

# **SMARTron Software Requirements Specification**

*Version 0.4*

Prepared by Ryan Collins, Kim Fischer, Zak Gudlin, Stephen Iskander and  
Josh Reiss

13 February, 2019

# Table of Contents

<b>Mission Statement</b>	<b>2</b>
<b>1 Introduction</b>	<b>2</b>
1.1 Purpose	2
1.2 Scope	2
1.3 Overview	2
<b>2 Overall Description</b>	<b>3</b>
2.1 Product Perspective	3
2.1.1 User interfaces	3
2.1.2 Hardware interfaces	3
2.1.3 Software interfaces	3
2.1.4 Communications interfaces	3
<b>3 Specific Requirements</b>	<b>4</b>
3.1 Use Cases	4
3.2 Use Case Diagrams	14
3.3 Sequence Diagrams	15
<b>Appendix A: 200 Question Scantron Sheet</b>	<b>16</b>
<b>Appendix B: Sample Results</b>	<b>19</b>
<b>Glossary</b>	<b>26</b>

# Mission Statement

Creating a headless scantron analyzer that comes with a companion website which allows managing exams that have previously been scanned.

## 1 Introduction

### 1.1 Purpose

The purpose of this document is to give a detailed description of the requirements for the SMARTron software. It will illustrate the purpose and complete specifications for the development of the system. It will also explain the constraints, interfaces and interactions with other external applications. This document is primarily intended to be proposed to a stakeholder for its approval and a reference for developing the first version of the system for the development team.

### 1.2 Scope

SMARTron will be an automatic grading program maintaining compatibility with existing 200-answer Scantron answer sheets. The program will allow the user to maintain a familiar workflow of scanning answer sheets and receiving an email containing the results. This will be accomplished by a headless answer sheet analysis program that receives emails containing an answer key and student answer sheets from any scanner, and emails results to the instructor.

SMARTron will also include a web app providing benefits over the current Scantron workflow. Scanned exams are associated with an instructor's LakerNet ID, and they can log in to the web app to view and edit scanned exams. The web app will provide functionality to make corrections to answer keys and rename exams. Users will also have the option to create an answer key in-app and generate a custom answer sheet compatible with the analysis program.

### 1.3 Overview

## 2 Overall Description

### 2.1 Product Perspective

#### 2.1.1 User interfaces

The user will interact with a physical scantron sheet and a web-based client that allows for re-execution of the program with different inputs.

#### 2.1.2 Hardware interfaces

The user will have access to and utilize a faculty scanner. There he will be able to scan all scantron sheets including the answer key without leaving his building. The user's PC is where he will interact with the email containing all data and statistics from the test results.

#### 2.1.3 Software interfaces

The user will be able to utilize his existing Oswego email, which is a Google account, to initiate scanning the hard copy scantrons as well as receive the test results upon completion of the analysis by the program. The user will also be interacting with the SMARTron software in order to access results, create and edit answer keys. Microsoft Excel is the other software that the user wants to synchronize with SMARTron. Once the results have been emailed to the user, they should have the ability to upload/copy the results into a current Excel spreadsheet.

#### 2.1.4 Communications interfaces

Computer

Email

Scanner

## 3 Specific Requirements

### 3.1 Use Cases

Use Case UC-1	Email Scantron Sheets
Related Use Cases	TBD
Initiating Actor	A User
Actor's Goal	To successfully email all scanned Scantron sheets to the SMARTron analyzer
Participating Actors	Scanner, SMARTron analyzer
Preconditions	There must be an existing scanner and Scantron sheets; the SMARTron analyzer must be running and have an associated email address
Postconditions	The Scantron sheets are successfully scanned and emailed to the SMARTron analyzer

	Flow of Events for Main Success Scenario
1.	The user arrives at the scanner and inputs the email address associated with the SMARTron Analyzer
2.	The user places all Scantron sheets into the scanner and presses the “start” button
3.	The scanner scans all the sheets
4.	The scanner emails the scanned files to the SMARTron analyzer

	Flow of Events for Exception Scenario
1.	The user arrives at the scanner and inputs their email
2.	The user places all Scantron sheets into the scanner and presses the “start” button
3.	The scanner scans all the sheets

4.	The scanner attempts to email the SMARTron analyzer the scanned files
5.	The SMARTron analyzer fails to receive the scanned files

<b>Use Case UC-2</b>	<b>Login to SMARTron Web App</b>
<b>Related Use Cases</b>	TBD
<b>Initiating Actor</b>	A User
<b>Actor's Goal</b>	To access the SMARTron web app
<b>Participating Actors</b>	The SMARTron web app
<b>Preconditions</b>	The user must have an existing LakerApps account
<b>Postconditions</b>	The user has access to the features of the SMARTron web app

	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The user opens the SMARTron website in their web browser
<b>2.</b>	The user is prompted to login to the SMARTron web app
<b>3.</b>	The user enters their proper credentials (email and password)
<b>4.</b>	The user is redirected to the Logged-In home page on the SMARTron website

	<b>Flow of Events for Exception Scenario</b>
<b>1.</b>	The user opens the SMARTron website in their web browser
<b>2.</b>	The user is prompted to login to the SMARTron web app
<b>3.</b>	The user enters their credentials (email and password)
<b>4.</b>	The SMARTron system displays an error message to the user that they entered an invalid username/password

<b>Use Case UC-3</b>	<b>Edit Answer Key</b>
<b>Related Use Cases</b>	TBD
<b>Initiating Actor</b>	A User
<b>Actor's Goal</b>	To successfully edit an existing answer key
<b>Participating Actors</b>	The SMARTron web app
<b>Preconditions</b>	There must be an existing account on SMARTron; there must be an existing answer key to edit
<b>Postconditions</b>	The answer key is edited to the user's preferences

	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The user logs into their SMARTron account
<b>2.</b>	The user navigates to their answer key file
<b>3.</b>	The user makes their desired changes to the answer key
<b>4.</b>	The user saves the changes to the answer key

	<b>Flow of Events for Exception Scenario</b>
<b>1.</b>	The user logs into their SMARTron account
<b>2.</b>	The user navigates to their answer key file
<b>3.</b>	The user attempts to makes their desired changes to the answer key
<b>4.</b>	The user saves the changes to the answer key
<b>5.</b>	The SMARTron system displays an error message to the user that the answer key could not be edited



<b>Use Case UC-4</b>	<b>Grade Exams</b>
<b>Related Use Cases</b>	TBD
<b>Initiating Actor</b>	Computer System
<b>Actor's Goal</b>	To successfully grade every test
<b>Participating Actors</b>	The SMARTron system
<b>Preconditions</b>	There must be an answer key to follow; There must be a test/tests sent to the SMARTron system.
<b>Postconditions</b>	The tests have the proper grades assigned.

	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The SMARTron receives all the students' tests.
<b>2.</b>	The SMARTron reads in the answer key.
<b>3.</b>	The SMARTron grades each test appropriately.

	<b>Flow of Events for Exception Scenario</b>
<b>1.</b>	The SMARTron receives all the students test.
<b>2.</b>	The SMARTron reads in the answer key.
<b>3.</b>	The SMARTron fails to grade each test appropriately.

<b>Use Case UC-5</b>	<b>Match Grades to Corresponding Student</b>
<b>Related Use Cases</b>	TBD
<b>Initiating Actor</b>	A User
<b>Actor's Goal</b>	To successfully track each answer given by a student.
<b>Participating Actors</b>	The SMARTron system, A User
<b>Preconditions</b>	There must be at least one graded test from the SMARTron system; The user must have received an email to view the SMARTron results.
<b>Postconditions</b>	The SMARTron system displays the students answers; A user can navigate to individual tests for a given student

	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The user receives an email from the SMARTron system
<b>2.</b>	The user opens the email from the SMARTron system
<b>3.</b>	The SMARTron system displays the test results
<b>4.</b>	The user navigates to given student's answers
<b>5.</b>	The SMARTron system displays the student's answers

	<b>Flow of Events for Exception Scenario</b>
<b>1.</b>	The user receives an email from the SMARTron system
<b>2.</b>	The user opens the email from the SMARTron system
<b>3.</b>	The SMARTron system displays the test results
<b>4.</b>	The user navigates to given student's answers
<b>5.</b>	The SMARTron system displays the student's grades but fails to provide the user with a student's answers

<b>Use Case UC-6</b>	<b>Email Results to User</b>
<b>Related Use Cases</b>	UC-1
<b>Initiating Actor</b>	SMARTron Analyzer
<b>Actor's Goal</b>	To automate grading of Scantron sheets.
<b>Participating Actors</b>	User
<b>Preconditions</b>	There must be an existing SMARTron system; the user must scan the Scantron sheets.
<b>Postconditions</b>	The user has received a CSV file of exam grades

	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The SMARTron system emails the user.
<b>2.</b>	The user opens the email from the SMARTron system.
<b>3.</b>	The email displays the test results.
<b>4.</b>	The user receives the grade spreadsheet as an email attachment.

	<b>Flow of Events for Exception Scenario</b>
<b>1.</b>	The SMARTron system emails the user.
<b>2.</b>	The user opens the email from the SMARTron system.
<b>3.</b>	The SMARTron system attempts to displays the test results
<b>4.</b>	The SMARTron system displays an error message to the user that the grades were not calculated

<b>Use Case UC-7</b>	<b>Analyze Data for Each Question</b>
<b>Related Use Cases</b>	TBD
<b>Initiating Actor</b>	The SMARTron system
<b>Actor's Goal</b>	To successfully analyze every question
<b>Participating Actors</b>	The SMARTron system; A User
<b>Preconditions</b>	There must be at least one test to analyze and an answer key
<b>Postconditions</b>	The test displays the results and information on each question

	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The SMARTron system receives a test to analyze
<b>2.</b>	The SMARTron system analyzes a test
<b>3.</b>	The SMARTron system returns the results of the test to the user
<b>4.</b>	The user can view data on each question of the test

	<b>Flow of Events for Exception Scenario</b>
<b>1.</b>	The SMARTron system receives a test to analyze
<b>2.</b>	The SMARTron system analyzes a test
<b>3.</b>	The SMARTron system attempts to returns the results of the test to the user
<b>4.</b>	The SMARTron system displays an error message to the user that the data is not currently available.

<b>Use Case UC-8</b>	<b>Generate Custom Exam Sheet</b>
<b>Related Use Cases</b>	TBD
<b>Initiating Actor</b>	The User
<b>Actor's Goal</b>	To create a customized exam sheet for a multiple-choice test
<b>Participating Actors</b>	The SMARTron web app
<b>Preconditions</b>	The user must have an existing LakerApps account registered to the SMARTron system; the user must be logged into their account
<b>Postconditions</b>	A custom exam sheet is generated for future use

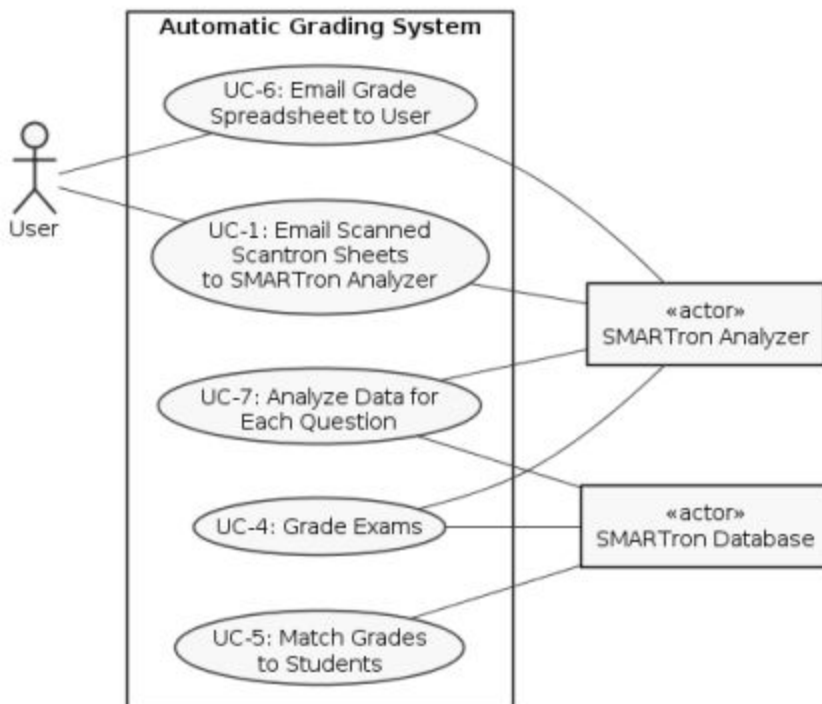
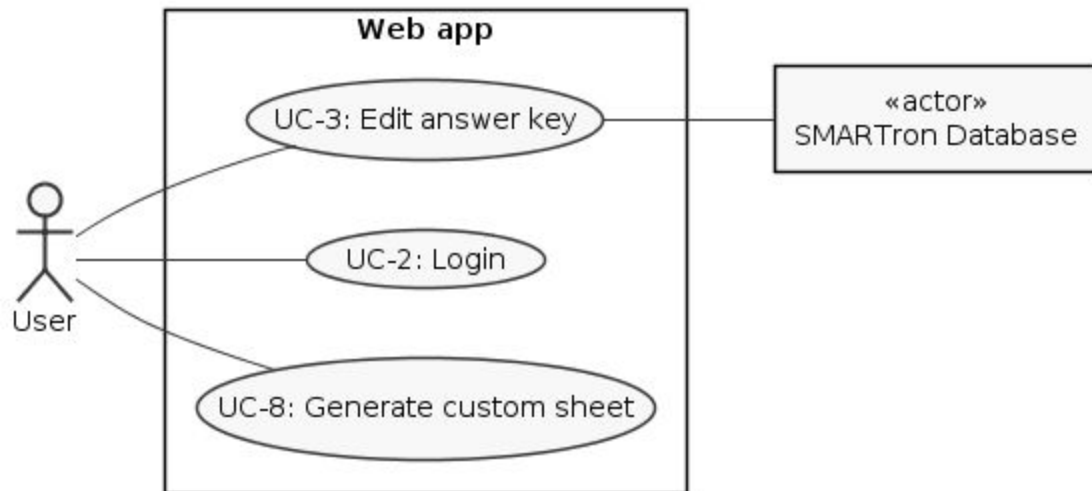
	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The user logs into the SMARTron web app
<b>2.</b>	The user navigates to the “create exam sheet” page
<b>3.</b>	The user customizes an exam sheet using the web app’s user interface
<b>4.</b>	The user saves the custom exam sheet

	<b>Flow of Events for Exception Scenario</b>
<b>1.</b>	The user logs into the SMARTron web app
<b>2.</b>	The user navigates to the “create exam sheet” page
<b>3.</b>	The user customizes an exam sheet using the web app’s user interface
<b>4.</b>	The SMARTron web app displays an error when the user attempts to save the custom exam sheet

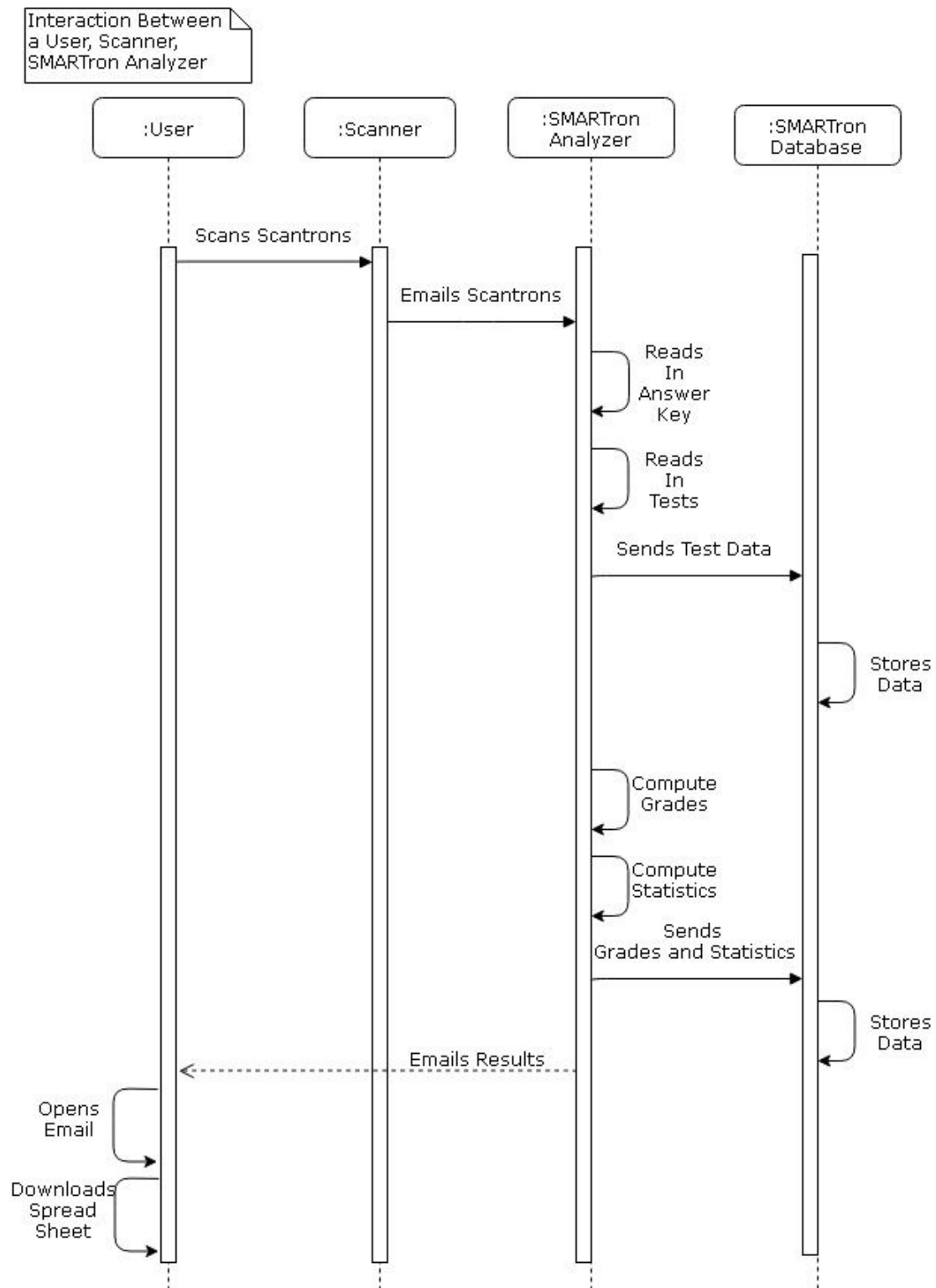
<b>Use Case UC-9</b>	<b>Fix Unbalanced/Unfair Test Questions</b>
<b>Related Use Cases</b>	UC-7
<b>Initiating Actor</b>	A User
<b>Actor's Goal</b>	To change point values of questions
<b>Participating Actors</b>	The SMARTron system
<b>Preconditions</b>	There must be an existing account on SMARTron; there must be an existing answer key
<b>Postconditions</b>	The user can change the point value of any question determined unfit

	<b>Flow of Events for Main Success Scenario</b>
<b>1.</b>	The user logs into their SMARTron account
<b>2.</b>	The user navigates to a “make changes” section
<b>3.</b>	The user chooses which data they would like to edit, question point values
<b>4.</b>	The user has the ability to change the point value associated with different questions

## 3.2 Use Case Diagrams

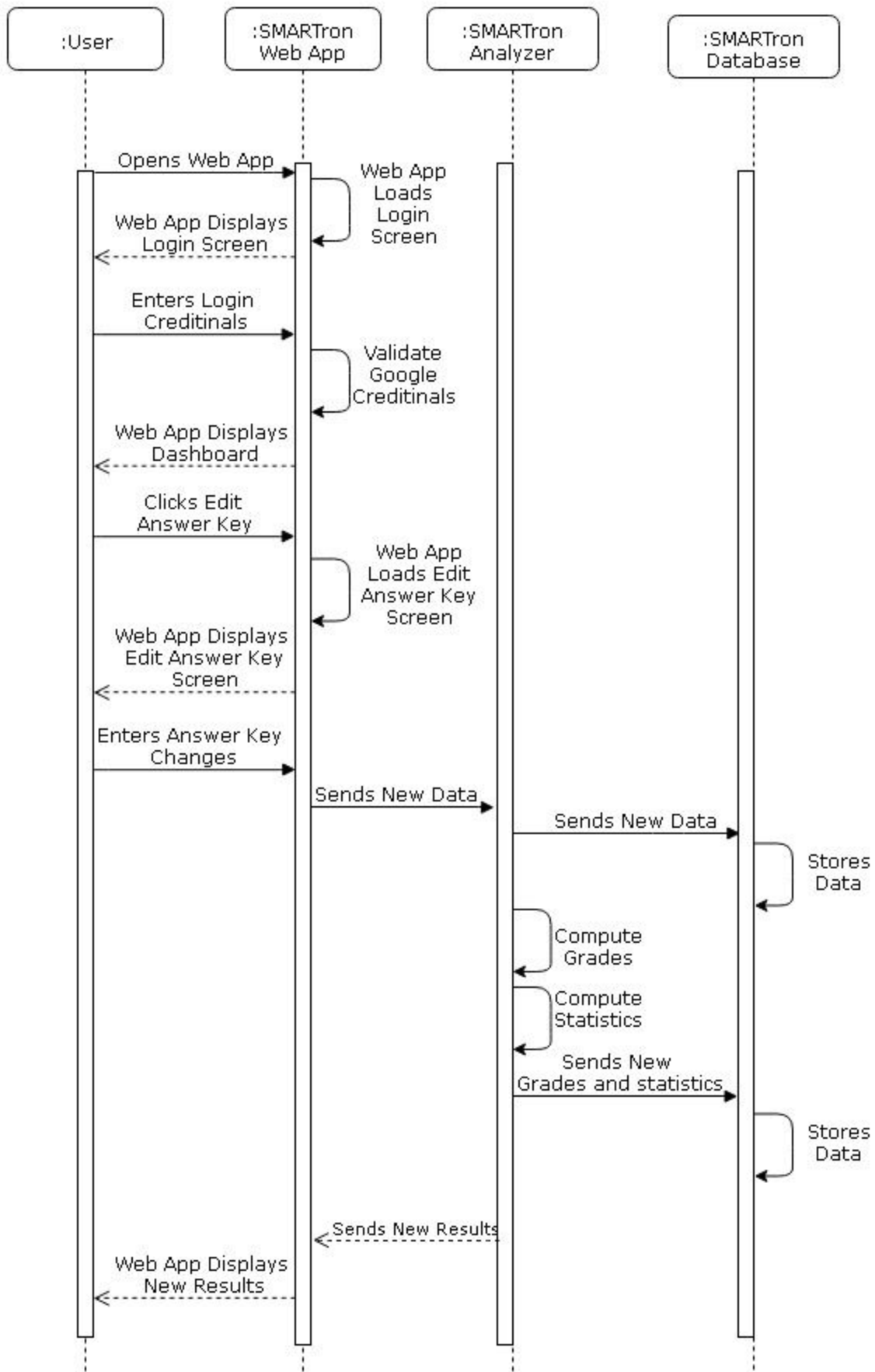


### 3.3 Sequence Diagrams





Editing Answer Key



## Appendix A: 200 Question Scantron Sheet

[illegible]



SIDE 2

101	A B C D E	111	A B C D E	121	A B C D E	131	A B C D E	141	A B C D E
102	A B C D E	112	A B C D E	122	A B C D E	132	A B C D E	142	A B C D E
103	A B C D E	113	A B C D E	123	A B C D E	133	A B C D E	143	A B C D E
104	A B C D E	114	A B C D E	124	A B C D E	134	A B C D E	144	A B C D E
105	A B C D E	115	A B C D E	125	A B C D E	135	A B C D E	145	A B C D E
106	A B C D E	116	A B C D E	126	A B C D E	136	A B C D E	146	A B C D E
107	A B C D E	117	A B C D E	127	A B C D E	137	A B C D E	147	A B C D E
108	A B C D E	118	A B C D E	128	A B C D E	138	A B C D E	148	A B C D E
109	A B C D E	119	A B C D E	129	A B C D E	139	A B C D E	149	A B C D E
110	A B C D E	120	A B C D E	130	A B C D E	140	A B C D E	150	A B C D E
151	A B C D E	161	A B C D E	171	A B C D E	181	A B C D E	191	A B C D E
152	A B C D E	162	A B C D E	172	A B C D E	182	A B C D E	192	A B C D E
153	A B C D E	163	A B C D E	173	A B C D E	183	A B C D E	193	A B C D E
154	A B C D E	164	A B C D E	174	A B C D E	184	A B C D E	194	A B C D E
155	A B C D E	165	A B C D E	175	A B C D E	185	A B C D E	195	A B C D E
156	A B C D E	166	A B C D E	176	A B C D E	186	A B C D E	196	A B C D E
157	A B C D E	167	A B C D E	177	A B C D E	187	A B C D E	197	A B C D E
158	A B C D E	168	A B C D E	178	A B C D E	188	A B C D E	198	A B C D E
159	A B C D E	169	A B C D E	179	A B C D E	189	A B C D E	199	A B C D E
160	A B C D E	170	A B C D E	180	A B C D E	190	A B C D E	200	A B C D E

**SCANTRON®**  
GENERAL PURPOSE  
ANSWER SHEET  
form no. 4521

EXAMPLES

- WRONG  
1 1 3 4 5  
2 1 2 4 5  
WRONG  
3 1 2 4 5  
RIGHT  
4 1 2 3 5

IMPORTANT DIRECTIONS  
FOR MARKING ANSWERS

- Use #2 pencil only.
- Do NOT use ink or ballpoint pens.
- Make heavy black marks that fill the circle completely.
- Erase cleanly any answer you wish to change.
- Make no stray marks on the answer sheet.

DO NOT WRITE  
IN THIS SPACE

Reorder Form No. 4521  
www.ScantronStore.com  
800-722-6876

**SCANTRON®**

© 2008 Scantron Corporation ALL RIGHTS RESERVED.

SCANTRON Trans-Optic® EM-4521-5654321

## Appendix B: Sample Results

Student Statistics Report				
Overall				
Student	Grade	Total	Percent	
	F	0 / 24	0.00	
	B	20 / 24	83.33	
	D	16 / 24	66.67	
	C	18 / 24	75.00	
	B	20 / 24	83.33	
	B	20 / 24	83.33	
	D	16 / 24	66.67	
	F	14 / 24	58.33	
	B	20 / 24	83.33	
	A	22 / 24	91.67	
	F	14 / 24	58.33	
	F	14 / 24	58.33	
	F	14 / 24	58.33	
	D	16 / 24	66.67	
	D	16 / 24	66.67	
	A	22 / 24	91.67	
	C	18 / 24	75.00	
	C	18 / 24	75.00	
	B	20 / 24	83.33	
	A	24 / 24	100.00	
	C	18 / 24	75.00	
	C	18 / 24	75.00	
	B	20 / 24	83.33	
	C	18 / 24	75.00	
	D	16 / 24	66.67	
	B	20 / 24	83.33	
	F	14 / 24	58.33	
	D	16 / 24	66.67	
	B	20 / 24	83.33	
	D	16 / 24	66.67	
	C	18 / 24	75.00	

3/8/2017

Student Statistics Report

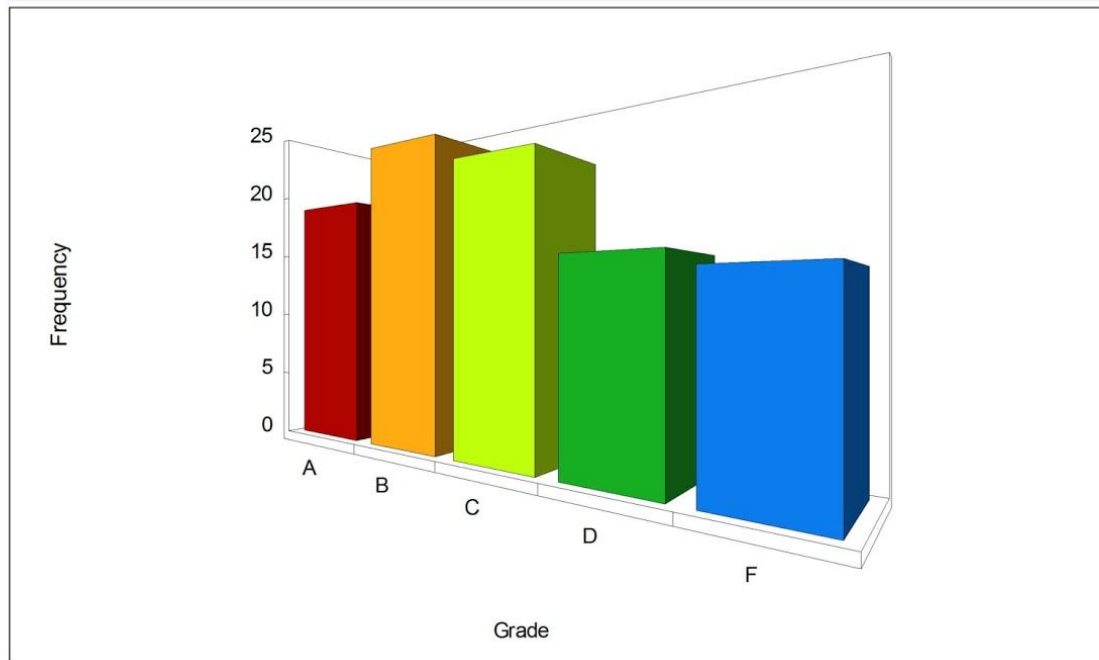
Page 1

## Class Frequency Distribution Report

Overall

Mean Score: 76.02%

Grade	Percent Score	Raw Score	Frequency	Percent
A	90.00 - 100.00	21.60 - 24.00	19	21.11
B	80.00 - 89.99	19.20 - 21.59	23	25.56
C	70.00 - 79.99	16.80 - 19.19	21	23.33
D	60.00 - 69.99	14.40 - 16.79	14	15.56
F	0.00 - 59.99	0.00 - 14.39	13	14.44






**Note:** No 3D bar graphs!

Test Statistics Report	
	Overall
<b>Score Data</b>	
Number of Graded Items	12
Total Points Possible	24
Maximum Score	24
Minimum Score	0
<b>Statistics</b>	
Mean Score	18.24
Mean Percent Score	76.02
Benchmark Score	-
Range of Scores	24.00
Standard Deviation	3.71
Variance	13.76
<b>Percentiles</b>	
Percentile (25)	16.00
Median Score	18.00
Percentile (75)	20.00
Inter Quartile Range	4.00
<b>Confidence Intervals</b>	
1%	17.22
5%	17.47
95%	19.02
99%	19.27
<b>Test Reliability</b>	
Kuder-Richardson Formula 20	0.57
Kuder-Richardson Formula 21	1.84
Coefficient (Cronbach) Alpha	0.57


## Condensed Item Analysis Report

Legend: Correct:  Incorrect:  Distractors Chosen More than Correct Answer: 




### Question1

Response	Frequency	Percent	
* A	83	92.22	
B	4	4.44	
C	0	0.00	
D	2	2.22	
E	0	0.00	
Missing	1	1.11	



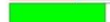
### Question2

Response	Frequency	Percent	
A	1	1.11	
B	1	1.11	
* C	87	96.67	
D	0	0.00	
E	0	0.00	
Missing	1	1.11	





### Question3

Response	Frequency	Percent	
A	4	4.44	
* B	82	91.11	
C	3	3.33	
D	0	0.00	
E	0	0.00	
Missing	1	1.11	





### Question4

Response	Frequency	Percent	
A	6	6.67	
B	34	37.78	
* C	49	54.44	
D	0	0.00	
E	0	0.00	
Missing	1	1.11	




### Question5

Response	Frequency	Percent	
A	5	5.56	
B	16	17.78	
C	3	3.33	
* D	65	72.22	
E	0	0.00	
Missing	1	1.11	


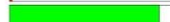

### Question6

Response	Frequency	Percent	
* A	78	86.67	
B	6	6.67	
C	0	0.00	
D	4	4.44	
E	0	0.00	
Missing	2	2.22	





### Question7

Response	Frequency	Percent	
A	0	0.00	
* B	79	87.78	
C	1	1.11	
D	8	8.89	
E	0	0.00	
Missing	2	2.22	





### Question8

Response	Frequency	Percent	
A	2	2.22	
* B	76	84.44	
C	11	12.22	
D	0	0.00	
E	0	0.00	
Missing	1	1.11	

### Question9

Response	Frequency	Percent	
A	43	47.78	
* B	21	23.33	
C	20	22.22	
D	5	5.56	
E	0	0.00	
Missing	1	1.11	

### Question10

Response	Frequency	Percent	
A	21	23.33	
* B	43	47.78	
C	11	12.22	
D	14	15.56	
E	0	0.00	
Missing	1	1.11	



Question11

Response	Frequency	Percent	
A	1	1.11	
B	6	6.67	
C	1	1.11	
*D	81	90.00	
E	0	0.00	
Missing	1	1.11	

Question12

Response	Frequency	Percent	
A	2	2.22	
B	6	6.67	
C	4	4.44	
*D	77	85.56	
E	0	0.00	
Missing	1	1.11	

## SMARTron Software Requirements Specification v0.4

Test Item Statistics Report									
Question		Summary Statistics				Reliability			
Question	Points	Graded	Correct	Incorrect	No Response	Point Biserial	Percent Correct		
Question1	2	90	83	6	1	0.35	92.22		
Question2	2	90	87	2	1	0.55	96.67		
Question3	2	90	82	7	1	0.40	91.11		
Question4	2	90	49	40	1	0.48	54.44		
Question5	2	90	65	24	1	0.58	72.22		
Question6	2	90	78	10	2	0.41	86.67		
Question7	2	90	79	9	2	0.35	87.78		
Question8	2	90	76	13	1	0.49	84.44		
Question9	2	90	21	68	1	0.37	23.33		
Question10	2	90	43	46	1	0.45	47.78		
Question11	2	90	81	8	1	0.36	90.00		
Question12	2	90	77	12	1	0.35	85.56		

## Glossary

Term	Definition
<i>User</i>	An individual who utilizes the system
<i>Scantron sheet</i>	A paper form that contains fields for answering multiple choice questions with a fixed layout
<i>PC</i>	Personal Computer
<i>SMARTron Analyzer</i>	The headless application that receives and processes Scantron sheets and emails results
<i>SMARTron Web App</i>	The web app that provides the user interface for viewing and correcting scanned exams
<i>LakerNet ID</i>	The username/identification a user will provide, specific to SUNY Oswego