* I finished all parts of this project
* My program run without bugs under both visual studio and g32, but I don’t know why after printing out the details of the recommended movies, the program get a bit slow under g32 in the sense that returning from the findMatches function to the main function takes a long time. This lagging time is is significantly shorter under visual studio and g32fast, but nonetheless not trivial under g32fast. My guess is that I created some temporary objects on the stack in the recommend\_movies function, so the compiler needs some time to clean up.
* I’ve not used banned STL containers.
* First of all, I tested the User and Movie class by passing in various parameters and use the getter functions to verify that I get expected behavior. Then I tested the TreeMultimap, UserDatabase, and MovieDatabase class by loading different files and then see how much time do I need for loading files and the getter functions (to see if I meet the big O requirement and to check if I get expected behavior). Lastly I checked the Recommender class by using the provided findMatches function.
* vector<string> history = { "mv1", "mv2" };

User user = User("joe", "joe@gmail.com", history);

assert(user.get\_full\_name() == "joe" && user.get\_email() == "joe@gmail.com");

assert(user.get\_watch\_history()[1] == "mv2");

vector<string> director = { "d1", "d2" };

vector<string> actor = { "a1", "a2" };

vector<string> genre = { "g1", "g2" };

Movie movie = Movie("id", "mv", "2023", director, actor, genre, 5);

assert(movie.get\_id() == "id" && movie.get\_title() == "mv");

assert(movie.get\_release\_year() == "2023" && movie.get\_rating() == 5);

assert(movie.get\_directors()[0] == "d1");

assert(movie.get\_actors()[1] == "a2");

assert(movie.get\_genres()[0] == "g1");

UserDatabase udb;

udb.load(USER\_DATAFILE);

assert(!udb.load(USER\_DATAFILE));

User\* user1 = udb.get\_user\_from\_email("AbFow2483@charter.net");

assert(user1->get\_full\_name() == "Abdullah Fowler");

assert(user1->get\_watch\_history()[0] == "ID22937");

MovieDatabase mdb;

mdb.load(MOVIE\_DATAFILE);

assert(!mdb.load(MOVIE\_DATAFILE));

Movie\* mv = mdb.get\_movie\_from\_id("ID25779");

assert(mv->get\_title() == "The Carpet of Horror");

vector<Movie\*> mv1 = mdb.get\_movies\_with\_actor("Joachim Fuchsberger");

assert(mv1[0]->get\_title() == "The Carpet of Horror");

vector<Movie\*> mv2 = mdb.get\_movies\_with\_director("M. Raja");

assert(mv2[0]->get\_title() == "Santosh Subramaniam");

vector<Movie\*> mv3 = mdb.get\_movies\_with\_genre("Animation");

assert(mv3[0]->get\_title == "Monkey Love Experiments");

Recommender r(udb, mdb);

findMatches(r, mdb, "RhBonner51535@ymail.com", 5);