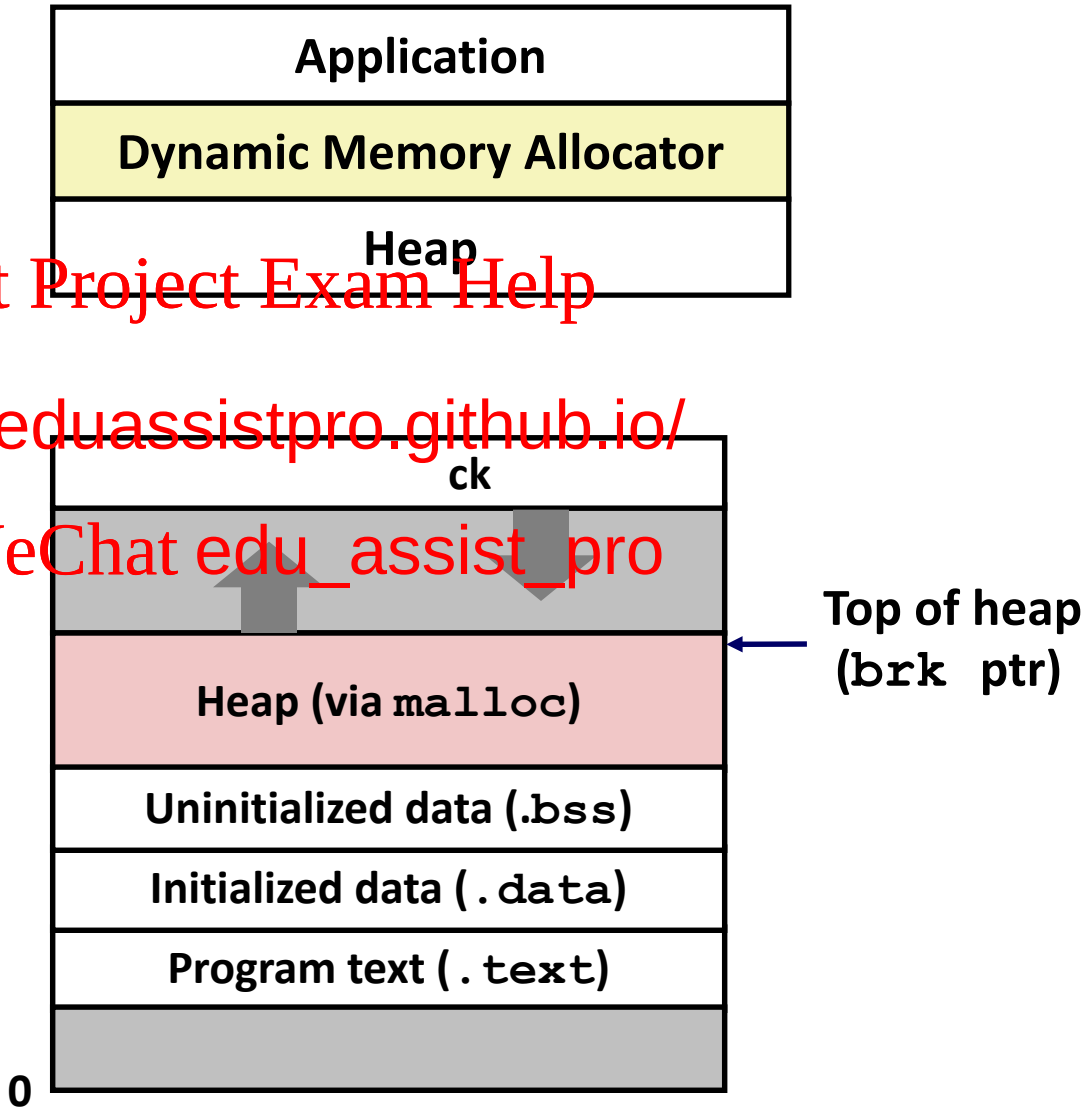
Dynamic Memory Allocation

- Programmers use *dynamic memory allocators* (such as `malloc`) to acquire VM at run time.
  - For data structu
    size is only known at
    runtime.
- Dynamic memory allocators manage an area of process virtual memory known as the *heap*.



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Dynamic Memory Allocation

- **Allocator maintains heap as collection of variable sized *blocks*, which are either *allocated* or *free***
- **Types of allocators**
  - ***Explicit allocato*** es space
    - E.g., `mall`
  - ***Implicit allocator:*** application alloc not free space
    - E.g. garbage collection in Pytho d Lisp

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- **Will discuss simple explicit memory allocation today**

The `malloc` Package

```
#include <stdlib.h>

void *malloc(size_t size)
```

- Successful:
  - Returns a pointer to a memory block of at least **`size`** bytes (typically) aligned to 8-byte boundary
  - If **`size =`**
- Unsuccessful: r **`o`**

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```
void free(void *p)
```

- Returns the block pointed at by **`p`** to pool of available memory
- **`p`** must come from a previous call to **`malloc`** or **`realloc`**

Other functions

- **`calloc`:** Version of **`malloc`** that initializes allocated block to zero.
- **`realloc`:** Changes the size of a previously allocated block.
- **`sbrk`:** Used internally by allocators to grow or shrink the heap

malloc Example

```
void foo(int n, int m) {
    int i, *p;

    /* Allocate a block of n ints */
    p = (int *) malloc(n * sizeof(int));
    if (p == NULL) {
        perror("malloc");
        exit(0);
    }

    /* Initialize allocated block */
    for (i=0; i<n; i++)
        p[i] = i;


    /* Return p to the heap */
    free(p);
}
```

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