Pre project

The analysis of C# to F#

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Automation

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Contents

1 Background

One of the biggest problems in modern application development is the rapidly growing complexity of all major software systems. This complexity makes it almost impossible to ensure the quality and accuracy of the code. It also becomes harder and harder to make changes to existing code without introducing new errors. All these difficulties multiply when you also want utilize modern computers with many CPU (central processing unit) cores for increased performance.

The imperative object-oriented programming paradigm has been dominant in software development for over 20 years. In the imperative paradigm the state variables will be handled explicitly, which can quickly give too much complexity. The functional programming paradigm has been known since the 1930's, but has not been popular with professional developers because of the slightly lower (single core) performance and greater resource use. Today these obstacles are long gone, and functional programming is experiencing a new renaissance due to significantly better control over complexity and parallelism.

We've received an assignment from Serit to translate parts of an existing project from C# code to F# code. C# is meant to be simple, modern, flexible and object oriented programming language. It is developed and maintained by Microsoft and is inspired by previous popular object-oriented languages like C++ and Java. F# is a hybrid language that supports both the familiar object-oriented method and functional programming. F# is also developed by Microsoft, and like C# also has access to Microsoft's .NET framework. Serit wants us to find out the benefits of switching from development in the programming language C# development to F#.

2 Problem for discussion

C# and F# works in different ways, they both have benefits and downsides. The main question is if it is worth it for a company to change their main programming language. We have to look at what the company wants to achieve by making the change, and that boils down to making quality programs for a low price.

A modern IT company uses a lot of time developing, changing and fixing code. If we can use a programming language that takes less time to develop and at the same time works better without generating errors, that could be very cost saving.

The programming language F# claims to be a solution to these problems by using less code, be more simple and have better error handling than other programming languages. Our task is to find out if those claims are true by answering these questions:

- What are the benefits of switching from C# to F#?
- To what degree can we reduce the number of lines written in the program code?
- How much time is saved in the debugging stage?
- How much time is saved in the development of the code?

3 Formulations of objectives

To work on an analysis (compare code) of the old code compared to the new code, where we will look at how compact the code is, how many errors there are, how self-explaining the code is and how easy it is to develop the code.

4 Project specification

4.1 Where Serit is now

- They have an ASP.NET Web application in C# where the user interface is based on ASP Web Forms. All code is written in English, as well as all the text in the user interface.
- Language support is dissolved in a separate module sCore.Translation which is called from the application and performs translation according to data recorded in a translation table.
- Translation tables are located in a SQL database.

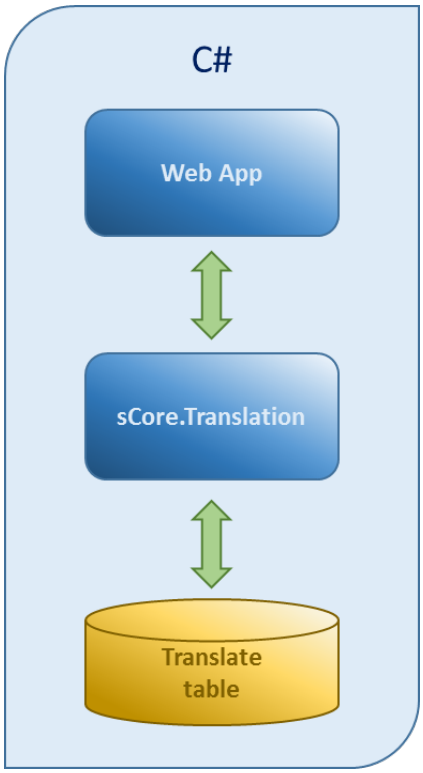

Figure 1: How the communication of Serit's sCore.Translation application looks now.

4.2 What Serit wants

- They want to have the existing translation module sCore.Translation developed as a separate module in the functional language F#. This should be able to be called from the present imperative program (C#) and from functional programs (F#).
- With the translation from C# to F# done, both languages and programming paradigms can be compared analytically. By this we can evaluate benefits (and possible disadvantages) with the functional paradigm in relation to an object-oriented imperative paradigm. The analysis will provide a better basis in the choice of programming language in future development projects.

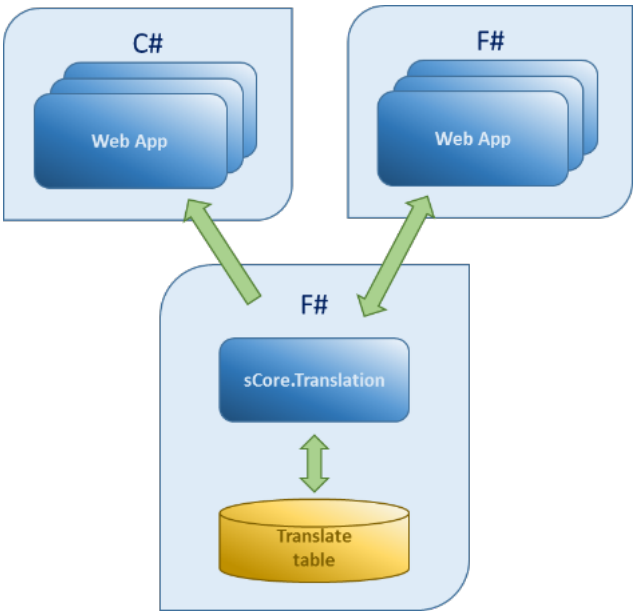

Figure 2: How they want the sCore.Translation application to communicate.

4.3 Method of translation

F# for fun and profit describes three levels of "sophistication" for porting code from C# to F#. The basic level is simply a direct port. Since F# supports imperative programming, we can translate directly. At the intermediate level, the code is refactored to be fully functional. The advanced level takes advantage of F#'s data type system.

There are two paths to achieve this goal: Either by first porting to F# and then refactoring to functional code, or by converting to functional code in C# before porting that to F#.

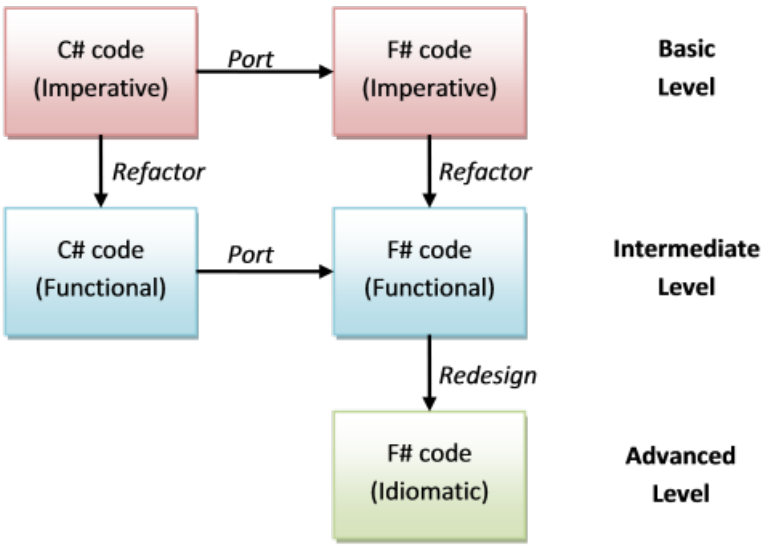

Figure 3: Method's of translating from C# to F#.

5 Temporary table of contents for project report

1. First page
2. Page 2
3. Summary
4. Foreword
5. Table of contents
6. Introduction
   (a) Background
   (b) Problem for discussion
   (c) Formulation of objectives
7. Main chapters
   (a) F# programming language
   (b) Imperative and functional programming
   (c) Project specification
   (d) Module A
      i. Solution
      ii. Analysis
   (e) Module B, C...
      i. Solution
      ii. Analysis
   (f) Complete analysis
      i. Development time
      ii. Readability and clarity
      iii. Debugging and error handling
      iv. Performance
8. Conclusion
9. Literature
10. Attachments
    (a) Code

6 Budget

In this bachelor project we are going to use our own computers to write the code. Since the F# is an open source software, and the C# is free for community to use there is no need for a budget concerning software and hardware. The only thing that we can see for now that might be worth mentioning is the gasoline expense from driving between UiT and Serit (ca. 5 km one way if you check on google maps).

We found the rates for car driving on naf.no. They are as follows:

	Amount	Amount
Price per km	(1 - 10 000 km)	kr 4,10 / km
Additional passenger	1	kr 1,00

Actual cost:

Expenses	Amount	Price	Sum
Driving from UiT to serit and back.	5 km * 2	kr 6,10 / km	kr 61,00
Status meetings at Serit each 7 days	20 Meetings	kr 61,00	kr 1220,00

7 Other resource needs

Mostly we will do the programming for our self, where we can find much on the internet. Serit has offered us with assistance and try to help us with whatever we might need help with. We will mostly use Jonas as our mentor in F#, because he is the go-to guy in that department. We will use Jens when it comes to the old existing software (program code) in C#.

7.1 Resource Contacts

Name	Company	Phone	Email
Sharma, Puneet	UiT	45063429	puneet.sharma@uit.no
Juselius, Jonas	Serit		Jonas.Juselius@itpartner.no
Blomli, Jens	Serit		Jens.Blomli@itpartner.no

8 Activity description

All activities include the total number of hours for all 3 group members. We are expecting each member to contribute equally to all parts of the project.

8.1 Activity list

Act.nr	Act. name	Description	Dep.
C1	Initiation document	Send in initiation document	
B1	Learning fundamentals of F#	Getting familiar with F#	
A1	Status meeting	Meeting to check where we are at	
B2	Existing code	Get the code from Serit and check through it	
C2	Write pre-project	Start working on the pre-project document	C1
A2	Meeting with Serit	Meeting with Serit where they will talk about the project we are to make	
A3	Status meetings with Serit (ongoing)	Each monday there will be a status meeting	
B3	Set up Github accounts and learn Github	Get familiar with github and register accounts	
B4	Module: sTranslate	Start working on the project from Serit	B1, B2, B3
B4a	Set up test database	Set up a test database to test against	
B4b	Connect to test database with F#	Make the database and F# work together	B4a
B4c	Make F# console app	Make a console application for the module	
B4d	Make the translate tool in F#	Make the translate tool in F#	B4b, B4c
B4e	Make F# module compatible with C# and .NET	Make the F# translate tool available for C#	B4d
B4f	Do a short analysis on the code	Make a short analysis of the sTransle module	B4e

A4	Meeting with mentor	Status meeting with mentor	
B5	Optional additional modules	If there is time, we will get more modules from Serit to work on	B4
C3	Deliver draft to UiT	Due date to deliver draft of project report	
C4	Write a complete analysis of F# vs. C#	Write the full analysis of F# and C#, pros and cons	B4, B5
A5	Posters for presentation	Make the posters for presentation	
A6	Course in presentation technique	Course in presentation technique will be offered for students	
A7	Presentation of project	The presentation of the projects in stands	
C5	Deliver project report	Due date for delivering project report	
C6	Deliver reflection notes	Due date for delivering reflection notes	
C7	Final presentation	Final presentation with individual examination	

8.2 Activities

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
C1	Initiation document

Purpose:

To make a basis for starting on the pre-project, and to introduce the project to our mentor.

Content / scope, procedure:

- Overview of background, problem, objectives and solution
- Plan work on the pre-project
- Due date 19.11.2015 documents.

Result:

Approved initiation document

Resource requirements:	**Performed by:**
72 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B1	Learning fundamentals of F#

Purpose:

To familiarize with F# and learn the basics of functional programming.

Content / scope, procedure:

- Install F# development tools
- Read/watch online tutorials
- Make some simple F# programs programming.

Result:

The team members understand the basic principles of functional programming, and can read and understand simple F# code.

Resource requirements:	**Performed by:**
30 hours per week over 4 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
A1	Status meeting

Purpose:

Status meeting after the holidays to plan work on the pre-project.

Content / scope, procedure:

- Meeting date 06.01.2016
- Follow-up on activity B1
- Planning for pre-project

Result:

Roadmap for pre-project work.

Resource requirements:	**Performed by:**
6 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B2	Existing code

Purpose:

To develop an understanding of the existing C# code.

Content / scope, procedure:

- Read the code which Serit has released on Github
- Discuss it with the rest of the team members

Result:

The team members understand the purpose and functionality of the code

Resource requirements:	**Performed by:**
30 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Mikkel

Akt. designation:	**Name:**
C2	Pre-project

Purpose:

To get a good plan before starting on the project.

Content / scope, procedure:

- Get information from Serit about how to conduct the project
- Plan and discuss what our plan for the project is
- Formulate the problem and objectives clearly
- Write a detailed activity description
- Gantt-diagram
- Due date 20.01.2016

Result:

A written plan and a good base before starting on the project.

Resource requirements:	**Performed by:**
45 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Mikkel

Akt. designation:	**Name:**
A2	Meeting with Serit

Purpose:

Get a presentation of the code we are going to translate.

Content / scope, procedure:

- Meeting date 18.01.2016
- Get information about the code we are going
- Learn how they want the structure and the syntax to be
- Learn more F#
- Plan future meetings

Result:

Get enough information about the project that we can start working on the translation of the code.

Resource requirements:	**Performed by:**
6 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Michael

Akt. designation:	**Name:**
A3	Status meetings with Serit (ongoing)

Purpose:

A meeting to check where we are at and if we are as scheduled.

Content / scope, procedure:

- Status meeting each monday with serit.

Result:

Check our current status.

Resource requirements:	**Performed by:**
6 hours per week for 9 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Mikkel

Akt. designation:	**Name:**
B3	Set up Github accounts and learn Github

Purpose:

To get a good platform for sharing code files in a organized way.

Content / scope, procedure:

- Set up a group account on Github
- Learn the all the basic of Github
- Find the best way to use Github with Visual Studio
- Connect and get files from Serit's Github

Result:

Good knowledge of Github and a good and easy way to handle the files in the project.

Resource requirements:	**Performed by:**
15 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.16	Jostein

Akt. designation:	**Name:**
B4	Module: sTranslate

Purpose:

To make an F# version of the sTranslate module provided by Serit.

Content / scope, procedure:

Sub-activities:

- B4a - Set up test database
- B4b - Connect to test database with F#
- B4c - Make F# console app
- B4d - Make the translate tool in F#
- B4e - Make F# module compatible with C# and .NET
- B4f - Do a short analysis on the code.

Result:

A working F# implementation of the C# module provided by Serit, as well as a short analysis and summary.

Resource requirements:	**Performed by:**
Refer to sub-activities	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B4a	To set up a database

Purpose:

To set up a database used for testing the sTranslate module.

Content / scope, procedure:

- We will be provided with SQL files for creating a translation database that will be used to test the sTranslate module. We will set up and run this database locally for use in testing.

Result:

The database is running and working as intended.

Resource requirements:	**Performed by:**
15 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B4b	Connect to test database with F#

Purpose:

Create a very simple F# program to run SQL queries on the database.

Content / scope, procedure:

- We will access the test database using F# Type Providers. We will write a simple program and get some data out of the database.

Result:

We are able to retrieve information from the database using F#.

Resource requirements:	**Performed by:**
30 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B4c	Make the F# console app

Purpose:

To create a test app with input and output functionality.

Content / scope, procedure:

- We will make a simple console application to test the program. It should take input in the correct format and give the correct output.

Result:

The console app is working.

Resource requirements:	**Performed by:**
45 hours per week for 2 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B4d	Make the translate tool in F#

Purpose:

To implement the translate tool in F#.

Content / scope, procedure:

- The translate tool is the program that will actually do the SQL query to the database. It will be called from the console app and return the correct translation.

Result:

The translate tool can be called from the test app, and return the correct translation.

Resource requirements:	**Performed by:**
45 hours per week for 3 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B4e	Make F# module compatible with C# and .NET

Purpose:

To implement the translate tool in F#.

Content / scope, procedure:

- Serit's entire project is written in C#. They should be able to call on our module without any problems.
- We will need to make sure our module is compatible.

Result:

The module is successfully used with the existing code.

Resource requirements:	**Performed by:**
10 hours per week for 3 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B4f	Do a short analysis on the code

Purpose:

To make some groundwork for the final analysis.

Content / scope, procedure:

Note any problems/difficulties we had when implementing these features in F# Compare the program code for C# and F#:

- Length
- Readability
- Conciseness

See if there are any differences in performance (it's a small program, but if it must be called many times it should be fast).

Result:

A short analysis and comparison.

Resource requirements:	**Performed by:**
45 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
A4	Meeting with mentor

Purpose:

For the mentor to see that work on the project is coming along well

Content / scope, procedure:

- Have a status meeting with our mentor
- The mentor will call a meeting in February

Result:

Progress overview

Resource requirements:	**Performed by:**
6 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
B5	Optional additional modules

Purpose:

Port additional modules to F# code.

Content / scope, procedure:

- Depending on available time, we will translate more modules from the same project into F#. We will use the same procedure as in activity A-7.

Result:

Additional F# modules and code to base the final analysis on.

Resource requirements:	**Performed by:**
90 hours per week over 3 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	11.04.16	Michael

Akt. designation:	**Name:**
C3	Deliver draft to UiT

Purpose:

We will make a draft of the project report so we can get feedback and see if we've achieved our goals.

Content / scope, procedure:

- We will use the completed work to write the draft, and skip items where we don't have anything to write.
- Explain problem and formulation of objectives.
- Describe the programming languages used and the different programming paradigms.
- Explain how we completed the task from Serit.
- Note any issues we had during work on the project, and how we solved these.
- Any deviations from the plan in the pre-project.
- Discuss our result and compare it to our objectives.
- How could we have avoided issues and what could have been done differently.
- Was the project successful or not (did we achieve our objective, and did we learn anything?)
- Due date 11.04.2016

Result:

Completed and documented project

Resource requirements:	**Performed by:**
30 hours per week for 3 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Mikkel

Akt. designation:	**Name:**
C4	Write a complete analysis of F# vs. C#

Purpose:

Finding out the benefits of using F# instead of C#.

Content / scope, procedure:

- Look at the amount of code used in the coding languages.
- Estimate the amount of bugs that can happen in the coding languages.
- Estimate the time used development using C# and F#.
- Discuss if it's worth training developers to use this new language..
- Make tables and visual data ready for the final project report
- Complete by 14.04.16

Result:

Data that are ready to be used in the final report.

Resource requirements:	**Performed by:**
80 hours per week for 4 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Michael

Akt. designation:	**Name:**
A5	Posters for presentation

Purpose:

The posters for the presentation must be printed.

Content / scope, procedure:

- Discuss and design the concept for our stand
- Prepare the presentation
- Show our work in an understandable way
- Easy graphical presentations to make the results very clear
- Hand in the produced poster for printing no later than 15.04.2016

Result:

Posters to use at the presentation

Resource requirements:	**Performed by:**
30 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
A6	Course in presentation technique

Purpose:

To improve our presentation skills before the oral presentation in June.

Content / scope, procedure:

- Follow course in presentation technique
- Learn and get better presenting a project
- Discuss and practice presenting
- The course will be from 19. - 22. April

Result:

Increased presentation skills

Resource requirements:	**Performed by:**
24 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Michael

Akt. designation:	**Name:**
A7	Presentation of project

Purpose:

To present the project for others

Content / scope, procedure:

- Practice the presentation
- Presentation length should be around 10 minutes
- Explain who we are and our problem formulation
- Explain the background of the project
- Explain the basics of object-oriented programming and functional programming
- Take into consideration that our audience probably knows much less about programming than us.
- Avoid in-depth technical details
- Answer questions after the presentation, and at the stand
- Presentation date: 28.04.2016

Result:

Completed presentation

Resource requirements:	**Performed by:**
30 hours per week over 2 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Michael

Akt. designation:	**Name:**
C5	Deliver project report

Purpose:

The written project report serves as the documentation for the project

Content / scope, procedure:

- Read through feedback from the draft
- Discuss how we can improve the report
- Add missing stuff
- Eventual changes
- Due-date to deliver the final project report (Electronic): 12.05.2016

Result:

Delivered project report

Completed project

Resource requirements:	**Performed by:**
70 hours per week for 3 weeks	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Michael

Akt. designation:	**Name:**
C6	Deliver reflection notes

Purpose:

To summarize and reflect on what we have done.

Content / scope, procedure:

- Describe our experience with the project work
- Discuss if we achieved our goals/objectives
- Discuss if we managed to stay on the schedule we planned in the pre-project
- Due-date to deliver reflection notes: 18.05.2016

Result:

Overview of project completion and results

Resource requirements:	**Performed by:**
30 hours	All

Project:	**Date:**	**Sign:**
Basis for programming approach	20.01.2016	Jostein

Akt. designation:	**Name:**
C7	Final presentation with individual examination

Purpose:

To present our project

Content / scope, procedure:

- Condense the project report to a short oral presentation
- Our audience will be professionals with relevant education
- Presentation length including questions will be 45 min.
- Practice the presentation as a group
- Individual examinations 9. and 10. of June

Result:

Completed presentation for individual examination

Resource requirements:	**Performed by:**
25 hours per week for 4 weeks	All

8.3 Gantt-Diagram