Other than OOAD?

CSCI 4448/5448: Object-Oriented Analysis & Design

Lecture 41

Acknowledgement & Materials Copyright

- I'd like to start by acknowledging Dr. Ken Anderson
- Ken is a Professor and the Chair of the Department of Computer Science
- Ken taught OOAD on several occasions, and has graciously allowed me to use his copyrighted material for this instance of the class
- Although I will modify the materials to update and personalize this class, the original materials this class is based on are all copyrighted © Kenneth M. Anderson; the materials are used with his consent; and this use in no way challenges his copyright

Before we start…

- Remaining OOAD classes
  - Mon 11/30 – Today's Lecture
  - Wed 12/2, Fri 12/4 – Graduate Pecha Kucha presentations
  - Mon 12/7 – Final brief OOAD Lecture – Final Exam Review, Class Wrap-up
  - Tue 12/8 – Reading Day, no classes
- Other assignments
  - Tue 12/1 – Pecha Kuchas must be submitted
    - For presentations, you can share slides on Zoom OR I can load and share them OR record your presentation
  - Project 6/Semester Project with recorded demonstration – due Fri 12/4 noon (adjusted late penalties, hard deadline of 12/7 midnight)
  - Quiz 11 this week – due Mon 12/7
  - Extra Credit/Participation Article Review [up to 2] – Open until Mon 12/7 at noon
  - Graduate Project final presentation – due Mon 12/7 noon
  - Final Exam (Online/Optional) – available starting Wed 12/9 morning through Thursday midnight

Before we start: Discussion Topics Revisited

1. Class Questions
   - Do let me know in Quiz 11 about any changes for OOAD you'd recommend, I do pay attention and make changes
2. Languages
   - Python is my first choice, have used Node.JS, R, C, and Matlab/Octave lately
3. Source Control
   - Git (& Git Bash) is my go-to, haven't worked in a group shared repo for some time
4. Design-First
   - Unless it's a simple piece of code, I'll use UML to sketch out the system, especially use cases
5. Favorite References
   - I'm a book guy (as you know), see the list at the end of this lecture
6. Team Projects
   - Last time I worked in industry, I drove Scrum and Kanban based s/w teams; I think a good agile process makes for a happier & productive experience
7. Best Software/System
   - Longest-lived: FireWorks by EST (started in 1998, still in use)
   - Most complex: SimPy based network communication simulation
8. What Went Wrong
   - Usually people issues; me or others
9. Testing
   - Honestly, not a good tester; haven't used TDD personally; more test after/with; put a test department in place at last position
10. Best Mentor, Leader, Manager, Peer
    - Been lucky to have a few folks who helped focus my career a little sharper or gave me an honest word or two when I needed it

Goals of the Lecture

- Review software language landscape
- Survey development processes other than OOAD
- The state of OO and software
- Some other sources to review…

Languages…

- The TIOBE Index – which language has been used for the most lines of code… Of ~700 Programming Languages… https://www.tiobe.com/tiobe-index/

1. Java
2. C
3. Python
4. C++
5. C#
6. Visual Basic
7. JavaScript
8. PHP
9. SQL
10. R
11. Swift
12. Go
13. Ruby
14. Assembly
15. PL/SQL
16. Perl
17. Objective-C
18. MATLAB
19. Classic Visual Basic
20. Scratch

Object Oriented Languages…

- Object-oriented – at least in part

1. Java
2. C
3. Python
4. C++
5. C#
6. Visual Basic
7. Javascript
8. PHP
9. SQL
10. R
11. Swift
12. Go
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?. Kotlin

One of the reasons for the OOAD class…

Most development is in OO languages, whether used in true Object fashion or not.

What about the others?

- C (and Pascal, Rust, etc.) – Imperative, Procedural
- SQL and PL/SQL – Domain Specific for Databases, Procedural
- Assembly – Microprocessor dependent, functional/procedural?
- R (and Mathematica, MATLAB) – Domain Specific for Math/Statistics, primarily Procedural
- Scratch – Educational visual programming

- Not Listed:
- F#, Erlang, Haskell - Functional
- Lisp – Functional, used for AI
- APL – Symbolic language for mathematics
- Prolog – Logic/goal programming
- Etc…

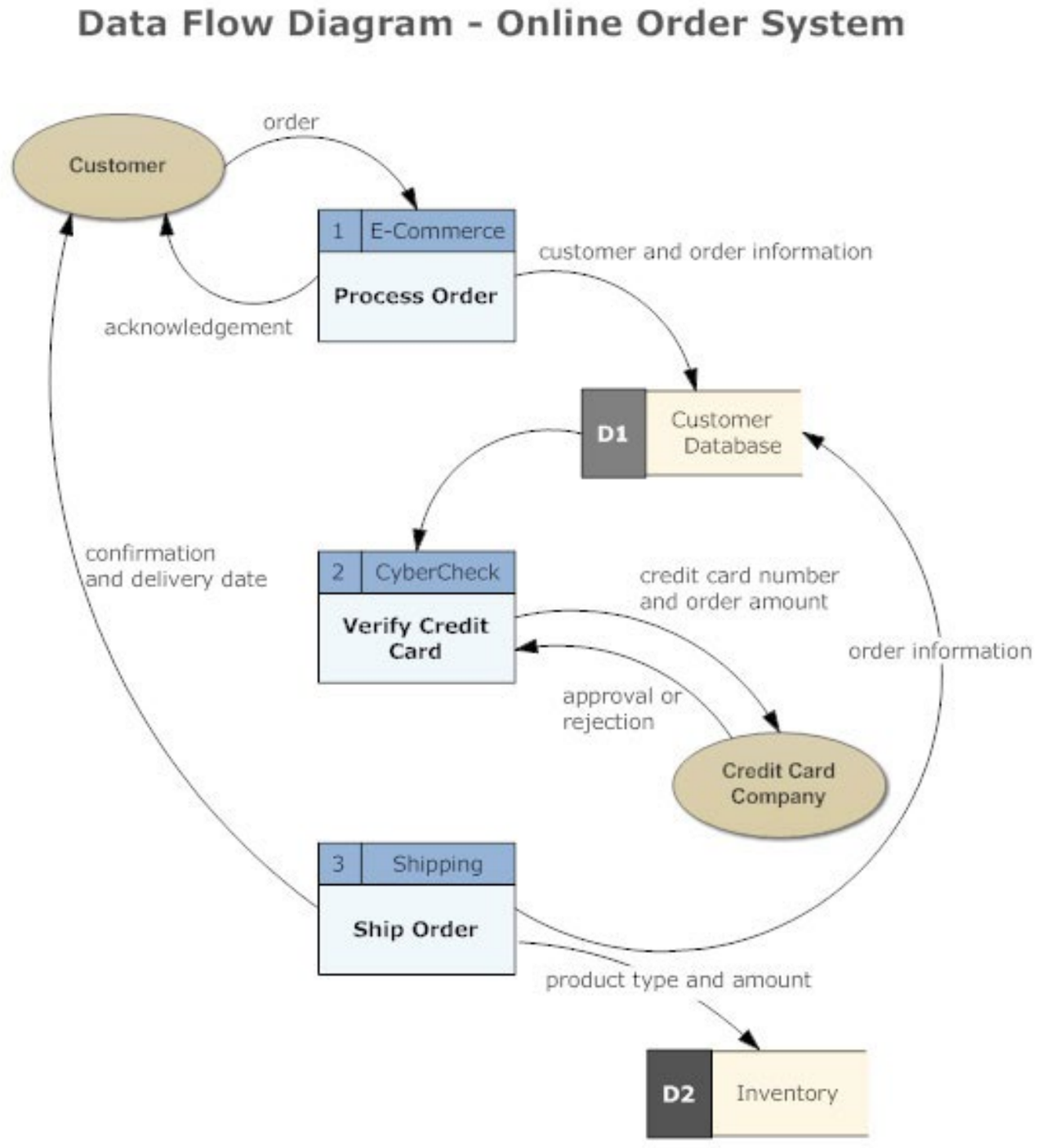
If not OO, what?

- If not all languages are OO…
- What approaches are there for Analysis and Design besides OOAD?

- Data Flow Oriented Design
- Structured Analysis and Design Technique (SADT)
  - IDEF0 through IDEF5
- Cleanroom Software Development
- Dynamic Systems Development Method (DSDM)
- Test Driven Development (we've reviewed… doesn't replace OO)
- Domain Driven Design (DDD)
- Behavior Driven Development (BDD)

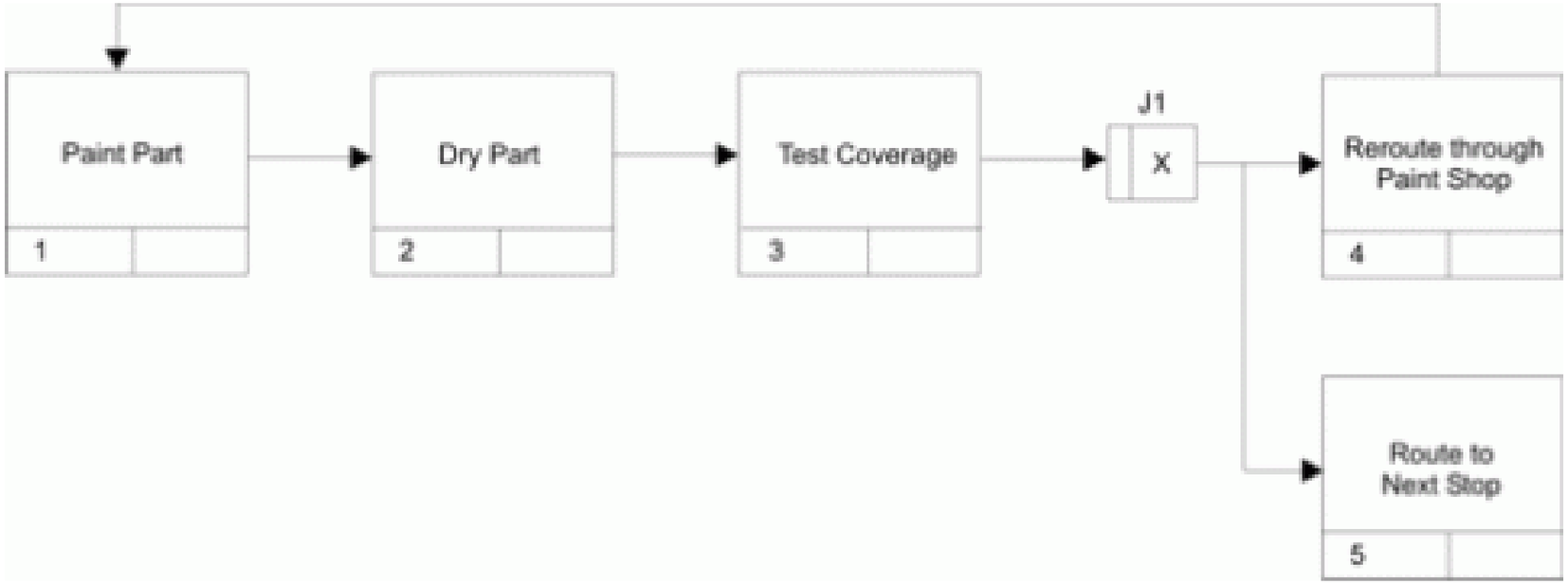
Data Flow Oriented Design

- Data Flow Diagrams (we mentioned these before as a design technique…)
  - From Structured Design in 1970s
- Data Flow Diagrams aren't flow charts
- Process of Data Flow design
  - Trace the "main path" from the primary input to the primary output
  - Identify the most abstract input (MAI) and most abstract output (MAO) points
  - Top module decomposes into "get MAI", "MAI-->MAO", and "put MAO" (with actual names)
  - Recursively decompose "get MAI" modules into "get next MAI" and "next MAI-->MAI" modules
  - Recursively decompose "put MAO" modules into "MAO-->next MAO" "put next MAO" and modules
  - Apply this entire process recursively to the "MAI-->MAO" modules
- Plus: A repeatable/cookbook like procedure
- Minus: May not scale up or work with non-hierarchical architectures
- https://www.cs.odu.edu/~price/cs451/Lectures/05design/dataflow/
- https://www.smartdraw.com/data-flow-diagram/



SADT – Structured Analysis and Design Technique

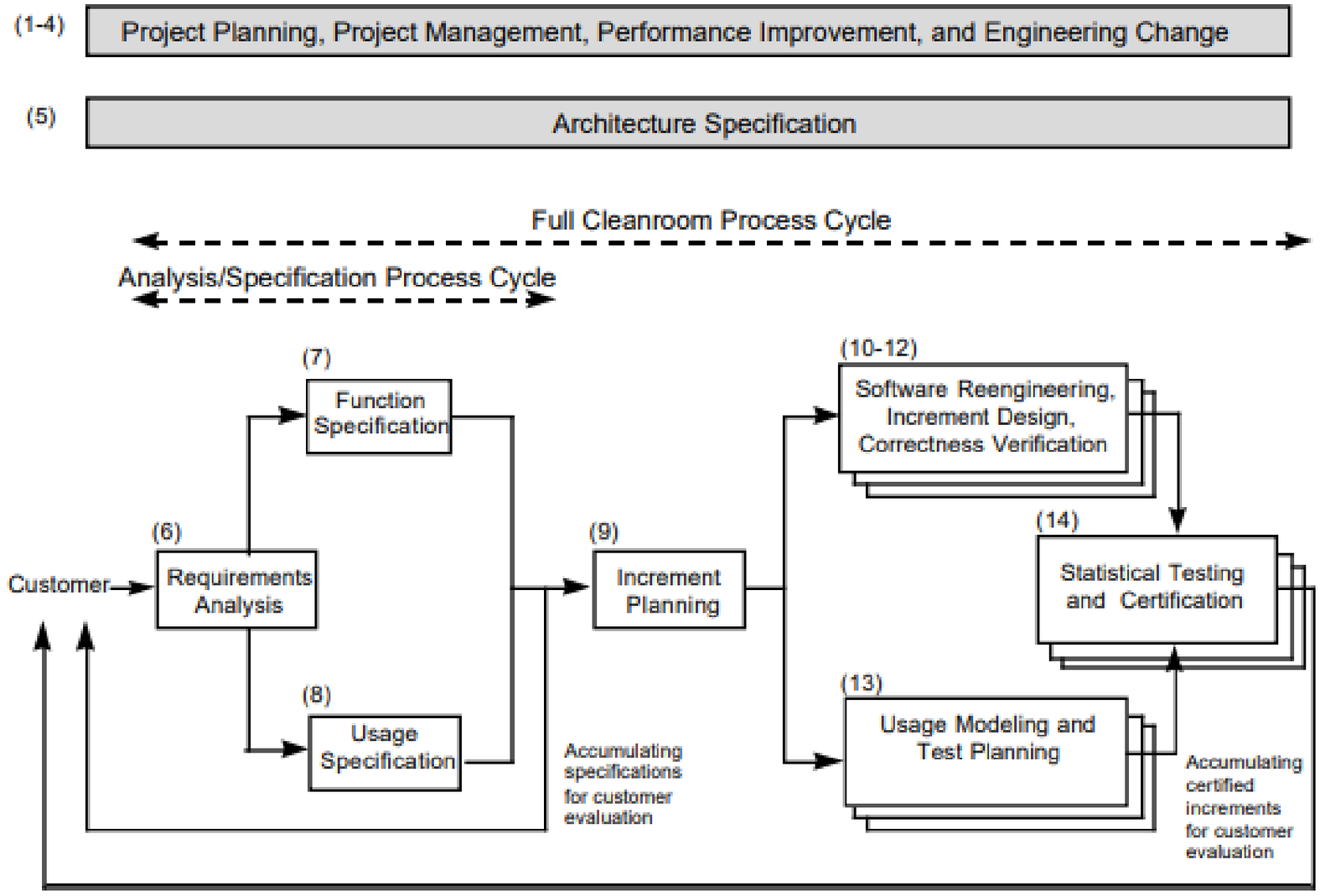
- Starts with Ross in late 60s, formalized as IDEF0 (Integrated DEFinition for Process Description) in 1981
- Later: IDEF3 for business process models, IDEF5 for ontology description capture (showing properties and relations between concepts)



- https://www.idef.com/idef3-process-description-capture-method/

Cleanroom Software Engineering

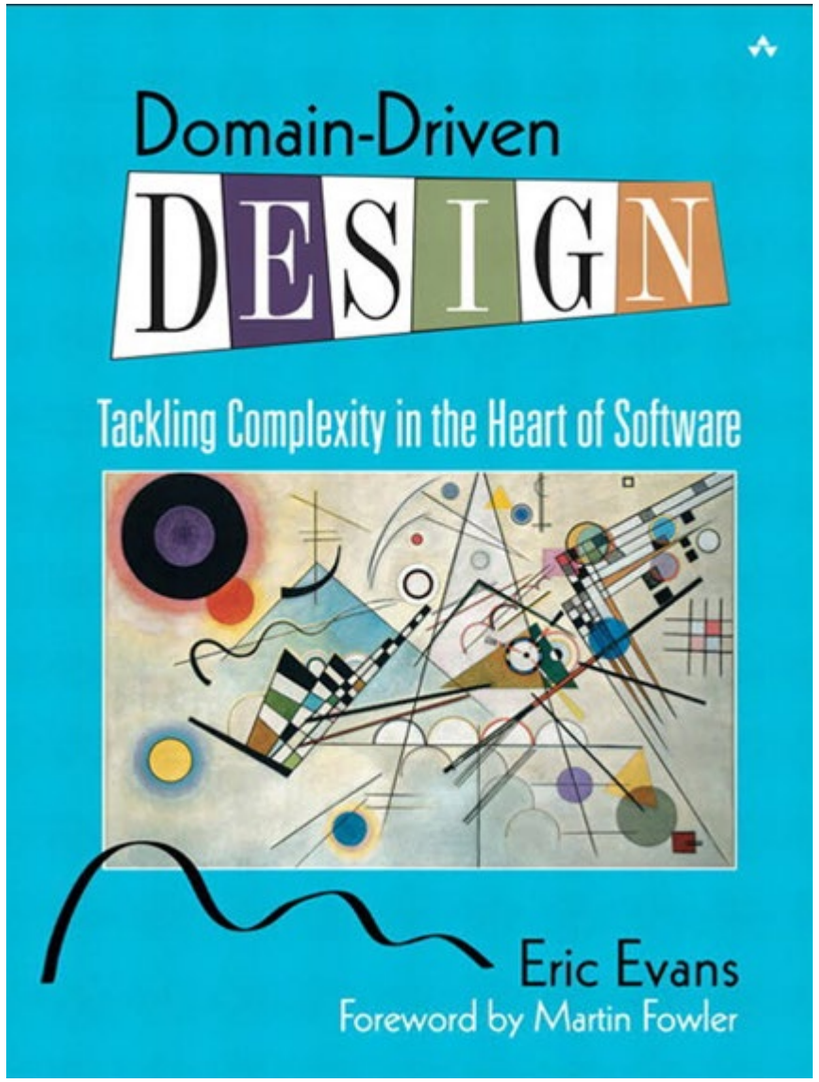
- Development of high-reliability software systems under statistical quality control
- Key objective is zero failures in use
- Includes formal methods and usage models
- Includes full life cycle elements for design, test, and management
- https://resources.sei.cmu.edu/asset_files/TechnicalReport/1996_005_001_16502.pdf



Dynamic Systems Development Method (DSDM)

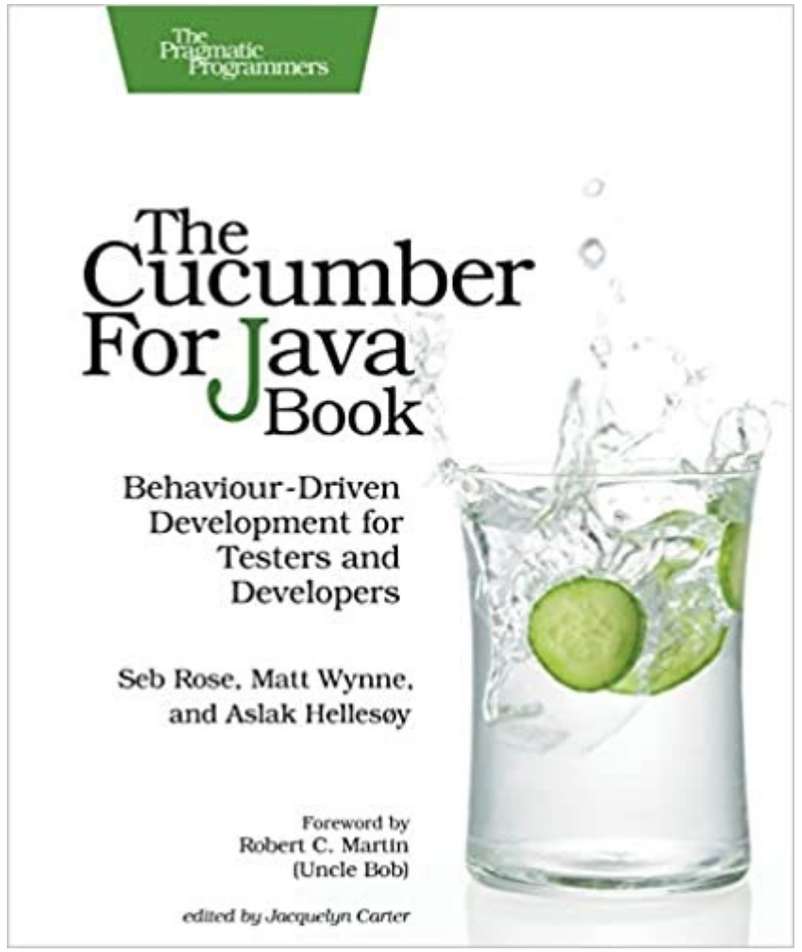
- More a project management methodology…
- An agile method for projects to strengthen the earlier RAD (Rapid Application Development)/JAD (Joint Application Development) methods
- Eight Principles
  - Focus on the business need
  - Deliver on time
  - Collaborate
  - Never compromise quality
  - Build incrementally from firm foundations
  - Develop iteratively
  - Communicate continuously and clearly
  - Demonstrate control
- Can mix with Scrum or other project management approaches
- https://www.agilebusiness.org/page/whatisdsdm
- https://www.agilebusiness.org/page/TheDSDMAgileProjectFramework

Domain-driven Design (DDD)



- Term coined in Evans 2004 Book – widely praised
- (Business) Domain-driven (Software) Design
  - Develop software for complex needs by connecting implementation to a model of core business concepts
  - Primary focus on core domain and domain logic and a model to drive complex designs
  - Technical and domain experts work to iterate to the conceptual core problems
    - https://dddcommunity.org/learning-ddd/what_is_ddd/
- Strategic Design
  - Business Domains – areas of activity or services
  - Ubiquitous Language – speak in terms of the business domain
  - Context Maps and Boundaries – designs for model subdivisions and interfaces
- Tactical Design
  - Business Logic Patterns – Transaction Scripts, Active Records, Domain Models
  - Architecture Patterns – Layered, Ports & Adapters, Command Query Responsibility Segregation (CQRS)
- Event Storming
  - Structured group modeling technique for the business process – find domain events, users, business processes, commands, aggregates, external systems, and views

Behavior Driven Development



- First came from Dan North around 2009
- Refinement of Test Driven Development and Acceptance Test Driven Development…
  - Apply the “Five Why’s” to user stories to make their purpose match business outcomes
  - Minimize waste by only implementing elements needed for business outcomes
  - Drive these approaches down to lowest abstraction levels in software, distribute behavior to make evolution easier
- BDD aka Specification by Example
  - As A-I Want-So That = narrative notation for user stories
  - Given-When-Then = notation to develop specification of acceptance criteria
  - Three Amigos = Business, Developer, Tester work in Specification Workshops
- Cucumber – a tool for developing requirements as shown above
- https://www.agilealliance.org/glossary/bdd

Is OOAD alive or dead?

- Many of the processes we just looked at are using OO elements in their modeling or process discovery
- Majority of most used languages are OO – it's not leaving us any time soon
- Procedural/functional languages still have a place
  - But will struggle with increases in size and change
- Like most tools, OO is dangerous in the wrong hands
  - To do it right takes some work and study, not usually appreciated by casual coders and scripters
- Learn from other's OO experience – patterns, code smells, refactoring, test approaches
- Use strong OO design for test, maintainability, and change
  - Leave a clean campsite for the next camper!

Where do we go from here? Software Trends

- One person's view (but I don't disagree much)…
- All about the cloud – leveraging services, tools, and infrastructure (with the IoT) – AWS, Google, Azure
- Containers – Docker and Kubernetes are key technologies
- Microservice Architectures – vs. large monolithic systems (almost OO at larger scale)
- OO rules: Python in general, Java (with Spring) for enterprise scale
  - Still C for embedded systems
  - Watch the newer languages – Rust, Swift, Kotlin, TypeScript…
- For the Web and Cross Platform Apps – JavaScript and React (Angular, Vue also)
- Native App Development – Kotlin/Android, Swift/Apple/iOS
- APIs = REST
- Databases – top choices are still SQL based
  - Some roles for NoSQL: Mongo, Redis, Cassandra
- Agile development processes and DevOps continuous test/integration
- Be user aware – UX and UI design are key skills
- https://towardsdatascience.com/20-predictions-about-software-development-trends-in-2020-afb8b110d9a0

Further Review - Videos

- Agile Product Ownership in a Nutshell
  - Favorite video for explaining Agile best practices and key elements in 15 minutes
  - https://www.youtube.com/watch?v=502ILHjX9EE
- Martin Fowler
  - A popular speaker, he has a list of videos at his site https://martinfowler.com/videos.html
  - Check out “Not Just Code Monkeys”: https://www.youtube.com/watch?v=Z8aECe4lp44
- Steve McConnell
  - Lots of videos out there from his training company Construx
  - “Seven Unbreakable Rules of Software Leadership”
  - https://www.youtube.com/watch?v=iW3ED4UxVgA
- Rich Sheridan
  - Lots of TED type talks on software related topics
  - https://www.youtube.com/watch?v=fj7QK-hOBDI

From a CS book guy…

- Code Complete 2 – Steve McConnell
  - Also Clean Code – Robert “Uncle Bob” Martin (the other “Clean” books are good too, esp. Clean Architecture)
- Patterns of Enterprise Application Architecture, Refactoring, UML Distilled – Martin Fowler
- Working Effectively with Legacy Code – Michael Feathers
- A good OO Pattern book – Head First is fine, might want one for your language
- A good TDD book – I like TDD for Embedded C by Grenning
  - You might want something specific to another language or a general book like The Art of Unit Testing – Manning or TDD by Beck
- A good UX book or two
  - UX Team of One – Buley; Don’t Make Me Think - Krug
- The free Pro Git – Chacon & Straub; Git for Teams – Westby
- The Pragmatic Programmer: Journeyman to Master – Hunt & Thomas
  - “Why spend your life developing software unless you care about doing it well?” —Andrew Hunt and Dave Thomas
- Joy Inc. and Chief Joy Officer – Rich Sheridan

Next Steps

- Last Quiz (11) open this week through Mon 12/7 – just a class survey – free quiz grade if you complete it
- Wed/Fri: Pecha Kuchas!
- Project 6 (Semester Project submission/demo) – Friday 12/4
- Bonus points are posted; Extra Credit/Participation Article Review (s) [up to 2] – Mon 12/7
- Graduate Project Final Presentation
- Final Exam (Online/Optional) – starting Wed 5/9 on Canvas
- See the class staff for anything you need
- Hang in there, it's almost done…