Shanghai Jiaotong University
Introduction to Computing Systems

# Introduction to Computing Systems Experiment4

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# 1 How to Use my Program

- Turn asm into obj.
- You should load user_program.obj and interrupt_service_routine separately. **No matter which program is loaded first, please set PC to x3000 to run user program.**
- **Set the breakpoint in x301D**, which is halt.
- **If you wish to see clear the 10 times of echoes of your input character**, you can set a breakpoint at x2017.

# 2 How my Program Works

## 2.1 Systematic Decomposition of User Program

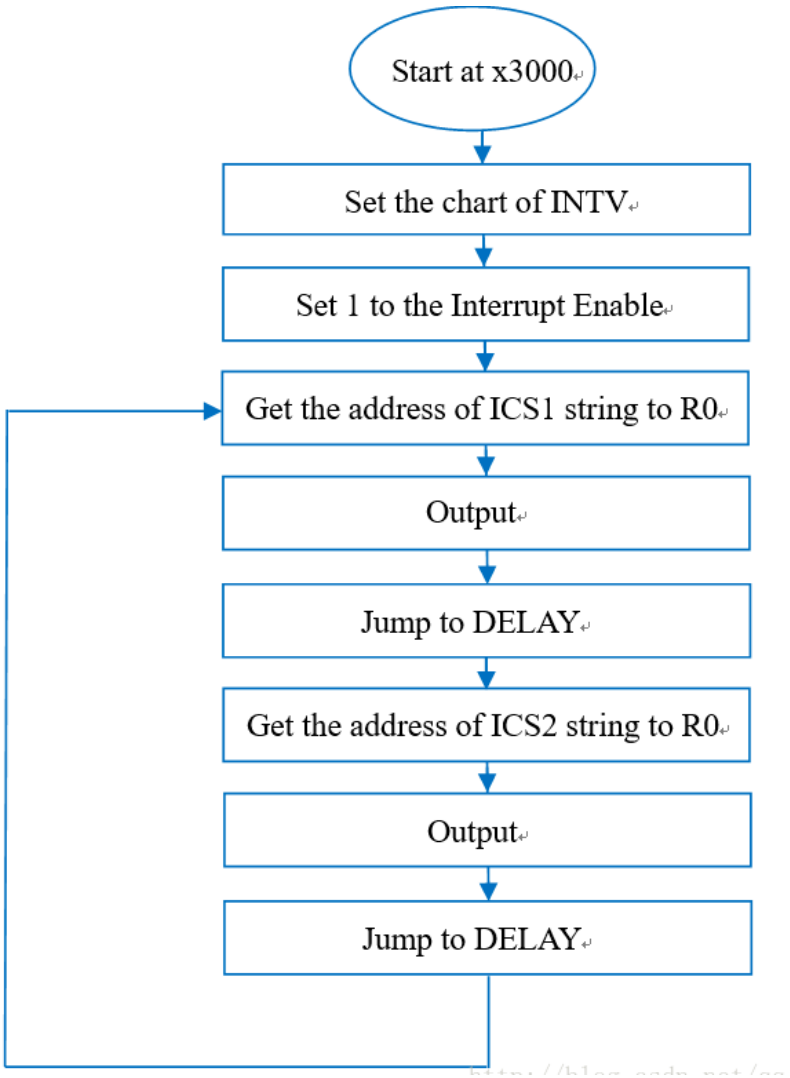


Figure 1: Systematic Decomposition of User Program

Here, ICS1 is either CHECKER1, which begins with "**"(pattern 1 line 1), or CHECKER3(pattern 2 lien 1), which begins with "##".ICS2 is either CHECKER2(2) or CHECKER4 (pattern 2 lien 2).

First, we initialize stack pointer, set1 to the interrupt enable, and set the interrupt vector table.
To output the patterns on the monitor, we first get the address of the string using LEA. We use TRAP x22 to output, and in order to slow down the counter, we use a subroutine: counter, to count from 2500 to 1 and display next line.

## 2.2 Systematic Decomposition of Interrupt Service Routine

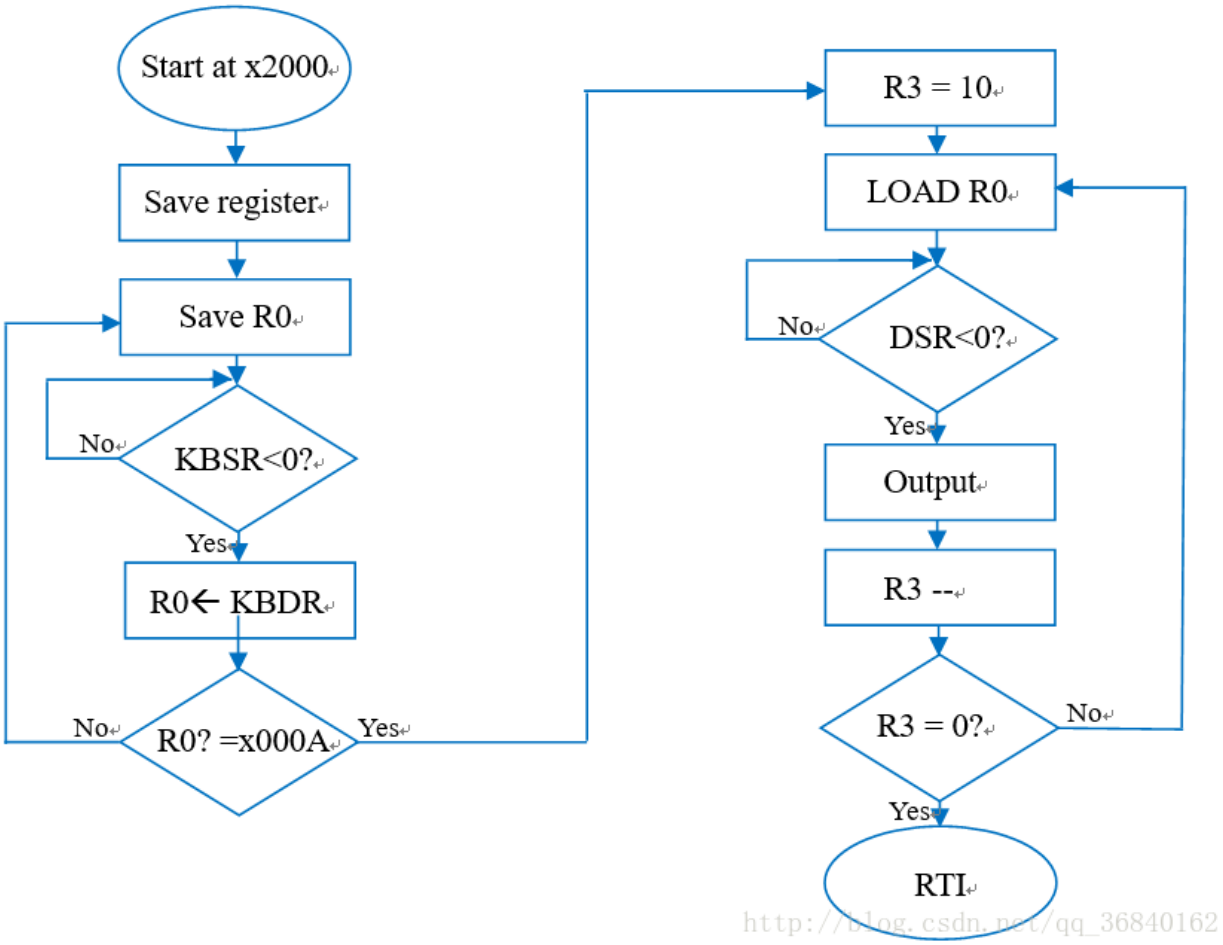


Figure 2: Systematic Decomposition of Interrupt Service Routine

First, we need to save registers to be used in service routine.
For input character, we first examine KBSR, if the Ready bit is set, we read the character and store it. Then we examine whether the second input is Enter, which is x0001. If it is so, we start to output.
For output, we have to loop for 10 times. Thus, we set R3 to be 10 and countdown. Everytime we chekc the DSR, if the Ready bit is set, we output the character, and R3 decrements.
At the end of the service routine, we restore registers, and RTI to restore PSR and PC.

## 2.3 Interaction between Two to Change the Pattern

The experiment requires us to change pattern between # and * once an interrupt occurs. This is done by examining whether the value in R5 is an even number or an odd number by using AND,R5,#0. First, R5 is initialized to 0. Since it is an even number, we go to * REPUT session. Once we go to interrupt service routine, and R5 increments, changing from an even number to an odd number or from an odd nubmer to an even number. So that when we go back to user program, the pattern is changed.

## 2.4 A glimpse of Output

If we set a breakpoint at x3017, the console window is like this:

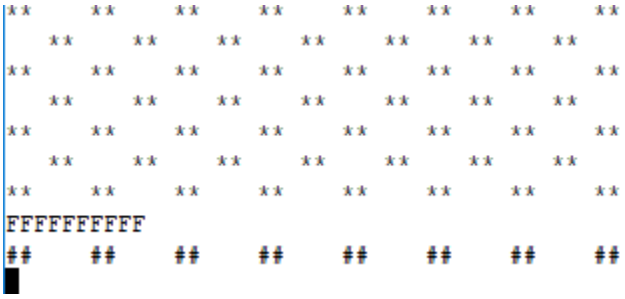


Figure 3: Console Window