

Computer Architecture

Micro-Programmed Control

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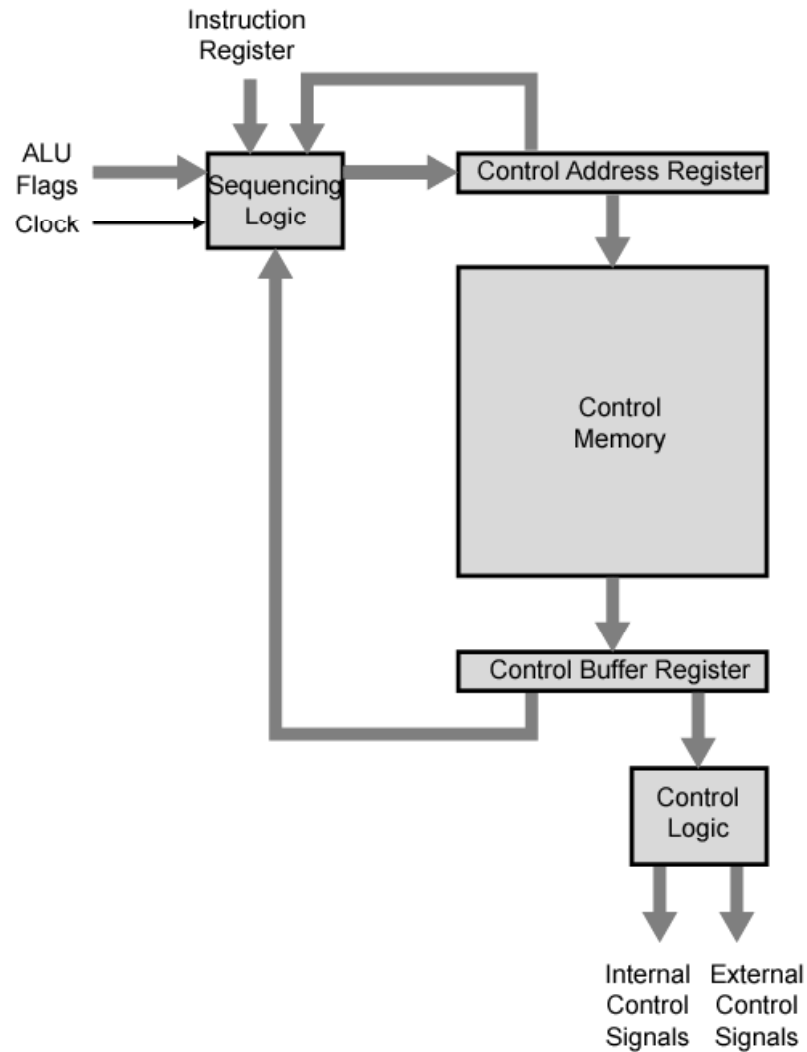
Microprogrammed Control

- A microprogram has a sequence of instructions in a microprogramming language.
 - These are very simple instructions that specify micro-operations.

Microprogrammed Control

- A microprogrammed control unit is a simple logic circuit that is capable of:
 - Sequencing through microinstructions
 - Generating control signals to execute each microinstruction.
- As in a hardwired control unit, the control signal generated by a microinstruction are used to cause register transfers and ALU operations.

Control Unit Organization



Micro-programmed Control

- Use sequences of instructions to control complex operations.
- Called micro-programming or firmware

Micro-programmed Control

- All the control unit does is generate a set of control signals.
- Each control signal is on or off.
- Represent each control signal by a bit.
- Have a control word for each micro-operation.
- Have a sequence of control words for each machine code instruction.
- Add an address to specify the next micro-instruction, depending on conditions.

Micro-programmed Control

- Today's large microprocessor
 - Many instructions and associated register-level hardware
 - Many control points to be manipulated
- This results in control memory that
 - Contains a large number of words
 - co-responding to the number of instructions to be executed
 - Has a wide word width
 - Due to the large number of control points to be manipulated

Micro-program Word Length

- Based on 3 factors
 - Maximum number of simultaneous micro-operations supported
 - The way control information is represented or encoded
 - The way in which the next micro-instruction address is specified

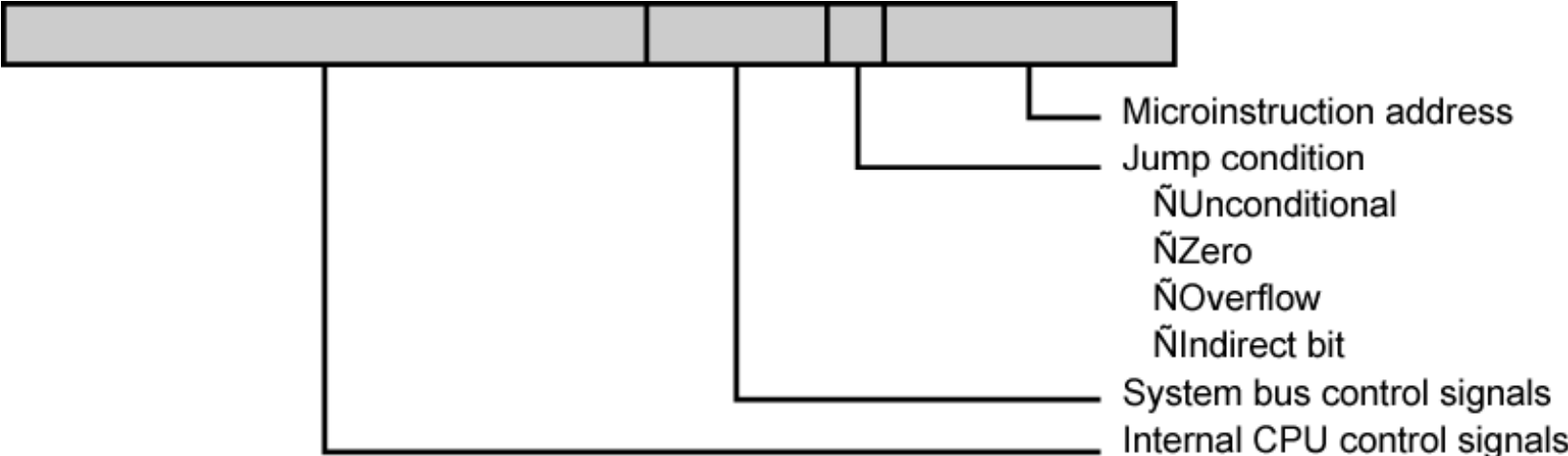
Micro-instruction Types

- Each micro-instruction specifies single (or few) micro-operations to be performed
 - (*vertical* micro-programming)
- Each micro-instruction specifies many different micro-operations to be performed in parallel
 - (*horizontal* micro-programming)

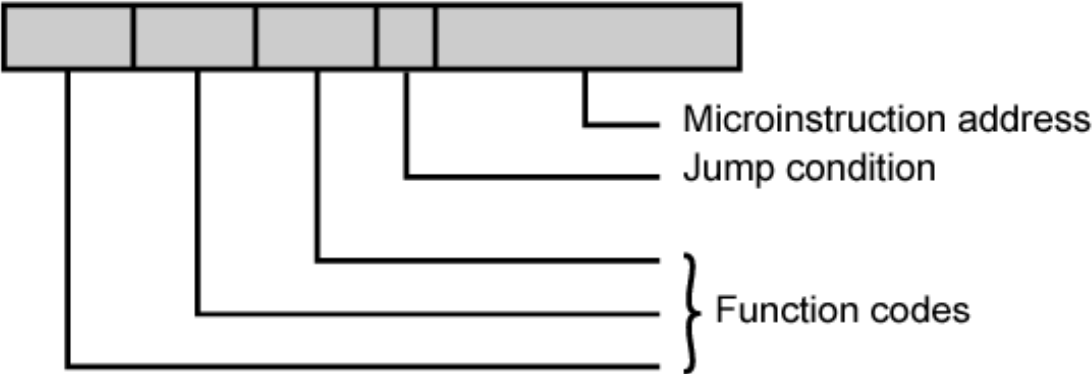
categories of microprogramming

- **Vertical**
 - Shorter word
 - More decoding needed to interpret fields (maximal encoding)
 - Words are more functional
 - Micro data hardware path more complicated
 - Ex: older IBM main frames (s360/s3670) used it
- **Horizontal**
 - Longer word
 - Direct relationship between fields/word bits and control signals
 - Minimal encoding of fields - may have a bit significant relationship between word bits and control signals.
 - Micro data hardware path simpler
 - Ex: PowerPC's employed horizontal code

Typical Microinstruction Formats



(a) Horizontal microinstruction



(b) Vertical microinstruction

hardware vs microprogrammed

- Advantages Of Microprogrammed
 - Usually Easier To Document And Understand
 - More Flexible: Easier, Faster, And Cheaper To Fix Design bugs
- Disadvantages Of Microprogrammed
 - May Be Slower Than Direct Hardware Implementation
 - May Involve More Support People

Questions

