

Exercise walk-through

7.2

Encapsulation and UML class diagrams

International Baccalaureate · IB Diploma · Computer Science · HL

Oop . 2.1

Reasoning

A class defines a type with state and behaviour. An object is an instance .

Encapsulation controls access through an interface so operations can preserve invariants. Inheritance models an appropriate type relationship; composition models an object containing or using another object. encapsulation: Controlling access to state through an interface. instance: An individual object of a class.

Oop · executable trace

- Trace the state changes and boundary guard.
- Run the boundary case and compare the printed output.

```
class Account:
    def __init__(self, balance):
        self.balance = balance
    def withdraw(self, amount):
        if amount < 0 or amount > self.balance:
            return False
        self.balance -= amount
        return True
a, b = Account(15), Account(20)
print(a.withdraw(30), a.balance, b.balance)
print(a.withdraw(15), a.balance, b.balance)
```

Exercises 2.1·2.2

2.1 Explain what is meant by encapsulation.

[2]

2.2 State **two** advantages of making an attribute private and providing a mutator.

[2]

Exercises 2.1-2.2

2.1 Explain what is meant by encapsulation.

[2]

2.1

- the data and the methods that act on it are bundled in one class
- the data is hidden and can only be reached through those methods

2.2 State **two** advantages of making an attribute private and providing a mutator.

[2]

2.2

- the mutator can reject invalid values, so the object stays valid
- the inside of the class can change without breaking code that uses it

Exercises 2.3-2.4

2.3 Draw the UML class diagram for the gym member in the worked example, with a constructor, `add_credits(n)`, `book()` and `get_credits()`. [4]

2.4 State the output of `acc = Account("Bo", -20.0)`, then `print(acc.get_balance())`

Exercises 2.3-2.4

2.3 Draw the UML class diagram for the gym member in the worked example, with a constructor, `add_credits(n)`, `book()` and `get_credits()`. [4]

2.3

- name compartment Member
- - name: String, - credits: int
- + Member(name), + add_credits(n): void, + book(): bool, + get_credits(): int
- - on the attributes and + on the methods

2.4 State the output of `acc = Account("Bo", -20.0)`, then `print(acc.get_balance())`

2.4

- **0.0**: the constructor stores `max(0.0, -20.0)`

Exercises 3.1-3.2

3.1 In a UML class diagram, what does - before an attribute mean?

[1]

☐

A it is public

B it is private

C it is static

D it can be negative

3.2 Which method is an accessor?

[1]

☐

A `set_age(a)`

B `get_age()`

C `birthday()`

D `__init__(name, age)`

Exercises 3.1-3.2

3.1 In a UML class diagram, what does - before an attribute mean?

[1]

- ☐ **A** it is public
☐ **B** it is private
☐ **C** it is static
☐ **D** it can be negative

3.1 B

- - private, + public

3.2 Which method is an accessor?

[1]

- ☐ **A** `set_age(a)`
☐ **B** `get_age()`
☐ **C** `birthday()`
☐ **D** `__init__(name, age)`

3.2 B

- it returns a value and changes nothing

Exercise 3.3

3.3 Why should a mutator check a new value **before** changing the attribute?

[1]

☐

A checking is faster before the change

B a rejected value then leaves the object unchanged

C accessors cannot read checked values

D the constructor needs the old value

Exercise 3.3

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3.3 B

- check, then change

Exercise 3.4 (a)

3.4 A school locker system stores a locker's number, whether it is locked and a 4-digit code.

(a) Draw a UML class diagram for **Locker** with a constructor and the public methods `lock()`, `unlock(code)` and `is_locked()`. [4]

Exercise 3.4 (a)

3.4 A school locker system stores a locker's number, whether it is locked and a 4-digit code.

(a) Draw a UML class diagram for `Locker` with a constructor and the public methods `lock()`, `unlock(code)` and `is_locked()`. [4]

(a)

- name compartment `Locker`
- private attributes with types: - `number: int`, - `locked: bool`, - `code: String`
- constructor + `Locker(number, code)`
- + `lock(): void`, + `unlock(code): bool`, + `is_locked(): bool`

Exercise 3.4 (b)

3.4 A school locker system stores a locker's number, whether it is locked and a 4-digit code.

(b) Write the method `unlock(code)`. It unlocks the locker and returns `True` only if `code` matches the stored code. [3]

Exercise 3.4 (b)

3.4 A school locker system stores a locker's number, whether it is locked and a 4-digit code.

(b) Write the method `unlock(code)`. It unlocks the locker and returns `True` only if `code` matches the stored code. [3]

(b) One answer:

```
def unlock(self, code):  
    if code == self._code:  
        self._locked = False  
        return True  
    return False
```

- compares `code` with the stored code
- sets `locked` to `False` only on a match
- returns `True` or `False`

Exercise 3.4 (c)

3.4 A school locker system stores a locker's number, whether it is locked and a 4-digit code.

(c) Explain why the code attribute should be private and have **no** accessor. [2]

Exercise 3.4 (c)

3.4 A school locker system stores a locker's number, whether it is locked and a 4-digit code.

(c) Explain why the code attribute should be private and have **no** accessor. [2]

(c)

- other code cannot read the code and open any locker
- the only way in is through **unlock**, which checks the code