

CSC340: Information Systems Analysis and Design

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Acknowledgement: Material Provided by
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Course Objectives

- ⇒ Examine the state-of-the-art for research & practice in Requirements Engineering.
 - ↳ Role of RE in software and systems engineering
 - ↳ Current techniques, notations, methods, processes and tools used in RE
- ⇒ Gain practical experience in selected RE techniques
 - ↳ Especially goal-oriented and object-oriented modelling techniques
- ⇒ Understand the essential nature of RE
 - ↳ Breadth of skills needed for RE, and the many disciplines on which it draws
 - ↳ Contextual factors & practicalities

A note about terms:

“Systems Analysis” \subset “Requirements Engineering”
SA typically refers only to information systems
RE applies to all software-intensive systems
This course is evolving to cover more of RE

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About the Course

Course website

↳ www.cs.toronto.edu/~csc340h/

Textbooks

Lecture Notes

↳ Available on the course website prior to each lecture

Coursework

↳ Carried out in teams of 3

↳ Each team submits one report (per assignment)

↳ All team members receive the same grade (exceptions can be negotiated)

Deadlines

↳ Are very strict (use a U of T medical certificate if you are seriously ill)

↳ Daily penalties apply to late work



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Assessment

⇒ 4 team assignments:

1. Conduct an inspection of an existing specification (10%)
 - Report on defects found, overall quality, and inspection stats
2. Perform a feasibility study for an information systems project (15%)
 - Write a feasibility report
3. Perform requirements modelling for the same project (10%)
 - Prepare requirements models
4. Perform a requirements analysis for the same project (10%)
 - Write a requirements specification

⇒ 2 tests:

↳ Midterm test (20%)

↳ Final Exam (35%)

➢ Must obtain at least 40% on this exam to pass the course.

Software-Intensive Systems

Software (on its own) is useless

- ☞ Software is an abstract description of a set of computations
- ☞ Software only becomes useful when run on some hardware
 - we sometimes take the hardware for granted
- ☞ Software + Hardware = "Computer System"

A Computer System (on its own) is useless

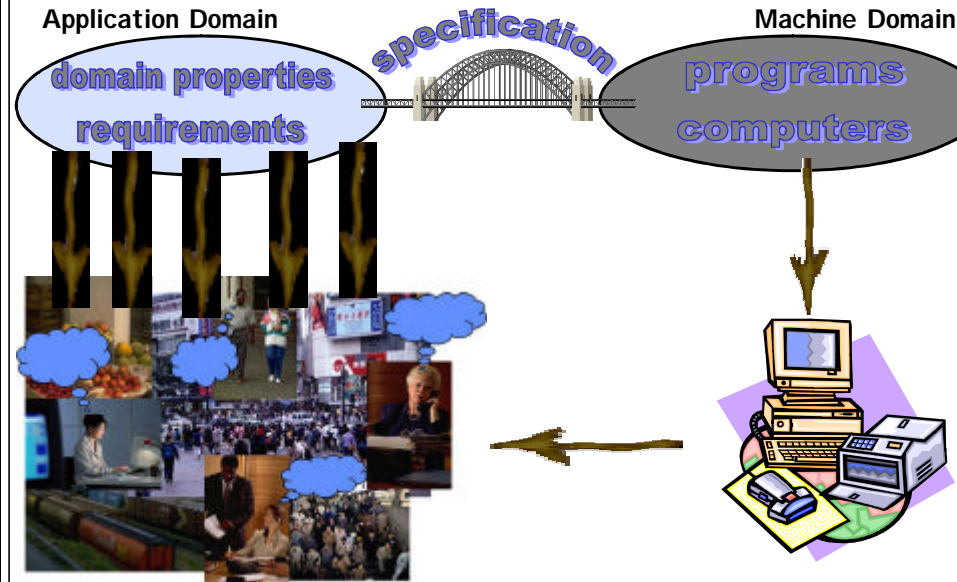
- ☞ Only useful in the context of some human activity that it can support
 - we sometimes take the human context for granted
- ☞ A new computer system will change human activities in significant ways
- ☞ Software + Hardware + Human Activities = "Software-Intensive System"

'Software' makes many things possible

- ☞ It is complex and adaptable
- ☞ It can be rapidly changed on-the-fly
- ☞ It turns general-purpose hardware into a huge variety of useful machines

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Where are the challenges?



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Quality = Fitness for purpose

Software technology is everywhere

- ☞ Affects nearly all aspects of our lives
- ☞ But our experience of software technology is often frustrating/disappointing

Software is designed for a purpose

- ☞ If it doesn't work well then either:
 - ...the designer didn't have an adequate understanding of the purpose
 - ...or we are using the software for a purpose different from the intended one
- ☞ Requirements analysis is about identifying this purpose
- ☞ Inadequate understanding of the purpose leads to poor quality software

The purpose is found in human activities

- ☞ E.g. Purpose of a banking system comes from the business activities of banks and the needs of their customers
- ☞ The purpose is often complex:
 - Many different kinds of people and activities
 - Conflicting interests among them



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Complexity of Purpose

⇒ People and software are closely-coupled

- ☞ Complex modes of interaction
- ☞ Long duration of interaction
- ☞ Mixed-initiative interaction
- ☞ Socially-situated interaction
- ☞ ...software systems and human activity shape each other in complex ways

⇒ The problems we'd like software to solve are "wicked"

- ☞ No definitive formulation of the problem
- ☞ No stopping rule (each solution leads to new insights)
- ☞ Solutions are not right or wrong
- ☞ No objective test of how good a solution is (subjective judgement needed)
- ☞ Each problem is unique (no other problem is exactly like it)
- ☞ Each problem can be treated as a symptom of another problem
- ☞ Problems often have strong political, ethical or professional dimensions

Dealing with problem complexity

Abstraction

- ☞ Ignore detail to see the big picture
- ☞ Treat objects as the same by ignoring certain differences
- ☞ (beware: every abstraction involves choice over what is important)

Decomposition

- ☞ Partition a problem into independent pieces, to study separately
- ☞ (beware: the parts are rarely independent really)

Projection

- ☞ Separate different concerns (views) and describe them separately
- ☞ Different from decomposition as it does not partition the problem space
- ☞ (beware: different views will be inconsistent most of the time)

Modularization

- ☞ Choose structures that are stable over time, to localize change
- ☞ (beware: any structure will make some changes easier and others harder)

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Which systems are soft?

Generic software components

- ☞ E.g. Core operating system functions, network services, middleware, ...
- ☞ Functionality relatively stable, determined by technical interfaces
- ☞ But note that these systems still affect human activity
 - E.g. concepts of a 'file', a 'URL', etc.

Control Systems

- ☞ E.g. aircraft flight control, industrial process control, ...
- ☞ Most requirements determined by the physical processes to be controlled
- ☞ But note that operator interaction is usually crucial
 - E.g. accidents caused when the system doesn't behave as the operator expected

Information Systems

- ☞ E.g. office automation, groupware, web services, business support, ...
- ☞ These systems cannot be decoupled from the activities they support
- ☞ Design of the software entails design of the human activity
 - The software and the human activities co-evolve

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Designing for people

What is the real goal of software design?

- ☞ Creating new programs, components, algorithms, user interfaces, ...?
- ☞ Making human activities more effective, efficient, safe, enjoyable, ...?

How rational is the design process?

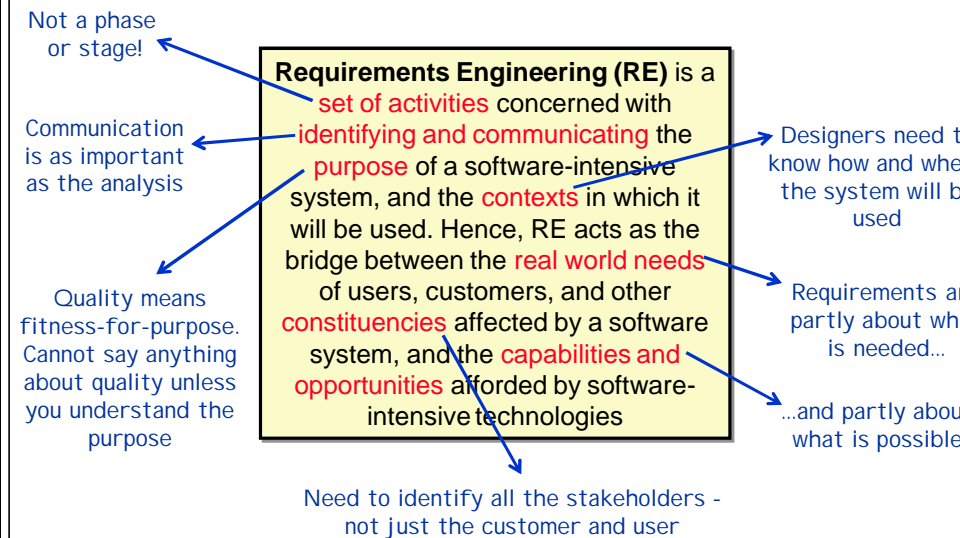
- ☞ **Hard systems view:**
 - Software problems can be decomposed systematically
 - The requirements can be represented formally in a specification
 - This specification can be validated to ensure it is correct
 - A correct program is one that satisfies such a specification
- ☞ **Soft systems view:**
 - Software development is embedded in a complex organisational context
 - There are multiple stakeholders with different values and goals
 - Software design is part of an ongoing learning process by the organisation
 - Requirements can never be adequately captured in a specification
 - Participation of users and others throughout development is essential
- ☞ **Reconciliation:**
 - Hard systems view okay if there is local consensus on the nature of the problem



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Definition of RE



Cost of getting it wrong

Cost of fixing errors

- ↳ Typical development process: requirements analysis ▸ software design ▸ programming ▸ development testing ▸ acceptance testing ▸ operation
- ↳ Errors cost more to fix the longer they are undetected
 - E.g. A requirements error found in testing costs 100 times more than a programming error found in testing

Causes of project failure

- ↳ Survey of US software projects by the Standish group:

	1994	1998
Successful	16%	26%
Challenged	53%	46%
Cancelled	31%	28%

Top 3 success factors: <ol style="list-style-type: none"> 1) User involvement 2) Executive management support 3) Clear statement of requirements Top 3 factors leading to failure: <ol style="list-style-type: none"> 1) Lack of user input 2) Incomplete requirements & specs 3) Changing requirements & specs

Summary

- ⇒ This course covers most of requirements engineering:
 - ↳ Analyzing problem situations
 - ↳ Studying human activities
 - ↳ Formulating requirements so that software solutions can be designed
- ⇒ This course is different to most CS courses
 - ↳ It is **not** about how to solve problems using computers
 - ↳ It is about how to identify problems worth solving
 - ↳ The subject matter is human activity:
 - how to understand it
 - how to support it using software technology
- ⇒ Your mileage will vary
 - ↳ Comments from students in previous years vary dramatically:
 - "At last - a course that actually taught me something useful"
 - "This course should be scrapped - it's an embarrassment to CS"

What do Requirements Analysts do?

Starting point

- ↳ Some notion that there is a "problem" that needs solving
 - e.g. dissatisfaction with the current state of affairs
 - e.g. a new business opportunity
 - e.g. a potential saving of cost, time, resource usage, etc.
- ↳ A Requirements Analyst is an agent of change

The requirements analyst must:

- ↳ identify the "problem"/"opportunity"
 - Which problem needs to be solved? (identify problem **Boundaries**)
 - Where is the problem? (understand the **Context/Problem Domain**)
 - Whose problem is it? (identify **Stakeholders**)
 - Why does it need solving? (identify the stakeholders' **Goals**)
 - How might a software system help? (collect some **Scenarios**)
 - When does it need solving? (identify **Development Constraints**)
 - What might prevent us solving it? (identify **Feasibility and Risk**)
- ↳ and become an expert in the problem domain
 - although ignorance is important too -- "the intelligent ignoramus"