

The background of the slide features a classical statue, likely the 'Alma Mater' statue at the University of Illinois, rendered in a monochromatic orange color. The statue is positioned in the center-right of the frame, with its arms outstretched. The overall image has a textured, slightly grainy appearance, suggesting it might be a scan or a digital overlay on a photograph.

Hexadecimal, UTF8, and C Programming

CS 240 - The University of Illinois

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Binary Digits

Number of Students at Illinois:

0b 1100 1100 0110 1011

Hexadecimal

Digits:

Place Value of Digits

0x

c

0

f

f

e

e

16^5

16^4

16^3

16^2

16^1

16^0

Place Value of Digits

0x

c

0

f

f

e

e

16^5

16^4

16^3

16^2

16^1

16^0

12×16^5

0×16^4

15×16^3

15×16^2

14×16^1

14×16^0

Place Value of Digits

0x c 0 f f e e

1048576 65536 4096 256 16 1

12 $\times 16^5$ **0** $\times 16^4$ **15** $\times 16^3$ **15** $\times 16^2$ **14** $\times 16^1$ **14** $\times 16^0$

12582912 0 61440 3840 224 15

Place Value of Digits

0x c 0 f f e e

=12,648,430₁₀

$$11_{10} = 0x$$

$$34_{10} = 0x$$

$$87_{10} = 0x$$

$$255_{10} = 0x$$

1 = 0x1
2 = 0x2
3 = 0x3
4 = 0x4
5 = 0x5
6 = 0x6
7 = 0x7
8 = 0x8

9 = 0x9
10 = 0xa
11 = 0xb
12 = 0xc
13 = 0xd
14 = 0xe
15 = 0xf

Students at Illinois:

0b 1100 1100 0110 1011

People Following Tay on Twitter:

101 0100 1001 0010 1010 0110 0000

ASCII



Organization

To begin to create words:

- A letter is _____ binary bits.
_____ hex digits!

(We call this unit a _____.)

Organization

Global standard called the **American Standard Code for Information Interchange (ASCII)** is a _____ for translating numbers to characters.

ASCII

Row	Column				0	1	2	3	4	5	6	7
	Bit Pattern		b7	b6	b5	0	0	0	0	1	1	1
	b4	b3	b2	b1	0	0	1	0	1	0	1	1
0	0	0	0	0	NUL	DLE	SP	0	@	P	~	p
1	0	0	0	1	SOH	DC1	!	1	A	Q	a	q
2	0	0	1	0	STX	DC2	"	2	B	R	b	r
3	0	0	1	1	LTX	DC3	#	3	C	S	c	s
4	0	1	0	0	EOT	DC4	\$	4	D	T	d	t
5	0	1	0	1	ENO	NAK	%	5	E	U	e	u
6	0	1	1	0	ACK	SYN	&	6	F	V	f	v
7	0	1	1	1	BEL	ETB	'	7	G	W	g	w
8	1	0	0	0	BS	CAN	(	8	H	X	h	x
9	1	0	0	1	HT	EM	)	9	I	Y	i	y
10	1	0	1	0	LF	SUB	*	:	J	Z	j	z
11	1	0	1	1	VT	ESC	+	;	K	[	k	{
12	1	1	0	0	FF	FS	,	<	L	\	l	!
13	1	1	0	1	CR	GS	-	=	M	]	m	}
14	1	1	1	0	SO	RS	.	>	N	^	n	~
15	1	1	1	1	SI	US	/	?	o	_	o	DEL

[1] Change of name

[2] New character

[3] Moved character

Fig. 14.12 ASCII, 1967 and 1968



ASCII

		Column							
		0	1	2	3	4	5	6	7
Bit Pattern		0	0	0	0	1	0	1	1
b7		0	0	0	1	0	1	1	1
b6		0	0	1	0	1	0	1	1
b5		0	1	0	0	0	1	0	1
b4 b3 b2 b1									
0	0 0 0 0	NUL	DLE	SP	0	@	P	~	p
1	0 0 0 1	SOH	DC1	!	1	A	Q	a	q
2	0 0 1 0	STX	DC2	"	2	B	R	b	r
3	0 0 1 1	LTX	DC3	#	3	C	S	c	s
4	0 1 0 0	EOT	DC4	\$	4	D	T	d	t
5	0 1 0 1	ENO	NAK	%	5	E	U	e	u
6	0 1 1 0	ACK	SYN	&	6	F	V	f	v
7	0 1 1 1	BEL	ETB	'	7	G	W	g	w
8	1 0 0 0	BS	CAN	(	8	H	X	h	x
9	1 0 0 1	HT	EM	)	9	I	Y	i	y
10	1 0 1 0	LF	SUB	*	:	J	Z	j	z
11	1 0 1 1	VT	ESC	+	;	K	[	k	{
12	1 1 0 0	FF	FS	,	<	L	\	l	!
13	1 1 0 1	CR	GS	-	=	M	]	m	}
14	1 1 1 0	SO	RS	.	>	N	^	n	~
15	1 1 1 1	SI	US	/	?	o	_	o	DEL

¹ Change of name

² New character

³ Moved character

Fig. 14.12 ASCII, 1967 and 1968

		Column	0	1	2	3	4	5	6	7
		Bit Pattern	b7	b6	b5					
			0	0	0	0	1	1	1	1
			0	0	1	1	0	0	1	1
			0	1	0	1	0	1	0	1
Row		b4	b3	b2	b1					
0	0 0 0 0	NUL	DLE	SP	0	@	P	~	P	
1	0 0 0 1	SOH	DC1	!	1	A	Q	a	q	
2	0 0 1 0	STX	DC2	"	2	B	R	b	r	
3	0 0 1 1	LTX	DC3	#	3	C	S	c	s	



0b 0100 0001 = 0x41 = A

0b 0100 0001 = 0x41 = A

0b 0100 00**10** = 0x4**2** = **B**

0b 0100 0001 = 0x41 = A

0b 0100 0010 = 0x42 = B

= 0x43 =

= 0x44 =

0b 0100 0001 = 0x41 = A

0b 01**1**0 0001 = 0x**61** = **a**

Shortcomings with ASCII



Other Character Encodings

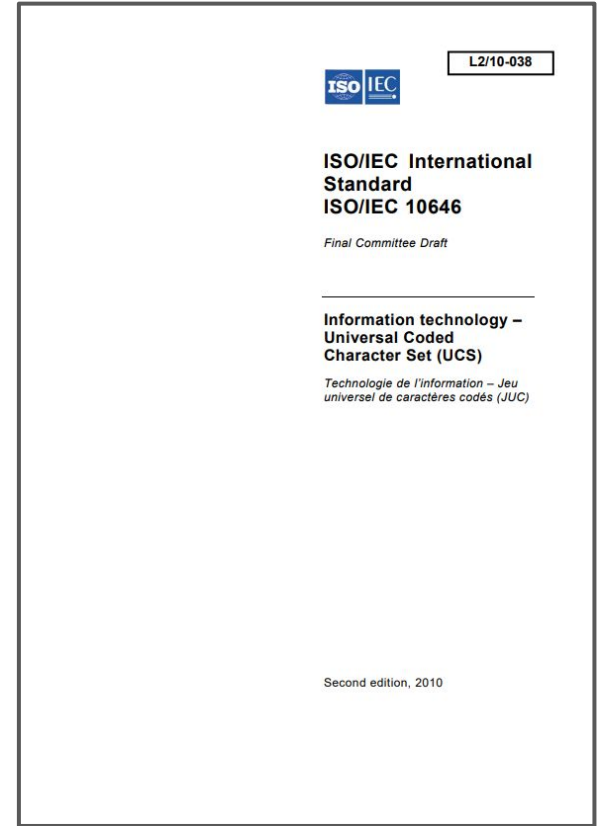
Character Encodings

There are many other character encodings beyond ASCII.

Character Encodings

One of the most common is the **Unicode Transformation Format (8-bit)**, commonly called:

ISO/IEC 10646





Length	Byte #1	Byte #2	Byte #3	Byte #4
1-byte:	0 _ _ _ _			
2-bytes:	110 _ _ _ _	10 _ _ _ _		
3-bytes:	1110 _ _ _ _	10 _ _ _ _	10 _ _ _ _	
4-bytes:	1111 0 _ _ _	10 _ _ _ _	10 _ _ _ _	10 _ _ _ _

Characters in UTF-8

a

Characters in UTF-8

€

U+03b5

0100 1000 0110 1001 1111 0000

1001 1111 1000 1110 1000 1001

0100 1000 | 0110 1001 | 1111 0000 |

1001 1111 | 1000 1110 | 1000 1001

Length	Byte #1	Byte #2	Byte #3	Byte #4
1-byte:	0 _ _ _ _			
2-bytes:	110 _ _ _ _	10 _ _ _ _		
3-bytes:	1110 _ _ _ _	10 _ _ _ _	10 _ _ _ _	
4-bytes:	1111 0 _ _ _	10 _ _ _ _	10 _ _ _ _	10 _ _ _ _

0100 1000 | 0110 1001 | 1111 0000 |

1001 1111 | 1000 1110 | 1000 1001

0100 1000 | 0110 1001 | 1111 0000 |
1001 1111 | 1000 1110 | 1000 1001

Hi



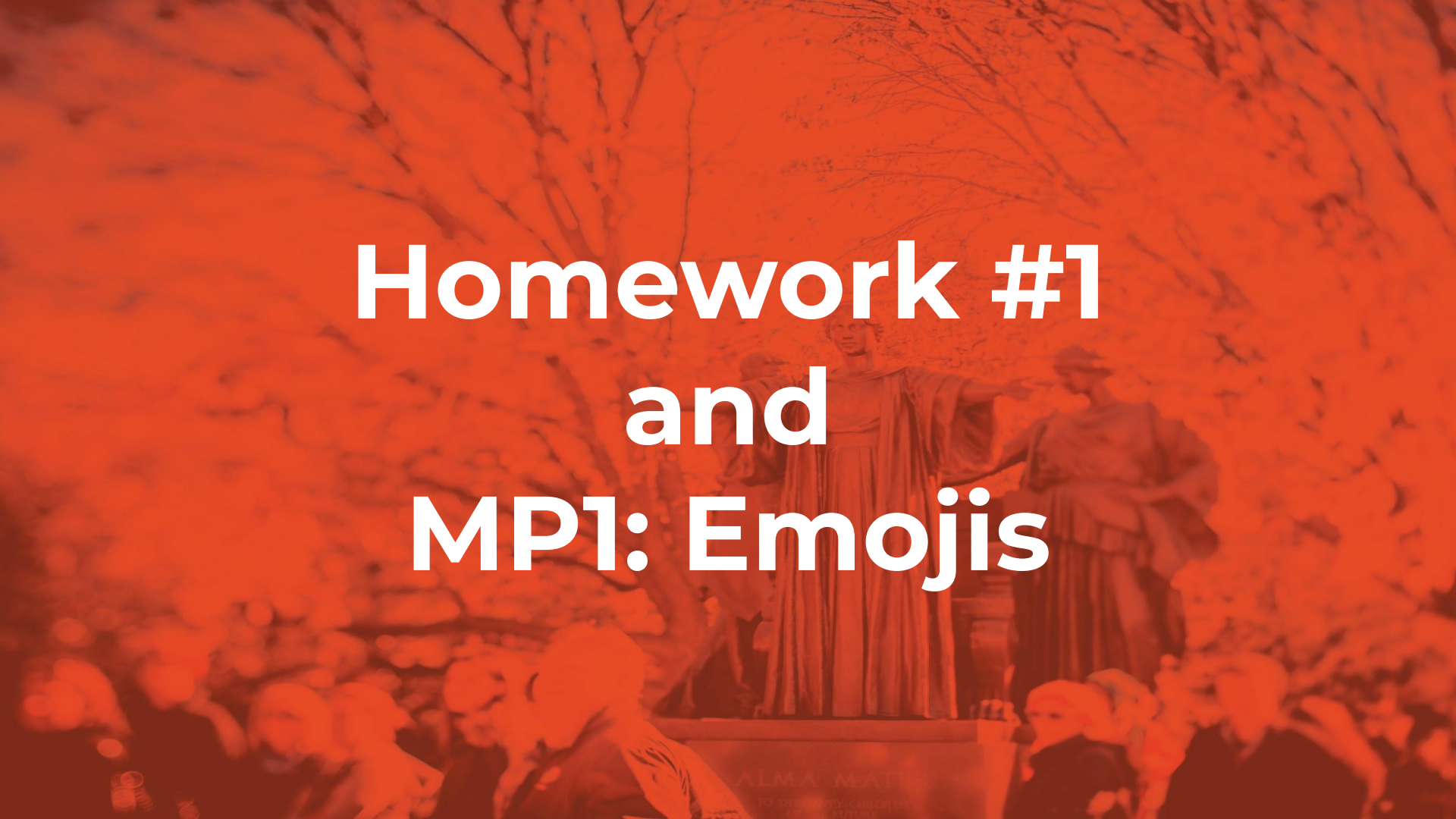
Programming in C

A photograph of a crowd of people gathered around a statue of Alma Mater, overlaid with a semi-transparent orange filter. The text "Programming in C" is centered in white. The background shows a large group of people, some looking towards the camera and others looking towards the statue. The statue is a large, classical-style figure, possibly representing a personification of wisdom or knowledge. The overall scene is outdoors, with trees and foliage visible in the background.

You already know C++!

You already know C++!

Programming in C **is a simplification of C++.**



Homework #1 and MP1: Emojis

Dream Computer

