

Constructors and destructors

Bachelor of Science - École polytechnique

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Key concepts

■ A constructor

- Is a method of a class that has the name of the class
- Used to initialize the fields of an object
- A class can have several constructors with different parameters

■ A destructor


- Is a method that has the name of the class prefixed by a tilde
- Called when the object is destroyed

Constructors

- When we allocate an object, we often have to
 - Pre-initialize some of the fields at fix values
 - Or to execute some code

```
struct monster_t {  
    const char* name;  
    int health;  
    int experience; // has to be initialized to 0  
  
    void print();  
};  
  
int main(int argc, char* argv[]) {  
    monster_t monster { "Pikachu", 42, 0 };  
  
    return 0;  
}
```


Error-prone



Constructors

- To initialize the fields of an object, use a **constructor**
 - A method with the name of the class
 - And with initialization parameters

```
struct monster_t {  
    const char* name;  
    int health;  
    int experience;  
  
    monster_t(const char* name, int health);  
  
    void print();  
};
```



A constructor

Constructor implementation

■ Three part in a constructor

- A declaration
- Followed by a set of field initializers that come after a **colon**
 - Initialize the fields like we initialize an object with **braces**
- A body that can contain more complex code

```
monster_t::monster_t(const char* name, int health)
    : name { name },
      health { health },
      experience { 0 } {
    // more complex initialisation code goes here
}
```

name of **this**

The field name of **this** is initialized
with the value of the parameter name

Using a constructor

- Using a constructor is transparent
 - Use it exactly as we use a list initializer for the fields when the structure does not have a constructor

```
int main(int argc, char* argv[]) {  
    monster_t m { "Pikachu", 42 };  
    return 0;  
}
```




Call `monster_t::monster_t(const char* name, int health)`
with the parameters `"Pikachu"` and `42`

=> `m.experience` is initialized to `0`

Using a constructor

- As soon as a constructor exists, we have to use it
 - Cannot use { "Pikachu", 42, 0 } anymore

```
int main(int argc, char* argv[]) {  
    monster_t m { "Pikachu", 42 };  
    return 0;  
}
```



Call `monster_t::monster_t(const char* name, int health)`
with the parameters "Pikachu" and 42

=> `m.experience` is initialized to 0

Chained constructors

- We can have several constructors with different parameters
 - And we can chain them

```
struct monster_t {  
    const char* name;  
    int health;  
    int experience;  
  
    monster_t(const char* name, int health);  
    monster_t(const char* name, int health, int experience);  
};  
  
monster_t::monster_t(const char* name, int health)  
    : monster_t(name, health, 0) { } // chained to second constructor  
  
monster_t::monster_t(const char* name, int health, int experience)  
    : name { name }, health { health }, experience { experience } { }
```


Default parameters

- We can achieve the same goal with default parameters

```
struct monster_t {  
    const char* name;  
    int health;  
    int experience;  
  
    monster_t(const char* name, int health, int experience = 0);  
};  
  
monster_t::monster_t(const char* name, int health, int experience)  
    : name { name }, health { health }, experience { experience } {  
}
```

Advanced constructor

- A constructor can execute any operation in its body

```
struct array_t {  
    monster_t** monsters;  
    size_t nb_monsters;  
  
    array_t(size_t n);  
};  
  
array_t::array_t(size_t n) {  
    monsters = new monster_t*[n];  
    nb_monsters = n;  
}  
  
int main(int argc, char* argv[]) {  
    array_t array { 78 };  
}
```

Destructor

- In this case, the memory has to be freed when the object is destroyed
 - Use a destructor
 - The destructor is a method named with the type prefixed with ~

```
struct array_t {  
    monster_t** monsters;  
    size_t nb_monsters;  
  
    array_t(size_t n);  
    ~array_t();  
};
```

Destructor

- Implementation of a destructor: like any other method

```
array_t::array_t(size_t n) {  
    monsters = new monster_t*[n];  
    nb_monsters = n;  
}  
  
array_t::~~array_t() {  
    delete[] monsters;  
}
```

Destructor

- The destructor is called
 - When we call delete
 - Or when a variable is destroyed (e.g., return from a call frame)

```
void test() {  
    array_t x { 4 };  
    array_t* p = new array_t { 4 };  
  
    delete p; // destructor of p called here  
  
    // destructor of x called when the  
    // function returns  
}
```

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