Computer Science Program, The University of Texas, Dallas

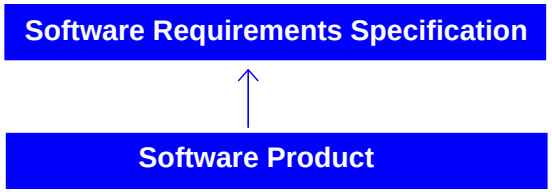
Software Quality Assurance
Software Configuration Management

Software Quality Assurance (SQA)

- a collection of activities "during" sw development
- focus on "increasing the quality" of sw (recall BCFH)
- often conducted by an independent group in the organization: often with the final veto over the release of a sw product

What is Software Quality?

- conformance to explicitly stated functional & performance reqs.



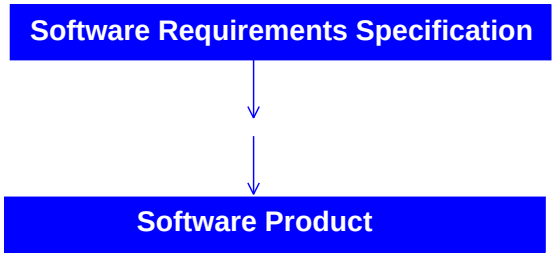
"Software Quality Factors" (broader than performance requirements)

-ilities:

-ities:

What is Software Quality?

- conformance to explicitly documented development standards
  (build the software the right way)



"Standards":

ANSI/IEEE (recall ATM example)
ISO
DOD/MIL 2167, Air Force, Navy
Bell Core (communication)
Department of Commerce, etc.

- conformance to implicit characteristics expected of all professionally developed sw *(expection of a reasonable person)*
- ***Make customer happy!***

Metrification of Software Quality

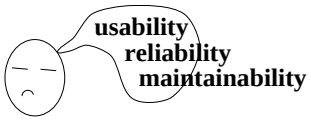
- an attempt to provide a quantitative assessment of sw quality
- usual metrification process:

  1. determine a set of desirable attributes (i.e., ilities)
  2. determine relative importance/weight of such attributes
  3. evaluate the quality (rating) of each of the attributes
  4. compute weighted rating for each
  5. sum up all the weighted ratings

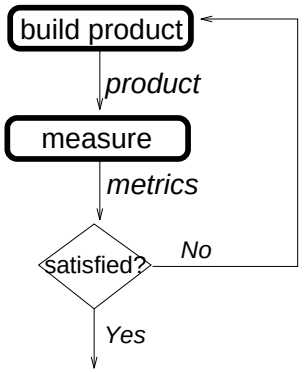
-ilities	relative weight	rating	weighted rating
usability	.3	6	1.8
reliability	.6	5	3.0
maintainability	.1	7	0.7
Overall Quality			5.5/10

- an inexact science at this point
- however, aids in understanding the factors that affect sw quality
  a first-cut approximation
  very poor quality factor

Build Software Quality



Product



Alas! Infinite design space

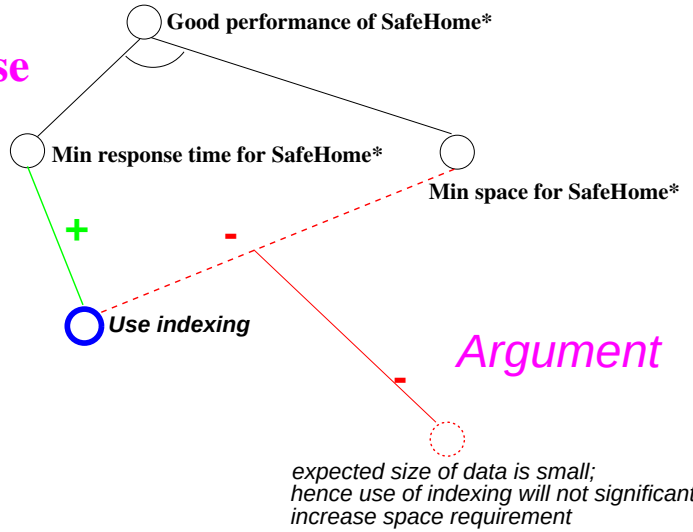
... but are you still trying to find the coin?

- **clarify**
- **consider design alternatives**
- **analyze tradeoffs considering domain characteristics**
- **record design rationale**

Process-oriented approach

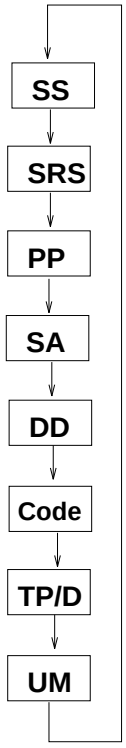
Decompose

Satisfice



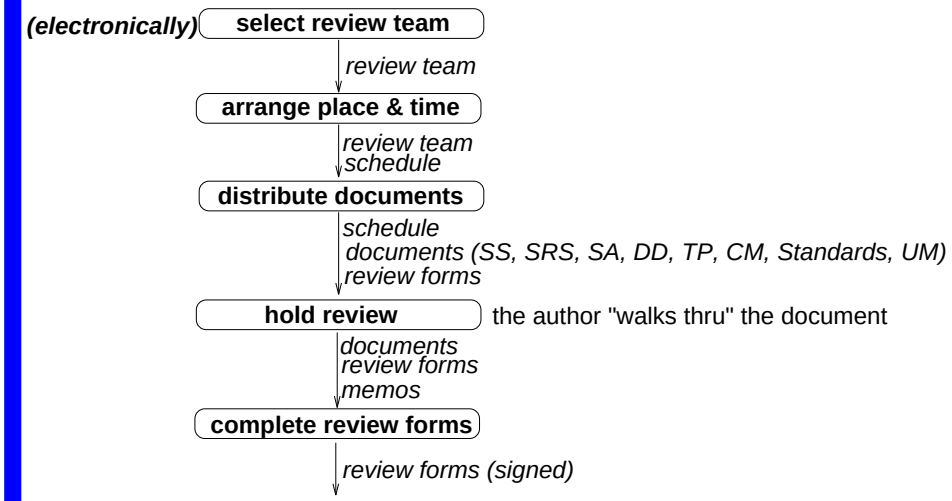
SQA Activities

- **Application of technical methods:**
  - analysis, selection & recommendation of CASE tools
    - *L-CASE* (e.g., Compiler, Debugger, Pretty Print, ...)
    - *U-CASE* (e.g., DFD/SADT/IDEF/OO/DD, SC, ...)
    - *I-CASE* (e.g., IEF/Composer, Teamwork, System Architect, ...)
  - Requirements (what, who, when, ...) & selection criteria (supportability)
- **Enforcement of standards**
  - What kind of standards are out there?
  - Which one to use? (e.g., International, North American, European)
  - Are standards fixed?
  - Certification needed?
- **Control of change:**
  - no change -> dead/no improvement
  - changing &conflicting reqs during and after
  - formal management of changes to the sw and documentation
- **Sw measure & reporting mechanisms:**
  - ongoing assessment of sw quality (SRS -> .. -> release)
  - tracking changes in quality as system evolves (e.g., ver2 << ver1?)
  - warning mgmt if quality appears to be degrading
- **Formal technical reviews**



SQA Activities

- **Formal technical reviews**
  - organization is similar to Code Inspection (moderator, inspectors, author)
  - but usually faster paced (>>150loc) & less intense (>>3lines)
  - often primarily to detect errors in a sw design (-> SRS -> SS)
  - on product, design (low-level, arch.), SRS, SS
- **Review Process Architecture**



SQA Activities

- *Purpose of formal technical reviews:*
  1. accept the product (SS/SRS/Arch..) without further modification
  2. accept the product provisionally; minor errors must be corrected, but no further review
  3. reject the product due to serious errors;
     Once errors are corrected, another review will be performed

- *Pressman's review guidelines:*

  review the product not the producer

  limit debate and rebuttal
  identify problem area but don't attempt to solve every problem

  develop a checklist to guide the review process

  ... and other things you've been doing all along
  limit size of review team
  require advance preparation ...

  train reviewers to review; periodically review the review process

Software Configuration Management (SCM)

- **A sw configuration collectively refers to all info. produced as part of the SE process**

- **The First Law of System Engineering:**

  No matter where you are in the system life cycle,
  the system will change,
  and the desire to change it will persist throughout the lifecycle

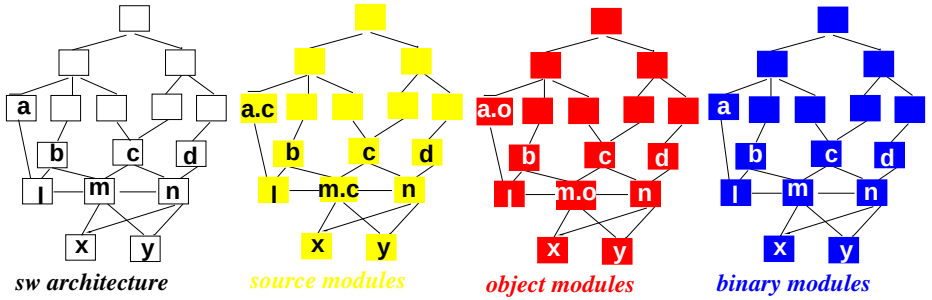
- **Purpose of SCM:**

  Manage the structure of a sw system over its lifetime

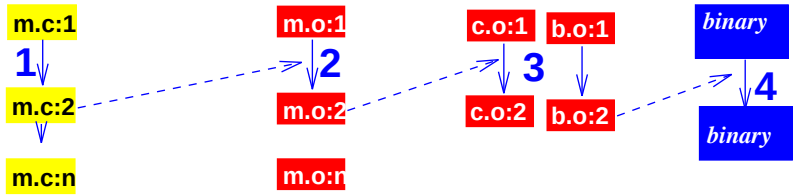
  Bring order to the chaos of a continually evolving sw system

- **SCM includes:**
  - *System Modeling*
  - *Version Control*
  - *Software Release*
  - *System Composition*
  - *Change Control*

System Modeling



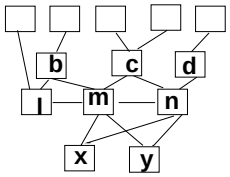
- assume a sw system is composed of an arbitrary collection of modules, each with a series of versions



- an interface is the link between
  the server module that provides a service and
  the client module that uses the service
  - ✠ *Recall: data flow*
  - ✠ *Recall: operation/service*

System Modeling

- then, a ***system model*** is a complete and detailed description of the client/server relationships in a sw system at a given point



Module m
mop1(s:string, h:vector)
x.op1(i)
y.k(u,v)
y.l(t)

Module x
op1 (p: int)
op2

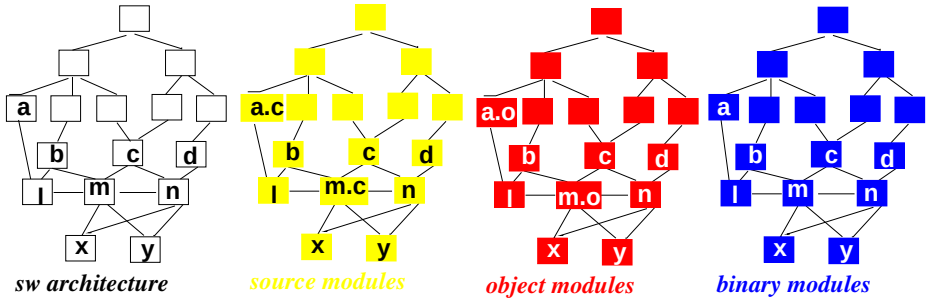
Module y
k(r,s: real)
l(c:boolean)

- a sw system is "consistently composed" if for every client/server relationship, the client & the server agree on the interface between them
  - *import/export (private/public) restrictions*
  - *# of parameters*
  - *parameter types*
  - *return type*

What if algorithms change?

- for every client/server relationship, the system model must specify the version of {the interface, the server, the client}
  - *names*

System Composition Process



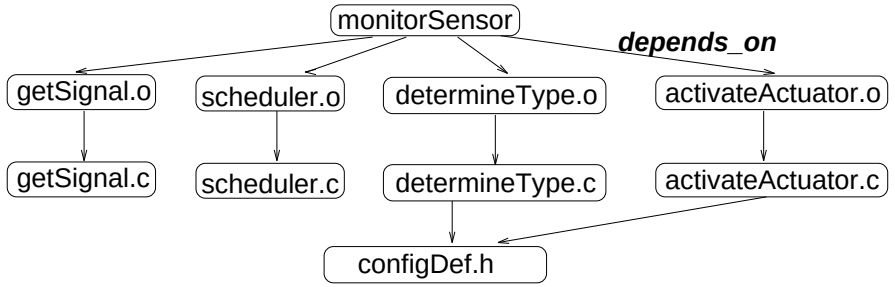
sw architecture *source modules* *object modules* *binary modules*

- Input: System Model and sw source/object/binaries
  Output: a correctly composed system
  Assume: modules are separately compiled to produce binary modules
  A formal "interface" is the only compile time link between client & server modules
- Use the system model to identify the correct binary version for each module
  preferably in terms of sw architecture versions
- For each client/server relationship, check that the client & the server were compiled with the same version

compiler checks: all imported modules (servers) exist
all operations invoked by the client exist
parameters (& types) match

System Composition Process

- *make*
  - automatic recompilation of modifed source code
  - *Component dependency graph*

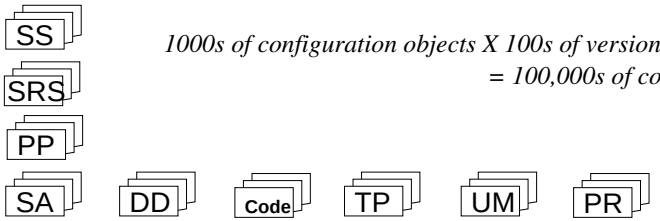


  - drawbacks:
    unnecessary recompilation with comments
    files instead of abstractions
    can be complicated to write and understand
    integration with VCS not adequate

- Module Interconnection Languages are used to express system models containing all of the rules for constructing composite/derived items.

Version Control

- a sw sys development involves the creation & evolution of 1000s of configuration objects
- every change to a config. object logically creates a new version of the object => 100s of versions of an object over the lifetime of a system



1000s of configuration objects X 100s of versions/conf.-obj =
= 100,000s of config-obj-versions

- any given instance of a sw sys is composed of specific versions of every object in the system
- a version control system combines procedures & tools to manage different versions of configuration objects

(e.g., archiving, automatic logging, differential comparison, etc.)

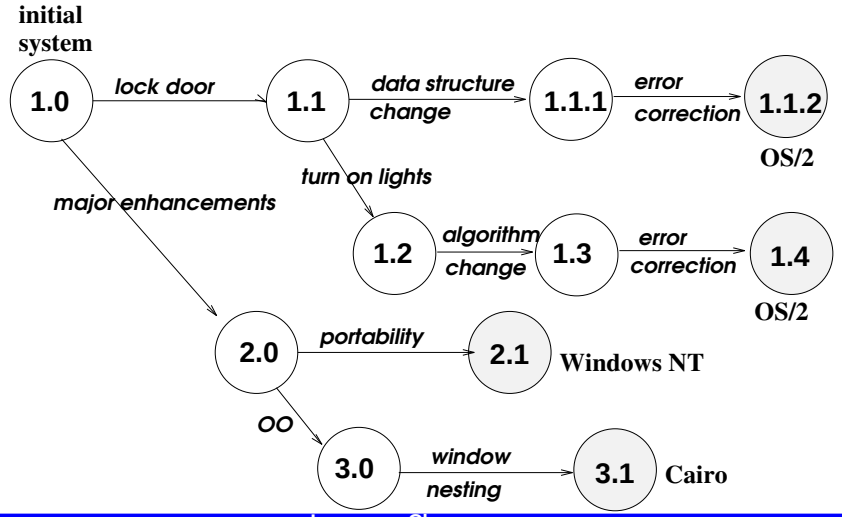
Do you know why you are working on your SRS now?
Are there 10 teams working on the same object?

Version Control

- an "evolution graph" represents diff. versions of a config. object /system
  - typical naming convention: major.minor.variant

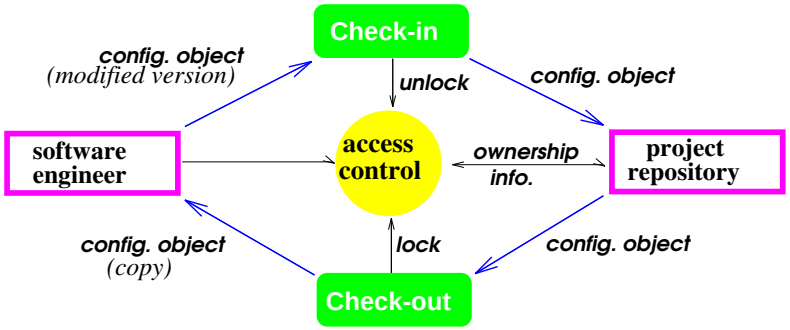
relative to the characteristics of sw system

  - major versions typically correspond to releases for the sw
  - minor versions for significant change (e.g., days' work)



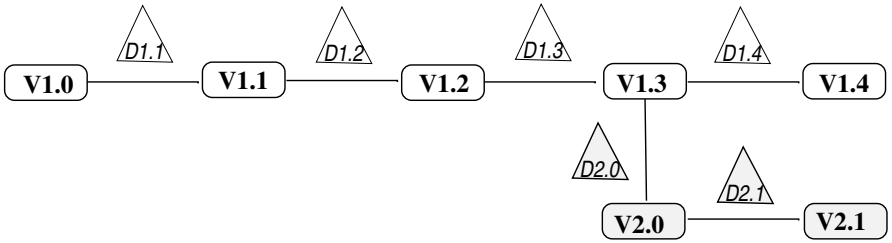
Change Control

- change must be "managed":
  (<-> an empty library, purchase of 100 copies of the same book, etc.)
- typically a "change committee": senior developers & managers
  - determines desirability of a change ***(e.g., control via PDA)***
  - detect conflicting/overlapping changes ***(e.g., no control via mobile phone)***
  - estimate the cost and impact of changes ***(e.g., SS, SRS/Proto, SA, DD, Code, TP/TD, UM, ...***
  - schedule changes relative to software releases
  - tracks the change process making sure change applications
- access and synchronization control
  - access control ensures the sw engineer is authorized to check out
  - synch. control locks the object at check-out & unlocks at check-in



Version Management Tools

- Consider parallel development releases



- large number of versions -> storage space explosion
  - delta = diff (old version, new version)
  - {version_i} = version_master + {delta_i}

	RCS	SCCS
version_master	version_last	version_first
format	ASCII text	ASCII text
user-supplied info	yes	no