PROGRAMMING IN ROLE ORIENTED CONCURRENT CONTEXTS WITH ROCOCO

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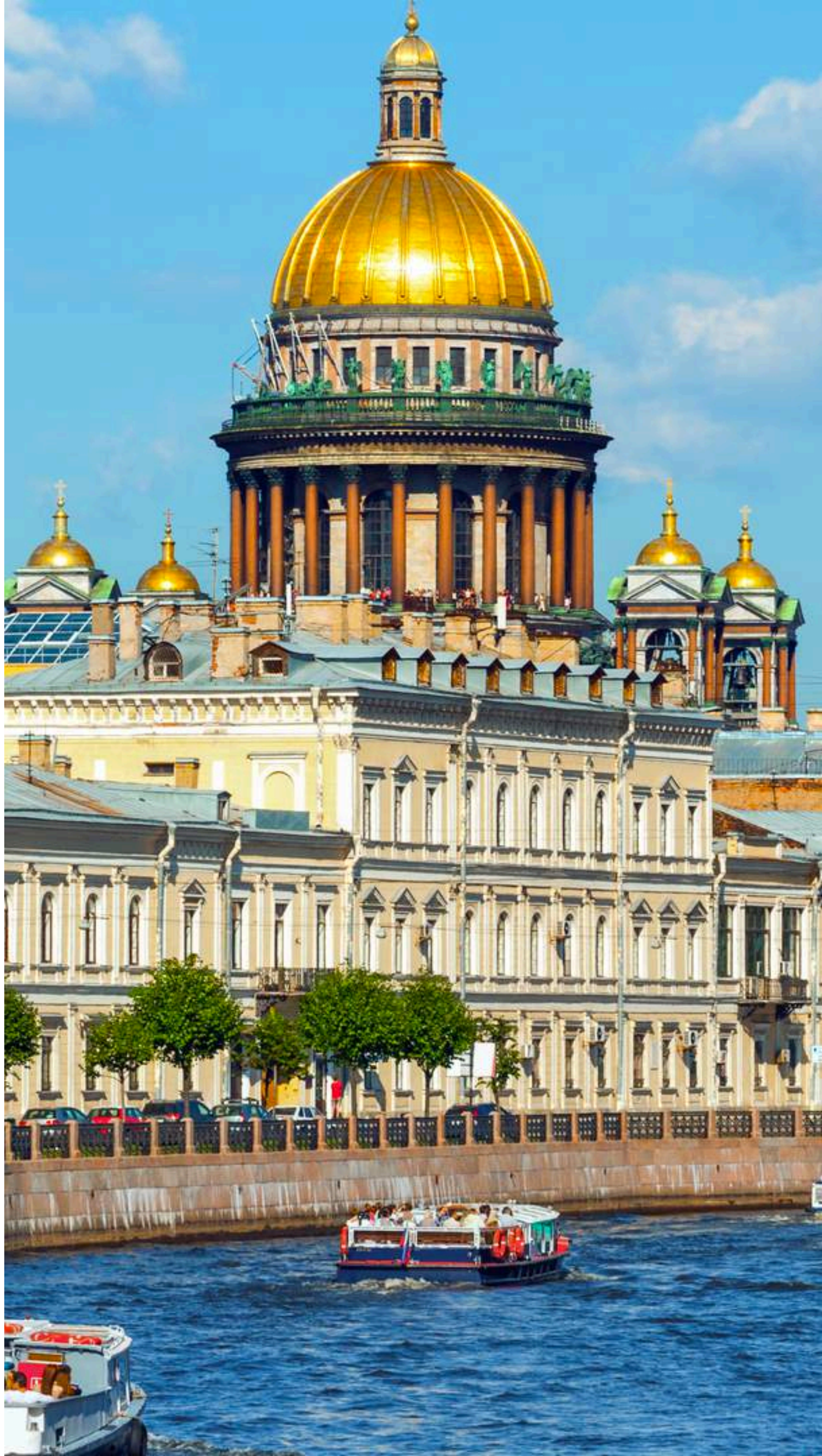
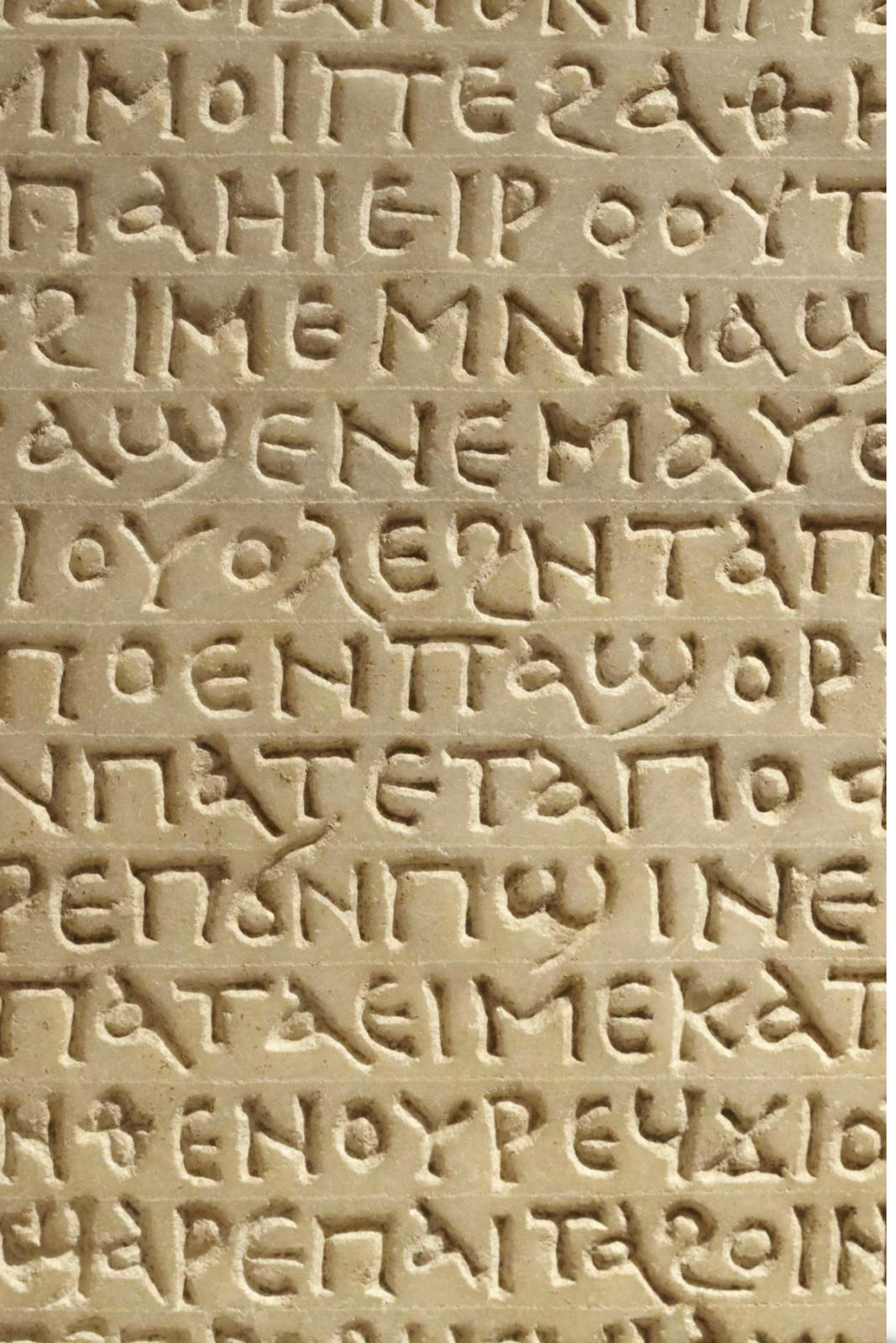




TECHNOLOGY

τέχνη

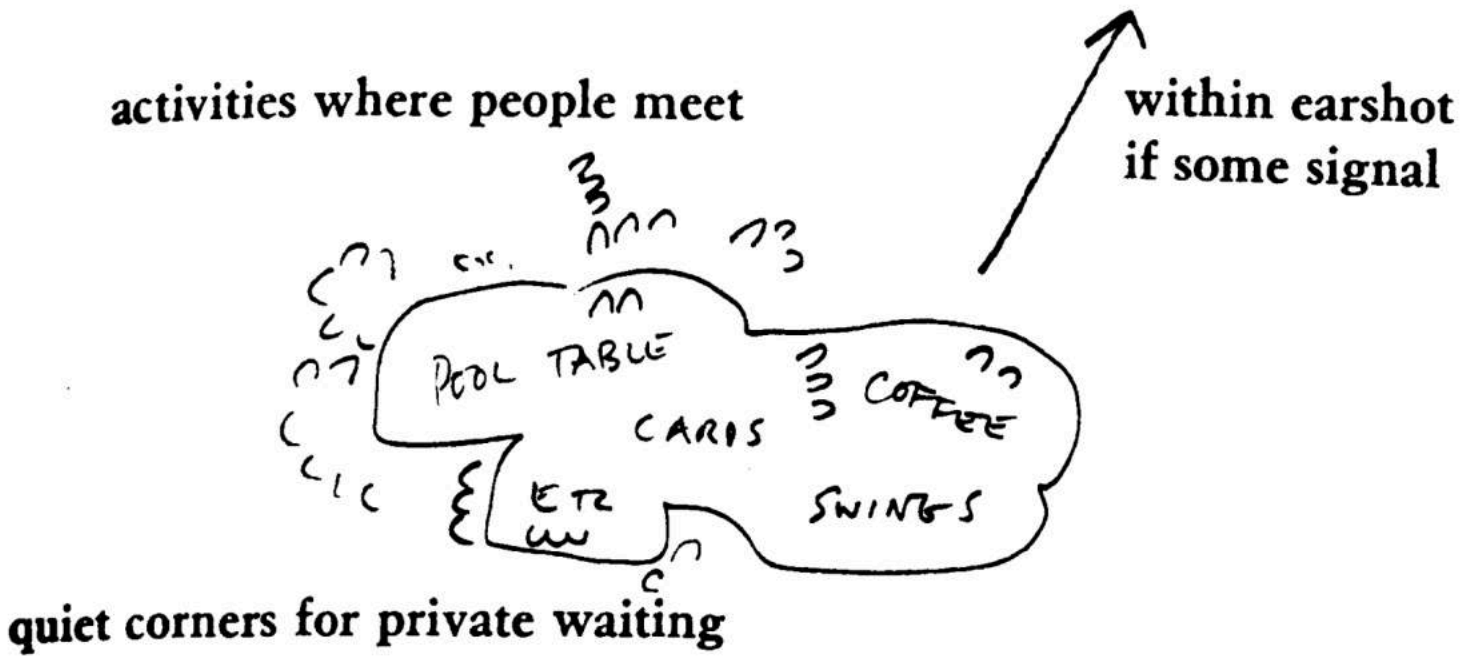
- téchnē means craftsmanship, craft or art in ancient Greeks
- and emphasizes both skill and beauty

VOID

FIRST, THERE WAS VOID

- In engineering or art disciplines, still except software development, architecture has always been about
  - to capture VOID
  - by defining FORM
  - to let both the stability and creativity happening ALIVE within the generated space
- Technical details and even measurements come later
- In software development, however, we ignore the very essense of form relying only on metrics such as coupling and cohesion, # of lines

PATTERN LANGUAGES


activities where people meet
within earshot if some signal
POOL TABLE
CARDS
COFFEE
ETC
SWINGS
quiet corners for private waiting

Gertrud & Cope

- Christopher Alexander introduced pattern languages in 1970s.
- A PATTERN — PLACE TO WAIT
  - In places where people end up waiting, create a situation which makes the waiting positive.
  - Fuse the waiting with some other activity—newspaper, coffee, pool tables, horseshoes; something which draws people in who are not simply waiting.
  - And also the opposite: make a place which can draw a person waiting into a reverie; quiet; a positive silence

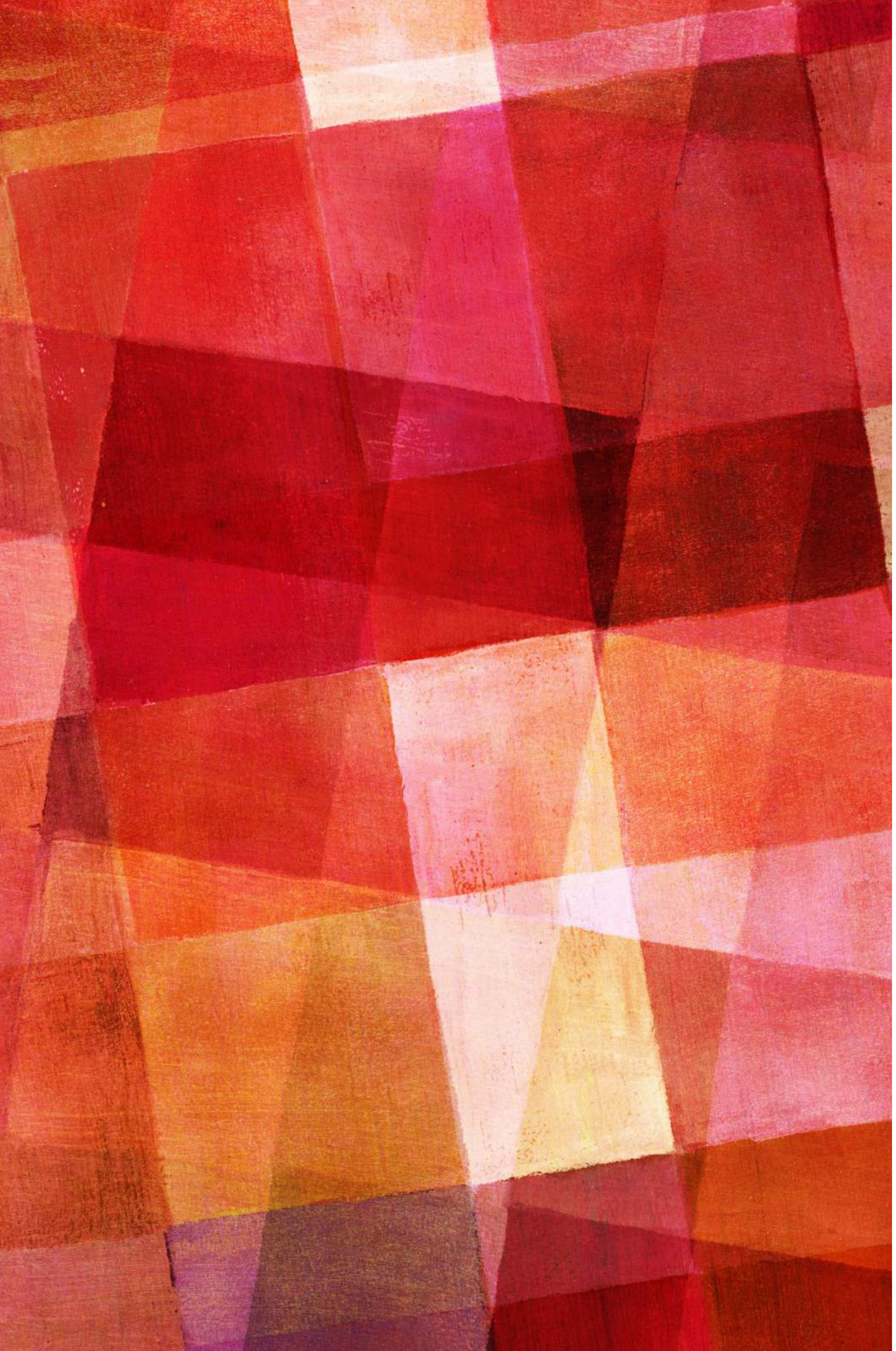
STRUCTURE EVOLVES IN TIME

- TEST OF TIME: Thinking too ahead in time and hardening the structure too early based on immature decisions without considering time will destroy the ALIVENESS of the architecture
- Timeless thinking is completely different and the very basic idea is the awareness of radically different rates of change of different parts of a solution
- Only then, we start to begin understanding the effects and importance of FORM & VOID

… several acts of building, each one done to repair and magnify the product of the previous acts, will slowly generate a larger and more complex whole than any single act can generate

-Christopher Alexander

OCCASVS
7
8
9
10
11
12



PARADIGM SHIFT

- As with other Newtonian and engineering methods, software or even computing itself has born from male principle in charge
  - crisp determination
  - command and control, etc.
- It is not so wrong to state that even the very first idea about the possibility of computers originated in military researches in 1930s
- Female principle, which is ignored for centuries is gaining importance now disguised as systems thinking
  - awareness of environment
  - feelings > intellect, etc.

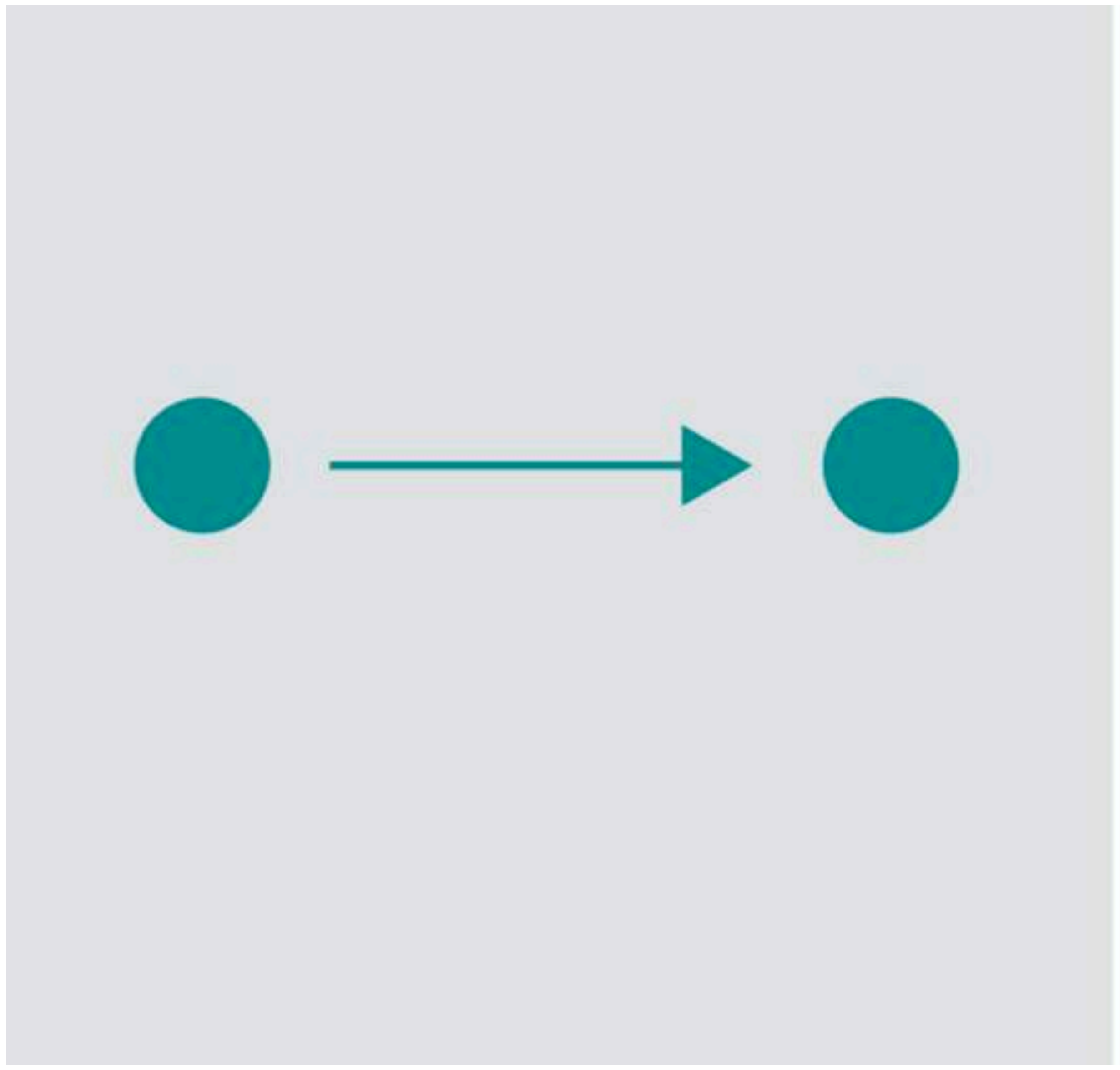
LOOK AT THE KEYS IN YOUR KEYBOARD: AREN'T THEY MILITARY?

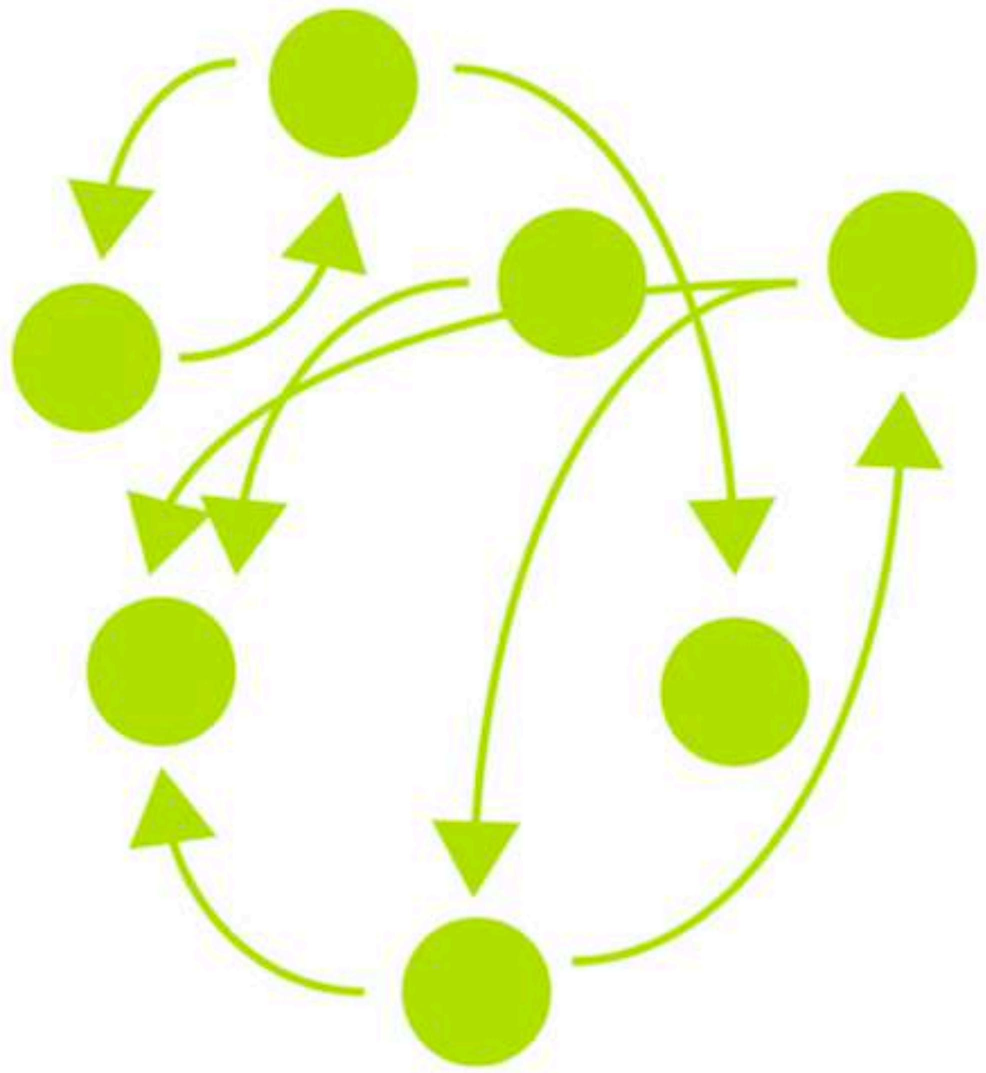
- command
  - enter
  - return (to base)
- control
- escape
- shift? (yes, even that)

- Can we blame the military for dominating the rest of the industry?
- However, this is not enough to explain what's really going on here
- Root cause of the problem is the way we think, our thought process
- We ignored female principle everywhere: in education, at work, …

SYSTEMS THINKING: SCIENCE FOR LIVING SYSTEMS

- We don't scare to look at really complex problems any more
- We are aware of them and develop methods to deal with them
- This is just a little bit off the road on our old way of thinking



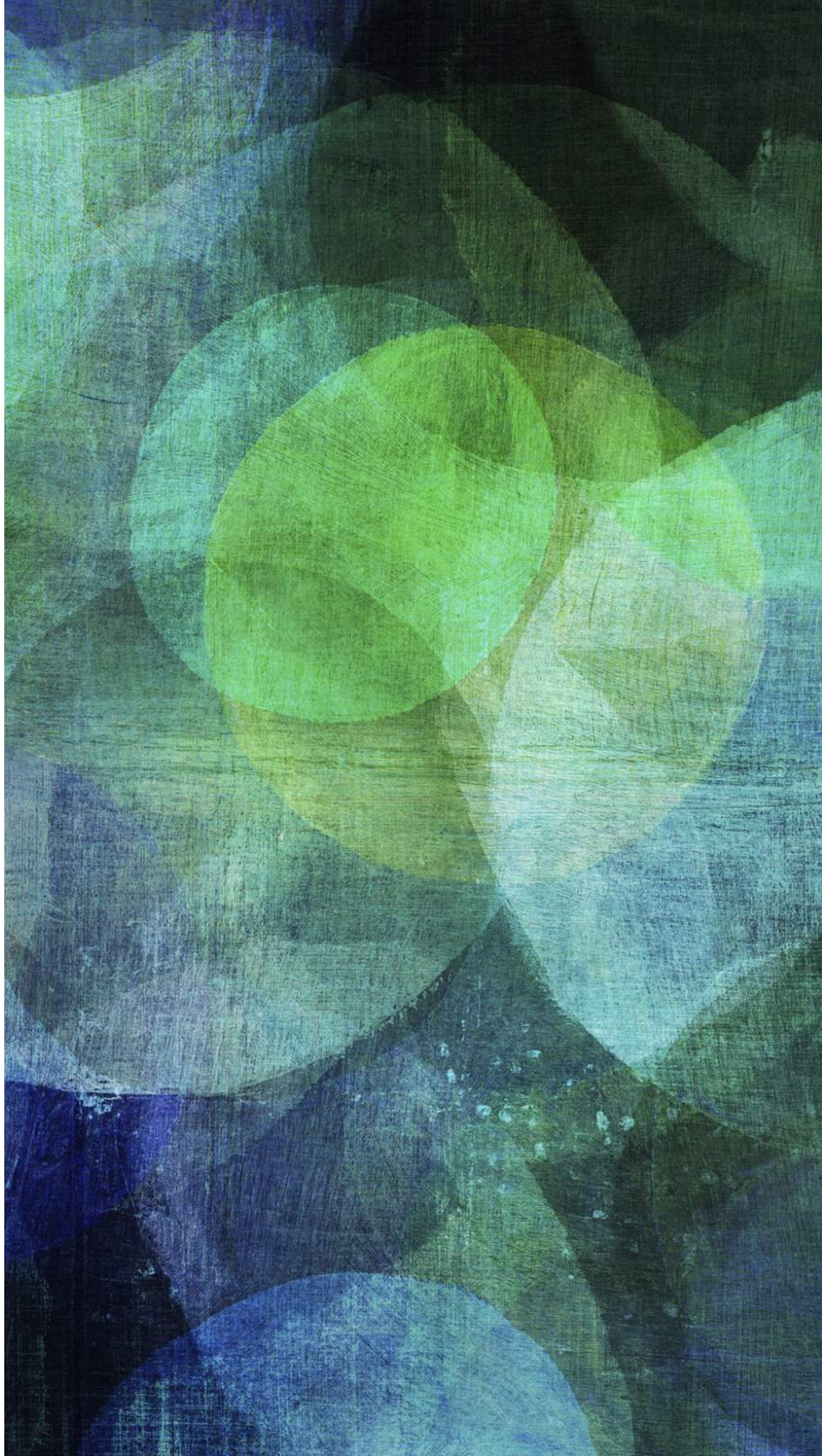


SO, WHAT IS

THE KEY:

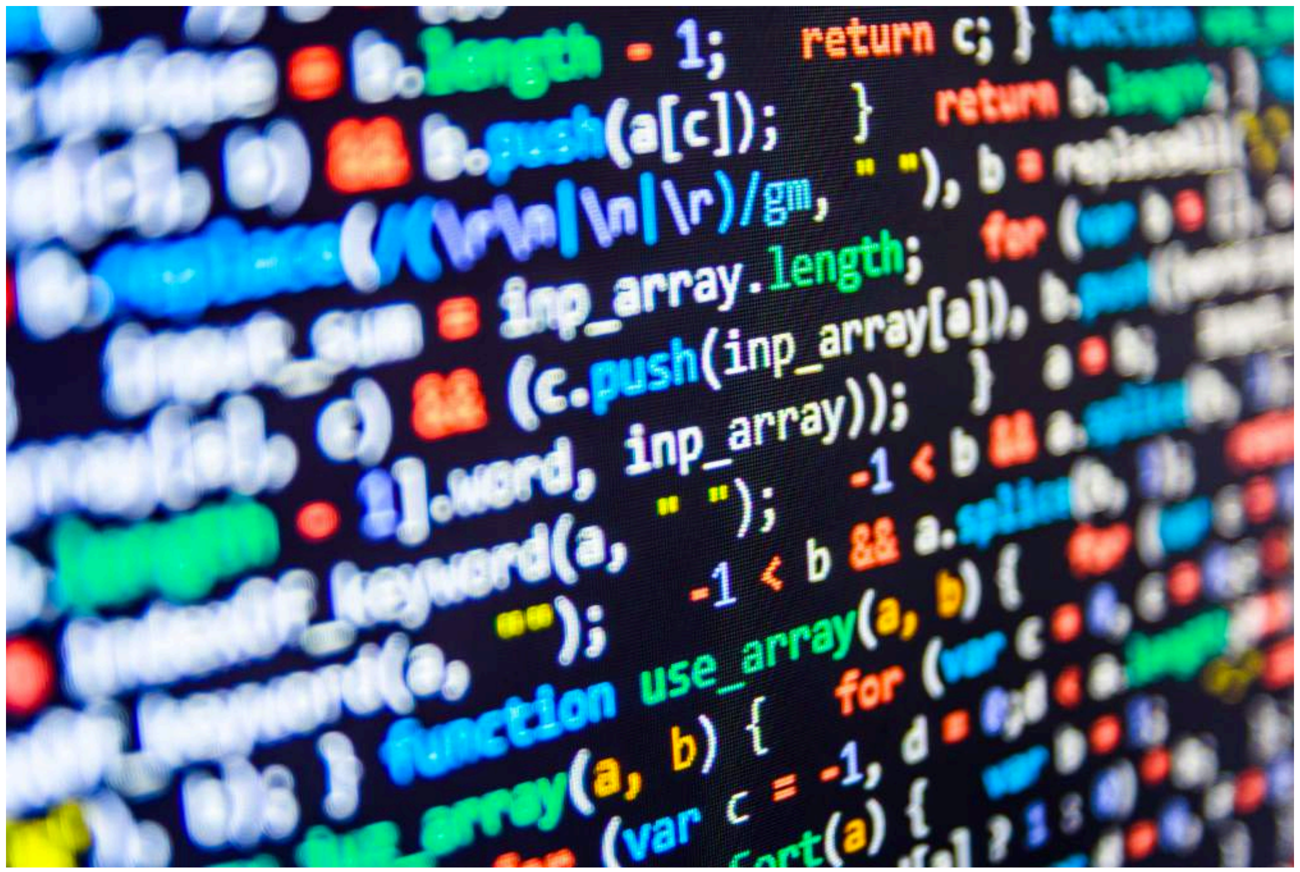
CO-EXISTANCE

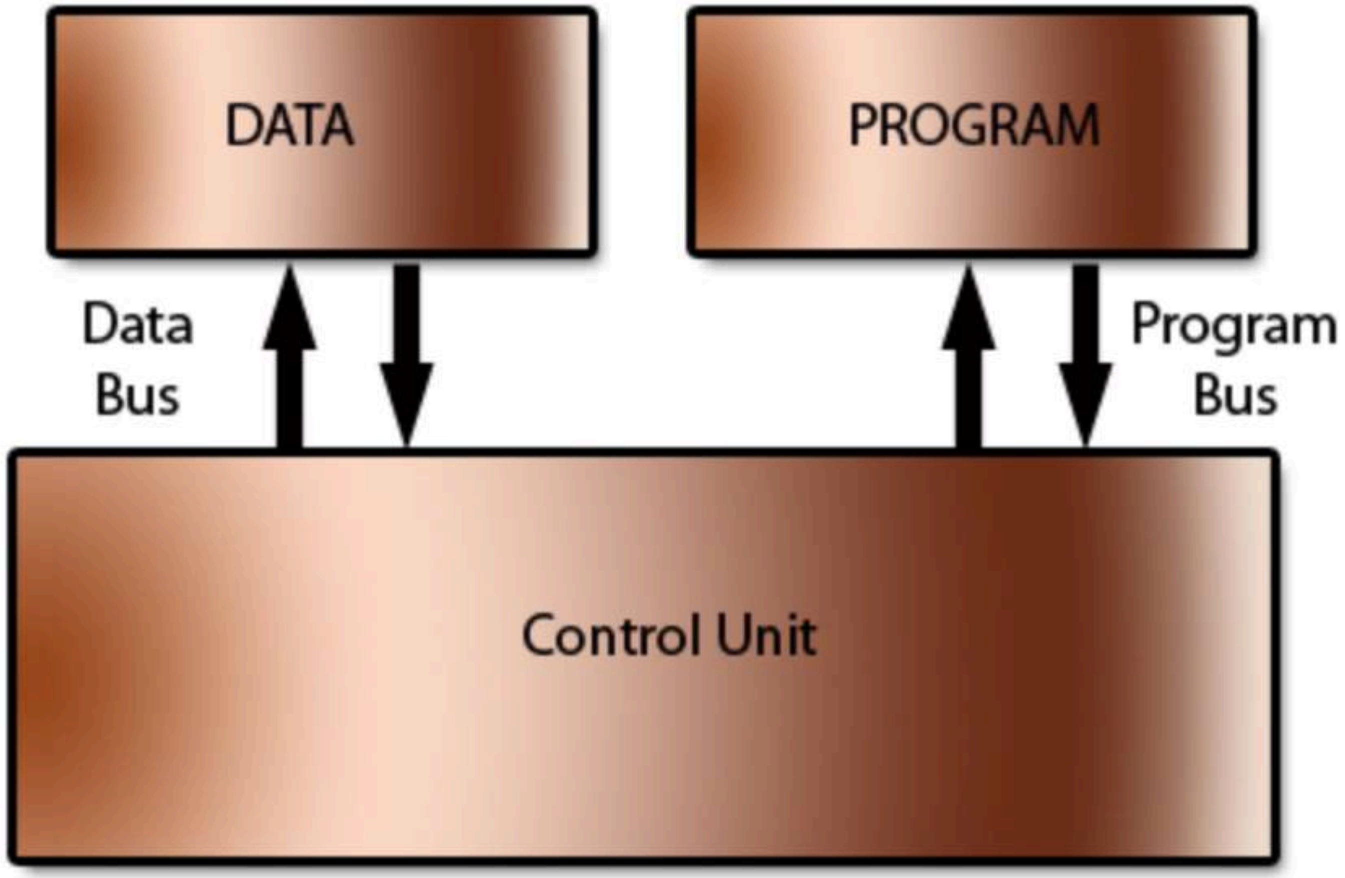
Every living system co-exits in a complex web of relations

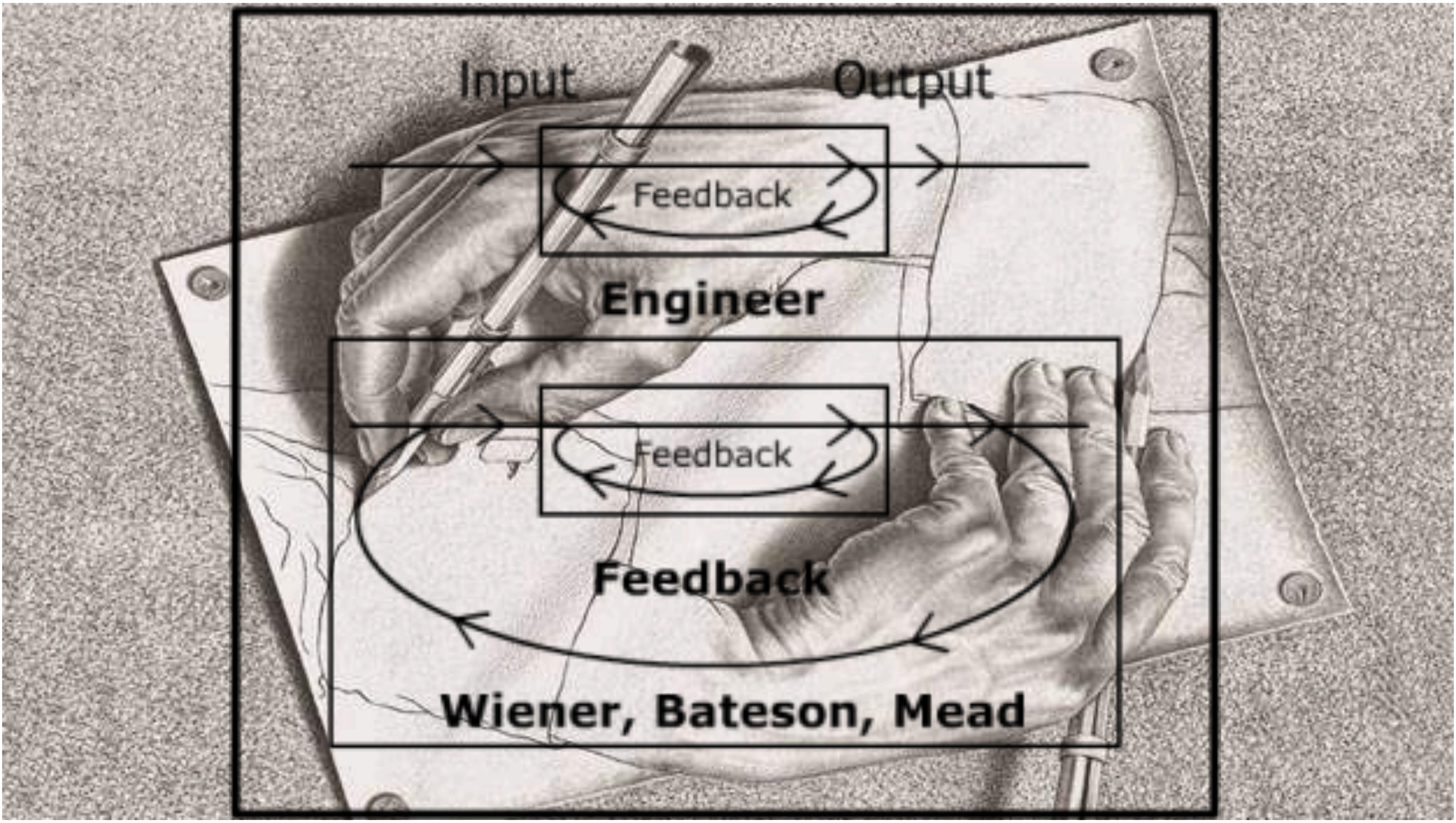


CAN YOU SAY SOFTWARE IS NOT A LIVING SYSTEM?

- Do you think Von-Neumann architecture will survive?
  - Well, it is the foundation of all computing so far
  - It won’t be completely forgotten but it may fade away
- WERE THERE AN ALTERNATIVE?



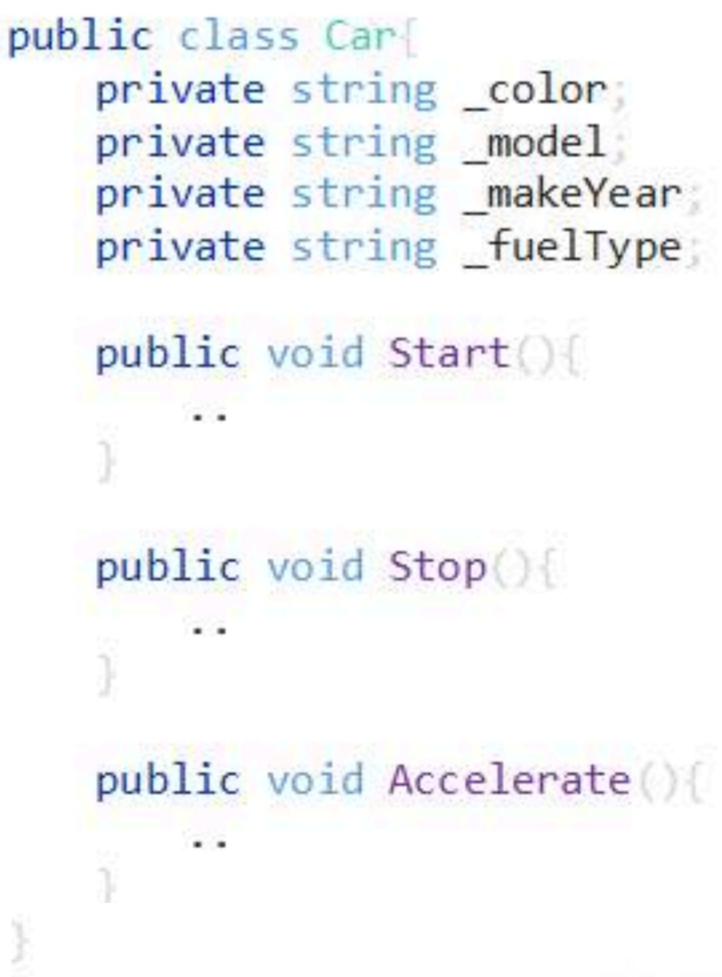



Input
Output
Feedback
Engineer
Feedback
Feedback
Wiener, Bateson, Mead

“

In computer terms, Smalltalk is a recursion on the notion of computer itself. Instead of dividing “computer stuff” into things each less strong than the whole -like data structures, procedures and functions which are the usual paraphernalia of programming languages- each Smalltalk object is a recursion on the entire possibilities of the computer. Thus its semantics are a bit like having thousands and thousands of computers all hooked together by a very fast network.

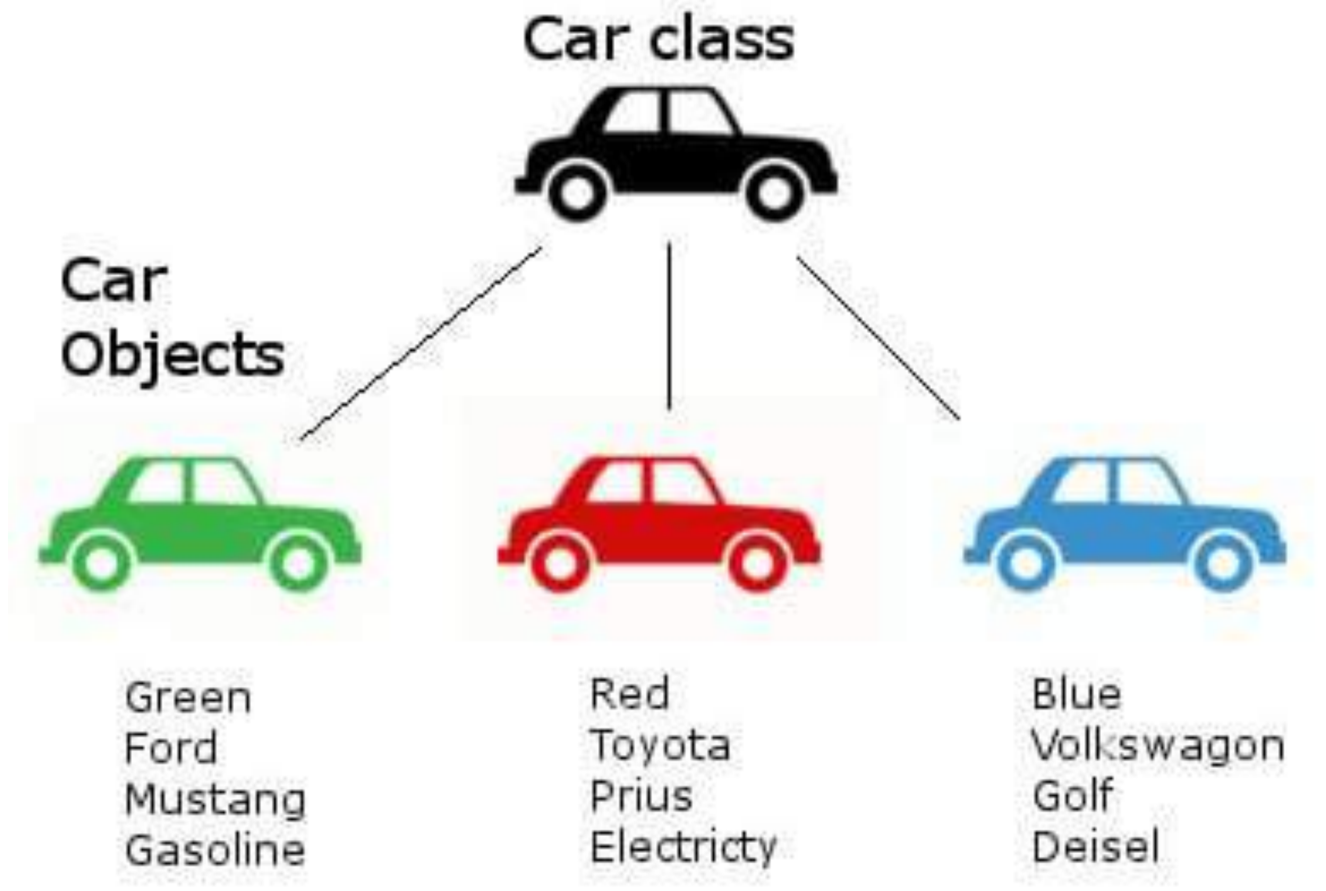
-Alan Kay



```
public class Car{
    private string _color;
    private string _model;
    private string _makeYear;
    private string _fuelType;

    public void Start(){
        ..
    }

    public void Stop(){
        ..
    }

    public void Accelerate(){
        ..
    }
}
```

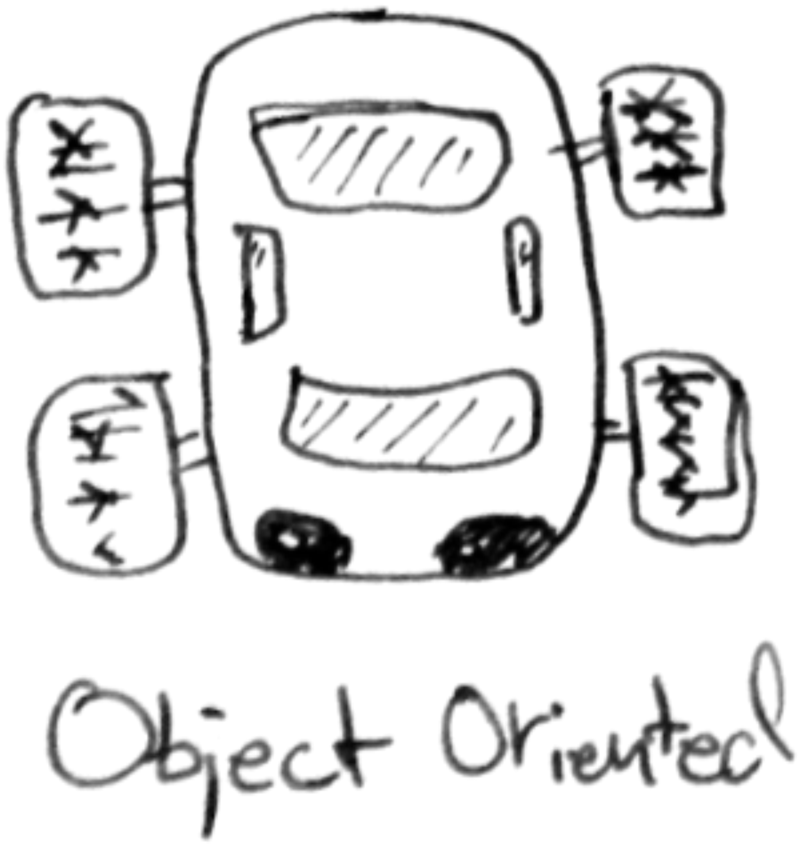
OO AS WE KNOW IT (NOW)

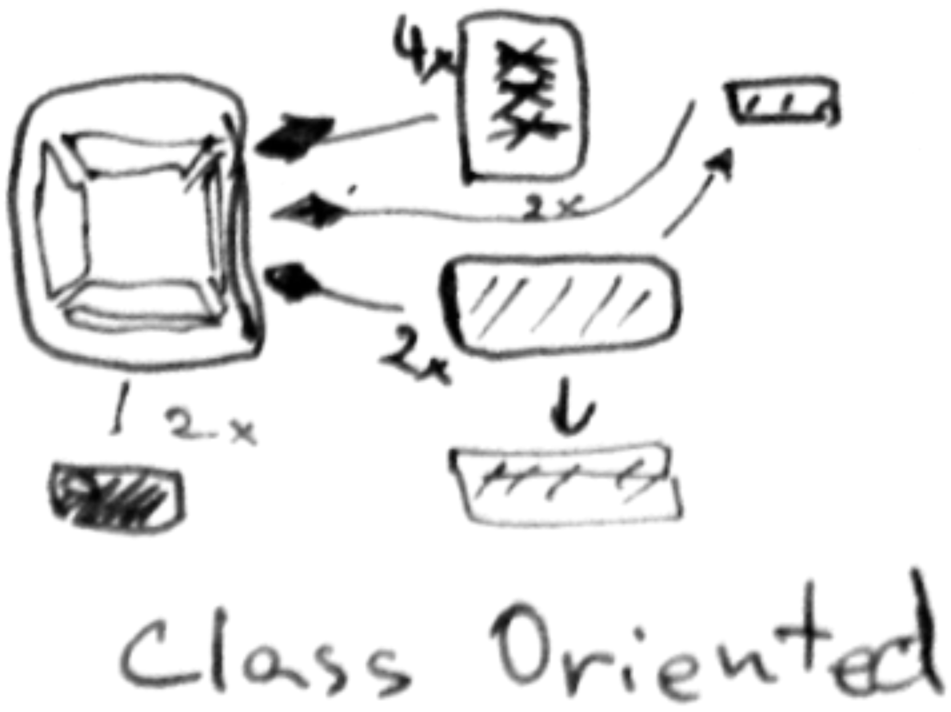
- Although there are methods (procedures) like Start, Stop and Accelerate, car is depicted from an angle of view which highlights data perspective
- This view is too narcissist
- Interaction with environment (such as road) is not designed
- There is no where to save the collaborative code in the source
  - when a human sits on the driver seat (as the driver) how the car collaborates?



CLASS ORIENTED IS NOT OBJECT ORIENTED (NOT EVEN CLOSE)

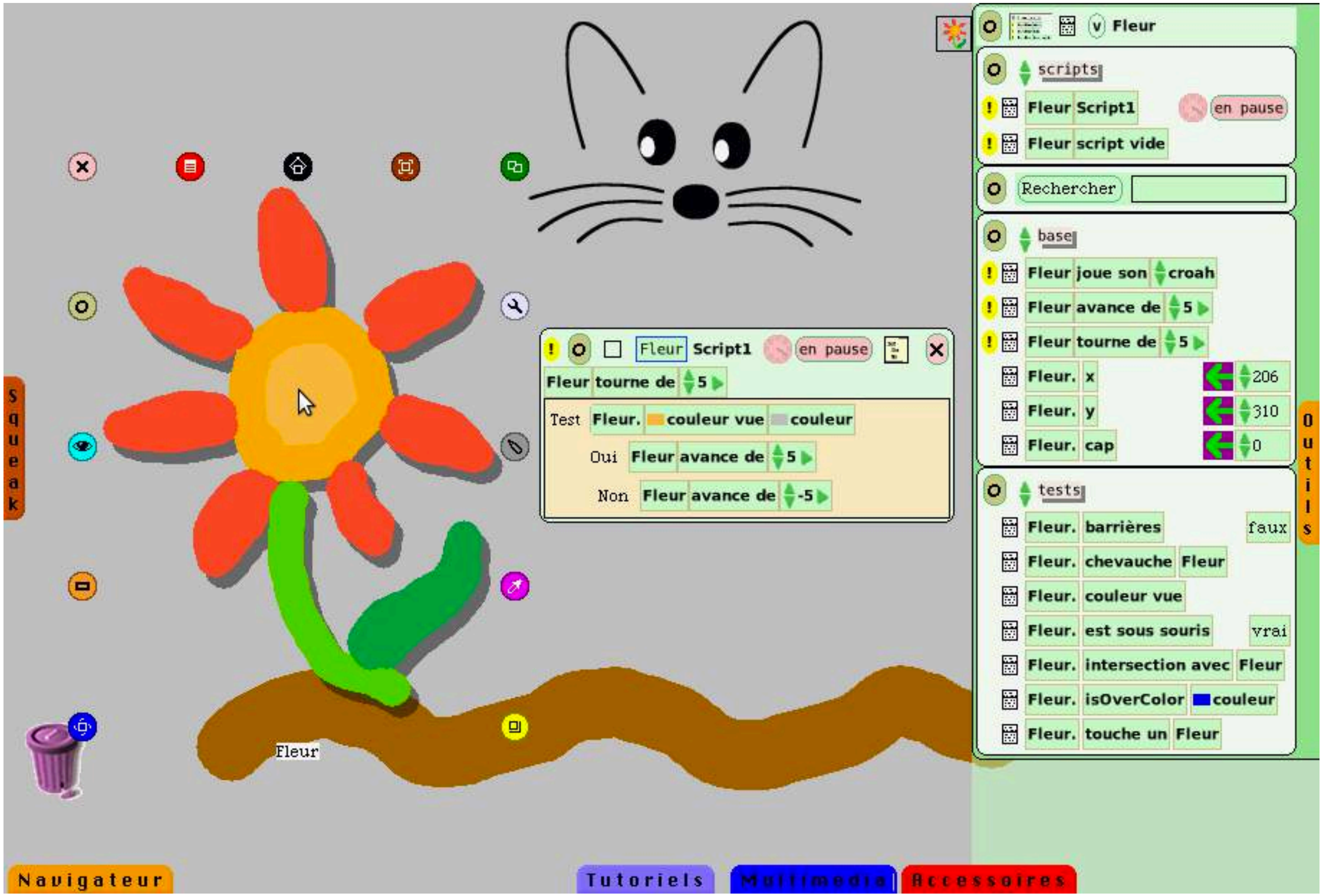
- Systems thinker says that a system is more than the sum of its parts
  - Is it enough to state that a car has 1 steering wheel and 4 tyres, etc. ?





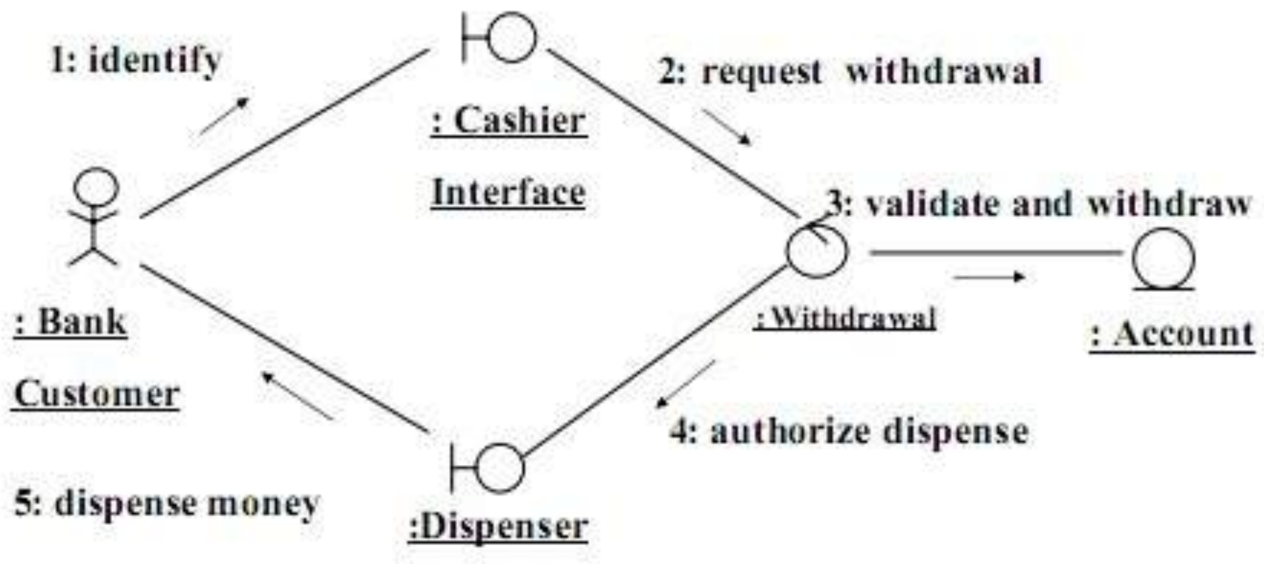
- Defining only the structure is not enough to design a living system
- Interactions should also be defined in bounding contexts (recursively)

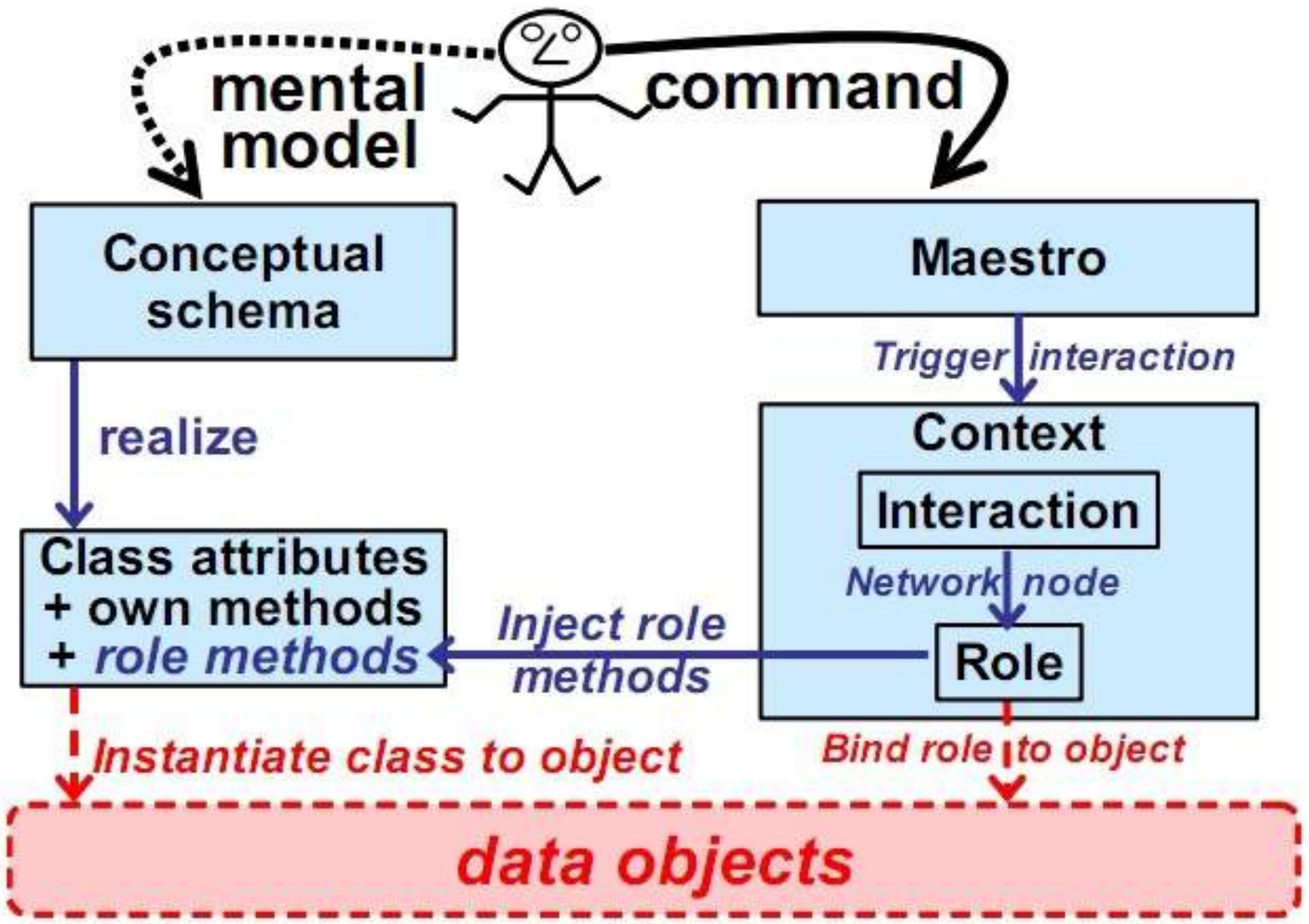
THIS IS THE VISION: OBJECTS AND SCRIPTS ARE HAND IN HAND



```
Fleur Script1   en pause
Fleur tourne de 5
Test  Fleur. couleur vue  couleur
   Oui  Fleur avance de 5
   Non  Fleur avance de -5
```

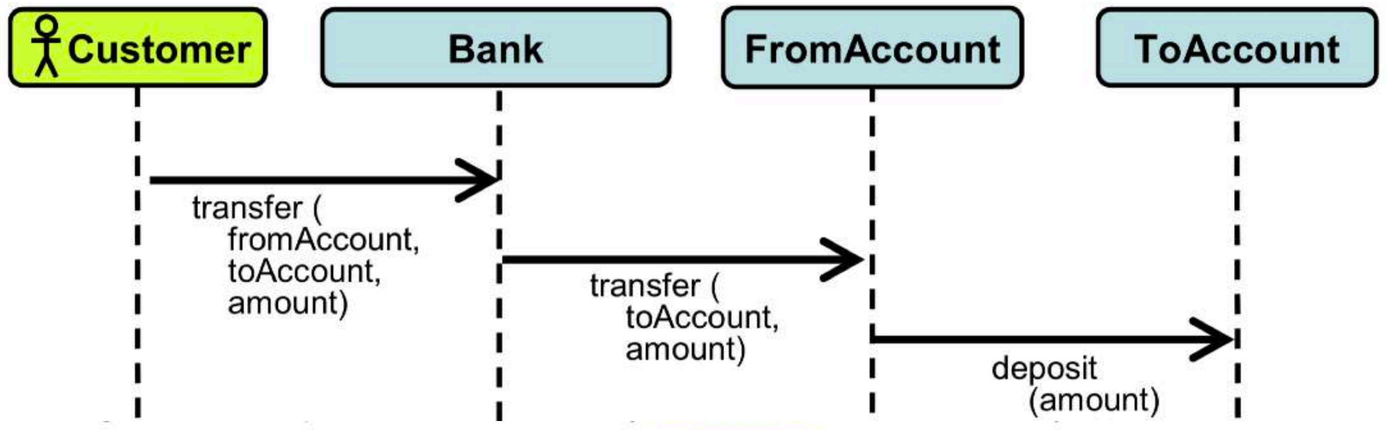
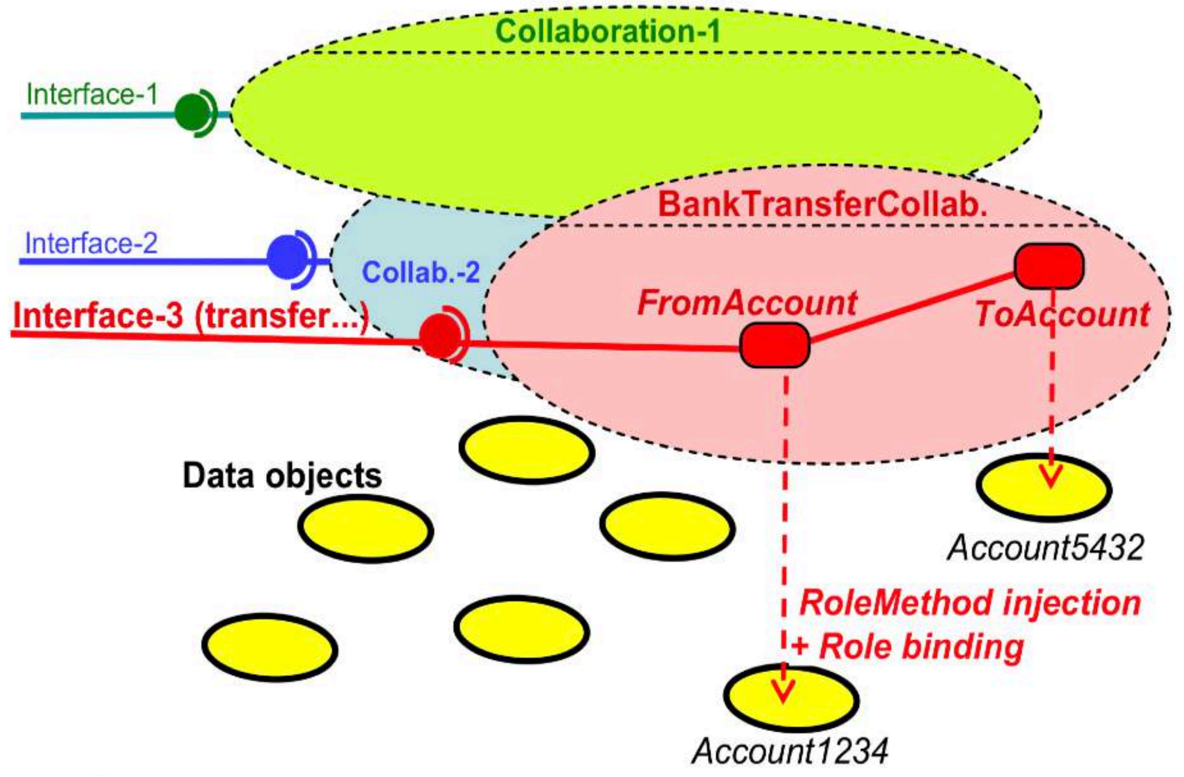
```
Fleur
scripts
  Fleur Script1        en pause
  Fleur script vide
Rechercher
base
  Fleur joue son croah
  Fleur avance de 5
  Fleur tourne de 5
  Fleur. x             206
  Fleur. y             310
  Fleur. cap           0
tests
  Fleur. barrières             faux
  Fleur. chevauche Fleur
  Fleur. couleur vue
  Fleur. est sous souris       vrai
  Fleur. intersection avec Fleur
  Fleur. isOverColor couleur
  Fleur. touche un Fleur
```

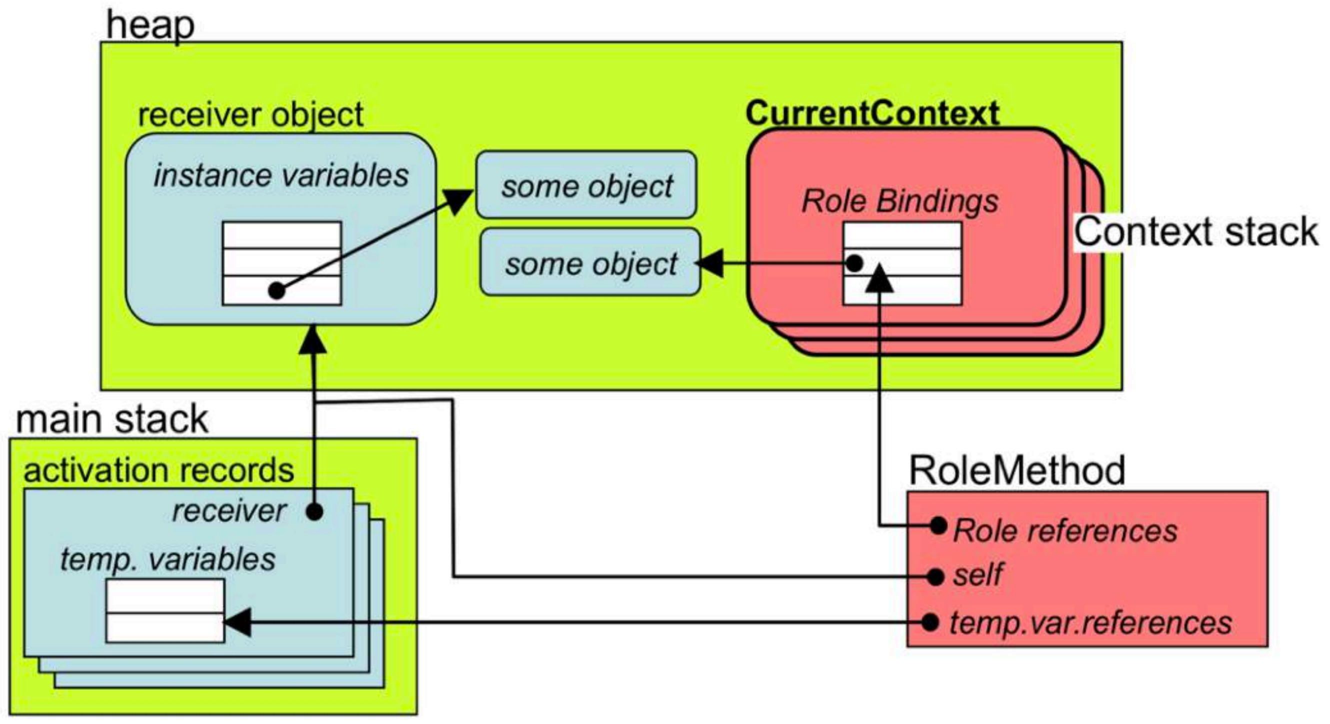




DATA-CONTEXT-INTERACTION

- DCI decouples inheritance mechanism from specifying the behavior in code and restricts the use of classes to only where they are needed and effective most: DATA
- DCI is a natural extension to object orientation to include use cases and the like directly in the code which are thought so far only as analysis and even test artifacts
-


Customer
Bank
FromAccount
ToAccount
transfer (fromAccount, toAccount, amount)
transfer (toAccount, amount)
deposit (amount)




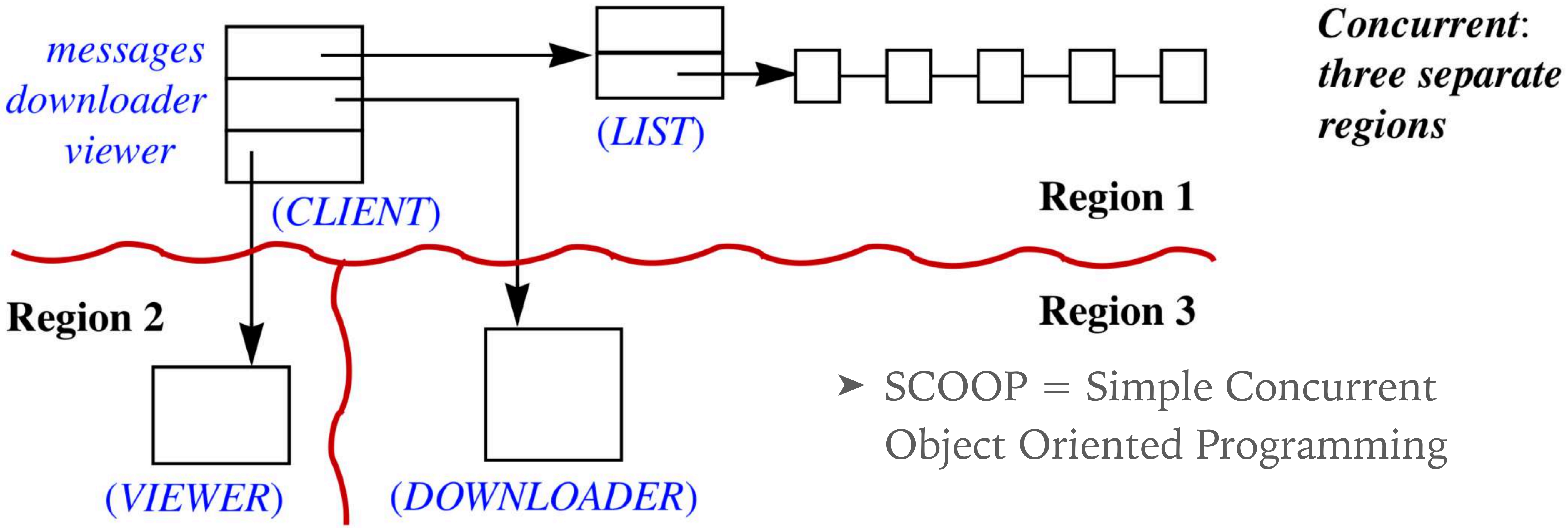
DCI EXECUTION MODEL

- DCI aligns well with end user
- DCI frees the data objects
- DCI allows contextual codes where the objects collaborate
- All the code to orchestrate the objects in a context is in the contextual code, they do not need to be inside the objects
- DCI execution model is single-threaded, is NOT concurrent
- ROCOCO addresses this issue by applying SCOOP technique

SCOOP

- Originated in Eiffel language

```
class CLIENT feature
    messages: LIST [STRING]                  -- Email messages received
    downloader: separate DOWNLOADER          -- Downloading engine
    viewer: separate VIEWER                  -- Message viewing engine
end
```



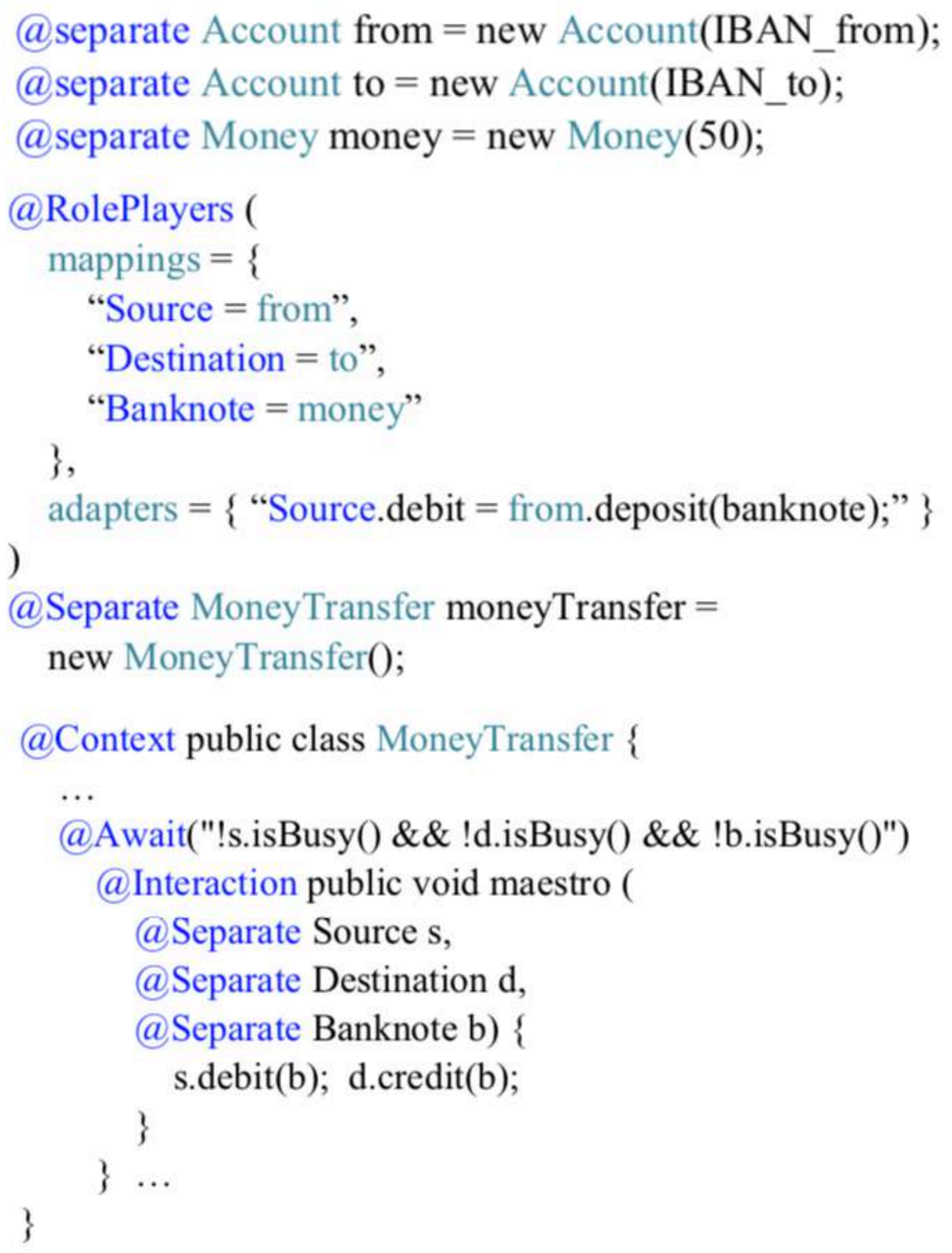
- SCOOP = Simple Concurrent Object Oriented Programming

ROCOCO = DCI + SCOOP

ROCOCO applies SCOOP to enable concurrency in a DCI way of role orientation

ROCOCO is named after a late Baroque ornamental and theatrical style to create surprise and the illusion of motion and drama, and technically means Role Oriented Concurrent Contexts

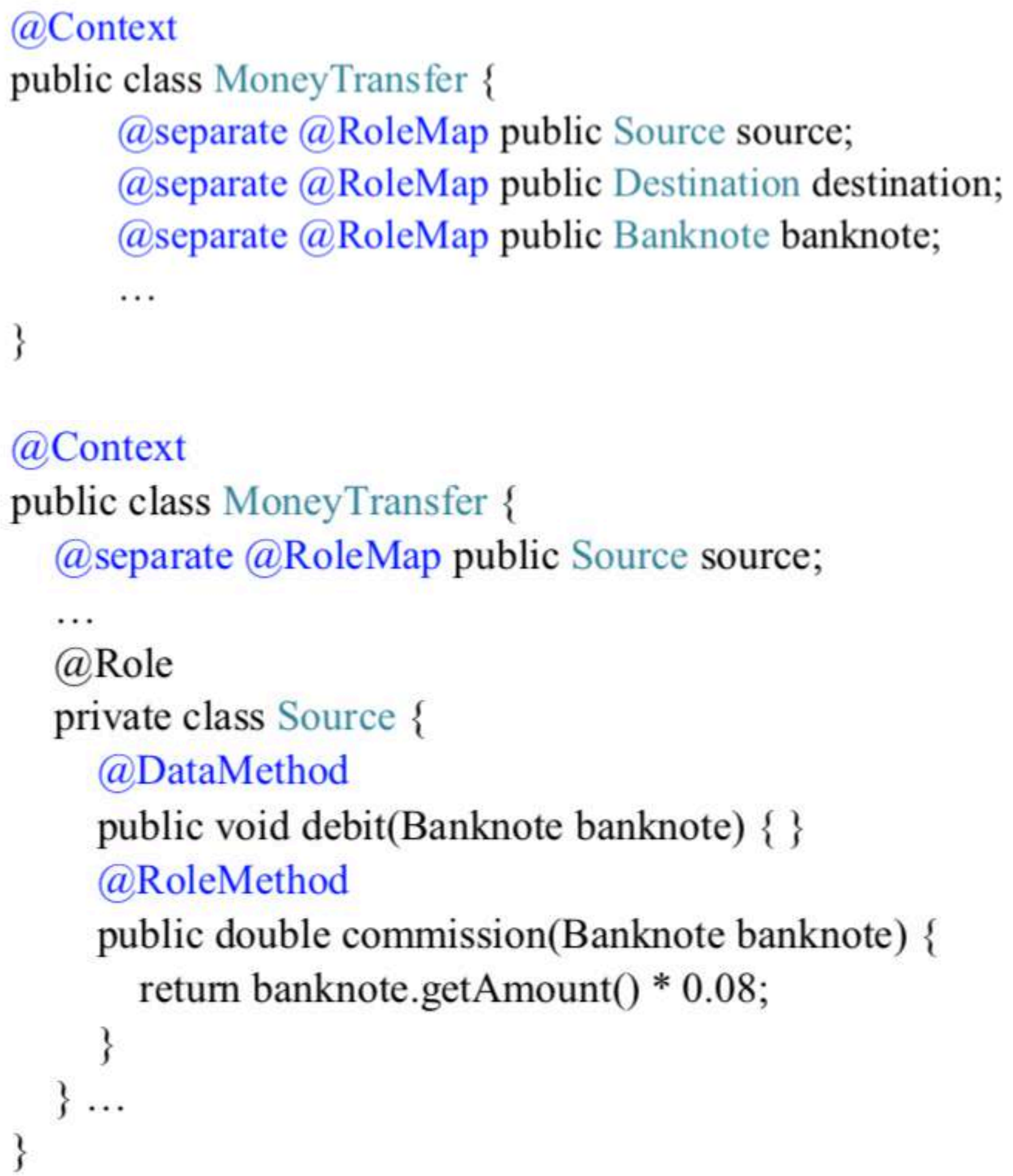
ROCOCO USAGE EXAMPLE



```
@separate Account from = new Account(IBAN_from);
@separate Account to = new Account(IBAN_to);
@separate Money money = new Money(50);

@RolePlayers (
   mappings = {
      “Source = from”,
      “Destination = to”,
      “Banknote = money”
   },
   adapters = { “Source.debit = from.deposit(banknote);” }
)
@Separate MoneyTransfer moneyTransfer =
   new MoneyTransfer();

@Context public class MoneyTransfer {
   …
   @Await("!s.isBusy() && !d.isBusy() && !b.isBusy()")
      @Interaction public void maestro (
         @Separate Source s,
         @Separate Destination d,
         @Separate Banknote b) {
            s.debit(b);  d.credit(b);
         }
      } …
}
```

- from, to and money objects are data objects
- these data objects are being used in MoneyTransfer context which knows all the actions and information about bank transfer, commissions, etc.
- @separate means that these objects and the context may all live in separate threads
- @RolePlayers maps each role to the data object which will play that role in the context

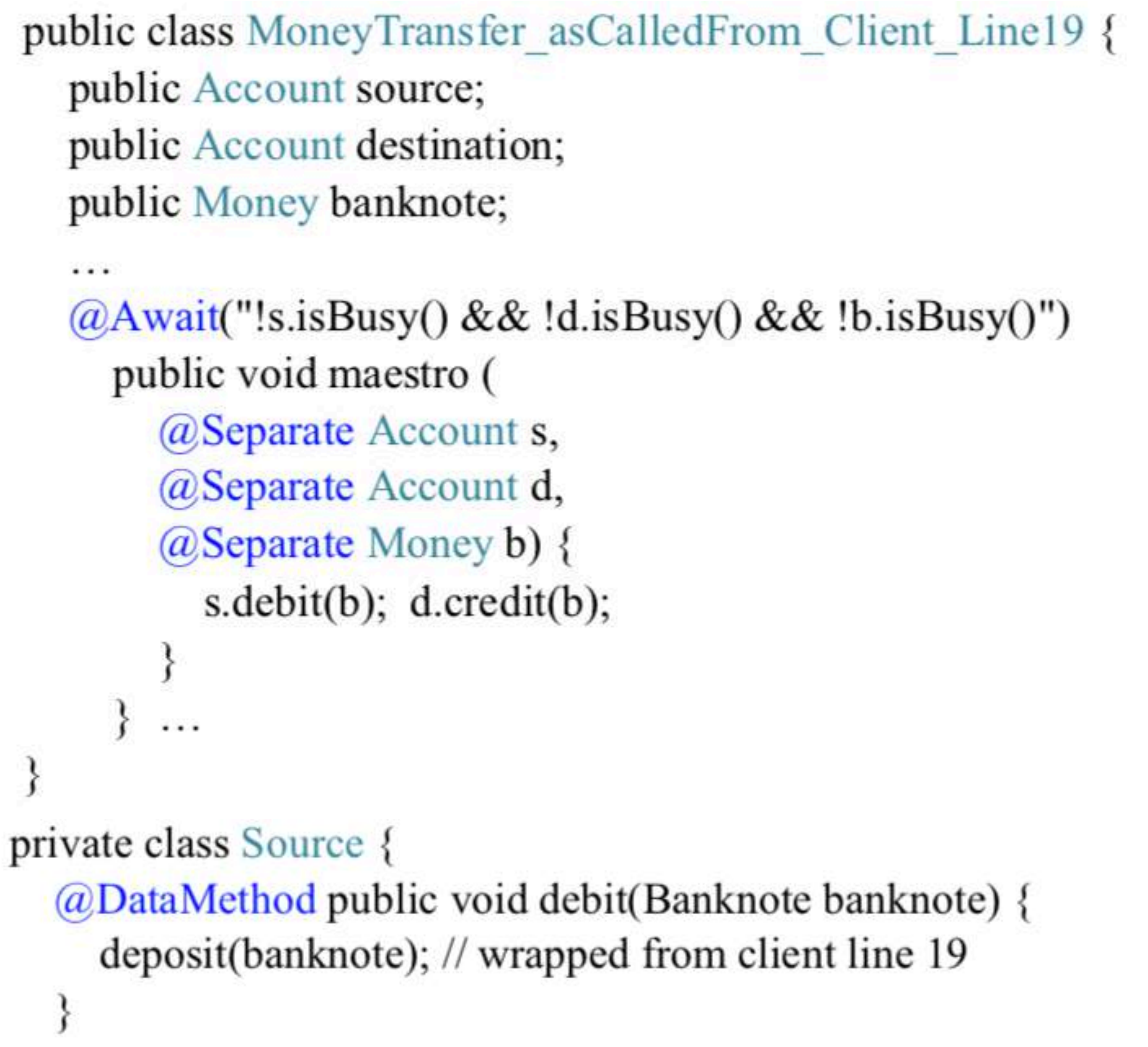
ROCOCO CONTEXT



```
@Context
public class MoneyTransfer {
        @separate @RoleMap public Source source;
        @separate @RoleMap public Destination destination;
        @separate @RoleMap public Banknote banknote;
        …
}

@Context
public class MoneyTransfer {
   @separate @RoleMap public Source source;
   …
   @Role
   private class Source {
      @DataMethod
      public void debit(Banknote banknote) { }
      @RoleMethod
      public double commission(Banknote banknote) {
         return banknote.getAmount() * 0.08;
      }
   } …
}
```

- In ROCOCO, a context is a class annotated with *@Context*
- The main responsibility of a context is to bring data objects together that will interact as role players within the context
- Good contexts are stateless, so a warning can be given if there is any field in the context which is not annotated with *@RoleMap*
- Context is constructed in an atomic call, once established, the role players do not change

ROCOCO TRANSFORMATION



```
public class MoneyTransfer_asCalledFrom_Client_Line19 {
  public Account source;
  public Account destination;
  public Money banknote;
  ...
  @Await("!s.isBusy() && !d.isBusy() && !b.isBusy()")
    public void maestro (
      @Separate Account s,
      @Separate Account d,
      @Separate Money b) {
        s.debit(b);  d.credit(b);
      }
    } ...
}
private class Source {
  @DataMethod public void debit(Banknote banknote) {
    deposit(banknote); // wrapped from client line 19
  }
```

- ROCOCO uses eclipse JAVA Development Toolkit (eclipse JDT) to perform the source code to source code transformation necessary and JSCOOP (an experimental port of SCOOP to JAVA)

- DCI to OOwR (object oriented code with roles) transformation processes only DCI annotations and leaves SCOOP annotations intact.
- DCI code is reduced to OOwR code so that OOwR to ROCOCO transformation is possible through SCOOP which is designed for OO may be applied later.
- After this stage, transformed (expanded) OOwR source code will include all information about role oriented aspects of the computation
- OOwR to ROCOCO transformation processes the SCOOP related annotations left intact by the DCI to OOwR transformation above

ROCOCO BENEFITS

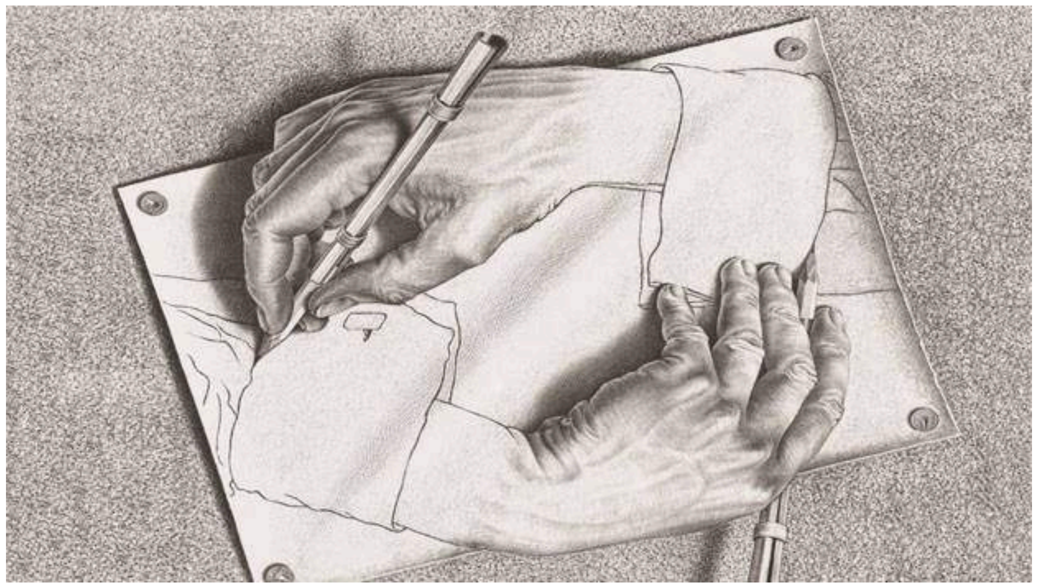
Relaxes the single-threaded constraint in DCI so that collaboration code remains readable

IDE understands the programmer

Correctness proofs become easier

Complete independence of objects from interfaces via data method adapters

paves a way to let the compiler decide optimally whether to run the routine concurrently or not



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Thank you for listening …

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