

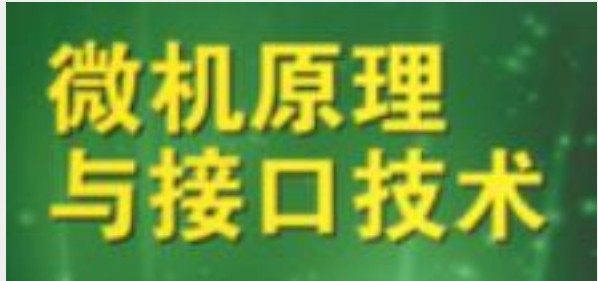
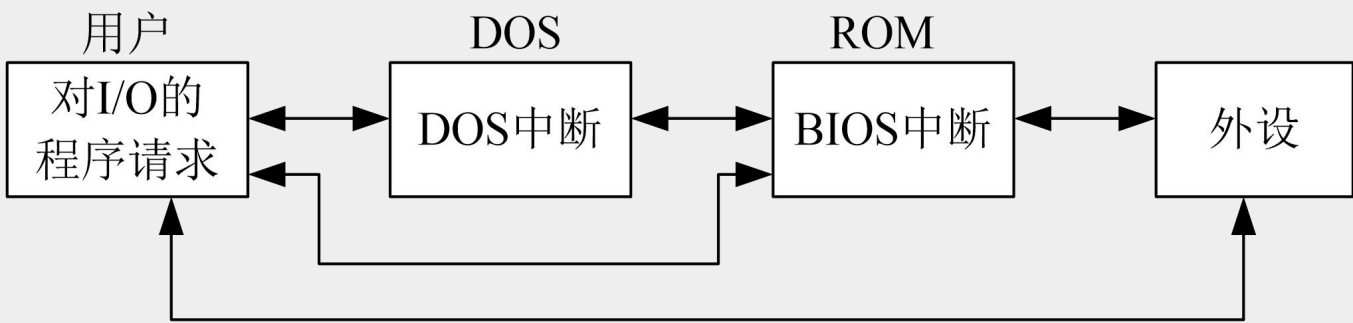
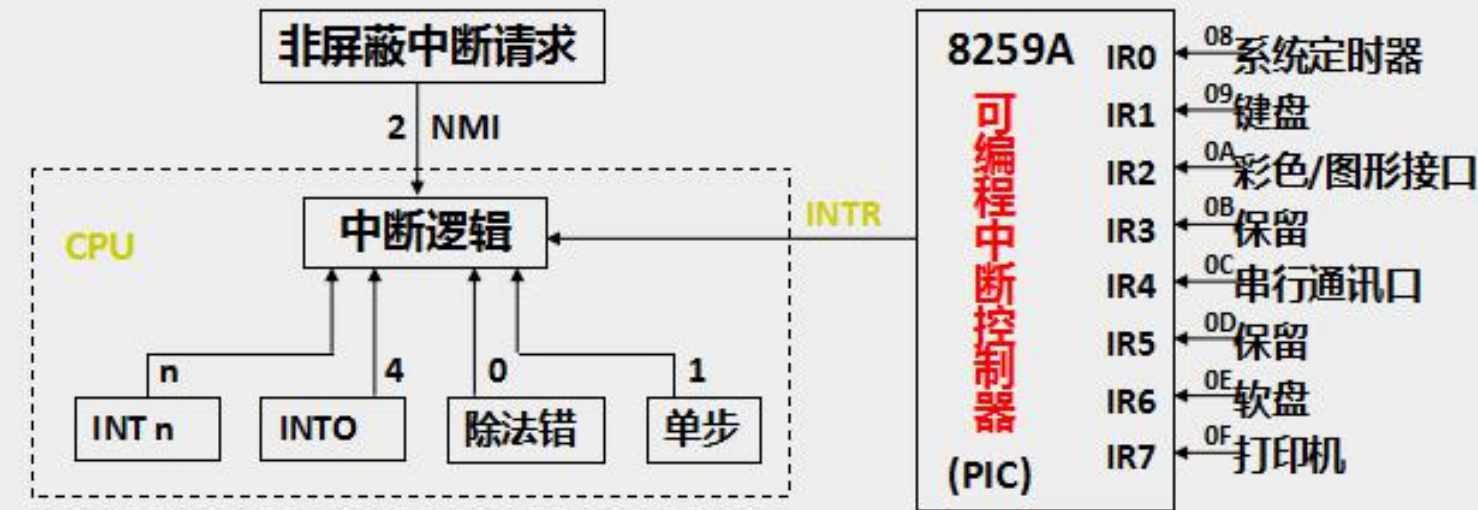
# 让计算机“唱歌”

贺利坚 主讲



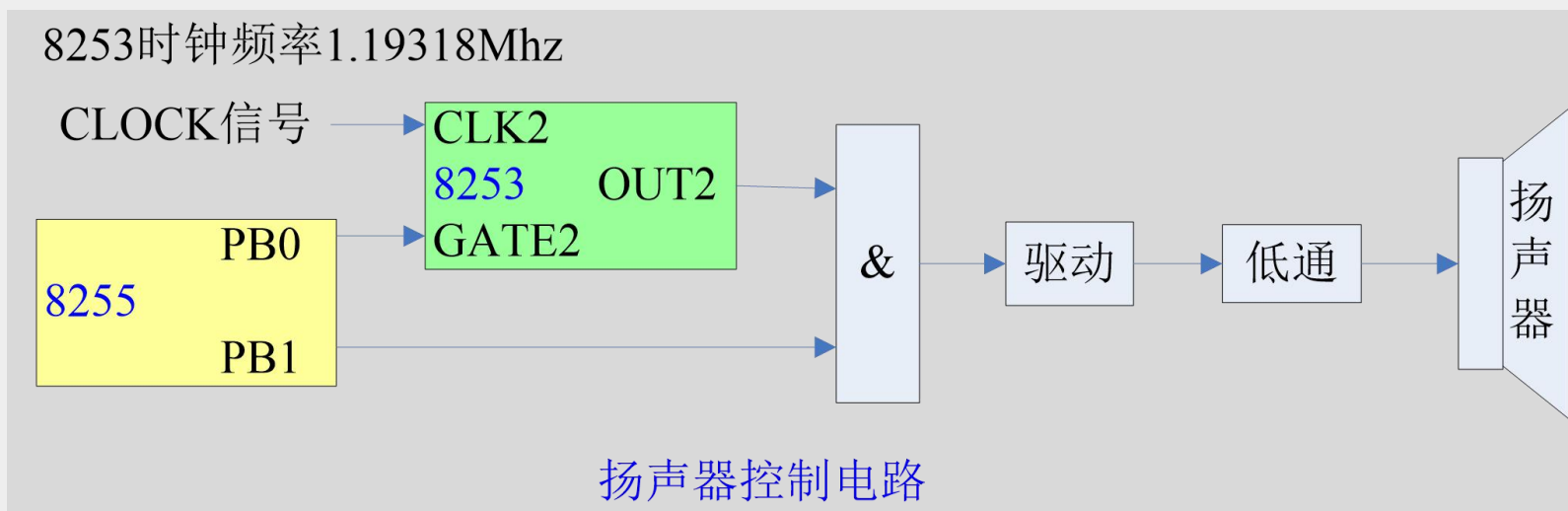
汇编语言程序设计  
Assembly Language

# 外部设备与如何被控制的？



- 可编程中断控制器8259A
- 可编程定时/计数芯片8253
- 可编程的并行接口8255A
- 可编程串行接口芯片16550
- 模/数和数/模转换器
- .....

# 与"计算机唱歌"有关的硬件及控制



## 8253 芯片(定时/计数器)的设置

```
mov al,0b6h ;8253初始化
out 43h,al ;43H是8253芯片控制口的端口地址
mov dx,12h
mov ax,34dch
div word ptr [si] ;计算分频值,赋给ax, [si]中存放声音的频率值。
out 42h, al ;先送低8位到计数器, 42h是8253芯片通道2的端口地址
mov al, ah
out 42h, al ;后送高8位计数器
```


## ;设置8255芯片(并行I/O), 控制扬声器的开/关

```
in al,61h ;读取8255 B端口原值
mov ah,al ;保存原值
or al,3 ;使低两位置1, 以便打开开关
out 61h,al ;开扬声器, 发声
... ;延时, 保持时间
...
mov al, ah
out 61h, al ;恢复扬声器端口原值
```

# “翻译”乐谱

;新年好“数字化”乐谱

```
dataseg segment
mus_freq dw 262,262,262,196
          dw 330,330,330,262
          dw 262,330,392,392
          dw 349,330,294
          dw 294,330,349,349
          dw 330,294,330,262
          dw 262,330,294,196
          dw 247,294,262,-1
mus_time dw 3 dup(12,12,25,25),12,12,50
          dw 3 dup(12,12,25,25),12,12,50
dataseg ends
```



## 新年好

英国歌曲  
杨世明译配

1 =  $\flat E$   $\frac{3}{4}$

1 1 1 5 | 3 3 3 1 | 1 3 5 5 | 4 3 2 - |

新年好 呀， 新年好 呀， 祝贺大 家 新年好。

2 3 4 4 | 3 2 3 1 | 1 3 2 5 | 7 2 1 - ||

我们唱 歌， 我们跳 舞， 祝贺大 家 新年好。

音符和发音频率(Hz)的对应关系:

低音符	频率	中音符	频率	高音符	频率
1	138	1	262	1	524
2	147	2	294	2	587
3	165	3	330	3	659
4	175	4	349	4	698
5	196	5	392	5	784
6	220	6	440	6	880
7	247	7	494	7	988

# 演奏程序

```
assume cs:codeseg, ds:dataseg, ss:stackseg
dataseg segment
mus_freq dw 262,262,262,196,330,330,330,262
          dw 262,330,392,392,349,330,294
          dw 294,330,349,349,330,294,330,262
          dw 262,330,294,196,247,294,262,-1
```

```
mus_time dw 3 dup(12,12,25,25),12,12,50
          dw 3 dup(12,12,25,25),12,12,50
```

```
dataseg ends
```

```
stackseg segment
```

```
db 100h dup (0)
```

```
stackseg ends
```

```
codeseg segment
```

```
start:
```

; 主程序

; 子程序：演奏一个音符

; 入口参数：si - 音符的频率的地址

; di - 音符的音长的地址

```
codeseg ends
```

```
end start
```

```
mov ax, stackseg
mov ss, ax
```

```
mov sp, 100h
```

```
mov ax, dataseg
```

```
mov ds, ax
```

```
lea si, mus_freq
```

```
lea di, mus_time
```

```
play:
```

```
mov dx, [si]
```

```
cmp dx, -1
```

```
je end_play
```

```
call sound
```

```
add si, 2
```

```
add di, 2
```

```
jmp play
```

```
end_play:
```

```
mov ax, 4c00h
```

```
int 21h
```

```
sound:
```

```
push ax
```

```
push dx
```

```
push cx
```

;8253 芯片(定时/计数器)的设置

;设置8255芯片, 控制扬声器的开/关

;延时一定的时长

;恢复扬声器端口原值

```
pop cx
```

```
pop dx
```

```
pop ax
```

```
ret
```

```
mov al,0b6h
```

```
out 43h,al
```

```
mov dx,12h
```

```
mov ax,34dch
```

```
div word ptr [si]
```

```
out 42h, al
```

```
mov al, ah
```

```
out 42h, al
```

```
in al,61h
```

```
mov ah,al
```

```
or al,3
```

```
out 61h,al
```

```
mov dx, [di]
```

```
wait1:
```

```
mov cx, 28000
```

```
delay:
```

```
nop
```

```
loop delay
```

```
dec dx
```

```
jnz wait1
```