

CS101
Spring 2018

Instructor: Ashley Taylor
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Midterm Exam

NAME (LAST, FIRST): _____

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Problem	1	2	3	4	5	TOTAL
Score						
	9	9	10	21	16	65

Instructions:

- The time for this exam is **1 hour and 20 minutes**, 80 minutes total. There are 65 points total, so you should spend a little more than 1 minute per point, though your pacing may be different on different problems.
- You are only allowed a pencil, pen, and eraser. Any other materials are strictly prohibited. You may not use any digital devices other than a clock for timing. You may ask the proctors for blank scratch paper.
- A **reference sheet** is included as the last page. You may detach it for your reference during the exam.
- For coding problems, we will forgive minor syntax errors (such as missing semicolons, etc.).
- For any problems involving calculations, we will accept an expression (that could be plugged into a calculator) in lieu of the numerical answer.

Please sign *before* beginning the exam:

I agree to abide by the spirit and letter of the Honor Code, and to follow the instructions above.

(Signature)

(Date)

1. Data Storage

- a) (4 points) Describe two types of data that are stored in computers. How is each type stored?
- b) (3 points) Each text message contains a date (which is 8 bytes), a time sent (which is 4 bytes), up to 160 characters of text, and the phone number of the sender (which is an 8-byte number). How many text messages can you store on an 128GB hard drive?
- c) (2 points) What would happen if you ran out of RAM? What would happen if you ran out of permanent storage?
-

2. Hardware

- a) (2 points) Rank the following from most to least abstract, where 1 is the most abstract:

_____ Programming Language

_____ Transistors

_____ Operating System

_____ Architecture

_____ Applications

_____ Computer Components (CPU, Permanent Storage, and RAM)

- b) (3 points) Choose three layers of abstraction (from the list in part a). Describe the purpose of each layer.

c) (4 points) Below is information about two different computers:

Computer A	Computer B
128GB Flash Drive	512GB Hard Drive
16GB RAM	8GB RAM
150DPI Screen	225DPI Screen
15 inch screen	13 inch screen

Assume that the costs of the two computers are the same. List two strengths of Computer A and two strengths of Computer B, describing the impact of each strength (as in, the sorts of tasks that it might be better at as a result). An example has been done for you:

Computer A has a 15 inch screen, whereas Computer B has a 13 inch screen. As a result, more information can be displayed on Computer A's screen at a time, leading to better multi-tasking.

3. Code Reading Questions

- a) (3 points) What is the value of x at the end of this code? Assume that 3pixels.jpg has 3 pixels. Show your work for partial credit.

```
x = 3;
y = 7;
img = new SimpleImage("3pixels.jpg");
for (pixel : img) {
    x = x + y;
    x = x + 1;
    y = 1;
}
```

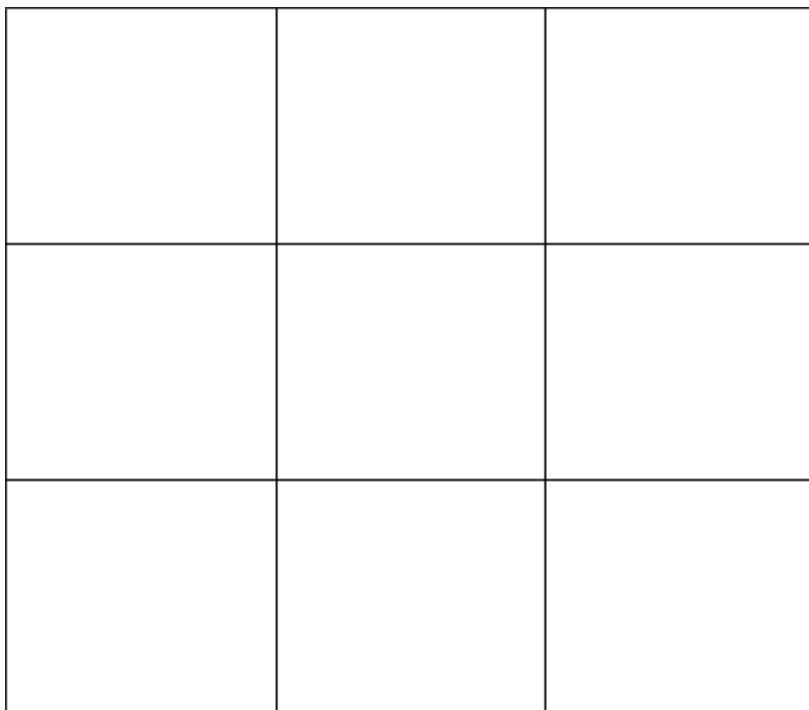
- b) (3 points) The following code is intended to change the top and bottom rows of x.png to orange. It has two logic bugs and three syntax bugs. Identify and correct **one** logic error and **two** syntax errors, clearly stating which is which.

```
img = new SimpleImage("x.png");
for (pixel : img) {
    if (pixel.getY() == 0 && pixel.getY == img.getHeight() - 1) {
        setRGB(0, 255, 125);
    }
}
print(img);
```

- c) (4 points) Draw what the output of the following code is, clearly labeling each pixel with its color (each box is a pixel); use English colors (e.g. black) instead of RGB values. Assume that `isOdd(number)` is true if number is an odd number.

```
img = new SimpleImage("output.png");
for (pixel : img) {
    if (isOdd(pixel.getX() + pixel.getY())) {
        pixel.setRGB(255, 0, 255);
    } else {
        pixel.setRGB(255, 0, 0);
    }
}
print(img);
```

output.png



4. Code and Spreadsheets

- a) (3 points) How would you store a JavaScript pixel in a spreadsheet? Clearly indicate what columns you would have, and what each row would represent. For reference, pixels have the following JavaScript methods to get information about the pixel - the same information should be accessible for a pixel in your spreadsheet.

*Note: **you should not write code for this part**, but drawings of your spreadsheet are encouraged.*

```
pixel.getX()  
pixel.getY()  
pixel.getRed()  
pixel.getGreen()  
pixel.getBlue()
```


Your code for part b below:

```
img = new SimpleImage("myimage.jpg");  
spreadsheet = new Spreadsheet("partBResult.csv");
```

- c) (8 points) For this part, we're going to make an image grayscale **in the spreadsheet**. You should set the cell values directly, rather than trying to convert from the spreadsheet to an image. You can assume that the spreadsheet is the same as from part b (so it has the same column names). We've provided the following code building blocks:

```
spreadsheet.getCell(row, "columnName");
```

Gives back the value in a cell at the given row (which is a number) and columnName (opposite of setCell from part b)

```
for (row : spreadsheet) { ...
```

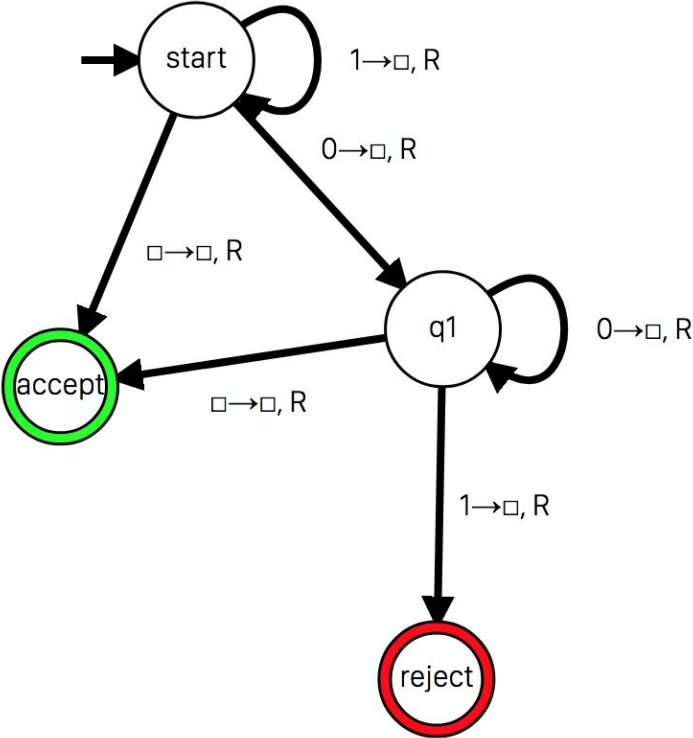
Goes over all the rows in the spreadsheet. Row takes on the values of the used row in the sheet (i.e. if there were 100 rows in the sheet, row would first be 1, then 2, and so on up to 100). row can be used as the row argument for `getCell` and `setCell`

```
spreadsheet = new Spreadsheet("partBResult.csv");
```

5. Potpourri

- a) (2 points) Facebook has had problems with explicit content in Live Videos uploaded to the site. How could they use Artificial Intelligence to confront this problem? Which kind(s) of AI that we talked about in class (natural language processing, artificial vision, and robotics) could be used?
- b) (2 points) Describe open-source software. How is it different from traditional software, and why would users or software developers prefer open-source?
- c) (4 points) Describe two ways a program might end. What abstraction layers of a computer are involved in each?

d) (4 points) Does the Turing Machine below accept or reject the input 1001? What is one input it accepts and one it rejects (besides 1001)? Each input should at least start with a number and be at least two non-blank characters.



e) (2 points) How does a digital camera work?

f) (2 points) What is a tradeoff and a benefit of data compression?

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```
pixel.getX()
pixel.getY()
pixel.getRed()
pixel.getGreen()
pixel.getBlue()
pixel.setRGB(red, green, blue)
pixel.isSimilarTo(red, green, blue, threshold)
```

```
image = new SimpleImage("image.png")
image.countNeighbors(pixel)
image.getHeight()
image.getWidth()
image.getPixel(row, column)
```

```
for (pixel : image) {
    // your code here
}
```

```
for (neighbor : image.getNeighbors(pixel)) {
    // your code here
}
```

```
if (condition) {
    // your code here
} else {
    // your code here
}
```

```
&& => and
|| => or
! => not
!= => is not equal
== => is equal
```

```
1TB = 1000GB
1GB = 1000MB
1MB = 1000KB
1KB = 1000 bytes
```

Bit: 0 is "off", 1 is "on"