

Functions Performed

1. **Red Flagging function** - This function will look at the bus that the infected student uses and will rely on the transportation manager's input on the embarkment times students had that bus ride with the infected student. This function runs a loop where the current time and distance from the same row will be divided to create the risk score for that student, and finish calculating that risk score for each student. From there, the first and last names will be collected. Thirdly, the risk scores are sorted in descending order, and then lastly, the student's full name is matched to their risk score.
2. **Notification Email function** - this function will take the list of red-flagged students and send a notification email through Gmail to anyone the client chooses through the input box. This allows for them to be able to send the output to themselves to continue with contact tracing or to the administration, all principals, the operations manager, and the transportation manager. This will alert the upcoming decisions on enforcement of safety precautions, continuing school or resuming, and, it will most importantly help reduce the spread of the virus as these students will be asked to go on a 7-10 day quarantine and return a negative COVID test before returning on campus.
3. **Add Student to Bus function** - This function will add a student to their new bus' log through a linked google form which will take input of their full name, grade, and new bus. This form will be linked to a spreadsheet that will record the input. Once the input is on the form response sheet, it will be transferred to the bus sheet of the new bus the student moves to which will check for the next available seat and add their information to that seat.
4. **Sorted Embarkment Times** - This function will take values from the embarkment spreadsheet and sort the times spent on the bus from highest to lowest. It will retrieve values from the cells and then sort them using bubble sort in descending order. These values will be displayed in the sorted times log.
5. **Distance Calculator** - This function will rely on the client's input of the infected student on the website through the input box. Then, it will retrieve the x and y position of the infected student and calculate the distances based on those coordinates. The preset coordinates will be retrieved into separate arrays (one x and one y array). From there, a for loop will traverse through all the elements one by one in order to calculate the distance of all students in the bus from the infected student's seat. The distance will be calculated using the distance formula and if the value is negative, it will swap the order from $(x_2 - x_1) + (y_2 - y_1)$ to $(x_1 - x_2) + (y_1 - y_2)$. Those values will then be inserted into the distance column of the main interface
6. **Risk-Rating System** - This function will require the input of the bus driver of the infected student's from specific questions regarding the social distancing, sanitizing, embarkment times, and more crucial information. This will help quantify the spread of the virus as

once the google form is filled out, a rating out of 5 will be given; a 1 being low-risk to a 5 being very high risk. This rating will be displayed in the risk rating log.

7. **Name Validation** - this function will collect the input of the first and last name cells. If anything other than a string is entered, an error message will occur asking to enter a valid name with no numbers.
8. **Data Validated Input Boxes on the Website** - these input boxes will be coded to not allow letters as these boxes correspond to the inputting of the coordinates of the infected student and another one for the inputting of the bus number to perform the functions on
9. **Dialogs with Feedback Displayed on the Website** - these dialogs will display feedback of any changes or data processing that has been done to the sheets and will update the user of what occurs after the button is pressed. This will help with the ergonomics, memorability, efficiency, learnability, and efficiency of the user with the website as it is all on one page and clearly labeled.
10. **Buttons on the Website to Run All Functions** - the buttons will encourage productivity as it will be easier to interact with instead of the script editor, allowing the contact tracing to be done in a manner where the client is comfortable as they have stated in page 2 of the appendix about how they are not “tech-savy” and therefore the usability of the website increases for xx.

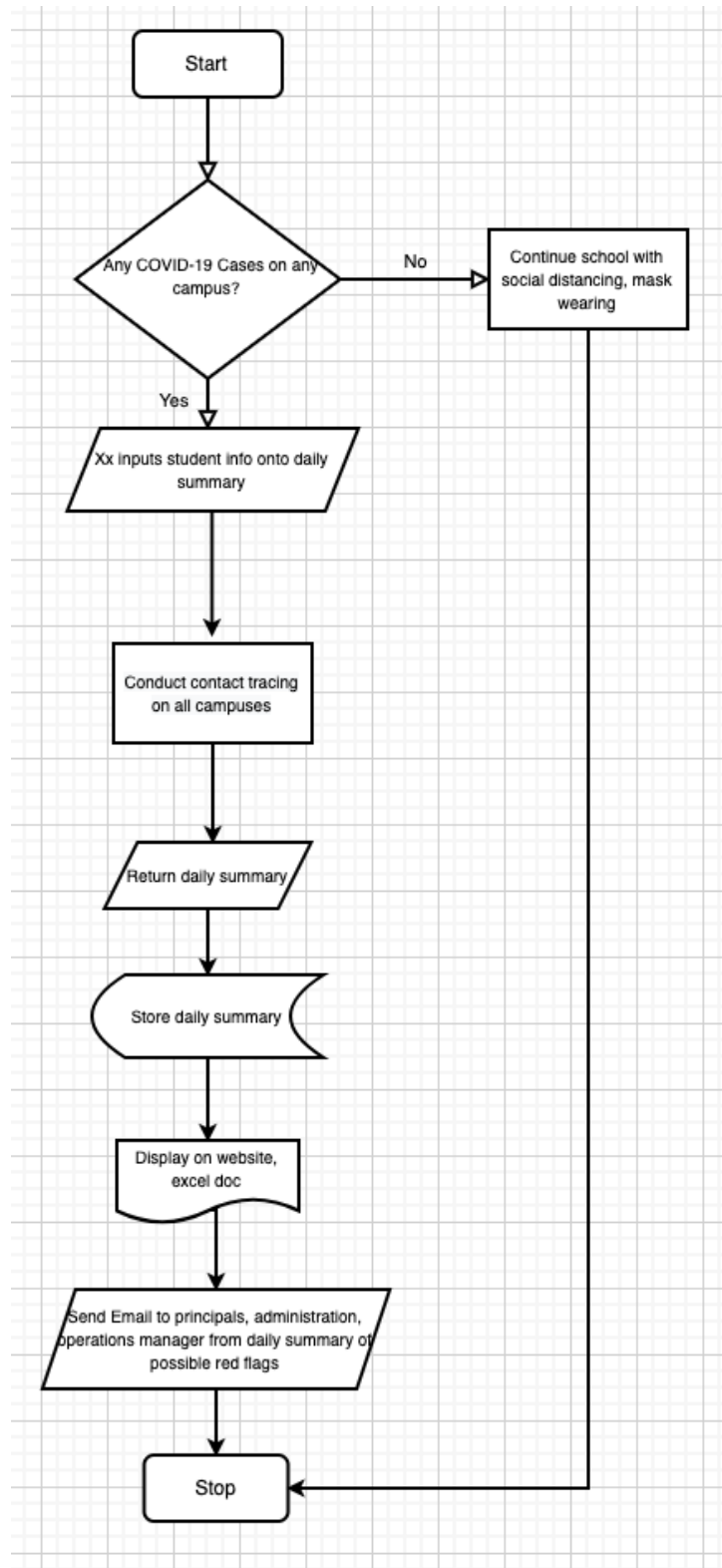
Inputs - The inputs for this process will be the embarkment times of all students on the bus from the day the infected student was announced. This will be done by the transportation manager and bus drivers and the times will be manually recorded by the bus drivers every morning and afternoon when the students are picked up from their homes. Also, the infected student will have to be manually inputted (via coordinates) into the system in order to back-track their interactions on their bus. Secondly, the bus number to perform functions on will be inputted as well along with the email of who to send the report to. This will be done by Xx, and this will mark the beginning of the contact tracing process. Another input from the users will be the add button which will include them on a bus. So for example, a student is added to bus 1, their details will be inserted into the bus. Lastly, an input that will be an extension towards the system will be the survey to the bus driver of the infected student. These questions will include what the social distancing looked like, the ventilation, mask-wearing, and embarkment times.

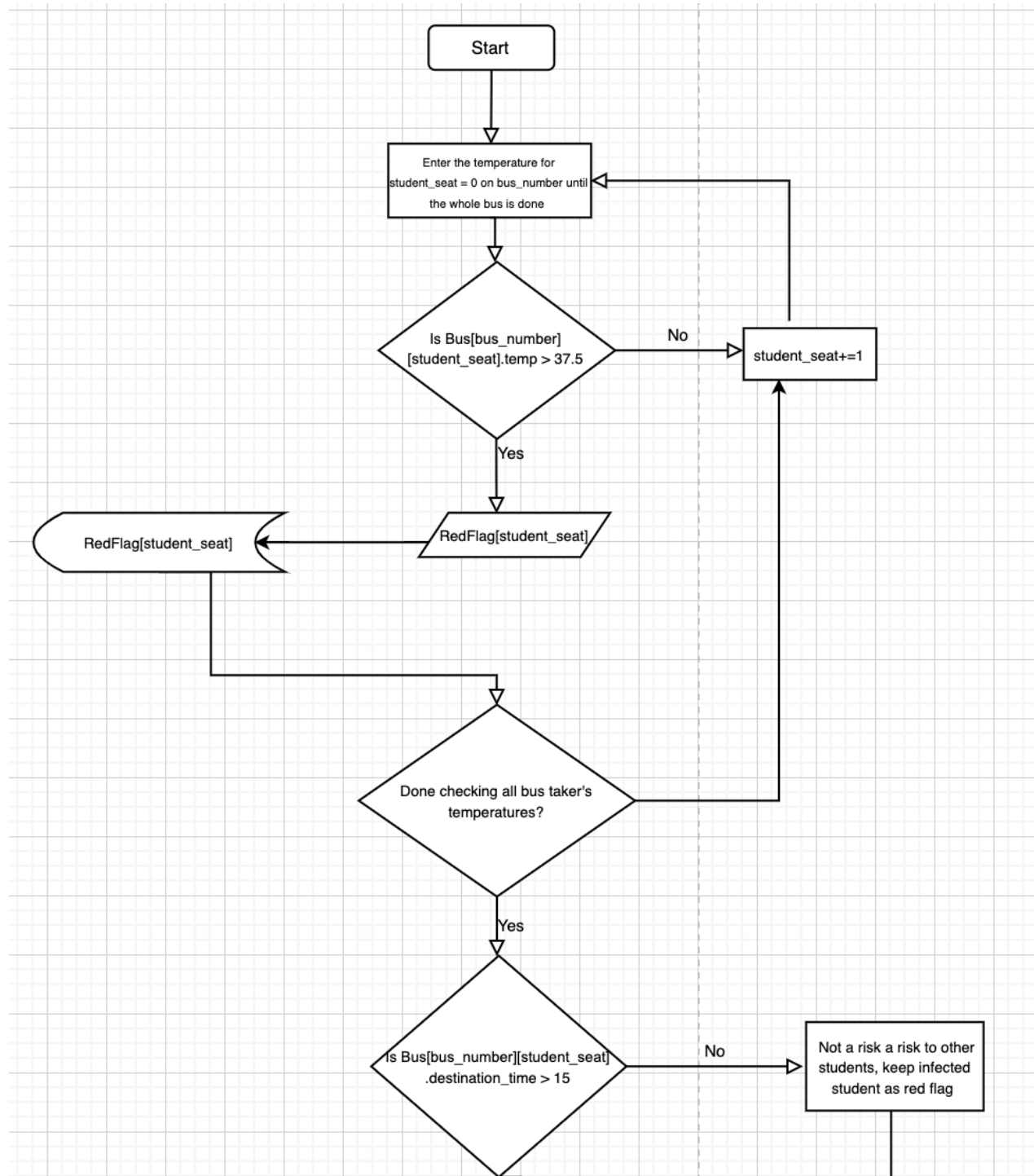
Outputs - The outputs for this process will be the possible red flags of students who could possibly contain COVID-19. This will be in the form of a list in order of the most at risk to the least, thanks to the risk score (time/distance). Another output from this system will be the notification email to the principals, administration, xx, and the transportation manager concerning the possible red flags outputted from the system. For example, this could look like a list of full names and their corresponding risk scores. This will help the administration devise a new plan in order to continue schooling while maintaining the safety of the students and staff. This can also help staff stricken safety precautions in order to avoid the spread of the virus. Thirdly, another output from the website perspective is the dialog windows with the feedback. These return after the buttons for the functions are pressed (individual windows will appear).

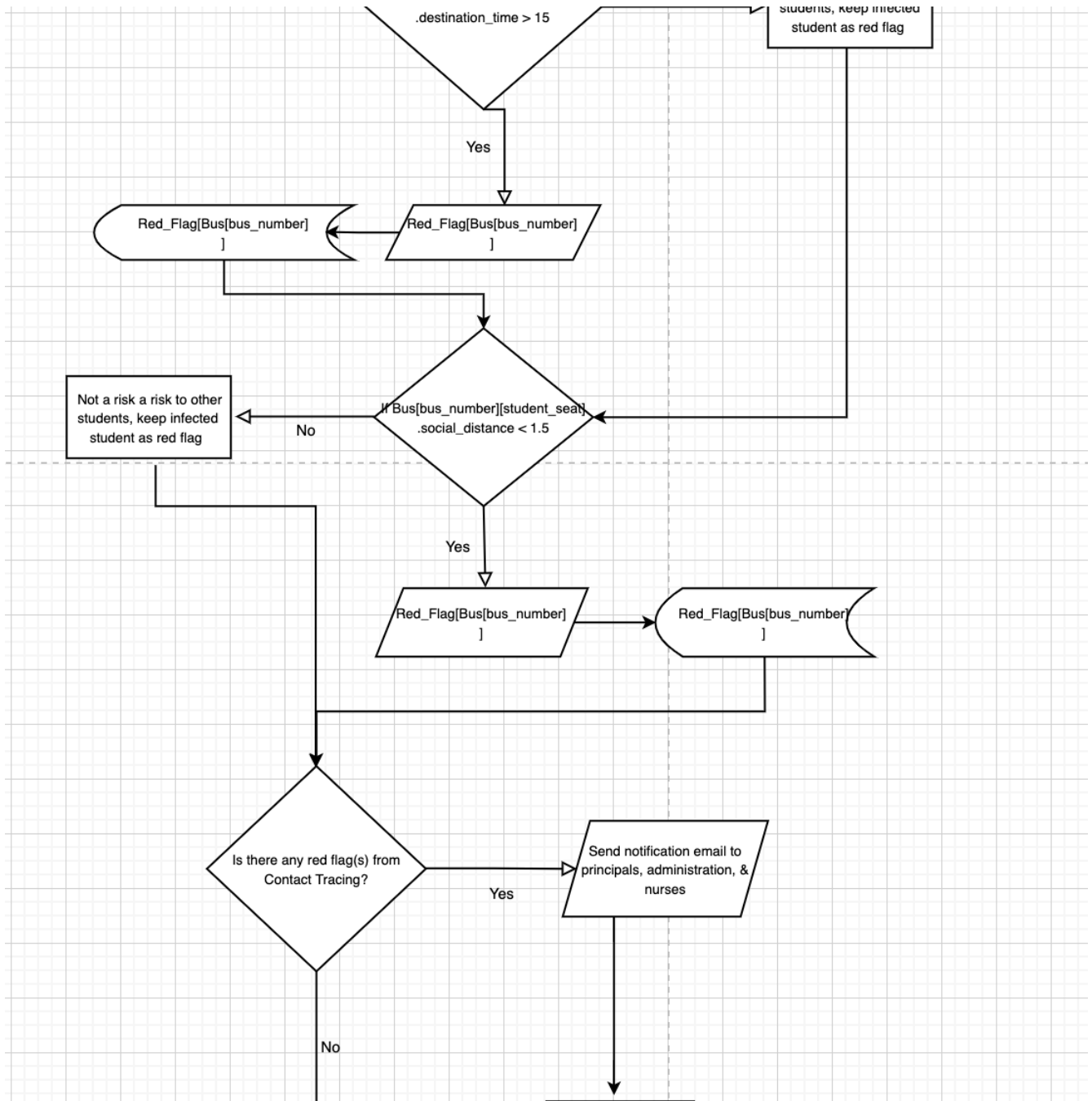
Lastly, the risk-score, sorted times array, distances and added names will be outputted via the sheets

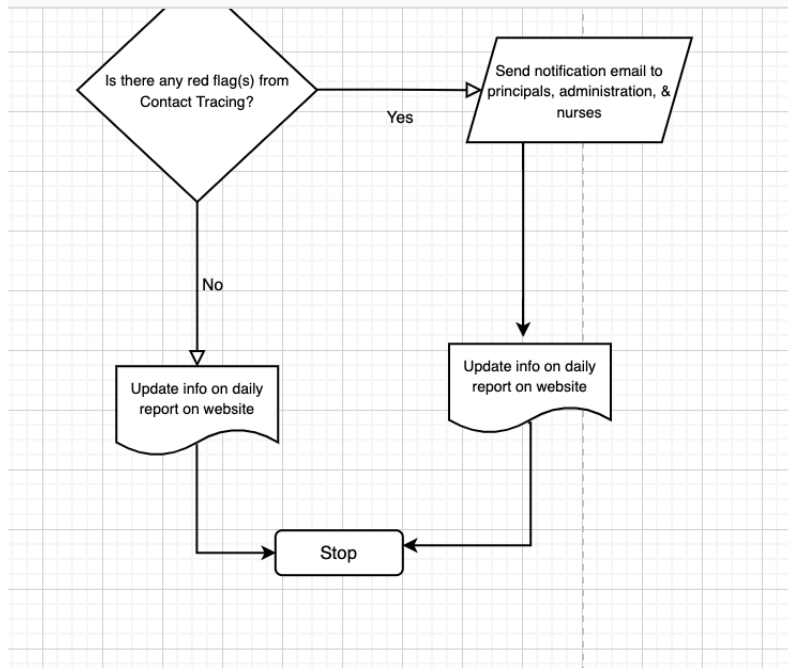
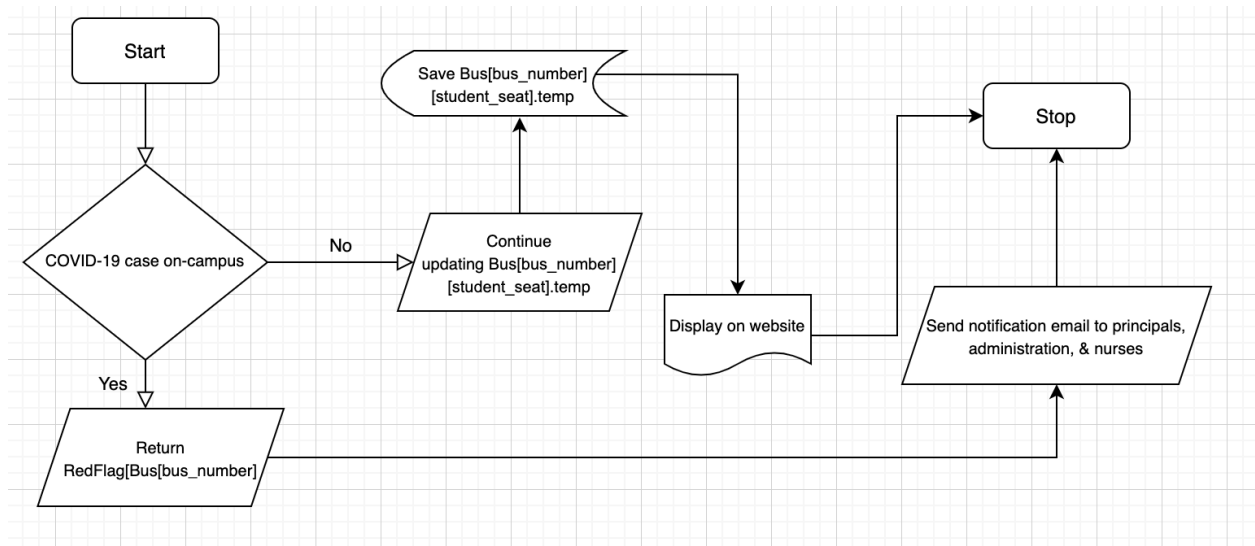
System Flowcharts

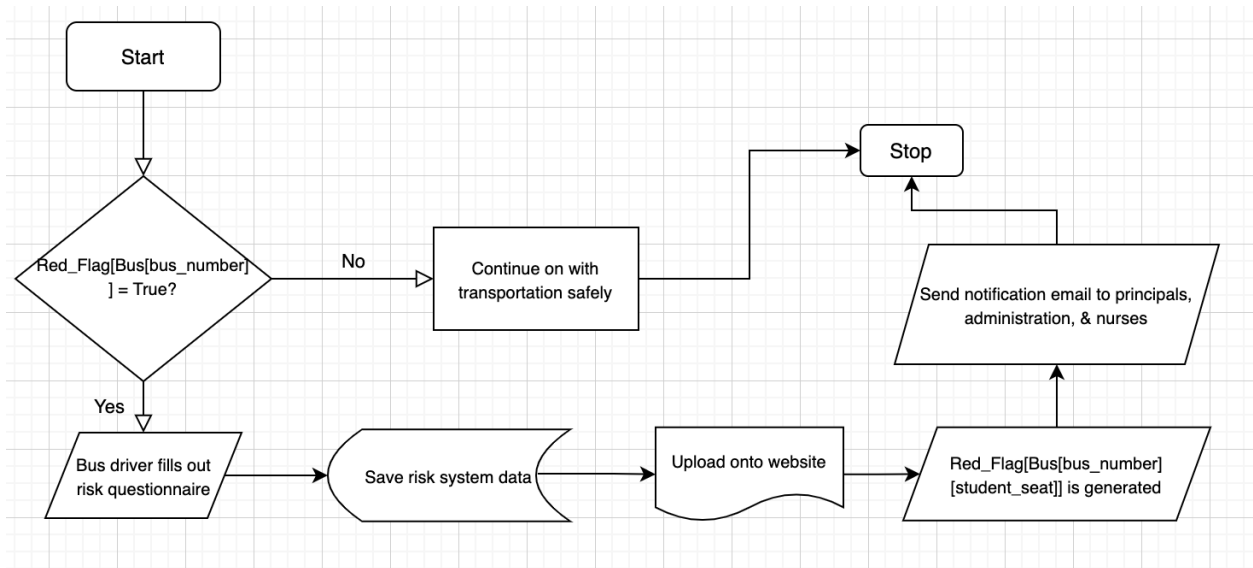
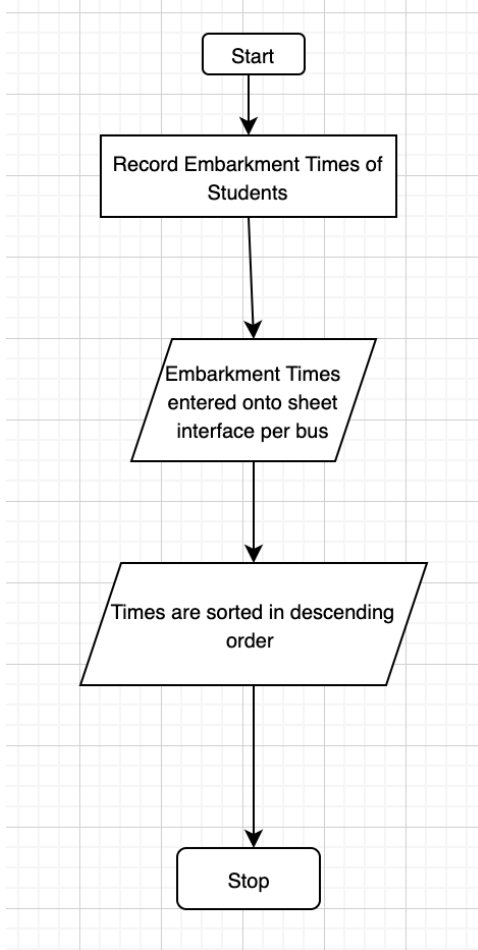
Figure 1 - General Contact Tracing Process

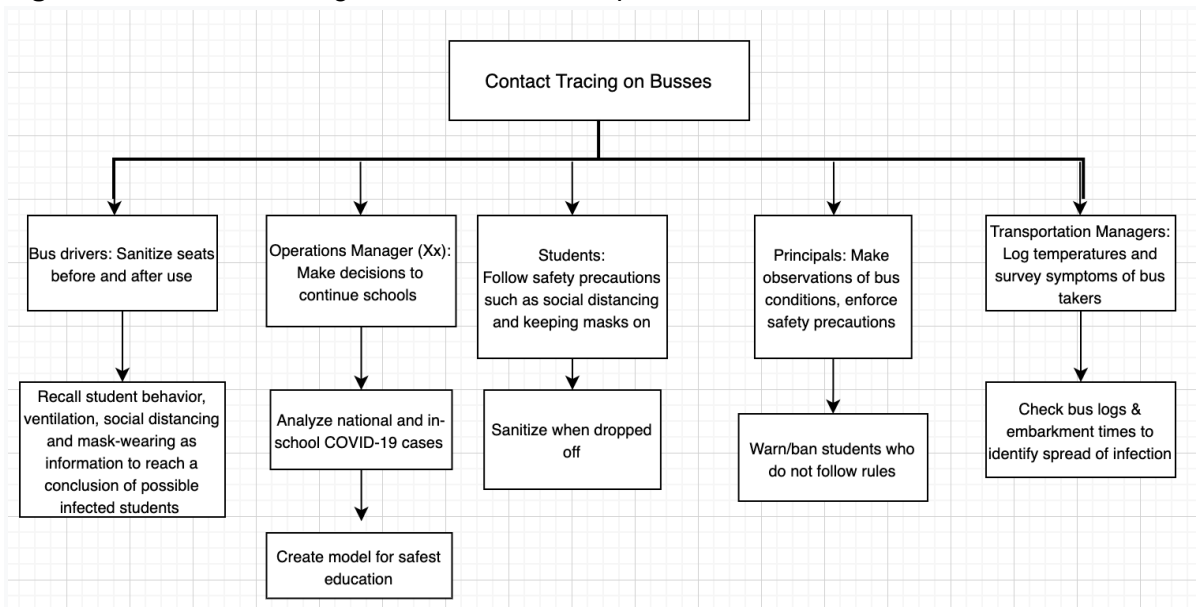
**Figure 2-** Full Process

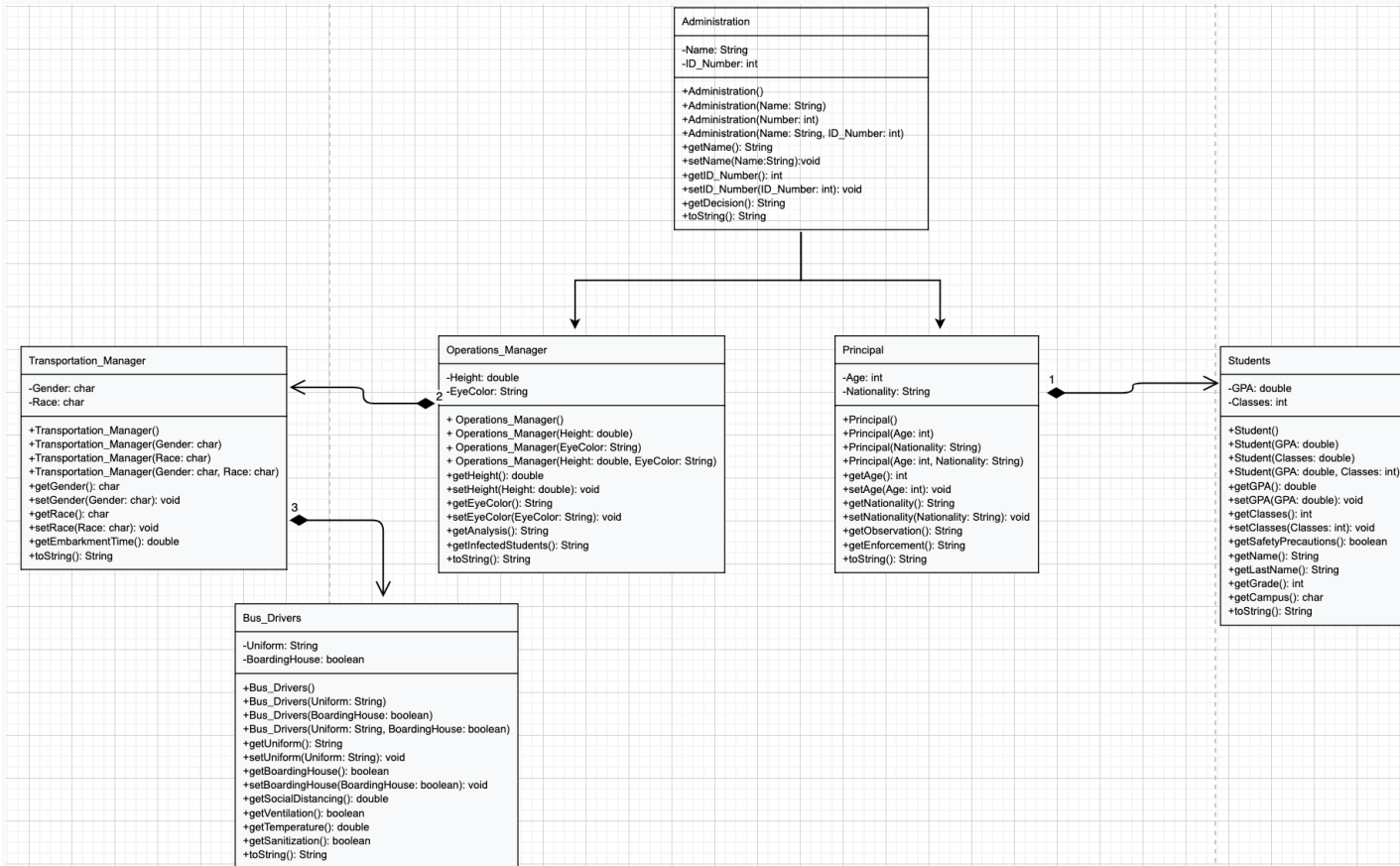




**Figure 3- Transportation Managers****Figure 4- Bus Driver Process**

**Figure 5-** Sorting Embarkment Times

Structure Diagram**Figure 1 - Contact Tracing on Busses broken up into main domains****OOP UML Diagram**



Extensibility:

This general idea could be transferred to different venues like exam halls or classrooms and such where the same variables are recorded such as time spent in the room, distance. Also, seats must be assigned in order for this to work which is very common in work/school contexts. This can extend to different models of busses as well and more busses. The script files and sheets can be shared by xx to different people, allowing the product to be passed down and modified.

Limitations and Restrictions:

Access Control - In this system, the operations manager and transportation manager will have editing access whereas administration and the principals will have viewing access. This is because the operations and transportation managers are the ones who will be actively involved in the process of collecting data in order for it to be inputted/outputted. Since the administration and the principals are not active in this process but still have power, they will have viewing access in order to then devise methods to reduce contact and allow safety precautions to be fully enforced and followed. However, the students will not have viewing access as this information is meant to be private. So for students and teachers, a notification could appear of potential red flags/exposures to the virus.

Databases and files created manually before writing the program -

This would be what the input spreadsheet would look like for the transportation manager and the operations manager

	A	B	C	D	E	F
1						
2	Bus Number 1					
3	First Name	Last Name	Grade	Seat #	Embarkment Time	
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14	Bus Number 2					
15	First Name	Last Name	Grade	Seat #	Embarkment Time	
16						
17						
18						
19						
20						
21						
22						

Pseudocode**Sorted Embarkment Times**

Bus is an array of students, Bus[x]

x = seat_number

n = length of array (amount of busses)

j is a temporary variable

For n in range n-1

 For x in range n-2

 if (Bus[x] > Bus[x+1])

 j = Bus[x]

 Bus[x] = Bus[x+1]

 Bus[x+1] = j

 Output Bus[x]

```

        End if
    End for
End for

```

Red Flag

```

bus _number = 0
student_seat = 0
name = get name
grade = get grade
distance = get distance
infected_student = get infected_student
embarkment_time = get embarkment_time

```

Create an array to store distance, bus_number, student_seat, name, grade

input distance, grade, name, surname, bus number and grade

```

If (Bus[bus_number][student_seat].distance < 1.5)
    Output Red_Flag[bus_number][student_seat]
    student_seat = student_seat +1
    if (student_seat = 21)
        bus_number = bus_number +1
else
    student_seat = student_seat +1
    if (student_seat = 21)
        bus_number = bus_number +1
if (embarkment_time > 15)
    if (distance < 1.5)
        Output Red_Flag[x]

```

Add

```

bus _number = get bus _number
new_bus = get new_bus number

```

```

if Input = "add"
    bus _number.addItem(name, surname, grade)

```

Risk-Rating System

The google form will ask questions to the bus drivers and they will rate the risk of risk of the spread from 1-5 (1 being low and 5 being high)

Output "Rate the social distancing of the infected student to other bus riders"

Inputs a number 1-5, int1

If input is not an integer or input > 5 or input < 1

 For input not equal to int or input > 5 or input < 1

 Output "Please input a number within the range"

 End for

End if

Store int1

Output "Rate the ventilation in the bus"

Inputs a number 1-5, int2

If input is not an integer or input > 5 or input < 1

 For input not equal to int or input > 5 or input < 1

 Output "Please input a number within the range"

 End for

End if

Store int2

Output "Rate the length of exposure based off of the time the infected student was on the bus"

Inputs a number 1-5, int3

If input is not an integer or input > 5 or input < 1

 For input not equal to int or input > 5 or input < 1

 Output "Please input a number within the range"

 End for

End if

Store int3

Output "Rate the mask-wearing of all bus riders"

Inputs a number 1-5, int4

If input is not an integer or input > 5 or input < 1

 For input not equal to int or input > 5 or input < 1

 Output "Please input a number within the range"

 End for

End if

Store int4

At the end of all 4 questions, the rating will be outputted

sum = int1 + int2 + int3 + int4

rating = sum/4

Output "Rating is a" rating "out of 5"

Name Validator Function

Input names onto googlescript

if name is an integer

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For name not equal to string
    Output "Please input a name without numbers"
End for
```

Email Notification

The list of red flags has already been outputted, RedFlag[x]

X = number of redflags

For x > 1

 getName, getLastName, getGrade

getEmailAdress of principals, administration and operations manager

Compose a new email where subject is the redflagged students from contact tracing on busses

Output "Hello, the following students were outputted as potential risks to containing COVID-19 from the GoogleScript." RedFlag[x]

Distances

Get infected_coordinates

Get x_array

Get y_array

For i in length of bus[x]

 Distance = $((X-x1)^2 + (y-y1)^2)$.squareroot

 Set distance to cell

Button

If Button_clicked == True

 Run corresponding function

Dialog

If Button_clicked == True and return value for function != null or != undefined

 Print return value for the corresponding function

Data Validated Input Boxes

If x_coordinate is an integer and y_coordinate is an integer

 Let user type integers

If bus_number is an integer

 Let user type integer

Test Plan

Action to be Tested	Test Method	Expected Result
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Add button which takes an input of the student's information (first name, last name, and grade) through a form and adds that to the bus log of their new bus	Input full name and grade to the form and observe if it added to the bus log	The ability to include a student's information like full name and grade onto the new bus log
"risk score" calculation (time/distance) and set those values to the corresponding student on the bus log. Then, sort these scores in descending order and sort the corresponding name array in that same order.	Input infected student coordinates, bus number, email to send information to and run distance function, then run the red flag function.	It will generate a red-flag list in order of highest to lowest risk score through calculating (time/distance), sorting those scores and the corresponding array of names in that order
Display a sorted list of embarkment times in descending order on the website	Input times in the embarkment times cells then press the sort times button	It should display the embarkment times in descending order as a dialog on the website and there is a sheet which shows it (setting the last cell as the array content) in case the dialog doesn't appear
Distance Calculator (Utilize 2 arrays (1 x-coordinate and 1 y-coordinate array) to calculate the distance from the infected student and then log those distances onto the bus log of the selected bus.)	Input the infected student as a set of coordinates that corresponds to a seat then press the calculate distance button	Calculate and then set the distance values from the infected student onto the bus log per student on the bus log
A risk-rating system that will take input from the bus driver of the infected student on how well various COVID-19 protocols were met to estimate the potential risk through a form by calculating a value from 1-5, 5 being worst spread and 1 being protocols followed and safety	Input the answers from the questionnaire to the bus drivers on a scale from 1-5	Return a value from 1-5 regarding the risk of the spread based on the average of the 4 questions

is met. This will then be displayed on the website as a dialog		
Send an email to the people of choice through an input box on the website when there is a red flag (case of the virus) which will display in order from the most at-risk to the least at-risk students from the bus	run the red flag function after inputting times and distances into the bus log.	send an email of sorted arrays to the email address entered
A name validator which will validate the first and last name range of cells (ex. If a grade is accidentally inputted for a first or last name, an error message is displayed on the website with a dialog")	Input a number in the name section	It should return an error if there is a number in the list of names of bus riders
Buttons for all the functions on the website (front-end)	Click the buttons to run the functions	Be able to run the functions from the front-end instead of making Xx run the function from the script editor (makes things easier). The function output should appear on the sheet with changed data and through dialogs with feedback.
Dialogs will be displayed after functions are ran to show timely feedback of what is being changed in the functions and sheets	Run Functions after entering the other information of which bus and coordinates of the infected student	Dialog windows will appear with timely feedback of what the function did as well as where to access this information or what it is doing after the button is pressed
Data validated input boxes that take in the coordinates of the infected student to calculate distances	Input a bus number into the input box and coordinates for the other boxes. Also try to input letters.	When the functions are run through the buttons, the output will be based on the bus which corresponds to the

accordingly. The same for the bus number input box to perform the functions on		inputted number. Also, no letters should be allowed to be typed
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