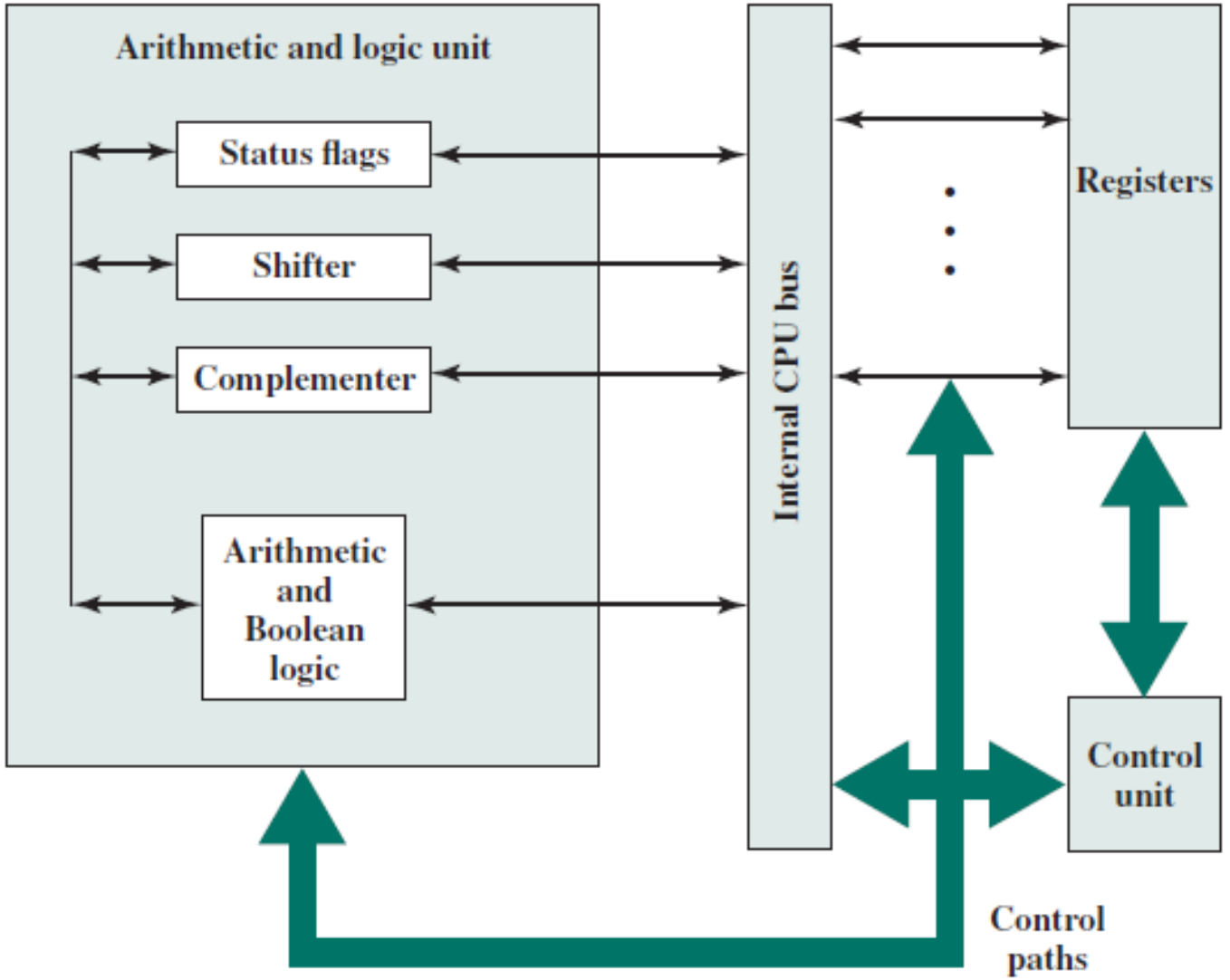
PROCESSOR STRUCTURE AND FUNCTION

PROCESSOR ORGANIZATION

- The processor, the things processor must do:
  - Fetch instruction: The processor reads an instruction from memory (register, cache, main memory).
  - Interpret instruction: The instruction is decoded to determine what action is required.
  - Fetch data: The execution of an instruction may require reading data from memory or an I/O module.
  - Process data: The execution of an instruction may require performing some arithmetic or logical operation on data.
  - Write data: The results of an execution may require writing data to memory or an I/O module.

Internal Structure of the CPU



REGISTER ORGANIZATION

- Within the processor, there is a set of registers that function as a level of memory above main memory and cache in the hierarchy.
- The registers in the processor perform two roles:
  - User-visible registers: Enable the machine- or assembly language programmer to minimize main memory references by optimizing use of registers.
  - Control and status registers: Used by the control unit to control the operation of the processor and by privileged, operating system programs to control the execution of programs.

User-Visible Registers

- A user-visible register is one that may be referenced by means of the machine language that the processor executes. We can characterize these in the following categories:
  - General purpose

    Any general-purpose register can contain the operand for any opcode. This provides true general-purpose register use. However, there are restrictions. For example, there may be dedicated registers for floating-point and stack operations.
  - Data

    Data registers may be used only to hold data and cannot be employed in the calculation of an operand address.
  - Address

    Address registers be a general purpose, or they are devoted to a particular addressing mode. Examples include the following: Segment pointers, Index registers, Stack pointer.
  - Condition codes

    Condition codes are bits set by the processor hardware as the result of operations. For example, an arithmetic operation may produce a positive, negative, zero, or overflow result.

Control and Status Registers

- Four registers are essential to instruction execution:
  - Program counter (PC)
  - Instruction register (IR)
  - Memory address register (MAR)
  - Memory buffer register (MBR)
- Many processor designs include a register or set of registers, known as the program status word (PSW), that contain status information. Common fields or flags include the following:
  - Sign
  - Zero
  - Carry
  - Equal