

A photograph of a campus scene. In the foreground, there are several tulips in shades of red and yellow. Behind them is a paved area, possibly a walkway or road. In the background, there are green lawns, trees with sparse leaves, and a white building. The right side of the image is overlaid with a dark red semi-transparent rectangle containing text.

# CS197C

Intro to C

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## ASCII

Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	<b>NUL</b> (null)	32	20	040	&#32;	Space	64	40	100	&#64;	@	96	60	140	&#96;	`
1	1	001	<b>SOH</b> (start of heading)	33	21	041	&#33;	!	65	41	101	&#65;	A	97	61	141	&#97;	a
2	2	002	<b>STX</b> (start of text)	34	22	042	&#34;	"	66	42	102	&#66;	B	98	62	142	&#98;	b
3	3	003	<b>ETX</b> (end of text)	35	23	043	&#35;	#	67	43	103	&#67;	C	99	63	143	&#99;	c
4	4	004	<b>EOT</b> (end of transmission)	36	24	044	&#36;	\$	68	44	104	&#68;	D	100	64	144	&#100;	d
5	5	005	<b>ENQ</b> (enquiry)	37	25	045	&#37;	%	69	45	105	&#69;	E	101	65	145	&#101;	e
6	6	006	<b>ACK</b> (acknowledge)	38	26	046	&#38;	&	70	46	106	&#70;	F	102	66	146	&#102;	f
7	7	007	<b>BEL</b> (bell)	39	27	047	&#39;	'	71	47	107	&#71;	G	103	67	147	&#103;	g
8	8	010	<b>BS</b> (backspace)	40	28	050	&#40;	(	72	48	110	&#72;	H	104	68	150	&#104;	h
9	9	011	<b>TAB</b> (horizontal tab)	41	29	051	&#41;	)	73	49	111	&#73;	I	105	69	151	&#105;	i
10	A	012	<b>LF</b> (NL line feed, new line)	42	2A	052	&#42;	*	74	4A	112	&#74;	J	106	6A	152	&#106;	j
11	B	013	<b>VT</b> (vertical tab)	43	2B	053	&#43;	+	75	4B	113	&#75;	K	107	6B	153	&#107;	k
12	C	014	<b>FF</b> (NP form feed, new page)	44	2C	054	&#44;	,	76	4C	114	&#76;	L	108	6C	154	&#108;	l
13	D	015	<b>CR</b> (carriage return)	45	2D	055	&#45;	-	77	4D	115	&#77;	M	109	6D	155	&#109;	m
14	E	016	<b>SO</b> (shift out)	46	2E	056	&#46;	.	78	4E	116	&#78;	N	110	6E	156	&#110;	n
15	F	017	<b>SI</b> (shift in)	47	2F	057	&#47;	/	79	4F	117	&#79;	O	111	6F	157	&#111;	o
16	10	020	<b>DLE</b> (data link escape)	48	30	060	&#48;	0	80	50	120	&#80;	P	112	70	160	&#112;	p
17	11	021	<b>DC1</b> (device control 1)	49	31	061	&#49;	1	81	51	121	&#81;	Q	113	71	161	&#113;	q
18	12	022	<b>DC2</b> (device control 2)	50	32	062	&#50;	2	82	52	122	&#82;	R	114	72	162	&#114;	r
19	13	023	<b>DC3</b> (device control 3)	51	33	063	&#51;	3	83	53	123	&#83;	S	115	73	163	&#115;	s
20	14	024	<b>DC4</b> (device control 4)	52	34	064	&#52;	4	84	54	124	&#84;	T	116	74	164	&#116;	t
21	15	025	<b>NAK</b> (negative acknowledge)	53	35	065	&#53;	5	85	55	125	&#85;	U	117	75	165	&#117;	u
22	16	026	<b>SYN</b> (synchronous idle)	54	36	066	&#54;	6	86	56	126	&#86;	V	118	76	166	&#118;	v
23	17	027	<b>ETB</b> (end of trans. block)	55	37	067	&#55;	7	87	57	127	&#87;	W	119	77	167	&#119;	w
24	18	030	<b>CAN</b> (cancel)	56	38	070	&#56;	8	88	58	130	&#88;	X	120	78	170	&#120;	x
25	19	031	<b>EM</b> (end of medium)	57	39	071	&#57;	9	89	59	131	&#89;	Y	121	79	171	&#121;	y
26	1A	032	<b>SUB</b> (substitute)	58	3A	072	&#58;	:	90	5A	132	&#90;	Z	122	7A	172	&#122;	z
27	1B	033	<b>ESC</b> (escape)	59	3B	073	&#59;	;	91	5B	133	&#91;	[	123	7B	173	&#123;	{
28	1C	034	<b>FS</b> (file separator)	60	3C	074	&#60;	<	92	5C	134	&#92;	\	124	7C	174	&#124;	
29	1D	035	<b>GS</b> (group separator)	61	3D	075	&#61;	>	93	5D	135	&#93;	]	125	7D	175	&#125;	}
30	1E	036	<b>RS</b> (record separator)	62	3E	076	&#62;	>	94	5E	136	&#94;	^	126	7E	176	&#126;	~
31	1F	037	<b>US</b> (unit separator)	63	3F	077	&#63;	?	95	5F	137	&#95;	_	127	7F	177	&#127;	DEL

**8 bits**  
**1 byte**

Calculator

PROGRAMMER

127

HEX 7F  
DEC 127  
OCT 177  
BIN 0111 1111

QWORD MS M\*

Lsh ↑	Rsh ↑	Or	Xor	Not	And
↑	Mod	CE	C	←	÷
A	B	7	8	9	×
C	D	4	5	6	—
E	F	1	2	3	+
(	)	±	0	.	=

## Memory

```
0x8f44008: U 01010101
0x8f44009: g 01100111
0x8f4400a: v 01110110
0x8f4400b: Å 01000001
0x8f4400c: n 01101110
0x8f4400d: Ä 11000011
0x8f4400e: ö 11110101
0x8f4400f: H 01001000
0x8f44010: ? 00111111
```

## 2's compliment

```
0x8be6008: U 01010101 85
0x8be6009: g 01100111 103
0x8be600a: v 01110110 118
0x8be600b: A 01000001 65
0x8be600c: n 01101110 110
0x8be600d: ã 11000011 -61
0x8be600e: õ 11110101 -11
0x8be600f: H 01001000 72
0x8be6010: ? 00111111 63
```

# sizeof

elinux.cs.umass.edu - PuTTY

```
#include<stdio.h>

int main(int argc, char * argv){
    char    aChar;
    int     anInt;
    float   aFloat;
    double  aDouble;
    printf("Type\tSize (bytes) \tSize (bits) \n");
    printf("char\t%i\t\t%i\n", sizeof(char), sizeof(char) *8);
    printf("int\t\t%i\t\t\t%i\n", sizeof(int), sizeof(int) *8);
    printf("float\t%i\t\t\t\t%i\n", sizeof(float), sizeof(float) *8);
    printf("double\t%i\t\t\t\t\t%i\n", sizeof(double), sizeof(double) *8);
    return 0;
}

"primitives.c" 14L, 406C          1,1          All
```

# Primitive Types

Type	Size (bytes)	Size (bits)
char	1	8
int	4	32
float	4	32
double	8	64

# Pointers

```

elinux.cs.umass.edu - PuTTY
#include<stdio.h>

int main(int argc, char * argv[]){
    char    aChar = '5';
    int     anInt = 5;
    float   aFloat= .5;
    double  aDouble= 5.5;
    double  dummy;
    printf("Value\t\tStart Address\tAddresses Used\n");
    printf("%c\t\t%p\t%i\n" ,aChar,&aChar, (void *)&anInt - (void *)&aChar);
    printf("%i\t\t%p\t%i\n" ,anInt,&anInt, (void *)&aFloat - (void *)&anInt);
    printf("%f\t\t%p\t%i\n" ,aFloat,&aFloat, (void *)&aDouble- (void *)&aFloat);
    printf("%lf\t\t%p\t%i\n",aDouble,&aDouble, (void *)&dummy - (void *)&aDouble);
    return 0;
}
"addresses.c" 15L, 519C                                     1,1           All

```



**size == addresses used**

Value	Start Address	Addresses Used
5	0x7ffdfb3ee48f	1
5	0x7ffdfb3ee490	4
0.500000	0x7ffdfb3ee494	4
5.500000	0x7ffdfb3ee498	8

## Your Assignment

```
XXXXXXXXXX
XP      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X        XX
XXXXXXXXXX
d
```

```
XXXXXXXXXX
X P      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X        XX
XXXXXXXXXX
a
```

```
XXXXXXXXXX
XP      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X        XX
XXXXXXXXXX
s
```

```
XXXXXXXXXX
X        XX
XPX XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X        XX
XXXXXXXXXX
w
```

```
XXXXXXXXXX
XP      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X        XX
XXXXXXXXXX
q
```

# Arrays

```

eLinux.cs.umass.edu - PuTTY
#include<stdio.h>

int main(int argc, char * argv[]){
    char a='a',b='b',c='c';
    char letters[3]={'a','b','c'};
    printf("Variables\t\tArray\n");
    printf("%p: %c\t%p: %c\n",&a,a,letters+0,*letters+0);
    printf("%p: %c\t%p: %c\n",&b,b,letters+1,*letters+1);
    printf("%p: %c\t%p: %c\n",&c,c,letters+2,*letters+2);
    return 0;
}
"array.c" 11L, 322C                               1,1                               All

```

Variables	Array
0x7ffd1fb99d4d: a	0x7ffd1fb99d50: a
0x7ffd1fb99d4e: b	0x7ffd1fb99d51: b
0x7ffd1fb99d4f: c	0x7ffd1fb99d52: c

## Arrays Shorthand

```
#include<stdio.h>

int main(int argc, char * argv[]){
    char myArray[3];
    myArray[0]='a';
    myArray[1]='b';
    myArray[2]='c';
    printf("myArray[0]: %c \t %p\n",myArray[0], &myArray[0]);
    printf("myArray[1]: %c \t %p\n",myArray[1], &myArray[1]);
    printf("myArray[2]: %c \t %p\n",myArray[2], &myArray[2]);
    return 0;
}

"array.c" 12L, 310C                               1,1                               All
elinux4:~/cs197c/S2014/Worksheets/week3/examples> gcc array.c
elinux4:~/cs197c/S2014/Worksheets/week3/examples> ./a.out
myArray[0]: a      0xbf8b6ffd
myArray[1]: b      0xbf8b6ffe
myArray[2]: c      0xbf8b6fff
```

## Matrices

```

#include<stdio.h>

int main(int argc, char * argv[]){
    char myMatrix[2][2];
    char * matrixAddr = &myMatrix[0][0];
    *(matrixAddr+0)='a';
    *(matrixAddr+1)='b';
    *(matrixAddr+2)='c';
    *(matrixAddr+3)='d';
    printf("\tCol 0\tCol 1\n");
    printf("row 0\t%c\t%c\n", *(matrixAddr+0), *(matrixAddr+1));
    printf("row 1\t%c\t%c\n", *(matrixAddr+2), *(matrixAddr+3));
    return 0;
}

```

```

"matrix2.c" 14L, 364C                               1,1           All
.elnux4:~/cs197c/S2014/Worksheets/week3/examples> gcc matrix2.c
.elnux4:~/cs197c/S2014/Worksheets/week3/examples> ./a.out

```

	Col 0	Col 1
row 0	a	b
row 1	c	d

## Matrices Rows

```
#include<stdio.h>

int main(int argc, char * argv[]){
    char myMatrix[2][2]={{'a','b'},{'c','d'}};
    char (*row0)[2] =(myMatrix+0);
    char (*row1)[2] =(myMatrix+1);
    printf("\tCol 0\tCol 1\n");
    printf("row 0\t%c\t%c\n",*((char *)row0+0),*((char *)row0+1));
    printf("row 1\t%c\t%c\n",*((char *)row1+0),*((char *)row1+1));
    return 0;
}
"matrix3.c" 11L, 328C                               1,1           All
elinux4:~/cs197c/S2014/Worksheets/week3/examples> gcc matrix3.c
.elinux4:~/cs197c/S2014/Worksheets/week3/examples> ./a.out
        Col 0    Col 1
row 0    a        b
row 1    c        d
```

## Matrices Shorthand

```
#include<stdio.h>

int main(int argc, char * argv[]){
    char myMatrix[2][2];
    myMatrix[0][0]='a';
    myMatrix[0][1]='b';
    myMatrix[1][0]='c';
    myMatrix[1][1]='d';
    printf("\tCol 0\tCol 1\n");
    printf("row 0\t%c\t%c\n",myMatrix[0][0],myMatrix[0][1]);
    printf("row 1\t%c\t%c\n",myMatrix[1][0],myMatrix[1][1]);
    return 0;
}

"matrix.c" 13L, 318C          1,1          All
elinux4:~/cs197c/S2014/Worksheets/week3/examples> gcc matrix.c
elinux4:~/cs197c/S2014/Worksheets/week3/examples> ./a.out
        Col 0    Col 1
row 0   a        b
row 1   c        d
```

# Strings

```
#include<stdio.h>

int main(int argc, char * argv[]){
    char * hi = "hi";
    printf("%s\n",hi);
    printf("%p:\t%c\t%i\n",hi+0,hi[0],hi[0]);
    printf("%p:\t%c\t%i\n",hi+1,hi[1],hi[1]);
    printf("%p:\t%c\t%i\n",hi+2,hi[2],hi[2]);
    return 0;
}
"string.c" 10L, 235C                               1,1                               All
elnux4:~/cs197c/S2014/Worksheets/week3/examples> gcc string.c
elnux4:~/cs197c/S2014/Worksheets/week3/examples> ./a.out
hi
0x80485c0:      h          104
0x80485c1:      i          105
0x80485c2:      0
```

Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr
0	0	000	NUL (null)	32	20	040	&#32;	Spa



## Your Assignment

```

XXXXXXXXXX
XP      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X      XX
XXXXXXXXXX
d

```

d=Right

```

XXXXXXXXXX
X P      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X      XX
XXXXXXXXXX
a

```

a=Left

```

XXXXXXXXXX
XP      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X      XX
XXXXXXXXXX
s

```

s=Down

```

XXXXXXXXXX
X      XX
XPX XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X      XX
XXXXXXXXXX
w

```

w=Up

```

XXXXXXXXXX
XP      XX
X X XX XX
X X  X XX
X XXX  XX
XX      X I
XXX XXX X
XXX XX  X
X      XX
XXXXXXXXXX
q

```

q=Quit

A photograph of a UMass Amherst campus scene, overlaid with a semi-transparent dark red filter. In the foreground, a row of tulips in shades of pink and yellow is in bloom. Behind them is a paved walkway and a grassy area. In the background, a large, modern building with horizontal bands of light and dark panels is visible, partially obscured by bare trees. The overall mood is serene and academic.

UMassAmherst  
The Commonwealth's Flagship Campus