Homework #2

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Problem #1 (of 1)

1. A default constructor (that zeroes everything out)

```
 99  class Queries_AR
100  {
101  public:
102      vector<array<char,32>> queries; // Vector for query storage, with each query being a 32-character array
103      long long int size; //Declaring the variable to store the size
104
105      Queries_AR() // Default Constructor
106      {
107
108      }
109      Queries_AR(char *path) //Custom Constructor that takes file path as input and retrieves queries from a text document
110
111      {
112          long long int fileSize = get_size(path); // getting the size of the file
113          cout<<"queries filesize:"<<fileSize<<endl; // printing the size of the file
114          // fflush(stdout);
115          queries.reserve(fileSize/45); //Reserving the space in the vector by file size & expected entry length
116          // cout<<"check1 \n";
117          readDataSet(path);
118      }
```

2. At least one custom constructor (e.g. one taking a file path or ifstream as input)

```
 99  class Queries_AR
100  {
101  public:
102      vector<array<char,32>> queries; // Vector for query storage, with each query being a 32-character array
103      long long int size; //Declaring the variable to store the size
104
105      Queries_AR() // Default Constructor
106      {
107
108      }
109      Queries_AR(char *path) //Custom Constructor that takes file path as input and retrieves queries from a text document
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111      {
112          long long int fileSize = get_size(path); // getting the size of the file
113          cout<<"queries filesize:"<<fileSize<<endl; // printing the size of the file
114          // fflush(stdout);
115          queries.reserve(fileSize/45); //Reserving the space in the vector by file size & expected entry length
116          // cout<<"check1 \n";
117          readDataSet(path);
118      }
```

3. A function to read the query dataset file.

```
    Queries_AR(char *path) //Custom Constructor that takes file path as input and retrieves queries from a text document

    {
        long long int fileSize = get_size(path); // getting the size of the file
        cout<<"queries filesize:"<<fileSize<<endl; // printing the size of the file
        // fflush(stdout);
        queries.reserve(fileSize/45); //Reserving the space in the vector by file size & expected entry length
        // cout<<"check1 \n";
        readDataSet(path);
    }
    void readDataSet(char* path){ // Function to read the query dataset file

        ifstream queryFile(path); // opening the file with given path
        int fileSize;
        string currLine; //Declaring the string currLine to store each line read from the file
        if (!queryFile.is_open())
        cout << "err: unable to open the file"; //print the error if the file cannot be opened
        bool val=false; //Declaring the boolean variable to alternate reading lines
        // cout<<"check2 \n";
        while (getline(queryFile, currLine)){ // while loop to read the lines from the file
            val=!val;
            if(val)
            continue;
            array<char,32> arr; // array to store the current query
            fileSize=33;
            while(--fileSize){
                arr[32-fileSize]=currLine[32-fileSize]; //Copying the chars from currLine to array
            }
            queries.emplace_back(arr); //Adding query to vector of queries
        }
        queries.shrink_to_fit(); //Shrink the vector to fit the actual number of elements
        // cout<<"check3 \n";
        fflush(stdout);
        cout << "\nqueries read successfully: " << queries.size();// Printing the no:of queries read
        queryFile.close();// Closing the file
    }
```

4. A search function designed to find a sequence fragment within class's data.

```
    }
    bool linear_search(char *c){ // Linear search for a query
        int temp;
        for(int i=0;i<queries.size();++i){ // Iterating through the queries
            temp=-1;
            while((++temp)<32&&queries[i][temp]==c[temp]); // Comparing the each character of the query
            if(temp==32)
            return true; // Returning true if all characters match
        }
        return false; // Returning false if no match is found
    }
    bool binary_search(char *c){ // Binary search for a query in the vector
        long long int start=0,end=queries.size();
        int temp; //declaring the temp variable
        while(start<=end){
            long long int mid= (end-start)/2+start; // calculating the middle index
            temp=-1; // initializing the temp to -1
            while((++temp)<32&&queries[mid][temp]==c[temp]); // while loop to compare each character of the query
            if(temp==32) // if statement to return true if all characters match
            return true;
            else if(queries[mid][temp]<c[temp]) // Move to the right half
            start=mid+1;
            else // Move to the left half
            end=mid-1;
        }
        return false; //return false if no match is found
    }
```

5. A function to sort the fragments of the Queries_AR object.

```
    }
    void sortQueries(){ // function to sort the fragments of the Queries_AR object.
        // cout<<"before sort"<<endl;
        // for(int i=0;i<10;++i){
        //     cout<<string(queries[i].begin(),queries[i].end())<<endl;
        // }
        //sort(queries.begin(),queries.end());
        // cout<<"after sort"<<endl;
        // for(int i=0;i<10;++i){
        //     cout<<string(queries[i].begin(),queries[i].end())<<endl;
        // }
        merge_sort(0, queries.size() - 1, queries); // merge sort method calling
    }
    ~Queries_AR(){} // queries_ar destructor
};

```

6. A destructor

```
    ~Queries_AR(){} // queries_ar destructor
};

class GNOME
{
    public:
    char *data = nullptr; // data pointer to store the gnome data
    long long int size = 0; // size variable to store the total size of the data
    GNOME(char *path) // Constructor that reads gnome data from a file
    {
        unsigned long long fileSize = get_size(path); // Getting size of the file and storing it in filesize
        cout<<"\ngnome size"<< fileSize<<endl; // Printing the size of the file
        fflush(stdout); // Flush the output buffer
        data = (char *)malloc(fileSize); // Allocating memory for the gnome data
        ifstream queryFile(path); // Open the file with the given path
        string currLine; // declaring string to store the each line read from the file
        currLine.reserve(100); // reversing the space for 100 characters
        if (!queryFile.is_open())  // condition to check if the file failed to open
            cout << "err: unable to open the file"; // print error message
        while (getline(queryFile, currLine)) //reading the file line by line until end of the file
        {
            if (currLine[0] != '>'){ // condition to check is the line doesnot start with >
                memcpy(data + size, currLine.c_str(), currLine.size()); //copying the current line content
                size+=currLine.size(); // incrementing the size
            }
        }
        cout<<"total chars read from gnome file:"<<size<<endl; // printing the total chars read from the gnome file
        queryFile.close(); // closing the file
    }
    ~GNOME() // destructor to free the allocated memory for gnome
    {
        free(data); // free the allocated memory
    }
};
```

A. (30 pts)

1. How long did it take you to search for the first 10K, 100K, and 1M 32-character long fragments of the *subject dataset* within the *query dataset*?

   Ans:

   Time taken to search for the first 10K:
   18624 seconds
   Approximately it takes 5.1733333 hours.

   Time taken to search for the first 100K:
   181741 seconds
   Approximately it takes 50.4836111 hours.

   Time taken to search for the first 1M: 504.836111 hours approx**.**

   I have calculated the approximate calculation for 1M is as below:

   Time taken to search for the first 1M = (Time taken for the first 100K fragments) * (1M / 100K)

   Time taken to search for first 1M fragments = 50.4836111 hours * (1,000,000 / 100,000)

   Time taken to search for first 1M fragments = 50.4836111 hours * 10

   Time taken to search for first 1M fragments = 504.836111 (**21 days approximately**)

2. **How long would it take to search for every possible 32-character long fragment of the *subject dataset* within the *query dataset*? Please note that depending on the efficiency of your algorithm, this step may take a long time. If the total time is greater than 24 CPU hours, provide an estimate rather than an exact number.**

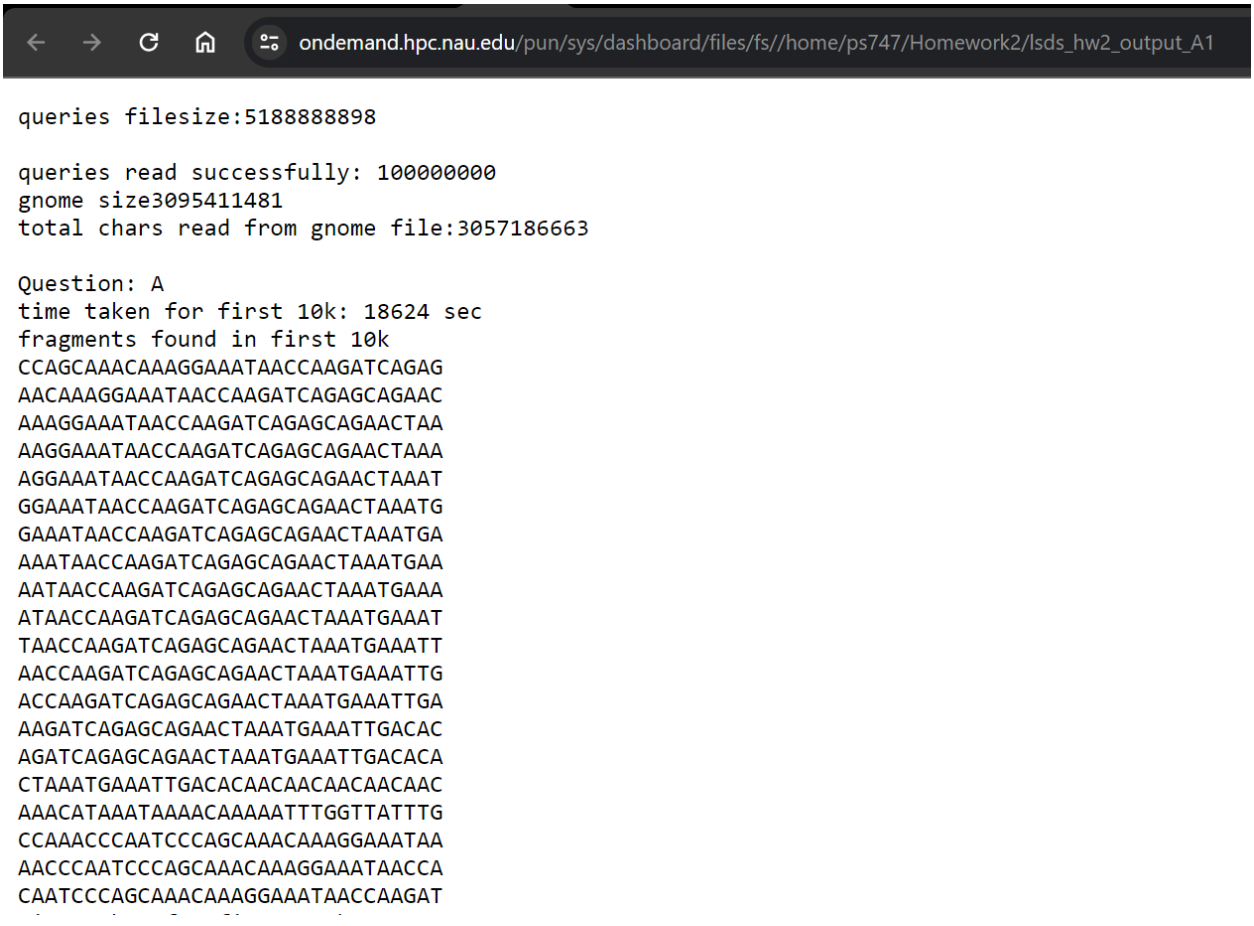
   Ans:
   The time required for every possible 32-character long fragment within the query data set, it takes approximately **1543378.21 hours**.

   To translate it in days it would take **64307.43 days** and if we converted it into years, it would take **176.18 years** to compute.

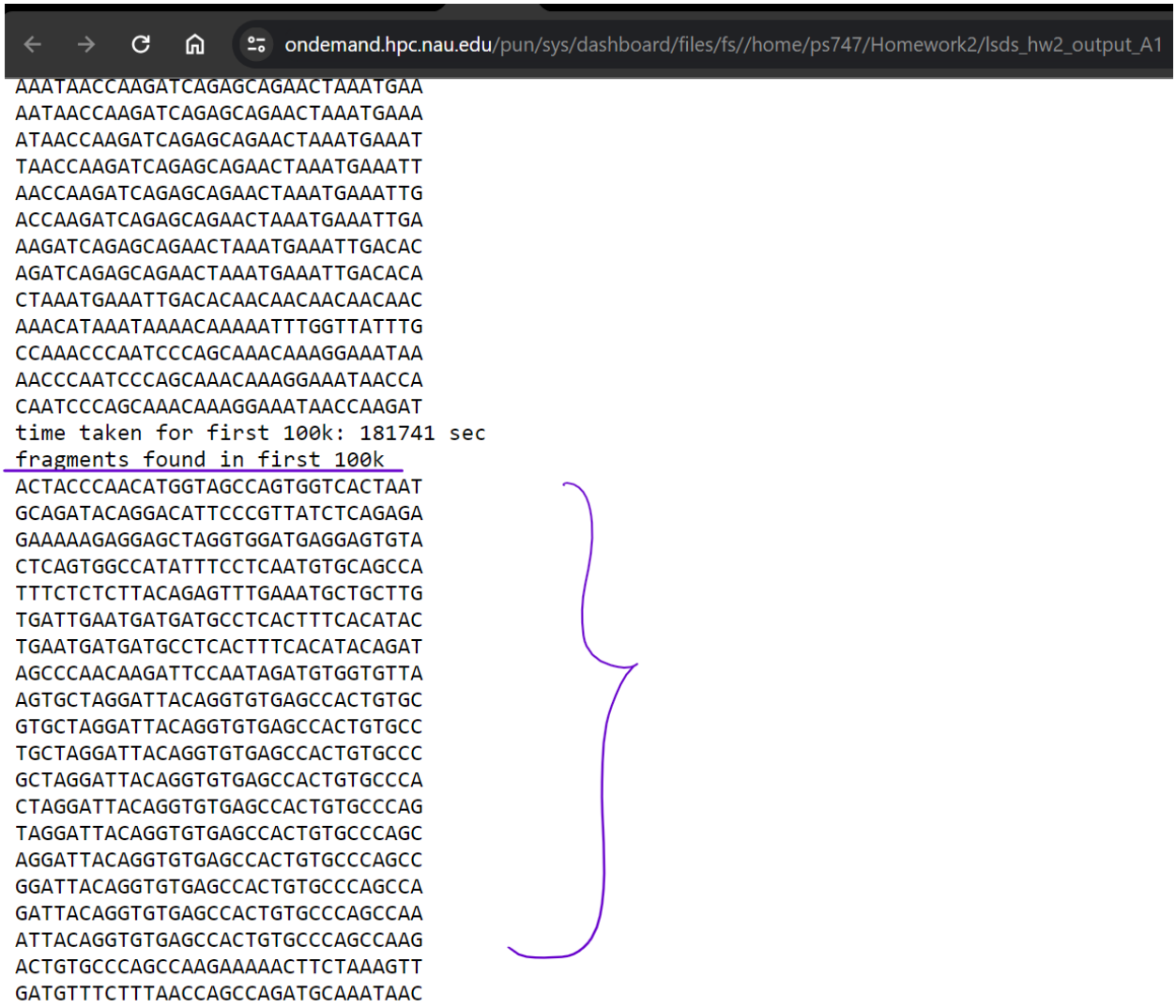
   As I have used Linear search here takes these many years to run the program.

3. **Print the 20 query fragments found within the *subject dataset* that have the largest indices (i.e. found later in the subject) for the first 10K, 100K, and 1M 32-character long fragments.**

   Screenshot that shows the last 20 fragments for 10k:



Screenshot that shows the last 20 fragments for 10k:



For 1M last 20 fragments:

The program is still running for the 1M 32-character long fragments. Due to this reason, I do not have the last 20 fragments for the 1M character long fragments.

B. (30 pts)

1: How long did it take you to search for the first 10K, 100K, and 1M 32-character long fragments of the *subject dataset* within the *query dataset*?

Ans:

Time taken to search for the first 10K: 0.074871 seconds.

Time taken to search for the first 100K: 0.625749 seconds.

Time taken to search for the first 1M: 4.95256 seconds.

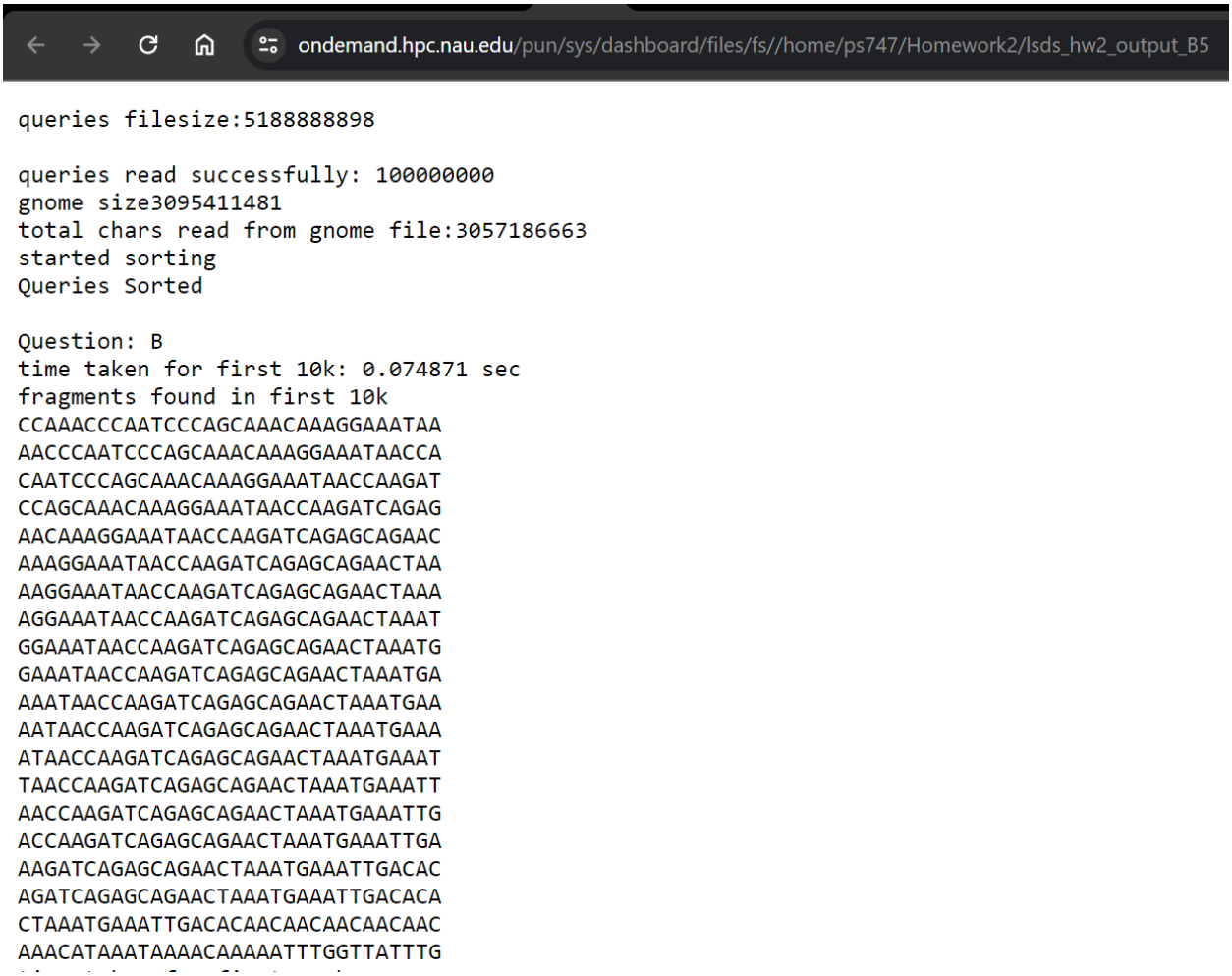
2: How long would it take to search for every possible 32-character long fragment of the *subject dataset* within the *query dataset*? Please note that depending on the efficiency of your algorithm, this step may take a long time. If the total time estimate is greater than 24 CPU hours, provide an estimate rather than exact number.

Total time taken is: 13519.3 seconds and it is approximately **3.7552778 hours.**

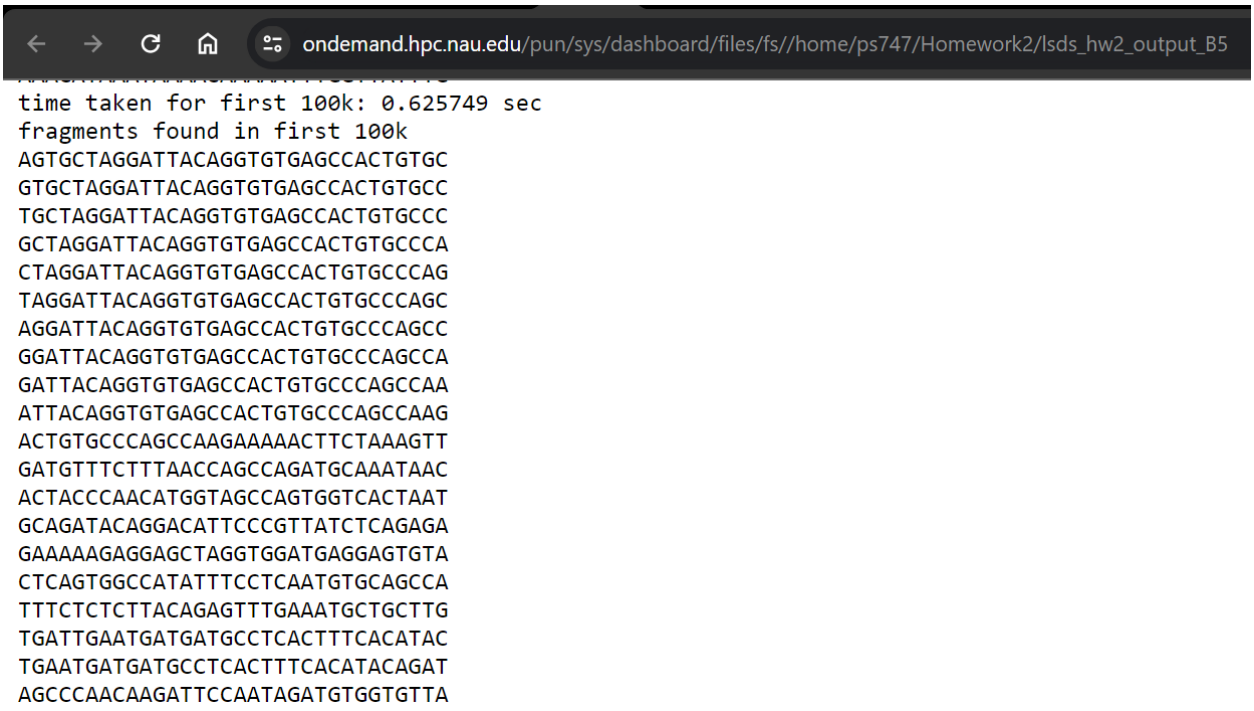
3: Print the 20 query fragments found within the *subject dataset* that have the largest indices (i.e. found later in the subject) for the first 10K, 100K, and 1M 32-character long fragments.

Ans:

Below is the screenshot for the 20 query fragments found within the first 10K.



Below is the screenshot for the 20 query fragments found within the first 100K.



Below is the screenshot for the 20 query fragments found within the first 1M.