

Fall, 2023

Name: \_\_\_\_\_

(Please: *don't* write your id number here!)

COP 3402 — Systems Software

## Midterm Exam

### Directions for this Test

This test has 9 questions and pages numbered 1 through 4.

This test will be for the rest of the class time (about half of the time for today's class) and is be closed book.

However, you may use one (1) page of notes on one (1) side of a standard 8.5 by 11 inch sheet of paper. These notes can either be hand-written or printed, but if printed, then the font must be a 9-point or larger font. These notes must be turned in with the exam.

If you need more space, use the back of a page. Note when you do that on the front.

Before you begin, please take a moment to look over the entire test so that you can budget your time.

### For Grading

Question:	1	2	3	4	5	6	7	8	9	Total
Points:	5	10	10	20	10	10	10	15	10	100
Score:										

All questions on this exam are related to the course outcome [Concepts].

1. (5 points) What is the main job of a compiler? (Circle the **one** correct answer's letter.)
  - A. To translate from a high-level programming language into the language of a machine.
  - B. To translate from an assembly language into a high level language.
  - C. To take note of all the ways that a programmer can do something.
  - D. To produce confusing error messages and make it difficult for people who are not expert to write programs, thus increasing salaries for expert programmers.
  
2. (10 points) How does the jump to register (JR) instruction in the Simplified RISC Machine (SRM) affect the SRM's PC register? (Circle the **one** correct answer's letter.)
  - A. The address given in the instruction is registered with the company, and used by the company to deliver a personal computer during the next business day.
  - B. If the first register given in the instruction contains a non-zero value, then the computer jumps to the address in the second register given in the instruction, by setting the PC to the address contained in the second register.
  - C. The address contained in the register named by the instruction replaces that address in the PC, so that the next instruction executed is the instruction at that address.
  - D. If the second register given in the instruction contains a non-zero value, then the computer jumps to the address in the first register given in the instruction, by setting the PC to the address contained in the first register.
  
3. (10 points) Why does every program that is supposed to finish (terminate) need to execute an EXIT instruction? (Circle the **one** correct answer's letter.)
  - A. Because, without an EXIT instruction, the VM will keep on interpreting each word as an instruction, adding 4 to the PC and executing instructions.
  - B. A program doesn't need to execute an EXIT instruction at all, because the VM will notice when the program is done and stop (terminate) the program's execution by itself.
  - C. Because, if the program does not execute an EXIT instruction, then the machine will catch on fire because it will not be able to find an exit.
  - D. Because, without an EXIT instruction the program would feel incomplete.

4. (20 points) Select all of the following that are valid reasons why static scoping is useful. (Circle **each letter** that is a valid reason.)
- A. It prevents variables from changing their values.
  - B. It allows the meaning of a function to rely on the most recent definition of each variable that is still active.
  - C. It describes an algorithm for searching for the most recent definition of a variable that is still active on the runtime stack.
  - D. It allows the meaning of a function to be understood from the closest textually surrounding definition of each variable.
  - E. It allows variables to be addressed using lexical addresses at compile time.
5. (10 points) Suppose the integer variable  $v$  is declared in a procedure  $p$  and that  $v$  has lexical address  $(0, 1)$ . What instruction and parameters in the SRM could be used to write a value into  $v$  while executing procedure  $p$ ? (Circle the **one** correct answer's letter.)
- A. The Store Word (SW) instruction, with the frame pointer register's value ( $GPR[\$fp]$ ) as the base address and an offset of 1, which signifies 4 bytes.
  - B. The Store Byte (SB) instruction, with the global pointer register's value ( $GPR[\$gp]$ ) as the base address and an offset of 8 bytes.
  - C. The print string (PSTR) instruction, with the global pointer register's value ( $GPR[\$gp]$ ) as the base address and an offset of 4 bytes.
  - D. The print string (PSTR) instruction, with the value of register  $\$a0$  containing the address of  $v$ , which could be formed from the value of the global pointer register, ( $GPR[\$gp]$ ), and an offset of 4 bytes.
6. (10 points) In the SRM, what kind of address is stored in the registers, such as the PC? (Circle the **one** correct answer's letter.)
- A. A street address.
  - B. A lexical address
  - C. A word address.
  - D. A byte address.

7. (10 points) In the SRM, what determines the initial value stored in the global pointer (`$gp`) register when the program starts running? (Circle the letter of the **one** correct answer.)
- A. It is always 1024.
  - B. It is the value of the data start field of the binary object file's header.
  - C. It is the smallest power of two that is larger than the last instruction's word address.
  - D. It is the smallest power of two that is larger than the last instruction's byte address.
8. (15 points) When writing a modular C program, when is it a good idea to use `#include "f.c"` to include a file `f.c` from inside another C file, `main.c`? (Circle the letter of the **one** correct answer.)
- A. Always; one should always include all of the `.c` files in `main.c`, so that the program can be compiled just by compiling `main.c`.
  - B. Whenever there is code that is in `main.c` calls a function that is defined in `f.c`, as this avoids errors when linking the program together.
  - C. Never; `main.c` should only include a header file `f.h` that declares the functions defined in `f.c`.
9. (10 points) Select all of the valid statements below that correctly describe the number of definitions and declarations of a given name that C allows in a given scope? (Circle the letter of **each** correct answer.)
- A. There can be as any number of definitions of a name visible in a scope, as long as there is at least one definition of each name that is used and all the definitions are the same.
  - B. There can be as any number of declarations of a name visible in a scope, as long as there is at least one declaration of each name that is used and all the declarations are the same.
  - C. There must be exactly one declaration of a name visible in a scope for each name that is used in that scope.
  - D. There must be exactly one definition of a name visible in a scope for each name that is used in that scope.