# Chapter 6. Struct and Classes

Programming Concepts in Scientific Programming

EPFL, Master class

October 23, 2017

## Types

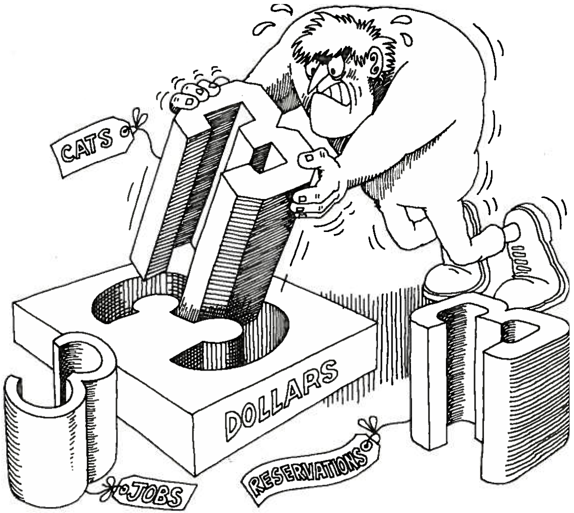
Known types

- void
- char
- short
- int
- long int
- float
- double
- long double
- pointers

Specifiers

- unsigned
- const

## Types



## Types

How to define new types ?

## New types

### How ?

```
struct NameType {
  double a;
  int b;
};
```

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};

```

## Structures

Example

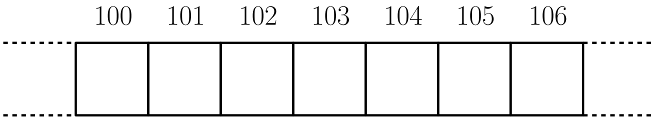
Definition

```
struct Planet {
  double coords[3];
  std::string name;
};
```

Creating a variable

```
  Planet p;
```

How is the memory representation ?



## Structures

### Example

How to access the variables of a structure

```
Planet p;
p.coords[0] = 10;
```

How to get the size of a structure (in bytes)

```
std::cout << sizeof(Planet) << std::endl;
```

## Classes

What is a class ?

A type associating
**Data** and **Functions**

## Objects

What is an object ?

An **instanciation**(variable)
of a **class**/**struct** type

## Classes

### Gathering data and functions

```cpp
struct Planet {
  void move(double delta[3]);
  double coords[3];
};
```

Vocabulary

- variables (state): members
- functions: methods

Usage:

```cpp

  p.move(delta);

```

## Classes

Can be done in C with multiple files (modules) ?

## Classes

### Encapsulation

```
class Planet {

public:
  Planet();                         // constructor
  ~Planet();                        // destructor
  void move(double delta[3]); // a method

private:
  double coords[3]; // a member
};
```

## Classes

### Encapsulation

```
class Planet {

public:
  Planet();                          // constructor
  ~Planet();                         // destructor
  void move(double delta[3]); // a method

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  double coords[3]; // a member
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## Classes

### Encapsulation

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public:
  Planet();                    // constructor
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private:
  double coords[3]; // a member
};
```

## Classes

### Encapsulation

```cpp
class Planet {

public:
  Planet();                     // constructor
  ~Planet();                    // destructor
  void move(double delta[3]); // a method

private:
  double coords[3]; // a member
};
```

- It is an interface (declaration in a .hh/.hpp file)
- Methods and members are accessible/inaccessible

## Classes

### Methods definitions (.cpp/.cc)

```

#include "planet.hh"

void Planet::move(double delta[3]) {
  // DO SOME CODE
}

```

## Classes

### Methods definitions (.cpp/.cc)

```
#include "planet.hh"

void Planet::move(double delta[3]) {
  // DO SOME CODE
}
```

## Classes

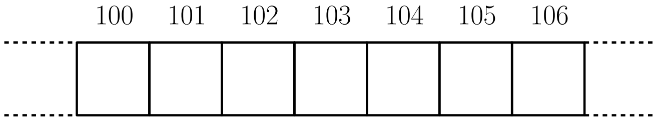
### Construction/Destruction

Constructor: set the initial state

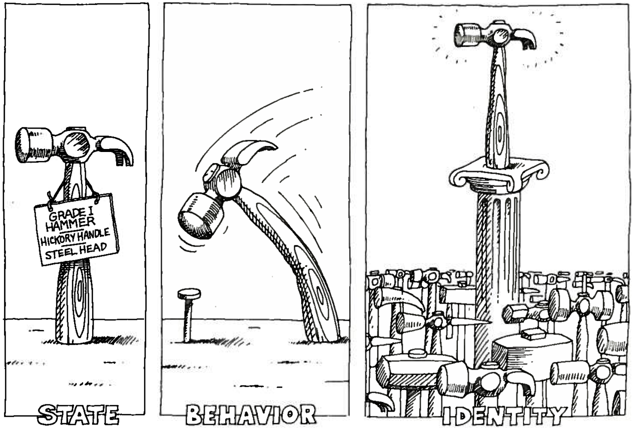
```
Planet::Planet() {
  coords[0] = 0.;
  coords[1] = 1.;
  coords[2] = 2.;
}
```

Destructor

```
Planet::~Planet() {}
```



# Classes&Objects



## Classes

### Constructor/Destructor

- Constructor sets the initial state
- Destructors release memory allocations

```
class Planet {

public:
  Planet();                     // constructor
  ~Planet();                    // destructor
  void move(double delta[3]); // a method

private:
  // a pointer member
    double *coords;
};

```

## Classes

### Constructor/Destructor

```
Planet::Planet() {
  coords = new double[3];
  coords[0] = 0.;
  coords[1] = 1.;
  coords[2] = 2.;
}

Planet::~Planet() {
  // delete memory
  delete[] coords;
}

```

# Classes

## Constructor with parameter(s)

```
class Planet {

public:
  Planet();                         // constructor
  Planet(double param1, int param2);
  Planet(const Planet &);           // copy constructor
  ~Planet();                        // destructor
  void move(double delta[3]);       // a method

private:
  // a pointer member
  double *coords;
};
```

# Classes

## Constructor with parameter(s)

```
class Planet {

public:
  Planet();                           // constructor
  Planet(double param1, int param2); // second constructor
  Planet(const Planet &);            // copy co
  ~Planet();                          // destructor
  void move(double delta[3]);         // a method

private:
  // a pointer member
  double *coords;
};
```

## Classes

### Copy constructor

```
Planet::Planet(const Planet &p) {

  // copy pointer ?
  coords = p.coords;


  // or copy the content ?
  coords = new double[3];
  for (int i = 0; i < 3; ++i) {
    coords[i] = p.coords[i];
  }
```

## Objects

Pointer/reference to object

```
Planet p;
Planet *ptr = &p;
Planet &ref = p;
```

Dynamically allocate an object

```
Planet *p1 = new Planet; // no parentheses!
Planet *p2 = new Planet(param1, param2);

p1->move(coords);
```

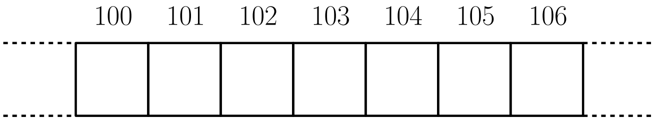
## Objects
### this pointer

What is the mysterious **this** ?

```
struct Planet {

  void test() { std::cout << this << std::endl; }
};

int main() {
  Planet p;
  std::cout << &p << std::endl;
}
```



## Classes friends

What happens if we do this ? (try it)

```cpp
class A {

private:
  int secret;
};

class B {
  int getSecret(A &a) { return a.secret; }
};
```

## Classes friends

```
class B;

class A {

private:
    friend B;
  int secret;
};

class B {
  int getSecret(A &a) { return a.secret; }
};

```

## Classes friends

```
class A;
int toto(A &a);

class A {

private:
    friend int toto(A &a);
  int secret;
};

int toto(A &a) { return a.secret; }

```

## Class operators

```
class A {
public:
  int operator[](int i) {
    // modifies the behavior
    return values[i] * 2;
  }

private:
  int values[100];
};

```

## Class operators

```
class A {
public:
  int operator[] (int i) {
    // modifies the behavior
    return values[i] * 2;
  }

private:
  int values[100];
};

```

You defined the operator [.]

```
  std::cout << a[2] << std::endl;
```

## Class

### Take away message

- **Class**: A type associating **Data** and **Functions**
- **Object/Instance**: A variable of a **class**/**struct** type
- **Methods**: Functions in a class
- **Members**: Variables in a class
- **Encapsulation**: mechanism allowing **public** and **private** sections
- **Operators**: special functions to define operators ()[]*-/+ etc.
- **this**: pointer to current object