# Further Programming

A-Level Computer Science ▪ Topic 20

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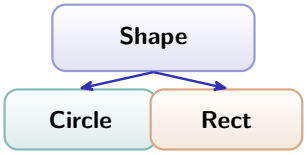





## What we will cover



# 1 Paradigms

## A paradigm is a style of programming

Four paradigms sit in this syllabus.

**low-level** 低级

machine code or assembly; registers and addresses; drivers, firmware

**imperative** 命令式

a sequence of commands that change state – Topics 9 and 11

**object-oriented** 面向对象

objects bundle data and methods; instances of classes

**declarative** 声明式

say *what*, not *how* – SQL, Prolog, Haskell



## Low-level and imperative

**Low-level** programming is close to the hardware. Each instruction maps to what the CPU runs. Addressing modes: immediate, direct, indirect, indexed, relative. Fast and compact; architecture-specific and hard to maintain.

**Imperative** (procedural / structured): assignments, conditionals, loops, function calls. **Variables** 变量 hold state; statements change it. Strong when the algorithm has clear sequential steps. Python, C.



## Declarative – what, not how

Two kinds:

- **functional** 函数式 – **pure functions** 纯函数 with no **side effects** 副作用 (Haskell, Lisp)
- **logic** 逻辑 – facts and rules; the engine answers a goal (Prolog)

SQL is the familiar example: `SELECT * FROM Customer WHERE Country = 'UK'` says what you want, not how to walk the records.

> Modern languages mix paradigms. Python supports procedural, OOP and functional. Pick the one that fits the problem.

# 2 OOP



## Four pillars

**encapsulation** 封装

data is hidden behind methods; a `BankAccount` hides `balance` behind `deposit()`

**inheritance** 继承

a **subclass** 子类 specialises a **superclass** 父类. Models is-a.

**polymorphism** 多态

the same call runs different code: every `Shape` has `Area()`

**abstraction** 抽象

show a simple interface; hide the implementation

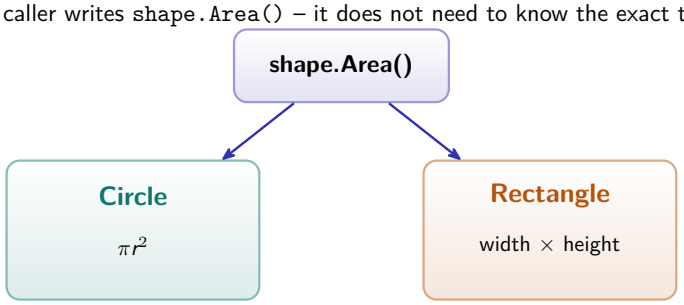


## Class vocabulary

| | |
|---|---|
| **class** | the template; an object is an **instance** 实例 of it |
| **constructor** | a special method that sets up attributes on creation |
| **getters setters** | read and write attributes through methods |
| **aggregation** | a "has-a" – an object built from other objects |

## Polymorphism in one picture

The caller writes `shape.Area()` – it does not need to know the exact type.




# 3 Files



## File operations in pseudocode

Extends Topic 10. Modes: `READ` (existing), `WRITE` (create/overwrite), `APPEND` (add at the end).

```
OPENFILE "names.txt" FOR READ
WHILE NOT EOF("names.txt") DO
  READFILE "names.txt", thisName
  OUTPUT thisName
ENDWHILE
CLOSEFILE "names.txt"
```

Always open, process, then close. Forgetting to close can lose data. `WRITE` when you meant `APPEND` overwrites everything.

## You cannot overwrite a line in place

**A members file needs one phone number changed. Why not just overwrite that line?**

Lines have different lengths. A longer replacement would run into the next record; a shorter one would leave part of the old line behind.

Pattern: open the original for `READ` and a temporary file for `WRITE`; write the new version of the changed line and the original of every other; close both; replace the original with the temp file.

The same shape handles deleting (skip the line) and inserting. Every line gets written – writing only the new record and losing the rest is the classic slip.

# 4 Exceptions



## Handle the errors you cannot prevent

An **exception** 异常 is a runtime error: divide by zero, file not found, index out of range. **Exception handling** 异常处理 lets the program respond instead of crashing.

`TRY` the risky code → `EXCEPT` a named error → `FINALLY` always runs

> A file may be deleted between "exists?" and "open". You cannot prevent that – only handle it. Do not swallow exceptions silently.

## Raising, and where to catch

A subroutine that detects an error can **raise** 抛出 it so the caller handles it:

```
IF b = 0 THEN
  RAISE DivideByZero
ENDIF
```

Handle close to the error if the response is simple, or higher up the **call stack** 调用栈 if only the outer code knows what to do.

Common names: `FileNotFound`, `IOError`, `DivisionByZero`, `IndexOutOfRange`, `InvalidArgument`, `NullReference`, `OutOfMemory`.

# 5 Recap



## Topic 20 – key takeaways

1. **Paradigms**
   low-level, imperative, OOP, declarative
2. **OOP**
   encapsulate, inherit, polymorph, abstract
3. **Files**
   open / process / close; update via a temp file
4. **Exceptions**
   TRY / EXCEPT / FINALLY; never swallow

## Check yourself

1. Which paradigm says *what* to compute, not *how*?
2. Inheritance models which relationship?
3. Why write an update to a temporary file?
4. Which block always runs, exception or not?

**Answers** **1.** declarative **2.** is-a **3.** variable-length lines cannot be overwritten in place **4.** FINALLY