The C programming language

```
main() { printf(&unix["\021%six\012\0"], (unix)["have"] + "fun" - 0x60); }
```

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Part 3 of 3

- standard C library
- strings in C, formatting
- data collections
  - stack
  - linked list
  - queues, trees, hashes and other
- program execution, process memory layout
- unit testing and integration testing
- to go further: calling conventions, ABI, SOs (DLLs), multithreading concepts

Standard C library headers

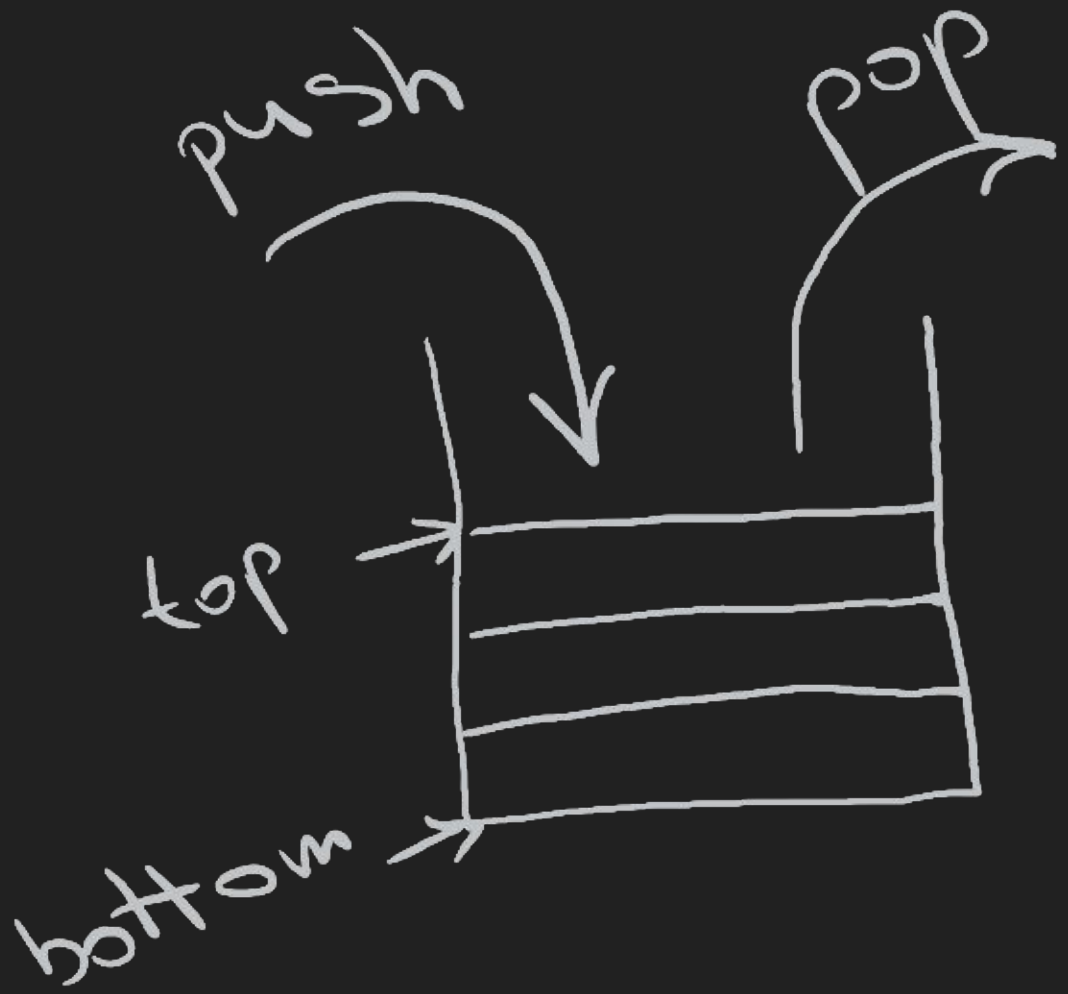
assert.h	complex.h	ctype.h	errno.h
fenv.h	float.h	inttypes.h	iso646.h
limits.h	locale.h	math.h	setjmp.h
signal.h	stdalign.h	stdarg.h	stdatomic.h
stdbool.h	stddef.h	stdint.h	stdio.h
stdlib.h	stdnoreturn.h	string.h	tgmath.h
threads.h	time.h	uchar.h	wchar.h
wctype.h			

Strings

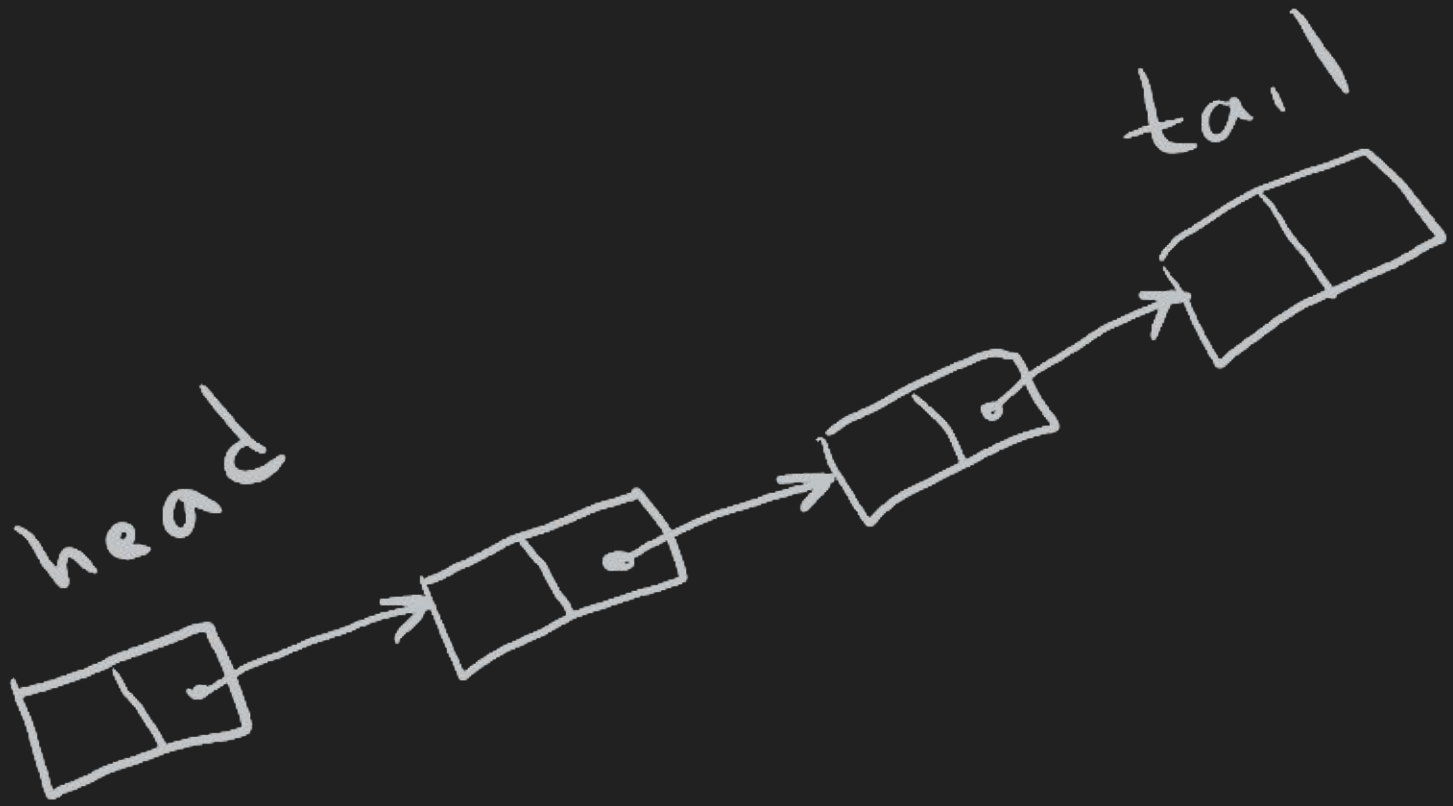
```
char a   = 'a',
     b[] = "b",
     *c  = "c";

char  sa[20] = "string";
char *sp     = "string";
// sizeof sa ?
// sizeof sp ?
// sa == &sa ?
// sp == &sp ?
// sa++ ?
// sp++ ?

int x = '1234';
char xar[] = { '1', '2', '3', '4' };
printf("  x: %x\n", x);
printf("xar: %x\n", *(int *)xar);
```

Stack

LIFO



Linked list



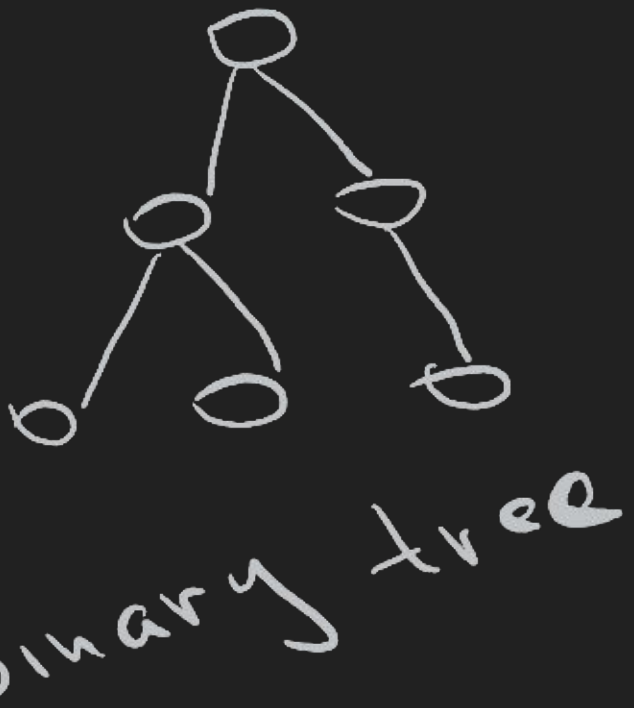
Queues

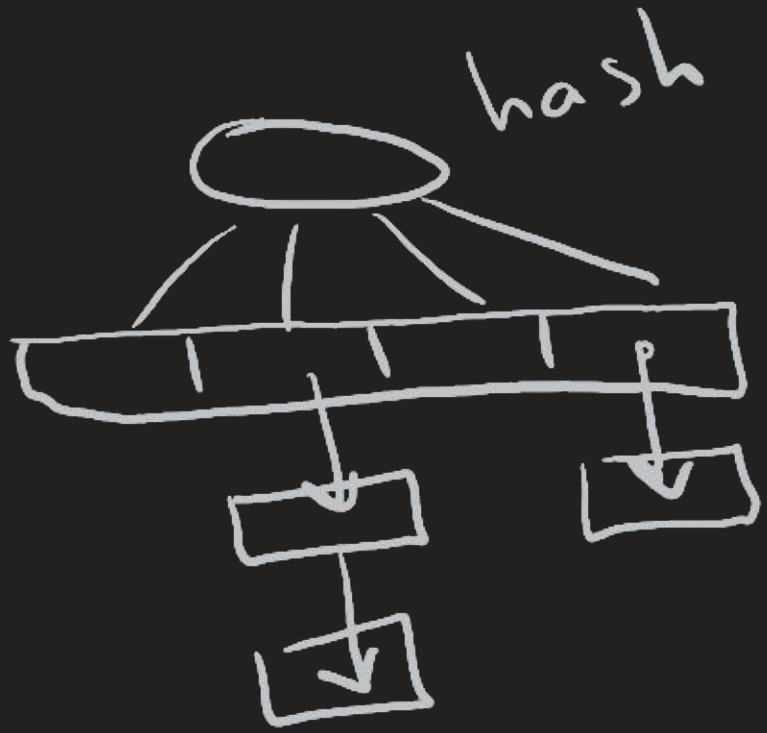
FIFO

queue

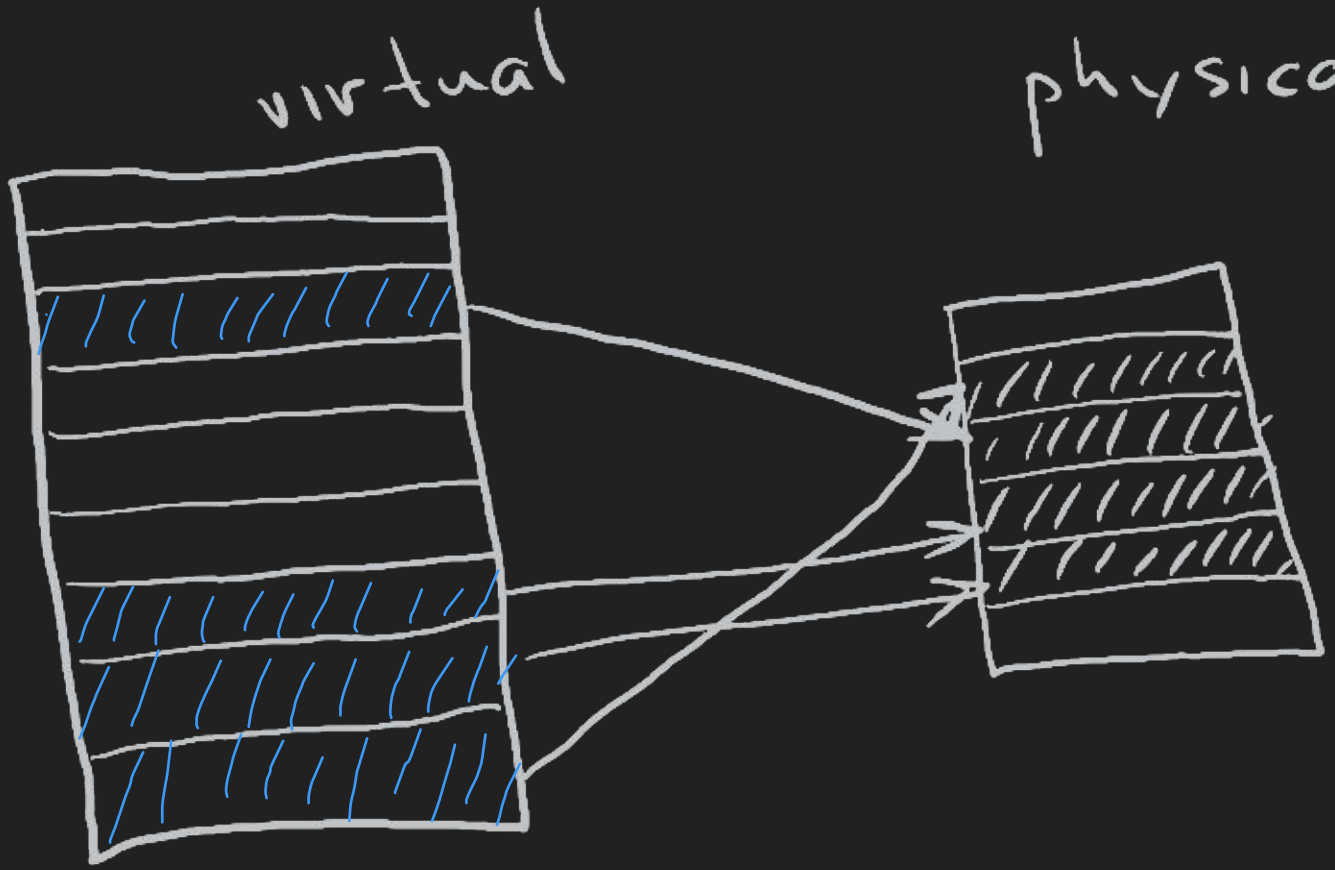
deque

Trees, hashes

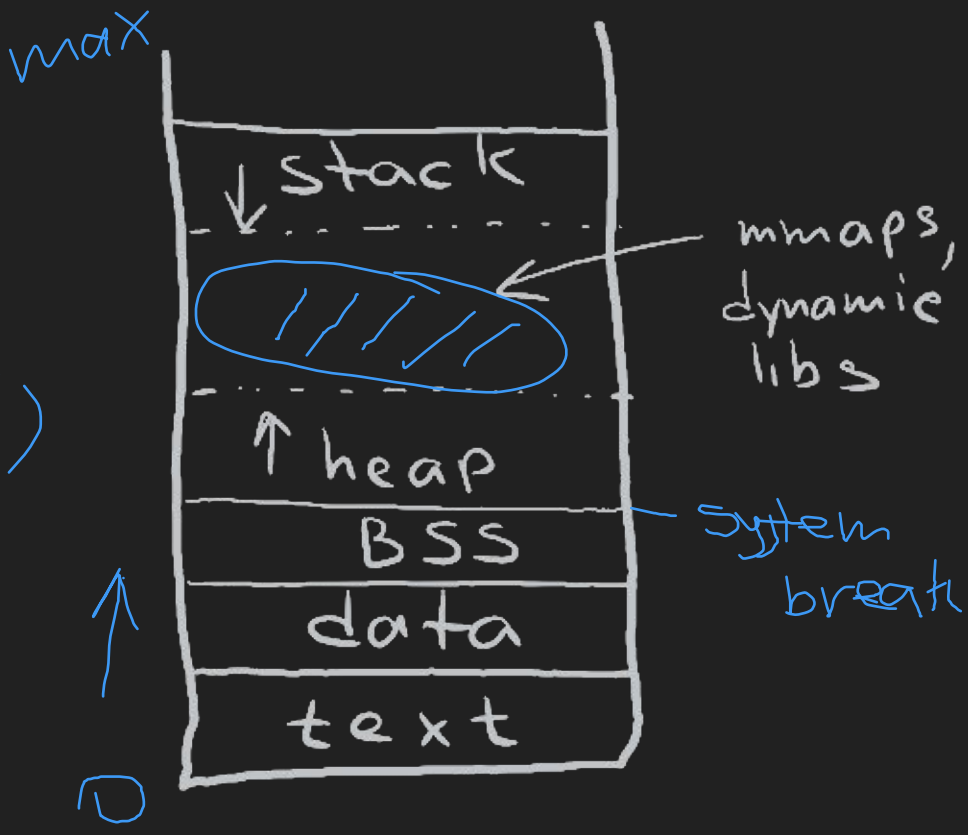




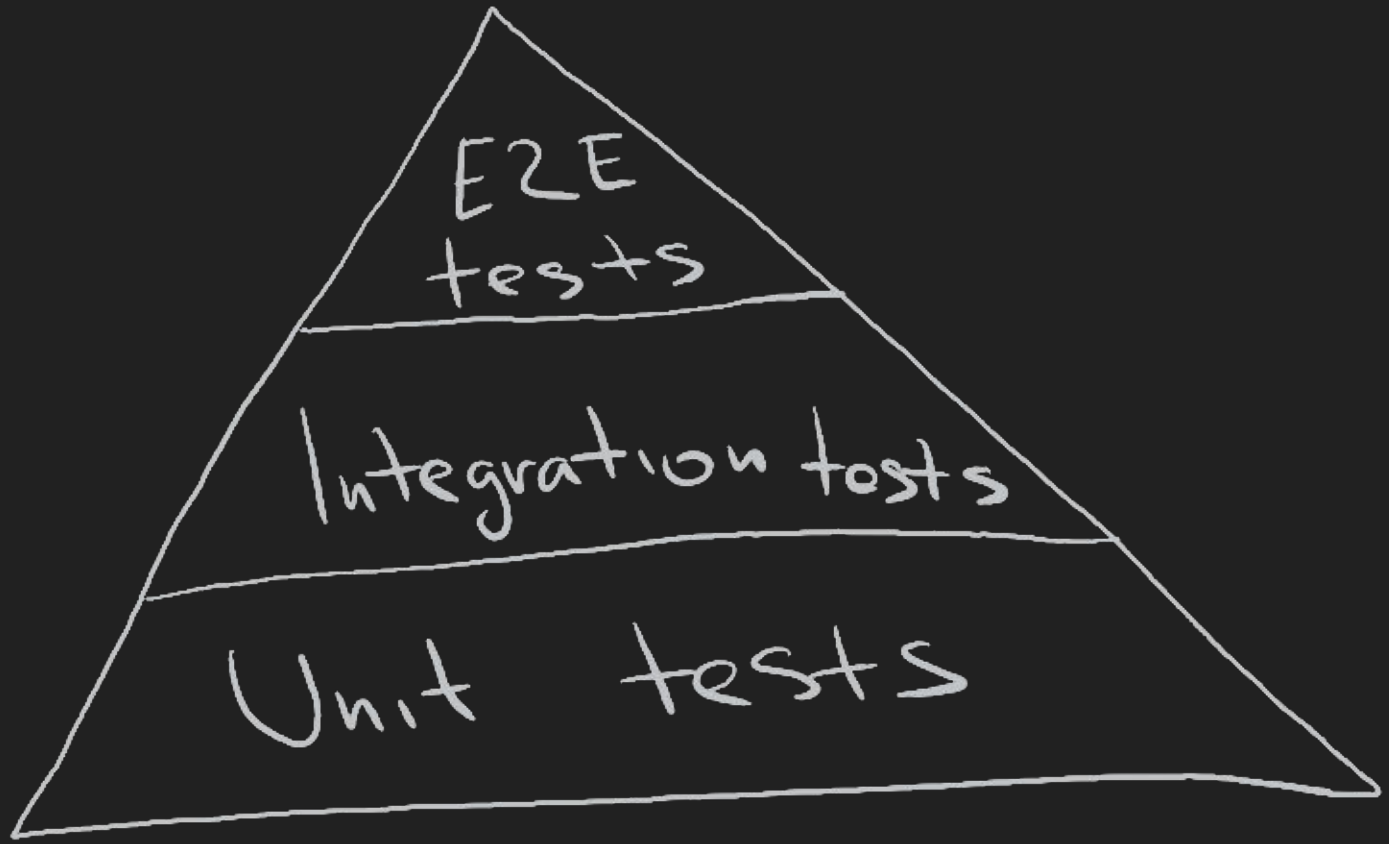
Virtual memory



Process memory



Testing pyramid



Home tasks

1. Write a function that copies a string to a new one dynamically allocated. The function should return the new string address or NULL in case of error. Avoid using the standard functions from string.h.
2. Write a stack library based on a linked list. Minimum set of operations: push(), pop().
3. Write a queue library based on an array. Minimum set of operations: enqueue(), dequeue().
4. Write the "map" function that receives an array of items, its size, and a function to apply individually to each item of the array. "map" could modify existing array or return a new one.
5. [OPTIONAL] Explain how the code from the title slide works (or unfold the code in text, make it simpler).