CSC230

Intro to C++ Lecture 10

Outline

- Memory Management

Dynamic memory in C

void * malloc(int num_bytes)

- Function defined in stdlib.h
- Allocates num_bytes of bytes and return a pointer to the allocated block of memory

free(void* ptr)

- Function defined in stdlib.h
- Return the memory pointed by ptr. The memory will be re-used by subsequent malloc calls

```
#include<stdio.h>
#include<stdlib.h>

int main()
{
  int *ptr;

  ptr = (int *)malloc(sizeof(int));

  *ptr = 25;
  free(ptr);
  return 0;
}
```

Both gcc and g++ can compile this code

Dynamic memory in C++

new

- Allocates memory from heap
- Returns a **pointer** to the memory
  - double *ptr = new double;
  - int *array = new int[24];

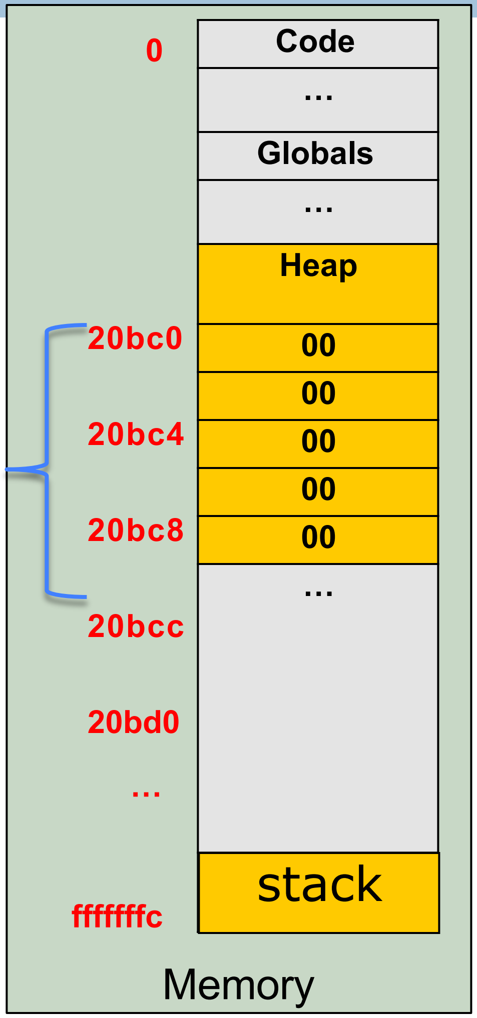
delete

- Returns the memory to heap
- followed by the pointer to the data that you want to deallocate
  - delete ptr;
  - delete [] ptr; // ptr is a pointer to an array

Dynamic memory allocation

```
#include <iostream>
using namespace std;

int main(int argc, char *argv[]){
  int count;
  cin >> count;
  int *salary=new int[count];
  delete [] salary;
  return 0;
}
```



new allocates:

salary[0]

salary[1]

salary[2]

salary[3]

salary[4]

What to fill?

- int*
- double*
- char*
- **char****
- color*

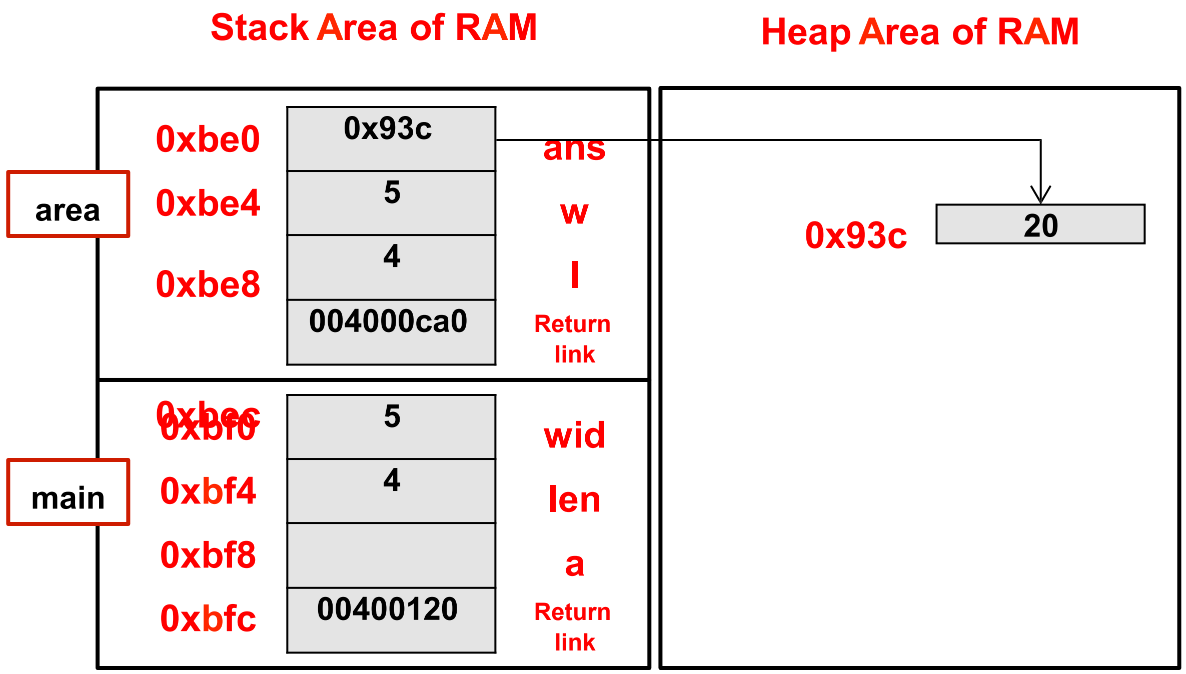
→

- ______ ptr = new int;
- ______ ptr = new double;
- ______ ptr = new char[10];
- ______ ptr = new char*[10];
- ______ ptr = new color;

Dynamic allocation

Dynamic Allocation

- Stored in heap
  - Pointer accesses it
- Exists until user 'delete' it
  - If it is not deleted, the data exists in heap even pointer dies



```
int  area(int, int);

int  main()
{
   int  wid  =  5,  len  =  4,
     a; a  =  area(wid,len);
}

int area(int  w,  int  l)
{
  int* ans = new int;
   *ans  =  w  *  l;
   return *ans;
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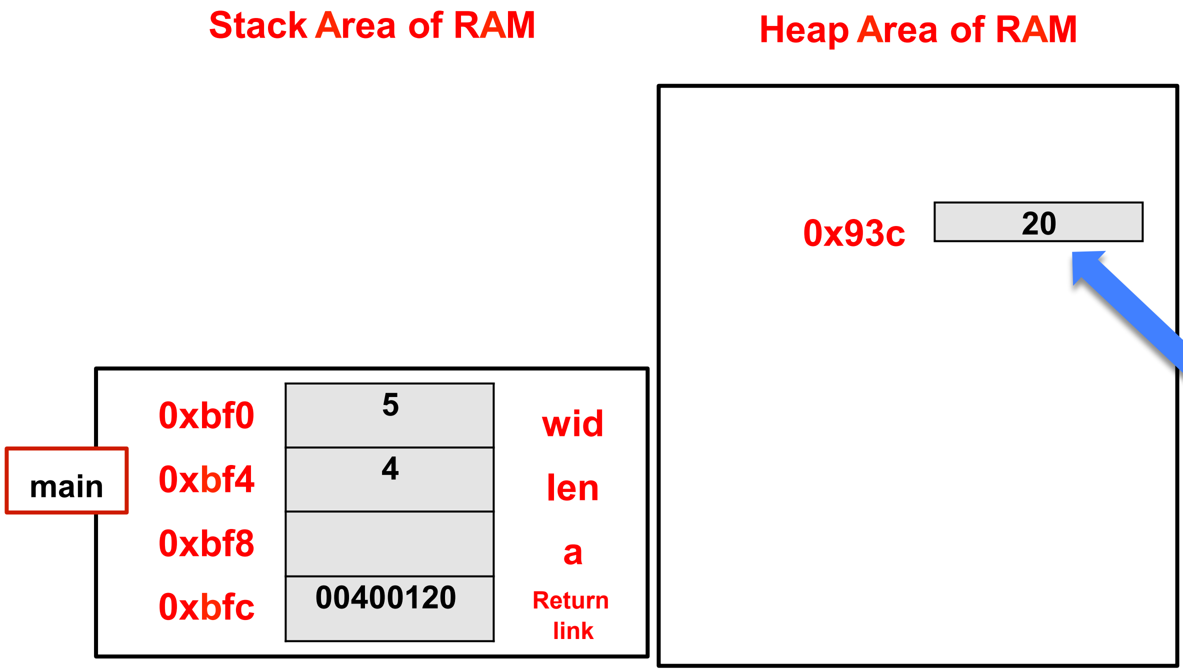

Memory Leak
No pointer to it. Memory space is wasted.

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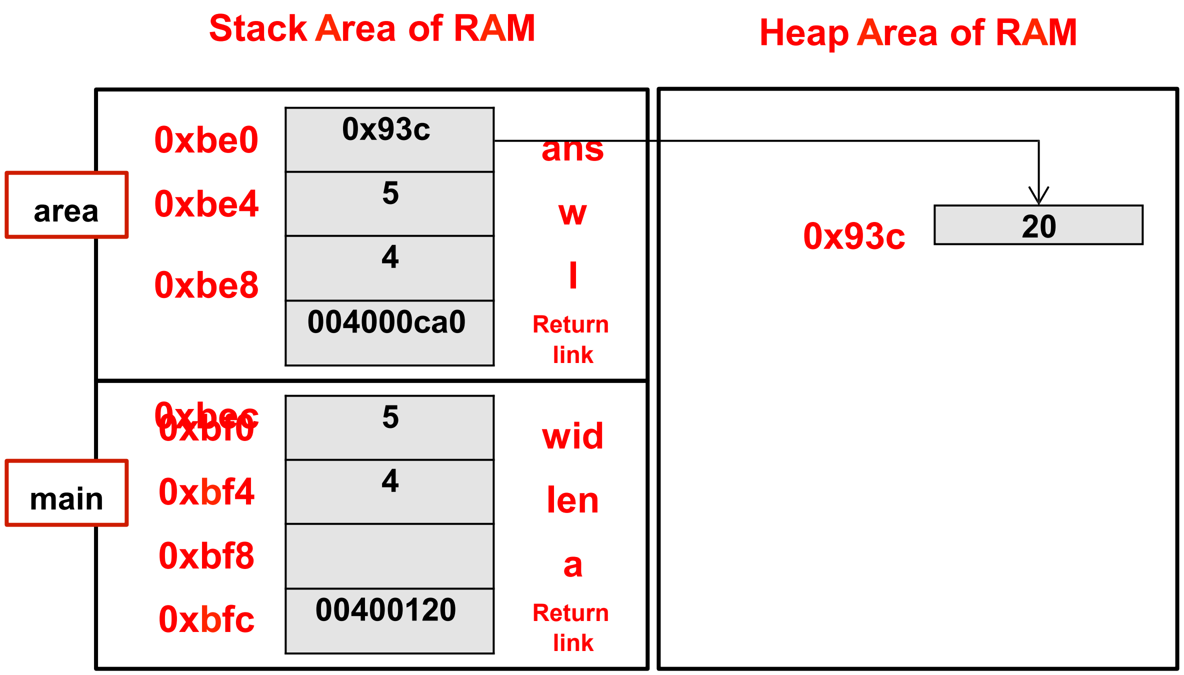

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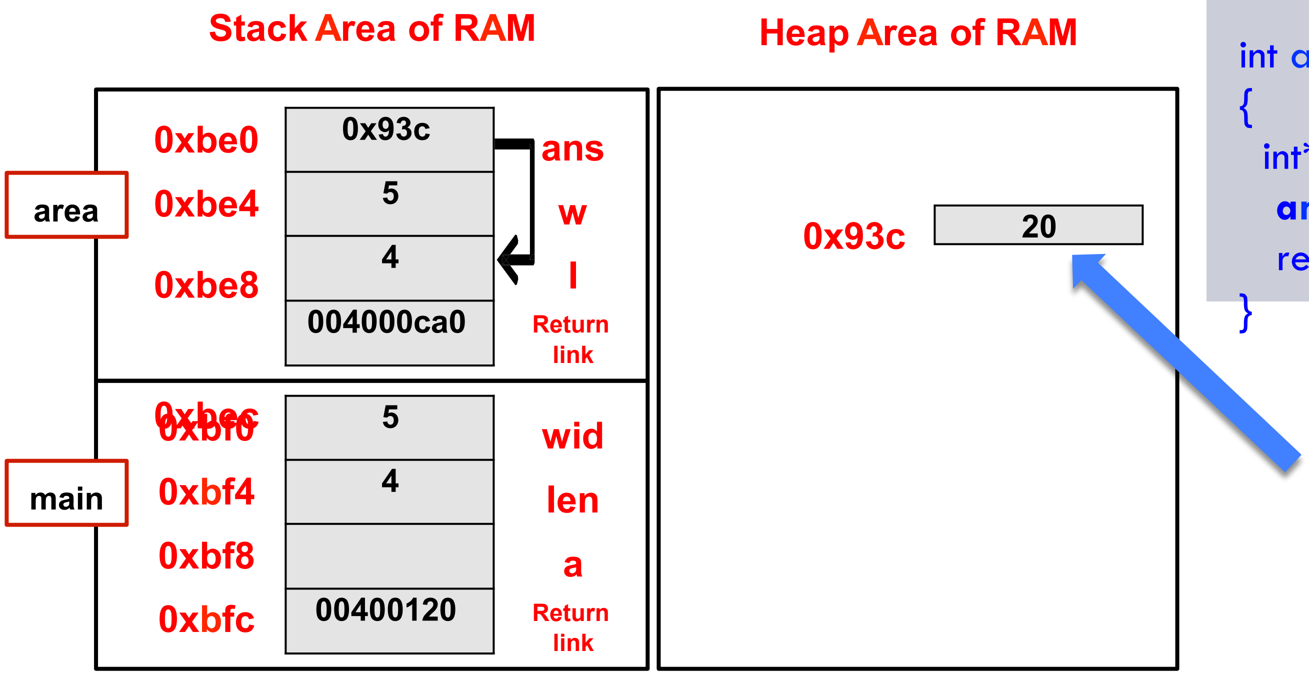

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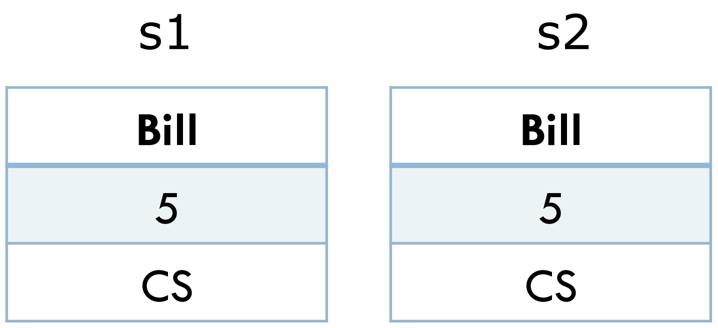
Object assignment

Assigning one struct or class object to another will cause an element by element copy of the source data.

```
#include<iostream>
using  namespace  std;
enum  {CS, MATH, BIO};
struct  student  {
    char  name[80];
    int  id;
    int  major;
};
int  main(int  argc,  char  *argv[])
{
    student  s1;
    strncpy(s1.name,"Bill",80);
    s1.id  =  5;
    s1.major  =  CS;
    student  s2  =  s1;
    return  0;
}
```



Objects in C++

- **Objects** can be created as local variables just like any basic data types in C++.

C++:

```
ComplexType num1;
```

Java: Nothing equivalent – Objects cannot be in **stack.**

Objects in **Heap**

C++:

ComplexType *num1 = new ComplexType(…);

Java:

ComplexType num1 = new ComplexType(…);

Arrays

- Basic data types and classes are treated the same way in C++, unlike Java.

C++: ComplexType **colors[5];**

Java: nothing equivalent.