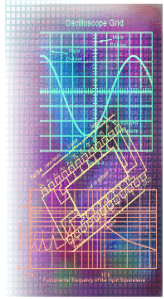


# IFSM 310

## Software and Hardware Concepts



"The ideal situation is to have real computing power close at hand - right at home. Something that dims streetlights and shrinks the picture on the neighbors TV when you crank it up."  
- Unknown

### Topics

Chapter 3: Data Representation (cont)

Field Stripping Computers

### Tech Tales

Tech: I would like you to quit any programs you're running and close all the windows.

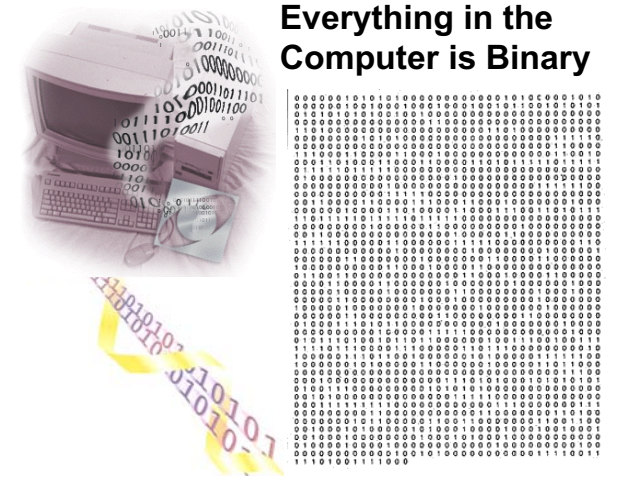
Caller: Well, OK... There are only two windows here in the basement and they are already closed...

**Exam - Next Class - First Thing**  
30 questions, 30 minutes



## Chapter 3

## Data Representation (cont.)



**Computer Representation of Data**  
Everything in Binary / Display in Hex

Value in Memory  
Instruction  
Data  
Format

Integer, Floating Point  
Logical, Signed, Unsigned  
Character, Audio, Video...

### Common Data Representations

Type of data	Standard(s)
Alphanumeric	Unicode, ASCII, EBCDIC
Image (bitmap)	GIF (graphical image format), TIFF (tagged image file format), PNG (portable network graphics)
Image (object)	PostScript, JPEG, SWF (Macromedia Flash), SVG
Outline graphics and fonts	PostScript, TrueType
Sound	WAV, AVI, MP3, MIDI, WMA
Page description	pdf (Adobe Portable Document Format), HTML, XML
Video	Quicktime, MPEG-2, RealVideo, WMV

### Numbers

We know that binary can represent decimal values.

But we have only see positive numbers.

How do we represent negative numbers?

### Sign Magnitude

High bit is sign 0 is +, 1 is -  
 Lower bits are binary  
 00010101 = +21  
 10010101 = -21

#### Problems

00000000 = 0  
 10000000 = -0  
 8 bit range -127 to +127

### One's Complement

High bit is sign 0 is +, 1 is -  
 Lower bits are inverted  
 To negate, invert all bits  
 00010101 = +21  
 11101010 = -21

#### Problems

00000000 = 0  
 11111111 = -0  
 8 bit range -127 to +127

### Two's Complement

High bit is sign 0 is +, 1 is -  
 Lower bits are inverted, plus 1  
 To negate, invert all bits, add 1

00010101 = +21  
 11101010 = -21 1's  
 +1  
 11101011 = -21 2's

### Two's Complement

Takes care of the -0 problem.

00000000 = 0  
 11111111 = -0 1's  
 +1  
 00000000 = 0 2's

8 bit range -128 to +127  
 16 bit range -32768 to +32767

### Floating Point

Way Complex - Trust Me.

+1234.5678 x 10<sup>+23</sup>

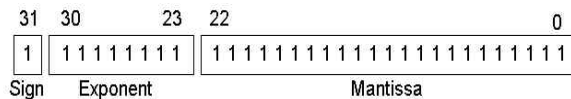
Precision - Number of Digits  
 Exponent - Excess Notation  
 Mantissa = # bits determine Precision  
 Normalized / Sign Bit

### IEEE 754 Formats

IEEE Short Real: 32 bits  
 1 bit for the sign  
 8 bits for exponent (-126 to +127)  
 23 bits for the mantissa  
 Also called single precision.

IEEE Long Real: 64 bits  
 1 bit for the sign  
 11 bits for exponent (-1022 to +1023)  
 52 bits for the mantissa  
 Also called double precision.

### The Parts

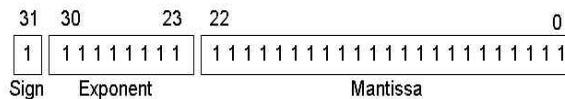


Sign: 0 = positive, 1 = negative

#### Mantissa:

Normalized to 1 digit before decimal  
 1101.101 = 1.101101 x 2<sup>3</sup>  
 0.000111 = 1.11 x 2<sup>-4</sup>

### The Parts



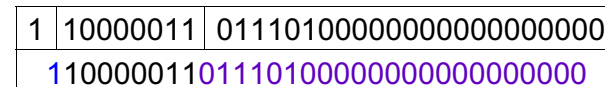
#### Exponent:

Value stored as excess 127  
 Take exponent, add 127  
 5 = 132  
 -5 = 122  
 Convert to binary

### Putting it all together

Decimal: -23.25  
 Binary: -10111.01 x 2<sup>0</sup>  
 Normalize: -1.011101 x 2<sup>4</sup>

Sign: 1  
 Mantissa: 011101 (drop leading 1.)  
 Exponent: 1000011 (4 + 127 = 131)



## Floating Point Issues

Range  
 Overflow  
 Underflow  
 Precision - Number of Digits  
 Truncation - too many bits

Floating Point - slow  
 Integers - Fast!

## Encoding Characters

	Bits	Characters
ASCII	7	128
EBCDIC	8	256
UNICODE	16	65536

## Encoding Characters

DECIMAL	BINARY	ASCII	EBCDIC
0	0000 0000	011 0000	1111 0000
1	0000 0001	011 0001	1111 0001
2	0000 0010	011 0010	1111 0010
3	0000 0011	011 0011	1111 0011
4	0000 0100	011 0100	1111 0100
5	0000 0101	011 0101	1111 0101
6	0000 0110	011 0110	1111 0110
7	0000 0111	011 0111	1111 0111
8	0000 1000	011 1000	1111 1000
9	0000 1001	011 1001	1111 1001

## ASCII Codes

ANSI standards  
 7 Bits, 128 Characters  
 Groups  
 Control  
 Letters  
 Digits  
 Punctuation

Extended (8 bit) Graphics

## Control Characters

Non printing  
  
 Transmission control  
 SOH / ACK / NAK / ETX  
  
 Device Control  
 BEL / XON / XOFF  
  
 Format Control  
 CR / LF / HT

## ASCII

Online  
 ASCII  
 Table

The table shows the ASCII character set with bit annotations. A red arrow labeled '1' points to the 'Most Significant Bits (MSB)' (bits 7-0). A red arrow labeled '2' points to the 'Least Significant Bits (LSB)' (bits 7-0). The table is as follows:

	000	001	010	011	100	101	110	111
0000	NUL	DLE	SPACE	0	@	P	~	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EOT	DC4	\$	4	D	T	d	t
0101	ENO	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

## ASCII Codes

Conversions

Digit to Binary, - 30h  
  
 Lower to Upper, - 20h  
  
 Upper to Lower, + 20h

## EBCDIC

Extended Binary Coded Decimal  
 Interchange Code  
  
 Developed by IBM  
  
 8 Bits, 256 codes  
  
 Different versions of EBCDIC

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	DLE	DS		SP	&	.	*	Ã	È	Ñ	ø	{	}	\	0
1	SOH	DC1	SOS		⊙	/	»	a	j	~	Ú	À	J	ÿ	1	
2	STX	DC2	FS	SYN	i	ª	º	¼	b	k	s	Ú	B	K	S	2
3	ETX	TM			ƒ	«	»	½	c	l	t	Ú	C	L	T	3
4	PF	RES	BYP	PN	£	¬	¸	¾	d	m	u	Ú	D	M	U	4
5	HT	NL	LF	RS	¤	•	µ	¿	e	n	v	Ý	E	N	V	5
6	LC	BS	ETB	UC	¥	®	¶	À	f	o	w	Þ	F	O	W	6
7	DEL	IL	ESC	EOT	¦	¯	¸	Á	g	p	x	ß	G	P	X	7
8		CAN			§	°	¹	Â	h	q	y	à	H	Q	Y	8
9		EM			¨	±	º	Ë	i	r	z	á	I	R	Z	9
A	SMM	CC	SM		[	]		:	Ä	É	Ò	â	à	í	ò	ú
B	VT	CU1	CU2	CL3	.	\$	.	•	Å	ì	Ó	ã	é	ì	ó	û
C	FF	IFS		DC4	¸	¸	%	®	Æ	í	Ô	ä	ê	ð	ô	ü
D	CR	KBS	ENQ	NAK	(	)	-	·	Ç	î	Õ	å	ë	ñ	+	ý
E	SO	IRS	ACK		+	:	»	=	È	ï	Ö	æ	ì	ò	ø	þ
F	SI	IUS	BEL	SUB	!	À	?	"	É	ð	×	ç	í	ó	ù	ÿ

## Unicode

16 bits - 65,536 characters

Double Byte Character Sets

Allows for  
Korean, Japanese, Russian, Others

## Unicode

0000	0000-00FF Latin-1 (ASCII)
1000	General character alphabets: Latin, Cyrillic, Greek, Hebrew, Thai...
2000	Symbols and dingbats: punctuation, math, technical, geometric shapes, etc.
3000	3000-33FF Miscellaneous punctuation, symbols, and phonetics for Chinese, Japanese, and Korean
4000	Unassigned
5000	4E00-9FFF Chinese, Japanese, Korean ideographs
A000	
B000	
D000	AC00-D7AF Korean Hangul syllables
E000	Space for surrogates
F000	E000-F8FF Private use

## Memory Addressing

Identifying numbers of memory bytes in primary storage

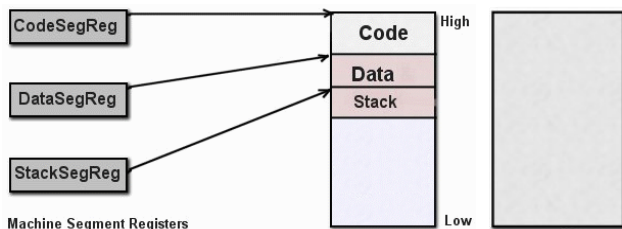
Simple or complex numeric values depending on memory model used by CPU

Flat memory addresses (single integer)

Segmented memory addresses (multiple integers)

Require definition of specific coding format

## Segmented vs. Flat Memory



Segmented

Flat

## Data Structures

Related groups of primitive data elements organized for a type of common processing

Defined and manipulated within software  
Commonly used data structures: arrays, linked lists, records, tables, files, indices, and objects

Many use pointers to link primitive data components

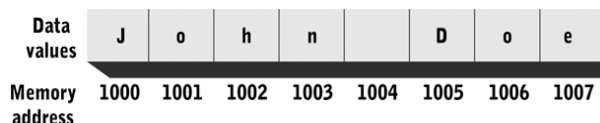
## Lists and Arrays

List

A set of related data values

Array

An ordered list in which each element can be referenced by an index to its position



## Linked Lists

Pointer

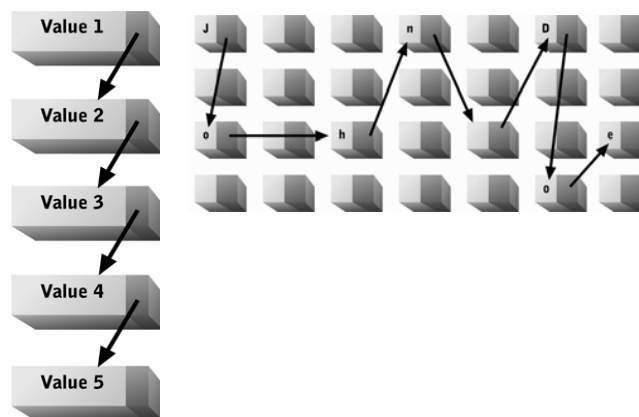
Data element that contains the address of another data element

Data structures that use pointers so list elements can be scattered among non-sequential storage locations

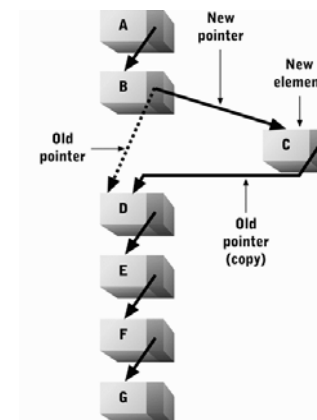
- Singly linked lists
- Doubly linked lists

Easier to expand or shrink than an array

## Linked Lists



## Linked Lists



## Organization of Data

### Records

Account-Number	Last-Name	First-Name	Middle-Initial	Street-Address	City	State	Zip-Code
----------------	-----------	------------	----------------	----------------	------	-------	----------

### Files - collection of records



## Summary

Everything is in binary - bits

How we organize the bits determine what they mean

# A+ Hands On

# Field Stripping Computers

## What You Will Do

Get a machine working

Run Diagnostics on it

Tear it down

Put it back together again

.... and it better Work!

## Dress Code

No Ties

No Rings/Jewelry

Plastic/Rubber Watches only

No Wool/Silk Clothing

## Static Electricity



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Ground Yourself  
Grounding Straps

## Tools

Flat Head Screwdriver  
Phillips Head Screwdriver  
Small Pair of Pliers  
Power Strips



## What You Will Do

Before taking apart,  
determine configuration  
Unit Examination / MSD

One Person Takes machine Apart  
One Person Takes Notes  
One Person Puts machine together  
.... and it better Work!

# What are you waiting for?

## Parting Thought

"Experts agree that the best type of computer for your individual needs is one that comes on the market about two days after you actually purchase some other computer."

- Dave Barry

End of Lesson