible polymer blends from polylactide and rubber

Introduction

In this sentence, the writer:

1 Polylactide (PLA) has received much attention in recent years due to its biodegradable properties, which offer important economic benefits. **2** PLA is a polymer obtained from corn and is produced by the polymerisation of lactide. **3** It has many possible uses in the biomedical field[1] and has also been investigated as a potential engineering material.[2,3] **4** However, it has been found to be too weak under impact to be used commercially.[4]

1_____

2_____

3_____

4_____

5 One way to toughen polymers is to incorporate a layer of rubber particles[5] and there has been extensive research regarding the rubber modification of PLA. **6** For example, Penney *et al.* showed that PLA composites could be prepared using blending techniques[6] and more recently, Hillier established the toughness of such composites.[7] **7** However, although the effect of the rubber particles on the mechanical properties of copolymer systems was demonstrated over two years ago,[8] little attention has been paid to the selection of an appropriate rubber component.

5_____

6_____

7_____

8 The present paper presents a set of criteria for selecting such a component.

8_____

Building A Model

In Sentence 1 '*Polylactide (PLA) has received much attention in recent years due to its biodegradable properties, which offer important economic benefits.*' **the writer establishes the importance of this research topic.**

Building A Model

In **Sentence 2** '*PLA is a polymer obtained from corn and is produced by the polymerisation of lactide.*' **the writer provides general background information for the reader**.

Building A Model

In Sentence 3 'PLA has many possible uses in the biomedical field[1] and has also been investigated as a potential engineering material [2,3]' the writer does the same as in Sentences 1 and 2, but in a more specific/detailed way, using research references to support both the background facts and the claim for significance.

Building A Model

In Sentence 4 'However, it has been found to be too weak under impact to be used commercially.[4]' **the writer describes the general problem area or the current research focus of the field.**

Building A Model

In Sentence 5 '*One way to toughen polymers is to incorporate a layer of rubber particles.*[5]' **the writer provides a transition between the general problem area and the literature review.**

Building A Model

In Sentence 6 'For example, Penney et al. showed that PLA composites could be prepared using blending techniques[6] and more recently, Hillier[7] established the toughness of such composites.' **the writer provides a brief overview of key research projects in this area**.

Building A Model

In **Sentence 7** '*However, although the effect of the rubber particles on the mechanical properties of copolymer systems was demonstrated over two years ago,*[8] *little attention has been paid to the selection of an appropriate rubber component.*' **the writer describes a gap in the research**.

Building A Model

In Sentence 8 '*The present paper presents a set of criteria for selecting such a component.*' **the writer describes the paper itself.**

Building A Model

In Sentence 9 *'On the basis of these criteria it then describes the preparation of a set of polymer blends using PLA and a hydrocarbon rubber(PI).'* **the writer gives details about the methodology reported in the paper**.

Building A Model

In **Sentence 10** '*This combination of two mechanistically distinct polymerisations formed a novel copolymer in which the incorporation of PI significantly increased flexibility.*' **the writer announces the findings**.

Building A Model

In Sentence 1   the writer establishes the importance of this research topic.

In Sentence 2   the writer provides general background information.

In Sentence 3   the writer does the same as in Sentences 1 and 2, but in a more specific/detailed way.

In Sentence 4   the writer describes the general problem area or the current research focus of the field.

In Sentence 5   the writer provides a transition between the general problem area and the literature review.

In Sentence 6   the writer provides a brief overview of key research projects in this area.

In Sentence 7   the writer describes a gap in the research.

In Sentence 8   the writer describes the paper itself.

In Sentence 9   the writer gives details about the methodology reported in the paper.

In Sentence 10 the writer announces the findings.

A Model For the Introduction

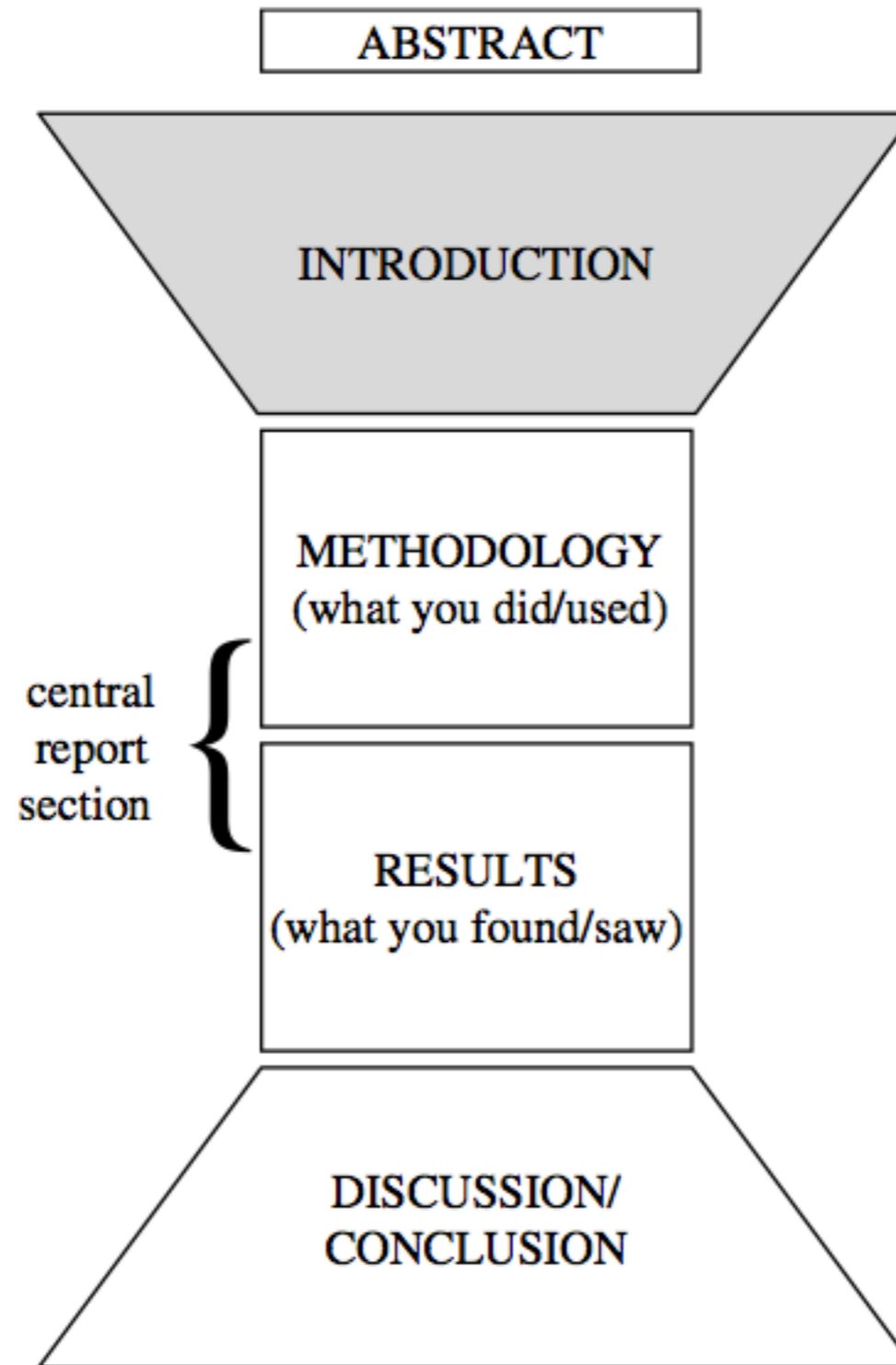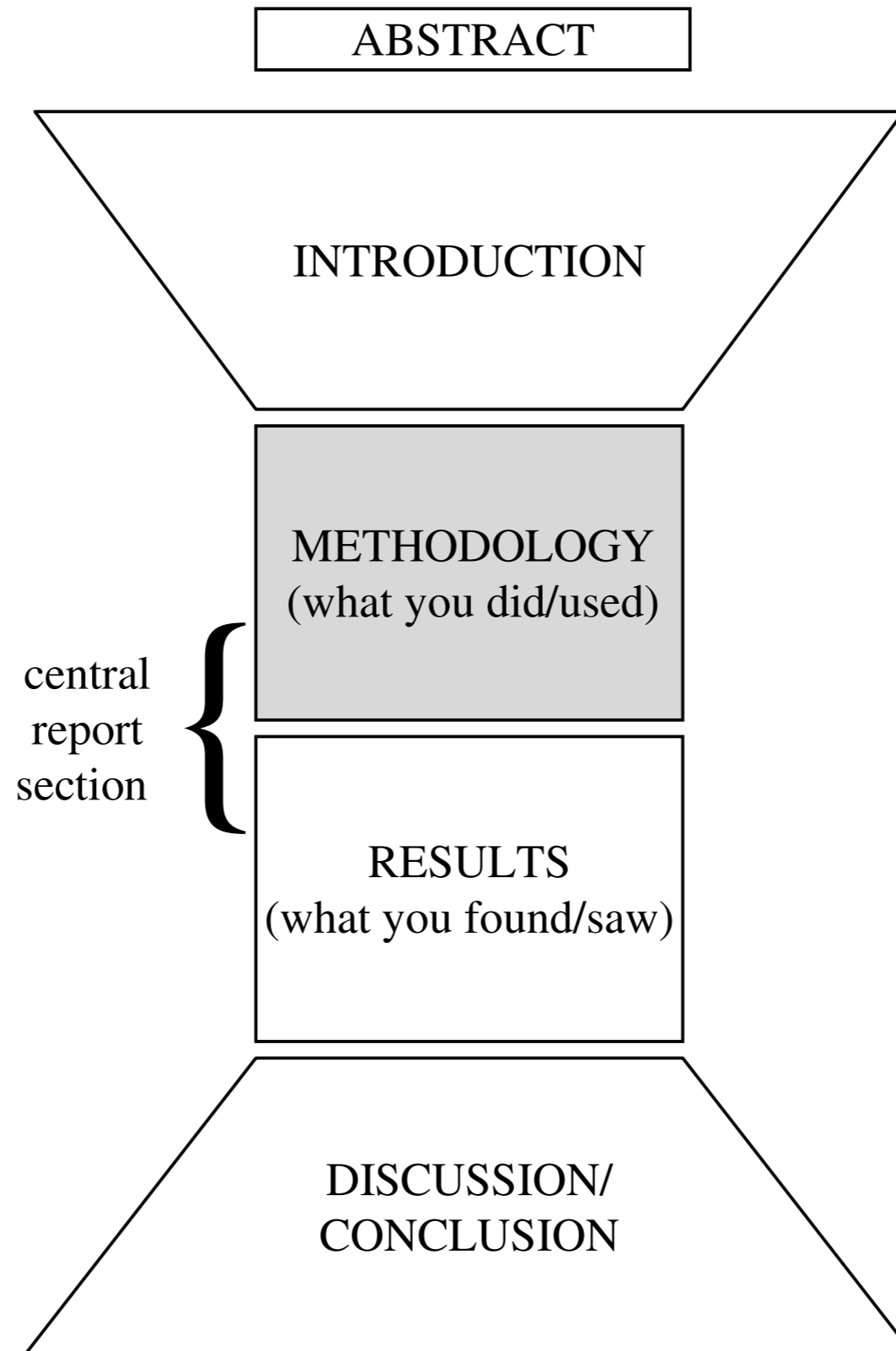| 1	ESTABLISH THE IMPORTANCE OF YOUR FIELD PROVIDE BACKGROUND FACTS/INFORMATION (possibly from research) DEFINE THE TERMINOLOGY IN THE TITLE/KEY WORDS PRESENT THE PROBLEM AREA/CURRENT RESEARCH FOCUS
2	PREVIOUS AND/OR CURRENT RESEARCH AND CONTRIBUTIONS
3	LOCATE A GAP IN THE RESEARCH DESCRIBE THE PROBLEM YOU WILL ADDRESS PRESENT A PREDICTION TO BE TESTED
4	DESCRIBE THE PRESENT PAPER

Introduction: Done.

Fig. 1. The shape of a research article or thesis.

Methodology: *Your Work*

ABSTRACT

INTRODUCTION

METHODOLOGY
(what you did/used)

central
report
section

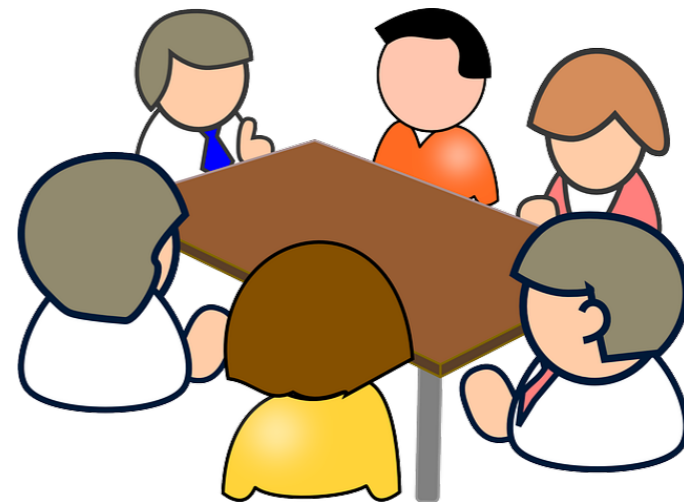RESULTS
(what you found/saw)

DISCUSSION/
CONCLUSION

Your Work as a Student

- Up to now, you have mostly written about science to **prove that you have understood known concepts**.

- **Your professor knows how to fill the gaps, understand what you write even if it's not clear.**

Work as a Scientist/Engineer

- Writing a scientific paper is different: **you will be the professor, the teacher**.

Work as a Scientist/Engineer

- Writing a scientific paper is different: **you will be the professor, the teacher**.