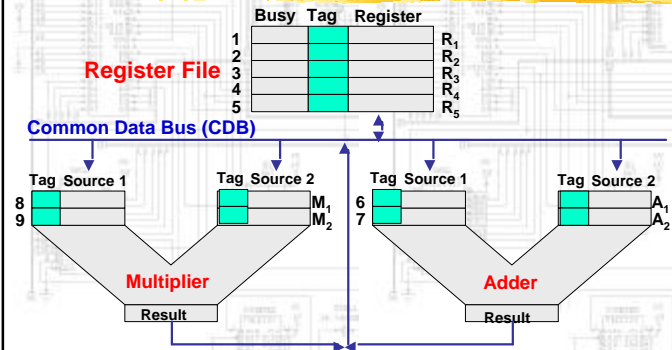


## Tomasulo's Method



## Tomasulo's Method

Busy Bit and Tag Register

- ⊕ Busy Bit
  - ⊕ Busy Bit: SET
    - ⊕ If destination register not yet written
  - ⊕ Busy Bit: RESET
    - ⊕ After the register received the result
- ⊕ Tag Register
  - ⊕ I identifies source of result

## Tomasulo's Method

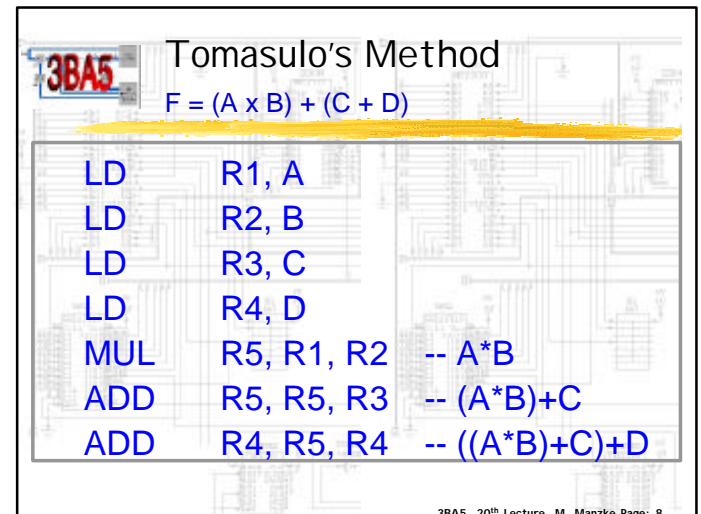
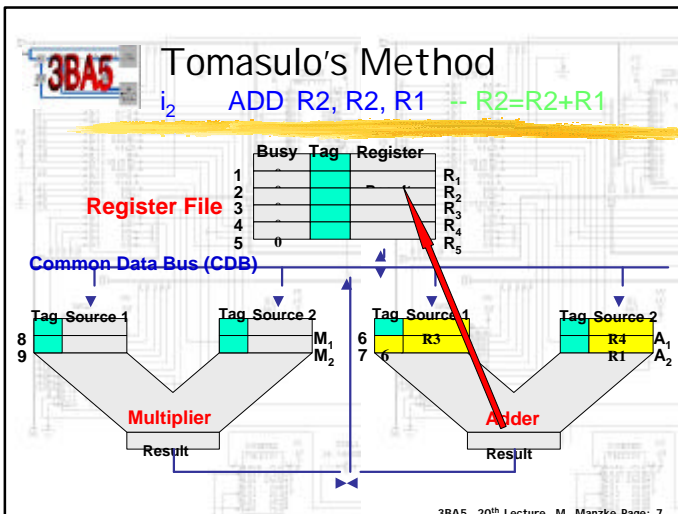
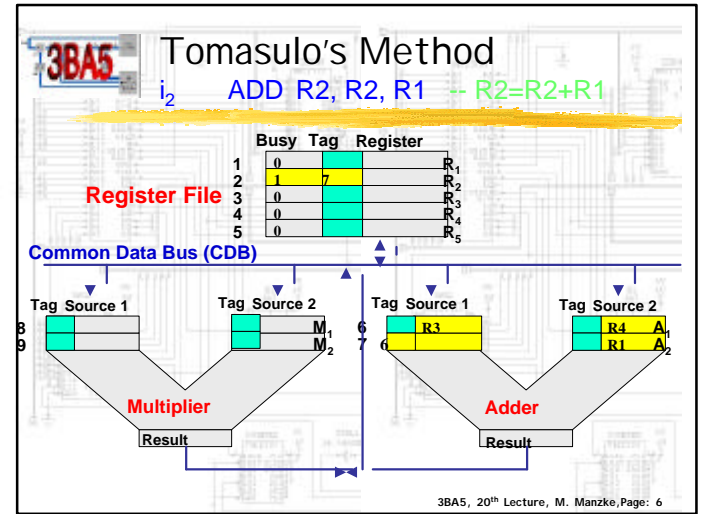
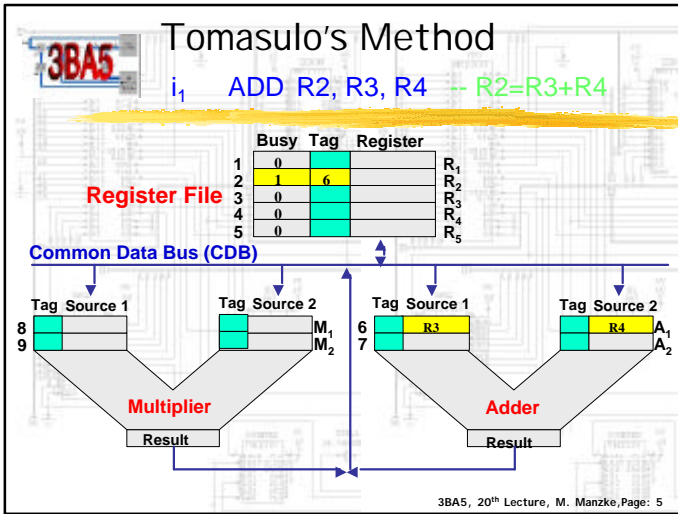
Functional Units

- ⊕ Functional Units
  - ⊕ Reservation Station
    - ⊕ May have more than one input register
      - ⊕ source 1 and source 2
  - ⊕ Tag Register
    - ⊕ Associated with source register of reservation station
- ⊕ Common Data Bus (CDB)

## Tomasulo's Method

ADD

$i_1$  ADD R2, R3, R4 --  $R2=R3+R4$   
 $i_2$  ADD R2, R2, R1 --  $R2=R2+R1$



**3BA5**

## Tomasulo's Method

$$F = (A \times B) + (C + D)$$

LD	R1, A	
LD	R2, B	
LD	R3, C	
LD	R4, D	
MUL	R5, R1, R2	-- A*B
ADD	R4, R3, R4	-- D+C
ADD	R4, R4, R5	-- (A*B)+(C+D)

**3BA5**

## Scoreboard Method

- ⊕ Systems with multiple functional units may execute instructions concurrently
- ⊕ Instructions may also be completed out of the original program order

**3BA5**

## Scoreboard Method

Developed for CDC6600

- ⊕ Issued Instructions are added to the scoreboard
- ⊕ Scoreboard data identify instruction influence on :
  - ⊕ Registers
  - ⊕ Functional Units

**3BA5**

## Scoreboard Method

Status Tables

- ⊕ The CDC used status tables for:
  - ⊕ Instructions
  - ⊕ Functional Units
  - ⊕ Destination Registers
- ⊕ To control instruction issue and to detect data hazards
- ⊕ Instructions are issued if
  - ⊕ The required functional unit is available and
  - ⊕ The destination register is available