Objectives

- To introduce software engineering and to explain its importance
- To set out the answers to key questions about software engineering
- To introduce ethical and professional issues and to explain why they are of concern to software engineers
- To learn to use advanced tools in software development
對象

- 電機系、或外系同學
- 對管理、開發大型軟體系統，有興趣研究的同學
- 想要瞭解複雜系統開發關鍵技術的同學
- 需要評估軟體團對成效與成本的同學

基本資料

授課教授: 王凡

- 上課時間: 13:20-16:10, Tuesday, 九十五年秋季
- 教室: 博理館212
  台灣代理：開發圖書公司
  台北縣中和市中山路二段327巷1號6樓
  02-82423988；0939-852332(魏錦鈴)
  http://www.kaifabook.com.tw
  kf.book@msa.hinet.net
Why software engineering?

- The economies of ALL developed nations are dependent on software.
- More and more systems are software controlled
- Software engineering is concerned with
  - theories,
  - methods and
  - tools
  for professional software development.
- Expenditure on software represents a significant fraction of GNP in all developed countries.

Software costs

- Software costs often dominate computer system costs.
  - The costs of software on a PC are often greater than the hardware cost.
- Software costs more to maintain than it does to develop.
  - For systems with a long life, maintenance costs may be several times development costs.
- Software engineering is concerned with cost-effective software development.
Activity cost distribution

For safety-critical or long-lifetime systems (>10 years),

Product development costs

Development and evolution costs for long-lifetime systems
Why do we need S.E.? 

Because we err.

The 1st Tacoma Narrows Bridge

November 7, 1940 approximately 11:00 AM

Car.mov
Why do we need S.E.?

Because we err.

The 1st Tacoma Narrows Bridge

November 7, 1940
approximately 11:00 AM
THE "BUG" HEARD 'ROUND THE WORLD
Discussion of the Software Problem Which Delayed the First
Shuttle Orbital Flight

John R. Garman
Deputy Chief
Spacecraft Software Division
NASA, Johnson Space Center
Houston, Texas
Aug 24, 1981
ACM SIGSOFT Software Engineering Notes,
Vol. 6, Nr. 5, Oct, 1981

French Guyana, June 4, 1996
$800 million software failure
Therac-25 Incidents

- Medical linear accelerator by AECL
- Computer-controlled (DEC PDP-11)
- Dual modes of X-ray and electron beams
- Successor to Therac-20 and Therac-6 by AECL and CGR
- Available in late 1982
- 11 Therac-25 were installed

6 accidents with death and serious injuries from 6/1985 to 1/1987
Software glitches leave Navy Smart Ship dead in the water

Gregory Slabodkin, GCN Staff

"Using Windows NT, which is known to have some failure modes, on a warship is similar to hoping that luck will be in our favor," DiGiorgio said.

Some more bugs (1)

- **Mars climate orbiter smashed into the planet instead of reaching a safe orbit ($165M), 1999**
  - Failure to convert English measures to metric values
  - Software shut the engine off 100ft above the surface.
- **US Vicennes mistook airbus 320 for a F-14 and shot it down, 1st Gulf War, 1988.**
  - 290 people dead
  - Why: Software bug - cryptic and misleading output displayed by the tracking software
Some more bugs (2)

Failure of the London Ambulance Service on 26 and 27 November 1992
- Load increased
- Emergencies accumulated
- System made incorrect allocations
  - more than one ambulance being sent to the same incident
  - the closest vehicle was not chosen for the emergency
- At 23:00 on October 28 the LAS eventually instigated a backup procedure, after the death of at least 20 patients

Some more bugs (3)

- British destroyer H.M.S. Sheffield; sunk in the Falkland Islands war
  - ship's radar warning system software allowed missile to reach its target
- An Air New Zealand airliner crashed into an Antarctic mountain
- North American Aerospace Defense Command reported that the U.S. was under missile attack;
  - traced to faulty computer software - generated incorrect signals
- Manned space capsule Gemini V missed its landing point by 100 miles;
  - software ignored the motion of the earth around the sun

Some more bugs (4)

- An error in an aircraft design program contributed to several serious air crashes
  
  ["Software Engineering: Report on a Conference sponsored by the NATO Science Committee, Brussels NATO Scientific Affairs Division," 1968, p. 121]

- Dallas/Fort Worth air-traffic system began spitting out gibberish in the Fall of 1989 and controllers had to track planes on paper
  

Some more bugs (5)

- F-18 fighter plane crashed
  - due to a missing exception condition
  
  [ACM SIGSOFT Software Engineering Notes, vol. 6, no. 2]

- F-14 fighter plane was lost
  - to uncontrollable spin, traced to tactical software
  
  [ACM SIGSOFT Software Engineering Notes, vol. 9, no. 5]

- Chicago cat owners were billed $5 for unlicensed dachshunds.
  - A database search on "DHC" (for dachshunds) found "domestic house cats" with shots but no license
  
  [ACM SIGSOFT Software Engineering Notes, vol. 12, no. 3]
Some more bugs (6)

- CyberSitter censors "menu */ #define"
  - because of the string "nu...de"

  [Internet Risks Forum NewsGroup (RISKS), vol. 19, issue 56]

- London's Docklands Light Railway – train stopped in the middle of nowhere due to future station location programmed in software

Some more bugs (7)

- Russia: Software bug made Soyuz stray.
  - STAR CITY, Russia(AP) – A computer software error likely sent a Russian spacecraft into a rare ballistic descent that subjected the three men on board to check-crushing gravity loads that made it hard to breathe, space experts said Tuesday.

- Korean Air crashed in Guam and killed 228 people.
  - A poorly programmed ground-based altitude warning system

- Faulty software in anti-lock brakes forced the recall of 39,000 trucks and tractors and 6,000 school buses in 2000.

  - Software shut the engines off 100 feet above the surface.

- US$59.5 billions loss in economy, 0.6%GDP, April 27, 2003
$4$ billion development effort
- $50\%$ system integration & validation cost
- $2,500,000+1,500,000$ lines of codes (most in Ada)

400 horses
100 microprocessors
Some facts

- Now most clients ask for total solutions (HW+SW) instead of plain IC designs.
- Most IC design houses now hire more SE engineers than HW engineers.
- Plain IC designs sell cheap.
  - SW adds significant margin of earnings.
- SW is usually used to make up for HW bugs.
- Most commercial Embedded software > 1M lines of code.
- SW team members come and go.

成績評量：(subject to changes)

- 期中考(20%)、
- 期末考(20%)、
- 3-4個學期計畫（40%）、
- 期末文獻閱讀報告（20%）
非目的

- 本門課程不以當學生為目的！
  - 六十分不能證明什麼，只能傷害你往後的申請案。
- 可是，
  - 作業缺交多次
  - 期中考、期末考成績慘不忍睹
  - 學期計畫多次未完成、敷衍了事
  - 期末報告準備不周
  必當！！！

學期計畫 (IBM Rational)

感謝IBM免費提供Rational Pro軟體
Your choice of project target
3-4 projects
- Requirement Analysis
- Design and Construction
- Testing
- Your choice of one more tools from Rational
- 三人一組
- 每個project需要每組作20分鐘報告一次
What is the UML?

- The UML combines the best of the best from
- UML stands for Unified Modeling Language
  - Data Modeling concepts (Entity Relationship Diagrams)
  - Business Modeling (work flow)
  - Object Modeling
  - Component Modeling
- The UML is the standard language for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system
- It can be used with all processes, throughout the development life cycle, and across different implementation technologies

History of the UML

Nov '97 - UML approved by the OMG
The UML may be used to:

- Display the boundary of a system & its major functions using use cases and actors
- Illustrate use case realizations with interaction diagrams
- Represent a static structure of a system using class diagrams
- Model the behavior of objects with state transition diagrams
- Reveal the physical implementation architecture with component & deployment diagrams
- Extend your functionality with stereotypes
**Actors**

An actor is someone or some thing that must interact with the system under development.

- Registrar
- Professor
- Student
- Billing System

**Use Case Diagram**

Use case diagrams are created to visualize the relationships between actors and use cases.

- Student
- Registrar
- Billing System
- Request Course Roster
- Maintain Schedule
- Maintain Curriculum
- Professor
Uses and Extends Use Case Relationships

As the use cases are documented, other use case relationships may be discovered
- A uses relationship shows behavior that is common to one or more use cases
- An extends relationship shows optional behavior

Sequence Diagram

A sequence diagram displays object interactions arranged in a time sequence:

1. fill in info
2. submit
3. add course (joe, math 01)
4. are you open?
5. are you open?
6. add (joe)
7. add (joe)
Collaboration Diagram

A collaboration diagram displays object interactions organized around objects and their links to one another.

1: set course info
2: process
3: add course
4: new course

Registrar
CourseForm

CourseManager
Course

IBM Rational Capabilities

Full UML supports
- Change and configuration management
  Manage lifecycle assets with process automation, change control, reporting and traceability.
- Design and construction
  Improve productivity in code-centric, model-driven, and rapid application development.
- Process and portfolio management
  Implement and manage enterprise processes and investments using proven tools and practices.
- Requirements and analysis
  Reduce project risk with requirements management and business, use case and data modeling.
- Software quality
  Improve software functionality, reliability, and performance throughout the development project.
- Express Middleware
  Easy to install, fast to deploy products for small and medium businesses.
Step 1: IBM ID及密碼設定

Step 2: 註冊
依指示設定IBM ID及密碼設定

• 長度絕不可超過80個字元
• 必須包含將使用者與網域值分隔的'@'字元（例如:lorem@ipsum.com）
• 必須由至少兩個以'.'分隔的子網域所組成（例如:ibm.com）
• 可以包含數字（0-9）、大小寫字母（A-Z、a-z）、連字號（-）、底線（_）、句號（.）、！、#、$、%、&、(')、+、/、=、?、[、]
• 不能包含任何空白、反斜線（\）、冒號（:）、雙引號（"）、分號（;）、逗點（,）、小於（<）及大於（>）字元、括弧（"、"）及星號（*）
已完成
IBM ID
及密碼設定
即將導回
AI
申請網站
Thank you for submitting your IBM Academic Initiative Application.

Please allow three to five business days for us to process your application. We will e-mail you with your membership approval or with any questions we may have.

In some countries, it is required that you sign and mail the Program Enrollment Agreement to IBM before program membership can be approved. The countries that require this are indicated by an asterisk (*) on our Program Agreement page.

- Back to the IBM Academic Initiative web site

IBM Academic Initiative Application
教師聯絡方式

- 教師與課程網址:
  http://cc.ee.ntu.edu.tw/~farn
- 教師email:
  farn@cc.ee.ntu.edu.tw
- 助教：未定（負責改作業、督導實習）

Course schedule (I)

1. 9/19  Introduction
2. 9/26  Ch. 1 、Ch. 2 、
   Project I: Requirement Analysis
   Introduction
3. 10/3  Ch. 4 、Ch. 6
4. 10/11 Project I: Requirement Analysis
   user requirement submission
5. 10/17 Ch. 7 、Ch. 8
預定課程進度（II）

6. 10/24  Class off
   Project I: presentation (20mins/team)
   Requirement Analysis: system requirement
   Project II: Design, construction, & unit testing introduction

7. 10/31  Class off

預定課程進度（III）

8. 11/7    Ch. 11, Ch. 13 (Design & Construction)
9. 11/14   Ch. 14, Ch. 22 (V&V)
10. 11/21  Project II: Presentation (20mins/team)
    Design, construction, & unit testing
    Project III: System Testing-Introduction
11. 11/28  Mid-term exam
12. 12/5    Ch. 23 & suppl. materials (Testing)
13. 12/12  Ch. 5, Ch. 28 (CMMI)
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<tbody>
<tr>
<td>12/19</td>
<td>Project III: Presentation (20mins/team)</td>
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<td>System Testing</td>
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<td>Project III: A tool in Rational introduction</td>
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<td>12/26</td>
<td>Paper-reading presentation</td>
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<td>Final exam.</td>
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</table>
I Requirement Analysis
- User requirement
- System requirement

II Design Construction Unit Testing (Java, C/C++, ...)

III System testing

III A tool in Rational

Test proceeds according to the system requirement

In English, charts, diagrams according to the user requirement.

Any tool in Rational not used in projects I, II, III.