

3. SUB-SYSTEMS

C.E. students will handle the creation of adjustment forms, while the E.E.E. students handle the circuit part.

3.1. Computer Engineering

Computer Engineering students Cem and Baran will be dealing with the data extraction from the transcript PDFs.

Using an algorithm, data will be read from transcripts in the form of PDFs. The data scraped will be used to fill an adjustment form. A log file containing accepted courses and letter grades will also be output.

3.1.1. Requirements

1. Read the PDF accurately.

- Using a Python script, data of all the must courses, general electives and non-departmental courses (considering the credit end ECTS information) will be extracted from any given transcript PDF.

18.12.2022

National ID	██████	Faculty	SCHOOL OF ENGINEERING AND NATURAL SCIENCES
Student ID	██████	Program	ELECTRICAL AND ELECTRONICS ENGINEERING
Name	██████████	Registrar Date / Program Language	██████████
Surname	██████	Class	4

Figure 10.1: Transcript

2019-2020 Fall					
MAT1051	Calculus I	4	D+	5.32	7.00
CMP1401*	Introduction to Programming (C)	3	F	0.00	6.00
PHY1001*	Physics I	4	F	0.00	7.00
MAT1041*	Linear Algebra	3	F	0.00	6.00
ENG1003*	Communications Skills and Academic Reporting I	3	F	0.00	4.00
Sem.Taken Credits : 17.00 Sem.Taken ECTS : 30.00 Grade Point Average(GPA) : 0.31 Tot.Cr.Comp. : 4.00 Tot.ECTS.Cr.Comp : 7.00 GNO : 0.31					

2019-2020 Spring					
EEE1002	Introduction to Electrical and Electronics Engineering	3	B	9.00	6.00
PHY1002	Physics II	4	B+	13.32	7.00
MAT1052	Calculus II	4	C+	9.32	7.00
MAT1006	Engineering Mathematics I	4	C	8.00	6.00
ENG1004	Communication Skills and Academic Reporting II	3	S	0.00	4.00
Sem.Taken Credits : 18.00 Sem.Taken ECTS : 30.00 Grade Point Average(GPA) : 2.64 Tot.Cr.Comp. : 22.00 Tot.ECTS.Cr.Comp : 37.00 GNO : 1.41					

Figure 10.2: Transcript

2. Process data.

- Run the data through an algorithm to see if the student has already taken a course (or an equivalent course) of their new major.
- Check if any course taken by the student can be entered as a non-departmental

course for the new major.

- Check for other elective courses (general elective and departmental elective). Higher grades are prioritized for any course that is not mandatory in the new major.

3. Fill adjustment form

- The necessary information that is held in values in the code are placed in the adjustment form (an Excel file).

4. Create a log file or a visual output.

Of the Course Taken/to be Taken at the Major Program					Equivalent Course in the Double Major Program				
Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / Semester	Grade	Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / Sem	Grade
TLL1004	Türk Dili ve Edebiyatı II		2020-2021 Spril	C+	TLL1004	Türk Dili ve Edebiyatı II		6	C+
ENG1003	İletişim Becerileri ve Akademik Raporlama I		2019-2020 Sum	B+	ENG1003	İletişim Becerileri ve Akademik Raporlama I		1	B+
MAT1052	Diferensiyel ve İntegral Hesap II		2019-2020 Spril	C+	MAT1052	Diferensiyel ve İntegral Hesap II		2	C+
MAT1041	Doğrusal Cebir		2019-2020 Sum	B+	MAT1041	Doğrusal Cebir		3	B+
ENR3001	Mühendisliğin Teknik Olmayan Yönleri		2021-2022 Fall	A	ENR3001	Mühendisliğin Teknik Olmayan Yönleri		6	A
HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		2021-2022 Sum	B-	HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		5	B-
EEE2204	Introduction to Digital Design		2020-2021 Spril	C	CMP1004	Dijital Mantığa Giriş		2	C
MAT3026	Olasılık ve İstatistik		2020-2021 Spril	B+	MAT3026	Olasılık ve İstatistik		6	B+
MAT1006	Engineering Mathematics I		2019-2020 Spril	C	MAT2033	Ayrık Matematik		1	C
PHY1002	Fizik II		2019-2020 Spril	B+	PHY1002	Fizik II		2	B+
PHY1001	Fizik I		2020-2021 Fall	S	PHY1001	Fizik I		1	S
ENG1004	İletişim Becerileri ve Akademik Raporlama II		2019-2020 Spril	S	ENG1004	İletişim Becerileri ve Akademik Raporlama II		2	S
MAT2062	Diferensiyel Denklemler		2020-2021 Fall	C+	MAT2062	Diferensiyel Denklemler		4	C+
CMP1401	Introduction to Programming (C)		2020-2021 Fall	B+	CMP1001	Programlamaya Giriş (C++)		1	B+
TLL1003	Türk Dili ve Edebiyatı I		2020-2021 Fall	B-	TLL1003	Türk Dili ve Edebiyatı I		5	B-
HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		2020-2021 Spril	B-	HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		6	B-
MAT1051	Diferensiyel ve İntegral Hesap I		2019-2020 Fall	D+	MAT1051	Diferensiyel ve İntegral Hesap I		1	D+
EEE3501	Signals and Systems		2020-2021 Sum	B+	Non-Dep	Non-Departmental Elective		6	B+
EEE1002	Introduction to Electrical and Electronics Engineering		2019-2020 Spril	B	Non-Dep	Non-Departmental Elective		8	B
GEP0608	European Integration and Turkish-European Relations		2020-2021 Spril	A-	GEP	General Elective		3	A-
GEP1006	History of Civilization II		2021-2022 Fall	B+	GEP	General Elective		4	B+
GEP0211	City and Landscape		2021-2022 Sum	B+	GEP	General Elective		7	B+
GEP0705-GEP	Literature and Society		2021-2022 Fall	B-	GEP	General Elective		7	B-
GEP0702	Critical Thinking and Literary Criticism		2021-2022 Fall	C+	GEP	General Elective		8	C+

Figure 11: Generated double major form

Yarıy	Kabul edildiği Programda muafiyet verilen BAU Dersinin Kodu ve Adı	Teorik	Pratik	Yerel Kred i	AKTS	Türü (Must, DEP, NONDEP, GEP)	Başarı Notu	Yarıy	Sayırlanan Dersin Kodu ve Adı TÜRKÇE ve İNGİLİZCE	Teorik	Pratik	Yerel Kred i	AKTS	Başarı Notu
1	ENG1003 İletişim Becerileri ve Akademik Raporlama I			3	4		B+		ENG1003 İletişim Becerileri ve Akademik Raporlama I			3	4	B+
1	MAT1051 Diferensiyel ve İntegral Hesap I			4	7		D+		MAT1051 Diferensiyel ve İntegral Hesap I			4	7	D+
1	PHY1001 Fizik I			4	7		S		PHY1001 Fizik I			4	7	S
1	MAT2033 Ayrık Matematik			3	6		C		MAT1006 Engineering Mathematics I			3	6	C
1	CMP1001 Programlamaya Giriş (C++)			3	6		B+		CMP1401 Introduction to Programming (C)			3	6	B+
1														
1														
1														
2	ENG1004 İletişim Becerileri ve Akademik Raporlama II			3	4		S		ENG1004 İletişim Becerileri ve Akademik Raporlama II			3	4	S
2	MAT1052 Diferensiyel ve İntegral Hesap II			4	7		C+		MAT1052 Diferensiyel ve İntegral Hesap II			4	7	C+
2	PHY1002 Fizik II			4	7		B+		PHY1002 Fizik II			4	7	B+
2	CMP1004 Dijital Mantığa Giriş			3	6		C		EEE2204 Introduction to Digital Design			3	6	C
2														
2														
2														
2														
3	MAT1041 Doğrusal Cebir			3	6		B+		MAT1041 Doğrusal Cebir			3	6	B+
3	GEP Genel Seçmeli			3	5		A-		GEP0608 European Integration and Turkish-European Relations			3	5	A-
3	CMP2003 Veri Yapıları ve Algoritmalar (C++)			4	7				EEE3116 Electronics II			4	8	D
3									EEE3115 Electronics I			4	8	F

Figure 12: Generated changing majors form

Note that the course at the bottom of the form is for demonstrating purposes only, as it shows how the cells can be merged when two courses combined are equivalent to one course that is in the curriculum of the new major. However the courses that were entered to the right-hand side are not actually equivalent to the left-hand side and in a realistic scenario a course with the grade "F" would not be entered to the form.

Functional Requirements

- The user creates an adjustment form by inputting the transcript.
- The program finds which mandatory courses of the new major have been taken by the student.
- The program counts equivalent courses taken by the student. (e.g. if CMP1041 is taken, CMP1001 should be counted as a taken course.)
- The program decides which courses taken by the student will be entered as non-departmental courses for the new major.
- The program checks if any course taken by the student can be entered as a departmental elective course and finds general elective courses taken.
- The program successfully fills the form.

Non-functional Requirements

- The program does not expose any private data of students.
- The program easily runs on average computers.
- The program completes the process in under 30 seconds.

3.1.2. Technologies and methods

Two main libraries were used. For scraping information from the transcript (.pdf file) tabula-py was used. For manipulating Excel files, openpyxl library was used.. Comparements of the data were made using plain Python. Other libraries were also used for purposes like reading data from a .csv file containing mandatory course information or for generating an executable file. An external database in the form of a text file and a custom format is made to keep equivalent course information.

Majority of the debugging/testing will be done using transcripts of team members studying Electrical and Electronics Engineering. Asst. Prof. Selin Nacaklı also provided exemplary adjustment forms as a reference for the output.

3.1.3. Conceptualization

As seen on Figure 13 the program will have only one use case, where the academic personnel uses it to create an adjustment form. Figure 14 shows an example use of the program. The transcript choosing function is visible. Figure 15 details the algorithm behind the code.

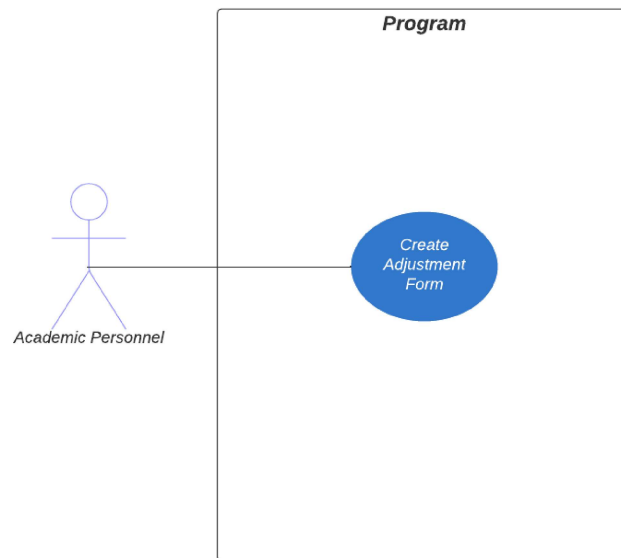


Figure 13: Use Case Diagram for the program

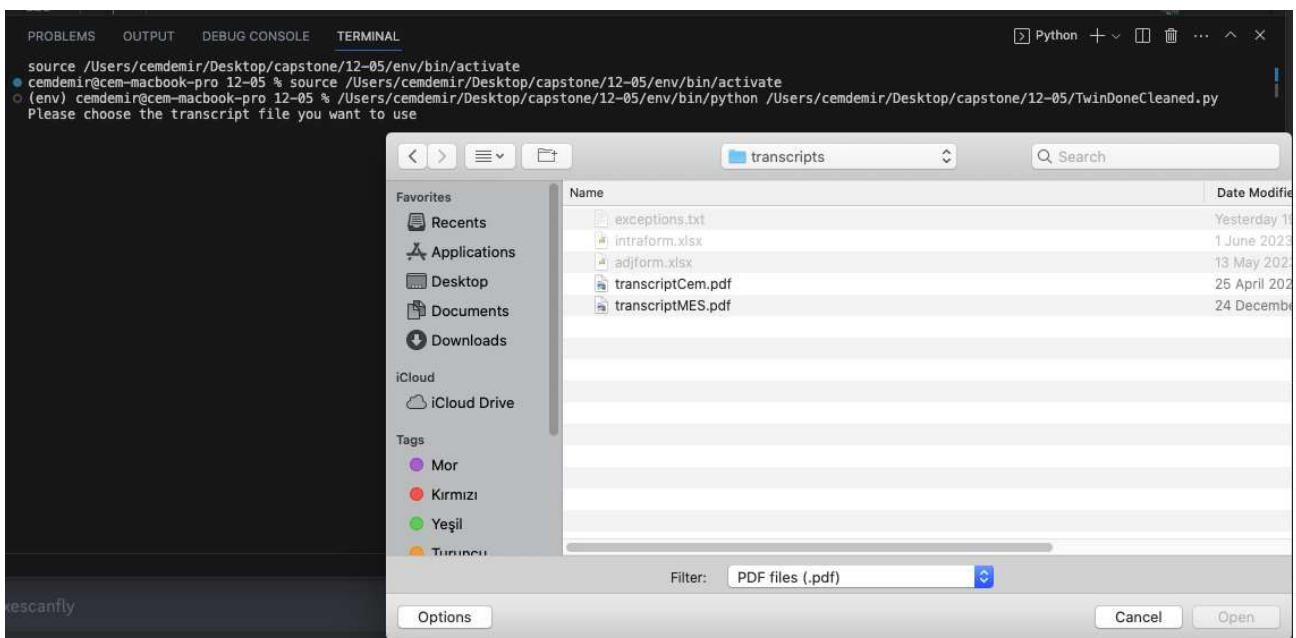


Figure 14: File browser to choose transcript

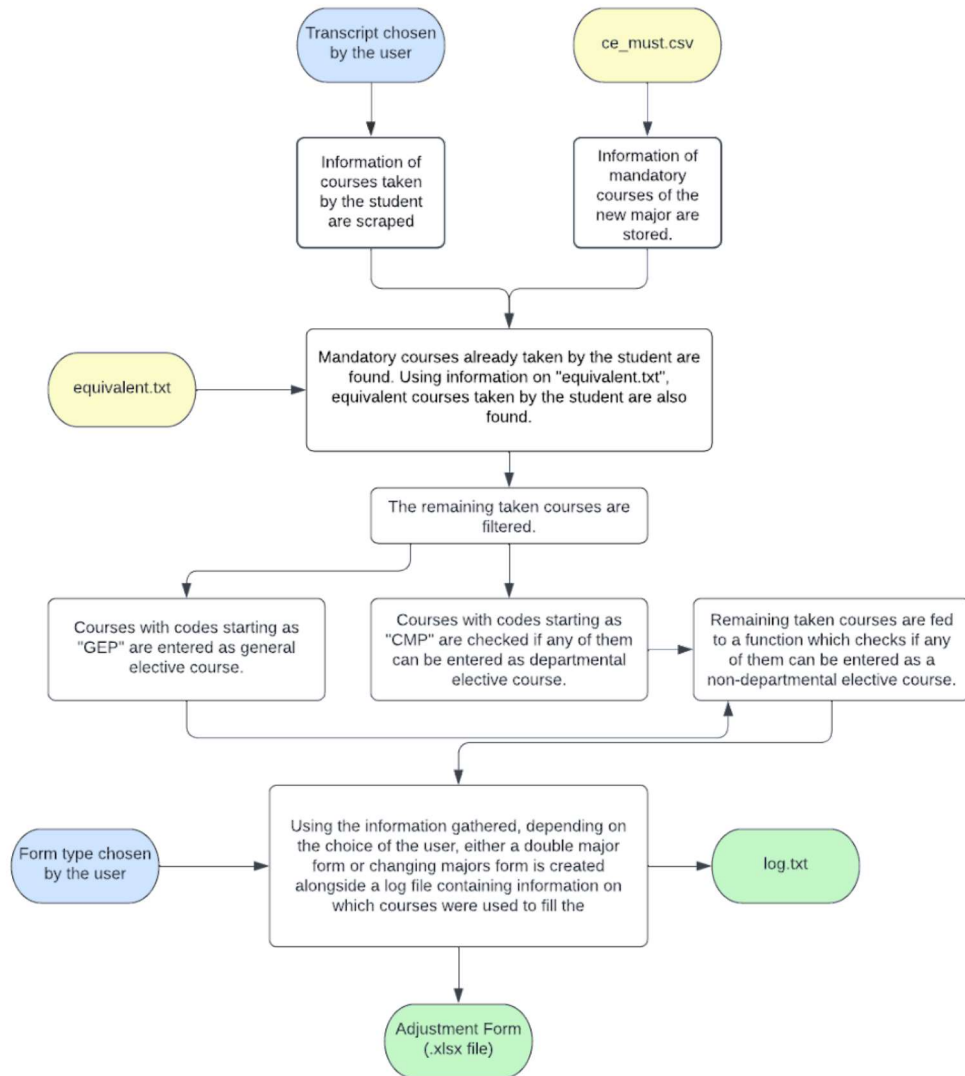


Figure 15: Flowchart of the software

3.1.4. Physical architecture

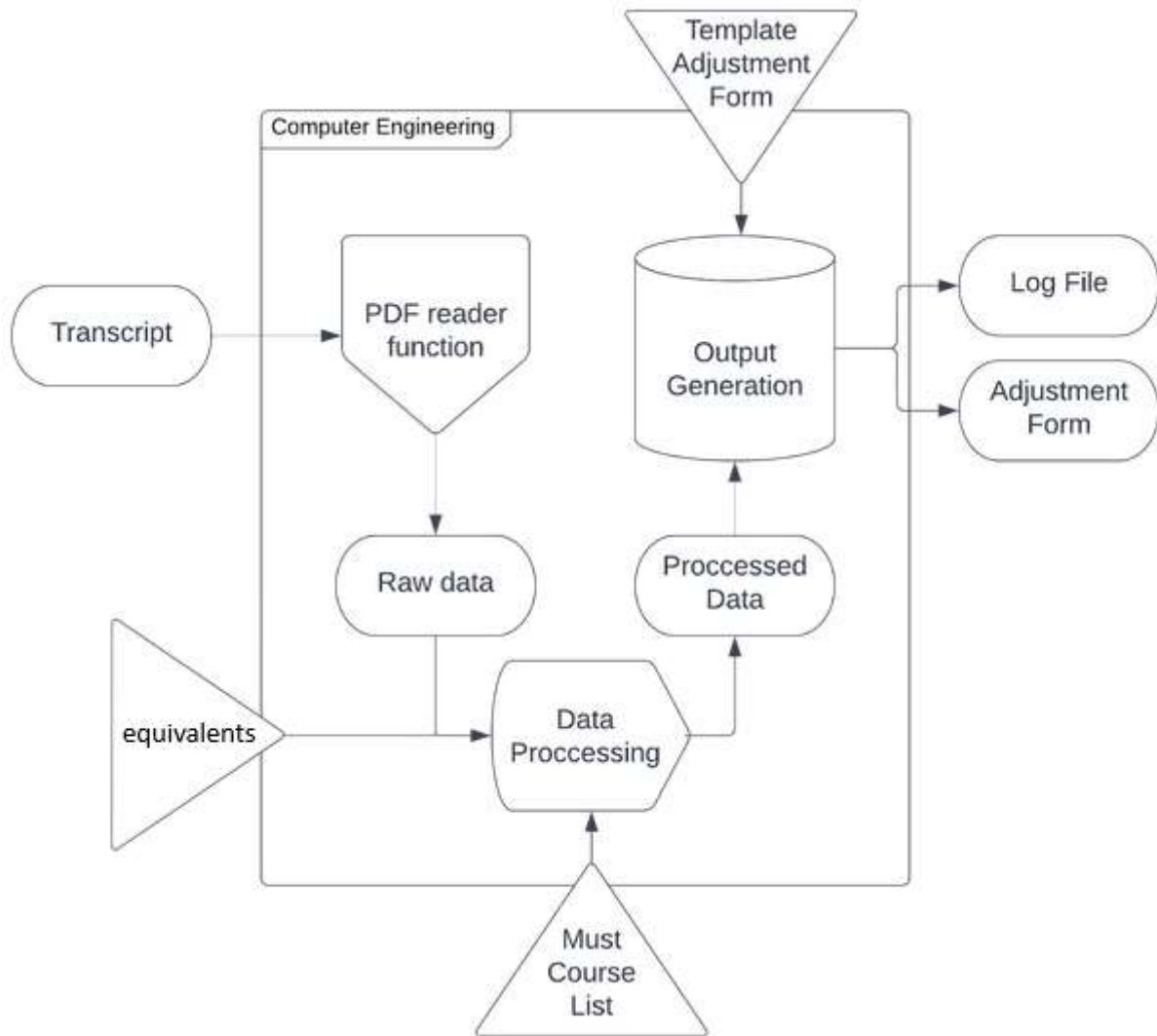


Figure 16: Low-Level Physical architecture

3.1.5. Materialization

The prototype developed in first semester proved to be useful and the whole project is built on top of it. Previous documents can be referred for information on the initial prototype. The transcripts are read with tabula module and the initial tests were run purely on must courses. Only after the base was built with must courses, the development progressed into further details. Figure 17 shows a test result of an adjustment form with must courses and a bug of the time that was named “Unnamed”. Figure 18 shows after the “Unnamed” bug was resolved. Refer to Figure 19 for a Major Change form with only must courses filled. With must courses done and “Unnamed” resolved, the development was in the next step of implementing DEP NONDEP GEP and equivalent courses. Equivalent courses were seen to be the most complex part of the process and was left to last. DEP NONDEP and GEP courses were one by one implemented without any major

issues. The equivalent courses required an external database that can be changed in the future. Thus “equivalents.txt” was created as can be seen in Figure20. Single course to single course was easily dealt with. However, “two courses equaling one” instances were particularly puzzling. Many dictionaries and lists were implemented to make the functionality work. Figure 21 shows the final version of the adjustment file with all courses implemented.

Of the Course Taken/to be Taken at the Major Program					Equivalent Course in the Double Major Program				
Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / Semester	Grade	Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / Sem	Grade
MAT1051	Diferensiyel ve Integral Hesap I		2019-2020 Fall	D+	MAT1051	Diferensiyel ve Integral Hesap I		1	D+
PHY1002	Fizik II		Unnamed: 0	B+	PHY1002	Fizik II		2	B+
MAT1052	Diferensiyel ve Integral Hesap II		Unnamed: 0	C+	MAT1052	Diferensiyel ve Integral Hesap II		2	C+
ENG1004	İletişim Becerileri ve Akademik Raporlama II		Unnamed: 0	S	ENG1004	İletişim Becerileri ve Akademik Raporlama II		2	S
MAT1041	Doğrusal Cebir		2019-2020 Sum	B+	MAT1041	Doğrusal Cebir		3	B+
ENG1003	İletişim Becerileri ve Akademik Raporlama I		2019-2020 Sum	B+	ENG1003	İletişim Becerileri ve Akademik Raporlama I		1	B+
MAT2062	Diferensiyel Denklemler		2020-2021 Fall	C+	MAT2062	Diferensiyel Denklemler		4	C+
TLL1003	Türk Dili ve Edebiyatı I		2020-2021 Fall	B-	TLL1003	Türk Dili ve Edebiyatı I		5	B-
PHY1001	Fizik I		2020-2021 Fall	S	PHY1001	Fizik I		1	S
TLL1004	Türk Dili ve Edebiyatı II		2020-2021 Sprin	C+	TLL1004	Türk Dili ve Edebiyatı II		6	C+
MAT3026	Olasılık ve İstatistik		2020-2021 Sprin	B+	MAT3026	Olasılık ve İstatistik		6	B+
HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		2020-2021 Sprin	B-	HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		6	B-
ENR3001	Mühendisliğin Teknik Olmayan Yönleri		2021-2022 Fall	A	ENR3001	Mühendisliğin Teknik Olmayan Yönleri		6	A
HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		2021-2022 Sum	B-	HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		5	B-

Figure 17: Adjustment form test

Of the Course Taken/to be Taken at the Major Program					Equivalent Course in the Double Major Program				
Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / Sem	Grade	Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / S	Grade
ENR3001	Mühendisliğin Teknik Olmayan Yönleri		2021-2022 Fall	A	ENR3001	Mühendisliğin Teknik Olmayan Yönleri		6	A
ENG1003	İletişim Becerileri ve Akademik Raporlama I		2019-2020 Sum	B+	ENG1003	İletişim Becerileri ve Akademik Raporlama I		1	B+
TLL1004	Türk Dili ve Edebiyatı II		2020-2021 Sprin	C+	TLL1004	Türk Dili ve Edebiyatı II		6	C+
TLL1003	Türk Dili ve Edebiyatı I		2020-2021 Fall	B-	TLL1003	Türk Dili ve Edebiyatı I		5	B-
ENG1004	İletişim Becerileri ve Akademik Raporlama II		2019-2020 Sprin	S	ENG1004	İletişim Becerileri ve Akademik Raporlama II		2	S
HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		2020-2021 Sprin	B-	HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		6	B-
MAT3026	Olasılık ve İstatistik		2020-2021 Sprin	B+	MAT3026	Olasılık ve İstatistik		6	B+
MAT2062	Diferensiyel Denklemler		2020-2021 Fall	C+	MAT2062	Diferensiyel Denklemler		4	C+
MAT1051	Diferensiyel ve Integral Hesap I		2019-2020 Fall	D+	MAT1051	Diferensiyel ve Integral Hesap I		1	D+
HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		2021-2022 Sum	B-	HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		5	B-
PHY1001	Fizik I		2020-2021 Fall	S	PHY1001	Fizik I		1	S
MAT1052	Diferensiyel ve Integral Hesap II		2019-2020 Sprin	C+	MAT1052	Diferensiyel ve Integral Hesap II		2	C+
PHY1002	Fizik II		2019-2020 Sprin	B+	PHY1002	Fizik II		2	B+
MAT1041	Doğrusal Cebir		2019-2020 Sum	B+	MAT1041	Doğrusal Cebir		3	B+

Figure 18: “Unnamed” fixed

Yarıy	Kabul edildiği Programda muafiyet verilen BAU Dersinin Kodu ve Adı				Teorik	Pratik	Yerel Kredi	AKTS	Türü (Must, DEP, NONDEP, GEP)	Başarı Notu	Yarıy	Saydırılan Dersin Kodu ve Adı TÜRKÇE ve İNGİLİZCE				Teorik	Pratik	Yerel Kredi	AKTS	Başarı Notu
1	ENG1003	İletişim Becerileri ve Akademik Raporlama I					3	4		B+	ENG1003	İletişim Becerileri ve Akademik Raporlama I					3	4	B+	
1	MAT1051	Diferensiyel ve İntegral Hesap I					4	7		D+	MAT1051	Diferensiyel ve İntegral Hesap I					4	7	D+	
1	PHY1001	Fizik I					4	7		S	PHY1001	Fizik I					4	7	S	
1																				
1																				
1																				
1																				
2	ENG1004	İletişim Becerileri ve Akademik Raporlama II					3	4		S	ENG1004	İletişim Becerileri ve Akademik Raporlama II					3	4	S	
2	MAT1052	Diferensiyel ve İntegral Hesap II					4	7		C+	MAT1052	Diferensiyel ve İntegral Hesap II					4	7	C+	
2	PHY1002	Fizik II					4	7		B+	PHY1002	Fizik II					4	7	B+	
2																				
2																				
2																				
2																				
3	MAT1041	Doğrusal Cebir					3	6		B+	MAT1041	Doğrusal Cebir					3	6	B+	
3																				
3																				
3																				
3																				
3																				
3																				
3																				
4	MAT2062	Diferensiyel Denklemler					3	6		C+	MAT2062	Diferensiyel Denklemler					3	6	C+	
4																				
4																				
4																				
4																				
4																				
4																				
5	HST1001	Atatürk İlkeleri ve İnkılap Tarihi I					2	2		B-	HST1001	Atatürk İlkeleri ve İnkılap Tarihi I					2	2	B-	
5	TLL1003	Türk Dili ve Edebiyatı I					2	2		B-	TLL1003	Türk Dili ve Edebiyatı I					2	2	B-	
5																				
5																				
5																				
5																				
5																				
6	ENR3001	Mühendisliğin Teknik Olmayan Yönleri					2	4		A	ENR3001	Mühendisliğin Teknik Olmayan Yönleri					2	4	A	
6	HST1002	Atatürk İlkeleri ve İnkılap Tarihi II					2	2		B-	HST1002	Atatürk İlkeleri ve İnkılap Tarihi II					2	2	B-	
6	MAT3026	Olasılık ve İstatistik					3	6		B+	MAT3026	Olasılık ve İstatistik					3	6	B+	
6	TLL1004	Türk Dili ve Edebiyatı II					2	2		C+	TLL1004	Türk Dili ve Edebiyatı II					2	2	C+	

Figure 19: Major change with only must courses

1	MAT1006=MAT2033
2	AIN1002=CMP1002
3	EEE2204=CMP1004
4	MAT3012=MAT2045
5	CMP1401=CMP1001
6	SEN2211+SEN2212=CMP2003

Figure 20: equivalents.txt

Of the Course Taken/to be Taken at the Major Program					Equivalent Course in the Double Major Program				
Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / Semester	Grade	Code	Name	Type (Must, Elec., GE Elec., Non Elec.)	Season / Sem	Grade
TLL1004	Türk Dili ve Edebiyatı II		2020-2021 Sprin	C+	TLL1004	Türk Dili ve Edebiyatı II		6	C+
ENG1003	İletişim Becerileri ve Akademik Raporlama I		2019-2020 Sum	B+	ENG1003	İletişim Becerileri ve Akademik Raporlama I		1	B+
MAT1052	Diferensiyel ve İntegral Hesap II		2019-2020 Sprin	C+	MAT1052	Diferensiyel ve İntegral Hesap II		2	C+
MAT1041	Doğrusal Cebir		2019-2020 Sum	B+	MAT1041	Doğrusal Cebir		3	B+
ENR3001	Mühendisliğin Teknik Olmayan Yönleri		2021-2022 Fall	A	ENR3001	Mühendisliğin Teknik Olmayan Yönleri		6	A
HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		2021-2022 Sum	B-	HST1001	Atatürk İlkeleri ve İnkılap Tarihi I		5	B-
EEE2204	Introduction to Digital Design		2020-2021 Sprin	C	CMP1004	Dijital Mantığa Giriş		2	C
MAT3026	Olasılık ve İstatistik		2020-2021 Sprin	B+	MAT3026	Olasılık ve İstatistik		6	B+
MAT1006	Engineering Mathematics I		2019-2020 Sprin	C	MAT2033	Ayrık Matematik		1	C
PHY1002	Fizik II		2019-2020 Sprin	B+	PHY1002	Fizik II		2	B+
PHY1001	Fizik I		2020-2021 Fall	S	PHY1001	Fizik I		1	S
ENG1004	İletişim Becerileri ve Akademik Raporlama II		2019-2020 Sprin	S	ENG1004	İletişim Becerileri ve Akademik Raporlama II		2	S
MAT2062	Diferensiyel Denklemler		2020-2021 Fall	C+	MAT2062	Diferensiyel Denklemler		4	C+
CMP1401	Introduction to Programming (C)		2020-2021 Fall	B+	CMP1001	Programlamaya Giriş (C++)		1	B+
TLL1003	Türk Dili ve Edebiyatı I		2020-2021 Fall	B-	TLL1003	Türk Dili ve Edebiyatı I		5	B-
HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		2020-2021 Sprin	B-	HST1002	Atatürk İlkeleri ve İnkılap Tarihi II		6	B-
MAT1051	Diferensiyel ve İntegral Hesap I		2019-2020 Fall	D+	MAT1051	Diferensiyel ve İntegral Hesap I		1	D+
EEE3501	Signals and Systems		2020-2021 Sum	B+	Non-Dep	Non-Departmental Elective		6	B+
EEE1002	Introduction to Electrical and Electronics Engineering		2019-2020 Sprin	B	Non-Dep	Non-Departmental Elective		8	B
GEP0608	European Integration and Turkish-European Relations		2020-2021 Sprin	A-	GEP	General Elective		3	A-
GEP1006	History of Civilization II		2021-2022 Fall	B+	GEP	General Elective		4	B+
GEP0211	City and Landscape		2021-2022 Sum	B+	GEP	General Elective		7	B+
GEP0705-GEP	Literature and Society		2021-2022 Fall	B-	GEP	General Elective		7	B-
GEP0702	Critical Thinking and Literary Criticism		2021-2022 Fall	C+	GEP	General Elective		8	C+

Figure 21: Adjustment form with NONDEP DEP GEP and equivalent courses

3.1.6. Evaluation

Initially, the code is tested with different transcript files to ensure it can process different courses and some exceptions that other students might have. Whilst developing the executable, different methods were used and tested on different OS's over multiple computers. In initial tests -before creating the executable- the code was transported with "requirements.txt" to install the modules required, however this method was not user friendly enough and had unreliable results during installment - one main issue being the packages were not being installed on the correct directory. Only after "pyinstaller" was used to create the .exe for Windows the code had a truly portable single file which performed remarkably fast while also keeping simplicity. On the other hand, to run the code on macOS / UNIX systems there is no single executable file and a small installation process which is dependent on the "requirements.txt" file is necessary. In the final stages of development, multiple Virtual Machines from Azure were used to test the program to isolate any problems that might arise from individual's operating systems. The program was further tested with unusual transcripts provided by our professor and modified transcripts to test in order to search for unseen bugs or overlooked details.