

Directory Description

```
1410S/
  -src/
    - DirectoryManager.java
    - Disk.java
    - DiskManager.java
    - FileInfo.java
    - Main.java
    - Printer.java
    - PrintJobThread.java
    - ResourceManager.java
    - UserThread.java
  - inputs/
    - USER1
    - USER2
    - USER3
    - USER4
  - outputs/
    - PRINTER1
    - PRINTER2
    - PRINTER3
  - resources/
    - christmas.png
    - disk.png
    - printer.png
    - user3.png
  - Makefile
  - README.md
```

The program starts running when the Makefile is run in the 1410S/ folder. This is done by calling

```
$ make
```

This compiles all the java files to binary and runs the Main executable. **Main** executable creates static objects of **Disk**, **Printer**, **UserThread**. It also statically makes an object for **DiskManager**, and 2 objects of **ResourceManager**, which are used to allocate resources like disks and printers.

Main also implements the entire GUI, and creates objects for different lines, shapes and images in JavaFX.

In the `public static void main(String[] args)` function, GUI is launched, and when the start button is clicked the **UserThreads** are started to execute.

Class Name	Role and Relationships
DirectoryManager.java	<ul style="list-style-type: none"> • Initializes a Hashtable which stores filename(string) as the key and data type FileInfo as the value. • It also defines defines functions to lookup and add to Hashtable.
Disk.java	<ul style="list-style-type: none"> • Takes in a Disk number and writes or reads a particular sector on the disk • Initializes a Disk with 1024 Sectors, with a total capacity defined by the User.
DiskManager.java	<ul style="list-style-type: none"> • It helps add files to Directory manager and lookup files. • This is done using synchronized functions. It also keeps track of which is the next empty sector in the specified disk. • As the name suggests it helps manage the disk and retrieve information correctly.
FileInfo.java	<ul style="list-style-type: none"> • Creates a datatype to store diskNumber, startingSector and fileLength for each file.
Printer.java	<ul style="list-style-type: none"> • Takes in a printer number and writes a line to the printer.
PrintJobThread.java	<ul style="list-style-type: none"> • It is initialized with file name, and manages the printer to print the particular file. • Looks up file using DiskManager • Retrieves Disk Number from FileInfo • Requests a free printer from ResourceManager printer object. • Reads all line from the Disk at

	<p>which the file is saved. And delays 200ms for each line.</p> <ul style="list-style-type: none">• Writes the entire file to the assigned printer and delays the thread for 2750ms for each line it writes.• Releases the requested printer to other threads.
ResourceManager.java	<ul style="list-style-type: none">• Manages the number of resources initialized to it.• Allocates a resources with the request function and blocks others to access it.• Releases the allocated resources and available to other threads when not in use anymore.
UserJobThread.java	<ul style="list-style-type: none">• Reads USERi files to recognizes .save, .end and .print commands and also lines to be written to a file• At .save, thread requests a disk to write into• At .end thread releases the requested disk• At .print it creates a new thread by making a printjobthread object and prints the specified file• Otherwise it writes the lines to the open file created at .save

UserJobThread.java and PrintJobThread.java manage concurrency by the use of threads. They extend the Thread class and Threads can run concurrently in Java program, With the help of this we are able to initialize multiple threads which run and start concurrently. We also use synchronized functions in DiskManager and ResourceManager to help maintain mutual exclusiveness, that is only one thread is able to access this function at a moment and other threads have to wait for the function to be ideal to be able to access it and use it.

Synchronized blocks in Java are marked with the synchronized keyword. A synchronized block in Java is synchronized on some object. All synchronized blocks synchronized on the same object can only have one thread executing inside them at the same time. All other threads attempting to enter the synchronized block are blocked until the thread inside the synchronized block exits the block.

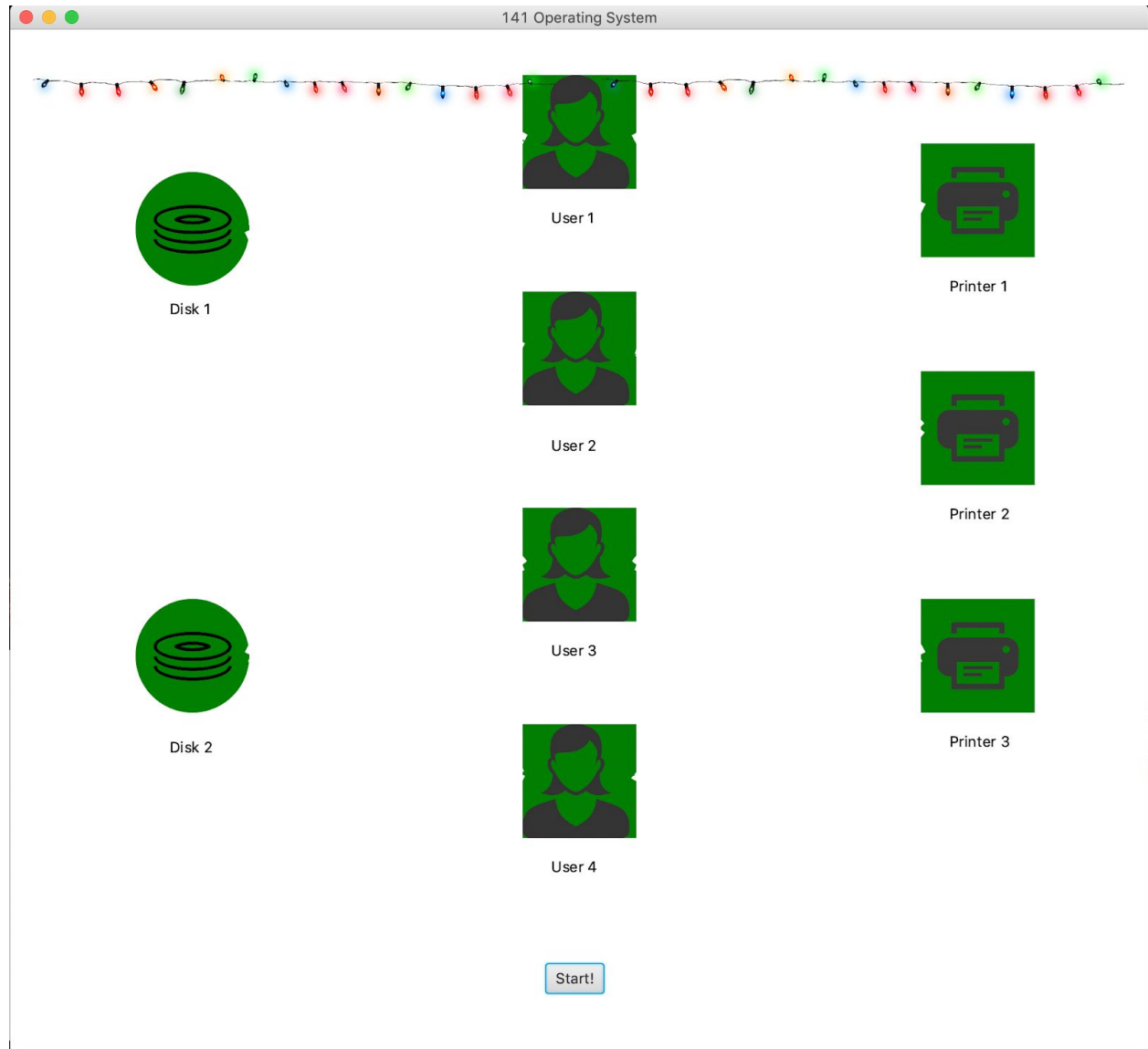


Fig 1. The Program opens to this screens and starts its execution when the start button is clicked.

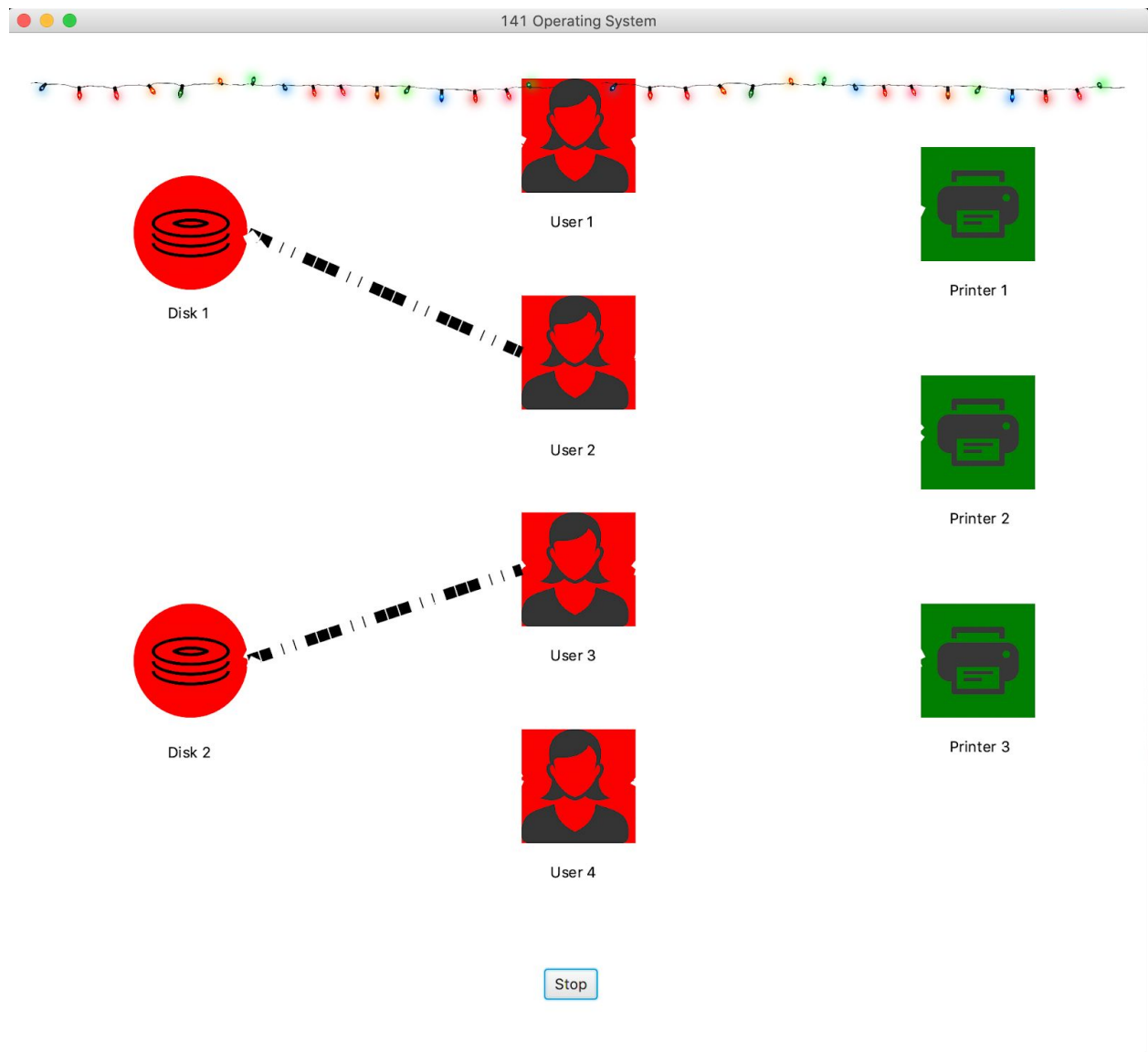


Fig2. The User threads USER1 USER2, USER3, USER4 are running and Disk1 and Disk2 are being used by threads USER2 and USER3 while USER1 and USER4 wait for their turn.

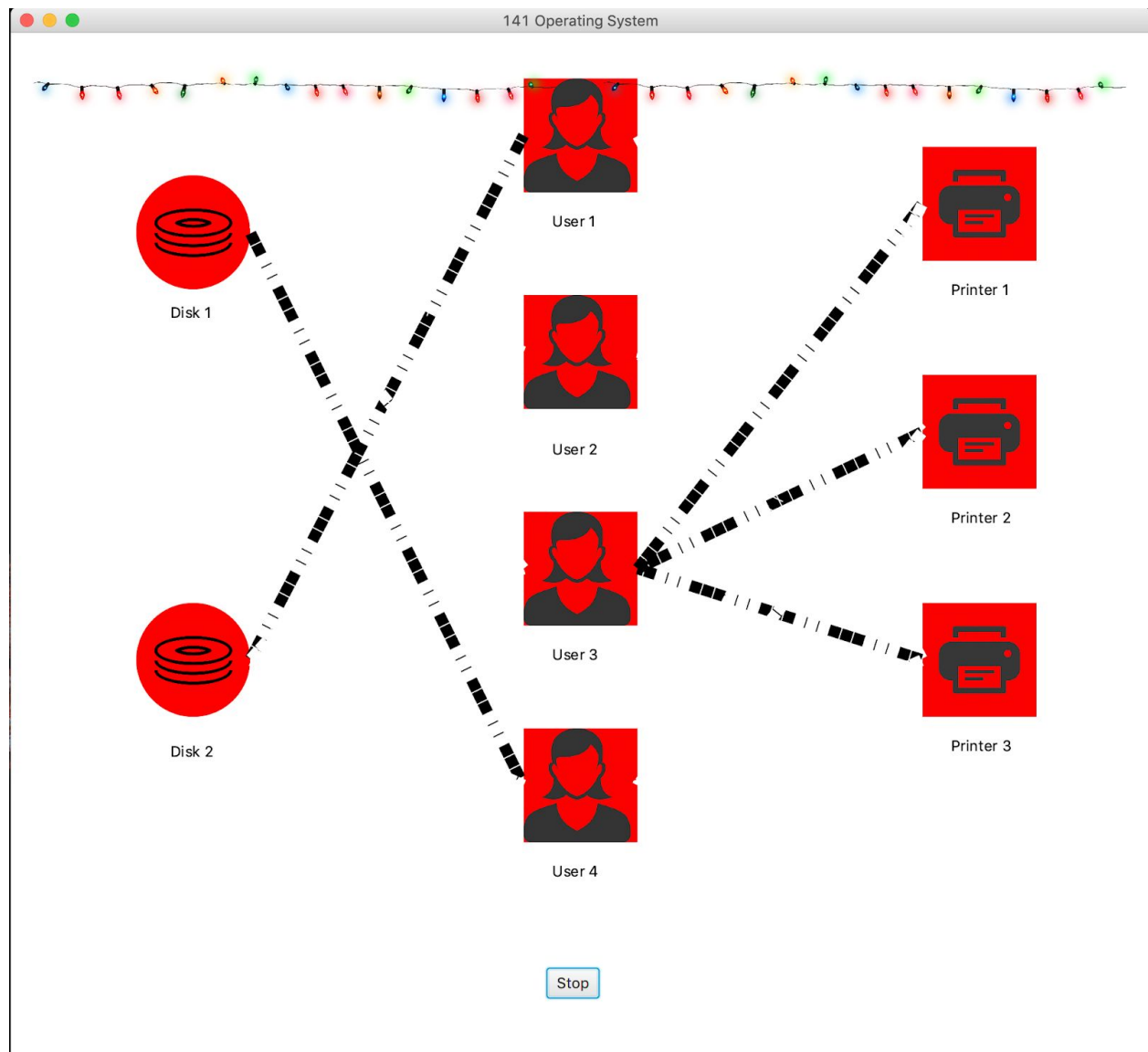


Fig 3. All threads are running concurrently. Disk1 is being accessed by USER4 and DISK2 is being used by User 1. USER3 meanwhile has access to all Printer threads, i.e. PRINTER1, PRINTER2 and PRINTER3



Fig 4. All User threads are running but USER3 has access to all the Printer Threads
PRINTER1, PRINTER2 and PRINTER3

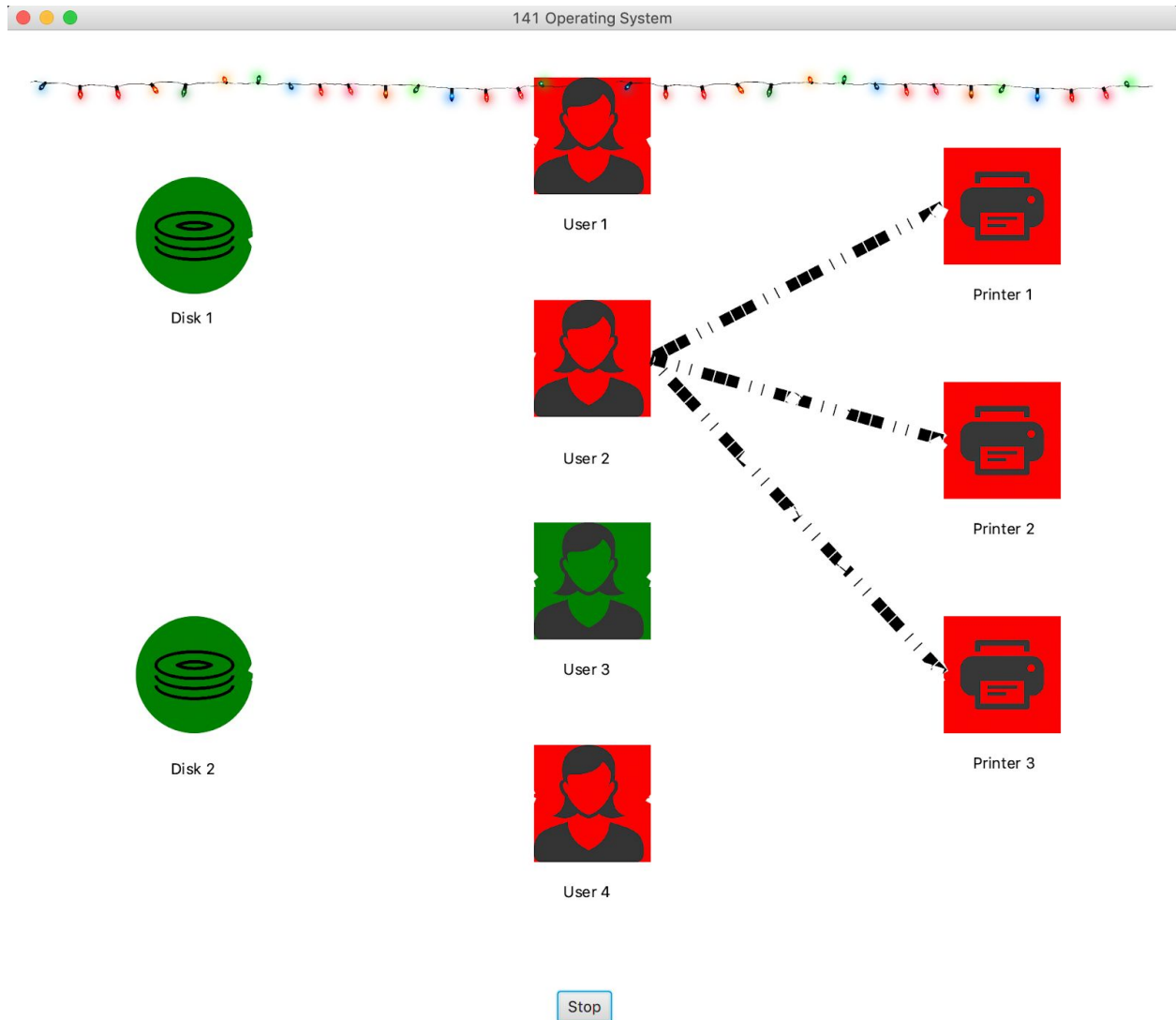


Fig 5. USER3 has finished executing and now USER2 is using PRINTER1, PRINTER2 and PRINTER3. While USER1 and USER4 wait for their turn.

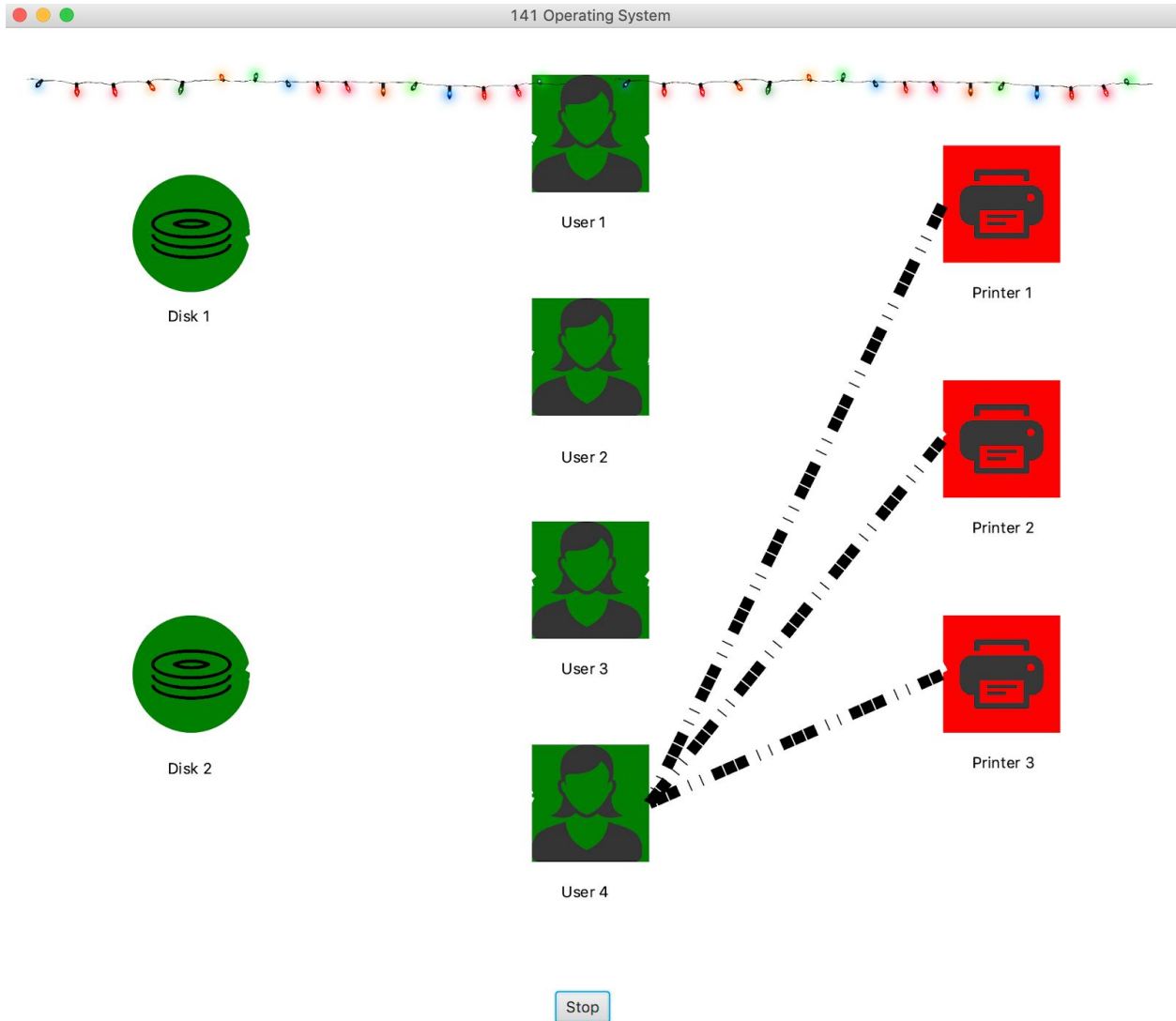


Fig 6. ALL USER threads have finished executing and now only PRINTER1, PRINTER2 and PRINTER3 are finishing up their print commands from USER4.

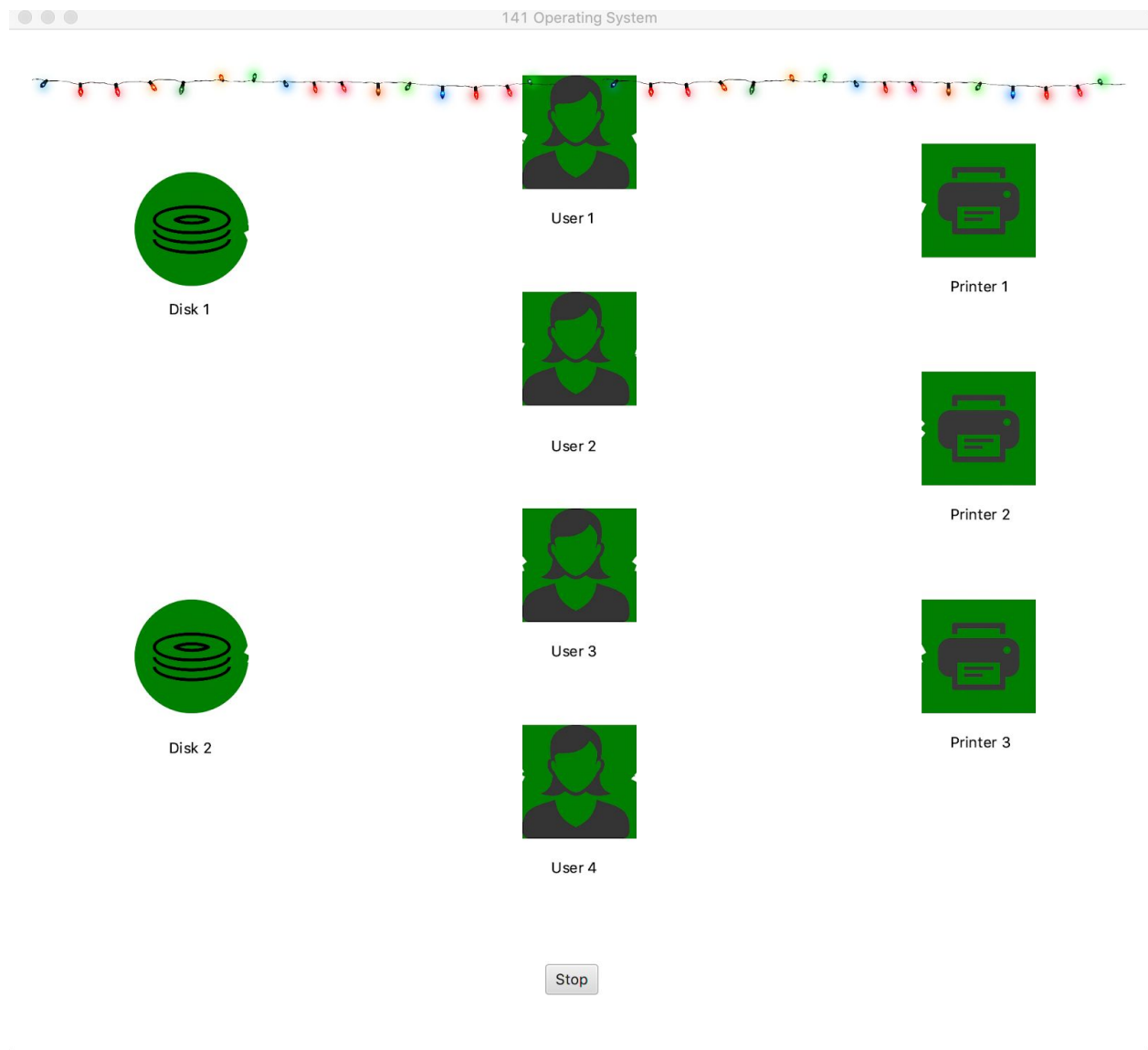


Fig 7. ALL Jobs are complete ad the the program is ready to terminate.

Terminal outputs

```
[Animeshs-MacBook-Pro:mine animesh$ make
javac -g -cp src src/DirectoryManager.java
javac -g -cp src src/Disk.java
javac -g -cp src src/DiskManager.java
javac -g -cp src src/Main.java
java -cp src Main
1010_+excecute ENTER!
Starting!!
Saving file Y2 to disk 2
Saving file BAR3 to disk 1
Writing 2.Y1 Y1111111
Writing 3.BAR1 11111111
Writing 2.Y2 Y2222222
Writing 3.BAR2 22222222
Writing 2.Y3 Y3333333
Writing 3.BAR3 33333333
Writing 3.BAR4 44444444
Writing 2.Y4 Y4444444
Writing 2.Y5 Y5555555
Writing 3.BAR5 55555555
Writing 2.Y6 Y6666666
Saved file to BAR3 to disk 1
Saving file F4 to disk 1
Writing 4.F1 11111111
Printing BAR3 to printer number 1
Printing BAR3 to printer number 3
Printing BAR3 to printer number 2
Writing 2.Y7 Y7777777
Writing 4.F2 22222222
Writing 4.F3 33333333
Writing 2.Y8 Y8888888
Writing 2.Y9 Y9999999
Writing 4.F4 44444444
Writing 4.F5 55555555
Saved file to Y2 to disk 2
Saving file W1 to disk 2
Writing 1.W1 W1111111
Saved file to F4 to disk 1
Writing 1.W1 W2222222
Saving file W4 to disk 1
Writing 4.W1 W1111111
Writing 1.W1 W3333333
Writing 4.W2 W2222222
Writing 1.W1 W4444444
Writing 4.W3 W3333333
Writing 1.W1 W5555555
Writing 4.W4 W4444444
Writing 4.W5 W5555555
Saved file to W1 to disk 2
Saving file X1 to disk 2
Writing 1.X1 X1111111
Saved file to W4 to disk 1
Saving file X4 to disk 1
Writing 4.X1 X1111111
Writing 1.X1 X2222222
Writing 1.X1 X3333333
Writing 4.X2 X2222222
Writing 1.X1 X4444444
Writing 4.X3 X3333333
Writing 1.X1 X5555555
Writing 4.X4 X4444444
Saved file to X1 to disk 2
Writing 4.X5 X5555555
Saving file Y1 to disk 2
Writing 1.Y1 Y1111111
Saved file to X4 to disk 1
Saving file Y4 to disk 1
```

Writing 4.Y1 Y1111111
Writing 1.Y1 Y2222222
Writing 1.Y1 Y3333333
Writing 4.Y2 Y2222222
Writing 4.Y3 Y3333333
Writing 1.Y1 Y4444444
Writing 4.Y4 Y4444444
Writing 1.Y1 Y5555555
Writing 4.Y5 Y5555555
Saved file to Y1 to disk 2
Saving file Z1 to disk 2
Writing 1.Z1 Z1111111
Saved file to Y4 to disk 1
Saving file Z4 to disk 1
Writing 4.Z1 Z1111111
Writing 1.Z1 Z2222222
Writing 4.Z2 Z2222222
Writing 1.Z1 Z3333333
Writing 4.Z3 Z3333333
Writing 1.Z1 Z4444444
Writing 1.Z1 Z5555555
Writing 4.Z4 Z4444444
Writing 4.Z5 Z5555555
Saved file to Z1 to disk 2
Saved file to Z4 to disk 1
Printed BAR3 to printer number 3
Printed BAR3 to printer number 1
Printed BAR3 to printer number 2
Printing Y2 to printer number 1
Printing Y2 to printer number 2
Printing Y2 to printer number 3
Printed Y2 to printer number 2
Printing Y2 to printer number 2
Printed Y2 to printer number 3
Printing Y2 to printer number 3
Printed Y2 to printer number 1
Printing F4 to printer number 1
Printed F4 to printer number 1
Printing W1 to printer number 1
Printed Y2 to printer number 2
Printing W1 to printer number 2
Printed Y2 to printer number 3
Printing W4 to printer number 3
Printed W1 to printer number 1
Printing W4 to printer number 1
Printed W1 to printer number 2
Printing X1 to printer number 2
Printed W4 to printer number 3
Printing W1 to printer number 3
Printed W4 to printer number 1
Printing X4 to printer number 1
Printed X1 to printer number 2
Printing Z1 to printer number 2
Printed W1 to printer number 3
Printing Y1 to printer number 3
Printed X4 to printer number 1
Printing X1 to printer number 1
Printed Z1 to printer number 2
Printing W1 to printer number 2
Printed Y1 to printer number 3
Printing X4 to printer number 3
Printed X1 to printer number 1
Printing Z4 to printer number 1
Printed X4 to printer number 3
Printed W1 to printer number 2
Printing W4 to printer number 3
Printing Y4 to printer number 2

```
Writing 4.Y3 Y3333333
Writing 1.Y1 Y4444444
Writing 4.Y4 Y4444444
Writing 1.Y1 Y5555555
Writing 4.Y5 Y5555555
Saved file to Y1 to disk 2
Saving file Z1 to disk 2
Writing 1.Z1 Z1111111
Saved file to Y4 to disk 1
Saving file Z4 to disk 1
Writing 4.Z1 Z1111111
Writing 1.Z1 Z2222222
Writing 4.Z2 Z2222222
Writing 1.Z1 Z3333333
Writing 4.Z3 Z3333333
Writing 1.Z1 Z4444444
Writing 1.Z1 Z5555555
Writing 4.Z4 Z4444444
Writing 4.Z5 Z5555555
Saved file to Z1 to disk 2
Saved file to Z4 to disk 1
Printed BAR3 to printer number 3
Printed BAR3 to printer number 1
Printed BAR3 to printer number 2
Printing Y2 to printer number 1
Printing Y2 to printer number 2
Printing Y2 to printer number 3
Printed Y2 to printer number 2
Printing Y2 to printer number 2
Printed Y2 to printer number 3
Printing Y2 to printer number 3
Printed Y2 to printer number 1
Printing F4 to printer number 1
Printed F4 to printer number 1
Printing W1 to printer number 1
Printed Y2 to printer number 2
Printing W1 to printer number 2
Printed Y2 to printer number 3
Printing W4 to printer number 3
Printed W1 to printer number 1
Printing W4 to printer number 1
Printed W1 to printer number 2
Printing X1 to printer number 2
Printed W4 to printer number 3
Printing W1 to printer number 3
Printed W4 to printer number 1
Printing X4 to printer number 1
Printed X1 to printer number 2
Printing Z1 to printer number 2
Printed W1 to printer number 3
Printing Y1 to printer number 3
Printed X4 to printer number 1
Printing X1 to printer number 1
Printed Z1 to printer number 2
Printing W1 to printer number 2
Printed Y1 to printer number 3
Printing X4 to printer number 3
Printed X1 to printer number 1
Printing Z4 to printer number 1
Printed X4 to printer number 3
Printed W1 to printer number 2
Printing W4 to printer number 3
Printing Y4 to printer number 2
Printed Z4 to printer number 1
Printed W4 to printer number 3
Printed Y4 to printer number 2
Animeshs-MacBook-Pro:mine animesh$
```

PRINTER FILE OUTPUTS

PRINTER1

```
[Animeshs-MacBook-Pro:outputs animesh$ cat PRINTER1
```

```
3.BAR1 11111111
3.BAR2 22222222
3.BAR3 33333333
3.BAR4 44444444
3.BAR5 55555555
2.Y1 Y1111111
2.Y2 Y2222222
2.Y3 Y3333333
2.Y4 Y4444444
2.Y5 Y5555555
2.Y6 Y6666666
2.Y7 Y7777777
2.Y8 Y8888888
2.Y9 Y9999999
4.F1 11111111
4.F2 22222222
4.F3 33333333
4.F4 44444444
4.F5 55555555
1.W1 W1111111
1.W1 W2222222
1.W1 W3333333
1.W1 W4444444
1.W1 W5555555
4.W1 W1111111
4.W2 W2222222
4.W3 W3333333
4.W4 W4444444
4.W5 W5555555
4.X1 X1111111
4.X2 X2222222
4.X3 X3333333
4.X4 X4444444
4.X5 X5555555
1.X1 X1111111
1.X1 X2222222
1.X1 X3333333
1.X1 X4444444
1.X1 X5555555
4.Z1 Z1111111
4.Z2 Z2222222
4.Z3 Z3333333
4.Z4 Z4444444
4.Z5 Z5555555
```

```
Animeshs-MacBook-Pro:outputs animesh$ █
```

PRINTER2

```
[Animeshs-MacBook-Pro:outputs animesh$ cat PRINTER2
```

```
3.BAR1 11111111
3.BAR2 22222222
3.BAR3 33333333
3.BAR4 44444444
3.BAR5 55555555
2.Y1 Y1111111
2.Y2 Y2222222
2.Y3 Y3333333
2.Y4 Y4444444
2.Y5 Y5555555
2.Y6 Y6666666
2.Y7 Y7777777
2.Y8 Y8888888
2.Y9 Y9999999
2.Y1 Y1111111
2.Y2 Y2222222
2.Y3 Y3333333
2.Y4 Y4444444
2.Y5 Y5555555
2.Y6 Y6666666
2.Y7 Y7777777
2.Y8 Y8888888
2.Y9 Y9999999
1.W1 W1111111
1.W1 W2222222
1.W1 W3333333
1.W1 W4444444
1.W1 W5555555
1.X1 X1111111
1.X1 X2222222
1.X1 X3333333
1.X1 X4444444
1.X1 X5555555
1.Z1 Z1111111
1.Z1 Z2222222
1.Z1 Z3333333
1.Z1 Z4444444
1.Z1 Z5555555
1.W1 W1111111
1.W1 W2222222
1.W1 W3333333
1.W1 W4444444
1.W1 W5555555
4.Y1 Y1111111
4.Y2 Y2222222
4.Y3 Y3333333
4.Y4 Y4444444
4.Y5 Y5555555
```

```
Animeshs-MacBook-Pro:outputs animesh$ █
```


PRINTER3

```
[Animeshs-MacBook-Pro:outputs animesh$ cat PRINTER3
3.BAR1 11111111
3.BAR2 22222222
3.BAR3 33333333
3.BAR4 44444444
3.BAR5 55555555
2.Y1 Y1111111
2.Y2 Y2222222
2.Y3 Y3333333
2.Y4 Y4444444
2.Y5 Y5555555
2.Y6 Y6666666
2.Y7 Y7777777
2.Y8 Y8888888
2.Y9 Y9999999
2.Y1 Y1111111
2.Y2 Y2222222
2.Y3 Y3333333
2.Y4 Y4444444
2.Y5 Y5555555
2.Y6 Y6666666
2.Y7 Y7777777
2.Y8 Y8888888
2.Y9 Y9999999
4.W1 W1111111
4.W2 W2222222
4.W3 W3333333
4.W4 W4444444
4.W5 W5555555
1.W1 W1111111
1.W1 W2222222
1.W1 W3333333
1.W1 W4444444
1.W1 W5555555
1.Y1 Y1111111
1.Y1 Y2222222
1.Y1 Y3333333
1.Y1 Y4444444
1.Y1 Y5555555
4.X1 X1111111
4.X2 X2222222
4.X3 X3333333
4.X4 X4444444
4.X5 X5555555
4.W1 W1111111
4.W2 W2222222
4.W3 W3333333
4.W4 W4444444
4.W5 W5555555
Animeshs-MacBook-Pro:outputs animesh$ █
```