Project Report

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Introduction

In this project we were given a prompt stating that "a pharmaceutical company manufactures 4 product lines from its factory in Dublin". In this report I will be preparing information on the manufacturing process, creating test data based on the given tasks, and implementing functions based on the tasks given to complete.

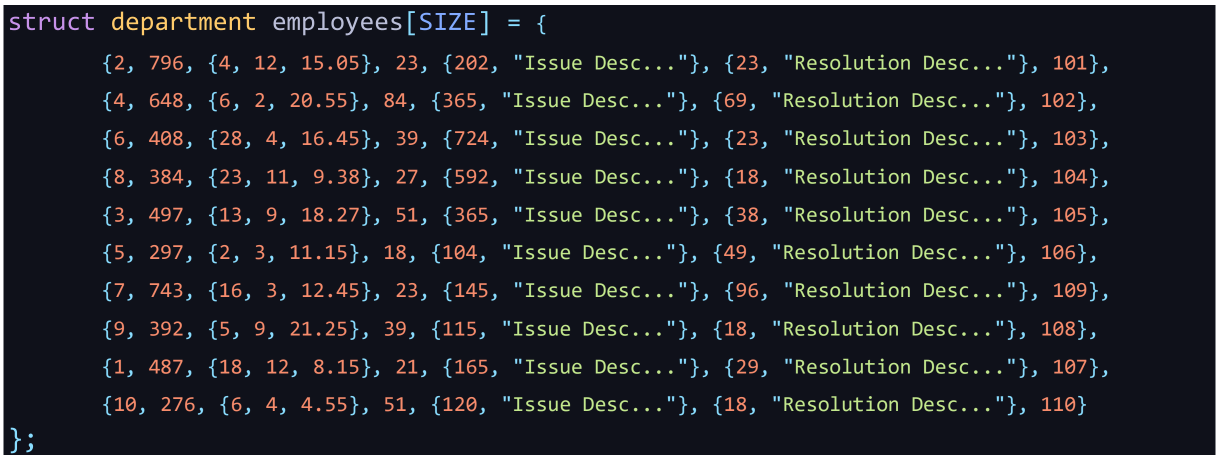
Design

In this project, the main data structure was to use the struct command in c to store different data types for the different variables.

The sorting algorithm used was the merge sort algorithm because of its efficiency. Merge sort uses recursion to divide, conquer and combine a given array in order.

Test Data

The data below is the test data used in the program to get results and to test each task.



```
struct department employees[SIZE] = {
        {2, 796, {4, 12, 15.05}, 23, {202, "Issue Desc..."}, {23, "Resolution Desc..."}, 101},
        {4, 648, {6, 2, 20.55}, 84, {365, "Issue Desc..."}, {69, "Resolution Desc..."}, 102},
        {6, 408, {28, 4, 16.45}, 39, {724, "Issue Desc..."}, {23, "Resolution Desc..."}, 103},
        {8, 384, {23, 11, 9.38}, 27, {592, "Issue Desc..."}, {18, "Resolution Desc..."}, 104},
        {3, 497, {13, 9, 18.27}, 51, {365, "Issue Desc..."}, {38, "Resolution Desc..."}, 105},
        {5, 297, {2, 3, 11.15}, 18, {104, "Issue Desc..."}, {49, "Resolution Desc..."}, 106},
        {7, 743, {16, 3, 12.45}, 23, {145, "Issue Desc..."}, {96, "Resolution Desc..."}, 109},
        {9, 392, {5, 9, 21.25}, 39, {115, "Issue Desc..."}, {18, "Resolution Desc..."}, 108},
        {1, 487, {18, 12, 8.15}, 21, {165, "Issue Desc..."}, {29, "Resolution Desc..."}, 107},
        {10, 276, {6, 4, 4.55}, 51, {120, "Issue Desc..."}, {18, "Resolution Desc..."}, 110}
};
```

Task 1 Walkthrough

This task was asking to organise the line logs by product ID, issue code, then date and time. In this task, merge sort was used to organise the array to be in the order needed. Then another function was created to display the new sorted data, only displaying product id, issue code, and date & time.

Task 2 Walkthrough

This task was stating that there was a change in the manufacturing process and that the same product could be manufactured on different lines. It's similar to task 1 as merge sort was also used on this. The main difference is that malloc() was used to temporarily allocate memory to the issueReport array, then freed right when the program is finished. Another difference is that instead of sorting by date and time, it was instead sorted by product id, then line id for all of the lines. Another function was created to display the sorted data, only showing the product id, line code and issue code.

Task 3 Walkthrough

This task is where the scanf() function was used. It was asking to use a function to find the earliest occurrence of an issue code. Using a for loop as well as an if statement to find when the first occurrence of the given issue code was used. In the same function, the sorted data was displayed, only showing the product id, line code and issue code if the given issue code was found in the program. If not found, the program would display an appropriate error message for the user.

Task 4 Walkthrough

This task was asking to provide a report summary of the number of issues reported per product. Basically, meaning that for each product, to count the number of issues reported, then to display it out onto the terminal. A for loop with a nested for loop was made to count the number of issues found for every product id. The displayed variables was the product id and the number of issues counted.

Pseudocode + Code

Below is the pseudocode created for the program as well as the implemented code version of it.

Pseudocode:

```
START
    DEFINE SIZE 10
    DEFINE LENGTH 20

    Typedef char STRING

    STRUCT dateTime:
        Int day
        Int month
        Float hourandMin

    STRUCT desc:
        Int code
        STRING description[LENGTH]

    STRUCT department:
        Int lineCode
        Int batchCode
        dateTime batchDateTime
        int productid
        desc issue
        desc resolution
        int employeeID

    VOID displayIssueReport(struct department **emp)
    VOID displaySortedDepartment(struct department *emp)
    VOID mergeSort(struct department *emp, low, high)
    VOID merge(struct department *emp, low, mid, high)
    VOID issueSort(struct department **emp, low, high)
    VOID issueMerge(struct department **emp, low, mid, high)
    VOID searching(struct department *emp)
    VOID noOFIssues(struct department *emp)

    ALGORITHM main():
        Int i
        STRUCT department *issueReport[SIZE]
        STRUCT department employees[SIZE] // initialised array

        // TASK 1
        mergeSort(employees, 0, SIZE-1)
        displaySortedDepartment(employees)

        // TASK 2
        FOR I = 0 to SIZE-1:
            // allocates memory for issueReport array
            issueReport[i] = (struct department *)malloc(Sizeof(struct
            department))

            IF issueReport[i] != NULL:
                IssueReport[i]->productID = employees[i].productID
                issueReport[i]->issue.code = employees[i].issue.code
                issueReport[i]->lineCode = employees[i].lineCode
            END IF
        END FOR

        issueSort(issueReport, 0, SIZE-1)

        PRINT ”issue Report Code”
        displayIssueReport(issueReport)
```

```
        FOR I = 0 to SIZE-1:
                IF issueReport[i] != NULL:
                        FREE issueReport[i]
                END IF
        END FOR

        // TASK 3
        PRINT "Search"
        searching(employees)

        // TASK 4
        PRINT "Summary Report of Issues"
        noOFIssues(employees)

        RETURN 0
END MAIN ALGORITHM

ALGORITHM mergeSort(emp, low, high);
        IF low < high:
                mid = (low + high) / 2
                mergeSort(emp, low, mid)
                mergeSort(emp, mid+1, high)
                merge(emp, low, mid, high)
        END IF
END mergeSort ALGORITHM

ALGORITHM merge(emp, low, mid, high):
        temp[high – low + 1]
        int I, j
        int k = low
        int ptrL = mid – low + 1
        int ptrR = high – mid
        STRUCT department LEFT[LENGTH], RIGHT[LENGTH]
        FOR I = 0 to ptrL:
                LEFT[i] = emp[low + i]
        END FOR

        FOR j = 0 to ptrR:
                RIGHT[j] = emp[mid + 1 + j]
        END FOR

        i = 0, j = 0
        WHILE i < ptrL AND j < ptrR:
                IF LEFT[i].productID < RIGHT[j].productID OR
                LEFT[i].productID == RIGHT[i].productID AND
                LEFT[i].issue.code < RIGHT[i].issue.code OR
                LEFT[i].productID == RIGHT[i].productID AND
                LEFT[i].issue.code == RIGHT[i].issue.code AND
                LEFT[i].batchDateTime.month <
                RIGHT[j].batchDateTime.month OR
                LEFT[i].productID == RIGHT[i].productID AND
                LEFT[i].issue.code == RIGHT[i].issue.code AND
                LEFT[i].batchDateTime.month ==
                RIGHT[i].batchDateTime.month AND
                LEFT[i].batchDateTime.day < RIGHT[i].batchDateTime.day
                OR
                LEFT[i].productID == RIGHT[i].productID AND
                LEFT[i].issue.code == RIGHT[i].issue.code AND
                LEFT[i].batchDateTime.month ==
                RIGHT[i].batchDateTime.month AND
                LEFT[i].batchDateTime.day == RIGHT[i].batchDateTime.day
                AND LEFT[i].batchDateTime.hourandMin <
                RIGHT[i].batchDateTime.hourandMin:
                        emp[k] = LEFT[i]
                        k = k + 1
                        i = i + 1
                        ELSE:
                            emp[k] = RIGHT[j]
                            k = k + 1
                            j = j + 1
                        END IF
                END WHILE
                WHILE i < ptrL:
                        emp[k] = LEFT[i]
                        k = k + 1
                        i = i + 1
                END WHILE

                WHILE j < ptrR:
                        emp[k] = RIGHT[j]
                        k = k + 1
                        j = j + 1
                END WHILE
        END merge ALGORITHM

        ALGORITHM displaySortedDepartment(emp):
                FOR I = 0  to SIZE-1:
                        PRINT “Department”
                        PRINT “Product ID:”, emp[i].productID
                        PRINT “Issue Code:”, emp[i].issue.code
                        PRINT “Date:”, emp.batchDateTime.date, “/”,
                        emp[i].batchDateTime.month, “/2024, Time:”,
                        emp[i].batchDsteTime.hourandMin
                END FOR
        END displaySortedDepartment ALGORITHM

        ALGORITHM issueSort(emp, low, high):
                IF low < high:
                        mid = (low + high) / 2
                        issueSort(emp, low, mid)
                        issueSort(emp, mid+1, high)
                        IssueMerge(emp, low, mid, high)
                END IF
        END issueSort ALGORITHM

        ALGORITHM issueMerge(emp, low, mid, high):
                temp[high – low + 1]
                int I, j
                int k = low
                int ptrL = mid – low + 1
                int ptrR = high – mid
                STRUCT department LEFT[LENGTH], RIGHT[LENGTH]
                FOR I = 0 to ptrL:
                        LEFT[i] = emp[low + i]
                END FOR

                FOR j = 0 to ptrR:
                        RIGHT[j] = emp[mid + 1 + j]
                END FOR

                i = 0, j = 0
                WHILE i < ptrL AND j < ptrR:
                        IF LEFT[i].productID < RIGHT[j].productID OR
                        LEFT[i].productID == RIGHT[i].productID AND
                        LEFT[i].lineCode < RIGHT[i].lineCode:
                            emp[k] = LEFT[i]
                            k = k + 1
                            i = i + 1
                        ELSE:
                            emp[k] = RIGHT[j]
                            k = k + 1
                            j = j + 1
                        END IF
                END WHILE
                WHILE i < ptrL:
                        emp[k] = LEFT[i]
                        k = k + 1
                        i = i + 1
                END WHILE

                WHILE j < ptrR:
                        emp[k] = RIGHT[j]
                        k = k + 1
                        j = j + 1
                END WHILE
        END issueMerge ALGORITHM

        ALGORITHM displayIssueReport(issueReport):
                Int i;

                FOR I = 0 to SIZE-1:
                        PRINT “Product ID:”, issueReport[i]->productID
                        PRINT “Issue Code:”, issueReport[i]->issue.code
                        PRINT “Line Code:”, issueReport[i]->lineCode
                END FOR
        END displayIssueReport ALGORITHM

        ALGORITHM searching(emp):
                Int search, i
                Int key = 0
                PRINT "please enter the issue code:"
                READ search

                FOR i = 0 to SIZE-1:
                        IF emp[i].issue.code == search:
                            key = 1
                            BREAK OUT OF LOOP
                        END IF
                END FOR

                IF key == 1:
                        PRINT "Initial Occurrence → Product ID:", emp[i].productID,
                        "Line Code:", emp[i].lineCode, "Issue Code:",
                        emp[i].issue.code
                ELSE:
                        PRINT "Issue Code Invalid"
                END IF
        END searching ALGORITHM

        ALGORITHM noOFIssues(emp):
                Int i, j
                Int count[SIZE] = {0}

                FOR i = 0 to SIZE-1:
                        FOR j = 0 to SIZE-1:
                            IF emp[i].productID == emp[j].productID:
                                    count[i] = count[i] + 1
                            END IF
                        END INNER FOR
                END OUTER FOR
```

```
            FOR i = 0 to SIZE-1:
                IF emp[i – 1].productID == emp[i].productID:
                    i = i + 1
                END IF

                PRINT "Product ID:", emp[i].productID, "Number of Issues",
                count[i]
            END FOR
        END noOFIssues ALGORITHM
END PROGRAM
```

Code:

```c
/*
Programs Description: This program demonstrates
    (1) sorting line logs by product ID, issue code, and date/time
    (2) sorting the files according to product id, then line code
    (3) searches for the first occurence of an issue code
    (4) finds the number of issues per product id

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*/
#include <stdio.h>
#include <stdlib.h>

#define SIZE 10
#define LENGTH 20

typedef char STRING;

// structure templates
struct dateTime {
    int day; // DD
    int month; //MM
    float hourandMin; // HR.MIN
};

struct desc {
    int code;
    STRING description[LENGTH];
```

```c
};

struct department {
    int lineCode;
    int batchCode;
    struct dateTime batchDateTime;
    int productID;
    struct desc issue;
    struct desc resolution;
    int employeeID;
};

// function assignments
void displayDepartment(struct department *);
void displayIssueReport(struct department **);
void displaySortedDepartment(struct department *);
void mergeSort(struct department *, int, int);
void merge(struct department *, int, int, int);
void issueSort(struct department **, int, int);
void issueMerge(struct department **, int, int, int);
void searching(struct department *);
void noOFIssues(struct department *);

int main() {
    int i, size;
    struct department *issueReport[SIZE];
    struct department employees[SIZE] = {
        {2, 796, {4, 12, 15.05}, 23, {202, "Issue Desc..."}, {23, "Resolution Desc..."}, 101},
        {4, 648, {6, 2, 20.55}, 84, {365, "Issue Desc..."}, {69, "Resolution Desc..."}, 102},
        {6, 408, {28, 4, 16.45}, 39, {724, "Issue Desc..."}, {23, "Resolution Desc..."}, 103},
        {8, 384, {23, 11, 9.38}, 27, {592, "Issue Desc..."}, {18, "Resolution Desc..."}, 104},
        {3, 497, {13, 9, 18.27}, 51, {365, "Issue Desc..."}, {38, "Resolution Desc..."}, 105},
        {5, 297, {2, 3, 11.15}, 18, {104, "Issue Desc..."}, {49, "Resolution Desc..."}, 106},
        {7, 743, {16, 3, 12.45}, 23, {145, "Issue Desc..."}, {96, "Resolution Desc..."}, 109},
        {9, 392, {5, 9, 21.25}, 39, {202, "Issue Desc..."}, {18, "Resolution Desc..."}, 108},
        {1, 487, {18, 12, 8.15}, 21, {165, "Issue Desc..."}, {29, "Resolution Desc..."}, 107},
        {10, 276, {6, 4, 4.55}, 51, {120, "Issue Desc..."}, {18, "Resolution Desc..."}, 110}
    };

    // displays the unsorted department elements
    printf("--------Unsorted Data--------\n");
    displayDepartment(employees);

    //TASK 1
    // uses mergeSort to sort the elements in the employees array
    mergeSort(employees, 0, SIZE - 1);

    // displays the sorted department elements
    printf("--------Sorted Data--------\n");
    displaySortedDepartment(employees);

    // TASK 2
    // loop to runs through each element in the array
    for (i = 0; i < SIZE; i++) {
        // allocates memory for the issueReport department struct
        issueReport[i] = (struct department *)malloc(sizeof(struct department));

        // checks if the allocation was successful
        if (issueReport[i] != NULL) {
            // assigns values to the issueReport array using values from the employees array
            issueReport[i]->productID = employees[i].productID;
            issueReport[i]->issue.code = employees[i].issue.code;
            issueReport[i]->lineCode = employees[i].lineCode;

        } // end if

    } // end for

    // uses issueSort to sort the elements in the employees array
    issueSort(issueReport, 0, SIZE - 1);

    // displays the issue report
    printf("-----Issue Code Report-----\n");
    displayIssueReport(issueReport);

    // Remember to use and eventually free the allocated memory for issueReport
    for (i = 0; i < SIZE; i++) {
        if (issueReport[i] != NULL) {
            free(issueReport[i]);

        } // end if

    } // end for

    // TASK 3
    // preforms a search on the employee data
    printf("\n\n---------Search---------\n");
    searching(employees);

    // TASK 4
    // generates a summary report of issues
    printf("\n\n------Summary Report of Issues------\n");
    noOFIssues(employees);

    return 0;
```

```c
} // end main

// displays the unsorted data
void displayDepartment(struct department emp[]) {
    int i;


    for (i = 0; i < SIZE; i++) {
        printf("-----------------------\n");
        printf("Line Code: %d\n", emp[i].lineCode);
        printf("Batch Code: %d\n", emp[i].batchCode);
        printf("Date: %d/%d/2024, Time: %.2f\n", emp[i].batchDateTime.day, emp[i].batchDateTime.month,
emp[i].batchDateTime.hourandMin);
        printf("Product ID: %d\n", emp[i].productID);
        printf("Issue Code: %d\n", emp[i].issue.code);
        printf("Issue Description: %s\n", emp[i].issue.description);
        printf("Resolution Code: %d\n", emp[i].resolution.code);
        printf("Resolution Description: %s\n", emp[i].resolution.description);
        printf("Employee ID: %d\n\n", emp[i].employeeID);

    } // end for

} // end displayDepartment


// TASK 1
// uses the merge sort algorithm to sort each variable O(NLog(N))
void mergeSort(struct department emp[], int low, int high) {
    int mid;


    // checks if the low value is lower than the high value
    if (low < high) {
        mid = (low + high) / 2;
        mergeSort(emp, low, mid);
        mergeSort(emp, mid + 1, high);
        merge(emp, low, mid, high);
    } // end if

} // end mergeSort

// the second part of mergeSort (arranging the values in order)
void merge(struct department emp[], int low, int mid, int high) {
    int temp[high - low + 1];
    int i, j, k = low;
    int ptrL = mid - low + 1, ptrR = high - mid;


    // creates temporary arrays
    struct department LEFT[LENGTH], RIGHT[LENGTH];

    // copying data into the temp arrays
    for (i = 0; i < ptrL; i++) {
        LEFT[i] = emp[low + i];

    } // end for

    for (j = 0; j < ptrR; j++) {
        RIGHT[j] = emp[mid + 1 + j];

    } // end for

    i = 0, j = 0;
    // merges the temp arrays back to emp
    while (i < ptrL && j < ptrR) {
        // compares the values by date and time
        if (LEFT[i].productID < RIGHT[j].productID ||
        LEFT[i].productID == RIGHT[i].productID && LEFT[i].issue.code < RIGHT[i].issue.code ||
        LEFT[i].productID == RIGHT[i].productID && LEFT[i].issue.code == RIGHT[i].issue.code &&
LEFT[i].batchDateTime.month < RIGHT[j].batchDateTime.month ||
        LEFT[i].productID == RIGHT[i].productID && LEFT[i].issue.code == RIGHT[i].issue.code &&
LEFT[i].batchDateTime.month == RIGHT[i].batchDateTime.month &&
        LEFT[i].batchDateTime.day < RIGHT[i].batchDateTime.day ||
        LEFT[i].productID == RIGHT[i].productID && LEFT[i].issue.code == RIGHT[i].issue.code &&
LEFT[i].batchDateTime.month == RIGHT[i].batchDateTime.month &&
        LEFT[i].batchDateTime.day == RIGHT[i].batchDateTime.day &&
        LEFT[i].batchDateTime.hourandMin < RIGHT[i].batchDateTime.hourandMin) {
            emp[k++] = LEFT[i++];

        } else {
            emp[k++] = RIGHT[j++];

        } // end if

    } // end while

    // copies the rest of the values into emp if there is any
    while (i < ptrL) {
        emp[k++] = LEFT[i++];

    } // end while

    while (j < ptrR) {
        emp[k++] = RIGHT[j++];

    } // end while
```

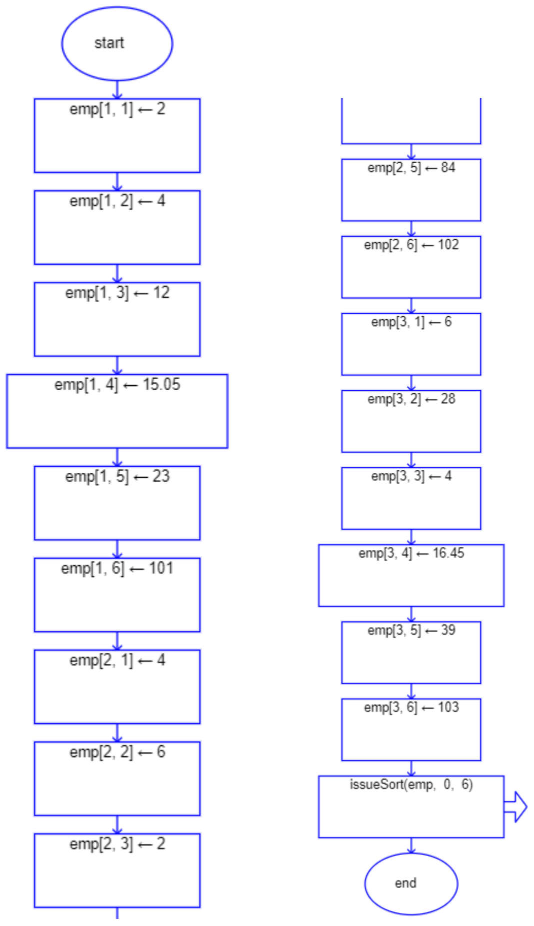
```c
} // end merge

// displays the sorted departments in order of date and time
void displaySortedDepartment(struct department emp[]) {
    int i;


    // reports each line log in productID, issueCode, an dateandTime
    for (i = 0; i < SIZE; i++) {
        printf("---Department---\n");
        printf("Product ID: %d\n", emp[i].productID);
        printf("Issue Code: %d\n", emp[i].issue.code);
        printf("Date: %d/%d/2024, Time: %.2f\n\n", emp[i].batchDateTime.day,
emp[i].batchDateTime.month, emp[i].batchDateTime.hourandMin);
    } // end for

} // end displaySortedDepartment

// TASK 2
// uses the merge sort algorithm to sort each variable O(NLog(N))
void issueSort(struct department **emp, int low, int high) {
    int mid;


    // checks if the low value is lower than the high value
    if (low < high) {
        mid = (low + high) / 2;
        issueSort(emp, low, mid);
        issueSort(emp, mid + 1, high);
        issueMerge(emp, low, mid, high);
    } // end if

} // end mergeSort

// the second part of mergeSort (arranging the values in order)
void issueMerge(struct department **emp, int low, int mid, int high) {
    int temp[high - low + 1];
    int i, j, k = low;
    int ptrL = mid - low + 1, ptrR = high - mid;


    // creates temporary arrays
    struct department LEFT[LENGTH], RIGHT[LENGTH];

    // copying data into the temp arrays
    for (i = 0; i < ptrL; i++) {
        LEFT[i] = *emp[low + i];

    } // end for
    for (j = 0; j < ptrR; j++) {
        RIGHT[j] = *emp[mid + 1 + j];

    } // end for

    i = 0, j = 0;
    // merges the temp arrays back to emp
    while (i < ptrL && j < ptrR) {
        // compares the values by date and time
        if (LEFT[i].productID < RIGHT[j].productID ||
        LEFT[i].productID == RIGHT[i].productID && LEFT[i].lineCode < RIGHT[i].lineCode) {
            *emp[k++] = LEFT[i++];

        } else {
            *emp[k++] = RIGHT[j++];

        } // end if

    } // end while

    // copies the rest of the values into emp if there is any
    while (i < ptrL) {
        *emp[k++] = LEFT[i++];

    } // end while

    while (j < ptrR) {
        *emp[k++] = RIGHT[j++];

    } // end while

} // end issueMerge

// displays the departments one by one
void displayIssueReport(struct department **issueReport) {
    int i;


    // prints the product id, issue code, and line code
    for (i = 0; i < SIZE; i++) {
        printf("Product ID: %d, ", issueReport[i]->productID);
        printf("Issue Code: %d, ", issueReport[i]->issue.code);
        printf("Line code: %d\n", issueReport[i]->lineCode);

    } // end for

} // end displayIssueReport
```

```c
// TASK 3
// searches for the initial occurence of an issue code
void searching(struct department emp[]) {
    int search, i, key = 0;


    // asks the user to enter an issue code
    printf("Please enter the issue code: ");
    scanf("%d", &search);

    // compares the given issue code with the issue codes in the structure
    for (i = 0; i < SIZE; i++) {
        if (emp[i].issue.code == search) {
            key = 1;
            break; // breaks out of the loop if the issue code is found

        } // end if

    } // end for

    // checks if the issue code given is in the structure and prints the corresponding product id and
line code
    if (key == 1) {
        printf("Initial Occurrence --> Product ID: %d, Line Code: %d, Issue Code: %d \n",
emp[i].productID, emp[i].lineCode, emp[i].issue.code);
    } else {
        printf("Issue Code Invalid\n");

    } // end if

} // end searching

// TASK 4
// makes a report summary of the number of issues per product
void noOFIssues(struct department emp[]) {
    int i, j, count[SIZE] = {0};


    // loop to find the amount of occurences of an issue
    for (i = 0; i < SIZE; i++) {
        for (j = 0; j < SIZE; j++) {
            if (emp[i].productID == emp[j].productID) {
                count[i]++;

            } // end if

        } // end for

    } // end for
    // checks if the current product id has been printed already
    for (i = 0; i < SIZE; i++) {
        if (emp[i - 1].productID == emp[i].productID) {
            i++;

        } // end if

        // prints the product ID as well as the number of issues
        printf("Product ID: %d ---- Number of Issues: %d\n", emp[i].productID, count[i]);

    } // end for

} // end noOFIssues
```

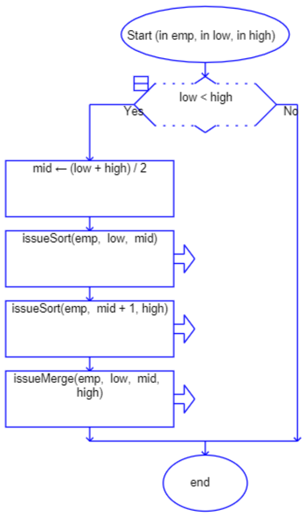
Flowchart

Below is the flowchart for the program. The flowchart was made using raptor and has three functions. In the raptor flowchart, only 3 lines of the test data was used.

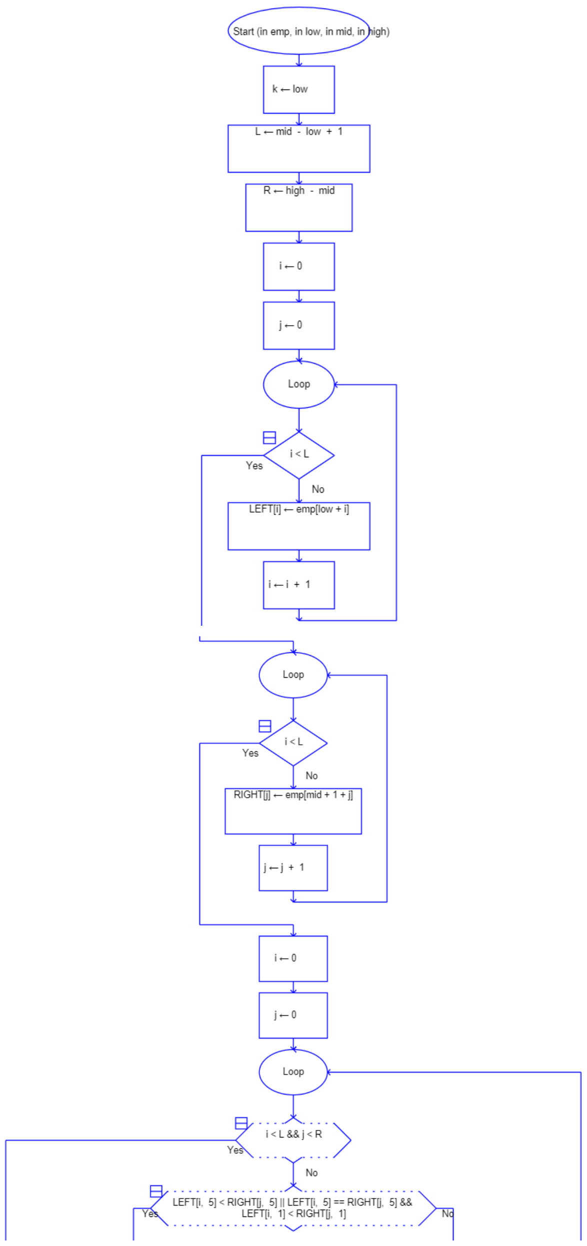
Main:

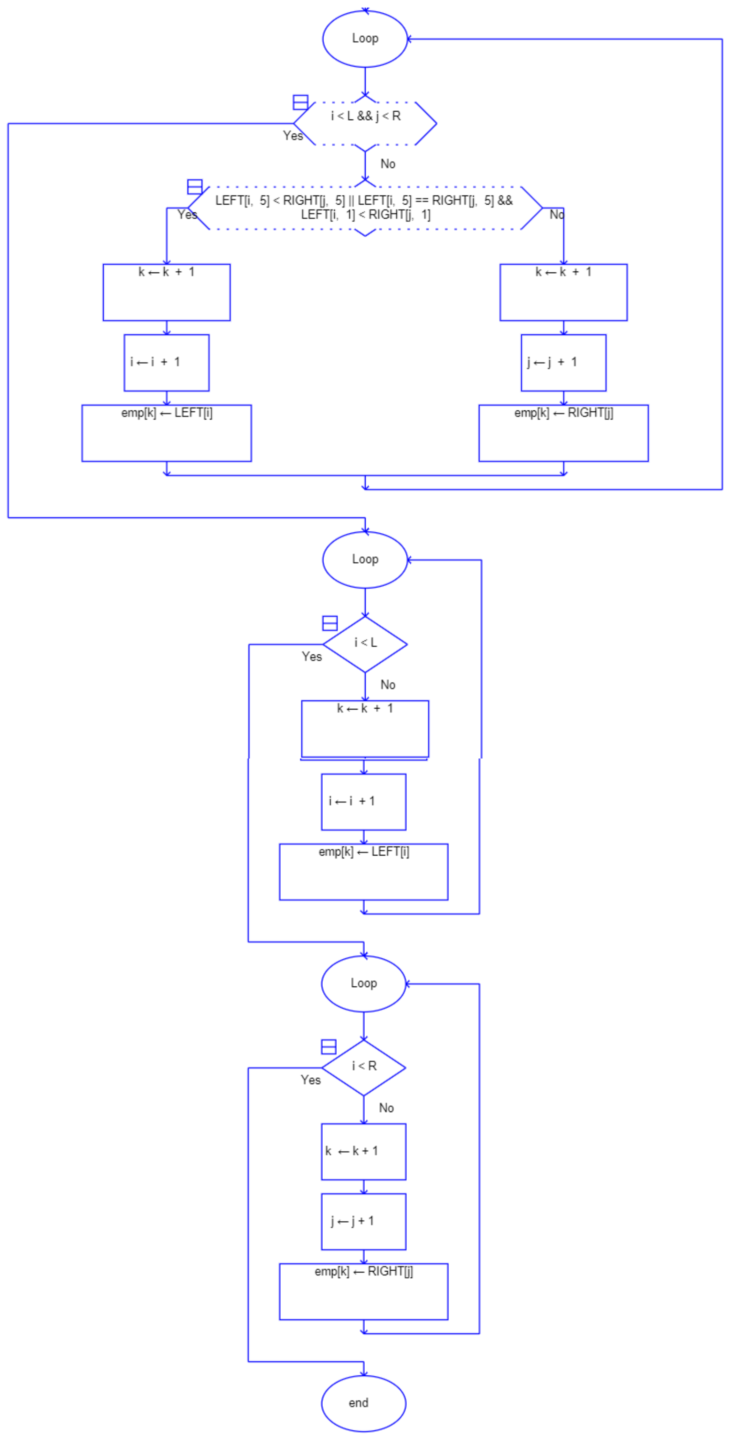


issueSort:


Start (in emp, in low, in high)
low < high
Yes
No
mid ⟵ (low + high) / 2
issueSort(emp, low, mid)
issueSort(emp, mid + 1, high)
issueMerge(emp, low, mid, high)
end

issueMerge:


Start (in emp, in low, in mid, in high)
k ⟵ low
L ⟵ mid - low + 1
R ⟵ high - mid
i ⟵ 0
j ⟵ 0
Loop
i < L
Yes
No
LEFT[i] ⟵ emp[low + i]
i ⟵ i + 1
Loop
i < L
Yes
No
RIGHT[j] ⟵ emp[mid + 1 + j]
j ⟵ j + 1
i ⟵ 0
j ⟵ 0
Loop
i < L && j < R
Yes
No
LEFT[i, 5] < RIGHT[j, 5] || LEFT[i, 5] == RIGHT[j, 5] && LEFT[i, 1] < RIGHT[j, 1]
Yes
No


Loop
i < L && j < R
Yes
No
LEFT[i, 5] < RIGHT[j, 5] || LEFT[i, 5] == RIGHT[j, 5] && LEFT[i, 1] < RIGHT[j, 1]
Yes
No
k ⟵ k + 1
i ⟵ i + 1
emp[k] ⟵ LEFT[i]
k ⟵ k + 1
j ⟵ j + 1
emp[k] ⟵ RIGHT[j]
Loop
i < L
Yes
No
k ⟵ k + 1
i ⟵ i + 1
emp[k] ⟵ LEFT[i]
Loop
i < R
Yes
No
k ⟵ k + 1
j ⟵ j + 1
emp[k] ⟵ RIGHT[j]
end