


Course Description

Facilitator Information	
Name	Assoc. Prof. Goh Wooi Boon
Biodata	<p>Associate Professor Goh Wooi Boon lectures at the School of Computer Engineering (SCE) at Nanyang Technological University. He has been instructing both undergraduates and graduates in the area of microprocessors and assembly language programming for more than 12 years. He was awarded Teacher-of-the-year in 2000 and has designed challenging practical-oriented programmes for the undergraduates at SCE. Prior to joining NTU, he was involved in the design and development of automated systems and robotic workcells at Hewlett Packard Singapore Pte. Ltd. He has conducted industry-oriented courses for IT professionals and engineers from IDA, DSO, MHA, HP, AMD, etc.</p> 
Organisation	Nanyang Technological University
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Course Information	
Title	Effective Assembly Programming – Exploiting the 80x86 Instruction Set
Description	<p>The existing install base of both the Intel and AMD 80x86-based instruction set far exceeds those of any other instruction set. It is therefore important that those developing software for this platform should be conversant with the functionality and application of the very rich instruction set of the 80x86 CPU. This practical course teaches you how to exploit the 80x86 instructions so that you can develop efficient program and write optimized assembly code segments. Each topical study is developed with a short lecture on relevant concepts and is then followed up with interesting practical exercises and challenges to help you understand and put into practice what you have learnt. Freeware tools will be provided to all participants to carry out these exercises. Even programmers writing in high-level languages like C/C++ can still benefit from learning how optimized assembly code segments can be realized as many compilers allow the programmer to mix both high and low-level codes for optimal performance.</p>
Objectives	<ol style="list-style-type: none"> 1. Understand the functionalities and applications of the rich instruction set and addressing modes of the 80x86 processor. 2. Learn to exploit the instruction set and architecture of the 80x86 CPU to develop efficient assembly programs. 3. Practise developing interesting assembly programs and analyze the performance of various optimized code segments.
Programme/Agenda	<p>Learn the tools</p> <ul style="list-style-type: none"> - Introduction to the Microsoft Assembler (MASM) - Useful assembler directives - Introduction to a full-screen disassembler/debugger for code analysis <p>80x86 Architecture and Memory Organization</p> <ul style="list-style-type: none"> - Real and Protected-mode memory addressing - Register functions and characteristics - Understanding data alignment and its effect on execution performance - The varying performance characteristics across CPUs in the 80x86 family - Length and execution time of 80x86 instructions <p>Addressing Modes</p> <ul style="list-style-type: none"> - Understand the numerous 80x86 addressing modes - Application of the different 80x86 addressing modes

	<ul style="list-style-type: none"> - Performing data arithmetic with the 80x86 rich addressing modes <p>Understanding Data</p> <ul style="list-style-type: none"> - The different data types, their characteristics and memory organization - Handling complex data - structures, 2D arrays and strings - Techniques for processing strings and arrays - Format conversion (Little and Big Endian) <p>Understanding Code</p> <ul style="list-style-type: none"> - Implementing conditional constructs - Implementing efficient and conditional loops - Conditional execution – how to avoid inefficient jump instructions - Implementing jump tables and hash tables <p>Modular Programming</p> <ul style="list-style-type: none"> - The stack and its uses - Implementing procedures and exploiting flexible procedure calls - Handling local variables using stack frames - The different methods of passing parameters - The different calling conventions <p>Integer Arithmetic</p> <ul style="list-style-type: none"> - Number representation, operations and their influence of the status flags - Techniques for extending numeric range - Implementing multi-precision arithmetic - Optimizing multiplication and division operations <p>Floating Point Arithmetic</p> <ul style="list-style-type: none"> - The FPU architecture of the 80x86 processor - FPU data types and representation - Basic and transcendental arithmetic - Generate a sine hash table and performing expression evaluation - Program flow control with the FPU status flags <p>Programming Exercises and Challenges</p> <ul style="list-style-type: none"> - Analysis of program execution using a disassembler/debugger - Stack manipulation exercises - Analysis of different calling conventions and parameter passing techniques - Manipulating 2D arrays to perform character-based animation of the screen - Write a simple virus scanner - Analysis of optimized and non-optimized arithmetic - Generate a realistic trajectory of a bouncing ball using FPU instructions - Develop simple Windows console-based games
Targeted audience	<p>This course is suitable for IT professionals and computer engineers who are:</p> <ul style="list-style-type: none"> - Developing 80x86-based programs (including those writing program using high-level languages). - Developing embedded applications. - Interested to know how efficient codes can be written.
Pre-requisite for the course	<p>To get the most out of this course, participants should have some prior exposure to basic assembly language programming and/or have gone through some basic microprocessor-related course at a tertiary level.</p> <p>Participants must bring along their own Notebooks (with Windows XP operating system installed).</p>
Instructional strategies	<p>This is a practical-oriented course involving hands-on exercises after each short topical study.</p> <p>Freeware tools will be provided for participants to do both static and live code analysis.</p>
Other Remarks	<p>Important:</p> <p>Because of the practical nature of the course, all participants must bring along their own Notebook with the Windows XP operating system installed. The necessary software that will be used during the course will be provided for you before the commencement of the course.</p>