ECE375
Data Manipulation and the LCD

TA:

School of Electrical Engineering and Computer Science

Oregon State University

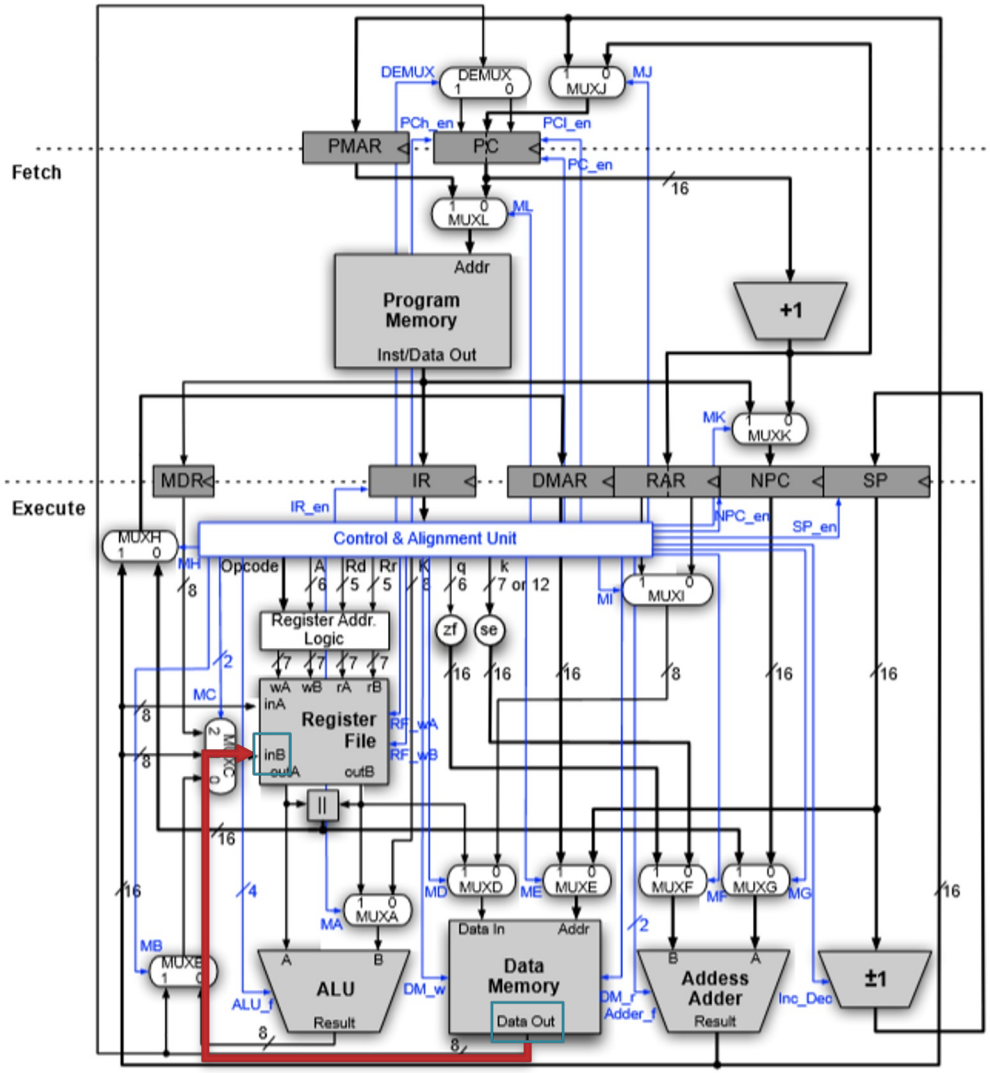
Goal of this Lab

- Learn data manipulation in Assembly.
- Use X/Y/Z registers as pointers.
- Use LCD driver function.

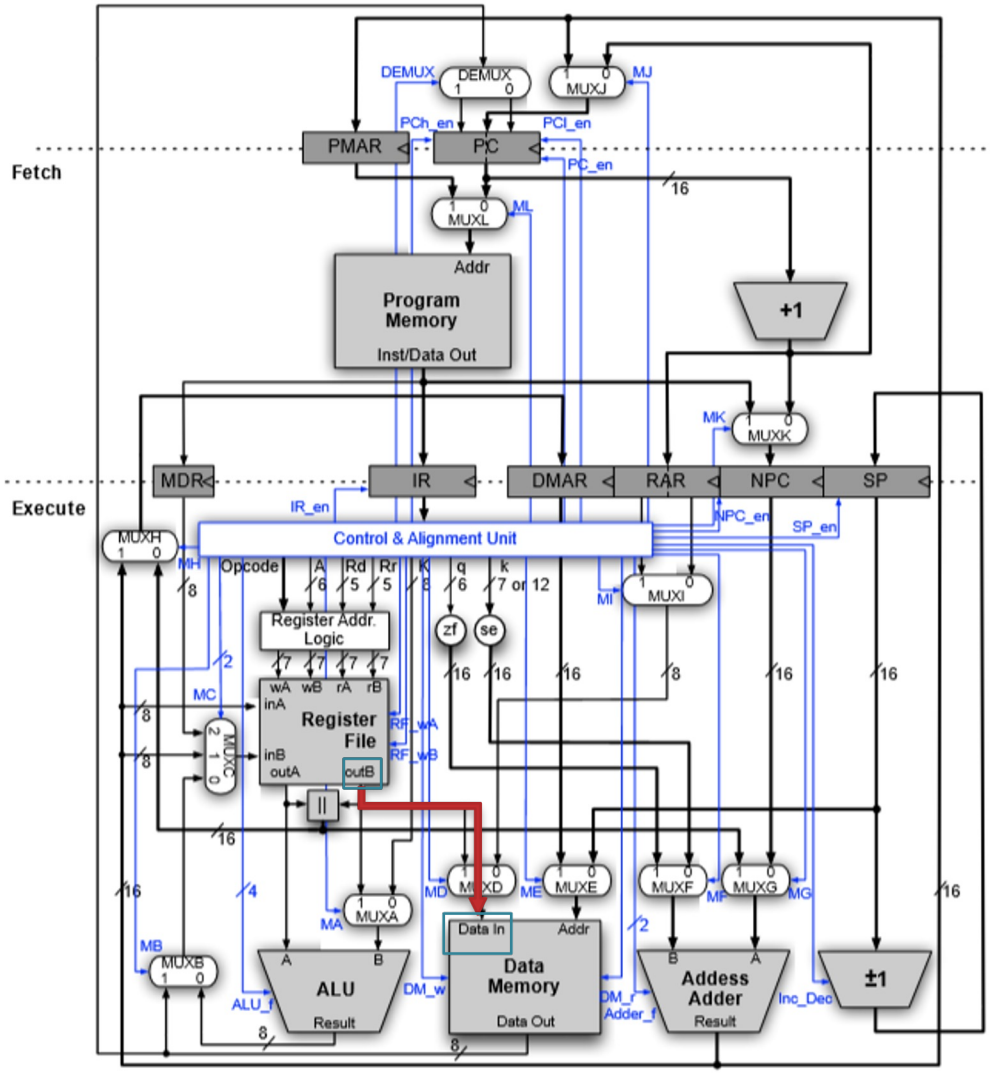
Data Manipulation

- Data memory – Register
- Data memory – Program Memory
- Register – Program Memory

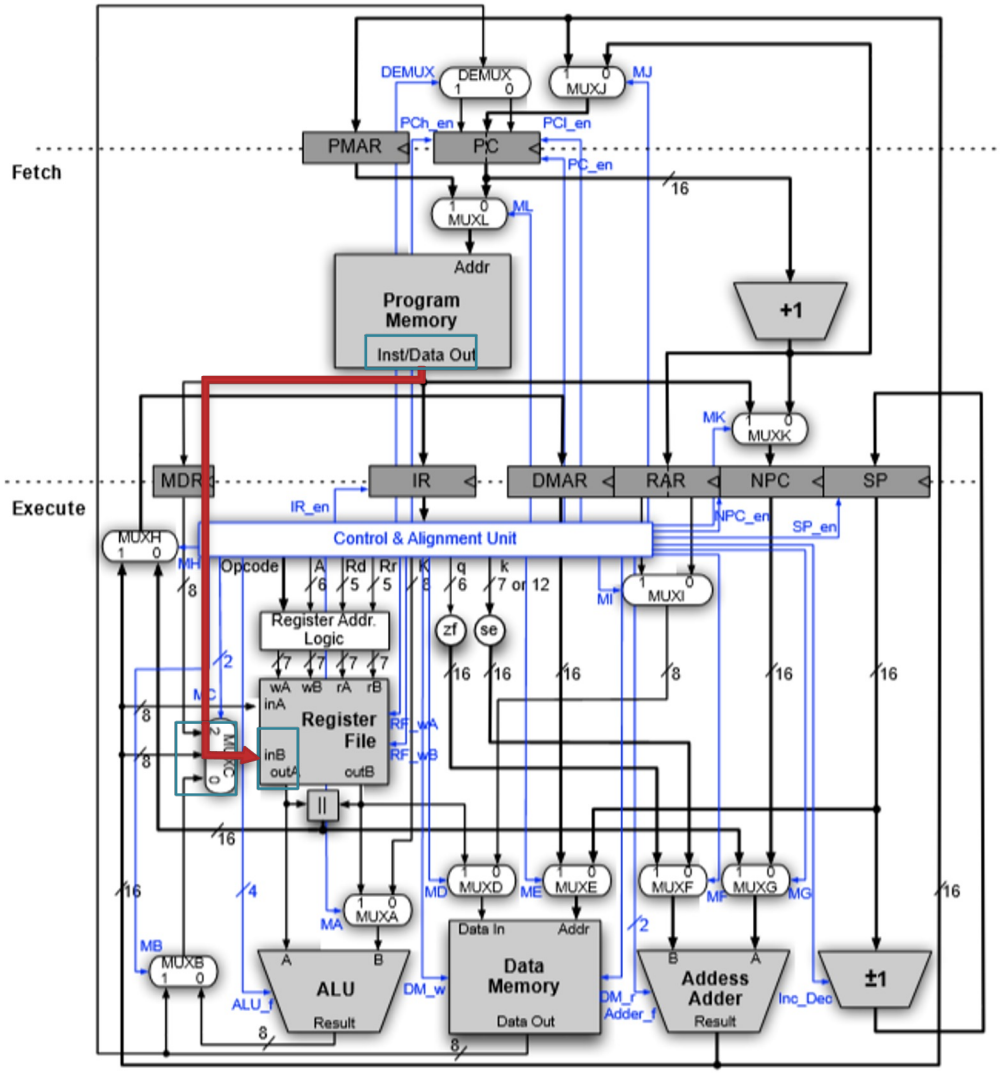
Data memory -> Register



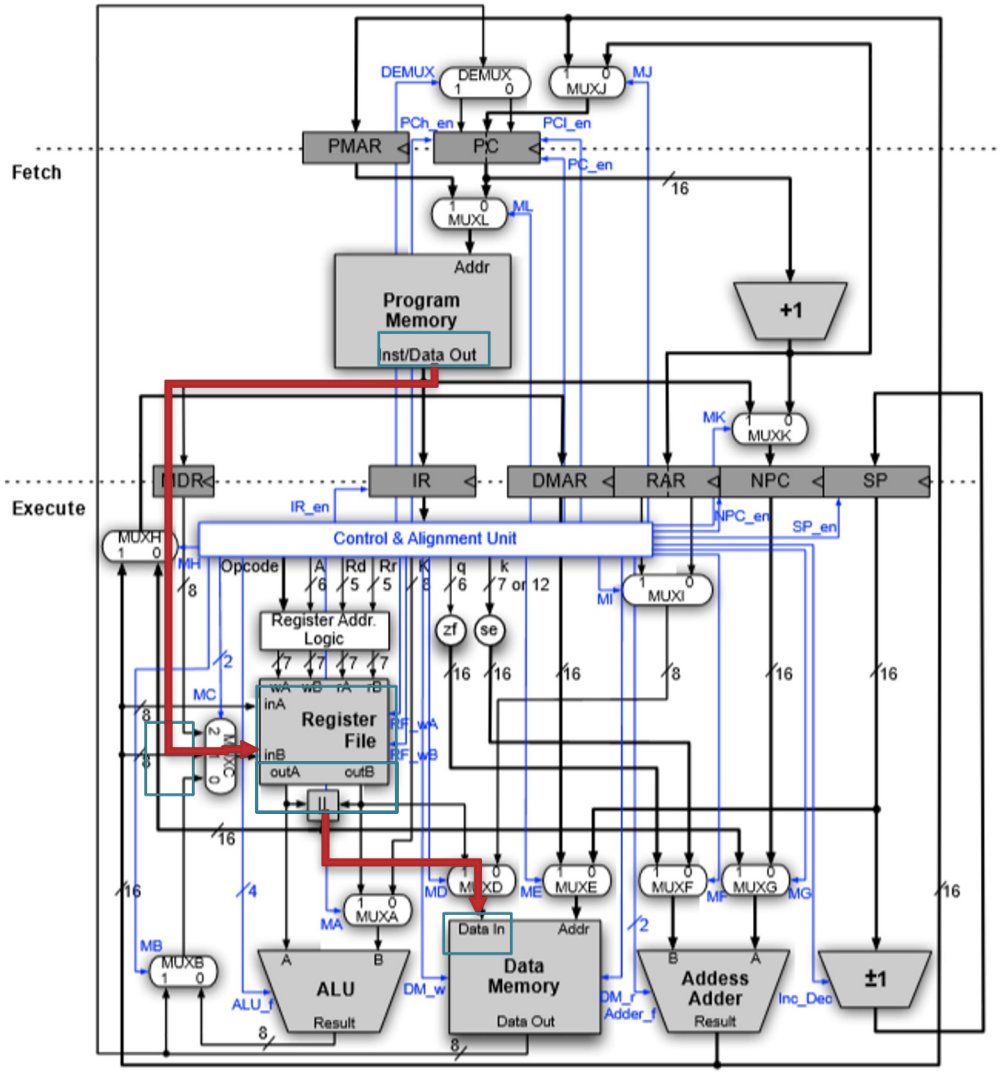
Register -> Data memory



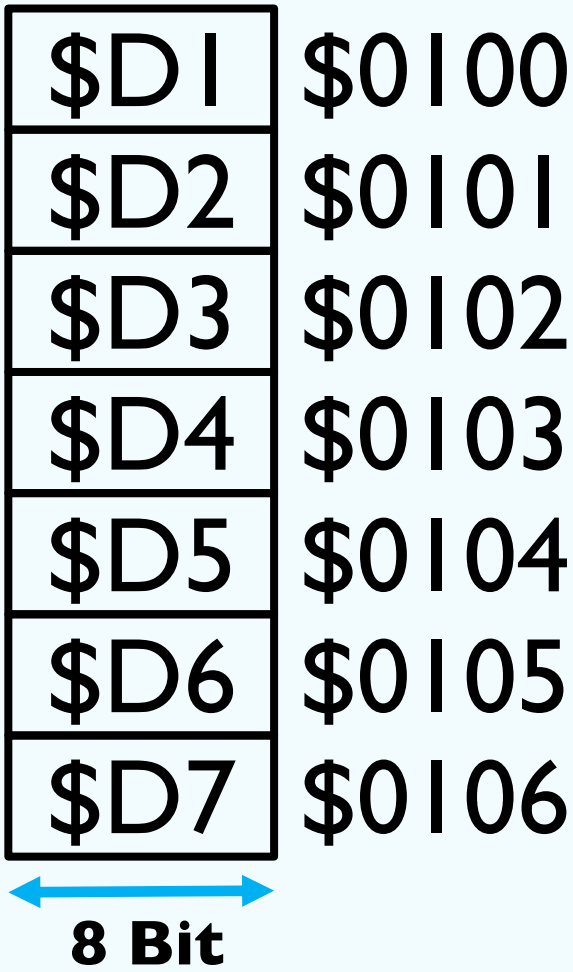
Program memory -> Register

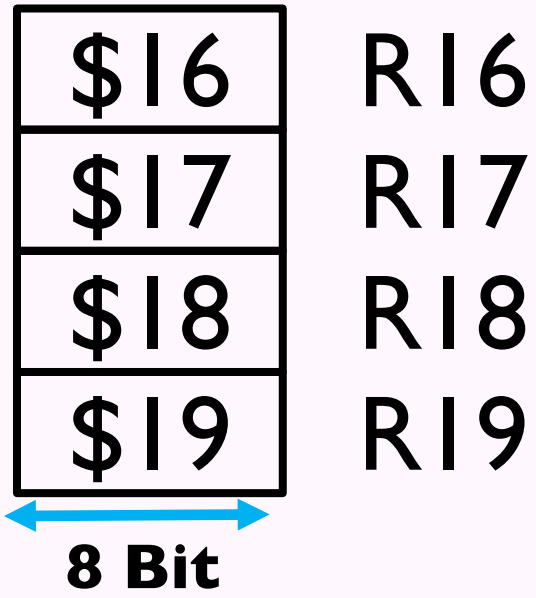


Program memory -> Data memory

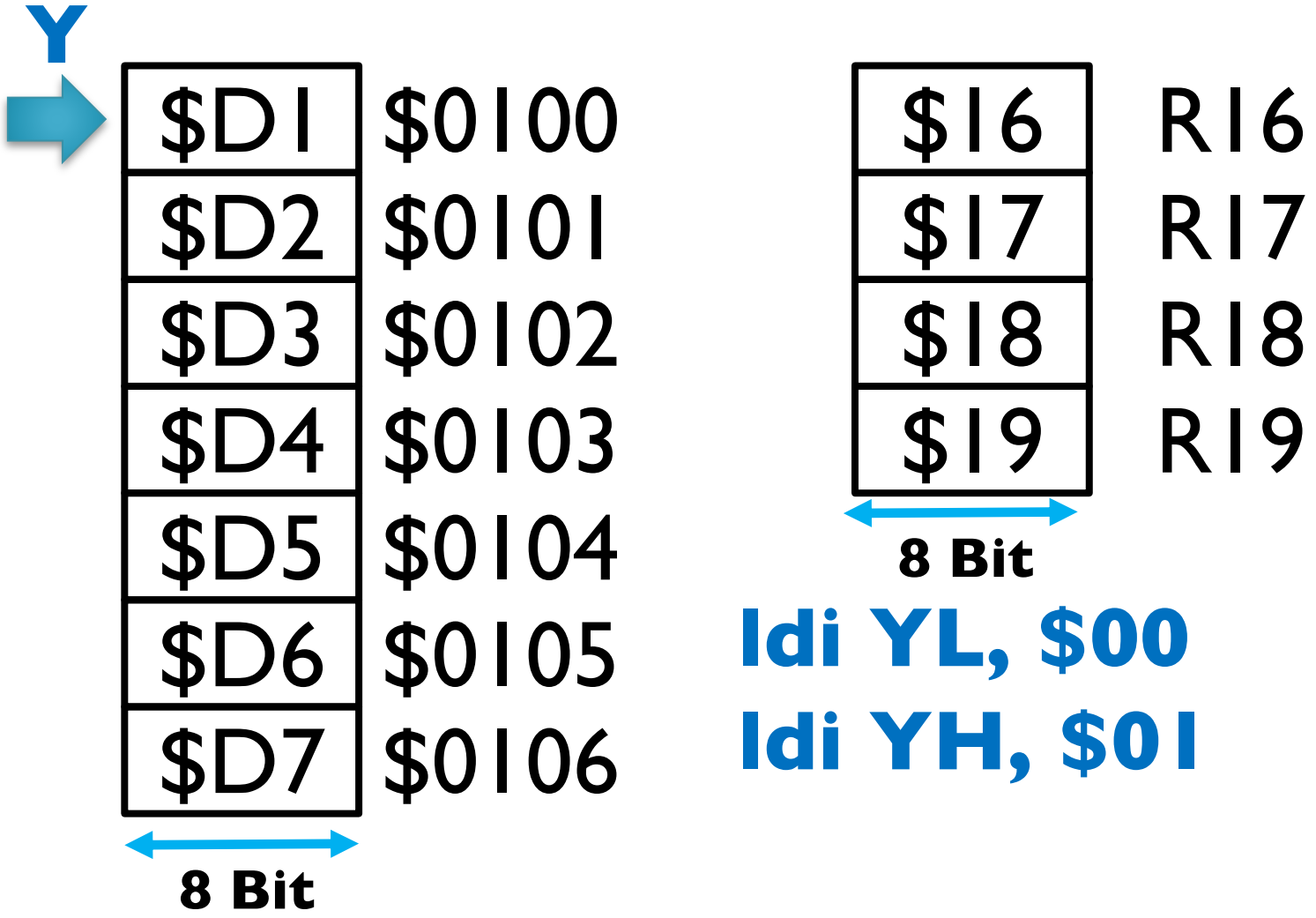


Data Memory & Register

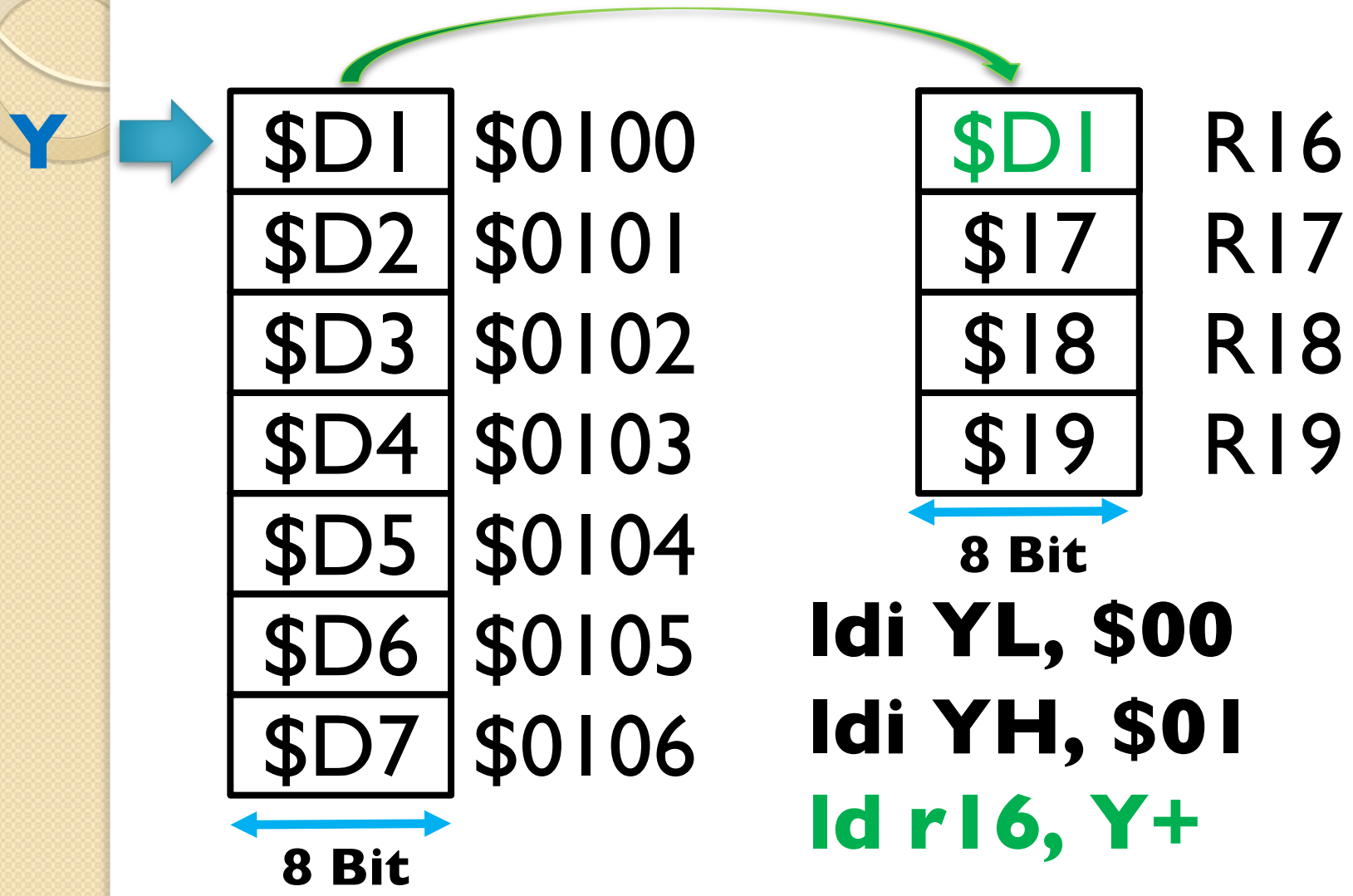




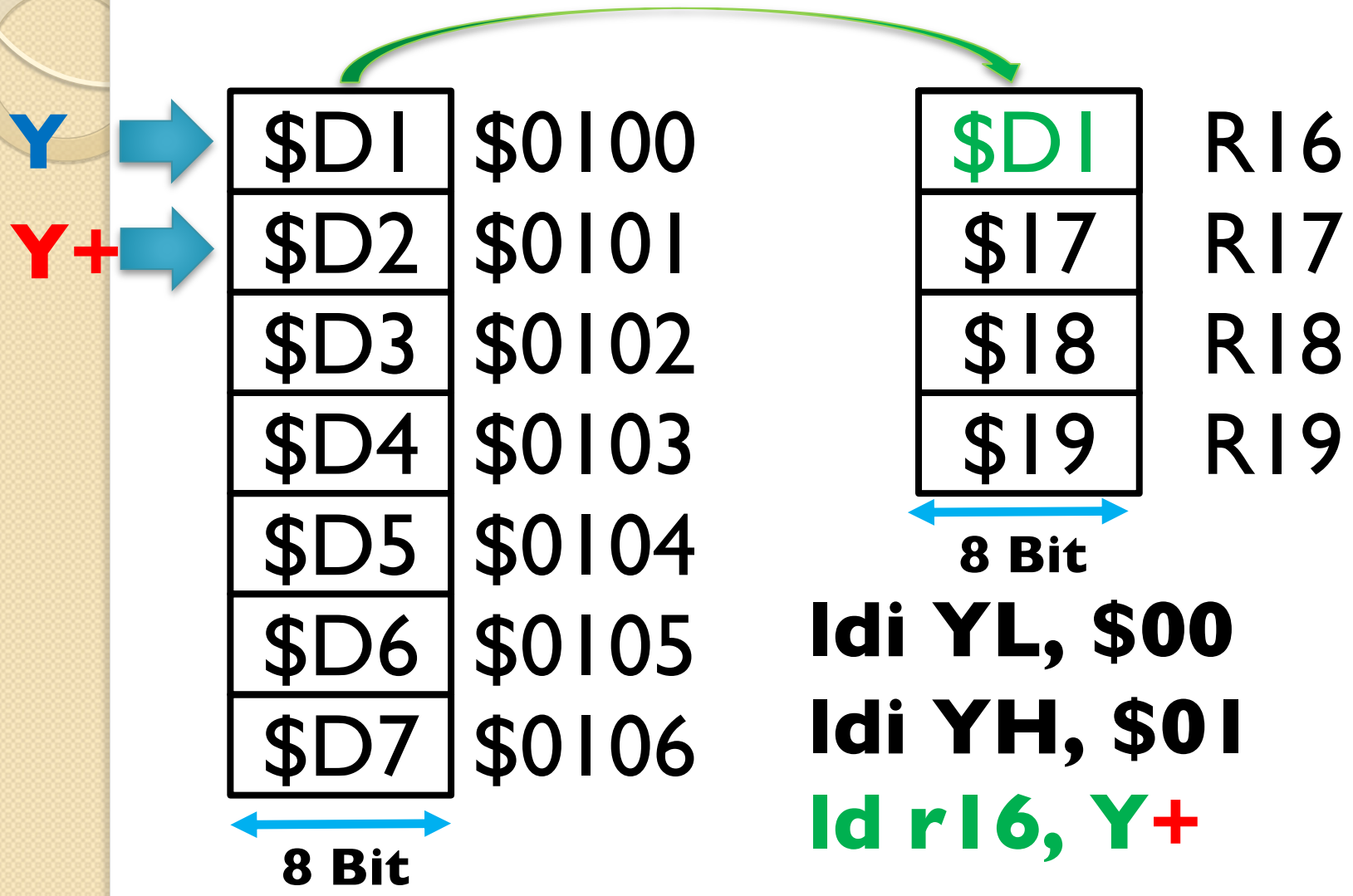
Data Memory to Register



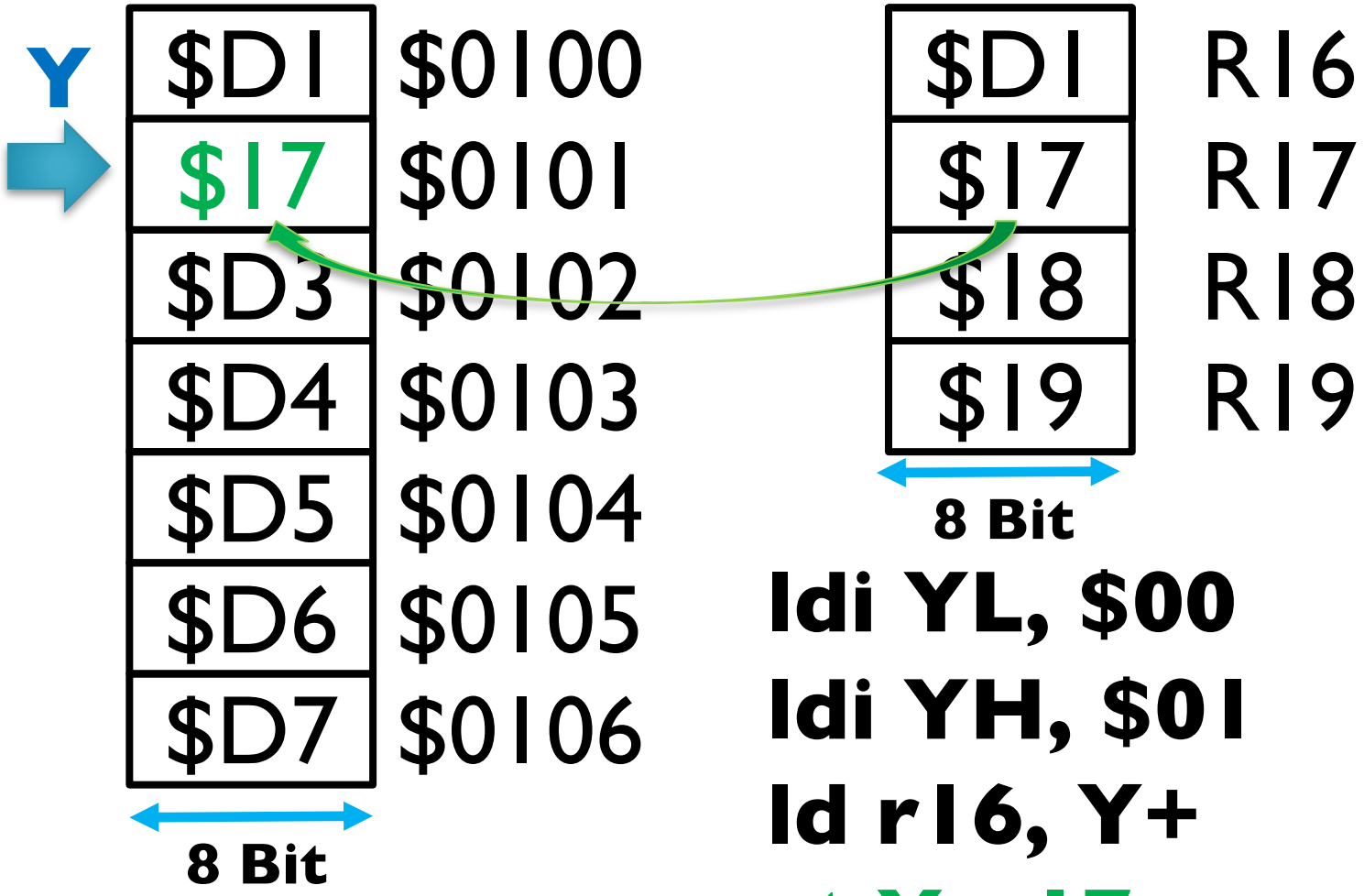
Data Memory to Register



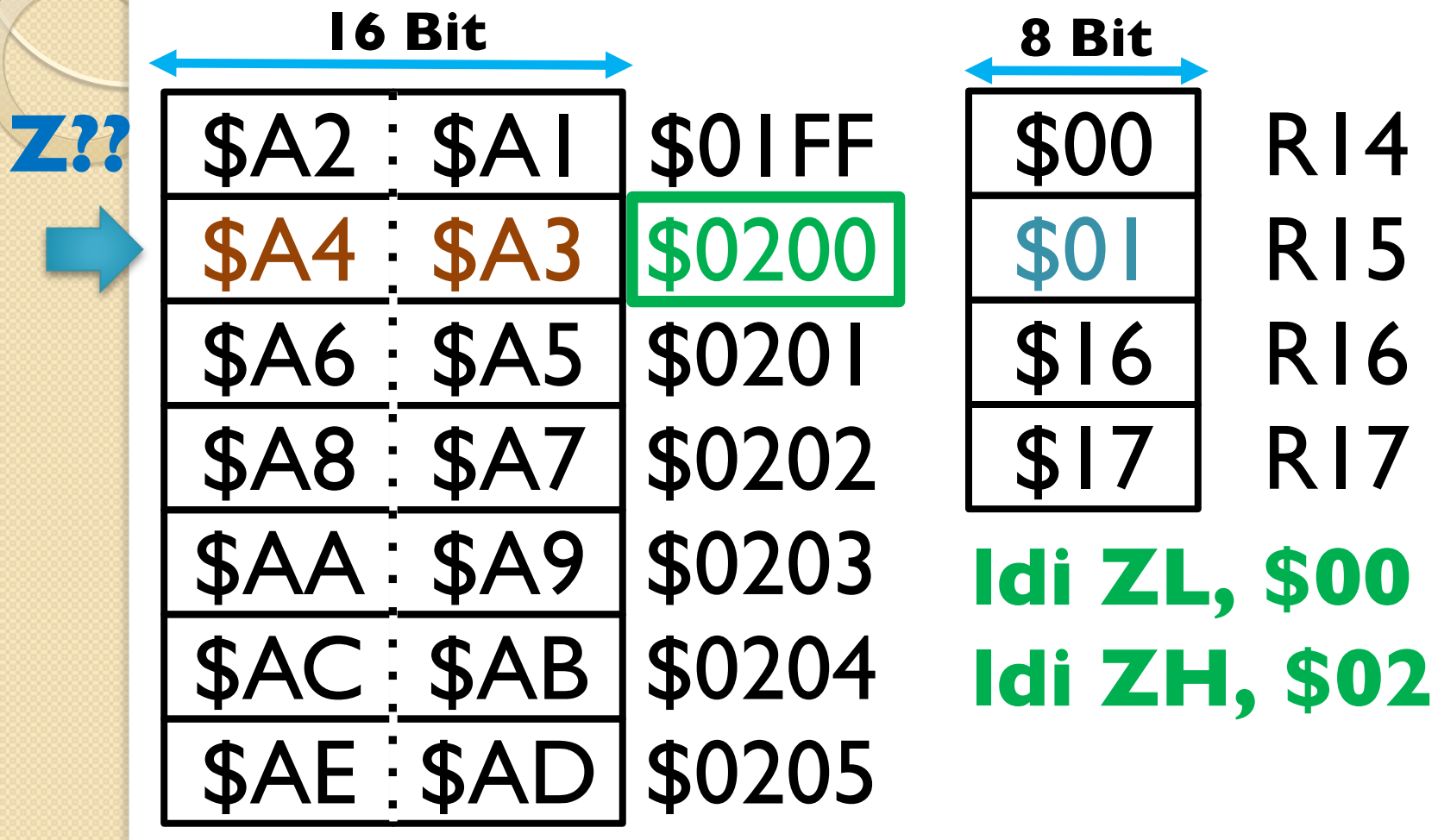
Data Memory to Register



Register to Data Memory



Program Memory to Register



Program Memory(16 bits) ≠ Register (8bits)

Cannot move data directly

Program Memory to Register

16 Bit		
$A2	$A1	$01FF
$A4	$A3	$0200
$A6	$A5	$0201
$A8	$A7	$0202
$AA	$A9	$0203
$AC	$AB	$0204
$AE	$AD	$0205

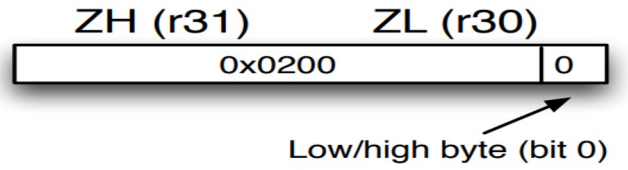
8 Bit	
$00	R14
$01	R15
$16	R16
$17	R17

ldi ZL, $00 << 1

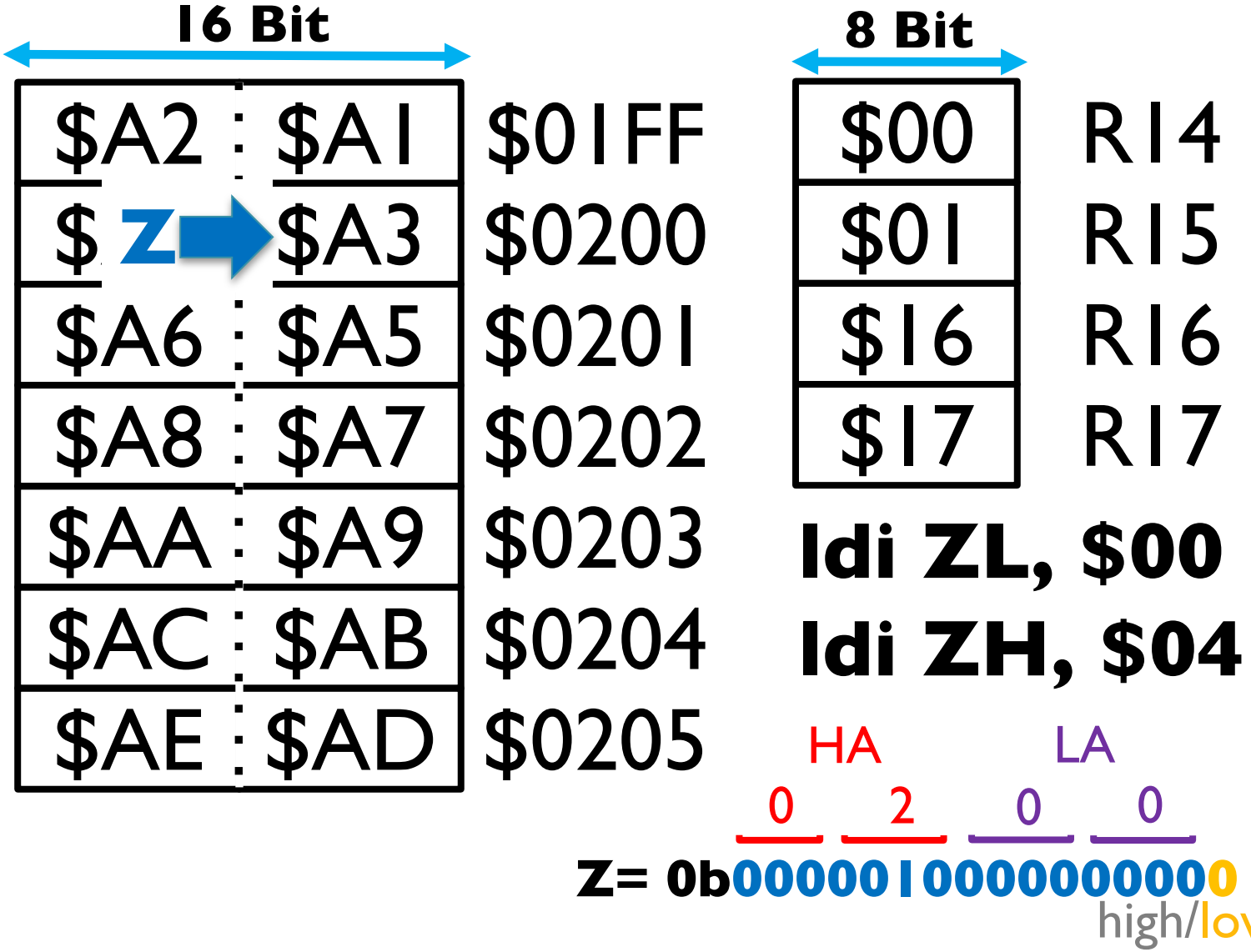
ldi ZH, $02 << 1

ZH 0 2 ZL 0 0

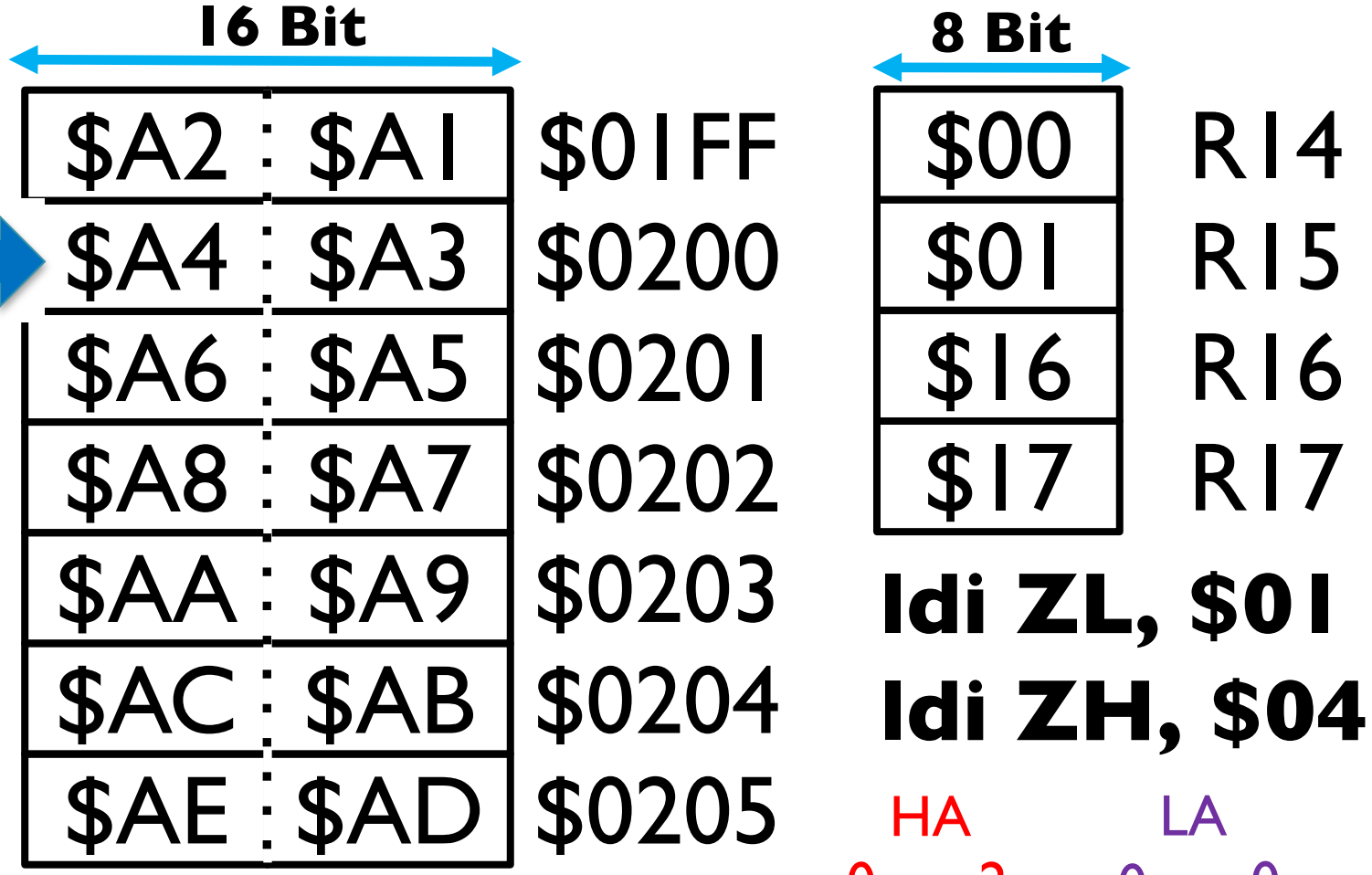
Z= 0b0000001000000000 << 1



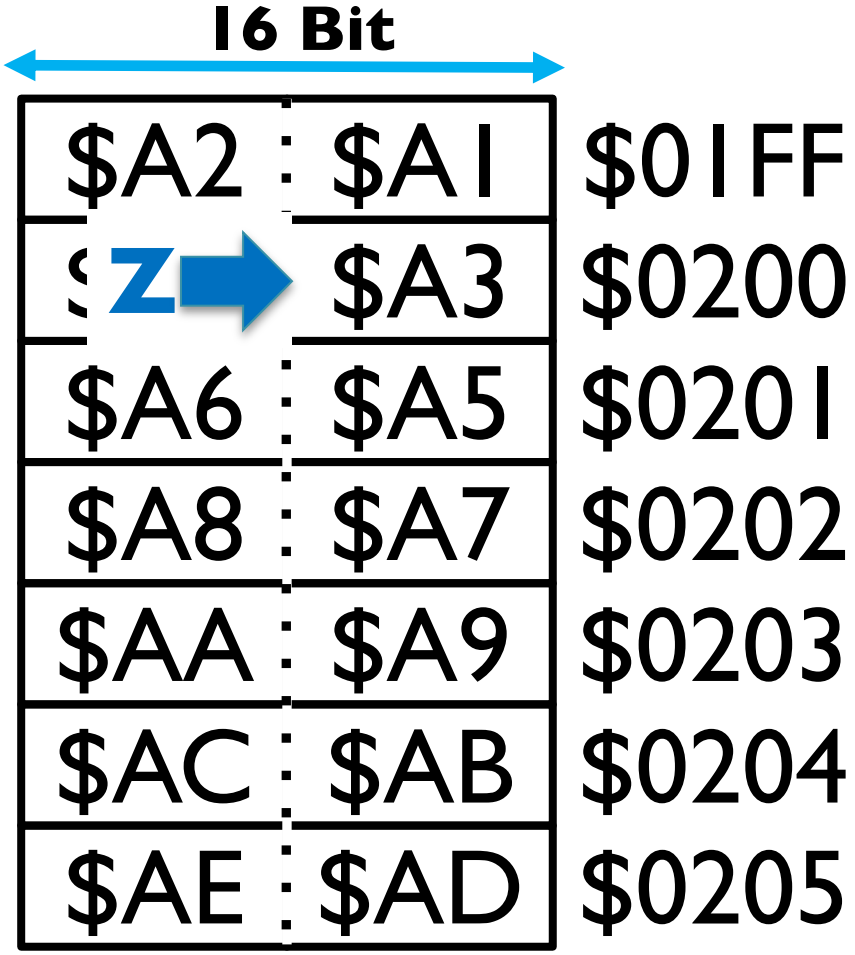
Program Memory to Register



Program Memory to Register



Program Memory to Register



HA LA

0 2 0 0

Z= 0b0000010000000000

high/low

ldi ZL, $00

ldi ZH, $02

ldi ZL, ($00<<1)

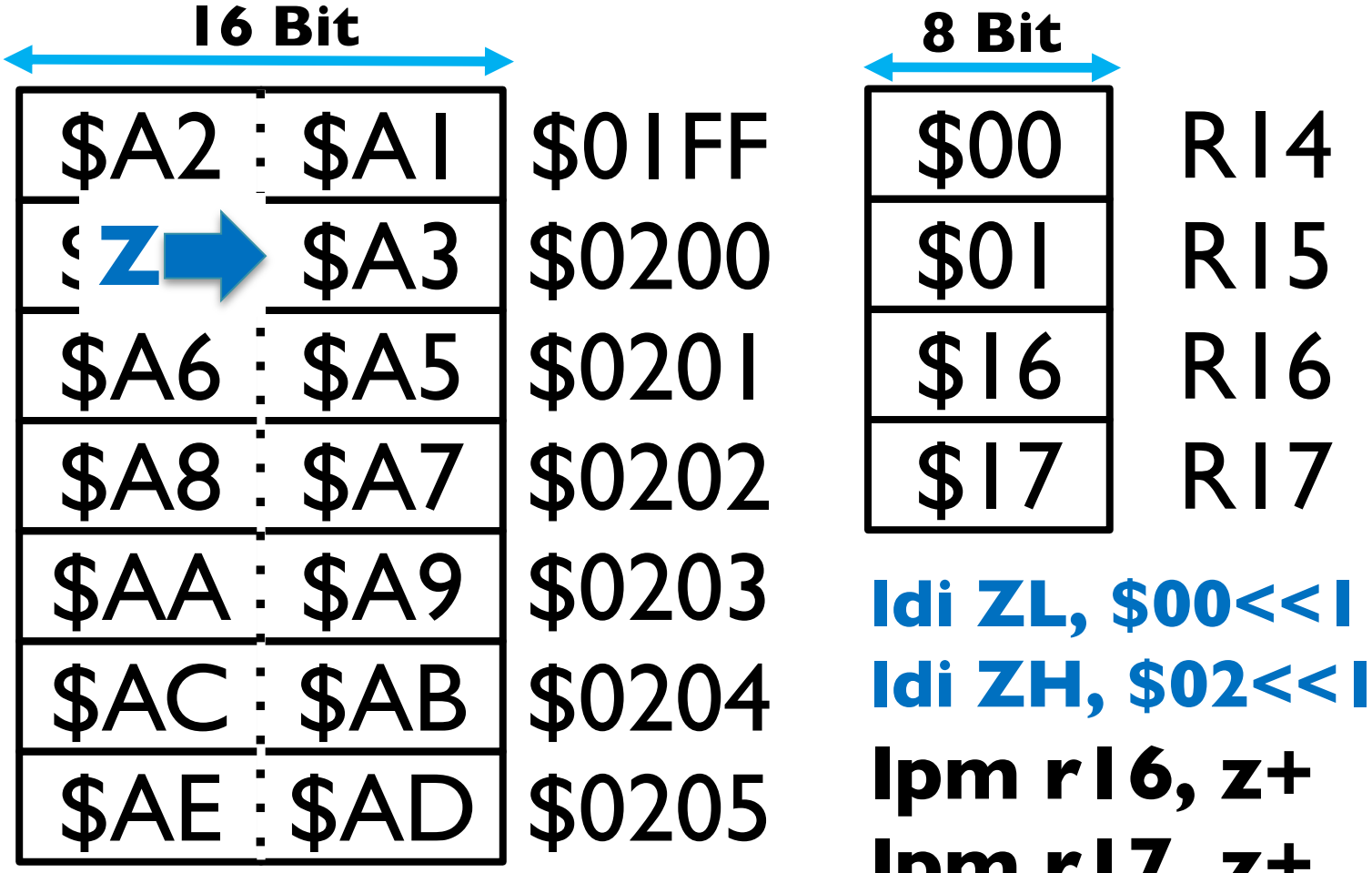
ldi ZH, ($02<<1)

or

ldi ZL, $00

ldi ZH, $04

Program Memory to Register



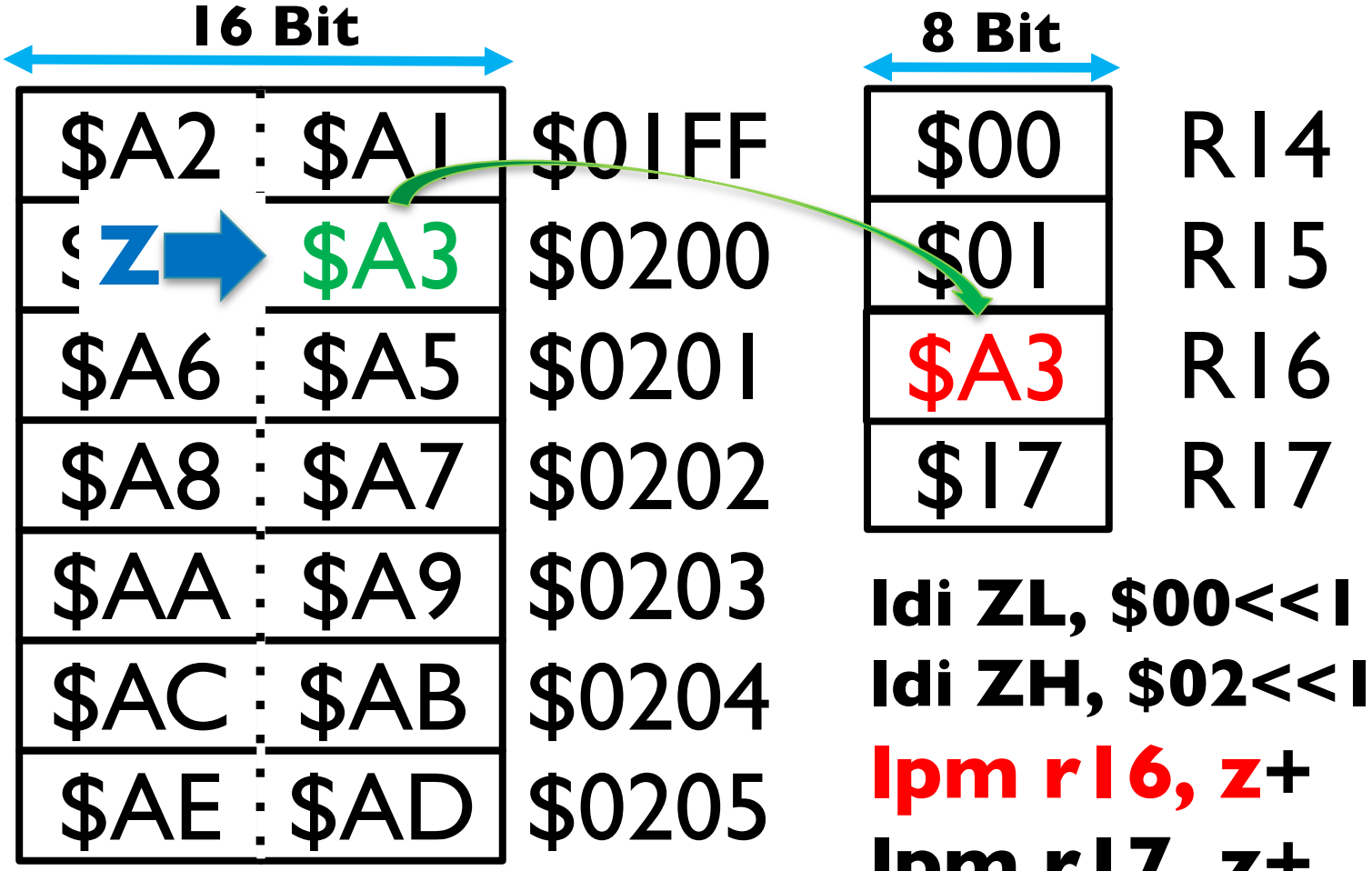
ldi ZL, $00<<1

ldi ZH, $02<<1

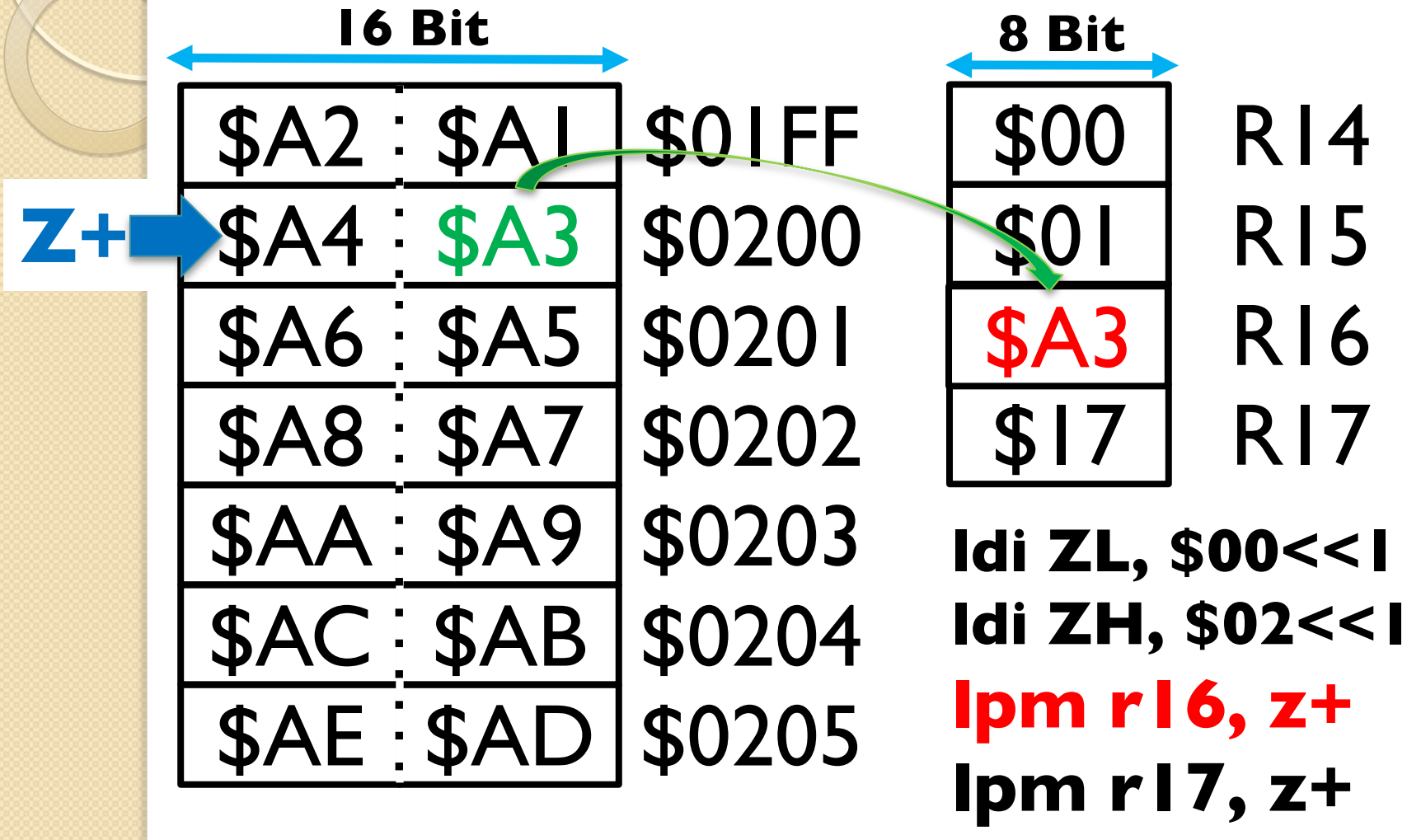
lpm r16, z+

lpm r17, z+

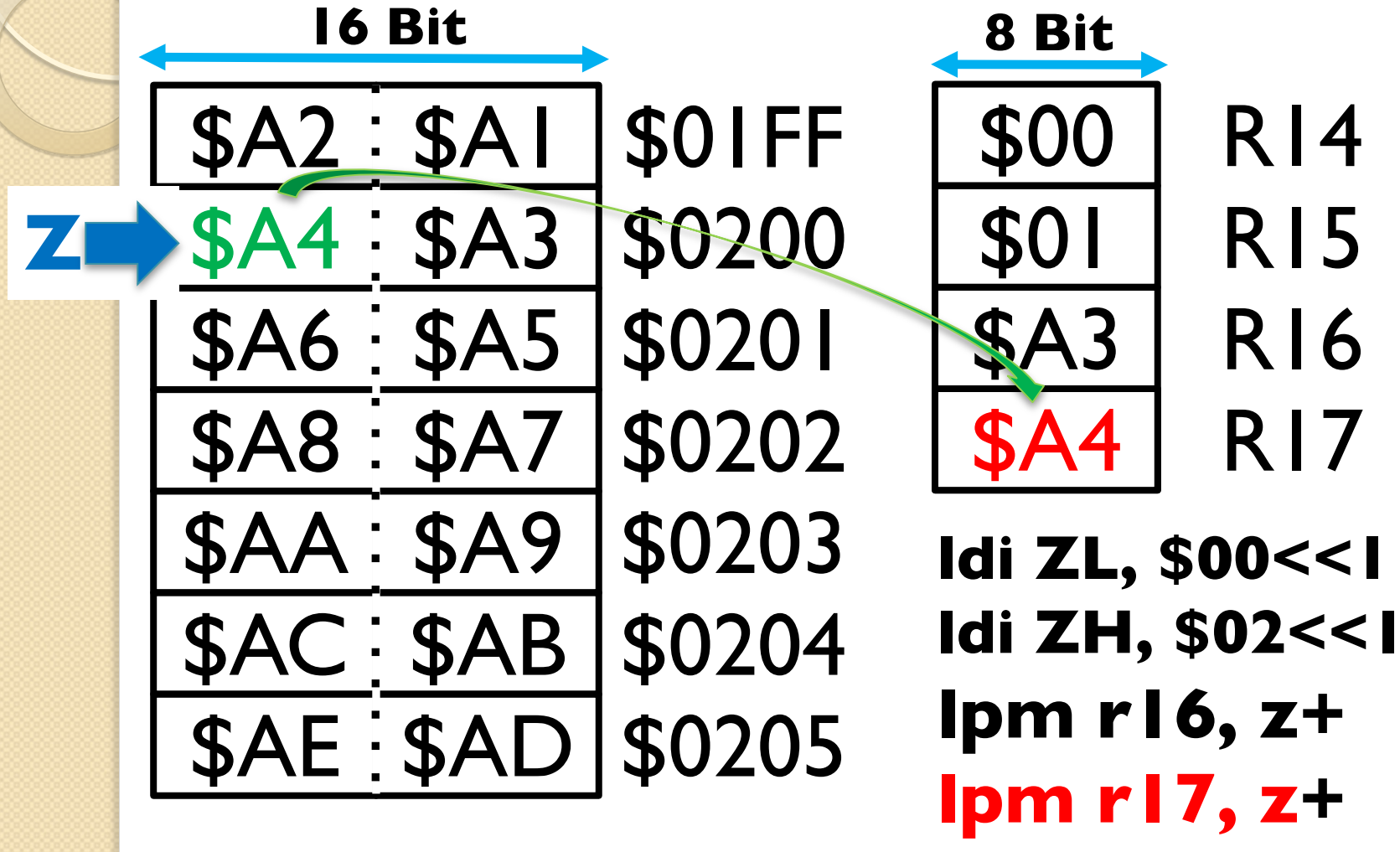
Program Memory to Register



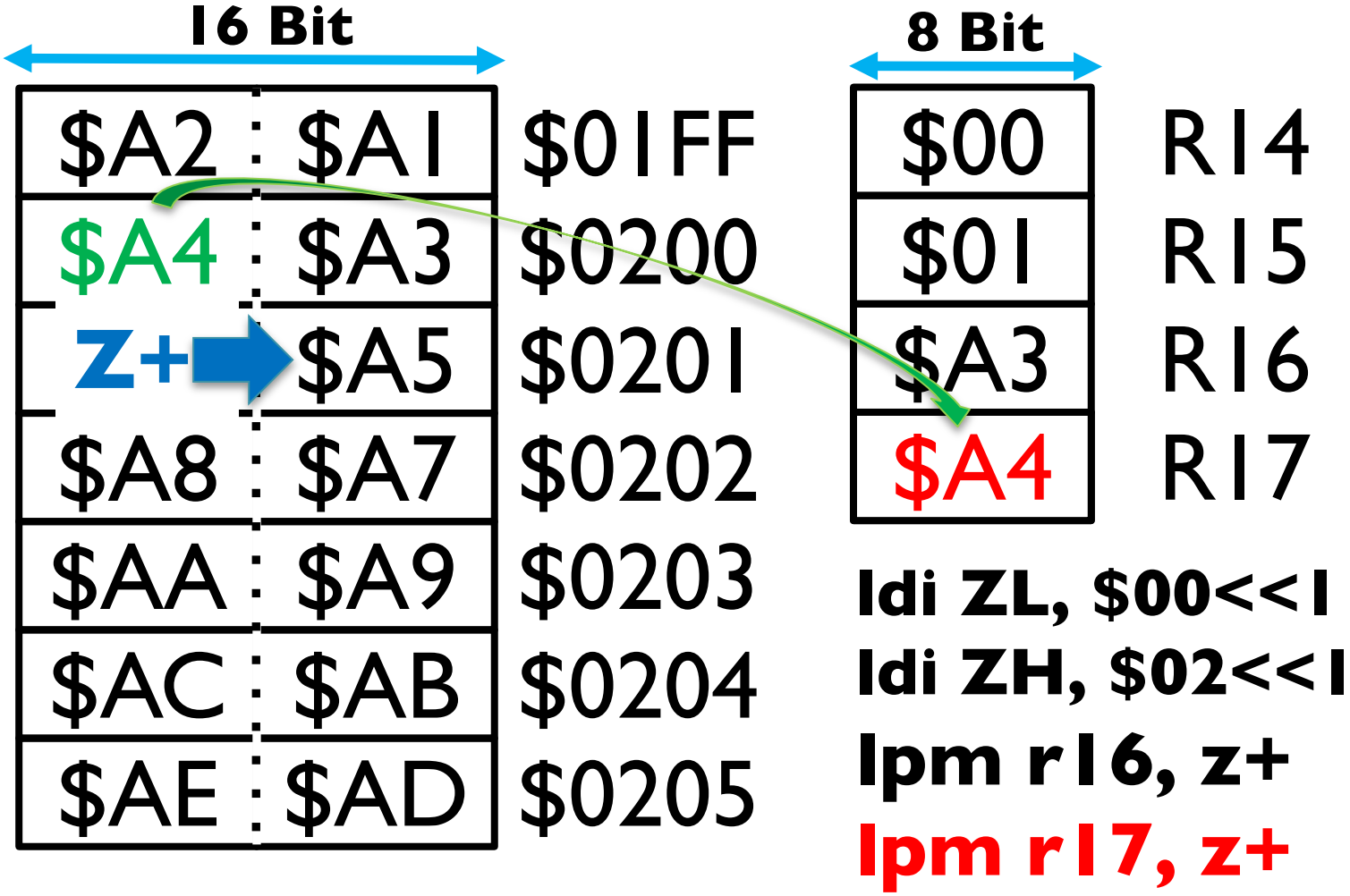
Program Memory to Register



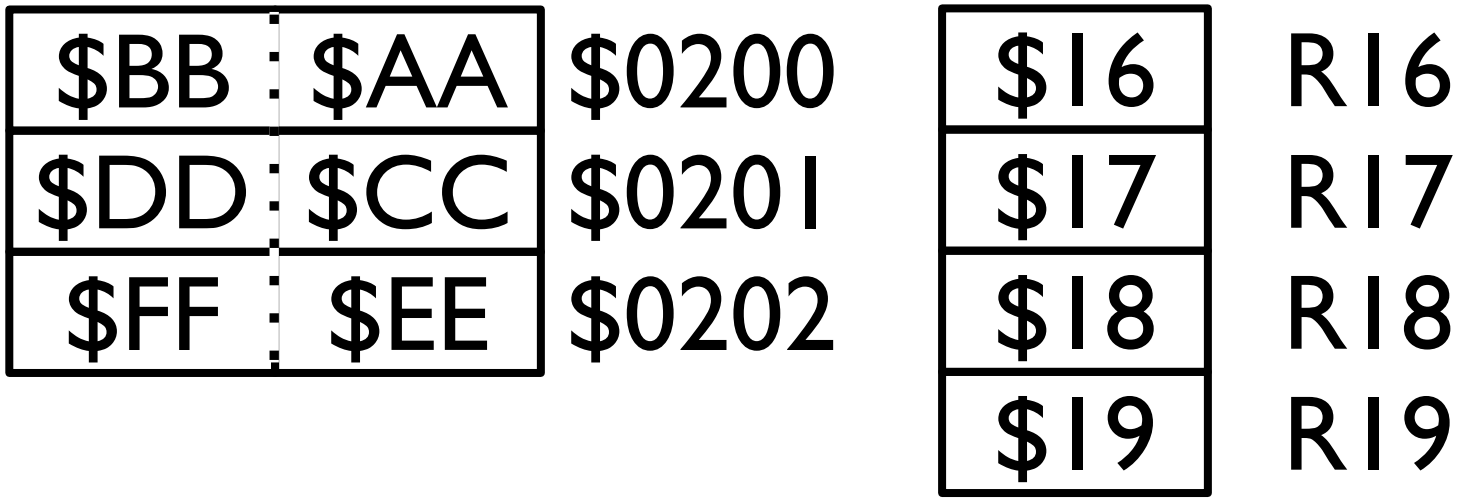
Program Memory to Register



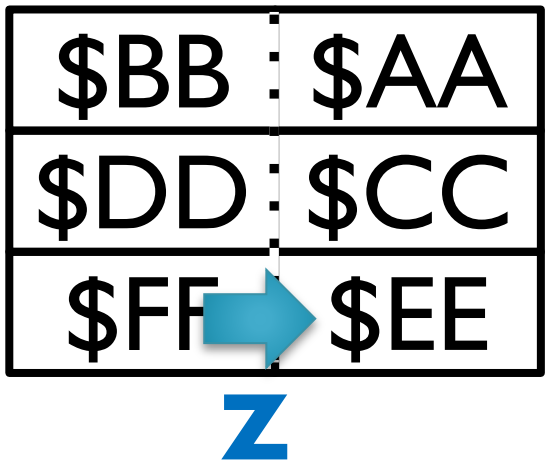
Program Memory to Register

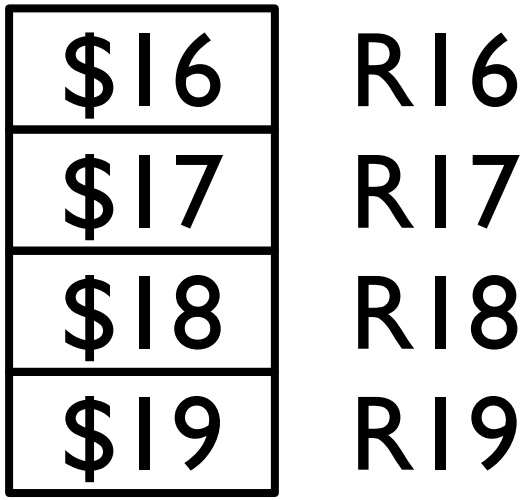


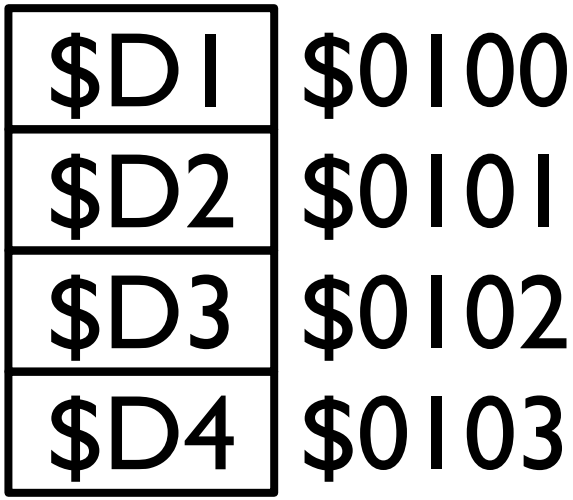
Program Memory to Data Memory



Program Memory to Data Memory

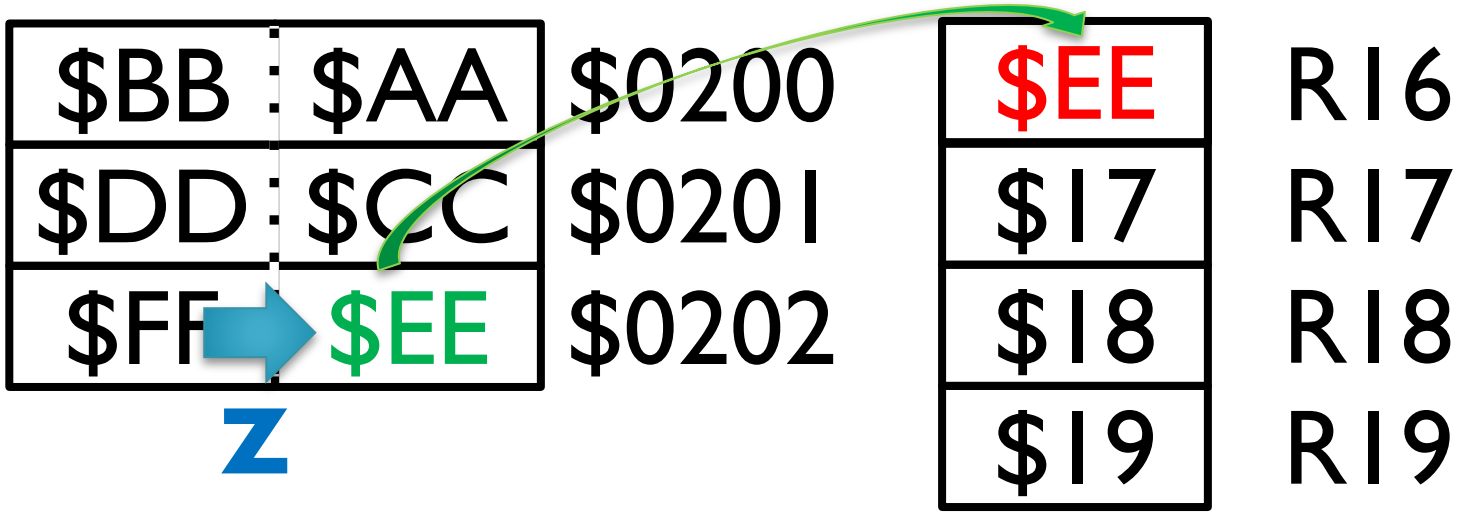







```
ldi ZL,$02<<1
ldi ZH, $02<<1
lpm r16, Z
```

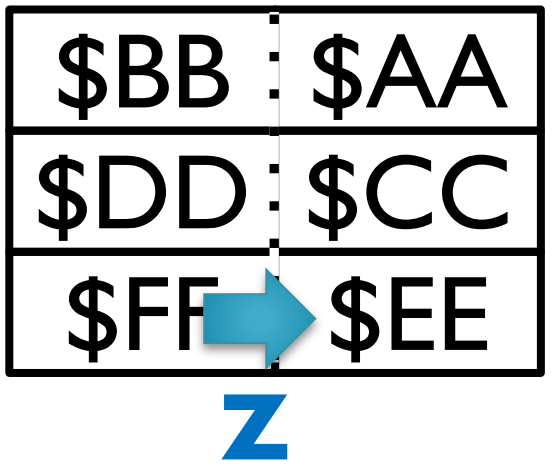
Program Memory to Data Memory

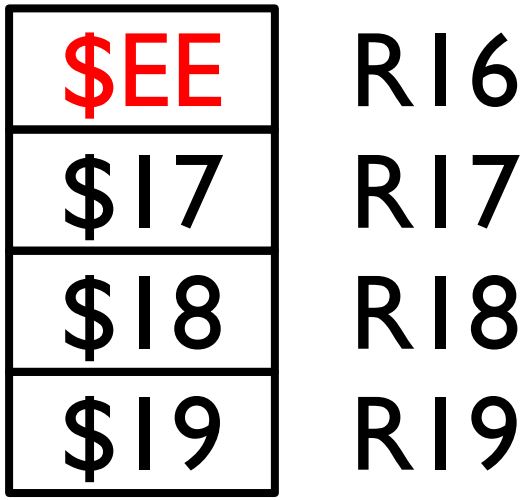


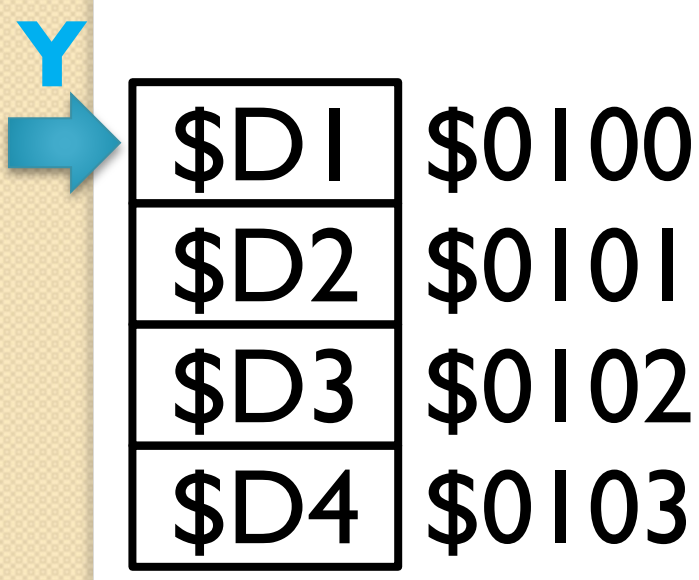
$D1	$0100
$D2	$0101
$D3	$0102
$D4	$0103

```
ldi ZL,$02<<1
ldi ZH, $02<<1
lpm r16, Z
```

Program Memory to Data Memory

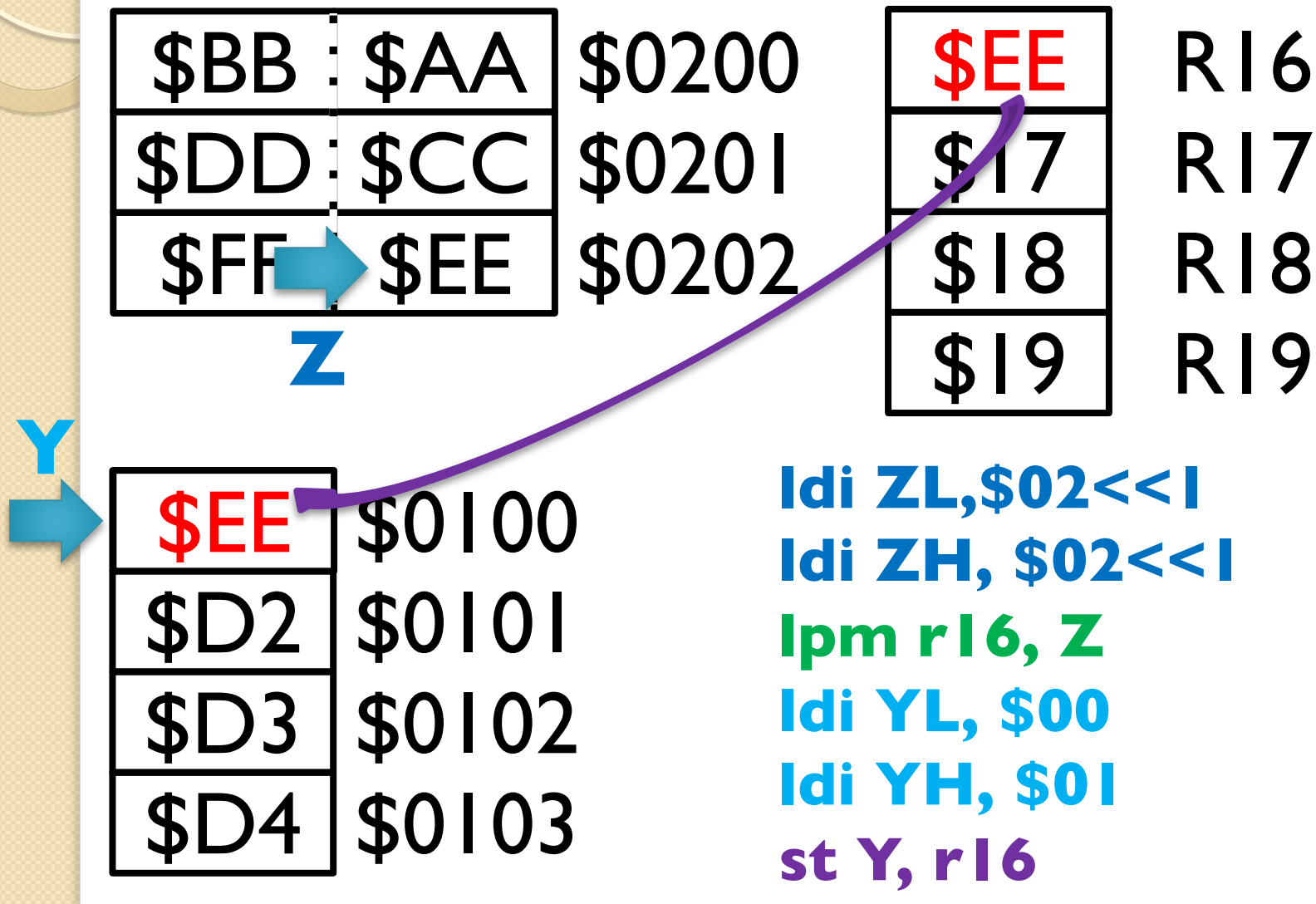







```
ldi ZL,$02<<1
ldi ZH, $02<<1
lpm r16, Z
ldi YL, $00
ldi YH, $01
```

Program Memory to Data Memory



LCD Display

- Address of Data memory
  - 1st line of LCD : $0100 - $010F
  - 2nd line of LCD : $0110 - $011F

- Stored Data in Program memory
  - STRING1_BEG: ; denotes the name of address
    .DB "Han Jang"
    STRING2_BEG:
    .DB "HelloWorld"

Text Scroll from left to right

- Refer to Data Transfer instructions in Ch.4: Atmel's AVR 8-bit Microcontroller, Part 1 – Assembly Programming

Check-off Lists

- Correct display functions accordingly with correction switch buttons.
- LCD Scrolling from left to right
- No dummy characters.
- Correct use of program memory.
- Correct use of data manipulation.

Questions?