The final is comprehensive, and you will be responsible for knowing everything on the midterm study guide as well as all of the material outlined here.

**ROR Analysis (see Cash Flow Analysis Handout)**
- Net Present Value (NPV)
  - What is it?
  - What is the formula for it?
    - as a function of interest rate \( i \).
    - or as a function of discount factor \( \delta \)
- Rate of Return
  - What is it?
  - How do you compute it?

**Messerschmitt Ch 5 – Client-Server Computing**
- Client-Server Architecture
- Three-Tier Client Server Architecture
- Thin Clients

**Messerschmitt Ch 6 -- Modularity and Layering**
- Modularity
- Granularity
- Hierarchy
- Interfaces – actions, parameters, and returns
- The Layering Principle
  - Layers of computing Infrastructure
    - Applications, Components, Middleware, Operating System, Networks
  - Data and Information in Layers
- Abstraction and Encapsulation

**Messerschmitt Ch 7 -- Computer and Communications Industries**
- Infrastructure and Applications
- Decomposition and Assembly (also covered in Ch 10)
- Components and Custom Development
- Interoperability
- Outsourcing
- System Integration
- Products and Services
- Stovepipe (turn-key solution) and Integrated Infrastructure
- Vertical Integration and Diversification
- Computing/Communications Convergence
- Standardization
Why are they needed?
Why do companies participate?
Reference Models and Interfaces
De Facto and De Jure Standards
Standards Bodies
Open Standards

Messerschmitt Ch 11

Messerschmitt Ch 15 -- Data Sharing
- DBMS
  - Capabilities—manage storage and processing and retrieval of information from one or more databases; maintain data integrity; access control
- Relational Database
  - Record, Field, Database Operations
- SQL

Messerschmitt Ch 9 -- Applications and the Organization
- Buy vs. Make vs. Outsource
- Application Lifecycle Model of Development

Messerschmitt Ch 10 -- Application Architecture
(Only topics that we get to on the last day of class (12/3) will be covered on the final)
- Object Oriented Programming (OOP)
- Object -- attributes, behavior
  - Method
  - Interface
  - Class
- Software Reuse – Why is it important? How does OOP help?
- Software Components
- Component Assembly tools – what do they do?
  - Visual (or Integrated Development Environment) vs. Scripting
- Software Frameworks – what do they do? examples?

Networks Reading
(some material in the slides is not in the book)
- Basic Concepts of:
  - Hosts, Routers, Links
  - What is a Packet?
  - What is Packet Switching?
  - Difference between IP Address and MAC address
  - Main idea of what a Routing Table does
  - What is Longest Prefix Match, how does it apply to routing?
  - Error Detection
    - What’s a Parity Bit
When does it work/not work
  o What is network congestion, how does it occur?
  o Congestion control
  o Flow Control
  o What is DNS – translates www.google.com to an IP Address
  o What is WWW – collection of hyperlinked resources, identified by URL’s
  o What is HTTP – protocol for connecting & getting data between a client/server

Layering of Network Architecture
- Physical Layer
- Link Layer
  - Ethernet
  - Ethernet Medium Access Control Protocol
  - Hubs and Switches
  - MAC Addresses
- Network Layer
  - Routing Table
  - Packet Forwarding
  - IP Addresses
- IP Addresses vs. MAC Addresses
- Encapsulation of IP packets within an Ethernet Frame
- Transport Protocols – TCP and UDP
- Typical Network Topologies (home, ISP, small business, large e-business, network service provider)
- Web Caching

Case Studies

*Note*: You should be able to understand the high level details from all these case studies—questions on the final will be similar to those on the midterm.

### Sun Case
- Why is the total cost of ownership (TCO) of a Windows PC much higher than the purchase price?
- What is a thin-client? Why might it have the potential to reduce the TCO?
- What are the drawbacks of having thin-client vs. a traditional fat-client?
- What selfish reasons does Sun have for advocating a thin-client model? Why does Microsoft prefer maintaining the dominance of the fat-client model?
- What is Java, and what advantages does it have over other languages?
- Since the case was written, which operating system has come to dominate the web-server market?

### MySQL
• What are the different segments of the database market? Which segment is MySQL strongest in? Which segment is the largest portion of the database market?
• Who are the three biggest suppliers of database management systems? What competitive advantages over the major DBMS suppliers does MySQL have in the Web Site data segment of the market?
• Why would large enterprises prefer to manage their mission-critical, enterprise-wide data with database software from one of the three major DBMS providers, rather than using MySQL’s product which is much cheaper?
• What is a General Public License (GPL)? Why were MySQL’s customers willing to pay for the product, when they could get the product for free under a GPL?

Akamai
• Where are the bottlenecks in the Internet according to the case study?
• What is a Content Distribution Network (CDN)? What does it provide over ordinary web Caching?
• Where did Akamai locate its servers? What barriers to entry existed for a new entrant to build a CDN to compete with Akamai?
• Did Akamai choose to market its products with a direct sales force or through distribution partners? What are the advantages of each choice?
• Why did Akamai’s marketing strategy have to change when they transitioned from the Free Flow product to the Edge Suite product?