NML 1

Project Title:
Accelerating Science with Machine Learning

Supervisor:
Dr. Edwin V. Bonilla (edwin.bonilla@nicta.com.au) and Dr. Fabio Ramos (fabio.ramos@sydney.edu.au)

Project Description
Scientists such as physicists or biologists deal with very complex models of nature. For example, a geophysicist may be interested in modelling how the heat is produced and transmitted in the earth in order to find suitable targets for geothermal energy exploration. However, these models usually take very long time to execute and, more importantly, when combined with machine learning algorithms they become the bottleneck when trying to predict unknown quantities in the problem. For example, in the geothermal exploration application we may be interested in predicting unknown geophysical properties of rocks such as porosity or density.

In this project we aim at building emulators for those physical models and incorporate them into machine learning algorithms in order to speed up the prediction process in scientific applications. There are many possibilities for machine learning methods underlying these emulators, for example Gaussian processes [1]. This project, despite its simplicity, has the potential of changing how prediction can be done in scientific applications and will expose the student to novel applications and very effective machine learning methods.

As a student involved in this project, you will work with senior researchers at NICTA and the University of Sydney and you will have the opportunity to apply your work to exciting problems such as those in the mineral exploration area [2].

Reference Material/Links (if applicable):

Requirements (if applicable):
The student should:
- Be very competent with a high level programming language such as C, C++ or Matlab (essential)
- Have some knowledge of machine learning (desirable)
- Be comfortable with basic maths and probabilities (essential)
NML 2

Project Title:
Probabilistic Learning of Expert Knowledge

Supervisor:
Dr. Edwin V. Bonilla (edwin.bonilla@nicta.com.au) and Dr. Fabio Ramos (fabio.ramos@sydney.edu.au)

Project Description
Many real applications of machine learning require the use of knowledge provided by an expert. For example, a geologist may have a good idea of what the geological structure of a specific region in Australia looks like and this knowledge can be exploited by machine learning techniques in order to develop practical algorithms for finding suitable targets for mineral exploration. Similarly, a medical doctor, based on his previous experience, can provide critical knowledge as input to automatic medical diagnosis algorithms. However, having useful representations of this knowledge and tools that aim at extracting this information is very hard and they may require a high cognitive load.

This project aims at using probabilistic representations and machine learning in order to elicit knowledge from experts in a similar way to how recommendation systems (such as those built in amazon.com) elicit preferences from users in order to recommend a product. We will exploit recent advances in preference learning (see e.g. [1]) and their applications such as computer graphics [2] and mineral exploration [3] to develop novel machine learning approaches for the learning of expert knowledge.

As a student involved in this project, you will work with senior researchers at NICTA and the University of Sydney and you will have the opportunity to apply your work to exciting problems such as those in the mineral exploration area.

Reference Material/Links (if applicable):


Requirements (if applicable):
The student should:
• Be very competent with a high level programming language such as C, C++ or Matlab (essential)
• Have some knowledge of machine learning (desirable)
• Be comfortable with basic maths and probabilities (essential)
Project Title: Visual Analytics of Time Series Data

Name of Supervisor: Jianlong Zhou (Jianlong.zhou@nicta.com.au)

Name of Joint/Co-Supervisor: Dr. Fang Chen, Dr. Jinjun Sun

Email of Joint/Co-Supervisor: Fang.Chen@nicta.com.au, Jinjun.Sun@nicta.com.au

Project Outline

With the advances of technologies in various areas, large amount of data are increasingly recorded. Besides the management of large amount data, the analyses and getting insight of large amount data are active research topics in recent years.

Two approaches are commonly used in data analysis: machine learning (ML) and visualization. ML tries to get insights from data while visualization aims to present original data as well as analysis results meaningfully to end users.

This research project focuses on the visualization of time series data. The objective of this project include: 1) investigate approaches that are used to present our specific time series data; 2) investigate approaches for presenting ML analysis results from our specific time series data; 3) implement the proposed mechanism; 4) carry out a small scale user experiment.

The ultimate goal of the project is to set up a framework of visual analytics for time series data, which presents analysis results from other approaches (e.g. ML) with the original data meaningfully.

Approaches used in this project include information visualization, human computer interaction (HCI) techniques, as well as effective presentation methods for ML results.

Techniques developed in this project will facilitate the effective presentation of data sets with ML results, which helps users understand data sets as well as analysis results easily. Students involved in this project will gain comprehensive knowledge on visualization, HCI techniques, computing skills as well as interesting domain knowledge.

The topic is available to 1 or 2 students with strong interest in HCI and information visualization.

Expected Outcomes

The student should implement a framework for information visualization with some high level languages (e.g. JavaScript, matlab, python, or others). A research report will be expected at the end of the project.

References

1. Making Machine Learning Transparent
2. The TimeViz Browser: A Visual Survey of Visualization Techniques for Time-Oriented Data
   (http://survey.timeviz.net/)
**Project Title:** Sensor Data Visualization on Android-based Devices

**Name of Supervisor:** Jianlong Zhou ([Jianlong.zhou@nicta.com.au](mailto:Jianlong.zhou@nicta.com.au))

**Name of Joint/Co-Supervisor:** Dr. Jinjun Sun, Dr. Fang Chen

**Email of Joint/Co-Supervisor:** Jinjun.Sun@nicta.com.au, Fang.Chen@nicta.com.au

**Project Outline**

Large amount of data are increasing collected from various sensors, such as sensor data from scientific experiments, and mobile devices. Most of sensor data are time series data. Besides the machine learning (ML) based analysis of such data sets, visualization of original data sets and ML results is helpful for users to get more insights from data.

This project aims to visualize sensor data and related ML results on Android based mobile devices. The objective of this project include: 1) investigate effective information visualization approaches on Android-based devices; 2) design a framework to present sensor data Android-based devices; 3) implement the proposed framework; 4) carry out a small scale user experiment.

The implemented framework should include three main modules: 1) data transfer: it can load data from remote source, such as our postgresql database. At the beginning, it can start from local csv and json. Ideally, it will build a OLAP cube like structure for plotting ([http://en.wikipedia.org/wiki/OLAP_cube](http://en.wikipedia.org/wiki/OLAP_cube)); 2) data visualization according to the samples above; 3) human interaction with the chart.

Approaches used in this project include user analysis, information visualization techniques, Android-based developing techniques, as well as ML for sensor data analysis.

Techniques developed in this project will facilitate the effectiveness of sensor data presentation. Students involved in this project will gain comprehensive knowledge on HCI techniques, computing skills as well as interesting Android-based developments.

The topic is available to 1 or 2 students with strong interest in HCI and visualization.

**Expected Outcomes**

The student should implement a framework for sensor data visualization on Android-based devices with high level languages (e.g. C#, Java). A research report will be expected at the end of the project.

**References**

3. [http://www.reddit.com/r/androiddev/comments/1dp0er/basic_data_visualization_in_android_development/](http://www.reddit.com/r/androiddev/comments/1dp0er/basic_data_visualization_in_android_development/)
**NML 5**

**Project Title:** Uncertainty Visual Analytics in Machine Learning

**Name of Supervisor:** Jianlong Zhou (Jianlong.zhou@nicta.com.au)

**Name of Joint/Co-Supervisor:** Dr. Jinjun Sun, Dr. Fang Chen

**Email of Joint/Co-Supervisor:** Jinjun.Sun@nicta.com.au, Fang.Chen@nicta.com.au

**Project Outline**

As machine learning (ML) techniques become more widely used in various fields, adequate methods have to be provided to allow users to employ ML techniques effectively. However, data is inherently uncertain and often incomplete and contradictory. Meanwhile, transformations with ML techniques also introduce uncertainty into data analysis pipeline. Therefore, a visual quantitative analysis of uncertainty in ML based data analysis process is helpful for users to make more informative decisions.

This research project focuses on the visual analysis of uncertainty in an ML based data analysis process. The objective of this project include: 1) uncertainty modeling; 2) design a mechanism to visualize uncertainty at each stage of ML process; 3) implement the proposed mechanism; 4) carry out a small scale user experiment.

Approaches used in this project include data modeling, human computer interaction (HCI) techniques, as well as effective presentation methods for ML results.

Techniques developed in this project will facilitate the decision making effectiveness in ML and improve impact of ML in real-world applications. Students involved in this project will gain comprehensive knowledge on uncertainty, HCI techniques, computing skills as well as various interesting machine learning techniques.

The topic is available to 1 or 2 students with strong interest in HCI and ML.

**Expected Outcomes**

The student should implement a framework for uncertainty visual analytics in ML with some high level languages (e.g. python). A research report will be expected at the end of the project.

**References**

1. Making Machine Learning Transparent

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**NML 6**

**Project Title:** Dynamic Workload Adaptation in Human Machine Interaction

**Name of Supervisor:** Jianlong Zhou (Jianlong.zhou@nicta.com.au)

**Name of Joint/Co-Supervisor:** Dr. Jinjun Sun, Dr. Fang Chen

**Email of Joint/Co-Supervisor:** Jinjun.Sun@nicta.com.au, Fang.Chen@nicta.com.au
Project Outline

Dynamic workload adjustments can be used in human-machine systems in order to improve user engagement and performance. In this project, we use physiological sensors such as Galvanic Skin Response (GSR) and Eye-tracker to obtain passive human sensing data. By analyzing the obtained sensing data in real-time, we can adapt a task in order to optimize workload in real-time, which allows the system to better fit the task to the user during working time. The more interesting aspects of this project is that it can be developed as an app on mobile devices and allows users use the proposed framework easily and conveniently.

The objective of this project include: 1) set up a dynamic workload adaptation framework based on our previous work; 2) implement the proposed mechanism; 3) carry out a small scale user experiment.

Techniques developed in this project will facilitate the human engagement and performance in different tasks in human machine system. Students involved in this project will gain comprehensive knowledge on HCI techniques, computing skills as well as various interesting machine learning techniques.

The topic is available to 1 or 2 students with strong interest in HCI and machine learning.

Expected Outcomes

The student should implement a framework for dynamic workload adaptation with some high level languages (e.g. matlab, python, C# or others). A research report will be expected at the end of the project.

References: Making Machine Learning Transparent

NML 7

Project Title: Water Pipe Bandits

Name of Supervisor: Dr. Bin Li (bin.li@nicta.com.au)
Name of Joint/Co-Supervisor: Dr. Yang Wang, Dr. Fang Chen
  yang.wang@nicta.com.au

Abstract

Multi-armed bandit is the problem a gambler faces at a set of slot machines, when deciding which machines to play over time to gain maximum money. It is a classical problem in probability theory. In this project, we view each water pipe as a slot machine with an unknown probability to fail in the near future. The aim is to apply multi-armed bandit algorithms to massive pipes in Sydney area for risk pipe detection to maximize the cost savings (avoided consequence of pipe failures).

Research Environment

The selected student will work with a team of researchers in the field of machine learning and data mining, at the NICTA headquarter at Australian Technology Park.

Novelty and Contribution

This project will help save millions of dollars each year due to early alarm of water pipes in Sydney area.

Expected Outcomes

This project will provide the student an opportunity to learn about machine learning and data mining. We will develop algorithms to benefit the society.

References

CitySketch: Land-Use Annotation on Water Pipe Networks

Name of Supervisor: Dr. Bin Li (bin.li@nicta.com.au)
Name of Joint/Co-Supervisor: Dr. Yang Wang, Dr. Fang Chen (yang.wang@nicta.com.au)

Abstract
The water pipe network is one of the most fundamental infrastructures in a city. Its layout is directly correlated to the population distribution in a city. In this project, we will advance one step further to conduct a finer analysis – To annotate regions with land-use labels (e.g., commercial, residential, and industrial) based on the water pipe layout patterns and features in a region. The project will be developed on the complete water pipe network in Sydney area.

Research Environment
The selected student will work with a team of researchers in the field of data mining and urban planning; at the NICTA headquarter at Australian Technology Park.

Novelty and Contribution
This project will help analyse the land-use development for urban planning in Sydney area.

Expected Outcomes
This project will provide the student an opportunity to learn about data mining. We will develop a visualisation tool to demonstrate a land-use map in Sydney.

Pre-requisites: Programming Skills

References

Big data analysis for understanding customer behaviour

Name of Supervisor: Dr. Bang Zhang (bang.zhang@nicta.com.au)
Name of Joint/Co-Supervisor: Dr. Yang Wang and Dr. Fang Chen (yang.wang@nicta.com.au)

Abstract
In this project, you will get hands-on experience on real-world customer consumption data. The aim of the project is to build a system to understand customer behaviour, e.g., customer segmentation, customer demand analysis, abnormally detection. The project consists of many components including data analysis, visualization and human computer interfacing. Successful candidates can select one of the components to make contributions. Your work will contribute to the system that makes real impacts on millions of residents in Sydney.

Research Environment
The selected student will work with a team of researchers in the field of machine learning and data mining, at the NICTA headquarter -- Australian Technology Park.
**Novelty and Contribution**
This project will design and develop algorithms that predict customer demand.

**Expected Outcomes**
This project will provide you an opportunity to learn about machine learning and data mining. We will develop algorithms to discover the critical factors that influence customer's behaviour.

**Pre-requisites:** Good programming skills

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**NML 10**

**Project Title:** How to save millions of dollars for water utility companies by picking out dying pipes

**Name of Supervisor:** Dr. Bang Zhang ([bang.zhang@nicta.com.au](mailto:bang.zhang@nicta.com.au))

**Name of Joint/Co-Supervisor:** Dr. Yang Wang and Dr. Fang Chen ([yang.wang@nicta.com.au](mailto:yang.wang@nicta.com.au)  [fang.chen@nicta.com.au](mailto:fang.chen@nicta.com.au))

**Abstract**
In this project, you will get hands-on experience of data analysis on real-world big data involving water main networks, soil maps and weather information in one of the biggest metropolises over the world. The aim of the project is to build a system to detect and predict risky water mains at early stages for utility company to prevent disastrous failures, thereby reducing the maintenance cost. The project consists of many components including data analysis, visualization and human computer interfacing. Successful candidates can select one of the components to make contributions. Your work will contribute to the system that makes real impacts on millions of residents in Sydney. At the end of the project, you will know something about survival analysis, Random Forests, Cox proportional hazards model and non-parametric Bayesian approach.

**Research Environment**
The selected student will work with a team of researchers in the field of machine learning and data mining, at the NICTA headquarter -- Australian Technology Park.

**Novelty and Contribution**
This project will design and develop algorithms that perform prediction on water main failures.

**Expected Outcomes**
This project will provide you an opportunity to learn about machine learning and data mining. We will develop algorithms to discover the critical factors that influence water main failures, and make predictions accordingly.

**Pre-requisites:** Good programming skills

**References**
Project Title: How to use machine learning and signal processing techniques to make a million dollar portable device for non-invasive diagnosis of cattle pregnancy

Name of Supervisor: Dr. Bang Zhang (bang.zhang@nicta.com.au)
Name of Joint/Co-Supervisor: Dr. Yang Wang and Dr. Fang Chen yang.wang@nicta.com.au  fang.chen@nicta.com.au

Abstract
This project aims at algorithm development that helps to realize non-invasive diagnosis of cattle pregnancy via portable monitoring device. Non-invasive pregnancy detection for cows can provide high productivity and tremendous convenience for cattle producers, especially in the remote rural areas where the lack of vet is severe. Specifically, bio-signals recorded by miniaturized monitoring device, a portable multi-lead ECG (electrocardiogram) scanner, are used for pregnancy detection in this work. The noninvasive characteristic of the scanner makes cattle pregnancy testing and fetal age determining safer and easier. The project consists of various components including signal de-noising, feature extraction, pattern classification, and visualization. Successful candidates can select one of the components to make contributions.

Research Environment
The selected student will work with a team of researchers in the field of machine learning and data mining, at the NICTA headquarters -- Australian Technology Park.

Novelty and Contribution
This project will design and develop algorithms that perform signal de-noising, feature extraction, pattern classification and visualization for bio-signal.

Expected Outcomes
This project will provide you an opportunity to learn about machine learning and data mining. Technical reports are expected at the end of the project.

Pre-requisites: Good programming skills

Project Title: Vehicle Tracking for Structural Health Monitoring

Name of Supervisor: Dr. Khoa Nguyen (khoa.nguyen@nicta.com.au)
Name of Joint/Co-Supervisor: Dr. Yang Wang and Dr. Fang Chen yang.wang@nicta.com.au

Pre-requisites: Good programming skills

Abstract
Structural health monitoring (SHM) is a technology to monitor civil infrastructure such as bridges and buildings using sensors. Data obtained from sensors can be used for early damage detection in structures. NICTA and Roads and Maritime Services (RMS) have conducted a SHM project for Sydney Harbour Bridge to monitor hundreds of joints underneath the bus lane. Current approach is to monitor the response of a joint to multiple loading traffic events and determine structural integrity of that joint.

It would be useful to compare multiple joints. By comparing how the responses of all joints change over time to similar events and looking for anomalies we should be able to detect any that are degrading at a different rate than the general population of joints thus warranting further inspection. In order to do so, we should be able to classify and track vehicles crossing the bridge and associate joint events with a specific vehicle.
Students will work with real data obtained from several sensors installed on the bridge, investigate a method for vehicle tracking and classification and implement it using a programming language. The topic is available to a student with strong interest in machine learning, a solid statistical background, and a strong programming skill.

Research Environment
The selected student will work with a team of researchers in the field of machine learning, at the NICTA headquarters -- the Australian Technology Park.

Novelty and Contribution
The NICTA team is a world research leader in machine learning. This project will investigate a method to classify and track vehicles for structural health monitoring problems.

Expected Outcomes
The student should exhibit autonomy and must have good programming skills in some high level language (e.g. Matlab, Java, C++). A research report will be expected at the end of the project.

References

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**NML 13**

**Project Title:** Joint Clustering for Structural Health Monitoring

**Name of Supervisor:** Dr. Khoa Nguyen ([khoa.nguyen@nicta.com.au](mailto:khoa.nguyen@nicta.com.au))

**Name of Joint/Co-Supervisor:** Dr. Yang Wang and Dr Fang Chen ([yang.wang@nicta.com.au](mailto:yang.wang@nicta.com.au))

**Abstract**

Structural health monitoring (SHM) is a technology to monitor civil infrastructure such as bridges and buildings using sensors. Data obtained from sensors can be used for early damage detection in structures. NICTA and Roads and Maritime Services (RMS) have conducted a SHM project for Sydney Harbour Bridge to monitor hundreds of joints underneath the bus lane. Current approach is to monitor the response of a joint to multiple loading traffic events and determine structural integrity of that joint. It would be useful to compare multiple joints. By comparing how the responses of all joints over time and looking for anomalies we should be able to detect any that are degrading at a different rate than the general population of joints thus warranting further inspection. In order to do so, we should be able cluster joints into groups which have similar response. Students will work with real data obtained from several sensors installed on the bridge, investigate a method for joint clustering and implement it using a programming language. The topic is available to a student with strong interest in machine learning, a solid statistical background, and a strong programming skill.

**Research Environment**

The selected student will work with a team of researchers in the field of machine learning, at the NICTA headquarters -- the Australian Technology Park.

**Novelty and Contribution**

The NICTA team is a world research leader in machine learning. This project will investigate a method to cluster joints for structural health monitoring problems.

**Expected Outcomes**

The student should exhibit autonomy and must have good programming skills in some high level language (e.g. Matlab, Java, C++). A research report will be expected at the end of the project.

**Pre-requisites:** Good programming skills

**NML 14**

**Project Title:** How confident is the prediction?

**Name of Supervisor:** Dr. Zhidong Li (zhidong.li AT nicta.com.au)

**Name of Joint/Co-Supervisor:** Dr. Yang Wang, Dr. Fang Chen


**Abstract**
Prediction is one of the major tasks in machine learning and data mining area. Evaluating the prediction confidence upon a variety of approaches is also a classical problem in statistical theory. In this project, we will survey the methods of water pipe failure prediction. The aim is to apply different prediction evaluation schemes to find out which prediction will be more confident. In other words, it is the prediction of prediction.

**Research Environment**
The selected student will work with a team of researchers in the field of machine learning and data mining, at the NICTA headquarter at Australian Technology Park.

**Novelty and Contribution**
This project will help to understand the prediction results of water-pipe failures in Sydney area, which is a problem with millions of dollars a year.

**Expected Outcomes**
This project will provide the student an opportunity to learn about machine learning and data mining with high performance language for data science (e.g. matlab, R or python). A technical report will be expected at the end of the project.

**Pre-requisites:** Programming Skills & Basic Probability Theory


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**NML 15**

**Project Title:** Data assembly of global water pipe networks

**Name of Supervisor:** Dr. Zhidong Li (zhidong.li AT nicta.com.au)

**Name of Joint/Co-Supervisor:** Dr. Yang Wang, Dr. Fang Chen


**Abstract**
Water pipe data from various data recourses illustrate different patterns while some common elements also exist. Grouping assets from different data recourses according to their common elements is a challenging problem. It requires some knowledge about probability and statistics (e.g. stochastic process).

In this project, we will examine the water pipe networks from more than 5 data recourses, with more than 1 million data records. The aim is to find equivalents between assets, and group the assets to improve the applicable tasks, such as failure prediction.

**Research Environment**
The selected student will work with a team of researchers in the field of machine learning and data mining, at the NICTA headquarter at Australian Technology Park.

**Novelty and Contribution**
This project will help to understand the connection between water pipe assets around the globe, which is a problem with billions of dollars a year.

**Expected Outcomes**
This project will provide the student an opportunity to learn about machine learning and data mining with high performance language for data science (e.g. matlab, R or python), and manipulation between different data recourses. A technical report will be expected at the end of the project.
**Pre-requisites:** Programming Skills & Basic Probability Theory


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**NML 16**

**Project Title:** Urban environment in Unity3D for a driving simulator

**Name of Supervisor:** Ronnie Taib ([ronnie.taib@nicta.com.au](mailto:ronnie.taib@nicta.com.au))

**Name of Joint/Co-Supervisor:** Dr. Julien Epps ([julien.epps@nicta.com.au](mailto:julien.epps@nicta.com.au))

**Abstract**

Research has shown it’s bad to use your mobile phone while driving. Yet, 20% of incidents and near-misses in a large field study could not be explained by any obvious distraction to the drivers. Daydreaming, stress and pressure, frustration, mental overload are all potential factors leading to incidents, and we believe a holistic approach focusing on the user’s physiology and behaviour is the best way to monitor them in real-time, in order to detect the onset of any risk situation.

NICTA has developed a driving simulator to explore these issues, using the Unity3D game engine for the virtual environment. The objective of this student project is to develop a new urban environment for the simulator. The first task will be to complete an in-house road network construction tool for Unity3D, where roads can be modelled, including multiple lanes, intersections and be superimposed on the terrain. Next, the student will need to populate the environment with buildings and other visual elements. Ideally, this could replicate a small section of the Sydney CBD.

The topic is available to 1 or 2 students with strong implementation skills in C#. Experience with Unity3D or game development will be a plus, but not mandatory. A taste for gaming and attention to details will be helpful.

**Research Environment**

The selected student will work with a team of senior researchers in the field of machine learning and human-computer interaction, at the NICTA headquarters at the Australian Technology Park.

**Novelty and Contribution**

This project is a very novel approach to road safety, and is gaining growing international attention. The student will need to look into novel ways to create urban settings in Unity3D, possibly automating some tasks.

**Expected Outcomes**

The student will complete a Unity3D road construction tool, and produce a urban environment to demonstrate it. Ideally, it should be a replica of an area of the Sydney CBD. A report will be expected at the end of the project.


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**NML 17**

**Project Title:** Driving simulator: taming the sensors

**Name of Supervisor:** Ronnie Taib ([ronnie.taib@nicta.com.au](mailto:ronnie.taib@nicta.com.au))

**Name of Joint/Co-Supervisor:** Dr. Julien Epps ([julien.epps@nicta.com.au](mailto:julien.epps@nicta.com.au))

**Abstract**


Research has shown it’s bad to use your mobile phone while driving. Yet, 20% of incidents and near-misses in a large field study could not be explained by any obvious distraction to the drivers. Day dreaming, stress and pressure, frustration, mental overload are all potential factors leading to incidents, and we believe a holistic approach focusing on the user’s physiology and behaviour is the best way to monitor them in real-time, in order to detect the onset of any risk situation. NICTA is exploring these issues by collecting physiological (EEG, skin conductance, blood volume pulse), behavioural (eye tracking, posture, wheel and pedal activity) and environmental (temperature) data during user studies. The objective of this student project is to (1) create a benchmark study of several skin conductance sensors, leading to a comparison of their respective strengths and weaknesses; and (2) to determine optimal positions for posture sensors in and around the driver’s seat, and physical embed them in the seat where possible. Small scale user studies will need to be conducted to achieve these goals.

A keen interest in empirical user studies, and a taste for “hacking” (electronics and DIY) sensors are paramount for this topic. Some programming skills (C# preferably, or Java) will also be required, in order to get the data out of the sensor and into the computer.

Research Environment
The selected student will work with a team of senior researchers in the field of machine learning and human-computer interaction, at the NICTA headquarters at the Australian Technology Park.

Novelty and Contribution
This project is a very novel approach to road safety, and is gaining growing international attention. Sensor benchmarking is crucially needed by the research community, but not receiving enough attention to date. Similarly, there is no good reference on sensor positioning for posture analysis in vehicles.

Expected Outcomes
The student will research into the two aspects, implement and run small-scale user studies, and write a report summarising the findings.

References: NICTA’s Driver Mental State Monitoring project

NML 18

Project Title:          Driving a model car “from the inside”
Name of Supervisor:   Ronnie Taib (ronnie.taib@nicta.com.au)
Name of Joint/Co-Supervisor:  Dr. Julien Epps (julien.epps@nicta.com.au)
Abstract
Research has shown it’s bad to use your mobile phone while driving. Yet, 20% of incidents and near-misses in a large field study could not be explained by any obvious distraction to the drivers. Day dreaming, stress and pressure, frustration, mental overload are all potential factors leading to incidents, and we believe a holistic approach focusing on the user’s physiology and behaviour is the best way to monitor them in real-time, in order to detect the onset of any risk situation.

NICTA is exploring these issues through user studies based on a driving simulator environment. A new development is to drive a model car using the driving simulator, in order to increase realism. The car is controlled by the simulator, and sends a camera feed back to the simulator, placing the driver virtually in the model car’s seat. The objective of this student project is to design and implement a framework for this simulator, including (1) a physical environment for the car to be driven, e.g. a car park with markers representing roads, some objects for buildings etc.; and (2) some safety features for the remote controlled car, e.g. object detection, emergency stop button, and a communication link to the driver.

Good electronics skills are required, as well as some creativity to transform a car park into a small-scale road environment. Some strong software skills (C# preferably, or Java) will also be required.

Research Environment
The selected student will work with a team of senior researchers in the field of machine learning and human-computer interaction, at the NICTA headquarters at the Australian Technology Park.

Novelty and Contribution
This project is a very novel approach to road safety, and is gaining growing international attention. This is a fairly new breed of simulator, so the student will need to research and invent adequate interaction and safety techniques.

**Expected Outcomes**
The student will build the physical environment, highlighting its requirements and limitations (so it can be deployed elsewhere), and will implement and test some safety features. Both aspects will be documented in a report.

**References:** NICTA’s Driver Mental State Monitoring project  