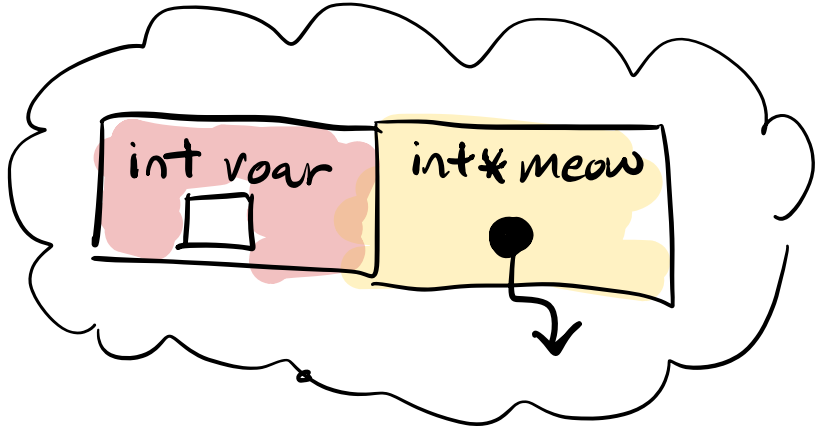


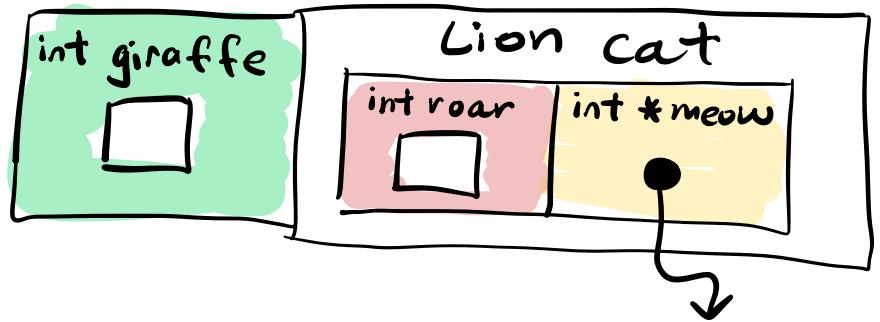
Some Pointers on Cats

Ben Yan

```
struct Lion {
    int roar;
    int* meow;
}
```



```
struct Savannah {
    int giraffe;
    Lion cat;
}
```

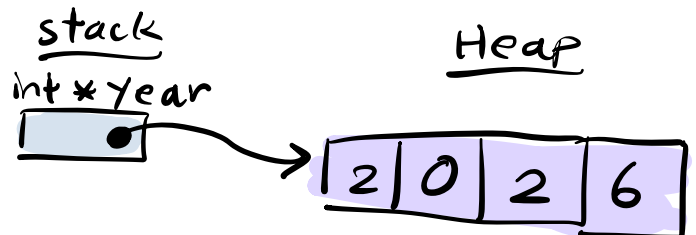


Task: Trace through this function, drawing the program's memory (stack & heap) at the designated spot.

```
void explore(Savanna *prairie) {
    Lion *leader = &((*prairie).cat);
    (*leader).meow = new int(2);
    (*leader).roar = 2;
    (*leader).meow = new int(3);
}

void kittens() {
    Savanna *habitat = new Savanna[3];
    habitat[1].giraffe = 3;
    explore(habitat);
    habitat[0].giraffe = 8;
    // DRAW THE MEMORY AS IT LOOKS HERE
}
```

* Indicate which variables are on stack vs. heap, eg.



* Indicate orphaned memory

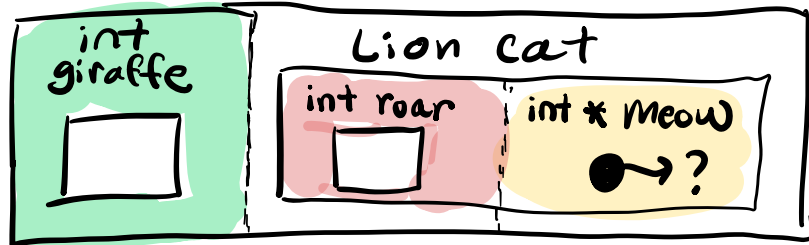
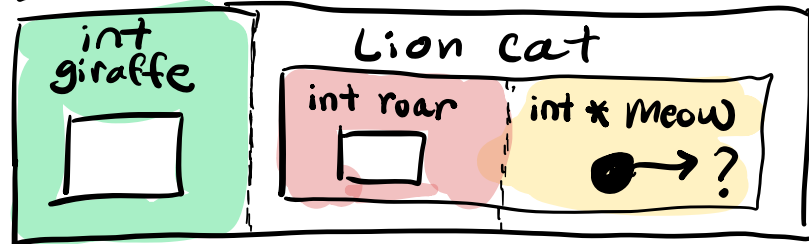
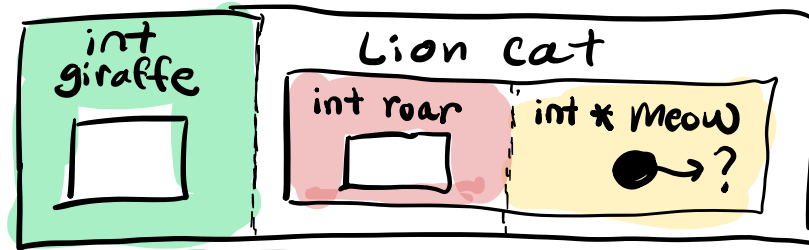
* Indicate with a ? any memory we don't know the value of, eg, uninitialized

kittens()

Savannah * habitat = new Savannah[3];

Stack (Kittens)

Heap

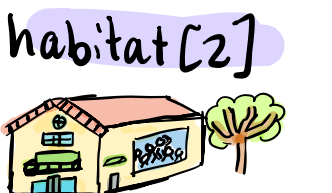
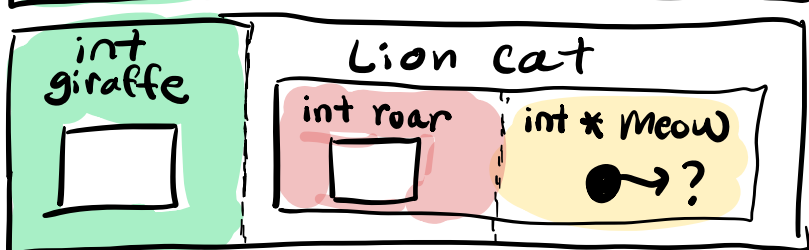
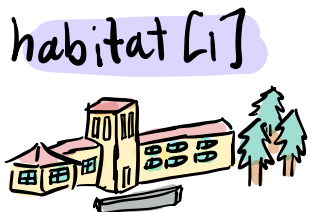
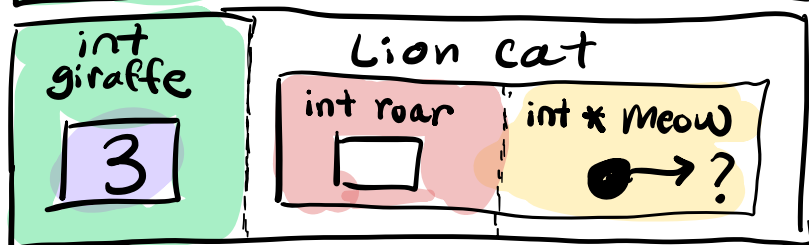
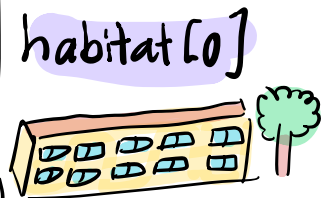
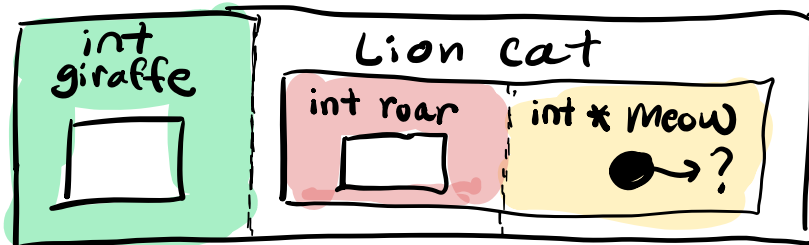


kittens()

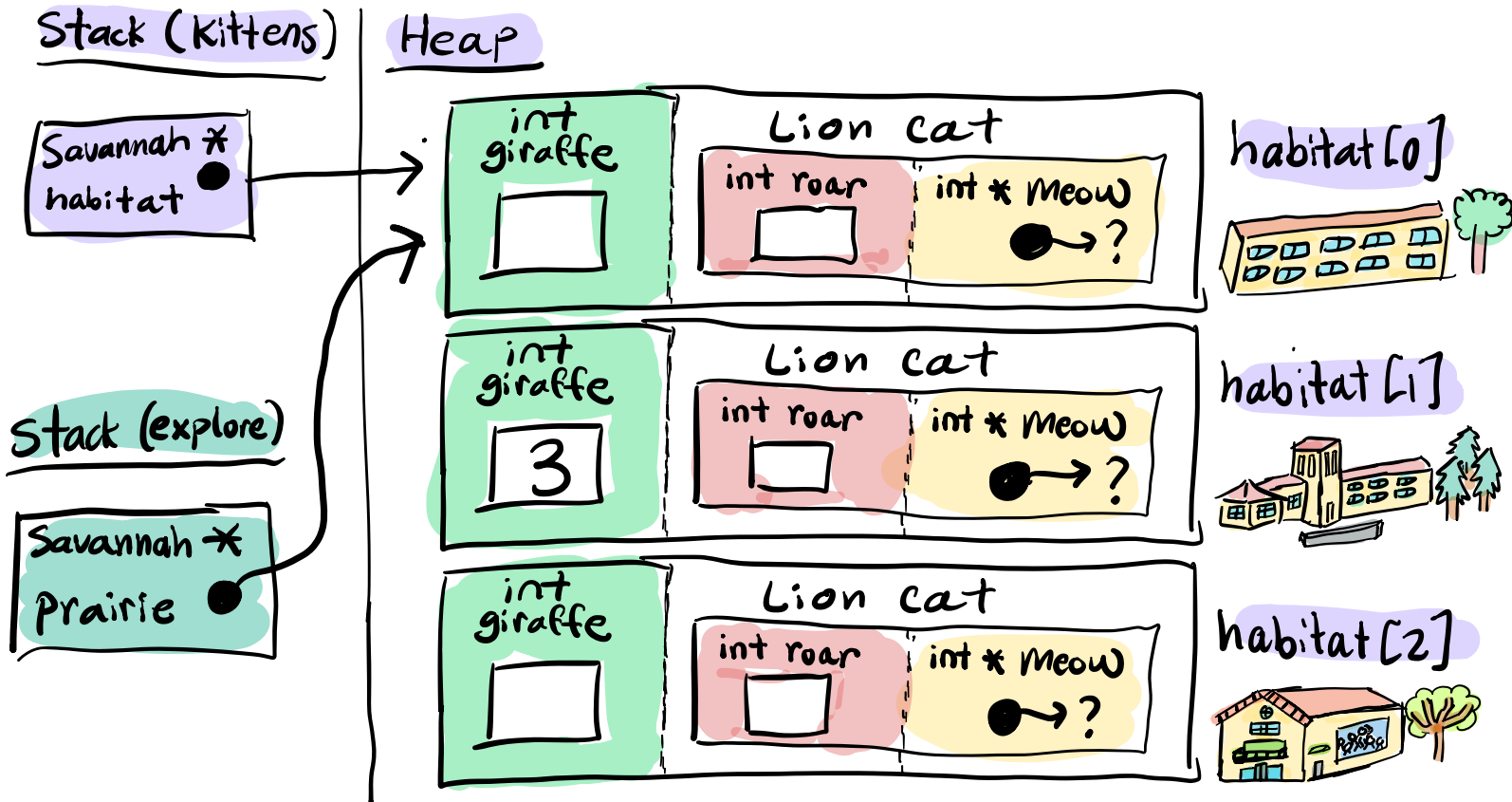
habitat[1].giraffe = 3;

Stack (Kittens)

Heap

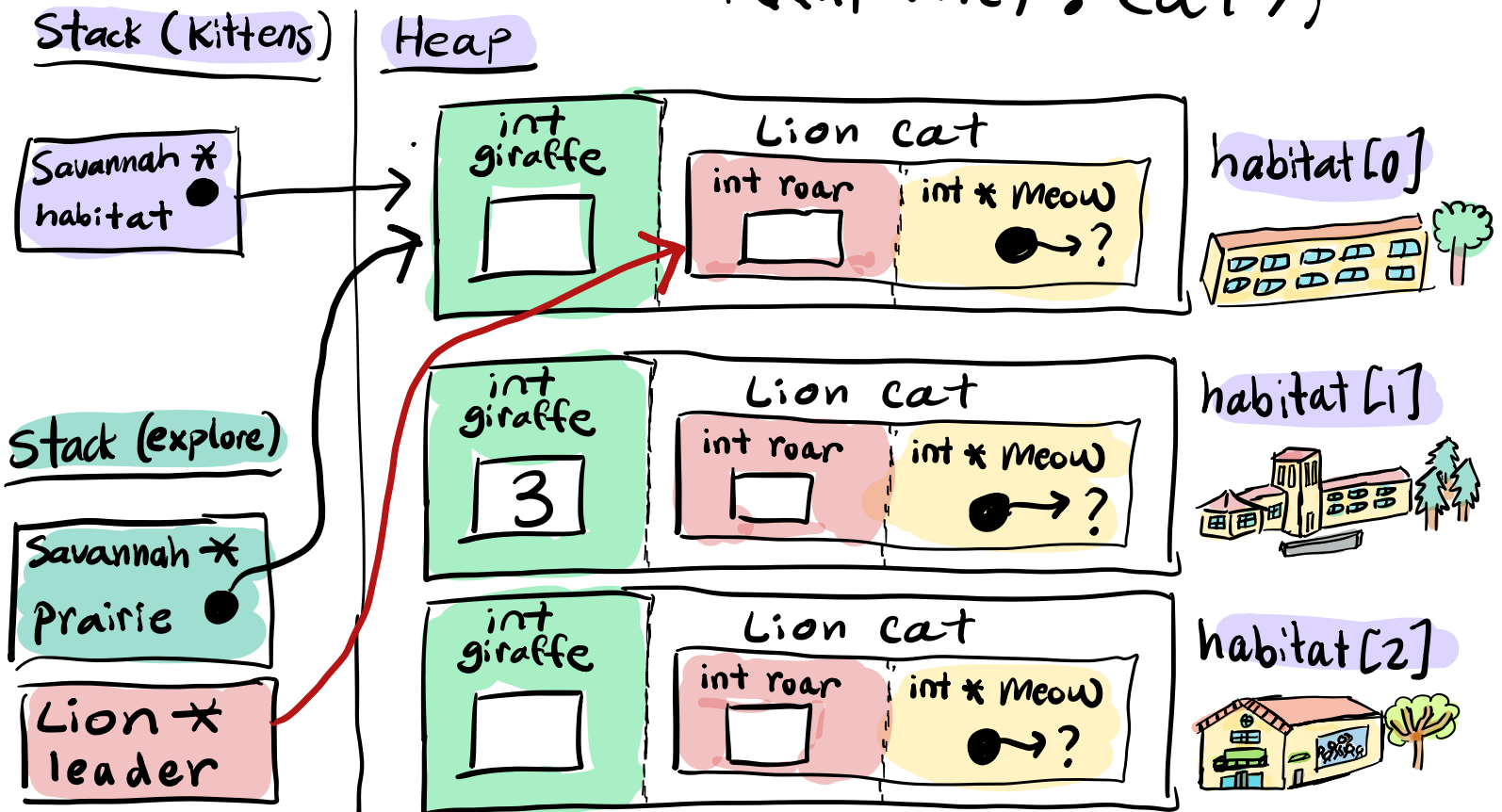


kittens() → explore(Savannah * prairie);
 explore(habitat) calls



explore()

Lion * leader = &((*prairie).cat);

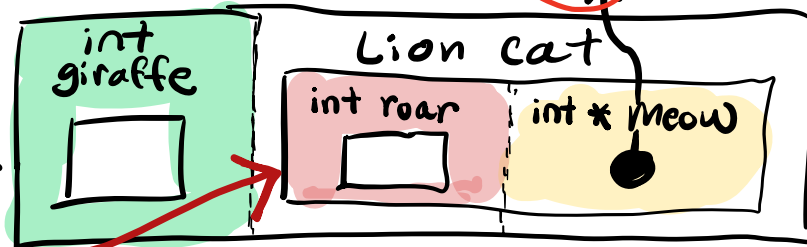


explore()
(*leader).meow = new int(2);

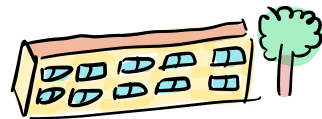
Stack (Kittens)

Heap

Savannah *
habitat

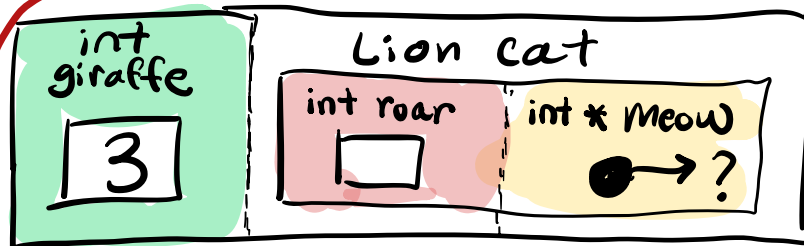


habitat[0]

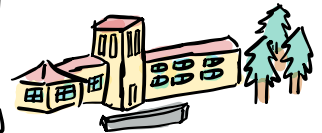


Stack (explore)

Savannah *
Prairie



habitat[1]



Lion *
leader



habitat[2]

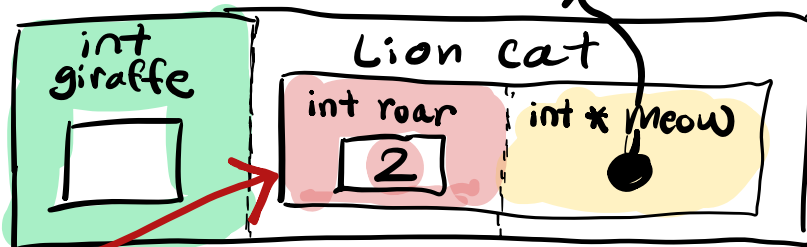


explore()
(*leader).roar = 2;

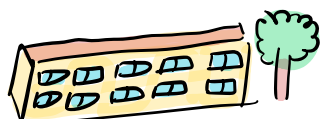
Stack (Kittens)

Heap

Savannah *
habitat

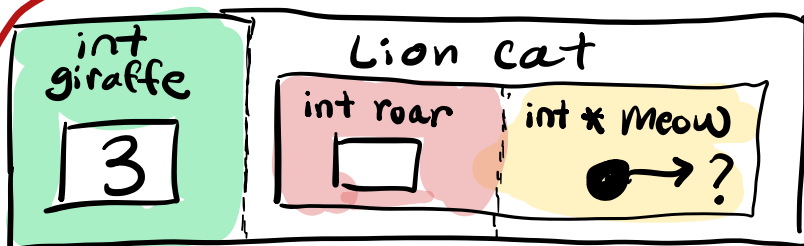


habitat[0]

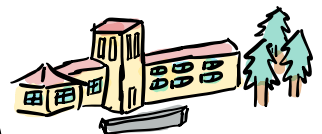


Stack (explore)

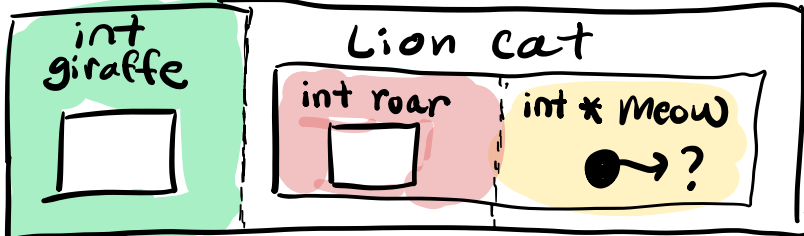
Savannah *
Prairie



habitat[1]



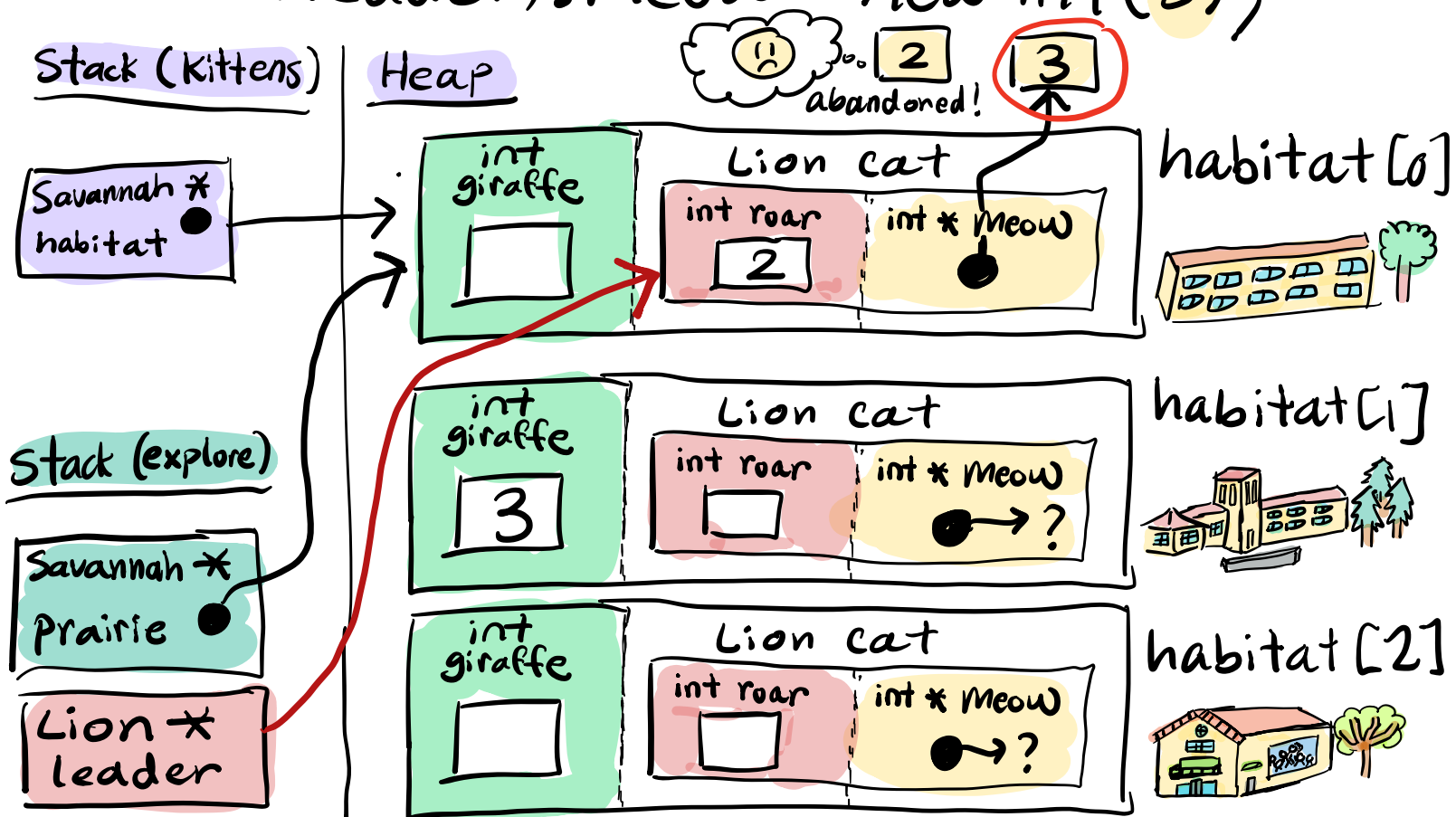
Lion *
leader



habitat[2]



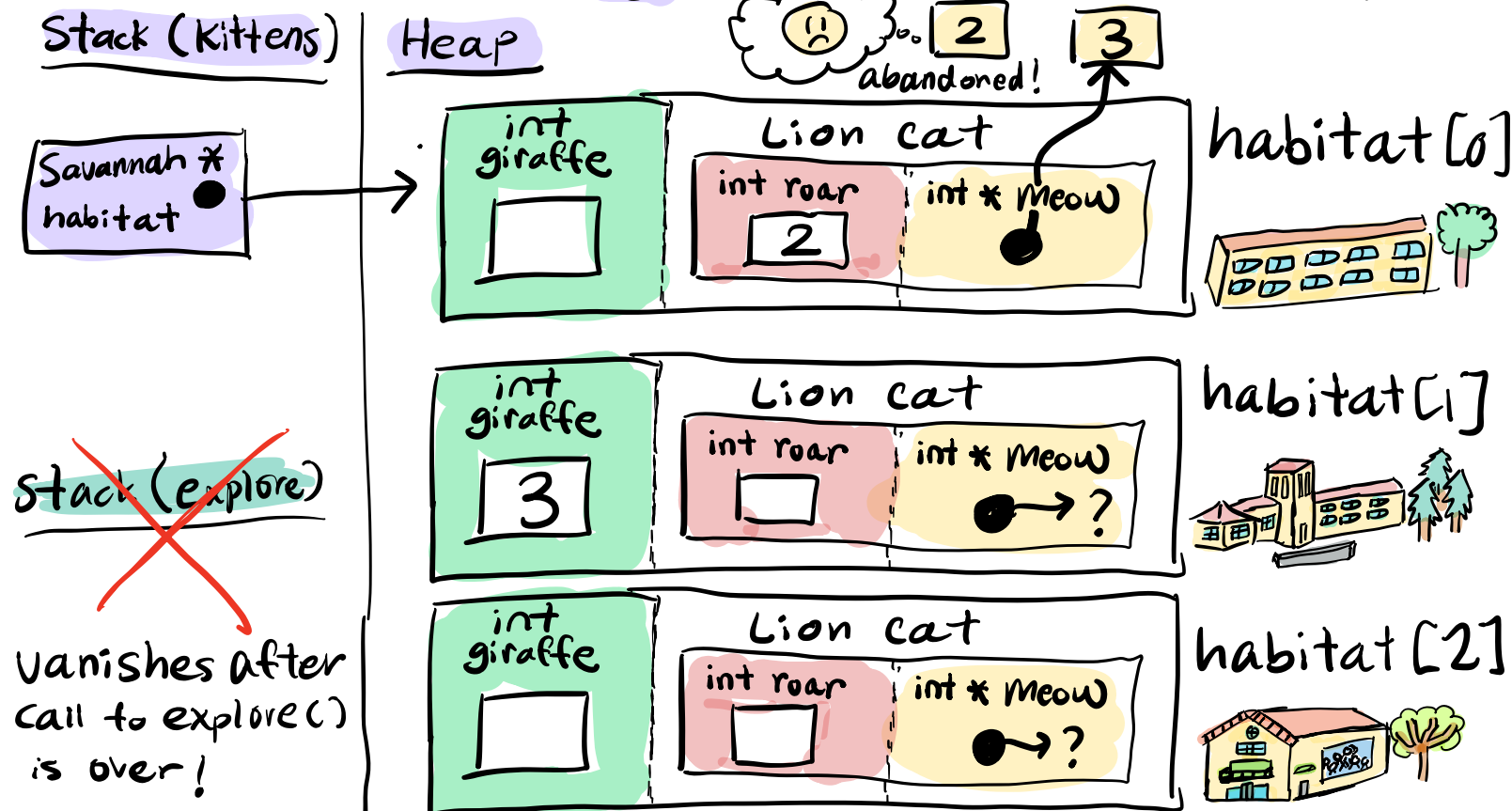
explore()
 (*leader).meow = new int(3);



explore()

return back to

kittens();
 explore(habitat); ✓



explore()
habitat[0].giraffe = 8;

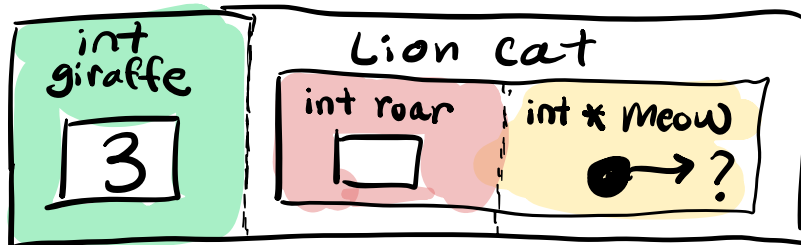
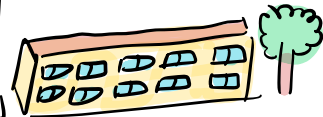
Stack (Kittens)

Heap

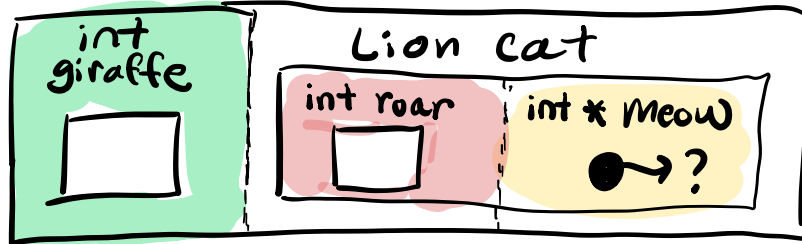
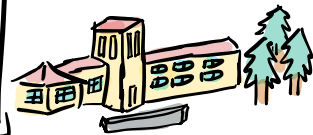
Savannah *
habitat



habitat[0]



habitat[1]



habitat[2]



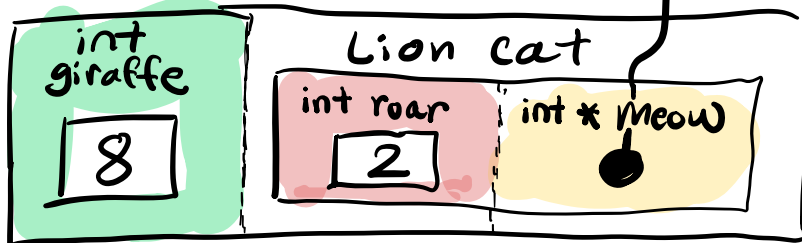
Final State of Memory

- for uninitialized / unknown values, ☹ for leaked memory

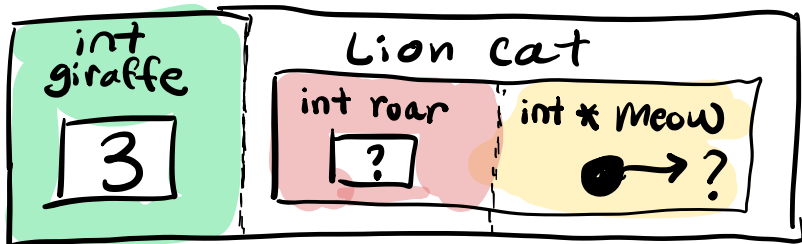
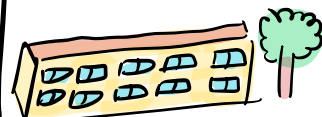
Stack (Kittens)

Heap

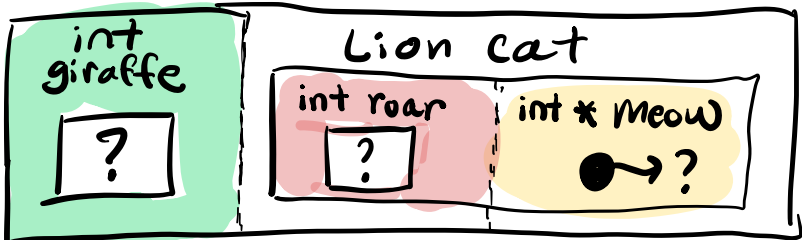
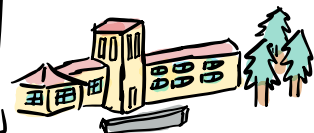
Savannah *
habitat



habitat[0]



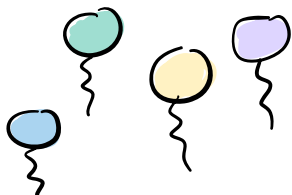
habitat[1]



habitat[2]



Welcome to
Stanford!



To 4 years of adventure