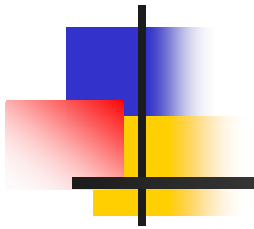
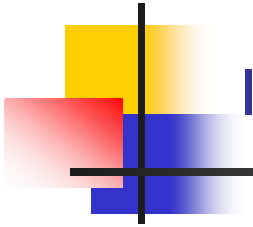


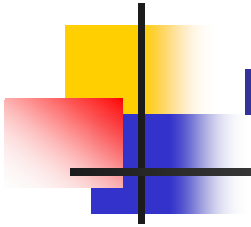
Integration Testing
Functional Decomposition Based

Chapter 13



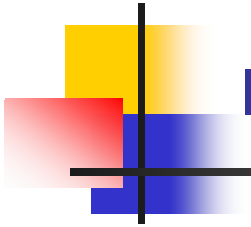
Integration Testing

- **What is integration testing?**



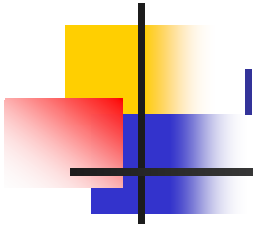
Integration Testing – 2

- **What is integration testing?**
  - **Test the interfaces and interactions among separately tested units**
  - **Three different approaches**
    - **What are they?**



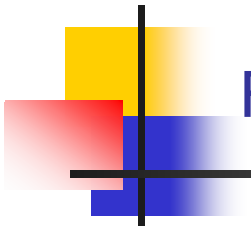
Integration Testing – 3

- **What is integration testing?**
  - **Test the interfaces and interactions among separately tested units**
  - **Three different approaches**
    - **Based on functional decomposition**
    - **Based on call graphs**
    - **Based on paths**



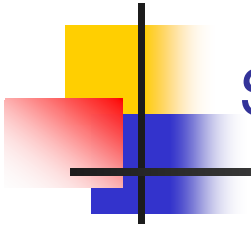
Integration Testing – 3

- **How does functional decomposition work?**



Functional Decomposition – 2

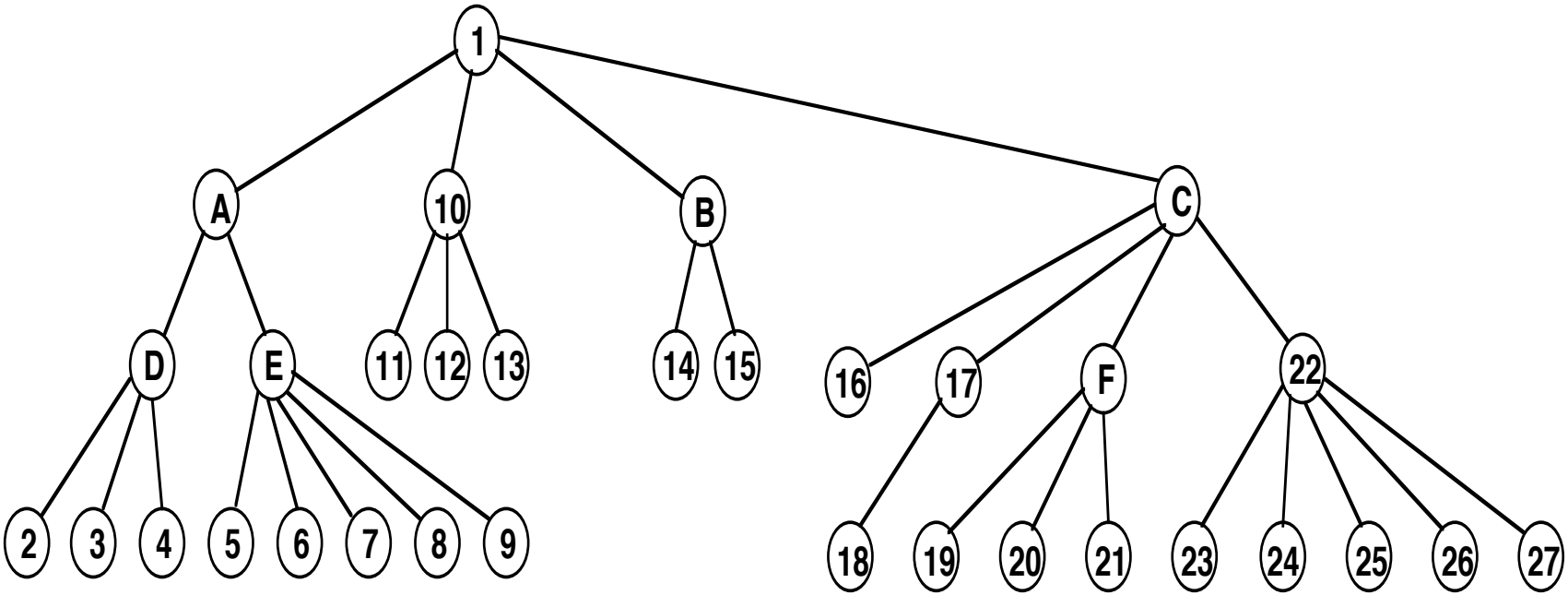
- **How does functional decomposition work?**
  - **Create a functional hierarchy for the software**
  - **Problem is broken up into independent task units, or functions**
  - **Units can be run either**
    - **Sequentially and in a synchronous call-reply manner**
    - **Or simultaneously on different processors**
  - **Used during planning, analysis and design**

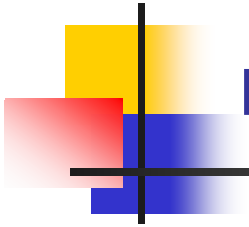


SATM Units

Unit	Level	Name
1	1	SATM system
A	1.1	Device sense & control
D	1.1.1	Door sense & control
2	1.1.1.1	Get door status
3	1.1.1.2	Control door
4	1.1.1.3	Dispense cash
E	1.1.2	Slot sense & control
5	1.1.2.1	Watch card slot
6	1.1.2.2	Get deposit slot status
7	1.1.2.3	Control card Roller
8	1.1.2.4	Control Envelope Roller
9	1.1.2.5	Read card strip
10	1.2	Central bank comm.
11	1.2.1	Get PIN for PAN
12	1.2.2	Get account status
13	1.2.3	Post daily transactions
B	1.3	Terminal sense & control
14	1.3.1	Screen door
15	1.3.2	Key sensor
C	1.4	Manage session
16	1.4.1	Validate card
17	1.4.2	Validate PIN
18	1.4.2.1	Get PIN
F	1.4.3	Close session
19	1.4.3.1	New transaction request
20	1.4.3.2	Print receipt
21	1.4.3.3	Post transaction local
22	1.4.4	Manage transaction
23	1.4.4.1	Get transaction type
24	1.4.4.2	Get account type
25	1.4.4.3	Report balance
26	1.4.4.4	Process deposit
27	1.4.4.5	Process withdrawal

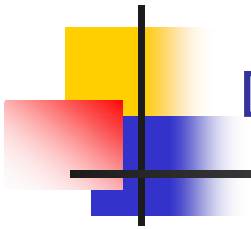
SATM functional decomposition tree





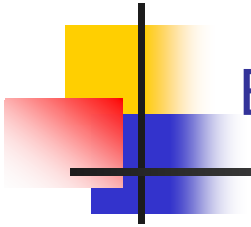
Decomposition-based integration strategies

- **What are the decomposition-based integration strategies?**



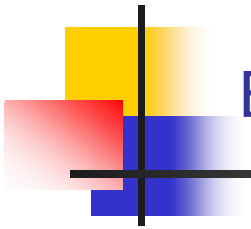
Decomposition-based integration strategies – 2

- **What are the decomposition-based integration strategies?**
  - **Top-down**
  - **Bottom-up**
  - **Sandwich**
  - **Big bang**



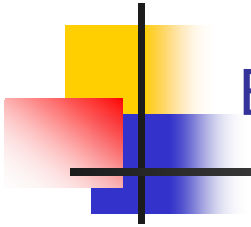
Big bang integration process

- **What is the big bang integration process?**



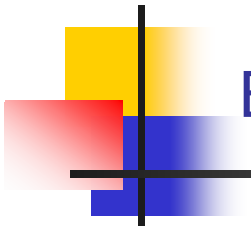
Big bang integration process – 2

- **What is the big bang integration process**
  - **All units are compiled together**
  - **All units are tested together**



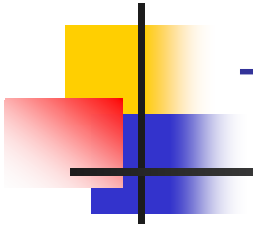
Big bang integration issues

- **What are the issues (advantages and drawbacks)?**



Big bang integration issues – 2

- **What are the issues (advantages and drawbacks)?**
  - **Failures will occur!**
  - **No clues to isolate location of faults**
  - **No stubs or drivers to write**

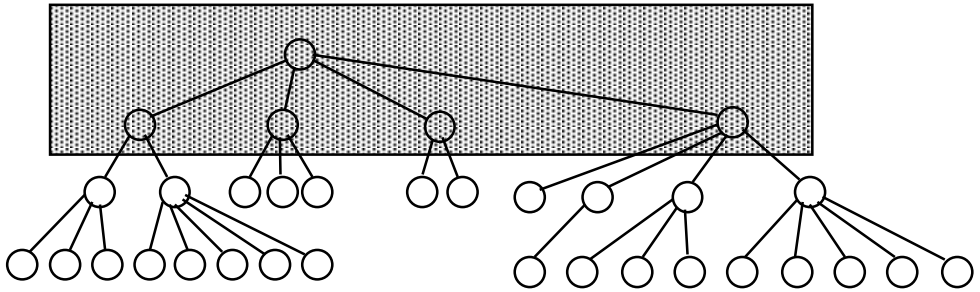


Top-down integration

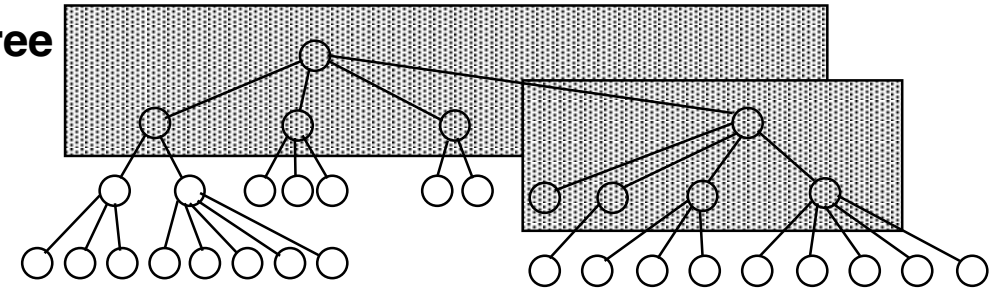
- **What is the top-down integration process?**

Top-Down integration example

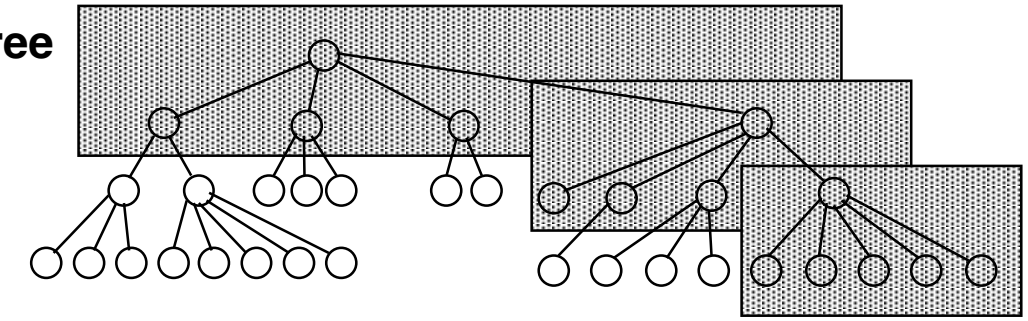
Top Subtree
Sessions 1-4

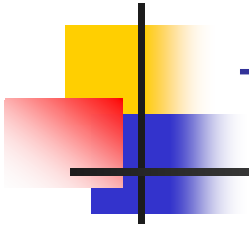


Second Level Subtree
Sessions 5-8



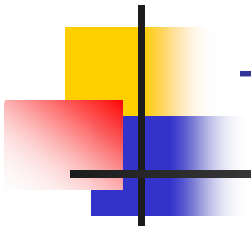
Bottom Level Subtree
Sessions 9-13





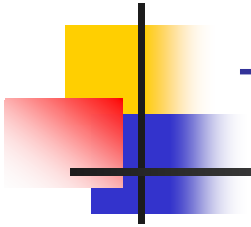
Top-Down integration process

- Strategy
  - **Focuses on testing the top layer or the controlling subsystem first**
    - **The main, or the root of the call tree**
- General process is
  - **To gradually add more subsystems that are referenced/required by the already tested subsystems when testing the application**
  - **Do this until all subsystems are incorporated into the test**



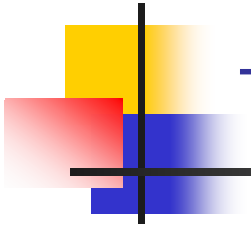
Top-Down integration process – 2

- **Stubs** are needed to do the testing
  - **A program or a method that simulates the input-output functionality of a missing subsystem by answering to the decomposition sequence of the calling subsystem and returning back simulated data**



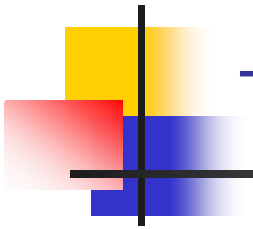
Top-Down integration issues

- **What are the issues?**



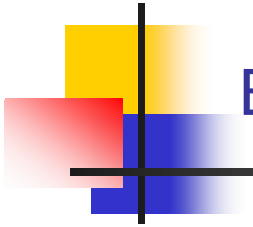
Top-Down integration issues – 2

- **What are the issues?**
  - **Writing stubs can be difficult**
    - **Especially when parameter passing is complex.**
    - **Stubs must allow all possible conditions to be tested**
  - **Possibly a very large number of stubs may be required**
    - **Especially if the lowest level of the system contains many functional units**



Top-Down integration issues – 3

- One solution to avoid too many stubs
  - **Modified top-down testing strategy**
  - **Test each layer of the system decomposition individually before merging the layers**
  - **Disadvantage of modified top-down testing**
    - **Both stubs and drivers are needed**

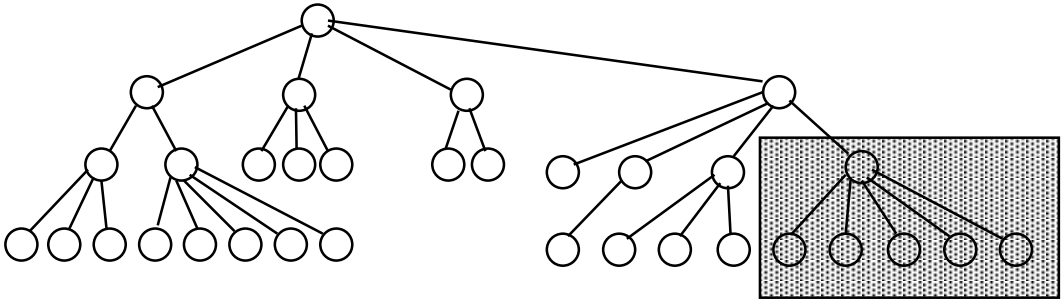


Bottom-up integration

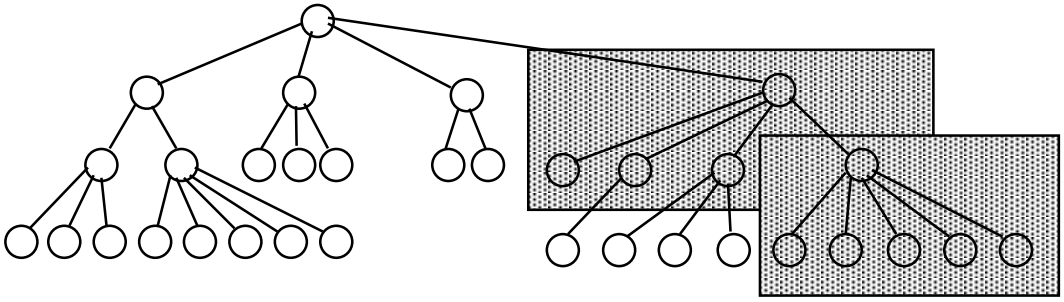
- **What is the bottom-up integration process?**

Bottom-up integration example

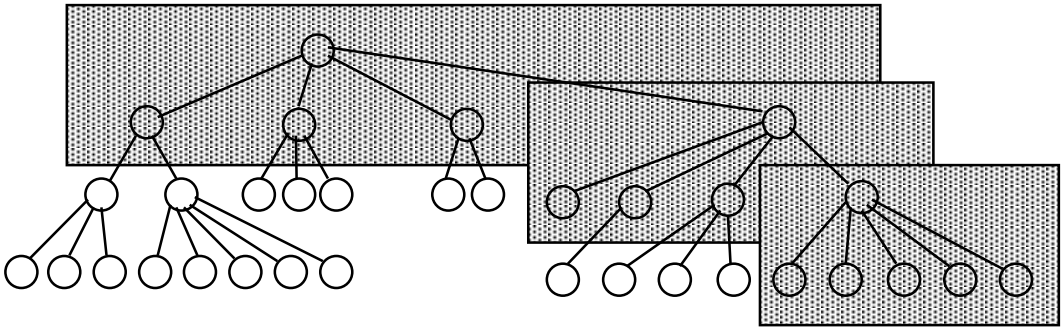
Bottom Level Subtree
Sessions 1-5

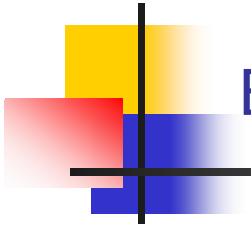


Second Level Subtree
Sessions 6-9



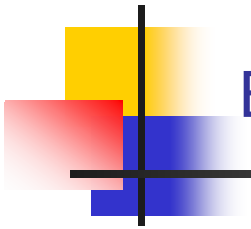
Top Subtree
Sessions 10-13





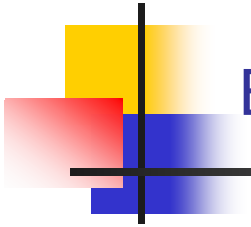
Bottom-Up integration process

- Bottom-Up integration strategy
  - **Focuses on testing the units at the lowest levels first**
  - **Gradually includes the subsystems that reference/require the previously tested subsystems**
  - **Do until all subsystems are included in the testing**



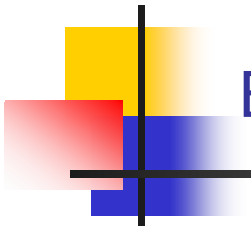
Bottom-Up integration process – 2

- **Drivers** are needed to do the testing
  - **A driver is a specialized routine that passes test cases to a subsystem**
    - **Subsystem is not everything below current root module, but a sub-tree down to the leaf level**



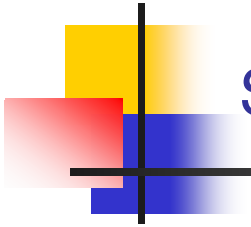
Bottom-up integration issues

- **What are the issues?**



Bottom-Up Integration Issues

- **What are the issues?**
  - **Not an optimal strategy for functionally decomposed systems**
    - **Tests the most important subsystem (user interface) last**
  - **More useful for integrating object-oriented systems**
  - **Drivers may be more complicated than stubs**
  - **Less drivers than stubs are typically required**

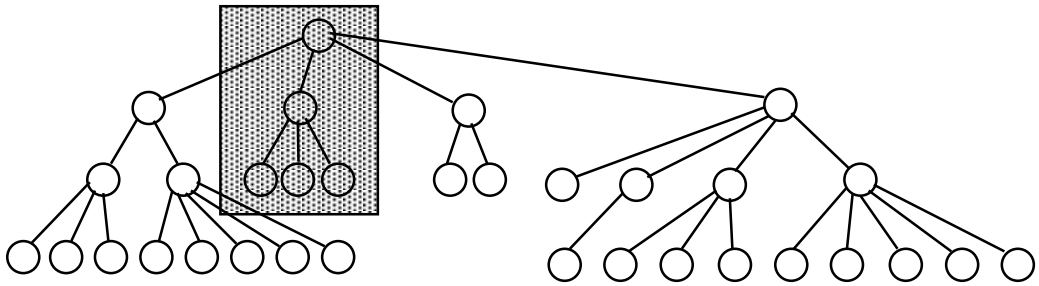


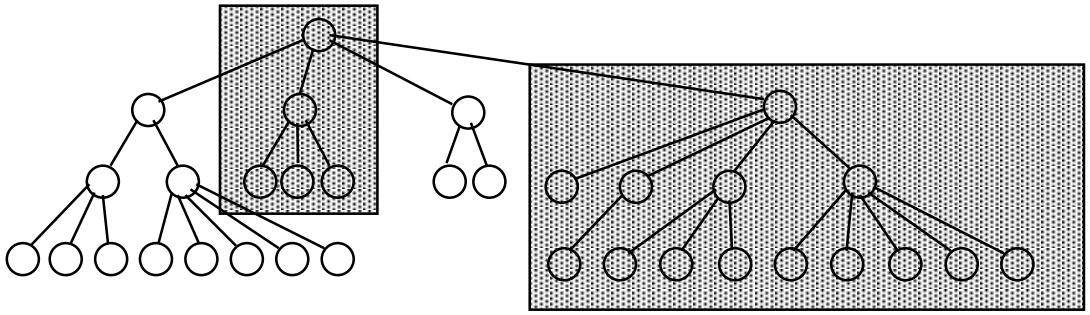
Sandwich integration

- **What is the sandwich integration process?**

Sandwich integration example

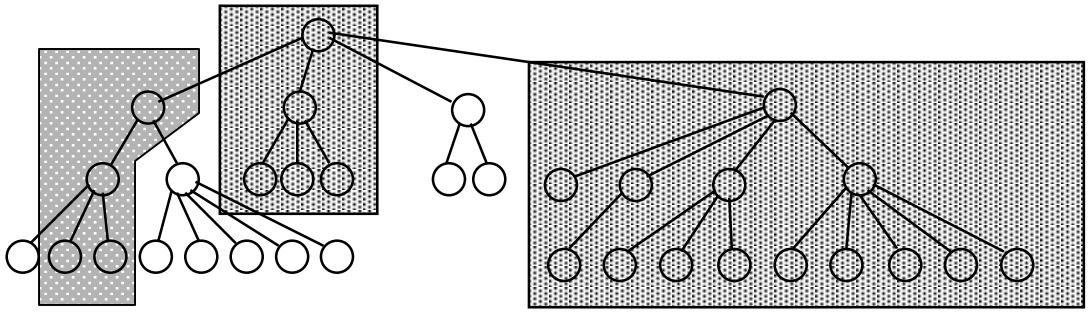
Sandwich 1
Sessions 1-3

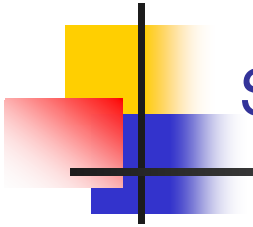




Sandwich 2
Sessions 4-13

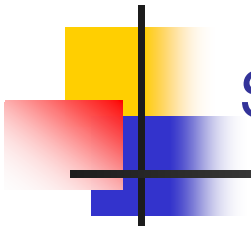
Sandwich 3
Sessions 14-15





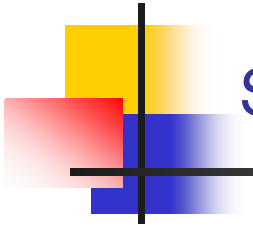
Sandwich integration process

- **What is the sandwich integration process?**
  - **Combines top-down strategy with bottom-up strategy**
    - **Doing big bang on a subtree**



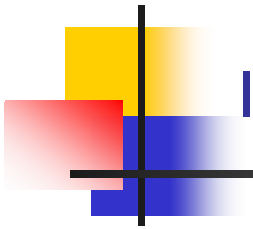
Sandwich integration issues

- **What are the issues?**



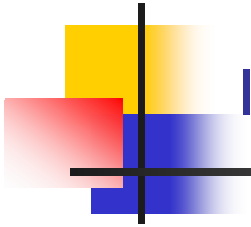
Sandwich integration issues – 2

- **What are the issues?**
  - **Less stub and driver development effort**
  - **Added difficulty in fault isolation**



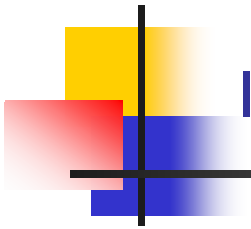
Integration test session

- For pure top down or bottom up have
  - **#sessions = #edges**
    - **Integrate one new node at a time**
    - **SATM has 42 edges, same as text's 42 sessions**



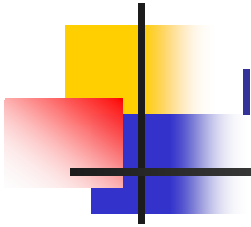
Integration test session

- Textbook
  - **A session is a test suite for a specific configuration of actual code, stubs and drivers**
  - **#sessions = #nodes – #leaves + #edges**
  - **This cannot be correct, as that would be more than the number of edges, which is impossible.**



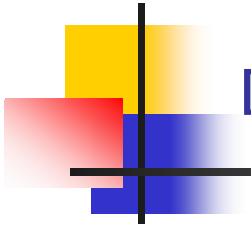
Integration work numbers

- For top-down integration
  - **#nodes – 1** **stubs are needed**
- For normal bottom-up integration
  - **#internal_nodes + 1** **drivers are needed**
    = #nodes – #leaves
    - **Internal nodes have both in and out edges**



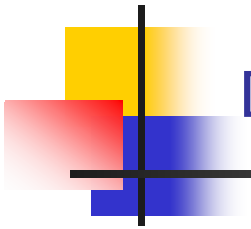
Integration work numbers

- For SATM have up to 42 integration test sessions
  - **Correspond to 42 separate sets of test cases**
- For top-down integration
  - **26 stubs are needed** **Not the 32 in the textbook**
- For normal bottom-up integration
  - **11 drivers are needed** **Not 10 in the textbook**



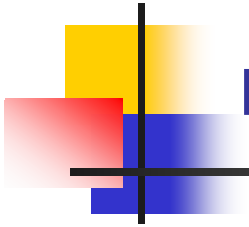
Decomposition-based drawback

- **What is the major drawback of decomposition-based integration?**



Decomposition-based drawback – 2

- **What is the major drawback of decomposition-based integration?**
  - **It is functionally based**
    - **Has the problems of all functional testing**
    - **How do we overcome the problems?**



Decomposition-based drawback – 3

- **How do we overcome the problems?**
  - **Move to structural-based testing**