Programming Paradigms

CT331 Week 4 Lecture 1

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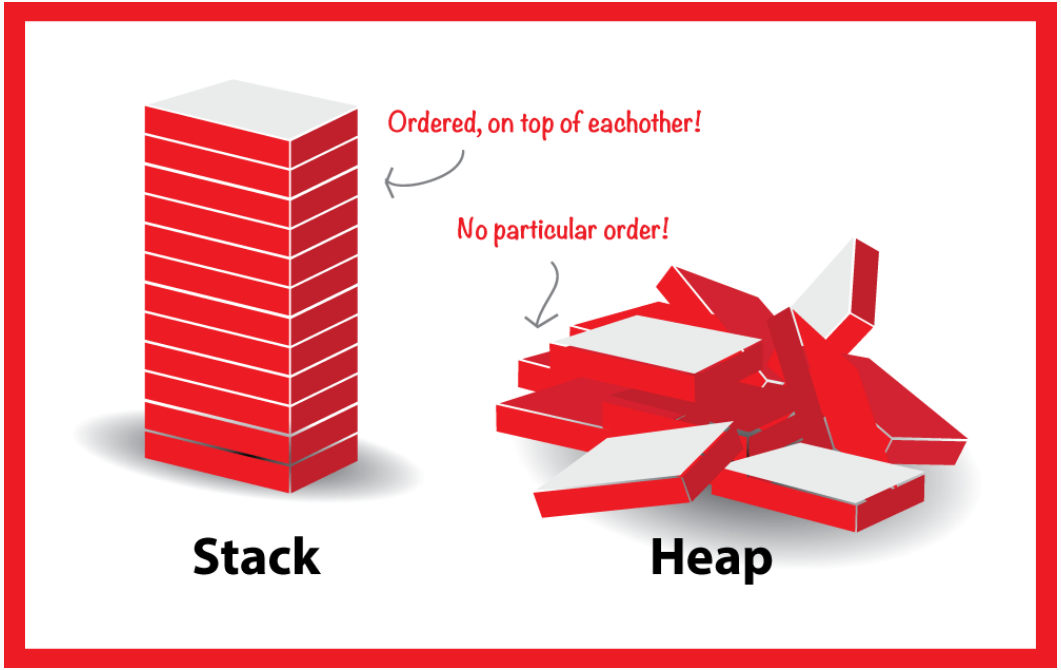
More Memory Allocation

Heap vs. Stack

Stack:



Heap vs. Stack

Stack:

- LIFO
- Push / Pop
- Limited size
- Limited access (scope)
- Very Fast

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```
char a = ‘a’;

int b = 100;
Int c = 50;

void swap(int* x, int* y){
                int temp = *x;
                *x = *y;
                *y = temp;
}

swap(b, c);
```

First, a, b and c are pushed onto the stack.

When swap() is called,
x , y and temp are pushed onto the stack.

When swap returns, x, y and temp are popped from the stack.

Their memory is no longer in use.

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What if we wanted to keep track of temp and use it later?

Heap vs. Stack

Heap:

- Unordered
- allocate / free
- unlimited size*
- global access (threads)
- Slower

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```
int b = 100;
Int c = 50;

void* swap(int* x, int* y){
        Int temp = *x;
        int* perm = malloc(int);
        perm = &temp;
        x = y;
        y = *perm;
    return perm;
}

void* p = swap(b, c);
…
free(p);
```

First, b and c are pushed onto the stack.

When swap() is called, x , y and temp are pushed onto the stack.

We allocate space in memory for perm using malloc.

When swap returns, x, y and temp are popped from the stack.

The memory allocated to perm is still in use!

Heap vs. Stack

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Ok, so we could just return temp in the same way but...

- Even when this function terminates, another function can access perm using that pointer.
- If we need to store a large amount of data (or an undeterminable amount of data) we can safely use heap.
    - No risk of stack overflow.
    - No risk of losing reference or accidental deallocation of memory.

Heap vs. Stack

Stack Pros:

- Fast
- Easy to manage

Stack cons:

- Limited size (stack overflow)
- Limited access (scope / closures)
- Cannot free memory

Heap Pros:

- Unlimited size
- Unlimited access

Heap Cons:

- Harder to manage (memory leaks!)
- Slower