

# Communications & Networking

FALL 2007

PROFESSOR A'ISHA AJAYI

**Kent State University—College of Business**

## Course Description

Class MIS 44042-001

Call # 14162

Location - BSA 213

Duration - T, TH

2:15PM - 3:30PM

Email - amajayi@kent.edu

Phone - (330) 672-1151

Office hours -

M 4:00—6:00 pm

T 1:00—2:00pm

TH 1:00—2:00pm

Other times by appointment

The evolution of technology, most notably IT and networking, have created many new opportunities and challenges for the modern enterprise.

Perhaps the chief challenge lies in the seamless integration of these technologies and application into current business practices.

This course is designed to provide the participant with a comprehensive overview of current trends in technology, applications, and international policy.

Lectures, assigned and other readings will form the backdrop for this exploration.

Students are encouraged to add to the dynamics of the course by providing addi-

tional resources such as articles or Web sites of interest.

This is your course! You will get out of it what you put into it. Time management is important.

There are no extensions for exams, assignments or other required course elements.

While attendance is not taken, it is your responsibility to get notes or other materials from your classmate should you miss classes. Good luck and enjoy the class.



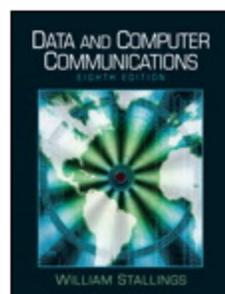
***Time management is perhaps the most important skill needed for successful completion of the course.***

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## Required Text:

### Data and Computer Communications, 8/E



**William Stallings**

Publisher: Prentice Hall  
Copyright: 2007  
Format: Paper; 896 pp

ISBN-10: 0132433109  
ISBN-13: 9780132433105



## Evaluation Criteria

		Points	Grade	Meaning of the grade
Exam 1	10%	97-100	A	Clear articulation of concepts, issues and application skills. Possesses high level content knowledge and ability to apply it to the field.
Exam 2	10%	92-96	A-	
Exam 3	10%	87-91	B+	Needs improvement in content knowledge and articulation. Sound knowledge of concepts.
		82-86	B	
Exam 4	10%	77-81	B-	
		72-76	C+	
Paper	25%	67-71	C	Lack of articulation of concepts, content knowledge or ability to apply them to the field.
		62-66	C-	
Final	35%	57-61	D+	
		52-56	D	
Total	100%	55-BELOW	F	

## Enrollment and Registration

Students have responsibility to ensure that they are properly enrolled in classes. You are advised to review your official course schedule during the first two weeks of the semester (session) to ensure that you are properly enrolled in this class and section. Should you find an error in your class schedule you must correct it immediately with your advising office. If registration errors are not corrected by the date specified by the Office of the Registrar for this session and you continue to attend and participate in classes for which you are not officially enrolled, you are advised now that you will not receive a grade at the conclusion of this semester for any class in which you are not properly enrolled.

## Students with Disabilities

In accordance with University policy, if you have a documented disability and require accommodations to obtain equal access in this course, please contact the instructor at the beginning of the semester (session) or when given an assignment for which an accommodation is required. Students with disabilities must verify their eligibility through the Office of Student Accessibility Services (SAS) in the Michael Schwartz Service Center (330) 672-3391. Hours of operation:

Monday, Thursday and Friday 8:00 a.m. - 5:00 p.m.  
 Tuesday & Wednesday 8:00 a.m. - 7:00 p.m. (during the academic year only)



## About the Paper

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A ten (10) page paper will be required as part of this course. The 10 pages are counted from introduction to conclusions.

Students are responsible for topic selection.

Required Elements:

- Headings, titles, etc.
- Introduction and conclusion
- Page numbers
- MLA or other standard citations
- Table of contents

- List of acronyms
- Bibliography
- List of figures

Please note that you must demonstrate your topic choice within the context of current business applications or environments.

The following metrics will be used to determine your grade for this element:

- |                                       |     |
|---------------------------------------|-----|
| • Technical depth and accuracy        | 20% |
| • Written communications              | 20% |
| • Organization and flow               | 20% |
| • Integration of theory and practices | 20% |
| • Execution                           | 20% |

## Exams

Four exams and a final are required as part of this course. These elements are designed to test the student's mastery of lectures, readings and theory related to the disciplines of communications and networking. The following question formats will be used on exams:

- Fill-in or short answer
- Matching
- Multiple choice
- Acronyms

Please note that the instructor will return each exam no later than 1 week from its scheduled date. The instructor will not answer any questions during the exam. No make-ups or rescheduling of the exams is permitted. A grade of 0 will be given if an exam is missed. There will be no

## From the Instructor

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Data communications and networking is a difficult subject to master in a single semester or session. Reading assigned materials prior to lectures will help increase your mastery of associated theory and practices.

Here are a few of my favorite places to help you with this material.

[www.techguide.com](http://www.techguide.com)

[www.whatis.com](http://www.whatis.com)

## Course Goals

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- To provide the participant with a comprehensive overview of current trends in information technology and applications.
- Enhanced business communications skills through written assignments and other course elements.
- To provide the participant with a template for analyzing IT requirements within an organization.
- Basic needs assessments techniques.
- Exposure to current trends in the use of IT (information Technology) in e-Commerce.



## Course Reading and Resources

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### Useful Documents

- [ASCII-IRA](#): A description of the International Reference Alphabet (IRA), also known as ASCII.
- [TCP/IP Checksum](#): Describes the error-detection calculation used by TCP, IP, and some other protocols.
- [Sampling Theorem](#): A proof of this useful theorem.
- [Sockets](#): A detailed programmer's introduction.
- [Standards Organizations](#): A review of some important standards-making organizations, including IETF, ITU, ISO, IEEE 802, and ATM Forum.
- [URL/URI](#): Describes Uniform Resource Locators and Uniform Resource Identifiers.
- [Augmented BNF](#): Described the formal language used in a number of RFCs. It is used to define the format of RFC 822 email messages, Web addresses, and other specifications.
- [Derivations](#): In a number of places in the book, I skip some steps in deriving a result. More detailed derivations are provided here.



## Useful Web Sites

 [Computer Science Student Resource Site](#): Help and advice for the long-suffering, overworked student.

 [Errata sheet](#): Latest list of errors, updated at most monthly. File name is Errata-DCC7e-mmyy. If you spot any errors, please email them to [ws@shore.net](mailto:ws@shore.net).

 [cnet Simulator](#): Developed by Professor Chris McDonald at the University of Western Australia. The *cnet* network simulator allows experimentation with various data link layer, network layer, routing and transport layer protocols, and with various network configurations.

 [Tools Page](#): Developed by Professor Kenneth Christensen at the University of South Florida. The *tools page* contains download tools primarily related to performance evaluation of computer networks and to TCP/IP sockets programming.

 [Projects Manual](#): This manual, developed by Prentice Hall, contains over 40 exercises that are suitable for use with Data and Computer Communications. It is available at a discount for courses using this textbook.

 [Standards](#): Variety of information on standards and standards bodies, provided by the IEEE Standards in Education Task Force.

**NEW**

 [Data Link Simulator](#): Developed by Peter King at Heriot-Watt University, Edinburgh. This tool enables students to write code for oriented data link protocols in Java and have them tested on a simulated communication channel.

 [Animation of Computer Networking Concepts](#): Provides a Web-based introduction to computer networks for non-CS majors. Although elementary, it provides a useful feel for some key concepts.

 On-line Simulation: Ann Burroughs, an Associate Professor at Humboldt State University has created two simulations that allow you to visualize some of the concepts in the book. They require ShockWave plug-ins and a reasonably up-to-date browser.

[Sliding Window](#) (377 kilobytes)

[Encapsulation](#) (25 kilobytes)

## Chapter 0 - Reader's Guide

 [Network World](#): Information and links to resources about data communications and networking.

 [IETF Directory and Database](#): Maintains archives that relate to the Internet and IETF activities. Includes keyword-indexed library of RFCs and draft documents as well as many other documents related to the Internet and related protocols.

 [Vendors](#): Links to thousands of hardware and software vendors who currently have WWW sites, as well as a list of thousands of computer and networking companies in a Phone Directory.

 [IEEE Communications Society](#): Good way to keep up on conferences, publications, etc. Has an on-line copy of my article on IPv6, which updates material in the book.

 [ACM Special Interest Group on Communications \(SIGCOMM\)](#): Good way to keep up on conferences, publications, etc.

 [International Telecommunications Union](#): Contains a listing of ITU-T Recommendations, plus information on obtaining ITU-T documents in hard copy or on DVD.

 [International Organization for Standardization](#): Contains a listing of ISO Standards, plus information on obtaining ISO documents in hard copy or on CD-ROM.

 [CommsDesign](#): Lot of useful articles, tutorials, and product information. A bit hard to navigate, but worthwhile.

## Chapter 2 - Protocol Architecture

- [TCP/IP Resources List](#): A useful collection of FAQs, tutorials, guides, Web sites, and books about TCP/IP
- [Networking Links](#): Excellent collection of links related to TCP/IP.
- [The Bongo Project](#): Running IP over bongo drums. An excellent demonstration of the flexibility of a layered protocol architecture and a source of ideas for projects.
- [OSI History](#): A brief history of the origins of the OSI model.

## Chapter 3 - Data Transmission

- [Fourier Series Synthesis](#): An excellent visualization tool for Fourier series.
- [Johns Hopkins Signals Demonstrations](#): Another source of visualization tools.
- [Math and Physics Applets](#): Yet another source of visualization tools.

## Chapter 4 - Transmission Media

- [Wireless Developer Network](#): News, tutorials, and discussions on wireless topics
- [Siemon Company](#): Good collection of technical articles on cabling, plus information about cabling standards.
- [About Antennas](#): Good source of information and links.
- [U.S. Frequency Allocation Chart](#): Chart plus background paper.

## Chapter 5 - Encoding and Signaling

## Chapter 6 - Digital Data Communications Techniques

## Chapter 7 - Flow Control

## Chapter 8 - Multiplexing

- [DSL Forum](#): Includes a FAQ and technical information about ADSL and other xDSL technology. Forum specifications.
- [Network and Services Integration Forum](#): Discusses current SONET products, technology, and standards.
- [SONET Home Page](#): Useful links, tutorials, white pages, FAQs.

## Chapter 9 - Spread Spectrum

- [Spread Spectrum Scene](#): Excellent source of information, including technical papers, links, and an online magazine.

## Chapter 10 - Circuit Switching and Packet Switching

- [Frame Relay Resource Center](#): Good source of information on frame relay.
- [Frame Relay Resource](#): Good source of tutorials, service providers, and other links.

## Chapter 11 - ATM

- [ATM Hot Links](#): Excellent collection of white papers and links.
- [MFA Forum](#): An industry forum to promote MPLS, frame relay, and ATM. Contains documents, vendor information,

and links.

 [Cell Relay Retreat](#): Contains archives of the cell-relay mailing list, links to numerous ATM-related documents, and links to many ATM-related web sites.

## Chapter 12 - Routing

## Chapter 13 - Traffic Management

## Chapter 14 - Cellular Wireless Networks

 [CDMA Development Group](#): A consortium of wireless companies active in CDMA wireless systems around the world.

 [Cellular Telecommunications and Internet Association](#): Another industry consortium.

 [3G Americas](#): A trade group of Western Hemisphere companies supporting TDMA, GSM, GPRS, EDGE, and UMTS. Includes industry news, white papers, and other technical information.

## Chapter 15 - LAN Overview

 [IEEE 802 LAN/MAN Standards Committee](#): Status and documents on all of the working groups.

## Chapter 16 - High-Speed LANs

 [Ethernet](#): Provides general Ethernet information, technical specifications, an Ethernet reading list, and an image of inventor Robert Metcalf's original 1976 Ethernet drawing.

 [IEEE 802.3 10 Gbps Ethernet Task Force](#): This group is developing a 10-Gbps Ethernet standard. The Web site includes an email archive and the documentation developed so far.

 [Fibre Channel Industry Association](#): An industry consortium.

 [Storage Network Industry Association](#): An industry forum of developers, integrators, and IT professionals who evolve and promote storage networking technology and solutions

 [CERN Fibre Channel homepage](#): Good source of info on Fibre Channel technology, products, etc.

 [LAN Interoperability Lab](#): University of New Hampshire (equipment testing for ATM, FDDI, Fast Ethernet, FDSE, Ethernet, OSPF, Network Management (SNMP), Token Ring, VG-AnyLAN).

## Chapter 17 - Wireless LANs

 [Wi-Fi Alliance](#): An industry group promoting the interoperability of 802.11 products with each other and with Ethernet.

 [IEEE 802.11 Wireless LAN Working Group](#): Contains working group documents plus discussion archives.

 [Wireless LAN Association](#): Gives an introduction to the technology, including a discussion of implementation considerations, and case studies from users. Links to related sites.

## Chapter 18 - Internet Protocols

 [IPv6](#): Contains information about IPv6 and related topics.

 [IPv6 Forum](#): An industry consortium that promotes IPv6-related products. Includes a number of white papers and articles.

 [IPv6 Working Group](#): Chartered by IETF to develop standards related to IPv6. The Web site includes all relevant RFCs and Internet drafts.

## Chapter 19 - Internetwork Operation

- [RSVP Project](#): Home page for RSVP development.
- [IP Performance Metrics Working Group](#): Chartered by IETF to develop a set of standard metrics that can be applied to the quality, performance, and reliability of Internet data delivery services. The web site includes all relevant RFCs and Internet drafts.
- [Inter-Domain Routing Working Group](#): Chartered by IETF to revise BGP and related standards. The web site includes all relevant RFCs and Internet drafts.
- [OSPF Working Group](#): Chartered by IETF to develop OSPF and related standards. The web site includes all relevant RFCs and Internet drafts.

## Chapter 20 -Transport Protocols

- [Center for Internet Research](#): One of the most active groups in the areas covered in this chapter. The site contains many papers and useful pointers.
- [TCP-Friendly Website](#): Summarizes some of the recent work on adaptive congestion control algorithms for non-TCP based applications, with a specific focus on schemes that share bandwidth fairly with TCP connections.
- [TCP Maintenance Working Group](#): Chartered by IETF to make minor revisions to TCP and to update congestion strategies and protocols. The web site includes all relevant RFCs and Internet drafts.

## Chapter 21 - Network Security

- [COAST](#): Comprehensive set of links to sites related to cryptography and network security.
- [IETF Security Area](#): Provides up-to-date information on Internet security standardization efforts.
- [The Cryptography FAQ](#): Lengthy and worthwhile FAQ covering all aspects of cryptography.
- [Tom Dunigan's Security Page](#): An excellent list of pointers to cryptography and network security web sites.
- [IEEE Technical Committee on Security and Privacy](#): An excellent list of pointers to cryptography and network security web sites.

## Chapter 22 - Distributed Applications

- [SMTP/MIME RFCs](#): A complete list, maintained by IETF.
- [Simple Web Site](#): Maintained by the University of Twente. It is a good source of information on SNMP, including pointers to many public-domain implementations and lists of books and articles.
- [World Wide Web Consortium](#): Contains up-to-date information on HTTP, HTML, and URLs.

## Appendix A - RFCs

- [RFCs](#): IETF RFC repository. Includes a [complete list](#) of all RFCs, constantly updated.

## Appendix C - Sockets Programming

- [Windows Sockets Development Information](#): A guide to users of WinSock, including sample source code and links to other pages.
- [UNIX Socket FAQ](#): Good list of questions and answers.
- [Beej's Guide to Network Programming](#): Using Sockets..
- [Windows Sockets: A Quick and Dirty Primer](#): By Jim Frost.

## Course Schedule

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### WEEK 1

1. Data Communications, Data Networking, and the Internet
    - 1.1 Data Communications and Networking for Today's Enterprise
    - 1.2 A Communications Model
    - 1.3 Data Communications
    - 1.4 Networks
    - 1.5 The Internet
    - 1.6 An Example Configuration
  2. Protocol Architecture, TCP/IP, and Internet-Based Applications
    - 2.1 The Need for a Protocol Architecture
    - 2.2 A Simple Protocol Architecture
    - 2.3 The TCP/IP Protocol Architecture
    - 2.4 The OSI Model
    - 2.5 Standardization within a Protocol Architecture
    - 2.6 Traditional Internet-Based Applications
    - 2.7 Multimedia
    - 2.8 Recommended Reading and Web Sites
    - 2.9 Key Terms, Review Questions, and Problems
- Appendix 2A The Trivial File Transfer Protocol

### WEEK 2

3. Data Transmission
    - 3.1 Concepts and Terminology
    - 3.2 Analog and Digital Data Transmission
    - 3.3 Transmission Impairments
    - 3.4 Channel Capacity
    - 3.5 Recommended Reading and Web Site
    - 3.6 Key Terms, Review Questions, and Problems
- Appendix 3A Decibels and Signal Strength
4. Guided and Wireless Transmission
    - 4.1 Guided Transmission Media
    - 4.2 Wireless Transmission
    - 4.3 Wireless Propagation
    - 4.4 Line-of-Sight Transmission
    - 4.5 Recommended Reading and Web Sites
    - 4.6 Key Terms, Review Questions, and Problems

### WEEK 3

5. Signal Encoding Techniques
  - 5.1 Digital Data, Digital Signals
  - 5.2 Digital Data, Analog Signals
  - 5.3 Analog Data, Digital Signals
  - 5.4 Analog Data, Analog Signals
  - 5.5 Recommended Reading
  - 5.6 Key Terms, Review Questions, and Problems
6. Digital Data Communication Techniques
  - 6.1 Asynchronous and Synchronous Transmission
  - 6.2 Types of Errors
  - 6.3 Error Detection
  - 6.4 Error Correction
  - 6.5 Line Configurations

- 6.6 Recommended Reading
- 6.7 Key Terms, Review Questions, and Problems

#### WEEK 4

- 7. Data Link Control
  - 7.1 Flow Control
  - 7.2 Error Control
  - 7.3 High-Level Data Link Control (HDLC)
  - 7.4 Recommended Reading
  - 7.5 Key Terms, Review Questions, and Problems
- Appendix 7A Performance Issues

- 8. Multiplexing
  - 8.1 Frequency-Division Multiplexing
  - 8.2 Synchronous Time-Division Multiplexing
  - 8.3 Statistical Time-Division Multiplexing
  - 8.4 Asymmetric Digital Subscriber Line
  - 8.5 xDSL
  - 8.6 Recommended Reading and Web Sites
  - 8.7 Key Terms, Review Questions, and Problems

#### WEEK 5

- 9. Spread Spectrum
  - 9.1 The Concept of Spread Spectrum
  - 9.2 Frequency Hopping Spread Spectrum
  - 9.3 Direct Sequence Spread Spectrum
  - 9.4 Code-Division Multiple Access
  - 9.5 Recommended Reading and Web Site
  - 9.6 Key Terms, Review Questions, and Problems

- 10. Circuit Switching and Packet Switching
  - 10.1 Switched Communications Networks
  - 10.2 Circuit Switching Networks
  - 10.3 Circuit Switching Concepts
  - 10.4 Softswitch Architecture
  - 10.5 Packet-Switching Principles
  - 10.6 X.25
  - 10.7 Frame Relay
  - 10.8 Recommended Reading and Web Sites
  - 10.9 Key Terms, Review Questions, and Problems

#### WEEK 6

- 11. Asynchronous Transfer Mode
  - 11.1 Protocol Architecture
  - 11.2 ATM Logical Connections
  - 11.3 ATM Cells
  - 11.4 Transmission of ATM Cells
  - 11.5 ATM Service Categories
  - 11.6 ATM Adaptation Layer
  - 11.8 Recommended Reading and Web Sites
  - 11.9 Key Terms, Review Questions, and Problems

- 12. Routing in Switched Networks
  - 12.1 Routing in Packet-Switching Networks
  - 12.2 Examples: Routing in ARPANET
  - 12.3 Least-Cost Algorithms
  - 12.4 Recommended Reading
  - 12.5 Key Terms, Review Questions, and Problems

#### WEEK 7

- 13. Congestion Control in Switched Data Networks
  - 13.1 Effects of Congestion
  - 13.2 Congestion Control

- 13.3 Traffic Management
- 13.4 Congestion Control in Packet-Switching Networks
- 13.5 Frame Relay Congestion Control
- 13.6 ATM Traffic Management
- 13.7 ATM-GFR Traffic Management
- 13.8 Recommended Reading
- 13.9 Key Terms, Review Questions, and Problems

- 14. Cellular Wireless Networks
  - 14.1 Principles of Cellular Networks
  - 14.2 First Generation Analog
  - 14.3 Second Generation CDMA
  - 14.4 Third Generation Systems
  - 14.5 Recommended Reading and Web Sites
  - 14.6 Key Terms, Review Questions, and Problems

## WEEK 8

- 15. Local Area Network Overview
  - 15.1 Background
  - 15.2 Topologies and Transmission Media
  - 15.3 LAN Protocol Architecture
  - 15.4 Bridges
  - 15.5 Layer 2 and Layer 3 Switches
  - 15.6 Recommended Reading and Web Sites
  - 15.7 Key Terms, Review Questions, and Problems

- 16. High-Speed LANs
  - 16.1 The Emergence of High-Speed LANs
  - 16.2 Ethernet
  - 16.3 Fibre Channel
  - 16.4 Recommended Reading and Web Sites
  - 16.5 Key Terms, Review Questions, and Problems
- Appendix 16A Digital Signal Encoding for LANs
- Appendix 16B Performance Issues
- Appendix 16C Scrambling

## WEEK 9

- 17. Wireless LANs
  - 17.1 Overview
  - 17.2 Wireless LAN Technology
  - 17.3 IEEE 802.11 Architecture and Services
  - 17.4 IEEE 802.11 Medium Access Control
  - 17.5 IEEE 802.11 Physical Layer
  - 17.6 IEEE 802.11 Security Considerations
  - 17.7 Recommended Reading and Web Sites
  - 17.8 Key Terms, Review Questions, and Problems

- 18. Internetwork Protocols
  - 18.1 Basic Protocol Functions
  - 18.2 Principles of Internetworking
  - 18.3 Internet Protocol Operation
  - 18.4 Internet Protocol
  - 18.5 IPv6
  - 18.6 Recommended Reading and Web Sites
  - 18.7 Key Terms, Review Questions, and Problems

## WEEK 10

- 19. Internetwork Operation
  - 19.1 Multicasting
  - 19.2 Routing Protocols
  - 19.3 Integrated Services Architecture
  - 19.4 Differentiated Services
  - 19.5 Recommended Reading and Web Sites
  - 19.6 Key Terms, Review Questions, and Problems

- 20. Transport Protocols
- 20.1 Connection-Oriented Transport Protocol Mechanisms
- 20.2 TCP
- 20.3 TCP Congestion Control
- 20.4 UDP
- 20.5 Recommended Reading
- 20.6 Key Terms, Review Questions, and Problems

#### WEEK 11

- 21. Network Security
- 21.1 Security Requirements and Attacks
- 21.2 Confidentiality with Conventional Encryption
- 21.3 Message Authentication and Hash Functions
- 21.4 Public-Key Encryption and Digital Signatures
- 21.5 Secure Socket Layer and Transport Layer Security
- 21.6 IPv4 and IPv6 Security
- 21.7 Recommended Reading and Web Sites
- 21.8 Key Terms, Review Questions, and Problems

#### WEEK 12

- 22. Internet Applications - Electronic Mail and Network Management
- 22.1 Electronic Mail: SMTP and MIME
- 22.2 Network Management: SNMP
- 22.3 Recommended Reading and Web Sites
- 22.4 Key Terms, Review Questions, and Problems

#### WEEK 13

- 23. Internet Applications - Internet Directory Service and World Wide Web
- 23.1 Uniform Resource Locators (URLs) and Uniform Resource Identifiers (URIs)
- 23.2 Internet Directory Service: DNS
- 23.3 Web Access: HTTP

- 24. Internet Applications - Multimedia
- 24.1 Digital Audio and Video
- 24.2 Audio and Video Compression
- 24.3 Streaming Audio and Video
- 24.4 Voice Over IP
- 24.5 Session Initiation Protocol
- 24.6 Real-Time Transport Protocol

## Important Dates:

Exam 1	Chapters 1 - 5	9/18/07
Exam 2	Chapters 6 - 12	10/9/07
Exam 3	Chapters 13 - 18	10/30/07
Exam 4	Chapters 19 - 24	11/27/07
Paper Due		11/13/07
Final Exam		12/10 - 16/07

### Staying in Touch

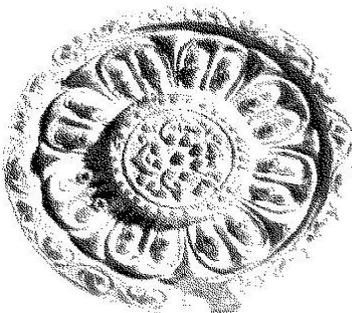


A'isha Ajayi  
BSA A419

Phone: (330) 672-1151  
e-mail: [amajayi@kent.edu](mailto:amajayi@kent.edu)

## Ethics and Academic Honesty

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You are encouraged to work together and help one another learn the material, but all submissions must be your own unique work (or those of your team for team projects). Cheating, plagiarism, copying and other behavior that is contrary to University standards will not be tolerated.

Any students found guilty of such offenses will be given a grade of "F" as a final grade. Additional penalties may be imposed; these will be determined on a case-by-case basis. Any student aiding another student will be considered to be an accessory and will be subject to the same penalties.