CS 3432 Fall 2021Lab 6:

Exception Handling

For this lab, you will implement an exception handler for a RISC-V processor running in bare metal mode. Libgloss is a free board support package (BSP) commonlyused with gcc and g++ to produce a fully linked executable for an embedded system. We will use the libgloss port for RISC-V machine mode that implements system calls through the Berkeley Host-Target Interface (HTIF), together with our RISC-V toolchain, to simulate running a RISC-V executable in machine mode on a RISC-V processor. The libgloss port is called libgloss-htif and can be found here: https://github.com/ucb-bar/libgloss-htif.

The exception that you will handle is an ecall trapexception caused by a Venus ecall instruction. Implementing the exception handler will allow you to run RISC-V assembly programs that use Venus ecall instructions over a simulated bare metal RISC-V processor using spike. The Venus ecall instructions are described here: https://github.com/kvakil/venus/wiki/Environmental-CallsYou are required to implement print_int, sbrk, exit, print_character, and exit2. For extra credit, you may also implement print_string.

The tasks that you should carry out are as follows:

1.Follow the instructions at https://github.com/ucb-bar/libgloss-htifto install libgloss-htif so that it works with your already installed RISC-V toolchain.

2.Follow the instructions at https://github.com/ucb-bar/libgloss-htifto compile, link, and run some example RISC-V programs in bare metal mode using your RISC-V gcc compiler, libgloss-htif, and spike.

3.In the same manner,assemble and run the provided example RISC-V assembly program ecall.s that contains two ecall instructions. Use your RISC-V objdump program to disassemble the executable and find the address of the main function. Use spike in debug mode to set a breakpoint at this address and step through the main function until an exception occurs. Examine the contents of the machine mode CSRs related to exception handling. Step through several instructions to observe how the exception is currently handled.

4.Write a trap handler that will emulate the ecall instructions using system calls available through HTIF. (See instructions at the bottom of the libgloss-htif readme).

The example ecall.s program is as follows:

```
.text
.globl  main
main:
addi sp,sp,-16
sw    ra,0(sp)
li      a0,9
li     a1,4
ecall
li      a4,5
```

```
sw      a4,0(a0)
lw      a1,0(a0)
li      a0,1
ecall
lw      ra,0(sp)
addi    sp,sp,16
li      a0, 10
ecall
```

The assembly program was translated from the following C program:#include <stdio.h>#include <stdlib.h>int main() {int *p = malloc(sizeof(int));*p = 5;printf("%d", *p);}We will work on and grade Lab 6 the last week of class during the lab session.