

Electronic Testing and Evaluation System: eTES

By

Wayne A. Sibley

Submitted to
the Faculty of the Information Engineering Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Engineering Technology

University of Cincinnati
College of Applied Science

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Wayne A. Sibley

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Date

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Abstract

The product eTES is an Electronic Testing and Evaluation System that provides innovative skill measurement services to organizations. Through a Web-based application, eTES delivers the technology that is needed by administrators to efficiently develop and deliver tests to their test-takers, from any place, at any time. eTES services are platform independent. Test-takers have the ability to take the tests online through a Web browser on any computer that has access to the Internet. This prominent part of the system gives test-takers the flexibility of taking a test outside the classroom. Furthermore, it gives administrators the flexibility to develop, deliver, and manage test anywhere, at anytime. In addition, eTES provides automatic grading and reporting of test-takers' responses. eTES automatic grading and reporting eliminates the complexities of instantly grading, calculating, and returning students' test scores and statistics.

1. Statement of Problem

To fully appreciate the need for electronic testing, it is important to understand what is happening to education. Changes are occurring in the work place that strongly influences postsecondary education. The changes involve the frequent shifts in technology as new innovations are being discovered. Because of the shifts in technologies, businesses are seeking employees with state-of-the-art skills. To attract such employees businesses are paying higher salaries to those who possess the skills needed. It is estimated that fifty percent of all job skills become outdated within three to five years (1). The pay differential between those with state-of-the-art skills and those with outdated skills has strongly influenced the need for adults to go back to school to sharpen their skills. Today's working adults above the age of twenty-four comprise forty-four percent of college students (2, pp.132-33). The population for higher education is increasing and becoming a target for e-learning (3).

E-learning enrollments are growing thirty-three percent a year and are expected to hit 2.2 million by 2004 (3). There is an area of opportunity for companies and institutes to make a profit from e-learning. For example, the University of Phoenix Online, a division of distance-learning company Apollo Group, made \$31.8 million in fiscal 2001 and \$23.6 million in the first six months of 2002 (3). Apollo Group President and CEO Todd Nelson called e-learning the "next great application of the Internet" (3).

E-learning comprises many components, and one that is vital to its existence is Computer Based Testing (CBT). Prometric, a subsidiary of Thomson Corporation, delivers CBT to more than 4,800 testing centers in about 140 countries (6). Prometric provides CBT services solution to sponsors and administrators of large-volume tests (6).

In the fiscal year ending December 2001, Prometric made an estimated \$300.0 million in sales (6). CBT systems has made Prometric the global leader in technology-enabled testing and assessment services (7).

While Prometric is the leader in the CBT industry, the company is closely followed by its top competitor, NCS Pearson (6). NCS Pearson, a subsidiary of Pearson Education, provides assessment and testing services to test publishers, state education agencies, the federal government, school districts, and commercial customers. In the fiscal year ending December 2002, NCS Pearson made an estimated \$820.0 million in sales. The proprietary CBT systems that Prometric and NCS Pearson market are based on three components: test development, test delivery, and data management (5).

It is clear that CBT is an important component that has driven e-learning to its success. Too often, today's and tomorrow's skills are measured with yesterday's technology (pencil and paper). As e-learners use technology tools, it is pertinent to have tools that measure the skills and knowledge of the learners using the same medium.

Both companies, Prometric and NCS Pearson, primarily target sponsors and administrators of large-scale assessment testing. The focus of this project is a Web-based assessment application that targets administrators of small-scale assessment testing. I have integrated and utilized the knowledge that I have in the following areas:

- Database Management: A SQL Server database has been developed to house data.
- Object Oriented Programming: This methodology was used through out the development of this system and has made the system's source code manageable, efficient, and reusable.

- The Internet: This project is a web-based application, where data is transported over the Internet
- Graphics in Communication: The interfaces are integrated with graphics and text.
- MultiMedia: This project delivers special types of test questions, such as text and images.
- Technical and Professional Writing: This project has been documented from the project proposal to the final report.
- Probability and Statistics: Used for analysis and reporting of test scores.

2. Description of Solution

2.1 The User Profile

The intended users of eTES consist of a System Administrator, Administrators, and Test-Takers.

2.1.1 System Administrator

The system administrator will manage the administrator organization accounts. The system administrator must possess basic computer data entry skills and be familiar in interacting with web forms.

2.1.2 Administrator

The administrators will be able to register students, departments, courses to departments, and other administrators to courses, provided that that they have been given rights to do so by the system administrator. Administrators can only register sections to their assigned course and enroll students into that section. This user will also have to ability to create tests and deliver those tests to their sections. The administrator must have basic computer data entry skills and must be familiar in interacting with web forms.

2.1.3 Test-Takers

The Test-takers will sign into the section and take the test that has been assigned to that section. Once a Test-taker completes a test, they can view their results immediately after or later in time, based upon the test sessions' configuration. This user must have basic computer knowledge and must be familiar in interacting with web forms.

3 Design Protocol

To help break the barrier to innovative skill measuring for small to medium scale organizations, I have developed an Electronic Testing and Evaluation System (eTES). eTES is an 3-tier, interactive, Web-based application, that provides electronic testing services to small and medium scale organizations.

3.1 System Design Methods

3.1.1 Context Diagram

eTES is a large complex system that is comprised of many functionalities. To begin designing this system, focus needed to be on how the system would be used, and how it would be built. By focusing on the actors and how they would interact with the system, helped to refine and further define the scope and boundaries of eTES. Figure 1 is a context diagram that was used to analyze the actors of eTES and to find potential use cases. Figure 1 depicts that actors and their involvement with eTES.

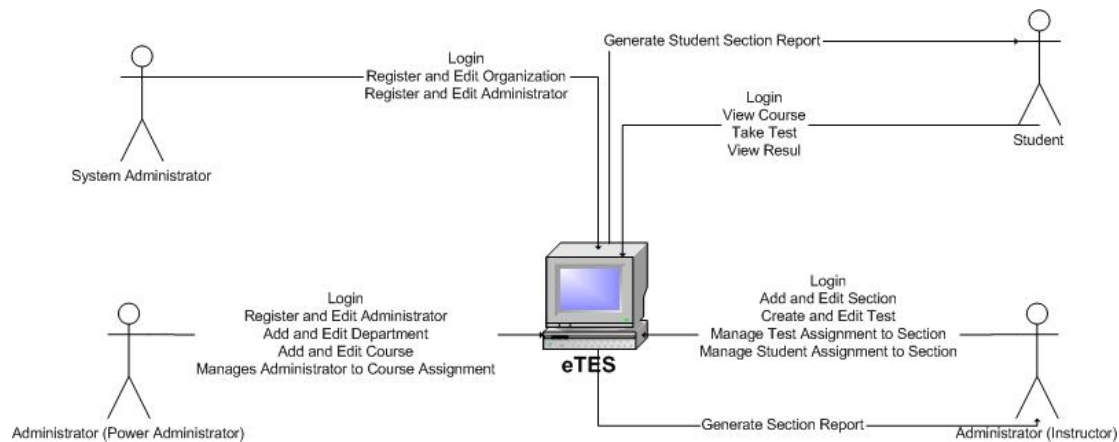


Figure 1. eTES Context Diagram

3.1.2 Use-Case Model Diagram

Once the use case and actors have been identified, a use-case diagram was constructed to graphically depict eTES scope and boundaries. Figure 2 represents the relationship between the actor and the use cases.

Figure 2 identifies the actor, System Administrator, and the use cases that a System Administrator can initiate. The System Administrator must first successfully log into the system. Once logged in, the System Administrator can initiate the Register Organization or Register Administrator use case.

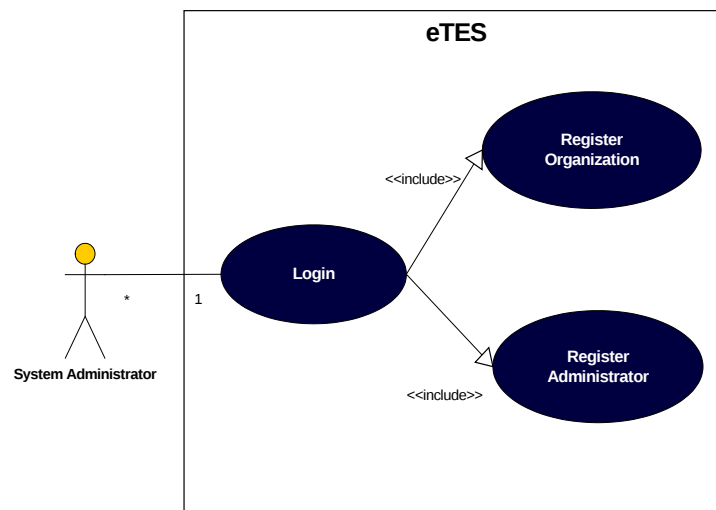


Figure 2. System Administrator Use-Case Model Diagram

Use-Case Model Diagrams were used through out the designing of eTES. More samples of these types of diagrams can be found in Appendix B.

3.1.3 Use-Case Narrative

Use case narratives were used to understand the typical courses of events and its alternate courses. The typical courses of events described in the use case narratives are step-by-step descriptions, starting with the actor initiating the use case and continuing until the end of the event. The alternate courses document the exceptions, or conditional paths, of the use case. An example of the use case narratives used to design eTES is show in Figure 3. Additional examples can be found in Appendix C.

USE CASE NAME:	Create Section	USE CASE TYPE Business Requirements: ☐ <i>System Analysis:</i> ☐ System Design: ☒
USE CASE ID:	2.2.1.1	
PRIORITY:	High	
SOURCE:	eTES_decomposition_diagram	
PRIMARY SYSTEM ACTOR	Administrator (Instructor)	
DESCRIPTION:	This use case describes the event of an Administrator (Instructor) creating and adding a new section to a course.	
PRE-CONDITION:	Administrator must be enrolled into a Course and their enrollment into the Course must have a status of 'P' or 'A'. Also, Administrator must be authenticated.	
TRIGGER:	Step: 2 is initiated when the form loads. Step: 4 is initiated when the Administrator selects a Department Step: 6 is initiated when the Administrator selects a Course Step 8 is initiated when the Administrator adds a new Section Step: 10 is initiated when the Administrator sends the new Section to the queue Steps:12 and 13 is initiated when the Administrator releases the item in the queue	

Figure 3. Expanded Version of Add Section Use-Case Narrative

TYPICAL COURSE	Actor Action	System Response
	Step 1: Administrator requests the Section Registration Form	Step 2 A list of Departments that contain the Courses the Administrator is registered in, is retrieved from the data store and the Section Registration Form is displayed to the Administrator
	Step 3: Administrator selects a Department	Step 4: The system updates the Section Registration form to displays the Active Course list associated with the selected Department
	Step 5: The Administrator Selects a Course	Step 6: The system updates the Section Registration form to display the active inactive, and expired Section lists with respect to the selected Course
	Step 7: The Administrator chooses to add a new Section to the selected Course	Step 8: The system prepares the form for data entry, such as enabling the appropriate controls.
	Step 9: The Administrator chooses sends the new Section.	Step 10: The system validates the data then sends the new Section object to the transaction queue
	Step 11 The Administrator chooses to release the Section item(s) in the queue	Step 12: The system adds the Section to the data store
		Step 13 The system updates the Section lists to reflect the addition.
ALTERNATE COURSES:	Alt-Step 2: In the event when the list cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that there has been a read error. The user should then be instructed to contact the system administrator. At this point the user should be redirected to the menu page.	
	Alt-Step 10: In the event of invalid data, the system will display an error message next to the fields that contain the invalid data. The system will not continue with the Administrators request until the data is validated.	
	Alt-Step 12: In the event that a Section cannot be added to the data store, an exception is thrown and the error details are logged. A Boolean value of FALSE is returned to the caller. The section is added to the Failed Transactions List The system redisplay the form to reflect this List to the Administrator along with a failure to add sections message.	
	Alt-Step 13: In the event where the Section List cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that the list has not been updated due to read failure. Instruct the Administrator to refresh the form, if problem persists then contact the system administrator.	
CONCLUSION:	This use case concludes in a true value being returned to the caller to indicate a successful addition of the Section to the data store. The system updates the Section List to reflect the addition.	
POST-CONDITION:	The Section has been added. The connection is closed and it hibernates in the connection queue.	
BUSINESS RULES	Only Administrators have authority to utilize the section registration functionalities	
IMPLEMENTATION CONSTRAINTS AND SPECIFICATIONS	A business process than can be invoked by the Section Registration form.	
ASSUMPTIONS:	Organization exist, Department exist, Course Exist, CAE Exist The Administrator is successfully authenticated The Administrator Course Enrollment has a status of 'P' or 'A'	

Figure 3. Concluded

3.1.4 Entity Relationship Diagram

The entity relationship diagram (ERD) was used in this project to depict the system's data in terms of entities. The ERD also identifies the entity's attributes and their relationship with other entities. Figure 4 shows the Student, SectionEnrollment, and Section objects, along with their attributes. The Student and Section objects work together in a many-to-many relationship to create a new object called section enrollments. The SectionEnrollments table has its own set of attributes which consist of the SectionEnrollments.Sectionid, SectionEnrollments.Studentid, and status. This partial diagram basically says, a student can enroll into many section, and a section can have many students. The complete ERD for the system can be found in Appendix E.

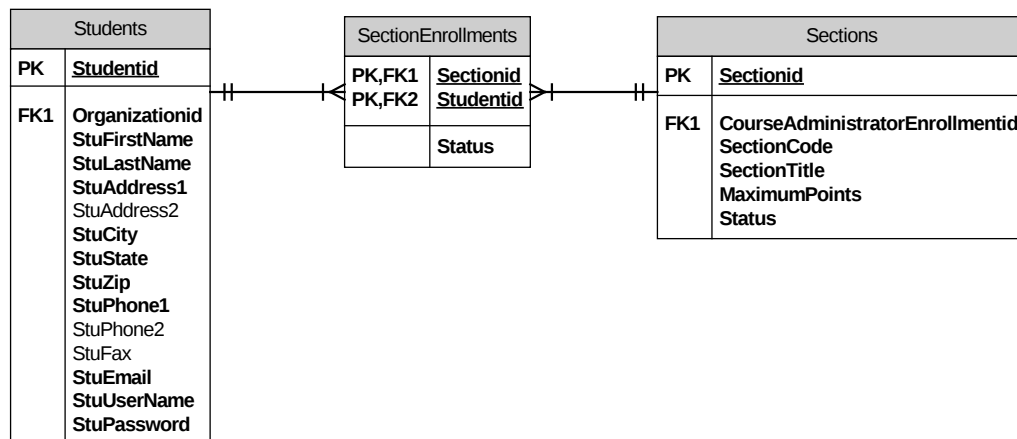


Figure 4. Partial Entity Relationship Diagram (ERD)

3.1.5 Data Flow Diagram

The data flow diagram (DFD) was used to depict the flow of data through out the eTES, and the work and processing performed by the eTES. Figure 5 shows the DFD for the section registration event. More sample DFDs can be found in Appendix D.

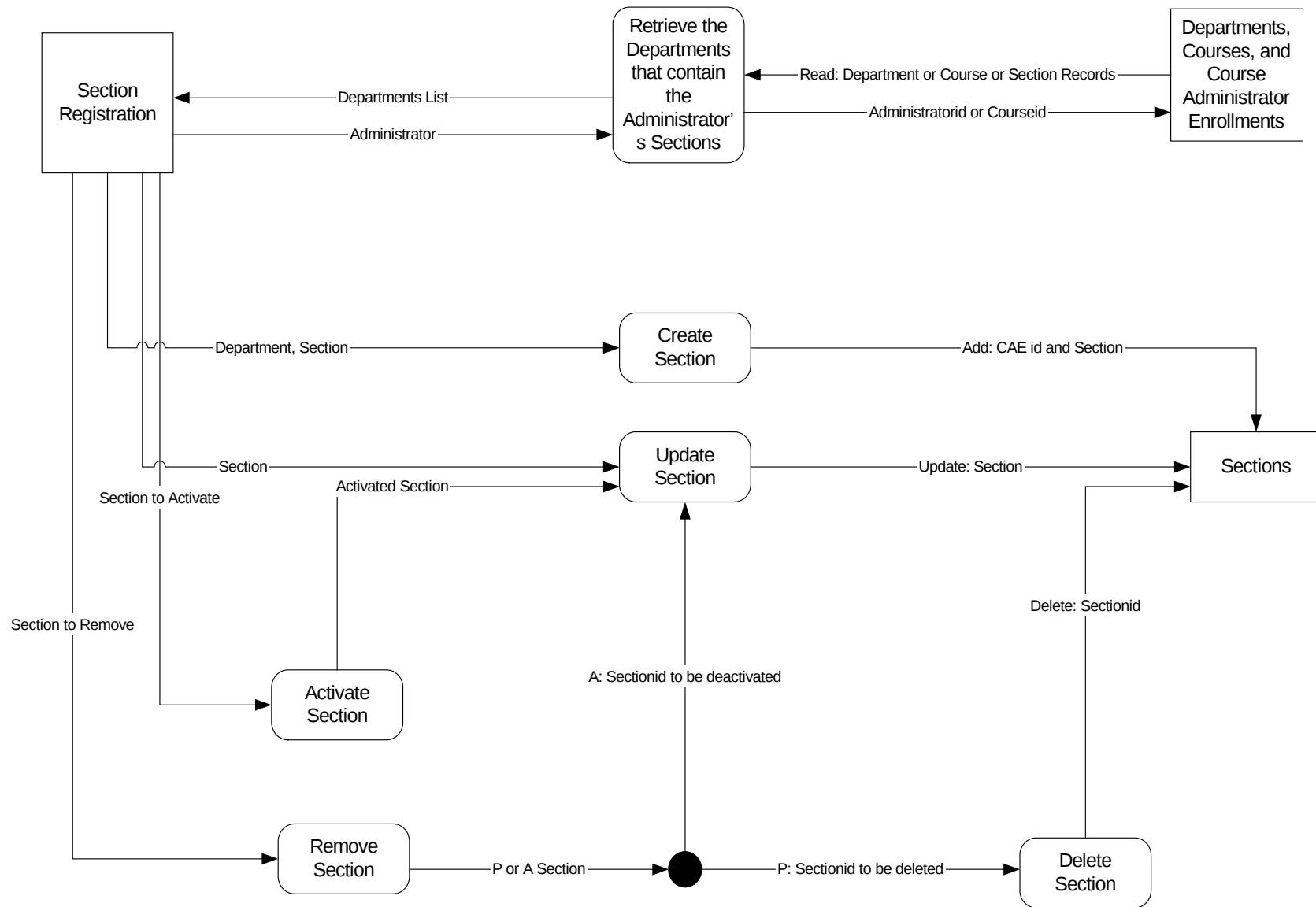


Figure 5. Section Registration Data Flow Diagram (DFD)

3.2 System Architecture

An architecture was needed to support an application that would be accessible and scalable. Such architecture would have to support the evolution of the application and make it more manageable. Based on the need for a scalable, accessible, reliable, and manageable system, eTES has been developed as a distributed application. The system's architecture is organized into three major layers, each of which can be distributed to different places on the network. The three layers in this application are: the presentation layer, business logic layer, and database layer.

3.2.1 Presentation Layer

The front-end of the application was developed with ASP.NET, JAVASCRIPT, HTML, and C#. The presentation layer provides an interface for the three types of users, System-Administrators, Administrator, and Test-Takers. Each user is will need to be successfully authenticated before entering system. The following sub-sections, list the forms each user can access.

3.2.1.1 System Administrator

- Web based interface to authenticate the System-Administrator.
- Web based interface displaying System-Administrators Menu options.
 - o Organization Registration
 - o Administrator Registration

3.2.1.2 Administrators

- Web based interface to authenticate the Administrator.
- Web based interface displaying Administrator Menus.
 - o Administrator Registration

- o Student Registration
- o Department Registration
- o Course Registration
- o Course Administrator Enrollments
- o Section Registration
- o Section Student Enrollments
- o Test Developer
- o Test Manager
- o Reports

3.2.1.3 Test-Takers

- Web based interface to authenticate the Test-Taker.
- Web based interface displaying Test-Taker Menus Options.
 - o Test Sessions
 - o Reports

3.2.2 Business Logic Layer

The business logic layer was developed with C# and provides the functionalities needed to pass data between the presentation and database layers. This layer consists of two components: the business entities and business processes.

3.2.2.1 Business Entity

The business entities are custom classes used to represent eTES objects, such as System-Administrators, Administrators, Test-Takers and so forth. The properties and methods of the business entities will be exposed to the presentation layer components. (See Figure 6) This exposure will provide the capabilities for data binding, along with

the ability to manage the entities format and their behavior. In addition, the business entities will be called and orchestrated by the business processes to interact with the database.

3.2.2.2 Business Process

Business Processes are used to centralize the system transactions. The presentation layer calls the business processes and exposes the user's data to the processes, for processing, as shown in Figure 6. The business processes then orchestrates the appropriate entities, calls the appropriate data access logic component, and passes the entities to initiate the transaction to the database. Only business processes can initiate database transactions.

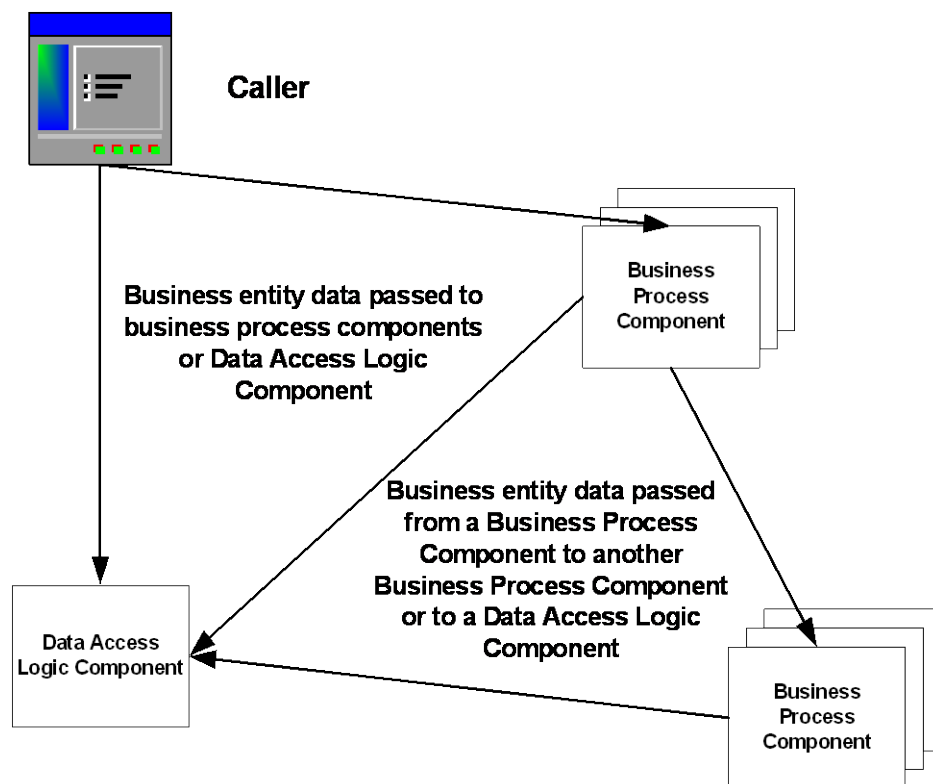


Figure 6. Business Logic Layer Structure

3.2.3 Database Layer

The database layer will be developed using C#, ADO.NET, and T-SQL. This layer will house the data and provide back-end support to the application. The database objects can only be accessed through stored procedures. The stored procedures can only be invoked by the Data Access Logic Component (DALC). The DALC will expose its methods to the business processes that will provide create, read, update, and delete (CRUD) operations against the database. (See Figure 7.)

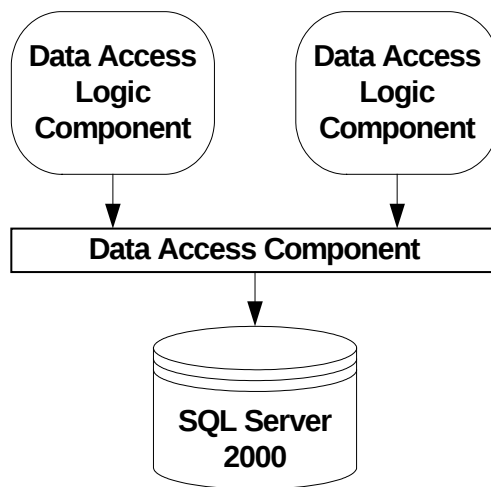


Figure 7. Database Layer Structure

3.3 eTES Services

eTES services includes, but are not limited to: test development, test delivery, and data management.

3.3.1 Test Development

Administrators have the ability to create and customize tests online from a web application. eTES provides services that allow administrators to create test questions in a text or image format. The administrator will have the ability to choose the format of the answers such as true/false or multiple choices. The features of the test development

service will give the administrator the flexibility and convenience needed to develop a test at any place, and anytime.

3.3.2 Test Delivery

Administrators will have the secured flexibility to administer and deliver tests online. Every test can be scheduled for activation, allowing administrators to control the delivery date, and time of the tests. In addition to the scheduling feature, an administrator can assign a single test to multiple sections, with exclusive scheduling. eTES's test delivery feature will administrator the flexibility and convenience needed to deliver a test at any place, and anytime.

3.3.3 Data Management

eTES provides server side data processing with automatic analysis and reporting. Global access to test results will be assigned to test takers and administrators only. The data management feature of this component will provide convenience of dynamic data to administrator and test takers.

4. Deliverables

To develop a 3-tier, interactive Web-based application, which would provide organizational setup, test development, test delivery, and data management services, the following requirements had to be implemented:

1. An Electronic Testing and Evaluation System.
2. A dynamic interface using C#, XHTML, ASP.NET, JAVASCRIPT
3. SQL Server 2000 RDBMS will provide back-end support for the application
4. T-SQL stored procedures to handle CRUD operations

5. All users of eTES will need to be authenticated
6. An System Administrator be able to complete the following task:
 - Register/edit organizations
7. An Administrator be able to complete the following task:
 - Register/edit Administrators within the organization
 - Register/edit students within the organization
 - Register/edit department within the organization
 - Register/edit courses within departments
 - Assign administrators to courses
 - Register/edit sections in courses
 - Develop/edit tests
 - Deliver tests to sections
 - View their students report
 - View their section report
8. A Student be able to complete the following task:
 - Take assigned test
 - View his/her test result
 - View assigned section results

5. Design and Development

5.1 Budget

Figure 8 shows the software resources that will be used to develop the eTES. The overall total for the Software is \$7,686.00.

Software						
Vendor	Source	Item	Item Details	Qty	Price	Line Total
Microsoft	www.microsoft.com	W2K Server	(With 5 Client Access Licenses)	1	\$999.00	\$999.00
Microsoft	www.microsoft.com	SQL Server 2000	1 Processor License 80 or more users (Standard Eddi	1	\$4,999.00	\$4,999.00
Adobe	www.adobe.com	Photoshop 6.0	Graphic design software	1	\$609.00	\$609.00
Microsoft	www.microsoft.com	VS.NET	Full Development Software Package	1	\$1,079.00	\$1,079.00
					Total	\$7,686.00

Figure 8. Software Budget

Figure 9 shows the hardware resources that will be used for the server and development station. The overall total for hardware is \$5,874.62.

Hardware						
Supplier	Source	Item	Item Details	Qty	Price	Line Total
Wayne	Wayne	Server	PII 500mhz, 528mb RAM, 80gb harddrive, with 3Comm NIC	1	\$800.00	\$800.00
Wayne	Wayne	Monitor	17 Sony	1	\$200.00	\$200.00
Wayne	Wayne	Mouse	Inteli PS2	1	\$9.99	\$9.99
Wayne	Wayne	Router	Cisco	1	\$175.00	\$175.00
Wayne	Wayne	Hub	3Com 8 Port	1	\$60.00	\$60.00
Wayne	Wayne	Cables	Cat5	1	\$14.95	\$14.95
Wayne	Wayne	Development Station	Dell Latitude C84, p4 2.4ghz, 40gb Harddrive, 1gb RAM	1	\$2,800.00	\$2,800.00
Wayne	Wayne	APC Smart-UPS 420	Power Supresser/Backup	1	\$219.79	\$219.79
Wayne	Wayne	Backup Tape Drive	Acer America Sony SDX 420C/R Tape drive AIT 35gb / 90gb	1	\$858.48	\$858.48
Wayne	Wayne	Backup Media	ADIC 8mm AIT-2 Tape Cartridge, 10-Pack	1	\$736.41	\$736.41
					Total	\$5,874.62

Figure 9. Hardware Budget

5.2 Timeline

Figure 10 shows the current and long term task requirements I will need to complete in order to successfully complete this project.

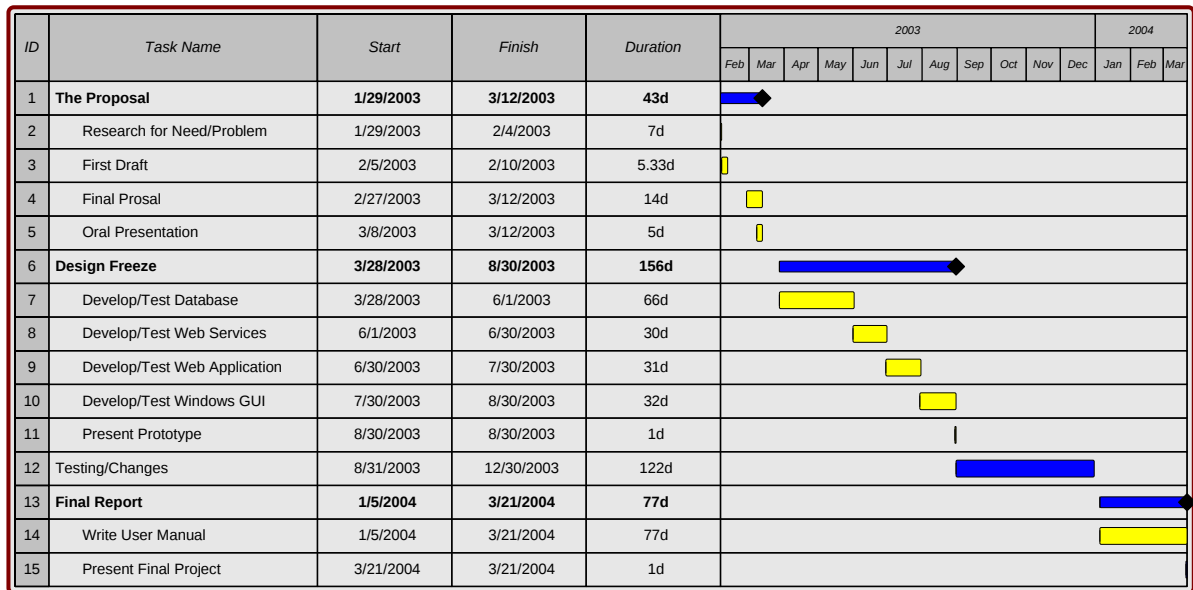


Figure 10. Project Schedule

5.3 Software

5.3.1 Visual Studio .NET

Visual Studio .NET is the only development environment built from the ground up for XML Web services. This package will enable me to employ XML and built-in Microsoft ADO.NET tools to build high-performance, data-driven applications that target a variety of platforms. Visual Studio .NET is the ideal tool for this project.

5.3.2 SQL Server 2000

SQL Server 2000 is a robust relational database management system that will provide the tools needed to house and manage the test taker's, administrator's and system's data. This database will run at a centralized location and provide back-end support to the front-end applications.

5.3.3 Windows 2000 Server

Microsoft's Windows 2000 (W2K) Server is a multipurpose network operating system for all size businesses. The server provides a will-integrated package containing the application development environment, security, and the scalability needed to successfully develop this project. I have the knowledge and experience to administer and develop applications on W2K server, making it the ideal operating system for the server station.

5.3.4 Adobe Photoshop 7.0

Adobe Photoshop 7.0 is a graphic designing software that produces high quality images for the web. Appearance is very important to this project therefore making Adobe Photoshop 7.0 the ideal tool that will insure the production of professional quality images.

5.4 Hardware

I own all of the hardware that will be used to develop this project. Each device will provide the performance needed to maintain the project stability and success.

6. Proof of Design

The proceeding section will discuss each deliverable and how they were met.

6.1 Interactive Web-based application with dynamic interfaces

The interfaces were developed using ASP.NET, C#, HTML, and JAVASCRIPT. The controls on the interface are server controls, which allow the users to interact with the interface. The content on each form is pulled from the database and then displayed to the user, providing a dynamic interface with up-to-date content..

6.2 SQL Server 2000 as a back-end support

SQL Server 2000 provided the back-end support needed for eTES. The relational management database system allowed me to create stored procedures to handle the *create*, *read*, *update*, and *delete* operations on the database layer. Also, I have gained extensive knowledge and fair experience in developing back-end support with SQL Server 2000, which made it the item of choice for this project.

6.3 User Authentication

ASP.Net offers a robust way to allow flexibility in how eTES can authenticate its users. Form mode, allows eTES to perform whatever kind of action desired when an unauthenticated user requests a page within the secured application. Figure 14 displays the homepage that provides an entry point for the users into the system. A user selects their role and the system will redirect the user to the login screen. All users will need to be authenticated before accessing any content beyond the homepage. Once the user has been authenticated, the user will be redirected to their appropriate task page.

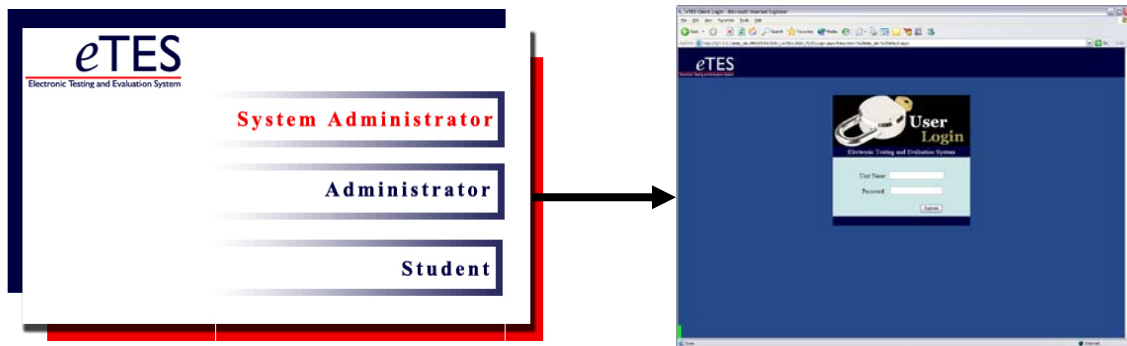


Figure 11. Homepage and Login Screen

6.4 System Administrator's functionalities

The System Administrator is the owner of the eTES application. This user's task involves the registration of organization within the system. Once an organization has been registered, the System Administrator will need to register and administrator (power administrator) to the organization. Using the forms shown in Figure 12 and Figure 14, the System Administrator is can perform operations such as adding, deleting, and updating organizations and administrators.



The screenshot shows the 'Organization Registration' form in the eTES application. The form has a dark blue header with the eTES logo and the title 'Organization Registration'. Below the header, there are two tabs: 'Organization' (selected) and 'Administrator'. The 'Organization' tab contains a form with the following fields: 'Organization Name', 'Address 1', 'Address 2', 'City', 'State', 'Zip Code', 'Phone Number 1', 'Phone Number 2', 'Fax Number', and 'Email'. Each field is preceded by an asterisk, indicating it is a required field. At the bottom right of the form, there are 'Clear' and 'Submit' buttons.

Figure 12.
Organization Registration Form



The screenshot shows the 'Administrator Registration' form in the eTES application. The form has a dark blue header with the eTES logo and the title 'Administrator Registration'. Below the header, there are two tabs: 'Organization' and 'Administrator' (selected). The 'Administrator' tab contains a form with the following fields: 'Organization Name' (with a dropdown menu), 'Administrative Role' (with a dropdown menu), 'Job Title', 'First Name', 'Last Name', 'Address 1', 'Address 2', 'City', 'State', 'Zip Code', 'Phone Number 1', 'Phone Number 2', 'Fax Number', 'Email', 'Username', 'Password', and 'Confirm Password'. Each field is preceded by an asterisk, indicating it is a required field. At the bottom right of the form, there are 'Clear' and 'Submit' buttons.

Figure 13.
Administrator Registration Form

6.5 Administrator's functionalities

The administrator's (power administrator) requirements involved an array of tasks. The tasks are grouped in the proceeding subsection and will be discussed with respect to the deliverables.

6.5.1 Administrator (Power Administrator) Registration Form

The Administrator Registration form provides functionality to the power administrator to register and edit administrators within the organization. Through this form power administrators can create, read, update, and delete administrators within their organization. (See Figure 14.)

eTES
Electronic Testing and Evaluation System

Administrator Registration

Administrators List

- Joe Shmoe
- Kamilia Sibley
- Ilene Sibley
- Anthony Sibley

Administrator Entry Form

*First Name: Tina

*Last Name: Smith

*Job Title: Trainer

*Administrator Role: Administrator

*Address 1: 1111 Forrest View

Address 2: P.O. Box 1211

*City: Cincinnati

*State: Ohio

*Zip: 45240

*Phone 1: 513-555-5555

Phone 2: 513-555-5555

Fax: 513-555-5555

*Email: admin@org.com

☒ Edit User Credentials

*Username: tinas

*Password: *****

*Re-Type Password: *****

Buttons: Delete, New, Send, Release, Cancel All, Cancel, Clear

Transaction Queue

Figure 14. Administrator Registration Form

6.5.2 Student Registration Form

The Student Registration form provides functionality to the power administrator to register and edit students. Through the Student Registration form, an organization power administrator can create, update, read, and delete students within their organization. (See Figure 15.)

Student List	Student Entry Form	Transaction Queue
Belinda Murphy Topaz Murphy Bill Gates	*First Name: Brian *Last Name: Mason *Address 1: 2222 Forrest View Address 2: P.O. Box 123 *City: Cincinnati *State: Ohio *Zip: 45240 *Phone 1: 513-555-5555 Phone 2: 513-555-5555 Fax: 513-555-5555 *Email: student@org.com ☒ Edit User Credentials *Username: bm *Password: ***** *Re-Type Password: ***** Delete New Send Release Cancel All Cancel Clear	

Figure 15. Student Registration Form

6.5.3 Department Registration Form

The Department Registration form provides functionality to the power administrator to register and edit departments. Through the Department Registration form, an organization power administrator can create, update, read, and delete departments within their organization. (See Figure 16.)

The screenshot displays the 'eTES Department Registration' interface. The top header includes the 'eTES' logo and the title 'Department Registration'. Below this, a navigation bar contains three tabs: 'Department List', 'Department Entry Form', and 'Transaction Queue'. The 'Department List' tab is active, showing a list of departments: 'Sales', 'R&D', and 'Social'. The 'Department Entry Form' tab is also visible, showing a form for entering department details. The form fields are as follows:

- Department Name: Marketing
- Department Description: Designed to improve student skills
- Address 1: 1111 Forest view
- Address 2: P.O. Box 123
- City: Cincinnati
- State: Ohio
- Zip: 45240
- Phone 1: 513-555-5555
- Phone 2: 513-555-5555
- Fax: 513-555-5555
- Email: dept@org.com

At the bottom of the form, there are buttons for 'Delete', 'New', 'Send', 'Release', 'Clear', 'Cancel', and 'Cancel All'. The 'Transaction Queue' tab is currently empty.

Figure 16. Department Registration Form

6.5.4 Course Registration Form

The Course Registration form provides functionality to the power administrator to register and edit courses. Through the Course Registration form, an organization power administrator can create, update, read, and delete courses within their organization. (See Figure 17.)

eTES
Electronic Testing and Evaluation System

Course Registration

Department List

R&D

Course List

Logistics

Course Entry Form

*Number: 100

*Title: Logistics

Term: Spring

Overview: Introduction course for beginners

Target Audience: New students

Goal: To give students the key concepts of the course

Prerequisites: Must be enrolled into the class

Start Date: 3/8/2004

End Date: 6/3/2004

EXIT

Clear Delete New Send Release Cancel Cancel All

Figure 17. Course Registration Form

6.5.5 Course Administrator Enrollment Form

The Course Administrator Enrollment form provides functionality to the power administrator to assign instructors to a course. Through this form a power administrator can add instructors to courses or remove instructors from courses. (See Figure 18.)

eTES
Electronic Testing and Evaluation System

Course Enrollments

DepartmentList

R&D

Course List

Logistics

Available Administrators

First Name	Last Name	Job Title	Action
Joe	Shmoe	Lead Trainer	Add
Anthony	Sibley	Director	Add

Inactive Administrators

First Name	Last Name	Job Title	Action
------------	-----------	-----------	--------

Current Enrollments

First Name	Last Name	Job Title	Action
Kamila	Sibley	Trainer	Remove
Ilene	Sibley	Trainer	Remove

EXIT

Figure 18. Course Enrollment Form

6.5.6 Section Registration Form

The Section Registration form provides functionality to the instructor to register and edit their sections. Through the Section Registration form, an instructor can create, update, read, and delete sections within their assigned courses. (See Figure 19.)

The screenshot displays the eTES Section Registration Form. The interface is divided into several sections:

- Header:** The top bar features the eTES logo (Electronic Testing and Evaluation System) and the title "Section Registration".
- Left Sidebar:**
 - Department List:** A dropdown menu currently showing "Sales".
 - Course List:** A list box showing "Intro to Sales".
 - Active Sections:** A list box showing "100-First Quarter Sales".
 - Inactive Sections:** A table with columns "Section Code", "Section Title", and "Action". It currently shows an empty row with "<>" in the first column.
- Main Content Area (Section Entry Form):**
 - Section Code:** A text input field containing "100".
 - Section Title:** A text input field containing "First Quarter Sales".
 - Maximum Points:** A text input field containing "200".
 - Buttons:** A row of buttons labeled "Remove", "New", "Send", and "Release". Below them are "Clear", "Cancel", and "Cancel All".
- Right Sidebar (Transaction Queue):** A large, empty white area for displaying transaction history.

Figure 19. Section Registration Form

6.5.7 Student Enrollment Form

The Student Enrollment form provides functionality to the instructor to enroll students into their sections. Through the Student Enrollment form, an instructor can add students to their sections or remove students from their sections. (See Figure 20.)

eTES
Electronic Training and Evaluation System

Student Enrollment Form

EXIT

Department List		Section Enrollments			
Sales		First Name	Last Name	Email Address	Action
Course List		Belinda	Murphy	bm@worldtech.com	Remove
Intro to Sales					
Section List					
100-First Quarter Sales					
Available Student List					
First Name	Last Name	Action			
Topaz	Murphy	Add			
Bill	Gates	Add			
<>					
Inactive Student List					
First Name	Last Name	Action			
<>					

Figure 20. Student Enrollment Form

6.5.8 Test Developer Form

The Test Developer form provides functionality to the instructor to develop tests. Through the Test Developer form, an instructor can create, read, update, and edit a test. (See Figure 21.)

The screenshot displays the 'Test Developer' interface within the eTES (Electronic Testing and Evaluation System) application. The interface is divided into several sections:

- Test List:** Located on the top left, it contains a dropdown menu currently showing 'Exam 1'.
- Question List:** Located below the Test List, it shows a list of questions. The first question is 'Wayne' with the text 'What color is an orange?'.
- Test Properties:** This central section contains:
 - Test Title:** A text field with 'Exam 1' entered.
 - Comments:** A text area with 'First exam of the quarter?' entered.
 - Action Buttons:** A row of buttons including 'New Test', 'Edit Test', 'Clear Test', 'Remove Test', and 'Add Test'.
- Question Entry:** This section allows for creating or editing a question:
 - Text Type:** A radio button is selected, and the text 'What color is an orange?' is entered in the adjacent field.
 - Image Type:** An unselected radio button with fields for 'Image Title', 'Select File', and a 'Browse...' button.
 - Question Points:** A small input field containing the number '4'.
- Answer Set Entry:** This section is for defining multiple-choice answers:
 - A list of checkboxes next to labels 'Choice 0' through 'Choice 9'.
 - The text for each choice is entered in a corresponding text field.
 - 'Choice 3: Orange' is the selected correct answer, indicated by a checked checkbox.
 - Action Buttons:** A row of buttons at the bottom including 'Remove', 'New', 'Send', 'Release', 'Clear', 'CancelAll', and 'Cancel'.
- Transaction Queue:** A large, empty vertical panel on the right side of the interface.

The top of the window features the 'eTES' logo and the title 'Test Developer'. An 'EXIT' button is visible in the top right corner.

Figure 21. Test Developer Form

6.5.9 Test Manager Form

The Test Manager form provides functionalities to the instructor to deliver tests to sections. Through the Test Manager form an instructor can assign a test to a section with specific configurations. Once a test has been added to a section, the instructor can update the test assignment or remove the test assignment from the section. (See Figure 22.)

The screenshot displays the eTES Test Manager interface. The top header includes the eTES logo and the title 'Test Manager'. The interface is divided into several sections:

- Department List:** A dropdown menu showing 'Sales'.
- Course List:** A dropdown menu showing '100-Intro to Sales'.
- Section List:** A table with columns 'Test Title', 'Date Created', 'Action', and 'Action'. It lists 'Exam 1' and 'Exam 2' with 'Configure' and 'Remove' links.
- Test Session Properties:** A section titled 'Section Test Configuration for Exam 3' containing fields for 'TestWeight' (78%), 'Start Date' (3/19/2004), 'End Date' (3/27/2004), 'Start Time' (1:00 P.M.), and 'End Time' (1:00 P.M.). It also has a checkbox for 'Edit Password' and password input fields.
- Available Test List:** A table with columns 'Test Title', 'Date Created', and 'Action'. It lists exams 4 through 15, all dated 2/4/2004, with 'Deliver' links.

Navigation buttons like '<>' are present at the bottom of the list sections. An 'EXIT' button is located in the top right corner.

Figure 22. Test Manager Form

6.5.10 Section Results Form

The Section Results form provides the instructor with up-to-date statistics from their section. Through this form the instructor can view the average, standard deviation, and number of test takers of each test. In addition, an instructor can view the points earned and section scores for each student. (See Figure 23.)

eTES
Electronic Testing and Evaluation System

Section Results

Department List
R&D

Course List
100-Logistics

Section List
101-Logic

Section Test Results

Test Title	Average	Standard Deviation	# of Test Takers
Exam 1	6	2.54950975679639	2
Exam 2	13	3	2
Exam 5	0	0	1

< >

Section Test Results

Student Name	Points Earned	Section Score(s)	Maximum Points
Belinda Murphy	25	0	500
Topaz Murphy	14	5	500

< >

Figure 23. Section Results Form

6.6 Student Functionalities

The student's deliverables consist of two requirements; there must be functionality for the student to take the test, and there must be functionality that allows the student to view their results. When a student is authenticated, they are redirected to the Student Entry form. This form allows the student to select a course and choose either to take a test or view their results of a previously taken test. (See Figure 24.) The proceeding sub-sections discuss how the student deliverables were met.

eTES
Electronic Testing and Evaluation System

EXIT

Course List

- 100-Logistics
- 100-Intro to Sales

Pending Tests

Test Title	Instructor's Comments	Start Date	Start Time	End Date	End Time	Action
Final Exam	Final Examination	3/14/2004	10:00 AM	3/26/2004	11:00 AM	Start Test

<>

Completed Tests

Test Title	Instructor's Comments	Start Date	Start Time	End Date	End Time	Action
Exam 1	First exam of the quarter	3/5/2004	1:25 PM	3/6/2004	11:55 PM	View Report
Exam 2	Second exam of the quarter	3/1/2004	1:00 PM	3/26/2004	11:50 PM	View Report
Exam 5	First exam of the quarter	3/4/2004	9:00 AM	3/8/2004	11:00 AM	View Report

<>

Figure 24. Student Entry Form

6.6.1 Test Session form

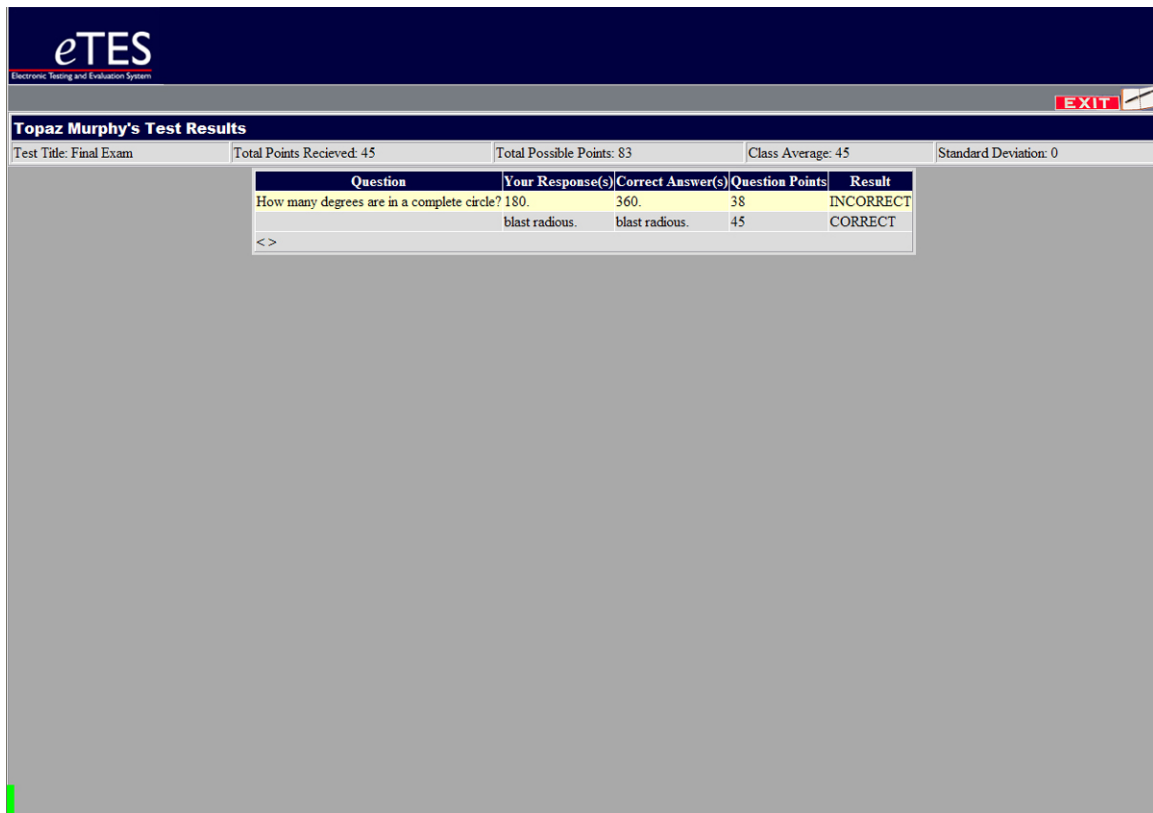
The Test Session form provides the functionality needed by the students to take their test. Through the Test Session form, students can take tests that have been assigned to their sections. When the test session starts, students can only navigate forward and backwards through the question set. Students have the option to skip a question and return to it later. Before a student submits a test for processing they must have answered all questions. The Test Session form provides all the functionality needed to satisfy the students' deliverables (See Figure 25.)

The screenshot displays the 'eTES' (Electronic Testing and Evaluation System) interface during a 'Test Session In Progress'. The main content area is a large grey rectangle. In the center, a smaller window titled 'Question 1 of 2' is active. This window contains the question 'How many degrees are in a complete circle?' and five radio button options: 180 (selected), 45, 90, 360, and 70. At the bottom of this window are two buttons: '<<< Previous Question' and 'Next Question >>>'. The top left of the interface shows the 'eTES' logo and the text 'Electronic Testing and Evaluation System'.

Figure 25. Test Session Form

6.1.2 Student Test Results form

Once a student has completed their test, they need a way to view their results. The Student Result form displays the total points the student received from test, the section average, standard deviation. In addition to the statistics, the student can also view the answers and their responses to the questions they responded to, along with the result. (See Figure 26.)



The screenshot shows the eTES (Electronic Testing and Evaluation System) interface. At the top, the eTES logo is displayed. Below it, a red 'EXIT' button is visible. The main section is titled 'Topaz Murphy's Test Results'. It contains a summary table with the following data:

Test Title	Total Points Received	Total Possible Points	Class Average	Standard Deviation
Final Exam	45	83	45	0

Below the summary table, there is a detailed table of questions and answers:

Question	Your Response(s)	Correct Answer(s)	Question Points	Result
How many degrees are in a complete circle?	180.	360.	38	INCORRECT
	blast radius.	blast radius.	45	CORRECT

At the bottom of the question table, there is a '<>' button.

Figure 26. Student Test Result form

7. Conclusion and Recommendations

7.1 Conclusion

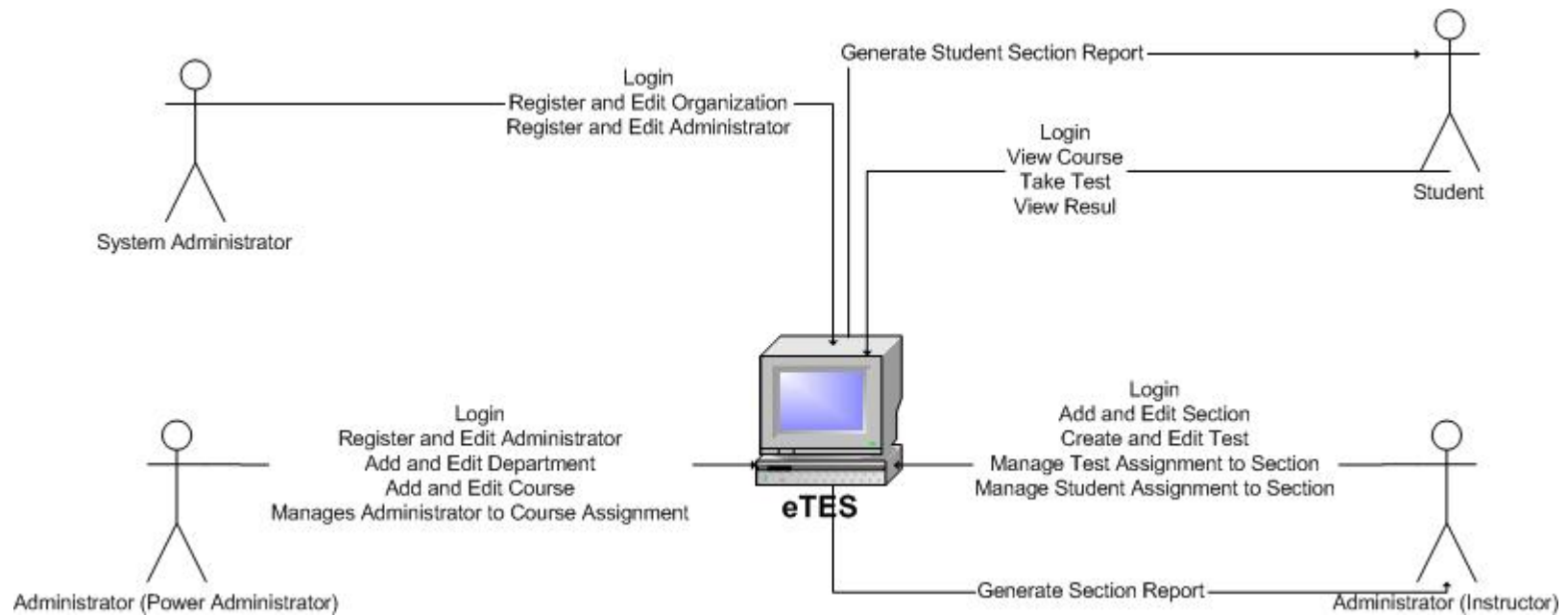
This project was created to aid in breaking the barrier to innovative skill measuring for small to medium scale organizations. The technologies and programming languages used to develop this projection consisted of: .NET Framework, ASP.NET, C#, HTML, JAVASCRIPT, T-SQL, Visual Studio .NET, and SQL Server 2000. The project was completed in 3 sequence of Senior Design III. The budget of \$13,160.62 was estimated this project during the first sequence Senior Design III. Since then technology has changed and prices have lowered as new technology replaced the existing technology. The project has met and exceeded all the Design Freeze deliverables. Unit and system testing was performed to insure the quality of the project.

7.2 Recommendations

When working with the design of this project, I have encountered a big challenge. I did not know how to design a distributed application. Knowing this, I continued with the development of this project. Half way through the project I discovered that the code was hard to manage. I created duplicate processes, methods, and data access logical components. I was overwhelmed with keeping track of the data flow within the project. To resolve the problem, I took a System Analysis and Design class, which prepared me with the fundamentals of designing a project through documentation. I learned how to create and work with context diagrams, decomposition diagrams, use case diagrams, use case narratives, and data flow diagrams. By knowing the fundamentals of system analysis and design methods, enabled and played a pertinent part in the successful completion of this project.

Appendix A

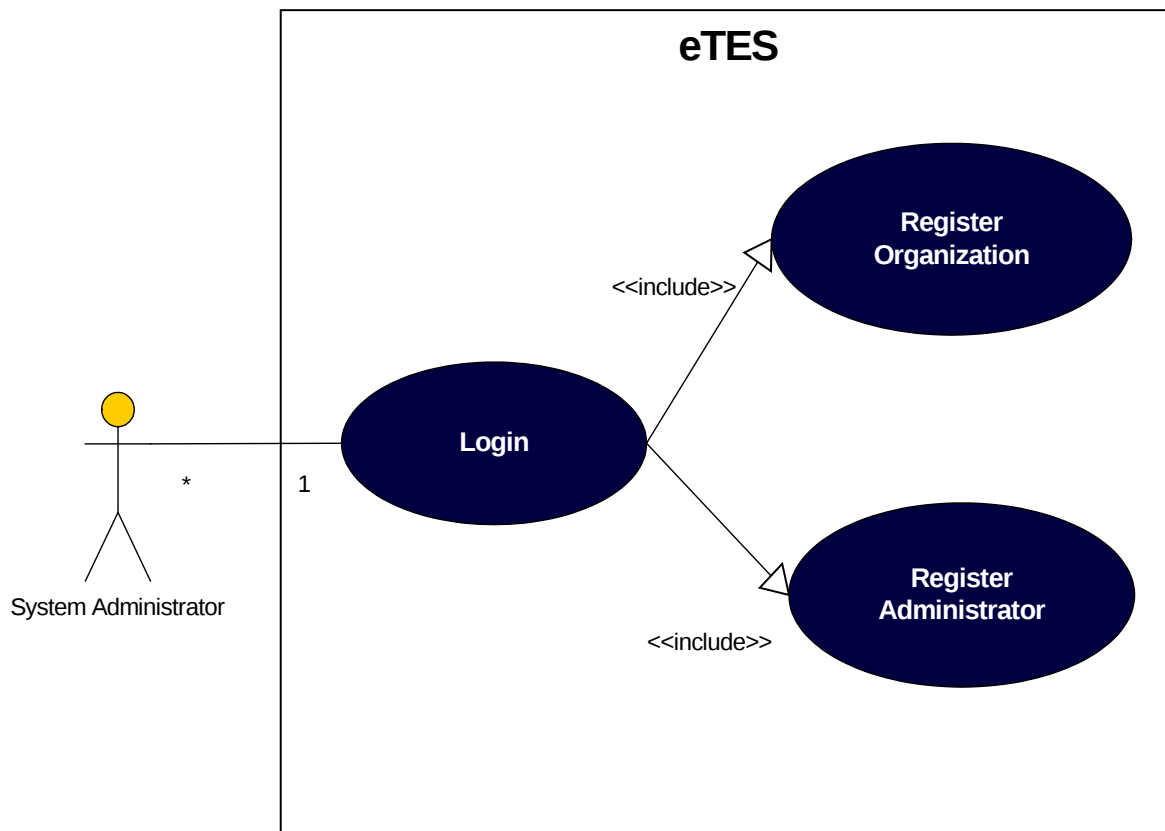
eTES Context Diagram



Appendix B

Use-Case Diagrams

B 1. System Administrator Sample Scenario

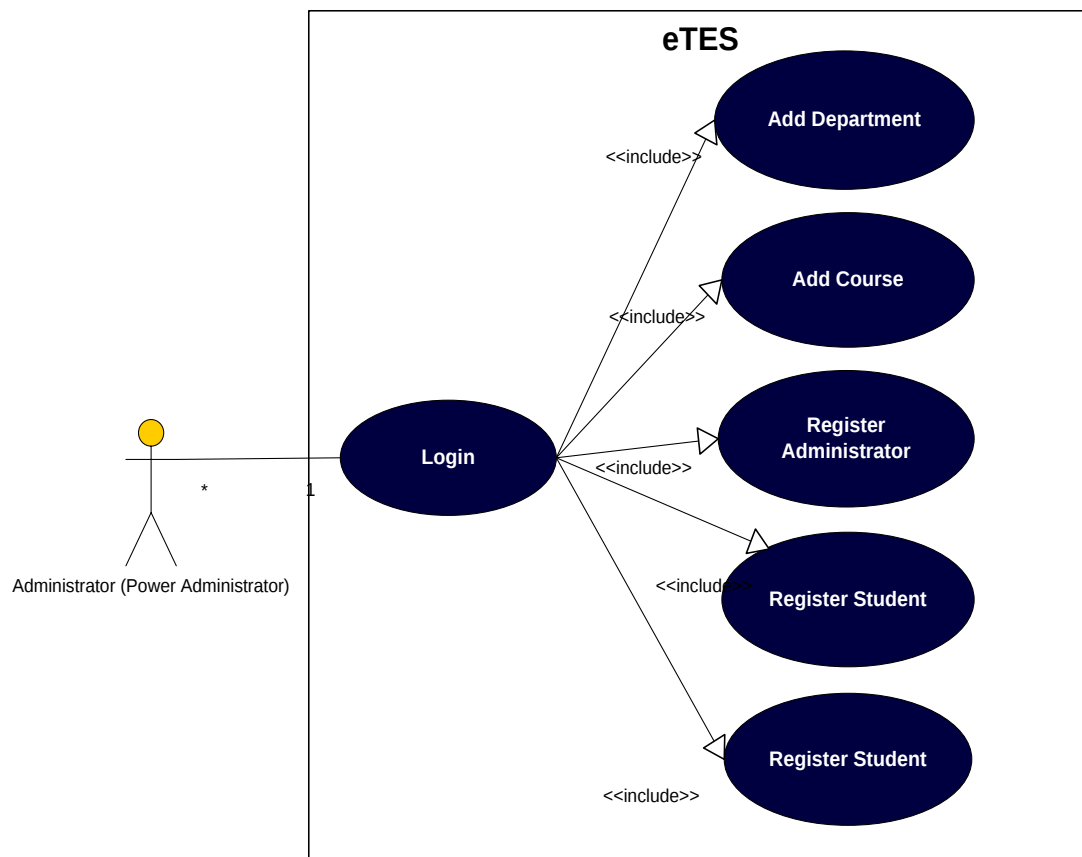


Scenario #1:

An System Administrator can complete the following task:

- Register Organization
- Register Administrator

B 2. Administrator (Power Administrator) Sample Scenario

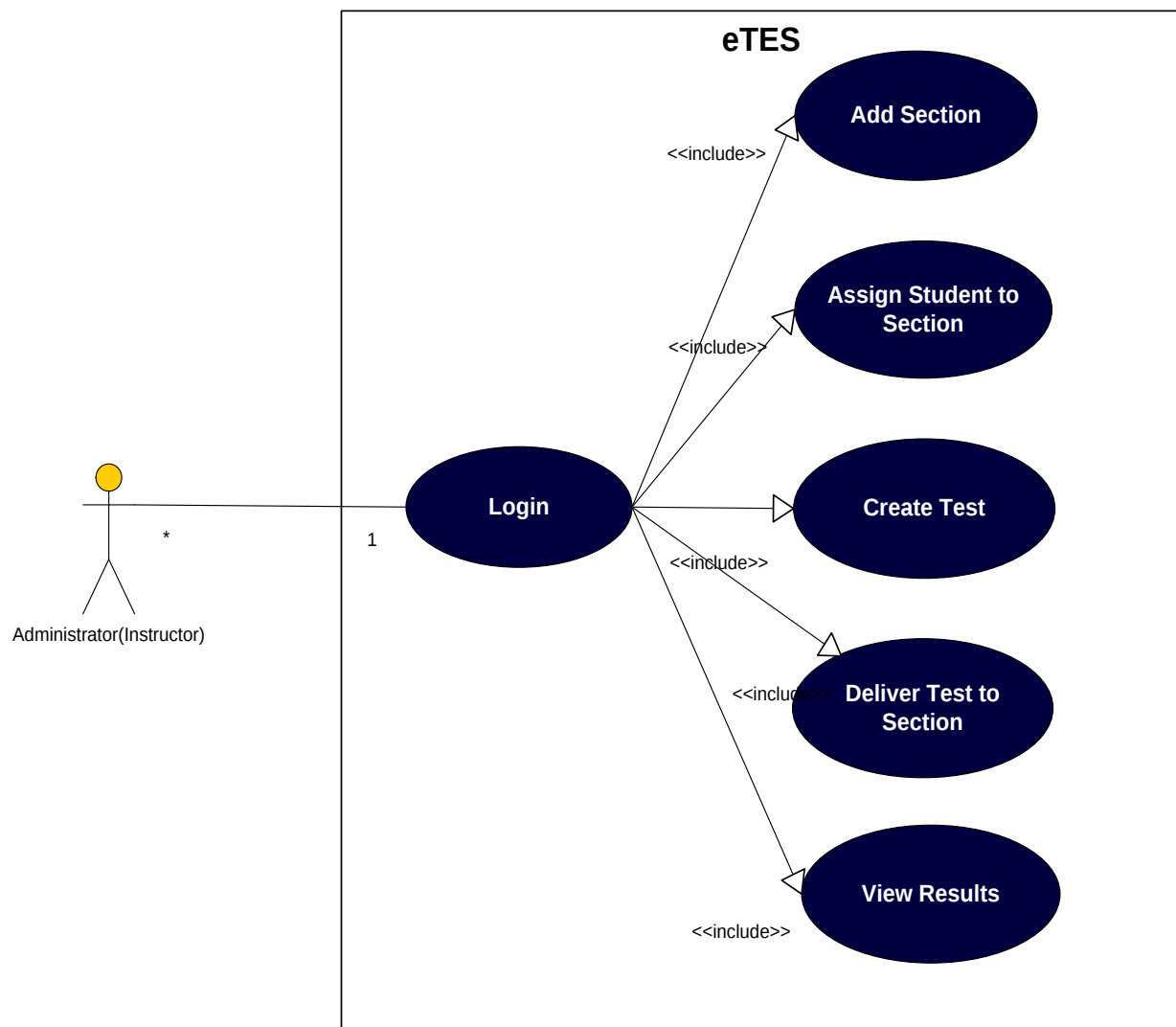


Scenario #2:

An Administrator (Power Administrator) can complete the following task:

- Add Department
- Add Courser
- Register Administrator
- Register Student
- Assign Administrator to Course

B 3. Administrator (Instructor) Sample Scenario

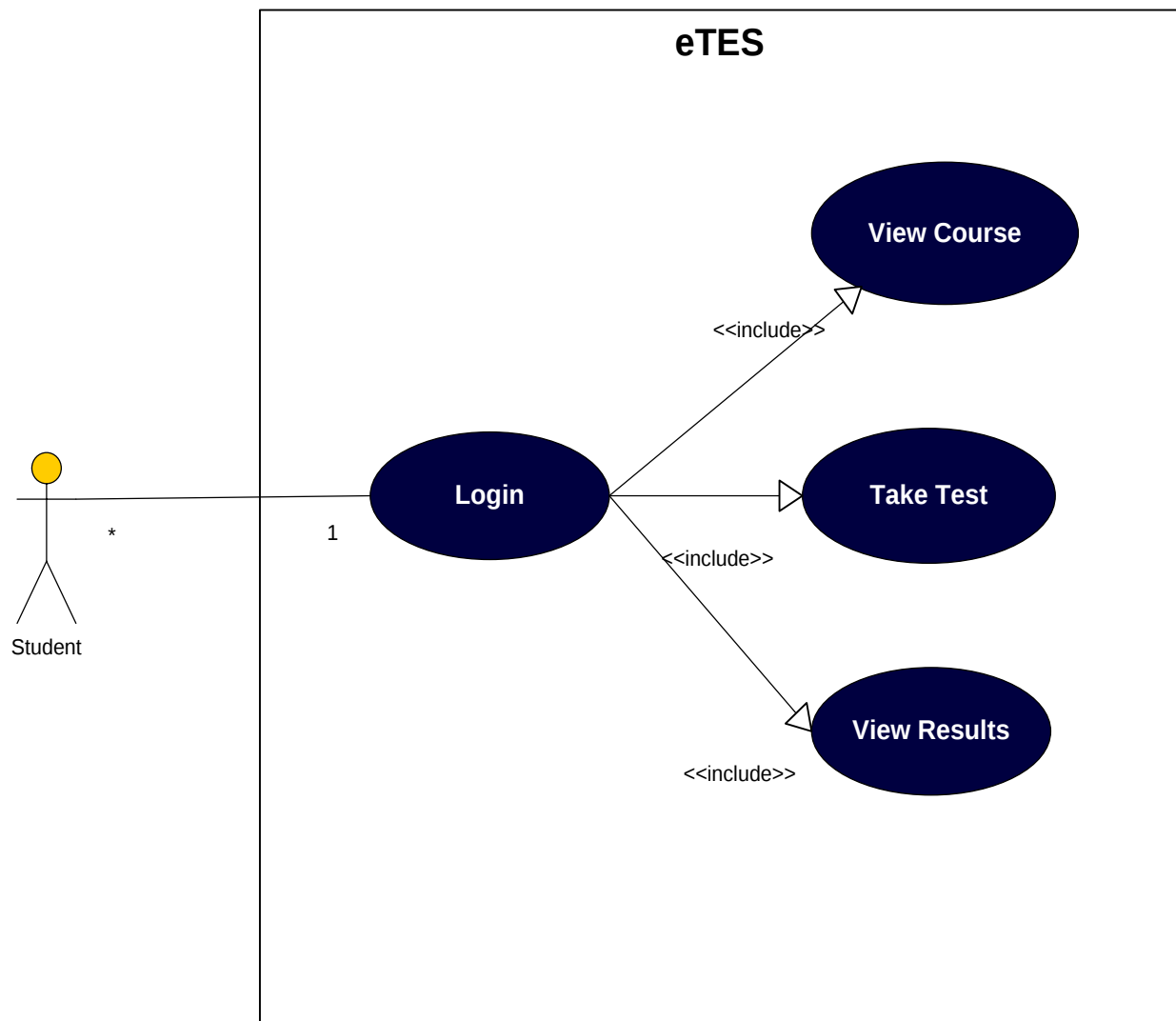


Scenario #3:

An Administrator (Instructor) can complete the following task:

- Add Section
- Assign Student to a Section
- Create Test
- Deliver Test to Section
- View Results

B 4. Student Sample Scenario



Scenario #4:

A Student can complete the following task:

- Login
- View Course
- Take Test
- View Results

Appendix C

Use-Case Narratives

C 1. Create Section use-case narrative

USE CASE NAME:	Create Section	USE CASE TYPE	
USE CASE ID:	2.2.1.1	Business Requirements:	☐
PRIORITY:	High	System Analysis:	☐
SOURCE:	eTES_decomposition_diagram	System Design:	☒
PRIMARY BUSINESS ACTOR:	Administrator		
PRIMARY SYSTEM ACTOR	Administrator		
OTHER PARTICIPATING ACTORS:	None		
DESCRIPTION:	This use case describes the event of an Administrator creating and adding a new section to a course.		
PRE-CONDITION:	Administrator must be enrolled into a Course and their enrollment into the Course must have a status of 'P' or 'A'. Also, Administrator must be authenticated.		
TRIGGER:	Step: 2 is initiated when the form loads. Step: 4 is initiated when the Administrator selects a Department Step: 6 is initiated when the Administrator selects a Course Step 8 is initiated when the Administrator adds a new Section Step: 10 is initiated when the Administrator sends the new Section to the queue Steps:12 and 13 is initiated when the Administrator releases the item in the queue		
TYPICAL COURSE	Actor Action	System Response	
	Step 1: Administrator requests the Section Registration Form	Step 2 A list of Departments that contain the Courses the Administrator is registered in, is retrieved from the data store and the Section Registration Form is displayed to the Administrator	
	Step 3: Administrator selects a Department	Step 4: The system updates the Section Registration form to displays the Active Course list associated with the selected Department	
	Step 5: The Administrator Selects a Course	Step 6: The system updates the Section Registration form to display the active inactive, and expired Section lists with respect to the selected Course	
	Step 7: The Administrator chooses to add a new Section to the selected Course	Step 8: The system prepares the form for data entry, such as enabling the appropriate controls.	

	Step 9: The Administrator chooses sends the new Section.	Step 10: The system validates the data then sends the new Section object to the transaction queue
	Step 11 The Administrator chooses to release the Section item(s) in the queue	Step 12: The system adds the Section to the data store
		Step 13 The system updates the Section lists to reflect the addition.
ALTERNATE COURSES:	Alt-Step 2: In the event when the list cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that there has been a read error. The user should then be instructed to contact the system administrator. At this point the user should be redirected to the menu page.	
	Alt-Step 10: In the event of invalid data, the system will display an error message next to the fields that contain the invalid data. The system will not continue with the Administrators request until the data is validated.	
	Alt-Step 12: In the event that a Section cannot be added to the data store, an exception is thrown and the error details are logged. A Boolean value of FALSE is returned to the caller. The section is added to the Failed Transactions List The system redisplay the form to reflect this List to the Administrator along with a failure to add sections message.	
	Alt-Step 13: In the event where the Section List cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that the list has not been updated due to read failure. Instruct the Administrator to refresh the form, if problem persists then contact the system administrator.	
CONCLUSION:	This use case concludes in a true value being returned to the caller to indicate a successful addition of the Section to the data store. The system updates the Section List to reflect the addition.	
POST-CONDITION:	The Section has been added. The connection is closed and it hibernates in the connection queue.	
BUSINESS RULES	Only Administrators have authority to utilize Section registration functionalities	
IMPLEMENTATION CONSTRAINTS AND SPECIFICATIONS	A business process than can be invoked by the Section Registration form.	
ASSUMPTIONS:	Organization exist Department exist Course Exist CAE Exist The Administrator is successfully authenticated The Administrator Course Enrollment has a status of 'P' or 'A'	
OPEN ISSUES:	none	

C 2. Modify Section use-case narrative

USE CASE NAME:	Modify Section	USE CASE TYPE	
USE CASE ID:	2.2.1.2	Business Requirements:	☐
PRIORITY:	High	System Analysis:	☐
SOURCE:	eTES_decomposition_diagram	System Design:	☒
PRIMARY BUSINESS ACTOR:	Administrator		
PRIMARY SYSTEM ACTOR	Administrator		
OTHER PARTICIPATING ACTORS:	none		
OTHER INTERESTED STAKEHOLDERS:	none		
DESCRIPTION:	This use case describes the event of a Administrator modify their Section(s) in the Course he/she is currently enrolled into		
PRE-CONDITION:	Administrator must be enrolled into a Course and their enrollment must have a status of 'P' or 'A'. The Administrator must be authenticated and has an existing Section		
TRIGGER:	Step: 2 is initiated when the form loads. Steps: 4 is initiated when the Administrator selects a department Steps 8 is initiated when the Administrator adds a new Section Steps: 10 is initiated when the Administrator sends the new Section to the queue Steps:12 and 13 is initiated when the Administrator releases the item in the queue		
TYPICAL COURSE	Actor Action	System Response	
	Step 1: Administrator requests the Section Registration Form	Step 2 A list of Departments that contain the Course(s) the Administrator is registered in, is retrieved from the data store . Then the Section Registration Form is displayed to the Administrator	
	Step 3: Administrator selects a Department	Step 4: The system updates the Section Registration form to display the Course list associated with the selected Department	
	Step 5: The Administrator Selects a Course	Step 6: The system updates the Section Registration form to display the active inactive, expired Section list with respect to the selected Course	
	Step 7: The Administrator chooses to modify an existing Section	Step 8: The system prepares the form for data entry by enabling the appropriate controls.	
	Step 9: The Administrator chooses to send the modified Section	Step 10: The system validates the data then adds the Modified Section to the Transaction Queue List	
	Step 11: The Administrator chooses to release the item(s) in	Step 12: The system applies the changes to the appropriate Section(s) in the data store.	

	the Transaction Queue List	
		Step 13 The system updates the Section lists to reflect the modified Section(s).
ALTERNATE COURSES:	Alt-Step 2: In the event when the list cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that there has been a read error. The user should then be instructed to contact the system administrator. At this point the user should be redirected to the menu page.	
	Alt-Step 10: In the event of invalid data, the system will display an error message next to the fields that contain the invalid data. The system will not continue with the Administrators request until the data is validated.	
	Alt-Step 12: In the event that a Section cannot be updated to the data store, an exception is thrown and the error details are logged. A Boolean value of FALSE is returned to the caller. The section is added to the Failed Transactions List The system redisplay the form to reflect this List to the Administrator along with a failure to add sections message.	
	Alt-Step 13: In the event where the Section List cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that the list has not been updated due to read failure. Instruct the user to refresh the form, if problem persists then contact the system administrator.	
CONCLUSION:	This use case concludes in a true value being returned to the caller to indicate a successful update of the Section to the data store	
POST-CONDITION:	The Section has been updated. The connection is closed and it hibernates in the connection queue.	
BUSINESS RULES	Only Administrators have authority to utilize Section registration functionalities	
IMPLEMENTATION CONSTRAINTS AND SPECIFICATIONS	A method than can be invoked by the caller.	
ASSUMPTIONS:	Organization exists Department exists Course exist CAE exists Section exists The Administrator is successfully authenticated The Administrator Course Enrollment has a status of 'P' or 'A'	
OPEN ISSUES:	none	

C 3. Remove Section use-case narrative

USE CASE NAME:	Remove Section	USE CASE TYPE	
USE CASE ID:	2.2.1.3	Business Requirements:	☐
PRIORITY:	High	System Analysis:	☐
SOURCE:	eTES_decomposition_diagram	System Design:	☒
PRIMARY BUSINESS ACTOR:	Administrator		
PRIMARY SYSTEM ACTOR	Administrator		
OTHER PARTICIPATING ACTORS:	none		
OTHER INTERESTED STAKEHOLDERS:	none		
DESCRIPTION:	This use case describes the event of a Administrator removing their Section(s) from the Course he/she is currently enrolled into		
PRE-CONDITION:	Administrator must be enrolled into a Course and their enrollment must have a status of 'P' or 'A'. The Administrator must be authenticated and has an existing Section		
TRIGGER:	Step: 2 is initiated when the form loads. Steps: 4 is initiated when the Administrator selects a department Steps 8 is initiated when the Administrator adds a new Section Steps: 10 is initiated when the Administrator sends the new Section to the queue Steps:12 and 13 is initiated when the Administrator releases the item in the queue		
TYPICAL COURSE	Actor Action	System Response	
	Step 1: Administrator requests the Section Registration Form	Step 2: A list of Departments that contain the Course(s) the Administrator is registered in, is retrieved from the data store . Then the Section Registration Form is displayed to the Administrator	
	Step 3: Administrator selects a Department	Step 4: The system updates the Section Registration form to displays the Course list associated with the selected Department	
	Step 5: The Administrator Selects a Course	Step 6: The system updates the Section Registration form to display the active, inactive, and expired Section list with respect to the selected Course	
	Step 7: The Administrator chooses to remove Section from the selected Course	Step 8: The system removes the selected Section from the Section List, then adds the Section to the Transaction Queue List	
	Step 9: The Administrator chooses to release the item(s) in the Transaction Queue List	Step 10: The system validates the Section status	
	Step 11 The Administrator chooses to release the Section	Step 12: Depending upon the Section Status, see the following use case:	

	item in the queue	Status 'P': 2.2.1.3.2 Status 'A': 2.2.1.3.1
		Step 13 The system updates the Section lists to reflect the deleted Section(s).
ALTERNATE COURSES:	Alt-Step 2: In the event when the list cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that there has been a read error. The user should then be instructed to contact the system administrator. At this point the user should be redirected to the menu page.	
	Alt-Step 10: In the event where Section status is neither 'P' or 'A', an exception with be thrown.	
	Alt-Step 12: In the event that a Section cannot be deleted or deactivated in the data store, an exception is thrown and the error details are logged. A Boolean value of FALSE is returned to the caller. The section is added to the Failed Transactions List The system redisplay the form to reflect this List to the Administrator along with a failure to add sections message.	
	Alt-Step 13: In the event where the Section List cannot be retrieved, an exception is thrown, error details are logged. Null is returned to the caller. The user should be prompt with a message indicating that "the list has not been updated due to read failure" instructs Administrator to "refresh the form. If the problem persists then contact the system administrator."	
CONCLUSION:	This use case concludes in a true value being returned to the caller to indicate a successful deletion of the Section(s) in the data store	
POST-CONDITION:	The Section has been deleted. The connection is closed and it hibernates in the connection queue.	
BUSINESS RULES	Only Administrators have authority to utilize Section registration functionalities	
IMPLEMENTATION CONSTRAINTS AND SPECIFICATIONS	A business process than can be invoked by the Section Registration form.	
ASSUMPTIONS:	Organization exist Department exist Course exists CAE exists Section exists The Administrator is successfully authenticated The Administrator Course Enrollment has a status of 'P' or 'A'	
OPEN ISSUES:	none	

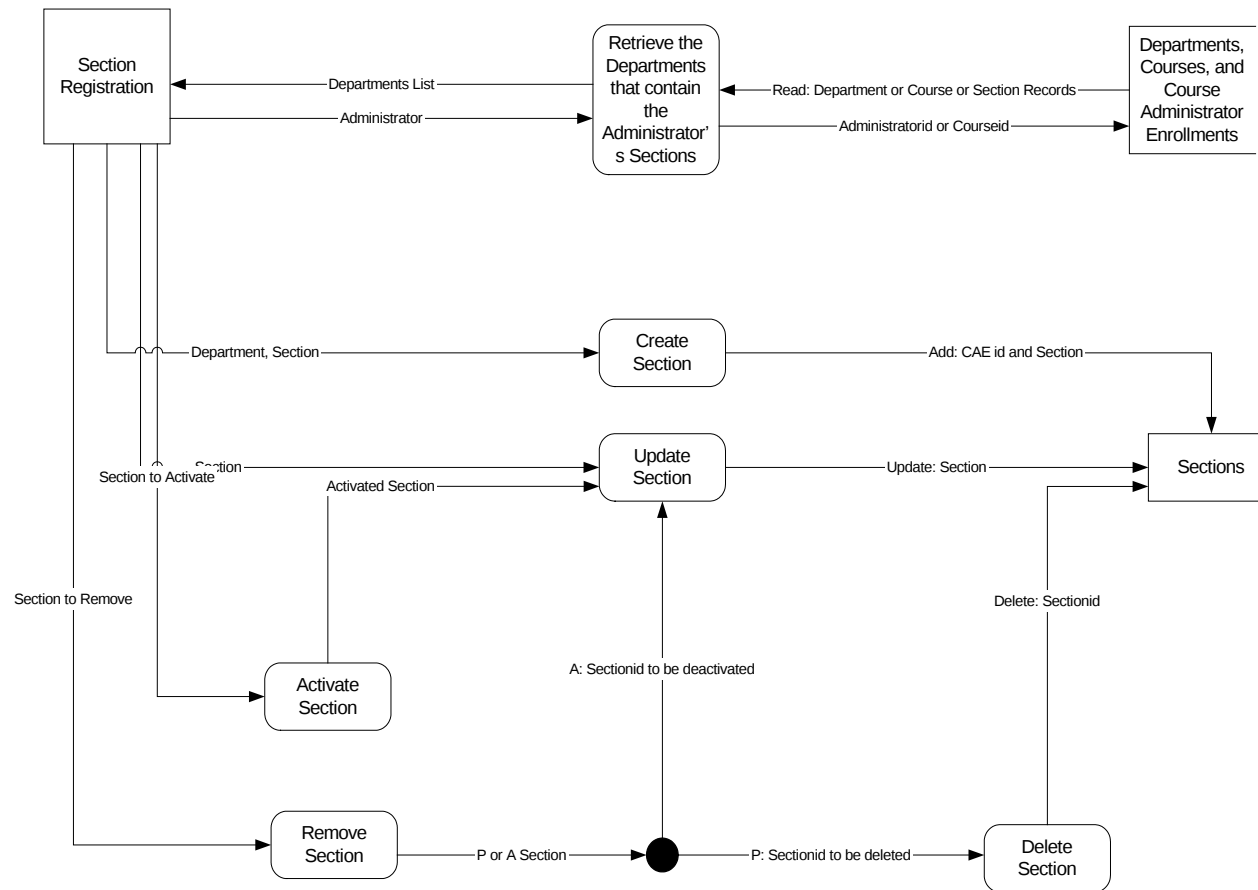
C 4. Deactivate Section use-case narrative

USE CASE NAME:	Deactivate Section	USE CASE TYPE	
USE CASE ID:	2.2.1.3.1	Business Requirements:	☐
PRIORITY:	High	System Analysis:	☐
SOURCE:	eTES_decomposition_diagram	System Design:	☒
PRIMARY BUSINESS ACTOR:	RemoveSection		
PRIMARY SYSTEM ACTOR	Administrator		
OTHER PARTICIPATING ACTORS:	none		
OTHER INTERESTED STAKEHOLDERS:	none		
DESCRIPTION:	This use case describes the event of a Section(s) being deactivated		
PRE-CONDITION:	Section must have a status of 'A'		
TRIGGER:			
TYPICAL COURSE	Actor Action	System Response	
	Step 1: RemoveSection invokes DeactivateSection	Step 2: The systems updates Section Status to 'P'.	
		Step 3: The systems passes the updated Section's ID to ModifySection to update the appropriate section in the data store	
		Step 4: The System returns a Boolean value of TRUE is returned to caller indicating that Section has been deactivated.	
ALTERNATE COURSES:	Alt-Step 2: In the event that a Section cannot be deactivated in the data store, an exception is thrown and the error details are logged. A Boolean value of FALSE is returned to the caller.		
CONCLUSION:	This use case concludes in a true value being returned to the caller to indicate a successful deactivation of the Section in the data store		
POST-CONDITION:	The Section has a status of 'A' within the data store. The connection is closed and it hibernates in the connection queue.		
BUSINESS RULES	A section can only be deactivated if its' status is of 'A'		
IMPLEMENTATION CONSTRAINTS AND SPECIFICATIONS	A method that can be invoked by the RemoveSection process		
ASSUMPTIONS:	Section exists		
OPEN ISSUES:	none		

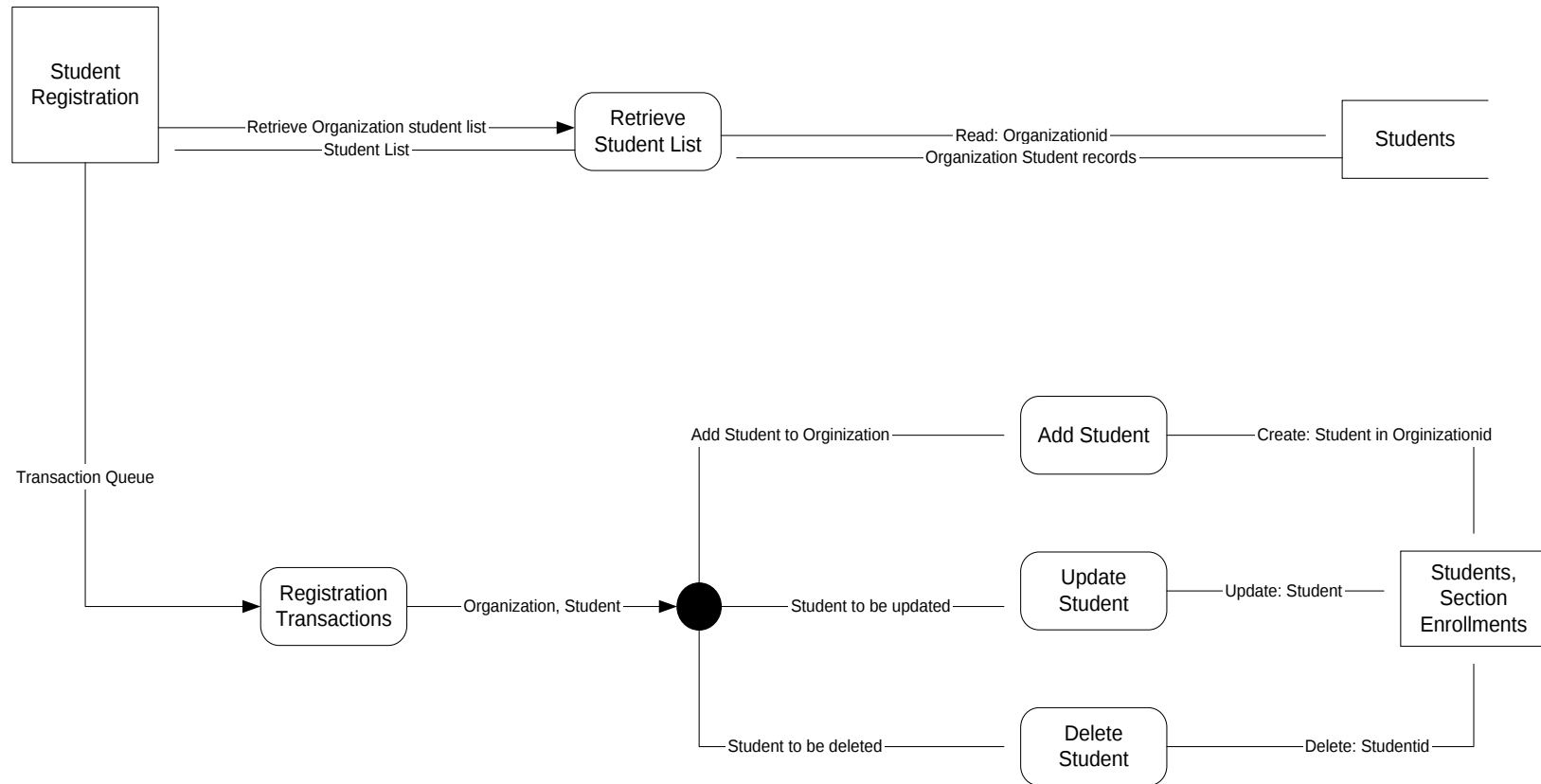
Appendix D

Data Flow Diagrams

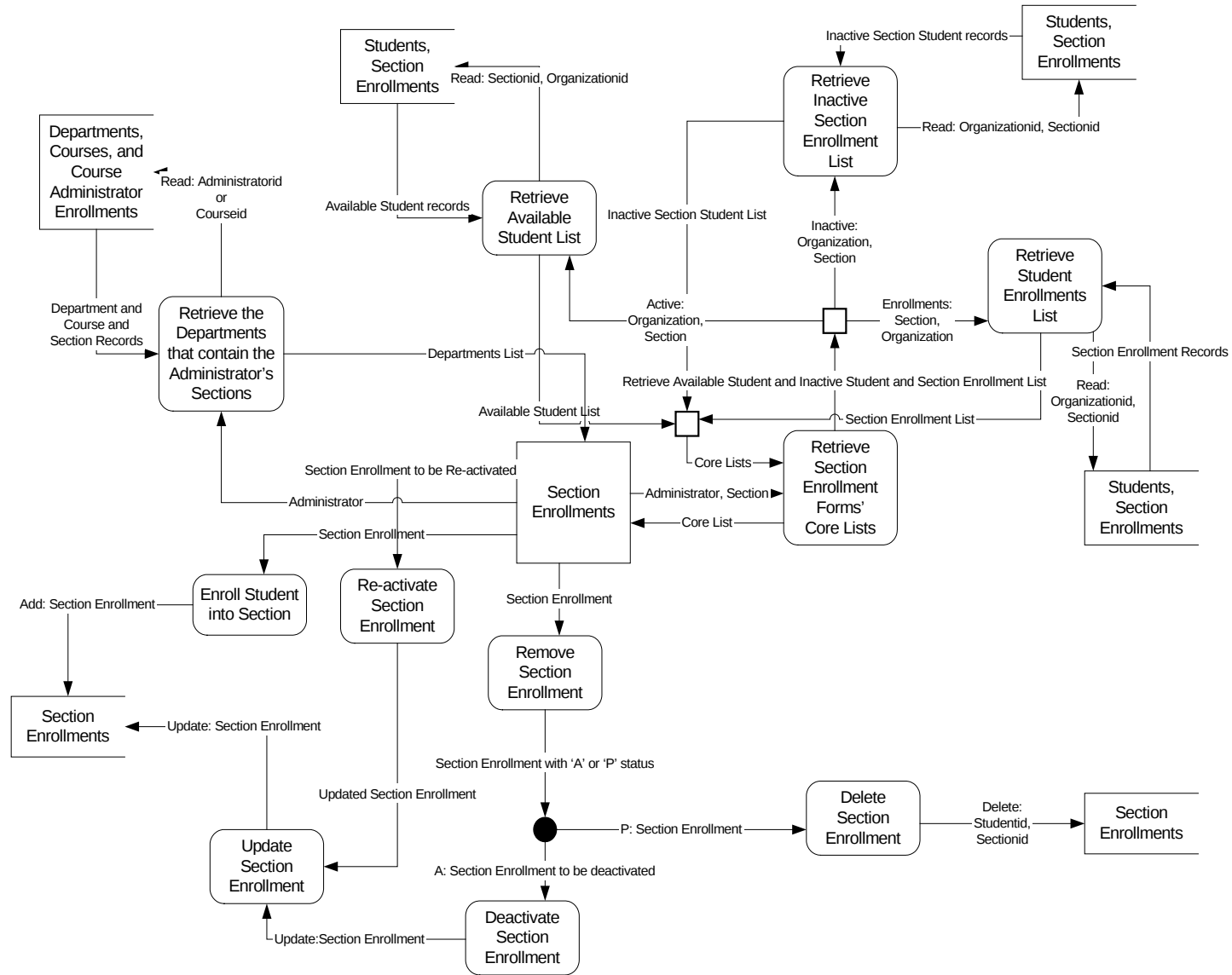
D 1. Section Registration Data Flow Diagram



D 2. Student Registration Data Flow Diagram

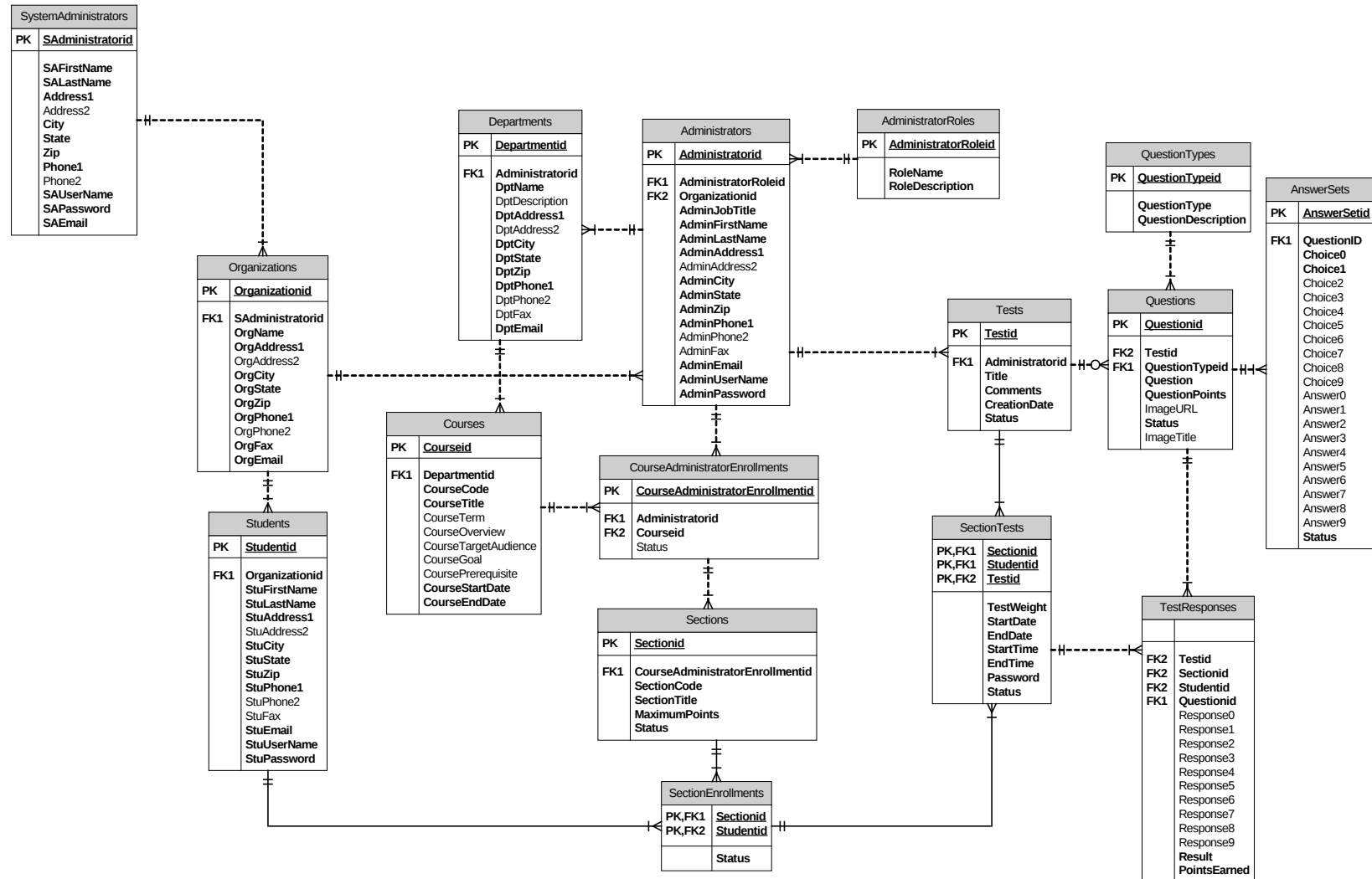


D 3. Student Section Enrollment Data Flow Diagram



Appendix E

Entity Relationship Diagram



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