

College Database

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Section I: Project Description

Colleges have been seeing a rise in enrollment since the turn of the millennium. A study from The National Center for Education Statistics shows that the overall enrollment rate of 18-to-24 year olds in the United States has increased from 35% in 2000 to 41% in 2018, and projects this trend to continue rising in the years to come. This means that Post Secondary institutions have to be accountable and maintain an exponentially increasing amount of data generated from their students, staff, and overall operations. This becomes an even bigger task if the institution only stores their records physically as paper files, as they have high storage costs and are easily prone to damage. Furthermore, Colleges that use computerized database management systems can also suffer from a lack of efficiency (which increases their storage costs) when poorly designed and are even prone to hacks that could cost them millions to resolve.

This database management system is designed to solve this problem, and allows a typical College to store valuable data pertaining to all of its operations. It has been efficiently designed to scale with the expected rise in enrollment, whilst minimizing the storage costs and ensuring an industry-standard integrity that will deter potential hacks. Furthermore, an Institution using this database management system will be able to store GeoLocation data that can be used to help new students easily find their way around campus.

Section II: Use Cases

Use Case #1 Title:	Enrolling in a Course without meeting Prerequisites
Actors:	Jason (Student), Data Structures(Course)
Description:	Jason is a newly admitted freshman majoring in Computer Science. Since he has had programming experience before, he decided to challenge himself by taking the Data Structures course in his first semester. However, he was soon to find out that he was unable to do so since the course enforces a prerequisite of the Intro to Programming to be completed before attempting the course. And since he was attempting to concurrently enroll in both courses, the system prevented him from doing so.

Use Case Title:	Locate a Classroom
Actors:	Niko (Student)
Description:	<p>Niko is a newly admitted transfer student majoring in Biology. He was not able to enroll in the classes he'd liked, so he settled with enrolling in classes that were crammed into a compact schedule with gaps as small 15 minutes between classes. He was worried that he would be late to some essential lectures during the first week, but fortunately, noticed that the school website has a feature that pinpoints a given campus location on a real-time map. Niko was then able to use this feature to locate all of his classes on time, and even used it to explore the campus during his free time.</p> <p>(Also talk about sections)</p>

Use Case Title:	Receive Grant
Actors:	Anna (Student) , Financial Aid (Grant), Scholarship(Grant)
Description:	Anna has decided to enroll in 15 units for the current semester. After registering for her courses, she incurred a hefty charge due to her new full-time status as well as additional fees related to her courses. However, she is a recipient of federal financial aid, and was also recently awarded a scholarship grant from the fellowship she is part of. She was later happy to find out that she received more money than she was charged, and received a refund amount that she used to buy herself a new laptop for her studies.

Use Case Title:	Earn a Degree
Actors:	Thomas (Student)
Description:	Thomas is a 5th year student majoring in Civil Engineering. He has completed all of his GE requirements, as well as his University requirements, and is currently enrolled in the last few classes required by his Bachelor's degree. Excited to be almost done with school, he applies for graduation in the Spring semester of that year, and was shortly approved since he was indeed only left with an amount of units that are considered acceptable, and as he was also in a good academic standing. A few months later, Thomas celebrated his tremendous achievement with his fellow classmates and family, and began preparing for his new job in the construction industry.

Use Case #3 Title:	Evaluate a Course
Actors:	Betty (Student), Prof. Potter (Instructor), Biology 100 (Course)
Description:	Betty has really enjoyed her semester and has learned a lot from her Biology 100 course. As she was preparing for her finals, she received a notice that the course evaluations were due within the next 10 days. Betty decided to go ahead and submit an evaluation for her Biology class and used that opportunity to praise her instructor's excellent teaching ability and the overall structure of the course.

Section III: Database Requirements (Business Rules)

1. Students

- a. A student shall have one unique student id
- b. A student shall have one first name
- c. A student shall have one last name
- d. A student shall have one email address
- e. A student shall have one phone number
- f. A student shall have zero or many addresses
- g. A student shall have many payment types
- h. A student shall have one academic level
- i. A student shall have one academic standing
- j. A student shall receive zero or many grants
- k. A student shall achieve zero or many academic honors
- l. A student shall have only one transcript
- m. A student shall enroll in one or many courses before the enrollment deadline
- n. A student shall major in one or many majors
- o. A student shall be charged zero or many fees

2. Staff

- a. A staff member shall have one unique staff id
- b. A staff member shall have one first name
- c. A staff member shall have one last name
- d. A staff member shall have one email address
- e. A staff member shall have one phone number
- f. A staff member may or may not be a finance member
- g. A staff member may or may not be a faculty member
- h. A staff member may or may not be an administration member
- i. A staff member shall have zero or many addresses
- j. A staff member shall have many payment types

3. Faculty

- a. A faculty member is a staff member
- b. A faculty member shall have one unique staff id
- c. A faculty member shall have one office phone number
- d. The faculty shall manage many courses offered to students
- e. A faculty member shall instruct zero or many course sections
- f. A faculty member shall chair at most one department

- g. A faculty member shall work in only one department
- h. A faculty member shall have an office in at most one room

4. Administration

- a. An administrative staff member is a staff member
- b. An administrative staff member shall have one unique staff id
- c. An administrative staff member shall have one office phone number
- d. An administrative staff member shall have one role
- e. An administrative staff member shall manage zero or many college coursework requirements
- f. An administrative staff member shall manage zero or many general education coursework requirements

5. Finance

- a. A finance staff member is a staff member
- b. A finance staff member shall have one unique staff id
- c. A finance staff member shall have one office phone number
- d. A finance staff member shall have one role
- e. A finance staff member shall manage at least one fee
- f. A finance staff member shall manage at least one grant

6. Payment Types

- a. A payment type shall have one unique staff id
- b. A payment type shall have one description
- c. A payment type shall have one address
- d. A payment type may or may not be a bank account
- e. A payment type may or may not be a credit card
- f. A payment type shall belong to many students
- g. A payment type shall belong to many staff

7. Bank Account

- a. A bank account is a payment type
- b. A bank account shall have one unique account number
- c. A bank account shall have one bank name
- d. A bank account shall have one routing number

8. Credit Card

- a. A credit card is a payment type
- b. A credit card shall have one unique card number
- c. A credit card shall have one bank name
- d. A credit card shall have one security code (ccv)
- e. A credit card shall have one expiry month
- f. A credit card shall have one expiry year

9. Address

- a. An address shall have one unique address id
- b. An address shall have one street name
- c. An address shall have one street number
- d. An address shall have one apartment number
- e. An address shall have one city
- f. An address shall have one state
- g. An address shall have one zip code
- h. An address shall belong to zero or many students
- i. An address shall belong to zero or many staff

10. Department

- a. A department shall have one unique department id
- b. A department shall have one department name
- c. A department shall have one department phone number
- d. A department shall be chaired by only one faculty member
- e. A department shall have zero or many faculty members
- f. A department shall offer zero or many courses
- g. A department shall offer zero or many majors
- h. A department may or may not have an office
- i. A department shall manage zero or many core requirements

11. Majors

- a. A major shall have one unique major id
- b. A major shall have one major name
- c. A major shall have one major type
- d. A major shall provide zero or many degrees
- e. A major shall be provided by at most one department
- f. A major shall have zero or many students

12. Degree

- a. A degree shall have one unique degree id
- b. A degree shall have only and only one degree level
- c. A degree shall have only and only one major
- d. A degree shall have at least one GE requirement
- e. A degree shall have at least one college requirement
- f. A degree shall have at least one core requirement

13. Degree Levels

- a. A degree level shall have one unique degree level id
- b. A degree level shall have one level
- c. A degree level shall be offered by zero or many degrees

14. Courses

- a. A course shall have one unique course id
- b. A course shall have one course title
- c. A course shall have one number of units
- d. A course shall have zero or many courses as prerequisites
- e. A course shall have zero or many sections
- f. A course shall be offered by one department
- g. A course shall have zero or many enrolled students before the enrollment deadline
- h. A course shall satisfy zero or many GE requirements
- i. A course shall satisfy zero or many college requirements
- j. A course shall satisfy zero or many course requirements
- k. A course shall have zero or many student evaluations
- l. A course shall be available in zero or many semesters
- m. A course shall have zero or many course fees

15. Sections

- a. A section shall belong to only and only one course
- b. A section shall have one unique section id
- c. A section shall have one section title
- d. A section shall have one section type
- e. A section shall may or may not be located in one classroom
- f. A section shall be in session for zero or many timeslots
- g. A section shall be in session for zero or many working days

16. Transcripts

- a. A transcript shall have one unique transcript id
- b. A transcript shall be belong to only one student
- c. A transcript shall have one GPA
- d. A transcript shall have one number of units taken
- e. A transcript shall have one path to the transcript file

17. Academic Levels

- a. An academic level shall have one academic level id
- b. An academic level shall have one academic level name
- c. An academic level shall belong to zero or many students

18. Academic Standing

- a. An academic standing shall have one academic standing id
- b. An academic standing shall have one academic standing name
- c. An academic standing shall have one minimum GPA requirement
- d. An academic standing shall belong to zero or many students

19. Honors (Strong)

- a. An academic honor shall have one unique honor id
- b. An academic honor shall have one title
- c. An academic honor shall have one description
- d. An academic honor shall be awarded to zero or many students

20. Grants

- a. A grant shall have one unique grant id
- b. A grant shall have one grant name
- c. A grant shall have one grant amount
- d. A grant shall have one grant provider
- e. A grant shall be received by zero or many students
- f. A grant shall be managed by zero or many finance staff members

21. Fees

- a. A fee shall have one unique fee id
- b. A fee shall have one fee name
- c. A fee shall have one fee amount
- d. A fee shall have one fee description
- e. A fee shall be charged by zero or many courses
- f. A fee shall be managed by zero or many finance staff members
- g. A fee shall be charged to zero or many students

22. Semesters

- a. A semester shall have one unique semester id
- b. A semester shall have one semester name
- c. A semester shall have one semester year
- d. A semester shall have zero or many courses available

23. Evaluations

- a. An evaluation shall have one unique evaluation id
- b. An evaluation shall evaluate one course
- c. An evaluation shall evaluate one faculty member
- d. An evaluation shall have one path to the file of evaluation contents

24. Timeslots

- a. A timeslot shall have one unique slot id
- b. A timeslot shall have one start time
- c. A timeslot shall have one end time
- d. A timeslot shall be on zero or many working days
- e. A timeslot shall belong to zero or many course sections

25. Working days

- a. A working day shall have one day id
- b. A working day shall have one day
- c. A working day shall have zero or many timeslots
- d. A working day shall belong to zero or many course sections

26. Buildings

- a. A building shall have one unique building id
- b. A building shall have one building name
- c. A building shall have one location
- d. A building shall contain zero or many rooms

27. Rooms

- a. A room shall have one unique room id
- b. A room shall have one room name
- c. A room shall have one room number
- d. A room shall have one capacity
- e. A room shall be located in only and only one building
- f. A room shall be a classroom to zero or many sections
- g. A room shall be an office to zero or many faculty staff members

28. Locations

- a. A location shall have one unique location id
- b. A location shall have one latitude
- c. A location shall have one longitude
- d. A location shall locate at most one building

29. GE Requirements

- a. A GE requirement shall have one unique requirement id
- b. A GE requirement shall have one area of study
- c. A GE requirement shall have one division level
- d. A GE requirement shall have one units requirement
- e. A GE requirement shall be satisfied by zero or many courses
- f. A GE requirement shall be required by zero or many degrees
- g. A GE requirement shall be managed by zero or many administration staff members

30. College Requirements

- a. A college requirement shall have one unique requirement id
- b. A college requirement shall have one description
- c. A college requirement shall have one units requirement
- d. A college requirement shall be satisfied by zero or many courses
- e. A college requirement shall be satisfied by zero or many degrees

- f. A college requirement shall be managed by zero or many administration staff members

31. Core Requirements

- a. A core requirement shall have one unique requirement id
- b. A core requirement shall have one area of study
- c. A core requirement shall have one division level
- d. A core requirement shall have one units requirement
- e. A core requirement shall be satisfied by zero or many courses
- f. A core requirement shall be satisfied by zero or many degrees
- g. A core requirement shall be managed by zero or many departments

Section IV: Detailed List of Main Entities, Attributes and Keys

1. Students (Strong)

- student_id: key, numeric
- first_name: alphanumeric
- last_name: alphanumeric
- email: alphanumeric
- phone: numeric

2. Staff (Strong)

- staff_id: key, numeric
- first_name: alphanumeric
- last_name: alphanumeric
- email: alphanumeric
- phone: numeric

3. Faculty (Weak)

- staff_id: key, numeric
- role: alphanumeric
- office_phone: numeric

4. Administration (Weak)

- staff_id: key, numeric
- role: alphanumeric
- office_phone: numeric

5. Finance (Weak)

- staff_id: key, numeric
- role: alphanumeric
- office_phone: numeric

6. ProcessFunds (Weak)

- fee: weak key, numeric
- grant: weak key, numeric
- processedBy: weak key, numeric

7. PaymentTypes (Strong)

- type_id: key, numeric
- address: weak key, numeric
- description: alphanumeric

8. StudentPaymentInfo (Weak)

- paymentInfo_id: key, numeric
- student: weak key, numeric
- paymentType: weak key, numeric

9. StaffPaymentInfo (Weak)

- paymentInfo_id: key, numeric
- staff: weak key, numeric
- paymentType: weak key, numeric

10. BankAccount (Weak)

- account_num: key, numeric
- bank: alphanumeric
- routing: numeric

11. Credit Card (Weak)

- card_num: key, numeric
- bank: alphanumeric
- ccv: numeric
- exp_date: composite, date

12. Address (Strong)

- address_id: key, numeric
- street_addr: composite, alphanumeric
- city: alphanumeric
- state: alphanumeric
- zipcode: numeric

13. StudentAddress (Weak)

- student_address_id: key, numeric
- student: weak key, numeric
- address: weak key, numeric

14. StaffAddress (Weak)

- staff_address_id: key, numeric
- staff: weak key, numeric
- address: weak key, numeric

15. Departments (Strong)

- dep_id: key, numeric
- name: alphanumeric
- phone: numeric

16. Departments (Strong)

- dep_id: key, numeric
- name: alphanumeric
- phone: numeric

17. MajorsRequirements (Weak)

- requirement_id: key, numeric
- requirement: weak key, numeric
- major: weak key, numeric
- department: weak key, numeric

18. Majors (Strong)

- major_id: key, numeric
- name: alphanumeric
- type: alphanumeric

19. MajorsByStudent (Weak)

- major: weak key, numeric
- student: weak key, numeric

20. Degree (Weak)

- degree_id: key, numeric
- major: weak key, numeric
- level: weak key, numeric

21. Degree Levels (Strong)

- degree_level_id: key, numeric
- level: alphanumeric

22. Courses (Strong)

- course_id: key, numeric
- title: alphanumeric
- units: numeric
- department: weak key, numeric

23. CourseAttributes (Weak)

- course: weak key, numeric
- GE: weak key, numeric
- core_req: weak key, numeric
- college_req: weak key, numeric

24. DegreeRequirements (Weak)

- degree: weak key, numeric

- GE: weak key, numeric
- core_req: weak key, numeric
- college_req: weak key, numeric

25. Enrollment (Weak)

- enrollment_id: key, numeric
- student: weak key, numeric
- course: weak key, numeric
- deadline: composite, timestamp

26. Sections (Weak)

- section_id: key, numeric
- title: alphanumeric
- type: numeric
- course: weak key, numeric
- instructor: weak key, numeric

27. ClassSchedule (Weak)

- schedule_id: key, numeric
- timeslot: weak key, numeric
- section: weak key, numeric
- day: weak key, numeric

28. Transcripts (Strong)

- transcript_id: key, numeric
- units_taken: derived, numeric
- GPA: derived, numeric
- student: weak key, numeric
- filepath: alphanumeric

29. Academic Levels (Strong)

- academic_level_id: key, numeric
- name: alphanumeric

30. Academic Standings (Strong)

- academic_standing_id: key, numeric
- standing: alphanumeric
- min_GPA: numeric

31. Honors (Strong)

- honor_id: key, numeric
- title: alphanumeric
- description: numeric

32. HonorsStudents (Weak)

- student: weak key, numeric
- honor: alphanumeric
- award_date: composite, date

33. Grants (Strong)

- grant_id: key, numeric
- name: alphanumeric
- amount: numeric
- provider: alphanumeric

34. GrantRecepients (Weak)

- receipient_id: key, numeric
- student: weak key, numeric
- grant: weak key, numeric
- award_date: composite, date

35. Fees (Strong)

- fee_id: key, numeric
- amount: numeric
- description: alphanumeric

36. CourseFees (Weak)

- course_fee_id: key, numeric
- course: weak key, numeric
- fee: weak key, numeric

37. StudentFees (Weak)

- student_fee_id: key, numeric
- student: weak key, numeric
- fee: weak key, numeric
- date: composite, timestamp

38. Semesters (Strong)

- semester_id: key, numeric
- semester: alphanumeric
- year: numeric

39. CoursesBySemester (Strong)

- evaluation_id: key, numeric
- course: weak key, numeric
- semester: weak key, numeric

40. Evaluations (Strong)

- evaluation_id: key, numeric
- course: weak key, numeric
- instructor: weak key, numeric
- filepath: alphanumeric

41. Timeslots (Strong)

- slot_id: key, numeric
- start: timestamp
- end: timestamp

42. WorkingDays (Strong)

- day_id: key, numeric
- day: alphanumeric

43. Buildings (Strong)

- building_id: key, numeric
- name: alphanumeric
- location_id: weak key, numeric

44. Rooms (Weak)

- room_id: key, numeric
- name: alphanumeric
- capacity: numeric
- room_no: numeric
- building_id: weak_key, numeric

45. Locations (Strong)

- location_id: key, numeric
- latitude: numeric
- longitude: numeric

46. GERequirements (Strong)

- requirement_id: key, numeric
- area: alphanumeric
- division: alphanumeric
- units_required: numeric

47. CollegeRequirements (Strong)

- requirement_id: key, numeric
- description: alphanumeric
- units_required: numeric

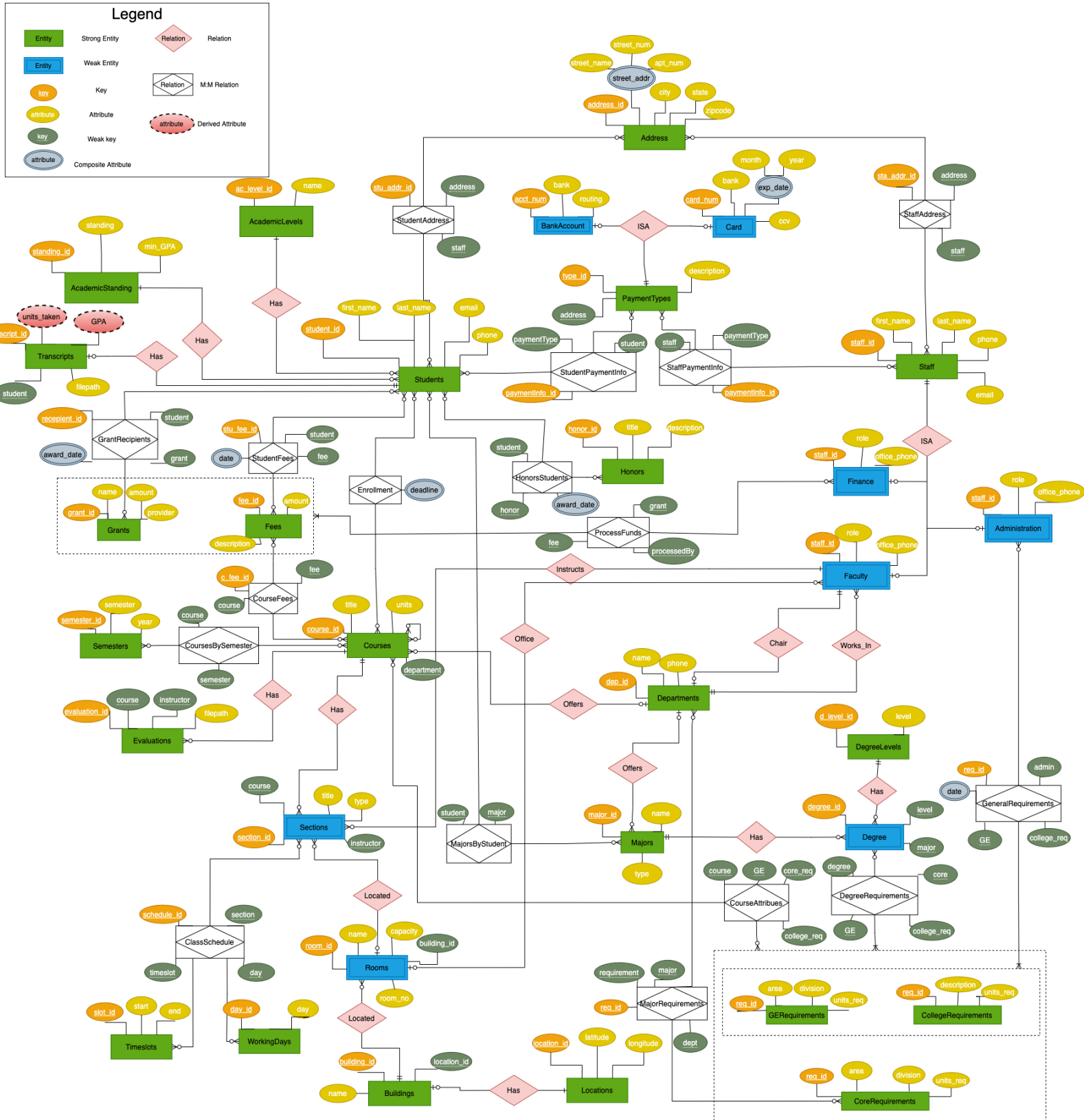
48. CoreRequirements (Strong)

- requirement_id: key, numeric
- area: alphanumeric
- division: alphanumeric
- units_required: numeric

49. GeneralRequirements (Strong)

- requirement_id: key, numeric
- GE: weak key, numeric
- college_req: weak key, numeric
- admin: weak key, numeric
- date: composite, date

Section V: Entity Relationship Diagram



Section VI: Testing Table

Rule	Entity A	Relation	Entity B	Cardinality	Pass /Fail	Error Description
1	Students	Has	AcademicLevels	M:1	Pass	None
2	Students	Has	AcademicStanding	M:1	Pass	None
3	Students	Has	Address	M:M	Pass	None
4	Students	Recieves	Grants	M:M	Pass	None
5	Students	Has	PaymentTypes	M:M	Pass	None
6	Students	Award	Honors	M:M	Pass	None
7	Students	Major	Majors	M:M	Pass	None
8	Students	Enroll	Courses	M:M	Pass	None
9	Students	Has	Fees	M:M	Pass	None
10	Students	Has	Transcripts	M:1	Fail	While multiple students could have the same GPA and units, they cannot have the same info that would be in a transcript
11	Staff	ISA	Administration	1:1	Pass	None
12	Staff	ISA	Faculty	1:1	Pass	None
13	Staff	ISA	Finance	1:1	Pass	None
14	Staff	Has	Address	M:M	Pass	None
15	Staff	Has	PaymentTypes	M:M	Pass	None
16	Staff	Office	Rooms	M:1	Fail	Total Participation rule broken
16	BankAccount	ISA	PaymentTypes	1:1	Pass	None
17	Card	ISA	PaymentTypes	1:1	Pass	None
18	Faculty	Instruct	Course	1:M	Fail	Total Participation rule broken
19	Faculty	Chair	Departments	1:1	Fail	Constraint was reversed. A Faculty member might not chair a Department
20	Faculty	Works_In	Departments	M:1	Pass	None

21	Finance	Manages	Fees	M:M	Fail	Total Participation rule broken
22	Finance	Manages	Grants	M:M	Fail	Total Participation rule broken
23	Administration	Manages	GERequirements	M:M	Fail	Total Participation rule broken
24	Administration	Manages	CollegeRequirement	M:M	Fail	Total Participation rule broken
25	Departments	Manages	CoreRequirements	M:M	Pass	None
26	Departments	Offers	Majors	1:M	Pass	None
27	Departments	Office	Rooms	1:1	Fail	Total Participation rule broken
28	Departments	Offers	Courses	1:M	Pass	None
29	Courses	Has	Fees	M:M	Pass	None
30	Courses	Has	Sections	1:M	Pass	None
31	Courses	Has	Evaluations	1:M	Pass	None
32	Courses	Satisfies	GERequirements	M:M	Pass	None
33	Courses	Satisfies	CollegeRequirements	M:M	Pass	None
34	Courses	Satisfies	CoreRequirements	M:M	Pass	None
35	Sections	Located	Rooms	M:1	Fail	Constraint fails. A section might exist without a room, ex - online learning
36	Sections	Scheduled	Timeslots	M:M	Pass	None
37	Sections	Scheduled	WorkingDays	M:M	Pass	None
38	Rooms	Located	Buildings	M:1	Pass	None
39	Buildings	Located	Locations	1:1	Pass	None
40	Timeslots	Scheduled	WorkingDays	M:M	Pass	None
41	Majors	Has	Degree	M:M	Pass	None
42	Degree	Has	DegreeLevels	M:M	Pass	None
43	Degree	Has	GERequirements	M:M	Pass	None
44	Degree	Has	CollegeRequirements	M:M	Pass	None
45	Degree	Has	CoreRequirements	M:M	Pass	None

