

复旦大学计算机科学技术学院
2020-2021 学年第一学期期中考试试卷

课程名称: 计算机系统基础 课程代码: COMP130156.01/COMP130143.02
开课院系: 计算机科学技术学院 考试形式: 开卷
姓名: 学号: 专业:

提示: 请同学们秉持诚实守信宗旨, 遵守考试纪律, 摒弃考试作弊。学生如有违反学校考试纪律的行为, 学校将按《复旦大学学生纪律处分条例》规定予以严肃处理。

题号	1	2	3	4	5	6	7	8	总分
得分									

1. (16 分)

Assume we are running code on a 6-bit machine using two's complement arithmetic for signed integers. A "short" integer is encoded using 3 bits. Fill in the empty boxes in the table below. The following definitions are used in the table:

short sy = -3;
int y = sy;
int x = -17;
unsigned ux = x;

Note: You need not fill in entries marked with "-".

Expression	Decimal Representation	Binary Representation
Zero	0	
-	-6	
-		01 0010
ux		
y		
$x > 1$		

TMax	
-TMin	
TMin+TMin	

2. (18 分)

Consider the following 8-bit floating point representation based on the IEEE floating point format:

- There is a sign bit in the most significant bit.
- The next 3 bits are the exponent. The exponent bias is $2^{3-1} - 1 = 3$.
- The last 4 bits are the fraction.
- The representation encodes numbers of the form: $V = (-1)^s \cdot M \cdot 2^E$, where M is the significand and E is the biased exponent.

The rules are like those in the IEEE standard (normalized, denormalized, representation of 0, infinity, and NaN). FILL in the table below. Here are the instructions for each field:

- **Binary:** The 8 bit binary representation.
- **M:** The value of the significand. This should be a number of the form x or x/y , where x is an integer, and y is an integral power of 2. Examples include 0, 3/4.
- **E:** The integer value of the exponent.
- **Value:** The numeric value represented.

Note: you need not fill in entries marked with "-".

Description	Binary	M	E	Value
Minus zero				-0.0
—	0 100 0101			
Smallest denormalized (negative)				
Largest normalized (positive)				
One				1.0
—				5.5
Positive infinity		—	—	$+\infty$

3. (6 分)

Consider the following C functions and assembly code:

```
int fun7(int a)
{
    return a * 30;
}

int fun8(int a)
{
    return a * 34;
}

int fun9(int a)
{
    return a * 18;
}
```

```
pushl %ebp
movl %esp, %ebp
movl 8(%ebp), %eax
sall $4, %eax
addl 8(%ebp), %eax
addl %eax, %eax
movl %ebp, %esp
popl %ebp
ret
```

Which of the functions compiled into the assembly code shown?

4. (6 分)

Consider the following C functions and assembly code:

```
int fun4(int *ap, int *bp)
{
    int a = *ap;
    int b = *bp;
    return a+b;
}

int fun5(int *ap, int *bp)
{
    int b = *bp;
    *bp += *ap;
    return b;
}

int fun6(int *ap, int *bp)
{
    int a = *ap;
    *bp += *ap;
    return a;
}
```

```
pushl %ebp
movl %esp, %ebp
movl 8(%ebp), %edx
movl 12(%ebp), %eax
movl %ebp, %esp
movl (%edx), %edx
addl %edx, (%eax)
movl %edx, %eax
popl %ebp
ret
```

Which of the functions compiled into the assembly code shown?

5. (10 分)

Consider the source code below, where M and N are constants declared with #define.

```
int array1[M][N];
int array2[N][M];

int copy(int i, int j)
{
    array1[i][j] = array2[j][i];
}
```

Suppose the above code generates the following assembly code:

```
copy:
    pushl %ebp
    movl %esp, %ebp
    pushl %ebx
    movl 8(%ebp), %ecx
    movl 12(%ebp), %ebx
    leal (%ecx, %ecx, 8), %edx
    sall $2, %edx
    movl %edx, %eax
    sall $4, %eax
    subl %edx, %eax
    sall $2, %eax
    movl array2(%eax, %ecx, 4), %eax
    movl %eax, array1(%edx, %ebx, 4)
    popl %ebx
    movl %ebp, %esp
    ret
```

What are the values of M and N?

M =
N =

Consider the following assembly representation of a function `foo` containing a `for` loop:

```

pushl %ebp
movl %esp, %ebp
pushl %ebx
movl 8(%ebp), %ebx
leal 2(%ebx), %edx
xorl %ecx, %ecx
cmpl %ebx, %ecx
jge .L4

.L6:
leal 5(%ecx, %edx), %edx
leal 3(%ecx), %eax
imull %eax, %edx
incl %ecx
cmpl %ebx, %ecx
jl .L6

.L4:
movl %edx, %eax
popl %ebx
movl %ebp, %esp
popl %ebp
ret

```

```
int foo(int a)
{
```

return result;

Consider the following C declarations:

```
    } OldSensorData;
```

```
} NewsSensorData;
```

allocated, but not used (to satisfy alignment).

of the data structure with a vertical line.

[illegible]

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

B. Now consider the following C code fragment:

```
void foo(OldSensorData *OldData)
{
    NewSensorData *newData;

    /* this zeros out all the space allocated for OldData */
    bzero((void *)OldData, sizeof(OldData));

    OldData->code = 0x104f;
    OldData->start = 0x80501ab8;
    OldData->raw[0] = 0xe1;
    OldData->raw[1] = 0xe2;
    OldData->raw[2] = 0x8f;
    OldData->raw[5] = 0xff;
    OldData->data = 1.5;

    newData = (NewSensorData *) OldData;
    ...
}
```

Once this code has run, we begin to access the elements of newData. Below, give the value of each element of newData that is listed. Assume that this code is run on a Little-Endian machine such as a Linux/x86 machine. You must give your answer in hexadecimal format. Be careful about byte ordering!

- (a) newData->start = 0x_____
- (b) newData->raw[0] = 0x_____
- (c) newData->raw[2] = 0x_____
- (d) newData->raw[4] = 0x_____
- (e) newData->sense = 0x_____

Problem 8. (18 分):

The problem concerns the following C code. This program reads a string on standard input and prints an integer in hexadecimal format based on the input string it read.

```
#include <stdio.h>

/* Read a string from stdin into buf */
int evil_read_string()
{
    int buf[2];
    scanf("%s", buf);
    return buf[1];
}

int main()
{
    printf("0x%x\n", evil_read_string());
}
```

Here is the corresponding machine code on a Linux/x86 machine:

```
08048414 <evil_read_string>:
8048414: 55          push    %ebp
8048415: 89 e5      mov     %esp, %ebp
8048417: 83 ec 14   sub     $0x14, %esp
804841a: 53         push    %ebx
804841b: 83 c4 f8   add     $0xfffffff8, %esp
804841e: 8d 5d f8   lea     0xfffffff8(%ebp), %ebx
8048421: 53         push    %ebx
8048422: 68 b8 84 04 08 push    $0x80484b8
8048427: e8 e0 fe ff ff call    804830c <_init+0x50> call scanf
804842c: 8b 43 04   mov     0x4(%ebx), %eax
804842f: 8b 5d e8   mov     0xffffffe8(%ebp), %ebx
8048432: 89 ec      mov     %ebp, %esp
8048434: 5d         pop     %ebp
8048435: c3         ret

08048438 <main>:
8048438: 55          push    %ebp
8048439: 89 e5      mov     %esp, %ebp
804843b: 83 ec 08   sub     $0x8, %esp
804843e: 83 c4 f8   add     $0xfffffff8, %esp
8048441: e8 ce ff ff ff call    8048414 <evil_read_string>
8048446: 50         push    %eax
8048447: 68 b8 84 04 08 push    $0x80484b8
804844c: e8 eb fe ff ff call    804830c <_init+0x80> call printf
8048451: 89 ec      mov     %ebp, %esp
8048453: 5d         pop     %ebp
8048454: c3         ret
```

- `scanf("%s", buf)` reads an input string from the standard input stream (`stdin`) and stores it at address `buf` (including the terminating `'\0'` character). It does not check the size of the destination buffer.

- `scanf("%s", buf)` reads an input string from the standard input stream (`stdin`) and stores it at address `buf` (including the terminating `'\0'` character). It does not check the size of the destination buffer.
 - `printf("0x%x", i)` prints the integer `i` in hexadecimal format preceded by `"0x"`.
 - Recall that Linux/x86 machines are Little Endian.
- You will need to know the hex values of the following characters:

Character	Hex value	Character	Hex value
'd'	0x64	'v'	0x76
'r'	0x72	'i'	0x69
't'	0x2e	'l'	0x6c
'e'	0x65	'o'	0x00
		's'	0x73

Here is a template for the stack, showing the locations of `buf[0]` and `buf[1]`. Fill in the value of `buf[1]` (in hexadecimal) and indicate where `ebp` points just after `scanf` returns to `evilreadstring`.

```
|<- buf[0]->|<-buf[1]->|
```

_____x0

(a) List the contents of the following memory locations just after `scanf` returns to `evilReadstring`. Each answer should be an unsigned 4-byte integer expressed as 8 hex digits.

```
buf[0] = 0x_____
buf[3] = 0x_____
```

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```
&ebp = 0x_____
```

You can use the following template of the stack as *scratch space*. *Note:* this does not have to be filled out to receive full credit.

[illegible]

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