

小型MASM编译器

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一.为什么要做MASM编译器

- gcc和clang
- 微软的MASM编译器缺点：
 - 词法和语法错误报错信息不完善，只告诉你错，不告诉你为什么错
 - 无法检测运行时错误
- 配合DOS获得更多缺点：
 - 一旦陷入死循环就会死机
 - 有些版本只有大写、单色字母（太丑）

```
emblem Version 5.00
Corp 1981-1985, 1987. All rights reserved

Symbol not defined: FFH
Value out of range
Syntax error
: Must be index or base register
: Operand must have size
: Improper operand type
: Symbol not defined: START_FALSE
: Phase error between passes
: Syntax error

symbol space free
```

```
1  assume cs:code,ds
2  data segment
3  BUF          db  ff
4  ERR          db  25
5  NUM          dw  "a"
6  data ends
7
8  code segment
9
10 start:
11     sub  bx,[ax]
12     mul  [bx+1]
13     mov  [bx],[bx+
14     loop start_fa
15     mov  ax,4c00h
16     int  21h
17
18 second:
19     mov  ah,02h
20     mov  dl,'ABC'
21     int  21h
22     ret
23
24 code ends
25 end start
26
```


二.我在我的编译器上做的工作

- 自己构建语法结构，实现词法分析、语法分析



```
assume cs:code,ds:data
data segment
BUF      db 0ffh dup(?)          ; 存读到
ERR      dw 256
NUM      db "abcd"
data ends

code segment
printf MACRO x
test:
    mov x,12
    int 21h
    ENDM

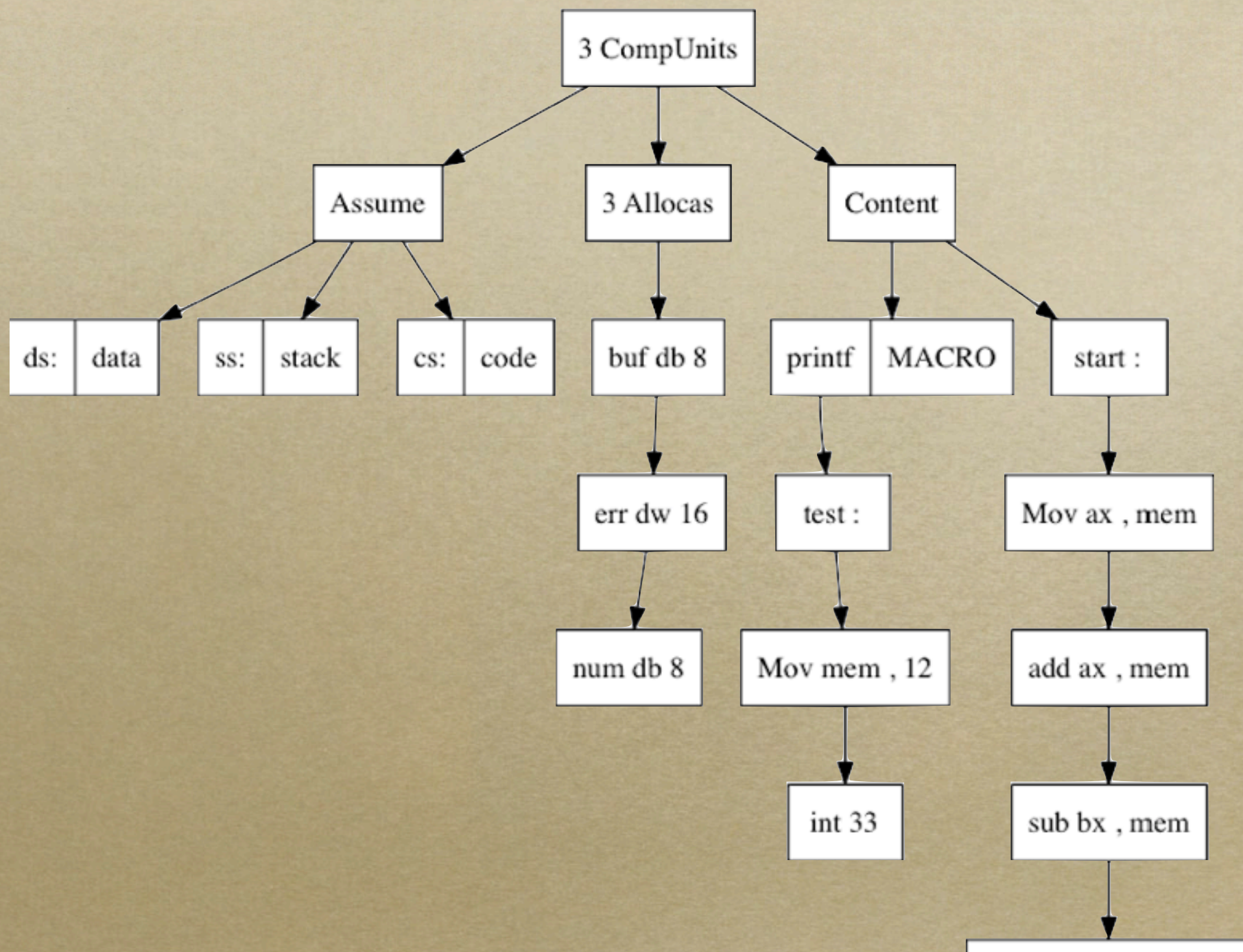
start:
    mov ax,offset BUF            ; mov指令 + 偏移量寻址
    add ax,ERR                   ; add指令 + 直接寻址
    sub bx,[bx]                  ; sub指令 + 寄存器寻址
    mul byte ptr [bx+1]          ; mul指令 + 寄存器加偏移
    div word ptr [bx+di+1]       ; div指令 + 更灵活的寻址
```

```
inc NUM                          ; inc指令
dec cx                          ; dec指令
loop start                      ; loop指令
cmp cx,ax                      ; cmp指令
jge start                      ; 比较指令
call second                    ; call指令
push ax                        ; push指令
pop ax                         ; pop指令
mov ax,4c00h
int 21h                        ; 调用中断驱动，结束程序

second:                          ; 定义函数
    mov ah,02h
    mov dl,'A'
    int 21h
    ret

code ends
end start
```


- 构建抽象语法树（AST），画出简单示意图



- 首先对一些词法和语法上的错误进行检错(同时输出对应行源码)

```
a5 ASTER — bash — 90x30
rishinseitekiMacBook-Air:a5 ASTER Li$ ./bin/parser -d asgn.dot test/err1.asm
[WARNING]:test/err1.asm: 3.(22) Hex Number should begin with '0-9', instead of 'a-f'

buf          db fffh dup(?)                ; 存读到的数字
               ^
[ERROR]: test/err1.asm: 4.(16) Can't store Number over 256 to [byte]!

err          db 257
               ^
[ERROR]: test/err1.asm: 5.(17) Wrong to store ASCII to [word]! please use [byte]

num          dw "abcd"
               ^
[ERROR]: test/err1.asm: 11.(13) There can't be ax! please use bx|si|di|num

    sub bx,[ax]
           ^
[WARNING]:test/err1.asm: 12.( 8) Mem length missing,do you mean 'word ptr' or 'byte ptr'?

    mul [bx+1]
         ^
[ERROR]: test/err1.asm: 13.(14) [Severe ERROR]:It's wrong to 'mov mem,mem'

    mov [bx],[bx+1]
          ^
[ERROR]: test/err1.asm: 20.(12) Too long string!

    mov dl,'abc'
          ^
rishinseitekiMacBook-Air:a5 ASTER Li$
```

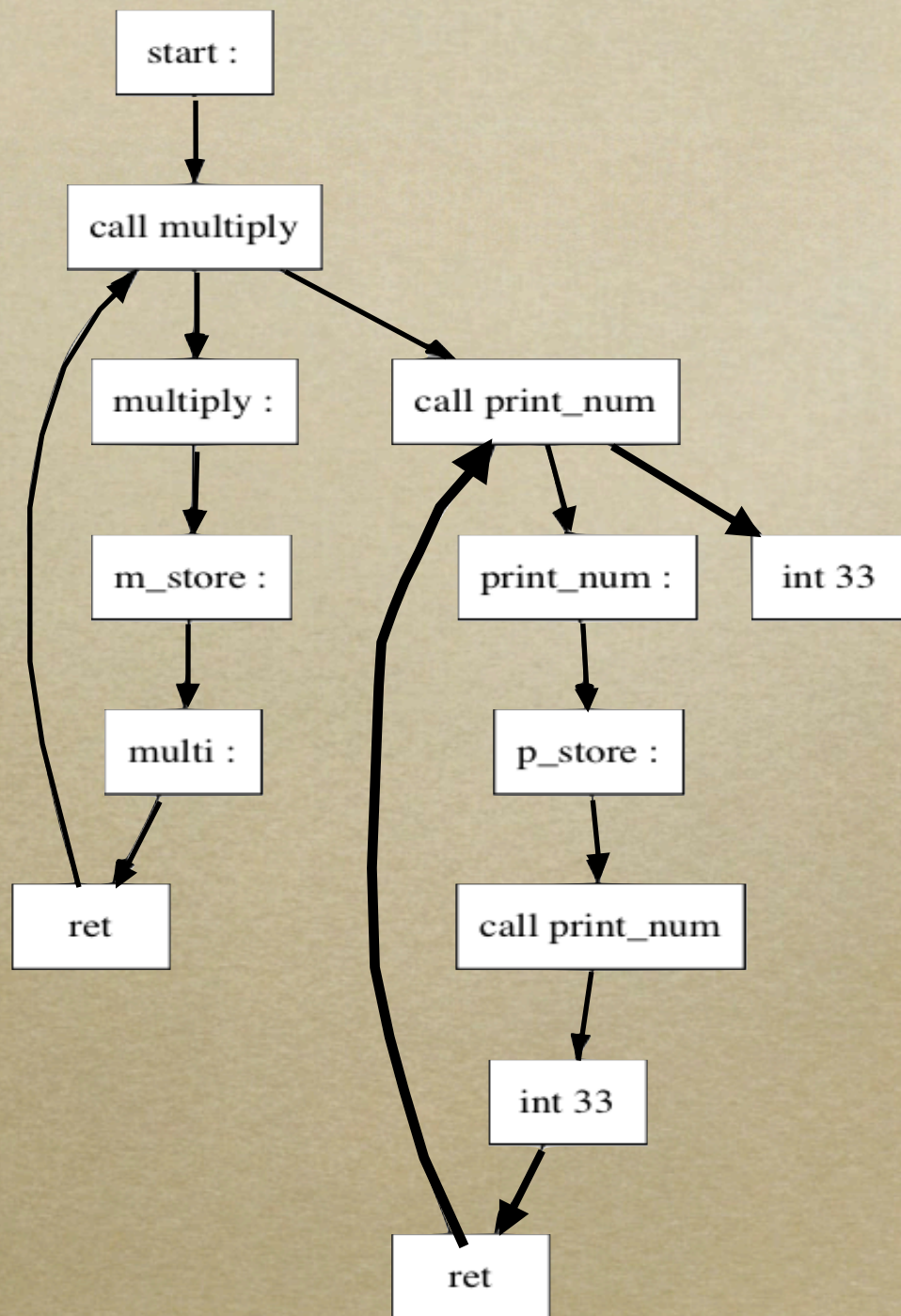

- 其次，建立符号表，检查引用Label和Mem时的错误

```
a5 ASTER — bash — 90x11
mov ax,num_f
      ^
rishinseitekiMacBook-Air:a5 ASTER Li$ ./bin/parser -d asgn.dot test/err2.asm
[ERROR]: test/err2.asm: 12.(12) The Memory address isn't defined : num_f

mov ax,num_f
      ^
rishinseitekiMacBook-Air:a5 ASTER Li$ ./bin/parser -d asgn.dot test/err2.asm
[ERROR]: test/err2.asm: 11.( 5)This label isn't defined : start_false

loop start_false
```


- 接下来要在对语法树的第2、3遍扫描上做文章了
- 1. 可以画出函数调用图
(其实更像是label的流程图)



- 2.如果程序企图输出一个不可见字符，
那么这个错误会被检测出来

```
36  second:
37      mov ah,02h
38      mov dl,03
39      int 21h
40      mov ah,02h
41      mov dl,1Ah
```



The screenshot shows a macOS terminal window with a title bar that reads "a5 ASTER — bash — 90x6". The terminal content displays a warning message in yellow: "[WARNING]:test/err2.asm: 39.(5) 这里将会输出一个不可见字符". Above the warning, there is a green caret (^) pointing to the instruction "mov dl,03". Below the warning, the instruction "mov dl,03" is shown again, with another green caret (^) pointing to the "03". The terminal prompt at the bottom is "rishinseitekiMacBook-Air:a5 ASTER Li\$".

```
[WARNING]:test/err2.asm: 39.( 5) 这里将会输出一个不可见字符

mov dl,03
rishinseitekiMacBook-Air:a5 ASTER Li$
```


- 3.可以检测出多种死循环代码（重要！）

```
a5 ASTER — bash — 76x20
[WARNING]:test/err2.asm: 16.(14) There is a died circle! Please fix it!
    loop loop1
    ^
[WARNING]:test/err2.asm: 21.(12) There is a died circle! Please fix it!
    je loop2
    ^
[WARNING]:test/err2.asm: 25.(13) There is a died circle! Please fix it!
    jge loop3
    ^
[WARNING]:test/err2.asm: 28.(10) 除数不能为0 !
    div al
    ^
[WARNING]:test/err2.asm: 30.(13) There is a died circle! Please fix it!
    jle loop4
    ^
```

```
13
14 loop1:
15     mov cx,2
16     loop loop1
17 loop2:
18     push 3
19     pop ax
20     cmp ax,3
21     je loop2
22 loop3:
23     add ax,30
24     cmp ax,20
25     jge loop3
26 loop4:
27     mul ah
28     div al
29     cmp cx,10
30     jle loop4
31
```


- 3.可以检测出多种死循环代码（重要！）

```
13  
14 loop1:  
15     mov cx,2  
16     loop loop1  
17 loop2:  
18     push 3  
19     pop ax  
20     cmp ax,3  
21     je loop2
```

a5 ASTER — bash — 76x20
[WARNING]:test/err2.asm: 16.(14) There is a died circle! Please fix it!

```
    loop loop1  
    ^
```

[WARNING]:test/err2.asm: 21.(12) There is a died circle! Please fix it!

```
    je loop2  
    ^
```

[WARNING]:test/err2.asm: 25.(13) There is a died circle! Please fix it!

```
    jge loop3  
    ^
```

[WARNING]:test/err2.asm: 28.(10) 除数不能为0 !

```
    div al  
    ^
```

[WARNING]:test/err2.asm: 30.(13) There is a died circle! Please fix it!

```
    jle loop4  
    ^
```

```
ax,30  
ax,20  
loop3
```

```
ah  
al  
cx,10  
loop4
```


三.总结

- 能分析主流指令，生成语法树
- 能对微软编译器不友好显示的信息，更加详细地报错，提示你为什么错，正确的应该怎么写
- 建立符号表，能检出符号表错误
- 针对运行时检查：
 - 能检出尝试输出不可见字符的错误
 - 能检出死循环错误
 - 能输出函数调用图
- 缺憾：不能完成代码生成

四. BUG & 新的理解

```
Block      : var_tok ':'      {  
                                $$ = new BlockNode($1,NULL);  
                                $$->setLoc((Loc*)&(@$));  
                                all_node.push_back((Node*)$$);  
                                global->SetLabelNode($1,((BlockNode*)$$));  
                                }  
BlockItem  {  
            line("Line:%-4d",@$first_line);  
            debug ("Block ::= %s : BlockItem\n", $1->c_str());  
            if(error_flag == 0)  
            {  
                BlockNode * now = global->GetLabelNode($1);  
                now ->block_root = (BlockItemNode *)$4;  
                now ->setLoc((Loc*)&(@$));  
                $$ = now;  
            }  
        }
```


四. BUG & 新的理解

var_tok MACRO

var_tok :

var_tok db

var_tok segment

var_tok ends

*LR(2) or
LR(1)?*

Thanks

A horizontal line with a black and red textured appearance, possibly a torn piece of paper or a decorative element, spanning the width of the page.