Introduction

The device is a game that is based on the electronic game, “Simon Says.” Instead of only having 4 options of pressing buttons in the traditional electronic game, the LEDs and switches of the Basys3 Board are used.

After clicking the reset button to initiate the game, a single LED is flashed. Now the game waits for the corresponding switch to be flipped on and off. After the correct switch is flipped on and off, the game repeats the first switch and adds another switch for the player to copy. Now the player must flip on and off the first and the second switch in sequence. This sequence must be repeated continuously adding one more LED until a sequence of 10 LEDs blink.

To beat the game you must repeat the sequence of all 10 corresponding switches back to the board, then the VGA will display a “You Win!” screen. The game does not have a time frame to complete the sequence, however you must wait for the sequence of LEDs to finish before you start flipping the corresponding switches. The switches will read once it is flipped back off.

Software Design

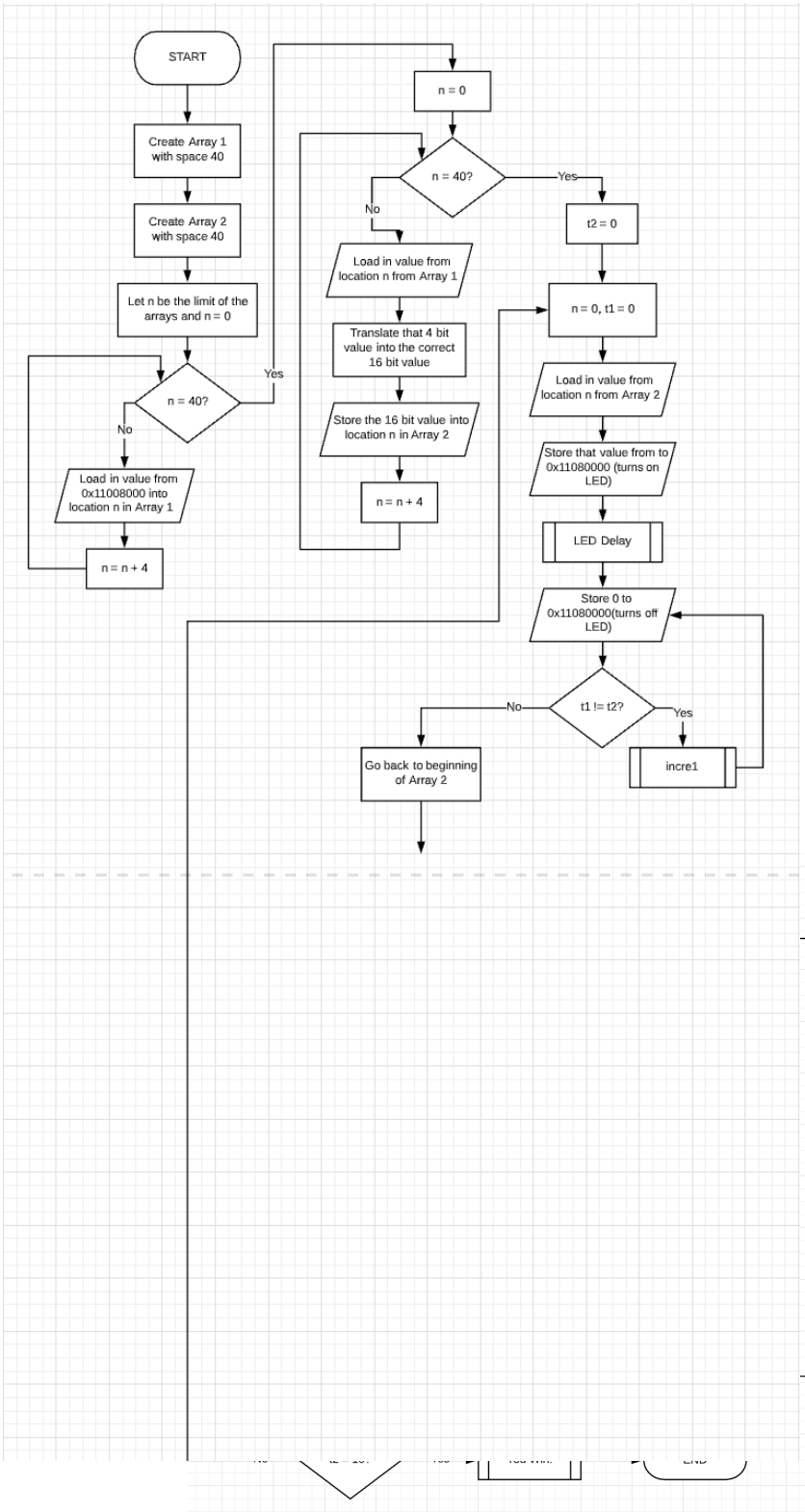
In the beginning of the program, the Start Screen appears and two Arrays are created. We do this because Array 1 contains the 4 bit values from the random number generator and Array 2 contains the 16 bit values from the Array 1 that has been translated into the correct LED.

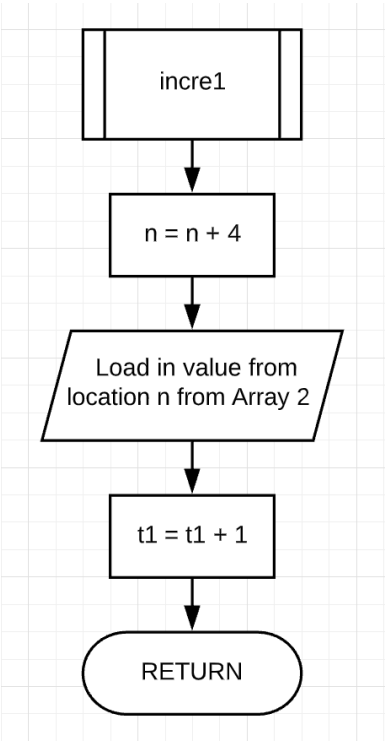
In the program, t1 is used to indicate the index of Array 2, and t2 is used to indicate where the limit of t1 is in Array 2. Once t2 reaches 10, the program ends and calls the “You Win!” screen. Also, Once t1 is equal to t2, we increment t2 by one until it reaches 10.

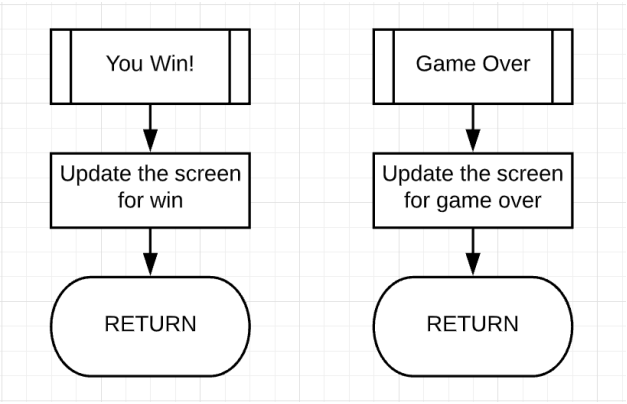
After initializing everything, we use t2 and t1 to show the LEDs, and we created a delay so that the LED would be visible for a time and then turn off by loading 0 into the address of the LED.

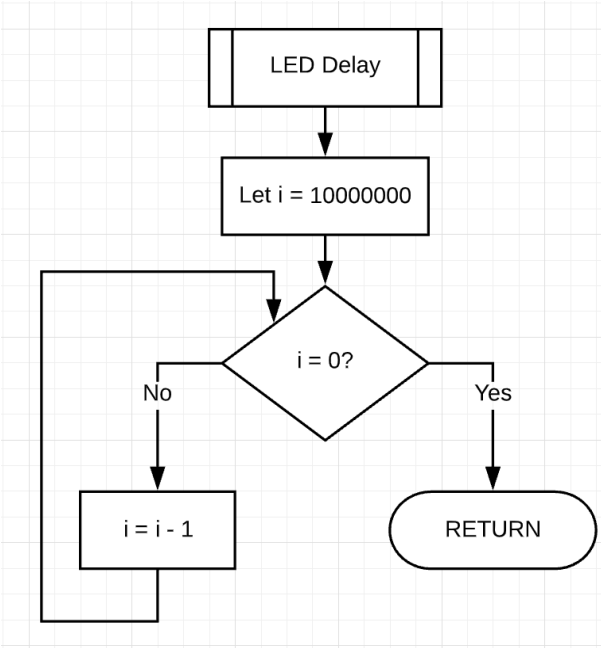
After the LEDs show, we then create a loop to wait until a switch is read, in which we create a switch delay so that it will keep loading in the value from the switch address until it reads something that is not zero. Likewise, it does not move on until the switch turns back off, or reads zero. This way, the switch has to be turned off for the program to continue.

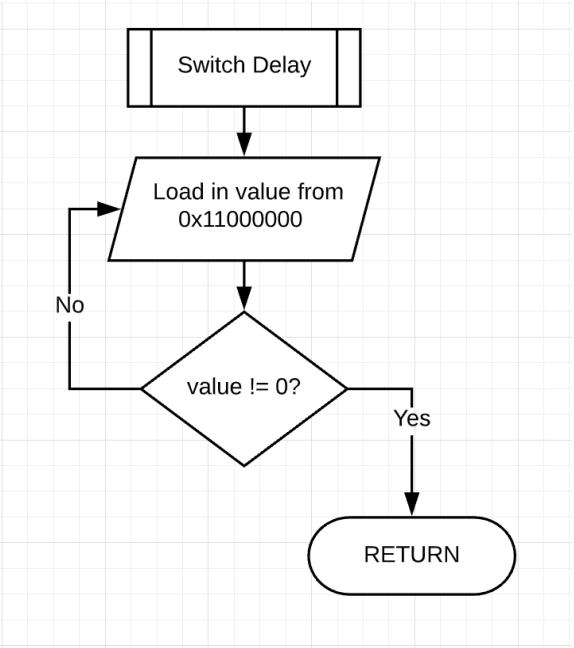
As before, t2 is also used to determine how many switches need to be turned on and off. Between each turn on and off of each switch, Array 2 index of t1 is used to compare to the input of the switch. If they are equal, then t1 is incremented by one and repeats that instruction. If they are not equal, then the program goes to the Game Over Screen and t2 is used to determine what the score is.


START
Create Array 1 with space 40
Create Array 2 with space 40
Let n be the limit of the arrays and n = 0
n = 40?
Yes
No
Load in value from 0x11008000 into location n in Array 1
n = n + 4
n = 0
n = 40?
Yes
No
Load in value from location n from Array 1
Translate that 4 bit value into the correct 16 bit value
Store the 16 bit value into location n in Array 2
n = n + 4
t2 = 0
n = 0, t1 = 0
Load in value from location n from Array 2
Store that value from to 0x11080000 (turns on LED)
LED Delay
Store 0 to 0x11080000(turns off LED)
t1 != t2?
No
Yes
Go back to beginning of Array 2
incre1


incre1
n = n + 4
Load in value from location n from Array 2
t1 = t1 + 1
RETURN


You Win!
Update the screen for win
RETURN
Game Over
Update the screen for game over
RETURN


LED Delay
Let i = 10000000
i = 0?
No
Yes
i = i - 1
RETURN


Switch Delay
Load in value from 0x11000000
No
value != 0?
Yes
RETURN

Operation Manual

Simon Says with LEDs and Switches

❑ Getting Started

For the ports, use Figure 1.

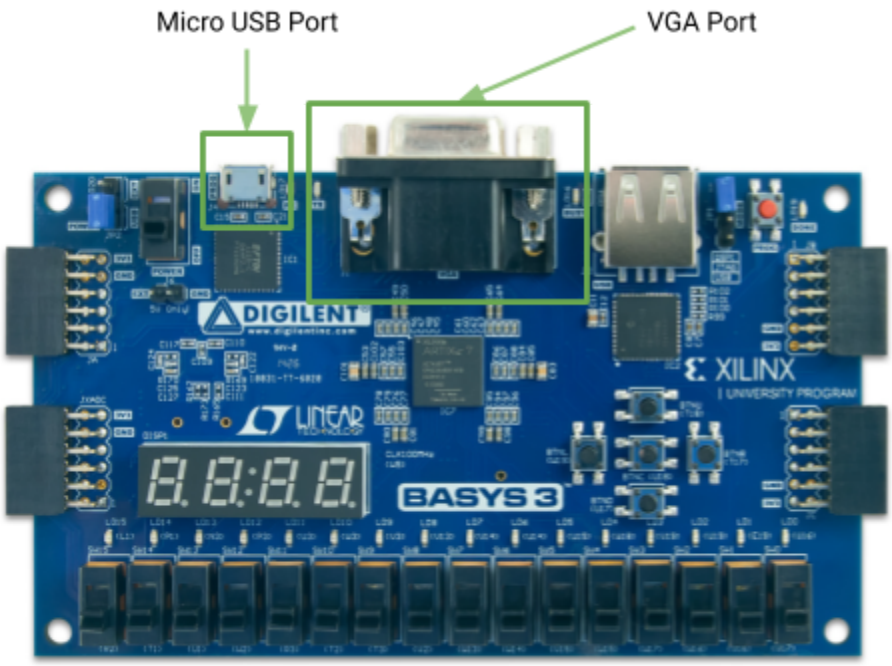


Figure 1. BASYS 3 Board Ports

To start, plug one end of the VGA cable to the BASYS Board and the other end to the monitor. Then, plug in the Micro USB cable into the board and the end into the computer. Plug the monitor into an outlet as well.

After generating the bitstream, open the hardware manager on the left and and make sure the board is connected. Then, program the device.

❑ **How to Use the Controls**

For the controls, refer to Figure 2.

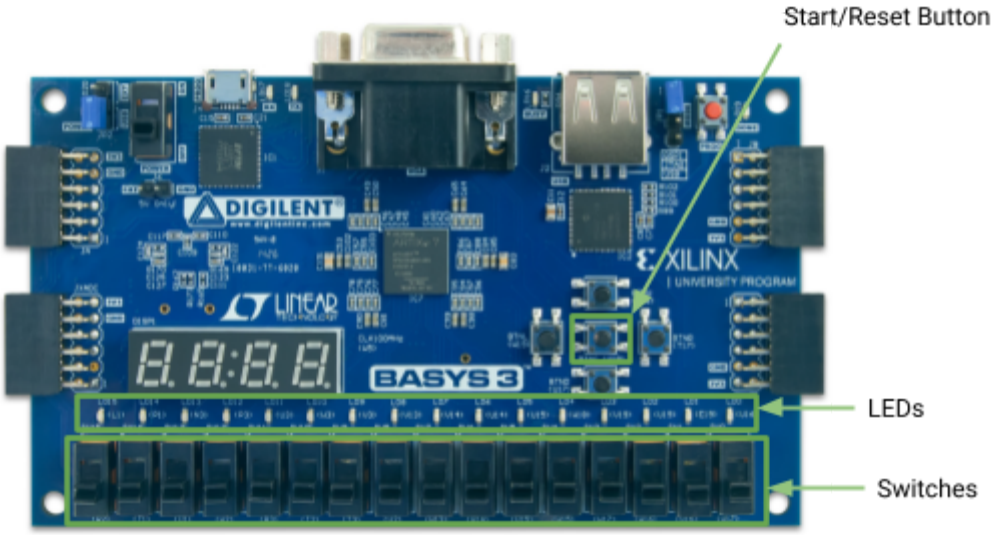


Figure 2. BASYS 3 Board

❑ **Start/Reset Button**

The middle button starts and resets the game. When the game is programmed to the BASYS 3 Board, the screen will prompt you with the image in Figure 3.

Figure 3. Start Screen

When the game is over, the screen will prompt with the image in Figure 4.

Figure 4. Game Over Screen

- **Switches**

  There are 16 black switches located at the bottom of the BASYS 3 Board, as seen in Figure 1.

  Each switch corresponds to the LED above it. To make sure the game starts correctly, make sure that the switches are completely down. To register the switch during the game, only flip the switches one at a time.

- **How to Play**

  When the game is first programmed onto the BASYS 3 Board, press the Start/Reset Button.

  Then, one LED will light up and then turn off. After, flip the corresponding switch on and off.
  After flipping the switch, the same LED will turn on and off, and another LED will turn on and off.
  After the two LEDs turn on and off, flip the corresponding switch one at a time, and flip the switch off before flipping the next switch on.

  Throughout the course of the game, a new LED will be added to the existing sequence of LEDs, and the goal is to flip the corresponding switches in the order of the shown LEDs until the sequence of the LEDs reach 10.

  Otherwise if the wrong switch is flipped on and off, then the board will prompt a “Game Over” screen as seen in Figure 4 and will prompt you to press the Start/Reset Button. As well in the bottom left, it will display your score out of 10, based on how many correct sequences that were flipped.

  After flipping 10 switches in the sequence of 10 LEDs, the screen will display a “You Win!” screen.

Appendix

```
# This program will execute the "Simon Says" game, along with displaying
# outputs on the VGA
#
# written by M. Tran and A. Callman

	.data
Array:		.space 40			#space for the first Array

Array2:		.space 40			#space for the second Array

	.text

.eqv BG_COLOR, 0x00		# black (0/7 red, 0/7 green, 0/3 blue)
.eqv VG_ADDR, 0x11100000
.eqv VG_COLOR, 0x11140000

main:
	li sp, 0x10000		#initialize stack pointer
	li s2, VG_ADDR		#load MMIO addresses
	li s3, VG_COLOR

	# fill screen using default color
	call draw_background
	call startScreen

begin:
	la	t0, Array		# set t0 to location of the start of the Array
	addi	s5, t0, 40		# set the limit of the array to 40
read:	beq	s5, t0, set
```

```
	lw	t2, 0x11008000		# load random numbers to address until it is
				# filled up with 10 random numbers
	sw	t2, 0(t0)
	addi	t0, t0, 4
	j read


# Since the values in Array are 4 bit values, we want them to translate into
# sixteen bit values, where it 0001 would translate to 0000000000000001, 0011
# translates to 0000000000000100, and so on
set:	la	t0, Array	# here we want to translate the values from start of Array
	la	t1, Array2
	li	s5, 0
	addi	s5, t0, 40

transfer:
	beq	s5, t0, set2		# branches if we reached the end of Array
	li	t4, 15
	lw	t5, 0(t0)		# load the value from Array
	bltu	t5, t4, fourt		# branches if the value from Array is less than 15
	li	t5, 0x8000		# 1000000000000000
ledTranslate:
	sw	t5, 0(t1)	# after it translates, stores the 16 bit value into Array2
	addi	t0, t0, 4		# goes to next index
	addi	t1, t1, 4
	j transfer

set2:
	addi	t2, x0, 0		#count for 10
	addi	s6, x0, 10		#limit of array
```

```
       addi   t0, t0, -40         #go to beginning of array
       li     a4, 0
       li     t1, 0
       add    t2, t1, x0

beginLED:
       la     t0, Array2
       li     t1, 0
       lw     t5, 0(t0)           # loads LED value from Array2
back:  sw     t5, 0x11080000, a6  # turns LED on
       j delay                          # delays led so it shows visibly

endDelay:
       sw     x0, 0x11080000, a6  # turns LED off
       bne    t2, t1, increl      # goes to increl if there is more than 1 in sequence
       j checkSwitches                  # jumps to check the switches

increl:
       addi   t0, t0, 4
       lw     t5, 0(t0)
       addi   t1, t1, 1
       j back

# Here it checks the sequence of switches that the user inputs.

checkSwitches:
       la     t0, Array2          # resets the location of Array2
       li     t1, 0
       lw     t5, 0(t0)           # gets the LED value
again: lw     t6, 0x11000000             # only reads the switches if a switch is high
```

```
	beqz	t6, again		# if no switch is read, then it loops again
	j delaySwitch		# jumps to delay the switches so that it will continue
				# once the switch is back to 0

# Here it checks the value of the LED to the value of the switch
endDelaySwitch:
	bne	t5, s11, over		# goes to the game over screen if they are not equal
	bne	t2, t1, incre2		# it it is correct, then checks to see if it reaches
				# the end of the sequence of switches, if not then
				# goes to incre2
	addi	t2, t2, 1		# adds 1 to t2 so that it will go to the next value
in Array2
	beq	t2, s6, win		# if it reaches the end of Array2, then go to the
youWin screen
	j beginLED			# if not, then goes back to the sequence of LEDs

incre2:
	addi	t0, t0, 4
	lw	t5, 0(t0)
	addi	t1, t1, 1
	j again


# Here it calls the win screen
win:	call draw_background		# makes the background black
	call youWin			# writes you win! on the screen
	j reset


over:	##update score and display game over
	call draw_background
```

```
       call gameOver              #go to game over screen
over2: lw     t3, 0x11000020             #if button is pressed start over
       beqz   t3, over2
       j reset



       #resets the game
reset: la     t0, Array
       addi   s5, t0, 40
       j begin

done: j done



#delays-------------------------------------------------------------------------
#this delay waits to read the switch until the switch is off
delaySwitch:
       li     s11, 0
       add    s11, t6, x0
notOff1:
       lw     t6, 0x11000000             #loops until the switch is off
       bnez   t6, notOff1
       j endDelaySwitch

#this delay gives time for the led to show and then to turn off
delay:
       li     a4, 10000000
loop3: beqz   a4, dd
       addi   a4, a4, -1
       j loop3
```

```
dd:    j endDelay



#LEDs-------------------------------------------------------------------------

#this section helps decode the unput of the first array to translate it into readable
LEDs in Array2

fourt: li     t4, 14

       bltu   t5, t4, threet

       li     t5, 0x4000          #0100000000000000

       j ledTranslate

threet:       li     t4, 13

       bltu   t5, t4, twelv

       li     t5, 0x2000          #0010000000000000

       j ledTranslate

twelv: li     t4, 12

       bltu   t5, t4, ele

       li     t5, 0x1000          #0001000000000000

       j ledTranslate

ele:   li     t4, 11

       bltu   t5, t4, ten

       li     t5, 0x800           #0000100000000000

       j ledTranslate

ten:   li     t4, 10

       bltu   t5, t4, nin

       li     t5, 0x400           #0000010000000000

       j ledTranslate

nin:   li     t4, 9

       bltu   t5, t4, eight

       li     t5, 0x200           #0000001000000000

       j ledTranslate

eight: li     t4, 8
```

```
       bltu   t5, t4, sev
       li     t5, 0x100           #0000000100000000
       j ledTranslate
sev:   li     t4, 7
       bltu   t5, t4, six
       li     t5, 0x80            #0000000010000000
       j ledTranslate
six:   li     t4, 6
       bltu   t5, t4, five
       li     t5, 0x40            #0000000001000000
       j ledTranslate
five:  li     t4, 5
       bltu   t5, t4, four
       li     t5, 0x20            #0000000000100000
       j ledTranslate
four:  li     t4, 4
       bltu   t5, t4, three
       li     t5, 0x10            #0000000000010000
       j ledTranslate
three: li     t4, 3
       bltu   t5, t4, two
       li     t5, 0x8                    #0000000000001000
       j ledTranslate
two:   li     t4, 2
       bltu   t5, t4, one
       li     t5, 0x4                    #0000000000000100
       j ledTranslate
one:   li     t4, 1
       bltu   t5, t4, zer
       li     t5, 0x2                    #0000000000000010
```

```
	j ledTranslate
zer:
	li	t5, 0x1			#0000000000000001
	j ledTranslate

# Press Button To Start Screen----------------------------------------

startScreen:
	li a3, 0xFF		# color white (7/7 red, 7/7 green, 3/3 blue)
	#P
	li a0, 8		# X coordinate
	li a1, 20		# starting Y coordinate
	li a2, 26		# ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
	li a0, 11		# X coordinate
	li a1, 21		# starting Y coordinate
	li a2, 22		# ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
	li a0, 9		# start X coordinate
	li a1, 20		# Y coordinate
	li a2, 10		# ending X coordinate
	call draw_horizontal_line  # must not modify: a3, s2, s3
	li a0, 9		# start X coordinate
	li a1, 23		# Y coordinate
	li a2, 10		# ending X coordinate
	call draw_horizontal_line  # must not modify: a3, s2, s3

	#R
	li a0, 13		# X coordinate
	li a1, 20		# starting Y coordinate
```

```
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 16           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 22           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 16           # X coordinate
li a1, 24           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 14           # start X coordinate
li a1, 20           # Y coordinate
li a2, 15           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 14           # start X coordinate
li a1, 23           # Y coordinate
li a2, 15           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#E
li a0, 18           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 19           # start X coordinate
li a1, 20           # Y coordinate
li a2, 20           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 19           # start X coordinate
li a1, 23           # Y coordinate
```

```
li a2, 19           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 19           # start X coordinate
li a1, 26           # Y coordinate
li a2, 20           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#S
li a0, 22           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 22           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 22           # X coordinate
li a1, 25           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 25           # X coordinate
li a1, 21           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 25           # X coordinate
li a1, 24           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 23           # start X coordinate
li a1, 20           # Y coordinate
li a2, 24           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 23           # start X coordinate
li a1, 23           # Y coordinate
li a2, 24           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
li a0, 23           # start X coordinate
li a1, 26           # Y coordinate
li a2, 24           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#S
li a0, 27           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 22           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 27           # X coordinate
li a1, 25           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 30           # X coordinate
li a1, 21           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 30           # X coordinate
li a1, 25           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 28           # start X coordinate
li a1, 20           # Y coordinate
li a2, 29           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 28           # start X coordinate
li a1, 23           # Y coordinate
li a2, 29           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 28           # start X coordinate
li a1, 26           # Y coordinate
```

```
li a2, 29           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3



#B
li a0, 35           # X coordinate
li a1, 20           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 38           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 22           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 38           # X coordinate
li a1, 24           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 36           # start X coordinate
li a1, 20           # Y coordinate
li a2, 37           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 36           # start X coordinate
li a1, 23           # Y coordinate
li a2, 37           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 36           # start X coordinate
li a1, 26           # Y coordinate
li a2, 37           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
#U
li a0, 40           # X coordinate
li a1, 20           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 43           # X coordinate
li a1, 20           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 41           # start X coordinate
li a1, 26           # Y coordinate
li a2, 42           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#TT
li a0, 46           # X coordinate
li a1, 20           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 45           # start X coordinate
li a1, 20           # Y coordinate
li a2, 47           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 50           # X coordinate
li a1, 20           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 49           # start X coordinate
li a1, 20           # Y coordinate
li a2, 51           # ending X coordinate
```

```
call draw_horizontal_line  # must not modify: a3, s2, s3



#O
li a0, 53           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 56           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 54           # start X coordinate
li a1, 20           # Y coordinate
li a2, 55           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 54           # start X coordinate
li a1, 26           # Y coordinate
li a2, 55           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#N
li a0, 58           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 61           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
```

```
li a0, 59           # start X coordinate
li a1, 20           # Y coordinate
li a2, 60           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#To
#T
li a0, 67           # X coordinate
li a1, 20           # starting Y coordinate
li a2, 26           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 66           # start X coordinate
li a1, 20           # Y coordinate
li a2, 68           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#O
li a0, 70           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 73           # X coordinate
li a1, 21           # starting Y coordinate
li a2, 25           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 71           # start X coordinate
li a1, 20           # Y coordinate
li a2, 72           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 71           # start X coordinate
```

```
li a1, 26           # Y coordinate
li a2, 72           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3



#S
li a0, 22           # X coordinate
li a1, 31           # starting Y coordinate
li a2, 33           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 22           # X coordinate
li a1, 37           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 26           # X coordinate
li a1, 31           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 26           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 37           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 23           # start X coordinate
li a1, 30           # Y coordinate
li a2, 25           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 23           # start X coordinate
li a1, 34           # Y coordinate
li a2, 25           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 23           # start X coordinate
li a1, 38           # Y coordinate
```

```
li a2, 25           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#T
li a0, 32           # X coordinate
li a1, 30           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 30           # start X coordinate
li a1, 30           # Y coordinate
li a2, 34           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#A
li a0, 38           # X coordinate
li a1, 31           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 42           # X coordinate
li a1, 31           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 39           # start X coordinate
li a1, 30           # Y coordinate
li a2, 41           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 39           # start X coordinate
li a1, 34           # Y coordinate
li a2, 41           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
#R
li a0, 46           # X coordinate
li a1, 30           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 50           # X coordinate
li a1, 31           # starting Y coordinate
li a2, 33           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 50           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 47           # start X coordinate
li a1, 30           # Y coordinate
li a2, 49           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 47           # start X coordinate
li a1, 34           # Y coordinate
li a2, 49           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#T
li a0, 56           # X coordinate
li a1, 30           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 54           # start X coordinate
li a1, 30           # Y coordinate
```

```
	li a2, 58           # ending X coordinate
	call draw_horizontal_line  # must not modify: a3, s2, s3

	j begin

# You Win! Screen ---------------------------------------------------------------
youWin:
	li a3, 0xFF         # color white (7/7 red, 7/7 green, 3/3 blue)
	li a0, 30           # X coordinate
	li a1, 22           # starting Y coordinate
	li a2, 25           # ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
	li a0, 34           # X coordinate
	li a1, 22           # starting Y coordinate
	li a2, 25           # ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
	li a0, 32           # X coordinate
	li a1, 26           # starting Y coordinate
	li a2, 30           # ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
	li a0, 31           # start X coordinate
	li a1, 26           # Y coordinate
	li a2, 33           # ending X coordinate
	call draw_horizontal_line  # must not modify: a3, s2, s3

	#O
	li a0, 37           # X coordinate
	li a1, 23           # starting Y coordinate
	li a2, 29           # ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
```

```
li a0, 41           # start X coordinate
li a1, 23           # Y coordinate
li a2, 29           # ending Y coordinate
call draw_vertical_line  # must not modify: a3, s2, s3
li a0, 38           # start X coordinate
li a1, 22           # Y coordinate
li a2, 40           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 38           # start X coordinate
li a1, 30           # Y coordinate
li a2, 40           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#U
li a0, 44           # X coordinate
li a1, 22           # starting Y coordinate
li a2, 29           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 48           # start X coordinate
li a1, 22           # Y coordinate
li a2, 29           # ending Y coordinate
call draw_vertical_line  # must not modify: a3, s2, s3
li a0, 45           # start X coordinate
li a1, 30           # Y coordinate
li a2, 47           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#Win
#W
li a0, 29           # X coordinate
```

```
li a1, 35           # starting Y coordinate
li a2, 43           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 31           # X coordinate
li a1, 39           # starting Y coordinate
li a2, 42           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 33           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 43           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 30           # X coordinate
li a1, 43           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 32           # X coordinate
li a1, 43           # Y coordinate
call draw_dot  # must not modify s2, s3

#I
li a0, 38           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 43           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 36           # start X coordinate
li a1, 35           # Y coordinate
li a2, 40           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 36           # start X coordinate
li a1, 43           # Y coordinate
li a2, 40           # ending X coordinate
```

```
call draw_horizontal_line  # must not modify: a3, s2, s3


#N
li a0, 43           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 43           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 44           # X coordinate
li a1, 36           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 45           # X coordinate
li a1, 38           # starting Y coordinate
li a2, 40           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 46           # X coordinate
li a1, 40           # starting Y coordinate
li a2, 42           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 47           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 43           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3


li a0, 50           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 41           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 50           # X coordinate
li a1, 43           # Y coordinate
```

```
        call draw_dot  # must not modify s2, s3

        ret



# Scores ---------------------------------------------------------------------
zeroScore:
        #zero
        li a0, 30           # X coordinate
        li a1, 51           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 51           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 31           # start X coordinate
        li a1, 50           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 31           # start X coordinate
        li a1, 56           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        ret

        #one
oneScore:
        li a0, 32           # X coordinate
        li a1, 50           # starting Y coordinate
```

```
        li a2, 56           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 31           # start X coordinate
        li a1, 56           # Y coordinate
        li a2, 33           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 31           # X coordinate
        li a1, 51           # Y coordinate
        call draw_dot  # must not modify s2, s3
        ret

twoScore:
        #two
        li a0, 30           # X coordinate
        li a1, 55           # starting Y coordinate
        li a2, 56           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 51           # starting Y coordinate
        li a2, 52           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 31           # start X coordinate
        li a1, 50           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 30           # start X coordinate
        li a1, 56           # Y coordinate
        li a2, 33           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 30           # X coordinate
```

```
        li a1, 51           # Y coordinate
        call draw_dot  # must not modify s2, s3
        li a0, 31           # X coordinate
        li a1, 54           # Y coordinate
        call draw_dot  # must not modify s2, s3
        li a0, 32           # X coordinate
        li a1, 53           # Y coordinate
        call draw_dot  # must not modify s2, s3
        ret

threeScore:
        #three
        li a0, 30           # X coordinate
        li a1, 51           # Y coordinate
        call draw_dot  # must not modify s2, s3
        li a0, 30           # X coordinate
        li a1, 55           # Y coordinate
        call draw_dot  # must not modify s2, s3
        li a0, 32           # X coordinate
        li a1, 53           # Y coordinate
        call draw_dot  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 51           # starting Y coordinate
        li a2, 52           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 54           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 31           # start X coordinate
```

```
        li a1, 50           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 31           # start X coordinate
        li a1, 56           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        ret

fourScore:
        #four
        li a0, 30           # X coordinate
        li a1, 50           # starting Y coordinate
        li a2, 53           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 50           # starting Y coordinate
        li a2, 56           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 30           # start X coordinate
        li a1, 53           # Y coordinate
        li a2, 33           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        ret

fiveScore:
        #five
        li a0, 30           # X coordinate
        li a1, 50           # starting Y coordinate
        li a2, 53           # ending Y coordinate
```

```
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 54           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 30           # start X coordinate
        li a1, 50           # Y coordinate
        li a2, 33           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 30           # start X coordinate
        li a1, 53           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 30           # start X coordinate
        li a1, 56           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        ret

sixScore:
        #six
        li a0, 30           # X coordinate
        li a1, 52           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 53           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 32           # start X coordinate
```

```
        li a1, 50           # Y coordinate
        li a2, 33           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 30           # start X coordinate
        li a1, 53           # Y coordinate
        li a2, 33           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 31           # start X coordinate
        li a1, 56           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 31           # X coordinate
        li a1, 51           # Y coordinate
        call draw_dot  # must not modify s2, s3
        ret

sevenScore:
        #seven
        li a0, 33           # X coordinate
        li a1, 50           # starting Y coordinate
        li a2, 56           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 30           # start X coordinate
        li a1, 50           # Y coordinate
        li a2, 33           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        ret

eightScore:
        #eight
```

```
        li a0, 30           # X coordinate
        li a1, 51           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 51           # starting Y coordinate
        li a2, 55           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 31           # start X coordinate
        li a1, 50           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 31           # start X coordinate
        li a1, 53           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        li a0, 31           # start X coordinate
        li a1, 56           # Y coordinate
        li a2, 32           # ending X coordinate
        call draw_horizontal_line  # must not modify: a3, s2, s3
        ret

nineScore:
        #nine
        li a0, 30           # X coordinate
        li a1, 51           # starting Y coordinate
        li a2, 53           # ending Y coordinate
        call draw_vertical_line  # must not modify s2, s3
        li a0, 33           # X coordinate
        li a1, 51           # starting Y coordinate
```

```
	li a2, 55           # ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
	li a0, 31           # start X coordinate
	li a1, 50           # Y coordinate
	li a2, 32           # ending X coordinate
	call draw_horizontal_line  # must not modify: a3, s2, s3
	li a0, 31           # start X coordinate
	li a1, 53           # Y coordinate
	li a2, 32           # ending X coordinate
	call draw_horizontal_line  # must not modify: a3, s2, s3
	li a0, 31           # start X coordinate
	li a1, 56           # Y coordinate
	li a2, 32           # ending X coordinate
	call draw_horizontal_line  # must not modify: a3, s2, s3
	ret


# Game Over Screen
--------------------------------------------------------------------------------


gameOver:
	#GAME OVER ------------------------
	#G
	li a3, 0xFF         # color white (7/7 red, 7/7 green, 3/3 blue)
	li a0, 30           # X coordinate
	li a1, 23           # starting Y coordinate
	li a2, 29           # ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
	li a0, 34           # X coordinate
	li a1, 27           # starting Y coordinate
	li a2, 30           # ending Y coordinate
	call draw_vertical_line  # must not modify s2, s3
```

```
li a0, 31           # start X coordinate
li a1, 22           # Y coordinate
li a2, 34           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 31           # start X coordinate
li a1, 30           # Y coordinate
li a2, 34           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 33           # start X coordinate
li a1, 26           # Y coordinate
li a2, 34           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#A
li a0, 37           # X coordinate
li a1, 23           # starting Y coordinate
li a2, 30           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 41           # X coordinate
li a1, 23           # starting Y coordinate
li a2, 30           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 38           # start X coordinate
li a1, 22           # Y coordinate
li a2, 40           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 38           # start X coordinate
li a1, 26           # Y coordinate
li a2, 40           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
#M
li a0, 44           # X coordinate
li a1, 22           # starting Y coordinate
li a2, 30           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 47           # X coordinate
li a1, 22           # starting Y coordinate
li a2, 30           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 50           # X coordinate
li a1, 23           # starting Y coordinate
li a2, 30           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 44           # start X coordinate
li a1, 22           # Y coordinate
li a2, 49           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#E
li a0, 53           # X coordinate
li a1, 23           # starting Y coordinate
li a2, 29           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 54           # start X coordinate
li a1, 22           # Y coordinate
li a2, 57           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 54           # start X coordinate
```

```
li a1, 26           # Y coordinate
li a2, 55           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 54           # start X coordinate
li a1, 30           # Y coordinate
li a2, 57           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#O
li a0, 30           # X coordinate
li a1, 36           # starting Y coordinate
li a2, 42           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 34           # start X coordinate
li a1, 36           # Y coordinate
li a2, 42           # ending Y coordinate
call draw_vertical_line  # must not modify: a3, s2, s3
li a0, 31           # start X coordinate
li a1, 35           # Y coordinate
li a2, 33           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 31           # start X coordinate
li a1, 43           # Y coordinate
li a2, 33           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#V
li a0, 38           # X coordinate
li a1, 35           # starting Y coordinate
li a2, 42           # ending Y coordinate
```

```
call draw_vertical_line  # must not modify s2, s3
li a0, 42           # start X coordinate
li a1, 35           # Y coordinate
li a2, 42           # ending Y coordinate
call draw_vertical_line  # must not modify: a3, s2, s3
li a0, 38           # start X coordinate
li a1, 43           # Y coordinate
li a2, 41           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#E
li a0, 46           # X coordinate
li a1, 36           # starting Y coordinate
li a2, 42           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 47           # start X coordinate
li a1, 35           # Y coordinate
li a2, 50           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 47           # start X coordinate
li a1, 43           # Y coordinate
li a2, 50           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 47           # start X coordinate
li a1, 39           # Y coordinate
li a2, 48           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#R
li a0, 53           # X coordinate
```

```
li a1, 36           # starting Y coordinate
li a2, 43           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 57           # X coordinate
li a1, 36           # starting Y coordinate
li a2, 38           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 57           # X coordinate
li a1, 40           # starting Y coordinate
li a2, 43           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 53           # start X coordinate
li a1, 35           # Y coordinate
li a2, 56           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 54           # start X coordinate
li a1, 39           # Y coordinate
li a2, 56           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3



#Score ---------------------------------
#S
li a0, 3            # X coordinate
li a1, 51           # starting Y coordinate
li a2, 52           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 3            # X coordinate
li a1, 55           # Y coordinate
call draw_dot  # must not modify s2, s3
```

```
li a0, 6            # X coordinate
li a1, 51           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 6            # X coordinate
li a1, 54           # starting Y coordinate
li a2, 55           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 4            # start X coordinate
li a1, 50           # Y coordinate
li a2, 5            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 4            # start X coordinate
li a1, 53           # Y coordinate
li a2, 5            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 4            # start X coordinate
li a1, 56           # Y coordinate
li a2, 5            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#C
li a0, 8            # X coordinate
li a1, 51           # starting Y coordinate
li a2, 55           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 9            # start X coordinate
li a1, 50           # Y coordinate
li a2, 10           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 9            # start X coordinate
```

```
li a1, 56           # Y coordinate
li a2, 10           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 11           # X coordinate
li a1, 51           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 11           # X coordinate
li a1, 55           # Y coordinate
call draw_dot  # must not modify s2, s3

#O
li a0, 13           # X coordinate
li a1, 51           # starting Y coordinate
li a2, 55           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 16           # X coordinate
li a1, 51           # starting Y coordinate
li a2, 55           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 14           # start X coordinate
li a1, 50           # Y coordinate
li a2, 15           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 14           # start X coordinate
li a1, 56           # Y coordinate
li a2, 15           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#R
li a0, 18           # X coordinate
```

```
li a1, 50           # starting Y coordinate
li a2, 56           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 21           # X coordinate
li a1, 51           # starting Y coordinate
li a2, 52           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 21           # X coordinate
li a1, 54           # starting Y coordinate
li a2, 56           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 19           # start X coordinate
li a1, 50           # Y coordinate
li a2, 20           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 19           # start X coordinate
li a1, 53           # Y coordinate
li a2, 20           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3



#E
li a0, 23           # X coordinate
li a1, 51           # starting Y coordinate
li a2, 55           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 24           # start X coordinate
li a1, 50           # Y coordinate
li a2, 25           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
li a0, 24           # start X coordinate
li a1, 53           # Y coordinate
li a2, 24           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 24           # start X coordinate
li a1, 56           # Y coordinate
li a2, 25           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

li a0, 28           # X coordinate
li a1, 51           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 28           # X coordinate
li a1, 55           # Y coordinate
call draw_dot  # must not modify s2, s3

#Press Button ----------------------------------------------------------------
#P
li a0, 3            # X coordinate
li a1, 3            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 6            # X coordinate
li a1, 4            # starting Y coordinate
li a2, 5            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 4            # start X coordinate
li a1, 3            # Y coordinate
li a2, 5            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
li a0, 4            # start X coordinate
li a1, 6            # Y coordinate
li a2, 5            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#R
li a0, 8            # X coordinate
li a1, 3            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 11           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 5            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 11           # X coordinate
li a1, 7            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 9            # start X coordinate
li a1, 3            # Y coordinate
li a2, 10           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 9            # start X coordinate
li a1, 6            # Y coordinate
li a2, 10           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#E
li a0, 13           # X coordinate
li a1, 4            # starting Y coordinate
```

```
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 14           # start X coordinate
li a1, 3            # Y coordinate
li a2, 15           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 14           # start X coordinate
li a1, 6            # Y coordinate
li a2, 14           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 14           # start X coordinate
li a1, 9            # Y coordinate
li a2, 15           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#S
li a0, 17           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 5            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 17           # X coordinate
li a1, 8            # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 20           # X coordinate
li a1, 4            # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 20           # X coordinate
li a1, 7            # starting Y coordinate
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
```

```
li a0, 18           # start X coordinate
li a1, 3            # Y coordinate
li a2, 19           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 18           # start X coordinate
li a1, 6            # Y coordinate
li a2, 19           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 18           # start X coordinate
li a1, 9            # Y coordinate
li a2, 19           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#S
li a0, 22           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 5            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 22           # X coordinate
li a1, 8            # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 25           # X coordinate
li a1, 4            # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 25           # X coordinate
li a1, 7            # starting Y coordinate
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 23           # start X coordinate
li a1, 3            # Y coordinate
```

```
li a2, 24           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 23           # start X coordinate
li a1, 6            # Y coordinate
li a2, 24           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 23           # start X coordinate
li a1, 9            # Y coordinate
li a2, 24           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3



#B
li a0, 30           # X coordinate
li a1, 3            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 33           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 5            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 33           # X coordinate
li a1, 7            # starting Y coordinate
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 31           # start X coordinate
li a1, 3            # Y coordinate
li a2, 32           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 31           # start X coordinate
```

```
li a1, 6            # Y coordinate
li a2, 32           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 31           # start X coordinate
li a1, 9            # Y coordinate
li a2, 32           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#U
li a0, 35           # X coordinate
li a1, 3            # starting Y coordinate
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 38           # X coordinate
li a1, 3            # starting Y coordinate
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 36           # start X coordinate
li a1, 9            # Y coordinate
li a2, 37           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#TT
li a0, 41           # X coordinate
li a1, 3            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 40           # start X coordinate
li a1, 3            # Y coordinate
li a2, 42           # ending X coordinate
```

```
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 45           # X coordinate
li a1, 3            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 44           # start X coordinate
li a1, 3            # Y coordinate
li a2, 46           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3



#O
li a0, 48           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 51           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 8            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 49           # start X coordinate
li a1, 3            # Y coordinate
li a2, 50           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 49           # start X coordinate
li a1, 9            # Y coordinate
li a2, 50           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#N
```

```
li a0, 53           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 56           # X coordinate
li a1, 4            # starting Y coordinate
li a2, 9            # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 54           # start X coordinate
li a1, 3            # Y coordinate
li a2, 55           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#To Reset-----------------------------------------------------------

#T
li a0, 4            # X coordinate
li a1, 11           # starting Y coordinate
li a2, 17           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 3            # start X coordinate
li a1, 11           # Y coordinate
li a2, 5            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#O
li a0, 7            # X coordinate
li a1, 12           # starting Y coordinate
li a2, 16           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
```

```
li a0, 10           # X coordinate
li a1, 12           # starting Y coordinate
li a2, 16           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 8            # start X coordinate
li a1, 11           # Y coordinate
li a2, 9            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 8            # start X coordinate
li a1, 17           # Y coordinate
li a2, 9            # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#R
li a0, 15           # X coordinate
li a1, 11           # starting Y coordinate
li a2, 17           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 18           # X coordinate
li a1, 12           # starting Y coordinate
li a2, 13           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 18           # X coordinate
li a1, 15           # starting Y coordinate
li a2, 17           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 16           # start X coordinate
li a1, 11           # Y coordinate
li a2, 17           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
li a0, 16           # start X coordinate
li a1, 14           # Y coordinate
li a2, 17           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#E
li a0, 20           # X coordinate
li a1, 12           # starting Y coordinate
li a2, 16           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 21           # start X coordinate
li a1, 11           # Y coordinate
li a2, 22           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 21           # start X coordinate
li a1, 14           # Y coordinate
li a2, 22           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 21           # start X coordinate
li a1, 17           # Y coordinate
li a2, 22           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#S
li a0, 24           # X coordinate
li a1, 12           # starting Y coordinate
li a2, 13           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 24           # X coordinate
li a1, 16           # Y coordinate
```

```
call draw_dot  # must not modify s2, s3
li a0, 27           # X coordinate
li a1, 12           # Y coordinate
call draw_dot  # must not modify s2, s3
li a0, 27           # X coordinate
li a1, 15           # starting Y coordinate
li a2, 16           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 25           # start X coordinate
li a1, 11           # Y coordinate
li a2, 26           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 25           # start X coordinate
li a1, 14           # Y coordinate
li a2, 26           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 25           # start X coordinate
li a1, 17           # Y coordinate
li a2, 26           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#E
li a0, 29           # X coordinate
li a1, 12           # starting Y coordinate
li a2, 16           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 30           # start X coordinate
li a1, 11           # Y coordinate
li a2, 31           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
```

```
li a0, 30           # start X coordinate
li a1, 14           # Y coordinate
li a2, 30           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3
li a0, 30           # start X coordinate
li a1, 17           # Y coordinate
li a2, 31           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

#T
li a0, 34           # X coordinate
li a1, 11           # starting Y coordinate
li a2, 17           # ending Y coordinate
call draw_vertical_line  # must not modify s2, s3
li a0, 33           # start X coordinate
li a1, 11           # Y coordinate
li a2, 35           # ending X coordinate
call draw_horizontal_line  # must not modify: a3, s2, s3

li     t1, 0
beq    t2, t1, zeroScore
addi   t1, t1, 1
beq    t2, t1, oneScore
addi   t1, t1, 1
beq    t2, t1, twoScore
addi   t1, t1, 1
beq    t2, t1, threeScore
addi   t1, t1, 1
beq    t2, t1, fourScore
addi   t1, t1, 1
```

```
	beq	t2, t1, fiveScore
	addi	t1, t1, 1
	beq	t2, t1, sixScore
	li	t1, 7
	beq	t2, t1, sevenScore
	addi	t1, t1, 1
	beq	t2, t1, eightScore
	addi	t1, t1, 1
	beq	t2, t1, nineScore

	ret

# draws a horizontal line from (a0,a1) to (a2,a1) using color in a3
# Modifies (directly or indirectly): t0, t1, a0, a2
draw_horizontal_line:
	addi sp,sp,-4
	sw ra, 0(sp)
	addi a2,a2,1 #go from a0 to a2 inclusive
draw_horiz1:
	call draw_dot  # must not modify: a0, a1, a2, a3
	addi a0,a0,1
	bne a0,a2, draw_horiz1
	lw ra, 0(sp)
	addi sp,sp,4
	ret

# draws a vertical line from (a0,a1) to (a0,a2) using color in a3
# Modifies (directly or indirectly): t0, t1, a1, a2
draw_vertical_line:
	addi sp,sp,-4
```

```
	sw ra, 0(sp)
	addi a2,a2,1
draw_vert1:
	call draw_dot  # must not modify: a0, a1, a2, a3
	addi a1,a1,1
	bne a1,a2,draw_vert1
	lw ra, 0(sp)
	addi sp,sp,4
	ret

# Fills the 60x80 grid with one color using successive calls to draw_horizontal_line
# Modifies (directly or indirectly): t0, t1, t4, a0, a1, a2, a3
draw_background:

	addi sp,sp,-4
	sw ra, 0(sp)
	li a3, BG_COLOR     #use default color
	li a1, 0      #a1= row_counter
	li s8, 60     #max rows
start: li a0, 0
	li a2, 79     #total number of columns
	call draw_horizontal_line  # must not modify: t4, a1, a3
	addi a1,a1, 1
	bne s8,a1, start    #branch to draw more rows
	lw ra, 0(sp)
	addi sp,sp,4
	ret

# draws a dot on the display at the given coordinates:
#      (X,Y) = (a0,a1) with a color stored in a3
```

```
#      (col, row) = (a0,a1)
# Modifies (directly or indirectly): t0, t1
draw_dot:
       andi s9,a0,0x7F     # select bottom 7 bits (col)
       andi s10,a1,0x3F    # select bottom 6 bits  (row)
       slli s10,s10,7      #  {a1[5:0],a0[6:0]}
       or s9,s10,s9 # 13-bit address
       sw s9, 0(s2)  # write 13 address bits to register
       sw a3, 0(s3)  # write color data to frame buffer
       ret
```