Start-Up Firms

Translate Research into Innovative Business Models

Organised by the National University of Singapore Centre of Entrepreneurship, the Industry Technology Relations Office, and the Business School Alumni Association, the Start-Up@Singapore national techno-venture business-plan competition aims to bring together aspiring entrepreneurs with lively ideas and cutting-edge thinking to exchange views with leaders and professionals in the high-tech industry.

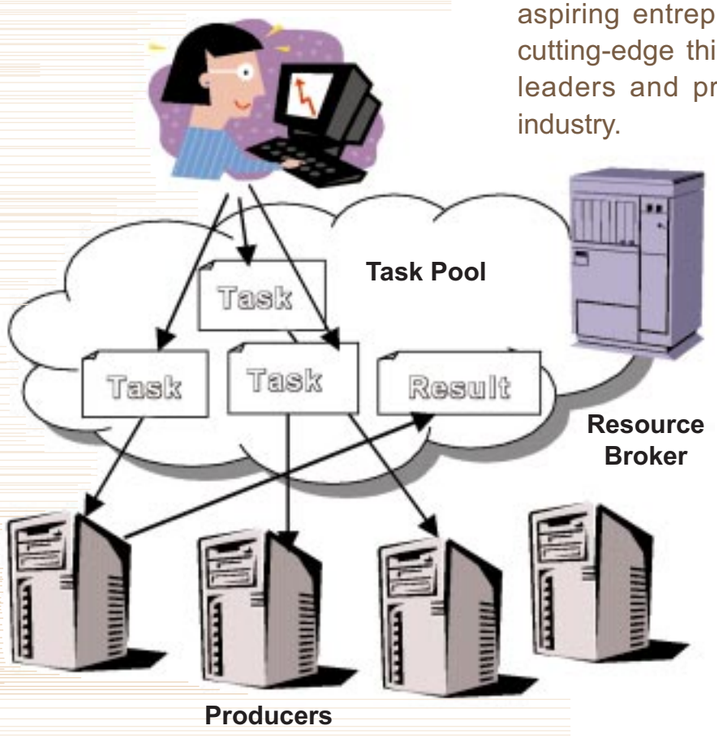

Figure 1: The ALiCE consumer–producer model.

Technology that harnesses the computing power of idling computers from networks .... Mathematical models that simulate the behaviour of living systems for drug research and development.... Programming that can be learned in a new way.... These winning ideas, which are being translated into successful working business models, garnered the top awards at the recent Start-Up@Singapore competition.

Atsuma Grid Technology and Systome Therapeutics were the joint winners with their high-performance computing-on-demand and metabolic pathway modelling, respectively. Expert, a start-up firm that offers the E*XPERT system, took the third prize with its algorithm learning system.

Atsuma represented Singapore at the Global Entrepreneurs Challenge in July this year, organised by Stanford University in the United States and the NUS Centre for Entrepreneurship. The business plan competition provided the battleground for 16 teams from leading universities worldwide.

The following innovations clinched the Start-Up@Singapore awards.

1. Commodity High-Performance Computing on Demand

A team from the NUS School of Computing, together with industry professionals, set up Atsuma Grid Technology to harness idle processor cycles for resource sharing. Associate Professor Teo Yong Meng, together with student Johan Prawira Gozali, developed software that can enable a company to combine computing resources on a corporate network and on the Internet into one "supercomputing" environment.

This process will potentially translate into supercomputer power without big hardware investment. Multinational corporations with offices around the globe can maximise equipment usage by taking advantage of spare capacity in different time zones. Companies with excess computing power can sell this processing capacity. The software thus offers lower business costs, access to scalable computational capabilities, and remote access to expensive computational resources, equipment, and hard-to-distribute large data sets.

Teo explains that in the ALiCE (Adaptive and ScaLable Internet-based Computing Engine) consumer–producer model (Figure 1), computer applications are submitted by a computer (referred to as the consumer) for execution on idle computers (referred to as producers) by means of a resource broker residing on another computer. The resource broker regulates the consumer's resource demand and the producers' idle cycles and sends jobs from its task pool to the producers for execution. A novel application-driven task-scheduling algorithm allows a consumer to select the performance level for each computer application to be executed. ALiCE breaks down large computations into smaller tasks that can be distributed among producers to be processed using parallel computing. Platform-independent, it offers simple grid application programming.

Atsuma has developed a number of grid applications, including tropical red-tide monitoring for the Centre for Remote Imaging, Sensing and Processing (Figure 2) and protein alignment and matching for the Bioinformatics Institute (Figure 3).

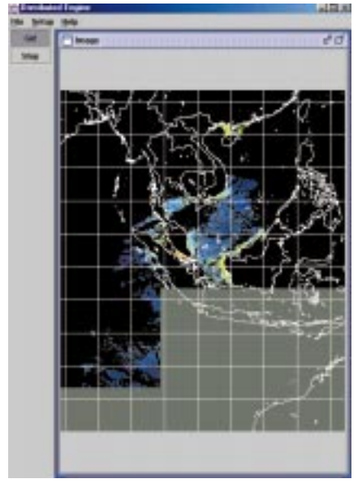

Figure 2: Georectification of satellite images.

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2. Accelerating Drug Development

On the average, a pharmaceutical company spends an estimated US$350 million over 13 years for every successful compound that reaches the market. With the advent of new biomedical techniques and technologies, reduction of this enormous investment is now possible. Genomics, proteomics, and combinatorial chemistry in amalgamation with high throughput screening have the ability to generate significant numbers of active compounds for a particular therapeutic target.

However, the pharmaceutical industry has so far applied these new methodologies piecemeal to certain selected stages of the development process only. A start-up firm in Singapore, Systome Therapeutics, has devised computational methods that not only reduce failure rates in clinical trials but also shorten the time spent in drug development.

Mki, short for Metablome Kinetics, comprises a series of computational algorithms that, when combined with gene profiling, can predict the behaviour of complex living systems. The *in silico* biological system, based on mathematical engineering principles, can calculate with a high degree of accuracy the concentration of metabolites in different tissues and under different disease conditions (Figure 4). It has so far been validated in the glucose-breakdown pathway in human muscle and blood cells and under normal and diseased conditions of *Trypanosoma brucei*, a single-cell protozoan.

One outstanding problem in modelling complex living systems is the accuracy of simulation. The commonly used bottom-up strategies, which break down the whole system into a myriad of

Figure 3: Protein alignment and matching.

separate steps and then try to build up a workable system step by step, require a multitude of kinetic variables and hence could become mathematically overwhelming. The team adopted a unique top-down methodology that eliminates the numerous variables and yet is robust enough to predict the actual biological system accurately.

The new approach looks at the system and the pathways as a whole and takes into account all the interrelationships within them, and each step as part of the whole rather than a series of

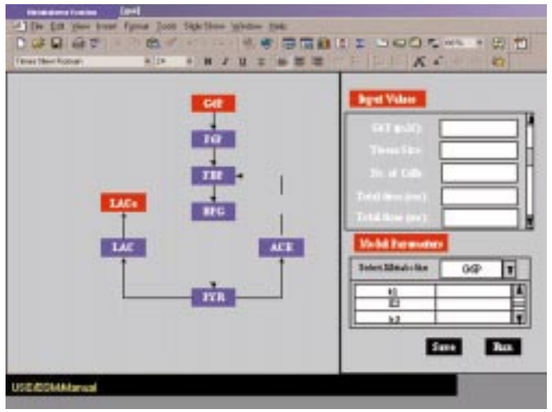

Figure 4: The graphical user interface of the Mki system.

discrete independent steps. This method can determine the whole system's steps altered in complex disease states when in relation to one another and not as single discrete steps separate from the system. By identifying such steps *in situ*, researchers can determine where therapeutic intervention strategies should be directed to achieve the most efficient and effective outcome.

The team has also extended the use of MKi to the pharmaceutical field by applying it to a pathway targeted by several pharmaceutical companies for treatment of diabetes. The computational software has predicted, in line with the findings of very expensive clinical trials, that targeting a particular pathway will not be effective and the proposed interaction can be toxic. This information could save several hundred million research-and-development dollars for the pharmaceutical companies involved.

Ultimately, the researchers hope to have the capability to tailor specific therapeutic regimes in particularly complex diseases to individual needs based on an individual's unique DNA. The company has filed a worldwide patent for the invention.

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3. E*XPERT Way to Programming

Associate Professor Andrew Lim, a researcher at the NUS School of Computing, co-founded Expert, a start-up firm that offers the E*XPERT system for teaching effective learning in algorithmic problem solving and programming. He used the system to train the Singapore team, comprising four junior college students, which participated in the International Olympiad in Informatics in 2001. They managed to garner two gold medals and two silver, jointly ranking first with Slovakia. This placement represented a big improvement over Singapore's 24th placing the year before.

Lim and his colleagues have tested E*XPERT on NUS undergraduates in the School of Computing, as well as customised the system for Victoria Junior College (Figure 5), whose team subsequently qualified for the finals in the Hewlett-Packard Education contest. The company is working with governmental organisations in China to tailor the product to their needs.

E*XPERT consists of a number of subsystems – Online Programming Courses, Interactive Tutor, Plagiarism Checker, and Judging Kernel – to optimise learning around the clock and to minimise the workload of teachers. It eliminates rote learning thanks to its unique plagiarism-detection technology. Teachers get relief from time-consuming grading and are assured of originality since the technology can identify a plagiarist.

The researchers have expanded current knowledge of plagiarism-checking with domain-specific information to increase the accuracy of the checker. They are fine-tuning this component and will be filing for a patent.

The start-up firm also has products under development for the study of mathematics and the English language, as well as a global test-administration system for conducting and grading multiple-choice questions, programming, mathematics and writing tests.

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*Figure 5: E*XPERT customised for Victoria Junior College.*