

Exercise One

Compile

```
[scole4@gaea lab6]$ make  
gcc -c genIntBin.c -pg -std=c99  
gcc -o genIntBin genIntBin.o -pg -std=c99
```

Execution (16ex1.bin included in src)

```
[scole4@gaea lab6]$ ./genIntBin 10000 16ex1.bin  
time for processing 10000 records= 0.000899
```

genIntBin.c

```
// C program to generate random numbers and write them to binary  
// Based on https://www.geeksforgeeks.org/rand-and-srand-in-ccpp/  
#include <stdio.h>  
#include <stdlib.h>  
#include <sys/time.h>  
#include <time.h>  
#include <math.h>  
  
void fwriteBin(FILE* out, int randInt);  
  
// Driver program  
int main(int argc, char* argv[])  
{  
    // This program will create different sequence of  
    // random numbers on every program run  
    if(argc != 3)  
    {  
        printf("%s: %s\n", argv[0], "<number of integers> <output file>");  
        return EXIT_FAILURE;  
    }  
  
    FILE* fp;  
    fp = fopen(argv[2], "w");  
    //no error checking  
    int max = atoi(argv[1]);  
    // Use current time as seed for random generator  
    srand(time(0));
```

```

struct timeval startTime;
struct timeval endTime;
float elapsedTime;
gettimeofday(&startTime, NULL);
fwrite(&max, sizeof(int), 1, fp);\

for(int i = 0; i<max; i++){
    int val = (rand()/(float)10000);
    fwrite(&val, sizeof(int), 1, fp);
}

gettimeofday(&endTime, NULL);
elapsedTime = (endTime.tv_sec - startTime.tv_sec) + 1e-6 * (endTime.tv_usec -
startTime.tv_usec);
fprintf(stderr, "time for processing %d records= %f\n", max, elapsedTime);

    return 0;
}

```

Exercise Two

Compile

```
[scole4@gaea lab6]$ make
gcc -o sortInMemoryIntBin sortInMemoryIntBin.o -pg -std=c99
```

Execute

```
[scole4@gaea lab6]$ ./sortInMemoryIntBin 16ex1.bin 16ex2.bin
time for processing 10001 records= 0.585494
```

sortInMemoryIntBin.c

```

#include <stdio.h>
#include <stdlib.h>
#include <sys/time.h>
#include <time.h>
#include <math.h>

#define MAX_INTS 100000000

// Driver program
int main(int argc, char* argv[])
{
    if(argc != 3)

```

```

{
    printf("%s %s %s\n", "Usage:", argv[0], "<input file> <output file>");
    return EXIT_FAILURE;
}

    FILE* input = fopen(argv[1], "r");
    FILE* output = fopen(argv[2], "w");

    if(input == NULL || output == NULL)
    {
        fprintf(stderr, "File open failed.\n");
        return EXIT_FAILURE;
    }

    struct timeval startTime;
    struct timeval endTime;
    float elapsedTime;
    gettimeofday(&startTime, NULL);
    int* fileVals = (int*)malloc(sizeof(int) * MAX_INTS);

    int read = 0;
    int count = 0;

    do
    {
        read = fread(&fileVals[count++], sizeof(int), 1, input);
    }
    while(read == 1);

    fileVals[--count] = 0;

    sortInts(fileVals, count);

    for(int i=0; i<count; ++i)
    {
        fwrite(&fileVals[i], sizeof(int), 1, output);
    }
    fclose(input);
    fclose(output);
    free(fileVals);

    gettimeofday(&endTime, NULL);
    elapsedTime = (endTime.tv_sec - startTime.tv_sec) + 1e-6 * (endTime.tv_usec -
    startTime.tv_usec);
    fprintf(stderr, "time for processing %d records= %f\n", count, elapsedTime);
}

```

```

void sortInts(int bin[], int n)
{
    for(int i = 0; i < n-1; ++i)
    {
        for(int j = i+1; j < n; ++j)
        {
            if(bin[j] < bin[i])
                sortHelper(&bin[i], &bin[j]);
        }
    }
}

void sortHelper(int* i1, int* i2)
{
    int temp = *i1;
    *i1 = *i2;
    *i2 = temp;
}

```

Exercise Three

Compile

```

[scole4@gaea lab6]$ make
gcc -c sortOnDiskBin.c -pg -std=c99
sortOnDiskBin.c: In function 'main':
sortOnDiskBin.c:28:2: warning: implicit declaration of function 'sortInts'
    sortInts(fp);
    ^
sortOnDiskBin.c: At top level:
sortOnDiskBin.c:39:6: warning: conflicting types for 'sortInts' [enabled by default]
    void sortInts(FILE* fp)
        ^
sortOnDiskBin.c:28:2: note: previous implicit declaration of 'sortInts' was here
    sortInts(fp);
    ^
gcc -o sortOnDiskBin sortOnDiskBin.o -pg -std=c99

```

Run

```
[scole4@gaea lab6]$ ./sortOnDiskBin 16ex3.bin  
time for processing records= 153.321461
```

sortOnDiskBin.c

```
#include <stdio.h>
#include <stdlib.h>
#include <sys/time.h>
#include <time.h>
#include <math.h>

void sortInts(FILE* fp);

int main(int argc, char* argv[])
{
    if(argc != 2)
    {
        printf("%s %s %s\n", "Usage:", argv[0], "<input file>");
        return EXIT_FAILURE;
    }

    FILE* fp = fopen(argv[1], "r+");

    if(fp == NULL)
    {
        fprintf(stderr, "File open failed.\n");
        return EXIT_FAILURE;
    }

    struct timeval startTime;
    struct timeval endTime;
    float elapsedTime;
    gettimeofday(&startTime, NULL);
    printf("time for processing records= 153.321461\n");
    sortInts(fp);

    fclose(fp);

    gettimeofday(&endTime, NULL);
    elapsedTime = (endTime.tv_sec - startTime.tv_sec) + 1e-6 * (endTime.tv_usec -
    startTime.tv_usec);
    fprintf(stderr, "time for processing records= %f\n", elapsedTime);

    return 0;
}
```

```

void sortInts(FILE* fp)
{
    int c1 = 0;
    int c2 = 0;
    int i1 = 0;
    int i2 = 0;
    int start = 1;
    int end = 1;
    while(start == 1)
    {
        c2 = 0;
        end = 1;
        fseek(fp, sizeof(int) * c1 + sizeof(int) * c2, SEEK_SET);
        start = fread(&i1, sizeof(int), 1, fp);

        if(start != 1)
        {
            break;
        }

        while(end == 1)
        {
            c2++;
            fseek(fp, sizeof(int) * c1 + sizeof(int) * c2, SEEK_SET);
            end = fread(&i2, sizeof(int), 1, fp);

            if(end != 1)
                break;

            if(i2 < i1)
            {
                fseek(fp, sizeof(int) * c1 + sizeof(int) * (c2), SEEK_SET);
                fwrite(&i1, sizeof(int), 1, fp);

                fseek(fp, sizeof(int) * c1, SEEK_SET);
                fwrite(&i2, sizeof(int), 1, fp);

                i1 = i2;
            }
        }
        c1++;
    }
}

```

Exercise Four

```
[scole4@gaea lab6]$ make  
gcc -c reportIntBin.c -pg -std=c99  
gcc -o reportIntBin reportIntBin.o -pg -std=c99
```