Class

Object-Oriented Programming with C++

Point

```
typedef struct point {
    int x;
    int y;
} Point;
```

Point

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typedef struct point {
    int x;
    int y;
} Point;
```

```
Point a;
a.x = 1;a.y = 2;
```

Point

```
typedef struct point {
    int x;
    int y;
} Point;
```

```
Point a;
a.x = 1;a.y = 2;
void print(const Point* p){
    printf("%d %d\n",p->x,p->y);
}
```

Point

```
typedef struct point {
    int x;
    int y;
} Point;
```

```
Point a;
a.x = 1;a.y = 2;
void print(const Point* p){
    printf("%d %d\n",p->x,p->y);
}
print(&a);
```

move (dx,dy)?

move (dx,dy)?

```
void move(Point* p,int dx, int dy) {
        p->x += dx;
        p->y += dy;
}
```

Prototypes

```
typedef struct point {
    int x;
    int y;
 } Point;
void print(const Point* p);
void move(Point* p,int dx, int dy);
```

Usage

```
Point a;
Point b;
a.x = b.x = 1; a.y = b.y = 1;
move(&a,2,2);
print(&a);
print(&b);
```

C++ version

```
class Point {
public:
    void init(int x, int y);
    void move(int dx, int dy);
    void print() const;

private:
    int x;
    int y;
} ;
```

Implementations

```
void Point::init(int ix, int iy) {
    x = ix; y = iy;
}
void Point::move(int dx, int dy) {
    x+= dx; y+= dy;
}
void Point::print() const {
    cout << x << ' ' << y << endl;
}
```

C vs. C++

```
typedef struct point {
    int x;
    int y;
} Point;

void print(const Point* p);
void move(Point* p,int dx,
int dy);

Point a;
a.x = 1; a.y = 2;
move(&a,2,2);
print(&a);
```

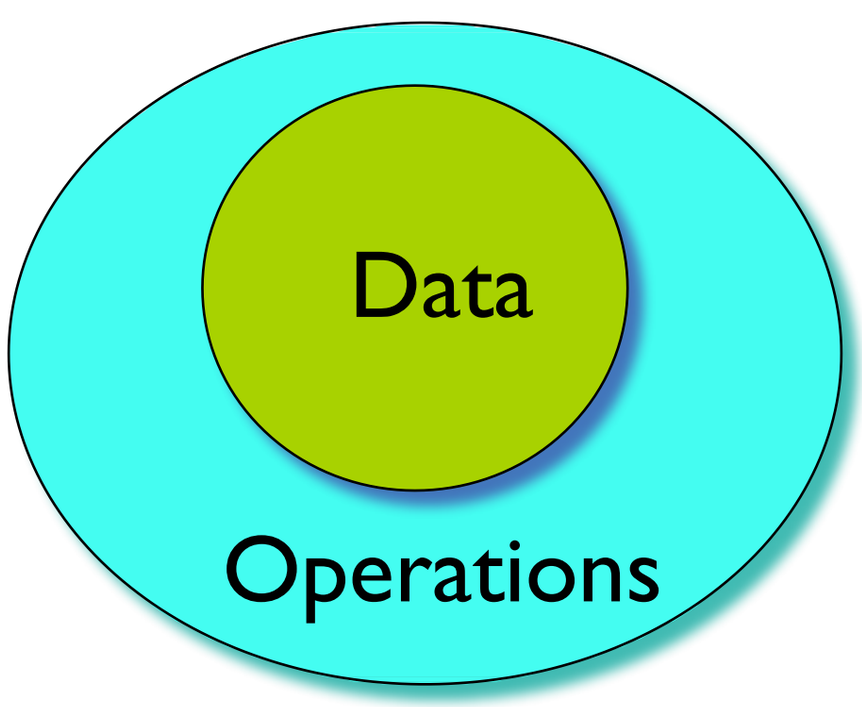
```
class Point {
public:
    void init(int x,int y);
    void print() const;
    void move(int dx,int dy);

private:
    int x;
    int y;
} ;

Point a;
a.init(1,2);
a.move(2,2);
a.print();
```

Objects = Attributes + Services

- Data: the properties or status
- Operations: the functions



Ticket Machine

- Ticket machines print a ticket when a customer inserts the correct money for their fare.
- Our ticket machines work by customers' inserting money into them, and then requesting a ticket to be printed. A machine keeps a running total of the amount of money it has collected throughout its operation.

Procedure-Oriented

- Step to the machine
- Insert money into the machine
- The machine prints a ticket
- Take the ticket and leave

Procedure-Oriented

- Step to the machine
- Insert money into the machine

We make a program simulate the procedure of buying tickets. It works. But there is no such machine. There's nothing left for the further development.

Something is there

Something is there

PRICE

balance

total

Something is there

PRICE

balance

total

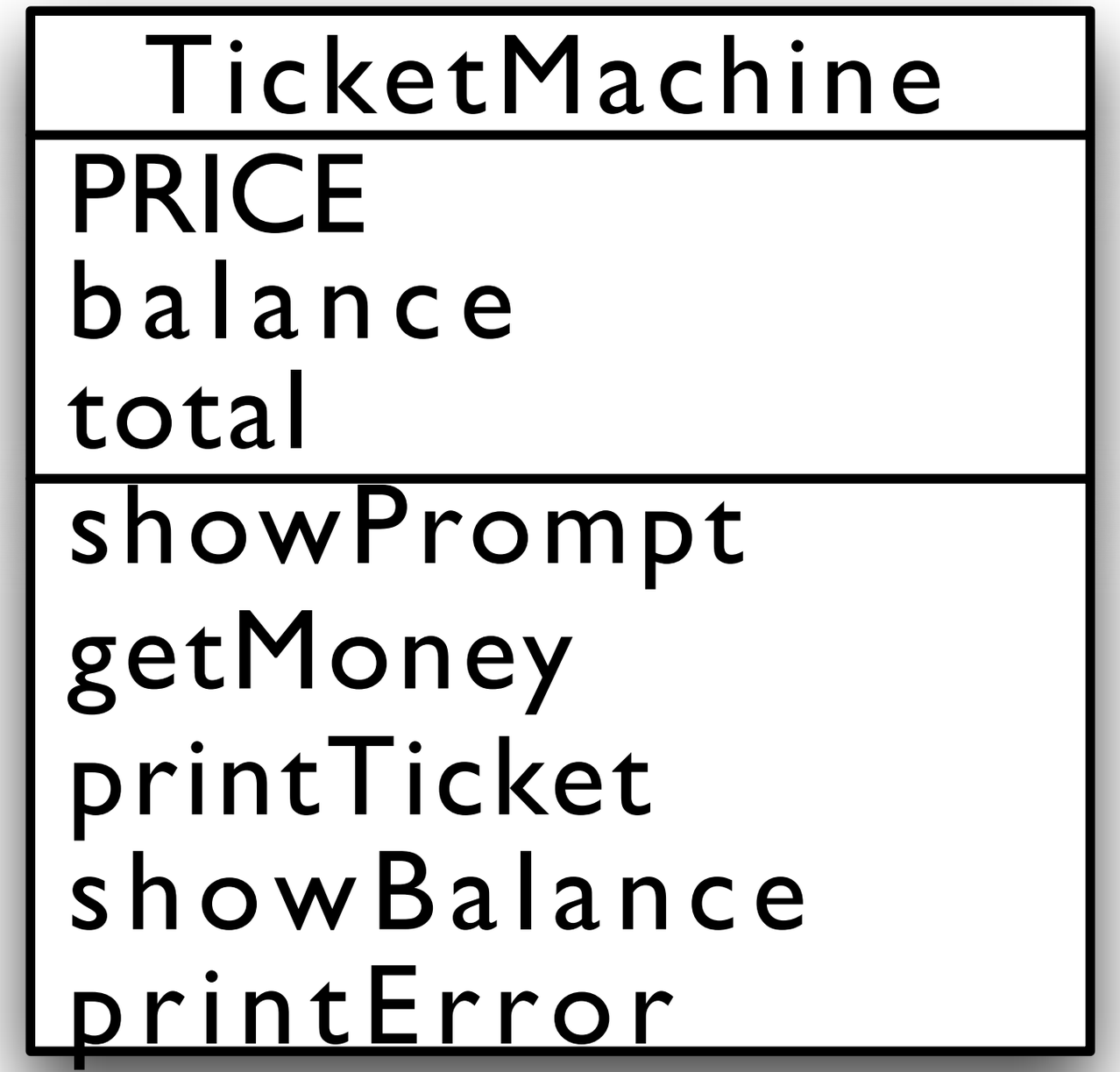
show prompt

print balance

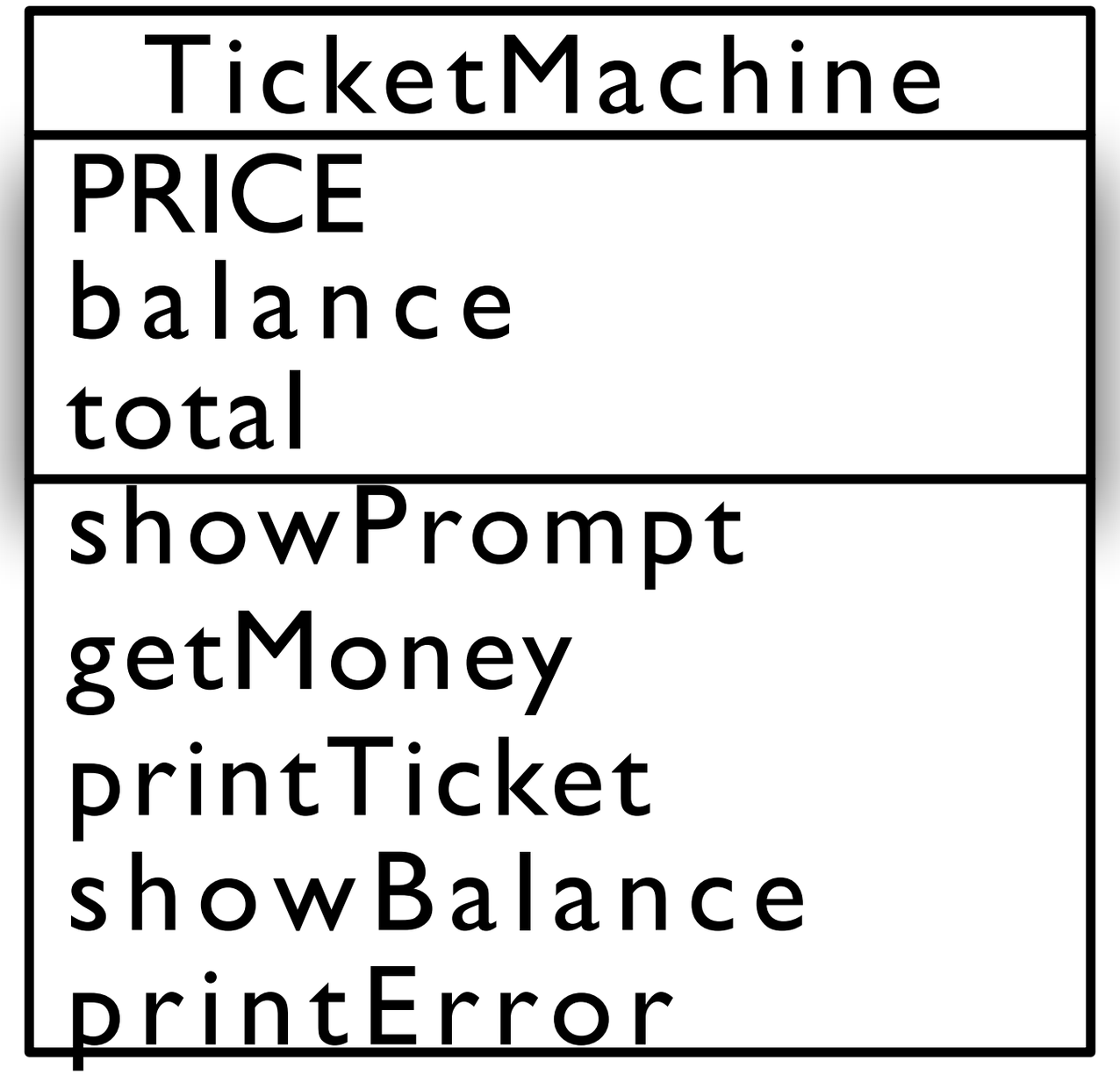
insert money

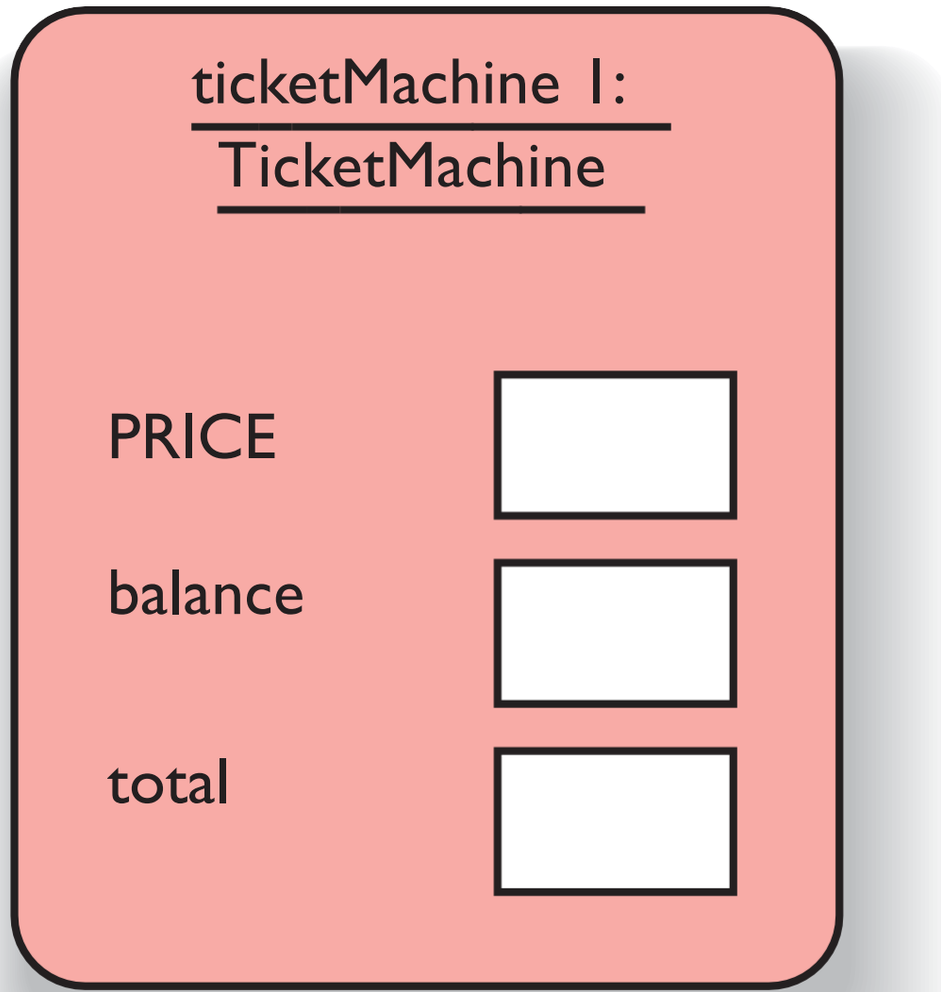
print ticket

Something is there



Something is there





Turn it into code

TicketMachine

PRICE

showBalance

printError

```
class TicketMachine {
  private:
        const int PRICE;
        int balance;
        int total;
};
```

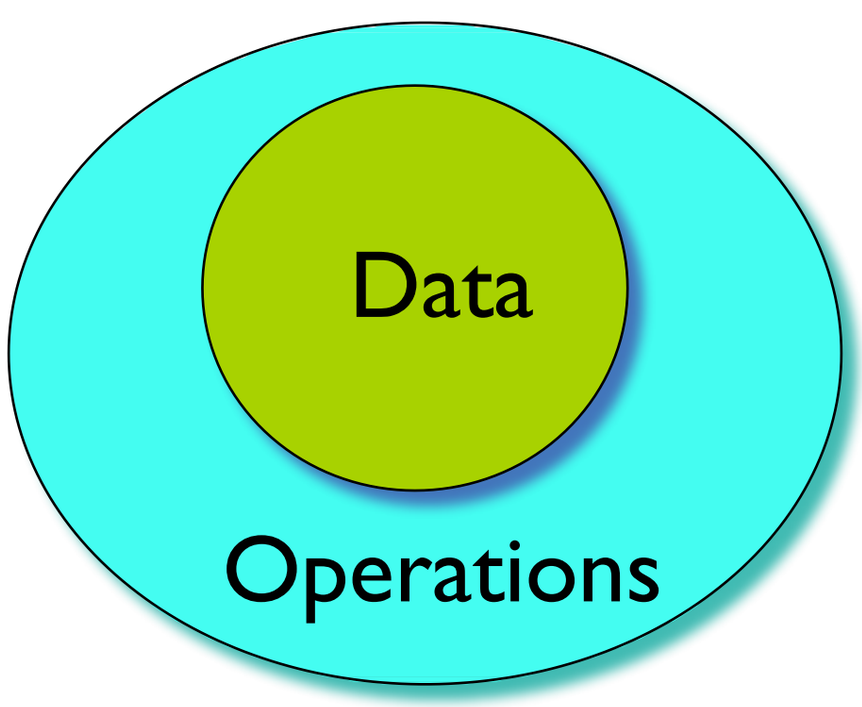
ticketMachine 1:

Turn it into code

```
class TicketMachine {
public:
        void showPrompt();
        void getMoney();
        void printTicket();
        void showBalance();
        void printError();
private:
        const int PRICE;
        int balance;
        int total;
};
```

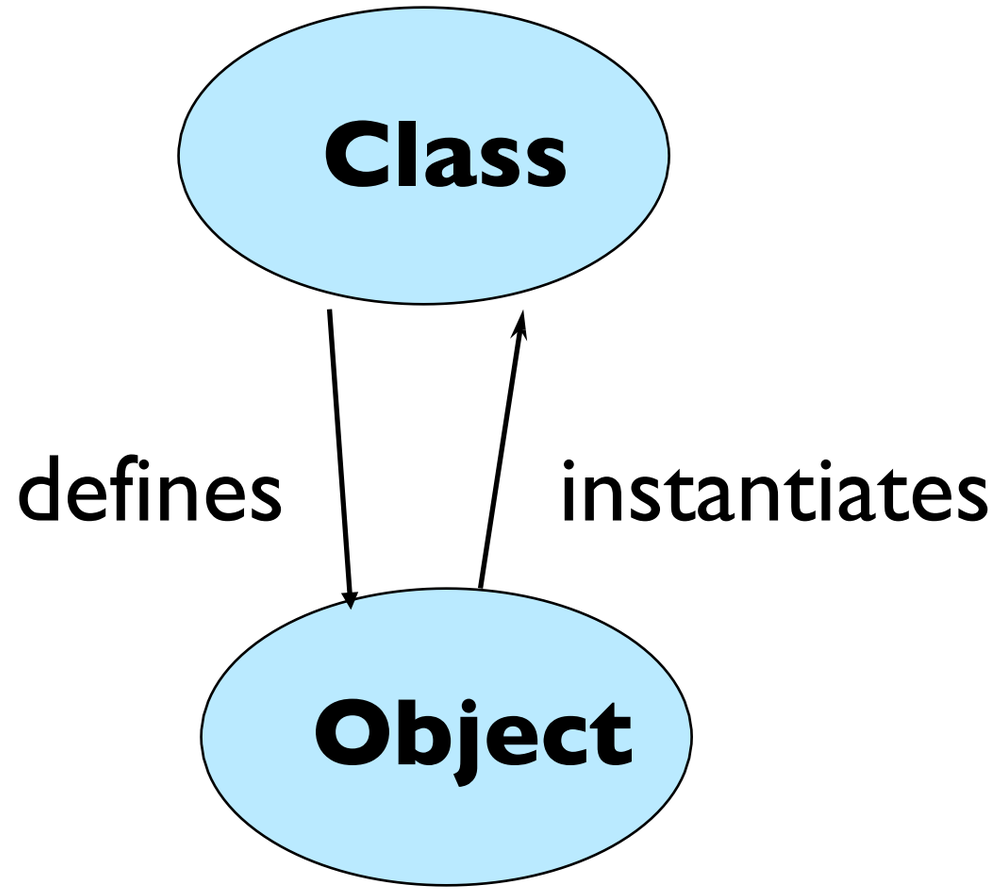
Objects = Attributes + Services

- Data: the properties or status
- Operations: the functions



Object vs. Class

- Objects (cat)
  - Represent things, events
  - Respond to messages at run-time
- Classes (cat class)
  - Define properties of instances
  - Act like types in C++



OOP Characteristics

1. Everything is an object.
2. A program is a bunch of objects telling each other what to do by sending messages.
3. Each object has its own memory made up of other objects.
4. Every object has a type.
5. All objects of a particular type can receive the same messages.

Definition of a Class

- In C++, separated .h and .cpp files are used to define one class.
- Class declaration and prototypes in that class are in the header file (.h).
- All the bodies of these functions are in the source file (.cpp).

:: resolver

- <Class Name>::<function name>
- ::<function name>

```
void S::f() {
    ::f(); // Would be recursive otherwise!
    ::a++; // Select the global 'a'
    a--; // The 'a' at class scope
}
```

Compilation unit

- The compiler sees only one .cpp file, and generates .obj file
- The linker links all .obj into one executable file
- To provide information about functions in other .cpp files, use .h

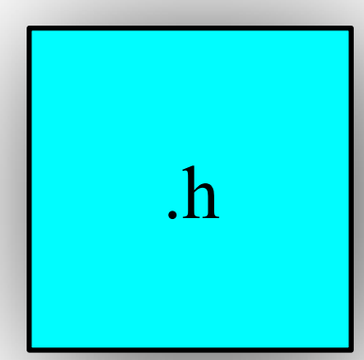
The header files

- If a function is declared in a header file, you *must* include the header file everywhere the function is used and where the function is defined.
- If a class is declared in a header file, you *must* include the header file everywhere the class is used and where class member functions are defined.

Header = interface

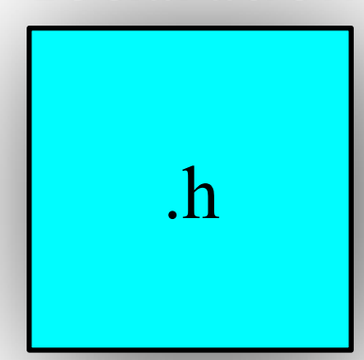
- The header is a contract between you and the user of your code.
- The compiler enforces the contract by requiring you to declare all structures and functions before they are used.

Structure of C++ program



Structure of C++ program

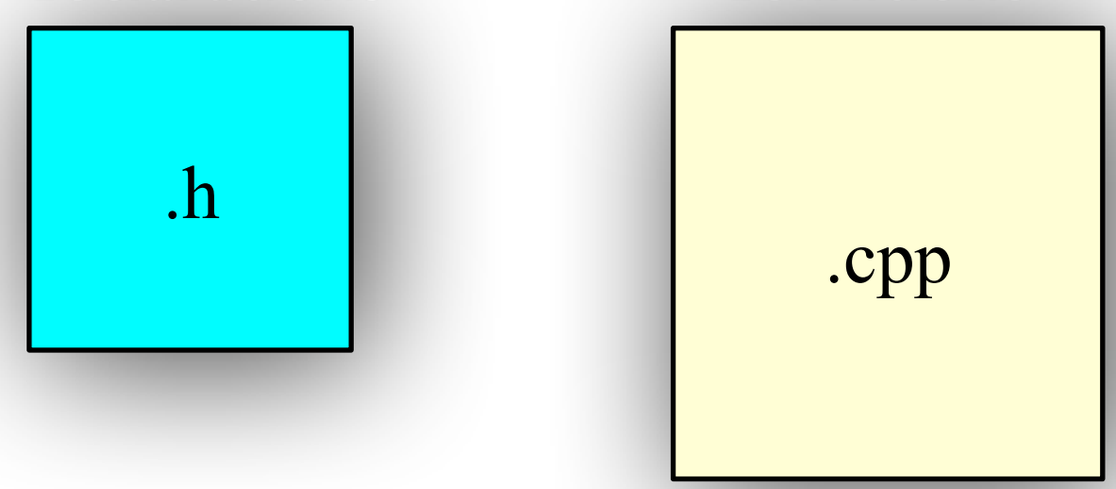
declarations



Structure of C++ program

declarations

definitions



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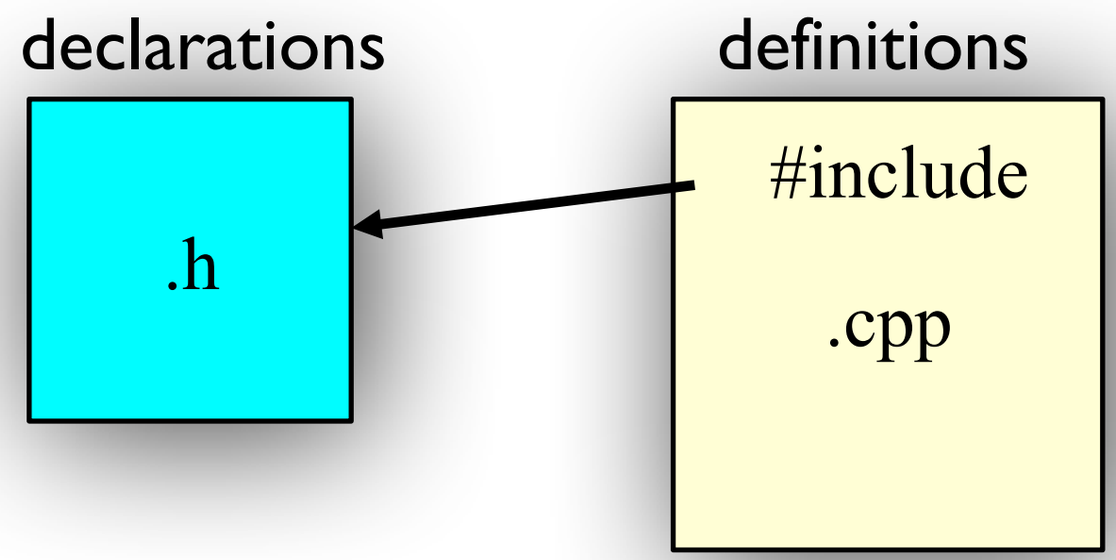

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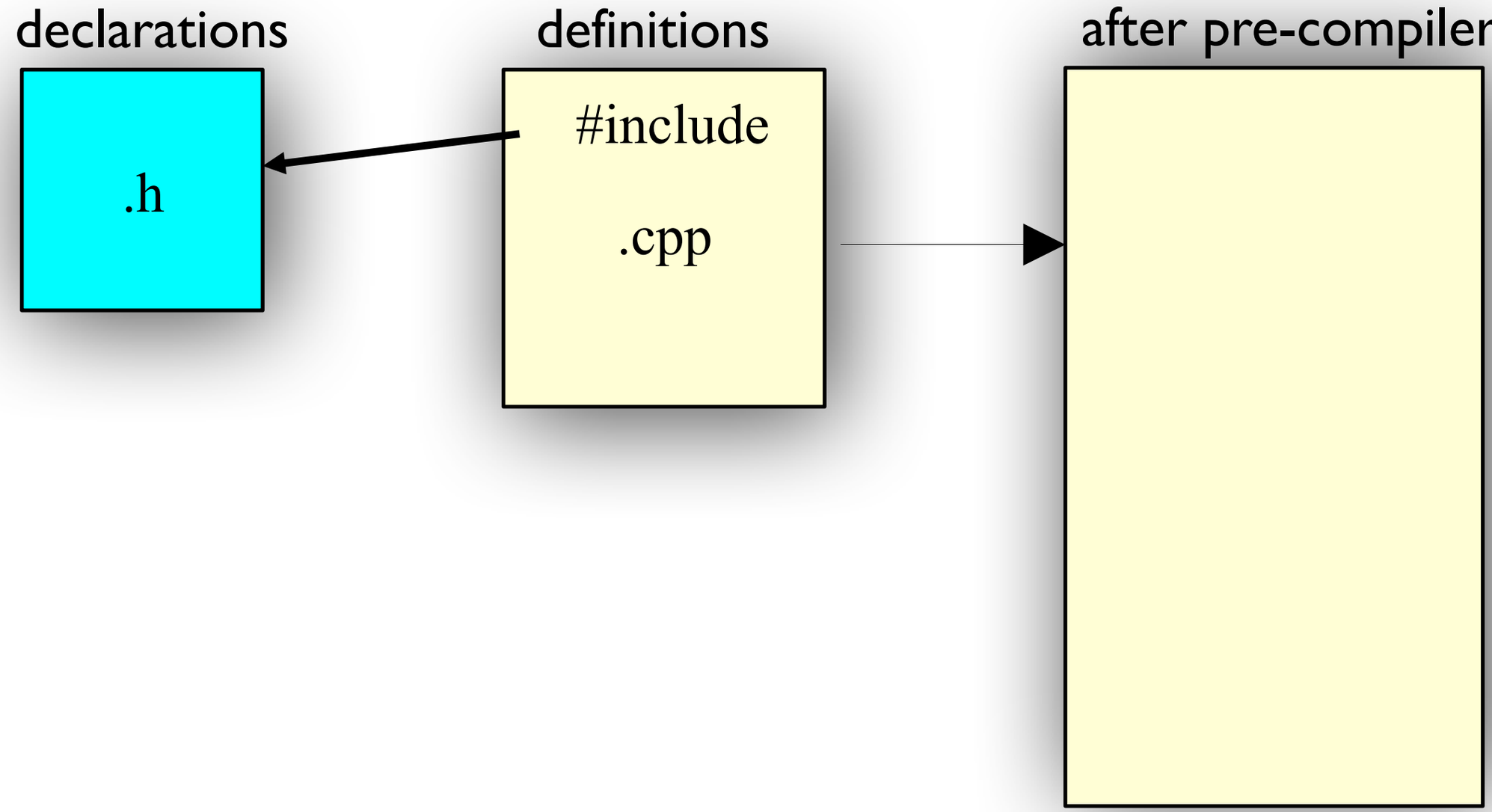

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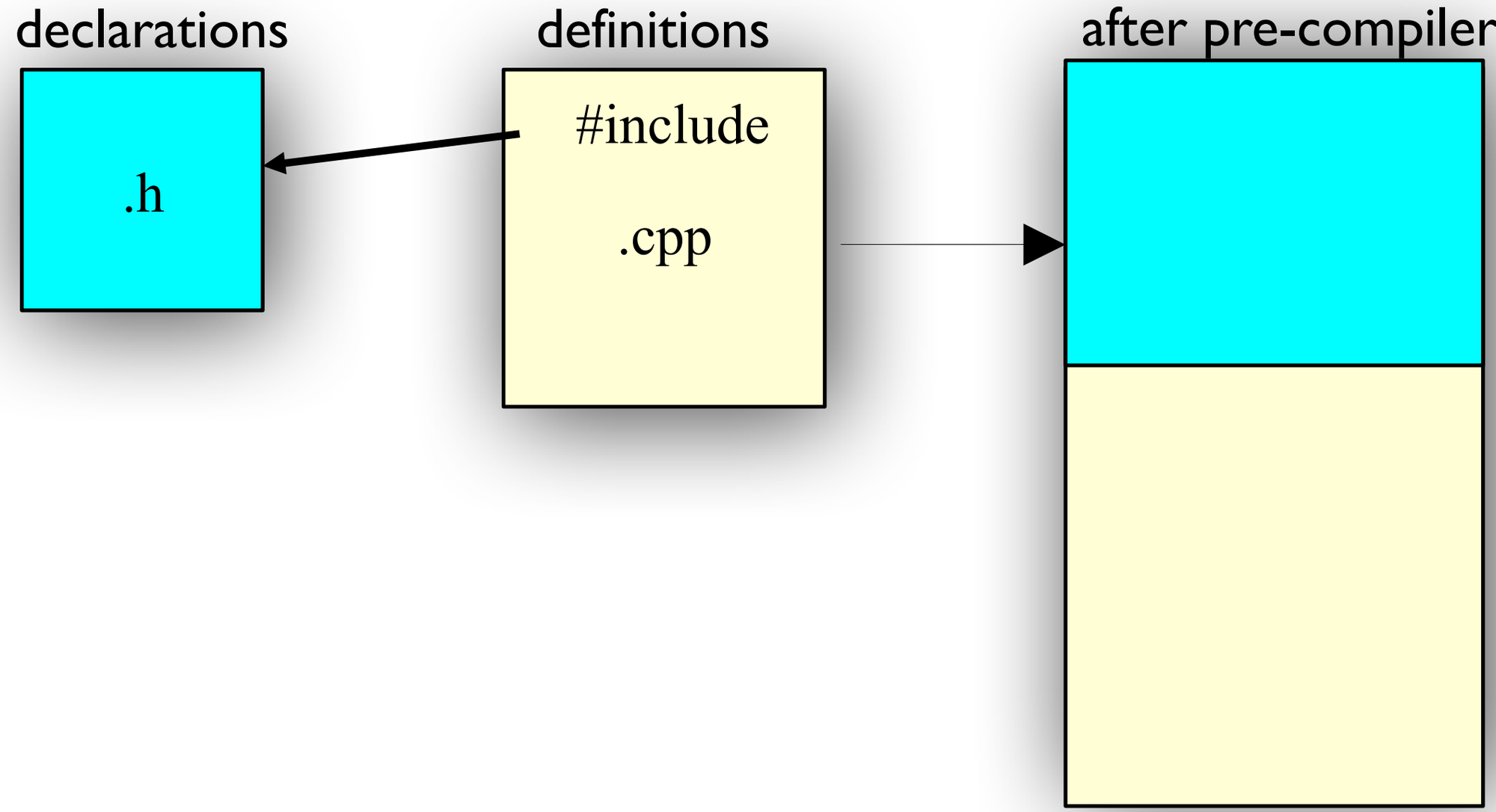

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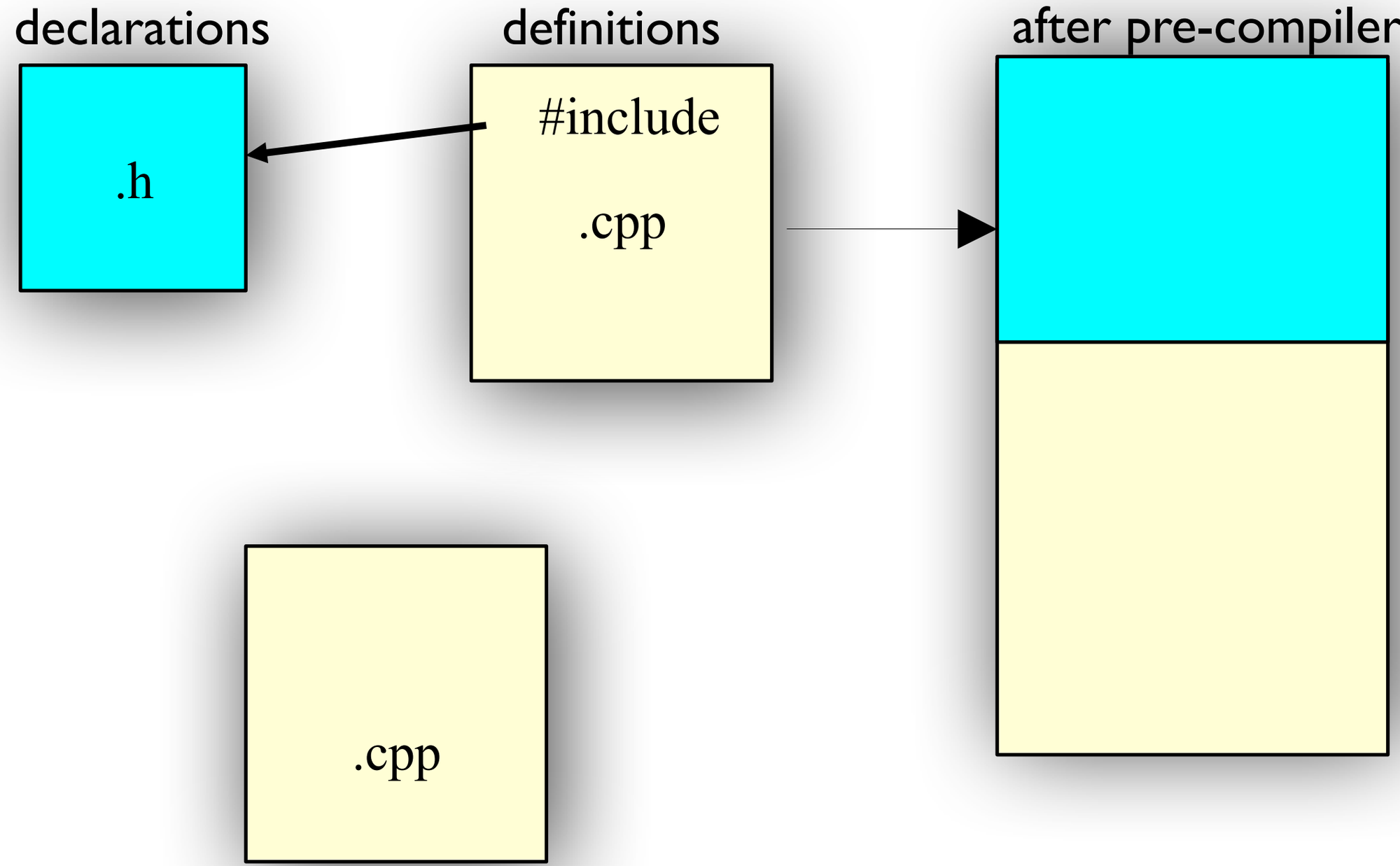
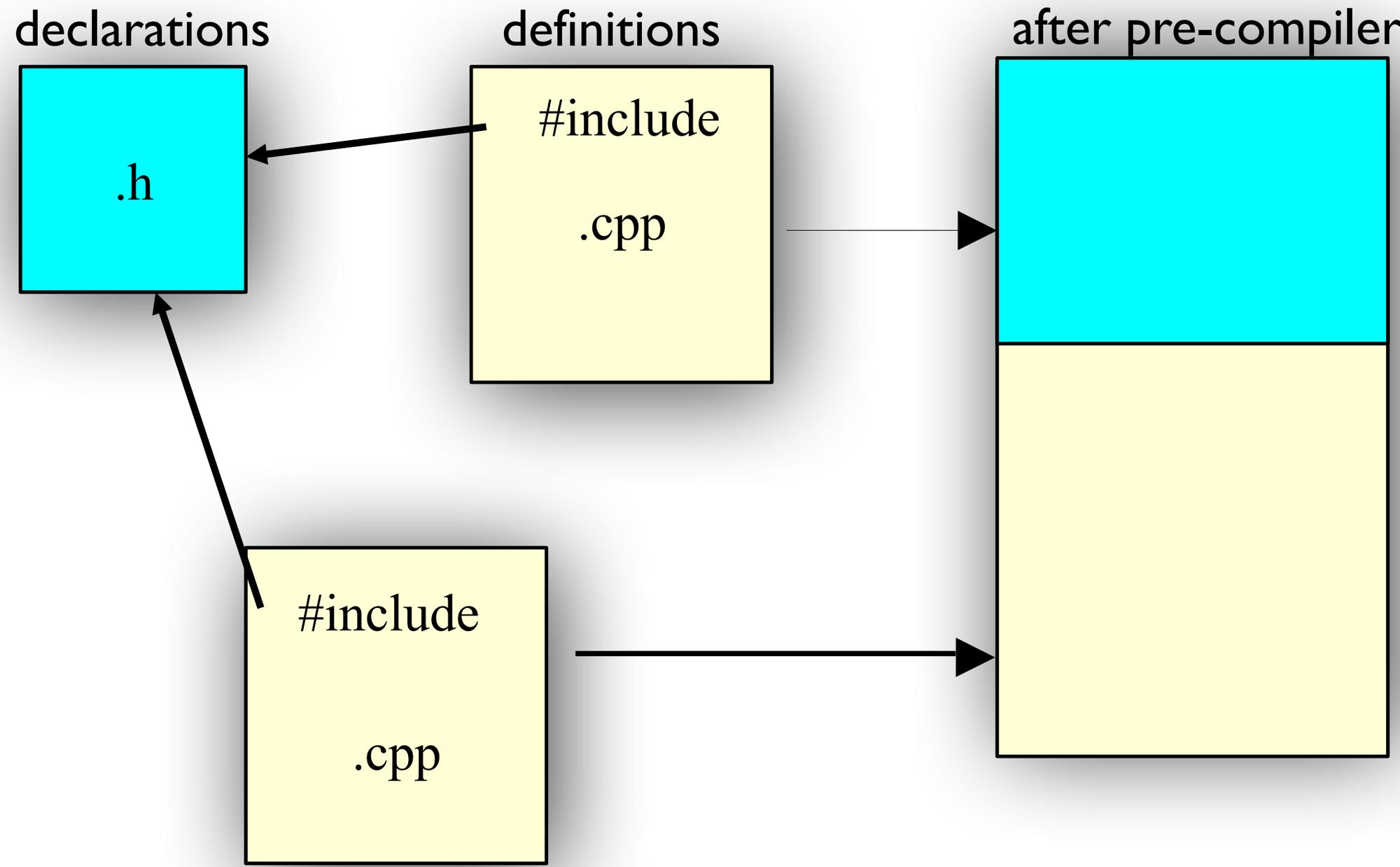


Other modules that use the functions

Structure of C++ program



Other modules that use the functions

Declarations vs. Definitions

- A .cpp file is a compile unit
- Only declarations are allowed to be in .h
  - extern variables
  - function prototypes
  - class/struct declaration

#include

#include

- `#include` is to insert the included file into the .cpp file at where the `#include` statement is.
  - `#include "xx.h"`: first search in the current directory, then the directories declared somewhere
  - `#include <xx.h>`: search in the specified directories
  - `#include <xx>`: same as `#include <xx.h>`

Standard header file structure

```
#ifndef HEADER_FLAG
#define HEADER_FLAG

// Type declaration here...

#endif // HEADER_FLAG
```

Tips for header

1. One class declaration per header file
2. Same prefix with source file.
3. The contents of a header file is surrounded with
   `#ifndef  #define...  #endif`

The CMake utility

- Assignment 002: open at PTA