Design Within a Class

Basis

- Look at slides on Abstract Data Types

  - **They give much of the underlying basis**

    - **Types of features**
    - **Properties of features**
    - **Documentation**

Designing a Class

- **Experience shows it is critical to properly design class interfaces, especially in multi-person projects**

Designing a Class – 2

- Experience shows it is critical to properly design class interfaces, especially in multi-person projects
- **Want a set of design principles that can lead to quality and durable classes**

  There are no rules

Designing a Class – 3

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- Want a set of design principles that can lead to quality and durable classes

  There are no rules

- **We are interested in how a class will appear to its clients**

  Not the internals

Designing a Class – 4

- Experience shows it is critical to properly design class interfaces, especially in multi-person projects
- Want a set of design principles that can lead to quality and durable classes

  There are no rules

- We are interested in how a class will appear to its clients

  Not the internals

- **Make an interface**

  *** simple * easy to learn**
  *** easy to remember * able to withstand change**

Side Effects & Functions

- **Functions should not have side effects**
  - » **Do not return a value and change state**

Side Effects & Functions – 2

- Functions should not have side effects
  - » Do not return a value and change state
  - » **A contentious issue**

    Efficiency being the prime motivation for functions with side effects

Referential Transparency – Definition

- An expression is **referentially transparent** if
  - **Any sub-expression may be replaced with its value without changing the expression**
  - **Expression becomes transparent**

Transparency is good – no surprises

Can reason more easily about the program

Side Effects – get_integer Problem

- Functions are used in expressions

  INTEGER get_integer is ... end

  Read integer from an input and return the result

- Use it in an expression, as functions are intended to be used

  result ← get_integer + get_integer

  Reads two integers from the input

- Referential transparency says we can do

  result ← 2 * get_integer

  Reads one integer from the input

Side Effects – get_integer Solution

- For input the design should be as follows

  get_integer is a procedure that saves value in an attribute

  last_integer : integer
  get_integer is ... last_integer ← the_value end

  Reference attribute when you want the value

  result ← 2 * last_integer
  or result ← last_integer + last_integer

  Both expressions use one integer from the input

  Use get_integer twice to read two values

  - **Program is clear with no surprises**
  - **Can reason more easily about the program**

Side Effects – remove Problem

- Consider the case of removing an item from a data structure

  remove (KEY : key) : DATA is ... end

  - **Need to search for the object**
  - **Useful to return data associated with the key**
  - **Have function with side effects**

- Consider alternative

  data ← search (key)
  remove (key)

  Two searches – inefficient

Side Effects – remove Solution

- Use the same design as get_integer

last_data : DATA
remove (KEY key)
is ... last_data ← the_value end

- **Remove saves the data in an attribute**
- **User accesses the data if they want it**
- **Clear as to what is happening**

Side Effects – remove Solution – 2

- Use the same design as get_integer

```
last_data  : DATA
remove (KEY key)
                    is ...  last_data ← the_value end
```

  - Remove saves the data in an attribute
  - User accesses the data if they want it
  - Clear as to what is happening

- **Keeping the last value, or current position (cursor) is a useful design strategy**
  - **Reduce number of functions with side effects**
  - **Can have operations relative to current position**

Side Effects – Sequence Generation

- Random number sequence generation

  value ← random

  Changes the "seed" on each call

- Poor abstraction → poor design
- Good abstraction → good design
  - **The underlying notion is of a sequence of random numbers**
  - **This abstraction is data based – not operation based**

  random.forth
  value ← random.item

Side Effects – Optimizing Compiler

- Even when the programmer knows about the side effects problems can occur

Suppose you program the following where f_b is a function with side effects

r ← f_a (f_b , f_b)

An optimizing compiler, may see f_b as a function and replace one of the calls with the result of the other call

Side Effects – Argument Order

- Even when the programmer knows about the side effects problems can occur

Suppose you program the following where f_b is a function with side effects

r ← f_a (f_b , f_b)

Which call is done first?

Compiler dependent. Order of parameter evaluation is rarely part of a language definition

Active Data Structures

- Fits with functions with no side effects
  - » **Maintain**

    current object
    current position
    etc.

Active Data Structures – 2

- Fits with functions with no side effects
  - » Maintain

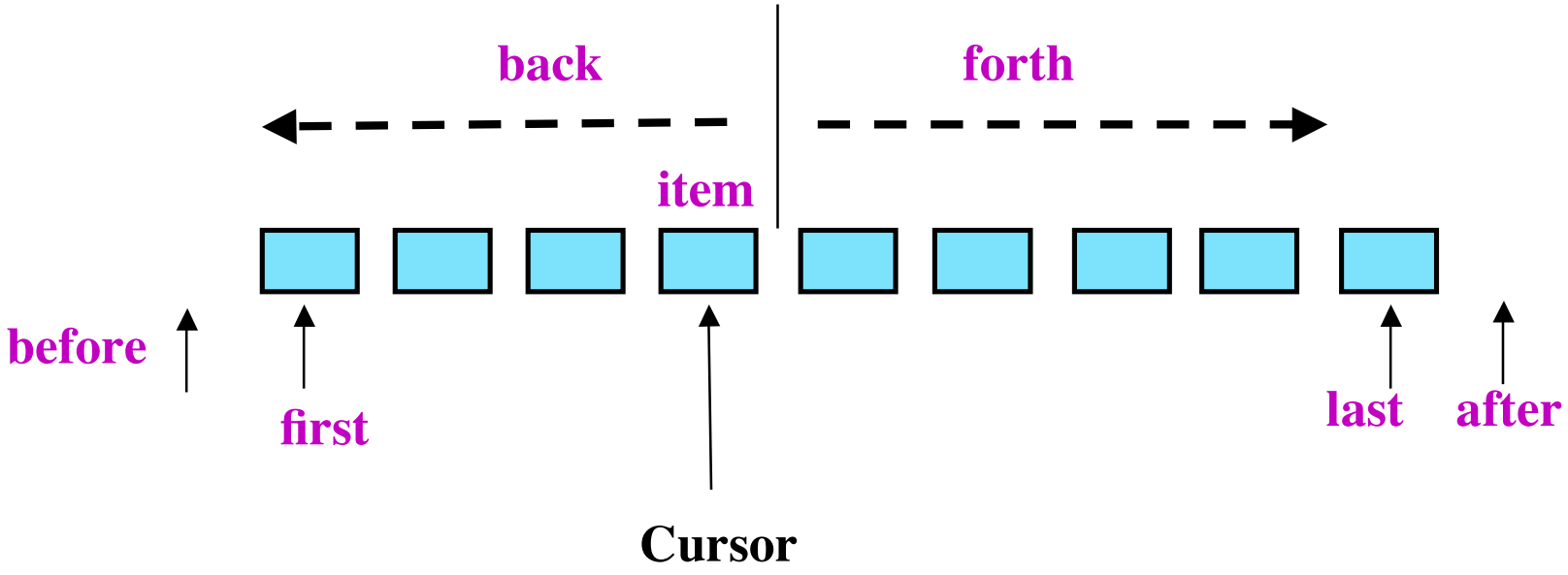
    current object
    current position
    etc.

  - » **Provide methods that are relative to current**

    item, after, next, forth
    before, previous, back
    replace (data)

Active Data Structures – Example

a_sequence : SEQUENCE […]



Feature names are in magenta

Active Data Structures – 3

- Fits with functions with no side effects
  - » Maintain

    current object
    current position
    etc.

  - » Provide methods that are relative to current

    item, after, next, forth
    before, previous, back
    replace (data)

  - » **For singly linked lists**

    Automatically save pointer to previous node for the client

How Many Arguments for a Feature

- Arguments come in two types

How Many Arguments for a Feature – 2

- Arguments come in two types
  - » **operand**
    - **Value needed to do work**
    - **Must appear as an argument**

How Many Arguments for a Feature – 3

- Arguments come in two types
  - » operand
    - Value needed to do work
    - Must appear as an argument
  - » **option**
    - **Value used to make a choice as to how to do the work – output in blue in 20 point Helvetica**
    - **Should not appear as an argument**

How Many Arguments for a Feature – 4

- Arguments come in two types
  - » operand
    - Value needed to do work
    - Must appear as an argument
  - » option
    - Value used to make a choice as to how to do the work – output in blue in 20 point Helvetica
    - Should not appear as an argument
- For a good design

  Options are set with independent procedures

  object.set_font(...) object.set_font_size(...)

Class Size

- Should not be an issue

Class Size – 2

- Should not be an issue
  - » **Include what must be included**
    - **Design a complete, orthogonal set of methods**
    - **User has a simple, complete control of objects**
    - **No side effects among functions**

Class Size – 3

- Should not be an issue
  - » Include what must be included
    - Design a complete, orthogonal set of methods
    - User has a simple, complete control of objects
    - No side effects among functions
  - » **Include additional methods that can be justified**
    - **Increase the efficiency of combinations of operations**
    - **Simplify user manipulation of objects**
    - **Provide aliases**
      - **Easier use**
      - **Keep uniform names across classes for equivalent semantics**