ELECTRONIC MEASUREMENT & INSTRUMENTATION (BEC-29)

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UNIT-3

Data Acquisition and Conversion

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Introduction

A data acquisition system is a collection of software and hardware that allows one to measure or control physical characteristics of something in the real world.

Data acquisition systems can be classified into the following two types.

Analog Data Acquisition Systems

The data acquisition systems, which can be operated with analog signals are known as analog data acquisition systems.
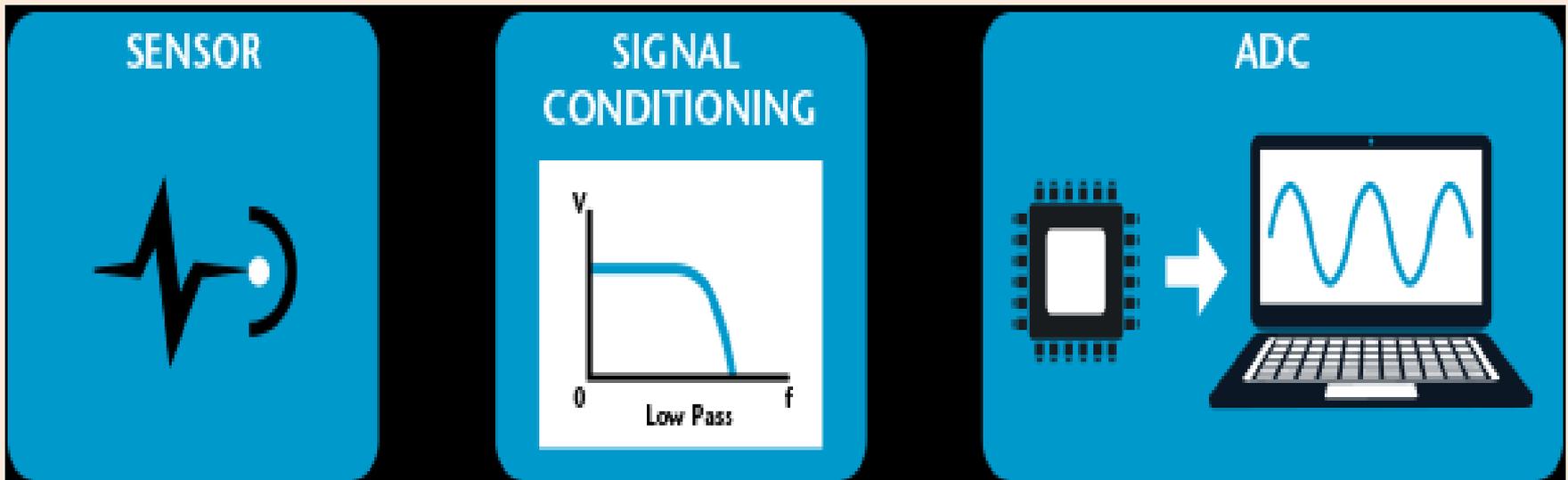
Digital Data Acquisition Systems

The data acquisition systems, which can be operated with digital signals are known as digital data acquisition systems. So, they use digital components for storing or displaying the information

Continue…

The components of DAS include:

➤ Sensors that convert physical parameters to electrical signals.

➤ Signal conditioning circuitry to convert sensor signals into a form that can be converted into digital values.

➤ Analog-to-digital converters that convert conditioned sensor signals to digital values.

Contd…

➢ To optimize the characteristics of the system in terms of performance, handling capacity and cost, the relevant sub systems can be combined.

➢ Analog Data Acquisition System is generally acquired and converted into digital form for the purpose of processing, transmission, display and storage.

➢ Processing may consist of a large variety of operations, ranging from simple comparison to complicated mathematical manipulations.

➢ It can be for such purposes as collecting information (averages, statistics), converting the data into a useful form (e.g., calculations of efficiency of motor speed, torque and power input developed), using data for controlling a process, performing repeated calculations to separate signals buried in the noise, generating information for display, and various other purposes.

The important Factors to Consider When Setting Up a Data Acquisition System are as follows:

– Accuracy and resolution

– Number of channels to be monitored

– Analog or digital signal

Contd..

- Single channel or multichannel
- Sampling rate per channel
- Signal conditioning requirements of each channel
- Cost

The various general Configuration of Data Acquisition System are:

➢ **Single channel possibilities**

- Direct conversion
- Pre-amplification and direct conversion
- Sample and hold, and conversion
- Pre-amplification, signal conditioning and any of the above

➢ **Multi channel possibilities**

- Multiplexing the outputs of single channel converters
- Multiplexing the output of sample-hold circuits
- Multiplexing the inputs of sample-hold circuits
- Multiplexing low level data

Objectives of Data Acquisition System

1. It must acquire the necessary data, at correct speed and at the correct time

2. Use of all data efficiently to inform the operator about the state of the system

3. It must monitor the complete plant operation to maintain on-line optimum and safe operations.

4. It must provide an effective human communication system and be able to identify problem areas, thereby minimizing unit availability and maximizing unit through point at minimum cost.

5. It must be able to collect, summarize and store data for diagnosis of operation and record purpose.

6. It must be able to compute unit performance indices using on-line, real-time data.

7. It must be flexible and capable of being expanded for future require

8. It must be reliable, and not have a down time greater than 0.1%.
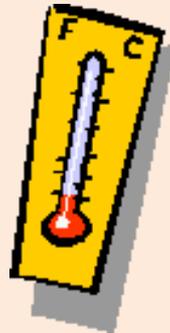
PHYSICAL SYSTEM/CONDITIONS

Physical condition that can be used as input of DAS or which can be represented in Digital form are as under…

- Temperature
- Pressure
- Light
- Force

- Displacement
- Level
- Electric signals
- ON/OFF switch

TRANSDUCERS

- A transducer converts temperature, pressure, level, length, position, etc. into voltage, current, frequency, pulses or other signals.

- A transducer thus converts the physical conditions in electrical waveform for easy signal processing

SIGNAL CONDITIONING

- Signal conditioning circuits improve the quality of signals generated by transducers before they are converted into digital signals by the PC's data- acquisition hardware.

- Most common signal conditioning functions are amplification, linearization, cold-junction compensation, filtering, attenuation, excitation, common-mode rejection, and so on.
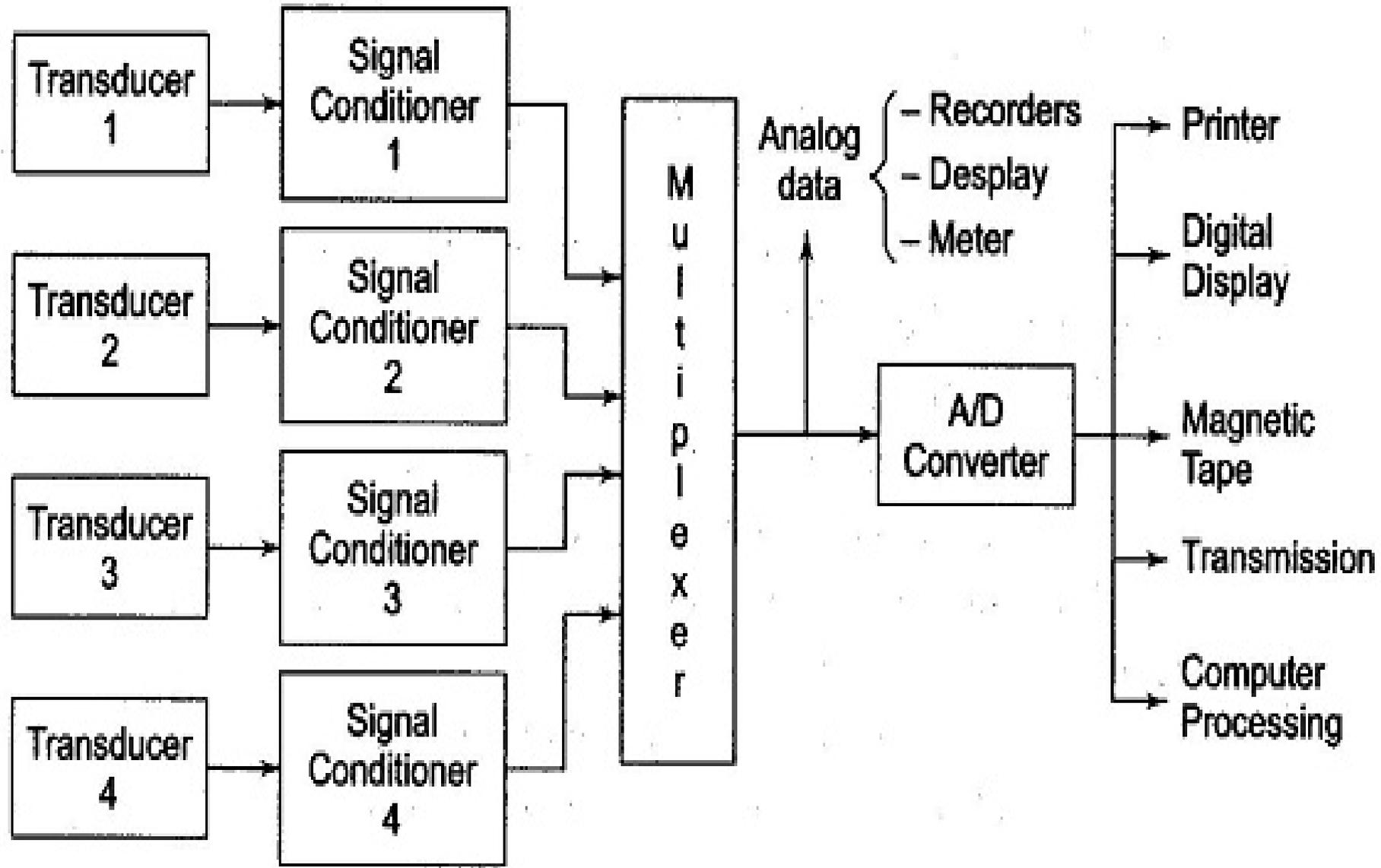
ANALOG DIGITAL(A/D) CONVERTER

Analog to digital (A/D) conversion changes analog voltage or current levels into digital information. The conversion is necessary to enable the computer to process or store the signals.
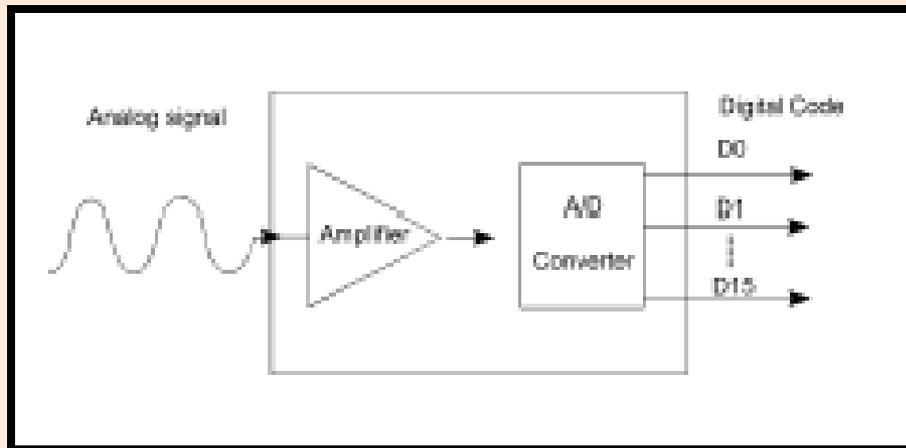
Block Diagram of DAS
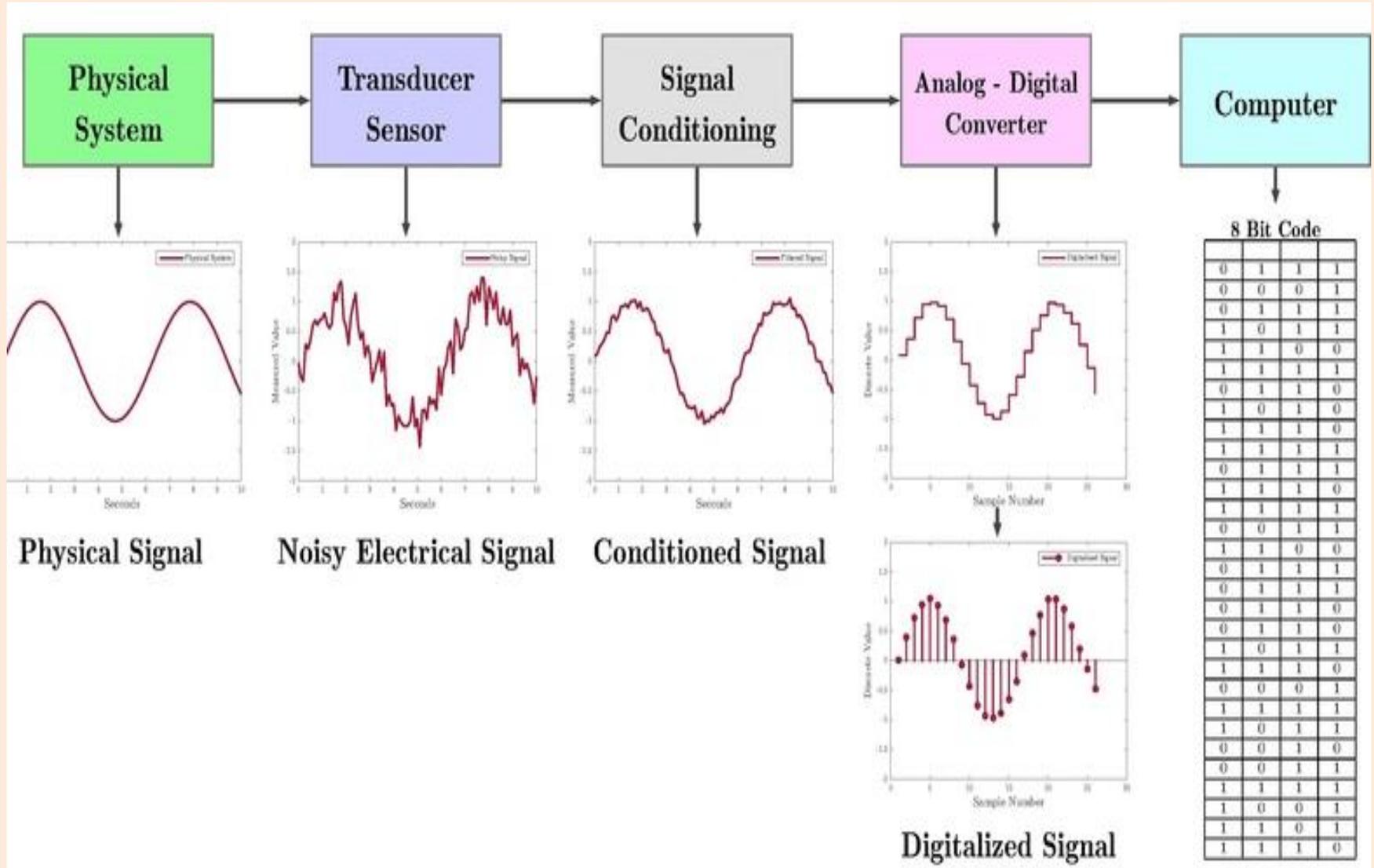
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DATA ACQUISITION HARDWARE

DAQ hardware interfaces the signal and a PC. It could be in the form of modules that can be connected to the computer's ports or cards connected to slots in the motherboard. Following are some hardware's....

- CAMAC – Computer Automated Measurement and Control
- Industrial Ethernet
- Industrial USB
- LAN eXtensions for Instrumentation
- NIM
- PowerLab
- VME bus
- VXI

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DATA ACQUISITION SOFTWARE

- DAQ software is needed in order for the DAQ hardware to work with aPC.
- Involves the use of a programming language, such as:
    - C++, visual C++
    - BASIC, Visual Basic +Add-on tools (such as Visual lab with VTX)
    - Fortran
    - Pascal
    - Ladder logic
    - Lab view
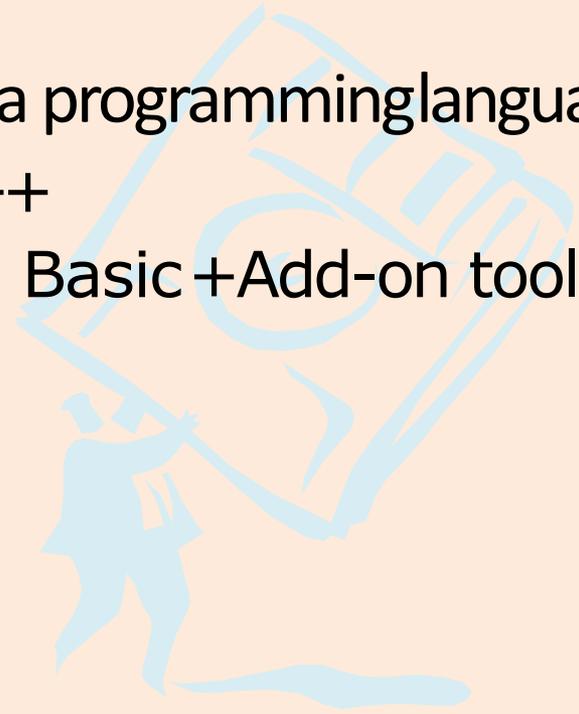
MERITS/ADVANTAGES

- Reduced data redundancy
- Reduced updating errors and increased consistency
- Greater data integrity and independence from applications programs
- Improved data access to users through use of host and query languages
- Improved data security
- Reduced data entry, storage, and retrieval costs
- Facilitated development of new applications program

DEMERITS/DISADVANTAGES

- Database systems are complex, difficult, and time-consuming to design

- Substantial hardware and software start-up costs

- Damage to database affects virtually all applications programs

- Extensive conversion costs in moving form a file-based system to a database system

- Initial training required for all programmers and users

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Assignment Questions

- What is DAS?

- State the important factors that decide the configuration and subsystem of DAS.

- Explain with block diagram the a generalized DAS.

- State the objective of DAS.

Conceptual Questions

- Digital acquisition systems are used when _____
  a) bandwidth is high
  b) bandwidth is medium
  c) bandwidth is zero
  d) bandwidth is low

- For lower accuracies _____
  a) digital acquisition system is used
  b) both digital and analog acquisition systems are used
  c) analog acquisition system is used
  d) mechanical data acquisition system is used

- What is a digital recorder?
  a) records digital data
  b) records analog data
  c) does not record data
  d) records both analog and digital data

Contd..

- **Which module of data acquisition system (DAQ) consists of the CPU that controls the complete data acquisition system?**
  a. Input module
  b. Output module
  c. Sampling module
  d. Control module

- **The capacity of data acquisition system (DAQ) can be specified in terms of_____**

- a. number of control elements

- b. number of channels

- c. number of interfaces

- d. number of functions

THANK YOU