



**UNIVERSIDAD TÉCNICA DEL NORTE**

**FACULTY OF APPLIED SCIENCES ENGINEERING  
CAREER OF COMPUTER SYSTEMS ENGINEERING**

## **SCIENTIFIC PAPER**

**SUBJECT:**

**“STUDY OF THE INTEGRATION OF FRAMEWORK BOOTSTRAP AND  
PRIMEFACES FOR THE DEVELOPMENT OF ADAPTIVE WEB APPLICATIONS  
WITH JAVA SERVER FACES.**

**APPLICATION: NOTES CONTROL SYSTEM FOR THE EDUCATIONAL UNIT  
MARIANO SUAREZ VEINTIMILLA”**

**AUTHOR**

**Wilson Mauricio Tituaña Maldonado**

**DIRECTOR**

**ING. Mauricio Rea**

**IBARRA – ECUADOR**

# STUDY OF THE INTEGRATION OF FRAMEWORK BOOTSTRAP AND PRIMEFACES FOR THE DEVELOPMENT OF ADAPTIVE WEB APPLICATIONS WITH JAVA SERVER FACES.

## APPLICATION: NOTES CONTROL SYSTEM FOR THE EDUCATIONAL UNIT MARIANO SUAREZ VEINTIMILLA

*Wilson Mauricio Tituaña Maldonado*

Pucara vía antigua, Antonio Ante, Imbabura

wtituana@utn.edu.ec

**Abstract.** *The growth in web and mobile development in recent times has raised the demand for development of applications that cover all the needs of the customer and in the same way meet the parameters required in software development such as usability, flexibility and modularity are A very important part for the creation of software that provides quality service.*

*In order to meet these needs, the study of two web tools that provide the appropriate elements for the development of mobile web applications, this analysis will serve as a basis for future studies and as an academic resource for all software developers.*

### Keywords

Integration, Software, Java Server Faces, Primefaces, Bootstrap, web applications

**Resumen.** *El crecimiento en el desarrollo de la tela y el móvil en estos últimos tiempos ha elevado la demanda de desarrollo de aplicaciones que cubran todas las necesidades del cliente y la forma misma cumplan los parámetros exigidos en el desarrollo del software cuentas como usabilidad, flexibilidad y modularidad que son Una parte muy importante para la creación de un software que brinde servicio de calidad.*

*Con el afán de cumplir estas necesidades se realiza el estudio de dos herramientas que proporcionan los elementos adecuados para el desarrollo de aplicaciones web móviles, este análisis servirá de base para futuros estudios y como recurso académico para todos los desarrolladores de software.*

### Palabras Claves

Integración, Software, Java Server Faces, Primefaces, Bootstrap, aplicaciones web.

## 1. Introduction

Initially web applications were created for desktop browsers to facilitate user tasks, but in recent years web applications have been growing rapidly and increasing its complexity due to the accelerated growth of technology that compels the developer to look for new efficient solutions that are Adapt to current devices such as Smartphones, tablets and others.

Bootstrap is a front-end framework, was created by Mark Otto and a group of developers as an internal solution to the inconsistencies and reduce the huge work involved in maintaining projects, was published in August 2011 as a device approach project Mobile open source based CSS style sheets. So far one of the best structured and independent frameworks of work, capable of integrating with all applications based on the HTML standard effectively (Camacho, 2015).

Primefaces for its part, an open source framework created specifically to speed up the Front-End development of web applications based on Java technology such as JSF Java Server Pages (jsp). One of the prime objectives is to provide a set of flexible components and capabilities to integrate with other technologies that have similar components and also offers several predesigned templates (Primetek, 2015).

## 2. Research Technology

### 2.1 Java Server Faces

JSF is a fast application development oriented (RAD) technology, as most frameworks use the jsf pattern development in three-layer view controller model (MVC), it is specially defined for web application development with java language, its Great flexibility allows easy coupling with other technologies. The number of components makes jsf one of the most robust frameworks. It depicts its following figure architecture:

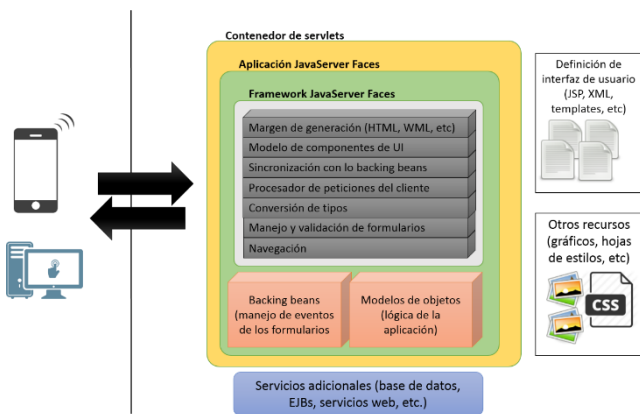


Figura. 1. Architecture JSF (Mann, 2005)

#### 2.1.1 How JSF Works

JavaServer Faces is responsible for managing the events sent by the JSF components and processing them. The events are generated by the activities performed by the user, such as pressing a button or any other component associated with an event or the famous listener, which will make a call to the controller's methods.

When the user clicks the button, the generated event is sent to the server where it will be processed by the facesServlet. This is referred to as the life cycle of a JSF request consisting of several phases that handle those events.

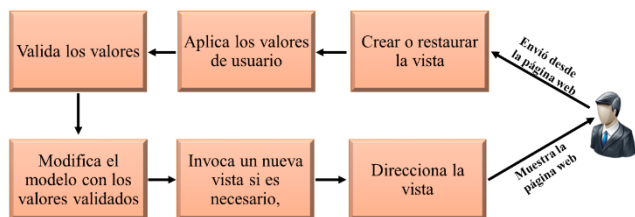


Figura. 2. Life cycle of a JSF application (Ed Burns, 2010)

### 2.2 Bootstrap

Bootstrap is a framework that facilitates the development of the web interface and is based on the standards of HTML, CSS and Javascript, incorporate several pre-designed forms, form, buttons, menus and other components that facilitate and accelerate the front development of applications Web.

Bootstrap is based on the concept "First Mobile or Mobile First" which refers to the ability to dynamically adapt to the size of the device from which the user enters the application, so that the website interface is flexible and consistent thanks To its architecture based on "responsive design" adaptive design. (Spurlock, 2013).

Bootstrap is mainly based on CSS stylesheets and in the LESS dynamic style sheet language, it also has built-in javascript plugins that for their correct operation require jQuery.

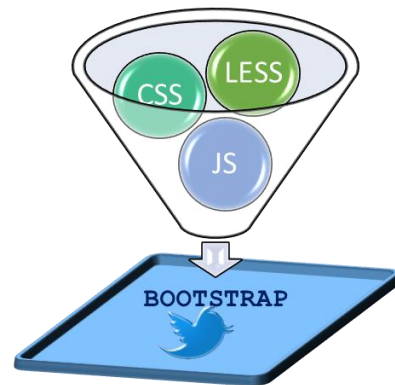


Figura. 3. Architecture Bootstrap.

### 2.3 Primefaces

Primefaces is a Font-end framework created mainly to be integrated with java server faces, offers a library of very light and easy components to implement in a web application, does not require additional configurations or external dependencies, since everything is Packaged in a file of type jar, the same that you can download it from its official page. <http://primefaces.org/downloads>.

Primefaces is a framework that helps to create the most elegant and intuitive user interfaces, is open source, its development and maintenance is done by the company Turca Prime Technology. (PrimeTek, 2009-2014).

### 2.3.1 Main features

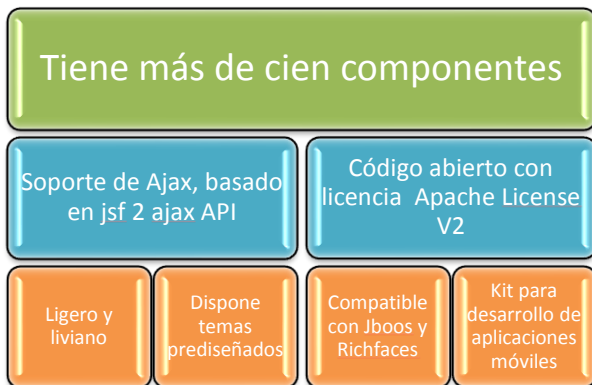


Figura. 4. Main features of Primefaces.

### 2.4 Integration Bootstrap y Primefaces

The development of web applications has undergone considerable changes due to the great demands that arise year after year, factors such as security, versatility, efficiency and among others cause the developer to move in the search for new alternatives that comply with the norms so Demanding standards that are currently in place.

So we have chosen to join several technologies, such as frameworks and APIs that help improve the quality, design, presentation and manipulation of data within the application, in this way is intended to meet customer expectations. For this reason, the Bootstrap and Primefaces frameworks are chosen because they are tried and tested tools and highly recommended by experts in the area of web development.

#### 2.4.1 Analysis of Bootstrap and Primefaces integration

Since the two frameworks are oriented to improve the user interface and have the ability to run in the same work environment independently and synchronously.

##### 2.4.1.1 Ease of development

For the analysis of these tools has been chosen eclipse as IDE development, since it includes all the characteristics necessary to generate this type of projects.

Let's see the parameters that will allow us to know the ease of installation and use of each tool within the IDE development.

Parámetros	Criterios	Bootstrap	Primefaces
Aprendizaje	Disponibilidad de información	Si	Si
Componentes de interfaz de usuario	Disponibilidad de componentes	Si	Si
Facilidad para el desarrollo	Facilidad de instalación	Si	Si
	Facilidad de uso		
	Soporte Ajax		

Figura. 5. Learning Criteria.

In the following table you can see the most relevant points that will help to understand the structure of each framework and open the way to integration.

	Bootstrap	Primefaces
Ejecuta en JSF	Si	Si
Dependencias Externas	No	No
100% compatibles	No	No
Estructura de archivos	Hojas de estilo	Java clases
Open Source	Si	Si
Disponibilidad de componentes	100%	100%

Figura. 6. Functional information of frameworks.

### 2.5 Framework integration

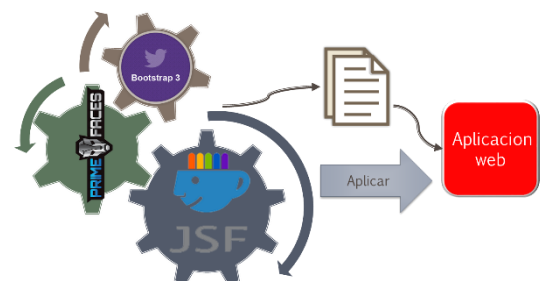


Figura. 7. Graphical representation of integration.

You can combine these two frameworks as follows, making use of the bootstrap components directly using the class notation with the HTML elements and styleClass with the Primefaces components in JSF.

The following code fragment shows how the frameworks are integrated in the same development environment.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE HTML>
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:h="http://java.sun.com/jsf/html"
      xmlns:f="http://java.sun.com/jsf/core"
      xmlns:ui="http://java.sun.com/jsf/facelets"
      xmlns:p="http://primefaces.org/ui">
<h:head>
  <f:facet name="first">
    <meta name="viewport"
          content="width=device-width, user-scalable=no,
                 initial-scale=1.0, maximum-scale=1.0, minimum-
scale=1.0" />
  <title>ejemplo</title>
</f:facet>
  <f:facet name="middle">
    <h:outputStylesheet name="bootstrap/css/bootstrap.css" />
  </f:facet>
  <f:facet name="last">
    <h:outputScript name="bootstrap/js/bootstrap.js" />
  </f:facet>
</h:head>
</h:body>
<h:body>
```

Figura. 7. Integration of Bootstrap and Primefaces in jsf.

As you observe the document is perfectly structured and ready to use, at this point it is worth mentioning the concept, which clarifies the importance of using the library jquery in Bootstrap, but also says that if within the same development environment is made use of a Framework that includes jquery you have to remove the reference to jquery that makes Bootstrap.

Now you will understand why you did not add the jquery reference in the above code fragment. It is also very important to correctly configure the viewport parameters, so that the browser can optimize the presentation of the web page.

### 2.6 Bootstrap integration tests and Primefaces

What we must do in this phase is to create chord structures so that at the moment the components can be synchronized in a way that does not affect the normal functioning of the elements of the framework in each of the technologies that are in use. Keep in mind that this is only a matter of changing or improving the presentation of the elements of the framework primefaces by means of bootstrap, but do not alter the natural functions of the components. Clarified this we go to the code where it will be able to visualize in a better way what it is wanted to realize.

In the next window you can see in detail how the use of these two technologies radically changes the aesthetic presentation of the page. So that the user sits in a pleasant working environment and can operate intuitively within the application.



Figura. 8. Testing the use of Bootstrap and Primefaces within a JSF page.

## 3. Results

As a final result we obtained a software on the web (Note System for the Unidad Educativa Mariano Suárez Veintimilla.) Where the technologies mentioned in the previous points are applied:

### 3.1 Software

Below are some screenshots of the note system.



Figura. 9. Main note system interface

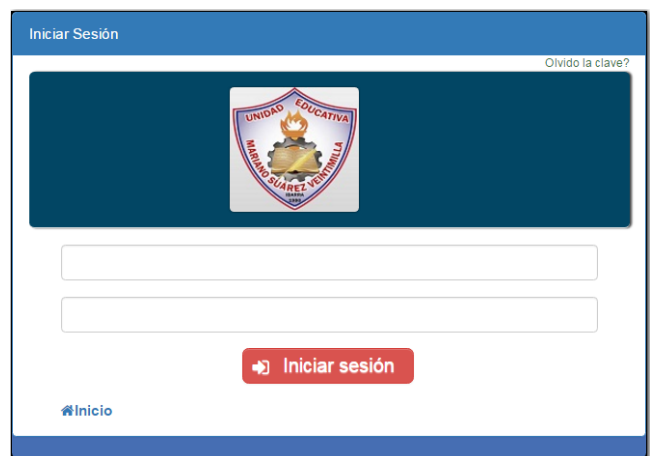


Figura. 10. Interface to the notes system.

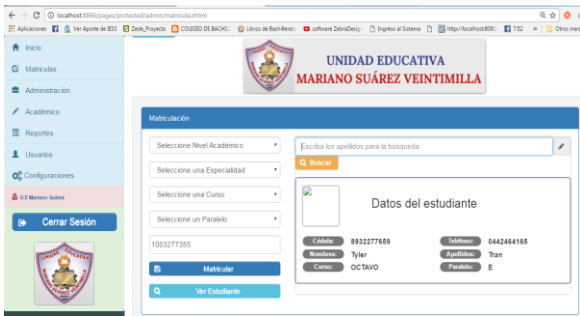


Figura. 11. Notes system management interface Administrator.



Figura. 12. System management interface notes Teachers.

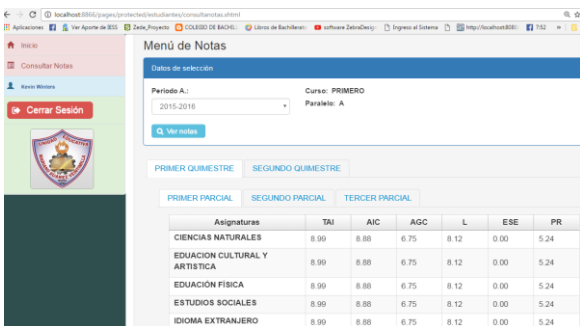


Figura. 13. Student Query Interface Students.

### 3.2 Impact analysis

#### 3.2.1 Social

In the social field the development of web applications in general contribute to society; Through the globalization and distribution of knowledge to improve their quality of life. The following table analyzes the impact of this project on society:

Nivel de impacto	3	2	1	0	-1	-2	-3	TOTAL
Inclusión social		X						2
Condiciones de vida		X						2
Contribución social			X					1
<b>TOTAL</b>								<b>5</b>

Tabla. 1. Table of social indicators

To calculate, the following formula is used, which determines the index that corresponds to each impact.

$$\text{Impact Level} = (\text{Impact } \Sigma) / (\text{Number of Impacts})$$

$$\text{Social impact} = 5/3$$

$$\text{Social impact} = 1,66 \dots \approx 2$$

- **Social inclusion**

The system of notes to be accessible through the internet allows people to have more collaboration facilities helping to work faster from more comfortable places, providing a factor of social inclusion that is often detracted from the difficulty of localization or mobility of people.

- **Life conditions**

The notes system provides facilities, a clear and simple process in notes management; Improving the quality of life and work through distributed systems, and allows people to make better use of their time.

#### 3.2.2 Economic

Within the economy projects are the basis of growth and development, through this tool that helps the generation and monitoring of them; The economic scope of a social group is greatly improved. The use of this accessible and easy to use tool reduces time.

The following table provides an analysis of the economic impact:

Nivel de impacto Indicadores	3	2	1	0	-1	-2	-3	TOTAL
Reducción de gastos		X						2
Ahorro de tiempo	X							3
Productividad			X					1
<b>TOTAL</b>								<b>6</b>

**Tabla. 2.** Table of economic indicators

To calculate, the following formula is used, which determines the index that corresponds to each impact.

$$\text{Impact Level} = (\text{Impact } \Sigma) / (\text{Number of Impacts})$$

Impacts)

$$\text{Economic impact} = 6/3$$

$$\text{Economic impact} = 2$$

- **Cost reduction**

The use of paper that is not a reliable hundred percent to store information, in addition to the costs involved, thanks to this software is intended to reduce the costs of those mentioned above as is the consumption of office supplies.

### 3.2.3 Environmental

At present, the environment is a determining factor in any project that is developed as it can be a definitive acceptance factor for the project to be fully implemented.

The software in relation to the environment presents points in favor as it is the reduction of the use of materials and against due to the generation of expenses of energy and hardware.

The following table analyzes the impact of this project on the environment:

Nivel de impacto Indicadores	3	2	1	0	-1	-2	-3	TOTAL
Contaminación				X				0
Huella ecológica		X						2
Deforestación		X						2
<b>TOTAL</b>								<b>4</b>

**Tabla. 3.** Table of environmental indicators

To calculate, the following formula is used, which determines the index that corresponds to each impact.

$$\text{Impact Level} = (\text{Impact } \Sigma) / (\text{Number of Impacts})$$

Impacts)

$$\text{Social impact} = 4/3$$

$$\text{Social impact} = 1.33 \dots \approx 1$$

- **Deforestation**

Reducing paper consumption in all notes management steps greatly reduces deforestation because everything is stored digitally.

## 4. Conclusions

Throughout this project has been working with several technologies, which allowed the development of a system of notes for the Educational Unit "Mariano Suárez Veintimilla" came to fruition thanks to the joint work and effort of both parties was achieved to meet all Objectives drawn and from which the following conclusions have been reached.

The documentation made in this project will help the developers to correctly use each of the components of the framework.

In terms of project development, it was possible to identify that frameworks are not fully compatible.

Using the Bootstrap and Primefaces frameworks allows the developer to create elegant applications in a short time, reducing the cost in creating the software and raising its profits.

Development with these tools allowed to create a flexible and dynamic application capable of adapting to the size of the devices where the service is running.

The grading system was developed applying the tools of study, and satisfying satisfactorily with the requirements of the user.

## 5. Acknowledgments

First of all, I thank the Technical University of North, for opening my doors and dressing all the tools that contributed to my ethical and professional education throughout my student life, thanks for the welcome you were for a long time, you were my second home.

This special thanks goes to my tutor magister Mauricio Rea, director of work of degree for offering me his support



as a professional and friend and to be an excellent guide during the duration of the present work of degree.

And how not to thank my friends and college students who were part of my growth.

## Bibliographic references

- [1] =Balaji Varanasi, S. B. (2014). Introducing Maven.
- [2] Barzanallana, R. (s.f.). Obtenido de <http://www.um.es/docencia/barzana/DIVULGACION/INFORMA TICA/Historia-desarrollo-aplicaciones-web.html>
- [3] Barzanallana, R. (10 de 10 de 2012). Universidad de Murcia. Obtenido de [view-source:http://www.um.es/docencia/barzana/DIVULGACION/INFORMA TICA/Historia-desarrollo-aplicaciones-web.html](http://www.um.es/docencia/barzana/DIVULGACION/INFORMA TICA/Historia-desarrollo-aplicaciones-web.html)
- [4] Bhaumik, S. (2015). Bootstrap Essentials. Packt Publishing Ltd.
- [5] Camacho, R. M. (09 de 03 de 2015). CONOZCAMOS TWITTER BOOTSTRAP. Obtenido de Curiotek: <http://curiotek.com/2015/03/09/conozcamos-twitter-bootstrap/>
- [6] Cédric Simon. (2011). Curso de Java Server Faces 2 con Hibernate 3.
- [7] Chamling, S. (2011). sanwebe.com. Obtenido de <http://www.sanwebe.com/2013/02/bootstrap-framework-quick-start>
- [8] Ed Burns, C. S. (2010). The complete reference JavaServer Faces. The McGraw-Hill Companies.
- [9] Foundation, T. A. (2015, 04 07). Apache Tomcat. Retrieved from <http://tomcat.apache.org/tomcat-7.0-doc/>
- [10] Herrera, D. (13 de febrero de 2013). Desarrollo Avanzado Web. Obtenido de <http://todosobreprogramacion.blogspot.com/2013/02/que-es-j2ee.html>
- [11] Hlavats, I. (2013). Instant PrimeFaces Starter. Packt Publishing.
- [12] librosweb. (s.f.). Obtenido de [http://librosweb.es/libro/bootstrap\\_3/capitulo\\_1/compatibilidad\\_con\\_los\\_navegadores.html](http://librosweb.es/libro/bootstrap_3/capitulo_1/compatibilidad_con_los_navegadores.html)
- [13] Magno, A. (2013). Mobile-first Bootstrap. Packt Publishing Ltd.
- [14] Mann, K. D. (2005). Java Server Faces. Manning Publications Co.
- [15] Martin , K., Rafael , C., Sylvi , L., Salvatore , S., Sundaragopal , V., Steve , B., & Craig , F. (2012). Developing Web Applications using JavaServer Faces. Poughkeepsie, New York, Estados Unidos: Red paper.
- [16] Mert Çalıřkan, O. V. (2013). PrimeFaces Cookbook. Packt Publishing.
- [17] Mestras, J. P. (2009). El patrón Modelo-Vista-Controlador (MVC). Madrid: Dep. Ingeniería del Software e Inteligencia Artificial.
- [18] Momjian, B. (2014). PostgreSQL 9.3.5 Documentation. California.
- [19] Orlando57. (2004). Cognigen. Obtenido de <http://www.cognigen-agent.iwarp.com/Cog13.htm>
- [20] Otto, M. (2012). <http://bootstrap-history.akiyan.tokyo/>. Obtenido de <http://getbootstrap.com/getting-started/>
- [21] PrimeTek. (2009-2014). Primefaces. Obtenido de <http://www.primefaces.org/downloads>
- [22] Primetek. (2015). Why Primefaces. Obtenido de <http://www.primefaces.org/whyprimefaces>
- [23] Republic, T. (2016). Working with Bootstrap 3 Responsive Layout - Tutorial Republic. Obtenido de <http://www.tutorialrepublic.com/twitter-bootstrap-tutorial/bootstrap-responsive-layout.php>
- [24] Spurlock, J. (2013). Bootstrap. Sebastopol, Estados Unidos: O'Reilly Media, Inc.
- [25] TheCoder4Eu. (2015). Bootsfaces. Retrieved from BootsFaces: the next-gen JSF Framework based on Bootstrap: <http://www.bootsfaces.net/>
- [26] Tituaña, M. (2015).
- [27] Varela, J. C. (2014). Implementación de un sistema de gestión académica por quimestres para la escuela de educación básica "Dos de Marzo" con licenciamiento libre. Ibarra.

## About the Author...

**Mauricio Tituaña** He completed his studies at the Venezuelan school, his secondary studies at the Instituto Superior Cooperativo Bogotá. Currently he graduated from the Computer Systems career at Universidad Técnica del Norte. Passionate about computer science and interested in the advances that these can bring to the future of humanity.