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Course: ECE596C
Section: T01

Assignment ID: cpp_basics
Assignment Title: C++ Basics

Submission Source: https://github.com/uvic-seng475-2020-05/cpp_basics-JudeOnyia.
git

Commit ID: 7b152b90b1aae6b185214853ebc2d42a85e9389a

Submitted Files

=====

drwxrwxr-x	66	2020-05-22	14:45	./app
-rw-rw-r--	2243	2020-05-22	14:45	./app/test_random.cpp
-rw-rw-r--	6163	2020-05-22	14:45	./app/test_rational.cpp
-rw-rw-r--	343	2020-05-22	14:45	./CMakeLists.txt
-rw-rw-r--	140	2020-05-22	14:45	./IDENTIFICATION.txt
drwxrwxr-x	24	2020-05-22	14:45	./include
drwxrwxr-x	56	2020-05-22	14:45	./include/ra
-rw-rw-r--	2377	2020-05-22	14:45	./include/ra/random.hpp
-rw-rw-r--	6766	2020-05-22	14:45	./include/ra/rational.hpp
drwxrwxr-x	32	2020-05-22	14:45	./lib
-rw-rw-r--	1287	2020-05-22	14:45	./lib/random.cpp
-rw-rw-r--	391622	2020-05-22	14:45	./README.pdf

Results

=====

Package	Operation	Target	Status
nonprog	generate	---	OK (0.0s)
random_orig	generate	---	OK (0.4s)
random_orig	configure	---	OK (2.1s)
random_orig	build	test_random	FAIL (2 0.1s 2L)
random_sane	generate	---	OK (0.4s)
random_sane	configure	---	OK (2.0s)
random_sane	build	test_random	FAIL (2 1.5s 160L)
rational_orig	generate	---	OK (0.3s)
rational_orig	configure	---	OK (2.0s)
rational_orig	build	test_rational	FAIL (2 0.2s 2L)
rational_sane	generate	---	OK (0.5s)
rational_sane	configure	---	OK (2.2s)
rational_sane	build	test_rational	FAIL (2 1.5s 747L)

Normally, an operation is indicated as having a status of either "OK" or "FAIL". A status of "?" indicates that the operation could not be performed for some reason (e.g., due to an earlier error or being a manual step). The time (in seconds) required for an operation is denoted by an expression consisting of a number followed by the letter "s" (e.g., "5.0s"). In the case of a test that consists of multiple test cases, the number of failed test cases and total number of test cases is expressed as a fraction (e.g., "10/50" means 10 test cases failed out of 50 test cases in total). The length (in lines) of the log file generated by an operation is denoted by an expression consisting of a number followed by the letter "L" (e.g., "10L"). To ascertain the reason for the failure of an operation, check the contents of the log file provided.

Legend

=====

Package: nonprog
Nonprogramming exercises

Package: random_orig
The code as originally submitted by the student.
Build target: test_random
Build the test_random program.

Package: random_sane
Code with modifications to perform API sanity checking.
Build target: test_random
Build the test_random program.

Package: rational_orig
The code as originally submitted by the student.
Build target: test_rational
Build the test_rational program.

Package: rational_sane
Code with modifications to perform API sanity checking.
Build target: test_rational
Build the test_rational program.

```
1  gmake: *** No rule to make target `test_random'.  Stop.  
2  ERROR: build failed to generate executable test_random
```

```
1 /home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake
2 -S/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
3 nyia/tmp/package-random_sane/source
4 -B/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
5 nyia/tmp/package-random_sane/derived --check-build-system
6 CMakeFiles/Makefile.cmake 0
7 /usr/bin/gmake -f CMakeFiles/Makefile2 test_random
8 gmake[1]: Entering directory
9 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
10 yia/tmp/package-random_sane/derived'
11 /home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake
12 -S/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
13 nyia/tmp/package-random_sane/source
14 -B/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
15 nyia/tmp/package-random_sane/derived --check-build-system
16 CMakeFiles/Makefile.cmake 0
17 /home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E
18 cmake_progress_start
19 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
20 ia/tmp/package-random_sane/derived/CMakeFiles 4
21 /usr/bin/gmake -f CMakeFiles/Makefile2 CMakeFiles/test_random.dir/all
22 gmake[2]: Entering directory
23 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
24 yia/tmp/package-random_sane/derived'
25 /usr/bin/gmake -f CMakeFiles/ra.dir/build.make CMakeFiles/ra.dir/depend
26 gmake[3]: Entering directory
27 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
28 yia/tmp/package-random_sane/derived'
29 cd
30 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
31 ia/tmp/package-random_sane/derived &&
32 /home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E
33 cmake_depends "Unix Makefiles"
34 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
35 ia/tmp/package-random_sane/source
36 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
37 ia/tmp/package-random_sane/source
38 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
39 ia/tmp/package-random_sane/derived
40 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
41 ia/tmp/package-random_sane/derived
42 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
43 ia/tmp/package-random_sane/derived/CMakeFiles/ra.dir/DependInfo.cmake --color=
44 Scanning dependencies of target ra
45 gmake[3]: Leaving directory
46 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
47 yia/tmp/package-random_sane/derived'
48 /usr/bin/gmake -f CMakeFiles/ra.dir/build.make CMakeFiles/ra.dir/build
49 gmake[3]: Entering directory
50 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
51 yia/tmp/package-random_sane/derived'
52 [ 25%] Building CXX object CMakeFiles/ra.dir/lib/random.cpp.o
53 /home/frodo/public/ugls_lab-4.0.70/bin/c++
54 -I/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
55 nyia/tmp/package-random_sane/source/include -pedantic-errors -std=gnu++17 -o
56 CMakeFiles/ra.dir/lib/random.cpp.o -c
57 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
58 ia/tmp/package-random_sane/source/lib/random.cpp
59 [ 50%] Linking CXX static library libra.a
60 /home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -P
61 CMakeFiles/ra.dir/cmake_clean_target.cmake
62 /home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E
```

```
63 cmake_link_script CMakeFiles/ra.dir/link.txt --verbose=1
64 /usr/bin/ar qc libra.a CMakeFiles/ra.dir/lib/random.cpp.o
65 /usr/bin/ranlib libra.a
66 gmake[3]: Leaving directory
67 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
68 yia/tmp/package-random_sane/derived'
69 [ 50%] Built target ra
70 /usr/bin/gmake -f CMakeFiles/test_random.dir/build.make
71 CMakeFiles/test_random.dir/depend
72 gmake[3]: Entering directory
73 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
74 yia/tmp/package-random_sane/derived'
75 cd
76 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
77 ia/tmp/package-random_sane/derived &&
78 /home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E
79 cmake_depends "Unix Makefiles"
80 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
81 ia/tmp/package-random_sane/source
82 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
83 ia/tmp/package-random_sane/source
84 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
85 ia/tmp/package-random_sane/derived
86 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
87 ia/tmp/package-random_sane/derived
88 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
89 ia/tmp/package-random_sane/derived/CMakeFiles/test_random.dir/DependInfo.cmake
90 --color=
91 Scanning dependencies of target test_random
92 gmake[3]: Leaving directory
93 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
94 yia/tmp/package-random_sane/derived'
95 /usr/bin/gmake -f CMakeFiles/test_random.dir/build.make
96 CMakeFiles/test_random.dir/build
97 gmake[3]: Entering directory
98 `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
99 yia/tmp/package-random_sane/derived'
100 [ 75%] Building CXX object CMakeFiles/test_random.dir/app/test_random.cpp.o
101 /home/frodo/public/ugls_lab-4.0.70/bin/c++
102 -I/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
103 nyia/tmp/package-random_sane/source/include -pedantic-errors -std=gnu++17 -o
104 CMakeFiles/test_random.dir/app/test_random.cpp.o -c
105 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
106 ia/tmp/package-random_sane/source/app/test_random.cpp
107 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
108 ia/tmp/package-random_sane/source/app/test_random.cpp: In function `int
109 main()`:
110 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
111 nyia/tmp/package-random_sane/source/app/test_random.cpp:18:8: error: pass
112 ing `const lcg` {aka `const ra::random::linear_congruential_generator`} as `this
113 ` argument discards qualifiers [-fpermissive]
114     18 |     cg == cg;
115
116 ^~
117 In file included from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_A
118 ssgn_1/cpp_basics-JudeOnyia/tmp/package-random_sane/source/app/test_random.cpp:2
119 :
120 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
121 nyia/tmp/package-random_sane/source/include/ra/random.hpp:32:8: note: in call
122 to `bool ra::random::linear_congruential_generator::operator==(const ra::random:
123 :linear_congruential_generator&)`
124     32 |     bool operator==(const linear_congrue
```

```
125 ntial_generator& obj){
126     |           ^~~~~~
127 /home/judeonyia/Documents/ECE596C
128 _Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-random_sane/source
129 /app/test_random.cpp:19:8: error: passing 'const lcg' {aka 'const ra::random::li
130 near_congruential_generator'} as 'this' argument discards qualifiers [-fpermissi
131 ve]
132     19 |     cg != cg;
133         |         ^~
134 In file included from /home/judeonyia/D
135 ocuments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-ra
136 ndom_sane/source/app/test_random.cpp:2:
137 /home/judeonyia/Documents/ECE596C_Assign
138 ments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-random_sane/source/includ
139 e/ra/random.hpp:37:8: note:   in call to 'bool ra::random::linear_congruential_g
140 enerator::operator!=(const ra::random::linear_congruential_generator&)'
141     37 |
142     bool operator!=(const linear_congruential_generator& obj){
143         |           ^~~~
144 ~~~~
145 gmake[3]: *** [CMakeFiles/test_random.dir/app/test_random.cpp.o] Error 1
146 gm
147 ake[3]: Leaving directory `/home/judeonyia/Documents/ECE596C_Assignments/ECE596C
148 _Assgn_1/cpp_basics-JudeOnyia/tmp/package-random_sane/derived'
149 gmake[2]: *** [CM
150 akeFiles/test_random.dir/all] Error 2
151 gmake[2]: Leaving directory `/home/judeony
152 ia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/packag
153 e-random_sane/derived'
154 gmake[1]: *** [CMakeFiles/test_random.dir/rule] Error 2
155 g
156 make[1]: Leaving directory `/home/judeonyia/Documents/ECE596C_Assignments/ECE596
157 C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-random_sane/derived'
158 gmake: *** [test
159 _random] Error 2
160 ERROR: build failed to generate executable test_random
```

```
1  gmake: *** No rule to make target `test_rational'.  Stop.  
2  ERROR: build failed to generate executable test_rational
```

May 22, 20 14:46	Log: rational_sane build test_rational	Page 1/13
1	/home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake	
2	-S/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO	
3	nyia/tmp/package-rational_sane/source	
4	-B/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO	
5	nyia/tmp/package-rational_sane/derived --check-build-system	
6	CMakeFiles/Makefile.cmake 0	
7	/usr/bin/gmake -f CMakeFiles/Makefile2 test_rational	
8	gmake[1]: Entering directory	
9	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
10	ya/tmp/package-rational_sane/derived'	
11	/home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake	
12	-S/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO	
13	nyia/tmp/package-rational_sane/source	
14	-B/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO	
15	nyia/tmp/package-rational_sane/derived --check-build-system	
16	CMakeFiles/Makefile.cmake 0	
17	/home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E	
18	cmake_progress_start	
19	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
20	ia/tmp/package-rational_sane/derived/CMakeFiles 4	
21	/usr/bin/gmake -f CMakeFiles/Makefile2 CMakeFiles/test_rational.dir/all	
22	gmake[2]: Entering directory	
23	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
24	ya/tmp/package-rational_sane/derived'	
25	/usr/bin/gmake -f CMakeFiles/ra.dir/build.make CMakeFiles/ra.dir/depend	
26	gmake[3]: Entering directory	
27	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
28	ya/tmp/package-rational_sane/derived'	
29	cd	
30	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
31	ia/tmp/package-rational_sane/derived &&	
32	/home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E	
33	cmake_depends "Unix Makefiles"	
34	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
35	ia/tmp/package-rational_sane/source	
36	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
37	ia/tmp/package-rational_sane/source	
38	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
39	ia/tmp/package-rational_sane/derived	
40	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
41	ia/tmp/package-rational_sane/derived	
42	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
43	ia/tmp/package-rational_sane/derived/CMakeFiles/ra.dir/DependInfo.cmake --color=	
44	Scanning dependencies of target ra	
45	gmake[3]: Leaving directory	
46	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
47	ya/tmp/package-rational_sane/derived'	
48	/usr/bin/gmake -f CMakeFiles/ra.dir/build.make CMakeFiles/ra.dir/build	
49	gmake[3]: Entering directory	
50	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
51	ya/tmp/package-rational_sane/derived'	
52	[25%] Building CXX object CMakeFiles/ra.dir/lib/random.cpp.o	
53	/home/frodo/public/ugls_lab-4.0.70/bin/c++	
54	-I/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO	
55	nyia/tmp/package-rational_sane/source/include -pedantic-errors -std=gnu++17 -o	
56	CMakeFiles/ra.dir/lib/random.cpp.o -c	
57	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
58	ia/tmp/package-rational_sane/source/lib/random.cpp	
59	[50%] Linking CXX static library libra.a	
60	/home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -P	
61	CMakeFiles/ra.dir/cmake_clean_target.cmake	
62	/home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E	

May 22, 20 14:46	Log: rational_sane build test_rational	Page 3/13
125	tional_sane/source/include/ra/rational.hpp:80:12: note: in call to 'ra::math::	
126	rational<T>::int_type ra::math::rational<T>::truncate() [with T = short int; ra:	
127	:math::rational<T>::int_type = short int]'	
128	80 int_type truncate() {	
129	~~~~~	
130		
131	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assg	
132	n_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:	
133	36:3: error: passing 'const ra::math::rational<short int>' as 'this' argument di	
134	scards qualifiers [-fpermissive]	
135	36 c.is_integer();	
136	~~~~~	
137	In file i	
138	ncluded from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_b	
139	asics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:	
140	/home/	
141	judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp	
142	/package-rational_sane/source/include/ra/rational.hpp:85:8: note: in call to '	
143	bool ra::math::rational<T>::is_integer() [with T = short int]'	
144	85 bool is	
145	integer() {	
146	~~~~~	
147	/home/judeonyia/Documents/ECE596C_Assignme	
148	nts/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/te	
149	st_rational.cpp:37:3: error: passing 'const ra::math::rational<short int>' as 't	
150	his' argument discards qualifiers [-fpermissive]	
151	37 c;	
152	~~~~~	
153	In f	
154	ile included from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/	
155	cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:	
156	/	
157	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
158	a/tmp/package-rational_sane/source/include/ra/rational.hpp:90:8: note: in call	
159	to 'bool ra::math::rational<T>::operator!() [with T = short int]'	
160	90 boo	
161	l operator!() {	
162	~~~~~	
163	/home/judeonyia/Documents/ECE596C_Assignm	
164	ents/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/t	
165	est_rational.cpp:38:5: error: passing 'const ra::math::rational<short int>' as 't	
166	this' argument discards qualifiers [-fpermissive]	
167	38 c == c;	
168	~~~~~	
169	In file included from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C	
170	_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational	
171	.cpp:2:	
172	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics	
173	-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational.hpp:95:8: note:	
174	in call to 'bool ra::math::rational<T>::operator==(const ra::math::rational<T>	
175	&) [with T = short int]'	
176	95 bool operator==(const rational& obj) {	
177	~~~~~	
178	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/c	
179	pp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:39:5:	
180	error: passing 'const ra::math::rational<short int>' as 'this' argument discard	
181	s qualifiers [-fpermissive]	
182	39 c != c;	
183	~~~~~	
184	In file included	

May 22, 20 14:46	Log: rational_sane build test_rational	Page 2/13
63	cmake_link_script CMakeFiles/ra.dir/link.txt --verbose=1	
64	/usr/bin/ar qc libra.a CMakeFiles/ra.dir/lib/random.cpp.o	
65	/usr/bin/ranlib libra.a	
66	gmake[3]: Leaving directory	
67	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
68	ya/tmp/package-rational_sane/derived'	
69	[50%] Built target	
70	/usr/bin/gmake -f CMakeFiles/test_rational.dir/build.make	
71	CMakeFiles/test_rational.dir/depend	
72	gmake[3]: Entering directory	
73	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
74	ya/tmp/package-rational_sane/derived'	
75	cd	
76	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
77	ia/tmp/package-rational_sane/derived &&	
78	/home/frodo/public/ugls_lab-4.0.70/packages/cmake-3.17.1/bin/cmake -E	
79	cmake_depends "Unix Makefiles"	
80	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
81	ia/tmp/package-rational_sane/source	
82	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
83	ia/tmp/package-rational_sane/source	
84	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
85	ia/tmp/package-rational_sane/derived	
86	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
87	ia/tmp/package-rational_sane/derived	
88	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
89	ia/tmp/package-rational_sane/derived/CMakeFiles/test_rational.dir/DependInfo.cma	
90	ke --color=	
91	Scanning dependencies of target test_rational	
92	gmake[3]: Leaving directory	
93	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
94	ya/tmp/package-rational_sane/derived'	
95	/usr/bin/gmake -f CMakeFiles/test_rational.dir/build.make	
96	CMakeFiles/test_rational.dir/build	
97	gmake[3]: Entering directory	
98	'/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn	
99	ya/tmp/package-rational_sane/derived'	
100	[75%] Building CXX object CMakeFiles/test_rational.dir/app/test_rational.cpp.o	
101	/home/frodo/public/ugls_lab-4.0.70/bin/c++	
102	-I/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO	
103	nyia/tmp/package-rational_sane/source/include -pedantic-errors -std=gnu++17 -o	
104	CMakeFiles/test_rational.dir/app/test_rational.cpp.o -c	
105	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
106	ia/tmp/package-rational_sane/source/app/test_rational.cpp	
107	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny	
108	ia/tmp/package-rational_sane/source/app/test_rational.cpp: In instantiation of	
109	'void do_test() [with T = short	
110	int]':	
111	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-	
112	JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:86:21: requir	
113	ed from here	
114	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_b	
115	asics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:35:3: err	
116	or: passing 'const ra::math::rational<short int>' as 'this' argument discards qu	
117	alifiers [-fpermissive]	
118	35 c.truncate();	
119	~~~~~	
120	In file included fro	
121	m /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO	
122	nyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:	
123	/home/judeonyia/D	
124	ocuments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-ra	

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187	from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-Ju	
188	deOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:	
189	/home/judeonyi	
190	a/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package	
191	-rational_sane/source/include/ra/rational.hpp:100:8: note: in call to 'bool ra	
192	::math::rational<T>::operator!=(const ra::math::rational<T>&) [with T = short in	
193	t]	
194	100 bool operator!=(const rational& obj) {	
195	~~~~~	
196	/hom	
197	e/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/t	
198	mp/package-rational_sane/source/app/test_rational.cpp:40:5: error: passing 'cons	
199	t ra::math::rational<short int>' as 'this' argument discards qualifiers [-fpermi	
200	ssive]	
201	40 c < c;	
202	~~~~~	
203	In file included from /home/judeonyia/Do	
204	cuments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-ra	
205	tional_sane/source/app/test_rational.cpp:2:	
206	/home/judeonyia/Documents/ECE596C_Ass	
207	ignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/i	
208	nclude/ra/rational.hpp:105:8: note: in call to 'bool ra::math::rational<T>::op	
209	erator<(const ra::math::rational<T>&) [with T = short int]'	
210	105 bool opera	
211	tor<(const rational& obj) {	
212	~~~~~	
213	/home/judeonyia/Documents/ECE	
214	596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/	
215	source/app/test_rational.cpp:41:5: error: passing 'const ra::math::rational<shor	
216	t int>' as 'this' argument discards qualifiers [-fpermissive]	
217	41 c > c;	
218	~~~~~	
219		
220	In file included from /home/judeonyia/Documents/ECE596C_Assignm	
221	ts/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/tes	
222	t_rational.cpp:2:	
223	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/	
224	cpp_basics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational.hpp:11	
225	0:8: note: in call to 'bool ra::math::rational<T>::operator<(const ra::math::r	
226	ational<T>&) [with T = short int]'	
227	110 bool operator<(const rational& obj)	
228	{	
229	~~~~~	
230	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C	
231	Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.	
232	cpp:42:5: error: passing 'const ra::math::rational<short int>' as 'this' argumen	
233	t discards qualifiers [-fpermissive]	
234	42 c <= c;	
235	~~~~~	
236	In file	
237	included from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_	
238	basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:	
239	/home	
240	/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tm	
241	p/package-rational_sane/source/include/ra/rational.hpp:115:8: note: in call to	
242	'bool ra::math::rational<T>::operator<=(const ra::math::rational<T>&) [with T =	
243	short int]'	
244	115 bool operator<=(const rational& obj) {	
245	~~~~~	
246	~~~~~	
247	/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-Ju	
248	deOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:43:5: error: pass	

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```
249 ing 'const ra::math::rational<short int>' as 'this' argument discards qualifiers
250 [-fpermissive]
251 43 | c >= c;
252 | ~~~~~
253 In file included from /home/j
254 udeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/
255 package-rational_sane/source/app/test_rational.cpp:2:
256 /home/judeonyia/Documents/
257 ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_s
258 ne/source/include/ra/rational.hpp:120:8: note: in call to 'bool ra::math::rati
259 onal<T>::operator==(const ra::math::rational<T>&) [with T = short int]'
260 120 |
261 bool operator==(const rational& obj){
262 | ~~~~~
263 /home/judeonyia/
264 Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-r
265 ational_sane/source/app/test_rational.cpp: In instantiation of 'void do_test() [
266 with T = int]':
267 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp
268 _basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:87:15:
269 required from here
270 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assg
271 n_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:
272 35:3: error: passing 'const ra::math::rational<int>' as 'this' argument discards
273 qualifiers [-fpermissive]
274 35 | c.truncate();
275 | ^
276 In file included
277 from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-Ju
278 deonyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:
279 /home/judeonyi
280 a/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package
281 -rational_sane/source/include/ra/rational.hpp:80:12: note: in call to 'ra::mat
282 h::rational<T>::int_type ra::math::rational<T>::truncate() [with T = int; ra::ma
283 th::rational<T>::int_type = int]'
284 80 | int_type truncate() {
285 | ~~~~~
286 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_b
287 asics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:36:3: err
288 or: passing 'const ra::math::rational<int>' as 'this' argument discards qualifie
289 rs [-fpermissive]
290 36 | c.is_integer();
291 | ^
292 In file included from /h
293 ome/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia
294 /tmp/package-rational_sane/source/app/test_rational.cpp:2:
295 /home/judeonyia/Docum
296 ents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-ratio
297 nal_sane/source/include/ra/rational.hpp:85:8: note: in call to 'bool ra::math::
298 rational<T>::is_integer() [with T = int]'
299 85 | bool is_integer() {
300 | ~~~~~
301 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/c
302 pp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:37:3:
303 error: passing 'const ra::math::rational<int>' as 'this' argument discards qual
304 ifiers [-fpermissive]
305 37 | !c;
306 | ^
307 In file included from /home/jud
308 eonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/pa
```

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```
312 kage-rational_sane/source/app/test_rational.cpp:2:
313 /home/judeonyia/Documents/EC
314 E596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane
315 /source/include/ra/rational.hpp:90:8: note: in call to 'bool ra::math::rationa
316 l<T>::operator!() [with T = int]'
317 90 | bool operator!() {
318 | ~~~~~
319 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-J
320 udeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:38:5: error: pas
321 sing 'const ra::math::rational<int>' as 'this' argument discards qualifiers [-fp
322 ermissive]
323 38 | c == c;
324 | ~~~~~
325 In file included from /home/judeon
326 yia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/packa
327 ge-rational_sane/source/app/test_rational.cpp:2:
328 /home/judeonyia/Documents/ECES9
329 6C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/so
330 urce/include/ra/rational.hpp:95:8: note: in call to 'bool ra::math::rational<T
331 >::operator==(const ra::math::rational<T>&) [with T = int]'
332 95 | bool opera
333 tor==(const rational& obj){
334 | ~~~~~
335 /home/judeonyia/Documents/EC
336 E596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane
337 /source/app/test_rational.cpp:39:5: error: passing 'const ra::math::rational<int
338 >' as 'this' argument discards qualifiers [-fpermissive]
339 39 | c != c;
340 | ^
341 | ~~~~~
342 In file included from /home/judeonyia/Documents/ECE596C_Assignments/
343 ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_r
344 ational.cpp:2:
345 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp
346 _basics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational.hpp:100:8
347 : note: in call to 'bool ra::math::rational<T>::operator!=(const ra::math::rat
348 ional<T>&) [with T = int]'
349 100 | bool operator!=(const rational& obj){
350 | ~~~~~
351 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1
352 /cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:40:
353 5: error: passing 'const ra::math::rational<int>' as 'this' argument discards qu
354 alifiers [-fpermissive]
355 40 | c < c;
356 | ~~~~~
357 In file included from /
358 home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyi
359 a/tmp/package-rational_sane/source/app/test_rational.cpp:2:
360 /home/judeonyia/Docu
361 ments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-ratio
362 nal_sane/source/include/ra/rational.hpp:105:8: note: in call to 'bool ra::math
363 ::rational<T>::operator<(const ra::math::rational<T>&) [with T = int]'
364 105 |
365 bool operator<(const rational& obj){
366 | ~~~~~
367 /home/judeonyia/Do
368 cuments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rat
369 ional_sane/source/app/test_rational.cpp:41:5: error: passing 'const ra::math::ra
370 tional<int>' as 'this' argument discards qualifiers [-fpermissive]
371 41 | c >
```

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```
373 c;
374 | ~~~~~
375 In file included from /home/judeonyia/Documents/ECE596C_Assi
376 gnments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/ap
377 p/test_rational.cpp:2:
378 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Ass
379 gn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational.h
380 pp:110:8: note: in call to 'bool ra::math::rational<T>::operator<(const ra::ma
381 th::rational<T>&) [with T = int]'
382 110 | bool operator<(const rational& obj){
383 | ~~~~~
384 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assg
385 n_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.c
386 pp:42:5: error: passing 'const ra::math::rational<int>' as 'this' argument disc
387 ards qualifiers [-fpermissive]
388 42 | c <= c;
389 | ~~~~~
390 In file include
391 d from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-
392 JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:
393 /home/judeon
394 yia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/packa
395 ge-rational_sane/source/include/ra/rational.hpp:115:8: note: in call to 'bool
396 ra::math::rational<T>::operator<=(const ra::math::rational<T>&) [with T = int]'
397 115 | bool operator<=(const rational& obj){
398 | ~~~~~
399 /home/ju
400 deonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/p
401 ackage-rational_sane/source/app/test_rational.cpp:43:5: error: passing 'const ra
402 ::math::rational<int>' as 'this' argument discards qualifiers [-fpermissive]
403 43 | c >= c;
404 | ~~~~~
405 In file included from /home/judeonyia/Documents/
406 ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_s
407 ne/source/app/test_rational.cpp:2:
408 /home/judeonyia/Documents/ECE596C_Assignments
409 /ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/include/r
410 a/rational.hpp:120:8: note: in call to 'bool ra::math::rational<T>::operator==
411 (const ra::math::rational<T>&) [with T = int]'
412 120 | bool operator==(const r
413 ational& obj){
414 | ~~~~~
415 /home/judeonyia/Documents/ECE596C_Assignm
416 ents/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/t
417 est_rational.cpp: In instantiation of 'void do_test() [with T = long int]':
418 /home
419 e/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/t
420 mp/package-rational_sane/source/app/test_rational.cpp:88:16: required from her
421 e
422 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
423 nyia/tmp/package-rational_sane/source/app/test_rational.cpp:35:3: error: passing
424 'const ra::math::rational<long int>' as 'this' argument discards qualifiers [-f
425 permissive]
426 35 | c.truncate();
427 | ^
428 In file included from /home/jude
429 onyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/pac
430 kage-rational_sane/source/app/test_rational.cpp:2:
431 /home/judeonyia/Documents/EC
```

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```
435 596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/
436 source/include/ra/rational.hpp:80:12: note: in call to 'ra::math::rational<T>:
437 :int_type ra::math::rational<T>::truncate() [with T = long int; ra::math::ration
438 al<T>::int_type = long int]'
439 80 | int_type truncate() {
440 | ^
441 | ~~~~~
442 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics
443 -JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:36:3: error: p
444 assing 'const ra::math::rational<long int>' as 'this' argument discards qualifie
445 rs [-fpermissive]
446 36 | c.is_integer();
447 | ^
448 In file included from /h
449 ome/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia
450 /tmp/package-rational_sane/source/app/test_rational.cpp:2:
451 /home/judeonyia/Docum
452 ents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-ratio
453 nal_sane/source/include/ra/rational.hpp:85:8: note: in call to 'bool ra::math::
454 rational<T>::is_integer() [with T = long int]'
455 85 | bool is_integer() {
456 | ~~~~~
457 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assg
458 n_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:
459 37:3: error: passing 'const ra::math::rational<long int>' as 'this' argument dis
460 cards qualifiers [-fpermissive]
461 37 | !c;
462 | ^
463 In file included from
464 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOn
465 yia/tmp/package-rational_sane/source/app/test_rational.cpp:2:
466 /home/judeonyia/Do
467 cuments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rat
468 ional_sane/source/include/ra/rational.hpp:90:8: note: in call to 'bool ra::mat
469 h::rational<T>::operator!() [with T = long int]'
470 90 | bool operator!() {
471 | ~~~~~
472 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn
473 _1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:3
474 8:5: error: passing 'const ra::math::rational<long int>' as 'this' argument disc
475 ards qualifiers [-fpermissive]
476 38 | c == c;
477 | ~~~~~
478 In file includ
479 ed from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics
480 -JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:
481 /home/judeo
482 nyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/pack
483 age-rational_sane/source/include/ra/rational.hpp:95:8: note: in call to 'bool
484 ra::math::rational<T>::operator==(const ra::math::rational<T>&) [with T = long i
485 nt]'
486 95 | bool operator==(const rational& obj){
487 | ~~~~~
488 /ho
489 me/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/
490 tmp/package-rational_sane/source/app/test_rational.cpp:39:5: error: passing 'con
491 st ra::math::rational<long int>' as 'this' argument discards qualifiers [-fpermi
492 ssive]
493 39 | c != c;
494 | ~~~~~
```

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```
487 In file included from /home/judeonyia/
488 Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-r
489 ational_sane/source/app/test_rational.cpp:2:
490 /home/judeonyia/Documents/ECE596C_A
491 ssignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source
502 /include/ra/rational.hpp:100:8: note: in call to 'bool ra::math::rational<T>::
503 operator!=(const ra::math::rational<T>&) [with T = long int]'
504 100 | bool ope
505 rator!=(const rational& obj){
506 ~~~~~
507 /home/judeonyia/Documents/
508 ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sa
509 ne/source/app/test_rational.cpp:40:5: error: passing 'const ra::math::rational<l
510 ong int>' as 'this' argument discards qualifiers [-fpermissive]
511 40 | c < c;
512 ~~~~~
513
514 In file included from /home/judeonyia/Documents/ECE596C_Assignm
515 ents/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/t
516 est_rational.cpp:2:
517 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_
518 1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational.hpp:
519 105:8: note: in call to 'bool ra::math::rational<T>::operator<(const ra::math:
520 :rational<T>&) [with T = long int]'
521 105 | bool operator<(const rational& obj
522 ) {
523 ~~~~~
524 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C
525 _Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational
526 .cpp:41:5: error: passing 'const ra::math::rational<long int>' as 'this' argumen
527 t discards qualifiers [-fpermissive]
528 41 | c > c;
529 ~~~~~
530 In file in
531 cluded from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_ba
532 sics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:
533 /home/
534 judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/
535 package-rational_sane/source/include/ra/rational.hpp:110:8: note: in call to '
536 bool ra::math::rational<T>::operator>(const ra::math::rational<T>&) [with T = lo
537 ng int]'
538 110 | bool operator>(const rational& obj){
539 ~~~~~
540
541 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
542 ia/tmp/package-rational_sane/source/app/test_rational.cpp:42:5: error: passing '
543 const ra::math::rational<long int>' as 'this' argument discards qualifiers [-fpe
544 rmissive]
545 42 | c <= c;
546 ~~~~~
547 In file included from /home/judeony
548 a/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/packag
549 e-rational_sane/source/app/test_rational.cpp:2:
550 /home/judeonyia/Documents/ECE596
551 C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/sou
552 rce/include/ra/rational.hpp:115:8: note: in call to 'bool ra::math::rational<T
553 >::operator<=(const ra::math::rational<T>&) [with T = long int]'
554 115 | bool
555 operator<=(const rational& obj){
556 ~~~~~
557 /home/judeonyia/Documen
558 ts/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational
```

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```
559 _sane/source/app/test_rational.cpp:43:5: error: passing 'const ra::math::rationa
560 l<long int>' as 'this' argument discards qualifiers [-fpermissive]
561 43 | c >
562 c;
563 ~~~~~
564 In file included from /home/judeonyia/Documents/ECE596C_Ass
565 signments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/
566 app/test_rational.cpp:2:
567 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_A
568 ssgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational
569 .hpp:120:8: note: in call to 'bool ra::math::rational<T>::operator>=(const ra:
570 :math::rational<T>&) [with T = long int]'
571 120 | bool operator>=(const ration
572 al& obj){
573 ~~~~~
574 /home/judeonyia/Documents/ECE596C_Assignments/
575 ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_r
576 ational.cpp: In instantiation of 'void do_test() [with T = long long int]':
577 /home
578 e/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/t
579 mp/package-rational_sane/source/app/test_rational.cpp:89:21: required from her
580 e
581 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
582 nyia/tmp/package-rational_sane/source/app/test_rational.cpp:35:3: error: passing
583 'const ra::math::rational<long long int>' as 'this' argument discards qualifier
584 s [-fpermissive]
585 35 | c.truncate();
586 ^
587 In file included from /home
588 /judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tm
589 p/package-rational_sane/source/app/test_rational.cpp:2:
590 /home/judeonyia/Document
591 s/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_
592 sane/source/include/ra/rational.hpp:80:12: note: in call to 'ra::math::rationa
593 l<T>::int_type ra::math::rational<T>::truncate() [with T = long long int; ra::ma
594 th::rational<T>::int_type = long long int]'
595 80 | int_type truncate()
596 ~~~~~
597
598 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Ass
599 gn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp
600 :36:3: error: passing 'const ra::math::rational<long long int>' as 'this' argume
601 nt discards qualifiers [-fpermissive]
602 36 | c.is_integer();
603 ^
604 In f
605 ile included from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/
606 cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:
607 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
608 a/tmp/package-rational_sane/source/include/ra/rational.hpp:85:18: note: in call
609 to 'bool ra::math::rational<T>::is_integer() [with T = long long int]'
610 85 |
611 bool is_integer() {
612 ~~~~~
613 /home/judeonyia/Documents/ECE596C
614 _Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/sour
615 ce/app/test_rational.cpp:37:3: error: passing 'const ra::math::rational<long lon
616 g int>' as 'this' argument discards qualifiers [-fpermissive]
617 37 | !c;
618 ~~~~~
619
620 | ^
```

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```
621 In file included from /home/judeonyia/Documents/ECE596C_Assignments/ECE
622 596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rati
623 onal.cpp:2:
624 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_ba
625 sics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational.hpp:90:8: no
626 te: in call to 'bool ra::math::rational<T>::operator!() [with T = long long in
627 t]'
628 90 | bool operator!() {
629 ~~~~~
630 /home/judeonyia/Document
631 s/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_
632 sane/source/app/test_rational.cpp:38:5: error: passing 'const ra::math::rational
633 <long long int>' as 'this' argument discards qualifiers [-fpermissive]
634 38 |
635 c == c;
636 ~~~~~
637 In file included from /home/judeonyia/Documents/ECE596
638 C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/sou
639 rce/app/test_rational.cpp:2:
640 /home/judeonyia/Documents/ECE596C_Assignments/ECE59
641 6C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rati
642 onal.hpp:95:8: note: in call to 'bool ra::math::rational<T>::operator==(const
643 ra::math::rational<T>&) [with T = long long int]'
644 95 | bool operator==(cons
645 t rational& obj){
646 ~~~~~
647 /home/judeonyia/Documents/ECE596C_Assi
648 gnments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/ap
649 p/test_rational.cpp:39:5: error: passing 'const ra::math::rational<long long int
650 >' as 'this' argument discards qualifiers [-fpermissive]
651 39 | c != c;
652 ~~~~~
653
654 In file included from /home/judeonyia/Documents/ECE596C_Assignments/
655 ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_r
656 ational.cpp:2:
657 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp
658 _basics-JudeOnyia/tmp/package-rational_sane/source/include/ra/rational.hpp:100:8
659 : note: in call to 'bool ra::math::rational<T>::operator!=(const ra::math:rat
660 ional<T>&) [with T = long long int]'
661 100 | bool operator!=(const rational& o
662 bj){
663 ~~~~~
664 /home/judeonyia/Documents/ECE596C_Assignments/ECE59
665 6C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_ration
666 al.cpp:40:5: error: passing 'const ra::math::rational<long long int>' as 'this'
667 argument discards qualifiers [-fpermissive]
668 40 | c < c;
669 ~~~~~
670 In
671 file included from /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1
672 /cpp_basics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:2:
673 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOny
674 ia/tmp/package-rational_sane/source/include/ra/rational.hpp:105:8: note: in ca
675 ll to 'bool ra::math::rational<T>::operator<(const ra::math::rational<T>&) [with
676 T = long long int]'
677 105 | bool operator<(const rational& obj){
678 ~~~~~
679
680 /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_ba
681 sics-JudeOnyia/tmp/package-rational_sane/source/app/test_rational.cpp:41:5: erro
```

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```
682 r: passing 'const ra::math::rational<long long int>' as 'this' argument discards
683 qualifiers [-fpermissive]
684 41 | c > c;
685 ~~~~~
686 In file included fro
687 m /home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeO
688 e-rational_sane/source/app/test_rational.cpp:2:
689 /home/judeonyia/D
690 uments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-ra
691 tional_sane/source/include/ra/rational.hpp:110:8: note: in call to 'bool ra::m
692 ath::rational<T>::operator>(const ra::math::rational<T>&) [with T = long long in
693 t]'
694 110 | bool operator>(const rational& obj){
695 ~~~~~
696 /home
697 /judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tm
698 p/package-rational_sane/source/app/test_rational.cpp:42:5: error: passing 'const
699 ra::math::rational<long long int>' as 'this' argument discards qualifiers [-fpe
700 rmissive]
701 42 | c <= c;
702 ~~~~~
703 In file included from /home/judeony
704 ia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/packag
705 e-rational_sane/source/app/test_rational.cpp:2:
706 /home/judeonyia/Documents/ECE596
707 C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/sou
708 rce/include/ra/rational.hpp:115:8: note: in call to 'bool ra::math::rational<T
709 >::operator>=(const ra::math::rational<T>&) [with T = long long int]'
710 115 |
711 bool operator>=(const rational& obj){
712 ~~~~~
713 /home/judeonyia/Do
714 cuments/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rat
715 ional_sane/source/app/test_rational.cpp:43:5: error: passing 'const ra::math::ra
716 tional<long long int>' as 'this' argument discards qualifiers [-fpermissive]
717
718 43 | c >= c;
719 ~~~~~
720 In file included from /home/judeonyia/Documents/
721 ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sa
722 ne/source/app/test_rational.cpp:2:
723 /home/judeonyia/Documents/ECE596C_Assignments
724 /ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/source/include/r
725 a/rational.hpp:120:8: note: in call to 'bool ra::math::rational<T>::operator>=
726 (const ra::math::rational<T>&) [with T = long long int]'
727 120 | bool operator
728 >=(const rational& obj){
729 ~~~~~
730
731 gmake[3]: *** [CMakeFiles/test_
732 rational.dir/app/test_rational.cpp.o] Error 1
733 gmake[3]: Leaving directory '/home
734 /judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tm
735 p/package-rational_sane/derived'
736 gmake[2]: *** [CMakeFiles/test_rational.dir/all
737 /Error 2
738 gmake[2]: Leaving directory '/home/judeonyia/Documents/ECE596C_Assignm
739 ents/ECE596C_Assgn_1/cpp_basics-JudeOnyia/tmp/package-rational_sane/derived'
740 gma
741 ke[1]: *** [CMakeFiles/test_rational.dir/rule] Error 2
742 gmake[1]: Leaving directo
743 ry '/home/judeonyia/Documents/ECE596C_Assignments/ECE596C_Assgn_1/cpp_basics-Jud
744 eOnyia/tmp/package-rational_sane/derived'
```

```
745 gmake: *** [test_rational] Error 2
746 ERR
747 OR: build failed to generate executable test_rational
```

```
1  commit b985c965a338d89c78c23abef0753310181f7f60
2  Author: JudeOnyia <60678029+JudeOnyia@users.noreply.github.com>
3  Date:   Sat May 16 21:50:59 2020 -0700
4
5      First commit. Added IDENTIFICATION text file
6
7  commit 4ff2d9e74af1f94ec6313fc01c20c8c8e3e27d16
8  Author: Jude Onyia <judeonyia10@gmail.com>
9  Date:   Mon May 18 13:12:36 2020 -0700
10
11     B-1 part a to part e (detailed description below)
12     1) Set up the files to contain the linear_congruential_generator class
13     2) Created the type member, int_type
14     3) Created the constructor
15     4) Created the static member function, default_seed
16     5) Created data members, a_, c_, m_ and s_
17     6) Created static data member, seed_
18
19  commit 7eca19d8d2e76ce9cd63378701749c9bb635e3bf
20  Author: Jude Onyia <judeonyia10@gmail.com>
21  Date:   Mon May 18 13:51:49 2020 -0700
22
23     Moved class definition from hpp file to cpp file, fixed the
24     static function default_seed, and removed static variable seed_.
25
26  commit 6c3e60a42aad47c86ffe70982d73c3d5a64a958e
27  Author: Jude Onyia <judeonyia10@gmail.com>
28  Date:   Mon May 18 15:26:42 2020 -0700
29
30     B-1 part f to part i (detailed description below)
31     1) created the multiplier, increment and modulus functions
32     2) created the seed function to restart the sequence generation process
33     3) add a member data to indicate how many next positions should be
34         discarded in the generated sequence. This defaults to zero
35     4) created the discard function to set the discard member data
36     5) overloaded the operator() function to advance the generator to the
37         next position, and skip positions that are to be discarded
38
39  commit 9c8bd027d1dc11a56e090004d1ba352b4367890d
40  Author: Jude Onyia <judeonyia10@gmail.com>
41  Date:   Mon May 18 19:16:06 2020 -0700
42
43     B-1 part m to part o (detailed description below)
44     1) created the min and max member functions
45     2) overloaded the equality and inequality operators
46     3) provided a stream inserter (non member function)
47     4) enveloped the class and stream inserter with namespace ra::random
48
49  commit 26b588789ebd411370795830191f65b188d68c3e
50  Author: Jude Onyia <judeonyia10@gmail.com>
51  Date:   Tue May 19 01:14:59 2020 -0700
52
53     Attempt on test code for lcg class.
54
55  commit 3d58a7f5c52fe5f1cac773182784a3bba2a349e3
56  Author: JudeOnyia <60678029+JudeOnyia@users.noreply.github.com>
57  Date:   Tue May 19 01:41:40 2020 -0700
58
59     Fixed the random.hpp file to have the proper declarations, and
60     modifies the random.cpp file to have definitions of some member functions
61     and the non-member function (operator<<).
62
```

```
63 commit 9793c850025d636b22bc0b4fc20624eab8dd0f13
64 Author: Jude Onyia <judeonyia10@gmail.com>
65 Date: Tue May 19 02:13:19 2020 -0700
66
67     Some error correction made of random.hpp and the test_random.cpp
68
69 commit ed7deaa5cea91373489078fd2cd3a38a5d18f16c
70 Author: JudeOnyia <60678029+JudeOnyia@users.noreply.github.com>
71 Date: Tue May 19 19:47:55 2020 -0700
72
73     Corrected the definition of the seed member function and the operator()
74
75 commit b78d4a953eeabfd9cc5cf3e5866afb36e2d2378b
76 Author: JudeOnyia <60678029+JudeOnyia@users.noreply.github.com>
77 Date: Tue May 19 20:04:24 2020 -0700
78
79     Moved the constructor and the stream inserter definitions back to the header
    file
80
81 commit 27cd751979710a2e089c05cedc0f1df4332eac70
82 Author: Jude Onyia <judeonyia10@gmail.com>
83 Date: Tue May 19 20:49:00 2020 -0700
84
85     Code Finally Builds. Moved stream inserter definition back to
86     random.cpp, removed the const prefix in stream inserter.
87
88 commit af187b18f31b16877d39b41292d52ce67087077e
89 Author: Jude Onyia <judeonyia10@gmail.com>
90 Date: Wed May 20 01:58:14 2020 -0700
91
92     Completed draft of the test of every member and non member function
93
94 commit 2d6841b73b55efdf874307fa8e8d7ec305e31d0c
95 Author: Jude Onyia <judeonyia10@gmail.com>
96 Date: Wed May 20 02:21:52 2020 -0700
97
98     Moved constructor to random.cpp
99
100 commit e76162cfa44cc606be634bb1f86470d3de21128a
101 Author: Jude Onyia <judeonyia10@gmail.com>
102 Date: Wed May 20 15:44:11 2020 -0700
103
104     Began B2 Parts a to h (detailed below)
105     1) created the template class rational
106     2) created the default constructor
107     3) created the two parameter constructor
108     4) created the numerator and denominator member functions
109
110 commit 56ef8368c9372dd7fc68ff3d3c6a54d3a4ea97f4
111 Author: Jude Onyia <judeonyia10@gmail.com>
112 Date: Wed May 20 17:04:06 2020 -0700
113
114     Wrote set up for compound assignment operators
115
116 commit 336f8371c02d5d8c31f0e09d20fbac69f6cd4d05
117 Author: Jude Onyia <judeonyia10@gmail.com>
118 Date: Wed May 20 18:18:27 2020 -0700
119
120     1) Created the truncation function
121     2) Wrote test for the default constructor
122     3) Wrote test for constructor with single argument
123     4) Wrote test for constructor with 2 arguments
```

```
124     5) Wrote test for truncation function
125
126 commit a3443247cb741d1417acf72568bdbf6b0fd88c4c
127 Author: Jude Onyia <judeonyia10@gmail.com>
128 Date:   Wed May 20 19:20:23 2020 -0700
129
130     1) Wrote is_integer function
131     2) Tested is_integer function
132
133 commit 5259695fc4569c708380890aff19c477f40c2b1a
134 Author: Jude Onyia <judeonyia10@gmail.com>
135 Date:   Wed May 20 19:40:18 2020 -0700
136
137     1) Wrote operator overload for Not(!) operator
138     2) Tested Not(!) operator overload
139
140 commit 81dea77023c36e9e44073e4a565c44f661c16674
141 Author: Jude Onyia <judeonyia10@gmail.com>
142 Date:   Wed May 20 20:11:56 2020 -0700
143
144     1) Wrote the Equality(==) and Inequality(!=) operator overloads
145     2) Tested these operator overloads
146
147 commit 1b9e521fe3e52ec3ae9281ecce871b470fa79c02
148 Author: Jude Onyia <judeonyia10@gmail.com>
149 Date:   Wed May 20 21:04:59 2020 -0700
150
151     1) Wrote the operator overloads for: <, >, <=, >=
152     2) Tested these operator overloads
153
154 commit 944cd522cd5ede4c7ac8faalb9530669cbcd38ae
155 Author: Jude Onyia <judeonyia10@gmail.com>
156 Date:   Wed May 20 23:31:28 2020 -0700
157
158     1) Wrote code for maintaining reduced form of rational number
159     2) Wrote code for ensuring that denominator is not negative
160     3) Tested both code
161
162 commit 0e547c08ff83c80e76d4ca9ca9761317ba487486
163 Author: Jude Onyia <judeonyia10@gmail.com>
164 Date:   Wed May 20 23:59:36 2020 -0700
165
166     1) Wrote condition for when the denominator is zero
167     2) Tested this condition
168
169 commit 34d8990468b542e4574f8c13a36dc4dc55b7294a
170 Author: Jude Onyia <judeonyia10@gmail.com>
171 Date:   Thu May 21 00:52:45 2020 -0700
172
173     1) Fixed the truncation function
174     2) Wrote operator overload for prefix increment and decrement
175     3) Tested operator overloads
176
177 commit e9433fdab5c078db150a3b6a98a86f3df3701b9e
178 Author: Jude Onyia <judeonyia10@gmail.com>
179 Date:   Thu May 21 01:06:11 2020 -0700
180
181     1) Wrote operator overload of postfix increment and decrement
182     2) Tested these operator overloads
183
184 commit e010f2b773d186879550d3bfe3f7f4c980737195
185 Author: Jude Onyia <judeonyia10@gmail.com>
```

```
186 Date: Thu May 21 17:27:22 2020 -0700
187
188 1) Wrote code to turn the numerator and denominator to be whole numbers
189 if they weren't.
190 2) wrote operator overloads for (+=), (-=), (*=), and (/=)
191 3) Tested these operators
192
193 commit e0548c8d558cd4ada2bd90c01f6cdee196e84d08
194 Author: Jude Onyia <judeonyia10@gmail.com>
195 Date: Thu May 21 19:21:53 2020 -0700
196
197 1) Wrote non-member operator overloads Unary plus(+) and minus(-)
198 2) Tested these overloads
199
200 commit d445a44110bbe92770b9e072335b7b5233153fbf
201 Author: Jude Onyia <judeonyia10@gmail.com>
202 Date: Thu May 21 20:23:09 2020 -0700
203
204 1) Wrote the code for operator overload of binary add, sub, mult, div
205 2) Tested these overloads
206
207 commit 9938166711a7217237a7db89686466edd839e740
208 Author: Jude Onyia <judeonyia10@gmail.com>
209 Date: Thu May 21 23:25:53 2020 -0700
210
211 1) Wrote Stream Inserter overload and Stream Extractor overload
212 2) Tested both overloads
213
214 commit 1bcd8abbd4501751eal70a67def4f3d1e4c2f202
215 Author: Jude Onyia <judeonyia10@gmail.com>
216 Date: Fri May 22 00:21:46 2020 -0700
217
218 Make sure both the random and rational classes had const correctness
219
220 commit ced72293aad6b851b297ed027b22cde116a1aa57
221 Author: Jude Onyia <60678029+JudeOnyia@users.noreply.github.com>
222 Date: Fri May 22 01:44:33 2020 -0700
223
224 Added Fake README.pdf just to test assignment precheck
225
226 commit d00bca51cb1849ae3f839288912b9c879f2566a3
227 Author: Jude Onyia <60678029+JudeOnyia@users.noreply.github.com>
228 Date: Fri May 22 14:04:42 2020 -0700
229
230 Added the right README.pdf
231
232 commit 5ceed22f6bf97b14db0740bfecbcbcd96470460bb
233 Author: Jude Onyia <judeonyia10@gmail.com>
234 Date: Fri May 22 14:17:39 2020 -0700
235
236 Removed the exception in stream extractor of rational.hpp
237
238 commit db4937544ca01321325836abb71e7cffd584457c
239 Author: Jude Onyia <judeonyia@ugls5.ece.uvic.ca>
240 Date: Fri May 22 14:31:05 2020 -0700
241
242 Check report
243
244 commit 7b152b90b1aae6b185214853ebc2d42a85e9389a
245 Author: Jude Onyia <judeonyia@ugls5.ece.uvic.ca>
246 Date: Fri May 22 14:42:38 2020 -0700
247
```

248 Removed report assigne precheck

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Course: ECE 596C
Due Date: May 22, 2020

Assignment 1: Non – Programming Exercise

8.8 a)

If the tree is balanced and we assume worst case, the asymptotic time complexity of the function is the height of the balanced tree, which is **$O(\log n)$** .

8.8 b)

If the tree is not balanced, assuming worst case of the search for a node with the value and worst case of the imbalance of the tree, the asymptotic time complexity is **$O(n)$** .

8.9 a)

The source code performs a sequential accumulative sum of the lower triangle of the matrix. From inspecting the source code, it is evident that the elements included in the accumulation consist of half of the matrix excluding the primary diagonal elements (i.e. $a(0,0)$, $a(1,1)$, etc.), plus the primary diagonal elements. Since the code loops over these elements, the asymptotic time complexity is $O(\frac{n^2-n}{2} + n)$, this can be reduced to **$O(n^2)$** .

8.9 b)

Since the allocation of memory for the variables created in this function are not dependent on n , assuming the maximum value of type int is greater than n , then the asymptotic space complexity of the function is **$O(1)$** .

8.10 a)

The asymptotic time complexity of reverse_array_1 is $O(\frac{n}{2})$, this can be reduced to **$O(n)$** . Assuming the maximum value of type int is greater than n , the asymptotic space complexity is **$O(1)$** .

8.10 b)

The asymptotic time complexity of reverse_array_2 is **$O(n)$** . The space complexity is **$O(n)$** because a vector of size n is created. The assumption here is also that the maximum value of type int is great than n .

Based on asymptotic complexity analysis, both have the same time complexity, however, `reverse_array_1` has a space complexity of $O(1)$ while `reverse_array_2` has $O(n)$. Therefore, `reverse_array_1` is preferable.

We would need to calculate the overall speedup of the program when each of the three parts are optimized.

$$S_o = \frac{1}{(1 - f_e) + \frac{f_e}{S_p}} = \frac{1}{(1 - 0.05) + \frac{0.05}{10}} = 1.0471$$
$$S_o = \frac{1}{(1 - f_e) + \frac{f_e}{S_p}} = \frac{1}{(1 - 0.5) + \frac{0.5}{1.05}} = 1.0244$$
$$S_o = \frac{1}{(1 - f_e) + \frac{f_e}{S_o}} = \frac{1}{(1 - 0.1) + \frac{0.1}{3}} = 1.0714$$

If we assume the worst case of all bits having the value 1 (or even just the most significant bit having the value 1), the while loops will iterate until the most significant bit of value 1 has been checked. Hence, it will iterate for the bit-length of the integer. The number of bits of the integer is $\log_2(n)$, rounded up. Therefore, the asymptotic time complexity is $\mathbf{O(\log\ n)}$. The asymptotic space complexity is $\mathbf{O(1)}$ because if the number of bits used for n is changed, the only memory affected is that of n.

```

unsigned int hamming_2(unsigned int n){
    unsigned int total_bit_num = sizeof(int) * CHAR_BITS; // Number of bits in n
    unsigned int partition_1 = (~ (unsigned int)0) / 3; // Binary 01010101
    unsigned int partition_2 = (~ (unsigned int)0) / 5; // Binary 00110011
    unsigned int partition_4 = (~ (unsigned int)0) / 17; // Binary 00001111

    n -= (n >> 1) & partition_1; //Count the ones of each 2 bits and
    //replace those 2 bits with result

```

```

n = (n & partition_2) + ((n >> 2) & partition_2); //Count the ones of each 4 bits
//and replace those 4 bits with result
n = (n + (n >> 4)) & partition_4; // Count the ones of each 8 bits and
//replace those 8 bits with result

if(total_bit_num > 8) n += n >> 8; //move result of each 16 bits into lowest 8 bits
if(total_bit_num > 16) n += n >> 16; //move result of each 32 bits into lowest 8 bits
if(total_bit_num > 32) n += n >> 32; //move result of each 64 bits into lowest 8 bits
return n & 0x7F; // bit AND with decimal number 127 will keep the 8 bits
}

```

The advantage of the algorithm is that it's asymptotic time complexity is **O(1)**, less than hamming_1's complexity of $O(\log n)$. The disadvantage is that it requires more space in memory than hamming_1.

8.13 c)

The reasoning behind using asymptotic complexity is to have a sense of the effect of problem size on the performance of the program as the problem size increases to relatively huge amount. The asymptotic analysis is necessary to calculate the rate of program's performance and memory requirement as the problem size increases.

Reference

[1] Joel Yliluoma, WP2 - Nifty Revised, without multipliations, Bit-counting algorithms, 2013.
<https://bisqwit.iki.fi/source/misc/bitcounting/>

```
1  # Specify Minimum Required Version
2  cmake_minimum_required(VERSION 3.1 FATAL_ERROR)
3
4  # Specify Project and Language
5  project(random_and_rational LANGUAGES CXX)
6
7  # Set Include Directory
8  include_directories(include)
9
10 # Add Executable Program
11 add_executable(random app/test_random.cpp lib/random.cpp)
12 add_executable(rational app/test_rational.cpp)
```

```

1  #ifndef random_hpp
2  #define random_hpp
3  #include <iostream>
4  namespace ra::random{
5      class linear_congruential_generator {
6      public:
7          typedef unsigned long long int int_type; // type member
8          static int_type default_seed(){ return (int_type)1;} // Function to return default seed of one for all objects
9
10         // Constructor that initializes the multiplier, increment and modulus. Seed is optional argument.
11         linear_congruential_generator(int_type a, int_type c, int_type m, int_type s = default_seed());
12
13         const int_type multiplier() const { return a_;} // Function to return multiplier value
14         const int_type increment() const { return c_;} // Function to return increment value
15         const int_type modulus() const { return m_;} // Function to return modulus value
16         const int_type position() const { return x_;} // Function to return the current position in the sequence
17
18         // Function to restarts the sequence generation process with a new seed value
19         void seed(int_type s);
20
21         // Operator to advance the generator to the next position in the sequence
22         // with consideration to the number of positions to be discarded
23         int_type operator() ();
24
25         // Function to discard the next n numbers in the generated sequence
26         void discard(unsigned long long n){ n_ = n; }
27
28         const int_type min() const { return c_==(int_type)0? (int_type)1 : (int_type)0; } // Function to get the smallest value
29         const int_type max() const { return m_-(int_type)1; } // Function to get the largest value in sequence
30
31         // Operator to test two linear_congruential_generator objects for equality
32         bool operator==(const linear_congruential_generator& obj){
33             return (a_==obj.multiplier() && c_==obj.increment() && m_==obj.modulus() && x_==obj.position());
34         }
35
36         // Operator to test two linear_congruential_generator objects for inequality
37         bool operator!=(const linear_congruential_generator& obj){
38             return !(a_==obj.multiplier() && c_==obj.increment() && m_==obj.modulus() && x_==obj.position());
39         }
40
41     private:
42         int_type a_; // multiplier
43         int_type c_; // increment
44         int_type m_; // modulus
45         int_type x_; // current position in the generated sequence
46         unsigned long long n_ = (unsigned long long)0; // number of positions to

```

```
    discard in the sequence
48     };
49
50     // Stream inserter
51     std::ostream& operator<<(std::ostream& outStream, const linear_congruential_
generator& objA);
52 }
53 #endif
```

```

1  #include <iostream>
2  #include "ra/random.hpp"
3
4  namespace ra::random {
5      typedef linear_congruential_generator::int_type int_type;
6
7      // Constructor that initializes the multiplier, increment and modulus. S
      eed is optional argument.
8      linear_congruential_generator::linear_congruential_generator(int_type a,
9          int_type c, int_type m, int_type s){
10          a_ = a;
11          c_ = c;
12          m_ = m;
13          if( (c_ % m_)==(int_type)0 && (s % m_)==(int_type)0 ) x_ = (int_type
14              )1;
15          else x_ = s;
16      }
17
18      // Function to restarts the sequence generation process with a new seed
19      value
20      void linear_congruential_generator::seed(int_type s){
21          if( (c_ % m_)==(int_type)0 && (s % m_)==(int_type)0 ) x_ = (int_type
22              )1;
23          else x_ = s;
24          n_ = (unsigned long long)0;
25      }
26
27      // Operator to advance the generator to the next position in the sequenc
28      e
29      // with consideration to the number of positions to be discarded
30      int_type linear_congruential_generator::operator() () {
31          ++n_;
32          do{
33              x_ = (a_ * x_ + c_) % m_;
34              --n_;
35          } while(n_);
36          return x_;
37      }
38
39      // Stream inserter
40      std::ostream& operator<<(std::ostream& outStream, const linear_congruent
41          ial_generator& objA){
42          outStream << objA.multiplier() << " " << objA.increment() << " " << o
43              bjA.modulus() << " " << objA.position();
44          return outStream;
45      }
46  }

```

```
1  #include "ra/random.hpp"
2  #include <iostream>
3  #include <random>
4
5  int main() {
6
7      typedef ra::random::linear_congruential_generator::int_type int_type;
8      using std::cout;
9      using std::endl;
10
11      // Test class against linear congruential engine in standard library
12      // Test constructor with no seed input
13      // Test the operator() and the operator<<
14      ra::random::linear_congruential_generator obj_mine(14,5,29);
15      std::linear_congruential_engine<std::uint_fast32_t,14,5,29> obj_theirs;
16      obj_mine();
17      obj_theirs();
18      //cout << "lc generator object: " << obj_mine << endl;
19      //cout << "lc engine current state: " << obj_theirs << endl;
20
21      // Compare their minimum and maximum
22      //cout << "lc generator min value: " << obj_mine.min() << endl;
23      //cout << "lc engine min value: " << obj_theirs.min() << endl;
24      //cout << "lc generator max value: " << obj_mine.max() << endl;
25      //cout << "lc engine max value: " << obj_theirs.max() << endl;
26
27      // Test constructor with seed input
28      // Test seed() member function
29      // Test operator== and operator!=
30      ra::random::linear_congruential_generator obj_mine_A(97,41,300,77);
31      //cout << "lc generator object (seed must be 77): " << obj_mine_A << endl;
32      //obj_mine_A.seed(259);
33      //cout << "lc generator object (seed change to 259): " << obj_mine_A << endl;
34      ;
35      obj_mine_A.seed(77);
36      ra::random::linear_congruential_generator obj_mine_B(97,41,300,77);
37      ra::random::linear_congruential_generator obj_mine_C(20,58,300,77);
38      //cout << "lc generator equality check (Must be true): " << (obj_mine_A==obj_mine_B) << endl;
39      //cout << "lc generator equality check (Must be false): " << (obj_mine_A==obj_mine_C) << endl;
40      //cout << "lc generator inequality check (Must be false): " << (obj_mine_A!=obj_mine_B) << endl;
41      //cout << "lc generator inequality check (Must be true): " << (obj_mine_A!=obj_mine_C) << endl;
42
43      // Test the discard member function
44      for(int i=0; i<90; ++i){
45          obj_mine_A();
46      }
47      obj_mine_B.discard(90);
48      //cout << "lc generator discard function check (Must be true): " << (obj_mine_A()==obj_mine_B()) << endl;
49
50      // Test condition when increment and seed are both zero
51      ra::random::linear_congruential_generator obj_mine_D(20,0,300,0);
52      //cout << "lc generator seed (Must be 1): " << obj_mine_D << endl;
53
54      return 0;
55
56
```



```
57 }
```

```

1  #ifndef rational_hpp
2  #define rational_hpp
3  #include <iostream>
4  #include <algorithm>
5  #include <string>
6  #include <sstream>
7  namespace ra::math{
8  template<class T>
9  class rational {
10     public:
11         typedef T int_type;
12
13         // Function to reduce the form of the rational number
14         void reduce_form(){
15             long long the_gcd = std::__gcd((long long)n_, (long long)d_);
16             n_ = (int_type)( (long long)n_ / the_gcd ); // Also make numerator a
whole number;
17             d_ = (int_type)( (long long)d_ / the_gcd ); // Also make denominator
a whole number
18         }
19
20         // Function to Prevent denominator from having zero or negative value
21         void denominator_handle(){
22             if(d_ == (int_type)0){
23                 n_ = std::numeric_limits<int_type>::max();
24                 d_ = (int_type)1;
25             }
26             if(d_ < (int_type)0) { d_ = d_ * (int_type)(-1); n_ = n_ * (int_type
)(-1); }
27         }
28
29         // Default constructor sets rational number to 0
30         rational(){
31             n_ = (int_type)0;
32             d_ = (int_type)1;
33         }
34
35         // Constructor to specify numerator and denominator values
36         rational(int_type n, int_type d = (int_type)1){
37             n_ = n;
38             d_ = d;
39             reduce_form();
40             denominator_handle();
41         }
42
43         const int_type numerator() const { return n_; } // Function to return th
e numerator value
44         const int_type denominator() const { return d_; } // Function to return
the denominator value
45
46         // Operator for compound addition (+=)
47         rational& operator+=(const rational& obj){
48             n_ = (n_ * obj.denominator()) + (obj.numerator() * d_);
49             d_ = d_ * obj.denominator();
50             reduce_form();
51             return *this;
52         }
53
54         // Operator for compound subtraction (-=)
55         rational& operator--=(const rational& obj){
56             n_ = (n_ * obj.denominator()) - (obj.numerator() * d_);
57             d_ = d_ * obj.denominator();

```

```
58         reduce_form();
59         return *this;
60     }
61
62     // Operator for compound multiplication (*=)
63     rational& operator*=(const rational& obj){
64         n_ = n_ * obj.numerator();
65         d_ = d_ * obj.denominator();
66         reduce_form();
67         return *this;
68     }
69
70     // Operator for compound division (/=)
71     rational& operator/=(const rational& obj){
72         n_ = n_ * obj.denominator();
73         d_ = d_ * obj.numerator();
74         reduce_form();
75         denominator_handle();
76         return *this;
77     }
78
79     // Function for rounding the rational number towards zero (discard fract
80     ional part)
81     int_type truncate(){
82         return (int_type)((long long)(n_ / d_));
83     }
84
85     // Function to check if rational number is an integer
86     bool is_integer(){
87         return (d_==(int_type)1 );
88     }
89
90     // Operator to check if a rational number is zero (!)
91     bool operator!(){
92         return (n_==(int_type)0);
93     }
94
95     // Operator to check equality of rational numbers (==)
96     bool operator==(const rational& obj){
97         return ( (n_/d_) == (obj.numerator()/obj.denominator()) );
98     }
99
100    // Operator to check inequality of rational numbers (!=)
101    bool operator!=(const rational& obj){
102        return ( (n_/d_) != (obj.numerator()/obj.denominator()) );
103    }
104
105    // Operator to check less than of rational numbers (<)
106    bool operator<(const rational& obj){
107        return ( (n_/d_) < (obj.numerator()/obj.denominator()) );
108    }
109
110    // Operator to check greater than of rational numbers (>)
111    bool operator>(const rational& obj){
112        return ( (n_/d_) > (obj.numerator()/obj.denominator()) );
113    }
114
115    // Operator to check less than or equals to of rational numbers (<=)
116    bool operator<=(const rational& obj){
117        return ( (n_/d_) <= (obj.numerator()/obj.denominator()) );
118    }
```

```

119      // Operator to check greater than or equals to of rational numbers (>=)
120      bool operator>=(const rational& obj){
121          return ( (n_/d_) >= (obj.numerator()/obj.denominator()) );
122      }
123
124      // Operator to perform prefix increment (++obj)
125      rational& operator++(){
126          n_ = n_ + d_;
127          return *this;
128      }
129
130      // Operator to perform prefix and decrement (--obj)
131      rational& operator--(){
132          n_ = n_ - d_;
133          return *this;
134      }
135
136      // Operator to perform postfix increment (obj++)
137      rational operator++(int){
138          rational<int_type> obj_copy(n_,d_);
139          n_ = n_ + d_;
140          return obj_copy;
141      }
142
143      // Operator to perform postfix decrement (obj--)
144      rational operator--(int){
145          rational<int_type> obj_copy(n_,d_);
146          n_ = n_ - d_;
147          return obj_copy;
148      }
149
150      private:
151          int_type n_; // Numerator
152          int_type d_; // Denominator
153  };
154
155      // Operator to perform Unary plus (+)
156      template<class int_type>
157      rational<int_type> operator+(const rational<int_type>& obj){
158          return rational<int_type>+(obj.numerator()),obj.denominator());
159      }
160
161      // Operator to perform Unary minus (-)
162      template<class int_type>
163      rational<int_type> operator-(const rational<int_type>& obj){
164          return rational<int_type>-(obj.numerator()),obj.denominator());
165      }
166
167      // Operator to perform Binary addition (+)
168      template<class int_type>
169      rational<int_type> operator+(const rational<int_type>& obj_A, const rational<int
170      _type>& obj_B){
171          int_type n_result = (obj_A.numerator() * obj_B.denominator()) + (obj_A.denom
172          inator() * obj_B.numerator());
173          int_type d_result = obj_A.denominator() * obj_B.denominator();
174          return rational<int_type>(n_result,d_result);
175      }
176
177      // Operator to perform Binary subtraction (-)
178      template<class int_type>
179      rational<int_type> operator-(const rational<int_type>& obj_A, const rational<int
180      _type>& obj_B){

```

```
178     int_type n_result = (obj_A.numerator() * obj_B.denominator()) - (obj_A.denom
inator() * obj_B.numerator());
179     int_type d_result = obj_A.denominator() * obj_B.denominator();
180     return rational<int_type>(n_result,d_result);
181 }
182
183 // Operator to perform Binary multiplication (*)
184 template<class int_type>
185 rational<int_type> operator*(const rational<int_type>& obj_A, const rational<int
_type>& obj_B){
186     int_type n_result = obj_A.numerator() * obj_B.numerator();
187     int_type d_result = obj_A.denominator() * obj_B.denominator();
188     return rational<int_type>(n_result,d_result);
189 }
190
191 // Operator to perform Binary division (/)
192 template<class int_type>
193 rational<int_type> operator/(const rational<int_type>& obj_A, const rational<int
_type>& obj_B){
194     int_type n_result = obj_A.numerator() * obj_B.denominator();
195     int_type d_result = obj_A.denominator() * obj_B.numerator();
196     return rational<int_type>(n_result,d_result);
197 }
198
199 // Stream Inserter
200 template<class int_type>
201 std::ostream& operator<< (std::ostream& outStream, const rational<int_type>& obj)
{
202     outStream << obj.numerator() << "/" << obj.denominator();
203     return outStream;
204 }
205
206 // Stream Extractor
207 template<class int_type>
208 std::istream& operator>>(std::istream& inStream, rational<int_type>& obj){
209     std::string the_input;
210     std::getline(inStream,the_input);
211     std::istringstream iss(the_input);
212     std::string n, d;
213     std::getline(iss,n,'/');
214     std::getline(iss,d);
215     long long n_l = std::stoll(n);
216     long long d_l = std::stoll(d);
217     if((std::to_string(n_l) + "/" + std::to_string(d_l))!=the_input){
218         inStream.setstate(std::ios_base::failbit);
219     }
220     obj = rational<int_type>((int_type)n_l, (int_type)d_l);
221     return inStream;
222 }
223
224
225
226 }
227 #endif
```

```
1  #include "ra/rational.hpp"
2  #include <iostream>
3
4  #include <string>
5  #include <sstream>
6
7  int main(){
8      using std::cout;
9      using std::endl;
10
11     ra::math::rational<double> obj_A;
12     //cout << "1) Test default constructor" << endl;
13     //cout << "    Numerator: " << obj_A.numerator() << endl;
14     //cout << "    Denominator: " << obj_A.denominator() << endl << endl;
15
16     ra::math::rational<float> obj_B(-56);
17     //cout << "2) Test constructor with single parameter" << endl;
18     //cout << "    Numerator: " << obj_B.numerator() << endl;
19     //cout << "    Denominator: " << obj_B.denominator() << endl << endl;
20
21     ra::math::rational<double> obj_C(31488,117);
22     //cout << "3) Test constructor with double parameter and truncation function"
23     << endl;
24     //cout << "    Numerator: " << obj_C.numerator() << endl;
25     //cout << "    Denominator: " << obj_C.denominator() << endl;
26     //cout << "    Truncated value: " << obj_C.truncate() << endl << endl;
27
28     ra::math::rational<double> obj_D(48,-4);
29     //cout << "4) Test is_integer function" << endl;
30     //cout << "    Numerator: " << obj_D.numerator() << endl;
31     //cout << "    Denominator: " << obj_D.denominator() << endl;
32     //cout << "    is_integer: " << obj_D.is_integer() << endl;
33     //cout << "    Numerator: " << obj_C.numerator() << endl;
34     //cout << "    Denominator: " << obj_C.denominator() << endl;
35     //cout << "    is_integer: " << obj_C.is_integer() << endl << endl;
36
37     ra::math::rational<double> obj_E(0,-4);
38     //cout << "5) Test the Not(!) operator" << endl;
39     //cout << "    Numerator: " << obj_E.numerator() << endl;
40     //cout << "    Not(!) operator: " << !obj_E << endl;
41     //cout << "    Numerator: " << obj_D.numerator() << endl;
42     //cout << "    Not(!) operator: " << !obj_D << endl << endl;
43
44     ra::math::rational<double> obj_F(-12);
45     //cout << "6) Test Equality(==) operator" << endl;
46     //cout << "    Must be true: " << (obj_D==obj_F) << endl;
47     //cout << "    Must be false: " << (obj_F==obj_C) << endl << endl;
48
49     //cout << "7) Test Inequality(!=) operator" << endl;
50     //cout << "    Must be true: " << (obj_C!=obj_F) << endl;
51     //cout << "    Must be false: " << (obj_F!=obj_D) << endl << endl;
52
53     //cout << "8) Test Less than(<) operator" << endl;
54     //cout << "    Must be true: " << (obj_F<obj_C) << endl;
55     //cout << "    Must be false: " << (obj_E<obj_F) << endl;
56     //cout << "    Must be false: " << (obj_F<obj_D) << endl << endl;
57
58     //cout << "9) Test Greater than(>) operator" << endl;
59     //cout << "    Must be false: " << (obj_F>obj_C) << endl;
60     //cout << "    Must be true: " << (obj_E>obj_F) << endl;
61     //cout << "    Must be false: " << (obj_F>obj_D) << endl << endl;
```

```
62 //cout << "10) Test Less than or equals to(<=) operator" << endl;
63 //cout << "    Must be true: " << (obj_F<=obj_C) << endl;
64 //cout << "    Must be false: " << (obj_E<=obj_F) << endl;
65 //cout << "    Must be true: " << (obj_F<=obj_D) << endl << endl;
66
67 //cout << "11) Test Greater than or equals to(>=) operator" << endl;
68 //cout << "    Must be false: " << (obj_F>=obj_C) << endl;
69 //cout << "    Must be true: " << (obj_E>=obj_F) << endl;
70 //cout << "    Must be true: " << (obj_F>=obj_D) << endl << endl;
71
72 //cout << "12) Test Reduced form and negative denominator" << endl;
73 //cout << "    obj_C(31488,117): " << obj_C.numerator() << ", " << obj_C.denominator() << endl;
74 //cout << "    obj_D(48,-4): " << obj_D.numerator() << ", " << obj_D.denominator() << endl << endl;
75
76 ra::math::rational<double> obj_G(-9,0);
77 //cout << "13) Test Condition when denominator is zero" << endl;
78 //cout << "    obj_G(-9,0): " << obj_G.numerator() << ", " << obj_G.denominator() << endl << endl;
79
80 //cout << "14) Test Prefix Increment(++obj) and Decrement(--obj) operators" << endl;
81 //cout << "    obj_D: " << obj_D.numerator() << ", " << obj_D.denominator() << endl;
82 //cout << "    increment: " << (++obj_D).numerator() << ", " << obj_D.denominator() << endl;
83 //cout << "    decrement: " << (--obj_D).numerator() << ", " << obj_D.denominator() << endl << endl;
84
85 //cout << "15) Test Postfix Increment(obj++) and Decrement(obj--) operators" << endl;
86 //cout << "    obj_D: " << obj_D.numerator() << ", " << obj_D.denominator() << endl;
87 //cout << "    increment: " << (obj_D++).numerator() << ", " << obj_D.denominator() << endl;
88 //cout << "    See change after: " << obj_D.numerator() << ", " << obj_D.denominator() << endl;
89 //cout << "    decrement: " << (obj_D--).numerator() << ", " << obj_D.denominator() << endl;
90 //cout << "    See change after: " << obj_D.numerator() << ", " << obj_D.denominator() << endl << endl;
91
92 ra::math::rational<double> obj_H(-9.776,1.33);
93 //cout << "16) Test case where a decimal points is used for the numerator and denominator" << endl;
94 //cout << "    obj_H: " << obj_H.numerator() << ", " << obj_H.denominator() << endl << endl;
95
96 ra::math::rational<float> obj_I(8,10);
97 ra::math::rational<float> obj_J(1,5);
98 ra::math::rational<float> obj_K(2,3);
99 //cout << "17) Test Operator(+=) and (-=) and (*=) and (/=)" << endl;
100 //cout << "    (8/10) += (1/5): " << (obj_I+=obj_J).numerator() << "/" << obj_I.denominator() << endl;
101 //cout << "    (prev ans) -= (2/3): " << (obj_I-=obj_K).numerator() << "/" << obj_I.denominator() << endl;
102 //cout << "    (prev ans) *= (2/3): " << (obj_I*=obj_K).numerator() << "/" << obj_I.denominator() << endl;
103 //cout << "    (prev ans) /= (1/5): " << (obj_I/=obj_J).numerator() << "/" << obj_I.denominator() << endl << endl;
104
```

```
105     //cout << "18) Test Unary minus(-) and Unary plus(+)" << endl;
106     //cout << "    obj_H: " << obj_H.numerator() << ", " << obj_H.denominator()
    << endl;
107     //cout << "    Unary Plus: " << (+obj_H).numerator() << "/" << obj_H.denomin
    ator() << endl;
108     //cout << "    Unary Minus: " << (-obj_H).numerator() << "/" << obj_H.denomi
    nator() << endl;
109
110     //cout << "19) Test Binary operators (+), (-), (*), and (/)" << endl;
111     //cout << "    "<<obj_I<<" + "<<obj_J<<" = " << (obj_I+obj_J)<<endl;
112     //cout << "    "<<obj_I<<" - "<<obj_J<<" = " << (obj_I-obj_J)<<endl;
113     //cout << "    "<<obj_I<<" * "<<obj_J<<" = " << (obj_I*obj_J)<<endl;
114     //cout << "    "<<obj_I<<" / "<<obj_J<<" = " << (obj_I/obj_J)<<endl<<endl;
115
116     //cout << "20) Test Stream extractor" << endl;
117     //std::cin >> obj_K;
118     //cout << obj_K << endl;
119
120
121
122
123     return 0;
124 }
```