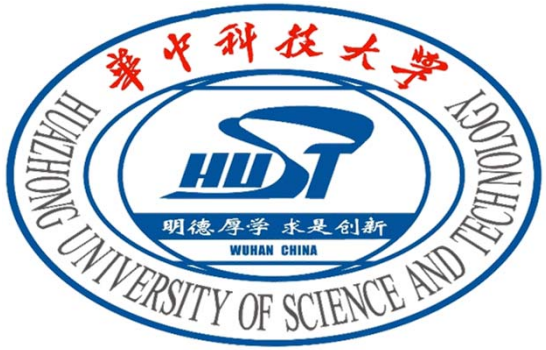
微机原理与接口技术

MIPS数据传输指令

华中科技大学　左冬红



数据传输指令

- 寄存器与存储器之间数据传输
- 通用寄存器与特殊寄存器之间数据传输
- 通用寄存器赋值指令

表述约定

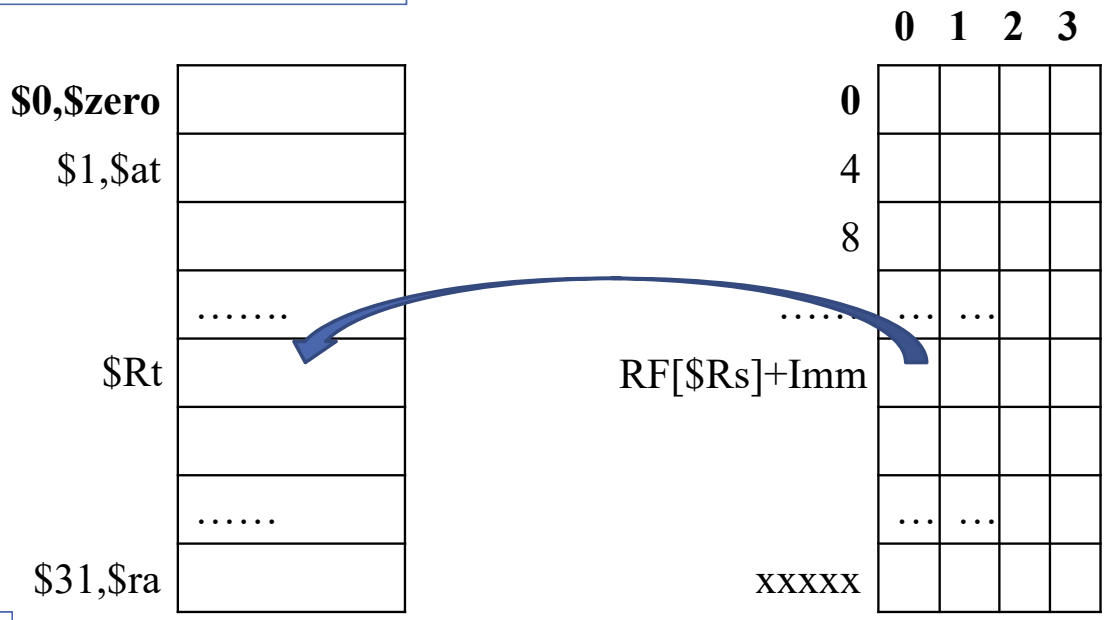
寄存器编号或寄存器名称		$17,$s1
寄存器的值	RF[$s1]	
存储单元地址	Imm($17),Imm($s1)	
存储的数据	mem[Imm+RF[$s1]]	
立即数	4，-12	Imm

存储器到寄存器数据传送

装载：load 简写l

指令格式　　lx $Rt, imm($Rs)　　x——w,h,hu,b,bu

指令功能



1个寄存器32位

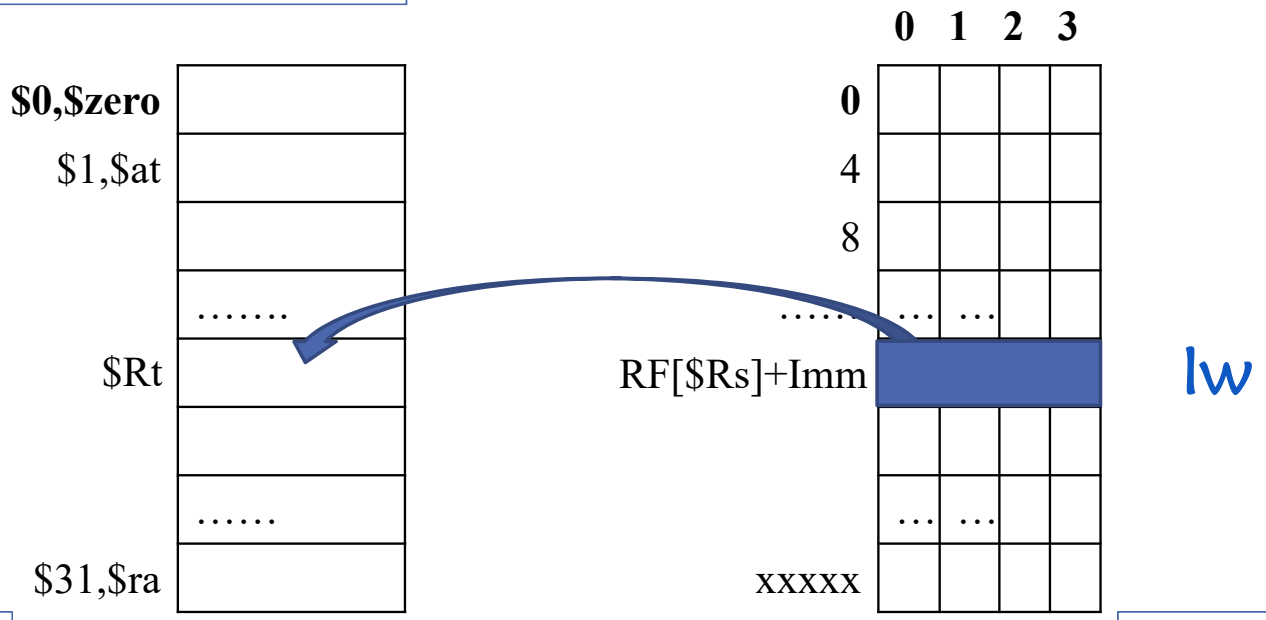
1个单元1B

存储器到寄存器数据传送

装载：load 简写l

指令格式　　lx $Rt, imm($Rs)

指令功能



1个寄存器32位

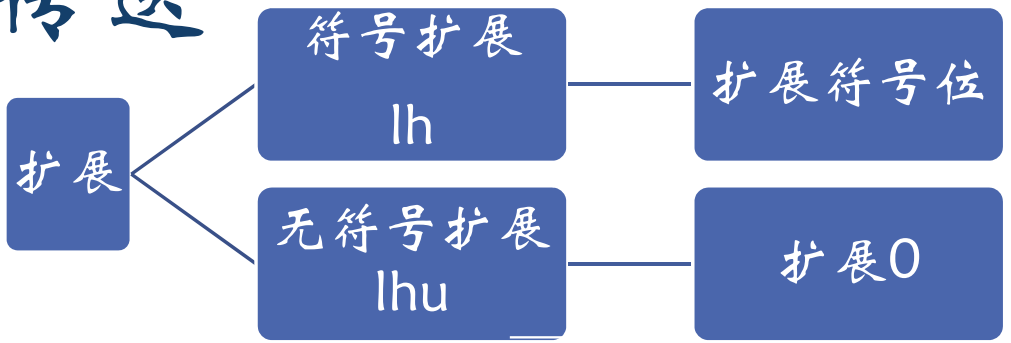
1个单元1B

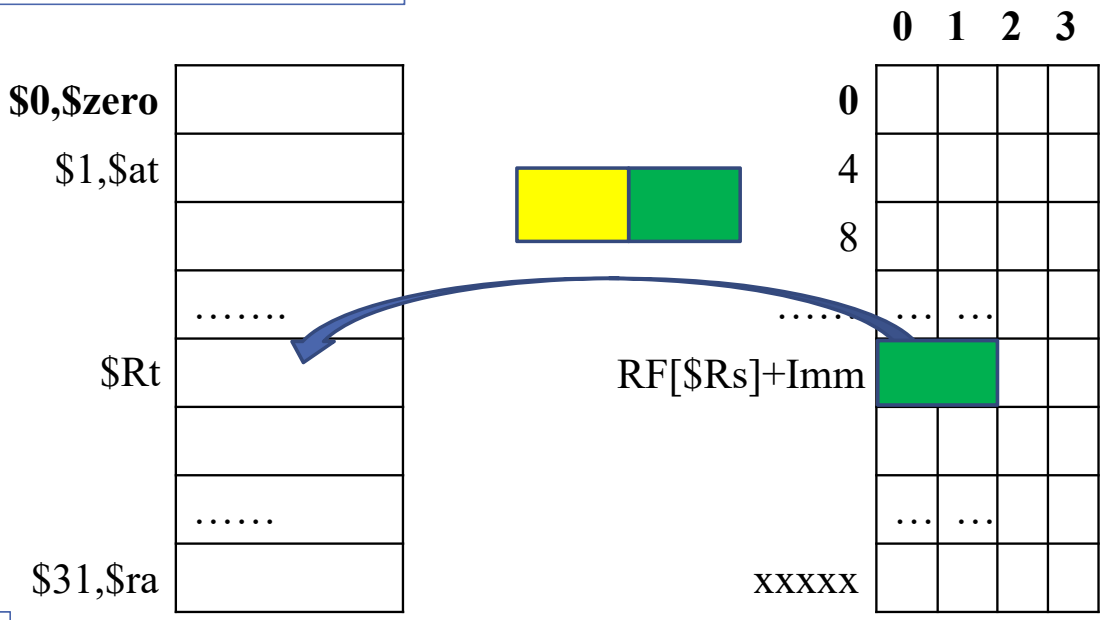
存储器到寄存器数据传送

装载：load 简写l

指令格式　　lx $Rt, imm($Rs)

指令功能





1个寄存器32位

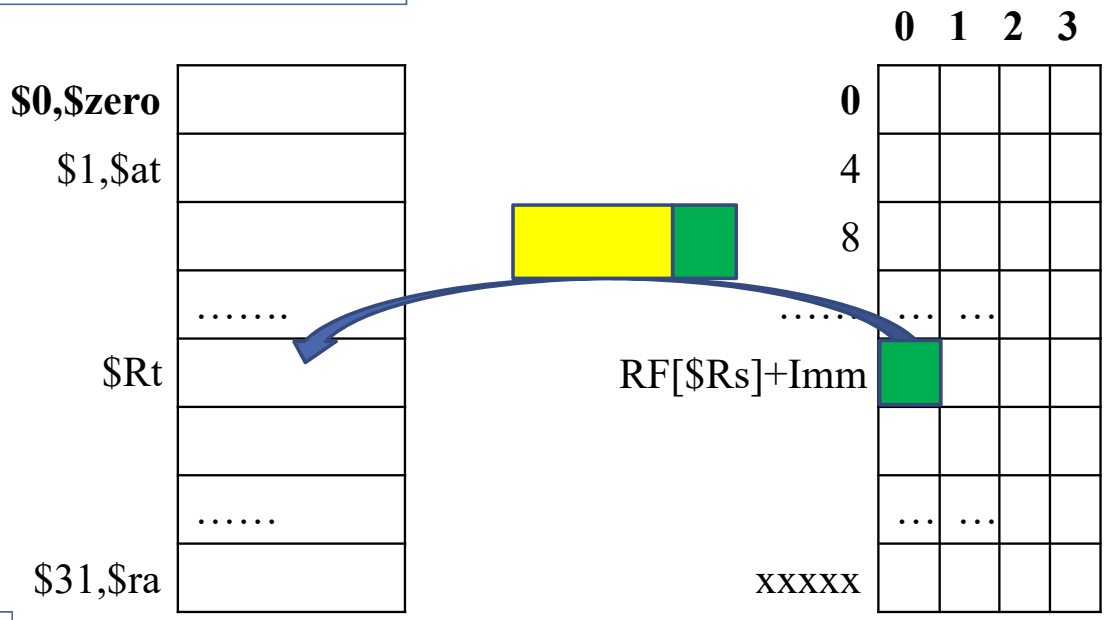
1个单元1B

存储器到寄存器数据传送

装载：load 简写l

指令格式　　lx $Rt, imm($Rs)

指令功能



lb,lbu

1个寄存器32位

1个单元1B

存储器到寄存器数据传送

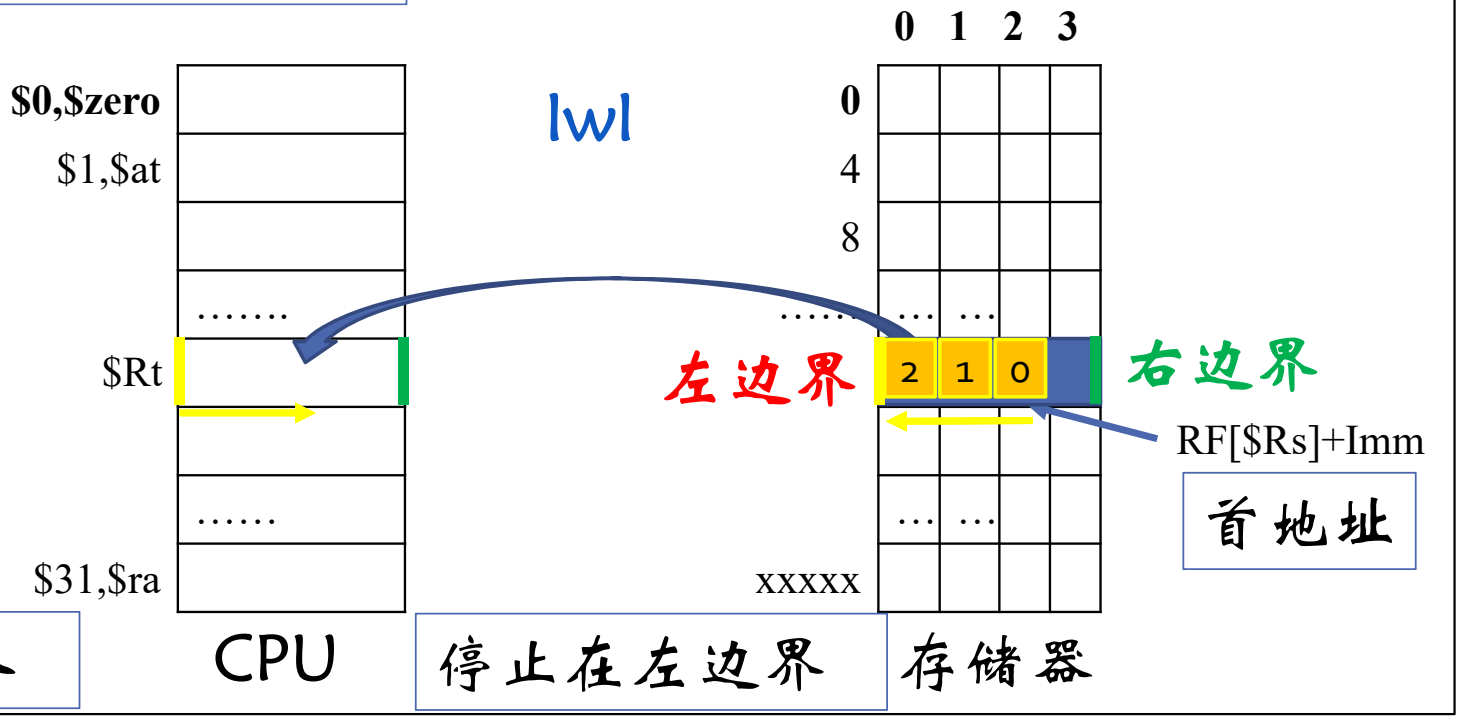
装载：load 简写l

指令格式　lx $Rt, imm($Rs)

指令功能

lwl，左边界对齐非规则字访问

lwr，右边界对齐非规则字访问



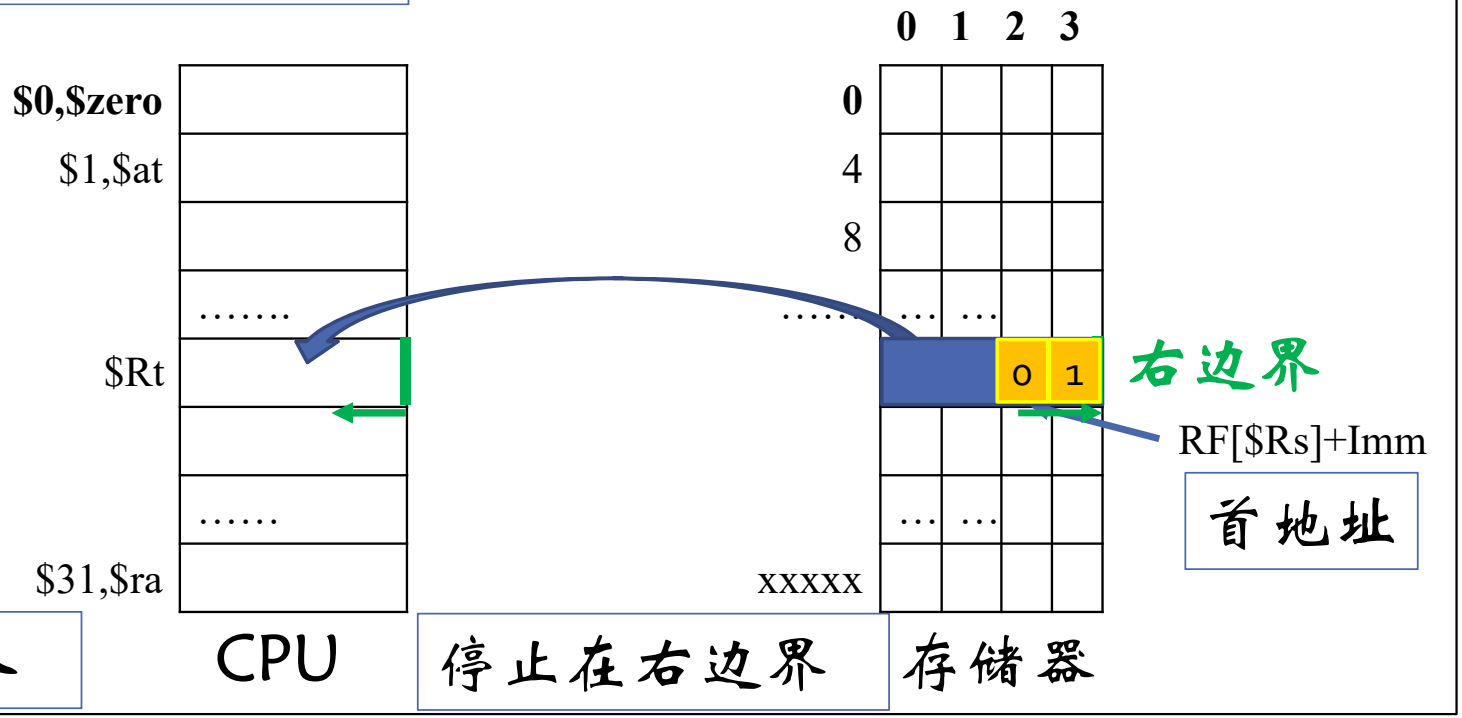
存储器到寄存器数据传送

装载：load 简写l

指令格式　　lx $Rt, imm($Rs)

lwr，右边界对齐非规则字访问

指令功能



从右边开始写入

停止在右边界

存储器到寄存器数据传输示例

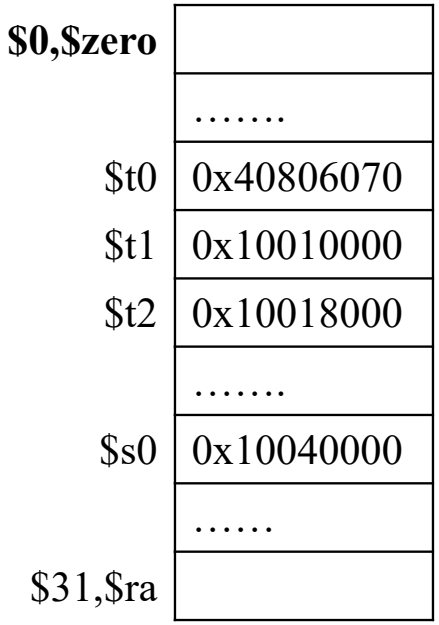
MIPS大字节序

lw $t0,0($s0)

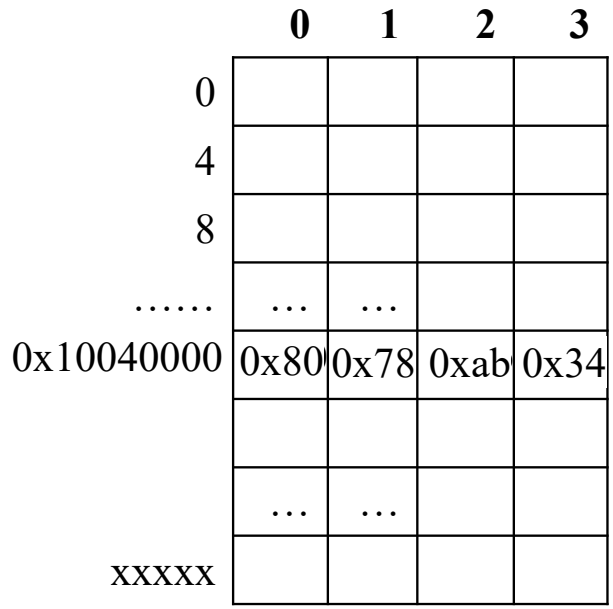
0x8078ab34

存储器地址

RF[$Rs]+Imm
=0x10040000+0
=0x10040000



CPU

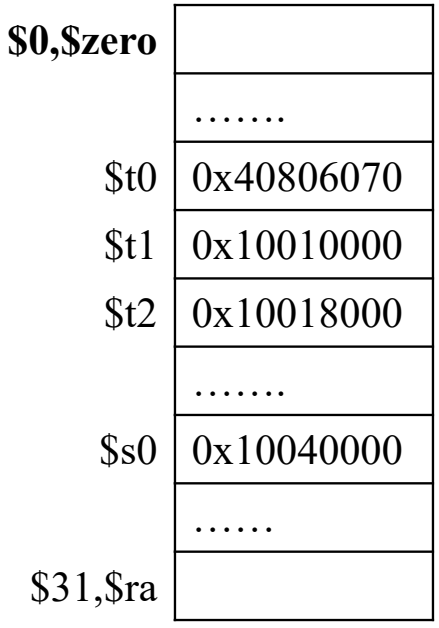


存储器

存储器到寄存器数据传输示例

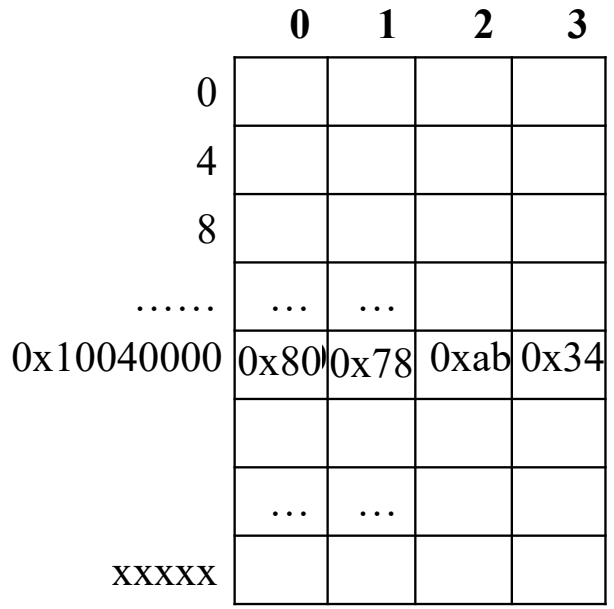
lh $t0,0($s0)

lhu $t0,0($s0)



CPU

0xffff8078



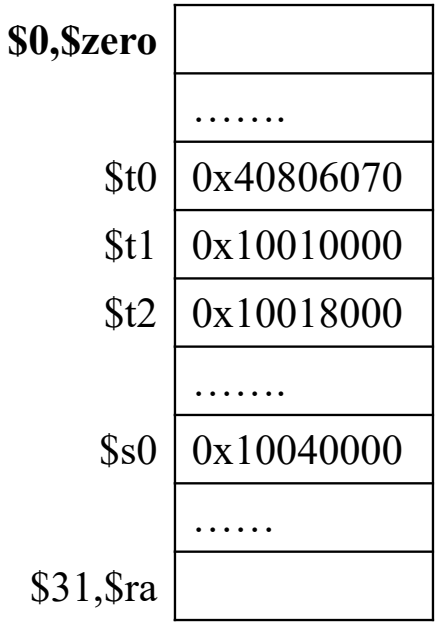
0x00008078

存储器

存储器到寄存器数据传输示例

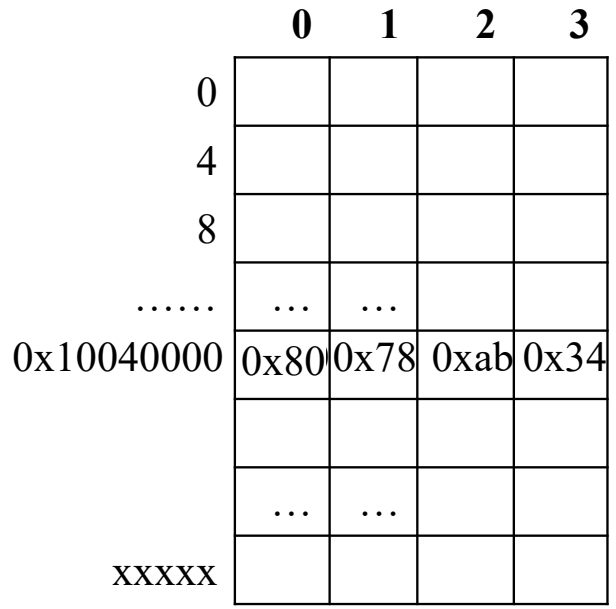
lb $t0,0($s0)

lbu $t0,0($s0)



CPU

0xffffff80



0x00000080

存储器

存储器到寄存器数据传输示例

lwl $t0,2($s0)

存储器首地址

RF[$Rs]+Imm
=0x10040000+2
=0x10040002

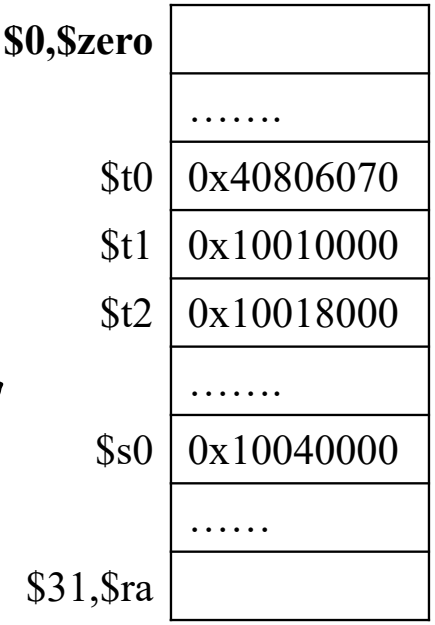
lwr $t0,-1($s0)

存储器首地址

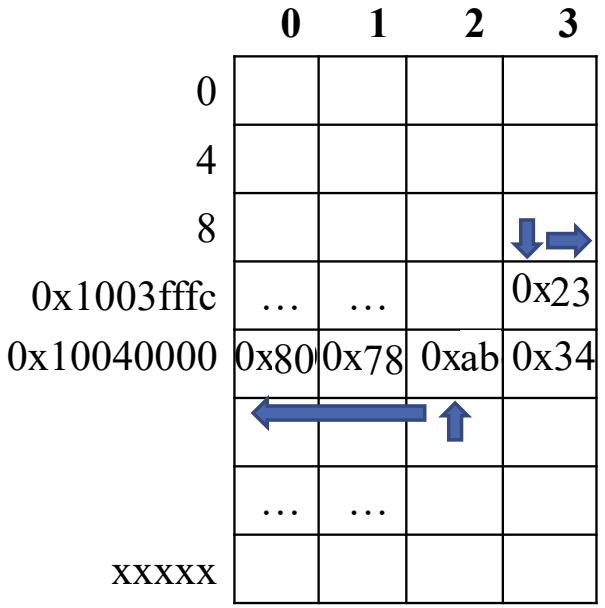
RF[$Rs]+Imm
=0x10040000+0xffffffff
=0x1003ffff

-1的补码

Imm在机器指令中为16位符号数补码，扩展为32位之后再参与运算



CPU



存储器

存储器到寄存器数据传输示例

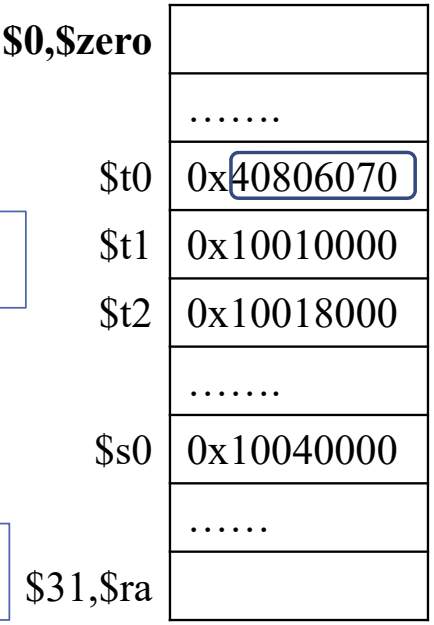
lwl $t0,2($s0)

lwr $t0,-1($s0)

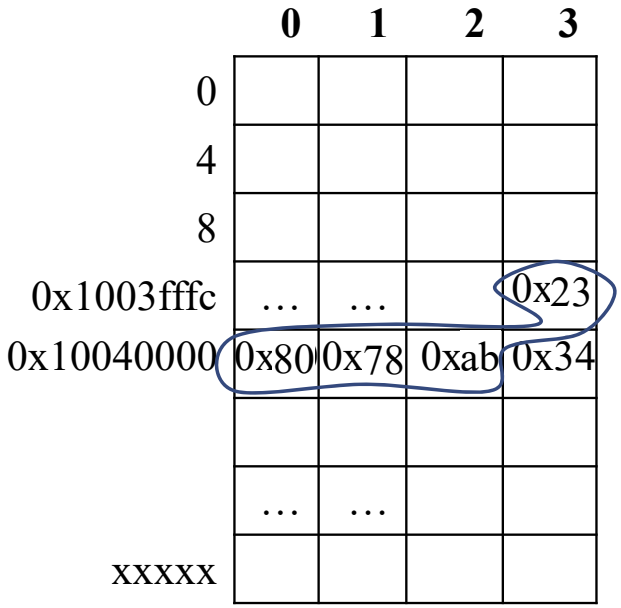
首地址是否边界对齐？

什么字节序？

功能：非规则字数据读取



CPU



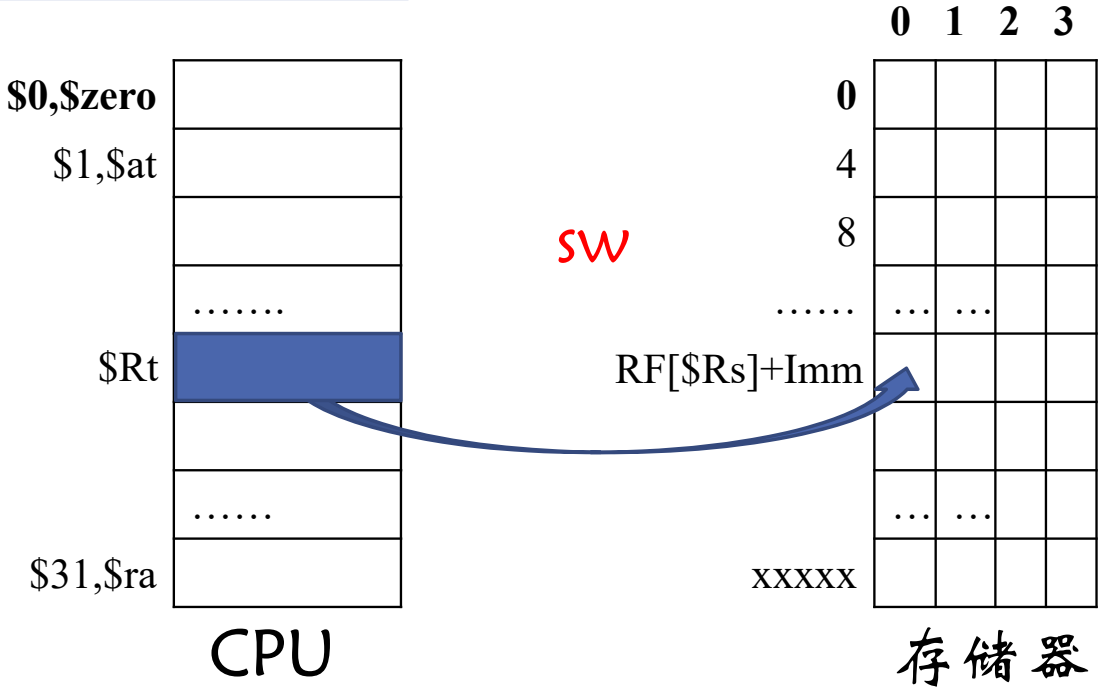
存储器

寄存器到存储器数据传输

存储：store 简写s

指令格式　　sx $Rt, imm($Rs)　　x——w,h,b

指令功能



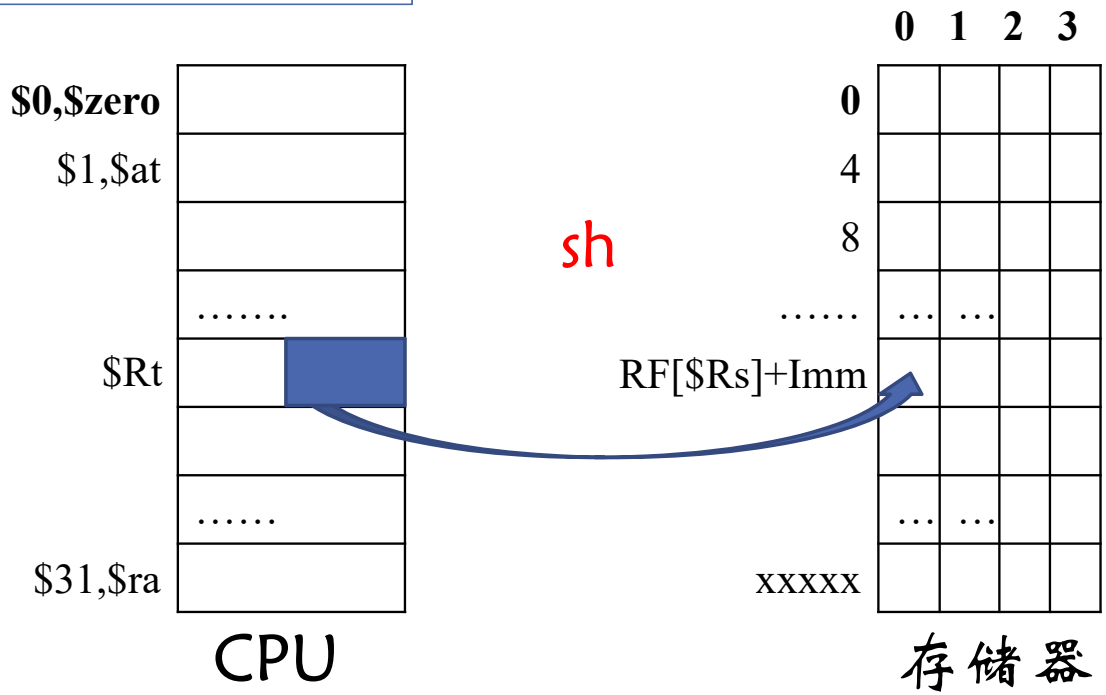
寄存器到存储器数据传输

存储：store 简写s

指令格式　　sx $Rt, imm($Rs)　　x——w,h,b

指令功能

截断，存储低半字



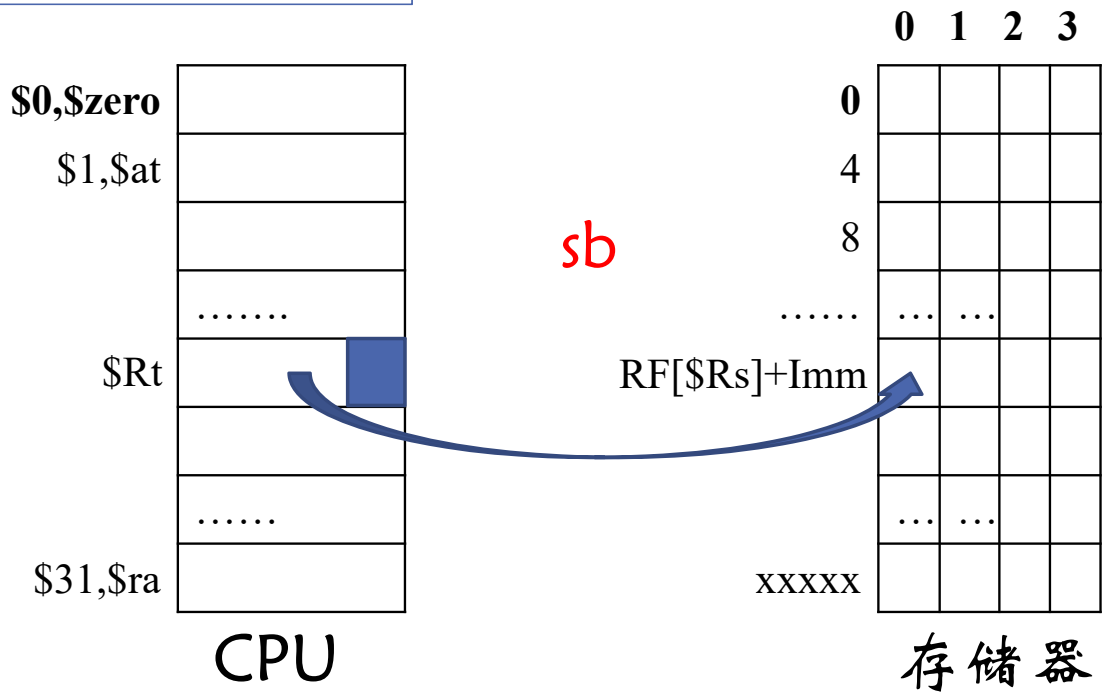
寄存器到存储器数据传输

存储：store 简写s

指令格式　　sx $Rt, imm($Rs)　　x——w,h,b

指令功能

截断，存储低字节

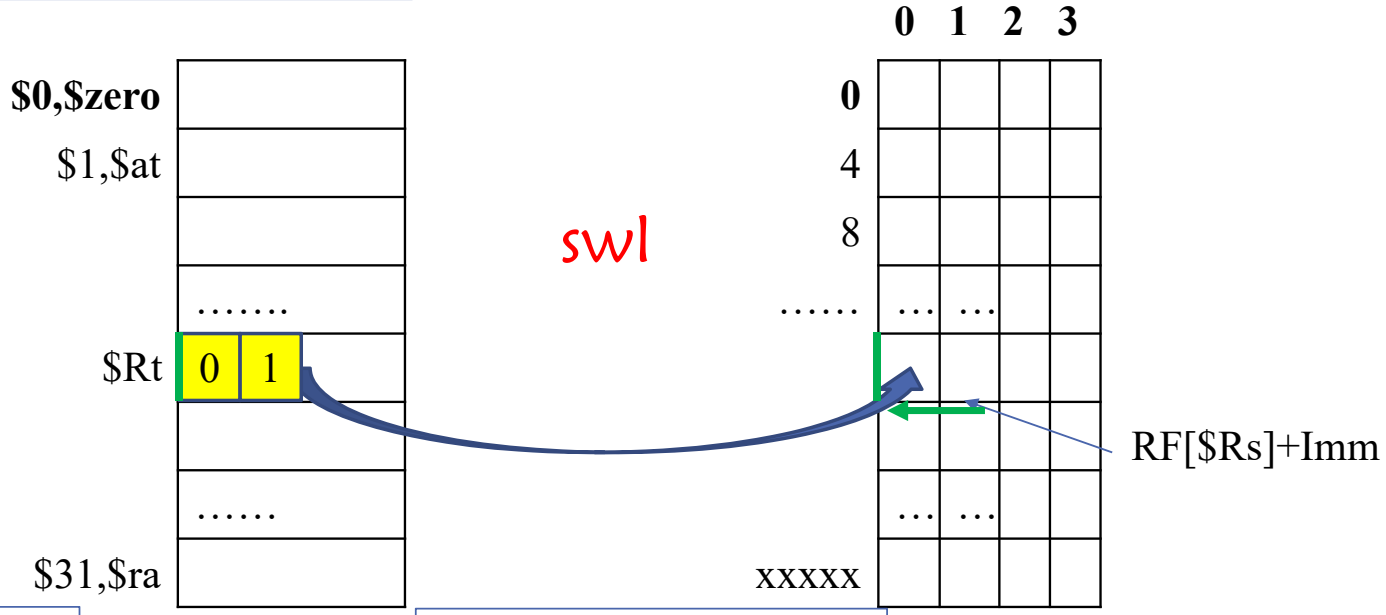


寄存器到存储器数据传输

存储：store 简写s

指令格式　　sx $Rt, imm($Rs)　　x——w,h,b

指令功能



从左边开始存储

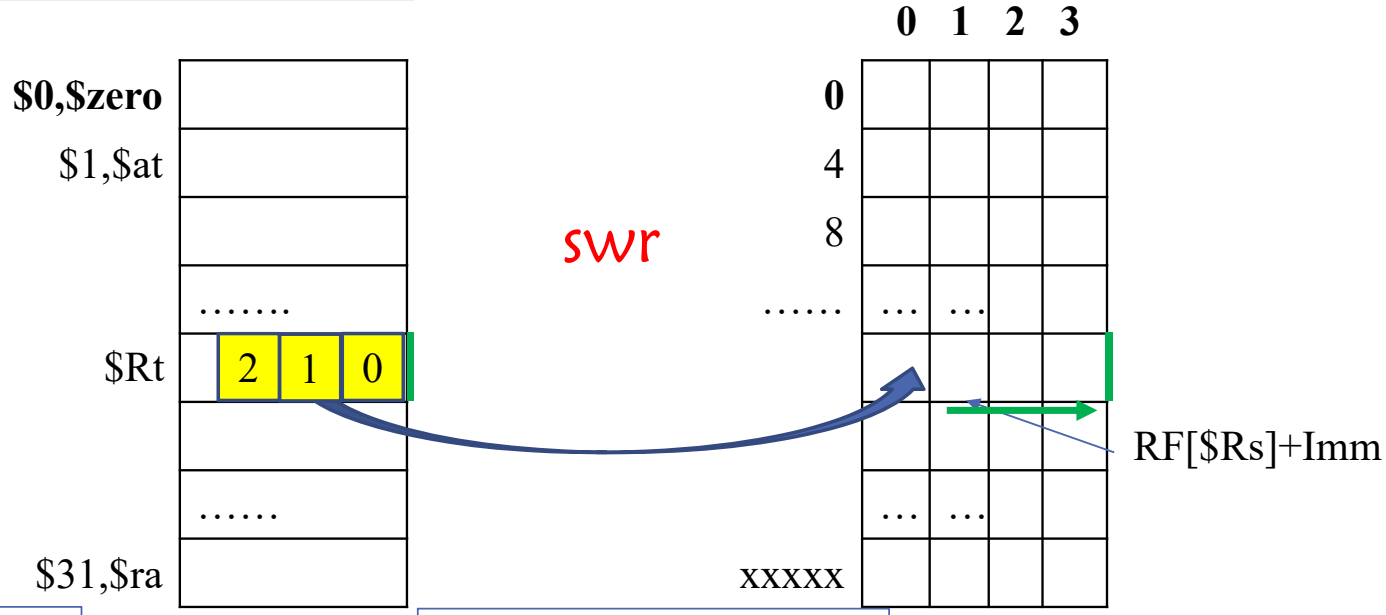
停止在左边界

寄存器到存储器数据传输

存储：store 简写s

指令格式　　sx $Rt, imm($Rs)　　x——w,h,b

指令功能



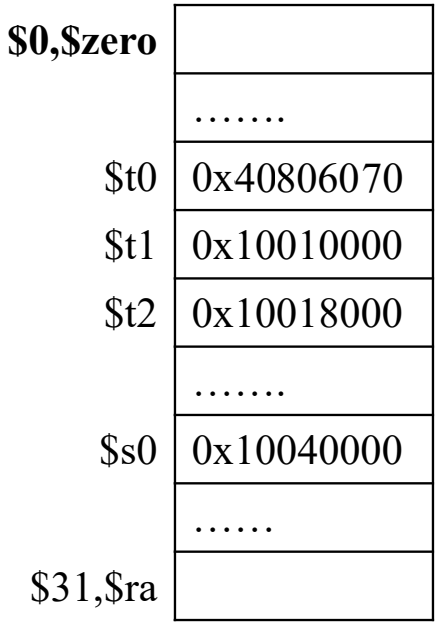
从右边开始存储　　停止在右边界

寄存器到存储器数据传输示例

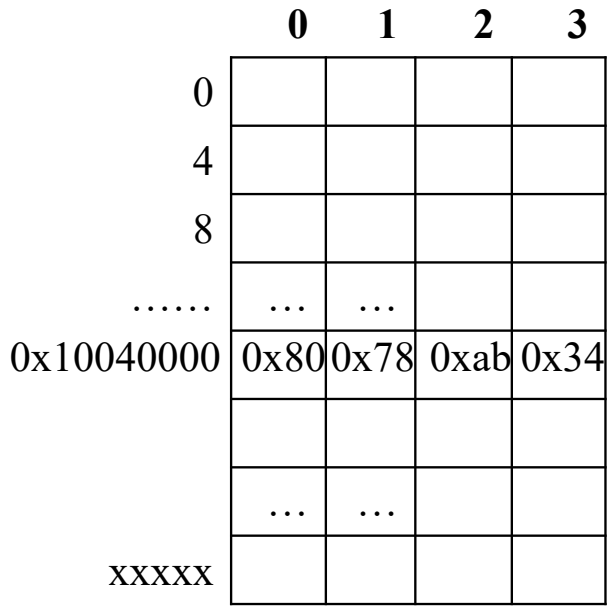
sw $t0,0($s0)

存储器地址

RF[$Rs]+Imm
=0x10040000+0
=0x10040000



CPU



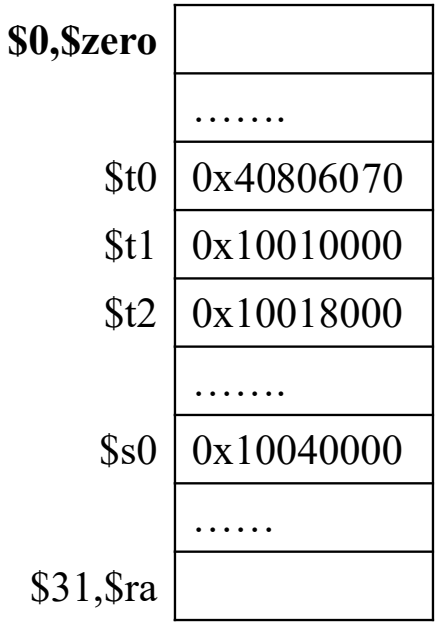
存储器

寄存器到存储器数据传输示例

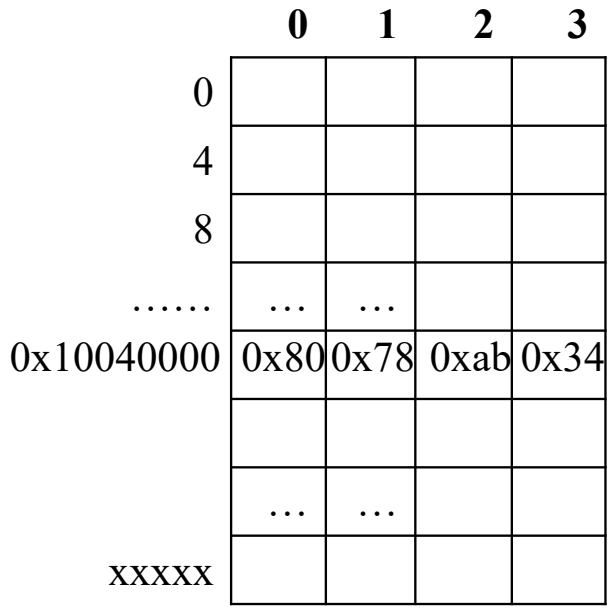
sh $t0,0($s0)

存储器地址

RF[$Rs]+Imm
=0x10040000+0
=0x10040000



CPU



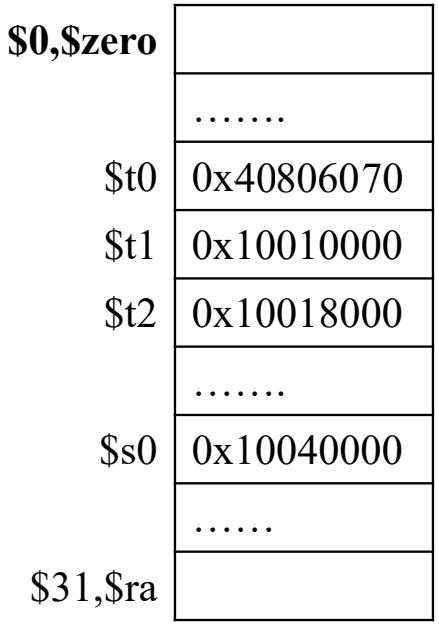
存储器

寄存器到存储器数据传输示例

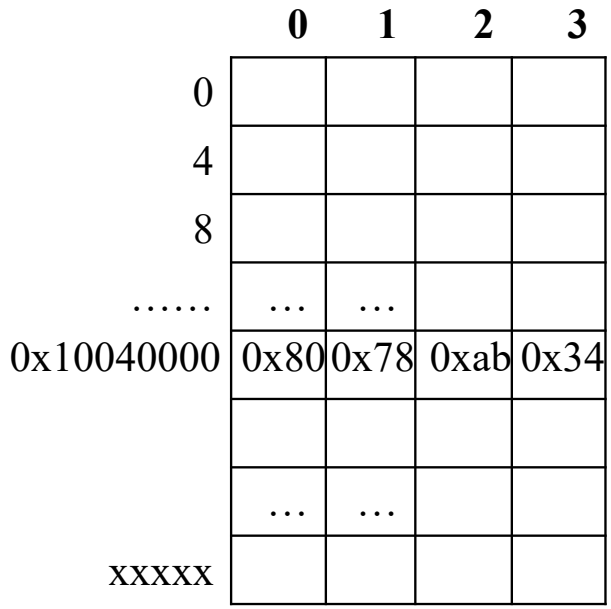
sb $t0,0($s0)

存储器地址

RF[$Rs]+Imm
=0x10040000+0
=0x10040000



CPU



存储器

寄存器到存储器数据传输示例

swl $t0,1($s0)

存储器地址

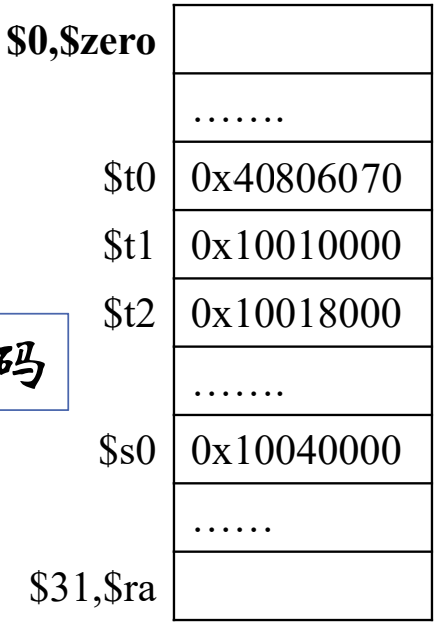
RF[$Rs]+Imm
=0x10040000+1
=0x10040001

swr $t0,-2($s0)

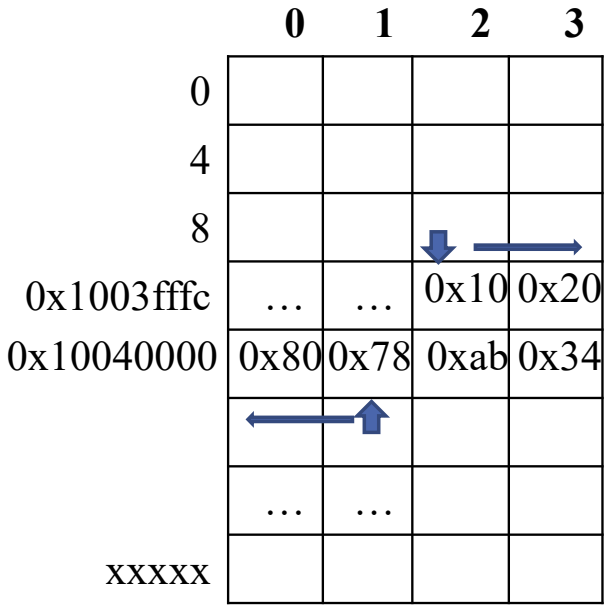
存储器地址

-2的补码

RF[$Rs]+Imm
=0x10040000+0xfffffffe
=0x1003fffe



CPU



存储器

特殊寄存器与通用寄存器之间数据互传

特殊寄存器:hi、lo

保存乘除法运算结果：
乘法：hi保存高32位、lo保存低32位
除法：hi保存余数、 lo保存商

指令格式	指令功能
mfhi $Rd	RF[$Rd]=RF[hi]
mflo $Rd	RF[$Rd]=RF[lo]
mthi $Rs	RF[hi]=RF[$Rs]
mtlo $Rs	RF[lo]=RF[$Rs]

寄存器赋初值

指令格式	lui $Rt,Imm
指令功能	RF($Rt)={Imm,16'h0}

通常与逻辑运算指令ori一起实现给寄存器赋32位初值

小结

- 数据传送指令
  - 存储器与寄存器之间数据传输有多种类型
    - 存储器数据传输到寄存器若需位扩展
      - 符号扩展
      - 无符号扩展
    - 寄存器传输到存储器只需截断
    - 非规则字存\取指令必须成对使用
  - hi\lo寄存器与通用寄存器之间的数据传输
    - 指令中仅一个操作数$Rd或$Rs, hi,lo隐含在操作码中
  - 寄存器赋初值，数据传送lui指令仅实现高16位赋值

下一讲：运算类指令