CIS 422/522

Software Requirements
and a little Quality Assurance (2)

I'LL NEED TO KNOW YOUR REQUIREMENTS BEFORE I START TO DESIGN THE SOFTWARE.
FIRST OF ALL, WHAT ARE YOU TRYING TO ACCOMPLISH?
I'M TRYING TO MAKE YOU DESIGN MY SOFTWARE.
I MEAN WHAT ARE YOU TRYING TO ACCOMPLISH WITH THE SOFTWARE?
I WON'T KNOW WHAT I CAN ACCOMPLISH UNTIL YOU TELL ME WHAT THE SOFTWARE CAN DO.
TRY TO GET THIS CONCEPT THROUGH YOUR THICK SKULL: THE SOFTWARE CAN DO WHATEVER I DESIGN IT TO DO!
CAN YOU DESIGN IT TO TELL YOU MY REQUIREMENTS?
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Technical Specification

The SRS
The role of rigorous specification

Requirements Documentation

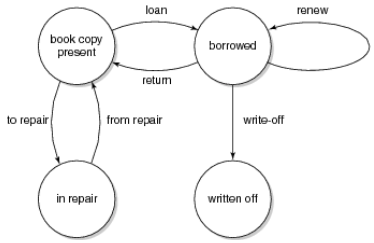
- Is a detailed requirements specification necessary?
- How do we know what “correct” means?
  - How do we decide exactly what capabilities the modules should provide?
  - How do we know which test cases to write and how to interpret the results?
  - How do we know when we are done implementing?
  - How do we know if we’ve built what the customer asked for (may be distinct from “want” or “need”)?
  - Etc…
- Correctness is a *relation* between a spec and an implementation (M. Young)
- Implication: until you have a spec, you have no standard for “correctness”

Technical Requirements

- Focus on developing a technical specification
  - Should be straight-forward to determine acceptable inputs and outputs
  - Preferably, can systematically check completeness consistency
- A little rigor in the right places can help a lot
  - Adding formality is not an all-or-none decision
  - Use it where it matters most to start (critical parts, potentially ambiguous parts)
  - Often easier, less time consuming than trying to say the same thing in prose
- E.g. in describing conditions or cases
  - Use predicates (i.e., basic Boolean expressions)
  - Use mathematical expressions
  - Use tables where possible

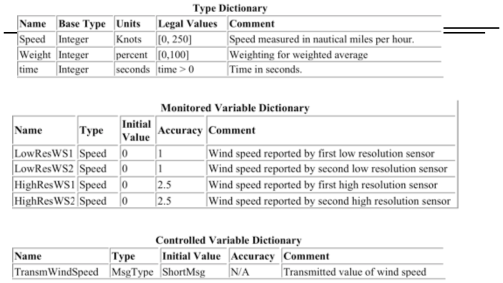
Example state transition diagram

Does the Address Book have stateful behavior?
What are the states? Transitions?



SE, Modeling, Hans van Vliet, ©2008

Formal Specification Example



Type Dictionary

Name	Base Type	Units	Legal Values	Comment
Speed	Integer	Knots	[0, 250]	Speed measured in nautical miles per hour.
Weight	Integer	percent	[0,100]	Weighting for weighted average
time	Integer	seconds	time > 0	Time in seconds.

Monitored Variable Dictionary

Name	Type	Initial Value	Accuracy	Comment
LowResWS1	Speed	0	1	Wind speed reported by first low resolution sensor
LowResWS2	Speed	0	1	Wind speed reported by second low resolution sensor
HighResWS1	Speed	0	2.5	Wind speed reported by first high resolution sensor
HighResWS2	Speed	0	2.5	Wind speed reported by second high resolution sensor

Controlled Variable Dictionary

Name	Type	Initial Value	Accuracy	Comment
TransmWindSpeed	MsgType	ShortMsg	N/A	Transmitted value of wind speed

- SCR formal model
  - Define explicit types
  - Variables monitored or controlled

Quality Requirements

Terminology

- Avoid “functional” and non-functional" classification
- Behavioral Requirements – any information necessary to determine if the run-time behavior of a given implementation constitutes an acceptable system
  - All quantitative constraints on the system's run-time behavior
  - Other objective measures (safety, performance, fault-tolerance)
  - In theory all can be validated by observing the running system and measuring the results
- Developmental Quality Attributes - any constraints on the system's static construction
  - Maintainability, reusability, ease of change (mutability)
  - Measures of these qualities are necessarily relativistic (I.e., in comparison to something else

Behavioral vs. Developmental

Behavioral (observable)	**Developmental Qualities**
• Performance • Security • Availability • Reliability • Usability	• Modifiability(ease of change) • Portability • Reusability • Ease of integration • Understandability • Support concurrent development
Properties resulting from the behavior of components, connectors and interfaces that exist at run time.	Properties resulting from the structure of components, connectors and interfaces that exist at design time *whether or not they have any distinct run-time manifestation*.

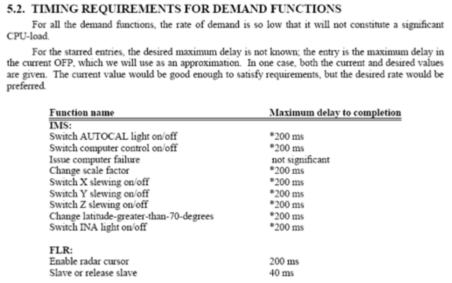
Specifying Quality Requirements

- Is it important to specify the quality requirements explicitly? Unambiguously?
  - Hint: what role would quality requirements play in customer acceptance?
- Are these kinds of specifications adequate?
  - "The system interface shall be easy to use."
  - "The system shall support the maximum number of simultaneous users"

Specifying Quality Requirements

- When using natural language, write objectively verifiable requirements when possible
  - Load handling: "The system will support 15 or more concurrent users while staying within required performance bounds."
  - Maintainability: "The following kinds of requirements changes will require changes in no more than one module of the system…"
  - Performance:
    - "System output X has a deadline of 5 ms from the input event."
    - "System output Y must be updated at a frequency of no less than 20 ms."

Example Timing Requirements

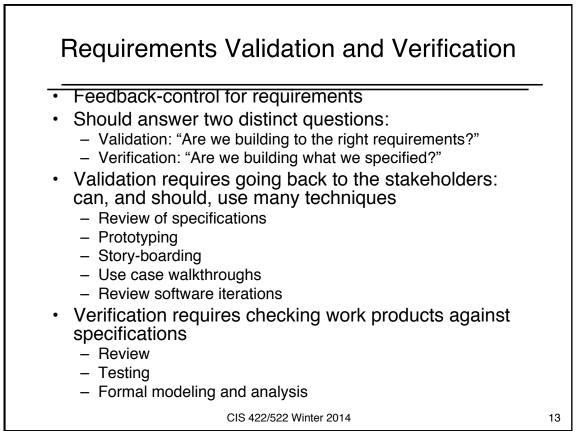


5.2. TIMING REQUIREMENTS FOR DEMAND FUNCTIONS

For all the demand functions, the rate of demand is so low that it will not constitute a significant CPU-load.

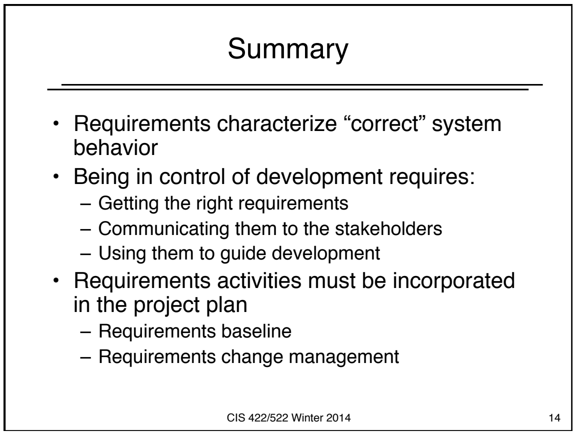
For the starred entries, the desired maximum delay is not known; the entry is the maximum delay in the current OFP, which we will use as an approximation. In one case, both the current and desired values are given. The current value would be good enough to satisfy requirements, but the desired rate would be preferred.

Function name	Maximum delay to completion
IMS:	
Switch AUTOCAL light on/off	*200 ms
Switch computer control on/off	*200 ms
Issue computer failure	not significant
Change scale factor	*200 ms
Switch X slewing on/off	*200 ms
Switch Y slewing on/off	*200 ms
Switch Z slewing on/off	*200 ms
Change latitude-greater-than-70-degrees	*200 ms
Switch INA light on/off	*200 ms
FLR:	
Enable radar cursor	200 ms
Slave or release slave	40 ms



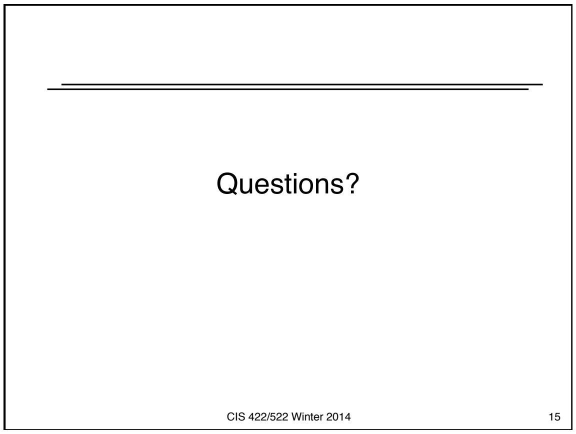
Requirements Validation and Verification

- Feedback-control for requirements
- Should answer two distinct questions:
  - Validation: “Are we building to the right requirements?”
  - Verification: “Are we building what we specified?”
- Validation requires going back to the stakeholders: can, and should, use many techniques
  - Review of specifications
  - Prototyping
  - Story-boarding
  - Use case walkthroughs
  - Review software iterations
- Verification requires checking work products against specifications
  - Review
  - Testing
  - Formal modeling and analysis

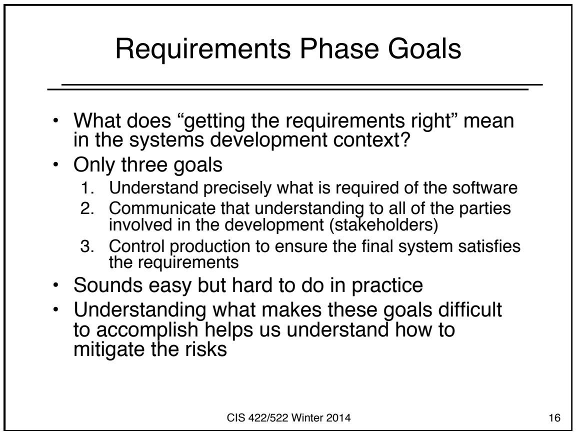


Summary

- Requirements characterize “correct” system behavior
- Being in control of development requires:
  - Getting the right requirements
  - Communicating them to the stakeholders
  - Using them to guide development
- Requirements activities must be incorporated in the project plan
  - Requirements baseline
  - Requirements change management

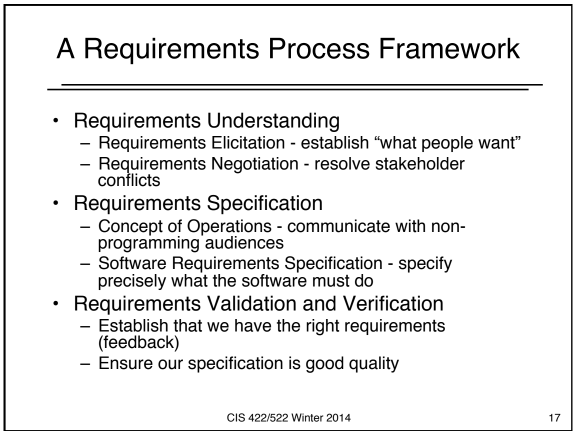


Questions?



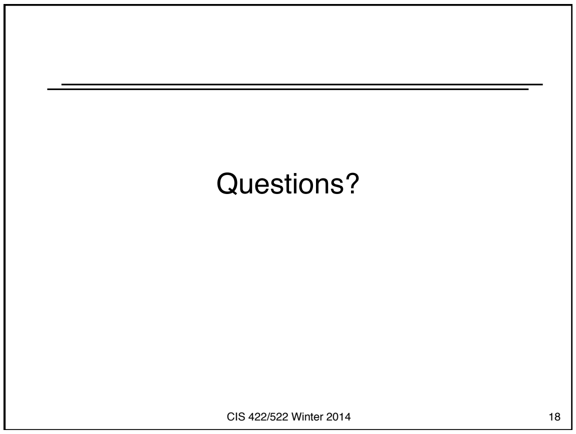
Requirements Phase Goals

- What does “getting the requirements right” mean in the systems development context?
- Only three goals
  1. Understand precisely what is required of the software
  2. Communicate that understanding to all of the parties involved in the development (stakeholders)
  3. Control production to ensure the final system satisfies the requirements
- Sounds easy but hard to do in practice
- Understanding what makes these goals difficult to accomplish helps us understand how to mitigate the risks



A Requirements Process Framework

- Requirements Understanding
  - Requirements Elicitation - establish “what people want”
  - Requirements Negotiation - resolve stakeholder conflicts
- Requirements Specification
  - Concept of Operations - communicate with non-programming audiences
  - Software Requirements Specification - specify precisely what the software must do
- Requirements Validation and Verification
  - Establish that we have the right requirements (feedback)
  - Ensure our specification is good quality



Questions?