Abstract Factory Pattern – Creational

- Intent

  Provide an interface for creating families of related or dependent objects without specifying their concrete classes

- Motivation

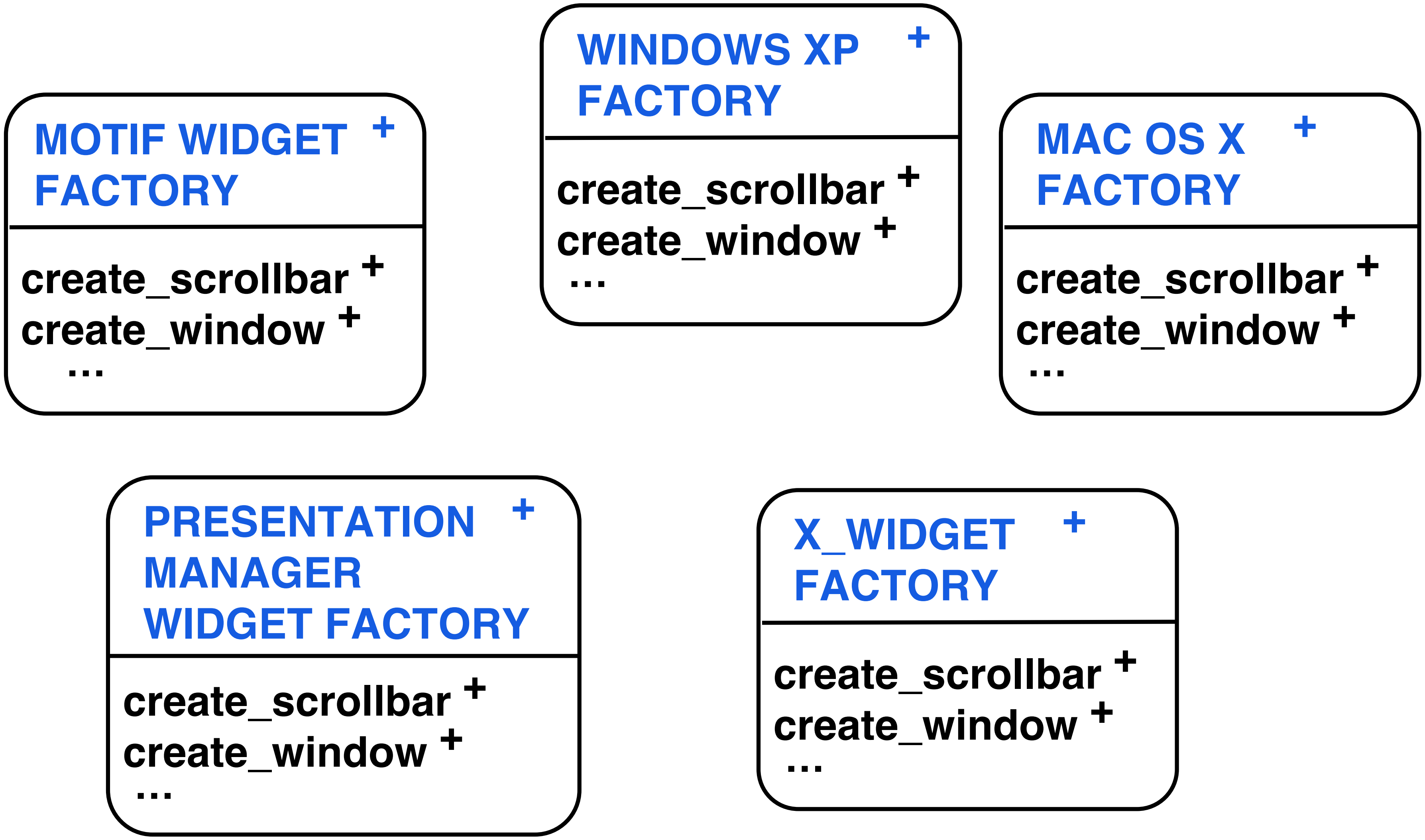
  » **Building a user interface toolkit that supports multiple look and feel standards**

  WINDOWS XP, MAC OS X, Motif, Presentation Manager, X Window

  » **Have different appearances and behaviour for a large set of subclasses**

  scroll bars, windows, buttons, ...

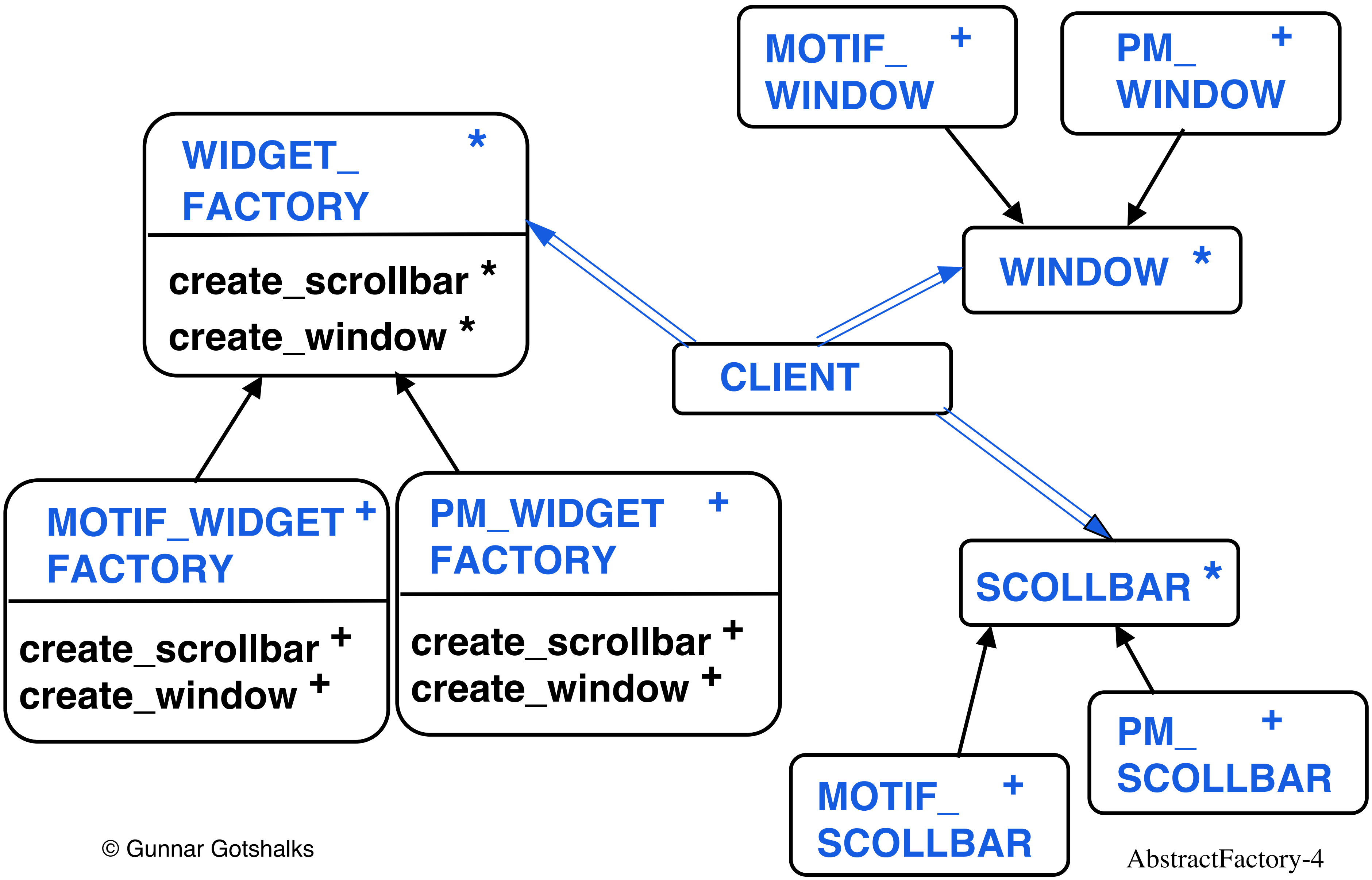
Example of a set of Families of Products



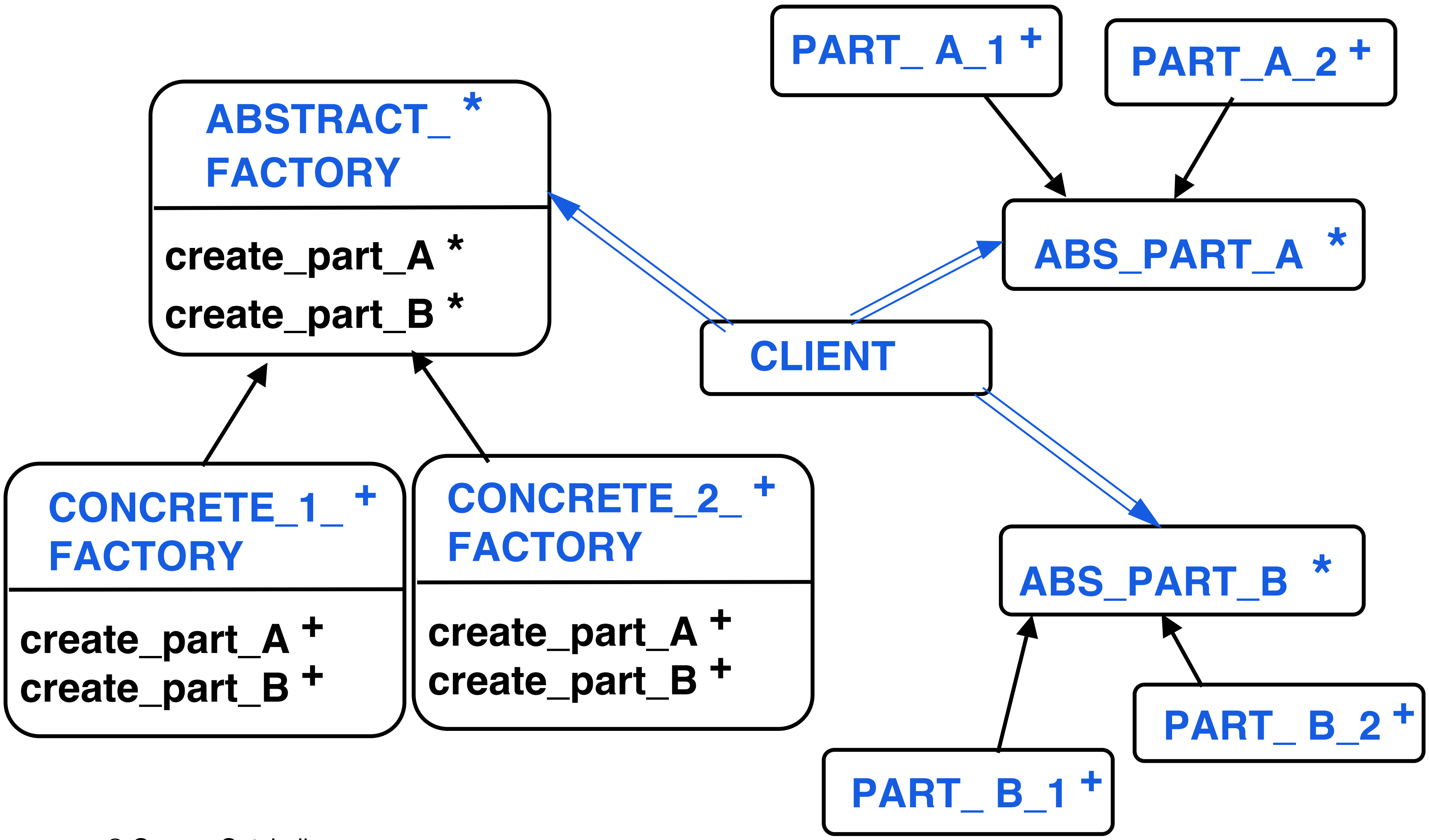
AF – Applicability

- System should be independent of how its products are created, composed and represented
- System should be configured with one of multiple families of products
- Family of related product objects is designed to be used together and you need to enforce this constraint
- Provide a class library of products and you want to reveal just their interfaces not their implementations

AF – Example Architecture



AF – Abstract Architecture



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AF – Participants

- Abstract factory

  Declares interface for operations that create abstract parts

- Concrete factory

  Implements operations to create parts

AF – Participants – 2

- Abstract part

  Declares an interface for a type of part

- Concrete part

  » **Defines part to be created by the corresponding concrete factory**

  » **Implements Abstract_Part interface**

- Client

  Uses only the interfaces declared by Abstract_Factory and Abstract_Part

AF – Collaborations

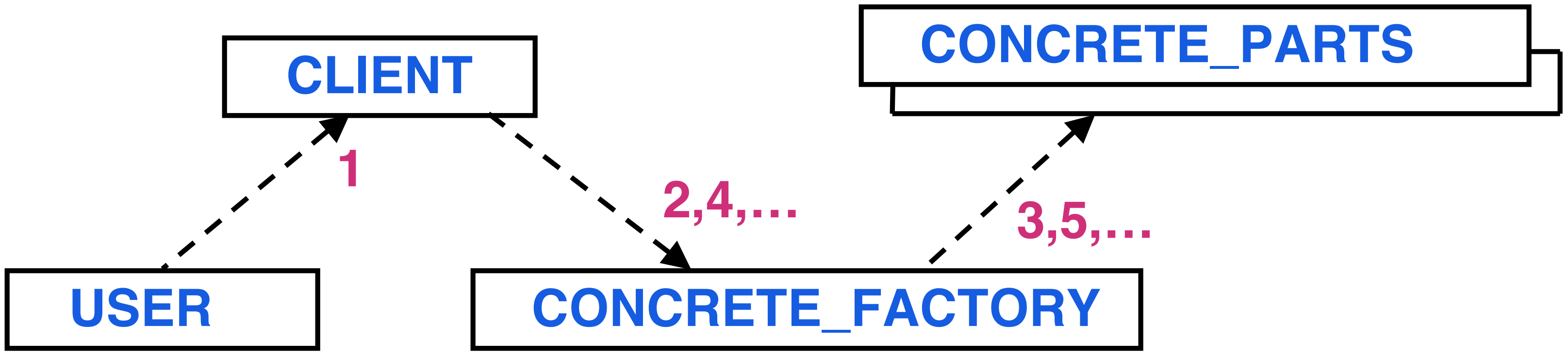
- A single instance of Concrete_Factory is created at run time
  - » **Creates parts having a particular implementation**
  - » **To create different parts, use a different concrete factory**

- Abstract_Factory defers creation of parts to its Concrete_Factory subclass

AF – Scenario

Scenario: Build a product

1 create client.make(aFactory)
2 aFactory.make_part_1(…)
3 part_1.make (…)
4 aFactory. make _part_2 (…)
5 part_2.make (…)
…



AF – Consequences

- Isolates concrete classes
  - » **Factory encapsulates responsibility and process of creating parts**
  - » **Isolates clients from implementation classes**
- Exchanging product families easy

  Concrete factory appears once where it is instantiated
- Promotes consistency among products
- Supporting new kinds of products is difficult

  Fixes set of parts to be created

AF – Implementation

```
class MAZE_FACTORY feature
    make_maze : MAZE is
        do  create Result   end

    make_room ( id : INTEGER ) : ROOM is
        do create Result.make ( id )  end

    make_door ( r1  : ROOM ; r2 : ROOM ) : DOOR
       do create Result.make ( r1, r2 ) end

    make_wall : MAZE is
        do create Result.make   end

end
```

AF – Implementation – 2

```
-- Client program

class MAZE_GAME     create create_maze
feature
   create_maze ( factory : MAZE_FACTORY ) is
      local  maze : MAZE  ;  r1, r2 : ROOM  ;  door : DOOR
      do
         maze := factory.make_maze
         r1 := factory.make_room (1)
         r2 := factory.make_room(2)
         door := factory.make_door ( r1, r2 )
         maze.add_room (r1 )  ;  maze.add_room ( r2 )
-- Construct contents of maze – next slide
      end
end
```

AF – Implementation – 3

```
-- Construct contents of maze

r1.set_side ( North , factory.make_wall )
r1.set_side ( East , door )
r1.set_side ( South , factory.make_ wall)
r1.set_side ( West , factory.make_ wall)

r2.set_side ( North , factory.make_ wall)
r2.set_side ( East , factory.make_ wall )
r2.set_side ( South , factory.make_ wall)
r2.set_side ( West , door)
```

AF – Implementation – 4

```
class ENCHANTED_MAZE_FACTORY inherits MAZE_FACTORY
feature

   make_room ( id : INTEGER ) : ROOM is
     local room : ENCHANTED_ROOM
      do
            cast_a_spell(id)
            create  room.make ( id, spell )  ;  Result := room
      end

   make_door ( r1 : ROOM ; r2 : ROOM ) : DOOR is
      local door : DOOR_NEEDING_SPELL
      do
            create door.make ( r1, r2 )  ;  Result := door
      end
end
```

AF – Implementation – 5

```
-- Imagine a subclass of wall is damaged if a bomb goes off
-- Have a subclass of room with a bomb in it

class BOMBED_MAZE_FACTORY inherits MAZE_FACTORY
feature
 make_wall : WALL is
       local  wall : BOMBED_WALL
      do     create wall.make  ;  Result := wall   end

 make_room ( id : INTEGER ) : ROOM is
       local  room : ROOM_WITH_BOMB
       do   create room.make ( id )  ;  Result := room   end
end
```

AF – Implementation – 6

```
-- Create various games

game : MAZE_GAME

factory_1 : ENCHANTED_MAZE_FACTORY   // Game 1
create factory_1
create game . create_maze ( factory_1 )


factory_2 : BOMBED_MAZE_FACTORY        // Game 2
create factory_2
create game . create_maze ( factory_2 )
```

Abstract Factory – Related Patterns

- Abstract Factory classes can be implemented with Factory Method or Prototype
- Concrete factories are often Singletons