ENGLISH FOR INFORMATION TECHNOLOGY 5

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MAHASARAKHAM
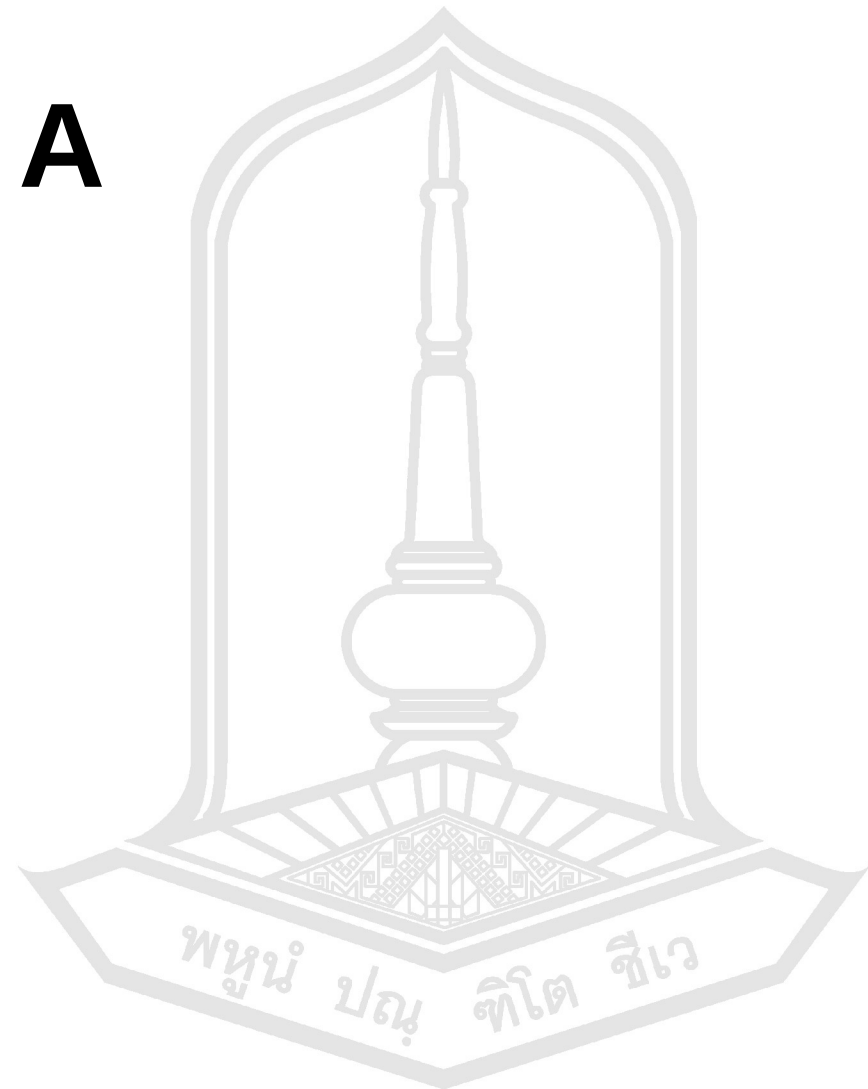U N I V E R S I T Y
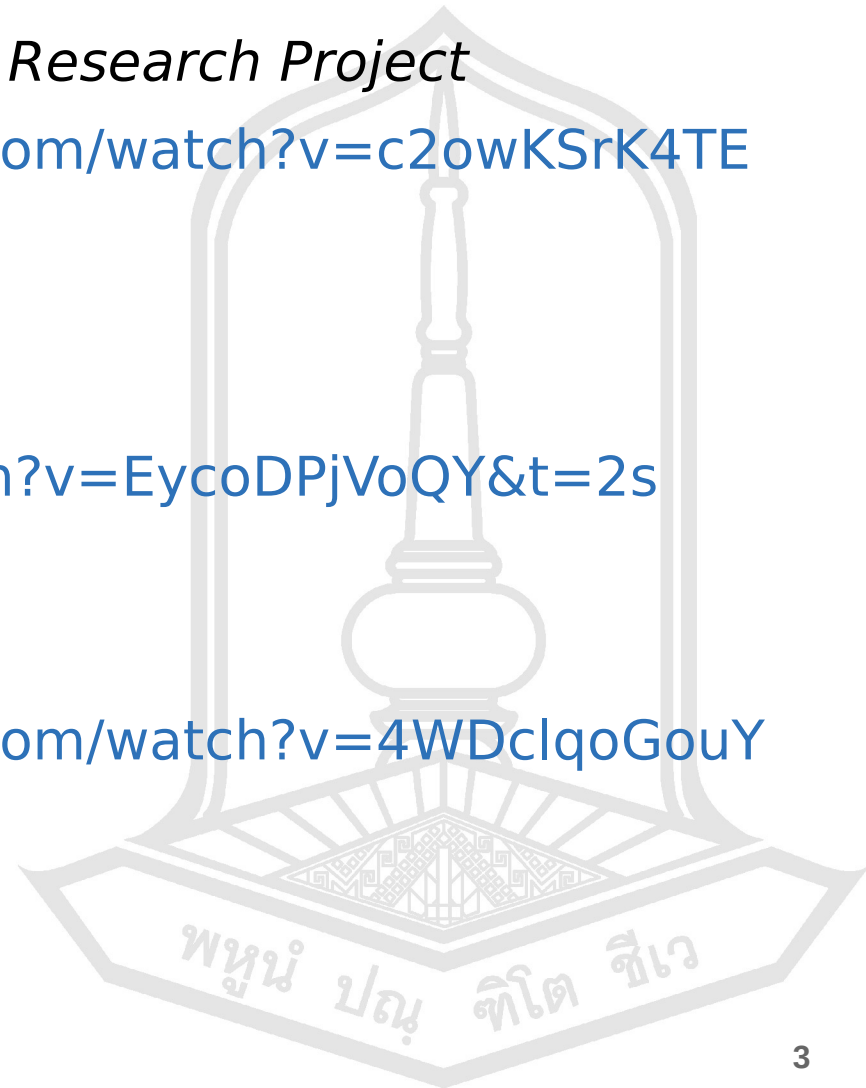
HOW TO WRITE A RESEARCH INTRODUCTION

วิธีการเขียนบทนำ

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Lecturer

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Watch a video

- *Writing the Introduction to Your Research Project*
- Youtube: https://www.youtube.com/watch?v=c2owKSrK4TE

- *How to write an Introduction*
- Youtube: https://www.youtube.com/watch?v=EycoDPjVoQY&t=2s

- *Introduction Paragraph*
- Youtube: https://www.youtube.com/watch?v=4WDclqoGouY
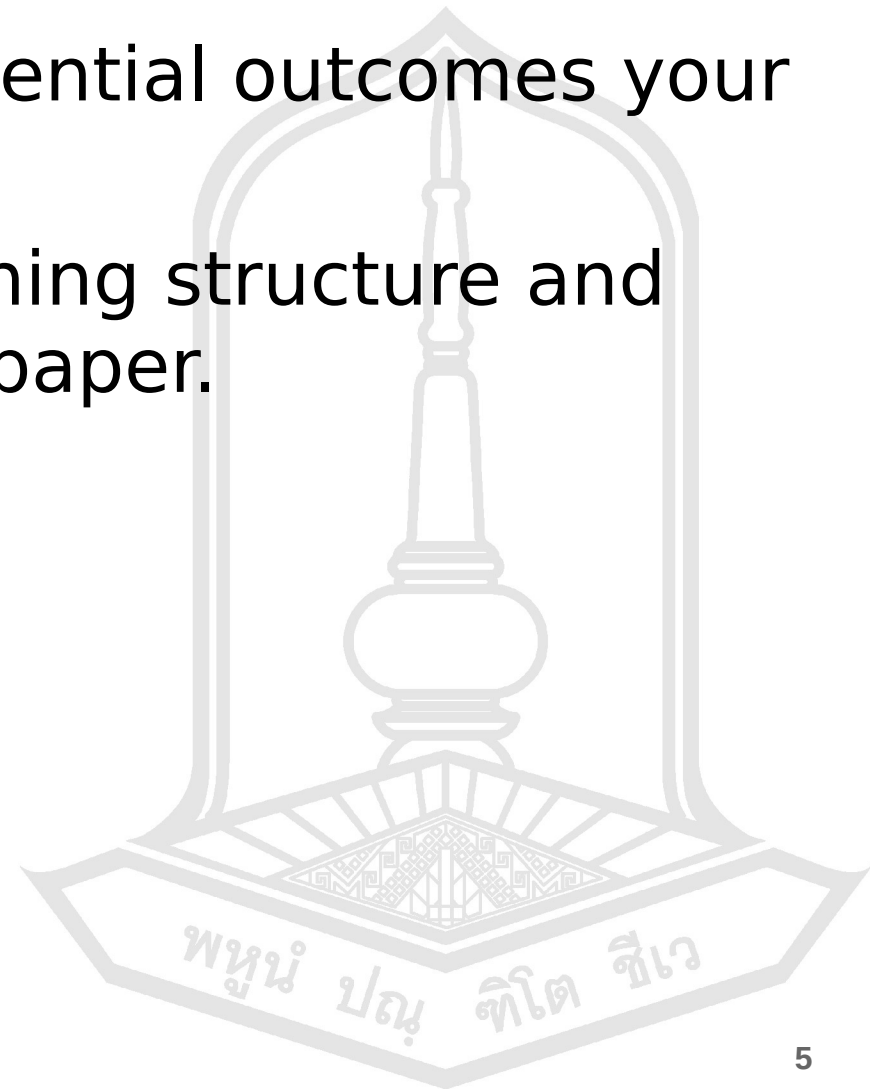
Definition of the introduction

- The introduction leads the reader from a general subject area to a particular topic inquiry.

- It establishes to scope, context, and significance of the research being conducted by summarizing current understanding and background information about the topic,

  - Stating the purpose of the work in the form of the research problem supported by a hypothesis or a set of questions

  - Explaining briefly the methodological approach used to examine the research problem

cr. http://libguides.usc.edu/writingguide/introduction

Definition of the introduction

- Highlighting the potential outcomes your study can reveal
- Outlining the remaining structure and organization of the paper.

Importance of a good introduction

- Think of the introduction as a mental road map that must answer for the reader these four questions:
  - What was I studying?
  - Why was this topic important to investigate?
  - What did we know about this topic before I did this study?
  - How will this study advance new knowledge or new ways of understanding?
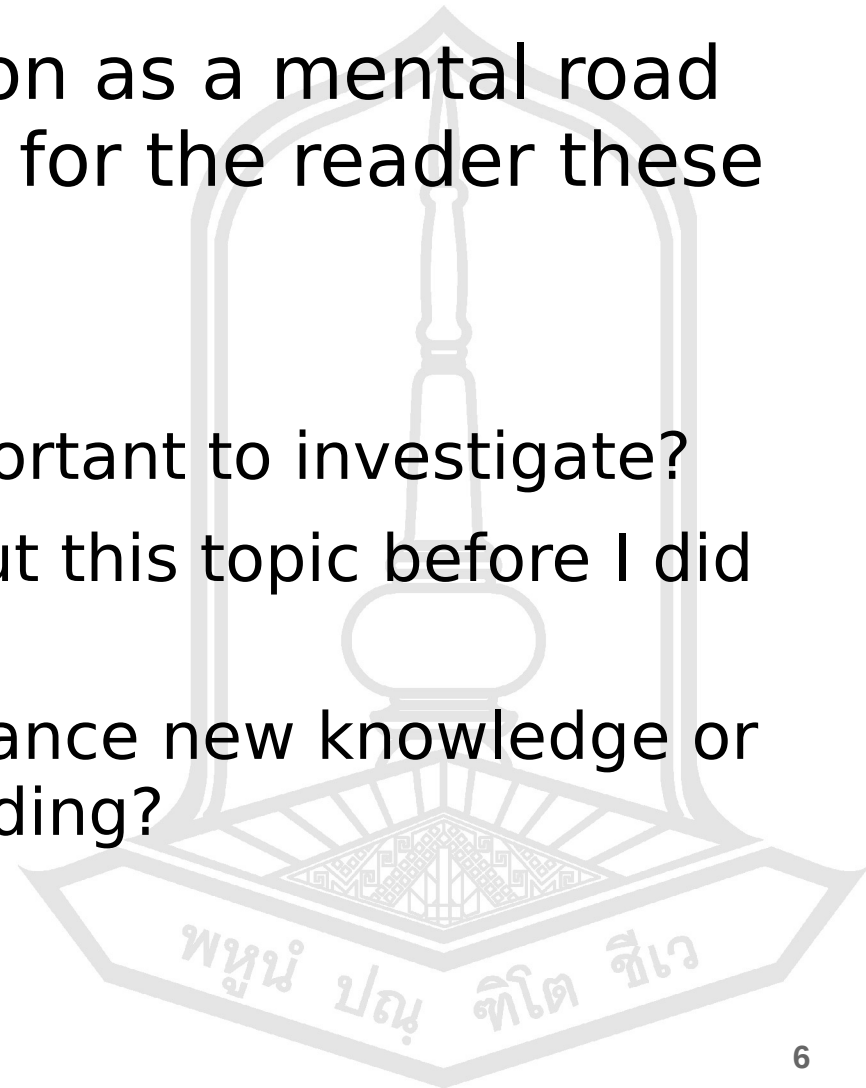
Goals of a good introduction

- Ensure that your summarize prior studies about the topic in a manner that lays a foundation for understanding the research problem

- Explain how your study specifically addresses gaps in the literature, insufficient consideration of the topic, or other deficiency in the literature

- Note the broader theoretical, empirical, and/or policy contributions and implications of your research.
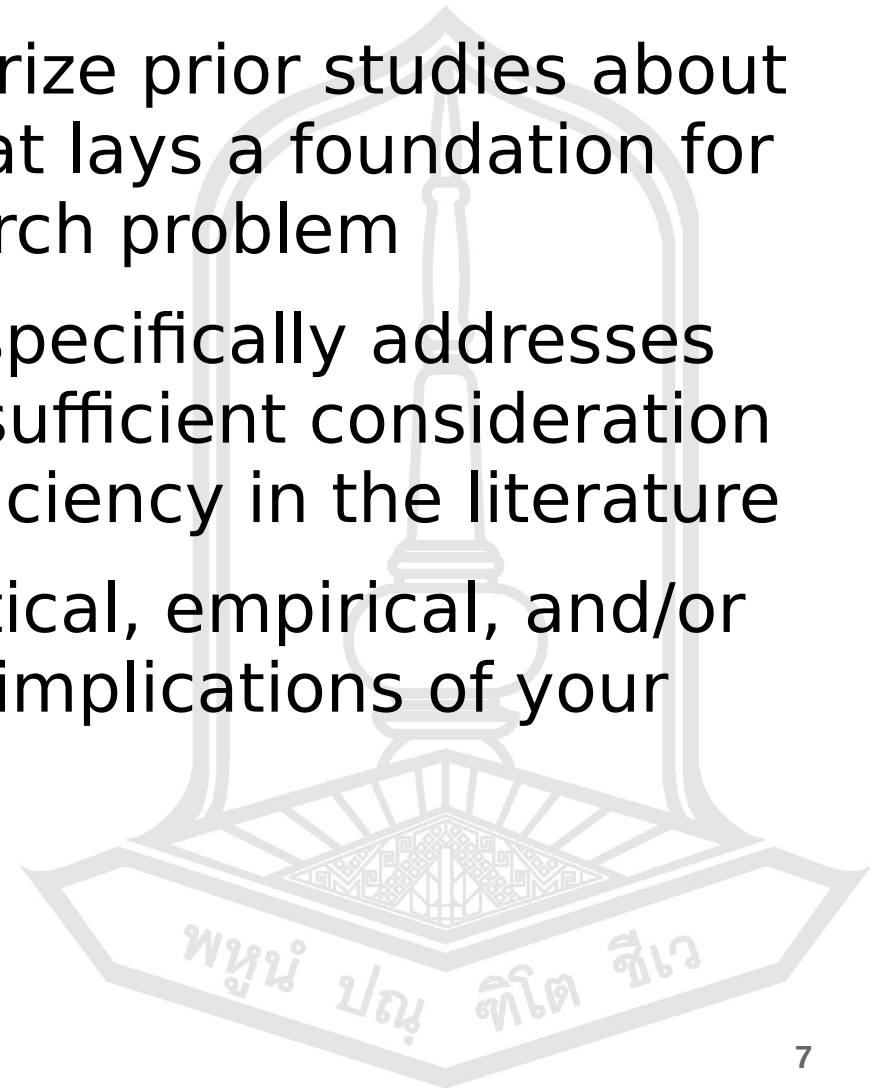
Introducing the topic of the paper

- **Announce your research topic**
  - You can start your introduction with a few sentences which announce the topic of your paper and give an indication of the kind of research questions you will be asking.
  - The first few sentences should act as an indication of a broader problem which you will then focus in on more closely in the rest of your introduction, leading to your specific research questions.

cr. http://www.wikihow.com/Write-a-Research-Introduction
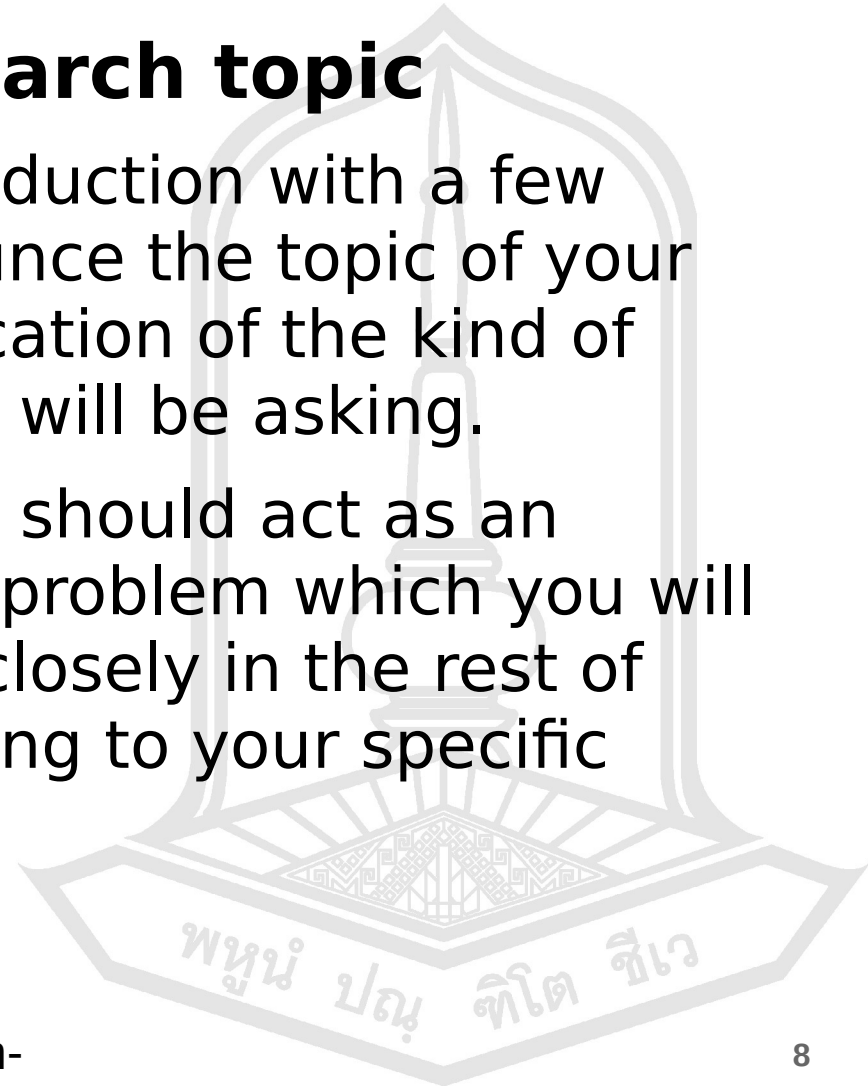
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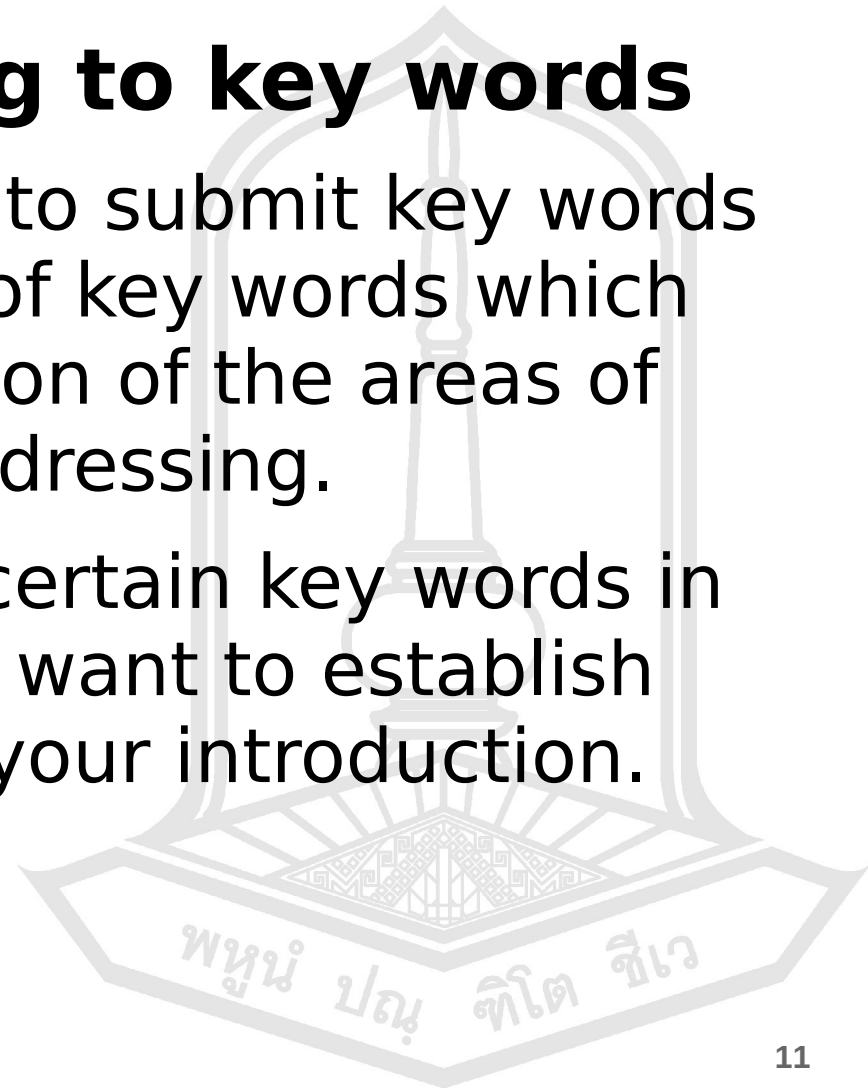
1. Introduction

Handwritten character recognition systems have several important applications, such as zip-code recognition, writer identification for e.g. forensic research, searching in historical manuscripts, and others. For such applications, the system should be able to recognize handwritten characters written on many different kinds of documents, such as contemporary or historical manuscripts. The aim is to let the system to automatically extract and recognize the characters that are embedded in the manuscript. The quality of the manuscript is one of the factors that can improve the recognition accuracy (Gupta et al., 2011). It is essential to deal with the different problems that occur in the manuscripts, such as distortions in a character image and the background noise that can appear during the scanning process. The aim of our work is to develop new algorithms that can obtain a high recognition accuracy.

Announce your research topic

In this paper we emphasize the importance of the recognition of complex handwritten Thai, Bangla, and Latin scripts, for which the handwritten characters and digits are highly varying due to different shapes, strokes, curls, and concavities (Mandal et al., 2011). Some samples of the handwritten characters are shown in Fig. 1. Note that the handwritten images shown in this paper are resized to the same resolution for illustration purposes. Due to the high variety, the direct use of pixel intensities may not work very well, because there is sometimes little overlap between two handwritten images displaying the same character. Therefore, in this paper we propose to use feature extraction techniques which are robust to local displacements, but still provide discriminative feature vectors as representation of the handwritten characters. The feature extraction methods
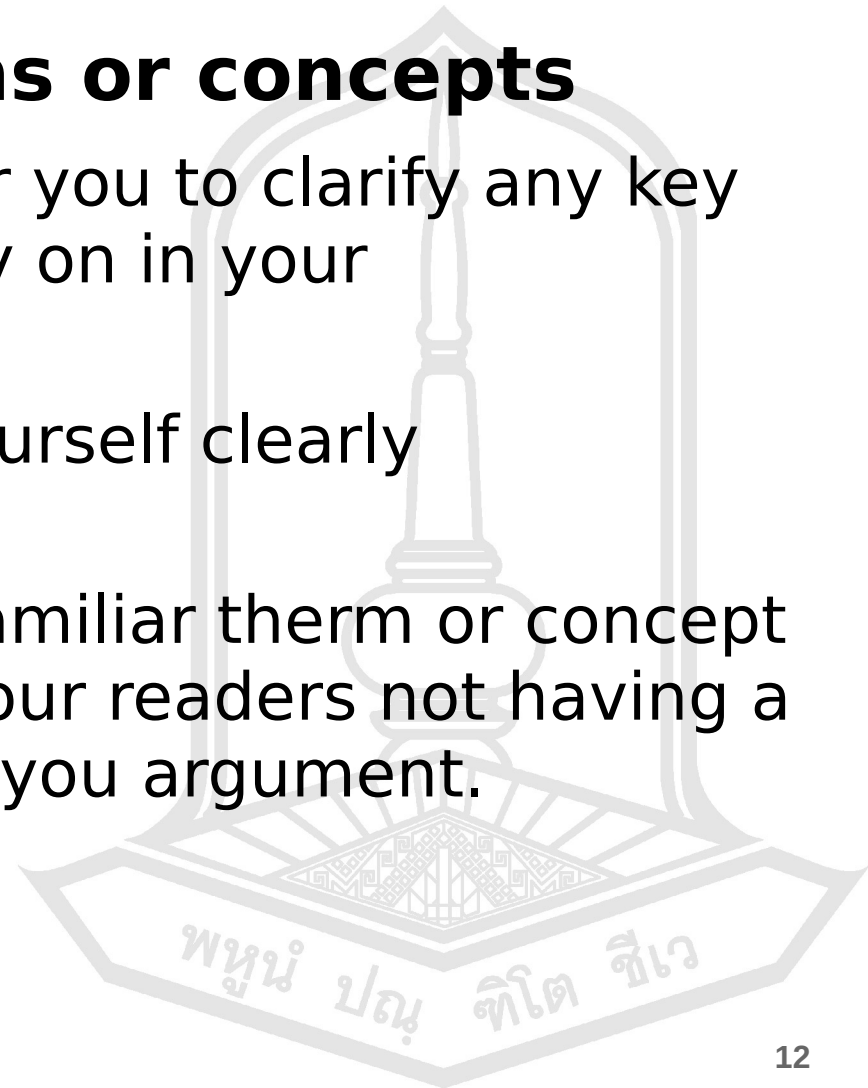
Introducing the topic of the paper

- **Consider referring to key words**
  - You will be required to submit key words along with a series of key words which give a quick indication of the areas of research you are addressing.
  - You may also have certain key words in your title which you want to establish and emphasised in your introduction.

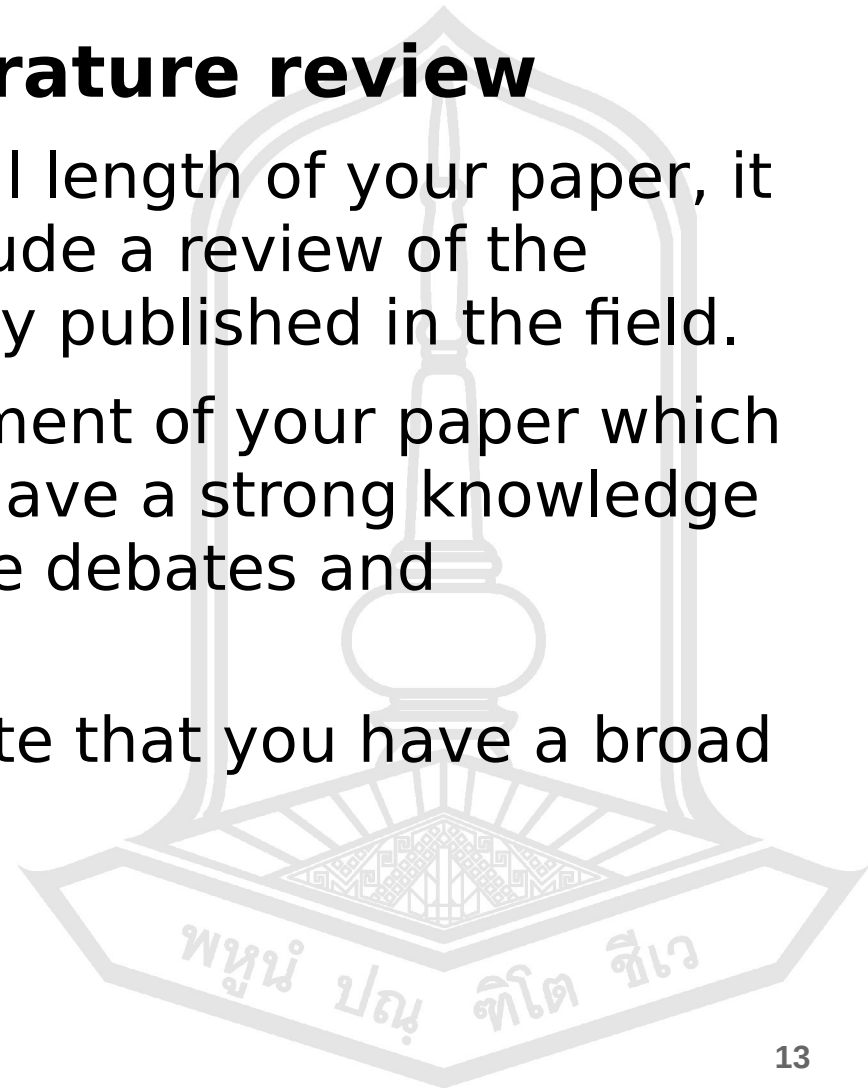# Introducing the topic of the paper

- **Define any key terms or concepts**
  - It may be necessary for you to clarify any key terms or concepts early on in your introduction.
  - You need to express yourself clearly throughout your paper
  - So, if you leave an unfamiliar therm or concept unexplained you risk your readers not having a clear understanding of you argument.

Introducing the topic of the paper

- **Introduce a brief literature review**
 - Depending on the overall length of your paper, it will be necessary to include a review of the existing literature already published in the field.
  - This is an important element of your paper which demonstrates that you have a strong knowledge and understanding of the debates and scholarship in your area.
  - You should aim to indicate that you have a broad knowledge.

Introducing the topic of the paper

- – It is important to be concise in the introduction, so provide an overview on recent developments in the primary research rather than a lengthy discussion.

- – A strong literature review presents important background information to your own research and indicates the importance of the filed.
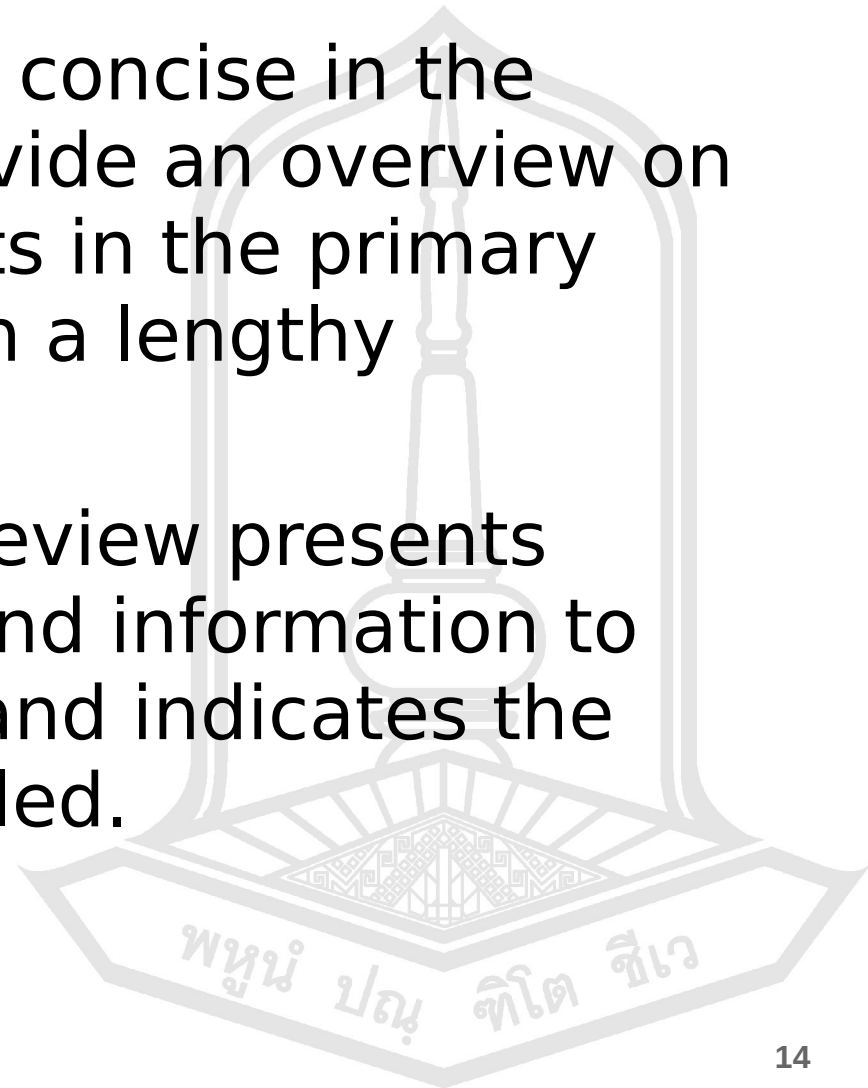
Literature review

Related work: In previous studies, the raw image (IMG) method, which directly copies the intensities of the pixels of the ink trace (Surinta et al., 2013), has often been used as the feature extraction method. It extracts a high dimensional feature vector that depends on the size of the input image.

In recent years, deep learning architectures (Hinton et al., 2006; Schmidhuber, 2015) have been effectively used for handwritten digit recognition. Most of the studies have focused on the bench-mark MNIST dataset (LeCun and Cortes, 1998) and achieved high accuracies such as higher than 98% or 99%. The MNIST dataset consists of isolated handwritten digits with size of 28×28 pixel resolution and contains 60,000 training images and 10,000 test images. In Hinton et al. (2006), a greedy training algorithm is proposed for constructing a multilayer network architecture which relies on the restricted Boltzmann machine, called deep belief networks (DBN). The performance obtained from the DBN with three hidden layers (500–500–2000 hidden units) on the MNIST dataset was 98.75%. This accuracy is higher than obtained with a multi-layer perceptron and a support vector machine (SVM).

Furthermore, the convolutional neural network (CNN) (LeCun et al., 1998) is used as a feature extraction and classification technique,

Literature review

Furthermore, the convolutional neural network (CNN) (LeCun et al., 1998) is used as a feature extraction and classification technique, and the accuracy obtained is 99.47% (Jarrett et al., 2009). In another CNN-based method (Cireşan et al., 2011), the committee technique is proposed. Here multiple CNNs are combined in an ensemble, for which different CNNs are trained on different pixel resolutions of the images. The images in the dataset are rescaled from 28×28 ($N \times N$) to $N = 10, 12, 14, 16, 18,$ and 20 pixel resolutions. Then, 7-net committees are used. This method obtained the high accuracy of 99.73% on MNIST. However, a single CNN in their work is reported to take approximately 1–6 h for training on a graphics processing unit (GPU) and the 7-net committees are seven times slower than a single CNN. The best technique for the MNIST dataset uses an ensemble of 35-net committees (Cireşan et al., 2012). This technique obtained the very high accuracy of 99.77%. Although such high recognition performances are sometimes achieved, these methods require large training sets and long training times to make the recognition system work well.

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Introducing the topic of the paper

- **Use the literature to focus in on your contribution**
  - A comprehensive literature review can be a very effective way to frame your own research paper.
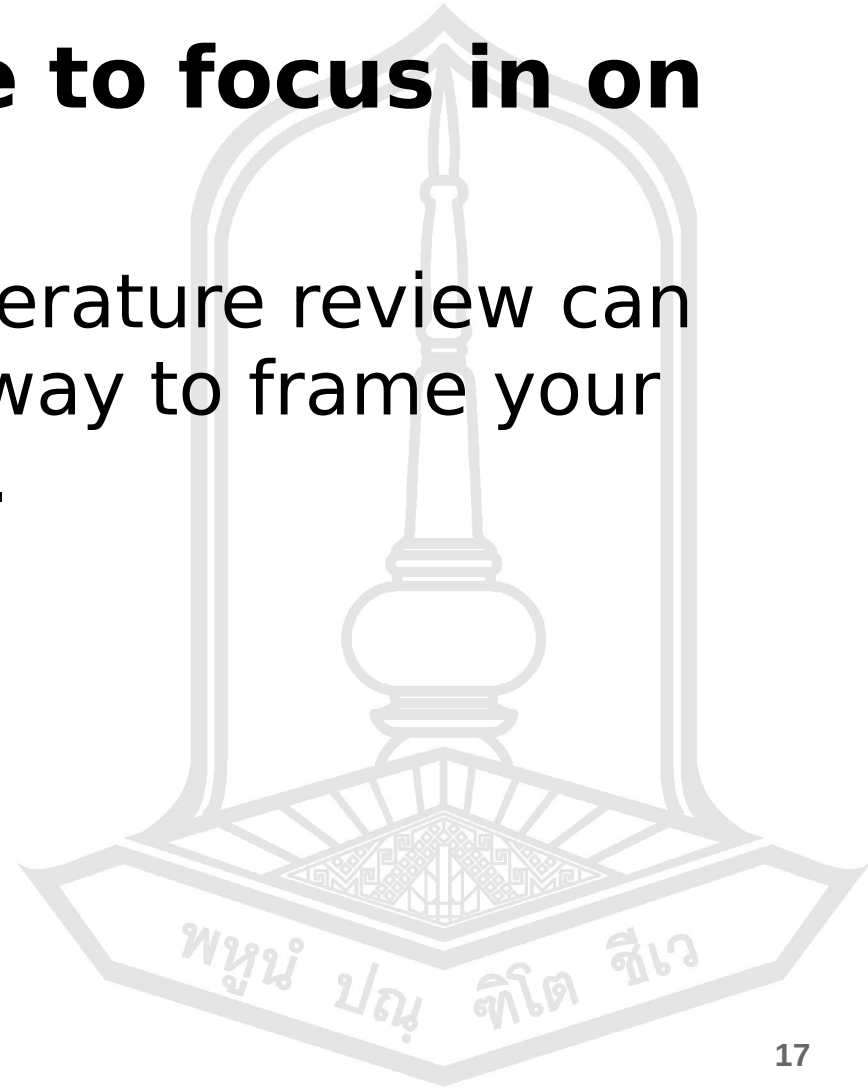
Contributions

Contributions of our paper: This paper first of all provides a new standard Thai handwritten character dataset for comparison of feature extraction techniques and methods. In this paper we will make use of three complex datasets in total, namely Bangla, Thai, and Latin, for which very high recognition accuracies have not been obtained before. This is due to the difficult problems of the Thai and the Bangla handwritten scripts such as the complex structural characteristics of the characters, the similarities between the character sets (see Fig. 7(a) and (b)), the similar structures between different characters (see Fig. 4), and the background noise. These factors negatively affect the performance of a handwritten character recognition system.

Introducing the topic of the paper

- **State your research questions**
  - The research questions generally come towards the end of the introduction, and should be concise and closely focused.
  - The research question might recall some of the key words established in the first few sentences and the title of your paper.
  - A good research question should shape a problem into a testable hypothesis.

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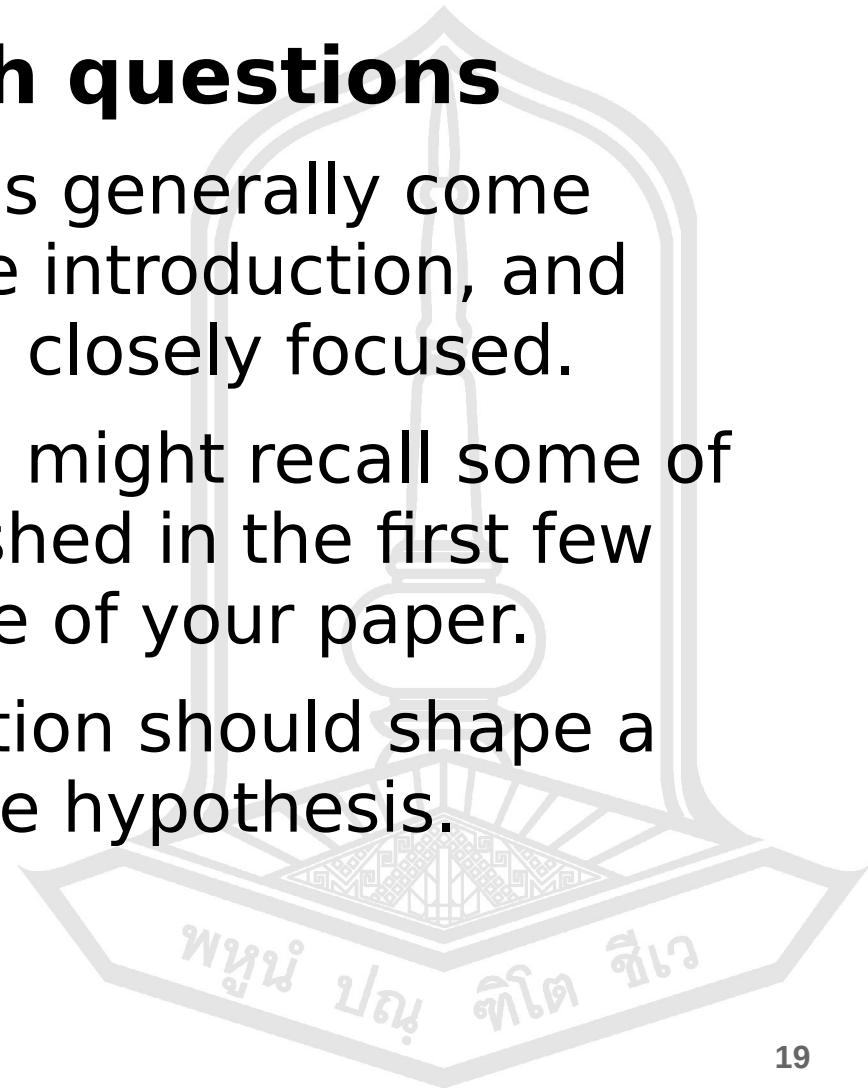
Research question

been obtained before. This is due to the difficult problems of the Thai and the Bangla handwritten scripts such as the complex structural characteristics of the characters, the similarities between the character sets (see Fig. 7(a) and (b)), the similar structures between different characters (see Fig. 4), and the background noise. These factors negatively affect the performance of a handwritten character recognition system.

Introducing the topic of the paper

- **Indicate your hypothesis**
  - After you have specified your research questions you need to give a clear and concise articulation of your hypothesis, or your thesis statement.
  - This is a statement which indicates your essay will make a specific contribution and have a clear result rather than just covering a broader topic.

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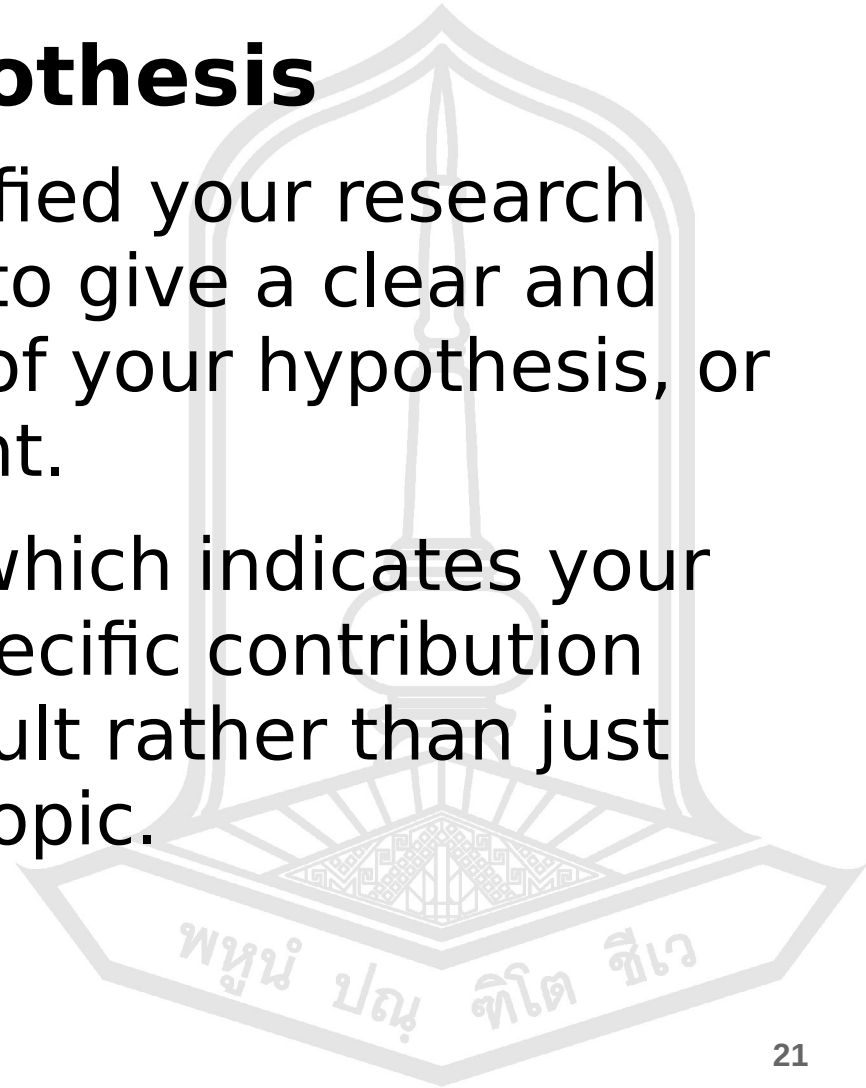
Indicate hypothesis

To address the problems mentioned, two local gradient feature descriptors that extract feature vectors from the challenging handwritten character images are proposed, namely the scale invariant feature transform keypoint descriptor (Lowe, 2004) and the histogram of oriented gradients (Dalal and Triggs, 2005). The feature descriptors compute feature vectors with image filters such as the Sobel filter and the Gaussian filter. Subsequently, the orientations within each region are calculated and weighted into an orientation histogram. Because these feature descriptors are invariant to small local displacements, the descriptors provide robust feature vectors.

Introducing the topic of the paper

- **Outline the structure of your paper**
  - In some cases the final part of an introduction to a research paper will be a few lines that provide an overview of the structure of the body of the paper.
  - This is not always necessary.
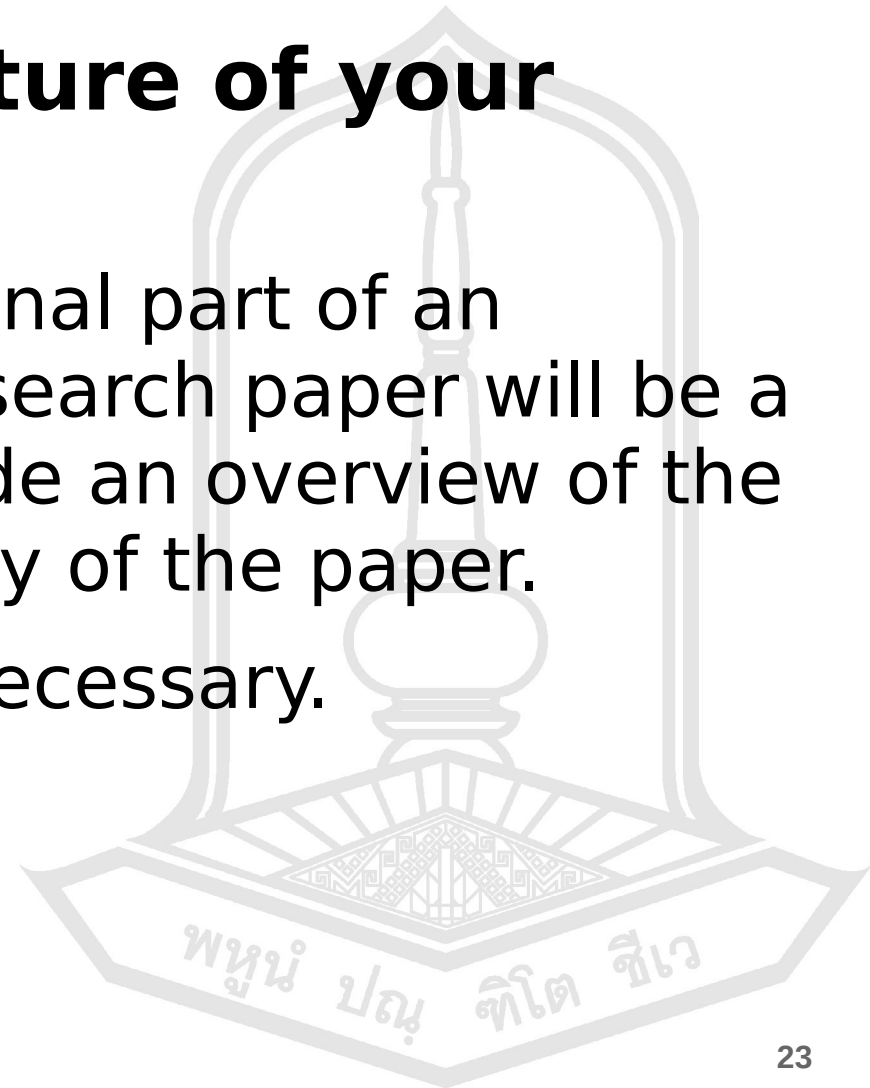
Paper outline

Paper outline: This paper is organized in the following way. Section 2 describes the local gradient feature descriptors. Section 3 describes the two classifiers including the k-nearest neighbors algorithm as a simple classifier and the support vector machine algorithm with the radial basis function kernel as a more powerful classifier. The handwritten character datasets which are used in the experiments, namely Thai, Bangla, and Latin scripts, are described in Section 4. The experimental results of the different combinations of feature descriptors and classifiers are presented in Section 5. The conclusion and some directions for future work are given in the last section.

example

- http://www.ai.rug.nl/~mrolarik/Publications/EAAI2015/EAAI2015-45-2015-1-s2.0-S0952197615001724-main.pdf
- http://www.ai.rug.nl/~mrolarik/Publications/EANN2015/EANN2015-0517002.pdf
- http://www.ai.rug.nl/~mrolarik/Publications/IEEESSCI-2015.pdf
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