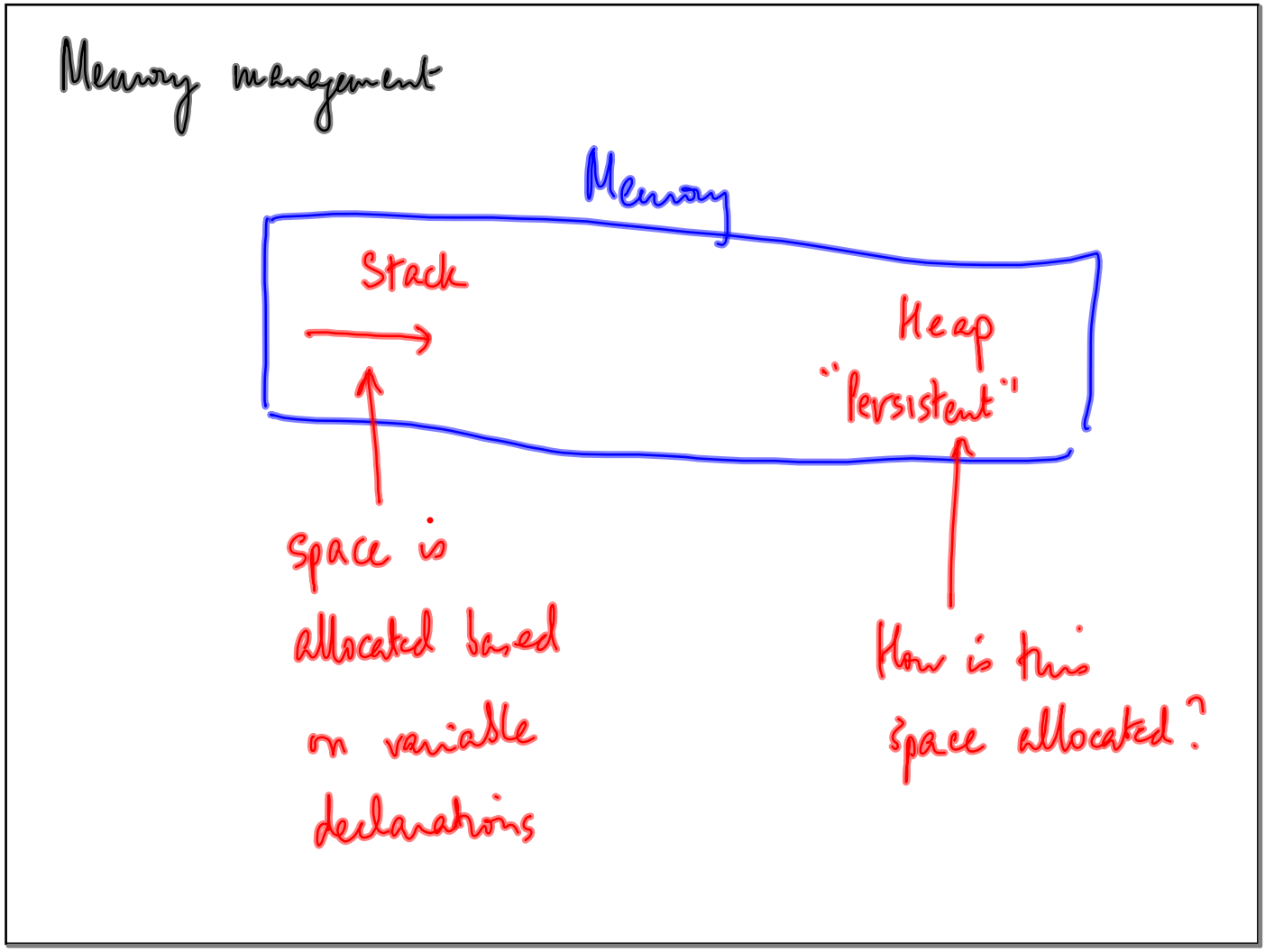
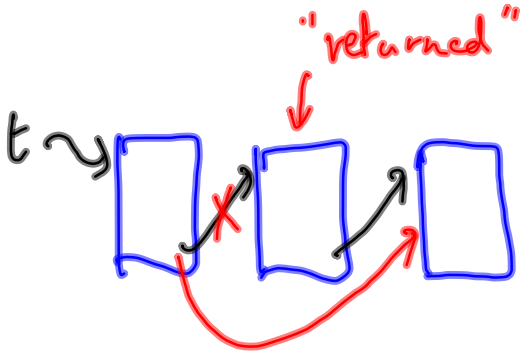
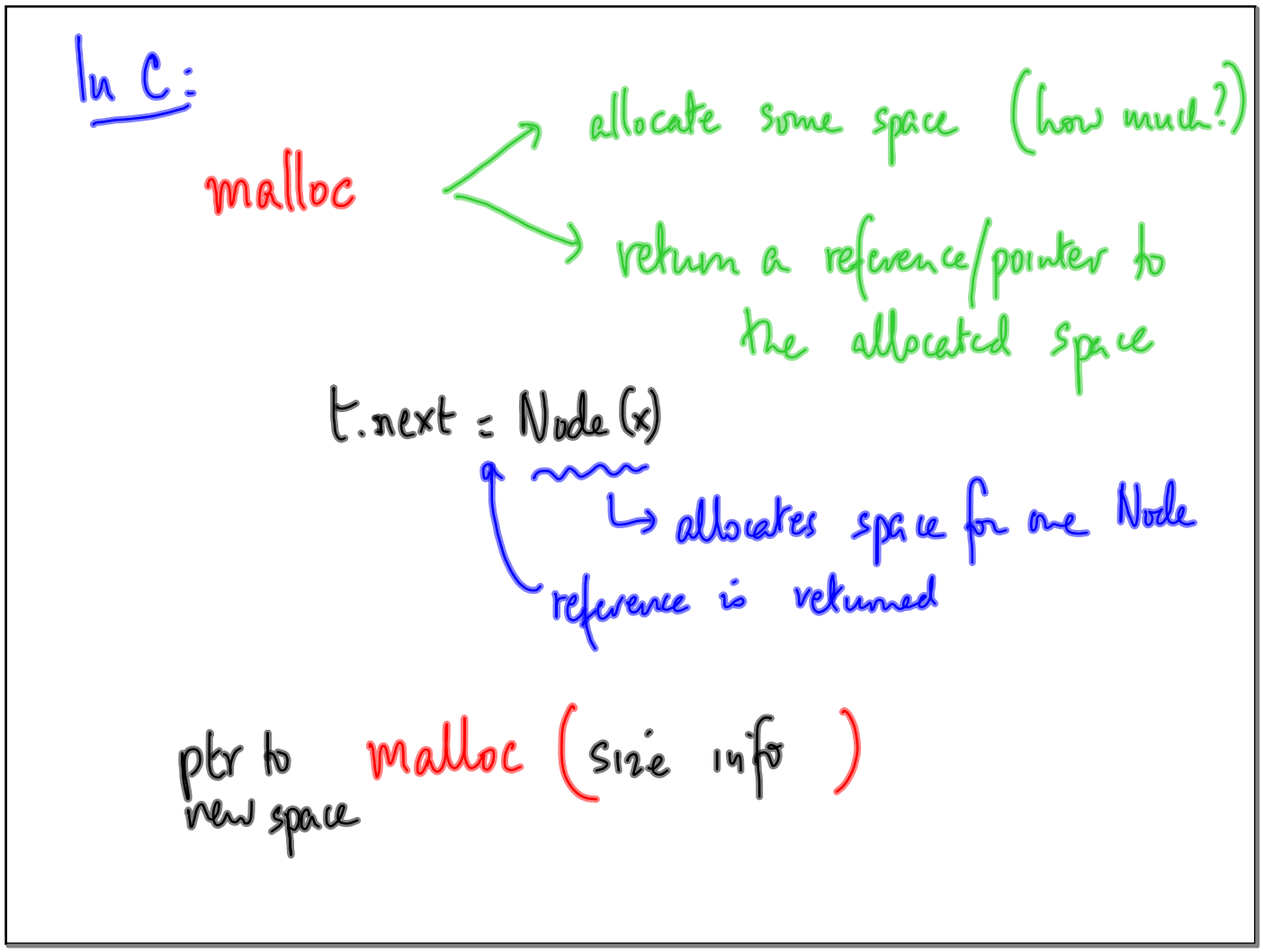

Memory management
Memory
Stack
Heap
"Persistent"
Space is allocated based on variable declarations
How is this space allocated?

```
class Node:
    def append(self, x):
        .
        .
        t.next = Node(x)
    def delete(self, x):
        :
        t.next = t.next.next
```

← implicitly creates space on the "heap"




In C:
malloc
allocate some space (how much?)
return a reference/pointer to the allocated space
t.next = Node(x)
allocates space for one Node
reference is returned
ptr to new space
malloc (size info)

We need to obtain size of a datatype

sizeof(int)
sizeof(float)

Can then use this like a number

```
int *a;
a = malloc(75 * sizeof(int))
```
(not quite!)

*(a+i) is same as a[i] etc

Weak type of polymorphism

return type of malloc is (void *)

int *a; Type of a is (int *)

generic pointer

Use explicit type conversion = "type casting"

```
int x,y; float z;
z = ((float)x)/y ;
```

```
int *a;
a = (int *)malloc(75 * sizeof(int));
```

Returning free space to the heap:

```
free(a);
```

a must point to space got from previous malloc

What would `free(a+5);` mean?

malloc may fail

returns NULL - for pointers, C equivalent of Python None

Should always use malloc as follows:

```
a = (int *) malloc( --);
if (a != NULL) { -- }
```

Defining dynamic data structures

Need to define "units" such as


```
struct pair {
    int x;
    int y;
};
struct pair p,q;
```

name of new user defined type

– defines/declares two concrete variables of this new type

Access components of struct using .

```
p.x = 17;

q.y = p.x;
```

:

Recursive datatype

```
struct node {
    int value;
    struct node *next;
};
```

A function to create a node with a given value

```
(struct node *)createnode (int v) {
        struct node *temp;
        temp = (struct node *) malloc (sizeof(struct node));
        if (temp != NULL) {
            (*temp).value = v;
            (*temp).next = NULL;
        }
        return (temp);
}
```

(*p).v occurs very often

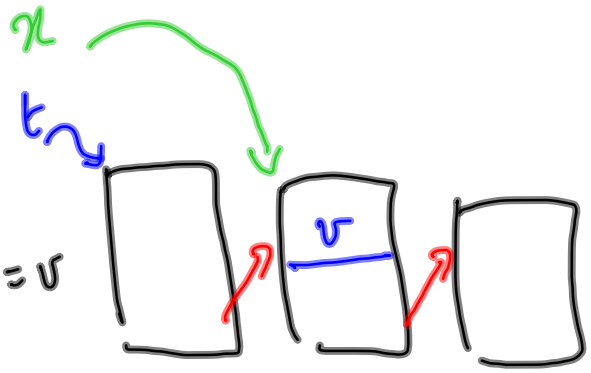
equivalently written as

p->v

```
:
if (temp != NULL){
    temp -> value = v;
    temp -> next = NULL;
}
```

```
... delete (struct node *l, int v) {
  .
  .
  .
  search for v s.t.
    (t->next)->value = v
  x = t->next;
  t->next = (t->next)->next;

  free(x);
```



MUST return deleted node to heap

Function prototypes

Give a summary of a function's arguments & return types before it is used

(unless return type is int)

```
int factorial(int);
int main() {
    : ← factorial(x)
}
int factorial(int n) {
}
```