

# Programming Assignment Lecture II

## PA1-1

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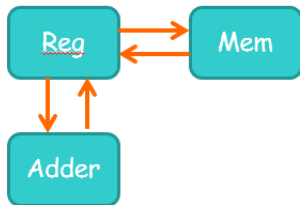
# The simplest computer- Turing machine

Architecture of the simplest computer

To place programs Memory

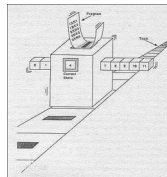
To process data Adder

To store temporary results efficiently  
Reg



Working mode of the simplest computer

- ▶ Fetch instruction from Mem using PC.
- ▶ Execute instruction.
- ▶ Update PC.



# Programming Assignment Lecture II

- 1 Sketlon of NEMU
- 2 Requirements of PA1-1

# Structure of PA

```
ics2017
|---nanos-lite    # mini operating system kernel
|---navy-apps     # apps
|---nemu          # NEMU
|---nexus-am      # abstract machine
```

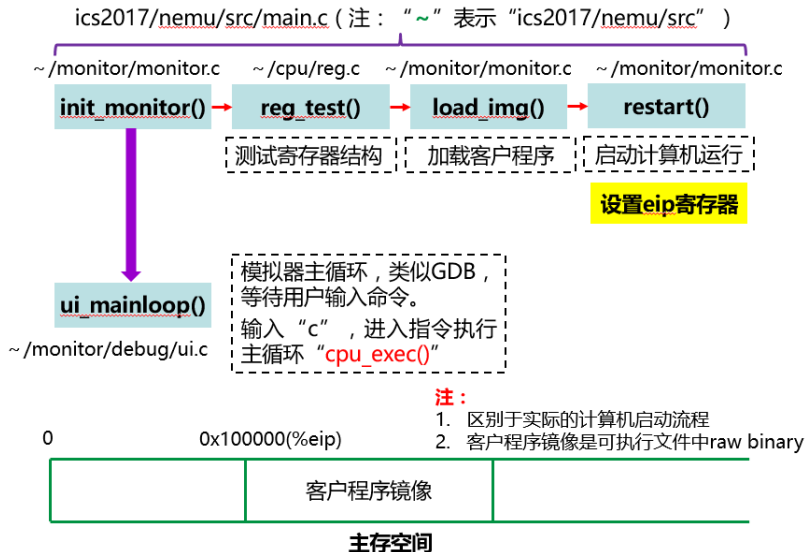
# Structure of NEMU

```

nemu
├── include
│   ├── common.h           # 存放全局使用的
│   ├── cpu                # 公用的头文件
│   │   ├── decode.h       # 译码相关
│   │   ├── exec.h         # 执行相关
│   │   ├── reg.h          # 寄存器结构体的
│   │   └── rtl.h          # RTL指令
│   ├── debug.h            # 一些方便调试用的
│   ├── device             # 设备相关
│   ├── macro.h            # 一些方便的宏定
│   ├── memory             # 访问内存相关
│   ├── monitor
│   │   ├── expr.h         # 表达式求值相关
│   │   ├── monitor.h
│   │   └── watchpoint.h   # 监视点相关
│   └── nemu.h
├── Makefile               # 指示NEMU的编译
├── Makefile.git           # git版本控制相
├── runall.sh              # 一键测试脚本
└── src                    # 源文件
    ├── cpu
    │   ├── decode         # 译码相关
    │   ├── exec           # 执行相关
    │   ├── intr.c         # 中断处理相关
    │   └── reg.c          # 寄存器相关
    ├── device             # 设备相关
    ├── main.c             # 你知道的...
    ├── memory
    │   └── memory.c        # 访问内存的接口
    ├── misc
    │   └── logo.c         # "i386"的logo
    ├── monitor
    │   ├── cpu-exec.c     # 指令执行的主循
    │   └── diff-test

```

# Flow of execution



# main()

nemu/src/main.c

init\_monitor() Initialize monitor

ui\_mainloop() Ui main loop

## Tip - Ctags

Ctags is a programming tool that generates an index (or tag) file of names found in source and header files of various programming languages.

Depending on the language, functions, variables, class members, macros and so on may be indexed. These tags allow definitions to be quickly and easily located by a text editor.

# init\_monitor()

nemu/src/monitor/monitor.c

init\_log() Initialize log file

reg\_test() Test the CPU\_State struct

load\_img() Load the image to memory

restart() Set %eip

init\_\*( ) Do some else initialization work

welcome() Output **Welcome to NEMU!**



## ui\_mainloop()

nemu/src/monitor/debug/ui.c

```
while(1)
{
    read the user command
    execute the user command
}
```

We already have implemented some commands

c,q,help

### Question

In cmd\_c(), we call the function cpu\_exec(-1), why -1?

# Commands in monitor

命令	格式	使用举例	说明
帮助(1)	<code>help</code>	<code>help</code>	打印命令的帮助信息
继续运行(1)	<code>c</code>	<code>c</code>	继续运行被暂停的程序
退出(1)	<code>q</code>	<code>q</code>	退出NEMU
单步执行	<code>si [N]</code>	<code>si 10</code>	让程序单步执行 <code>N</code> 条指令后暂停执行, 当 <code>N</code> 没有给出时, 缺省为 <code>1</code>
打印程序状态	<code>info SUBCMD</code>	<code>info r</code> <code>info w</code>	打印寄存器状态 打印监视点信息
表达式求值	<code>p EXPR</code>	<code>p \$eax + 1</code>	求出表达式 <code>EXPR</code> 的值, <code>EXPR</code> 支持的 运算请见 <a href="#">调试中的表达式求值</a> 小节
扫描内存(2)	<code>x N EXPR</code>	<code>x 10 \$esp</code>	求出表达式 <code>EXPR</code> 的值, 将结果作为起始内存 地址, 以十六进制形式输出连续的 <code>N</code> 个4字节
设置监视点	<code>w EXPR</code>	<code>w *0x2000</code>	当表达式 <code>EXPR</code> 的值发生变化时, 暂停程序执行
删除监视点	<code>d N</code>	<code>d 2</code>	删除序号为 <code>N</code> 的监视点

备注:

- (1) 命令已实现

# Infrastructure

- ▶ Improve developing efficiency.

## Examples

- ▶ Makefile
- ▶ Vivado
- ▶ Google
  - ▶ Adder
  - ▶ Multiplier

# Programming Assignment Lecture II

- 1 Sketlon of NEMU
- 2 Requirements of PA1-1

# Requirements of PA1-1

`nemu/include/cpu/reg.h` Implementing the struct of Regs

`nemu/src/monitor/debug/ui.c` Parsing commands

`nemu/src/monitor/debug/ui.c` Implementing some commands

# Struct of Regs

- ▶ `nemu/include/cpu/reg.h`
- ▶ The function `reg_test()` in `nemu/src/cpu/reg.c` will test your implementing. Assertion fail will be triggered if you are wrong.
- ▶ If right, you will **hit good trap** if you enter the command 'c' in monitor.

## Tip

- ▶ Understand the structure of CPU regs.
- ▶ Understand the differences between struct and union in C language.

# Parsing commands

- ▶ `nemu/src/monitor/debug/ui.c ui_mainloop()`
- ▶ Nothing to say.
- ▶ `RTFSC,RTFM`

## Tip

- ▶ `man readline`
- ▶ `man strtok`
- ▶ `man sscanf`

# Implementing some commands -1

- ▶ `nemu/src/monitor/debug/ui.c`
- ▶ `si`
- ▶ `info r`
- ▶ `x`

## Question

Do you know what type the array **`opcode_table`** is ?

## Tip

- ▶ Understand function pointer



## Implementing some commands -2

si

- ▶ Understand the meaning of **cpu\_exec().RTFSC**

info r

- ▶ So easy!

x

- ▶ Try to find the interface of accessing memory.

Tip

Function **load\_default\_img()** in `nemu/src/monitor/monitor.c` will tell you whether your command **x** is right.

The end

Thanks!