

Ingineria programării

Curs 12 – 24–25 mai

Outline

- ▶ Previous courses...
 - Testing
 - SOLID Refactoring
- ▶ Program Quality
- ▶ Metrics
- ▶ Copyright

Degradation of code

- ▶ **Rigidity** – the tendency for software to be difficult to change, even in simple ways
- ▶ **Fragility** – the tendency of the software to break in many places every time it is changed
- ▶ **Immobility** – the inability to reuse software from other projects or from parts of the same project
- ▶ **Viscosity** – it is easy to do the wrong thing, but hard to do the right thing

SOLID Refactoring

▶ Cohesion

- The Release Reuse Equivalency Principle
- The Common Closure Principle
- The Common Reuse Principle

▶ Coupling

- Acyclic Dependencies Principle
- The Stable Dependencies Principle
- The Stable Abstractions Principle

Assessing quality

- ▶ How do we measure the quality of an item?
 - **Construction quality** (how well it is built, whether the raw material has flaws, etc ...)
 - **Design quality** (comfort, elegance...)
 - A combination between quality of design and construction (sturdiness...)
- ▶ In general, we can say that chair A is better than chair B regarding some particular aspect, but it is usually difficult to say by how much.

Software Quality (1)

- ▶ We do not assess construction quality (=> unique among engineering applications)
- ▶ All quality attributes refer to design.
- ▶ Esthetic qualities:
 - Software is mostly invisible, and esthetics only matter for the visible elements
 - Apart from the GUI, observable aspects software are:
 - Notations for design and writing of code
 - Behavior of software when interacting with other entities.

Software Quality (2)

- ▶ When discussing software quality we must:
 - **Define those attributes of quality** that are of interest;
 - Determine a way of **measuring those attributes**;
 - Find a way of **representing design**;
 - **Write specifications** that will guide developers (following and implementing design qualities).

Source Code

- ▶ Code that implements a given design is a representation of that design.
- ▶ Performing quality assurance after writing code is expensive and possibly useless.
- ▶ Usually, only the manner in which the code is written is taken into account (coding style, design patterns, adaptability, maintenance, reuse (coupling, cohesion), security)

Software Quality (3)

- ▶ Measures the appropriateness of software to the environment it is used in.
- ▶ Various aspects taken into account are:
 - The software is running;
 - The software performs according to specifications;
 - The software is safe;
 - The software can be adapted as requirements change.
- ▶ All measurements regarding quality are relative!

Aspects of Software Quality

- ▶ Safety
- ▶ Efficiency
- ▶ Maintenance
- ▶ Usability



Safety



- ▶ Is the software **complete, correct and robust**?
 - **Completeness** – works for all possible inputs;
 - **Consistency** – always behaves as expected;
 - **Robustness** – behaves well in abnormal situations (eg. Lack of resources, lack of internet connection, etc.)

Efficiency

- ▶ The software makes efficient use of available resources (CPU time, network connection, etc.)
- ▶ Efficiency is always less important than safety. It is easier to make safe software efficient than the reverse



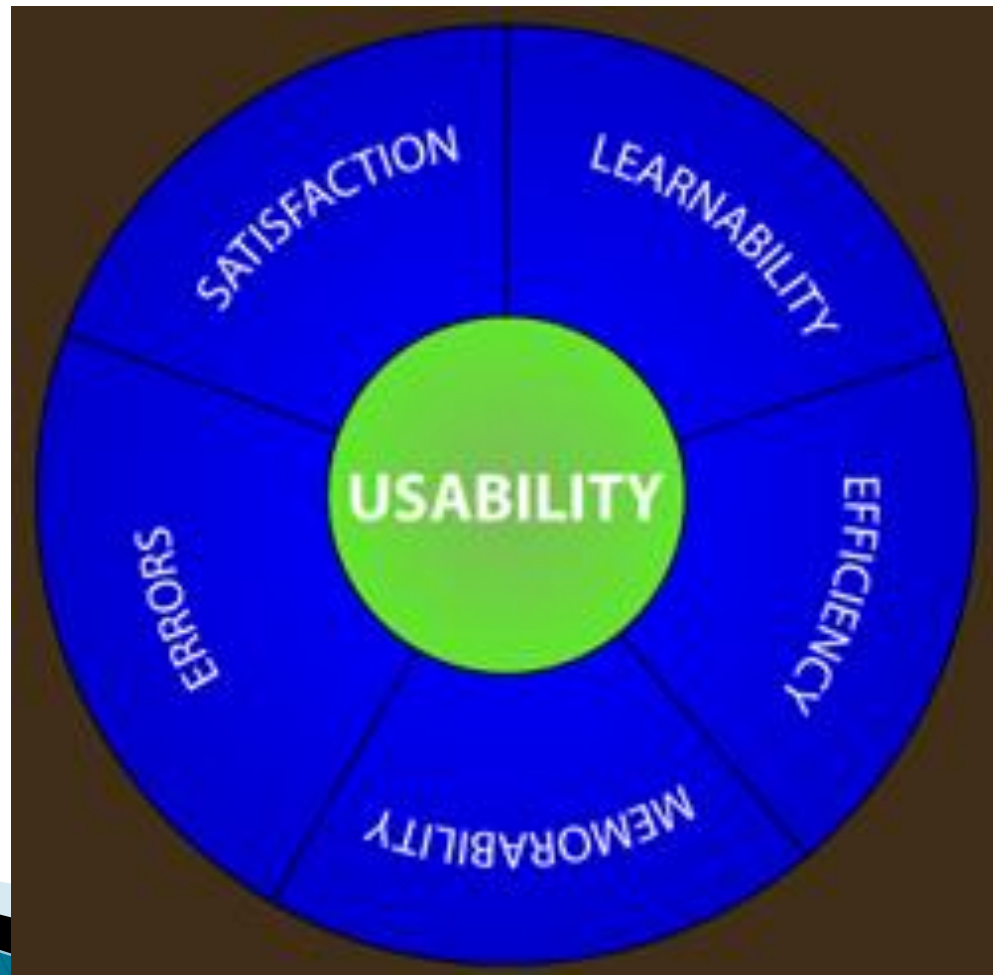
Maintenance



- ▶ How easily can the design be changed or adapted?
- ▶ Types of maintenance:
 - **Corrective**: error fixing;
 - **Perfective**: adding features that should have been part of the product;
 - **Adaptive**: updating software as requirements change.

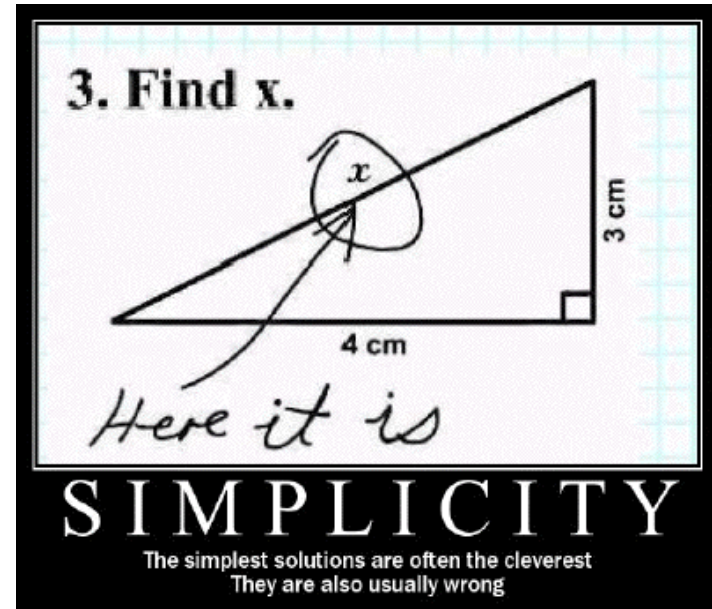
Usability

- ▶ How easily can the software be taught and used?



Measurable Attributes

- ## ► Simplicity



- ## ► Modularity



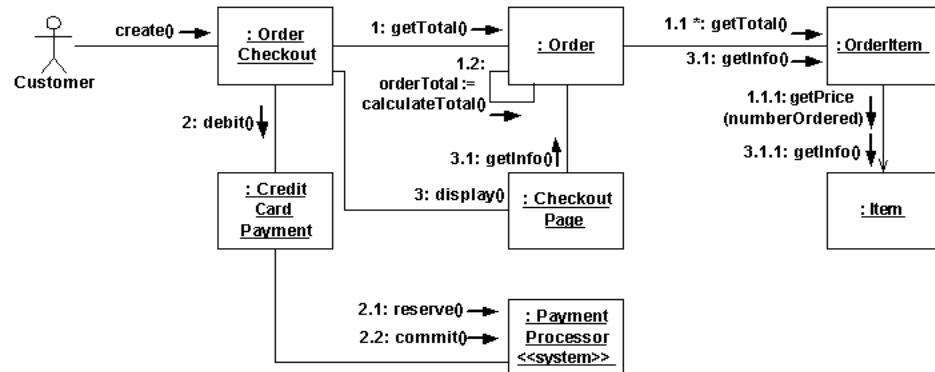
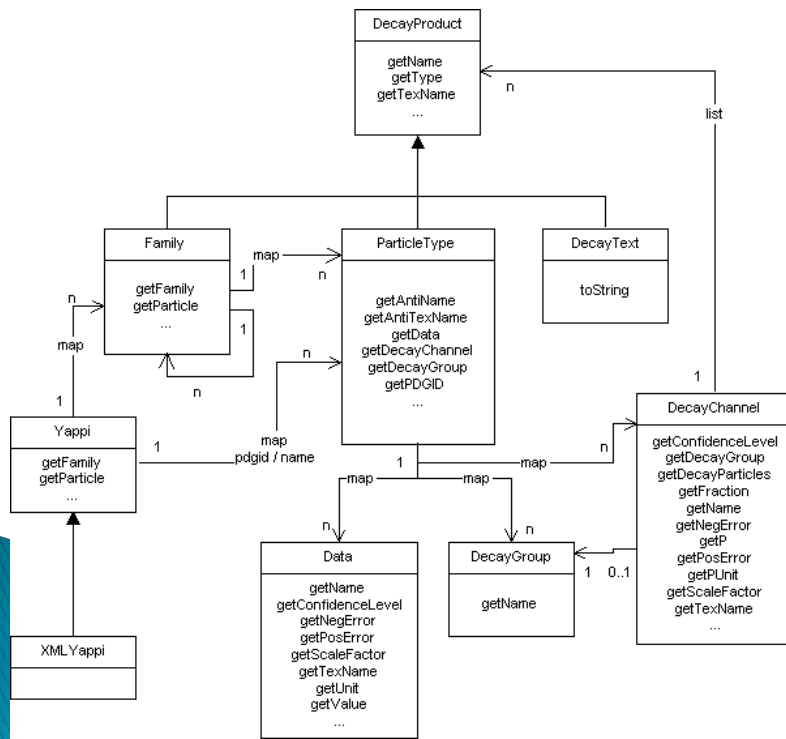
Simplicity



- ▶ The reverse of complexity.
- ▶ Aspects of complexity:
 - **Control flow:** counts all the possible execution paths for a program
 - **Information flow:** measures amount of data transmitted within the program
 - **Understanding:** counts the number of identifiers and operators

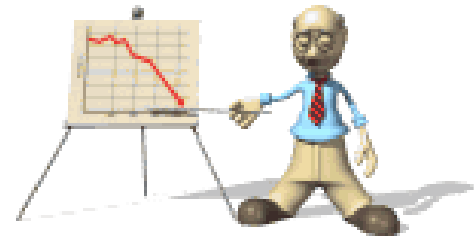
Modularity

- ▶ Can be measured by examining :
 - **Cohesion**: how well the components of a module collaborate.
 - **Coupling**: interaction between modules



Why Use Metrics?

- ▶ We use metrics to
 - understand
 - control
 - predict



What Should We Measure

- ▶ Size of software
- ▶ Complexity of software
- ▶ Robustness of software
- ▶ Amount of time required to develop some software
- ▶ Resource allocation for development
- ▶ Productivity of effort
- ▶ Development costs

Estimation

- ▶ Intuitively, estimation seem subjective
 - To inexperienced persons, it looks like predicting the future
 - This is reinforced when estimation is incorrect and projects are delivered late
- ▶ Formal estimation processes
 - allows the project team to reach a consensus on the estimates
 - improve the accuracy

Estimation

- ▶ Successful estimations take into account the following
 - Work Breakdown Structure (WBS) – what are the tasks that need to be performed to finish the product?
 - Assumptions – how to deal with incomplete information
 - Trust – if stakeholders and engineers trust each other, the estimate will be more accurate

Work Breakdown Structure

- ▶ A list of tasks that, if completed, will produce the final product
 - Broken down by feature
 - By project phase (requirements tasks, design tasks, programming tasks, QA tasks, etc.)
 - Some combination of the two
 - Should reflect the way previous projects have been developed

Work Breakdown Structure

- ▶ A project should be broken down into 10 – 20 tasks
 - Regardless of the size of the project
 - For large projects (e.g. an operating system), the tasks are large
 - For smaller projects, the tasks are correspondingly smaller
- ▶ Create an estimate for the cost of each task
 - Most accurate estimates are those that rely on prior experience
 - NO estimate is guaranteed to be accurate

Assumptions

- ▶ At the beginning of the development team members do not have all the information
 - Assumptions are needed to fill in missing things
 - Assumptions can also be placeholders which will be corrected later
 - If an assumption is proven incorrect, the timeline of the project **MUST** be adjusted
- ▶ For effective estimates, assumptions need to be written down
 - If not, the team will need to have the same discussion again

Assumptions and Trust

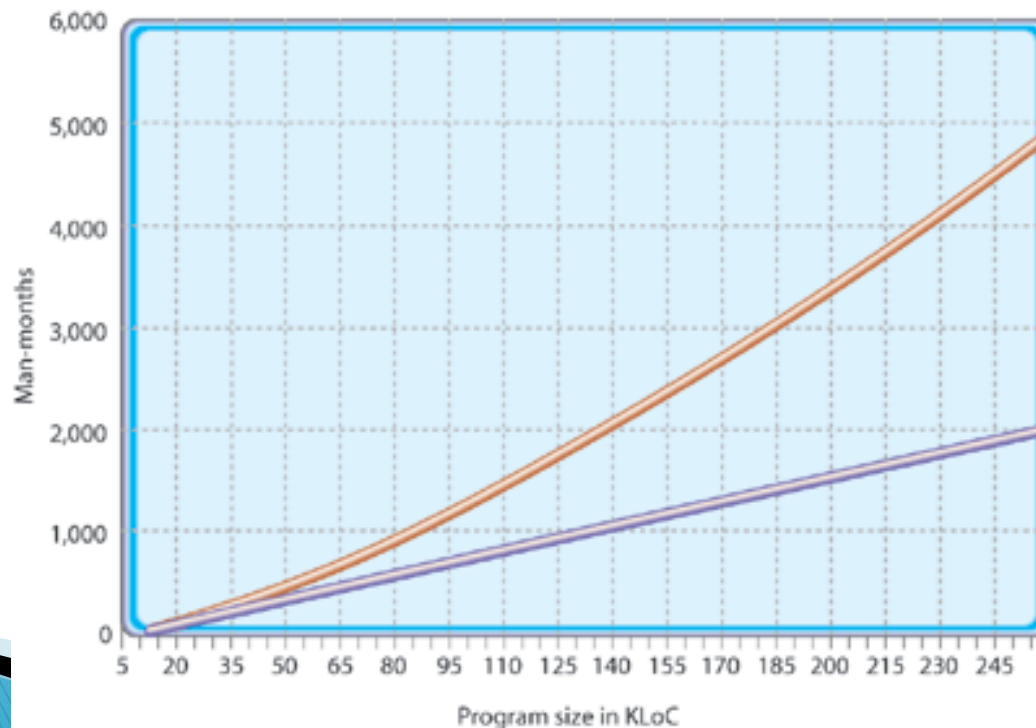
- ▶ Estimates can either be a source of trust or distrust between the project team and managers.
- ▶ Stakeholders need the project completed but usually do not have software engineering experience
- ▶ Project managers must take care to make the estimation process as open and honest as possible

Assumptions and Trust

- ▶ It is common for nontechnical people to assume that programmers pad their estimates
 - They have a “rule” by which they cut off a third or half of any estimate
 - This lack of trust causes engineers to automatically pad their estimates
- ▶ An important part of running successful software projects is reaching a common understanding between the engineers, managers, and stakeholders.

Basic Metrics

- ▶ KLOC: Kilo Lines Of Code
- ▶ Effort, PM: Person – Month



COCOMO 2

- ▶ Boehm 1995
- ▶ Takes into consideration high level development tools and techniques
 - Prototyping
 - Modular development
 - 4GL (fourth generation language)
- ▶ Allows for estimates from the very first stages of development

COCOMO 2: Initial prototyping

- ▶ Effort required to create a prototype of the application
- ▶ Based on the Number of Object Points (NOP)
- ▶ Formula for computing effort:

$$PM = (1 - P_{reuse}) \frac{NOP}{PROD}$$

NOP

- ▶ Investigate the screens and dialogs that are needed
 - Simple: 1
 - Complex: 2
 - Very complex: 3
- ▶ Reports that need generated
 - Simple: 2
 - Complex: 5
 - Very complex: 8
- ▶ Each lower level module (eg. 3GL): 10
- ▶ The sum of all of the above represents the NOP.

COCOMO 2: after prototyping

- ▶ Estimate the total lines of code (ESLOC)
- ▶ Takes into account
 - Requirements instability
 - Possibilities of code reuse

COCOMO 2: Influences on Costs

- ▶ Product attributes
 - Safety, module complexity, size of user manual, size of the required database, amount of reusable components
- ▶ Platform attributes
 - Constraints referring to execution time; platform volatility, memory constraints

COCOMO 2: Influences on Costs (cont.)

▶ Personnel attributes

- Analyst experience; developer experience; personnel continuity; knowledge of the domain of the problem to be solved with regards to analysts and developers; knowledge of the programming language and development tools

▶ Project attributes

- Required tools; distance between development teams (eg. different countries) and quality of communication; Development plan compression

The Planning Game

- ▶ A planning method from Extreme Programming (XP)
- ▶ A method used to manage the negotiation between the engineering team (Development) and the stakeholders (Business)
 - Treats the planning process as a game
 - playing pieces are “user stories” written on cards
 - the goal is to assign value to stories and put them into production over time

The Planning Game

- ▶ Unlike other planning methodologies, it does not require a documented description of the scope of the project to be estimated
- ▶ The Planning Game combines
 - estimation
 - identifying the scope of the project
 - Identifying the tasks required to complete the software

The Planning Game

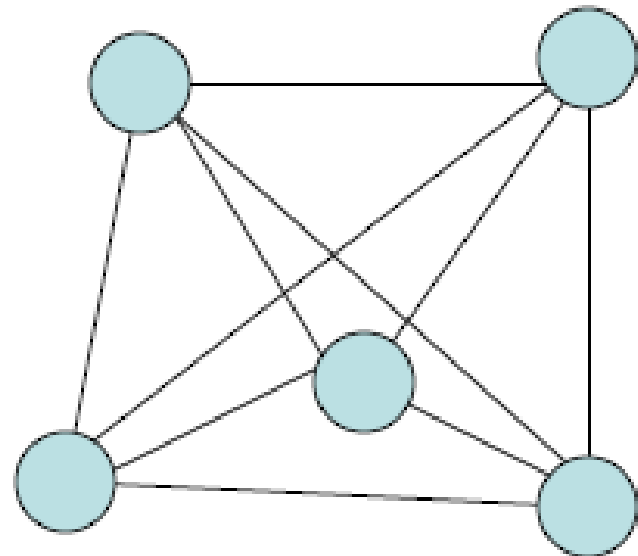
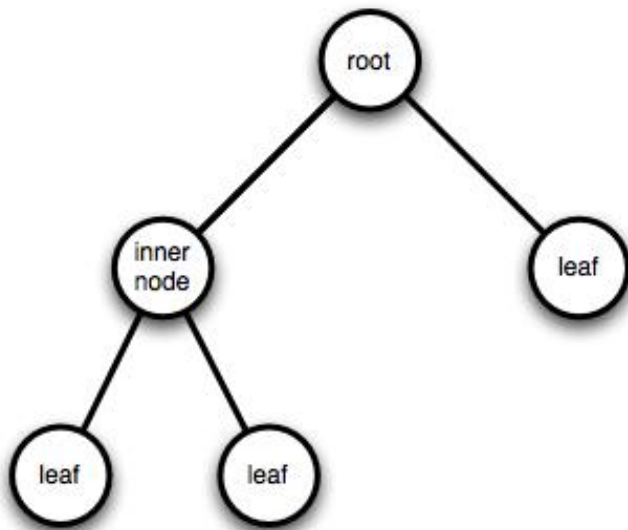
- ▶ The planning process is highly iterative. Each iterations looks like this:
 - **Scope** is established by having Development and Business work together to interactively write the stories.
 - Each **story** is given an estimate of 1, 2, or 3 weeks.
 - Larger stories are split into multiple iterations
 - Business is given an opportunity to steer the project between iterations.
 - The **estimates** are created by the programmers, based on the stories that are created.
 - **Commitments** are agreed upon

Distributing Workforce Over Time

- ▶ 20 PM. Are the following correct?
 - 20 people working 1 month
 - 4 people working 5 months
 - 1 person working 20 months
- ▶ Individual productivity decreases as team size increases
 - Communication overhead
 - On adding new members, productivity decreases initially
- ▶ *Adding people to a team behind of schedule makes that project more behind schedule.*
(Brooks' law)

Distributing Workforce Over Time (2)

- ▶ For a team with P members, one can have between $P-1$ and $P(P-1)/2$ communication channels
- ▶ Each channel is a decrease in efficiency



How Not to Plan and Estimate Costs

- ▶ We have 12 months to finish the job, so it will take 12 months.
- ▶ A competitor asked for \$1.000.000. We will ask for \$900.000.
- ▶ The client budget is \$500.000. That will be the exact cost of development.
- ▶ Development takes 1 year, but we say it will take 10 months. A delay of 2 months is not important...

Problems with Metrics

- ▶ Lack of accuracy
- ▶ Employee pushback
- ▶ Use for other purposes than intended
- ▶ Animosity within the development team

Copyright

- ▶ The rights enjoyed by authors with regards to their work;
- ▶ Copyright is the instrument of protection of authors and their work;
- ▶ *Copyright gives the creator of an original work exclusive right for a certain time period in relation to that work, including its **publication, distribution and adaptation**; after which time the work is said to enter the public domain.*

Exclusive rights

- ▶ Several exclusive rights typically attach to the holder of a copyright:
 - to produce copies or reproductions of the work and to sell those copies (mechanical rights; including, sometimes, electronic copies: distribution rights)
 - to create derivative works (works that adapt the original work)
 - to perform or display the work publicly (performance rights)
 - to sell or assign these rights to others
 - to transmit or display by radio or video (broadcasting rights)

Bibliography

- ▶ Extreme Programming Explained by Kent Beck (Addison Wesley, 2000)
- ▶ Applied Software Project Management, by Andrew Stellman and Jennifer Greene (O'Reilly, 2006)

Links

- ▶ **Bug Life Cycle:** <http://www.buzzle.com/editorials/4-6-2005-68177.asp>,
<http://qastation.wordpress.com/2008/06/13/process-for-bug-life-cycle/>
- ▶ **COCOMO:** <http://en.wikipedia.org/wiki/COCOMO>
- ▶ **Curs 12, Ovidiu si Adriana Gheorghies:**
<http://www.info.uaic.ro/~ogh/files/ip/curs-12.pdf>