

SANTA CLARA UNIVERSITY
Department of Computer Engineering

COEN 001

Final Exam

Fall 2002

Read the ENTIRE exam first and do the definitions/problems you know first, then return to the problems with which you are less familiar. You will have 3 hours to do as much as you can.

Please provide a definition of the following terms in your own words in the space provided. Each definition is worth 5 points.

analog data	D1
<p>The representation of information which can take on an infinitely-fine range of values. Examples of analog data are the phonograph, camera, television, tape player, radio, or thermostat.</p>	

digital data	D2
<p>This is a representation of information which can take on only a specific set of values, and whose values exist only at specific time instants. Examples of systems using digital data are the computer, the internet, a CD player, and digital clocks.</p>	

bit	D3
<p>The fundamental element of digital information systems. A single bit can represent 2 values, 1/0, true/false...</p>	

byte	D4
<p>A byte is a logical grouping of 8 bits.</p>	

Pixel	D5
<p>The basic unit of pictorial representation in digital systems. A picture element. It can be as small as 1 bit (black and white) or several bytes long in the case of color pictures.</p>	

The Hyper-TextMarkup Language (HTML)	D6
<p>HTML is a simple and universal language used for formatting, embedding graphics, and hyper textual linking of documents. It is the means by which web documents are represented (“the language of the web”). It allows users to share and browse information using a widely accepted protocol.</p>	

The Universal Resource Locator (URL)	D7
<p>The URL is the universal addressing mechanism for the World Wide Web. It denotes 1. an information service, 2. the location of the hosting server within the Internet, 3. the location of that information within the host, and 4. the document type.</p>	

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Protocol

D8

An agreed upon sets of rules providing order to different systems and situations. There are different protocols for different purposes. There are protocols for data storage, data transmission, etc.

Transducer

D9

An input transducer is a device that converts a physical signal from a source to an electrical, electromagnetic, or mechanical signal that is more suitable for communicating. An output transducer is a device that converts a received signal back into a useful physical quantity.

bit mapped graphics

D10

An image representation technique utilizing regularly arranged spatially separated pixels

vector graphics

D11

An image representation technique utilizing mathematical descriptions of objects contained in the image. The computer is able to redraw the image for viewing.

variable length coding of graphic images

D12

A coding technique wherein different numbers of bits are used to represent different characters based on their frequency of occurrence. Characters that appear more often have fewer bits in their code and characters not appearing as frequently have more bits in their code. The codes must be uniquely identifiable regardless of their length.

Lossy coding of images

D13

Lossy coding is a technique wherein an image is compressed with a loss of information but those quality is good enough to resemble the original and fool the human eye.

Oversampling of audio data

D14

The technique of sampling an audio signal at a rate faster than that required by the Nyquist sampling rate in order to aid in economically reproducing the original audio signal.

Frequency of an audio signal

D15

The number of oscillations of the signal per second, in hertz. It is a measurement of how rapidly the audio signal is changing.

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Bandwidth	<p>The highest frequency component in an audio signal is referred to as the bandwidth of the signal. A measure of the amount of information contained in a signal, for a transmission channel, a measure of the amount of information which it can transmit.</p>	D16
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Nyquist sampling rate	<p>IN ORDER TO BE PERFECTLY REPRESENTED BY ITS SAMPLES, A SIGNAL MUST BE SAMPLED AT A SAMPLING RATE EQUAL TO AT LEAST TWICE ITS HIGHEST FREQUENCY COMPONENT.</p>	D17
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FDMA frequency division multiple access.	<p>A technique in which each user is simply assigned an individual frequency (actually two frequencies, one for each direction of voice transmission) for the duration of a telephone call.</p>	D18
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TDMA time division multiple access	<p>A technique in which each user occupies the entire radio spectrum, but only for a brief time. After one user transmits a burst of information, that user is quiet for a time and another user transmits a burst. This continues for all the users until it is time for the first user to transmit again. TDMA lends itself naturally to digital signal processing.</p>	D19
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Circuit Switched Network	<p>A network in which connections between users are set up and taken down frequently under the control of the user as opposed to being permanent. Circuit-based networks maintain a path between the users for the duration of the session.</p>	D20
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Packet Based Network	<p>Packet-based networks are those in which individually addressed packets of information are sent into a communications system, and are individually forwarded until they reach the recipient.</p>	D21
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Ethernet	<p>The original Ethernet was a concept of a communications scheme that can link 256 computers and other office equipment for the purposes of sharing documents and other information. Ethernet II provides means of transmitting 10 Mbps data streams among large numbers of computers distributed over a 2.5 km (1.5 mile) diameter area.</p>	D22
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Cryptography	<p>The primary objective of cryptography is to allow two or more users to communicate securely over an insecure medium, such as the Internet.</p>	D23
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Cryptanalysis **D24**

Cryptanalysis is the process of recovering the encryption key from the cipher text; that is, breaking the code.

Unconditionally secure code. **D25**

A cryptosystem is said to be unconditionally secure if the cryptosystem is secure against an attack with an infinite amount of resources available

Computationally secure code. **D26**

A crypto system is said to be computationally secure if the best known attack requires an amount of computational resources that is far too excessive to be a threat in practice.

Public Key/Private Key ciphers. **D27**

With public key cryptography, the algorithm is chosen such that it is computationally infeasible to determine the private (decryption) key given the public (encryption) key and cipher text.

Digital Signature **D28**

A digital authentication mechanism to verify that you are who you say you are.

Voice over IP (VoIP) technology. **D29**

VoIP is telephone system based upon a packet-based communications scheme.

Quality of Service (QoS) protocols (when used in conjunction with VoIP) **D30**

QoS protocols allow VoIP to travel over privileged streams of traffic on the Internet, while the traditional service data is left to contend for the remaining bandwidth.

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For each of the following problems, show all your work and answer in the space provided.

True/False? Variable length coding works best with unevenly distributed occurrences of data. (5 points) Q1
True

Explain the difference between Web client software and Web server software. Which basic role does each play? (10 points) Q2
A web server is a computer running a software application that services requests from, and provides web pages to, other computers on the internet.
A web client is an application that presents/creates the user interface. It is basically receiving and displaying what the web server is providing.

Assume that it is desired to represent financial amounts ranging in size from zero to 4 billion dollars, with a precision of one dollar. How many decimal digits are needed to handle this requirement? How many binary digits are required? Explain your answer. (10 points) Q3
4,000,000,000 → 10 decimal digits required
 $2^{31} = 2,147,483,648$
 $2^{32} = 4,294,967,296$ → 32 binary digits are required.

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Assume that you are receiving a data stream representing 8x12 characters, and you have just received the following data:

000000011111100011000100110000101100000111000001
110000101111110011000100110000101100000100000000

what character does this data stream represent.(do your work in the space provided below) (10 points) Q4

character = **R**

1	1	1	1	1				
1	1				1			
1	1					1		
1	1						1	
1	1						1	
1	1	1	1	1	1			
1	1				1			
1	1					1		
1	1						1	

An image storage format uses 2 bits for each of the 3 primary colors per picture element. How many different colors may be represented in the displayed image? (10 points) Q5

2 bits → 4 gradations / primary color → 4*4*4 = 64 colors total.

What technique is often used in image compression that is fundamentally different than regular data compression. (10 points) Q6

Lossy image compression. It allows for the loss of data.

True/False? Sound travels in all mediums including a vacuum. (5 points)

Q7

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Which of the following apply to a pure sinusoidal wave of 880 Hz?
(15 points, put an 'X' in all applicable boxes)

Q8

- is a wave containing multiple frequency components
- is a pure tone
- has a bandwidth of 880 Hz
- none of the above

True/False: every audio waveform --whether speech, music, or any other sound-- can be built out of sinusoids at certain frequencies? (5 points)

Q9

Which of the following are **not** among the five major generic components of a telephone system: (10 points)

Q10

1. The microphone	2. The transmission system
3. The satellite	4. The switching system
5. The signaling system	6. The fiber optic cable system
7. The receiver	8. The microwave tower

A CD is being considered for storing telephone voice audio. If a person speaks on the telephone for approximately 4 hours a day, how many days' conversations can be stored. (Round off your answer to the nearest whole day.) (15 points)

Q11

The CD is 681, 984,000 bytes. You sample at 8,000 bytes/second, so about 85284 seconds. 24 hours = 14400 seconds $85284 / 14400 = 5.923$ so almost 6 days. (3 days if you record both ends of the conversation.)

The distance between the Moon and Earth is on average 240 Thousand miles. How long (in seconds) would it take for a command given on Earth to reach the Moon? (10 points)

Q12

$240000/186282 = 1.28837$ seconds

What is the primary physical origin of the limit that prevents zero latency, infinite bandwidth, and infinite information rates? (5 points)

Q13

Speed of Light

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True/False: In a fiber optic cable, the center conductor has a higher index of refraction than the cladding surrounding it. (5 points) Q14

The Transmitter power of a cellular phone tower is approximately: (10 points) Q15

- one thousand watts
- one hundred watts
- twenty-five watts**
- ten watts
- none of the above

True/False: Communication systems using fiber optic cables have a smaller bandwidth than those using geosynchronous satellites. (5 points) Q16

The overall GPS system contains only three elements. What are they? (10 points) Q17

1. **the satellites**
2. **the receivers**
3. **the system control center, which monitors the health and accuracy of the satellites.**

A telephone network ISDN transmission line is capable of which of the following bi-directional data speeds? (10 points) Q18

- 16 kbps
- 128 kbps
- 64 kbps
- 1.544 Mbps
- none of the above = 192 kbs**

True/False: In an Ethernet LAN, each connected device waits to transmit its messages, whenever there is a brief period of silence on the line. (5 points) Q19

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Explain why there is a need for several different types of addresses for use with the Internet. Specifically, explain the use for OUI and IP addresses, and for DNS names. (20 points) Q20

Why? DNS Host names allow the user to easily remember an address by relational names, while the IP and OUI addresses are used by the hardware and software to route all packets of information transmitted on the Internet.

OUI Addresses: These 48-bit addresses uniquely identify every Ethernet (and Token-Ring LAN card) ever made.

IP Addresses: These 32-bit addresses identify every attachment of a machine to the Internet

DNS Host names: These alphanumeric addresses parallel the IP Addresses in identifying individual network connections and sub nets, but are further distinguished by a domain hierarchy based on some or all of the following: country code, service code, network name, and/or organization name.

True/False: Existing telephone and circuit switched networks are tailored to the handling of high-speed data to and from a central office in a packetized form. (5 points) Q21

True/False: Public Key ciphers rely on the difficulty of factoring large numbers into primes. (5 points) Q22

True/False: Public Key/Private Key ciphers are unconditionally secure. (5 points) Q23

List the 4 commonly recognized threats to information security. (15 points) Q24

1. Data disclosure
2. Fraud
3. Data insertion, removal, and modification
4. Denial of service.

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What are the three types of corruption that voice data is subjected to when being transmitted over a packet based network (15 points)

Q25

1. delay – of information routed by the internet routers/switches.
2. lost packets – due to temporarily overloaded routers and insufficient cable capacities
3. variable rate – data arriving non-uniformly in time at the receiving end.

True/False: The cost of additional bandwidth is dropping faster than the prices of new faster personal computers. (5 points)

Q26

Telephone calls transmitted over the traditional Public Switched Telephone Network, (PSTN) work just fine. Why is there a move to convert to a VoIP type of technology? (10 points)

Q27

When greater than 5% of the US economy's transactions take place via the Internet, it makes imminent sense to integrate the voice and data into the same service. Sometime soon we will not distinguish a Web interaction from a phone conversation; each communication session with a friend will become a montage to specify, video, data and virtual reality whether the connection is wired, wireless, or over the cable TV, computer, cell phone or pocket computer.