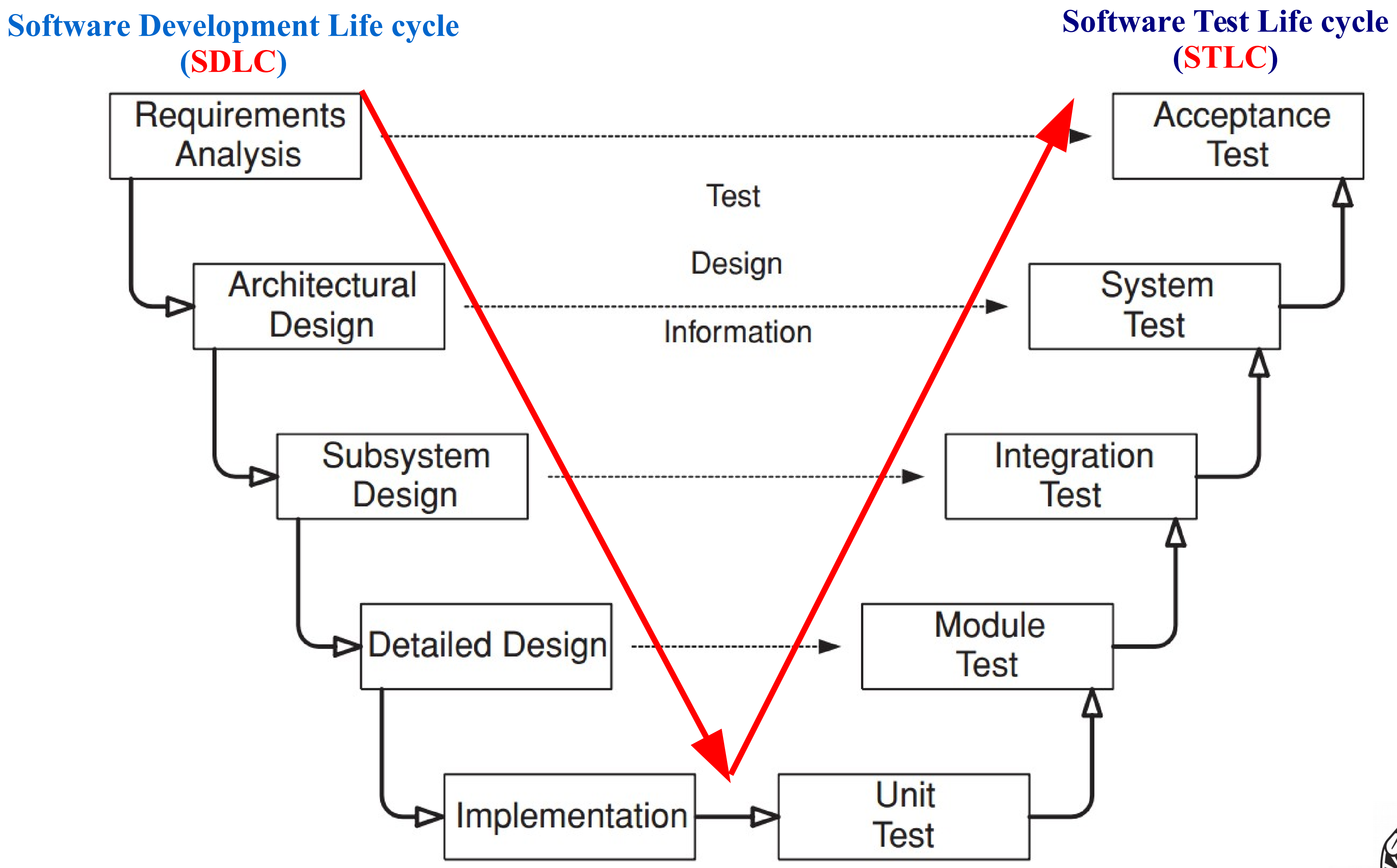
Topics for this Lecture

- Testing Granularity Levels
- The Concept of Integration Testing
- System Integration Techniques: Incremental, Top-down, Bottom-up, and Big-bang

V Model of Testing



Software development activities and testing levels- the "V Model"

Integration testing

- **Integration testing** is the combined execution of two or more modules, packages, components, or subsystems that have been created by multiple programmers or programming teams.
- This kind of testing typically starts as soon as there are two classes to test and continues until the entire system is complete.
- **Integration versus Unit Testing**
  - Integration testing focuses mainly on the interfaces and flow of data between the modules/components.
  - Unit testing tests small pieces of code, typically individual module/function, alone.
- **Challenges**:
  - How to test a partial system where not all parts exist?
    - Creating dummy programs called **Stubs** and **Drivers**.
      - **Stub**: Is called by the module under Test.
      - **Driver**: Calls the module to be tested.

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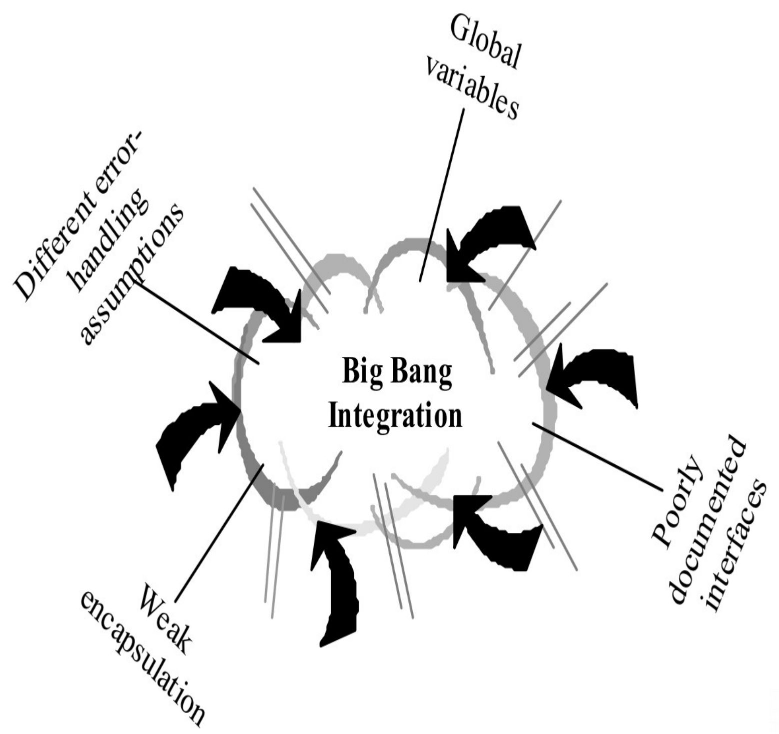
Big Bang Integration Test

- First, design, code, test, and debug each model. This step is called "unit development."
- Next, combine all those modules to construct the entire system.
- Then, test and debug the whole system.
- **Phased integration** can't begin until late in the project, after all the classes have been developer-tested.
- For small programs phased integration might be the best approach.


Global variables
Different error-handling assumptions
Big Bang Integration
Poorly documented interfaces
Weak encapsulation

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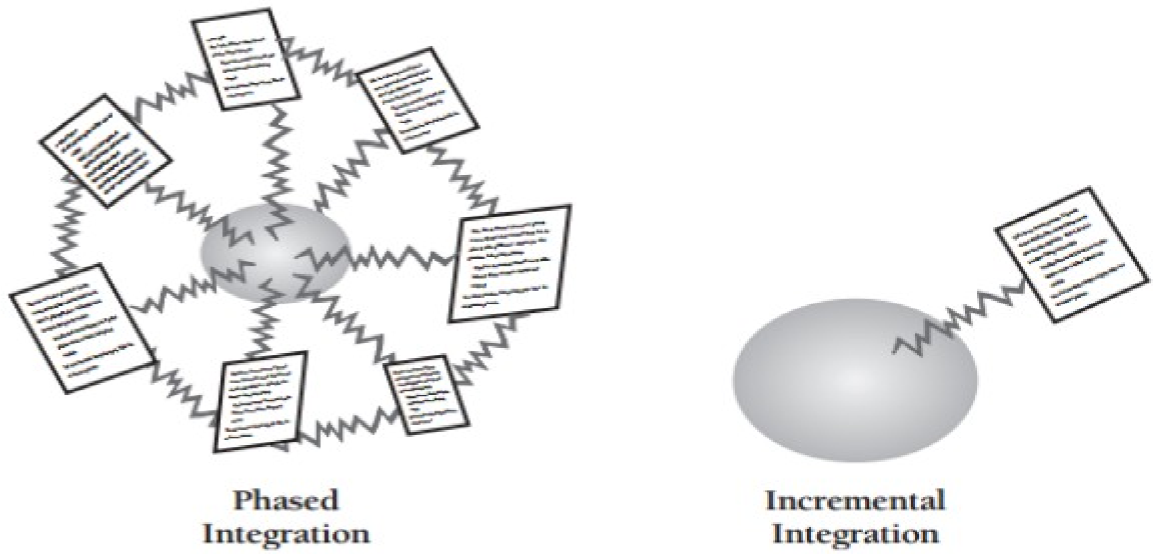
Incremental integration

- **Incremental integration**
- Develop a small, functional part of the system, which it will serve as a skeleton system
- Design, code, test, debug a small new piece
- Integrate this piece with the skeleton
- Test/debug it before adding any other pieces



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Benefits of incremental

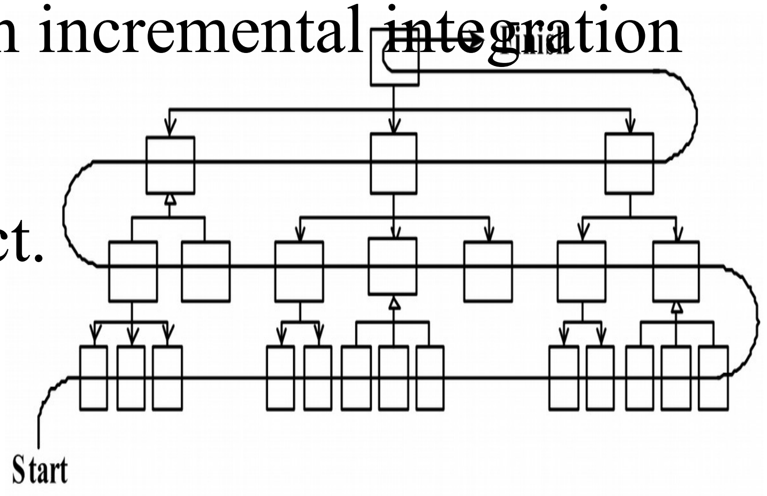
- **Advantages**:
  - Errors are easy to locate and fix
  - System is always in a (relatively) working state
  - You get improved progress monitoring
- **Drawbacks**:
  - With incremental integration, you have to plan more carefully
  - May need to create "stub" and “driver”versions of some features that have not yet been integrated

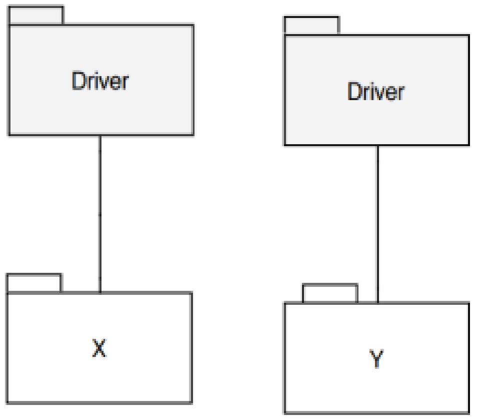
Incremental integration

- Incremental Approach is carried out by two different Methods:
  - Bottom Up Integration
  - Top Down Integration

Bottom-up integration

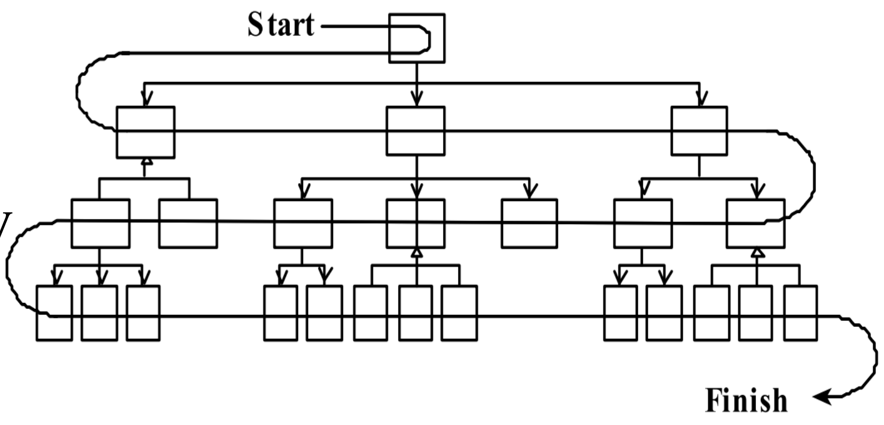
- You write and integrate the classes at the bottom of the hierarchy first.
- Adding the low-level classes one at a time rather than all at once is what makes bottom-up integration an incremental integration strategy
- Integration can start early in the project.
- The main problem with *bottom-up integration* is that it leaves integration of the major, high-level system interfaces until last.



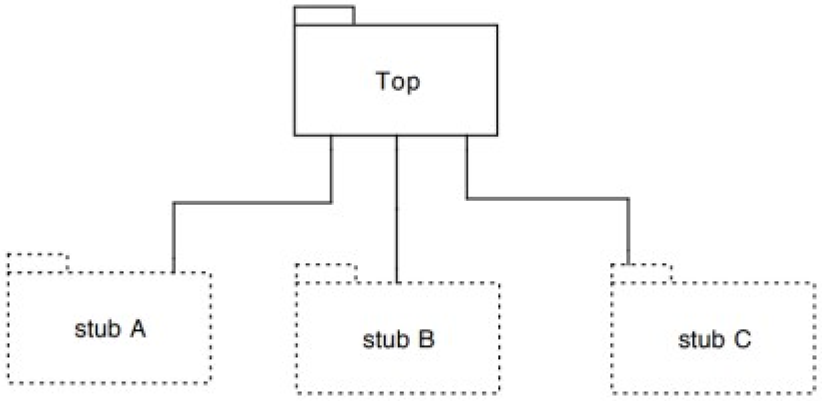


Top-down integration

- **Top down Integration Approach**: The module at the top of the hierarchy is written and integrated first



- Must write (lots of) **stub** lower modules to interact with.
- Then, as classes are integrated from the top down, stub classes are replaced with real ones
- You can complete a partially working system early in the project.



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