**ELEMENTS OF COMPUTING SYSTEMS-1**

**[19AIE101]**

**S1 B. TECH CSE (AIE)**

Submitted by

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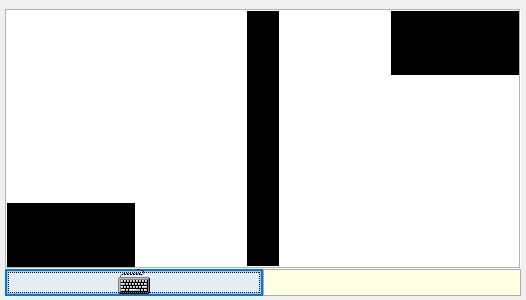
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**QUESTION-8**

When the User presses the W key, the following pattern should appear on the Hack Screen, when no key is pressed the Screen should be blank.



**PSUEDOCODE**

(START)

if (RAM[KBD] != 87):

goto START

R0 = SCREEN + 15 // MIDDLE LINE

R1 = 255

R2 = 1

(COLUMN)

if (R1==0):

goto BLOCKS

i = R2

(COL)

R0 = R0+i

RAM[R0] = -1

i = i-1

if(i>=0):

goto COL

R0=R0+32

R1=R1-1

goto COLUMN

(BLOCKS)

R3 = SCREEN + 24 // RECT\_ONE variables

R5 = 64

R7 = 7

R4 = 22528 // RECT\_TWO variables

R6 = 64

R8 = 7

(REC\_ONE) //RECT\_ONE

if (R5==0):

goto REC\_TWO

i = R7

(RECT1)

R3 = R3 + i

RAM[R3] = -1

i = i - 1

if (i>=0):

goto RECT1

R3 = R3 + 32

R5=R5-1

goto REC\_ONE

(REC\_TWO) //RECT\_TWO

if (R6==0):

goto END

n = R8

(RECT2)

R4 = R4 + n

RAM[R4] = -1

n = n - 1

if (n>=0):

goto RECT2

R4 = R4 + 32

R6=R6-1

goto REC\_TWO

(END)

goto END // Termination Loop

**HACK ASSEMBLY CODE**

(START)

@KBD

D=M

@87 // ASCII code for W

D=D-A

@START

D;JNE

// Middle Column Code

@16399 // 16384 + 15 (Column Block address)

D=A

@R0

M=D // R0=16399

@255 // 255 lines

D=A

@R1

M=D // R1=255

@1

D=A

@R2

M=D // R2=1

(COLUMN)

@R1

D=M

@BLOCKS

D;JEQ

@R2

D=M

@i

M=D

(COL)

@i

D=M

@R0

A=M+D

M=-1 // Setting values to ram address

@i

M=M-1

D=M

@COL

D;JGE

@32 // Code to go to next line

D=A

@R0

M=M+D

@R1

M=M-1

@COLUMN

0;JMP

// Upper and bottom Block Code

(BLOCKS)

@16408 // 16384 + 24 (First Block address)

D=A

@R3

M=D

@22528 // Second Block address

D=A

@R4

M=D

@64

D=A

@R5 // R5=64 for number of lines in that block

M=D

@64

D=A

@R6

M=D

@7

D=A

@R7 // R7=7 for number of lines in on block width

M=D

@7

D=A

@R8

M=D

(RECT\_ONE)

@R5

D=M

@RECT\_TWO

D;JEQ

@R7

D=M

@i

M=D

(RECT1)

@i

D=M

@R3

A=M+D

M=-1 // setting Value in Screen address

@i

M=M-1

D=M

@RECT1

D;JGE

@32

D=A

@R3

M=M+D

@R5

M=M-1

@RECT\_ONE

0;JMP

(RECT\_TWO)

@R6

D=M

@END

D;JEQ

@R8

D=M

@n

M=D

(RECT2)

@n

D=M

@R4

A=M+D

M=-1

@n

M=M-1

D=M

@RECT2 // Repeating Inner Loop 2

D;JGE

@32 // Code to go to next line

D=A

@R4

M=M+D

@R6

M=M-1

@RECT\_TWO //Repeating Outer Loop 2

0;JMP

(END) // Program Termination

@END // Infinite Loop

0;JMP

**SNAPSHOTS**



**Insights:**

* Computers are equipped with all sorts of input/output devices.
* And likewise, the head computer can also be connected to some input/output devices.
* Learnt to control and manipulate these I/O devices
* (Screen & Keyboard).
* Learnt about Screen Mapping and keyboard mapping by manipulating the bits.
* And learnt how turn the pixel on or off.
* We got to know how to use Registers as Variables (i.e., R0, R1, R2......)
* Learnt how to make loops using Labels and Jump statements.

**Contribution:**

Firstly, everyone in the group learnt about hack assembly code and how to manipulate screen using that.

(21115) Anshuman - Worked on Pseudo Code and Hack Code

(21152) Jagath - Worked on Hack Code

(21142) Sai Nikhil - Worked on Hack Code

(21136) Keerthan - Worked on Hack Code

(21154) Rohit Shibu - Worked a little on Pseudo-Code and Documentation

Finally, we worked as a group and had discussions with each other during the completion of the project.

Everyone member in the group has equal amount of Contribution towards the project.