CS 240: Programming in C Final Exam Spring 2025

Practice Final Exam

Version I

Name: $lacksquare$				
Usernam	e:			

Read all instructions before beginning the exam.

- This exam is intended to be equally or more difficult than the past official midterm provided.
- You are encouraged to post on Ed Discussion, without hesitation, any sort of question you may have about this practice exam.
- This is a closed book examination. No material other than those provided for you are allowed.
- You need only a pencil and eraser for this examination. If you use ink, use either black or blue ink. If you use pencil, your writing must be dark and clearly visible.
- This examination contains an amount of material that a well-prepared student should be able to complete in less than one hour.
- This examination is worth a total of 150 points. Not all questions are worth the same amount. Plan your time accordingly.
- Write legibly. You should try to adhere to the course code standard when writing your solution(s). Egregious violations may result in point deductions.
- Read each question carefully and only do what is specifically asked for in that problem.
- Assume appropriate includes have been added to the code segments shown in the problems.
- Circle your answer in true or false questions. On this exam problem 18 is false.
- Some problems require several steps. Show all your work. Partial credit can only be rewarded to work shown.
- Write your username on EVERY page where indicated. Any page without a username will receive a zero for the material on that page.

Signature:

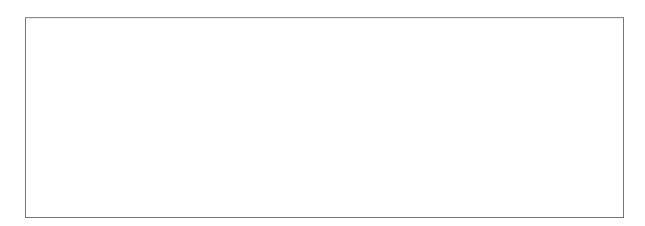
Do not open the examination booklet until instructed.

- 1. (1 point) True or False: The -S GCC flag will generate an executable.
- 2. (2 points) Write a single valid to compile the C file named purdue.c, that includes up.h, with warnings as errors adhering to the C17 standard. The executable should be named boilermaker. Multiple valid answers.

- 3. (2 points) Which of the following correctly represents the stages of the compilation process using GCC, in order?
 - A. Preprocessing \rightarrow Linking \rightarrow Compilation \rightarrow Object file creation
 - B. Compilation \rightarrow Object file creation \rightarrow Linking \rightarrow Preprocessing
 - C. Preprocessing \rightarrow Compilation \rightarrow Object file creation \rightarrow Linking
 - D. Object file creation \rightarrow Preprocessing \rightarrow Linking \rightarrow Compilation
- 4. (2 points) Write the conversion specifier to read a string composed of capital letters between T to L and digits from 0 to 9.

- 5. (1 point) True or False: fclose() will not produce a segmentation violation if a NULL pointer is passed in as an argument.
- 6. (3 points) The following is the creation and allocation of a simple single linked list node with an integer value. Assuming successful memory allocation, would the code produce an error? If yes then state why this is the case, if no then state the output.

```
struct node *new = calloc(1, sizeof(struct node));
assert(new);
new->value = 240;
printf("%d\n", new->next);
```



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7.	. (1 point) True or False: The number of characters printf() will print the array of characters (string), and the NUL terminator contained by it.	depends on the size of
8.	. (2 points) What is the value displayed by the printf() statement on a	64-bit system?
	<pre>void read(char name[32]) { printf("sizeof = %lu\n", sizeof(name)); }</pre>	
9.	. (3 points) Provide the fscanf() statement to read the name, Linus Torv 1991, from the following file input, ignore everything else. The file points variables to store the inputs are called name (string with a buffer size of 1	er is named fp, and the
	(Linus Torvalds)+(Linux:1991)	
10.	(3 points) Implement a header guard for a header file using the macro ide to implement the preprocessor directives in order of appearance.	ntifier UP_H. Make sure

11. (4 points) The following code segment has a signal handler that, when receiving a signal triggered by pressing CTRL-C, will cause the infinite while loop to end, terminating the program. However, when compiled at an unknown optimization level, pressing CTRL-C does not cause program termination as expected. Briefly explain what is causing the problem and propose a rewrite of a single existing non-blank line to fix the issue.

```
unsigned char stop = 0;
1.
2.
3.
    void signal_handler(int x) {
4.
        stop = 1;
    }
5.
6.
7.
    int main(void) {
8.
        signal(SIGINT, signal_handler);
9.
10.
        /* Pressing Ctrl-C invokes signal_handler() */
11.
12.
        while (!stop);
13. }
```

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12.	(1 point) True or False: pointed to by a file point	clearerr() clears the end-of-file and error in er.	dicators for the stream
13.	(2 points) Which of the scanf() when reading from	following can be used to create functionally om stdin?	equivalent behavior to
	A. fwrite()		
	B. sscanf()		
	C. fprintf()		
	D. fscanf()		
14.	` = ,	ure with fields in this order: a structure point be the size of the structure on a 32-bit system	
15.	` - ,	with fields in this order: an integer, a structure size of the union on a 64-bit system?	e pointer, and a charac-
16.	(1 point) True or False:	The heap grows upwards, from lower to higher	memory addresses.
17.	(2 points) Use typedef to node.	o define a new type node_t as an alias for an ex	disting structure struct

18. (1 point) True or False: In a pipelined food production process at McDonald's, it is essential to package fries before any other menu items to optimize throughput.

19. (3 points) What is the output of the following program? State the value displayed by printf(), undefined behavior, or error produced.

```
#define MOD(x) (-x)
int main() {
   int num = 10;
   printf("%d\n", MOD(num++));
}
```

20. (3 points) Which of the following variables have their corresponding values stored in the stack?

```
struct node {
    int val;
    struct node *next;
};

int a = 10;

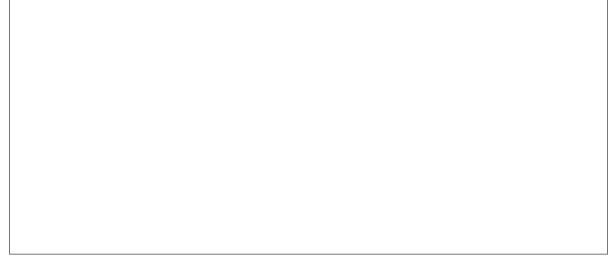
int main() {
    struct node *b = malloc(sizeof(struct node));
    static int c = 20;
    int *d = calloc(80, sizeof(int));
    char *e = "Bill Joy";
}
```

21. (3 points) What is the output of the following program? State the values displayed by printf(), undefined behavior, or error produced.

```
int x = 4;

void modifier() {
    int x = 1;
    x += 5;
    {
        extern int x;
        x *= 2;
    }
    printf("%d ", x);
}

int main() {
    modifier();
    printf("%d\n", x);
}
```



22. (2 points) What is the GDB command to resume the execution of the program until the next breakpoint or error?

unsigned long number;

union data {

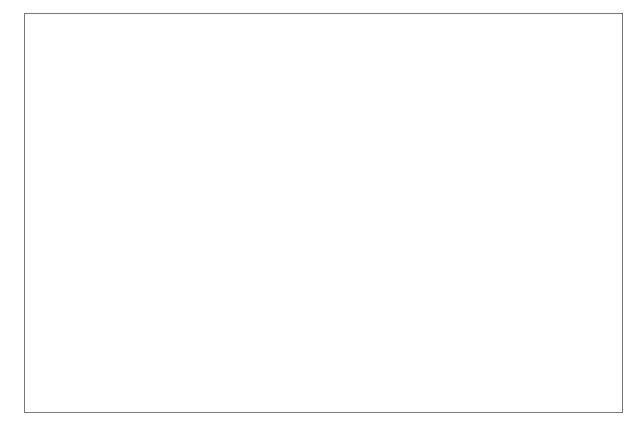
23. (3 points) For the following code segment, what is the value displayed by the printf() statement on a little-endian system.

int main() {

```
unsigned short bytes[4];
} unit;

unit.number = 0xA1B2C3D4E5F6A7B8;
printf("%x %x\n", unit.bytes[1], unit.bytes[3]);
}
```

24. (4 points) Write the necessary single declaration for the bit flags in this order: NONE, PASSPORT, BOARDING_PASS, I20, and I94. There are multiple answers.





25. (3 points) The following two code segments depict different implementations of a function. State which implementation is faster, and briefly explain why that is the case.

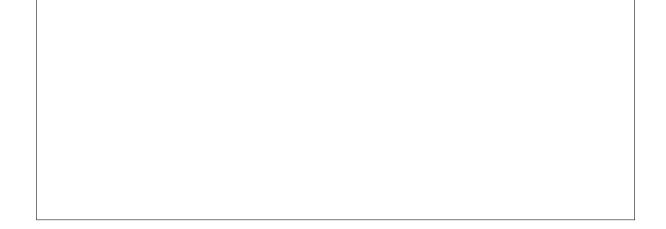
```
int first(int n) {
    if (n \le 1) {
        return 1;
    }
    return n * first(n - 1);
}
int second(int n) {
    int result = 1;
    for (int i = 1; i <= n; i++) {
        result *= i;
    }
    return result;
}
```

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6.	unsigned long. Revers	action convert_endian(), that takes in as an se the endianess of the argument and return it will be given for other approaches.	

. (2 points) Briefly explain what the unsigned keyword does.	27.

- 28. (1 point) True or False: You can assign a pointer to an array of the same type.
- 29. (2 points) Given the following code segment, what is the value displayed by the printf() statement.

```
int array[] = { 2, 1, 6, 2, -3, 0 };
int *p = &array[2];
printf("%d\n", (p -= array[1] - array[3])[*(p - 2)]);
```



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30.	•	_		,			the c bit s		_	nent	in p	robl	em 3	0, wl	hat w	ould	the	follo	owin	g pr	intf	() state-
			pri	ntf(("%1	u %	Lu\n'	", s	ize	of(8	karra	ay),	siz	eof(arra	y));						
31.	(1	pc	int)	Tru	ie oi	Fa.	se: f	wri	te()	do	es no	t re	quire	the	mem	ory a	ddre	esses	s of v	writt	en va	ariables.
32.															func ter aı							ers, and s.
33.							lly a ro, ii					y of	inte	gers,	arra	y, w	ith 1	100 1	rows	and	400	columns

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34.	pointer to the root of a tree_t, with a left and	Spring 2025 ursive function tree_height(), which takes is a preexisting binary tree. The tree is made dright pointer to a node. This function returns itself has a height of 0.	in a single parameter—a up of structures of type

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			ume that you have a doubly-lie integer value, val, a next poi	inked list node structure of type inter, and a prev pointer.						
	35. (4 points) Write a function remove_tail() that takes the <i>address</i> of a pointer to the doubly-linked list. Remove and deallocate the tail of the list, updating the relevant Assume the list is not empty.									

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m	nido	lle o	f a l	inked	list. Ma	ake the	argumen	that takes t point to t Assume the	the head o	of the list			

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37.	(2 points) Rewrite the struncation.	second line in this code segment for it to produce a	a result without intege
	<pre>int n = 10; double result =</pre>	n / 3;	
38.	(2 points) What statem	nent about C macros is false?	
	B. Macros can take ar	d by their values during the preprocessing stage. guments, similar to functions. ecked by the compiler.	
	V 2	nultiple lines using the '/' character.	
39.	` = ,	The srandom() function is used to seed the random generates pseudo-random numbers based on	
40.	(2 points) Define a vari be modified.	able named my_var that is a pointer to an intege	er whose pointer canno
41.	` - /	tion, my_realloc(), that when used in the followage specified new size by the second argument, for the second argument, for the second argument.	
	-	<pre>oc(10 * sizeof(int)); , 20 * sizeof(int));</pre>	

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Cont	inua	ion	of p	roblem 4		
					The strcmp() function stops comparing ner of the strings.	g two strings when it encount
(2 pc	ints)	Wh	at i	s the cor	nversion specifier for an unsigned sho	ort?

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14.	and posi	an intion	ntege speci	r—an ified b	Spring 2025 Function named toggle_bit() that takes two argument returns the result of flipping (toggling) the bit in the y the second argument. The function must use bitwise be given for other approaches.	first argument at the

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	, - ,	: A void pointer can be directly dereferenced	without typecasting.
46.	(2 points) Briefly expla	in a disadvantage of using global variables.	
47.	*	CC command to compile lookup.c into look	kup.o to be used later for
48.	and scanner.so. State	t directory (not in the library search path) the e the GCC command to compile and link the st the libraries, creating an executable named	C file in the current direc-

49.	(3 points) Write a macro named ABS that takes one argument and returns the absolute value of the argument.							

- 50. (2 points) Which of the following optimizations is not typically included with the -03 flag?
 - A. Aggressive function inlining.
 - B. Vectorization of loops.
 - C. Full debugging information generation.
 - D. Code motion to reduce runtime overhead.
- 51. (3 points) Given the following function and its corresponding stack dump, which line numbers contain the return address and integer i?

```
void dump(int x, int y) {
   int i = 0x11223344;
   long l = 0xbeefbeefdecafbad;
}
```

1.	0x7ffffffffe3b0:	01	00	00	00	00	00	00	00
2.	0x7fffffffe3a8:	43	11	40	00	00	00	00	00
3.	0x7fffffffe3a0:	b0	e3	ff	ff	ff	7f	00	00
4.	0x7fffffffe398:	ad	fb	ca	de	ef	be	ef	be
5.	0x7fffffffe390:	00	00	00	00	44	33	22	11
6.	0x7fffffffe388:	2c	11	40	00	00	00	00	00

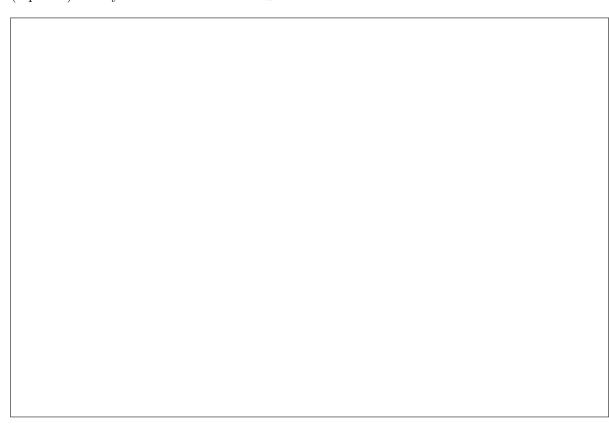
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	/-						
52.	(2 p	oints) Wł	hat de	oes A	ASLR stand for?	
53.	(2 p	oints) Wł	hich c	of the	e following statements about system calls is true?	
	A.	Syste	em c	alls a	llow	a program to directly interact with the CPU regist	ers.
	В.	Syste	em ca	alls a	re ex	ecuted entirely in user space without involving the	kernel.
	С.	Syste	em ca	alls pr	rovide	e an interface for programs to request services from	the operating system.
	D.	-	em o guage		are o	only available in assembly language and cannot l	be used in high-level
54.	` -		·			that supports double-buffering, state the prototype ore the next video blit or lock returns and after a v	
	- Swa	po vic	100 0	direr		To the liest video ont of foot feeting and after a v	

56. (1 point) True or False: GPIO stands for generic purpose in and out.

57. (2 points) Briefly describe an advantage of using goto.

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			d links magic.c and ca	sting.c into a static libr	

59. (2 points) Briefly describe what socket() does.



- 60. (2 points) What is the primary purpose of the function SDL_LoadBMP()?
 - A. To initialize the SDL library for image handling.
 - B. To load a BMP image file into an SDL_Surface.
 - C. To save an SDL_Surface as a BMP file on disk.
 - D. To apply a color filter to a surface.
- $61.\ (1\ \mathrm{point})$ True or False: \mathtt{sscanf} NUL terminates strings.
- 62. (1 point) We hope you enjoyed CS 240. Good luck in the final!