Digital System Design

Function

Register Transfer Level Design

Logic Design

Circuit Design

Physical Design

Top-down Digital System Design

Functional Design

- Functional design based on:
  - Requirement specification
- Target implementation influences the design flow
  - CPU
  - ASIC (Application Specific Integrated Circuits)
  - FPGA (Field Programmable Gate Arrays)
- Requirements:
  - Operation, Performance, Interface, Cost, Size, Power dissipation…
- Functional design may be verified through simulation

Register Transfer Level Design (RTL)

- This step in the design flow transforms the high-level functional design into a description at the register level.
- The Register Transfer Level Design describes the design at the following level of abstraction:
  - Registers
  - Memory
  - Arithmetic Units
  - State Machines
- RTL designs are validated through simulation

Logic Design

- At this stage of the design flow the register level transfer design is compiled into logic design.
- Again the design may be verified through simulation.
- Please note:
  - Simulation may be used to guaranty that the design meets the specification.
  - The simulation in every step in the design flow allows for the interception of errors early in the design.

Circuit Design

- At this stage in the design flow the logic design is compiled into circuit design.
- The step is strongly influenced by the target implementation.
- Again the design may be verified through simulation specifically through:
  - Timing simulation
  - Circuit analysis.

Physical Design

- In the final step in the design flow the circuit design determines the physical chip layout.
- Physical properties may be verified:
  - Chip area
  - Power dissipation
  - Clock frequency

Digital System Design Hierarchy

Functi ign — Description

RTL Design — R1 <- R1 +R2

Logic Design — Gates

Circuit Design — Circuit

Physical Design — Transistor

High

Level of abstraction

Low

Small number of complex components

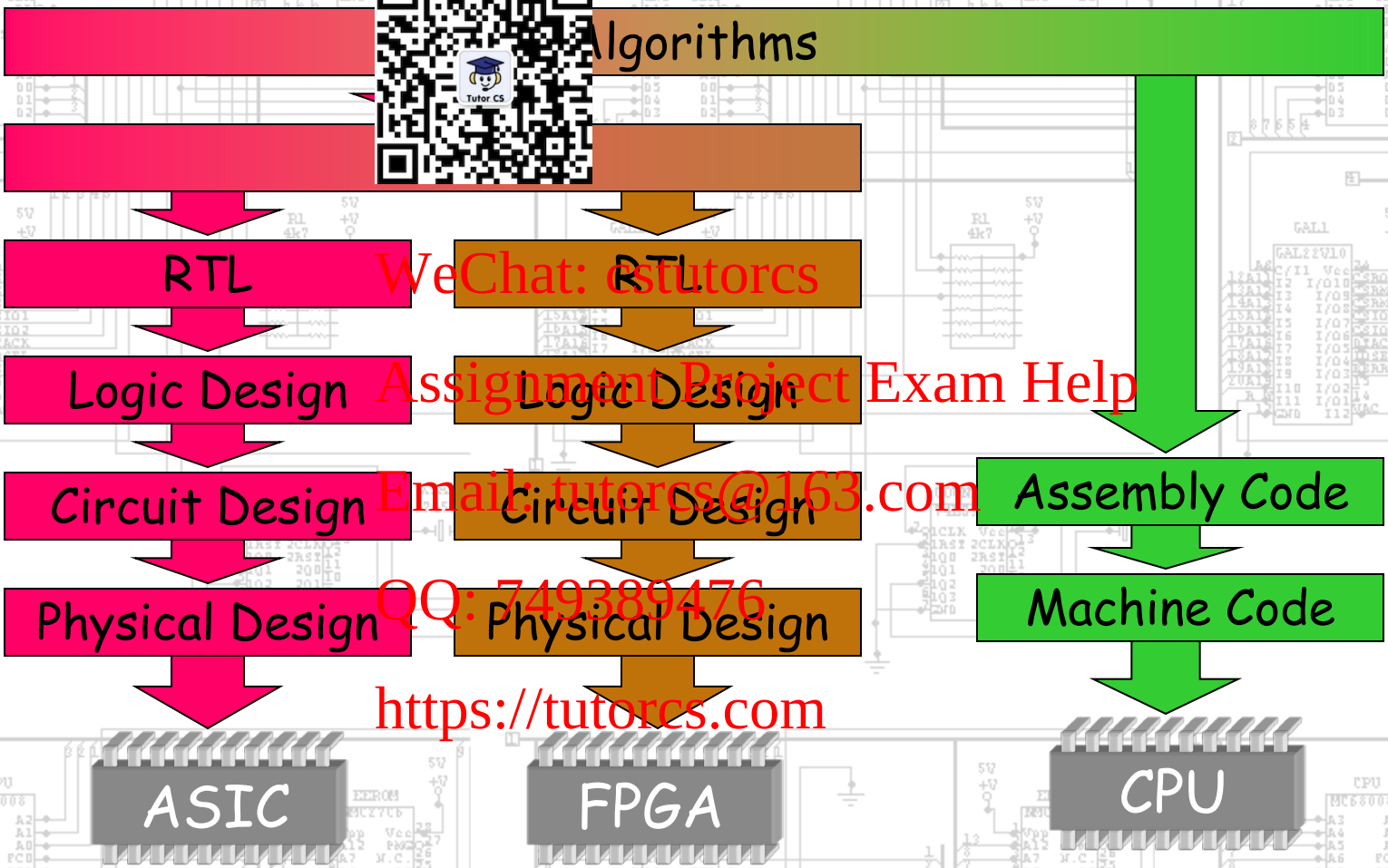
Large number of simple components

Hardware Description Languages

- Hardware Description Languages are used to:
  - Describe digital systems
  - Model digital systems
  - Design digital systems
- Hardware Description Languages:
  - VHDL, Verilog and more
- **VHDL**
  - VHSIC Hardware Description Language
  - **VHSIC**
    - Very High Speed Integrated Circuit Language

Target Implementation

Design flow depends on target hardware



Application Specific Integrated Circuits

Design Views

Transistors

Register

Processor

Behavioural

Structural

Algorithms

Cells

Modules

Register Transfers

Chips

Boolean Expressions

Boards

Transfer Functions

Physical