

SOFTWARE DESIGN AND ARCHITECTURE

SWE 4601



WELCOME TO SWE 461

- Instructor: Md. Jubair Ibna Mostafa
- Designation: Assistant Professor
- Office:Room: 502, 2nd Academic Building, IUT
- Mobile: 01783905098
- Email: jubair@iut-dhaka.edu

GRADING POLICY

▪ Attendance	10%
▪ Quiz/Assignment	15%
▪ Mid	25%
▪ Final	50%

may change (in case...)

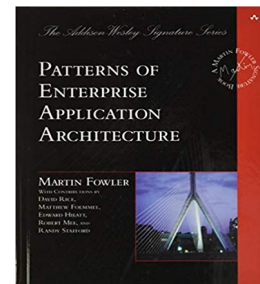
LATE POLICY, ATTENDANCE, & MAKEUP

- Late assignment is accepted up to 3 days late
 - But will be penalized 20% for each late day
- Attendance will be taken at the beginning of each lecture
 - Official / medical issues must be presented within one week
- No makeup exam/assignment will be given for missing exam or quiz

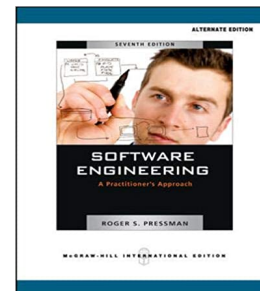
WHICH BOOKS WILL BE USED

- Some design and architecture related paper (will be given)
- Some websites like [Martin Fowler](#)

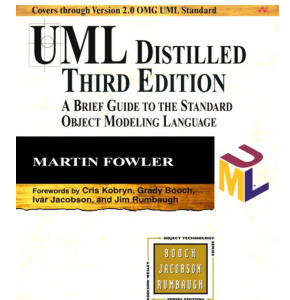
- Patterns of Enterprise Application Architecture
 - Martin Fowler



- Software Engineering
 - Roger Pressman 7th Edition



- UML Distilled
 - Martin Fowler



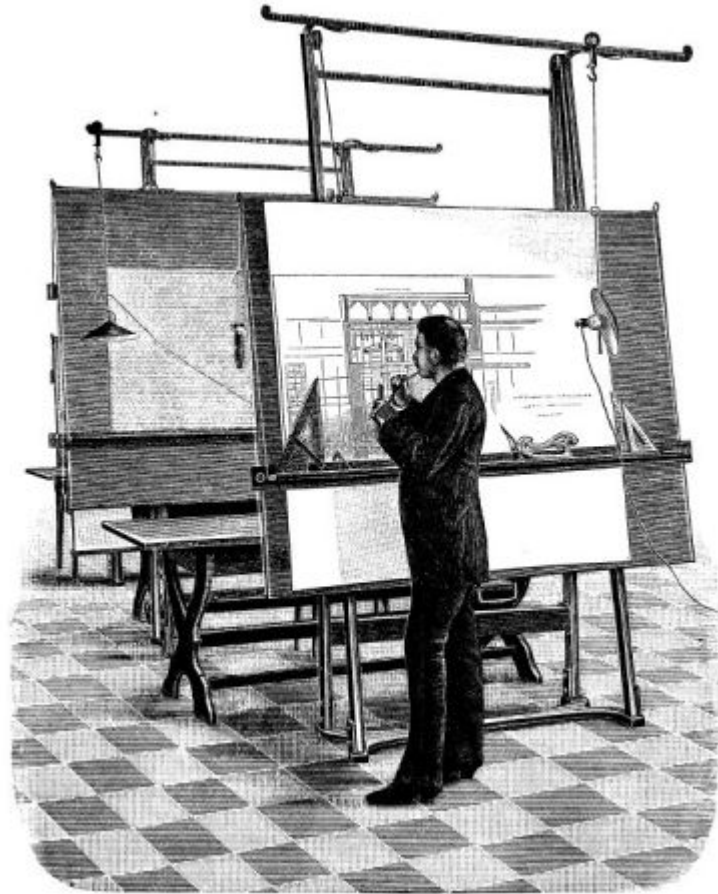
- Service-Oriented Architecture: Analysis and Design for Services and Microservices
 - Thomas Erl



WHAT IS ENGINEERING DESIGN?

- A specification for the construction of a system
- Usually in the form of a document
- Design is passed to manufacturing team and they build the system from it

ENGINEERING DESIGN



“You can use an eraser on the drafting table or a sledge hammer on the construction site.”

--Frank Lloyd Wright

Engineering Process (Partial and Simplified)

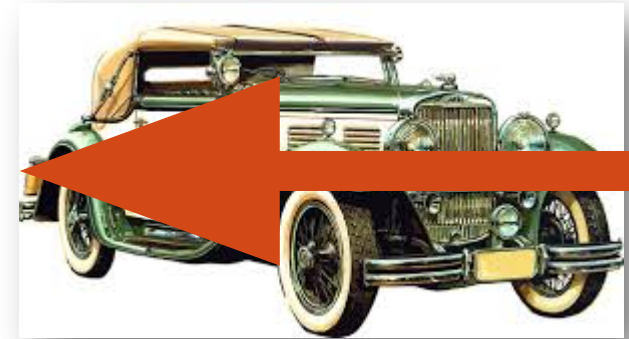


Requirements

Design Team



Manufacturing Team



Product

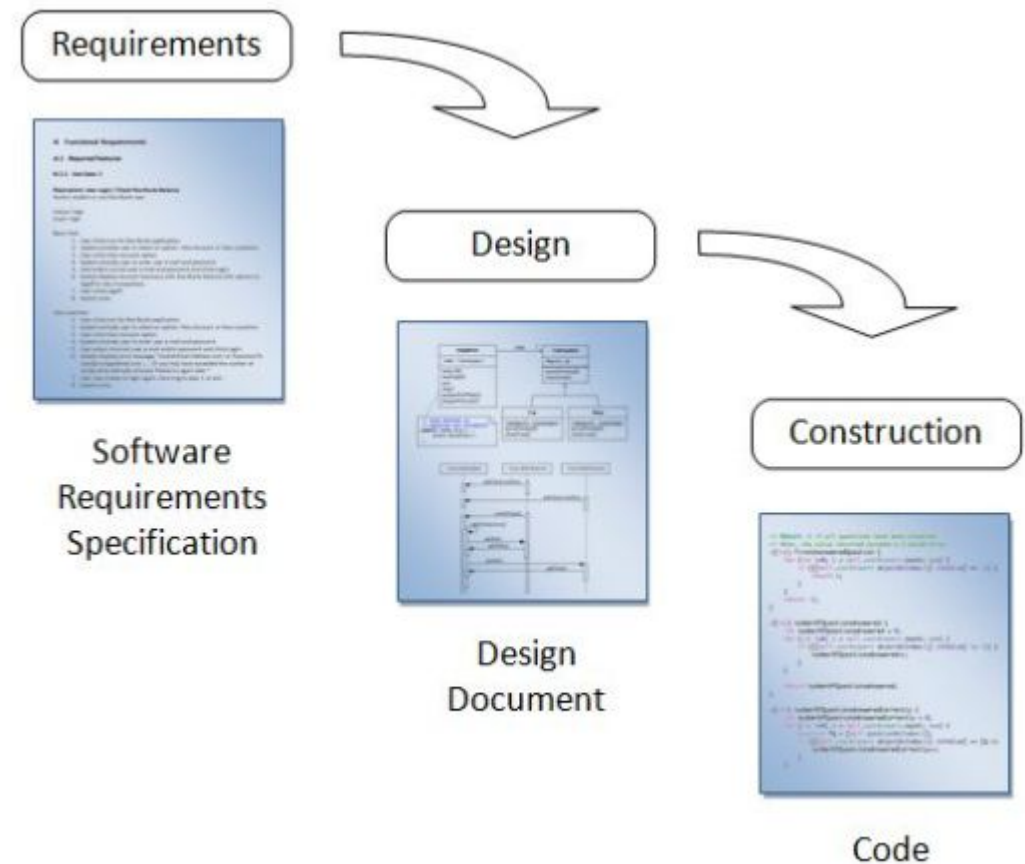


Design

Where do we fit code and
programmers in a
software development process?

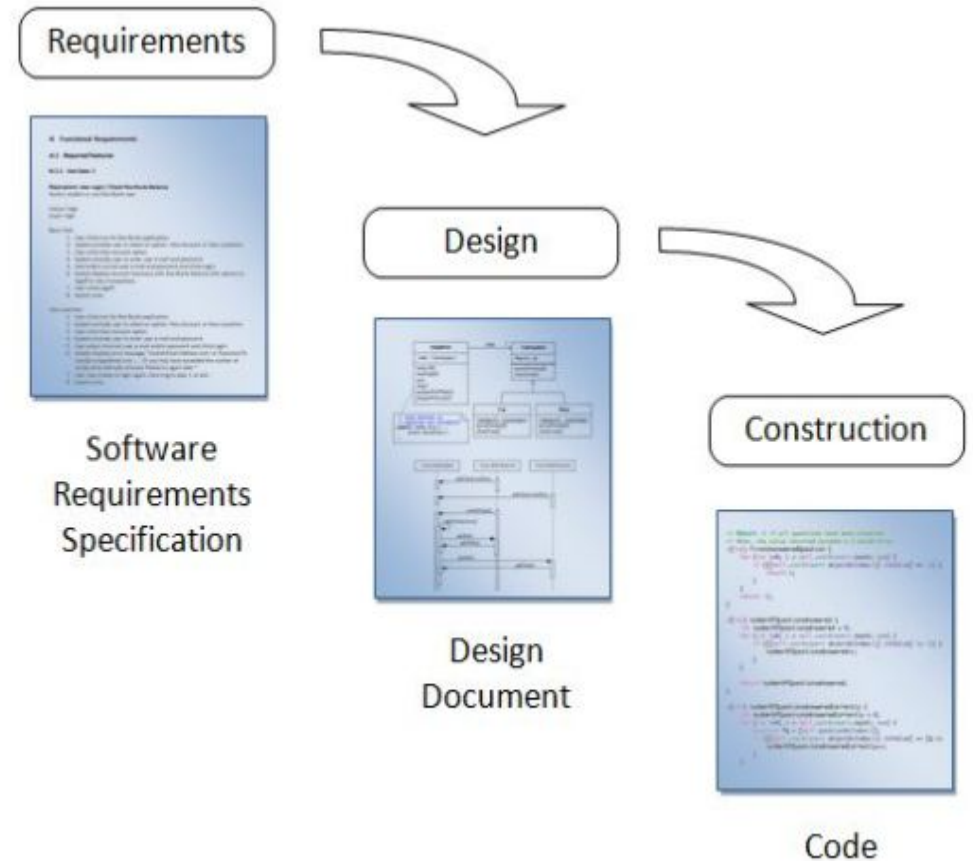
What is Software Design?

- Design bridges that gap between knowing what is needed (software requirements specification) to entering the code that makes it work (the construction phase).
- Design is both a verb and a noun.
 - -- -- Carl Steinitz



What is Software Design?

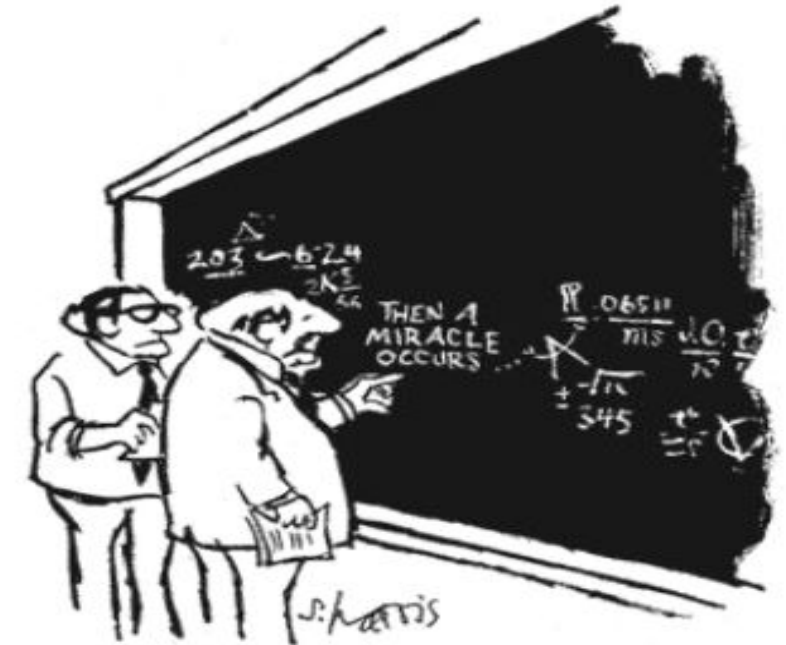
- During the design phase, software engineers **apply their knowledge of the problem domain and implementation technologies** in order to **translate system specifications** into **plans** for the technical implementation of the software
- The resulting design expresses the overall structure and organization of the planned implementation. **It captures the essence of the solution independent of any implementation language.**



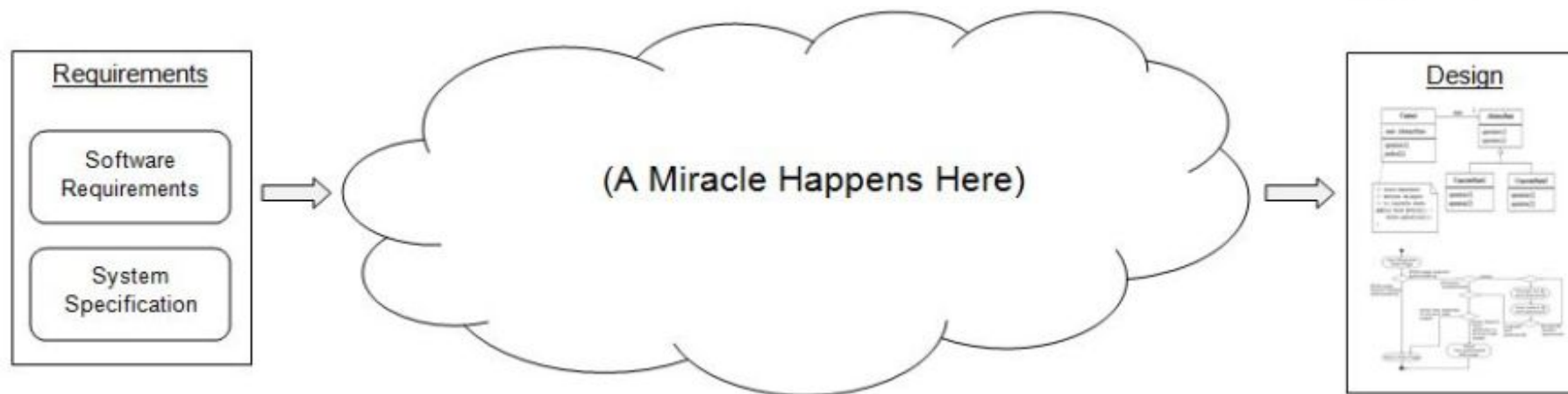
What is Software Design?

There is a famous cartoon showing two professors at a chalkboard examining a proof that includes the step “then a miracle occurs”.

At times it seems like this is the most that can be hoped for during software design.

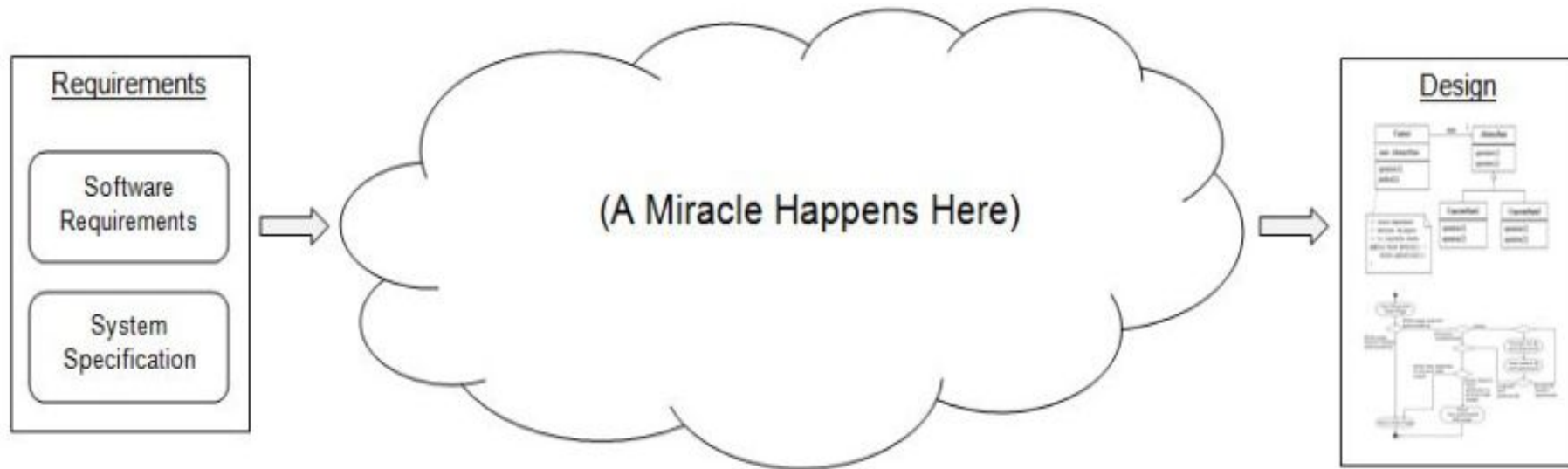


"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."



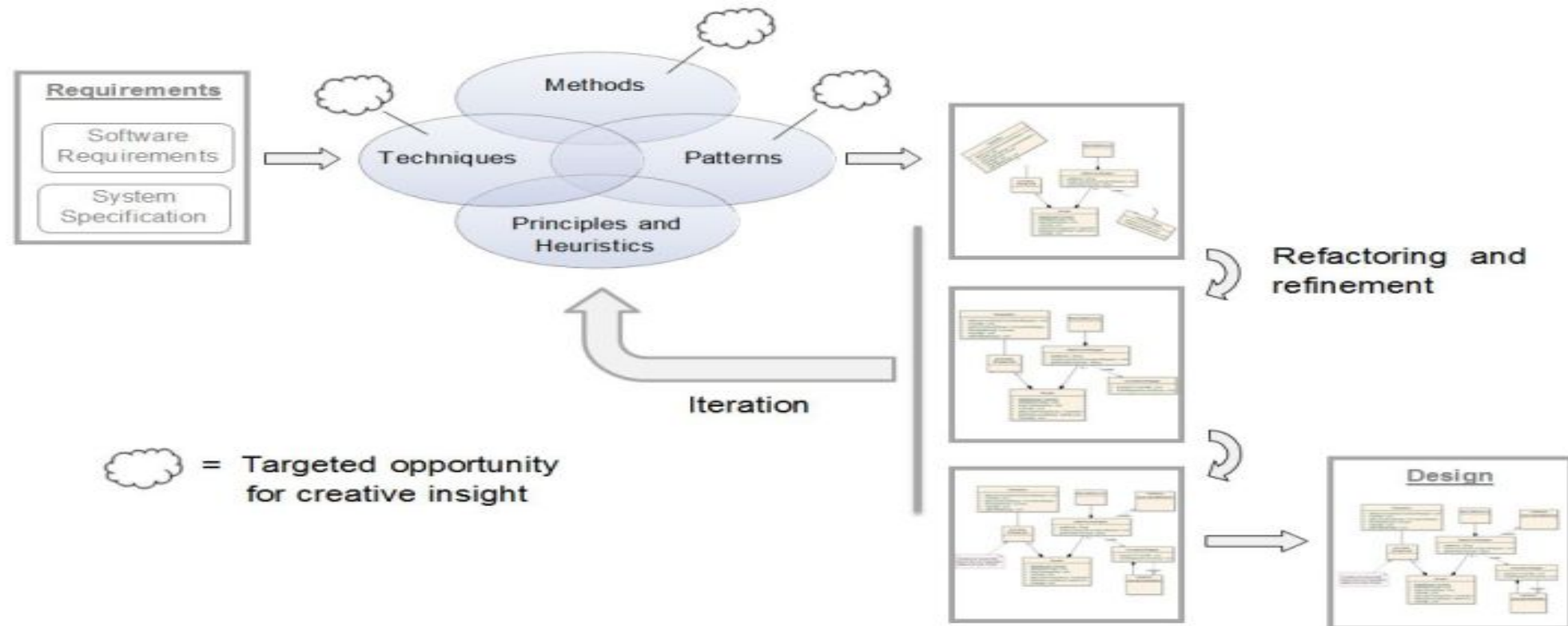
Software Design Cont'd

- Relying on miracles or exceptional ingenuity isn't a reliable (predictable or repeatable) way of arriving at a design.



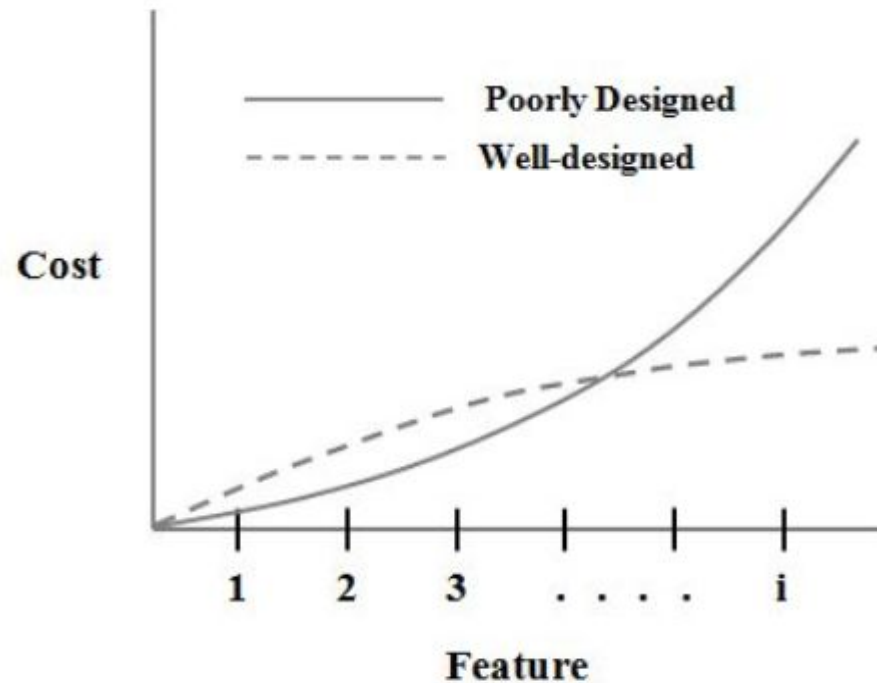
Software Design Cont'd

- The design process can be made more systematic and predictable through the application of **methods, techniques and patterns**, all applied according to **principles and heuristics**.



Importance of Managing Complexity

- Poorly designed programs are difficult to understand and modify.
- The larger the program, the more pronounced are the consequences of poor design.



- Cost of adding the i^{th} feature to a well-designed and poorly designed program

What is Software Design?

- A **specification** for construction of a software
- **Software design** is possibly a **document** that produced by a process to transform user requirements into some suitable form, which helps the programmer in software coding and implementation
- A **software architect** is a software development expert who makes high-level design choices and tries to enforce technical standards, including software coding standards, tools, and platforms.
- A software **manufacturer** can **build** software **product** from a software design.

In software engineering -

- Who are the designers?
 - Designer or Architect
- Who are the manufacturers?
 - Developer
- What is the product?
 - Software

Code as design

- Source code is the software design
- Programmers are designers
- The software itself is the product, code is NOT the product
- Compilers and linkers are manufacturers



Jack W Reeves
Author of
What is software design?
C++ journal, Fall 1992

Reeves Quotes

... programming is not about building software; programming is about **designing** software

... software designs tend to be incredibly **large** and **complex**.

... software designs are almost always **evolving**.

... design is the source code listing.

... software is **cheap** to **build**.

Software development teams also tend to be **fluid** ...

AGILE BEFORE AGILE WAS BORN

Also consider how the **process of software development is changing**. Once upon a time we had **the waterfall process**. Now we talk of spiral development and rapid prototyping. (...) **they are really just excuses to start coding earlier** in the life cycle. This is good. (...) It also means that it is more likely that the **software designers (...) are still around to do the detailed design**.

- Reeves in 1992

Validating a design

Hardware

- Structural analysis
- **Scale** modeling
- Simulation
- Prototyping and mockup
- And many more rigorous steps ...

Software

- Testing
- Debugging
- Prototyping?

More on Code As design

- Rework is accepted when coding – like in other designing process
- Layered process of designing is seen in coding
- Software design is complete when coded *and* tested
- Building the traditional design doc is easier and accurate *after* coding is done

Software Engineering Process (Partial and Simplified)



Manufacturer



Intro - SDA

```
503     message =  
504     if not hasattr(self, 'headers_buffer'):  
505         self._headers_buffer = []  
506         self._headers_buffer.append((" %s %d %s\r\n" %  
507             (self.protocol_version, code, message)).encode(  
508                 'latin-1', 'strict'))  
509  
510     def send_header(self, keyword, value):  
511         """Send a MIME header to the headers buffer."""  
512         if self.request_version != 'HTTP/0.9':  
513             if not hasattr(self, 'headers_buffer'):  
514                 self._headers_buffer = []  
515                 self._headers_buffer.append(  
516                     ("%s: %s\r\n" % (keyword, value)).encode('latin-1', 'strict'))  
517  
518             if keyword.lower() == 'connection':  
519                 if value.lower() == 'close':  
520                     self.close_connection = True  
521                 elif value.lower() == 'keep-alive':  
522                     self.close_connection = False  
523
```

11/18/2021

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COURSE OUTLINE

- Software design fundamentals
 - What is software design
 - What is a good design?
- Auxiliary designs
 - UML
 - Architectural
 - Component
 - UI
- Architecture concepts
 - Different architecture patterns (MVC, layered)
- Distributed Software Architecture
 - Load balancing
 - Distributed state management
- Service Oriented Architecture
 - Microservice
 - Microservice vs Monolith