

# 中国科学技术大学

## 2016-2017 学年第二学期考试试卷

考试科目：计算机组成原理

得分：

院系：

姓名：

学号：

### 一、简单题 (40 分=5 分\*8)

现代计算机优化冯诺依曼结构

现代计算机以存储器为中心，而冯诺依曼结构以运算器为中心。

指令类型&寻址方式

中断系统组成

#### 0、中断机构组成



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##### 1. CPU中断禁止/允许：IF@PSW

PSW即程序状态字（程序状态寄存器），Program Status Word。

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
				OF	DF	IF	TF	SF	ZF		AF		PF		CF

##### 2. CPU中断请求/响应控制：INTR、INTA

##### 3. 中断响应/返回：中断隐指令

##### 4. 断点/现场保存：MEM (stack)

##### 5. 中断服务

✓中断源识别/判优：中断控制器

✓ISR入口：向量方式、非向量方式



嵌入式系统实验室  
EMBEDDED SYSTEM LABORATORY  
Beihua Institute for Advanced Study of USTC

一个请求源对应一个 INTR 中断请求标记触发器

①保护程序断点②寻找服务程序入口地址③关中断

通过中断控制器识别和判优中断源。

中断隐指令保护断点、中断服务程序 ISR 保存和恢复寄存器内容。

## 总线同步异步半同步的读写时序图

### 同步/异步传送例题

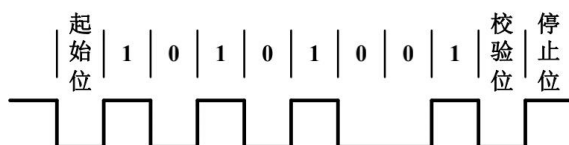


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- 例 画图说明异步串行传送方式发送十六进制数据95H。要求字符格式为：1位起始位、8位数据位、1位偶校验位、1位终止位

解：95H = 1001 0101B

异步串行传送在起始位后传输数据位的最低位，数据位的最高位之后传输校验位，最后终止位。95H的偶校验位为0，波形图如下：



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## 快表慢表作用

快表:

### ✓为什么要使用快表?

- 页表一般保存在主存中，即使逻辑页已经在主存中，也至少需要访问两次物理主存才能完成需要的访存操作，这使得虚存的存取时间加倍

### ✓为减少访存次数，对页表进行二级缓存，将页表中最活跃的部分存放在高速存储器（如Cache）中，组成快表TLB

- TLB：专用于页表缓存的高速存储部件
- 保存在主存中的完整页表称为慢表

慢表:

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示意图表示指令周期、机器周期、访存周期、总线周期、DMA 周期之间关系

定长机器周期：机器周期=时钟周期

不定长指令周期：分别为 3、4、5 个机器周期

总线周期指完成一次总线操作的时间

DMA 周期挪用（周期窃取）

DMA 控制器与主存间传送一个数据时，占用（窃取）一个或多个 CPU 周期。即 CPU 暂停工作一个周期，然后继续执行程序。

CPU 设计步骤

指令集、单周期、多周期、流水线、数据通路、控制信号、状态机

PC，手机区别

<https://www.jianshu.com/p/a227659401c4>

二、综合题（60 分）

~~1.用 4 位 booth 算法计算  $3*4$  (7 分)~~

2.cache 直接映射, 判断 hit/miss (8 分)

3.disk/DMA controller,作用, 工作方式 (7 分)

4.计算存储器单个芯片全部以及总容量, 位数 (8 分)

5.abs instruction : why mips don't have?, if have, what format?

abs instruction: 绝对值指令

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This is how the C library function `abs()` does it in assembly without branching:

$$\text{abs}(x) = (x \text{ XOR } y) - y$$

where  $y = x \gg 31$  (assuming 32-bit input), and  $\gg$  is arithmetic right shift operator.

**Explanation of the above formula:** We want to generate 2's complement of negative  $x$  only.

$$y = 0xFFFF, \text{ if } x \text{ is negative}$$
$$0x0000, \text{ if } x \text{ is positive}$$

So when  $x$  is positive  $x \text{ XOR } 0x0000$  is equal to  $x$ . And when  $x$  is negative  $x \text{ XOR } 0xFFFF$  is equal to 1's complement of  $x$ . Now we just need to add 1 to get its 2's complement which is what expression  $-y$  is doing. Because  $0xFFFF$  is -1 in decimal.

**Let's look at assembly generated for following code by gcc (4.6.3 on my machine):**

C code:

```
main()
{
    int x;
    int output = abs(x);
}
```

gcc 4.6.3 generated assembly snippet (AT&T syntax), with my comments:

```
movl    -8(%rbp), %eax    # -8(%rbp) is memory for x on stack
sarl    $31, %eax         # shift arithmetic right: x >> 31, eax now represents y
movl    %eax, %edx        #
xorl    -8(%rbp), %edx     # %edx = x XOR y
movl    %edx, -4(%rbp)     # -4(%rbp) is memory for output on stack
subl    %eax, -4(%rbp)     # (x XOR y) - y
```

**BONUS (from Hacker's Delight):** If you have a fast multiply by +1 and -1, the following will give you `abs(x)`:

```
if (x < 0) {
```

0 GCD program x86 assembly language

**Related**

332

How can I determine if a .NET assembly was built for x86 or x64?

483

When is assembly faster than C?

247

What does multicore assembly language look like?

650

How do I achieve the theoretical maximum of 4 FLOPs per cycle?

1444

Replacing a 32-bit loop counter with 64-bit introduces crazy performance deviations with `_mm_popcnt_u64` on Intel CPUs

842

C++ code for testing the Collatz conjecture faster than hand-written assembly - why?

**Hot Network Questions**

How do I print the last sequence of lines between a start and an end pattern?

Avoid walking into a rectangle

Encouraging a diverse pool of applicants for a postdoctoral position?

Can a warlock with Repelling Blast use Eldritch Blast to push 10 feet a creature of any size?

I feel like my DMing skills are making the game less enjoyable

How to share solutions in a way they won't get uploaded

How many different versions of cover art has Frank Herbert's Dune had since 1965?

Why aren't garage door sensors retroflective on one end?

Does tire pressure affect rolling resistance on pavement?

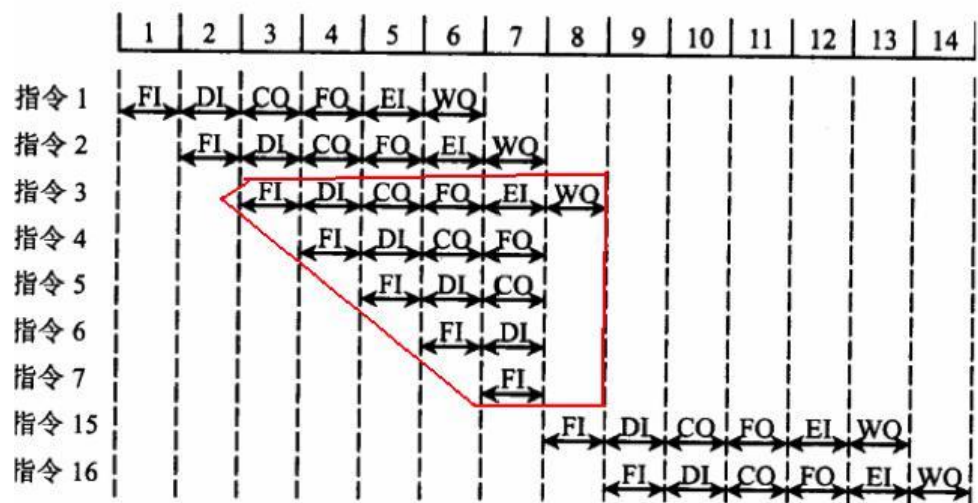
How to draw alpha helices in Chemdraw?

How do I engage someone who is playing his character poorly?

Why is "TZ=Asia/Kolkata date --date="1/1/1906" invalid?

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6.pipeline (10 分)



跳转指令是？

指令 3

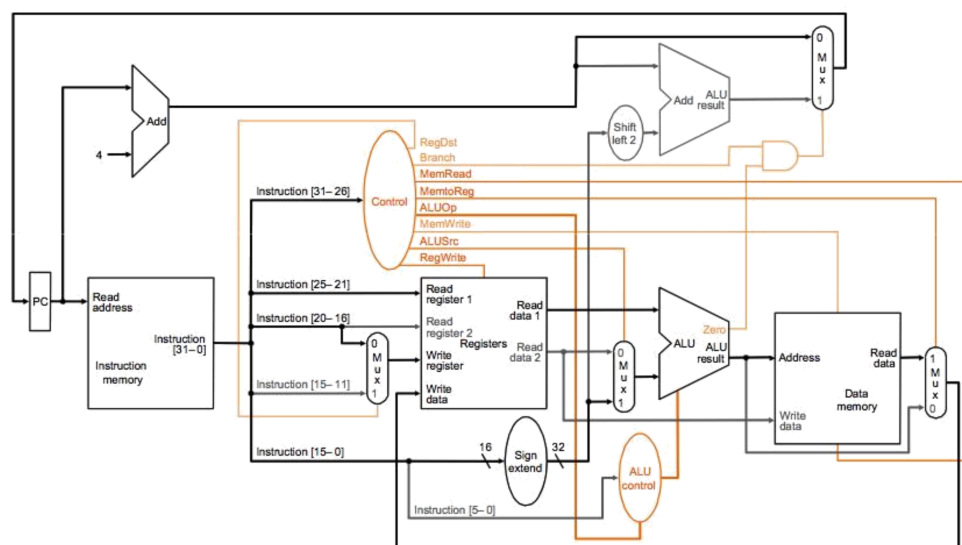
延迟槽可插入几条指令？

4 条 指令 4~7

为减少流水线损失可采取哪些措施？

分支预测等。

7.指令执行 (15 分)



and sw 指令执行过程?

执行中的控制信号?

若采用单周期, 则指令周期长度是?