## CS 240: Programming in C Final Exam Spring 2025

Practice Final Exam

Version I

$\mathbf{Name}$ :	
Usernan	ne·

## Read all instructions before beginning the exam.

- This exam is intended to be equally or more difficult than the past official final exam 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:

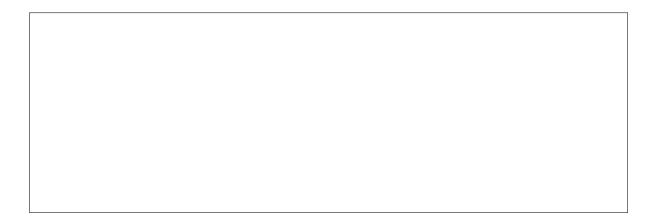
Do not open the examination booklet until instructed.

- 1. (1 point) True or False: The -S GCC flag will generate an executable.
- 2. (2 points) Write a single valid GCC command 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 the size of the array of characters (	<del>-</del>	
8.	(2 points) What is the value display	ayed by the printf() statement	ent on a 64-bit system?
	<pre>void read(char name[32]) {     printf("sizeof = %lu\r }</pre>		
9.	(3 points) Provide the fscanf() sta 1991, from the following file input, variables to store the inputs are cal	ignore everything else. The f	file pointer is named fp, and the
	(Linus Torvalds)+(Linux:19	991)	
10.	(3 points) Implement a header guar to implement the preprocessor dire	_	

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;

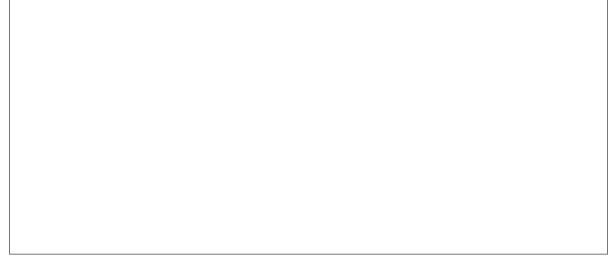
int main() {
    struct node *b = malloc(sizeof(struct node));
    static int c = 20;
    int *d = calloc(80, sizeof(int));
    char *e = "Bill Joy";
}
```

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?

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23. (3 points) For the following code segment, what is the value displayed by the printf() statement on a little-endian 64-bit system.

```
int main() {
    union data {
        unsigned long number;
        unsigned short bytes[4];
    } unit;

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

24. (4 points) Write a single declaration of an enum, essentials, with the members, NONE, OWL, WAND, BROOM, and LETTER, in order, such that NONE has a value of 0 and each subsequent member must occupy a distinct increasing power-of-two value starting from the least significant bit.



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.

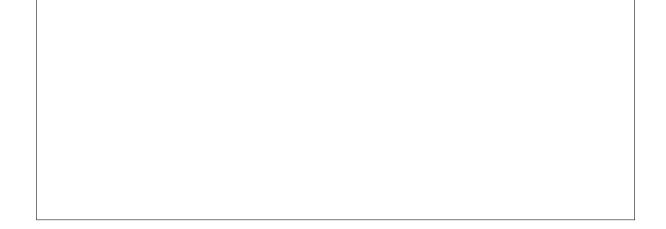
```
int first(int n) {
    if (n \le 1) {
        return 1;
    }
    return n * first(n - 1);
}
int second(int n) {
    int result = 1;
    for (int i = 1; i <= n; i++) {
        result *= i;
    }
    return result;
}
```

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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.	

0.00		
	. (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. (2 mo	(2 points) Based on the ment output in a 64-bit	e code segment in problem 29, what would the fo	
	printf("%lu %lu	<pre>\n", sizeof(&amp;array), sizeof(array));</pre>	
31.	(1 point) True or False	e: fwrite() does not require the memory address	sses of written variables.
32.		unction prototype of a function func that takes function that returns a void pointer and that takes	
33.	(2 points) Dynamically and initialize it to zero	y allocate a 2D array of integers, array, with 10 p, in a single line.	00 rows and 400 columns

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35.	a doubly-linked list and returns	void. Remove and deallocate the ta	il of the list, updating the

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mic	ddle ( id. I	of a l	inked	list. Ma	ke the a	_head()	that takes point to the Assume the	he head o	f the list.	This fu	unction ret	urı

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37.	(2 points) Rewrite the second line in this code segment for it to produce a result variation.	ithout integer
	<pre>int n = 10; double result = n / 3;</pre>	
38.	(2 points) What statement about C macros is false?	
	<ul><li>A. Macros are replaced by their values during the preprocessing stage.</li><li>B. Macros can take arguments, similar to functions.</li><li>C. Macros are type-checked by the compiler.</li></ul>	
	D. Macros can span multiple lines using the '/' character.	
39.	(1 point) True or False: The srandom() function is used to seed the random number and the random() function generates pseudo-random numbers based on that seed	
40.	(2 points) Define a variable named my_var that is a pointer to an integer whose pointed.	pointer cannot
41.	(5 points) Write a function named toggle_bit() that takes two arguments—an and an integer—and returns the result of flipping (toggling) the bit in the first ar position specified by the second argument. The function must use bitwise operations. No credit will be given for other approaches.	gument at the

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	a	C 11 41		
(	Continuation	of problem 41		

42. (1 point) True or False: The strcmp() function stops comparing two strings when it encounters the NUL terminator in either of the strings.

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43. (3 points) What is the output of the following program? State the values displayed by printf(), undefined behavior, or error produced.

```
int main() {
    if (printf("A") || printf("B")) {
        printf("C");
    }
    printf("\n");
}
```

44. (3 points) Write a function, my\_realloc(), that when used in the following example, will reallocate memory to the specified new size by the second argument and have ptr point to the new region. Set the pointer to NULL if reallocation fails.

```
int *ptr = malloc(10 * sizeof(int));
my_realloc(&ptr, 20 * sizeof(int));
```

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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 lookry without linker errors.	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;
}
```

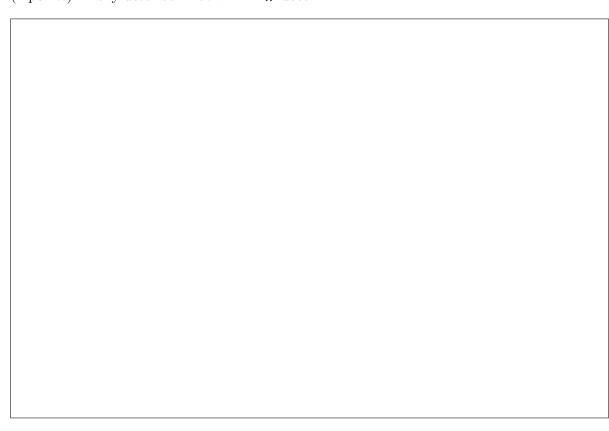
1.	0x7ffffffffe3b0:	01	00	00	00	00	00	00	00
2.	0x7fffffffe3a8:	43	11	40	00	00	00	00	00
3.	0x7fffffffe3a0:	b0	e3	ff	ff	ff	7f	00	00
4.	0x7fffffffe398:	ad	fb	ca	de	ef	be	ef	be
5.	0x7fffffffe390:	00	00	00	00	44	33	22	11
6.	0x7fffffffe388:	2c	11	40	00	00	00	00	00

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52.	(2 points) What does AS	LR stand for?	
53.	(2 points) Which of the f	ollowing statements about system calls is true	?
	, -	program to directly interact with the CPU reg	
	· ·	uted entirely in user space without involving t	
	C. System calls provide a	an interface for programs to request services fro	om the operating system.
	D. System calls are on languages.	ly available in assembly language and canno	ot be used in high-level
54.	· - /	at supports double-buffering, state the prototy before the next video blit or lock returns and	

- 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 cas	ting.c into a static library

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!