University of Sevilla

Higher Technical School of Computer Engineering

D04 – Student #3 Testing Report

Degree in Computer Engineering - Software Engineering

Desing and Testing II

Course 2024 – 2025

Date	Version
23/05/2025	v1.0

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Repository: https://github.com/DP2-2025-C1-040/Acme-ANS

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1. Revision Table

Date	Version	Description	Delivery
23/05/2025	v1.0	First report's version	D04
24/05/2025	v2.0	Add comparison between two computers	D04
25/06/2025	v3.0	Corrections First Call	C2

2. Execution summary

For this testing document, each of the implementations present in the mandatory requirements of the D04 deliverable have been developed and explained.

Both the system performance and the functional performance of each and every one of the requested functions have been evaluated, in this case, those related to ‘flight assignment’ and ‘activity log’. The methodology provided in Lesson 04, ‘S01 - Formal testing’ and ‘S02 - Performance testing’ was followed.

The system performs robustly in terms of functionality, although there are areas that could use a little attention.

3. Introduction

This document is divided into two distinct sections:

1. Functional testing: a list of implemented test cases, grouped by functionality, will be presented. For each one, a description and an indication of how effective it is in detecting errors will be given. For effectiveness, the code coverage and a screenshot of the code will be used to check that all possible decisions have been tested during the execution of the program to avoid the existence of errors.

2. Performance testing: appropriate graphs and a 95% confidence interval will be provided for the time taken for the requests in the tests on two different computers. In addition, after the tests on the different computers, it will be indicated which of these is the most powerful and offers the best performance.

4. Functional Testing

Tests cases related to flight assignment:

- Create flight assignment:
    - Description: the restrictions of all the fields of the flight assignment creation form are tested with values related to positive, negative and hacking cases.
    - Coverage: 99.6%
    - Effectiveness: coverage is almost 100%, so it is almost perfect. We notice some yellow lines in some cases of null objects, for example ‘crewMember != null’, because in no case this object is going to be null.
- Delete flight assignment:
    - Description: the elimination of a flight assignment is tested, with positive, negative and hacking cases. In addition, its associated activity logs are checked for deletion.
    - Coverage: 59.8%
    - Effectiveness: in this case, the coverage is 63% due to the unbind method and some “object != null”, as in no case this method is entered but it is necessary for the other services.
- List landed flight assignments:
    - Description: the list of landed flight assignments associated with the currently logged-in flight crew member is tested. The different hacking cases are also verified.
    - Coverage: 100%
    - Effectiveness: perfect coverage.
- List programmed flight assignments:
    - Description: the list of programmed flight assignments associated with the currently logged-in flight crew member is tested. The different hacking cases are also verified.
    - Coverage: 100%
    - Effectiveness: perfect coverage.
- Publish flight assignment:
    - Description: the publication of a flight assignment is tested. It is checked that if the leg has already occurred, it cannot be published and the different cases of hacking.
    - Coverage: 97.2%

- Effectiveness: almost perfect coverage with some yellow lines in some cases of null objects.

- Show flight assignment:
  - Description: the display of a flight assignment, with its corresponding flight crew member and associated leg, is tested. In addition, the different hacking cases are tested.
  - Coverage: 98.9%
  - Effectiveness: near-perfect coverage. We notice some yellow lines in some cases of null objects, for example 'assignment != null', because in no case this object is going to be null.

- Update flight assignment:
  - Description: the constraints of all fields of a flight assignment update form are tested with values for positive, negative and hacking cases.
  - Coverage: 98.5%
  - Effectiveness: near-perfect coverage. Same case as above with null objects.

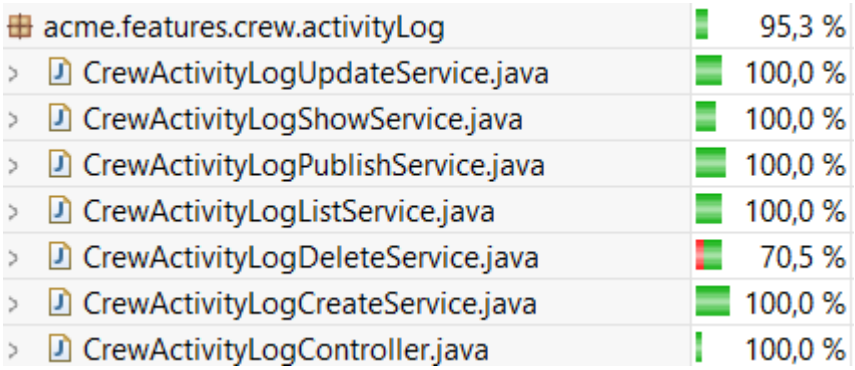
In short, the only red thing that can be seen is the unbind method of the delete service, since it is not executed at any time, as it is impossible to enter this condition. On the other hand, the lines in yellow have already explained the reason for their cause. For all these reasons and for having an average coverage of 93.5% in flight assignment, it is considered that the existence of potential failures or bugs is negligible.

Test cases relating to activity log records:

- Create activity log:
    - Description: the restrictions of all the fields of the activity log creation form are tested with values related to positive, negative and hacking cases.
    - Coverage: 100%
    - Effectiveness: perfect coverage.
- Delete activity log:
    - Description: the elimination of an activity log is tested, with positive, negative and hacking cases.
    - Coverage: 70.5%
    - Effectiveness: coverage is around 70% due to the unbind method, as in the delete flight assignment. This is not a cause for concern as the unbind method is the same as in other services and is already proven to work correctly in those services.
- List activity logs:
    - Description: the list of activity logs associated with the currently logged-in flight crew member is tested. The different hacking cases are also verified.
    - Coverage: 100%
    - Effectiveness: perfect coverage.
- Publish activity log:
    - Description: the publication of a activity log is tested. It is checked that if the associated flight assignment is not published, the activity log cannot be published and the different cases of hacking.
    - Coverage: 100%
    - Effectiveness: perfect coverage.
- Show activity log:
    - Description: the display of a activity log, with its corresponding flight assignment, is tested. In addition, the different hacking cases are tested.
    - Coverage: 100%
    - Effectiveness: perfect coverage.

- Update activity log:
    - Description: the constraints of all fields of a activity log update form are tested with values for positive, negative and hacking cases.
    - Coverage: 100%
    - Effectiveness: perfect coverage.

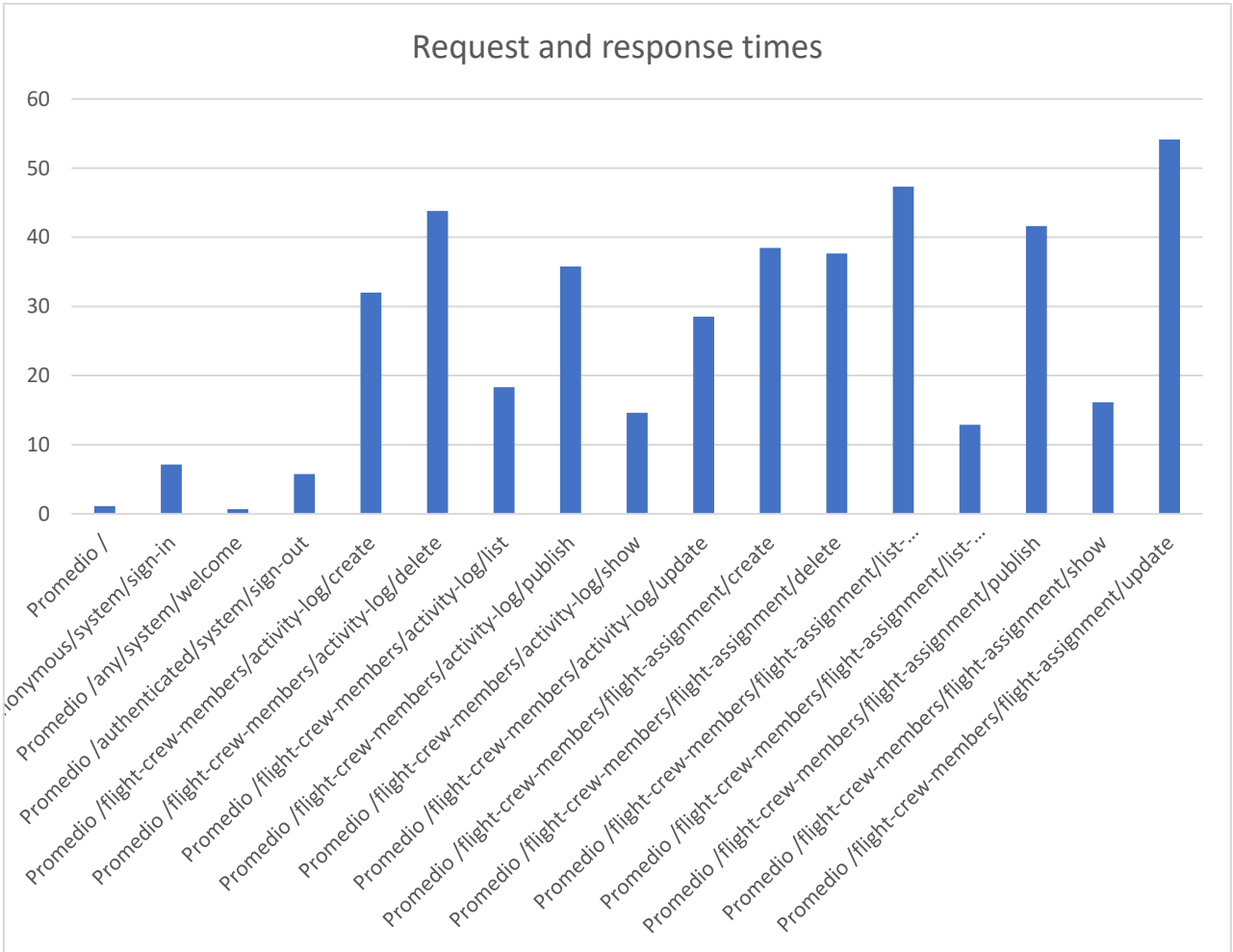
In short, the only red thing that can be seen is the unbind method of the delete service, since it is not executed at any time, as it is impossible to enter this condition. On the other hand, the lines in yellow have already explained the reason for their cause. For all these reasons and for having an average coverage of 95.3% in activity log, it is considered that the existence of potential failures or bugs is negligible.



5. Performance testing

After performing the set of tests for the appropriate functionalities, all the steps shown in 'S02 - Performance testing' have been carried out, obtaining the following results:

Promedio /	1,11908194
Promedio /anonymous/system/sign-in	7,15005147
Promedio /any/system/welcome	0,6736705
Promedio /authenticated/system/sign-out	5,73552049
Promedio /flight-crew-members/activity-log/create	32,0134874
Promedio /flight-crew-members/activity-log/delete	43,7840338
Promedio /flight-crew-members/activity-log/list	18,3401975
Promedio /flight-crew-members/activity-log/publish	35,7766541
Promedio /flight-crew-members/activity-log/show	14,6028433
Promedio /flight-crew-members/activity-log/update	28,5038834
Promedio /flight-crew-members/flight-assignment/create	38,4464875
Promedio /flight-crew-members/flight-assignment/delete	37,669543
Promedio /flight-crew-members/flight-assignment/list-landed	47,3172475
Promedio /flight-crew-members/flight-assignment/list-programmed	12,8989294
Promedio /flight-crew-members/flight-assignment/publish	41,6194275
Promedio /flight-crew-members/flight-assignment/show	16,128854
Promedio /flight-crew-members/flight-assignment/update	54,1563999
Promedio general	15,2472312



As can be seen in the images above, the average time taken by the system to perform a request is approximately 15.2 ms, i.e. 0.015 seconds, which is quite fast.

Furthermore, the bar chart clearly shows that the requests that take the longest time are those that handle a larger amount of data and validations, specifically those related to the update, delete and list of a flight assignment. This is partly due to the fact that several validations of the FlightAssignment class and the associated ActivityLog class (because access to the associated activity logs requires access to flight assignments).

Although the performance tests without indexes met the established requirements (with an average of 15 ms), it was decided to add indexes on the most queried fields. The appropriate comparisons are made of the different values obtained in each test and we obtain:

Before				*After*		
Media	15,2472312			Media	8,579185766	
Error típico	0,74258784			Error típico	0,440434464	
Mediana	9,5095			Mediana	5,96835	
Moda	0,411999			Moda	0,248599	
Desviación estándar	20,579198			Desviación estándar	12,20567791	
Varianza de la muestra	423,50339			Varianza de la muestra	148,9785732	
Curtosis	6,61648773			Curtosis	7,121238251	
Coeficiente de asimetría	2,35580792			Coeficiente de asimetría	2,488307167	
Rango	121,905			Rango	85,637301	
Mínimo	0,1918			Mínimo	0,1858	
Máximo	122,0968			Máximo	85,823101	
Suma	11709,8736			Suma	6588,814668	
Cuenta	768			Cuenta	768	
Nivel de confianza(95,0%)	1,45774576			Nivel de confianza(95,0%)	0,864600032	
Interval (ms)	13,7894854	16,704977		Interval (ms)	7,714585733	9,4437858
Interval (s)	0,01378949	0,01670498		Interval (s)	0,007714586	0,00944379

The indexes reduced the average to 8.6 ms (has improved by 44%), which improves the stability of the system and prepares it for higher data volume scenarios.
To determine whether the average times before and after the changes can be considered the same or not, a z-test was performed with the following results:

Prueba z para medias de dos muestras

	46,109499	*55,1475*
Media	15,2069936	8,51847088
Varianza (conocida)	423,50339	148,978573
Observaciones	767	767
Diferencia hipotética de las mec	0	
z	7,74188975	
P(Z<=z) una cola	4,885E-15	
Valor crítico de z (una cola)	1,64485363	
Valor crítico de z (dos colas)	9,77E-15	
Valor crítico de z (dos colas)	1,95996398	

Given this two-tailed p-value result (≈0), we can conclude that, being in the interval between [0, 0.05), the changes made have been fruitful and have helped to improve performance.

The performance of the system will now be compared on two different computers. The first computer will be the one on which all the above tests have been performed and the second will be another team member's computer. Here are the results:

Computer1				*Computer2*		
Media	8,57918577			Media	6,45906328	
Error típico	0,44043446			Error típico	0,34109603	
Mediana	5,96835			Mediana	4,40485	
Moda	0,248599			Moda	0,3476	
Desviación estándar	12,2056779			Desviación estándar	9,45273049	
Varianza de la muestra	148,978573			Varianza de la muestra	89,3541137	
Curtosis	7,12123825			Curtosis	14,5108171	
Coeficiente de asimetría	2,48830717			Coeficiente de asimetría	3,16009522	
Rango	85,637301			Rango	87,2468	
Mínimo	0,1858			Mínimo	0,1318	
Máximo	85,823101			Máximo	87,3786	
Suma	6588,81467			Suma	4960,5606	
Cuenta	768			Cuenta	768	
Nivel de confianza(95,0%)	0,86460003			Nivel de confianza(95,0%)	0,66959256	
Interval (ms)	7,71458573	9,4437858		Interval (ms)	5,78947072	7,12865584
Interval (s)	0,00771459	0,00944379		Interval (s)	0,00578947	0,00712866

We can see the difference in results.

Prueba z para medias de dos muestras		
	55,1475	*53,924*
Media	8,518470884	6,3971794
Varianza (conocida)	148,978573	89,3541137
Observaciones	767	767
Diferencia hipotética de las medias	0	
z	3,805451804	
P(Z<=z) una cola	7,07728E-05	
Valor crítico de z (una cola)	1,644853627	
Valor crítico de z (dos colas)	0,000141546	
Valor crítico de z (dos colas)	1,959963985	

As can be seen, the value of the two-tail p-value is 0.00014, value which is in the Interval [0, 0.05).

6. Conclusions

After creating this testing report, it has been concluded that this phase of the project lifecycle is vital. Verifying that all developed functions work correctly and are thoroughly checked to minimise errors or failures, as well as ensuring that performance is optimised as much as possible, are fundamental aspects for the client. A thoroughly tested system allows the end-user to use it quickly and intuitively, avoiding problems that can detract from their experience.
In addition, a meticulous testing process contributes to customer satisfaction and product reputation, ensuring that quality and efficiency expectations are consistently met.

7. Bibliography

- 06 Annexes - Material provided in the subject Design and Testing II by the University of Seville.
- L04 - S01 - Formal testing - Material provided in the subject Design and Testing II by the University of Seville.
- L04 - S02 - Performance testing - Material provided in the subject Design and Testing II by the University of Seville.