

# Final Report Draft

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## 1 Introduction

When looking at certain fields, it can sometimes be obvious whether or not computer driven solutions are applicable to it. In math for instance, it is rather well known that computers can handle the problems related to computation like equations. However, where things become less clear is when trying to apply these techniques to completely man-made systems. What I wanted to look at is whether or not computers could answer a few questions in the field of law. Namely, can they determine ones guilt or innocence, and is it possible to find laws which contradict themselves.

## 2 The Problem

This project started out with the intention of creating a program which could find contradictions between written laws and facts to determine innocence or guilt. The scope was gradually reduced until it came to the process of creating a program which could check if students were qualified to take certain courses or majors, and if there were any contradictions within the majors and courses themselves. While this is not the original intended idea for the project, the code could possibly be used for the purpose of assessing laws in the future. Replacing courses & majors with laws, as well as replacing students with suspects, the program could serve as a way to narrow down potential suspects as well as check for any contradicting law.

## 3 The Literature & Interest

There are a few projects that have been attempted to codify laws into computers. A Korean development team was able to codify building permit laws into a computer to determine who should receive building permits. This project translated the laws themselves into their component parts, and used a programs to analyze these parts in order to use the law when determine when to give a

building permit [2]. This project was useful in determining how best to describe my parameters when defining the object used. Another project regarding engineering laws was able to codify contradictions into computers to help solve their problems. [1]. It gave me a general idea of how best to look for contradictions using well defined objects. Lastly, there was an article which talked about a programming language which handles tax law. This article mainly focuses on the language itself, but it does provide insight on to how laws were defined using that language [3]. This again helped me narrow down my definitions and parameters for defining what exactly it was I was analyzing.

From the above literature, it is evident that there exists interest in the field of converting laws into computer executable code. However, throughout my research I could not find a program which took federal laws, codified them, and used them in some executable form. So there is a problem. With the interest in the subject of law displayed by those articles as well as my own, I believe this meets the requirement of an unsolved problem which has interest in the greater field.

## 4 Methodology

Using the knowledge from my research, I began working on what I believed was the most important aspect of the project: defining what exactly a course and major was. I looked at what were the essential pieces of what a course was, and tried to determine what information was necessary and what could be removed. In the end, I broke courses into 6 sections in the order: (Name, Course ID, Credits, Hard Requirement; Soft Requirements; Number of Soft Requirements needed). Name is self explanatory, it is the name of the course. Similarly, Course ID is the ID of the course (ex. MATH-121). Credits was the number of credits the course was worth. Hard requirements were requirements which could not be circumvented by taking another course. Examples of this would be if a requirement stated: "PHYS-201 and MATH-122- Must be completed prior to taking this course.". In this case, both PHYS-201 and MATH-122 would be considered hard requirements. Soft Requirements are those which may be circumvented by another course. An example of this would be: "CHEM-112 OR CHEM-118 - Must be completed prior to taking this course." CHEM-112 and CHEM-118 would be listed as soft requirements with the number of course needed to take would be 1. Majors can be codified in much the same way as courses. We simply list each of their requirements in the form of a course. I take this input and place it into a C++ program to generate prolog code that I can use to test contradictions.

The prolog code generated by the C++ program is `courseName(Course)` which holds the name of the course, `hardReqs(Course, X)` which holds the name of

the course and a list of all hard requirements, `softReqs(Course, X)` which holds the name of the course and a list of all soft requirements starting with the number of soft requirements needed, `allReqs(Course, X)` which holds the name of the course and a list of all requirements for that course, and `canTake(Course, Student)` which changes depending on the requirements of the course. Essentially `canTake(Course, Student)` checks if a student can take a given course by checking if the student has taken or is taking the required courses for this course.

With this in place, checking a students eligibility for a given course, or progress towards a major was as simple as checking if a student can take a course or if a student "can take" a major. Once I had a clear definition of what courses and majors were, and I was confident with the ability to check eligibility, I could begin to look more thoroughly at defining contradictions. The main contradictions I was interested in were references to non-existent courses, redundant requirements, and impossible requirements. The first contradiction is rather obvious, it is not desirable to have references to non-existent courses in the database as it may serve to confuse students when deciding which courses to take. Redundant requirements were requirements that need not necessarily be listed. As an example, if Course 1 requires Courses 2 & 3, but Course 2 already requires Course 3, then Course 3 need not be listed as a requirement for Course 1. Finally, impossible requirements were those in which the course being checked is required by one of its requirements. An example of this being Course 1 requiring Course 2 which itself requires Course 1.

## 5 Problems Encountered

When codifying both courses and majors, there were a few common and uncommon problems which sprang up. There were a few instances of courses having different soft requirements with different courses. There were three cases which came from this problem

1. One requirement is a subset of the other.

In this case, I create what I call a supplementary requirement. These are differentiated by the program by having "-A", "-B", ... "-Z" at the end of the course name. An example would be BIOL-300-A. The program handles these slightly differently than proper courses. If a supplementary course is a requirement of another course, instead of checking whether they have taken it, the program checks if they can take it. This is because if a student can take the supplementary course, they have met the requirements for it, and since a supplementary course merely exists to confirm whether a student has taken further requirements, then it doesn't need to be taken. In any event, if the one requirement is a subset of another, then I create a supplementary requirement using the smaller subset and make larger soft requirement require the number of courses it needed +

the number needed for the smaller list. This is to ensure a course is not counted twice when checking whether a student can take a course.

2. Neither requirement has matching elements.

In this case, I create supplementary requirements equal to the number of soft requirements.

3. One requirement has x elements in another requirement.

For this, an example will provide the explanation:

One Section requires 1 course from BIOL-205, ENSC-220, or ENSC-230 to be taken.

Another Section requires 2 of BIOL-205, BIOL-235, BIOL-240, BIOL-265, BIOL-270, BIOL-275, BIOL-280, BIOL-300, BIOL-330, BIOL-335, BIOL-340, CHEM-221, CHEM-260, or CHEM-270 to be taken.

In order to check if BIOL-205 is being used for the first section, I check if the requirement is met without it. So I make a requirement for 1 of ENSC-220 or ENSC 230. If that is true, then BIOL-205 is not being used as a requirement for the first section and it can be safely assumed that BIOL-205 can be used for the other section. If however it is false, one of two things is true: the student has taken BIOL-205 and it is being used as a required course for the first requirement, or the student hasn't met the first requirement. Since this check comes after the first requirement is checked, it can be assumed that the student has met the requirement for it, so we discard the second assumption. This leaves us with the student having taken BIOL-205 for the prior requirement. In this case, instead of checking the above section with BIOL-205 in it, we make a requirement without it. So 2 of BIOL-235, BIOL-240, BIOL-265, BIOL-270, BIOL-275, BIOL-280, BIOL-300, BIOL-330, BIOL-335, BIOL-340, CHEM-221, CHEM-260, or CHEM-270 to be taken.

This method ensures that BIOL-205 doesn't count for two separate requirements in the same major.

This was only ever a problem for one major: the Environmental Science major, however, this can be done for other courses should a problem like this be found again. It can work with shared courses of any number, but it may become unwieldy to handle since the programmer must consider how many combinations of courses exist.

Aside from this, I could not check if a student had taken a course multiple times. For the Theatre majors, this would be necessary. As a result, I could

not use my model to find accurate results from the theatre majors, and I did not end up considering them

## 6 Contradictions Used

Creating contradictions were made using prolog facts which would determine if certain facts about a course or major requirement were in line with what was expected.

1. `check-non-existent-reqs(Course)`

This would check if any course required a course which was not real. It first confirms if the course being tested is real and then checks its requirements. This requirement check is a deep check, so if a requirement of the initial course requires a non-existent course, it would catch this. The only time it would result in false is if a non-existent course is found. This is done by checking if the current course checked has an `allReqs(Course, X)` associated with it. Given how the list is created, any course without a corresponding `allReqs` fact must not exist. This is useful for finding and erasing references to courses which no longer exist.

2. `self-requirement(Course)`

This will check if a course requires itself by checking if it listed itself as a requirement, or any course required by it listed it as a requirement. This again is a deep check, so it will find the course even if the requirements don't initially list it as a requirement. This will help in eliminating loops and causing undo confusion when checking requirements.

3. `check-redundancy(Course)`

This will check if a course requires a course which itself is required by a separate requirement. This only looks at hard requirements since soft requirements are not always guaranteed to be taken, however it is still a deep search. This will help in removing unnecessary courses from the requirement list.

I had created two other contradictions which would check if a soft requirement was being used properly by comparing their number required to the number of courses available, but with some majors and courses allowing courses to count multiple times towards the same requirement, I could not guarantee how helpful this would be to the project as a whole.

## 7 Code

For this project, I used two languages to create the code. I used C++ to automate the process of creating facts in prolog. I did this because, while each

course has different requirements, they all follow basic rules. To create multiple facts for each of them would be rather inefficient, so I opted to somewhat automate the process. As outlined in the methodology, I categorized courses according to the criteria listed. I then created functions to read this input and translate it into course objects. Using test cases, I verified that (as long as the input is correct) the code worked. There are 4 course possibilities. A course with no requirements, a course with only hard requirements, a course with only soft requirements, and a course with both hard and soft requirements. By verifying that it worked on each course type, it is clear that it works. I would then translate these course objects into several facts to be output to a prolog file. The same 4 course possibilities were tested here and were shown to translate properly. So I am sure that all facts in the prolog program generated from the C++ program is what I expected it to be.

I also had a separate prolog file which held the facts I used to test for the contradictions. I used similar test cases to determine whether or not they worked. I created a few facts which were not used in this particular project, but they could be used in other applications. An example of this is the misuse of soft requirements facts. I intended these to be used in cases where soft requirements were impossible, or were veiled hard requirements. However, it came to my attention late in the project's testing that a student could take the same course multiple times to fulfill some soft requirements. Since I was unsure of which courses would be subject to this rule, I decided not to use it for this project.

To get the final project file, the C++ file would output the automated prolog code to a file and then attach the facts written in the separate prolog file to the end of the automated output. This allowed me to test the facts on actual data using SWI Prolog.

I intended to check for looping requirements after this. This is where a course requires a course which at some point requires the initial course. If there was a looping requirement at any point, the program would stall and stack overflow. This did happen once over the course of testing, but it was from a mistake on my part. Since it did not occur in any other instance, it is safe to say there are not any looping requirements as the courses and majors are listed on the self service website.

## 8 Results and Future Application

On self-service, there are a little over 1000 courses and around 50 majors listed. Of those listed, 118 instances of references to non-existent courses were found. These instances can be found below in Appendix A. From the 28th non-existent course found, all following instances were found in majors. So having out of 1000 course only 27 instances of non-existent references means that looking at any one course there is about a 3% chance of encountering a non-existent course. This is not awful. However, that means that the remaining 91 instances were found

in the 50 majors. On paper, that means that each major references around 1.8 non-existent courses. Some obviously list more and some may list none, but it is clear from these findings that more attention needs to be put into the majors on the self service site. Some of the courses found may have been courses offered in the past 4 years. In those cases, keeping them as requirements for the sake of older students is likely a good idea. However, in cases where a referenced course has not been offered for 4 years, it is likely a good idea to remove them. If we are unsure of what courses were offered how long ago, it may be prudent to keep a list of offered courses for each academic year if one does not already exist.

When testing the redundancies, they are not as major of an issue as references to non-existent courses. The number of redundant instances also reflects this. Instances of all redundant course requirements can be found in Appendix B. With only 30 being found and all of them residing in the courses and not the majors, there doesn't need to be too much haste in correcting these. To reiterate, it may be wise to keep some of these visible to lower confusion of what courses are required. However, I do not think there is any harm in removing them either. There is an equally sound argument that student would be confused seeing the same requirement listed under another required course. I recommend this decision being made based on which seems like it would be beneficial to student planning.

Clearly, there were problems which my program was able to identify and I was able to document. So it shows that there are some existing problems on the self-service site as well as some redundant information. This will be useful in cleaning the site and making it more understandable. I am surprised there were as many problems as were found, but it is good that they were found in a test environment. We can ensure that future students will not go searching for courses which no longer exist when planning out their schedule with this information.

From here, the school can use this program to find problems in the future assuming that there are not any major changes to how courses and majors are categorized in the future. However, it may be applied in the field which I had originally intended to use it in: Law. Rather than using courses and majors, they could be replaced with federal or state laws. There requirements could be a set of requirement for someone to have broken those laws, and students could be mirrored as suspects. If a suspect has met all the requirements to break a given law, the program would be able to tell a court of guilt. It could also be used in the same way it was here and find problems within the laws themselves. There may even be applications beyond what I have mentioned here, but these are the primary uses I see for this framework moving into the future.

## 9 Appendix A) Non-existent references

When looking for contradictions, I used the command:

```
forall(courseName(X), x-fact(X)).
```

To find all instances of that rule being broken. I would then document the error, remove it from the file used for testing and run it again to find the next contradiction.

First, I looked at whether courses had requirements which did not exist. Below are a list of courses which have non-existent requirements.

1. For BIOL-300 Aquatic Ecology, there is a requirement: "CHEM-112 OR CHEM-113 OR CHEM-118 - Must be completed prior to taking this course." However, CHEM-113 was not a course which was found during the codification phase. Searching for CHEM-113 on the site returns no results, and scouring all chemistry courses available results in no instance of CHEM-113. So this requirement needs to be updated.
2. For BUAD-210 Entrepreneurship, there is a requirement: "BUAD-205 or BUAD-215 - Must be completed prior to taking this course." However, BUAD-215 was not a course which was found during the codification phase. Searching for BUAD-215 on the site returns no results, and scouring all business courses available results in no instance of BUAD-215. So this requirement needs to be updated.
3. For BUAD-218 Information Systems, there is a requirement: "BUAD-205 or BUAD-215 - Must be completed prior to taking this course." As previously mentioned, BUAD-215 is not a course listed.
4. For BUAD-233 Marketing Management, there is a requirement: "BUAD-110 OR BUAD-205 or BUAD-215 - Must be completed prior to taking this course."
5. For BUAD-248 Business Analytics, there is a requirement: "BUAD-205 or BUAD-215 - Must be completed prior to taking this course." As previously mentioned, BUAD-215 is not a course listed.
6. For BUAD-322 Student-Managed Fund, there is a requirement: "BUAD-205 or BUAD-215 - Must be completed prior to taking this course." As previously mentioned, BUAD-215 is not a course listed.
7. For BUAD-335 Cost Accounting, there is a requirement: "BUAD-205 or BUAD-215 - Must be completed prior to taking this course." As previously mentioned, BUAD-215 is not a course listed.
8. For BUAD-345 Income Taxation, there is a requirement: "BUAD-205 or BUAD-215 or permission - Must be completed prior to taking this course." As previously mentioned, BUAD-215 is not a course listed.



9. For MATH-122 Calculus II, there is a requirement: "MATH-121 or MATH-119 - Must be completed prior to taking this course.". However, MATH-119 was not a course which was found during the codification phase. Searching for MATH-119 on the site returns no results, and scouring all math courses available results in no instance of MATH-119. So this requirement needs to be updated.
10. For PHYS-201 Newtonian Mechanics, there is a requirement: "MATH-121 or MATH-118 - Must be completed prior to taking this course.". However, MATH-118 was not a course which was found during the codification phase. Searching for MATH-118 on the site returns no results, and scouring all math courses available results in no instance of MATH-118. So this requirement needs to be updated.
11. For PHYS-202 Newtonian Mechanics, there is a requirement: "PHYS-201 and MATH-122 or MATH-119 - Must be completed prior to taking this course.". However, MATH-119 was not a course which was found during the codification phase. Searching for MATH-119 on the site returns no results, and scouring all math courses available results in no instance of MATH-119. So this requirement needs to be updated.
12. For PHYS-299 Introductory Special Topics, there is a requirement: "MATH-121 or MATH-118 - Must be completed prior to taking this course." As previously mentioned, MATH-118 is not a listed course.
13. For one of the requirements of the Health and Exercise Science Major, MATH-118 is listed as an optional course. As previously mentioned, MATH-118 is not a listed course.
14. For ECON-321 Intermed Theory: Microeconomic, there is a requirement: "MATH-111 OR MATH-112 OR MATH-118 OR MATH-121 - Must be completed prior to taking this course." As previously mentioned, MATH-118 is not a listed course. Likewise MATH-112 is also not an existing course. Searching for MATH-112 on the site returns no results, and scouring all math courses available results in no instance of MATH-112. So this requirement needs to be updated.
15. For ECON-322 Intermed Theory: Macroeconomic, there is a requirement: "MATH-111 OR MATH-112 OR MATH-118 OR MATH-121 - Must be completed prior to taking this course." As previously mentioned, MATH-118 is not a listed course.
16. For COMM-220 Public Speaking there is a requirement: "INQ-110 or INQ-120 or HNRS-105 or HNRS 110 or HNRS-120. - Must be completed prior to taking this course.". However, HNRS-105 was not a course which was found during the codification phase. Searching for HNRS-105 on the site returns no results, and scouring all honors courses available results in no instance of HNRS-105. So this requirement needs to be updated.

17. For MATH-131 Discrete Mathematics, there is a requirement: "MATH-121 or CPSC-120 or CPSC-150. - Must be completed prior to taking this course.". However, CPSC-150 was not a course which was found during the codification phase. Searching for CPSC-150 on the site returns no results, and scouring all computer science courses available results in no instance of CPSC-150. So this requirement needs to be updated.
18. For ENGL-321 Advanced Grammar and Style, there is a requirement:"INQ-110, INQ-120, HNRS-105, HNRS-110 or HNRS-120 or permission." As previously mentioned, HNRS-105 is not a listed course.
19. For ENGL-350 Focus: Genre Studies, there is a requirement:"ENGL-240 OR ENGL-250 - Must be completed prior to taking this course.". However, neither ENGL-240 nor ENGL-250 are courses listed on the site.
20. For ENGL-350 Studies in Drama, there is a requirement:"ENGL-240 OR ENGL-250 - Must be completed prior to taking this course.". However, neither ENGL-240 nor ENGL-250 are courses listed on the site.
21. For ENST-290 Sustainable Agr & Food Systems, there is a requirement:"ENSC-101 ENST-103 or ENST-105 or ENVI-101 or ENVI-103 or ENVI-105 or permission. - Must be completed prior to taking this course.". However, there are no courses listed under ENVI on the site.
22. For I.R./POLI-209 Res. Methods in Public Affairs, there is a requirement:"Sophomore standing, POLI 111 or 112 & one other course in the major; or ENVI 105 or permission. - Must be completed prior to taking this course." As previously mentioned, no course exists with ENVI as its tag.
23. For NEUR/PSYC-330, there is a requirement: "PSYC 101 or BIOL 120 or BIOL 190. - Must be completed prior to taking this course.". However, BIOL-120 was not a course which was found during the codification phase. Searching for BIOL-120 on the site returns no results, and scouring all biology courses available results in no instance of BIOL-120. So this requirement needs to be updated.
24. For PSYC-410, there is a requirement: "PSYC-202 OR PSYC-205 - Must be completed prior to taking this course.". However, PSYC-205 was not a course which was found during the codification phase. Searching for PSYC-205 on the site returns no results, and scouring all psychology courses available results in no instance of PSYC-205. So this requirement needs to be updated.
25. For SOCI-337 Environmental Sociology, there is a requirement: "One 200-level SOCI course, or ENVI-105 or permission - Must be completed prior to taking this course." As previously mentioned, no course exists with ENVI as its tag.

26. For THEA-332 Focus: Shakespeare, there is a requirement: "ENGL-240 - Must be completed prior to taking this course." As previously mentioned, ENGL-240 is not a listed course.
27. For WRIT-306 Tutoring Writ. Across Curricul, there is a requirement: "INQ-110 or HNRS-105 or HNRS-110 or HNRS-120. - Must be completed prior to taking this course." As previously mentioned, HNRS-105 is not a listed course.
28. For a section of the Actuarial Science Major, STAT-302 is listed as a potential requirement. However, this class is not listed on the self service site at all.
29. For a section of the Applied Computer Science Major, STAT-202, CPSC-290, CPSC-340, CPSC-365, and CPSC-415 are listed as requirements. However, none of these class are listed on the self service site at all.
30. For a section of the Art Major and the Art Education Major, ARTH-226 is listed as a potential requirement. However, this class is not listed on the self service site at all.
31. For a section of the Biochemistry Major, BIOL-390, and CHEM-280 are listed as a potential requirements. However, neither of these classes are listed on the self service site at all.
32. For a section of the Business Administration Major, BUAD-215 is listed as a requirement. However, this class is not listed on the self service site at all.
33. For a section of the Business Administration Major, BUAD-225 is listed as a requirement. However, this class is not listed on the self service site at all.
34. For a section of the Chemistry Major, CHEM-110 is listed as a requirement. However, this class is not listed on the self service site at all.
35. For a section of the Chemistry Major, CHEM-113 is listed as a requirement. However, this class is not listed on the self service site at all.
36. For a section of the Chemistry Major, CHEM-280 is listed as a requirement. However, this class is not listed on the self service site at all.
37. For a section of the Chemistry Major, CHEM-250 is listed as a requirement. However, this class is not listed on the self service site at all.
38. For a section of the Chemistry Major, CHEM-430 is listed as a requirement. However, this class is not listed on the self service site at all.
39. For a section of the Christian Studies Major, RELG-215 is listed as a requirement. However, this class is not listed on the self service site at all.

40. For a section of the Christian Studies Major, RELG-312 is listed as a requirement. However, this class is not listed on the self service site at all.
41. For a section of the Christian Studies Major, RELG-330 is listed as a requirement. However, this class is not listed on the self service site at all.
42. For a section of the Christian Studies Major, RELG-214 is listed as a requirement. However, this class is not listed on the self service site at all.
43. For a section of the Christian Studies Major, RELG-240 is listed as a requirement. However, this class is not listed on the self service site at all.
44. For a section of the Criminal Justice Major, BUAD-215 is listed as a potential requirement. However, this class is not listed on the self service site at all.
45. For a section of the Criminal Justice Major, CJUS-227 is listed as a potential requirement. However, this class is not listed on the self service site at all.
46. For a section of the Education Professional Studies Major, TESL-320 is listed as a potential requirement. However, this class is not listed on the self service site at all.
47. For a section of the Education Professional Studies Major, EDUC-406 is listed as a potential requirement. However, this class is not listed on the self service site at all.
48. For a section of the Education Professional Studies Major, SOCI-221 is listed as a potential requirement. However, this class is not listed on the self service site at all.
49. For a section of the Education Professional Studies Major, EDUC-496 is listed as a potential requirement. However, this class is not listed on the self service site at all.
50. For a section of the Elementary Education Major, TESL-320 is listed as a potential requirement. However, this class is not listed on the self service site at all.
51. For a section of the English Education Major, ENGL-240 is listed as a potential requirement. However, this class is not listed on the self service site at all.
52. For a section of the English Education Major, ENGL-250 is listed as a potential requirement. However, this class is not listed on the self service site at all.
53. For a section of the English Education Major, ENGL-390 is listed as a potential requirement. However, this class is not listed on the self service site at all.

54. For a section of the English Education Major, ENGL-260 is listed as a potential requirement. However, this class is not listed on the self service site at all.
55. For a section of the English Education Major, ENGL-360 is listed as a potential requirement. However, this class is not listed on the self service site at all.
56. For a section of the History Major, HIST-242 is listed as a potential requirement. However, this class is not listed on the self service site at all.
57. For a section of the History Major, HIST-267 is listed as a potential requirement. However, this class is not listed on the self service site at all.
58. For a section of the History Major, HIST-269 is listed as a potential requirement. However, this class is not listed on the self service site at all.
59. For a section of the History Major, HIST-253 is listed as a potential requirement. However, this class is not listed on the self service site at all.
60. For a section of the Interdisciplinary Studies Major, TESL-320 is listed as a potential requirement. However, this class is not listed on the self service site at all.
61. For a section of the Interdisciplinary Studies Major, ENGL-240 is listed as a potential requirement. However, this class is not listed on the self service site at all.
62. For a section of the Interdisciplinary Studies Major, ENGL-250 is listed as a potential requirement. However, this class is not listed on the self service site at all.
63. For a section of the Interdisciplinary Studies Major, EDUC-242 is listed as a potential requirement. However, this class is not listed on the self service site at all.
64. For a section of the Interdisciplinary Studies Major, SOCI-221 is listed as a potential requirement. However, this class is not listed on the self service site at all.
65. For a section of the International Relations Major, HIST-353 is listed as a potential requirement. However, this class is not listed on the self service site at all.
66. For a section of the International Relations Major, SOCI-221 is listed as a potential requirement. However, this class is not listed on the self service site at all.

67. For a section of the Literary Studies Major, ENGL-240 is listed as a potential requirement. However, this class is not listed on the self service site at all.
68. For a section of the Literary Studies Major, ENGL-250 is listed as a potential requirement. However, this class is not listed on the self service site at all.
69. For a section of the Literary Studies Major, ENGL-260 is listed as a potential requirement. However, this class is not listed on the self service site at all.
70. For a section of the Literary Studies Major, ENGL-315 is listed as a potential requirement. However, this class is not listed on the self service site at all.
71. For a section of the Literary Studies Major, ENGL-330 is listed as a potential requirement. However, this class is not listed on the self service site at all.
72. For a section of the Literary Studies Major, ENGL-333 is listed as a potential requirement. However, this class is not listed on the self service site at all.
73. For a section of the Literary Studies Major, ENGL-334 is listed as a potential requirement. However, this class is not listed on the self service site at all.
74. For a section of the Literary Studies Major, ENGL-335 is listed as a potential requirement. However, this class is not listed on the self service site at all.
75. For a section of the Literary Studies Major, ENGL-336 is listed as a potential requirement. However, this class is not listed on the self service site at all.
76. For a section of the Mathematics Major, CPSC-150 is listed as a potential requirement. However, this class is not listed on the self service site at all.
77. For a section of the Mathematics Major, MATH-271 is listed as a potential requirement. However, this class is not listed on the self service site at all.
78. For a section of the Music Major, MUSC-261 is listed as a potential requirement. However, this class is not listed on the self service site at all.
79. For a section of the Music Major, MUSC-262 is listed as a potential requirement. However, this class is not listed on the self service site at all.

80. For a section of the Music Major, MUSC-343 is listed as a potential requirement. However, this class is not listed on the self service site at all.
81. For a section of the Music Major, MUSC-350 is listed as a potential requirement. However, this class is not listed on the self service site at all.
82. For a section of the Music Education Major, MUSC-261 is listed as a potential requirement. However, this class is not listed on the self service site at all.
83. For a section of the Music Education Major, MUSC-262 is listed as a potential requirement. However, this class is not listed on the self service site at all.
84. For a section of the Music Education Major, MUSC-343 is listed as a potential requirement. However, this class is not listed on the self service site at all.
85. For a section of the Music Education Major, MUSC-350 is listed as a potential requirement. However, this class is not listed on the self service site at all.
86. For a section of the Philosophy Major, PHIL-410 is listed as a potential requirement. However, this class is not listed on the self service site at all.
87. For a section of the Philosophy Major, PHIL-411 is listed as a potential requirement. However, this class is not listed on the self service site at all.
88. For a section of the Philosophy Major, PHIL-412 is listed as a potential requirement. However, this class is not listed on the self service site at all.
89. For a section of the Philosophy Major, PHIL-495 is listed as a potential requirement. However, this class is not listed on the self service site at all.
90. For a section of the Philosophy Major, PHIL-496 is listed as a potential requirement. However, this class is not listed on the self service site at all.
91. For a section of the Philosophy Major, PHIL-497 is listed as a potential requirement. However, this class is not listed on the self service site at all.
92. For a section of the Physics Major, CPSC-150 is listed as a potential requirement. However, this class is not listed on the self service site at all.
93. For a section of the Physics Major, MATH-271 is listed as a potential requirement. However, this class is not listed on the self service site at all.
94. For a section of the Physics Major, PHYS-191 is listed as a potential requirement. However, this class is not listed on the self service site at all.

95. For a section of the Physics Education Major, PHYS-191 is listed as a potential requirement. However, this class is not listed on the self service site at all.
96. For a section of the Psychology Major, PSYC-325 is listed as a potential requirement. However, this class is not listed on the self service site at all.
97. For a section of the Public Health Studies Major, CPSC-150 is listed as a potential requirement. However, this class is not listed on the self service site at all.
98. For a section of the Public Health Studies Major, CPSC-301 is listed as a potential requirement. However, this class is not listed on the self service site at all.
99. For a section of the Public Health Studies Major, CPSC-302 is listed as a potential requirement. However, this class is not listed on the self service site at all.
100. For a section of the Public Health Studies Major, PHST-405 is listed as a potential requirement. However, this class is not listed on the self service site at all.
101. For a section of the Public Health Studies Major, PHST-406 is listed as a potential requirement. However, this class is not listed on the self service site at all.
102. For a section of the Public Health Studies Major, PHST-407 is listed as a potential requirement. However, this class is not listed on the self service site at all.
103. For a section of the Public Health Studies Major, PHST-416 is listed as a potential requirement. However, this class is not listed on the self service site at all.
104. For a section of the Public Health Studies Major, PHST-495 is listed as a potential requirement. However, this class is not listed on the self service site at all.
105. For a section of the Public Health Studies Major, PHST-496 is listed as a potential requirement. However, this class is not listed on the self service site at all.
106. For a section of the Public Health Studies Major, PHST-497 is listed as a potential requirement. However, this class is not listed on the self service site at all.
107. For a section of the Public Health Studies Major, SOCI-242 is listed as a potential requirement. However, this class is not listed on the self service site at all.



108. For a section of the Religious Studies Major, RELG-295 is listed as a potential requirement. However, this class is not listed on the self service site at all.
109. For a section of the Religious Studies Major, RELG-205 is listed as a potential requirement. However, this class is not listed on the self service site at all.
110. For a section of the Sociology Major, PHST-405 is listed as a potential requirement. However, this class is not listed on the self service site at all.
111. For a section of the Sociology Major, PHST-406 is listed as a potential requirement. However, this class is not listed on the self service site at all.
112. For a section of the Sociology Major, PHST-407 is listed as a potential requirement. However, this class is not listed on the self service site at all.
113. For a section of the Sociology Major, PHST-416 is listed as a potential requirement. However, this class is not listed on the self service site at all.
114. For a section of the Sociology Major, PHST-495 is listed as a potential requirement. However, this class is not listed on the self service site at all.
115. For a section of the Sociology Major, PHST-496 is listed as a potential requirement. However, this class is not listed on the self service site at all.
116. For a section of the Sociology Major, PHST-497 is listed as a potential requirement. However, this class is not listed on the self service site at all.
117. For a section of the Sports Management Major, BUAD-215 is listed as a potential requirement. However, this class is not listed on the self service site at all.
118. For a section of the Sports Management Major, HHP-418 is listed as a potential requirement. However, this class is not listed on the self service site at all.

Thankfully, no self-requirements were found while checking for non-existence. Checking this fact reveals that this is the case as well.

## 10 Appendix B) Redundant Requirements

Next, I intended to check for redundant requirements. However, this wouldn't be very wise. Removing redundant requirements in some cases may confuse students into believing certain courses aren't required. For these tests, I do not consider soft requirements, only hard ones. This is because soft requirements are not always guaranteed to be fulfilled.

1. For ART-411, the requirement for ART-211 is redundant since ART-311 is a requirement which already requires ART-211.
2. For ART-411, the requirement for ART-111 is redundant since ART-311 is a requirement which already requires ART-211 which requires ART-111.
3. For ART-421, the requirement for ART-221 is redundant since ART-321 is a requirement which already requires ART-221.
4. For ART-421, the requirement for ART-121 is redundant since ART-321 is a requirement which already requires ART-221 which requires ART-121.
5. For ART-431, the requirement for ART-231 is redundant since ART-331 is a requirement which already requires ART-231.
6. For ART-431, the requirement for ART-131 is redundant since ART-331 is a requirement which already requires ART-231 which requires ART-131.
7. For ART-441, the requirement for ART-241 is redundant since ART-341 is a requirement which already requires ART-241.
8. For ART-461, the requirement for ART-261 is redundant since ART-361 is a requirement which already requires ART-261.
9. For ART-471, the requirement for ART-271 is redundant since ART-371 is a requirement which already requires ART-271.
10. For ART-471, the requirement for ART-171 is redundant since ART-371 is a requirement which already requires ART-271 which requires ART-171.
11. For ART-481, the requirement for ART-281 is redundant since ART-381 is a requirement which already requires ART-281.
12. For ART-481, the requirement for ART-181 is redundant since ART-381 is a requirement which already requires ART-281 which requires ART-181.
13. For BIOL-380, the requirement for MATH-115 is redundant since BIOL-315 is a requirement which already requires MATH-115.
14. For BIOL-380, there are requirements which will have already been met since they are the same as requirements for BIOL-315 which is a requirement for BIOL-380
15. For BIOL-400, the requirement for MATH-115 is redundant since BIOL-315 is a requirement which already requires MATH-115.
16. For BIOL-400, there are requirements which will have already been met since they are the same as requirements for BIOL-315 which is a requirement for BIOL-400
17. For BIOL-410, the requirement for MATH-115 is redundant since BIOL-315 is a requirement which already requires MATH-115.

18. For BIOL-410, there are requirements which will have already been met since they are the same as requirements for BIOL-315 which is a requirement for BIOL-410
19. For BIOL-415, the requirement for MATH-115 is redundant since BIOL-315 is a requirement which already requires MATH-115.
20. For BIOL-415, there are requirements which will have already been met since they are the same as requirements for BIOL-315 which is a requirement for BIOL-415
21. For BUAD-248, the requirement for MATH-111 is redundant since BUAD-218 is a requirement which already requires MATH-111.
22. For CHEM-332, the requirement for CHEM-255 is redundant since CHEM-331 is a requirement which already requires CHEM-255.
23. For CPSC-342, the requirement for MATH-122 is redundant since MATH-201 is a requirement which already requires MATH-122.
24. For CRWR-412, the requirement for CRWR-230 is redundant since CRWR-330 is a requirement which already requires CRWR-230.
25. For ENGS-200, the requirement for ENGS-191 is redundant since ENGS-192 is a requirement which already requires ENGS-191.
26. For ENGS-304, the requirement for PHYS-202 is redundant since PHYS-270 is a requirement which already requires PHYS-202.
27. For ENGS-330, the requirement for PHYS-202 is redundant since PHYS-270 is a requirement which already requires PHYS-202.
28. For MATH-342, the requirement for MATH-122 is redundant since MATH-201 is a requirement which already requires MATH-122.
29. For MATH-381, the requirement for MATH-122 is redundant since MATH-201 is a requirement which already requires MATH-122.
30. For PHYS-270, the requirement for PHYS-201 is redundant since PHYS-202 is a requirement which already requires PHYS-201.

## References

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