High-Level Language Interface

Computer Organization and Assembly Languages

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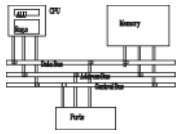
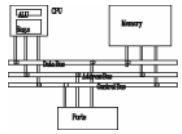
with slides by Kip Irvine

Why link ASM and HLL programs?



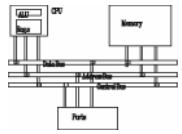
- Assembly is rarely used to develop the entire program.
- Use high-level language for overall project development
  - Relieves programmer from low-level details
- Use assembly language code
  - Speed up critical sections of code
  - Access nonstandard hardware devices
  - Write platform-specific code
  - Extend the HLL's capabilities

General conventions



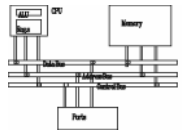
- Considerations when calling assembly language procedures from high-level languages:
  - Both must use the same naming convention (rules regarding the naming of variables and procedures)
  - Both must use the same memory model, with compatible segment names
  - Both must use the same calling convention

Calling convention



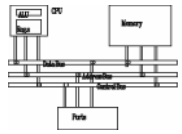
- Identifies specific registers that must be preserved by procedures
- Determines how arguments are passed to procedures: in registers, on the stack, in shared memory, etc.
- Determines the order in which arguments are passed by calling programs to procedures
- Determines whether arguments are passed by value or by reference
- Determines how the stack pointer is restored after a procedure call
- Determines how functions return values

External identifiers



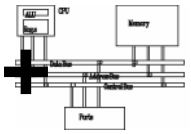
- An external identifier is a name that has been placed in a module's object file in such a way that the linker can make the name available to other program modules.
- The linker resolves references to external identifiers, but can only do so if the same naming convention is used in all program modules.

Inline assembly code



- Assembly language source code that is inserted directly into a HLL program.
- Compilers such as Microsoft Visual C++ and Borland C++ have compiler-specific directives that identify inline ASM code.
- Efficient inline code executes quickly because CALL and RET instructions are not required.
- Simple to code because there are no external names, memory models, or naming conventions involved.
- Decidedly not portable because it is written for a single platform.

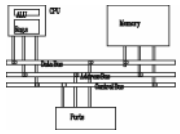
__asm directive in Microsoft Visual C++



- Can be placed at the beginning of a single statement
- Or, It can mark the beginning of a block of assembly language statements
- Syntax:

```
__asm  statement

__asm {
  statement-1
  statement-2
  ...
  statement-n
}
```

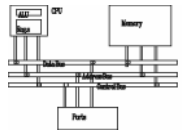
Commenting styles



All of the following comment styles are acceptable, but the latter two are preferred:

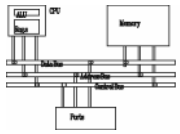
```
mov  esi,buf  ; initialize index register
mov  esi,buf  // initialize index register
mov  esi,buf  /* initialize index register*/
```

You can do the following . . .



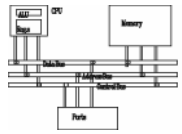
- Use any instruction from the Intel instruction set
- Use register names as operands
- Reference function parameters by name
- Reference code labels and variables that were declared outside the asm block
- Use numeric literals that incorporate either assembler-style or C-style radix notation
- Use the **`PTR`** operator in statements such as **`inc BYTE PTR [esi]`**
- Use the **`EVEN`** and **`ALIGN`** directives
- Use the **`LENGTH`**, **`SIZE`** and **`TYPE`** directives

You cannot do the following . . .



- Use data definition directives such as **DB**, **DW**, or **BYTE**
- Use assembler operators other than **PTR**
- Use **STRUCT**, **RECORD**, **WIDTH**, and **MASK**
- Use macro directives such as **MACRO**, **REPT**, **IRC**, **IRP**

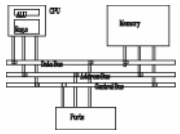
Register usage



- In general, you can modify **EAX**, **EBX**, **ECX**, and **EDX** in your inline code because the compiler does not expect these values to be preserved between statements
- Conversely, always save and restore **ESI**, **EDI**, and **EBP**.
- You can't use **OFFSET**, but you can us **LEA** instruction to retrieve the offset of a variable.

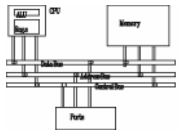
```
lea esi, buffer
```

File encryption example



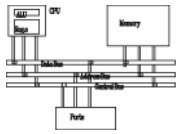
- Reads a file, encrypts it, and writes the output to another file.
- The **`TranslateBuffer`** function uses an **`__asm`** block to define statements that loop through a character array and XOR each character with a predefined value.

TranslateBuffer



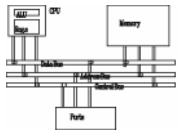
```
void TranslateBuffer(char * buf,
                     unsigned count,
                     unsigned char eChar )
{
  __asm {
     mov esi,buf      ; set index register
     mov ecx,count    /* set loop counter */
     mov al,eChar
  L1:
     xor  [esi],al
     inc  esi
     Loop L1
 } // asm

}
```

File encryption



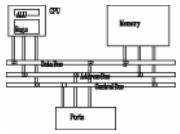
```
...
while (!infile.eof() )
{
  infile.read(buffer, BUFSIZE );
  count = infile.gcount();
  TranslateBuffer(buffer, count, encryptCode);
  outfile.write(buffer, count);
}
...
```

TranslateBuffer



```
    push ebp
    mov  ebp, esp
    sub  esp, 40h
    push ebx
    push esi
    push edi
    mov  esi,buf      ; set index register
    mov ecx,count    /* set loop counter */
    mov al,eChar
L1:
    xor  [esi],al
    inc  esi
    Loop L1
    pop  edi
    pop  esi
    pop  ebx
    mov  esp, ebp
    pop  ebp
```

File encryption



```
while (!infile.eof() )
  {
    infile.read(buffer, BUFSIZE );
    count = infile.gcount();
    __asm {                    to avoid the calling overhead
        lea esi,buffer
        mov ecx,count
        mov al, encryptChar
    L1:
        xor [esi],al
        inc  esi
        Loop L1
   } // asm
    outfile.write(buffer, count);
  }
```