



Robustness Index

A Software Metric for Measuring the Robustness of a Software System

A software metric allows for insight into the complexity, maturity, sufficiency, and success of a product, project, or process enabling continuous improvement of the quality of the product, project, or process making project management easier and making more common accurate estimates in cost, effort, and schedule.

The Robustness Index (RI) measures the ability of the software system to handle erroneous inputs, conditions, and external events without crashing, producing incorrect or unexpected results, or causing a failure.

The formula for calculating the Robustness Index involves a combination of factors related to error handling, exception management, and recovery mechanisms:

RI Formula
$RI (\%) = (\text{Number of Successfully Handled Errors} / \text{Total Number of Errors}) * 100$

The Robustness Index produces a percentage which represents the system's robustness in handling errors and results according to the requirements specified. The greater the percentage, the greater the reliability of the software system to effectively handle various inputs without compromising the system. The converse holds true as well.

Apply the Robustness Index Software Metric

Student Grade Management System (SGMS)

RI (%)	Description	Reasons
High (90% - 100%)	Handles a variety of inputs without crashing or producing incorrect results. Input Messages are informative to the Devs and user appropriate.	<ol style="list-style-type: none">1. Comprehensive Error Handling: invalid inputs and database errors.2. Error Messages are designed with the user in mind.3. Strong Exception Management: catching exceptions thrown to prevent system errors such as database access and execution or divide by zero computations.
Moderate (70% - 89%)	Handles common errors and exceptions with few exceptions outside of complex scenarios. Users may experience unexpected behavior or crashes in some cases.	<ol style="list-style-type: none">1. Basic error handling with few uncommon errors being unaccounted for.2. Some error messages may not be helpful to users.3. Only certain exceptions are handled by the system leaving gaps in exception handling across all modules.
Low (< 70%)	Struggles to handle erroneous and unexpected inputs often resulting in crashes or data corruption and inaccuracies. Users frequently encounter issues that disrupt the experience.	<ol style="list-style-type: none">1. Lacks basic and comprehensive error handling mechanisms leading to exceptions which cause system failure.2. Error messages are too technical or complex for the end users.3. The system is prone to crash due to lack of exception handling across modules.

RI Rating for the Student Grade Management System

Of the 15 input values which include exception handling inputs, malicious inputs, and incorrect inputs that were tested in various modules of the software system, 11 errors were handled successfully and 4 errors were handled unsuccessfully.

The RI Rating of the Student Grade Management System is 73 % scoring the software system a moderate Robustness Index rating:

RI
$RI (\%) = (11/15) * 100 = 73 \%$

List of Test Inputs (Total 15):

1. Invalid File Path: C:\Users\JohnDoe\Desktop\Grades 2021 Spring\CSC 835 2021 Spring.csv

PASS

Student Grade Management System

Where Data Masters

And Grads Rule!

Import Student Grade Records Form

File to Import C:\Users\JohnDoe\Desktop\Grades 2021 Spring\CSC 835 2021 Spring.csv

CancelImport

Error: Could not find a part of the path
C:\Users\JohnDoe\Desktop\Grades 2021 Spring\CSC 835 2021
Spring.csv.

OK

Import RecordsAdd RecordDelete RecordModify RecordPrint ReportSUN

2. Empty Input: Import Records

PASS

Student Grade Management System

Where Data Matters

And Grades Rule!

Import Student Grade Records Form

File to Import

Cancel

Import

There is some data missing in the form.

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SDW

3. Empty Input: Add Record

PASS

Student Grade Management System

Where Data Matters

And Grades Rule!

New Grade Record Form

Student ID

Course Prefix

Course Number

Grade

Year

Semester

Submit

There is some data missing in the form.

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SDW

4. Empty Input: Delete Record

PASS

Student Grade Management System

Where Data Masters

And Grades Rule!

Search for Grade Record Form

Student ID

Course Prefix

Course Number

Year

Semester

Search

There is some data missing in the form.
OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SW

5. Empty Input: Modify Record

PASS

Student Grade Management System

Where Data Masters

And Grades Rule!

Modify Grade Record Form

Student ID

Course Prefix

Course Number

Grade

Year

Semester

123456

CSC

835

2023

Summer

Submit

Cancel

There is some data missing in the form.
OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SW

6. Unexpected Input: Grade Record Search Form: Incorrect Data (non-existing student grade record)

PASS

Student Grade Management System

Where Data Matters

Search for Grade Record Form

And Grades Rule!

Student ID

123458

Course Prefix

ART

Course Number

099

Year

2000

Semester

Winter

Search

No student grade record found for:
Student ID: 123458
Course Prefix: ART
Course Number: 099
Year: 2000
Semester: Winter

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

See



- Unexpected Input: Modify Grade Record Form: Incorrect Data (non-existing student grade record)

FAIL: message to user misleading. Backend shows that no grade record was updated since the grade record was not found.

Student Grade Management System

Modify Grade Record Form

Student ID: 123457
Course Prefix: ART
Course Number: 099
Grade: A
Year: 2000
Semester: Winter

Submit

Existing grade has been modified successfully:
New Grade: Winter
Student ID: 123457
Course Prefix: ART
Course Number: 099
Year: A
Semester: 2000

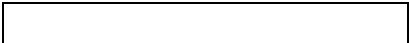
OK

Import Records Add Record Delete Record Modify Record Print Report

Form1.cs [Design] csc835StudentGradeManagementSystemCM Form1 - button20_Click(object sender, EventArgs e) Ln: 1578 Ch: 26 SPC: CRLF

Output

```
Show output from: Debug
The thread 0x4058 has exited with code 0 (0x0).
The thread 0x36dc has exited with code 0 (0x0).
The thread 0xb64 has exited with code 0 (0x0).
Connected to the MariaDB database.
No student grade record found for the specified student grade record:
Student ID: 123458
Course Prefix: ART
Course Number: 899
Year: 2000
Semester: Winter
Connection closed.
Connected to the MariaDB database.
Student Grade Record Found: 123456 CSC 835 2023 Summer
Connection closed.
The thread 0x4058 has exited with code 0 (0x0).
Connected to MariaDB database.
Rows affected: 0
Connection closed.
No data found.
Rows affected: -1
No data found.
Rows affected: -1
GPA: 0
Rows affected: 0
Connection closed.
The thread 0xf4c has exited with code 0 (0x0).
```



HeidiSQL 12.5.0.6677

Database: csc340_db

Query:

```
1 SELECT * FROM csc835_cruzmacias_courses;
2 SELECT * FROM csc835_cruzmacias_student_info WHERE StudentID = '123456';
3
4 SELECT * FROM csc835_cruzmacias_student_info WHERE StudentID IN ('123456', '189467', '475821');
5 SELECT * FROM csc835_cruzmacias_student_grades WHERE StudentID = '123456';
6
7 DELETE FROM csc835_cruzmacias_student_grades WHERE StudentID IN ('123456', '189467', '475821');
8 UPDATE csc835_cruzmacias_student_info SET OverallGPA = 0 WHERE StudentID IN ('123456', '189467', '475821');
```

StudentID	CourseID	Grade	Year	Semester
123456	CSC	B	2023	Summer
189467	CSC	B	2023	Summer
475821	CSC	B	2023	Summer
123456	CSC	A	2023	Spring
123456	CSC	B	2023	Spring

rs: c1 (497 B) Connected: 00:02 h MariaDB 10.8.3 Uptime: 33 days, 15:43 h Server time: 11:30 PM Idle

8. Invalid Input: Import Student Grade Records Form: Enter the path to an executable batch script which opens a command console in system root with administrative privileges.

PASS

Student Grade Management System

Where Data Meets Art & Science

Import Student Grade Records Form

File to Import: C:\cygwin64\Cygwin.bat

Cancel Import

Error: Index was outside the bounds of the array.
OK

Import Records Add Record Delete Record Modify Record Print Report

9. Invalid Student ID: Print Report Search for Student Record Form

PASS

Student Grade Management System

Where Data Matters

And Grades Rule!

Search for Student Record form

Student ID123458

Print Report Card

Print Transcript

Cancel

Search

Student grade records not found!

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

See

10. Invalid Student ID: Print Transcript Button with Non-Existing Student ID

FAIL: message to user misleading. Transcript.pdf is unchanged (see Date Modified).

Student Grade Management System

Where Data Matters

And Grades Rule!

Search for Student Record form

Student ID123458

Print Report Card

Print Transcript

Cancel

Search

Printing transcript to C:\Users\Public\Downloads\.

OK

Import Records

Add Record

Delete Record

Modify Record

Public Downloads

New

Copy

Paste

Move

Share

Delete

Sort

View

...

Users > Public > Public Downloads

Search Public Do...

Name	Date modified	Type	Size
Transcript	8/12/2023 4:14 PM	Chrome HTML Do...	2 KB

1 item

11. Invalid Input: Print Report Search for Student Record Form (non-numeric characters)

PASS

Student Grade Management System

Where Data Matters

And Grades Rule!

Search for Student Record form

Student ID

ABCD1234

Print Report Card

Print Transcript

Cancel

Search

Student grade records not found!

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SW

12. Invalid Input: Search for Grade Record Form (non-numeric characters and non-alpha characters)

PASS

Student Grade Management System

Where Data Matters

And Grades Rule!

Search for Grade Record Form

Student ID

ABCD1234

Course Prefix

111

Course Number

CSC

Year

Summer

Semester

2023

Search

No student grade record found for:
Student ID: ABCD1234
Course Prefix: 111
Course Number: CSC
Year: Summer
Semester: 2023

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SW

13. Invalid Input: Delete Grade Record Form (non-alphanumeric characters)

FAIL: message to user misleading. No grade record found to delete.

Student Grade Management System

Where Data Matters

And Grade Rule!

Delete Grade Record Form

Student ID

ABCD123456!

Course Prefix

ABCD123456!

Course Number

ABCD123456!

Year

ABCD123456!

Semester

ABCD123456!

Submit

Existing grade has been deleted successfully:
Student ID: ABCD123456!
Course Prefix: ABCD123456!
Course Number: ABCD123456!
Year: ABCD123456!
Semester: ABCD123456!

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SDN

14. Invalid Input: Add Grade Record Form (Duplicate Record)

FAIL: message to user does not inform the user that a duplicate record has been entered.

Student Grade Management System

Where Data Matters

New Grade Record Form

And Grades Rule!

Student ID

123456

Course Prefix

CSC

Course Number

835

Grade

A

Year

2023

Semester

Summer

Submit

New grade has been added successfully:
Student ID: 123456
Course Prefix: CSC
Course Number: 835
Grade: A
Year: 2023
Semester: Summer

OK

Import Records

Add Record

Delete Record

Modify Record

Print Report

SQL

Host: csitmariadb.eku.edu

Database: csc340_db

Query*

14

15

16

17

18

19

20

21

22

23

SELECT * FROM csc835_cruzmacias_student_grades WHERE StudentID = '123456';

csc835_cruzmacias_student_grades (5r x 6c)

StudentID	CoursePrefix	CourseNum	Grade	Year	Semester
123456	CSC	835	A	2023	Summer
123456	CSC	736	A	2023	Spring
123456	CSC	737	B	2023	Spring
123456	CSC	815	A	2022	Fall
123456	CSC	835	A	2023	Summer



15. Long SQL Injection: New Grade Record Form

PASS

Student Grade Management System

Where Data Matters

New Grade Record Form

And Grades Rule!

Student ID

Course Prefix

Course Number

Grade

Year

Semester

Submit

Error: Data too long for column 'StudentID' at row 1

OK

Import Records Add Record Delete Record Modify Record Print Report

SQL