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.

**Messerschmitt 5 – Client Server Computing**
- Client-Server Architecture
- Two-tier Client Server Architecture
- Three-Tier Client Server Architecture
- Thin Clients
- Scalability
- Peer-to-Peer (P2P)

**Messerschmitt Ch 6 -- Modularity and Layering**
- Modularity
- Granularity
- Hierarchy
- Interfaces – actions, parameters, and returns
- Data types
- Protocols
- The Layering Principle
  - Layers of computing Infrastructure
- Applications, Components, Middleware, Operating System, Networks
- Spanning Layer
- 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
- Bundled vs Unbundled Application
- Stovepipe and Integrated Infrastructure
- Vertical Integration and Diversification
- Venture Capital and Start-Ups
- 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 15 -- Data Sharing**
- DBMS
- Aggregation and sharing
- Capabilities—manage storage and processing and retrieval of information from one or more databases; maintain data integrity; access control
- Relational Database, table
  - Record, Field/Attribute, Keys
- SQL
  - Database Operations –SELECT, PROJECT, JOIN
- Markup Languages
  - XML vs. HTML
  - Uses
- Data Warehouses
  - Data warehouses vs. operational databases
  - OLAP vs. OLTP
- Data Mining (see slides)
  - Knowledge Discovery
  - Application Areas
  - Major data mining tasks

**Messerschmitt Ch 11.2 & Ch 18**
- Locating Things (Ch 11.2)
  - Names
  - Addresses
  - References
- Name services
  - Domain Name System (DNS)
- IP addresses and host names
- Hierarchy
- Routing in the Internet
  - Routers
  - Packet forwarding
  - Routing Tables
- Time Division Multiplexing
- Statistical Multiplexing
- 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
7 OSI Layers
Congestion Control vs. Flow Control
Transport Protocols – TCP and UDP
ISP, NSP, Local Loop, Telephone Company Local Office
Web Caching

Messerschmitt Ch 9 -- Applications and the Organization
- Buy vs. Make vs. Outsource
- Application Lifecycle Model of Development
  - Conceptualization
  - Analysis
  - Architecture
  - Development Evolution
  - Testing
  - Deployment
  - Operations, Maintenance, and Upgrade

Messerschmitt Ch 10 -- Application Architecture
- Decomposition vs. Assembly
- 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 vs. Scripting
- Software Frameworks – what do they do? examples?

Case Studies
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 a thin-client vs. a traditional fat-client? The advantages?
- 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?
- What is the N-tier Architecture?

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 was the open source movement? Who were part of it? In what areas? Who were threatened by it and why?
- 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?
- How did EdgeSuite differ from Akamai’s FreeFlow product?
- 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?

American Airlines (tentative)
• What do flight dispatchers do, and what information do they need to make their decisions? How did the dispatch automation package assist the flight dispatchers?
• What stages of development did the flight dispatch automation package go through?
• What were some of the benefits of good architecture and Object Oriented Programming in the context of the flight dispatch automation package?
• How did the flight dispatch automation package interact with AA's legacy systems?