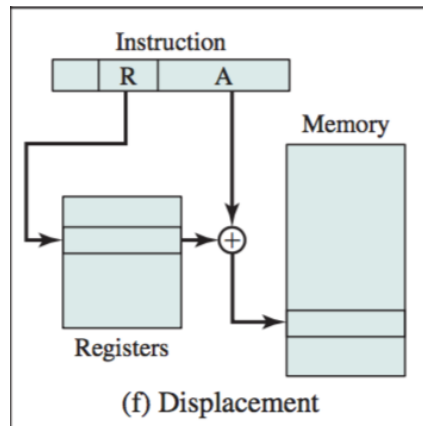


ISA - Instruction Set Architecture (V)

Addressing Modes (cont.)

Displacement



- **Combines** the capabilities of **direct** addressing and **register indirect** addressing.
- Instructions have **two address fields**, at least one of which (**A**) is **explicit**. The other address field (**R**) can be an implicit reference based on opcode, or can explicitly refer to a register whose contents are added to **A** to produce the actual address.
- *Advantage: flexibility*
- *Disadvantage: complexity*
- **Relative addressing**
 - The **R** field refers to the **PC**, which is implicitly in the instruction.
 - Typically the explicit address field is treated as 2's complement
 - The actual address the operation needs is a displacement relative to the **PC**'s value that is considered current execution point in a program.
 - The actual address is **PC's value + explicit address field value**.
 - Generally used by control flow instructions
- **Indexed addressing**
 - The **A** field refers a main memory address, and the register referred by the **R** field, usually is the index register, contains a displacement from that address
 - The actual address is the address in **A** field + the value in the index register

- Used to access an array whose elements are in successive memory locations. By incrementing or decrementing index register value, different element of the array can be accessed.
 - Index register is a general register. It is initialized to 0. After each operation, the index register is incremented or decremented by 1.
- **Register base-indexed addressing**
 - Two address fields, A and R, both refer to the registers, which usually are the index register and the base register.
 - The **actual address** is the **value in the base register + the value in the index register**
 - **Register base-scaled indexed addressing**
 - Three address fields, two refer to the registers, one is the scale
 - The **actual address** is **the value in the base register + (the value in the index register x scale)**
- Example:
 - Given the following memory values and register values, assume the LOAD instruction loads the value at a specific address to the accumulator based on the addressing mode. What values do the following instructions load into the accumulator?

GPRs

Address	Value
A	100
B	5
C	110
D	11

Main Memory

Address	Value
100	101
101	102
110	103
111	104

LOAD RegisterDirect C [110]

LOAD RegisterIndirect C [103]

LOAD Register Base-Indexed A, D [104] # A is base reg. and D is index reg.

LOAD Register Base-Scaled Indexed A, B, 2 [103] # A is base reg. and B is index reg.