ERASMUS MUNDUS
MSC IN DEPENDABLE SOFTWARE SYSTEMS

DESEM
SUMMER SCHOOL
JUNE—JULY 2015

* Faculté des Sciences et Technologies de Nancy
* 29th June – 4th July 2015
* In association with National University of Ireland, Maynooth and University of St. Andrew’s, Scotland
Monday June 29th

ATELA building - FST Nancy

09:00 - 9:30 Welcome session
09:30 - 10:30 Internship presentations - session 1
10:30 - 11:00 Tea/Coffee break
11:00 - 12:30 Internship presentations - session 2

Lunch break - Welcome buffet

Amphitheatre 5 - FST Nancy

14:15 - 15:30 Leslie Lamport (Microsoft Research) Programming Should Be More Than Coding

(https://www.youtube.com/watch?v=6QsTfL-uXd8)

ATELA building - FST Nancy

15:30 - 16:00 Tea/Coffee break
16:00 - 17:00 Internship presentations - session 3
18:30 Welcome reception - Lorraine University
Presidence Cours Léopold - Nancy
Tuesday June 30th

**ATELA building - FST Nancy**

9:00 - 10:30 Internship presentations - session 4

10:30 - 11:00 Tea/Coffee break

11:00 - 12:00 Internship presentations - session 5

12:00 - 12:30 Andrew Healy (Maynooth University)

An evaluation of the SMT-LIB repository as a benchmark source for software verification

Lunch break (free)

**ATELA building - FST Nancy**

14:30 - 15:30 Tutorial on the KeY verification system

Part 1 - Shmuel Tyszberowicz (Tel Aviv University)

15:30 - 16:00 Tea/Coffee break

16:00 - 17:00 Tutorial on the KeY verification system

Part 2 - Shmuel Tyszberowicz (Tel Aviv University)
Wednesday July 1st

ATELA building - FST Nancy

09:00 - 10:30 Internship presentations - session 6
10:30 - 11:00 Tea/Coffee break
11:00 - 12:00 Internship presentations - session 7

Lunch break (INRIA restaurant)

INRIA - LORIA building (Amphitheatre C)

14:00 - 14:30 Welcome talks and presentations (Inria GE - Loria)
14:30 - 15:30 Presentation of research activities on Software Engineering and Formal Methods
15:30 - 15:45 Tea/Coffee break
15:45 - 17:30 Visits and demonstrations
Thursday July 2nd

ATELA building - FST Nancy

09:30 - 10:30 Stephen Brown (Maynooth University)
Java Workshop - Dependable Programming in Java

10:30 - 11:00 Tea/Coffee break

Amphitheatre 5 –FST Nancy

11:00 - 12:15 Véronique Cortier (LORIA - CNRS)
Electronic voting: how logic can help

Lunch break – INRIA Restaurant

INRIA - LORIA building (Amphitheatre C)

14:00 - 15:00 Joris Rehm (Clearsy)
Formal Method as a Commercial Activity

15:00 - 16:00 Paul Brauner (Google Zurich) Testing stateful programs
via uniform sampling of algebraic datatypes

INRIA - LORIA building (Hall B)

16:00 - 17:30 Poster session

20:00 Summer School Dinner
Friday July 3rd

ATELA building - FST Nancy

09:30 - 10:30 Shmuel Tyszberowicz (Tel Aviv University)
Deverywhere: Develop Software Everywhere

10:30 - 11:00 Tea/Coffee break

Amphitheatre 5 - FST Nancy

11:00 - 12:15 Yves Le Traon (Luxemburg University)
Testing Large Scale Highly Configurable Systems with
Search-based Software Engineering

Lunch break - Buffet

ATELA building - FST Nancy

14:00 - 15:00 Pierre-Etienne Moreau (Loria - UL)
Rule programming and strategies in Java

15:00 - 16:00 Pascal Fontaine (Loria - UL)
Satisfiability checking for fun and profit
SATURDAY JULY 4TH

ATELA BUILDING - FST NANCY

9:00 - 10:30 Tutorial on Interactive Theorem Proving Using Isabelle/HOL - Part 1
Jasmin Blanchette (INRIA GE - MPI Saarbruecken)

10:30 - 10:45 Tea/Coffee break

10:45 - 12:15 Tutorial on Interactive Theorem Proving Using Isabelle/HOL - Part 1
Jasmin Blanchette (INRIA GE - MPI Saarbruecken)

12:15 - 12:30 Summer School closing
Name: Faizan Agha

Project Title: Dependability and Impact of Rogue Nodes in Opportunistic Networks

Supervisor: Dr. Stephen Brown

Personal Description

I hold a Computer Systems Engineering Degree from Pakistan’s top University, NUST. A variety of Electrical Engineering, Computing and Networking courses followed by an implementation of a MANET routing protocol (AODV) concluded my Undergrad Degree. The interdisciplinary degree widened my future prospects and lead to many exciting career opportunities. I have been a scholarship holder until my Undergrad, excelling in a number of national curricular/essay competitions back in my home country. I have a cross-functional work experience of 5 years, working as a Business Systems Developer (Java, Unix KSH, PL/SQL) and Lead Solution Architect in the top and international Telecom Organizations. My expertise involve Enterprise Charging/Billing and Intelligent Systems (INs). I have worked for international Telecom Providers of the world namely Telenor (Norway) and VimpleCom (Netherlands). I have also served as a Domain Expert and RFQ/RFP lead for a mega swap project, co-executed Internationally by Norway, Thailand, Malaysia and Pakistan. This prestigious Masters' program offered me to further leverage my skill set after a rich industry experience. I am a huge music fan, singer and passionate for driving/travelling with friends. I believe in team work and have a conviction, that success and wealth is a byproduct when the effort is based on hard work, honesty and cooperation.

Project Abstract

Opportunistic Networks (OppNets) have embarked several research areas in the field of Wireless Communications. OppNets are an extension to the classical Mobile Ad hoc Networks (MANETs) where the network is never dependent on any infrastructure (e.g. Access Points or centralized administrative nodes). Whereas a Rogue Access Point is typically immobile in the legacy infrastructure based networks, the research question in this project has addressed on how the penetration and mobility of a rogue nodes pattern impact the dependability and overall "Average Latency" in an OppNet Environment. Ad hoc networks are very challenging to model due to their mobility and intricate routing schemes. We simulated the rogue behavior by utilizing The ONE (Opportunistic Network Environment, by Nokia Research Centre) simulator to carry out our research in this perspective. The ONE simulator is an open source simulator developed in Java, operating at layer 3 of the OSI model. The Rogue behavior is customized in the simulator to observe the effect of malicious nodes. Finally we developed the desired reports to measure the performance and QoS metrics by carefully simulating the intended behavior, keeping rest of the parameters (e.g. node movement models, signal range and strength, Point of Interest (POI) etc) unchanged. Our results are encouraging, and coincide with the average latency deterioration patterns as modeled by a few previous researchers, with a few exceptions.
Name: Mani Balamaruthu

Project Title: A secure searcher for end-to-end encrypted email communication

Supervisor: Barak A. Pearlmutter

Personal Description

I’m a second year DESEM student at Maynooth University. I completed my first year at University of St Andrews. I completed my under graduate course at one of the top engineering universities in India, College of Engineering Guindy, Chennai. After the course, I joined Oracle India as a software developer where I was part of Oracle Business Intelligence applications development team and then in CRM cloud services applications development. Even though I consider Java as my go to guy for solving problems, I got familiar with variety of tools and programming languages during my tenure. I’m an ardent cricket fan; I’m always up for a heated discussion on who will play better!

Project Abstract

Email has become a common mode of communication for personal as well as business needs. There are different approaches to authenticate the sender of email message and ensure that the message could be read only by the intended recipient. A typical approach is to use an email encryption standard to encrypt the message for a secure communication. But a major drawback is that only the encrypted email messages are stored in the mail servers and the default search does not work on these encrypted data. This project details an approach that could be adopted for securely searching email messages protected using end-to-end encrypted email communication. This project proposes an overall design for securely searching encrypted email messages and provides an implementation in Java based on a cryptographically secure technique to realise that design. The implemented library is then integrated with an open source email client to assess its usability in a current live environment. The technique and the implemented library are further evaluated for security and scalability. The integrated email client could be configured for searching by any user. The research in this project would enhance email clients that support encrypted email transfer with a full secure search functionality.
Name: Lu Yang

Project Title: Project title: An Activity Theory Evaluation of a User Interface for a Web-based Virtual Research Environment (VRE)

Supervisor: Dr. John G. Keating

**Personal Description**

I am Lu Yang, a girl from China. In June 2013, I graduated from Nankai University and got my undergraduate degree. My major in undergraduate study is double degree of Information Security and Law. During my undergraduate study, I took part in a number of activities and projects. I also worked as an intern in Cosma International Group of Magna International Inc in 2013. In July 2013, I was accepted by Erasmus Mundus DESEM programme and have already finished the first year in University of St Andrews last year. This year I was in Maynooth University and I am graduating around July, 2015.

**Project Abstract**

Activity theory is a framework or descriptive tool which is commonly used in Human-computer Interaction. Especially, it is used more and more on the design and evaluation of some collaborative systems such as modular object-oriented dynamic learning environment (Moodle). Activity theory offers many advantages to interface design for interactive systems compared with traditional cognitive psychology approach because the traditional cognitive way cannot penetrate human side.

Therefore, the thorough analysis of human activities in Activity theory also makes it an effective and efficient way for system evaluation. Currently, there is some research work about the design or evaluation of some interactive systems, especially some commercial information systems. But none of them are doing research on online virtual research environment. Therefore, this thesis tries to evaluate the current interface of an online virtual research environment called CRADLE using Activity theory. We conduct a humanity study in this project which aims at finding contradictions between current usability and user expectations, therefore to design a better CRADLE interface for its next generation.

There are two primary objectives of this project:
1. Use activity theory as the framework for software evaluation together with user experience testing.
2. Present a design and improvement for a new interface which incorporates user and community presence before the implementation of the next version of CRADLE software.
Name: Rushikesh Sawant

Project Title: Improving Results of Differential Evolution Algorithm

Supervisor: Dr Diarmuid O'Donoghue

**Personal Description**

Rushikesh Sawant is currently a second year student of Erasmus Mundus Msc in Dependable Software Systems programme. He is a former software engineer with 3 years of experience in software development. His technical expertise includes SOA, BPM engineering, and Eclipse platform architecture. He is also a certified Java Programmer and holds a Bachelor of Engineering in Information Technology. His areas of interest include Software design, System modelling, and Artificial Intelligence. He is an engineer at heart, and will continue to be so.

**Project Abstract**

Optimization problem is of prime importance in scientific and engineering communities. Many day-to-day tasks in these fields can be classified as optimization problems. Due to enormous solution search space, optimization problems generally lie in class NP.

In such cases, engineers and researchers have to depend on algorithms and techniques that can find optimal solutions to these problems. One of the most reliable algorithm for numerical optimization problems is Differential Evolution (DE). Since its introduction, DE has been on the fore front when it comes to applicability of an optimization algorithm to variety of real-parameter optimization problems.

This property of DE has driven intensive research to further improve its results. In this thesis we present a variant of DE to improve its results. In doing so, we introduce a novel strategy to incorporate ancestral vectors into the optimization process. We show that a controlled introduction of ancestral vectors into the optimization process have a positive influence on convergence rate of the algorithm. Evaluation of the proposed algorithm forms a major part of this work, as an empirical evidence is the primary method to demonstrate the performance of stochastic algorithms. The resulting implementation of the algorithm is made available as an open source software component along with its reference manual.
Name: Gabriel H.R. Santos

Project Title: Quantifying Reliability Properties of Distributed Systems

Supervisors: Marie Duot-Kremer, Stephan Merz, Martin Quinson

Personal Description

I am currently studying at the Université de Lorraine for my second year in the programme. I currently hold a BSc. degree in Control Engineering from the Federal University of Santa Catarina, Brazil. Though my first degree had a stronger focus on control theory and electronics, a considerable part of it was also related to programming and software development. Due to my interest in programming and system modelling, I came to France still as an undergrad to work as an intern researcher at the Institute de Recherche en Informatique de Toulouse (IRIT) where I had the opportunity to work with systems modeling and verification. I have since developed a special interest for the topic with a particular focus on quantitative verification.

Project Abstract

The main idea behind this project is the use of statistical verification techniques for the analyses of large scale distributed systems. We build our tool on top of SimGrid, an open source simulator for grids, P2P, cloud and HPC systems. The simulator provides an API to build models of such systems in C, Java and other programming languages. SimGrid already possess some model checking capabilities but its verification scope is limited to safety properties such as assertion violations or detection of deadlock states. Due to the fact that the simulator has to keep track of a big number of variables, the use of quantitative analysis based on sampling is particularly interesting as it would be infeasible to generate the entire state space. This approach also avoids the problem of combinatorial explosion and thus more complex systems can be analyzed.
Name: Ahmad Abdelghany

Project Title: Property based testing

Supervisors: Horatiu Cirstea, Pierre-Etienne Moreau

Personal Description

Ahmad Abdelghany is an Egyptian software developer. He received his bachelor’s degree in computer systems from Ain Shams University, Cairo. He worked for two years as a software engineer for Asset Technology Group, a leading software house in Egypt, before he joins Voice and Multimedia Services team at Orange Labs Cairo, one of 18 international centers of the world’s leading telecommunications company. He is currently pursuing a joint master’s degree in Dependable Software Systems. The first year of the two-year Erasmus program is at University of Lorraine, France and the second year will be at National University of Ireland, Maynooth. Ahmad is happily married to Esraa Ali. Apart from coding, he enjoys reading, traveling and all kinds of sports. His happiest times though are when he manages to put his 2-years-old son, Omar, to sleep.

Project Abstract

Property-based testing has proven to be efficient in finding bugs early in the development cycle thus provides more confidence in tested software even though it does not provide a mathematical guarantee of correctness. Instead of one-input test scenario, a function is tested with many auto-generated test inputs and properties that a function should fulfill are verified. Libraries such as QuickCheck and SmallCheck, written in Haskell, implemented this approach and inspired similar implementations in other declarative as well as imperative languages.

We introduce a property-based testing framework for Java. This modular framework implements an Enumerator that can lazily enumerate potentially infinite set of objects of a given data type. It also provides an extension to JUnit, the most-common testing framework for Java, to run parameterized test methods against these sets of data.

While enumerating built-in types can be fully-automated, a common problem that usually rises from generating enumerations of user-defined types is the need for manually-written Generator for each type. This is of-course a time consuming and error prone process for users. In our approach, we introduce a library for automatic creation of Generators for structurally complex user-defined data types. We make the automatic test data generation completely transparent for the user with the ability to choose between random or exhaustive test strategies through annotations.
Name: Rohit Sharma

Project Title: Security management of Cloud-Native Applications

Supervisors: Rémi Badonnel, Olivier Festor

Personal Description

Rohit Sharma, born in Chandigarh, India is currently a first year student of Erasmus Mundus MSc in Dependable Software Systems programme at Universite de Lorraine, France. He holds a Bachelor's degree in Computer Science and Engineering from Panjab University, Chandigarh. He earned the Red Hat Certified Engineer certification by achieving 100% score. During his undergraduate studies he has done many freelance projects ranging from web development to server deployments. He holds a substantial experience of 4 years in multiple areas such as Operations, Research & Development, White box testing and automation. His interests lie in the areas of machine learning, security and distributed systems.

Project Abstract

Cloud computing is transforming our way of designing and implementing elaborated infrastructures and services accessible through the internet. Cloud computing offers a sufficiently high level of abstraction enabling users to dynamically build value-added solutions based on these services, opening the door to cloud-native applications. These applications are however exposed to a large variety of security attacks. Much research has been done to model and analyze security of cloud systems at Infrastructure and platform level but when it comes to cloud-native applications, the question remains unexplored.

This project focuses on analysis of architectural patterns used in development of cloud-native applications and identifying the security threats. Also, we propose a formal model for cloud-native applications and develop a tool to simulate this model and generate execution traces. Our ultimate goal is to analyze these traces using machine learning techniques to detect anomalies in context of application security.
Name: Manobala Namasivayam Nirmala

Project Title: Capture and study of attackers in Darknet

Supervisors: Prof. Isabelle Chrisment, Dr. Jérôme François

**Personal Description**

Manobala Namasivayam Nirmala is a first year student of DESEM program at University of Lorraine, Nancy, France. He was born in Coimbatore, Tamilnadu, India. He got his Bachelor's degree at Anna University, Chennai in Computer Science and Engineering in 2012. He initiated a startup called Acstoproda associated with graphics design and software development. After 2 years of running his company, he applied for an Erasmus Masters program to gain more knowledge on the concepts of developing reliable large scale software systems.

**Project Abstract**

The darknet is gaining popularity from the recent fall of Silk Road and other illicit anonymous darknet markets. A darknet is a private network which is a part of the worldwide web which is not indexed by standard search engines as it is encrypted and anonymous.

The project focuses on the analysis of network traffic data collected by network telescopes from deep web to identify attacks and characterize them. A network telescope is an internet system used to observe traffic targeting deep web addresses which constitutes the darknet. The traffic obtained using network telescope is analyzed for scans, DoS and backscatter.

The network data used for analysis is obtained from Nancy, France and Tokyo, Japan. After visualizing the network data for graphical analysis, clustering algorithms are used to detect attack patterns from the graph representation of the same. An adaptive streaming clustering algorithm has been developed and implemented, to generate labelled clusters based on the nature of the attacks detected, over a stream of dynamic network data. This tool can be used to directly analyze the nature of the attacks for any given gathered network traffic dataset.
Name: Milena Dyle

Project Title: Transformations of Event-B models into Spec# programs

Supervisor: Dominique Méry

Personal Description

Milena Dyle, was born in Tirana, Albania in May 09th, 1989. Currently she is following her first year of DESEM program in Université de Lorraine, France. She graduated from University of Tirana in Computer Science. During her studies she has always been proactive in participating in different activities, competitions and youth exchanges. She also led her group toward the first price of “Imagine Cup Albania”.

In her 20s she started a part-time job as software developer in IKUBINFO, a software engineering company in Albania, and she continued there in a fulltime position after graduations. During this period she has been part of big projects for the Albanian government such as “e-Filing of Taxes for General Directory of Taxes”, “InterOperability for Albanian Governement” ect. At the same time, she was offered a position at Faculty of Sciences, University of Tirana as a visiting teacher assistant for the seminars of Algorithmic.

Her main focus is software engineering, software modeling and specifications to deliver reliable and high quality software.

Project Abstract

Formal methods for system design contribute to the reliability and robustness of a design. Event-B is a formal method for system-level modelling and analysis. The Rodin IDE for Event-B provides support for modeling, refinement to represent systems at different abstraction levels and mathematical proof to prove models correctness. Spec# is a specification language for API contracts. The Spec# program verifier will prove the correctness of the program. Event B models can be transformed into executable programs that can be then verified by Spec#. EB2RC is an eclipse plug-in for Rodin to assist with transforming Event B models into pseudocode that we translate to Spec# by hand.

This project brings a new approach on how to extend the EB2RC plugin to improve the translation process. It introduces the decomposition concept in Event-B models in terms of reusability and encapsulation. Decomposition contributes in the correctness of the translation process. Finally, we illustrate the approach in two case studies.
Name: Worakarn Isaratham

Project Title: Equivalence Partitioning as A Basis for Dynamic Conditional Invariant Detection

Supervisor: Dr Rosemary Monahan

Personal Description
Growing up in the suburbs of Bangkok, Worakarn Isaratham discovered his interest in programming during middle school. Enrolling to the department of Computer Engineering at Chulalongkorn University was an obvious choice at the time. After completing his bachelor's degree, he worked as quality assurance engineer at Reuters Software (Thailand), gaining specialisations in automated testing and nonfunctional testing. After 4 years, he converted from the testing side to the development side, still at the same company, working on several projects using Java and .NET technologies. A year later he left the company for a small local startup company Qlovr, to work as an iOS developer. Then the opportunity to study in DESEM program came up and he could not let it slip away.

Project Abstract
Program invariants are statements asserting properties of programs at certain points. They can assist developers and testers in understanding the program, and can be used for automated formal verification of the program. However, despite their usefulness they are often omitted from code. Dynamic invariant detection is a technique that discovers program invariants by observing execution of the program. One type of invariants that presents challenge to this technique is conditional invariants, which are considered to be computationally infeasible to be computed exhaustively. We present a new approach to assist conditional invariants detection, by analysing test suites used to drive the execution of the programs for their use of equivalence partitioning – a very common testing technique – and inferring conditional invariants from this information. A prototype implementation, named Yacon, is developed to work in conjunction with a mature dynamic invariants detection tool Daikon. Given a set of splitting conditions, Daikon can use them to infer conditional invariants. Yacon attempts to recover partitioning information from a given test suite, producing splitting conditions as a result. We introduced two strategies to recover partitioning information, one based on the presence of boundary value analysis testing technique; the other based on invariants within the test suite itself. We evaluated the effectiveness of each recovery strategy and the approach as a whole, and found that our approach can help make Daikon perform significantly better. However, the two recovery strategies only work well in limited circumstances, suggesting possible improvement in finding more effective recovery strategies.
Name: Phattara Wangrungarun

Project Title: Web Service for 19th Century Irish Personal Name Matching

Supervisor: Adam Winstanley

Personal Description

A web developer from Thailand, 5 years experienced in front-end engineering, Ruby on Rails and Node.js. I’m not so talkative so I’m not so good at socializing, but I always like to hang out and be with my friends. Reading and drawing cartoons, playing computer and mobile games are my favorite hobbies.

Project Abstract

Before the first Irish civil registration on 1864, census materials were mostly lost or incomplete. So genealogical researches use parish records and also some ‘census substitute’ documents, such as land ownership and tenancy records. However, some of these documents do not contain enough information in identify individuals. Some of them contain name and address, whereas others might contain only name. Record linkage is one method to gather scattered information among many documents. It uses a person’s name as a reference to link that person’s information between many documents. With patience, more complete information about that person can be obtained. Apparently linking or matching person’s name is important in the process. Unfortunately, in the 19th century, in Ireland, there was no standard of the spelling of names, handwriting could be difficult to read and contractions or abbreviations were often used. The names with the same pronunciation and for the same individual could be written in many different ways. Moreover, Irish names which equivalent to modern names were used, for example, Irish version of ‘Smith’ could be ‘Gowan’. To handle these name variations, various solutions have been created to find matching different names that refer to the same person. However, for our extent knowledge, there is yet no public system which encodes those solutions together and provides a service of name matching. This project is to create one system to achieve this. We developed a web service system using Ruby on Rails framework to achieve our goal. The system is initially encoded with 4 matching algorithms, Levenshtein distance, soundex, Irish soundex, and lookup table. We also present a web interface for a client to use the system from the web browser. It is designed to be simple and extensible from using inheritance.
Name: Sebastian Duque

Project Title: Empowering Citizen Science: A Generic Data Collection Framework

Supervisor: Dr. Peter Mooney

Personal Description

Sebastián was born and raised in Medellín, Colombia. He graduated from EAFIT University as a Systems Engineer, a degree akin to Computer Science in most other countries, with some modules borrowed from other disciplines such as software engineering and business and entrepreneurship. During his studies, Sebastián lived in India for four months while on an internship with Infosys, in which he excelled on an Enterprise Web application development course.

He engaged briefly in research for interactive television applications before joining an IT consulting firm focused mainly on the banking sector, where he spent over two years providing solutions to clients in Colombia, Panamá and Chile. He gained valuable domain knowledge in core banking which, in addition to his communicational and technical abilities, resulted in promotions and increasing responsibility for the outcome of the projects he was involved in.

Sebastián is passionate about technology and enjoys being aware of the 'latest and greatest'. Other interests include exercising, meeting new people and learning about their cultures, sight-seeing and trying tasty -sometimes uncommon- foods, which makes traveling one of the things he enjoys the most as in doing so he can find all the rest.

Project Abstract

Citizen Science is an emerging field that seeks to expand scientific knowledge leveraging on a community of citizens that may not be traditionally qualified to engage in formal scientific research. Participants enroll as volunteers and their responsibilities vary depending on the model of each project. We focus on projects in which they are assigned and trained to perform data collection tasks.

Recent technologies, like the Internet, social networks and smart devices, have created a global platform for citizen science to expand, making possible to crowd source citizens from all over the world to work on a particular scientific problem.

Some organisations struggle to effectively answer: "How can the data or information be collected?" A robust user-interface (web/mobile) for capturing information is likely to lead to higher quality data than the traditional paper approach. Some projects have already developed mobile applications with different objectives (e.g. monitoring birds or water quality) but others see themselves hindered by the complexity and costs intrinsic to implementing such a platform for data collection.

This thesis designs and implements a web model for data collection that suits both small communities and larger organisations and reduces the technical effort while offering features commonly required by Citizen Science projects. A campaign is run as a case study that validates the value of the presented contribution, which is also evaluated and compared to previous work in the field.
Name: Suhyun Cha  
Project Title: Implementation of tongue based hearing enhancement system  
Supervisor: Barak A. Pearlmutter

Project Abstract

Hearing impaired people have been getting increased all over the world. Cochlear implantation is considered as a primary treatment of high degree hearing impairment. However, there still exist some risks and side effects of this surgical procedure even though there have been a lot of trials and researches over tens of years since the first surgery had been conducted because it is invasive way. In this study, we made a system that can help people to recognize the sound better when they have some trouble to listen to it by giving stimulus on their tongue, non-invasive way. We undertook an experiment with three subjects to verify the effect of this system for 15 days. After training of that period, the two subjects showed great improvement of more than 45% in recognizing sounds with the stimuli in a hardly-hearing situation compared to recognizing them with hearing only in the same situation. This demonstration can lead the research of auditory sensory substitution with tongue stimuli even though not all the subject showed positive results.

We used a ready-made device (mutebutton™) for giving the stimulus on tongue and implemented a computer program for training the user (subject) by guessing the right answer after hearing the sound with the ear and perceiving electric stimulus with the tongue at the same time. To use that device, we made a cochlear implant system simulator to generate the electric signal for stimulation with Matlab script language to realize all the steps in cochlear implant system because that language is optimized for dealing with the arrays and frequency domain conversions. Also, we made a computer program that trains the user by accepting and recording the user’s activity and notifying the right answer and overall progress in the Visual C# IDE for convenient construction of GUI program.

During the experiment, the subjects were trained with this system for 15 days with some vowel-consonant-vowel (VCV) sound. Their marks were analyzed everyday and their training sets were reset every day after a half of the experiment period for more training on their weak part. On their final measurement, they were tested by mixed set of non-stimulus and with-stimulus samples in various sound situation and the improvement was measured by comparing with-stimulus sample recognition rate with non-stimulus’.
Name: Jorge Ibarra Delgado

Project Title: Modelling and Transformation of Non-Functional Annotations

Supervisor: Juliana Bowles

**Personal Description**

Jorge Ibarra Delgado was born in Guadalajara, Mexico in January 19th, 1986. He got his bachelor degree at the Universidad de Guadalajara as a Computer Engineer in the year 2009. After 3 years of working at a start-up enterprise in his native city as a software developer and playing in a rock band, in 2012 he finally decides to go abroad in order to live in a country he was always interested to know: France. While still working distantly for the start-up enterprise in Guadalajara, he had french studies at Université Rennes 2. Being interested in continuing his computer science studies, and hopefully stay a little longer in Europe, he got the opportunity to study as an Erasmus Mundus student in the DESEM programme at the University of Lorraine, in Nancy, France. After finishing successfully that year now he’s studying his second year at the University of St. Andrews the topics of Software Engineering and Software Architecture.

![Diagram](image)

**Project Abstract**

A model is an abstract description of an artefact, we can obtain the key elements of a new or existing system and show these to the corresponding stakeholders in order to evaluate and validate our requirements, to verify our implementation and to have a rich documentation for further consulting. Model transformation are used to generate models out of existing ones, which can be effective and useful when we are targeting an specific semantic model, i.e. models that can be analysed formally such as various kinds of automata and Petri-nets. In this project we want to capture the specification of non-functional requirements, e.g. reliability, security, safety, availability, etc. into one model, preferably an annotated one, usually coming from an informal modelling method like UML and transform this model to a target model that can be related to an existing tool in order to make its analyse. Concretely, for this paper we created a language based on PlantUML and made its transformation to UPPAAL by creating a tool.
Name: Felicia Halim

Project Title: Enhancing the efficiency and effectiveness of heuristic search through fractional progress

Supervisor: Mike Weir

**Personal Description**

Felicia Halim was born in Jakarta, Indonesia. She started undergraduate degree in Universitas Indonesia. During her studies, she was teaching assistant for Discrete Mathematics and Calculus II. In her 4th year of undergraduate degree, she was selected as university representative for APEX Global IT Case Challenge 2011 hosted by School of Information System Singapore Management University. After graduated cum laude with computer science bachelor degree, she worked as Software Engineer for Astra Graphia Information Technology. She has experience developing web based application and implements business intelligence solution for automotive industry company. She has received a scholarship to study Double Erasmus Mundus Msc in Dependable Software System for two years. She spent the first year in National University of Ireland and is doing the second year in University of St Andrews, UK. Her aspiration is to have career in software development industry that able to produce high quality software.

**Project Abstract**

Local Minimum is commonplace throughout heuristic cost-based search. Techniques based solely on descent in cost can get stuck or become infeasible as a result. The Potential Fields Method was first is an approach of robot navigation that avoids the obstacle by detecting potential collisions in the unstructured environments to reach the goal. The standard technique generally works by minimize the potential collision to the obstacle and directed the robot closer to the goal by calculating its goal potential. The nature of standard technique that does not allow the robot to have direction away from the goal, will lead robot trap and getting stuck. This problem is identified as a local minimum problem because the potential need to be increased locally to get round the obstacle shape. Similar to robot, neural network can also suffer to local minimum problem. Depending on initial weights, the gradient can get stuck that make neural network unable to do classification task. This project is to investigate a novel technique known as fractional progress technique that is design to allow the potential to go up as well as down, but ensuring the chosen transition optimal at each stage. The algorithm works in systematic basis without the use of trees or probability and to ensure continual progress during the search. We will implement this novel technique in both robot navigation and neural network.
Name: Fahrurrozi Rahman

Project Title: A Probabilistic Model for Ancient Egyptian Hieroglyphs

Supervisor: Dr. Mark-Jan Nederhof

**Personal Description**

A self-proclaimed linguist who once dreamt to be a farmer. He usually can be found between the stacks of books in his room or cooking in the kitchen that makes him famous as a good cook (of course according to himself).

\[
\text{c: “he is seen”}
\]

\[
\begin{align*}
\text{log} & \quad \text{phon} \\
\text{phon} & \quad \text{phon} \\
\text{m} & \quad 3 \quad t \quad w = f
\end{align*}
\]

**Project Abstract**

In Ancient Egyptian hieroglyphs, words can be written in several ways. Depending on the creativity of the scribes, even inside the same text/corpus the same word can often be encountered written in two, three or more ways. Another complication is one hieroglyph sign can possess several different functions, e.g. as a phonogram (spelling out the word), a logogram (describing the meaning of the word), or a determinative (clarifying the meaning of the word). The same phonogram can also have different sound values in different words. We propose a probabilistic language model of Ancient Egyptian hieroglyphs that can be trained on data and refined as more data become available. The goal is to identify how the hieroglyph signs can form words from a given sequence of hieroglyph signs and a given sequence of transliteration by finding the most likely sequence of functions that connects them.

We use N-gram and Hidden Markov Model (HMM) as the language model which are built under finite state automata that represent the configuration of hieroglyph signs and the transliteration. Several smoothing techniques are also implemented to achieve the robustness of the system, i.e. to still give some meaningful output when confronted with unseen sequence of signs before.

We conducted test to evaluate the validity of our approach and conclude that it is successful to automatically recognising the sequence of functions between the hieroglyph signs and the transliteration.
Name: Lawan Thamsuhang Subba

Project Title: Container Based Lightweight Benchmarking

Supervisors: Dr Adam Barker, Dr Blesson Varghese

**Personal Description**

Lawan Thamsuhang Subba was born in Kathmandu, Nepal. He completed his Bachelors in Computer Engineering in 2009 from Kathmandu University. After completing his bachelors he started working for an outsourcing hub of the Dutch software company Procit in Nepal. Initially hired as an intern, he would later move up to the rank of Senior Software Engineer at which point he was maintaining the CRM for the Dutch telecommunications company MTTM. Besides his full time work, he is also working as a freelance developer and has built web applications for clients in Nepal and Canada. After actively working in the software industry for four years and witnessing firsthand the fragile and chaotic nature of software development. He joined the Erasmus Mundus DESEM program in 2013 looking for answers on how to introduce rigor and dependability into the software development process. When not working on projects and assignments he can be found hiking the remote Himalayan trails of Nepal, reading the latest trends in the software industry or watching cat videos on YouTube.

**Project Abstract**

The pay as you go pricing model and the scalable nature of Cloud computing makes it a desirable alternative to traditional computing, in which customers have to maintain and support the computing infrastructure. But the wide assortment of Cloud providers, services and virtual machine configurations available to use makes it difficult to select the optimal option that meets the requirements of an application. While benchmarks have normally been used to gauge systems performance, it is not always feasible on the cloud where virtual machines have enormous computing capacities (Cpu Cores, Memory and Storage) and benchmarks would incur substantial time and charges.

To address this issue, this dissertation reports the development of the Docker Container Lightweight Benchmarking Tool (DoCLite) that implements a lightweight and hybrid benchmarking technique. The lightweight technique uses containers to benchmark a subset of the systems resources. Whereas the hybrid technique combines the historic and current benchmark data. When compared with heavyweight benchmarking, both techniques show promising results.
Name: Agastya Silvina

Project Title: Cancer Automata Models

Supervisor: Dr Juliana Bowles

Personal Description

An avid gamer, programmer, learner, a happy-go-luck person... with just the right amount of

Project Abstract

Cancer is a chronic disease where cells grow and multiply in an uncontrollable manner ultimately spreading and invading surrounding tissue and metastasize in other parts or organs of the body. It can be understood as an out of control interaction between cells and their environment. There are many ways to model cancer growth, i.e. from applied math to computer simulation. We consider a very different, and in some respect novel, approach in this thesis through model checking.

In model checking, systems are modelled as finite state automata. Automata can be used to capture cancer evolving through a (discrete finite) sequence of progressive stages called as phenotypes. Cancer Hybrid Automata (CHA) were introduced by Loohuis et al. for that purpose and model the progression of cancer with discrete phenotypes. The model contains several states (stages and hallmarks of cancer) and a transition between stages indicates a progression or regression of the cancer. Given the lack of composition mechanisms for CHA and adequate tool support, this dissertation investigates and extends a cancer modelling framework using different kind of automata. We focus particularly on Priced Time Automata and Probabilistic Time Automata.

We choose breast cancer as an example to illustrate the different aspects of the modelling framework. Through composition we integrate additional patient information such as different kinds of treatments, rates of tumour growth and comorbidities. Our choice of timed automata and their variants makes it possible to verify the model using model checkers such as UPPAAL, TIGA, SMC, and so on. These model checkers make it possible to verify whether given properties, expressed in temporal logic such as TCTL or PCTL, are satisfied. The properties given could help us to analyse and compare the effectiveness of different treatment plans in terms of how they can inhibit the cancer and hence prevent it from reaching a state of metastasis.
Name: Andrii Kovalov

Project Title: Avoiding medication conflicts while combining clinical pathways for comorbid diseases

Supervisor: Dr Juliana Bowles

Personal Description
Hello! I am Andrii from Ukraine. I got my Bachelor’s and my first Master’s degree in Computer Science in Kharkiv National Aerospace University in Kharkiv, Ukraine. After graduation I worked as a Software Engineer for several years. In 2013 I started DESEM programme in Maynooth, in 2014 moved to St Andrews. If you are reading this and want to ask me a question, by all means do! andrewsk@ukr.net

Project Abstract
In the healthcare industry there are standardised instructions (clinical pathways) on how to treat certain diseases. Every pathway is focused on one disease. However, often patients have several comorbid diseases in which case multiple pathways should be applied. Often there are conflicts between certain medications. Our work focuses on finding a treatment plan which will contain the least of such conflicts. We represent each pathway as a graph of pharmaceutical actions, where every action contains one or more alternative medications with ‘scores’ defining how helpful they are. Then we translate the graphs and the conflicts with respective negative scores into logical and arithmetic expressions and use Z3 SMT solver to generate a treatment plan with the highest score.
Name: Patomporn Loungvara

Project Title: Enhancing a Therapeutic Mobile App through continual learning and automated conversation

Supervisor: Dr. Michael Wier

**Personal Description**

Patomporn Loungvara is a second year DESEM student in University of St Andrews. She has been interested in computer technology since she was in high school. She decided to enroll to the Faculty of Sciences of Chulalongkorn University, majoring in Computer Sciences and graduated with Bachelor of Science there. When she was in the university, she had an opportunity to join Summer Internship Student Programme at IBM Solution Delivery Co.,Ltd, and she realized that she is interested in project management. After graduating from the university, she had been working as a programmer in Credit Risk Management Team of Bangkok Bank Public Company Limited. Besides utilizing her knowledge of database system, programming and user-interface design, she gained a lot of experiences in the areas such as software business process, project management and presentation skills. After working for three years in industry background, she decided to continue to pursue the Master degree in Software Engineering field to sharpen her technical ability, business knowledge, and interpersonal skills, as well as prepare her for the future. Apart from doing things related to computer, she likes to travel in different places to broad her horizon and do photography. Every friend of her knows that she is a travel-aholic.

**Project Abstract**

Cognitive Behavioural Therapy (CBT) is a set of clinical methods to treat depression, anxious disorders and chronic fatigue syndrome. It is currently a fast growing field and a mobile application has been created to offer such therapy to patients on the move out with sessions with a therapist. The application asks the patient questions at various times during the week and interacts with the patient according to their responses. The aim of this project is to enhance the patient experience by learning their preferences and by automatically making a therapeutic conversation out of the question and answer sequences. A neural network may be used to enable the App to learn suitable questions for the patient based on their responses. A model of therapeutic conversations can be used to structure the question and answer sequences. These features will be tested through the simulation by using artificial patients.
Name: Onur Mirmaroglu

Project Title: Where are your data going? Feedback Mechanism for Data Leakage on Mobile Devices

Supervisor: Dr Tristan Henderson

Personal Description

Born in Manisa in 1989, grew up in Izmir, lived in Ankara, all of which in Turkey. Got his BSc Computer Engineering degree from Bilkent University. It wasn't easy, but worth it. Spent the first year in Maynooth. Lovely people. Currently studying in St Andrews. Lovely town. Don't know where he will be next year. Very old fashioned person, doesn't like computers. But it's the only field he is somehow good at. Doesn't have much work experience (internships don't count). Wishes to remain so, as academic life is better for him. Likes French movies, Belgium towns, Irish beers, Turkish foods. Backpacking is his only extracurricular activity. Interested in mobile technologies, operating systems, augmented reality, networks and distributed systems.

Project Abstract

In today's world, smartphones and tablets are the main, and rapidly becoming the only, mobile platform of choice for users. However, the explosion of development and consumption of mobile apps is a cause for concern from privacy perspective. While mobile platforms cannot fully guarantee users’ privacy against information-hungry applications, large amount of privacy-sensitive data stored on mobile devices even multiply these privacy risks as the data generated by these devices is often opaque to its owner. Although mobile privacy protection mechanisms have been widely explored by the research and commercial environment to date, much of these work either give little insight into the exposure level of private data or keep users out of the picture and stay as proof-of-concept. Hence, our work is motivated by the need for giving mobile users more control over their personal data. To this end, we address the challenge of privacy management and data transparency on mobile devices, particularly on Android. We developed an in-situ feedback mechanism on Android that: (1) dynamically prevents applications from accessing privacy-sensitive data without introducing an adverse effect to the user-desired functionality, and (2) unobtrusively yet saliently notifies users about access attempts. Considering the need for protecting mobile users’ personal information from exfiltration by access-hungry applications, we believe that our work will help users to make more informed and finer-grained privacy decisions on mobile devices.
Name: Junyi Zhang

Project Title: Rule-based Filing System

Supervisor: Graham Kirby

Personal Description

My name is Junyi Zhang and I come from China. I studied Computer Science and Technology during undergraduate in Harbin Institute of Technology. My undergraduate thesis is about colour recognition in embedded robot vision system. I am currently a first year master student in DESEM program.

I have done several projects under different platforms. I developed a rolling dice program on Android when we played Dungeons & Dragons. I designed a MIPS pipelined CPU in VHDL when studying computer architecture. I have also programmed a resource monitoring software on Windows, which monitors the resources on the laptop and kill DLL of certain threads. I am now doing a summer internship in Toshiba Medical Visualization System and I really enjoy the learning something different and fresh.

In my leisure time, I love travelling and photography. I’d like to take photos of the beautiful sceneries and make videos to document my journeys. I’d love to share the happy moments of my trips with my friends. I am also fascinated about sketch drawing and watching Japanese manga. My favourite manga is Bleach and I hope I can find a job relating to animation production or multimedia technology.

Project Abstract

Nowadays, our computers are filled up with millions of digital files. Organizing these files manually costs so much human efforts that we cannot afford it anymore. Therefore, filing systems that can arrange the files automatically in accordance with user preferences is in need. Group operations can be conducted periodically so that the users are released from repeated manual work.

In this research project, a rule-based filing system was designed, implemented, and evaluated. Functions operated by the system were selected based on a user-oriented survey. With this given function set, users are allowed to establish and modify rules that regulate the automatic manipulation on targeted files. Methodology and technologies to realize this system were stated and justified. Problems during development and issues existed in the software were elaborated; possible solutions to handle these problems were proposed. The usability of the software was evaluated through two surveys among potential users. The limitations of the software and approaches to improve the product quality were discussed as well. We concluded that the filing system we developed could basically meet the demands of users; however, it required further efforts to handle exceptions in different situations to enhance the overall quality of the software.
Name: Anders Olav Candasamy

Project Title: Defining a Network Protocol in a Domain Specific Language

Supervisor: Dr. Edwin Brady

Personal Description

My name is Anders Olav Candasamy and I am from Norway. I have a bachelor’s degree in Computer engineering from the University of Agder and am currently studying at the University of St Andrews for my masters degree. I love all parts of technology and consider myself a full-stack developer. I mainly work on the back-end side of things, but I also enjoy creating the front-end. The computer languages I primarily use are Java, Scala and JavaScript.

Project Abstract

Network protocols are a set of rules that strictly define the order and content of messages passed between users over a network. Often these protocols are used to define how to establish a secure and encrypted connection. As these protocols grow in complexity, it becomes increasingly complicated to implement them. Making matters worse is ensuring that the implementation adheres to the rules of the protocol. Dealing with these issues can cause implementations to become complicated and obscure a system’s properties and workflow. In this paper we will create a domain specific language that captures this complexity. The DSL will provide the syntax needed for precisely defining a protocol. We will then use this definition as a foundation for the protocols implementation.
Name: Gunyel Devrim

Project Title: REMox Tuberculosis Machine Learning

Supervisor: Dr. Tom Kelsey

Personal Description

She was born in 1986 in Turkey. Decided to be a scientist when she was 15 when someone offered her to be a theatre actress. She realised that whatever she would do, there should be mathematics in it. On the other hand, it didn’t stop her to act for 10 years and being a professional swimmer for 8 years till her 20s. After graduating as BSc. Computer Engineering degree, she started to work as junior consultant project manager for call centre technology companies. She worked for 4 years and realised that planning other engineers’ job and train them is not her thing and decided to be one of them. She started MSc. Computer Engineering in Turkey and met with Bioinformatics. Now, she is trying to figure out how to deal with academy after 5 years without programming. In addition struggle to survive in academy, she works in human rights organisations and organising events about nationalism and politics, cooking, gardening and dream about being a scientist one day.

Project Abstract

The REMox consortium, which also includes Prof. Stephen Gillespie from school of medicine, has been working on tuberculous treatment options for ten years in different countries. These data are will be analysed statistically by biomedical statisticians as planned by the clinical trial investigators. This project is about seeing if there is anything else in the data that can help with the analyses of the existing clinical trial and/or aid the design of future clinical trials.

This project is about seeing if there is anything else in the data that can help with the analyses of the existing clinical trial and/or aid the design of future clinical trials. The main objectives of this project are to clean the data (preprocessing), summarising the data statistically, making some exploratory data analysis to see the relationships between components of the data, give some statistics by grouping the data according to symptoms, patients etc. One of the main outcome of the project will be a visualisation report that gives time series plots, correlations between variables, pie, line and other charts. Furthermore, by using sequential (time) data, predictions about patient situation through the time can be performed. For instance, by using historical data, a new patient’s situation (symptoms through visits etc.) might be predicted by probabilistic models.
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