

Quiz submitted

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ACTUAL MIDTERM EXAM

⚠ This is a preview of the draft version of the quiz

Instructions

- This exam is an individual effort.
- You are not permitted to help others, in any way, with this exam.
- You are not permitted to release or to discuss this exam with anyone, except the course staff, until given permission to do so by the instructors (which will not occur until all students have completed the exam. There may be exceptional cases that take it late).
- A simple calculator is permitted, but won't prove to be helpful (we don't think).
- You have 180 minutes, from first exposure through submission to take this exam. Do not attempt to "peek", "check", or "test" the exam. This will start your clock.
- We only expect the exam to take 70-90 minutes.
- The exam counts for the 25% "exam portion" of the midterm grade, but is reduced to counting as a "double homework" for the final grade.
- In order to make the exam an "invested but low stakes" experience, half of this exam's weight toward the final grade may be dropped as one of the two "homework drops", but the full weight can't be dropped.
- This exam is closed book/closed notes. This is to ensure the exam is a good simulation of the final exam
- This is a self-proctored exam: You are responsible for ensuring that you, yourself, follow the rules and have a good and proper exam experience.

Quiz Type Graded Quiz

Points 100

Assignment Group ACTUAL MIDTERM EXAM

No

Shuffle Answers

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Time Limit 180 Minutes

Multiple Attempts No

View Responses Always

Show Correct Answers After Oct 14, 2024 at 12:01am

One Question at a Time No

Require Respondus LockDown Browser No

Required to View Quiz Results No

Monitor Required No

Due	For	Available from	Until
Feb 28, 2025	Everyone else	Feb 24, 2025 at 12:01am	May 9, 2025 at 11:59pm
Mar 2, 2025	1 student	Feb 26, 2025 at 12am	Mar 2, 2025 at 11:59pm
Jul 23, 2025	1 student	-	-

Score for this quiz: 0 out of 100

Submitted Mar 10 at 12:30am

This attempt took less than 1 minute.

Unanswered



Question 1

0 / 15 pts

Integers (5 points, 1 point per blank)

Fill in the five empty boxes in the table below when possible and indicate "UNABLE" if impossible.

- When providing binary, write digits without any prefixes or spaces. A suffix if "b" is optional (still no spaces).
- When writing out hexadecimal, write digits without any spaces and prefix with 0x (lowercase x, and still no spaces).
- Include no extraneous characters. Canvas just string matches. It does not understand meaning.

	4-bit 2s complement signed	4-bit unsigned
Binary representation of 9 decimal	<input type="text"/>	<input type="text"/>
Binary representation of decimal -8	<input type="text"/>	-----

<p>Integer (Decimal) value of most positive number</p>	<input type="text"/>	<input type="text"/>
<p>Integer (Decimal) value of (6 + 3)</p>	<input type="text"/>	<input type="text"/>

Answer 1:

(You left this blank)

UNABLE

Unable

unable

Answer 2:

(You left this blank)

1001

1001b

1001 b

Answer 3:

(You left this blank)

1000

1000b

1000 b

Answer 4:

(You left this blank)

7

Answer 5:

(You left this blank)

-7



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Question 2: Floats

This question is based upon an IEEE-like floating point format with the following specification:

- 8-bit width
- There is $s = 1$ sign bit
- There are $k = 3$ fraction/mantissa bits
- Wherever rounding is necessary, round-to-even should be used. You should give the rounded value of the encoded floating point number.

Unanswered



Question 2

0 / 1 pts

Question 2: Floats

2(A) (1 points) What is the bias?

7 (with margin: 0)

Unanswered



Question 3

0 / 1 pts

Question 2: Floats

2(B)(1 point) Consider the number line represented by this format. What is the maximum distance between two adjacent denormalized numbers? Round to the nearest power of 2 (it won't be exactly half way) and give the exponent (in decimal).

-10 (with margin: 0)

Unanswered



Question 4

0 / 1 pts

Question 2: Floats

2(C) (1 points) Consider the number line represented by this format. What is the maximum distance between two adjacent normalized numbers? Round to the nearest power of 2 (it won't be exactly half way) and give the exponent (in decimal).

-9 (with margin: 0)

Unanswered



Question 5

0 / 1 pts

Question 2: Floats

2(D) (1 points) If you take the greatest magnitude positive number representable on this number line, multiply it by 2, and then subtract 5, what do you get? (Do NOT include the sign).

Infinity

infinity

Inf

inf

INFINITY

Unanswered



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Question 2: Floats

2(E-H) (6 points) Fill in the following, use round-by-two, as necessary:

Value	Binary Representation	Decimal value
-54	<input type="text"/>	<input type="text"/>
Rounding error for the above (Decimal difference: Original - Rounded)	-----	<input type="text"/>

Answer 1:

(You left this blank)

1 1100 110

11100110

1110 0110

1 1100 110 b

1 1100 110b

11100110b

11100110 b

1110 0110b

1110 0110 b

Answer 2:

(You left this blank)

Answer 3:

(You left this blank)

2

**3. (20 points) Assembly**

Please consider the following assembly code segment:

```
(gdb) disassemble loop
Dump of assembler code for function loop:
0x0000000000001180 <+0>:    endbr64
0x0000000000001184 <+4>:    push   %r15
0x0000000000001186 <+6>:    xor    %eax,%eax
0x0000000000001188 <+8>:    mov    $0x2,%r15d
0x000000000000118e <+14>:   push   %r14
0x0000000000001190 <+16>:   mov    %edx,%r14d
0x0000000000001193 <+19>:   push   %r13
0x0000000000001195 <+21>:   mov    %edi,%r13d
0x0000000000001198 <+24>:   push   %r12
0x000000000000119a <+26>:   push   %rbp
0x000000000000119b <+27>:   mov    %esi,%ebp
0x000000000000119d <+29>:   push   %rbx
0x000000000000119e <+30>:   sub    $0x8,%rsp
0x00000000000011a2 <+34>:   cmp    %r14d,%eax
0x00000000000011a5 <+37>:   jl     0x11c0 <loop+64>
0x00000000000011a7 <+39>:   add    $0x8,%rsp
0x00000000000011ab <+43>:   pop    %rbx
0x00000000000011ac <+44>:   pop    %rbp
0x00000000000011ad <+45>:   pop    %r12
0x00000000000011af <+47>:   pop    %r13
0x00000000000011b1 <+49>:   pop    %r14
0x00000000000011b3 <+51>:   pop    %r15
0x00000000000011b5 <+53>:   ret
0x00000000000011b6 <+54>:   cs nopw 0x0(%rax,%rax,1)      # Safe to ignore this line
0x00000000000011c0 <+64>:   xor    %r12d,%r12d
0x00000000000011c3 <+67>:   test   %r13d,%r13d
0x00000000000011c6 <+70>:   jle    0x1212 <loop+146>
0x00000000000011c8 <+72>:   nopl   0x0(%rax,%rax,1)
0x00000000000011d0 <+80>:   xor    %ebx,%ebx
0x00000000000011d2 <+82>:   test   %ebp,%ebp
0x00000000000011d4 <+84>:   jle    0x11f8 <loop+120>
0x00000000000011d6 <+86>:   cs nopw 0x0(%rax,%rax,1)      # Safe to ignore this line
0x00000000000011e0 <+96>:   mov    0x2e29(%rip),%rsi      # 0x4010 <stdout@GLIBC_2.2.5>
0x00000000000011e7 <+103>:  mov    $0x6f,%edi
```

```
0x00000000000011ec <+108>: add    $0x1,%ebx
0x00000000000011ef <+111>: call   0x1050 <putc@plt>
0x00000000000011f4 <+116>: cmp    %ebx,%ebp
0x00000000000011f6 <+118>: jne    0x11e0 <loop+96>
0x00000000000011f8 <+120>: mov    0x2e11(%rip),%rsi    # 0x4010 <stdout@GLIBC_2.2.5>
0x00000000000011ff <+127>: mov    $0xa,%edi
0x0000000000001204 <+132>: add    $0x1,%r12d
0x0000000000001208 <+136>: call   0x1050 <putc@plt>
0x000000000000120d <+141>: cmp    %r12d,%r13d
0x0000000000001210 <+144>: jne    0x11d0 <loop+80>
0x0000000000001212 <+146>: mov    0x2df7(%rip),%rsi    # 0x4010 <stdout@GLIBC_2.2.5>
0x0000000000001219 <+153>: mov    $0xa,%edi
0x000000000000121e <+158>: call   0x1050 <putc@plt>
0x0000000000001223 <+163>: mov    $0x1,%eax
0x0000000000001228 <+168>: cmp    $0x1,%r15d
0x000000000000122c <+172>: je     0x11a7 <loop+39>
0x0000000000001232 <+178>: mov    $0x1,%r15d
0x0000000000001238 <+184>: jmp    0x11a2 <loop+34>
```

End of assembler dump.
(gdb)

Unanswered



Question 7

0 / 4 pts

3(A) (4 points): How many loops are within this question?

3 (with margin: 0)

Unanswered



Question 8

0 / 4 pts

3(B) (4 points): How many if statements are within this question (that can't be considered part of the pre-test for a while or for loop)?

1 (with margin: 0)

0 (with margin: 0)

Unanswered



Question 9

0 / 4 pts

3(C) (4 points): Do two or more loops share the same initial conditions? In other words, are two or more loops, regardless of what is accomplished within the body of each loop, initialized to begin with the same relevant state, i.e. initial values for variables relevant to each iteration of the loop> (Answer "Yes", or "No")

Yes

No

Unanswered



Question 10

0 / 4 pts

3(D) (4 points): Do two or more loops share the same end point? In other words, do they stop when the loop control variable reaches the same value or condition? (Answer "yes" or "no").

Yes

No

Unanswered



Question 11

0 / 4 pts

3(E) (4 points): If the function is called as "loop(4, 2, 1, 0, 0)", how many non-empty (more nothing or blank space) lines of output are produced? Please answer with a specific number in decimal or, if it isn't possible to know given the code provided, please answer with "UNKNOWN".

8 (with margin: 0)



4. (20 points) **Structs and Alignment**

Consider the following struct:

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```
struct {  
    short s1[2];    // shorts are a 2-byte type  
    long l;        // longs are an 8-byte type  
    char c;        // chars are a 1-byte type  
    short s2[4];   // shorts are a 2-byte type  
} exam;
```

Assume a system which requires “natural alignment”, i.e. each type needs to be aligned to a multiple of its size (width).

Unanswered



Question 12

0 / 4 pts

4(A) (4 points): How many bytes of padding would the compiler place immediately after `s1`?

4 (with margin: 0)

Unanswered



Question 13

0 / 4 pts

4(B) (4 points): How many bytes of padding would the compiler place immediately after `l`?

0 (with margin: 0)

Unanswered



Question 14

0 / 4 pts

4(C) (4 points): How many bytes of padding would the compiler place immediately after `c`?

1 (with margin: 0)

Unanswered



Question 15

0 / 4 pts

4(D) (4 points): How many bytes would of padding would the compiler place immediately after `s2`?

6 (with margin: 0)

Unanswered



Question 16

0 / 4 pts

4(E) (4 points): At most, how many bytes could be saved by reordering the fields of the struct?

8 (with margin: 0)

Unanswered



Question 17

0 / 3 pts

Arrays Sizes (4 points)

Please consider the **original** `struct_exam` from above. Answer with only a decimal number.

Definition A

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```
struct exam e1[ 2 ][ 3 ][ 4 ];
```

5(a)(1.5 point): How many bytes are allocated to e1? (Write "UNKNOWN" if not knowable):

Bytes

Hint: Think sizeof()

5(b) (1.5 point): What is the offset, in bytes, from the beginning of the array to e1[1][2][3].s2[1]

Bytes

Answer 1:

(You left this blank)

768

768B

768 B

768 Bytes

768 bytes

768Bytes

768bytes

Answer 2:

(You left this blank)

768

96B

96 B

96Bytes

96 Bytes

96bytes

96 bytes

756

756B

756 B

756bytes

756 bytes

756Bytes

756 Bytes

Unanswered



Question 18

0 / 2 pts

Array Arithmetic

5(c) (2 points): How many bytes are allocated for `arr` ? Assume the x86-64 shark machines.

```
short *arr = malloc (10*sizeof(short));
```



8 (with margin: 0)



6. Switch Statement (10 points)

Please consider the following assembly, compiled on a shark machine:

(gdb) disassemble foo

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Dump of assembler code for function foo:

```
0x0000000000001200 <+0>:    endbr64
0x0000000000001204 <+4>:    lea   -0x3(%rsi),%eax
0x0000000000001207 <+7>:    cmp   $0x6,%eax
0x000000000000120a <+10>:   ja    0x1233 <foo+51>
0x000000000000120c <+12>:   lea   0xdf1(%rip),%rdx    # 0x2004 or 8196 decimal
0x0000000000001213 <+19>:   movslq (%rdx,%rax,4),%rax
0x0000000000001217 <+23>:   add   %rdx,%rax
0x000000000000121a <+26>:   notrack jmp *%rax
0x000000000000121d <+29>:   nopl  (%rax)
0x0000000000001220 <+32>:   lea   (%rdi,%rdi,8),%edi
0x0000000000001223 <+35>:   lea   -0x4(%rdi),%eax
0x0000000000001226 <+38>:   ret
0x0000000000001227 <+39>:   nopw  0x0(%rax,%rax,1)
0x0000000000001230 <+48>:   add   $0x1,%edi
0x0000000000001233 <+51>:   mov   %edi,%eax
0x0000000000001235 <+53>:   sub   %esi,%eax
0x0000000000001237 <+55>:   ret
0x0000000000001238 <+56>:   nopl  0x0(%rax,%rax,1)
0x0000000000001240 <+64>:   lea   (%rdi,%rdi,2),%eax
0x0000000000001243 <+67>:   ret
0x0000000000001244 <+68>:   nopl  0x0(%rax)
0x0000000000001248 <+72>:   mov   %edi,%eax
0x000000000000124a <+74>:   shr   $0x1f,%eax
0x000000000000124d <+77>:   add   %eax,%edi
0x000000000000124f <+79>:   mov   %edi,%eax
0x0000000000001251 <+81>:   sar   %eax
0x0000000000001253 <+83>:   ret
```

End of assembler dump.

(gdb) x/201d 0x2000

0x2000: 131073 -3556 -3553 -3524

0x2010: -3516 -3537 -3540 -3540

0x2020: -3924 -3920 -3879 -3873

0x2030: -3884 -3888 -3888 680997

0x2040: 990059265 60 6 -4128

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(gdb) x/20x 0x2000

0x2000: 0x00020001 0xfffff21c 0xfffff21f 0xfffff23c

0x2010: 0xfffff244 0xfffff22f 0xfffff22c 0xfffff22c

0x2020: 0xfffff0ac 0xfffff0b0 0xfffff0d9 0xfffff0df

0x2030: 0xfffff0d4 0xfffff0d0 0xfffff0d0 0x000a6425

0x2040: 0x3b031b01 0x0000003c 0x00000006 0xffffefe0

Unanswered



Question 19

0 / 2 pts

At what address does the jump table start? [jmp_start]

Note: Answer in HEX, prefixing with 0x, and leaving off any leading 0s.

0x2004

2004

0x 2004

8196

8196d

8196 d

Unanswered



Question 20

0 / 2 pts

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At what address does the code for the default case begin? [def_addr]

Note: Answer in HEX, prefixing with 0x, and leaving off any leading 0s.

<+51>

+51

0x1233

1233

<+51>

<foo+51>

4659

Unanswered



Question 21

0 / 2 pts

How many cases fall through to the next case after executing some of their own code?

1 (with margin: 0)

Unanswered



Question 22

0 / 2 pts

How many values managed by the jump table are to code for the default case?

1 (with margin: 0)

Unanswered



Question 23

0 / 2 pts

Assume that this code is for a "switch (x)", what is the maximum value of x managed by the jump table?

9 (with margin: 0)

Unanswered



Question 24

0 / 1 pts

Part 6(A): Caching

Given a cache described as follows:

- Number of sets: 4
- Total size: 64 bytes (not counting meta data like the valid bit or the r, w, and x bits, etc.)
- 1-way set associative
- Replacement policy: Set-wise LRU
- 8-bit addresses

6(A)(1) (1 point) How many bits for the block offset?

4 (with margin: 0)

Unanswered



Question 25

0 / 1 pts

Quiz submitted

Part 6(A)(1): Caching

Given a cache described as follows:

- Number of sets: 4
- Total size: 64 bytes (not counting meta data like the valid bit or the r, w, and x bits, etc.)
- 1-way set associative
- Replacement policy: Set-wise LRU
- 8-bit addresses

6(A)(3) (1 point) How many bits for the set index?

2 (with margin: 0)

Unanswered



Question 26

0 / 1 pts

Part 6(A)(2): Caching

Given a cache described as follows:

- Number of sets: 4
- Total size: 64 bytes (not counting meta data like the valid bit or the r, w, and x bits, etc.)
- 1-way set associative
- Replacement policy: Set-wise LRU
- 8-bit addresses

6(A)(2) (1 point) How many bits for the tag?

2 (with margin: 0)

Unanswered



Question 27

0 / 1 pts

6(A)(3): Caching

Given a cache described as follows:

- Number of sets: 4
- Total size: 64 bytes (not counting meta data like the valid bit or the r, w, and x bits, etc.)
- 1-way set associative
- Replacement policy: Set-wise LRU
- 8-bit addresses

What is the maximum stride (index step) size while sequentially accessing a 1D long (8-byte type) array to maintain a cache miss rate of no more than 25%?

1 (with margin: 0)

Unanswered



Question 28

0 / 14 pts

7(A-G) Caching (14 points, 2 point each):

Given a cache described as follows:

- Number of sets: 4
- Total size: 64 bytes (not counting meta data like the valid bit or the r, w, and x bits, etc.)
- 1-way set associative
- Replacement policy: Set-wise LRU
- 8-bit addresses

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Consider the following memory access trace, which is in order and begins at the beginning of time. For each of the following memory accesses, please indicate if it hits or misses, and if it misses. In the event of a miss, please indicate of the miss evicts another entry or allocates (makes use of) an unused one, or whether it is a capacity, conflict, or compulsory (cold) miss, as prompted.

Question Number	Address	Hit or Miss? Select one (per row):	Miss Type (Choose N/A for Hit)? Select one (per row)
-----	0x4A	-----	-----
-----	0x9D	-----	-----
7(A)	0x4B	[Select]	[Select]
7(B)	0xEA	[Select]	-----
7(C)	0x3C	[Select]	[Select]
7(D)	0x70	[Select]	-----
7(E)	0x84	[Select]	-----
7(F)	0x42	[Select]	[Select]

Answer 1:

(You left this blank)

Hit

Miss

Unknowable

Answer 2:

(You left this blank)

Conflict

Compulsory

Capacity

N/A

Answer 3:

(You left this blank)

Hit

Miss

Unknowable

Answer 4:

(You left this blank)

Hit

Miss

Unknowable

Answer 5:

(You left this blank)

Conflict

Compulsory

Capacity

N/A

Answer 6:

(You left this blank)

Hit

Miss

Unknowable

Answer 7:

(You left this blank)

Hit

Miss

Unknowable

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Answer 8:

(You left this blank)

Hit

Miss

Unknowable

Answer 9:

(You left this blank)

Compulsory

Conflict

Capacity

N/A

Unanswered



Question 29

0 / 2 pts

8. (2 points): Memory Hierarchy and Effective Access Time

Imagine a system with a main memory layered beneath a cache:

- The cache has a 4ns access time.
- The main memory has an access time of 8ns.
- In the event of a miss, memory access time and cache access time **do overlap**.
- Do not round

8(A) (2 points) What would the miss rate need to be for the effective access time to be 5ns?

0.25 (with margin: 0)

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Quiz Score: 0 out of 100