Week 4

last time

4 2 6 8 1 3 7 5

linear search

binary search

bubble sort

selection sort

insertion sort

merge sort

O

Ω

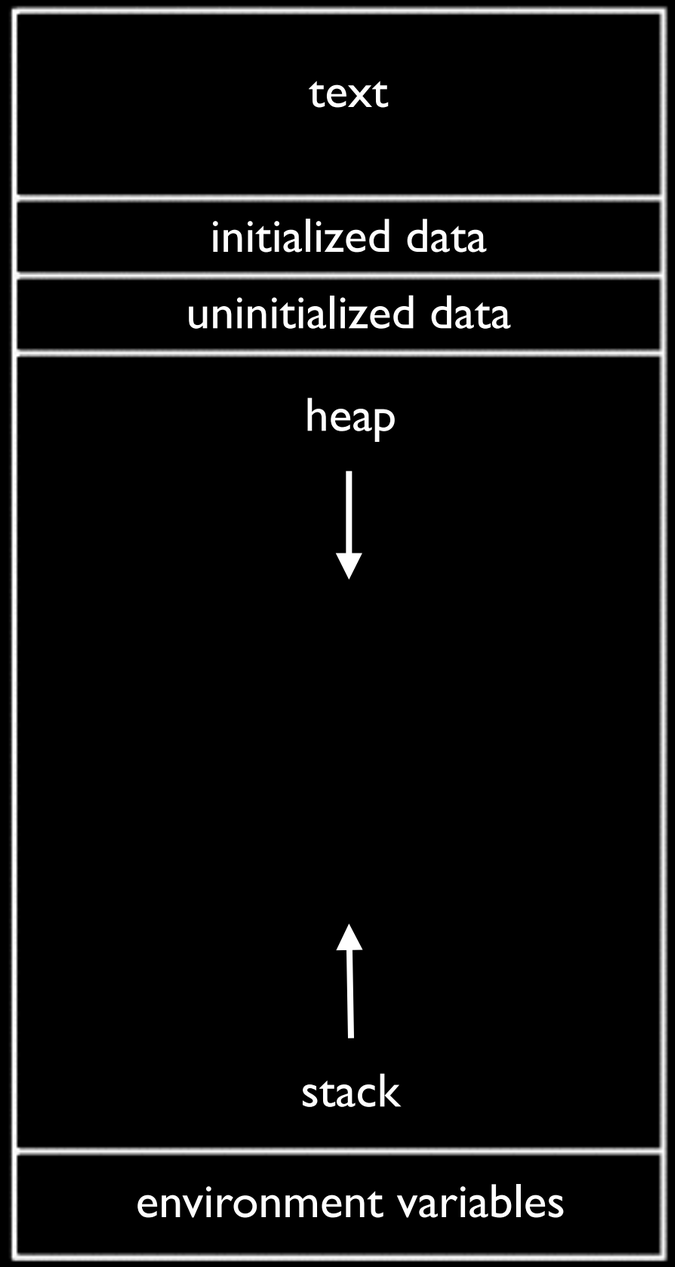
Θ

this time


YOU SAID STRINGS EXIST
TODAY DETERMINED THAT WAS A LIE
memegenerator.net

string

```
void swap(int a, int b)
{
    int tmp = a;
    a = b;
    b = tmp;
}
```


text
initialized data
uninitialized data
heap
stack
environment variables

Pointer Fun with Binky Preview

by Nick Parlante

This is document 104 in the Stanford CS Education Library — please see cslibrary.stanford.edu for this video, its associated documents, and other free educational materials.

```
char *
```

```
void swap(int a, int b)
{
    int tmp = a;
    a = b;
    b = tmp;
}
```

```
void swap(int a, int b)
{
    int tmp = a;
    a = b;
    b = tmp;
}
```

```
void swap(int *a, int *b)
{
    int tmp = *a;
    *a = *b;
    *b = tmp;
}
```

```
int main(void)
{
    int *x;
    int *y;

    x = malloc(sizeof(int));

    *x = 42;

    *y = 13;

    y = x;

    *y = 13;
}
```

```c
int main(void)
{
    int *x;
    int *y;

    x = malloc(sizeof(int));

    *x = 42;

    *y = 13;

    y = x;

    *y = 13;
}
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    x = malloc(sizeof(int));

    *x = 42;

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int main(void)
{
    int *x;
    int *y;

    x = malloc(sizeof(int));

    *x = 42;

    *y = 13;

    y = x;

    *y = 13;
}
```

```
get_char

get_double

get_float

get_int

get_long_long

get_string

...
```

memory leak

valgrind

valgrind --leak-check=full ./program

```
Invalid write of size 4
   at 0x4005FF: f (memory.c:21)
   by 0x400623: main (memory.c:26)

...

40 bytes in 1 blocks are definitely lost in loss record 1 of 1
   at 0x4C2AB80: malloc (in /usr/lib/valgrind/vgpreload_memcheck-amd64-linux.so)
   by 0x4005F6: f (memory.c:20)
   by 0x400623: main (memory.c:26)
```

valgrind

valgrind --leak-check=full ./program

```
Invalid write of size 4
   at 0x4005FF: f (memory.c:21)
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   by 0x4005F6: f (memory.c:20)
   by 0x400623: main (memory.c:26)
```
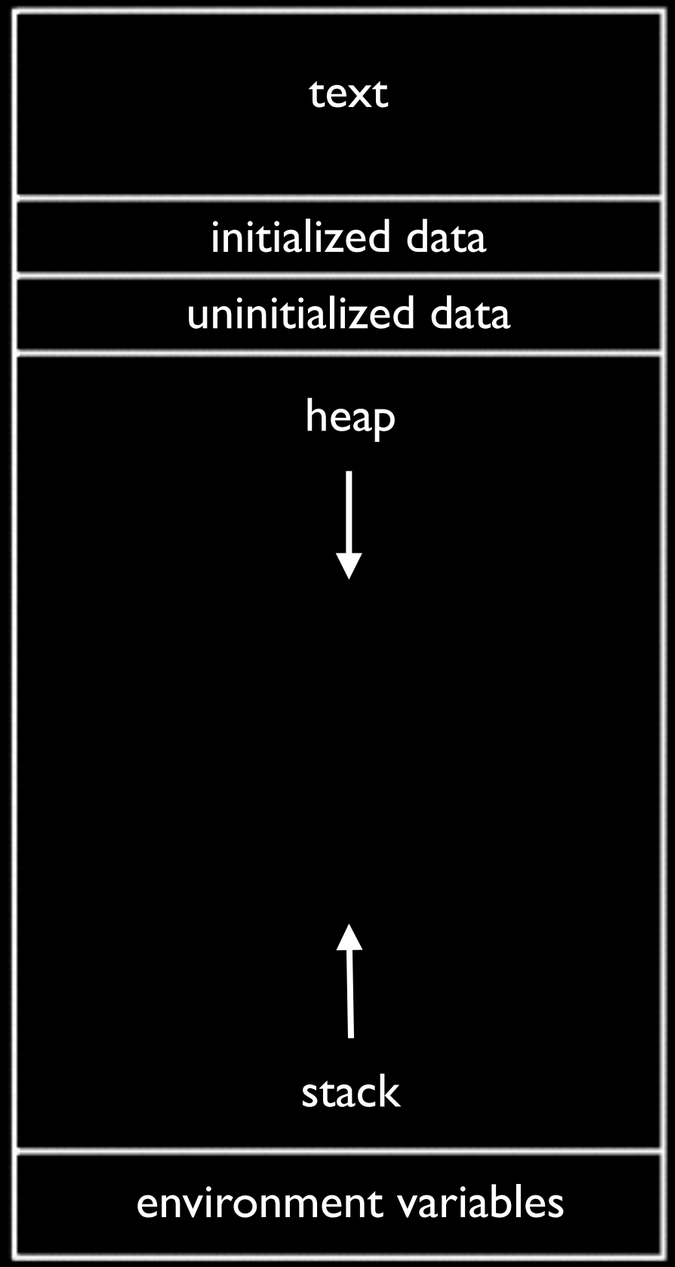


text
initialized data
uninitialized data
heap
stack
environment variables

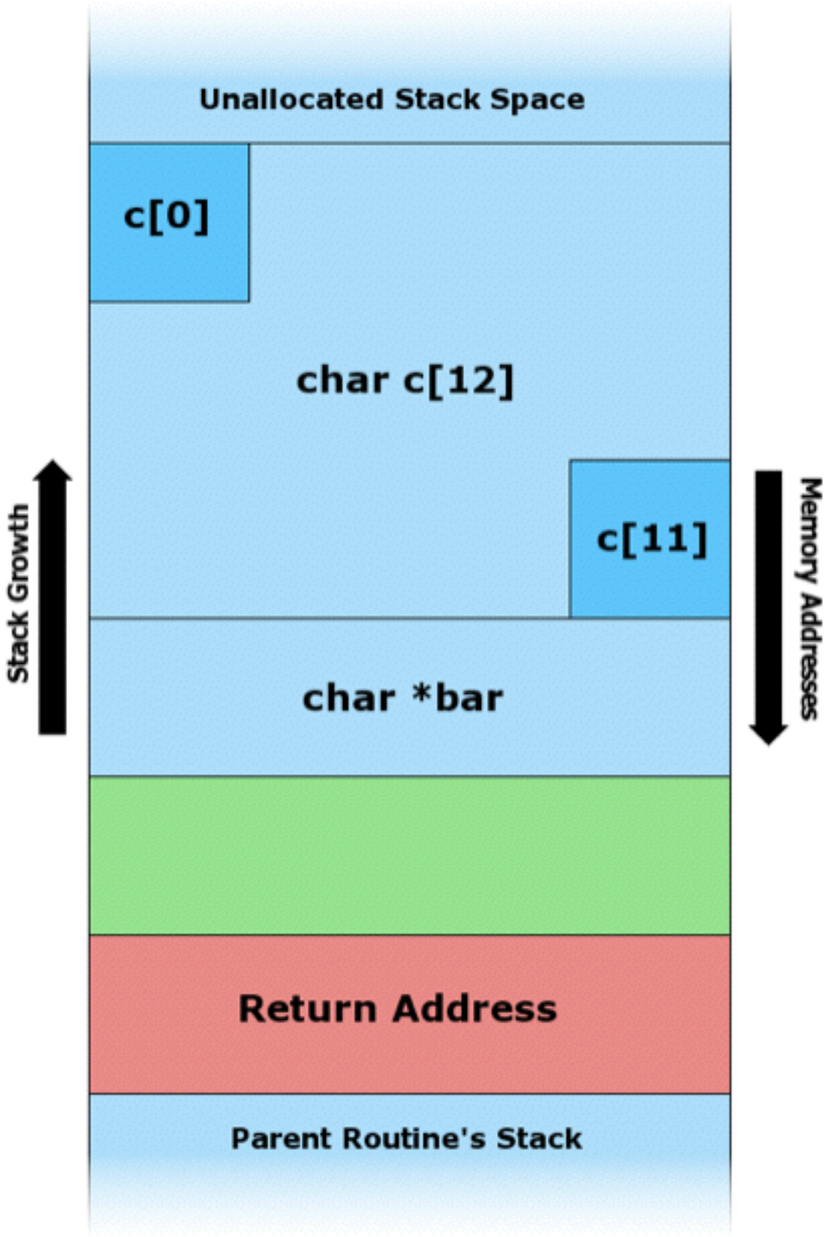
stack overflow

heap overflow

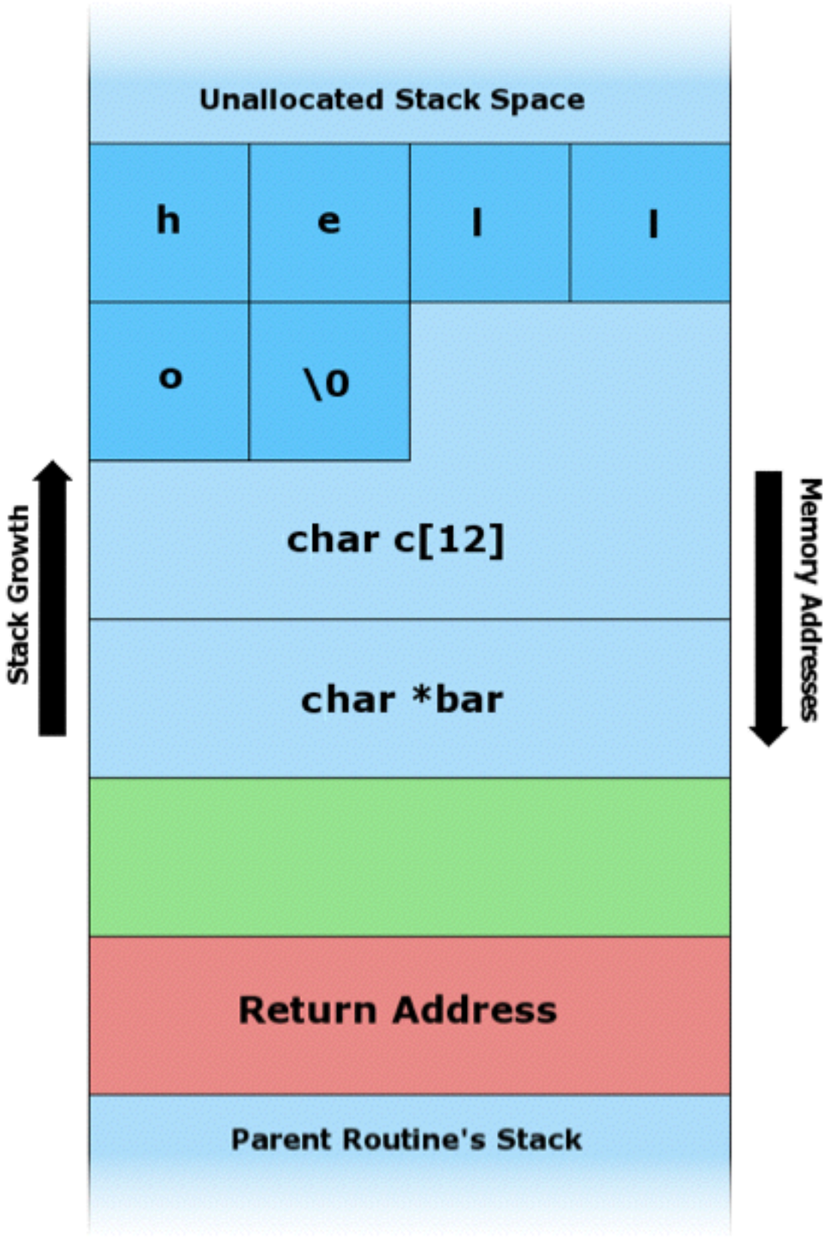
buffer overflow

```
#include <string.h>

void foo(char *bar)
{
    char c[12];
    memcpy(c, bar, strlen(bar));
}

int main(int argc, char *argv[])
{
    foo(argv[1]);
}
```

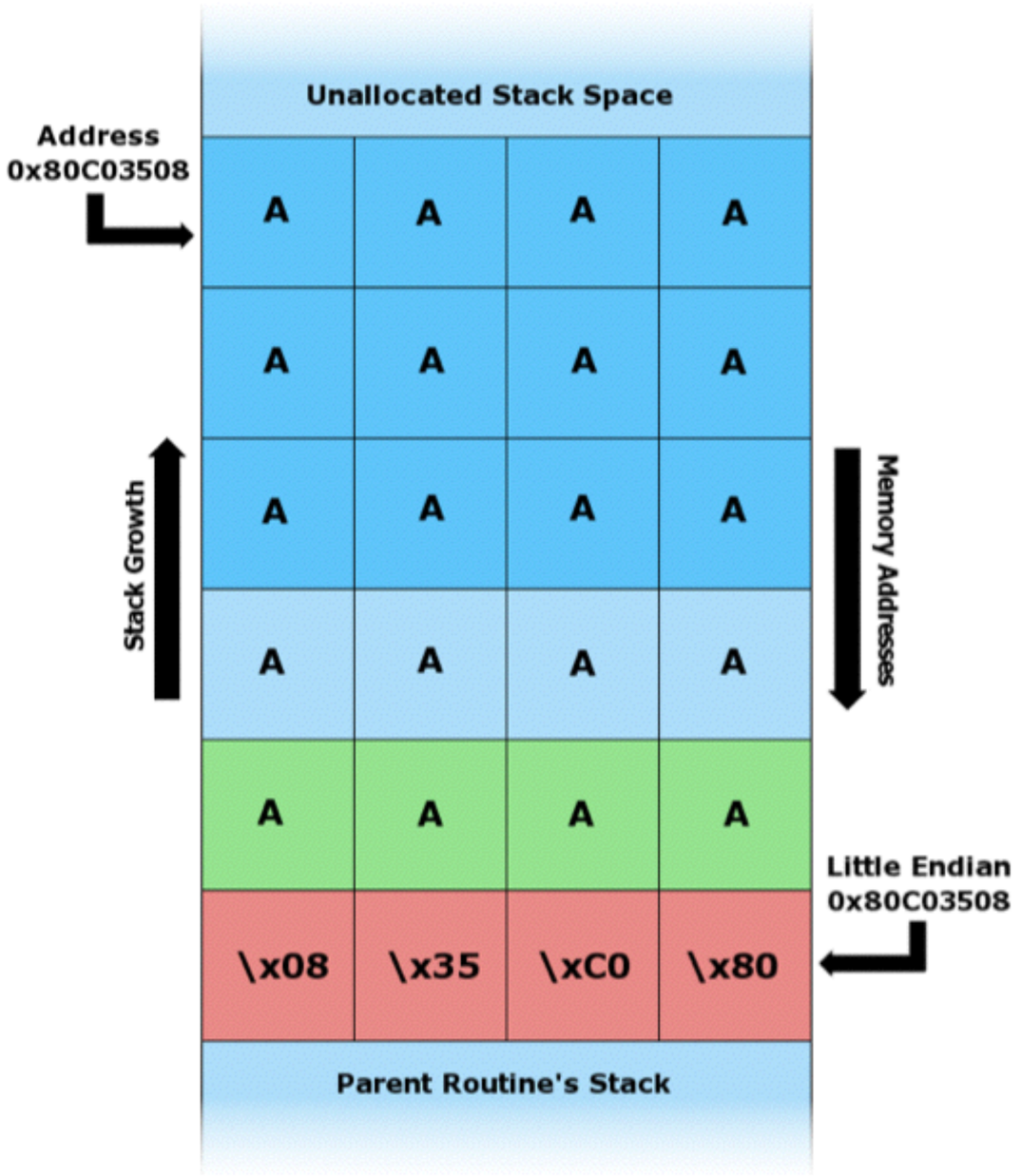
adapted from wikipedia.org/wiki/Stack_buffer_overflow



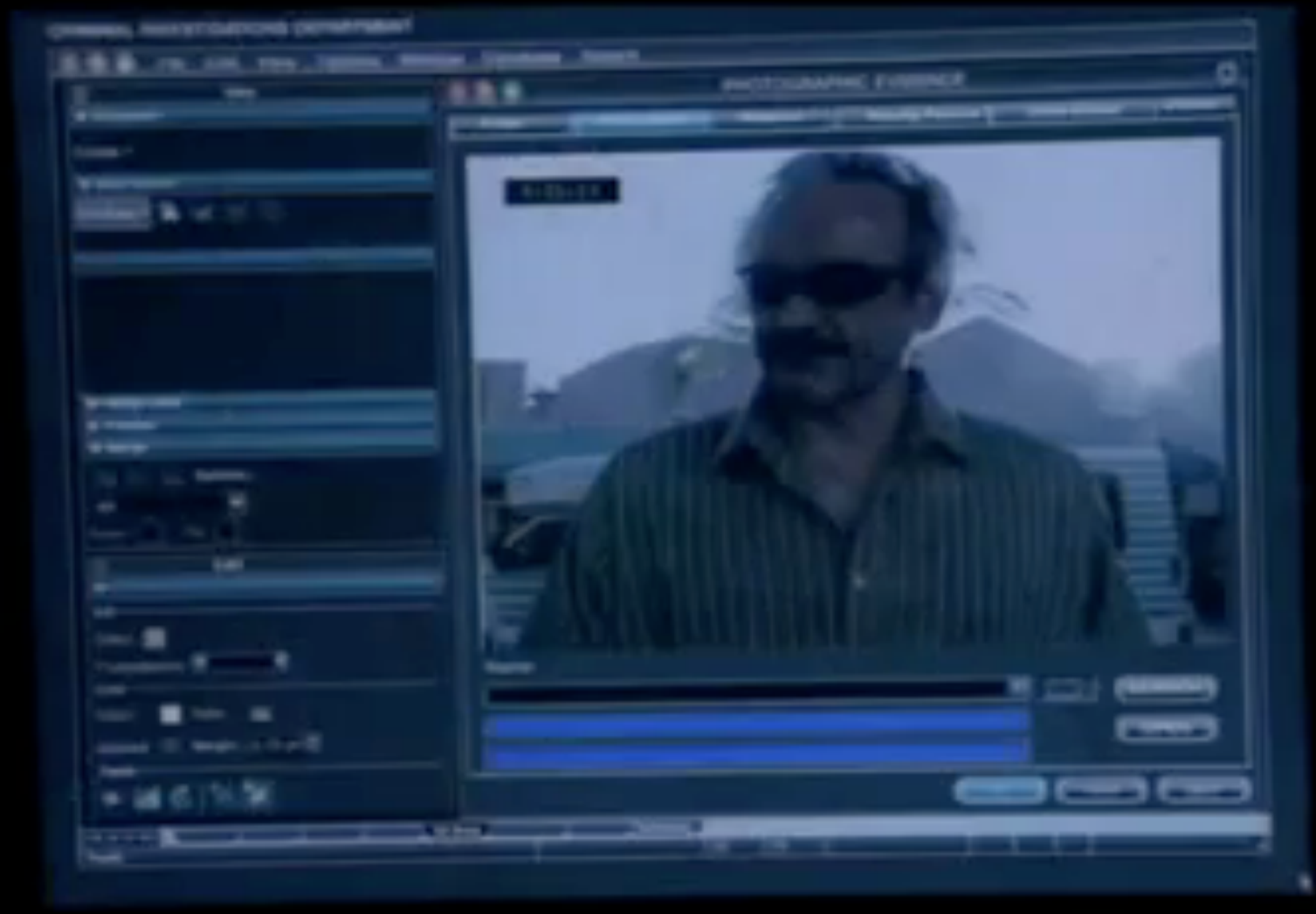
adapted from wikipedia.org/wiki/Stack_buffer_overflow



adapted from wikipedia.org/wiki/Stack_buffer_overflow

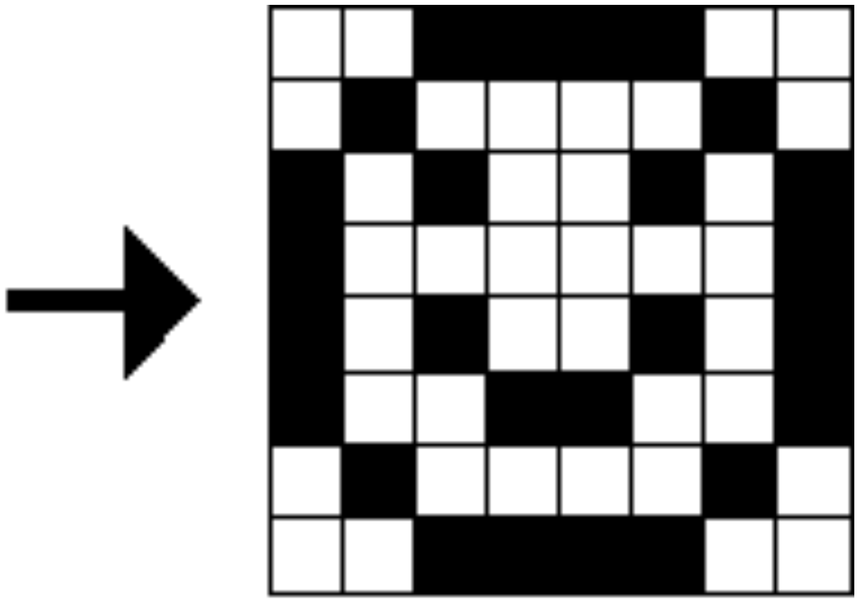


adapted from wikipedia.org/wiki/Stack_buffer_overflow



"enhance"

11000011
10111101
01011010
01111110
01011010
01100110
10111101
11000011



JPEG

255 216 255

decimal

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

binary

0, 1

hexadecimal

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f

255 216 255

255	216	255
11111111	11011000	11111111

255	216	255
1111 1111	1101 1000	1111 1111

255	216	255
1111 1111	1101 1000	1111 1111
f f	d 8	f f

255	216	255
1111 1111	1101 1000	1111 1111
f f	d 8	f f
0xff	0xd8	0xff

0xff 0xd8 0xff

BMP

offset	type	name	
0	WORD	bfType	BITMAPFILEHEADER
2	DWORD	bfSize	
6	WORD	bfReserved1	
8	WORD	bfReserved2	
10	DWORD	bfOffBits	
14	DWORD	biSize	BITMAPINFOHEADER
18	LONG	biWidth	
22	LONG	biHeight	
26	WORD	biPlanes	
28	WORD	biBitCount	
30	DWORD	biCompression	
34	DWORD	biSizeImage	
38	LONG	biXPelsPerMeter	
42	LONG	biYPelsPerMeter	
46	DWORD	biClrUsed	
50	DWORD	biClrImportant	
54	BYTE	rgbtBlue	RGBTRIPLE
55	BYTE	rgbtGreen	
56	BYTE	rgbtRed	
57	BYTE	rgbtBlue	RGBTRIPLE
58	BYTE	rgbtGreen	
59	BYTE	rgbtRed	

...

243	BYTE	rgbtBlue	RGBTRIPLE
244	BYTE	rgbtGreen	
245	BYTE	rgbtRed	

struct

```
typedef struct
{
    string name;
    string dorm;
}
student;
```

Week 4