

## HOW TO USE THIS BOOK

### A. Global Description

This book is given the title "Software Engineering", together with one of the program expertise in the Vocational School (SMK). However, the actual contents of this book is not specifically discuss on Software Engineering. From the perspective of Computer Science field of five sub-areas covered in this book, the sub-field of Engineering Software, Operating System, Algorithm and Data Structure, Programming Languages and Database. This curriculum tailored to the level of expertise SMK Program for Software Engineering.

Main subject of Engineering Software in general, describe the basics of Software Engineering, and solving problems, and methods of software development. The discussion about the sub-field of Operating System contains a computer system, the system operating and working in the computer network. The scope of the material basic algorithms include algorithms and advance algorithms. Sub field Programming Languages take a big portion, including GUI programming with VB & VB.Net, Java programming, C + + programming, Programming of object-oriented and web-based. Sub-sector which is the last part of this book is a data base with the scope of the system databases, conceptual modeling, relational database, Microsoft Access and SQL.

### B. Competency Map

In general, this book refers to the Standard and Competence Basic Competency (SKKD) for Vocational School (SMK) as follows :

1. Using a basic level of programming algorithm
2. Using advanced programming algorithm
3. Operate the database application
4. Create an application-based Microsoft Access
5. Mastering the basic techniques electronics
6. Mastering the digital electronics technology
7. Create file with HTML according to specifications
8. Applying the basics of creating a basic level of static web
9. Make the application using VB and VB.NET
10. Make the software application package
11. Doing programming data description (Structured-SQL Query Language) basic level
12. Operates programming data description language (SQL) advanced
13. Create a web page dynamic basic levels
14. Create a web page more dynamic level

15. Create a web application program using JSP Software Engineering
16. Make the application database using XML
17. Make a database program using Microsoft (SQL Server)
18. Make a database program using PL / SQL (Oracle)
19. Make the application using C + +
20. Explaining the system peripherals
21. Make the program in object-oriented programming language
22. Make the application using Java
23. Operate the computer operating system and text-based GUI

In this book, chapters not compiled based on SKKD, but the materials are developed based on the sequence of basic subject. So that in some chapters contain a mix of several standards of competence. Or a basic competency may not be on the competency standards groups such as SKKD on the list, but is on the other sub-chapters.

SKKD suitability and content of the chapter can be seen in the table below :

Competency Code	Competency	Relation
ELKA-MR.UM.001.A	Mastering the basic techniques electronics	3
ELKA.MR.UM.004.A	Mastering the digital electronics technology and Computer	3
TIK.PR02.001.01	Using a basic level of programming algorithm	5
TIK.PR02.002.01	Using advanced programming algorithm	6
HDW.OPR.103.(1).A	Operate the computer operating system and text-based	4
HDW.OPR.104.(1).A	Operate the computer operating system based GUI	4
TIK.PR02.020.01	Operate the database application	10 and 11
TIK.PR08.004.01	Create an application-based Microsoft Access	11
TIK.PR08.024.01	Create file with HTML according to specifications	13
TIK.PR08.027.01	Applying the basics of creating a basic level of static web	13
TIK.PR08.003.01	Make the application using VB and VB.NET	7
TIK.PR02.016.01	Make the software application package	7
TIK.PR03.001.01	Doing programming data description (Structured - SQL Query Language) basic level	12
TIK.PR03.002.01	Operates programming data description language	12

	(SQL) advanced	
TIK.PR04.002.01	Create a web page dynamic basic levels	13
TIK.PR04.003.01	Create a web page dynamic advance levels	13

Competency Code	Competency	Relation
TIK.PR02.009.01	Operate the program in object-oriented programming language	8
TIK.PR08.012.01	Make application program using Java	8
TIK.PR08.001.01	Make application program using C++	9
TIK.PR06.003.01	Describe Peripheral system	3
TIK.PR08.005.01	Make database using PL/SQL	10 and 12
TIK.PR08.006.01	Make database program using SQL server	12
TIK.PR08.008.01	Make JSP based we application web program	14

### C. How to use this book

This book is specifically aimed at students and teachers for the vocational school (SMK) expertise in RPL. However, this book is also open for general readers who are interested in the RPL, Algorithm and Programming, Database and the Internet. For students, this book can be a handbook, because this book is to provide learning materials that are complete enough for the subjects for three years at the school. Some parts of this book may need books to help enrich more insight and capacity building. Whereas for teachers, this book can be used as reference books to prepare teaching modules for the students.

This book is structured in such a way so that students can independently learn and encourage to try. Therefore, in this book, many will be found either in the form of illustration image, the scheme and program listings. This is so that students can easily understand the explanation or the application of a particular concept. The chapter will be ended with exercise of the subject.



## CHAPTER 6 ADVANCED PROGRAMMING ALGORITHM

I am sure most of you have seen the notation in Figure 6.1. Yes, it is a general mathematical notation used in Matrix. Matrix operation is an operation that is used in many calculation activities. Please review your mathematical course / book that discuss matrix, you'll see a lot of things may be calculated by using matrix.

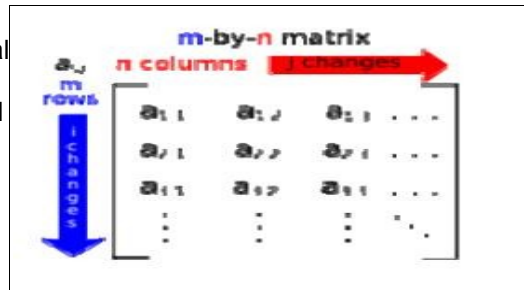


Figure 6.1. Matrix notation.

Have you ever heard MATLAB software? This software is based on mathematical operation and very popular among scientist, engineer and those who do lots of calculation. By using array, you can create a program to carry out matrix operation as in MATLAB.

The standard of competence in advanced programming algorithm consists of four (4) basic competences, namely, the use of array multidimensional, the use of procedure and function. In this book, each basic competence contains the material and exercise. The summary is at the end of each chapter. Before studying this competence, please review the principle of problem solution, the foundation of programming algorithm and supporting materials such as mathematics.

At the end the chapter has been included exercises compiled from the easiest to difficult level. These exercises are used to measure the capacity in this basic competence. Thus, after studying this basic competence either through teacher's guidance as well as self-study, one may evaluate one's capacity by completing the exercise.

### OBJECTIVES

After studying this chapter, it is hoped you could:

- Use multidimensional array.
- Use procedure and function

## 6. 1. MULTIDIMENSIONAL ARRAY

### 6.1.1. Concept of multidimensional array

One dimensional array as described in Chapter 5 is good to store similar sequential data, but how can we simultaneously keep list of cities with its respective temperature , or student's name and their respective final exam mark? In this case, we may use two one dimensional arrays, one array to store student's name, and one array to store student's mark. However, it is not a good choice as it makes more difficult to create a efficient program. The better choice would be using a multidimensional array. In such problem, we may store the data in two dimensional array. Examine figure to see the difference between **two one dimensional arrays** and **two dimensional array**.

Nama(4)		Nilai(4)	NilaiSiswa (4,1)	
Joni	70	0	Joni	70
Rudi	80	1	Rudi	80
Sari	45	2	Sari	45
Dono	56	3	Dono	56
Indro	77	4	Indro	77
Dua array satu dimensi			Array dua dimensi	

Figure 6.2. The difference between one dimensional array and two dimensional.

Two dimensional array has two indexes. The first index indicates the row whereas the second index indicates the column. In Figure 6.2, variable array NilaiSiswa has two indexes, namely, the first index with 4 indicates the maximum index value for the row is 4 (or there will be 5 row as row index starts at 0), while the second index with 1 indicates that the maximum number of column is 1(or there will be 2 column as the first column index is 0). To declare a two dimensional array may be use the following

```
Dim NilaiSiswa(4,1)
```

Whereas to access the value in array two dimensions could be used the following example.

Example 6.1. Read value from a multidimensional array

```
Print NilaiSiswa (3,0)
```

```
Print NilaiSiswa (3,1)
```

The first statement in Example 6.1 will produce "Dono" (the 4<sup>th</sup> row and the first column) whereas the second statement produced output 56 (the 4<sup>th</sup> row and second column).

One of the main advantage in using multidimensional array is a conceptually easier to managed. For example, if we want to create a game program and want to locate a place on a game board. Each square may be identified by using two numbers, as vertical and horizontal coordinate (or row and column). Such structure is a typical two dimensional array. Horizontal coordinate is the row index, while vertical coordinate is the column index. Multidimensional array may be expanded to more than two dimensional. In statement Dim Matrix (9,9,9) will create multidimensional arrays with 1000 elements (10x10x10).

### 6.1.2. Matrix operation with Multidimensional Array

As being described in the beginning of this chapter, we could use an array to carry out matrix operations. Examine the following Figure 6.3.

Figure 6.3 shows a two two dimensional matrix consists of 4 row and 3 column, normally noted as  $A_{4 \times 3}$ . This is a multidimensional array multidimensional defined as A (3, 2). Note that the array indexes is one number smaller than the actual array as index starts with 0. Whereas the matrix's index starts at 1. To create an array or matrix such as in Figure 6.3, we need a repetition structure. For structure may be used as we know exactly how many row and column of the array. The following picture in Figure 6.3 shows the flowchart to create a matrix.

$$A = \begin{bmatrix} 9 & 8 & 6 \\ 1 & 2 & 7 \\ 4 & 9 & 2 \\ 6 & 0 & 5 \end{bmatrix}$$

Figure 6.3. Matrix 4 x 3.

In Figure 6.4, there are two (2) counter variables namely I and J. I is used to index the row with 4 rows (1 to 4), whereas J is used to index the column that is 3 columns (1 to 3). Data reading will be as follows:

A(1,1) = ....  
 A(1,2) = ....  
 A(1,3) = ....  
 A(2,1) = ....  
 A(2,2) = ....  
 A(2,3) = .... etc.

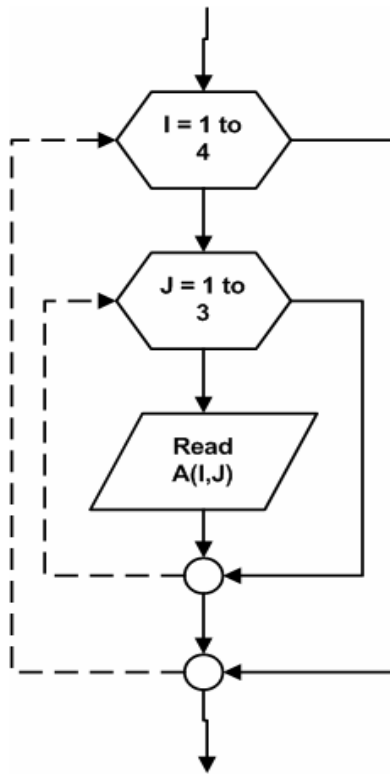


Figure 6.4. Algorithm to create matrix 4 x 3.

Example 6.2. Add matrix operation.

Note the following matrix operation:

$$\begin{bmatrix} 1 & 3 & 1 \\ 1 & 0 & 0 \\ 1 & 2 & 2 \end{bmatrix} + \begin{bmatrix} 0 & 0 & 5 \\ 7 & 5 & 0 \\ 2 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 1+0 & 3+0 & 1+5 \\ 1+7 & 0+5 & 0+0 \\ 1+2 & 2+1 & 2+1 \end{bmatrix} = \begin{bmatrix} 1 & 3 & 6 \\ 8 & 5 & 0 \\ 3 & 3 & 3 \end{bmatrix}.$$

The above matrix operation is an adding operation of two matrix with the same dimension 3 x 3. How is the algorithm?

The solution:



In the example, there are two matrices, namely, matrix A and matrix B. In addition, we need the third matrix C to store the sum of matrix A and matrix B. Figure 6.5 shows the algorithm to add two matrices.

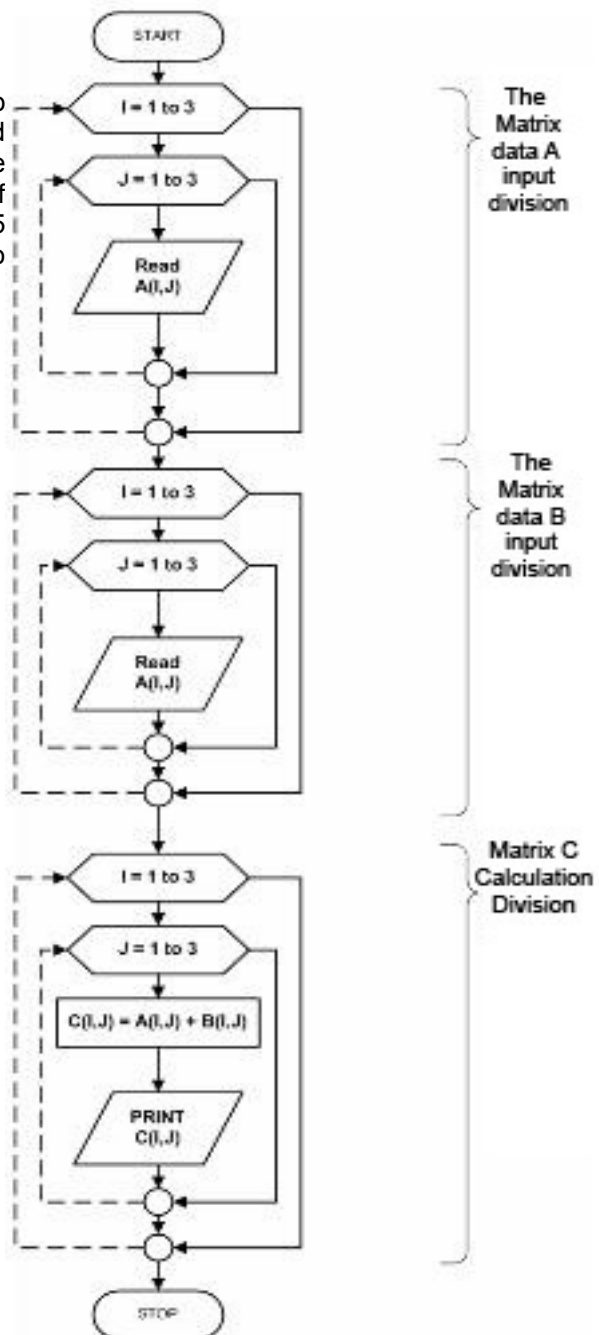


Figure 6.5. Algorithm to add two (2) matrices

## 6.2. PROCEDURE AND FUNCTION

Each programming language always provides built-in functions that have been defined by the programming language. However sometimes we need a certain procedures that will be used repeatedly and not available in built-in function.

Procedure is a collection statements as part of a larger program that does a certain task. The procedure also known as subroutine / subprogram is relatively independent on other part of the program. The advantages of using procedure are:

- Reduce code duplication.
- Provide possibility to re-use the code for other program.
- Breakdown a big problem into smaller parts and, thus, easier to solve. Please see problem reduction principles in Chapter 2.
- Make a code easier to read.
- Hide program details.

In flowchart, procedure is written using Predefined Process notation (see Chapter 5 for flowchart notation). The use of procedure is schematically shown in Figure 6.6.

The picture 6.6. showed had the main process that happened and had the actual procedure was part of this main process. When the main process needs a certain task then it calls certain procedure to complete the task. Examine the following example:

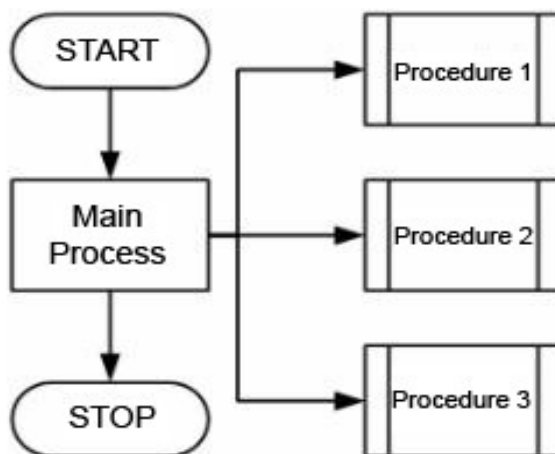


Figure 6.6. Schematics in procedure usage.

Example 6.3. Procedure.

Create an algorithm to calculate the area of triangle, square and circle.

The solution:

To create this algorithm we should look into the area calculation process of the triangle, square and circle as an independent program part. We could create procedure for respective processes and call it from the main process as shown in Figure 6.7.

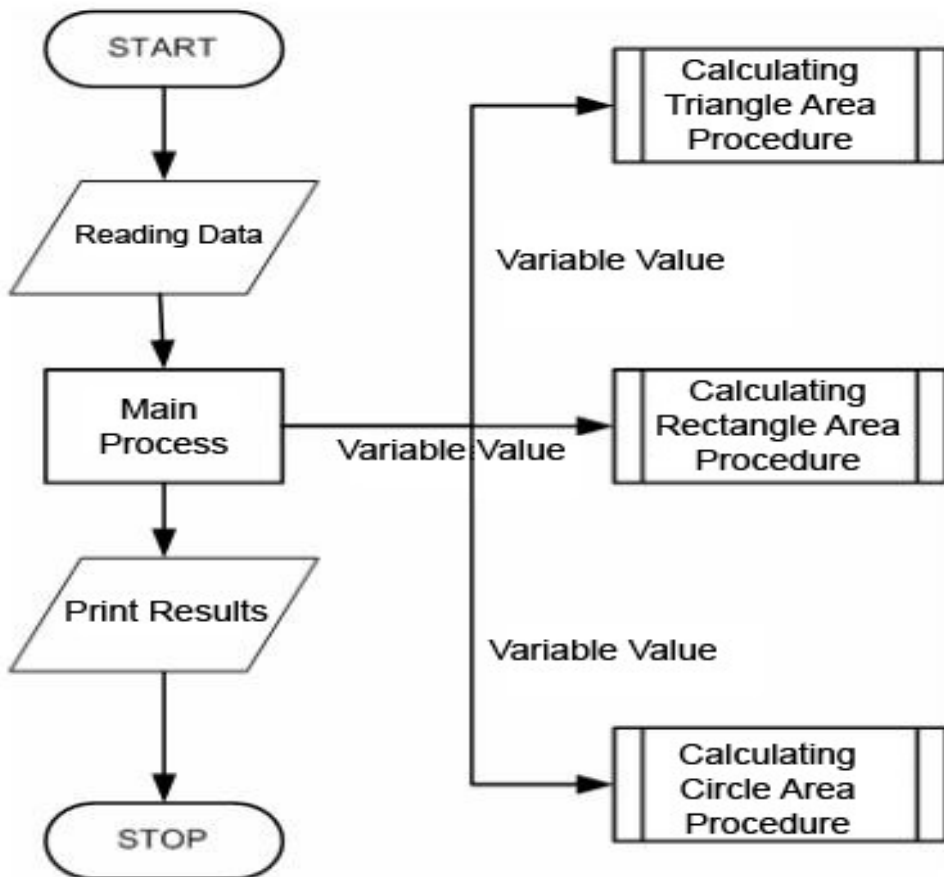


Figure 6.7. Solution for Example 6.3

Process sequence of Figure 6.7 is as follows.

- Read data.
- Main process to check input data.
- If input data is for triangle, then main process will call triangle area calculation procedure with the needed input variable for the procedure.
- Area calculation of triangle is performed within the procedure.
- As the area calculation completed, the final result is passed back into the main process to be print.

Similar process sequence is the same for square and circle.

A good procedure has the followings characteristics.

- logically inherent – has only one function – a good procedure has only one aim and not mixed with other functions. Thus, the procedure can be more focused and able easily to reach the aim.
- Independent – does not depend on the other procedure - a procedure must be able to run and tested without having to wait for other part of the program to be finished. Moreover variables used in this procedure are not influencing other variables in the whole program.
- Small size – the code size is short. Short code is easier to read and to fix. A long module should be considered to be broken into smaller modules.

### 6.3. SUMMARY

- Two dimensional arrays has two indexes. The first index indicates the row whereas the second index indicates column.
- Data reading and writing in multidimensional array is directly carried out by pointing to the index number.
- Procedure is a collection statements as part of a larger program that only does a certain task.

### 6.4. EXERCISE

1. Examine Example 6.1. Create an algorithm to do subtraction on two matrices.
2. Create an algorithm to multiply two matrices.
3. Using procedure create an algorithm to read matrix data then select the operation whether addition, subtraction or multiplication of two matrices.