CISS360: Computer Systems and Assembly Language
Quiz q0601

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Open `main.tex` and enter answers (look for `answercode`, `answerbox`, `answerlong`). Turn the page for detailed instructions. To rebuild and view pdf, in bash shell execute `make`. To build a gzip-tar file, in bash shell execute `make s` and you'll get `submit.tar.gz`.

Q1. Write a MIPS program gets an array of integers from the user and store the integers in the data segment. The array ends when the user enters -1; -1 is not part of the list. For instance if the array of integers is $4, 2, 3, 5, 7$, the user enters $4, 2, 3, 5, 7, -1$. (You may assume that the the list contains at least one integer.) The program then stores the size of the array and the values of the array in the data segment (at the beginning).

The program then scans the array of integers and prints the minimum value of the array.

For instance if the users enter $4, 2, 3, 5, 7, -1$, then $5, 4, 2, 3, 5, 7$ are stored in the data segment and 2 is printed.

Your code should be similar to a C/C++ program that uses a pointer to scan the array of integers instead of an index variable.

Answer:

```
                    .text
        .globl main

main:
        # get array of integers from the user
        addi  $t0, $zero, -1            # initialize index to 0
        la    $t1, numbers          #load address of numbers
input_loop:
        li    $v0, 5
        syscall
        move  $s0, $v0
        beq   $s0, $t0, exit_loop    # terminate when -1 entered
        sw    $s0, 0($t1)           # store  the input value in the array at current index
        addi  $t2, $t2, 1           # increment the size
        addi  $t1, $t1, 4           # move to the next element
        j     input_loop
```

```
exit_loop:
        # find and print the minimum value
        la     $t1, numbers         # reset address
        addi   $t2, $t2, -1            # up to n - 1
        lw     $t3, 0($t1)          # load the first element of the array
        move   $t4, $t3             # initialize min with the first element
        addi   $t1, $t1, 4          # move to the next element

find_min_loop:
        beq    $t2, $zero, print_min  # exit when the entire array is scanned

        lw     $t3, 0($t1)          # load the current element of the array
        blt    $t3, $t4, update_min # if t3 < t4, update min

        addi   $t1, $t1, 4          # move to the next element
        addi   $t2, $t2, -1         # decrement the counter
        j      find_min_loop

update_min:
        move    $t4, $t3        # move t3 to t4
        addi    $t1, $t1, 4
        addi    $t2, $t2, -1
        j       find_min_loop

print_min:
        li      $v0, 1
        move    $a0, $t4
        syscall

        li      $v0, 10
        syscall

        .data
numbers: .word 0
```

Instructions

In `main.tex` change the email address in

```
\renewcommand\AUTHOR{jdoe5@cougars.ccis.edu}
```

to yours. In the bash shell, execute "`make`" to recompile `main.pdf`. Execute "`make v`" to view `main.pdf`. Execute "`make s`" to create `submit.tar.gz` for submission.

For each question, you'll see boxes for you to fill. You write your answers in `main.tex` file. For small boxes, if you see

```
1 + 1 = \answerbox{}.
```

you do this:

```
1 + 1 = \answerbox{2}.
```

`answerbox` will also appear in "true/false" and "multiple-choice" questions.

For longer answers that needs typewriter font, if you see

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
\end{answercode}
```

you do this:

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
int x;
\end{answercode}
```

`answercode` will appear in questions asking for code, algorithm, and program output. In this case, indentation and spacing is significant. For program output, I do look at spaces and newlines.

For long answers (not in typewriter font) if you see

```
What is the color of the sky?
\begin{answerlong}
\end{answerlong}
```

you can write

```
What is the color of the sky?
\begin{answerlong}
The color of the sky is blue.
\end{answerlong}
```

For students beyond 245: You can put LaTeX commands in `answerbox` and `answerlong`.

A question that begins with "T or F or M" requires you to identify whether it is true or false, or meaningless. "Meaningless" means something's wrong with the statement and it is not well-defined. Something like "$1+_2$" or "$\{2\}^{\{3\}}$" is not well-defined. Therefore a question such as "Is $42 = 1+_2$ true or false?" or "Is $42 = \{2\}^{\{3\}}$ true or false?" does not make sense. "Is $P(42) = \{42\}$ true or false?" is meaningless because $P(X)$ is only defined if X is a set. For "Is $1 + 2 + 3$ true or false?", "$1 + 2 + 3$" is well–defined but as a "numerical expression", not as a "proposition", i.e., it cannot be true or false. Therefore "Is $1 + 2 + 3$ true or false?" is also not a well-defined question.

When writing results of computations, make sure it's simplified. For instance write 2 instead of $1 + 1$. When you write down sets, if the answer is $\{1\}$, I do not want to see $\{1, 1\}$.

When writing a counterexample, always write the simplest.

Here are some examples (see `instructions.tex` for details):

1. T or F or M: $1 + 1 = 2$ ..... T
2. T or F or M: $1 + 1 = 3$ ..... F
3. T or F or M: $1+^2 =$ ..... M
4. $1 + 2 =$ 3
5. Write a C++ statement to declare an integer variable named `x`.

   ```
   int x;
   ```

6. Solve $x^2 - 1 = 0$.

   Since $x^2 - 1 = (x - 1)(x + 1)$, $x^2 - 1 = 0$ implies $(x - 1)(x + 1) = 0$. Therefore $x - 1 = 0$ or $x = -1$. Hence $x = 1$ or $x = -1$.

7. Which is true? C
   (A) $1 + 1 = 0$
   (B) $1 + 1 = 1$
   (C) $1 + 1 = 2$
   (D) $1 + 1 = 3$
   (E) $1 + 1 = 4$