ECE 398
Lecture 5- Block Diagrams

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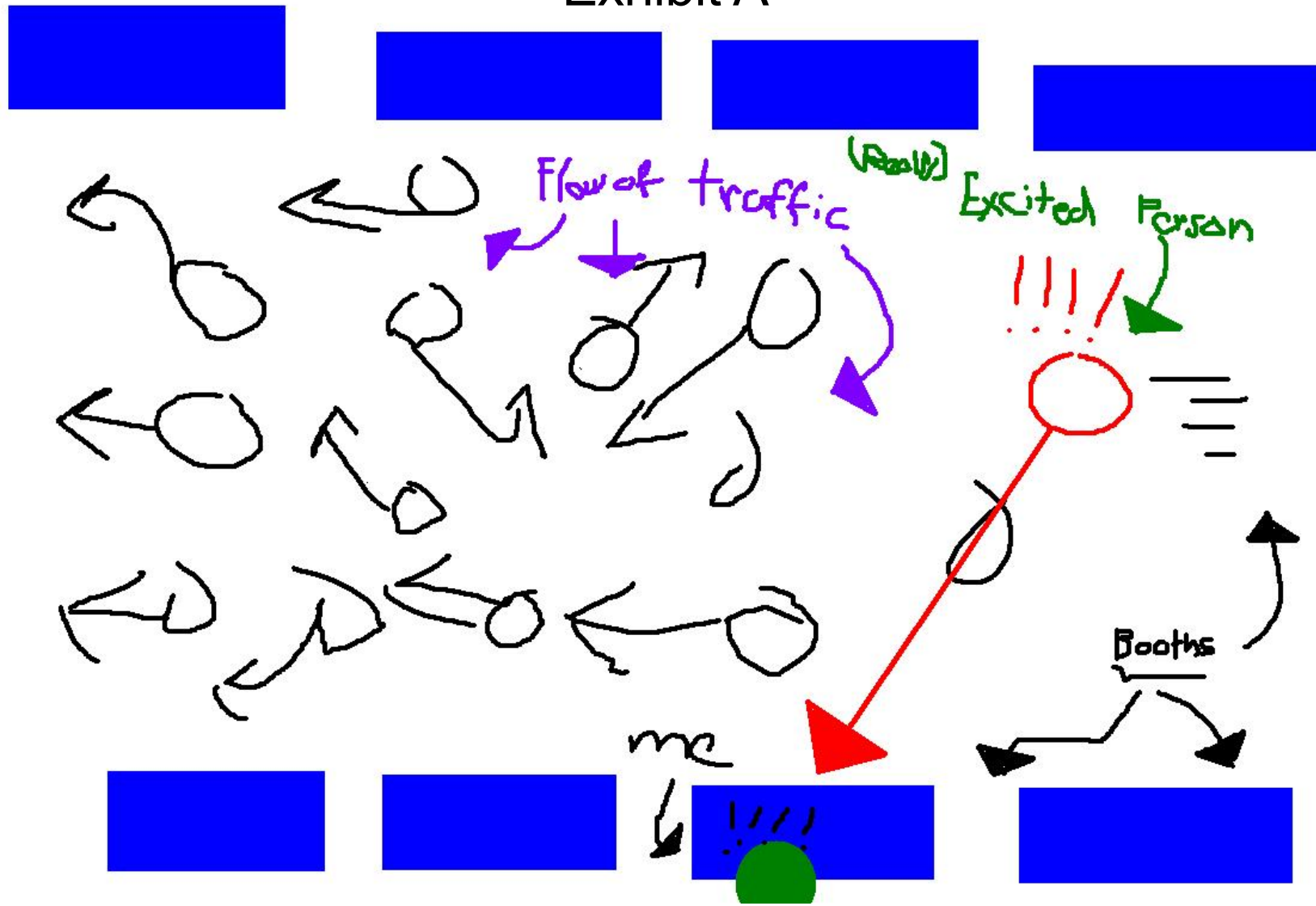
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Today's Goal

- Come up with a definition of a block diagram

-

- A block diagram is:

-

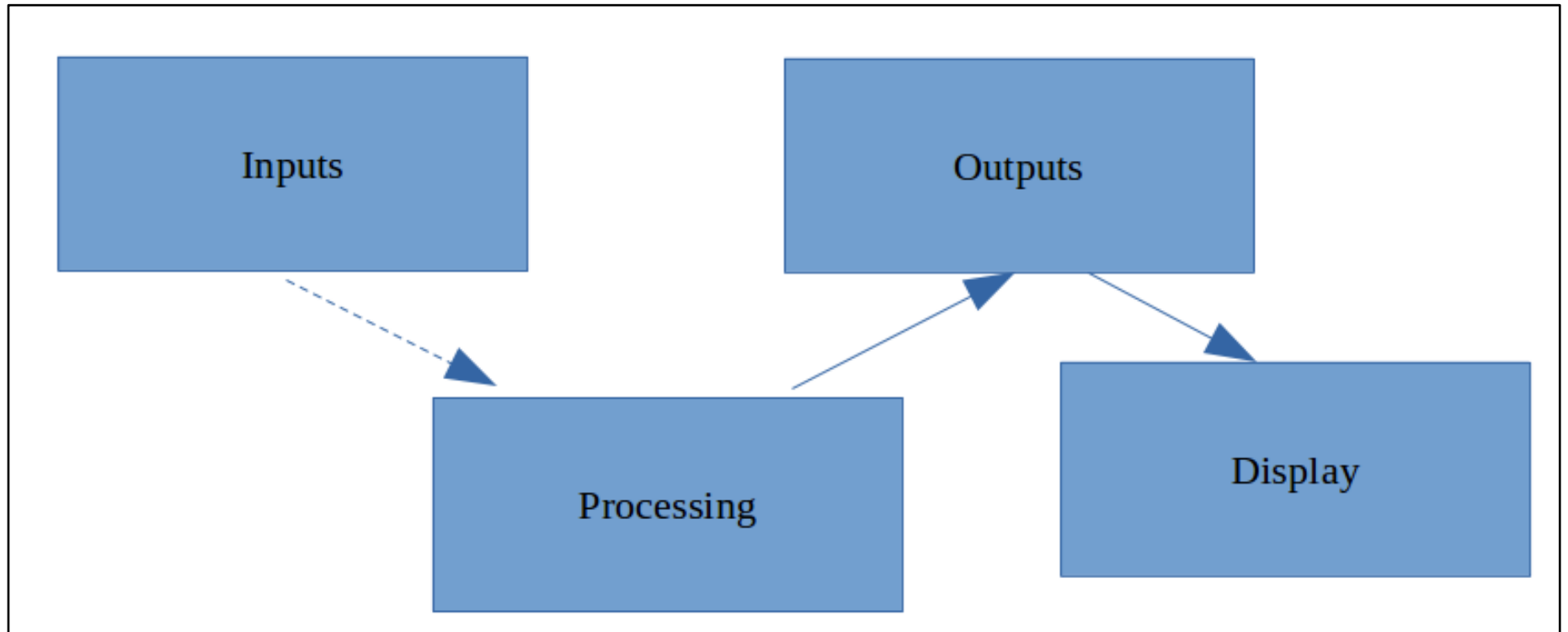 - Picture?
  - Chart?
  - Blocks?
  - Lines ?
  - System?
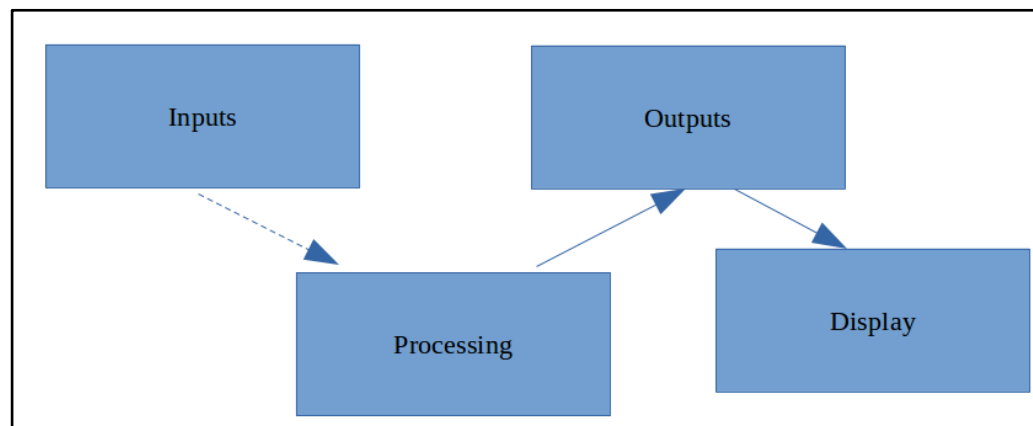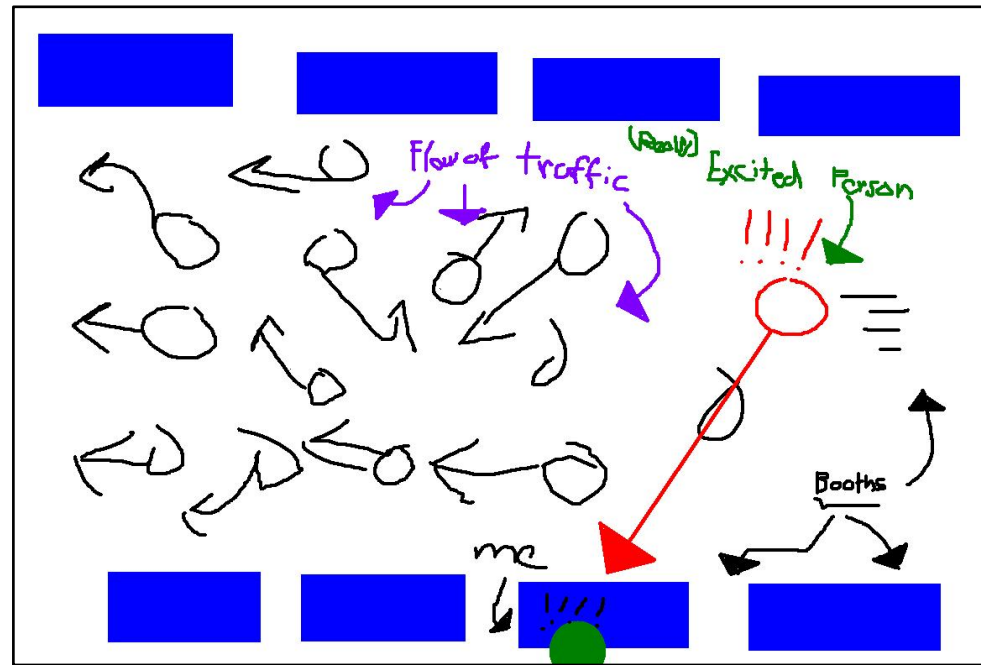
Is this a block diagram?

Exhibit A

How about this?

Exhibit B

Getting a Definition

Working Definition:

-
- Picture/Chart
- Blocks
- Lines

Questions to Help us with this Task

Q1: Where does a Block Diagram fit in the engineering process?

Q2: What are the different kinds of Block Diagrams?

Q3: What are common elements of a Block Diagram??

Q4: What are different elements of a Block Diagram?

Q5: What is the common purpose of all Block Diagrams?

Q6: What makes a Block Diagram effective?

Q7: What makes an ECE Senior Design Block Diagram effective?

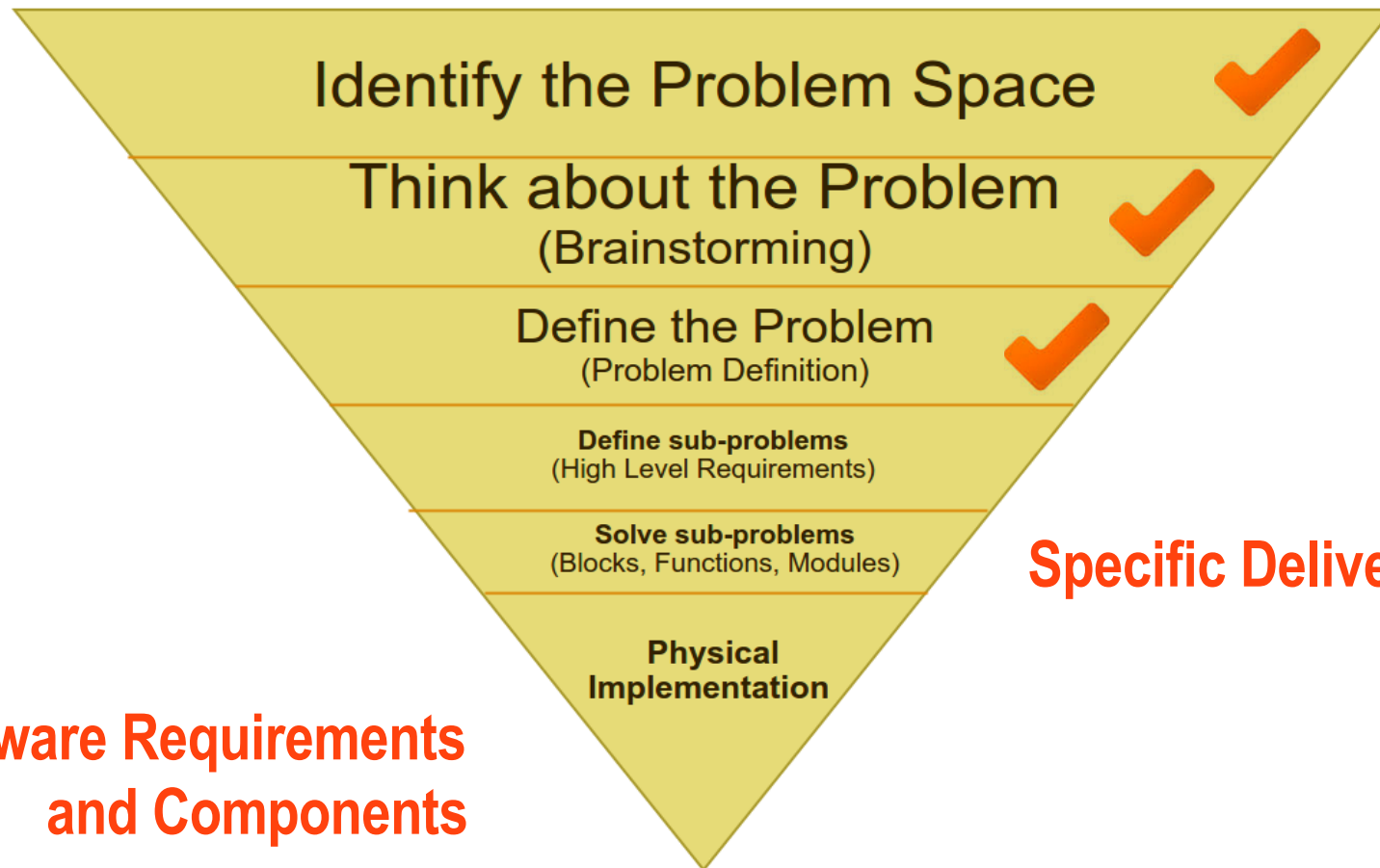# Where does a Block Diagram fit in the engineering process?

So far we have learned…...

- Lecture 1 – What is a problem?
-
- Lecture 2 - How to think about a problem.
-
- Lecture 3 - Defining the problem.
-
- Lecture 4 – Client (**Stakeholder)** Requirements.
-
- Today: **Block Diagrams**.

Engineering (or Requirements) Flow-down

High-Level Goals

Identify the Problem Space ✔

Think about the Problem
(Brainstorming) ✔

Define the Problem
(Problem Definition) ✔

Define sub-problems
(High Level Requirements)

Solve sub-problems
(Blocks, Functions, Modules)

Specific Deliverables

**Physical
Implementation**

**Hardware Requirements
and Components**

Still Working Definition:

-
- Visual Aid
- Composed of blocks
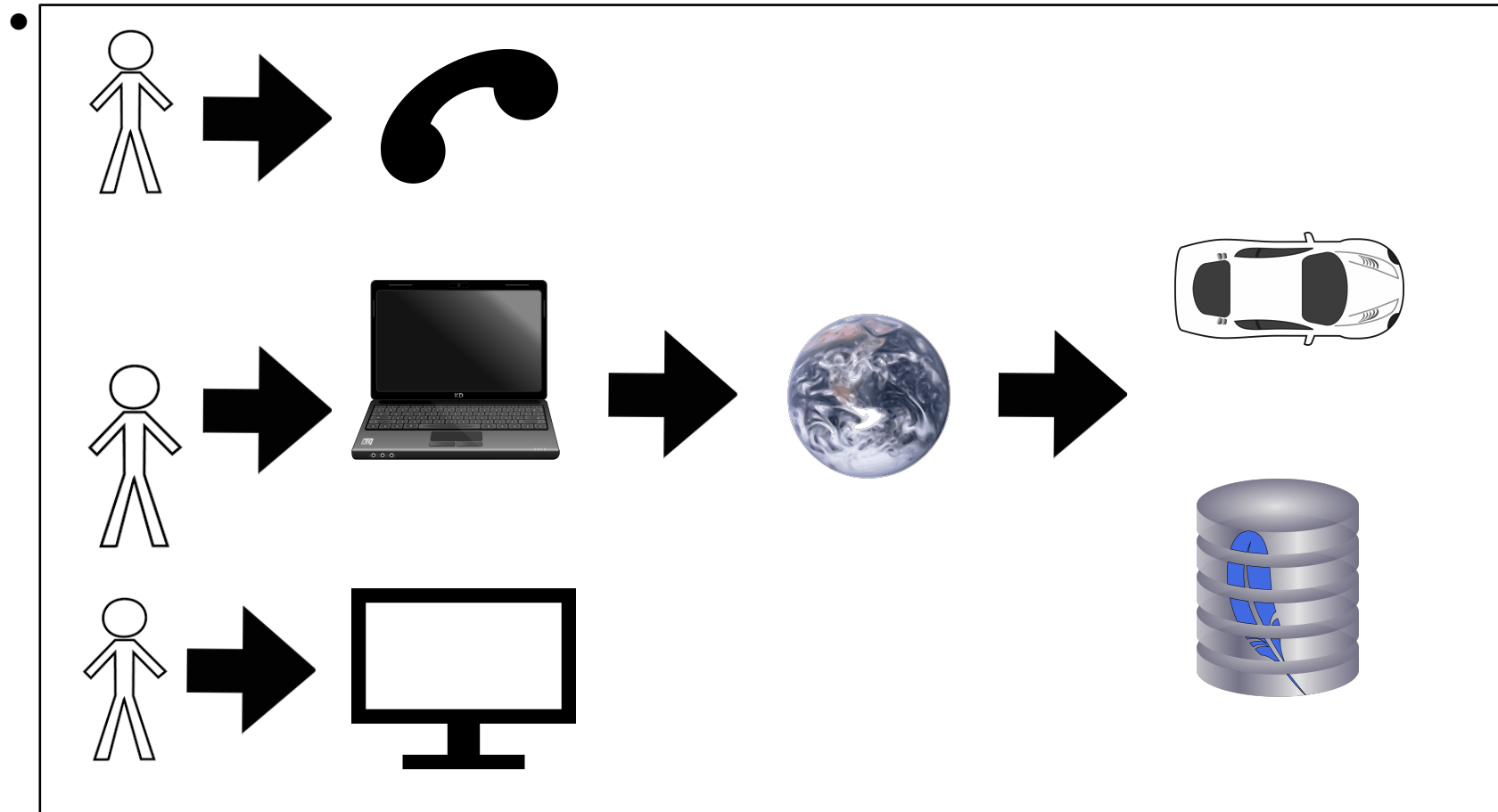- Links between blocks
- High-level to low-level

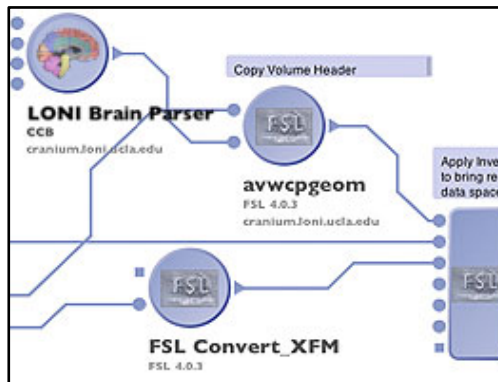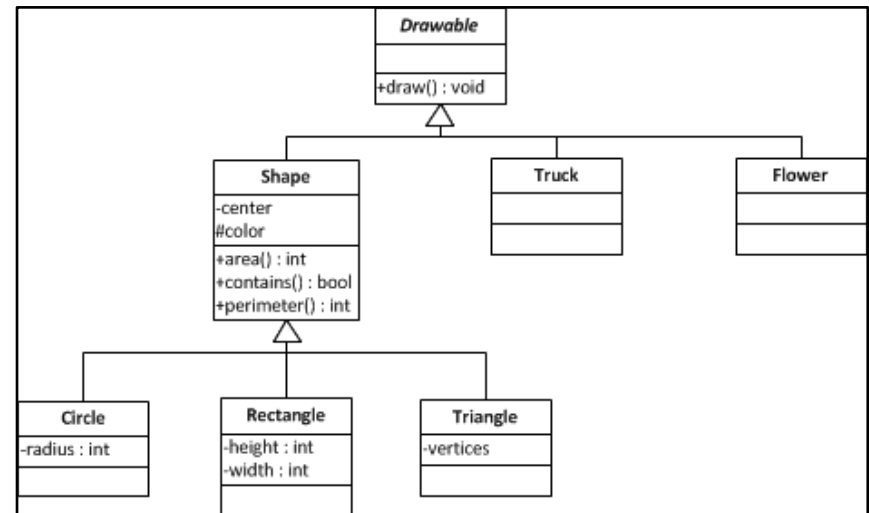# What are the different types of Block Diagrams?
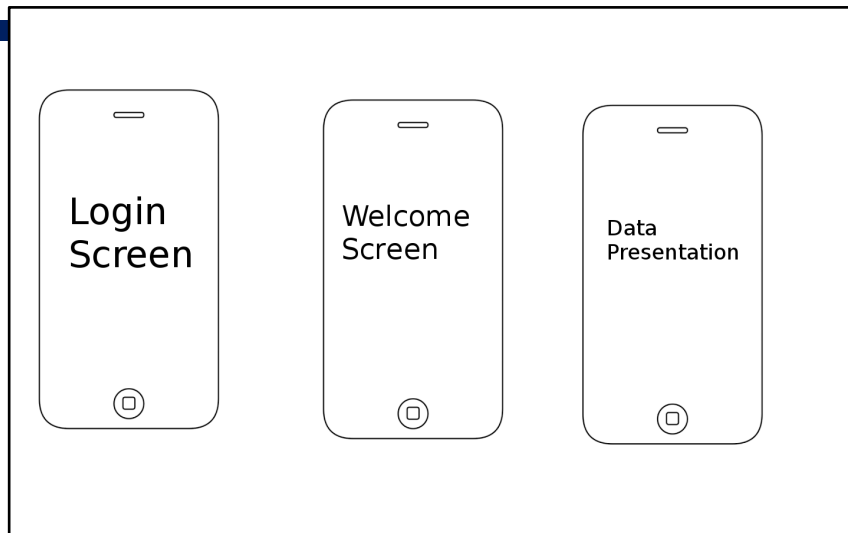
Many Shapes and Sizes

- Processes and Services:
    - Work-flows, Process Flows, Project Management
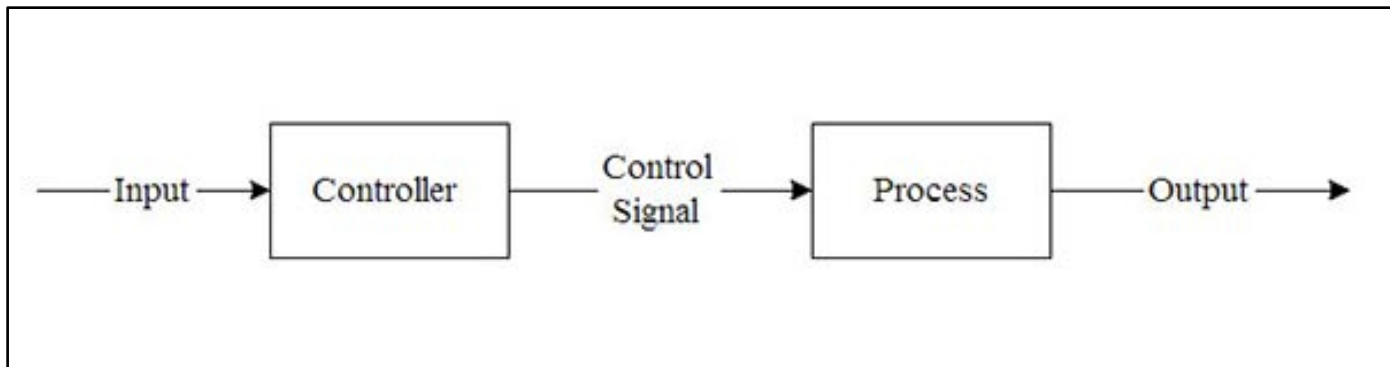   -

Many Shapes and Sizes

- Software:
- Flowcharts, UML Diagrams, Pipelines

Many Shapes and Sizes

- Control Systems
  -
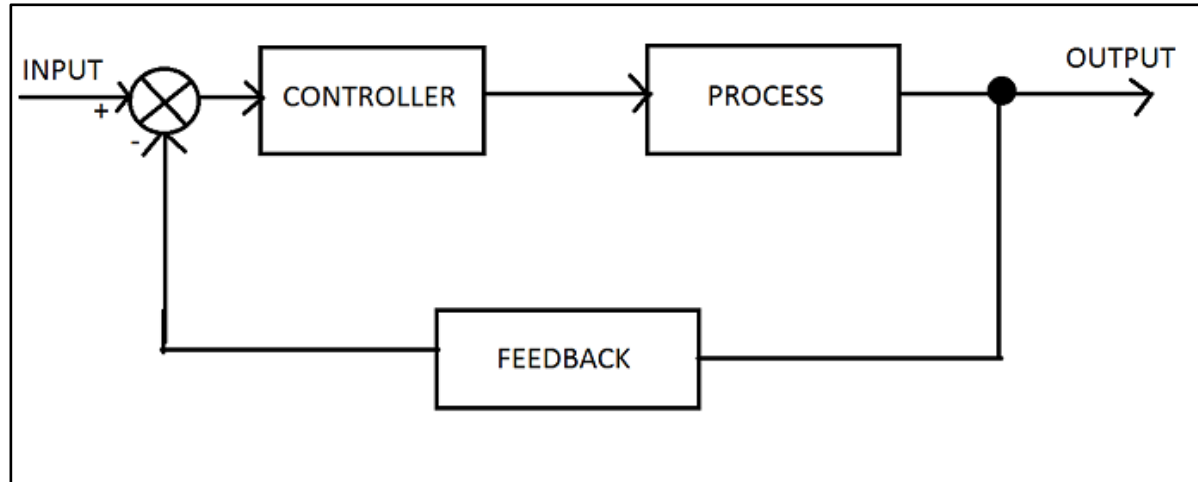
Many Shapes and Sizes

- Simulations
  - (i.e. Matlab, Simulink, PSPICE, Labview)
-
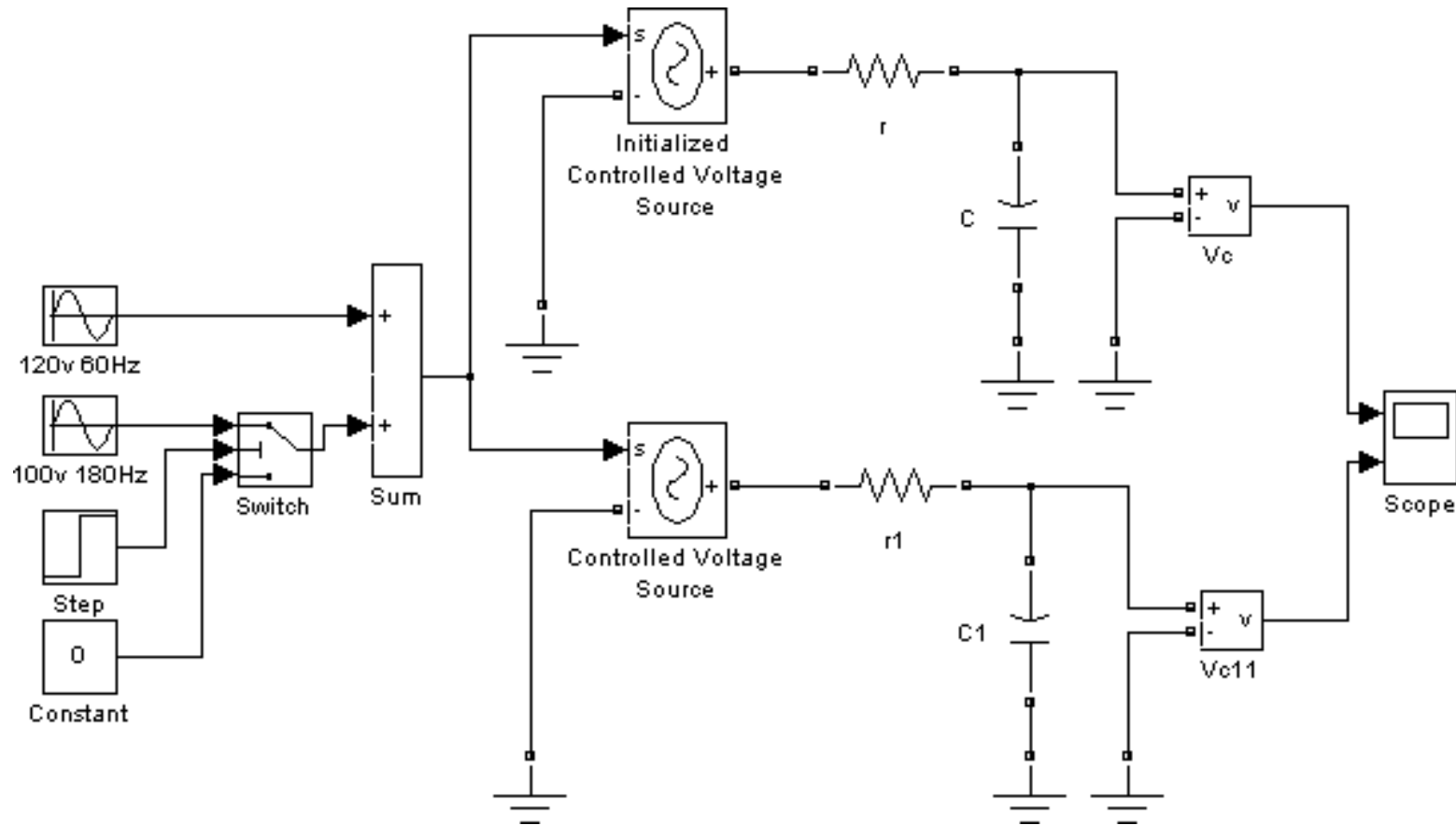
Many Shapes and Sizes

- Schematics
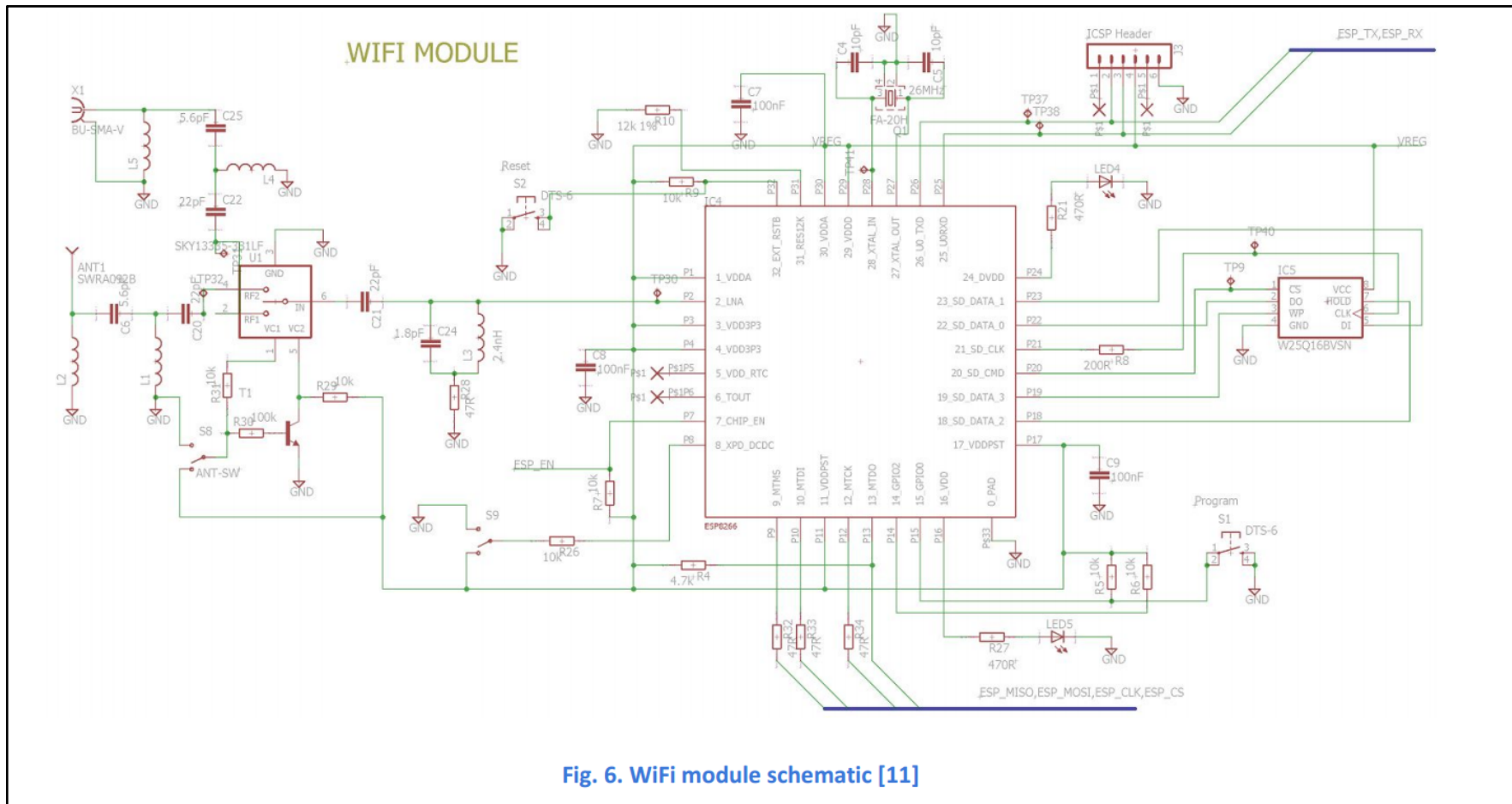
Fig. 6. WiFi module schematic [11]

What are COMMON elements of Block Diagrams?

What are DIFFERENT elements of Block Diagrams?

Many Shapes and Sizes

- Software:
-     Flowcharts, UML Diagrams, Pipelines
-

- Business:
  - Work-flows, Process Flows, Project Management
  -
- Control Systems
-

- Simulations:
-     Matlab/Simulink
-

- Schematics
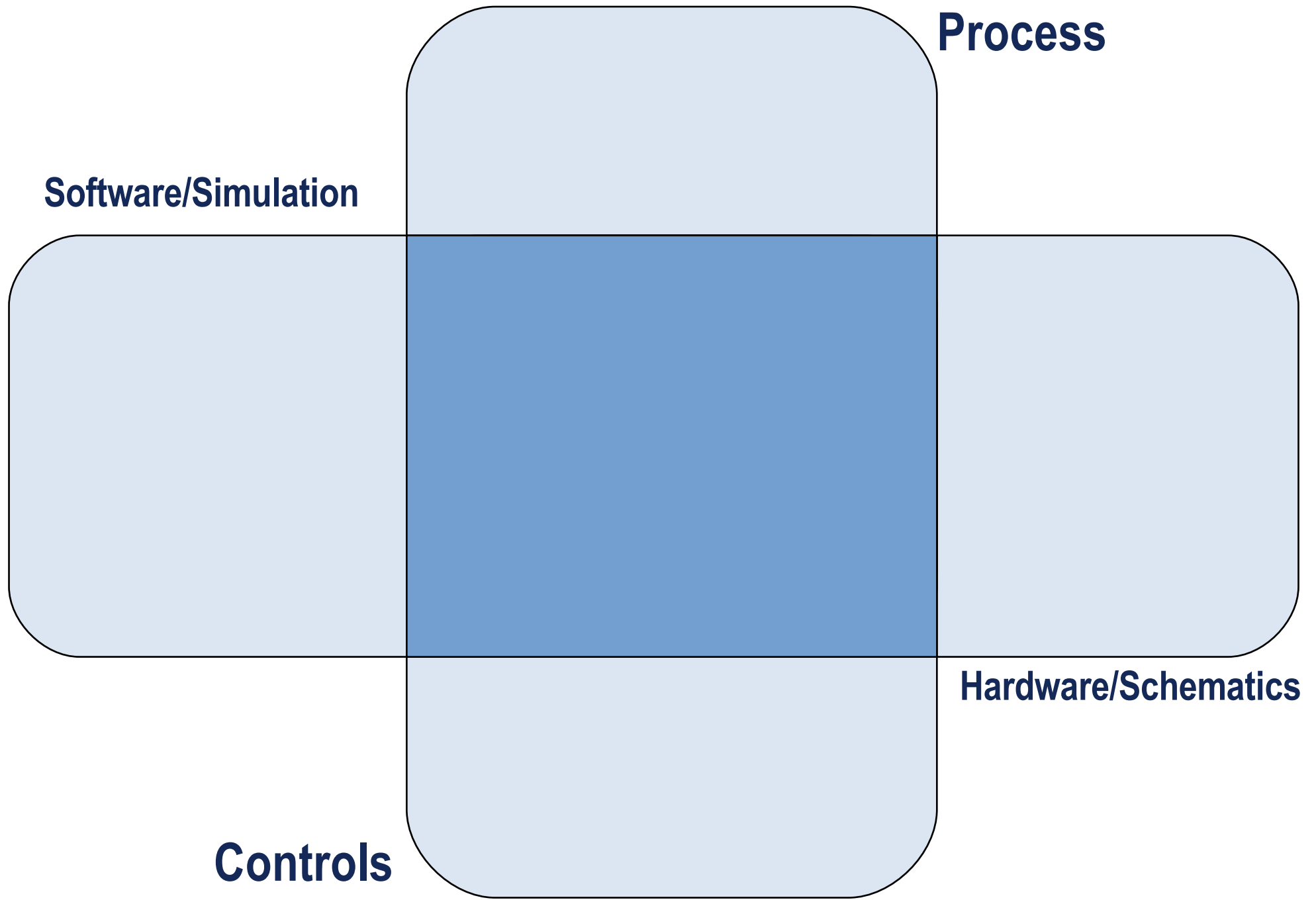
Process

Software/Simulation

Hardware/Schematics

Controls

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Working Definition:
- Visual Aid
- Composed of blocks
- Links between blocks
- High-level to low-level
- Convey some kind of information
- Depict information **FLOW**
- Show parts of a system, **any** system

What is a general purpose for Block Diagrams?

Towards a Definition

- A block diagram is…. **a Visual Aid**…. which describes…. **any system.** It is composed of…. **many blocks**…. with each block....
- **having connection(s) to another block(s).**
-
- A block diagram fits in…. **the middle of the engineering design process**….. and links the…. **problem statement, solution, and high-level requirements**…. to the…. **low-level requirements and deliverables**.
-
- A block diagram describes…. **a system and system components;** it conveys…. **information**…. about the system. It outlines…. **Information flow within the system.**
-
-
-
-
- **Good enough?**
-
-

No.
We can do better!

What makes an EFFECTIVE block diagram?

What Makes an Effective Block Diagram?
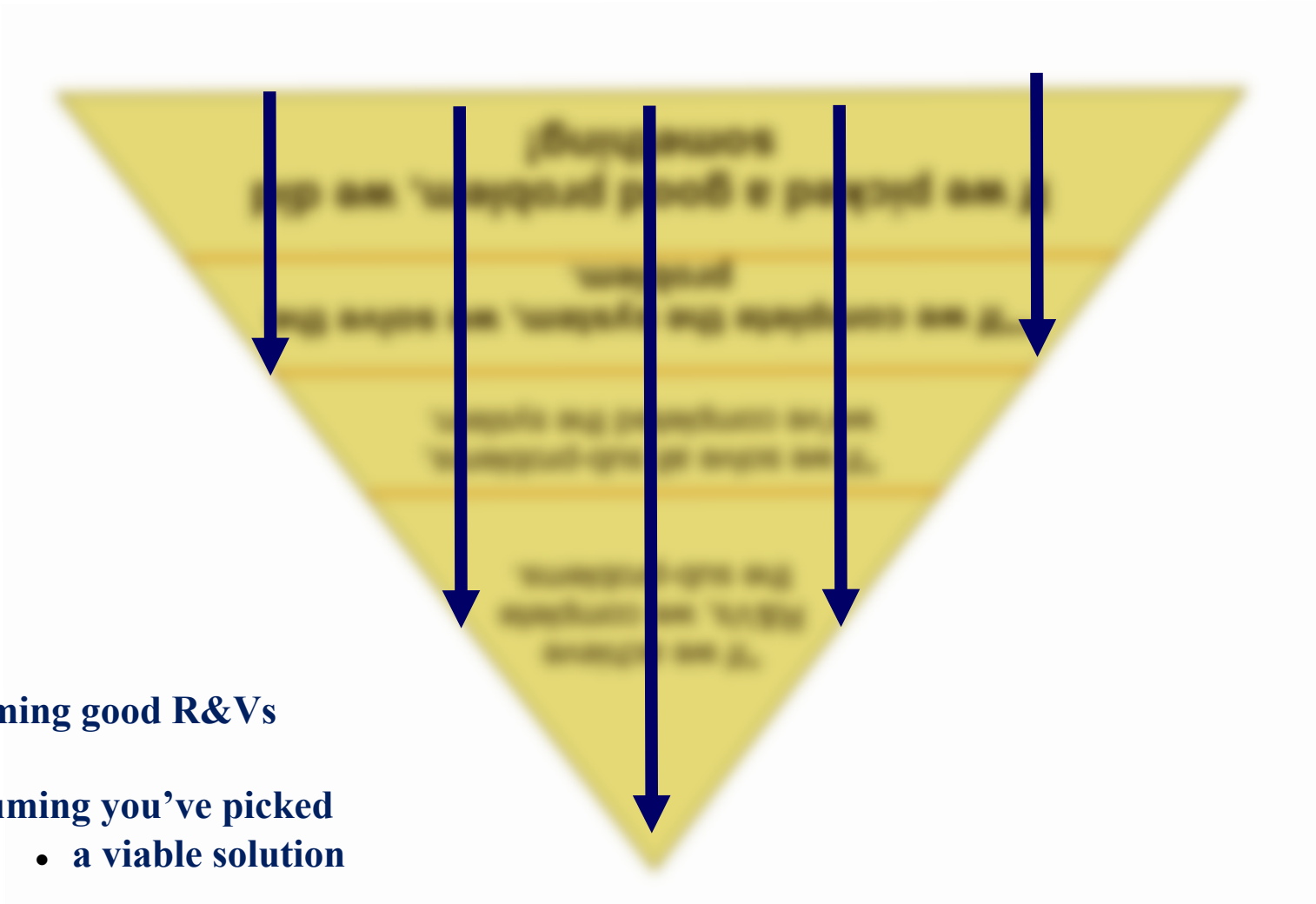
- Modularity

- Clear functions for each module

- Clear boundaries

- Modules are independent

- Problem is broken down into subproblems

- Subproblems map onto specific technical requirements and verifications (R&Vs)

What Makes an Effective Block Diagram?

*If we achieve R&Vs, we complete the sub-problems.

*If we solve all sub-problems, we've completed the system.

**If we complete the system, we solve the problem.

If we picked a good problem, we did something!

What Makes an Effective Block Diagram?

- *** Assuming good R&Vs**
-
- **** Assuming you've picked**
  - **a viable solution**

What Makes an Effective Block Diagram?

- **A block diagram helps us to understand:**
-
    - what the system does
    - what the subsystems are
    - what the function of each subsystem is
    - which blocks make up each subsystem
    - how each block contributes to the function
    - the input of each block
    - the output of each block
    - direction and type of information between blocks
    -

What Makes an Effective Block Diagram?

- **A block diagram also helps us:**
-

  - Divide labor amongst the team
  - Effectively communicate design choices/trade-offs
  - Establish requirements and how to verify
  - Actually build it (circuit, PCB, etc.)
  - Debug
  -

- **When do we start thinking about modules?**
-

  - *****WE START THINKING ABOUT*** MODULARITY FROM DAY 1**

What Makes an Effective Block Diagram?

- **A block diagram helps us to understand:**
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  - what the system does
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  -

High Level Requirements of a Block Diagram

- **Modularity:**
  - 1. Independent
  - 2. Separate Functions
  - 3. Clear Boundaries
  -

- **Information Flow:**
  - 1. Clear inputs and outputs
  - 2. Clear flow of information
  - 3. Clearly shows what the information is
-

- **Justified Design:**
  - 1. Functionality is clear (high-level and module functions)
    - 2. High-level reqs → Functional reqs → technical requirements
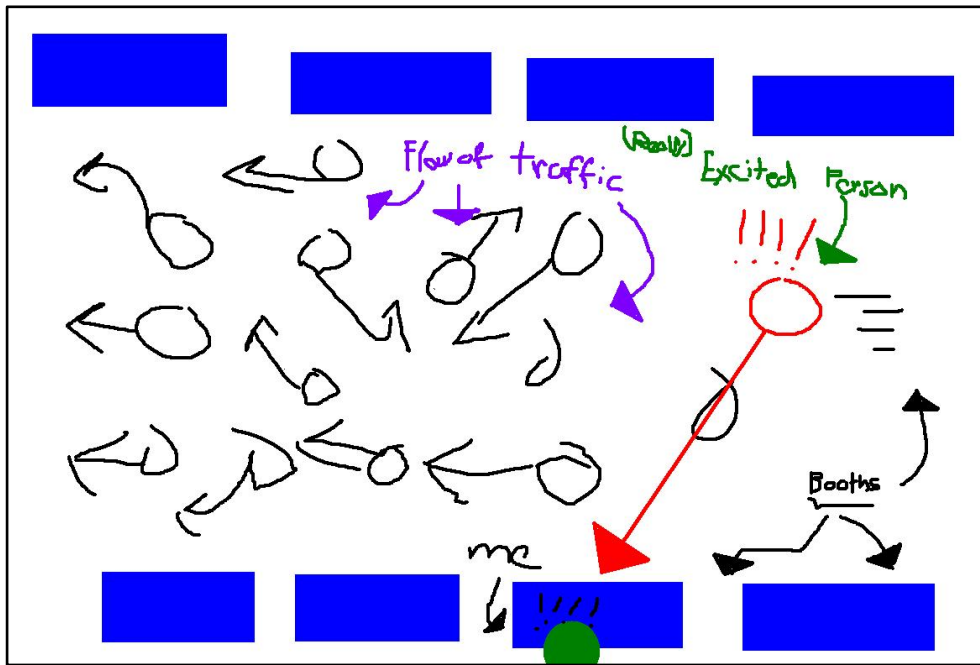   - 3. Design choices are outlined and defensible

-

-

What makes an effective block diagram?

Let's revisit our old friends.

Effective Block Diagrams

Block Diagram Checklist
- Functional Modules?
- Clear inputs and outputs?
- Justified Design?

Block Diagram Checklist
- Functional Modules?
- Clear inputs and outputs?
- Justified Design?

Effective Block Diagrams

Login
Screen

Welcome
Screen

Data
Presentation

Block Diagram Checklist
- **Functional Modules?**
- **Clear inputs and outputs?**
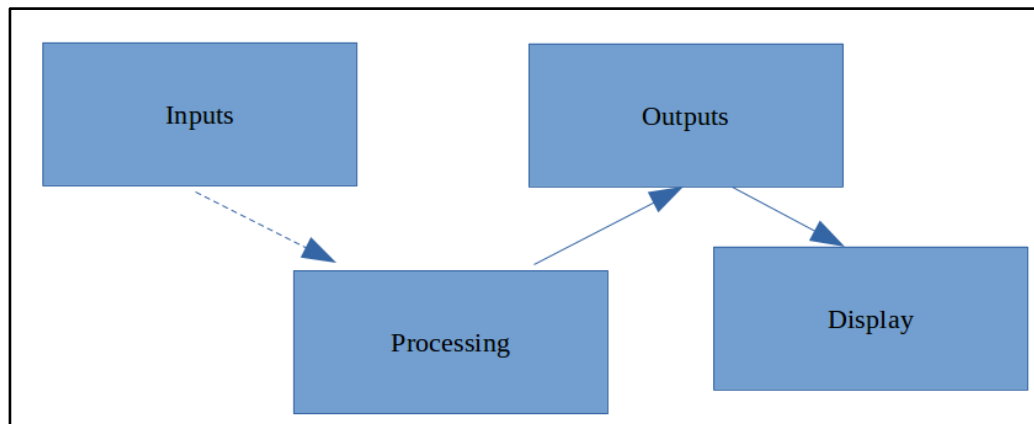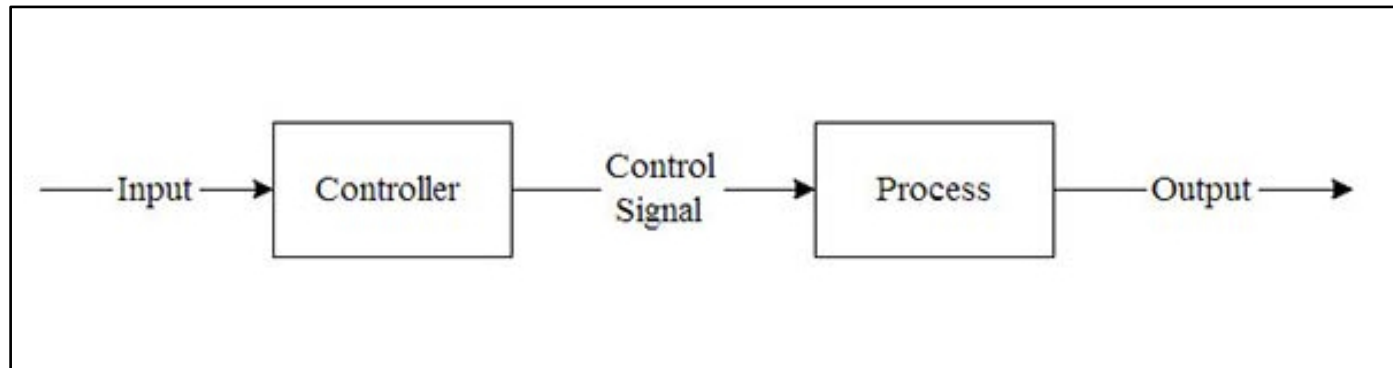- **Justified Design?**

Effective Block Diagrams

Block Diagram Checklist
- Functional Modules?
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- Justified Design?

Effective Block Diagrams

Fig. 6. WiFi module schematic [11]
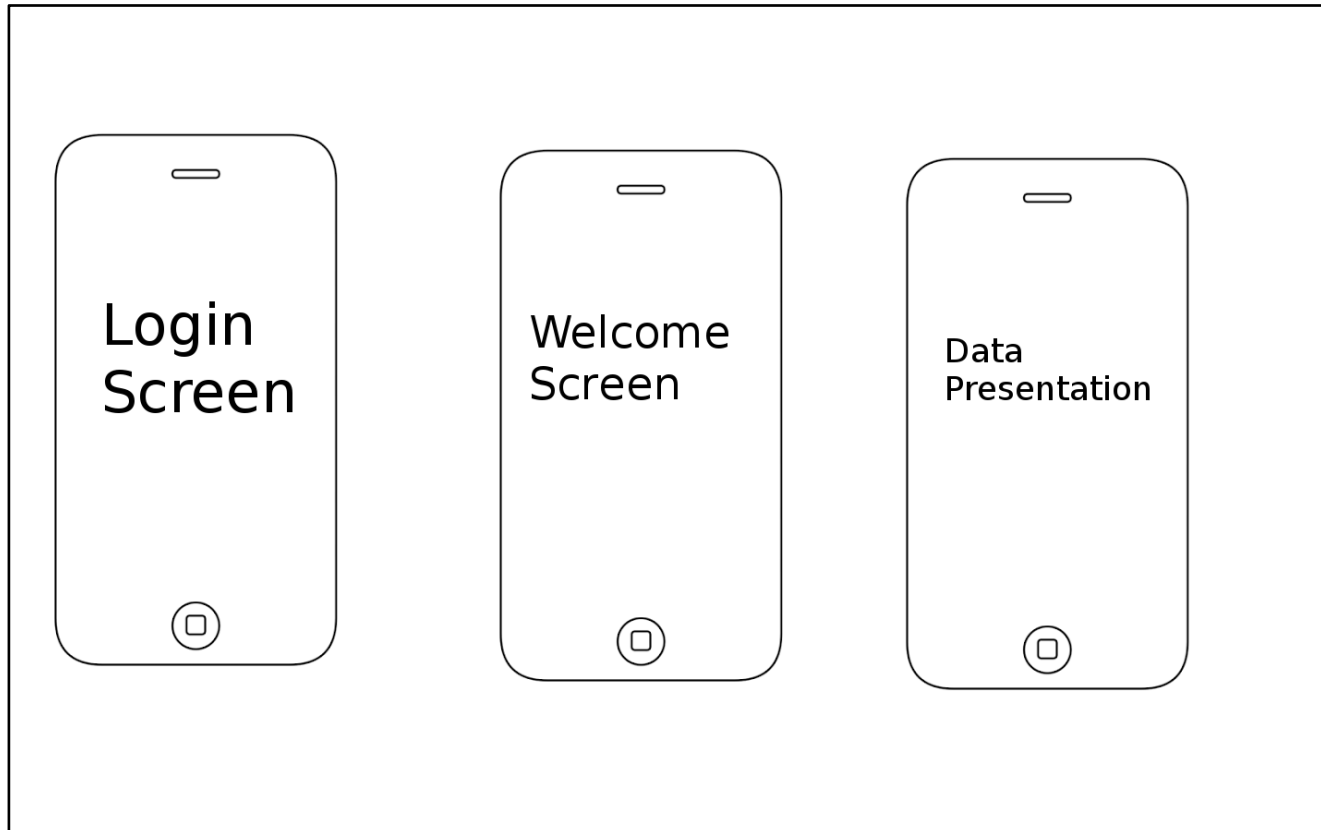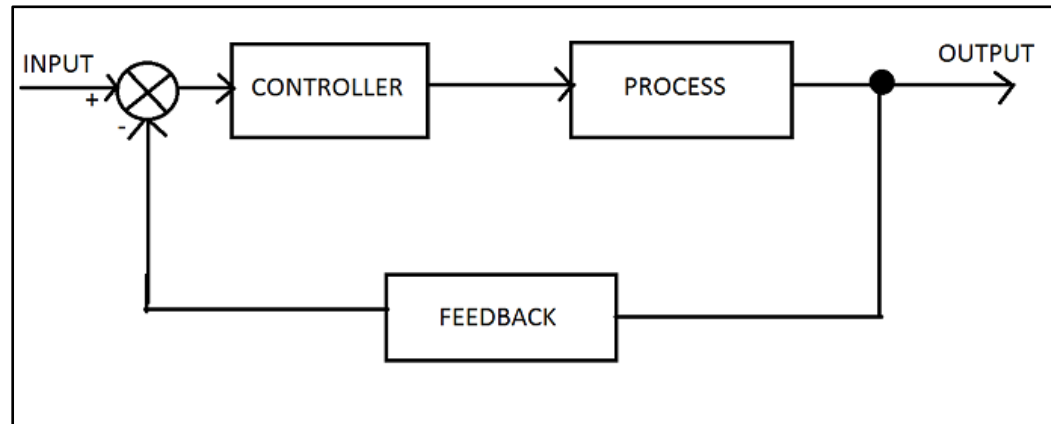
Block Diagram Checklist
- Functional Modules?
- Clear inputs and outputs?
- Justified Design?

What makes an effective ECE block diagram?

A good example.

Engineering (or Requirements) Flow-down

Lack of access to resources in developing countries

Lacking technology. Lacking infrastructure. Lacking funds.

Low-cost, scalable, efficient, wireless internet hub.

Sub-problems?

Block Diagram?

Implementation

Server (outside the scope of this class)

WiFi Module

Power Supply

Antenna

Solar Panel → Li-Ion Charger → Li-Ion Battery → Voltage Regulator

Charging Status

WiFi IC
- SPI
- UART
- Enable

Microcontroller
- I/O Data
- Control

NAND Flash

Reset Button

Serial Flash
- SPI

Status LEDs

Control Buttons

Control Module

— Data
— Power

Block Diagram Checklist
- Functional Modules?
- Clear inputs and outputs?
- Justified Design?

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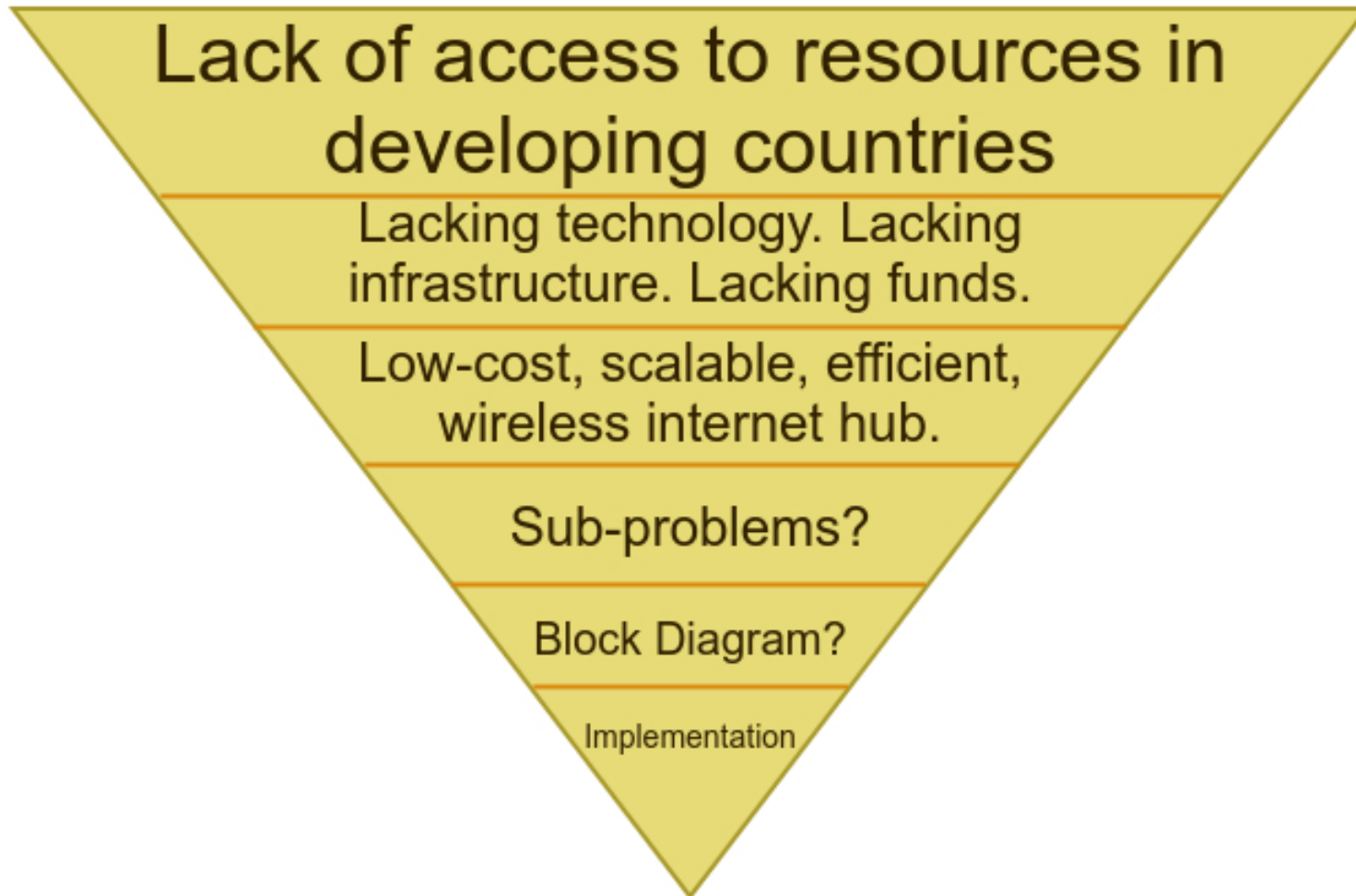# A Formal Definition of a Block Diagram

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-

Let's try it!

Car exercise.

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Questions?

Thank you and good job!

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