CS 32 - Discussion 1B

Week 2 - Dynamic Memory Allocation

Outline:

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   - The **new** and **delete** keywords

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   - Assignment (operator=).
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   Why and how we need to implement the above ourselves (as opposed to using built-in) when our class uses dynamic memory.

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   - **Assignment (operator=).**
   - **Destructors.**

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Dynamic Memory Allocation

Static allocation:

int arr[100];

Dynamic allocation:

int* arr = new int[100];

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  frees memory that was allocated by new

- **rule:**

  if new was called, then delete must be called
  (otherwise we get a memory leak)

Classes: Construction and Destruction

```
class Ec
{
    public:
        Ec(); // default constructor 1
        Ec(int data); // default constructor 2...
        Ec(const Ec& other); // copy constructor
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    private:
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Ec e1;
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Pass-by-value function calls

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void h(Ec e)
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    …
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void h(Ec e)
{
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    …
    return; // calls destructor to destroy local variable e
}

h(e1);
```

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Built-in (compiler-generated)

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A: No, b/c the built-in versions already do the right thing.

- **Q**: When would the built-in versions not do the right thing?

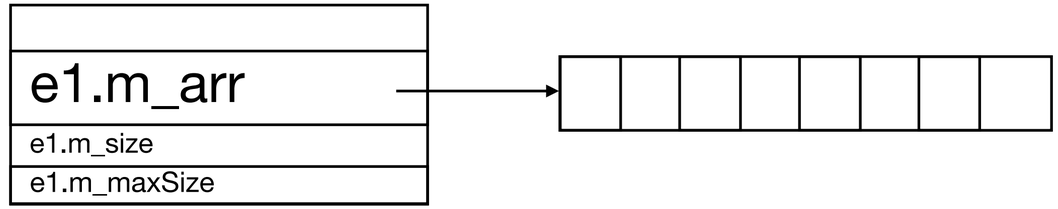
A: When the class uses dynamically allocated memory. (Possibly in other cases when the class has a pointer as a data member).

Copy Constructors:

Classes with Dynamically Allocated Data

The built-in copy constructor simply copies the values of e1's data members

Ec e1;

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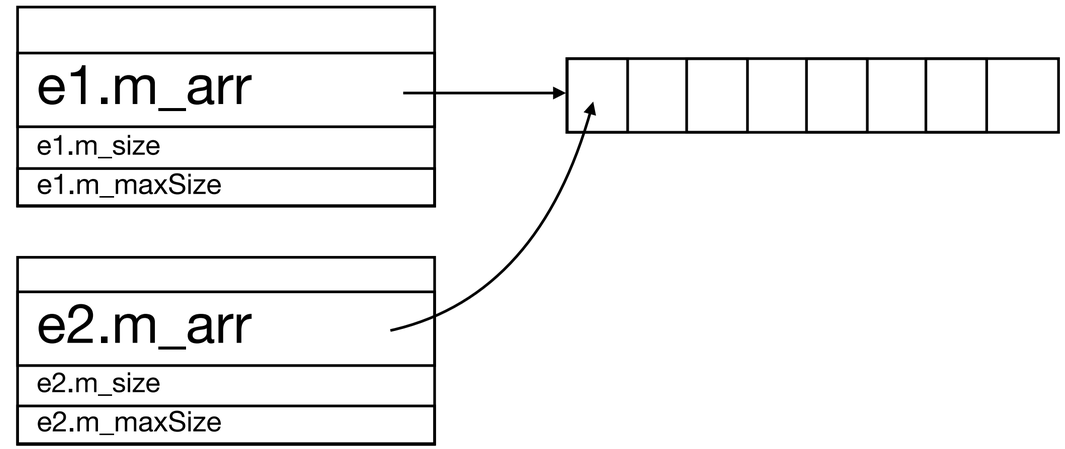

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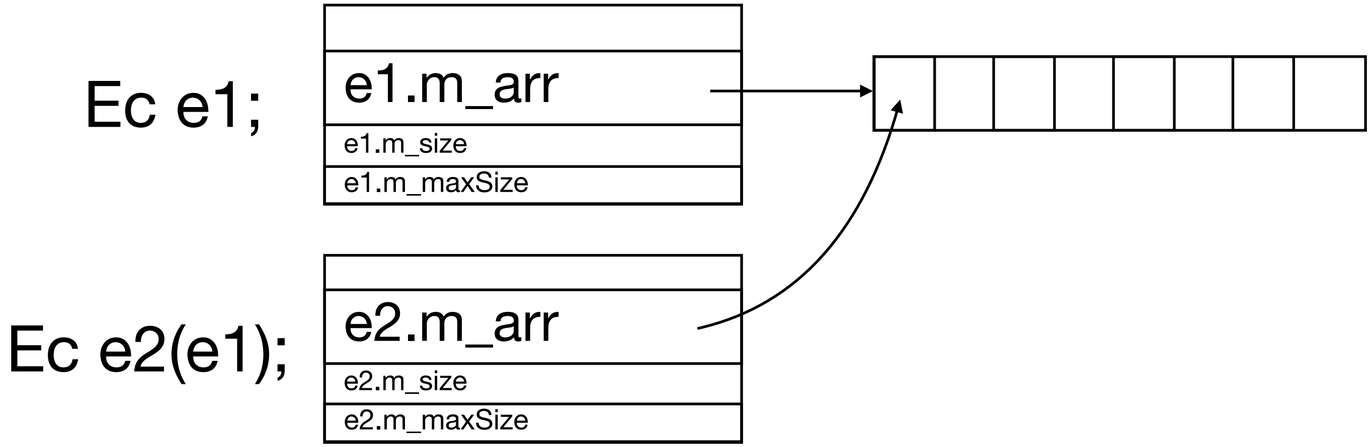

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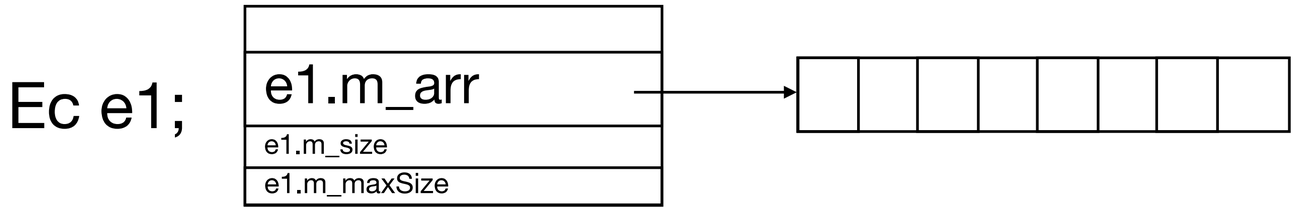

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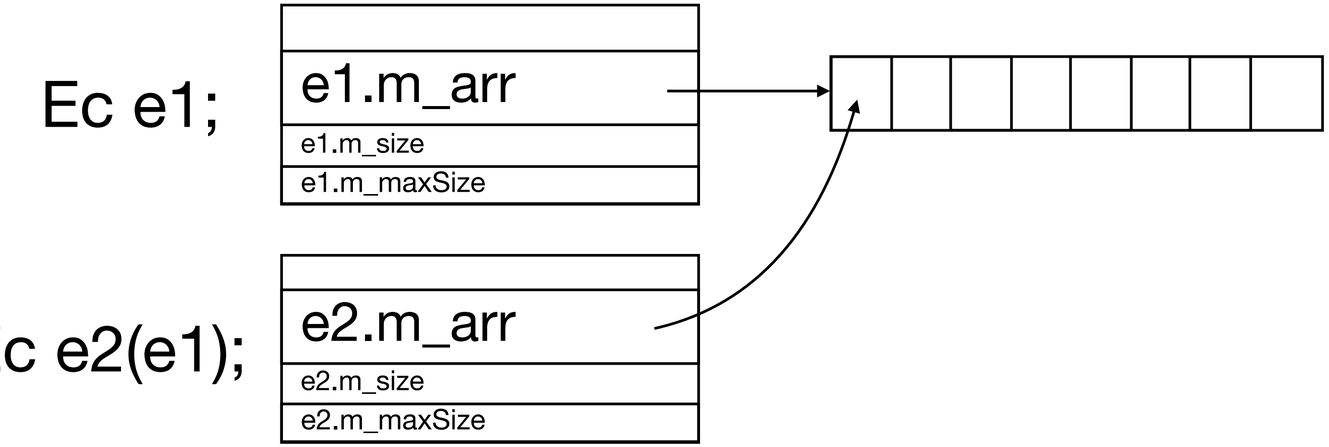

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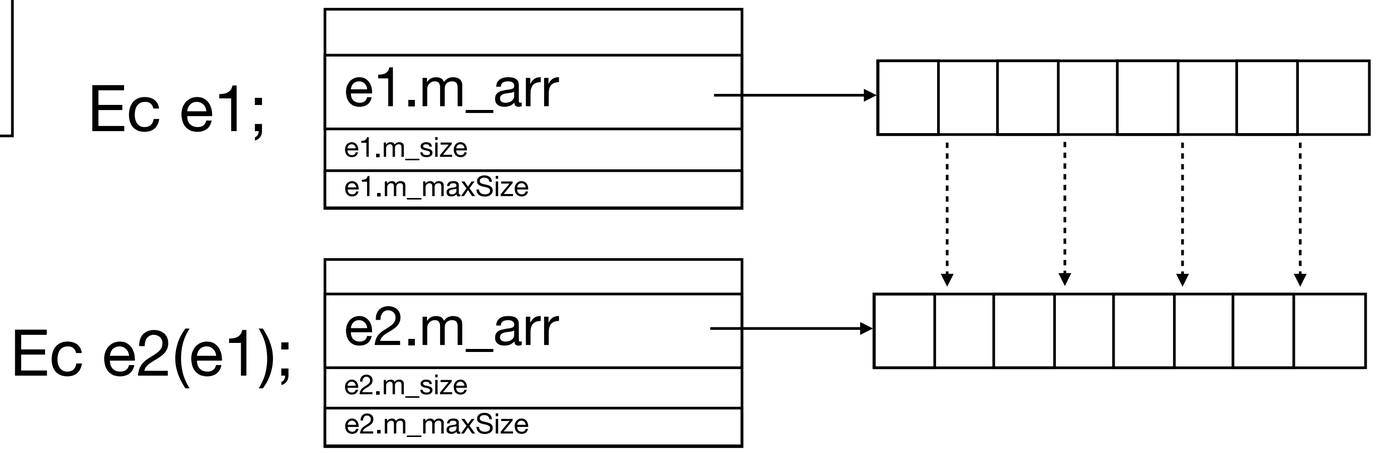

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Compiler-generated CC:

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Correct CC:

```
Ec::Ec(const Ec& other)
{
    m_size(other.m_size);
    m_maxSize(other.m_maxSize);
    m_arr = new int[m_maxSize];
    for (int i = 0; i < m_size; i++)
        m_arr[i] = other.m_arr[i];
}
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Destructors:

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Built-in Destructor

Simply calls destructor for each data member

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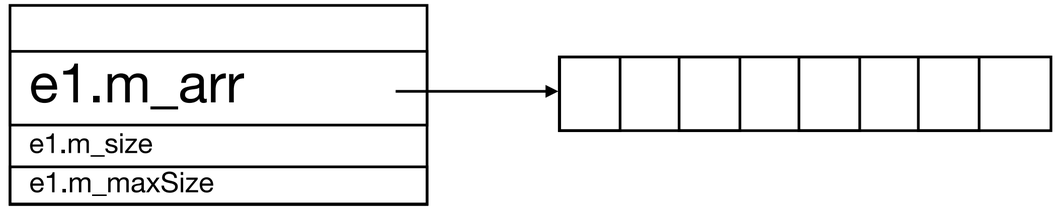

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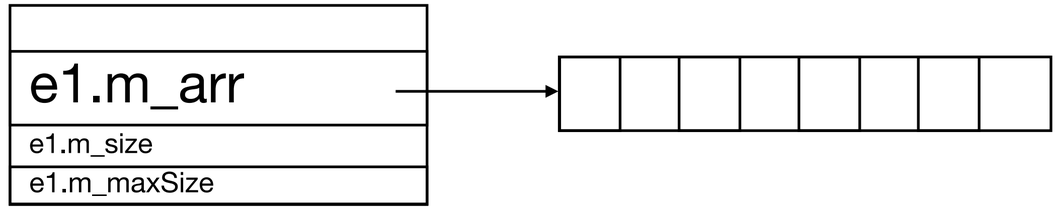

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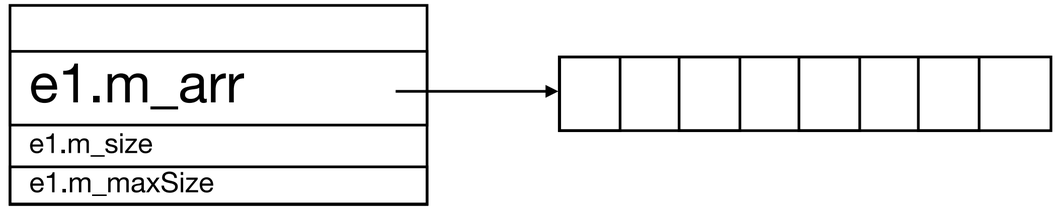

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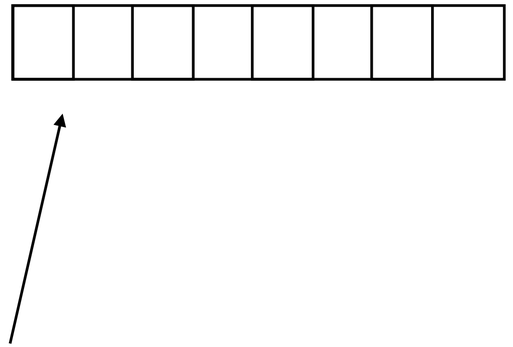


Need destructor to explicitly deallocate this memory

(Otherwise we have a memory leak)

Destructors:

Classes with Dynamically Allocated Data

```
class Ec
{
    public:
        Ec(int maxSize); // default constructor
        Ec(const Ec& other); // copy constructor
        Ec& operator=(const Ec& other); // assignment
        ~Ec(); // destructor

    private:
        int* m_arr;
        int m_size;
        int m_maxSize;
};
```

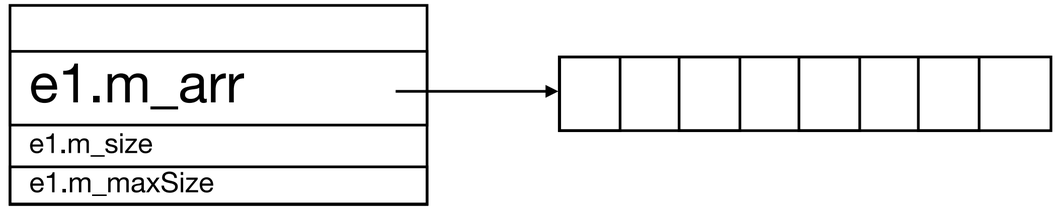
Default constructor:

```
Ec::Ec(int maxSize) : m_size(0), m_maxSize(maxSize)
{
      m_arr = new int[m_maxSize];
}
```

Built-in Destructor

Simply calls destructor for each data member

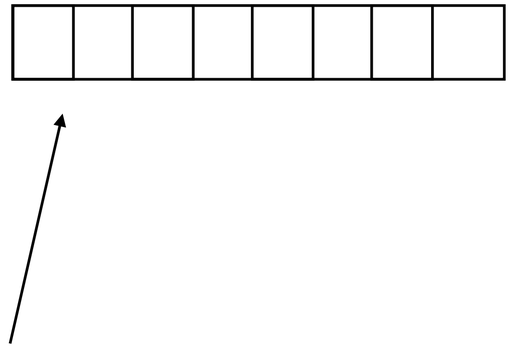
Ec e1(10);



Ec* ep = new Ec(10);

e1.~Ec();

delete ep;



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        int* m_arr;
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};
```

Default constructor:

```
Ec::Ec(int maxSize) : m_size(0), m_maxSize(maxSize)
{
      m_arr = new int[m_maxSize];
}
```

Built-in Destructor

Simply calls destructor for each data member

Correct Destructor

```
Ec::~Ec()
{
      delete [ ] m_arr;
}
```

Done.

- Resource: Smallberg's example string class.
  (code on course webpage)