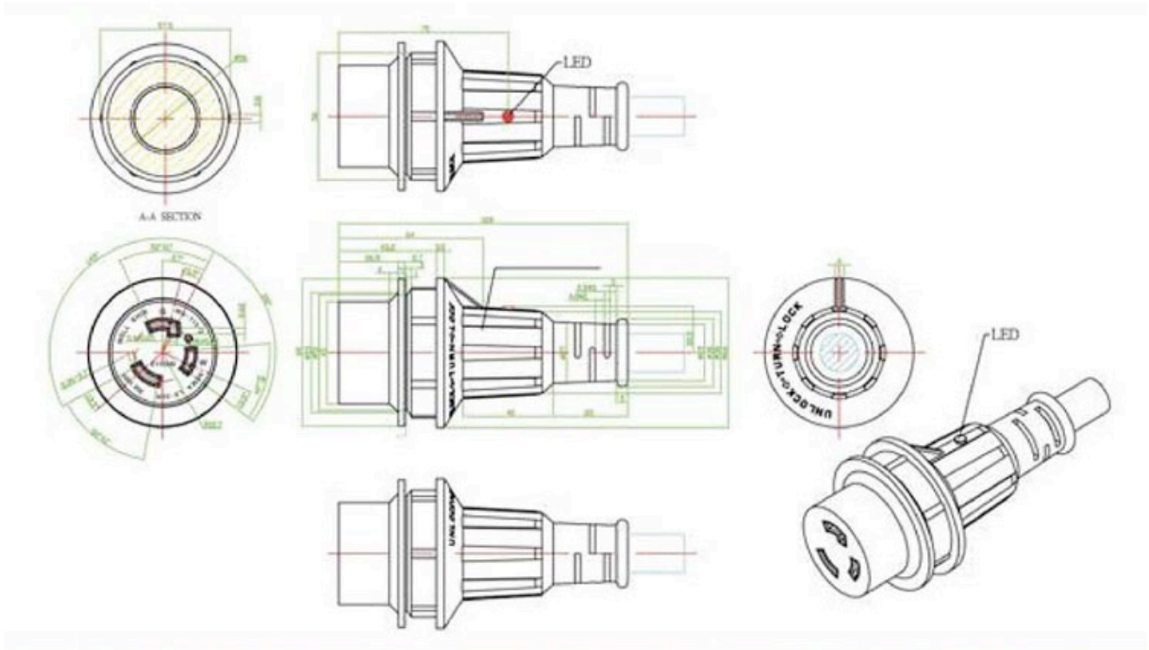
On the Challenges of Composing Multi-View Models

Matthias Schöttle and Jörg Kienzle

McGill

Multi-View Modelling



[Image credit: http://www.accesscontrolsales.com/mighty-cord-rv-cad.htm]

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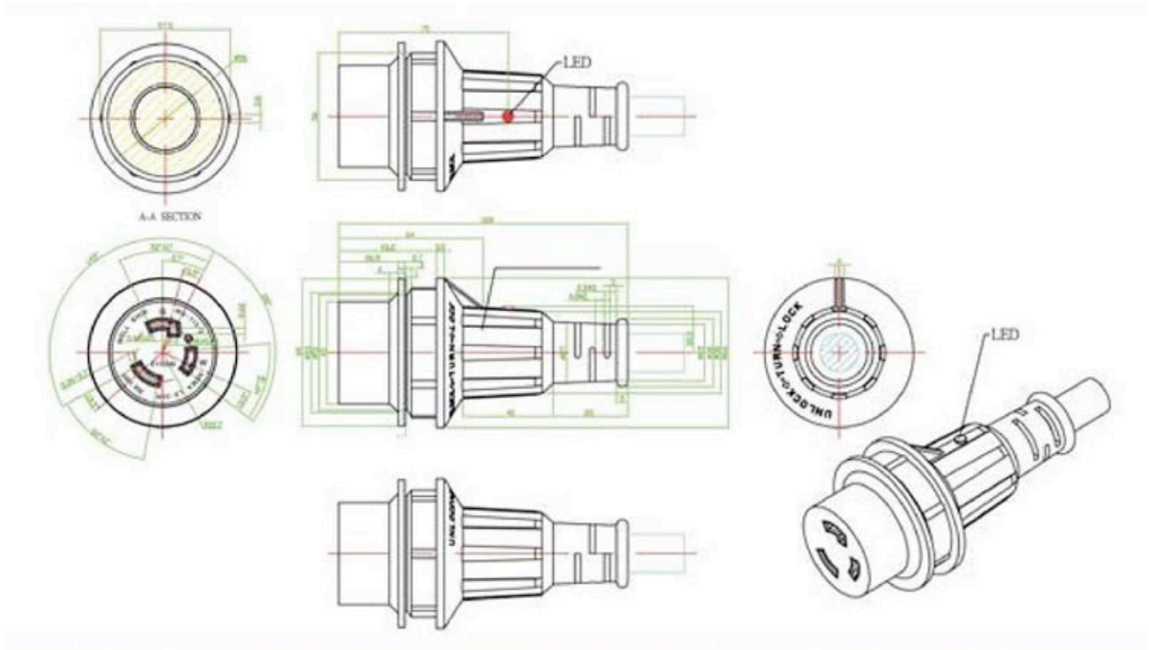

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Consistent Views

[Image credit: http://www.empowernetwork.com/msycks/blog/how-to-get-consistent-in-your/]

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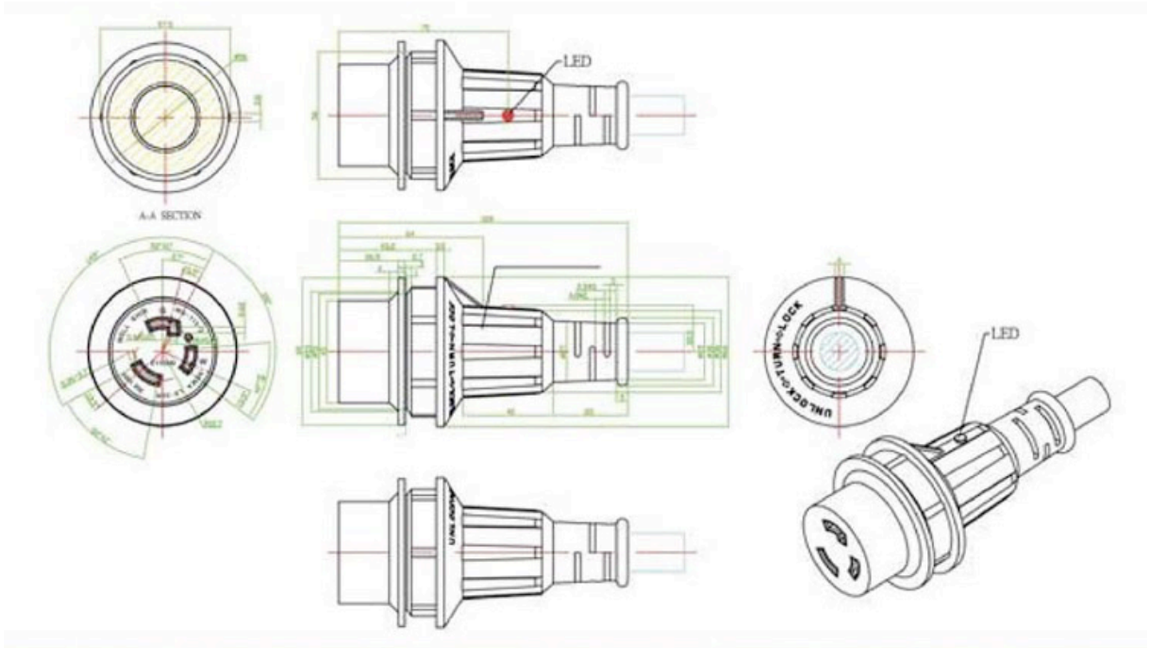

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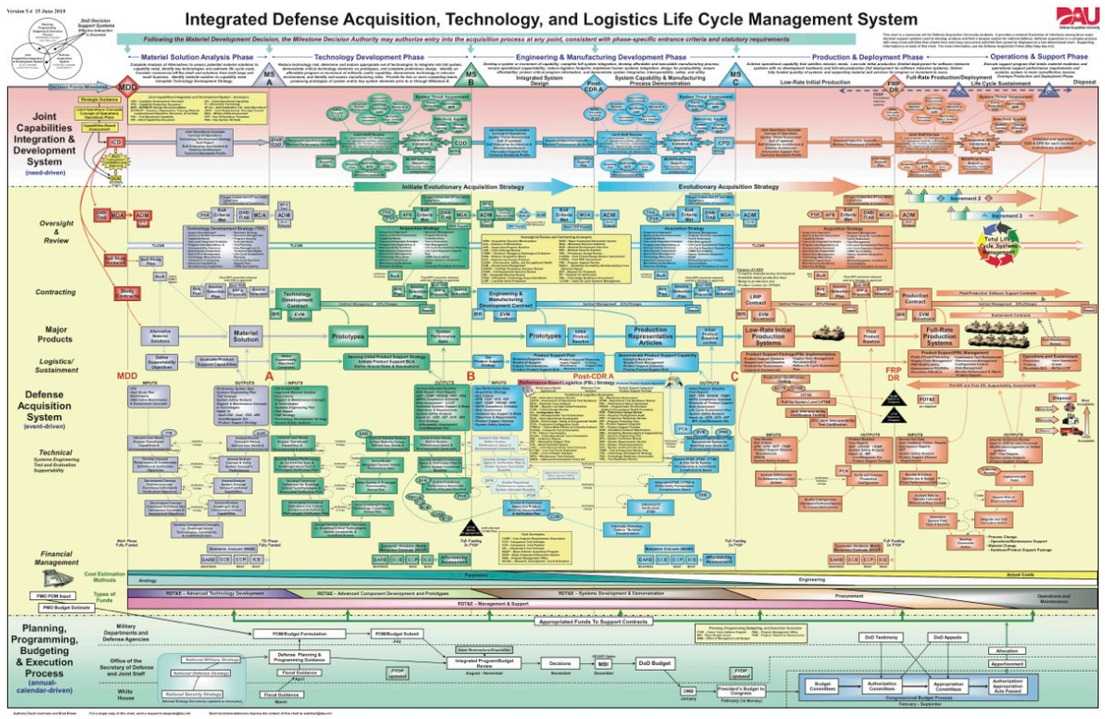
Complex Systems



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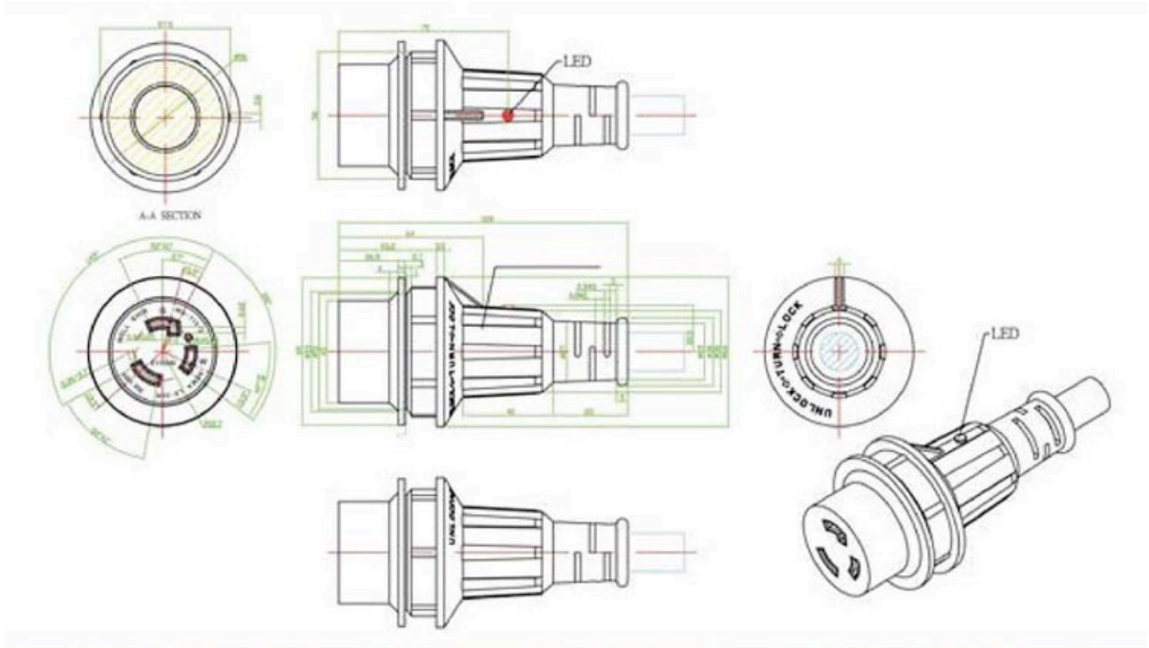

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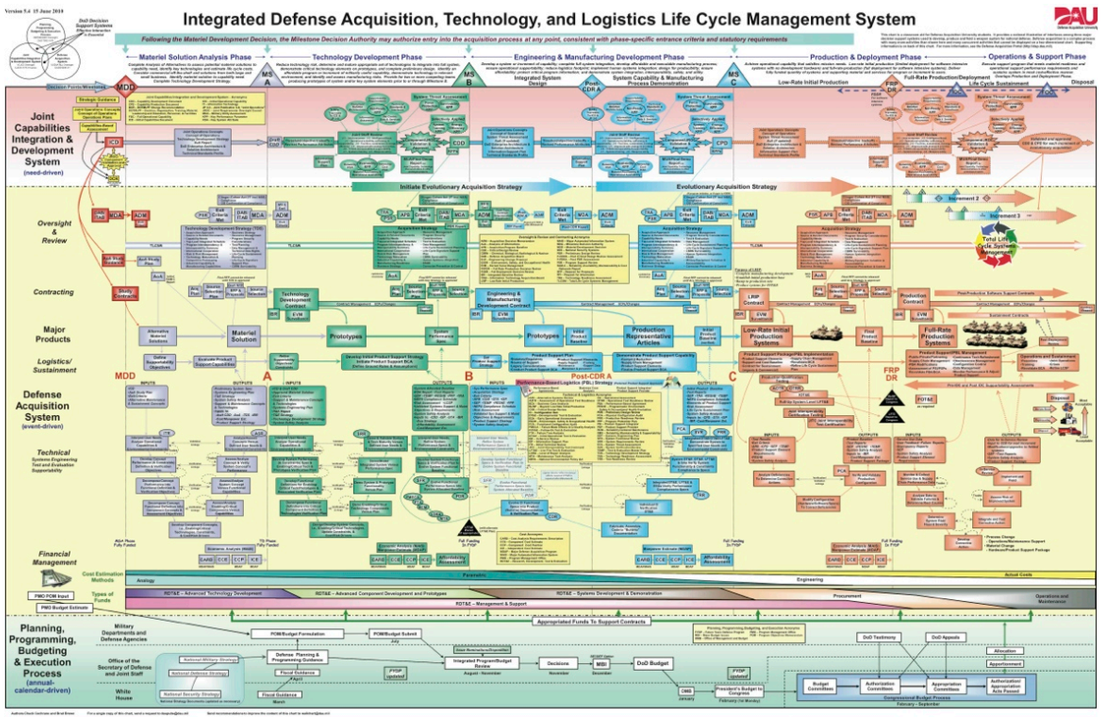

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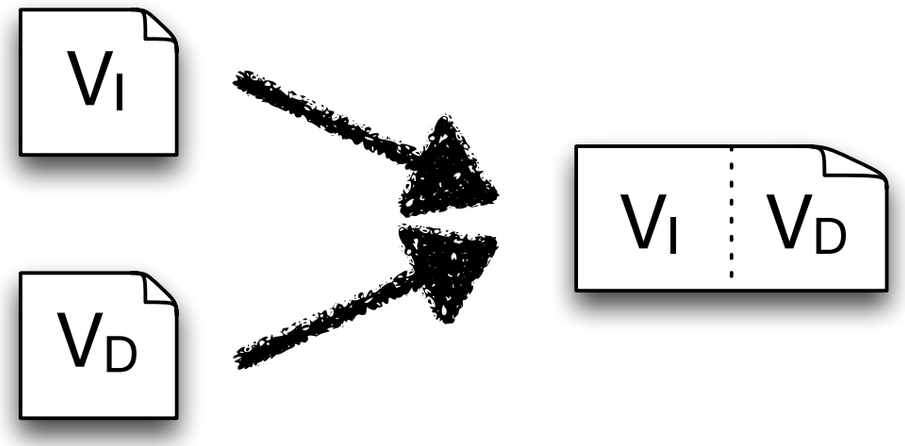
Composition

[Image credit: http://www.accesscontrolsales.com/mighty-cord-rv-power-cords.htm]

Overview

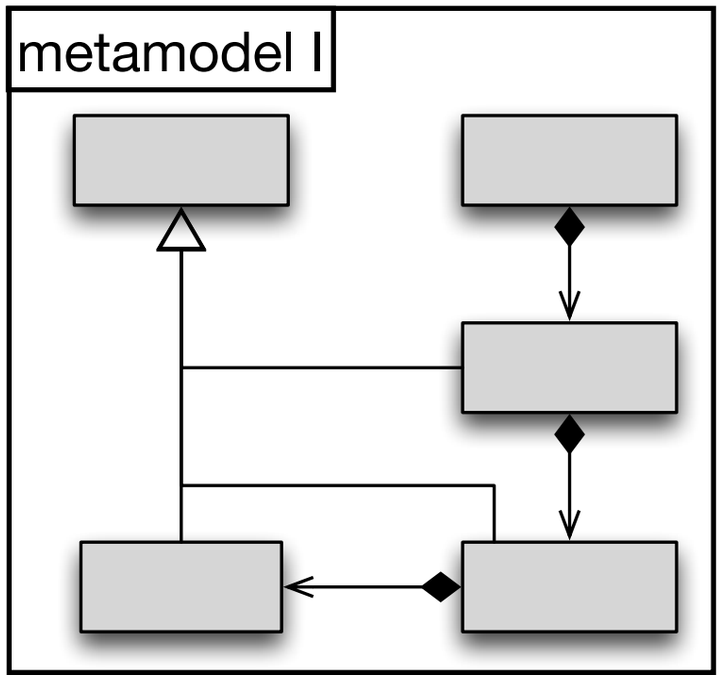


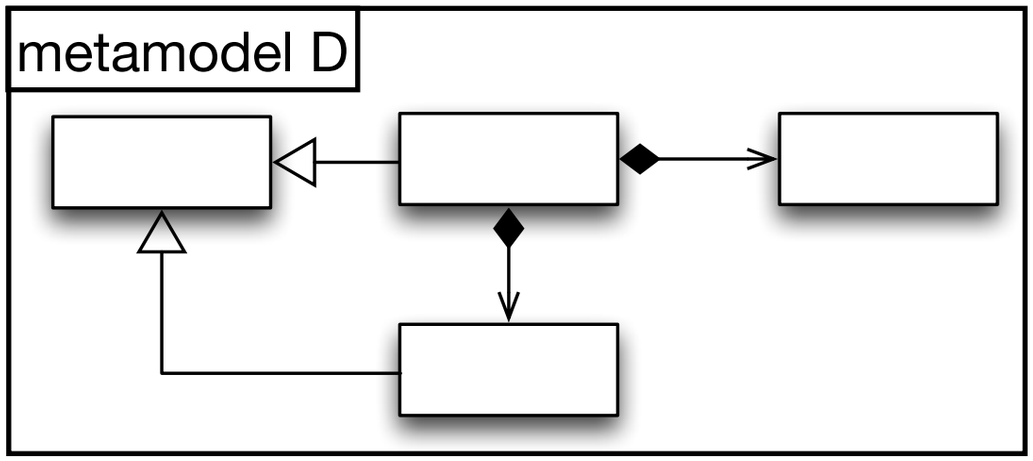
- Two independent modelling notations (I and D)
  - Metamodels and composers exist
- Integration to multi-view modelling notation
  - Ensure consistency between views
  - Ensure compatibility of composers
- Focus on technical side: Reuse

Contents

- General strategy for integrating two notations
  - Integration of metamodels
  - Composition of multi-view models
- Practical application of strategy to RAM
- Challenges faced
- Demo

Integration Strategy: Metamodels





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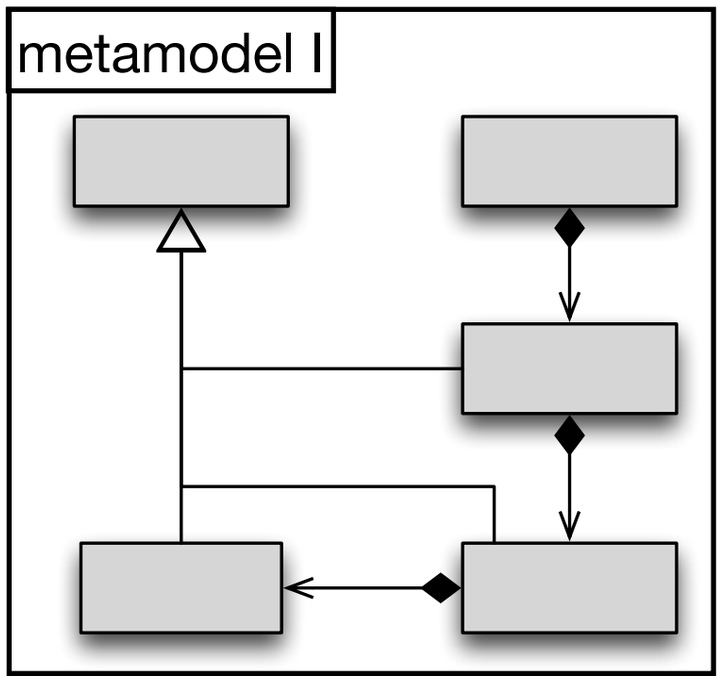

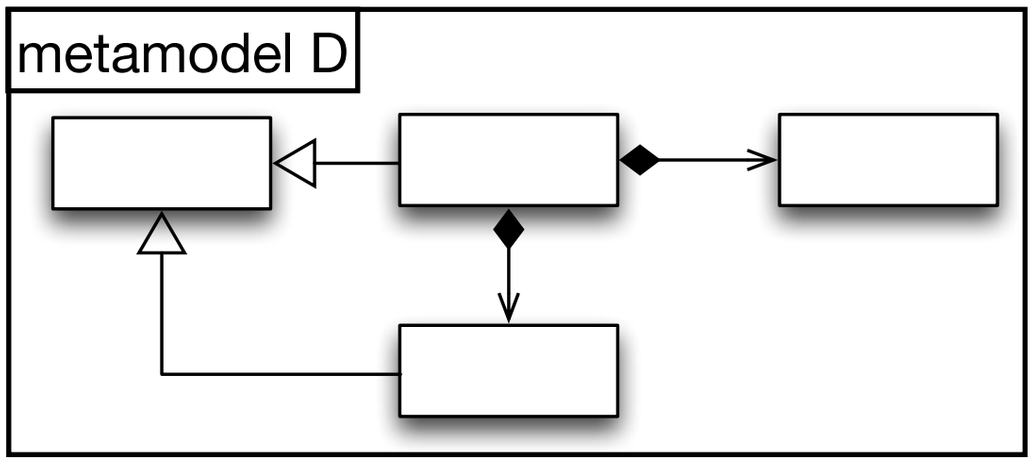

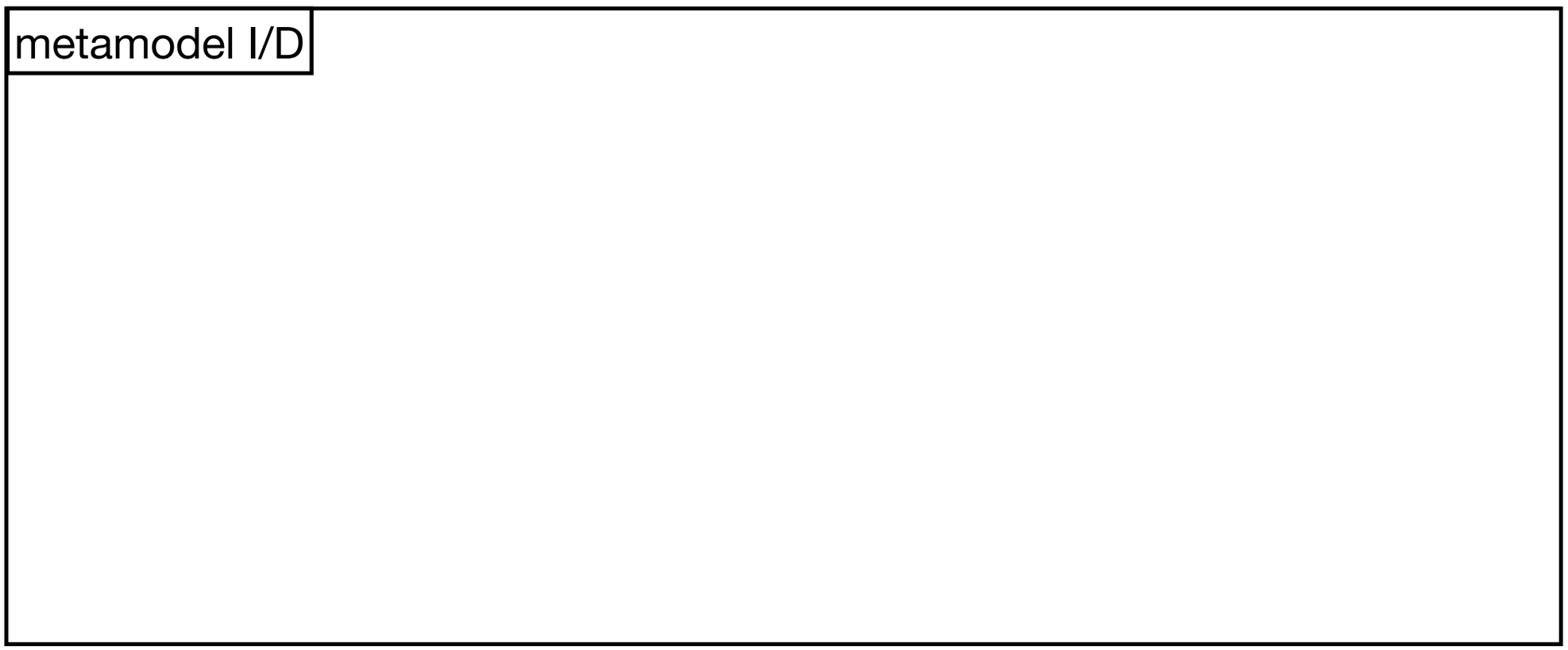

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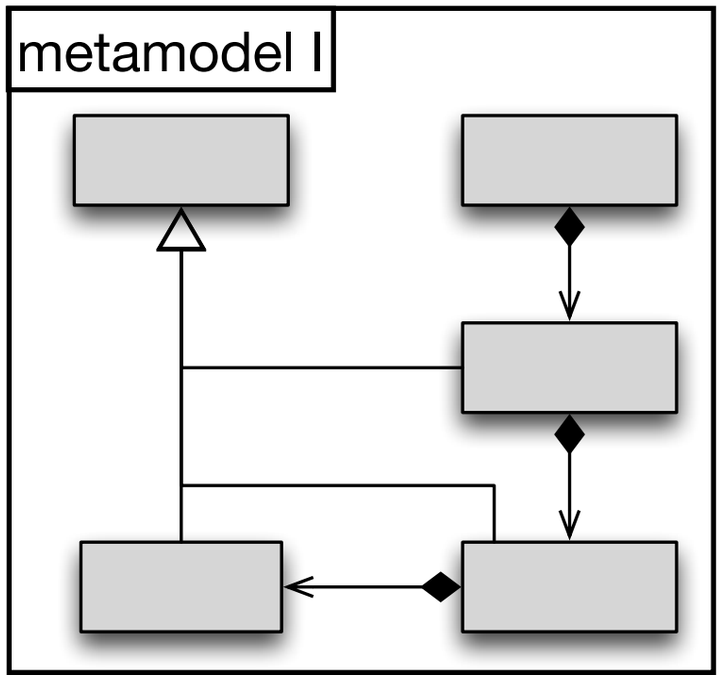

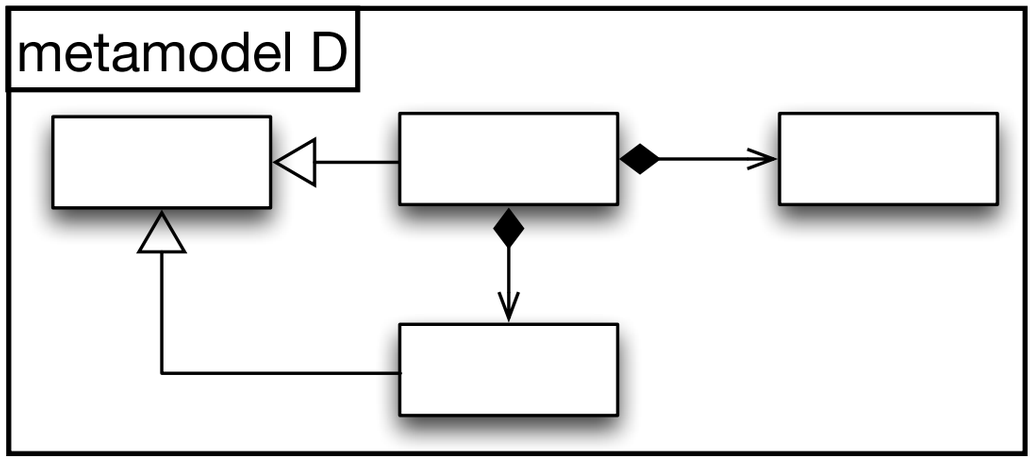

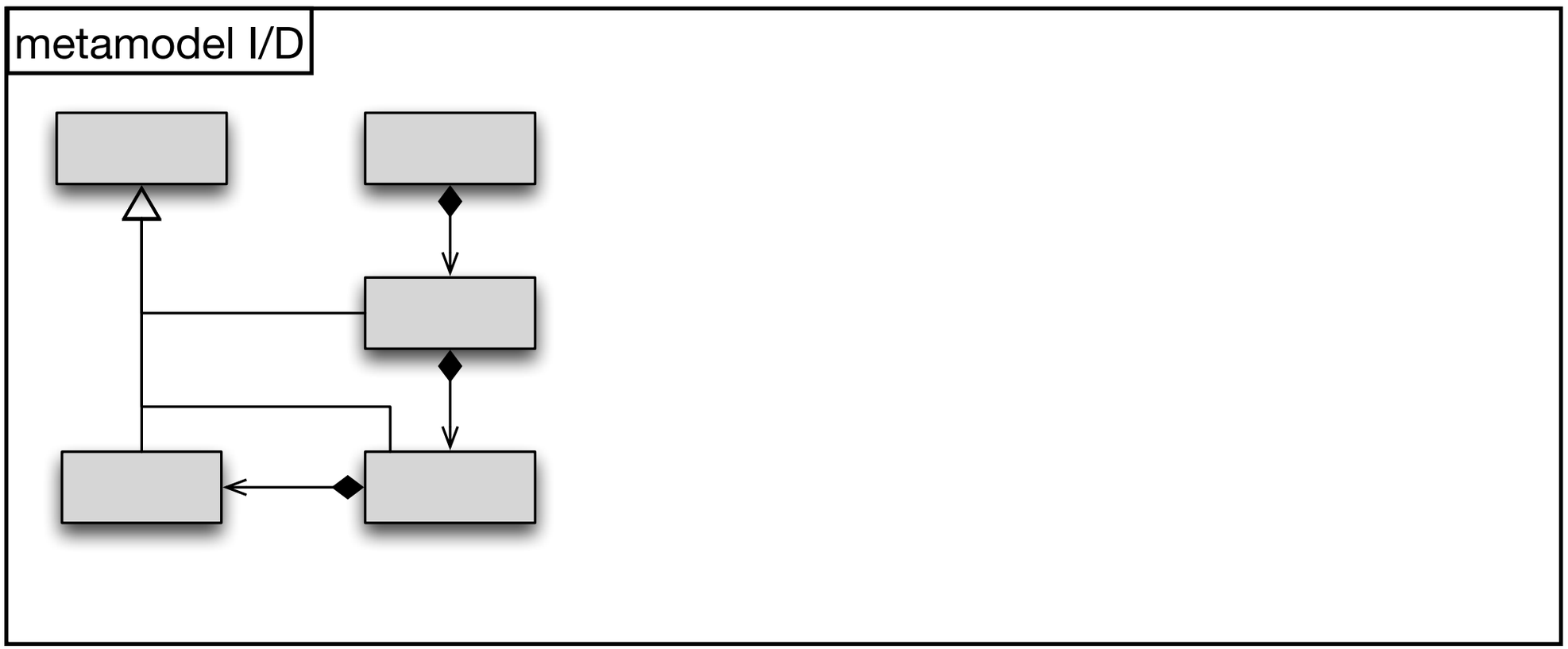

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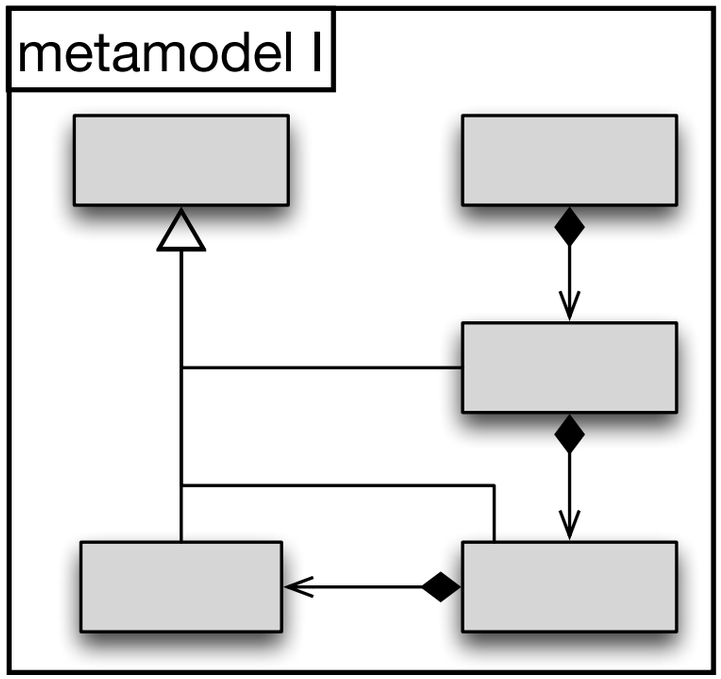

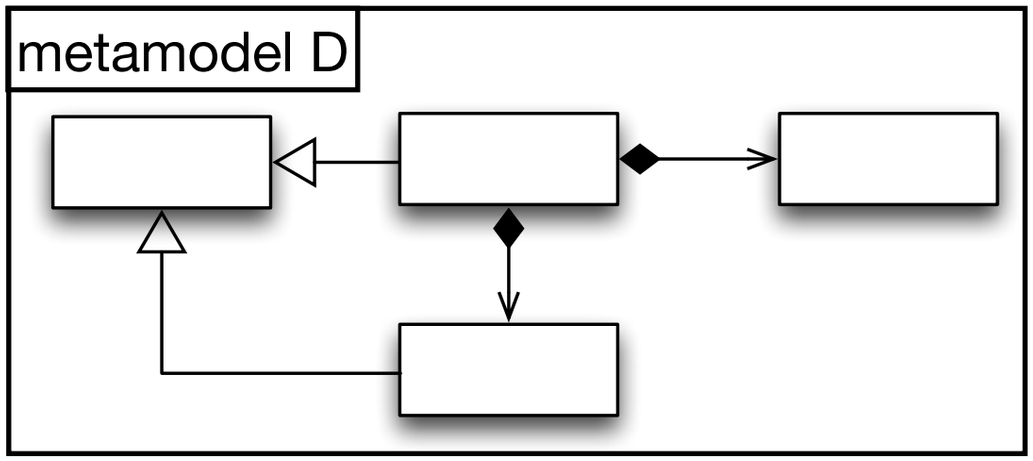

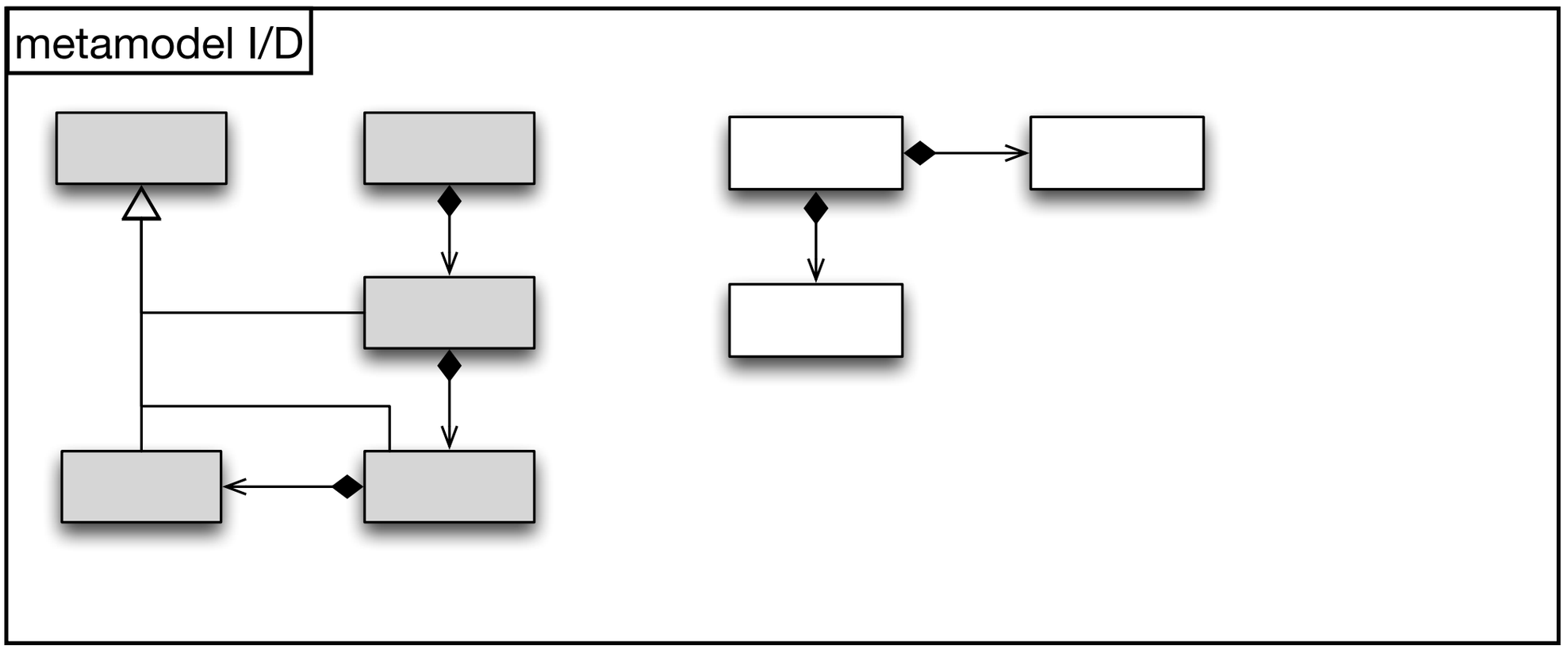

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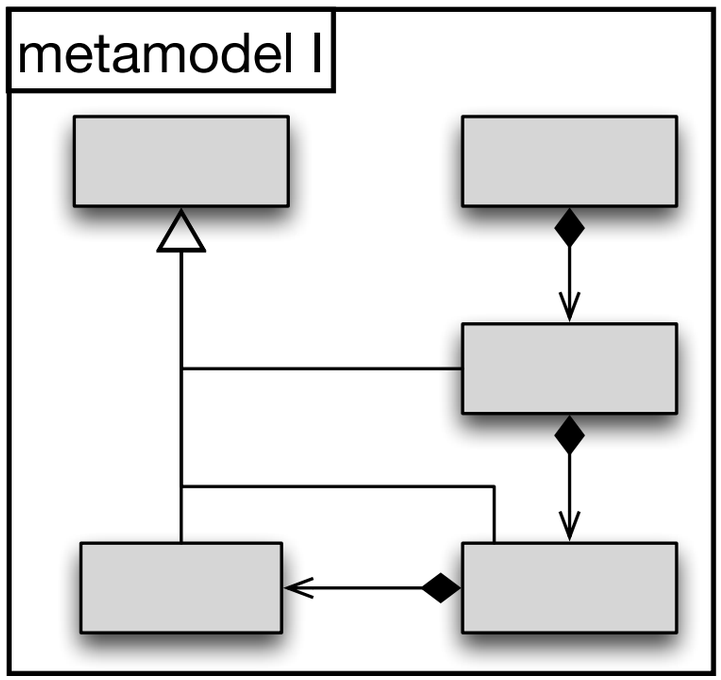

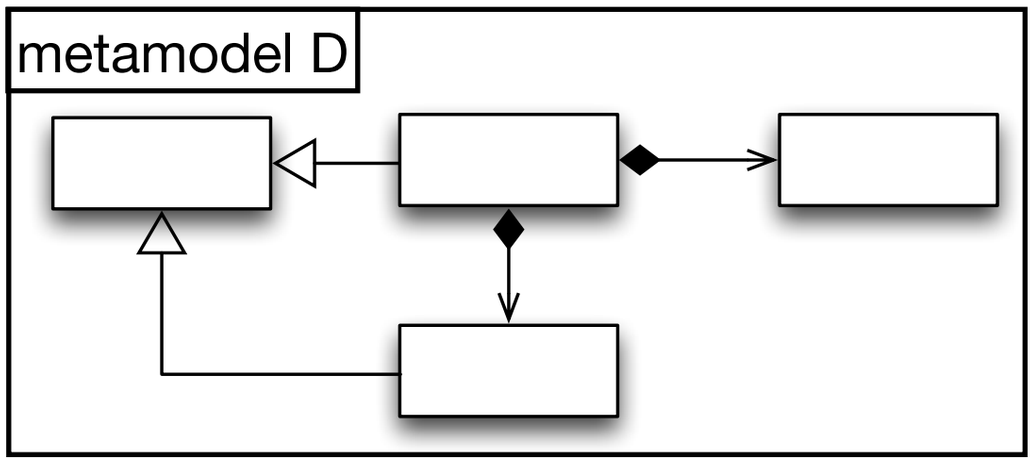

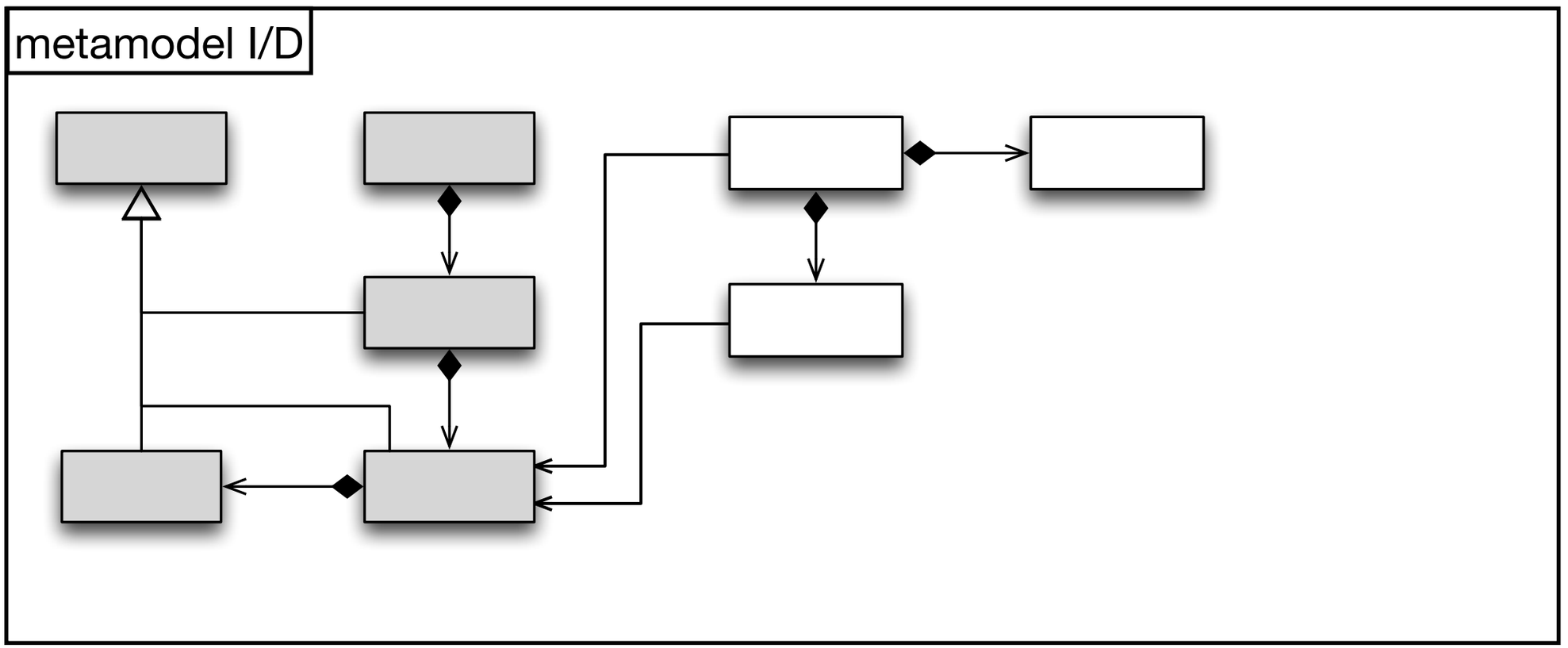

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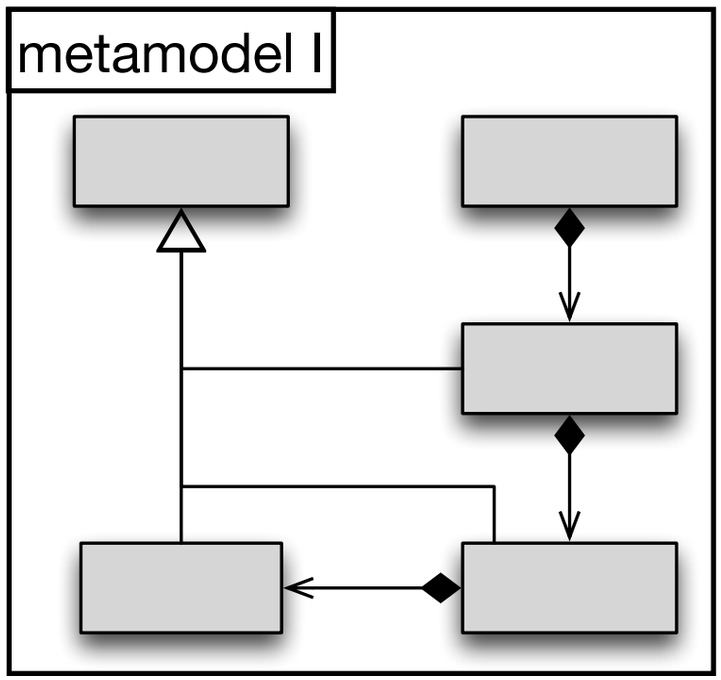
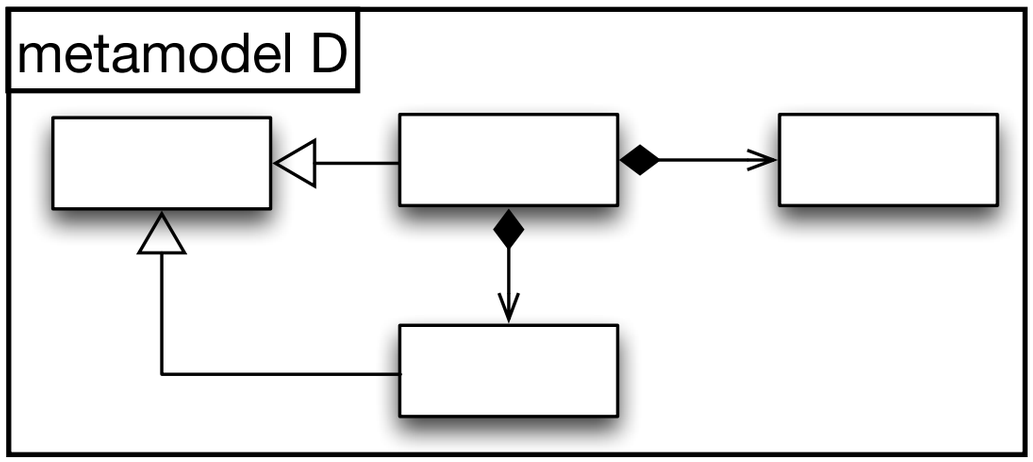
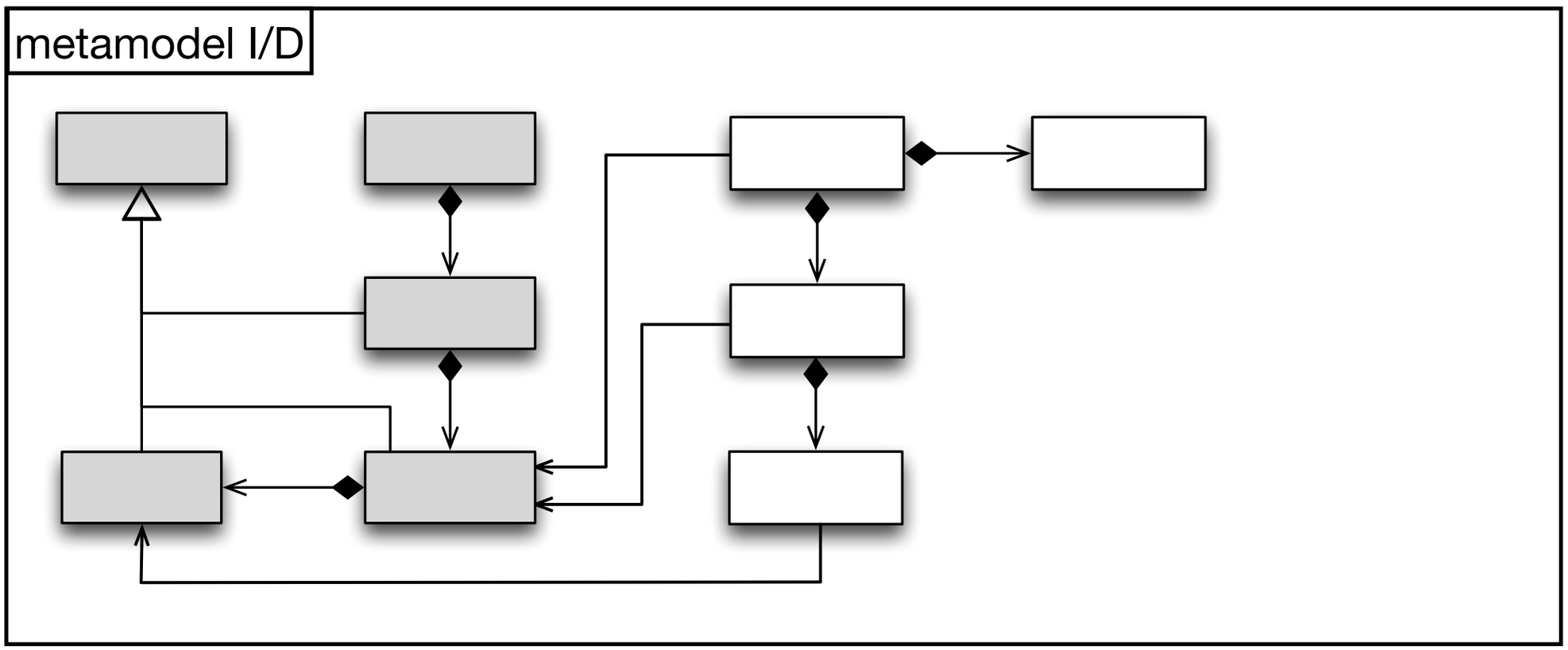
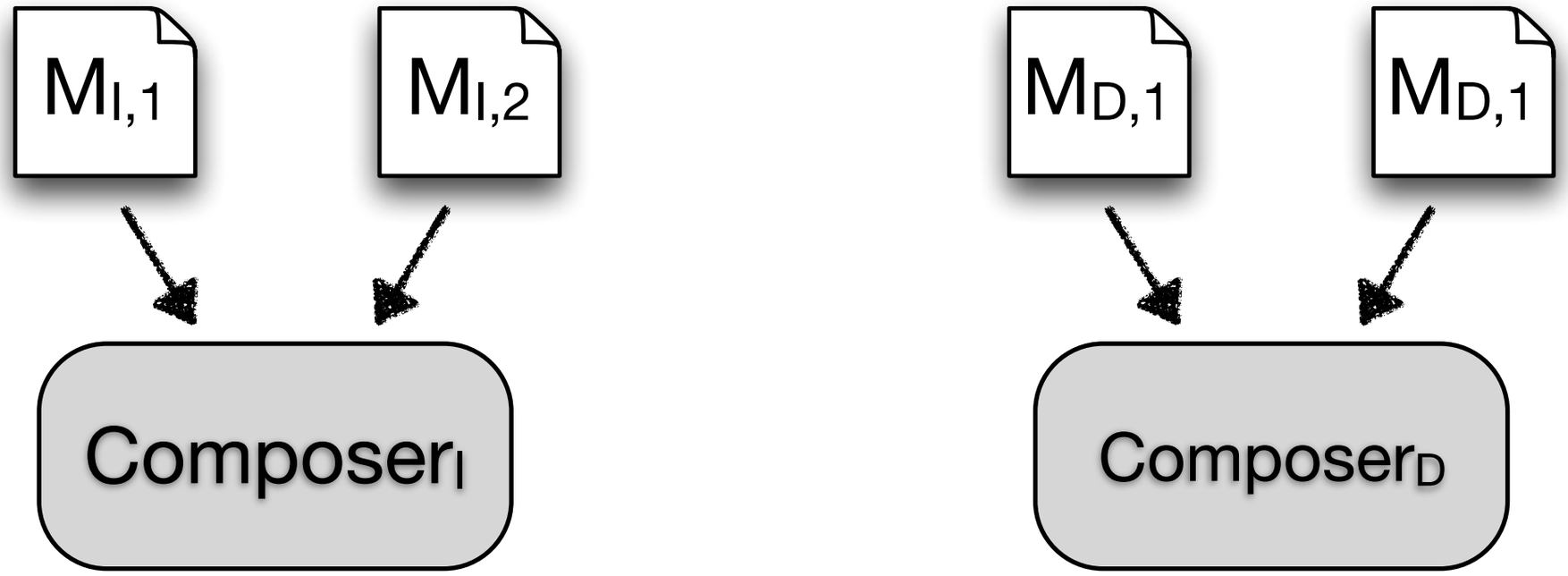






Integration Strategy: Composing



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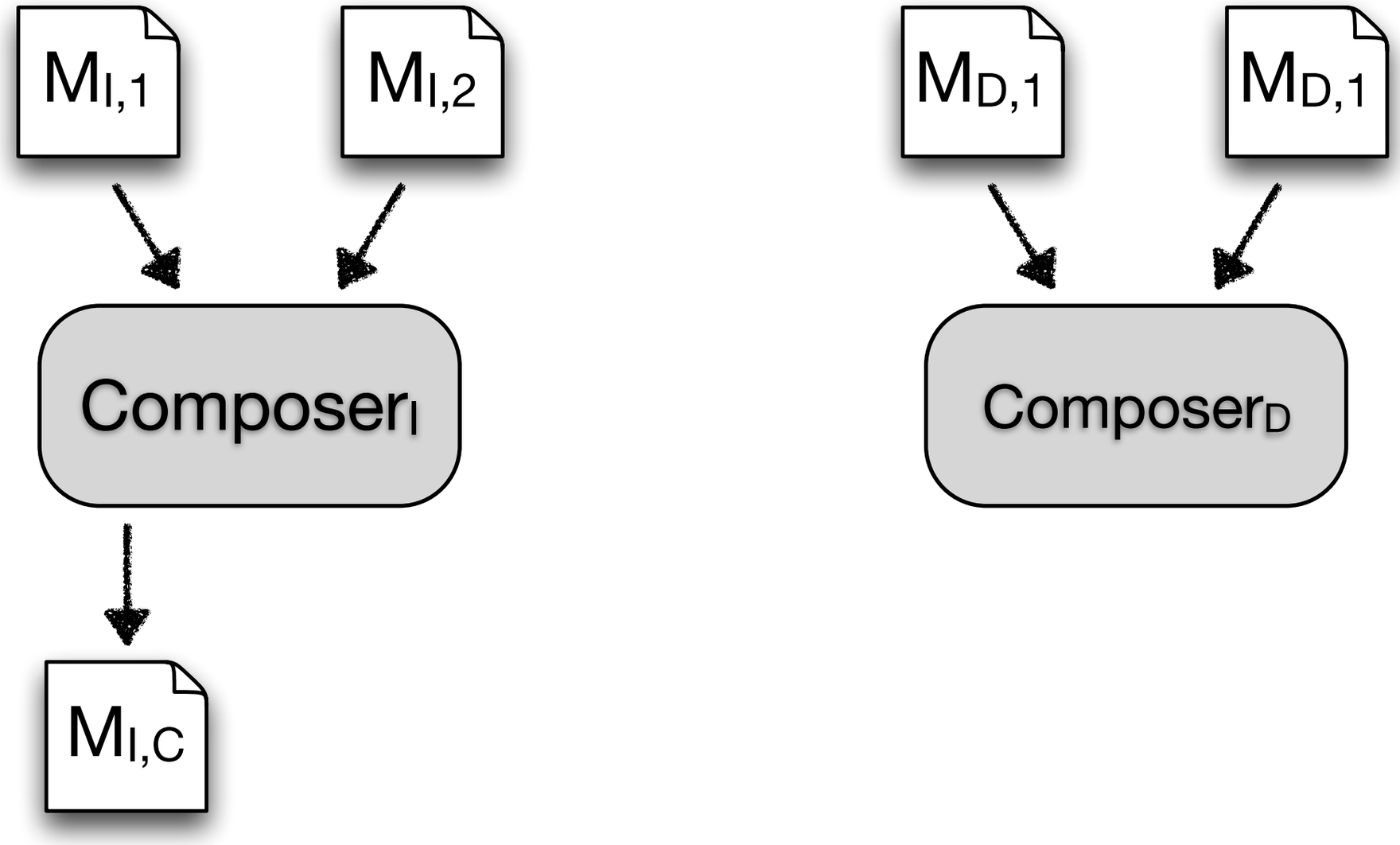

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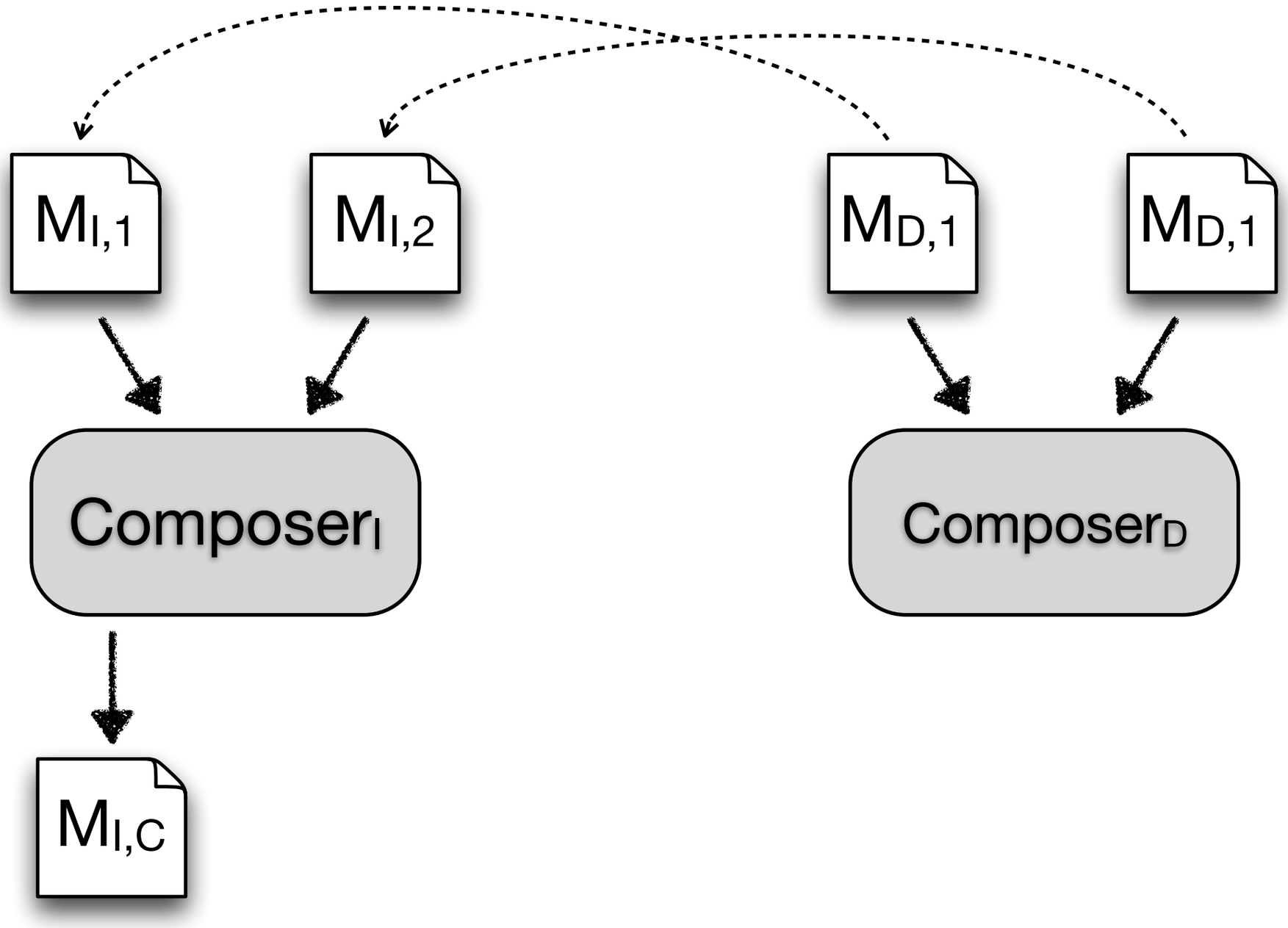

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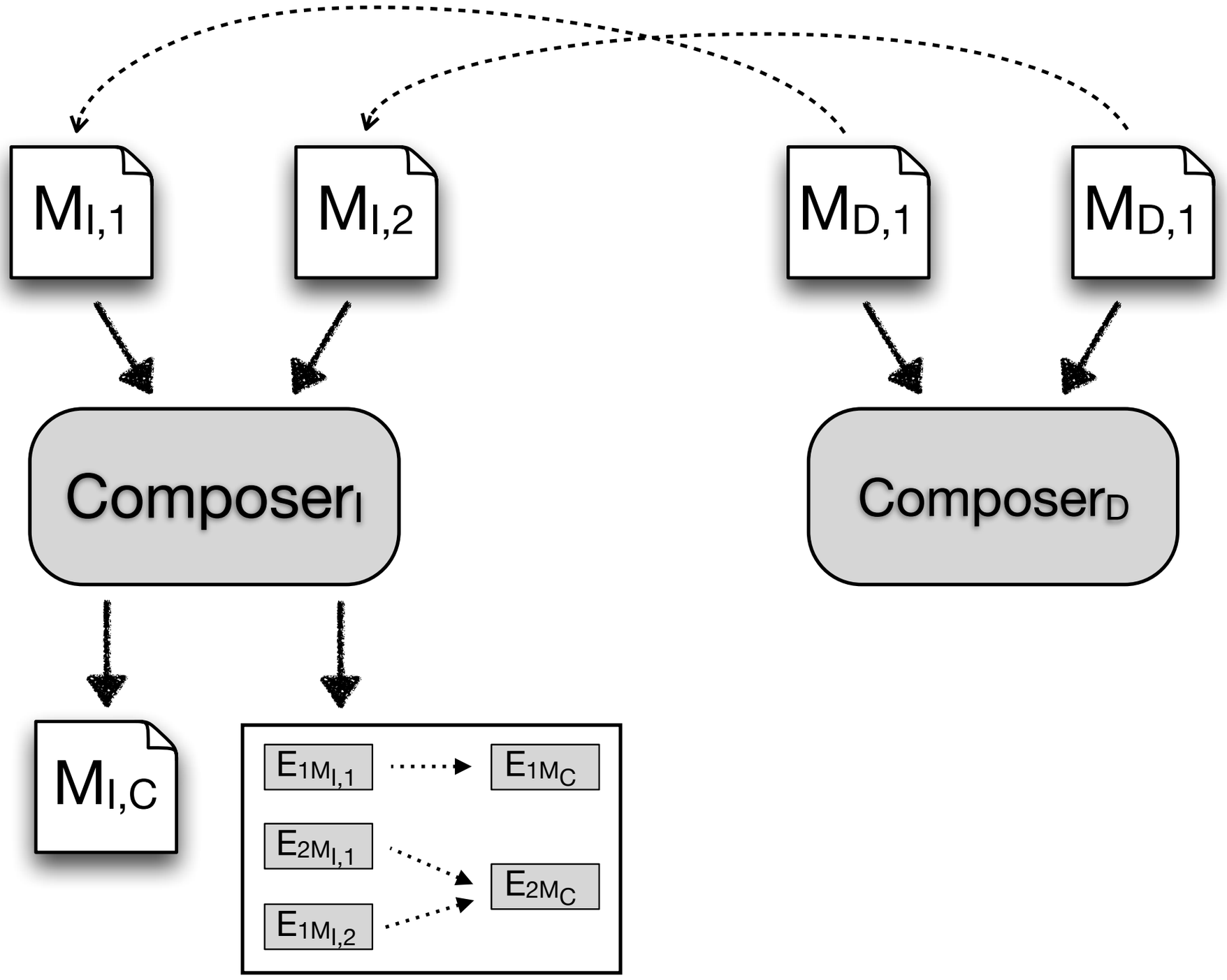

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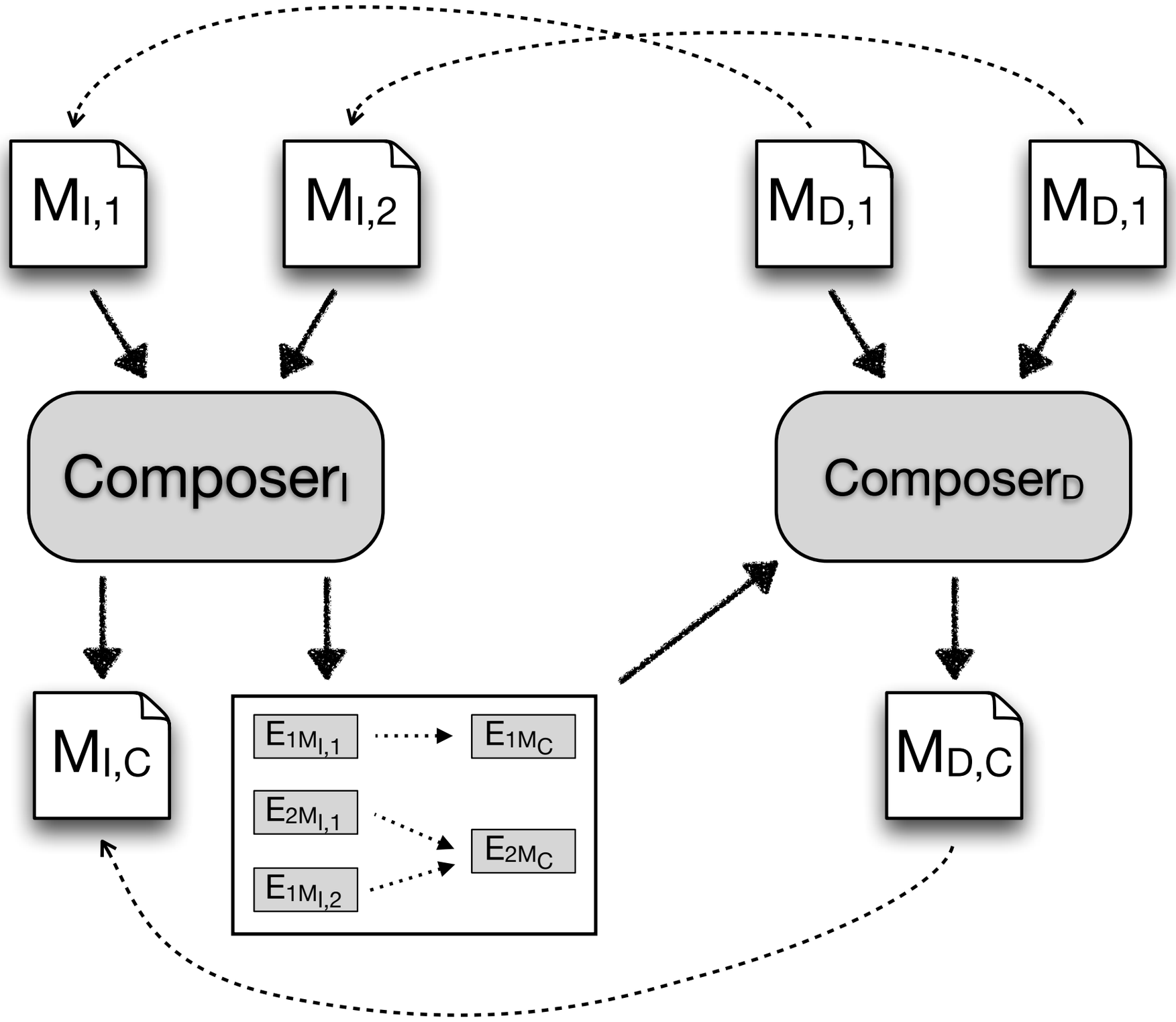

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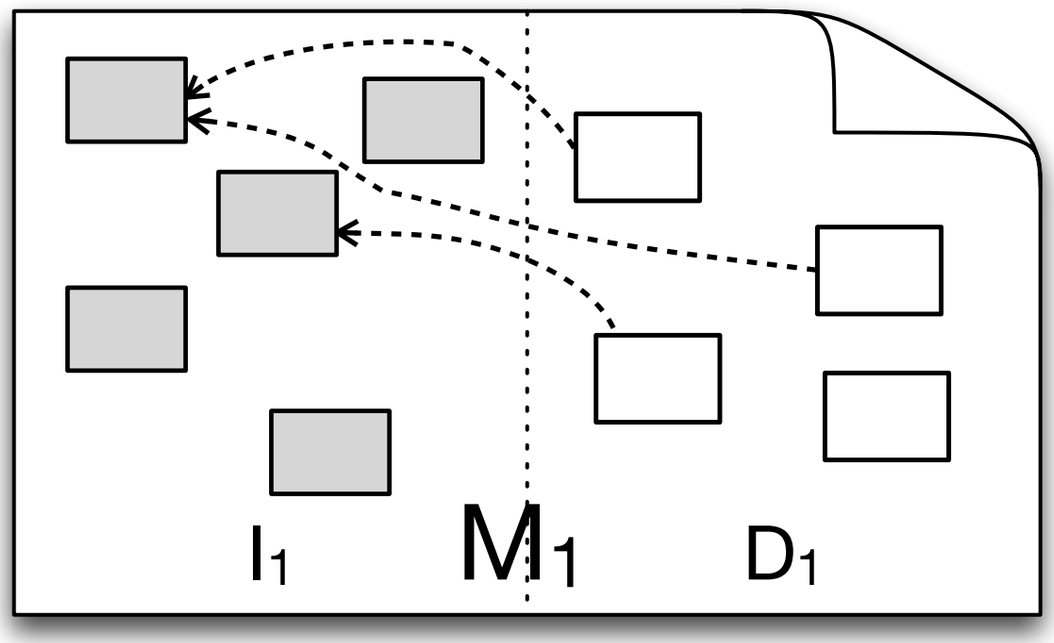

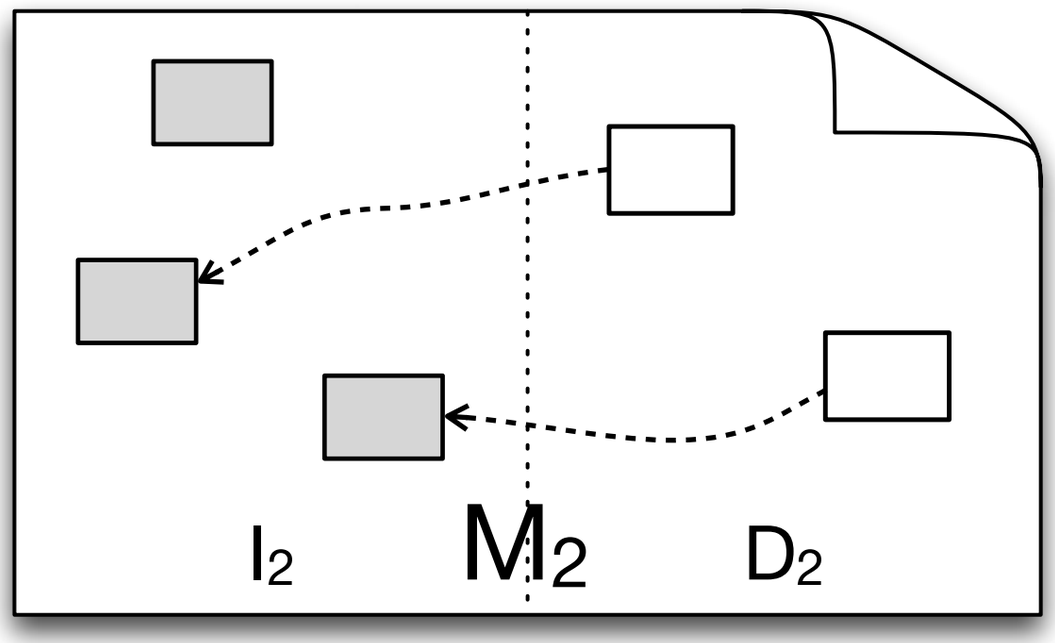

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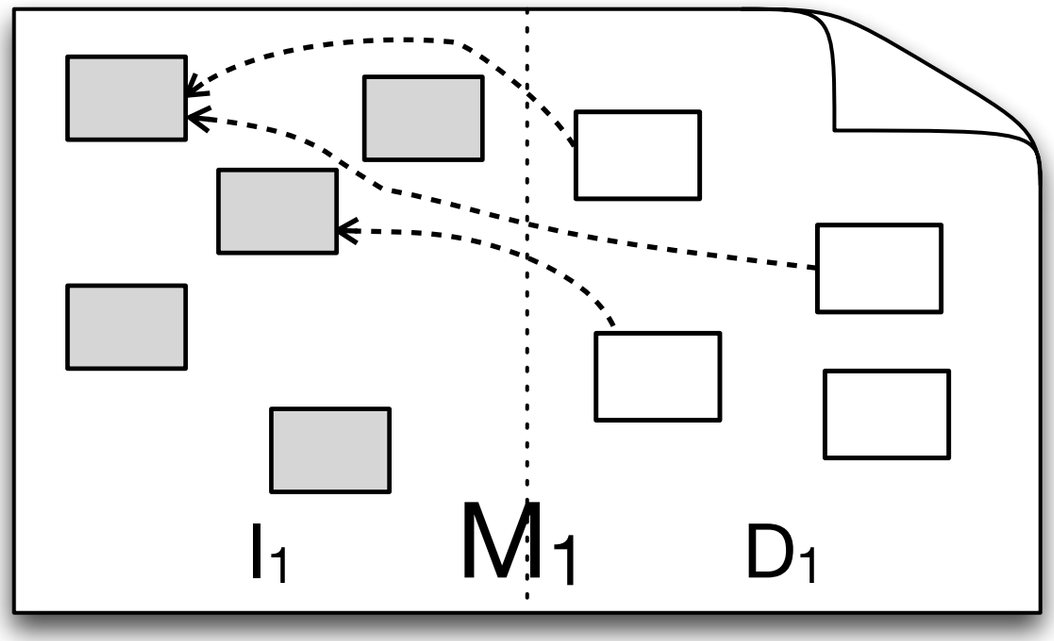

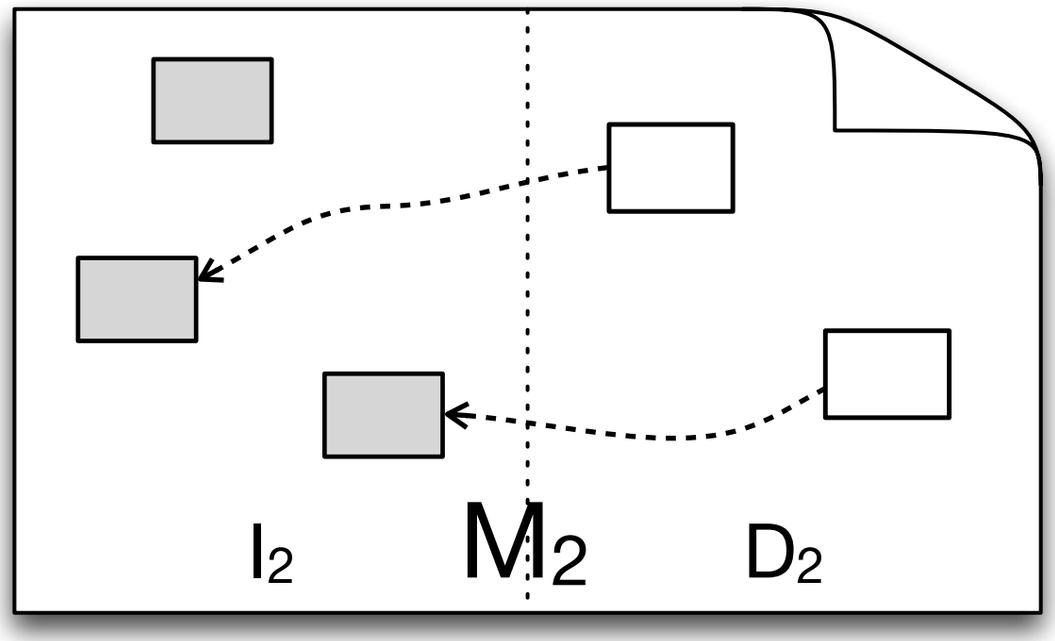

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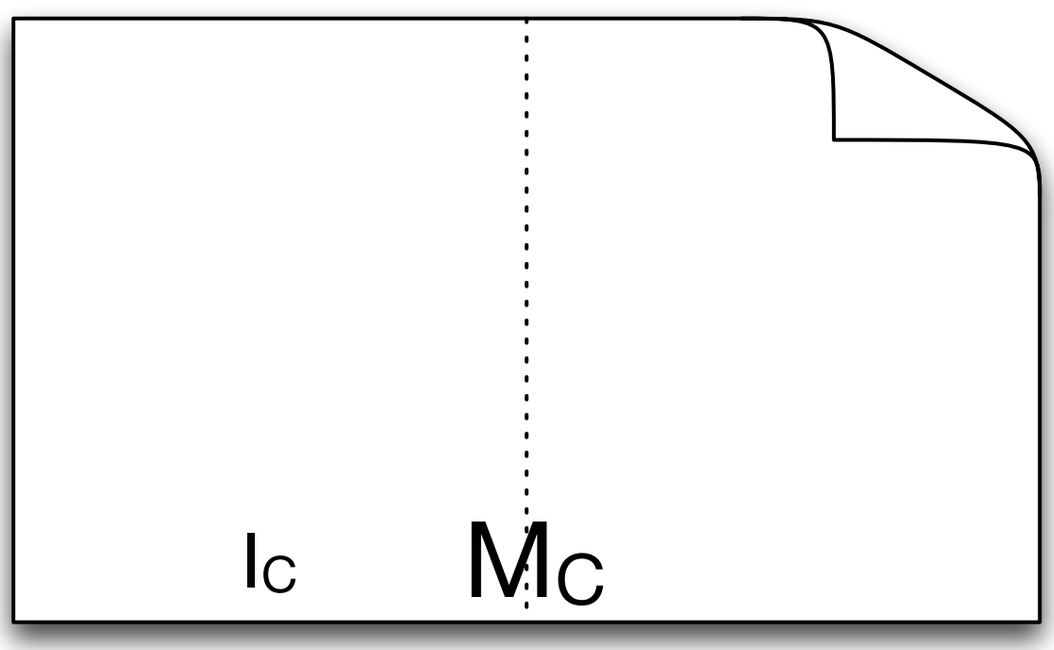

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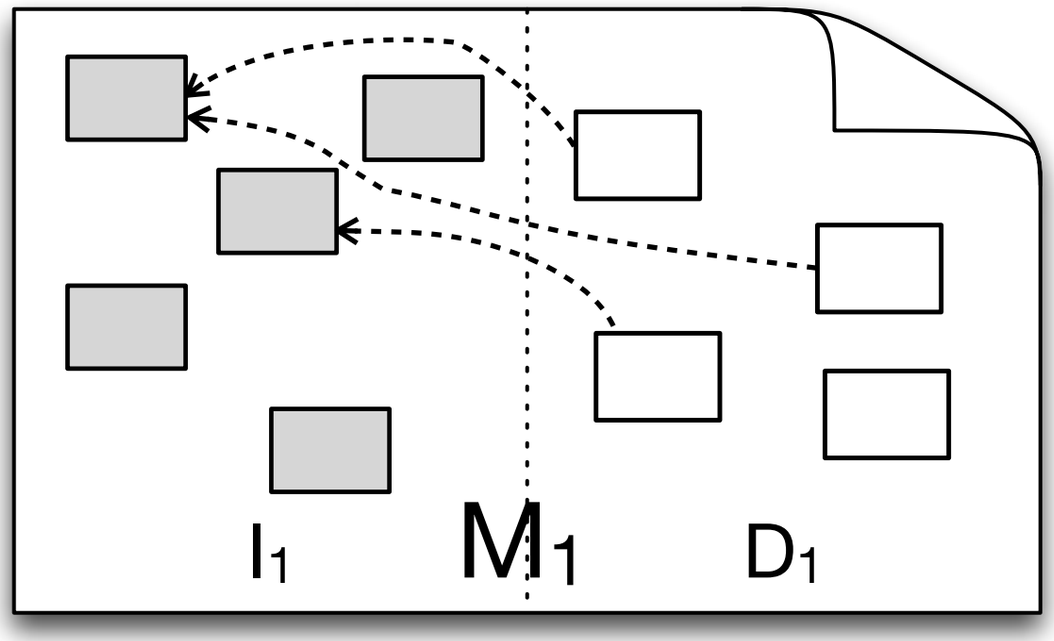

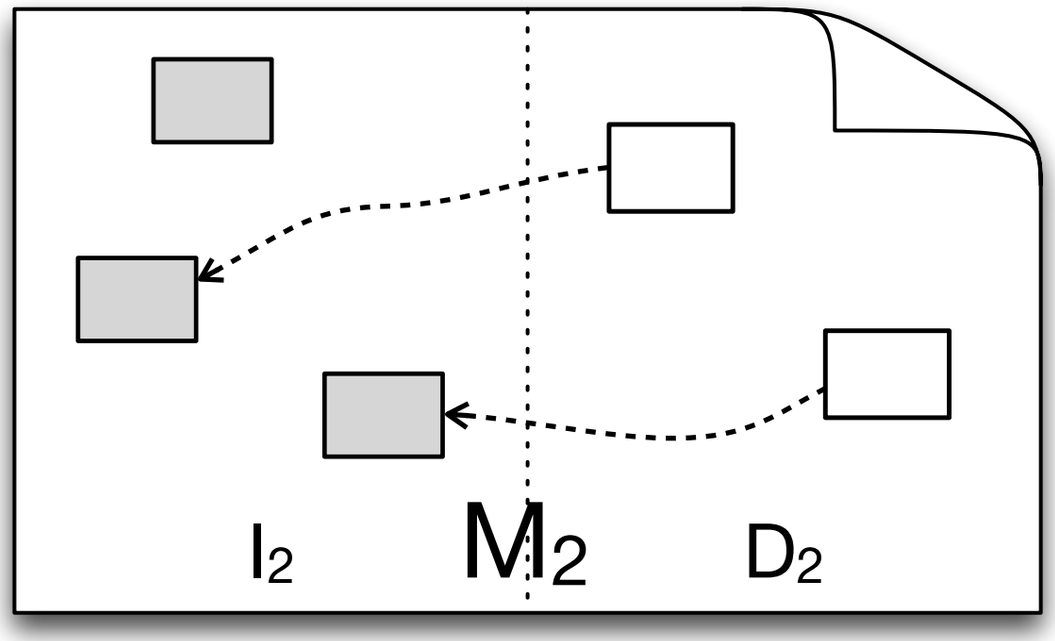

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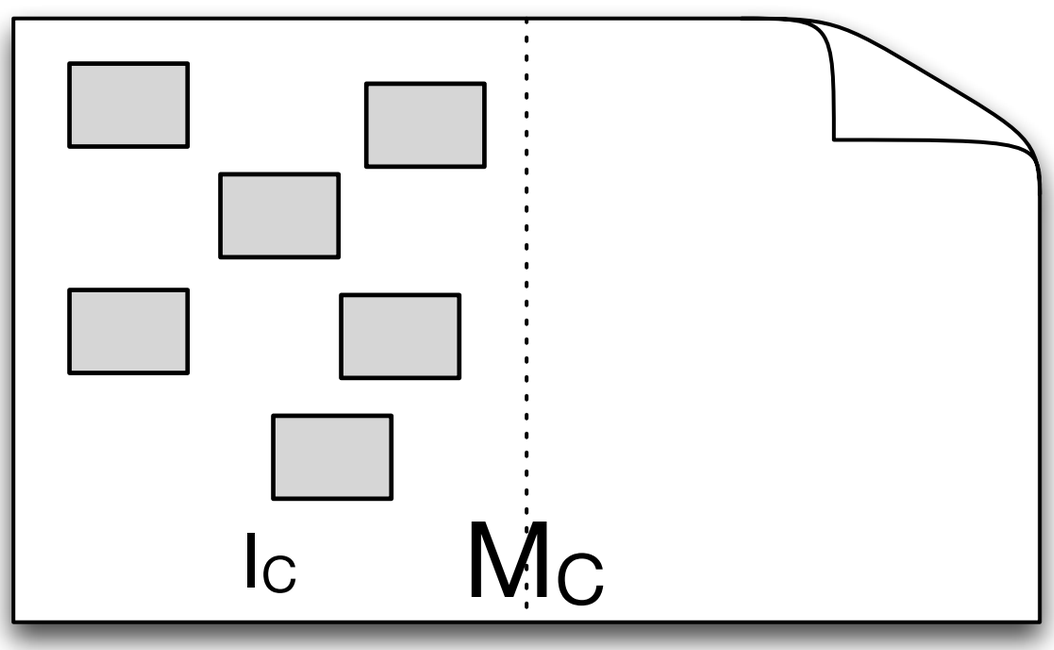

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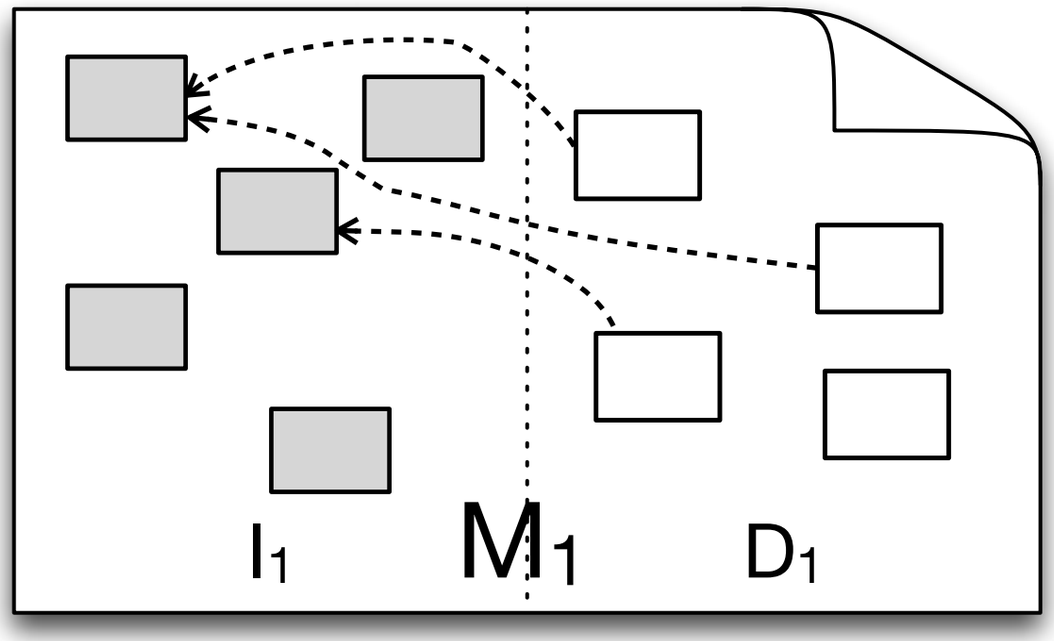

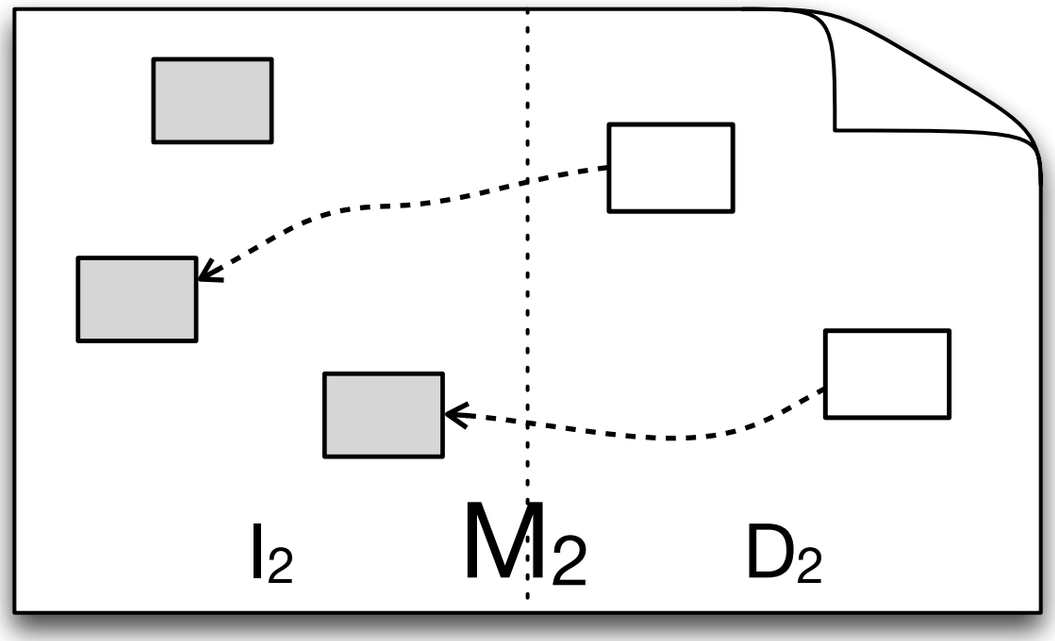

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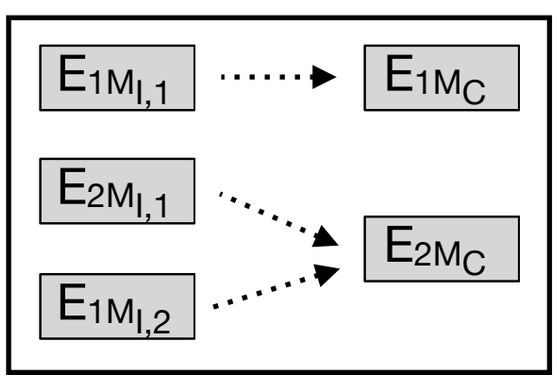

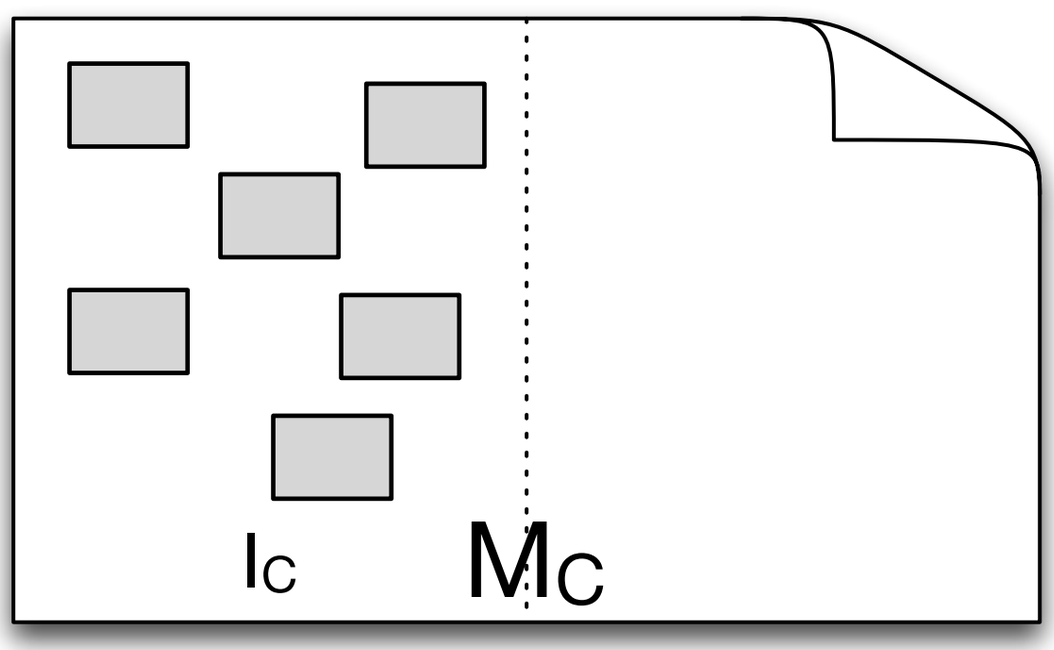

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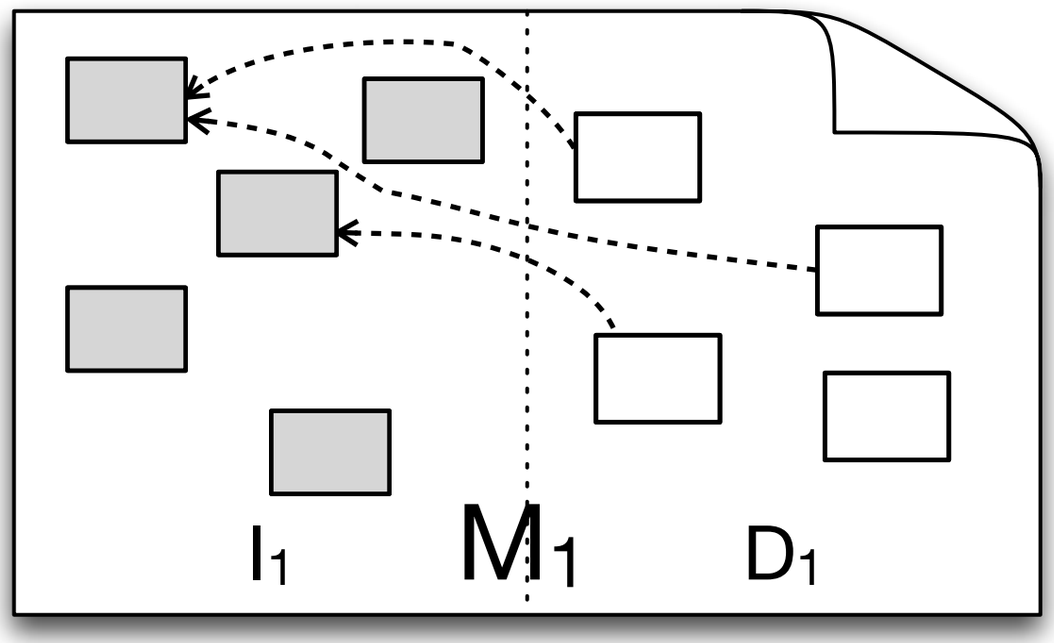

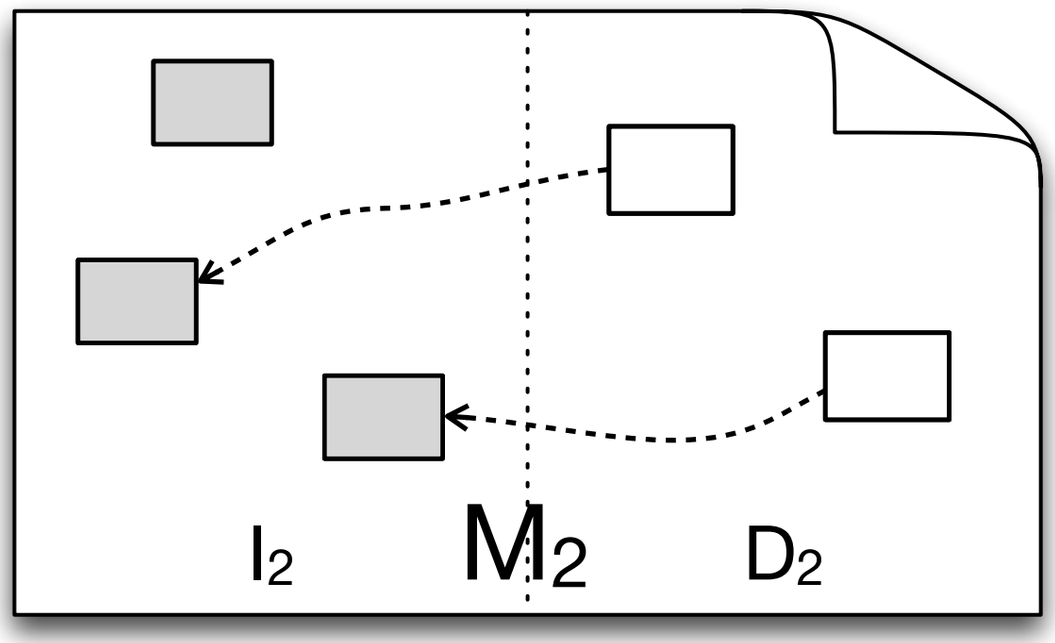

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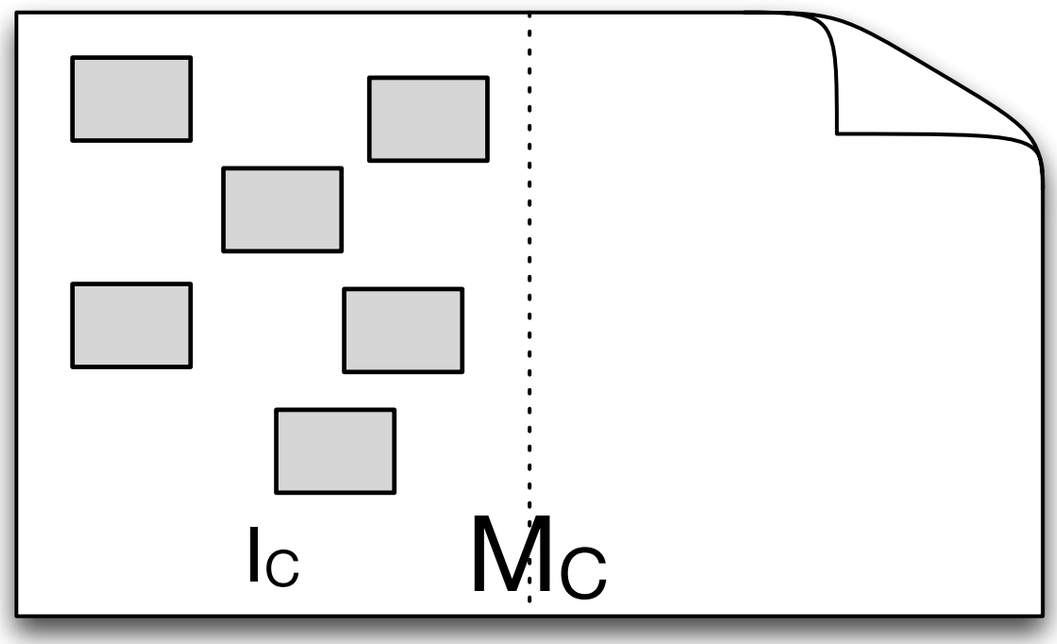

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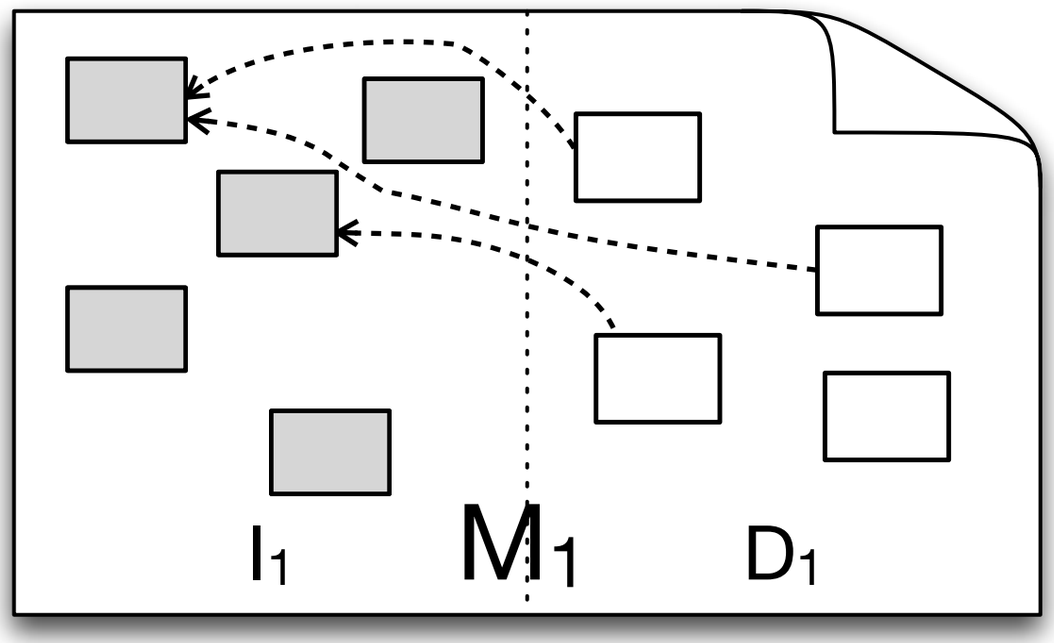

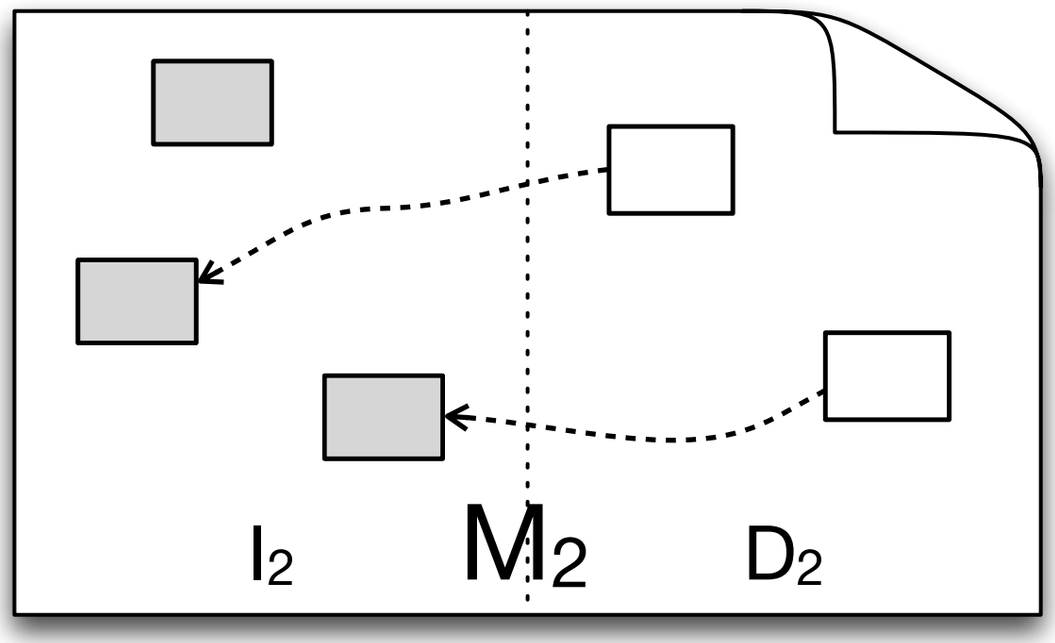

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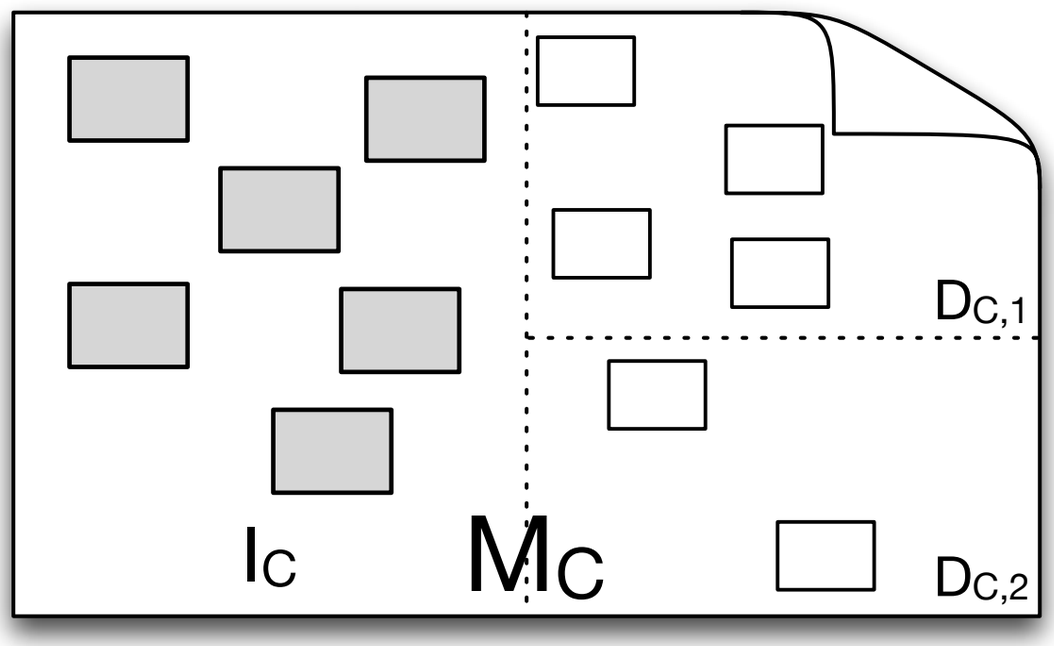

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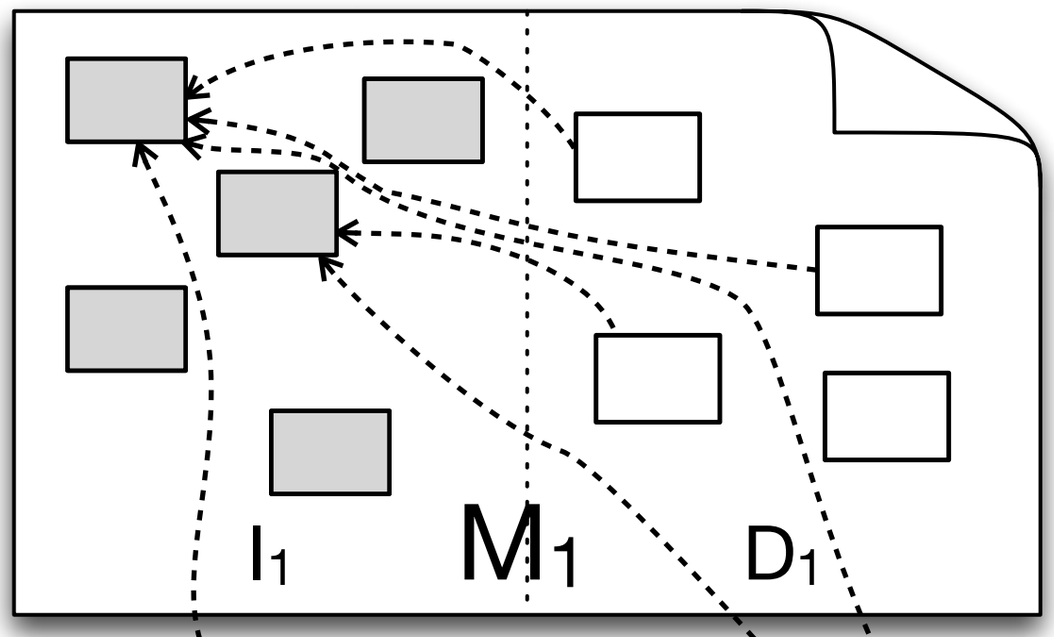

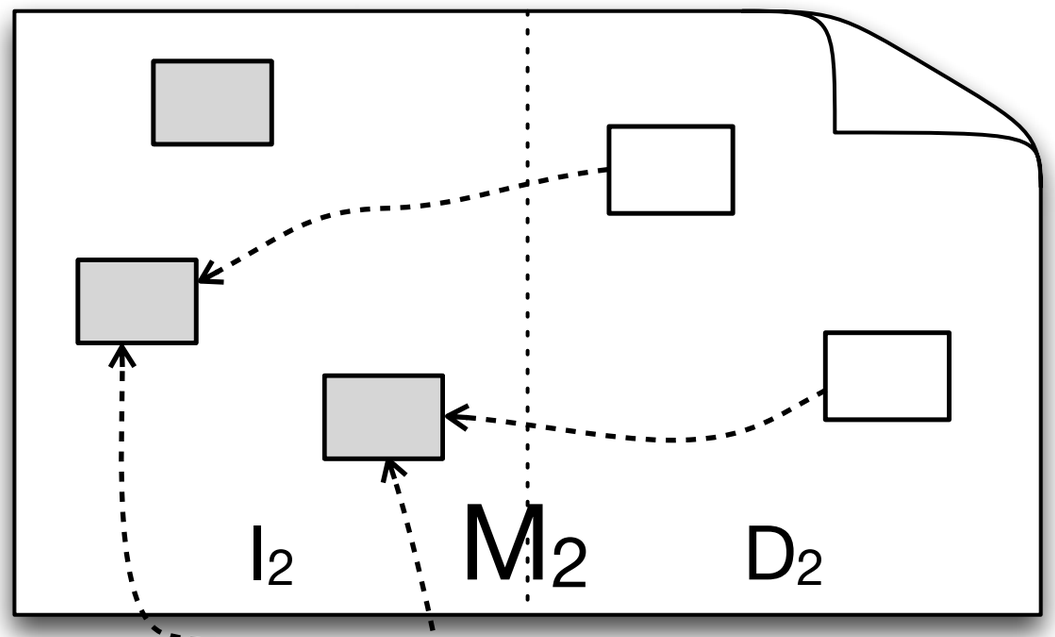

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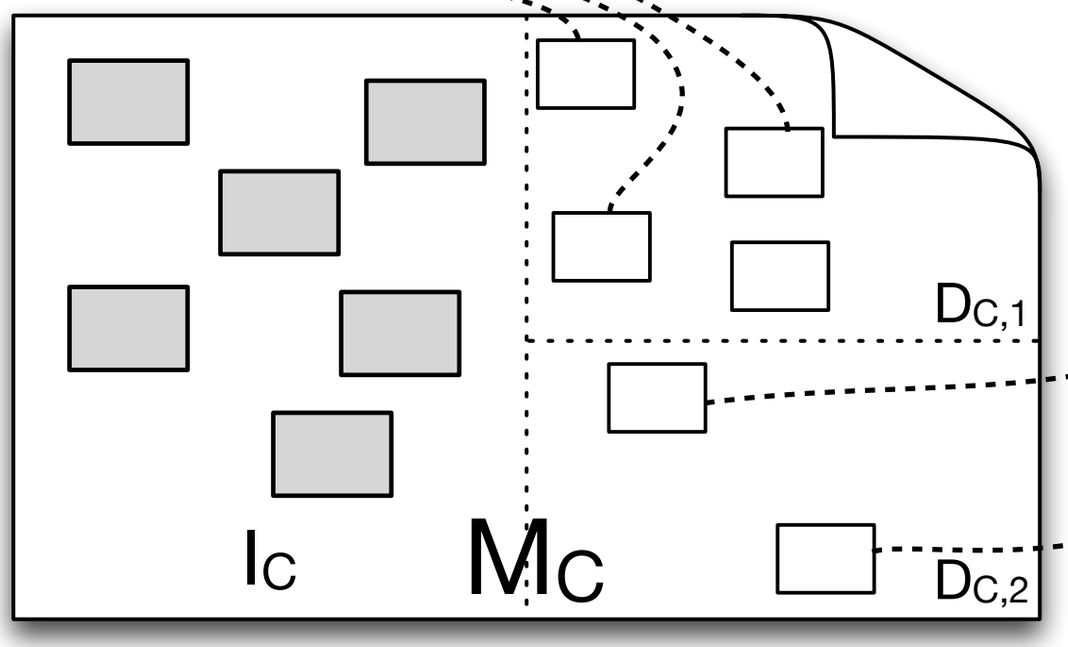

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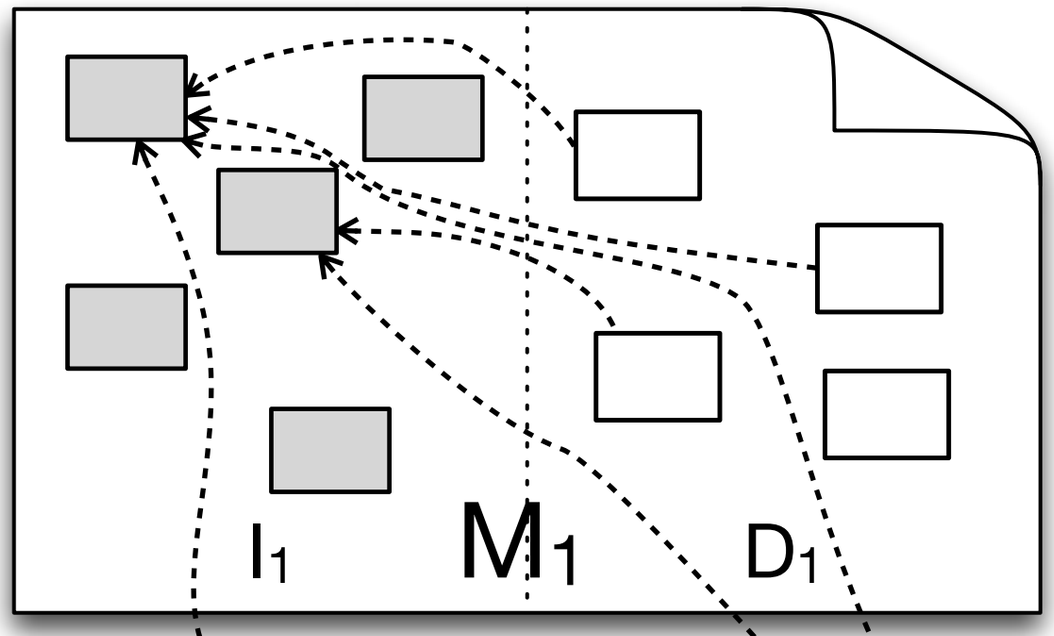

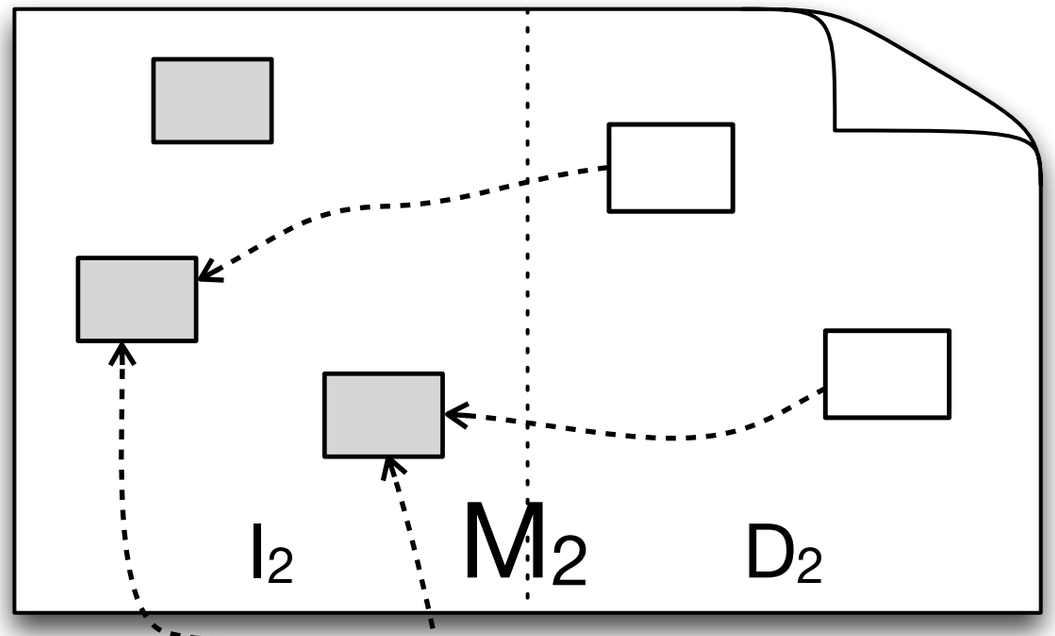

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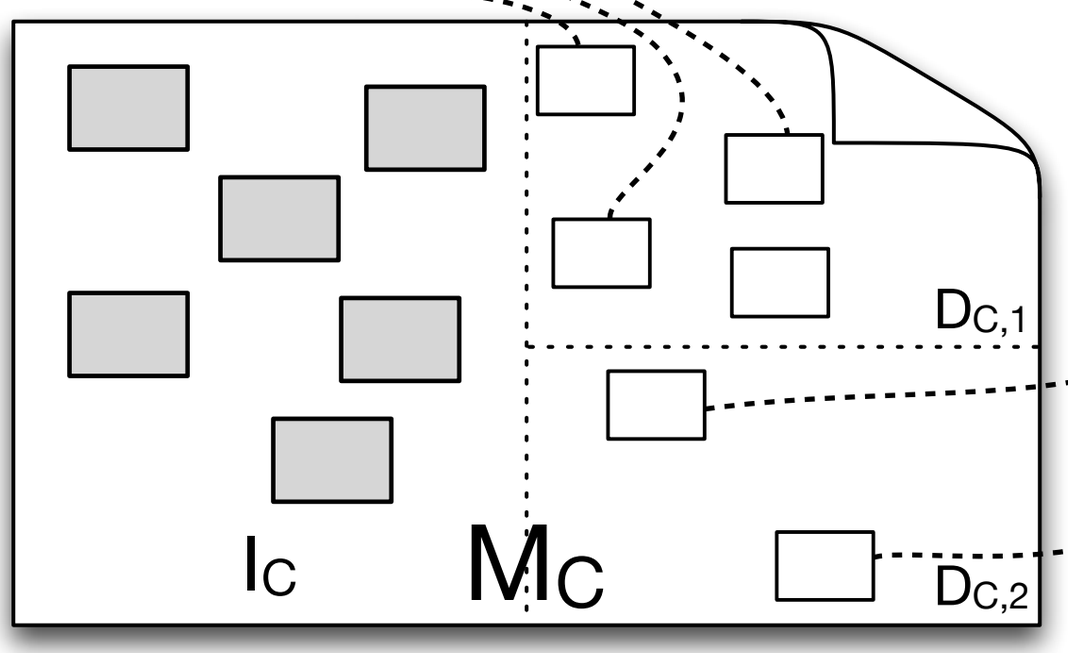

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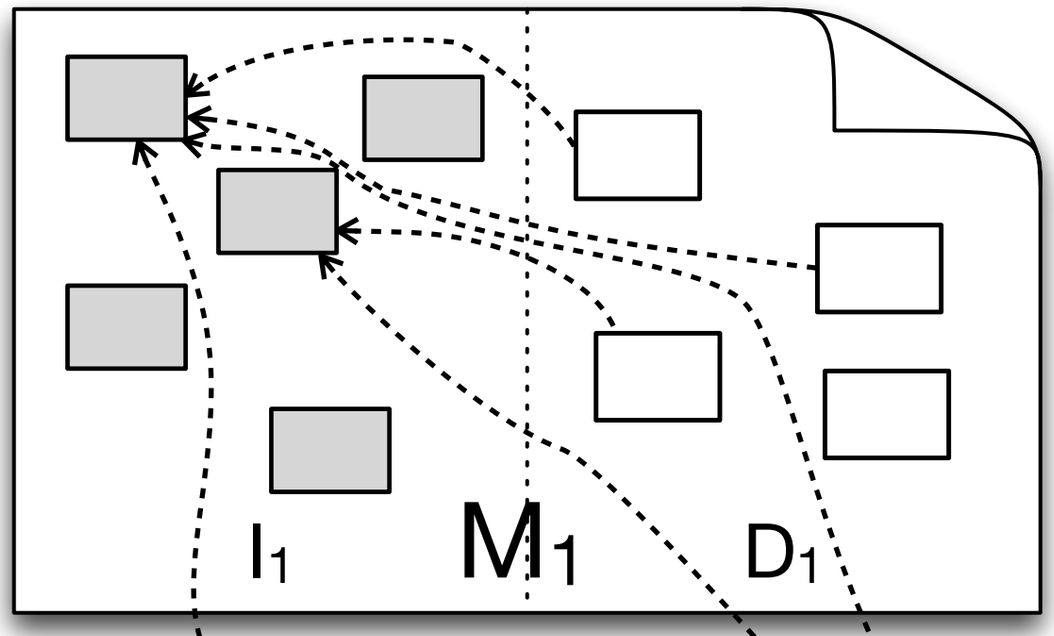

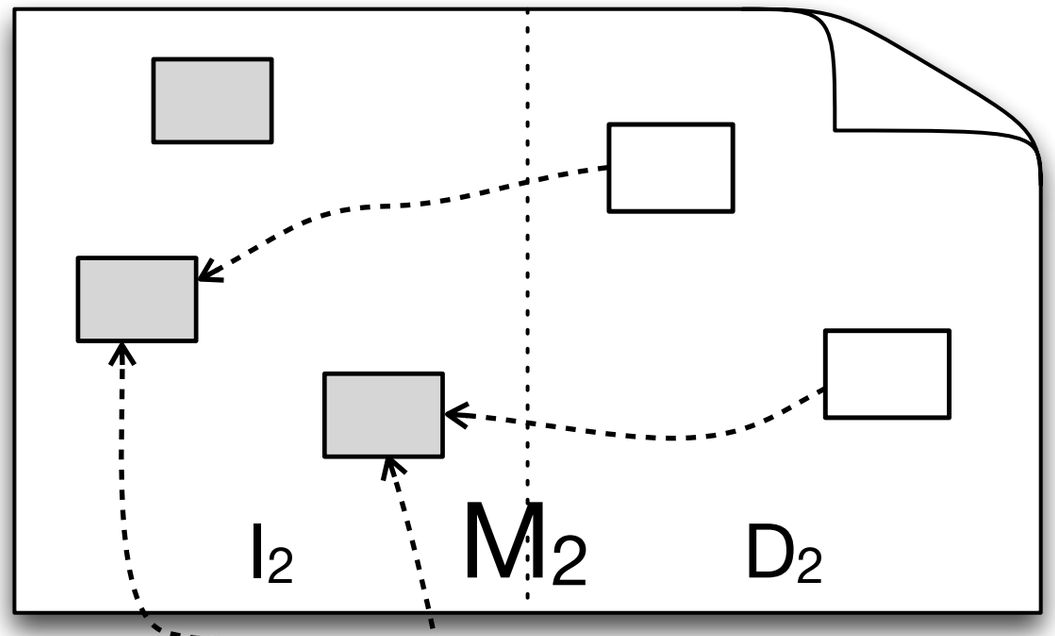

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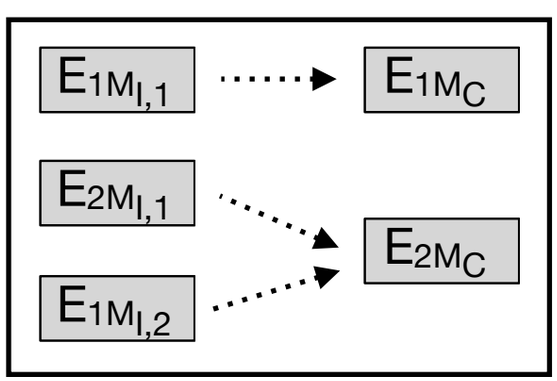

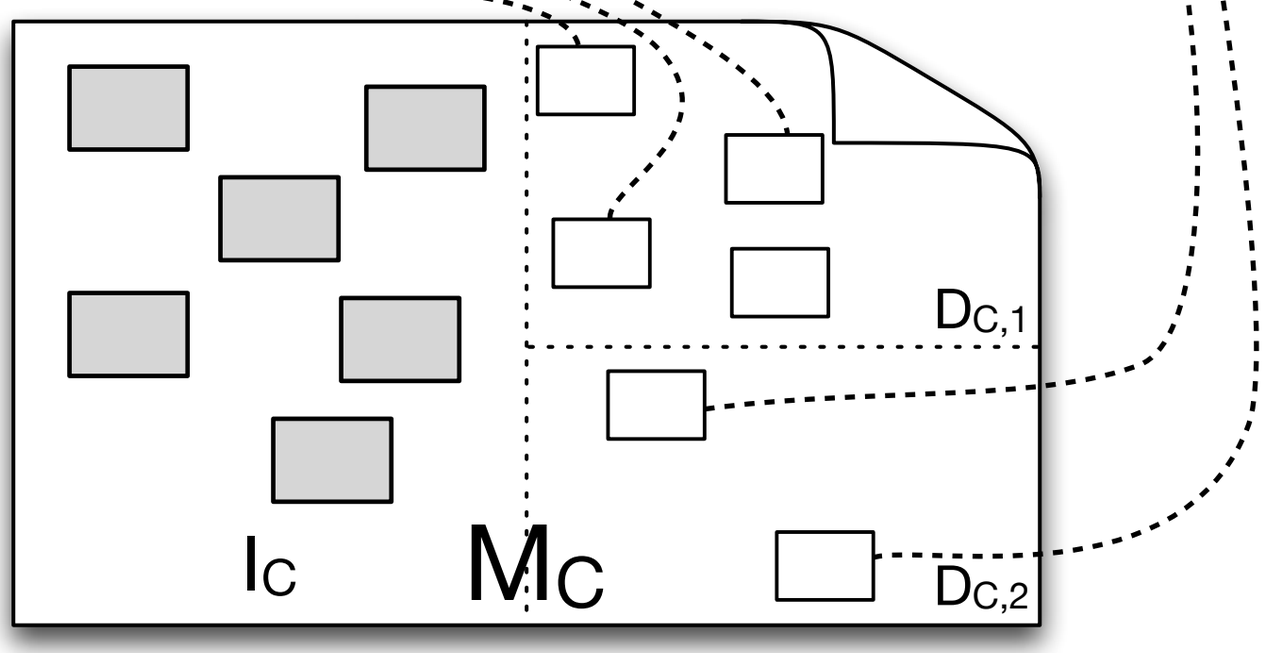

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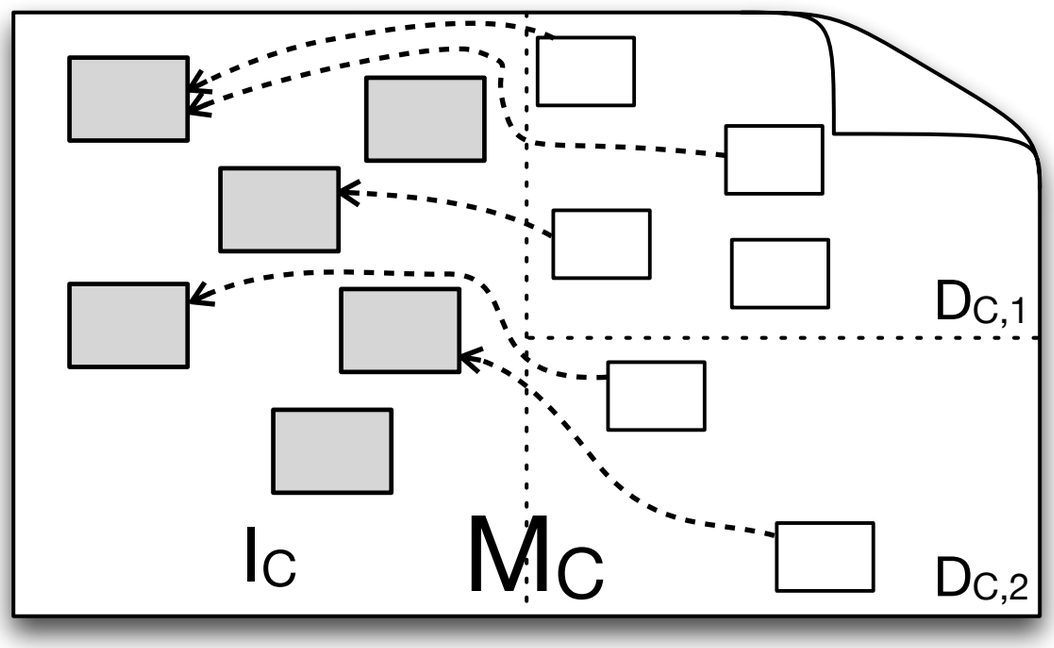
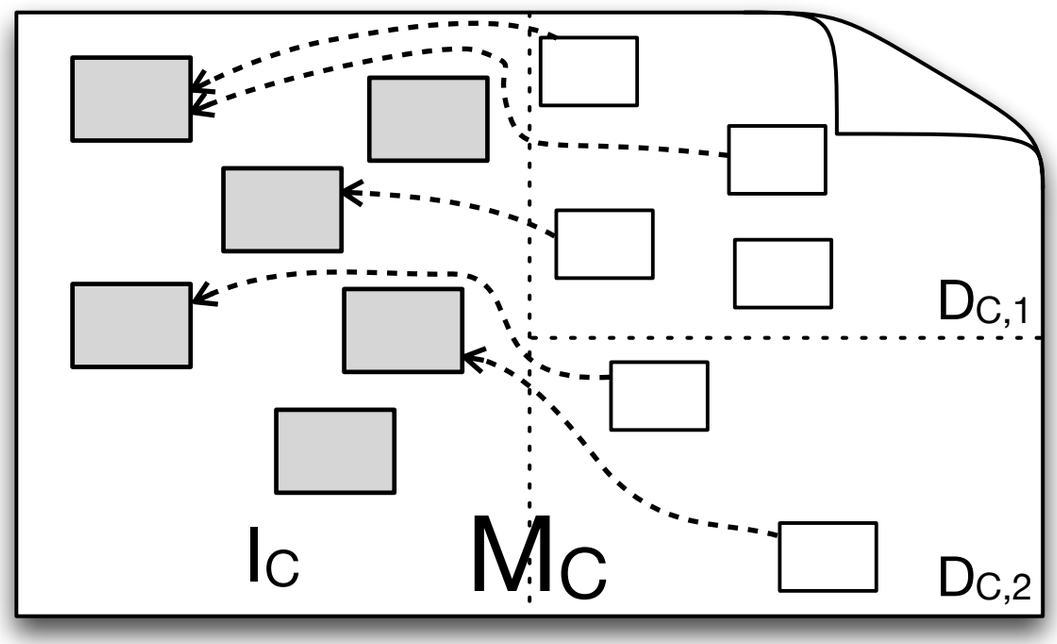
Step 3:
update references



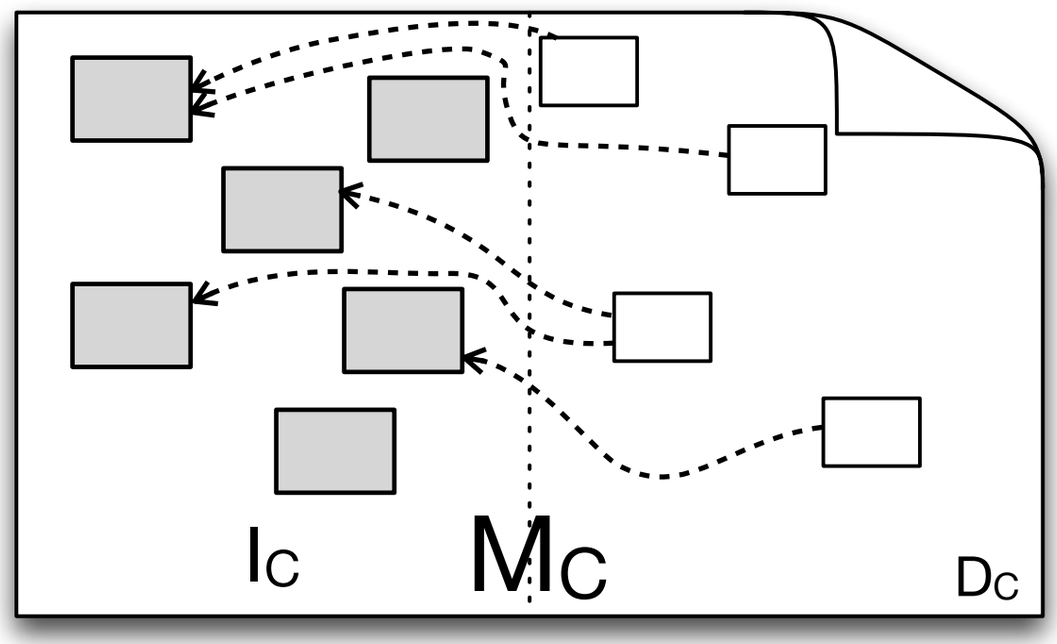
Integration Strategy: Process

Step 4:
compose D_C

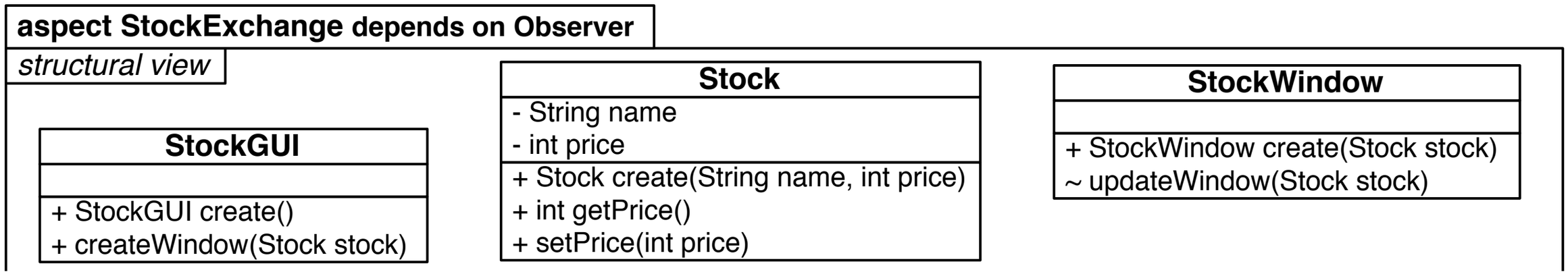


Integration Strategy: Process

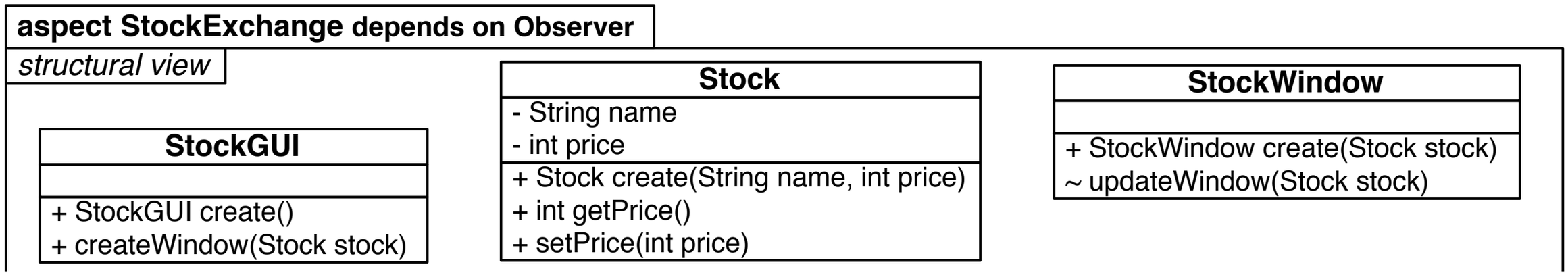
Step 4:
compose D_C

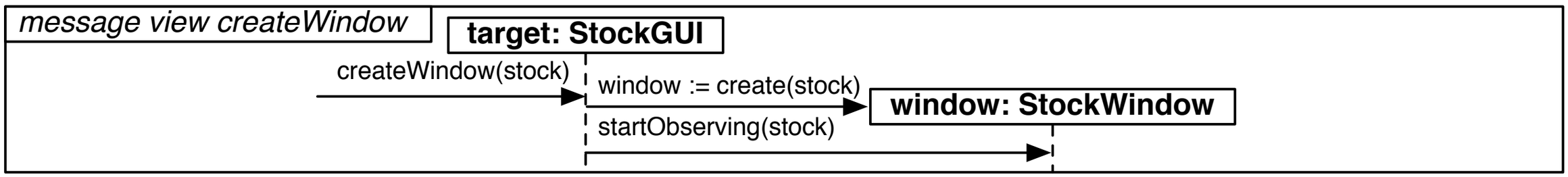


Practical Application to Reusable Aspect Models (RAM)

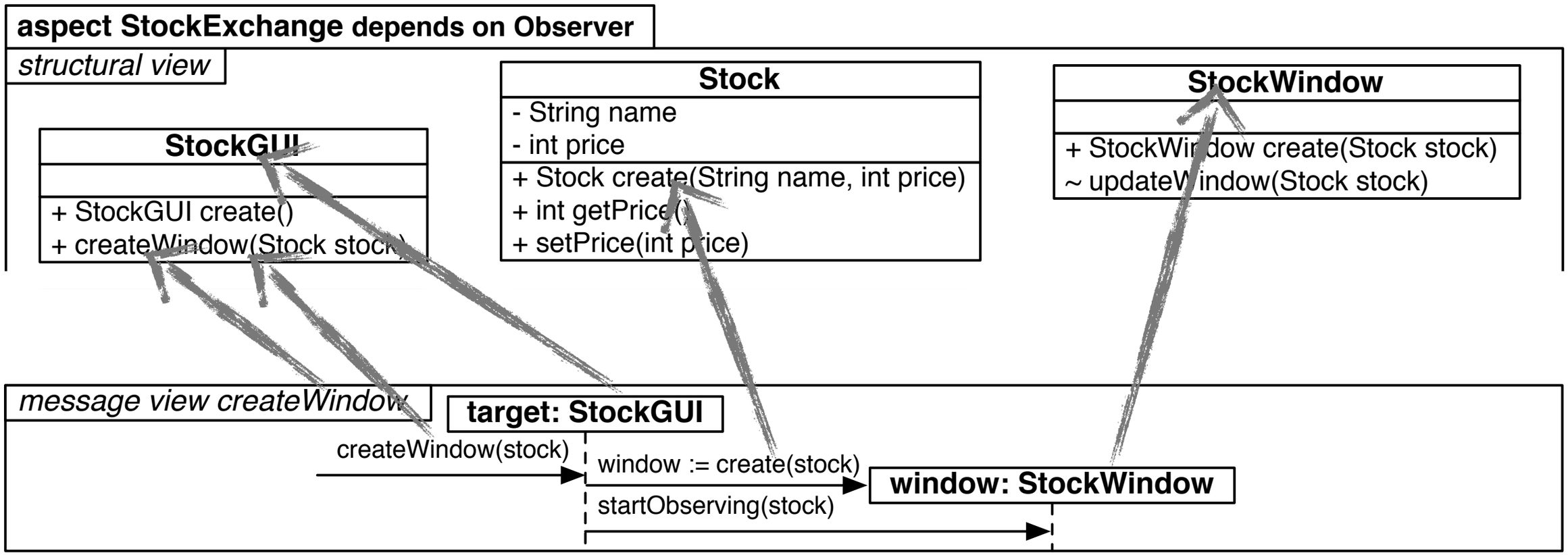


Practical Application to Reusable Aspect Models (RAM)

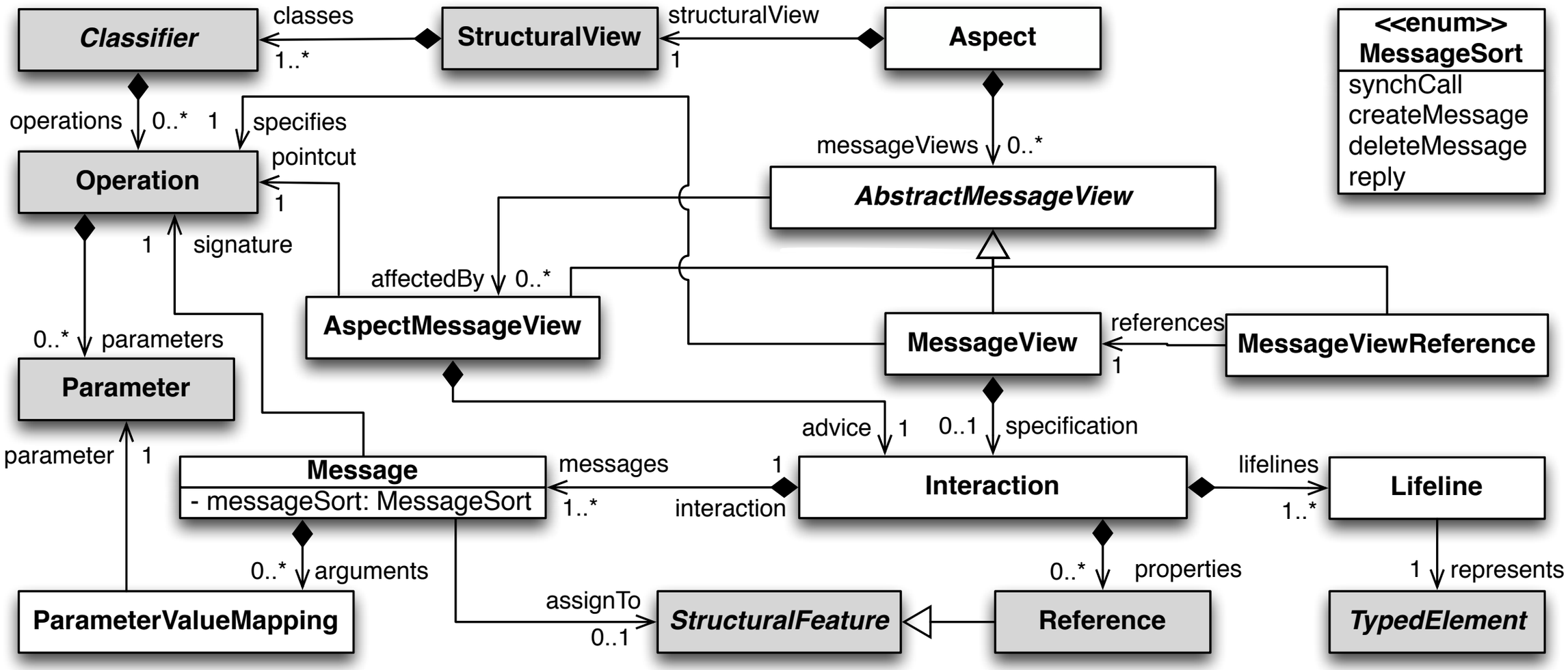




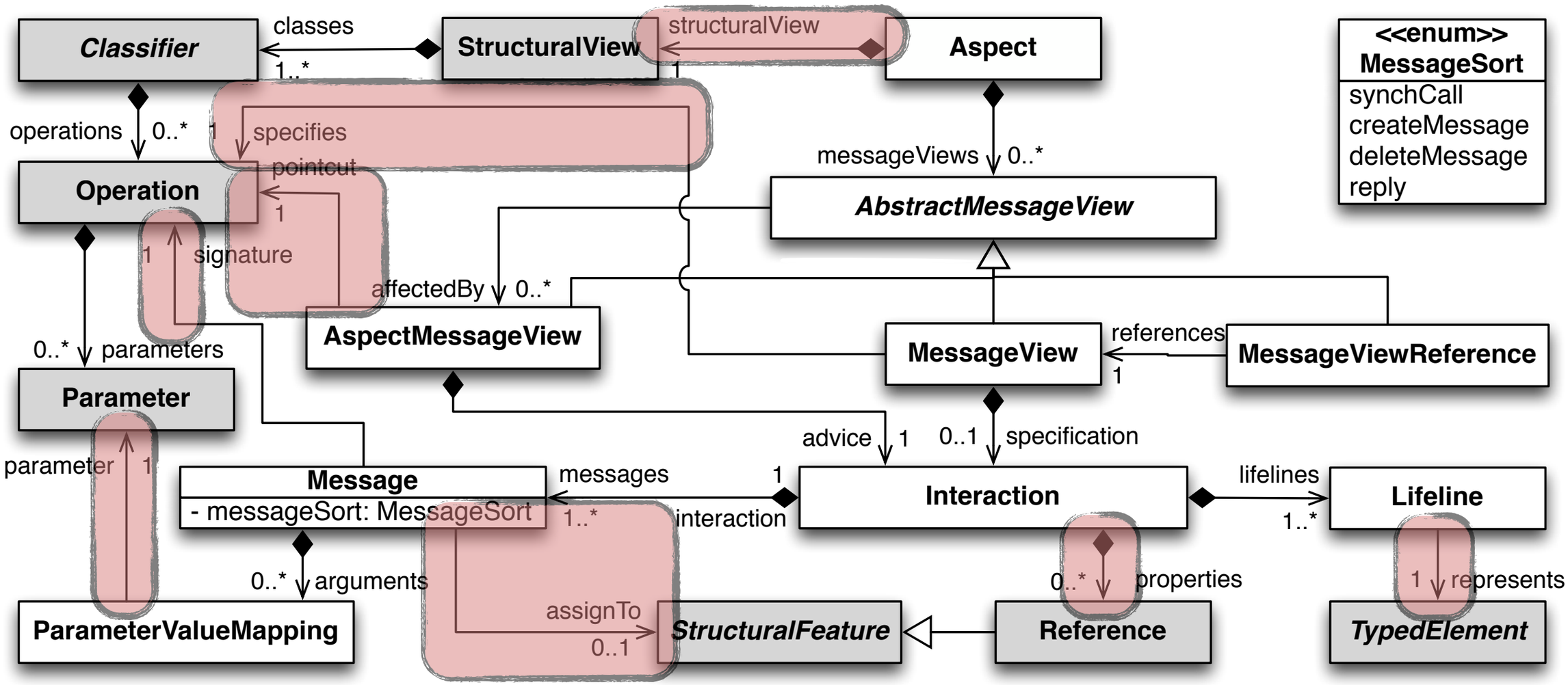
Practical Application to Reusable Aspect Models (RAM)



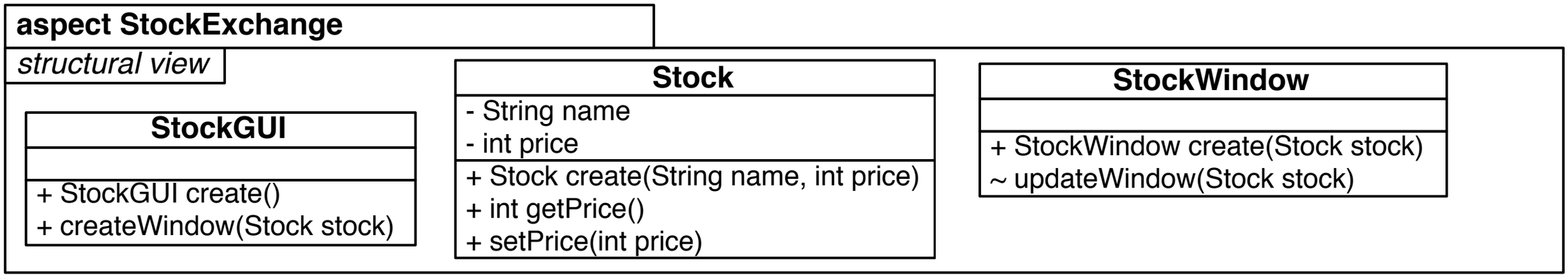
RAM: Metamodel



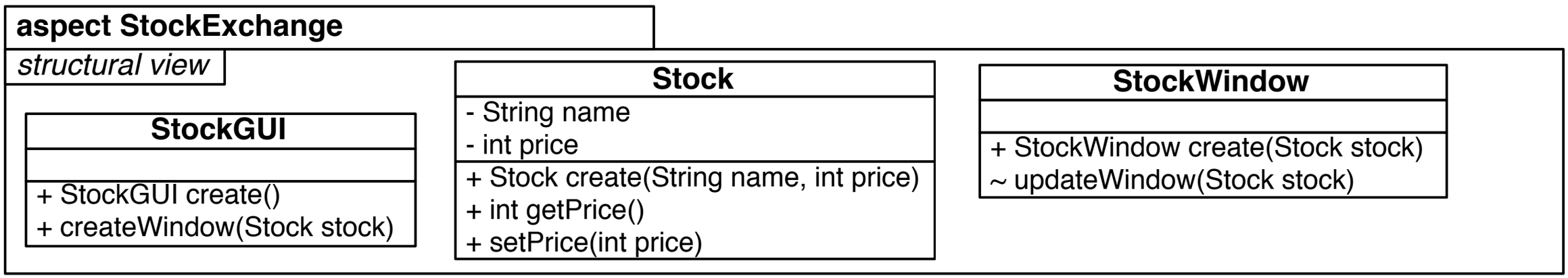
RAM: Metamodel

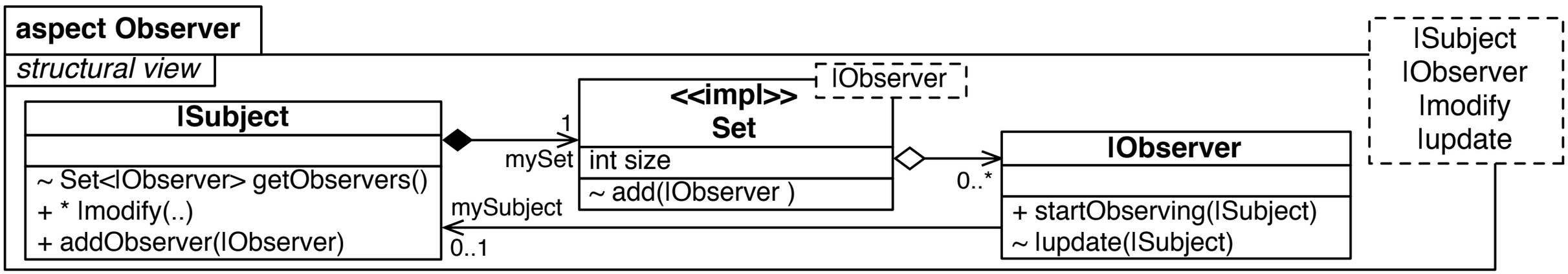


RAM: Concern Reuse

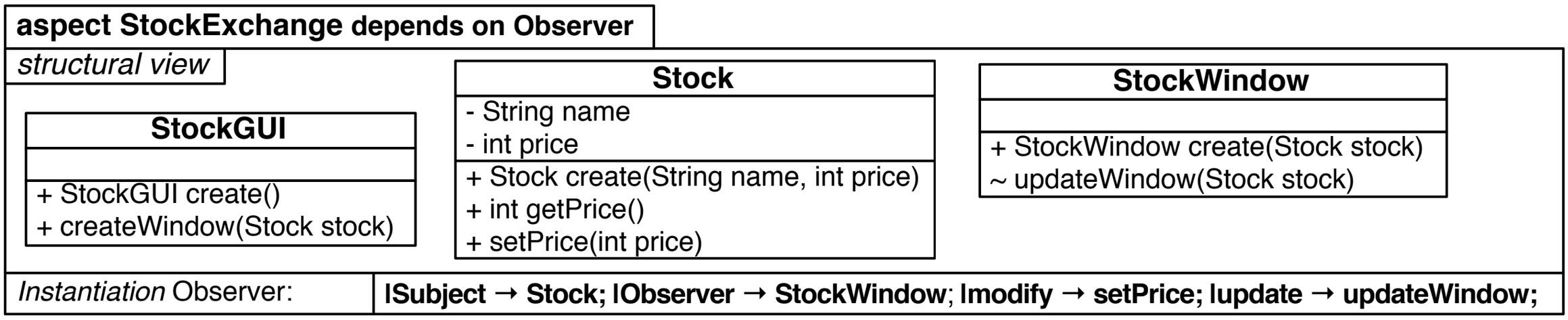


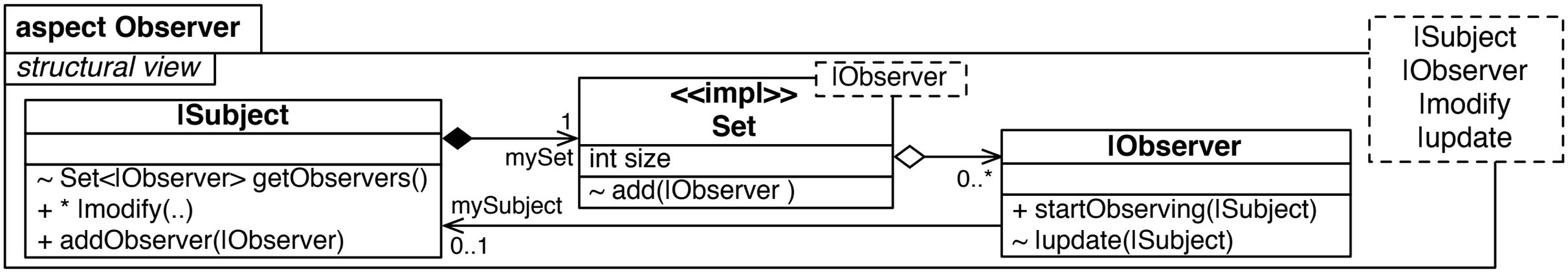
RAM: Concern Reuse



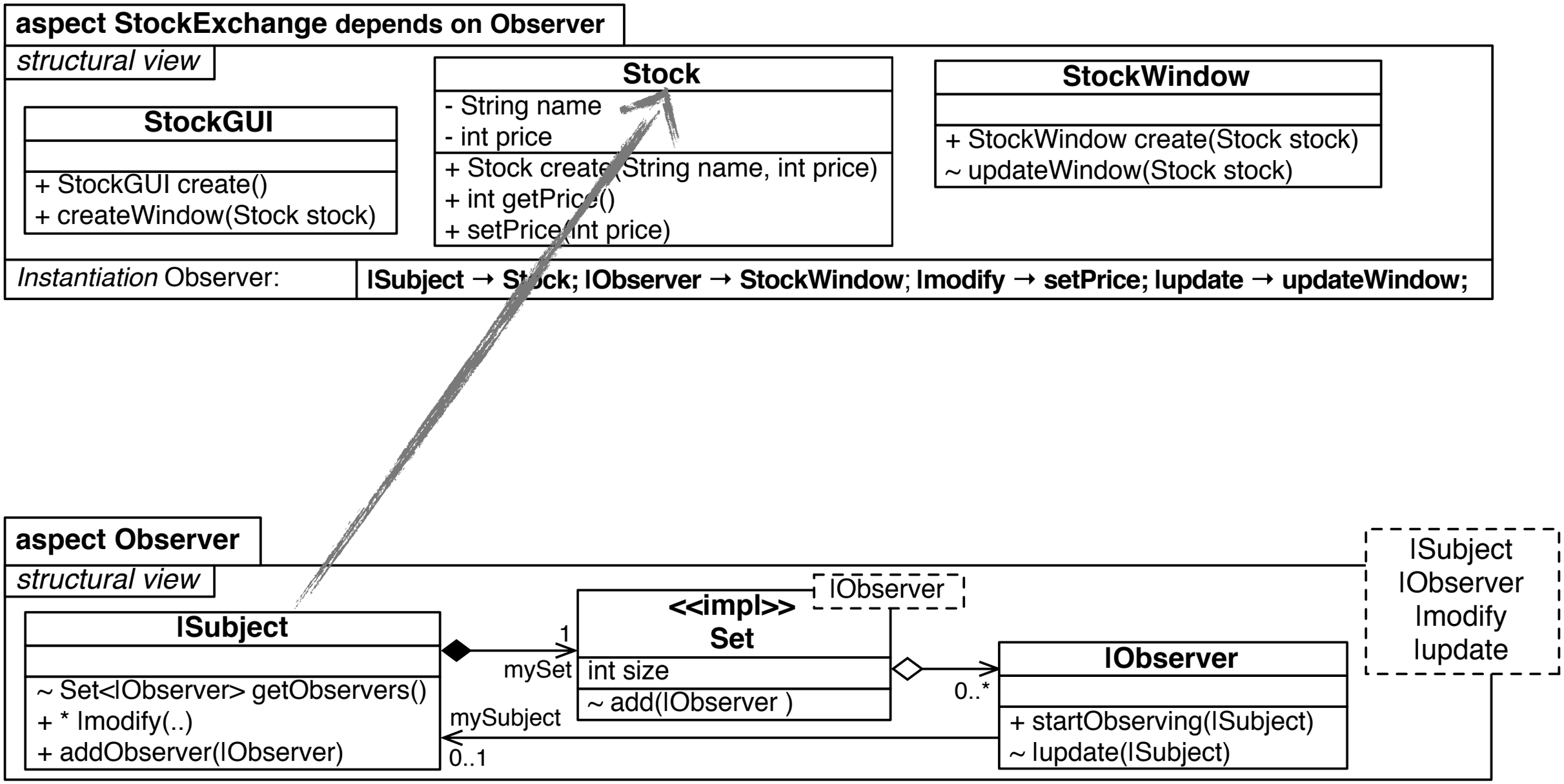


RAM: Concern Reuse

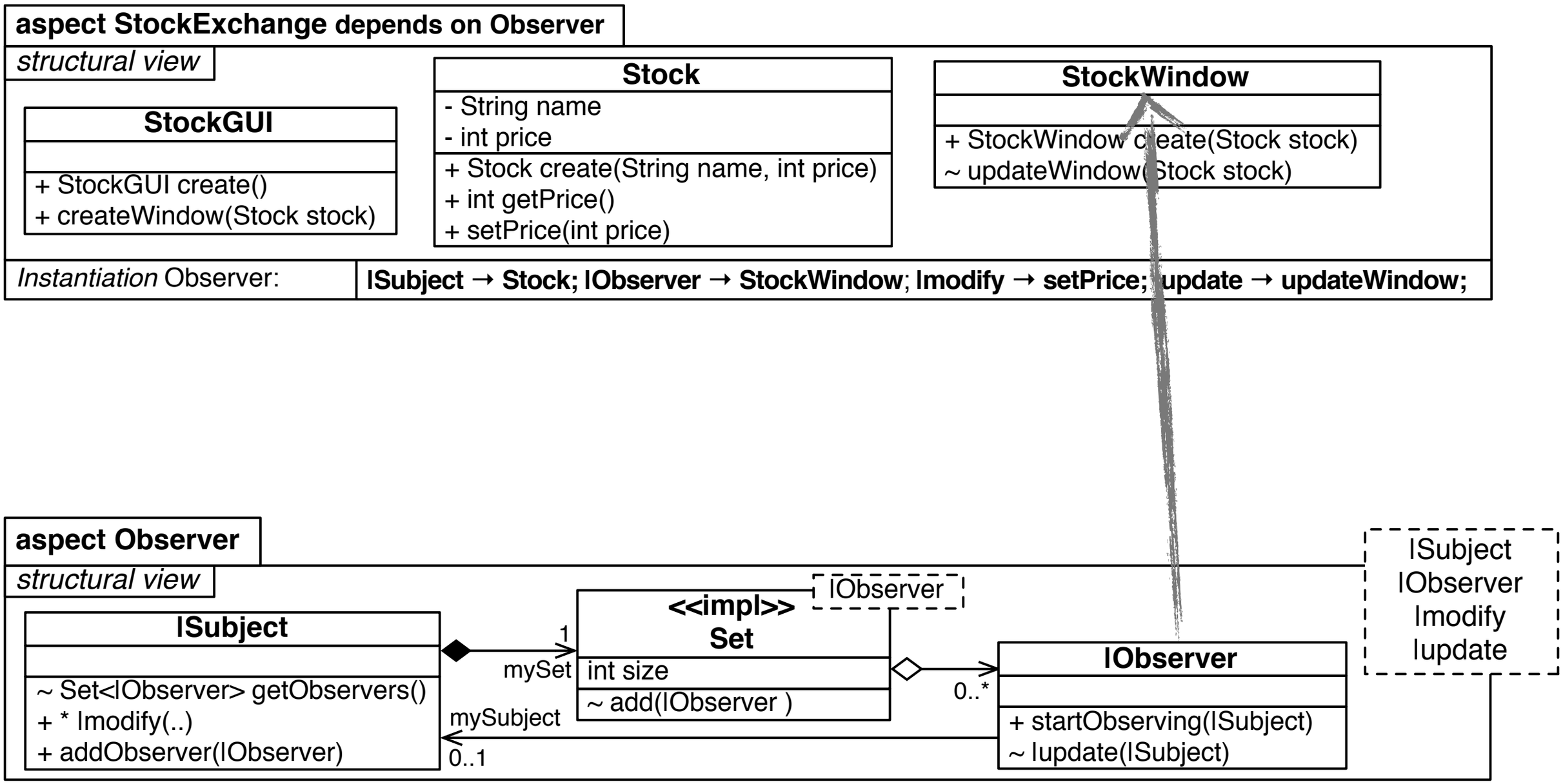




RAM: Concern Reuse



RAM: Concern Reuse



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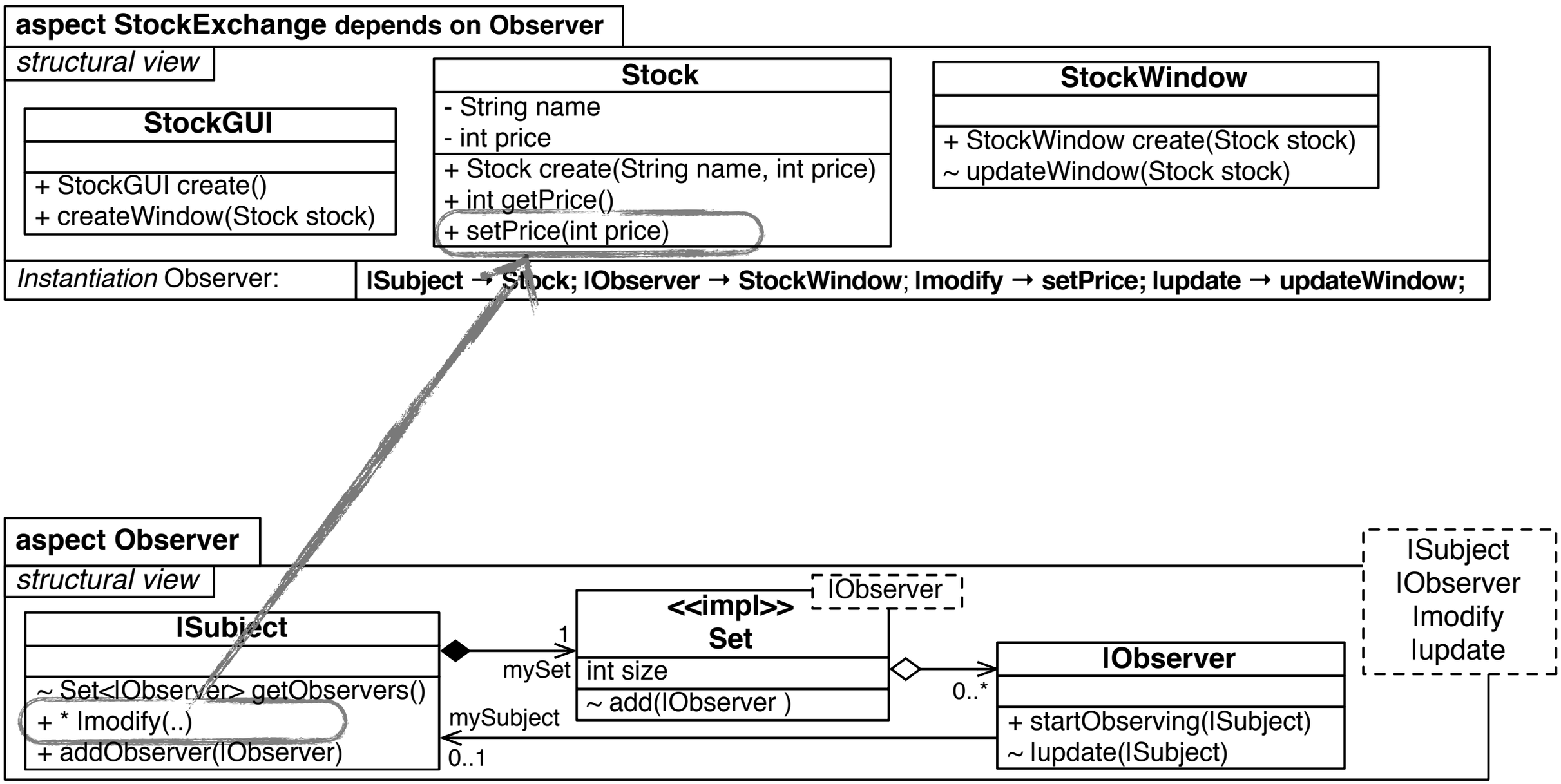

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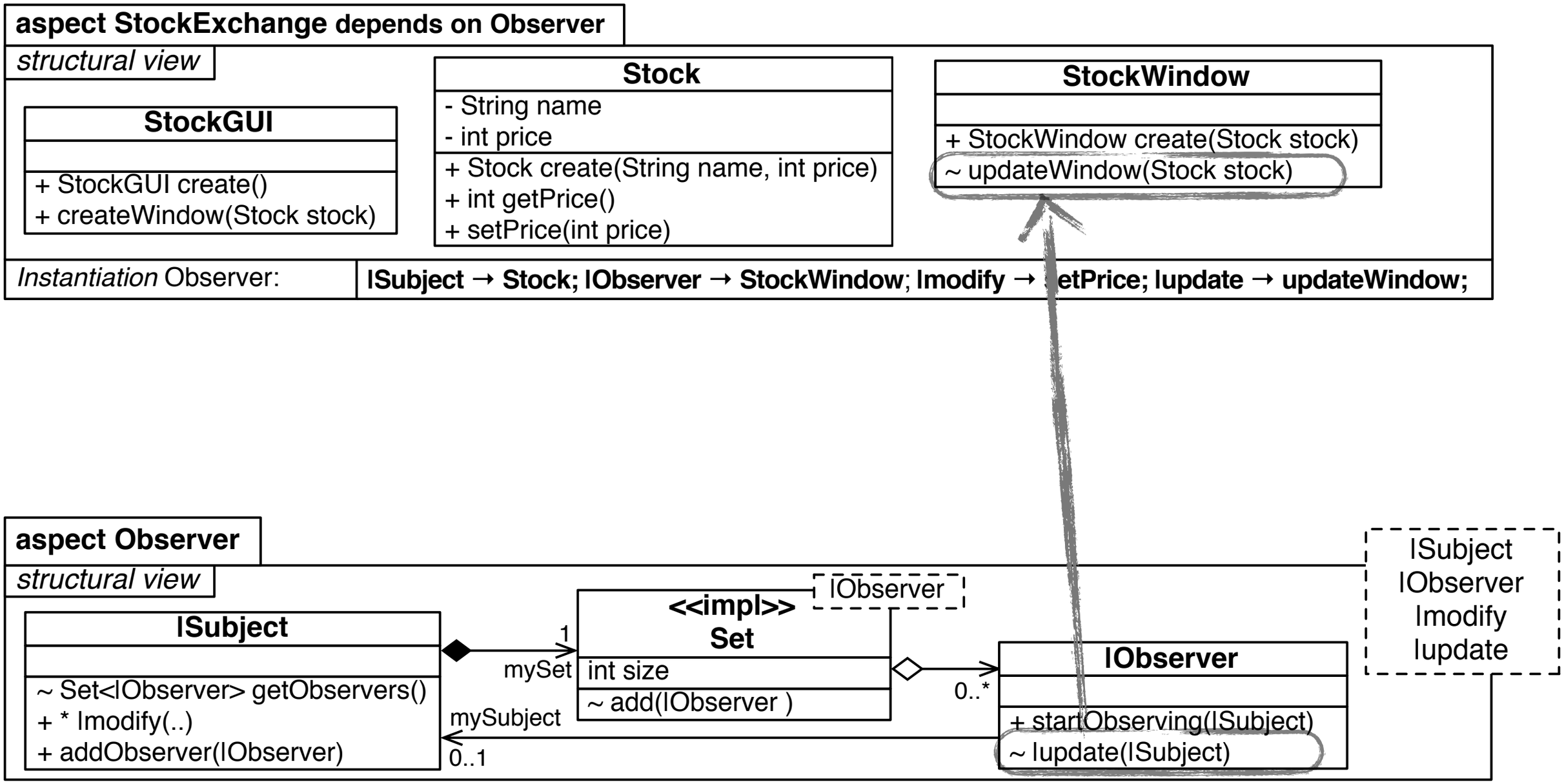
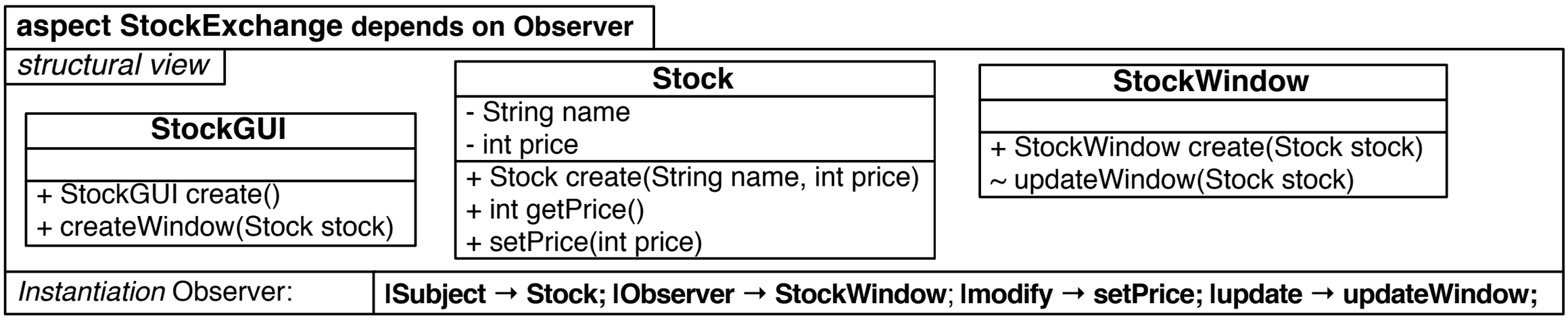
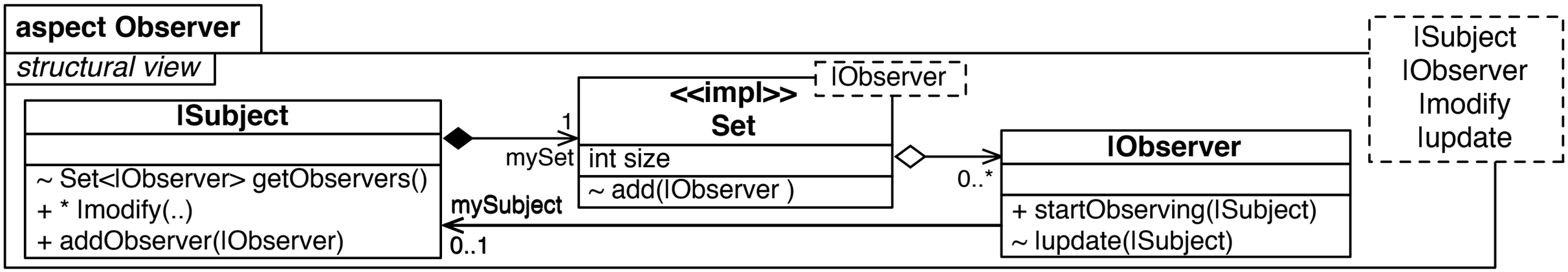


RAM: Weaving


aspect StockExchange depends on Observer
structural view
StockGUI
+ StockGUI create()
+ createWindow(Stock stock)
Stock
- String name
- int price
+ Stock create(String name, int price)
+ int getPrice()
+ setPrice(int price)
StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
Instantiation Observer:
ISubject → Stock; IObserver → StockWindow; Imodify → setPrice; Iupdate → updateWindow;


aspect Observer
structural view
ISubject
~ Set<IObserver> getObservers()
+ * Imodify(..)
+ addObserver(IObserver)
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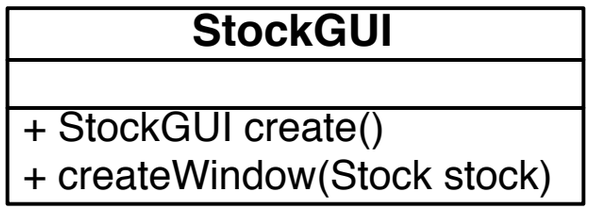
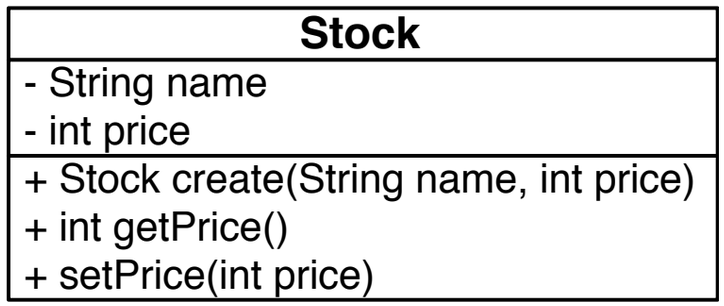
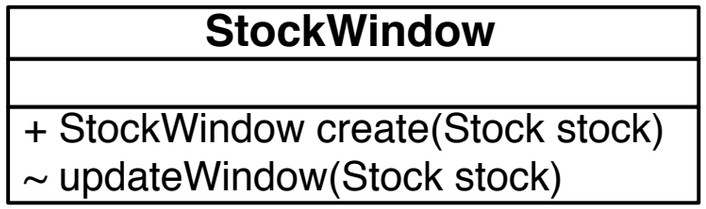
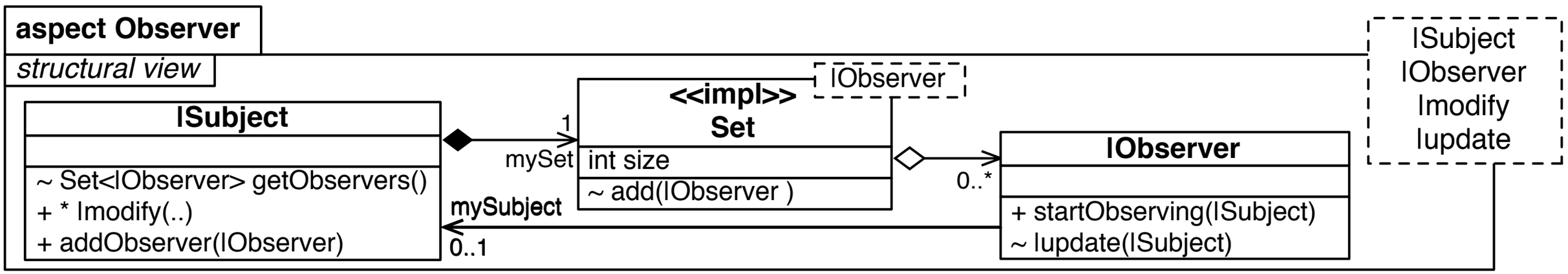
mySet
<<impl>>
Set
int size
~ add(IObserver)
IObserver
0..*
IObserver
+ startObserving(ISubject)
~ Iupdate(ISubject)
mySubject
0..1
ISubject
IObserver
Imodify
Iupdate

RAM: Weaving


StockGUI
+ StockGUI create()
+ createWindow(Stock stock)


Stock
- String name
- int price
+ Stock create(String name, int price)
+ int getPrice()
+ setPrice(int price)


StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)


aspect Observer
structural view
ISubject
~ Set<IObserver> getObservers()
+ * Imodify(..)
+ addObserver(IObserver)
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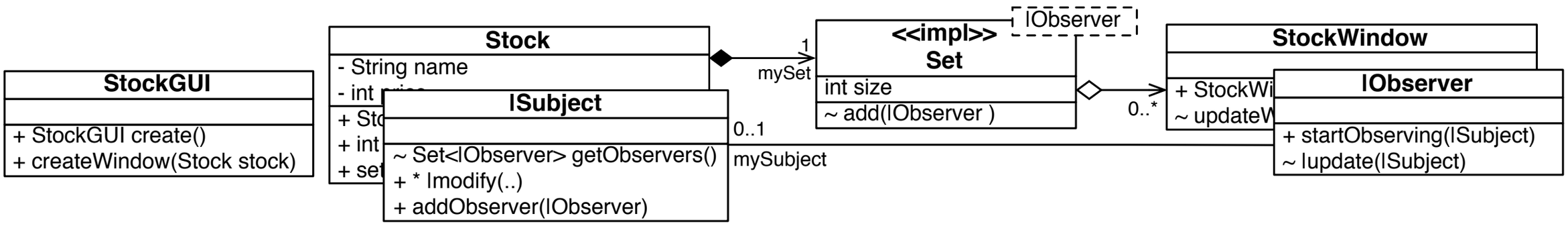
mySet
<<impl>>
Set
int size
~ add(IObserver)
IObserver
0..*
IObserver
+ startObserving(ISubject)
~ Iupdate(ISubject)
mySubject
0..1
ISubject
IObserver
Imodify
Iupdate

RAM: Weaving


StockGUI
+ StockGUI create()
+ createWindow(Stock stock)
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- String name
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+ addObserver(IObserver)
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StockWindow
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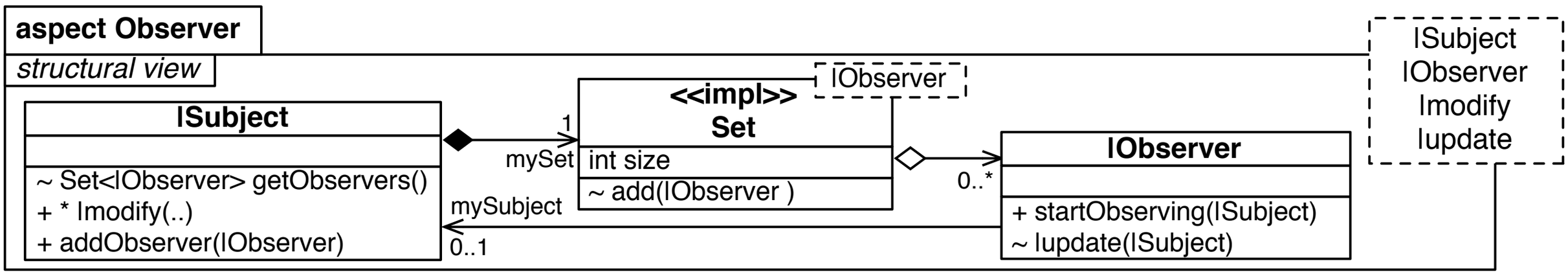
+ startObserving(ISubject)
~ Iupdate(ISubject)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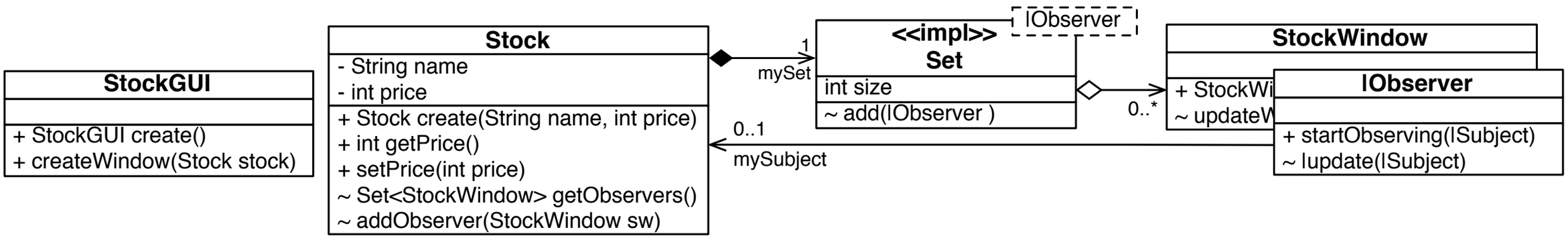
Iupdate

RAM: Weaving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mySubject
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StockWindow
+ StockWi
~ updateW
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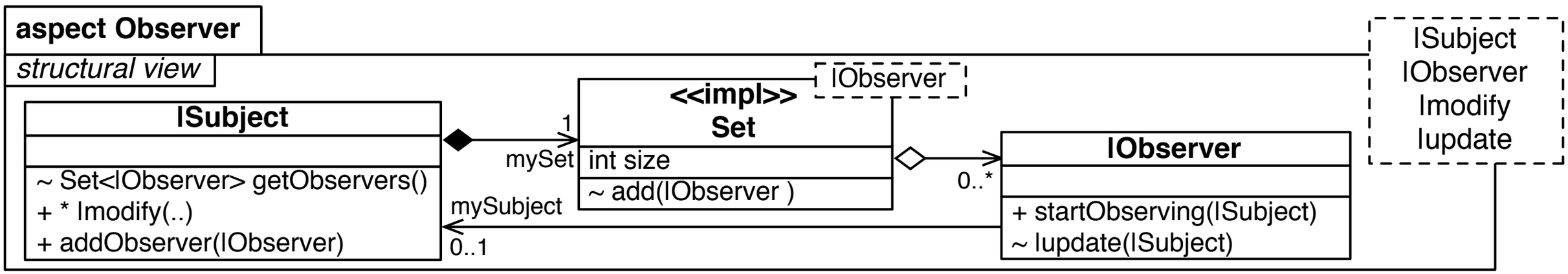
+ startObserving(ISubject)
~ lupdate(ISubject)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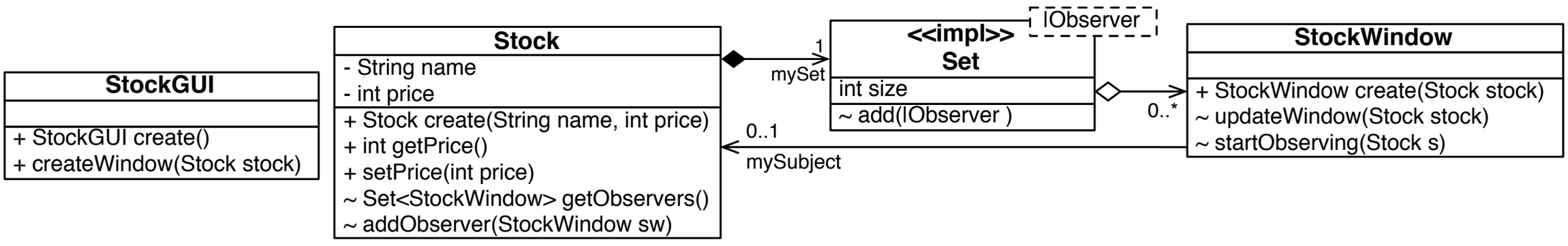
RAM: Weaving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+ setPrice(int price)
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~ addObserver(StockWindow sw)
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StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
~ startObserving(Stock s)
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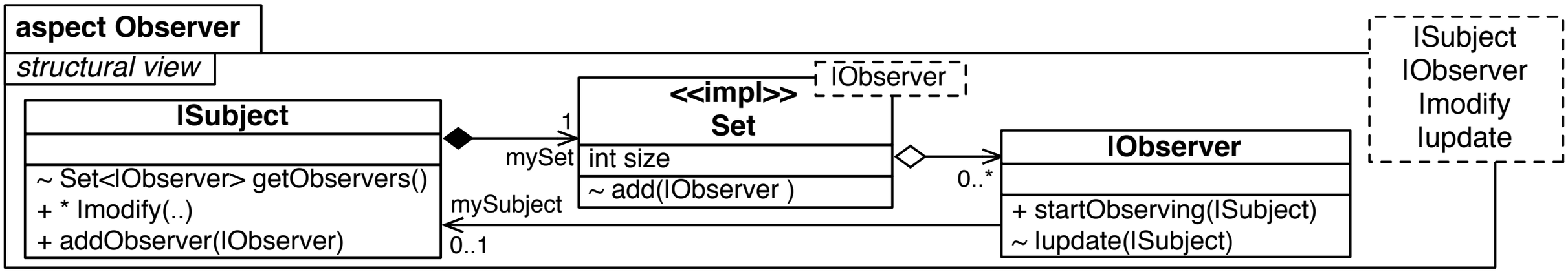
mySubject


aspect Observer
structural view
ISubject
IObserver
Imodify
Iupdate
ISubject
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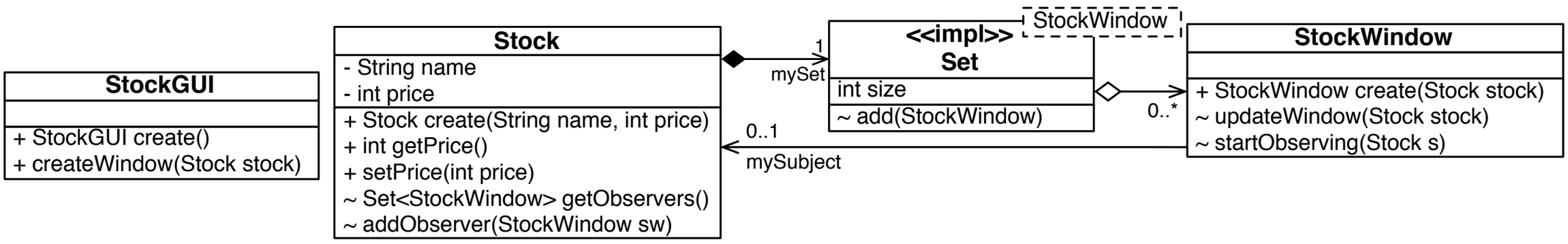
~ Iupdate(ISubject)
mySubject
0..1

RAM: Weaving


StockGUI
+ StockGUI create()
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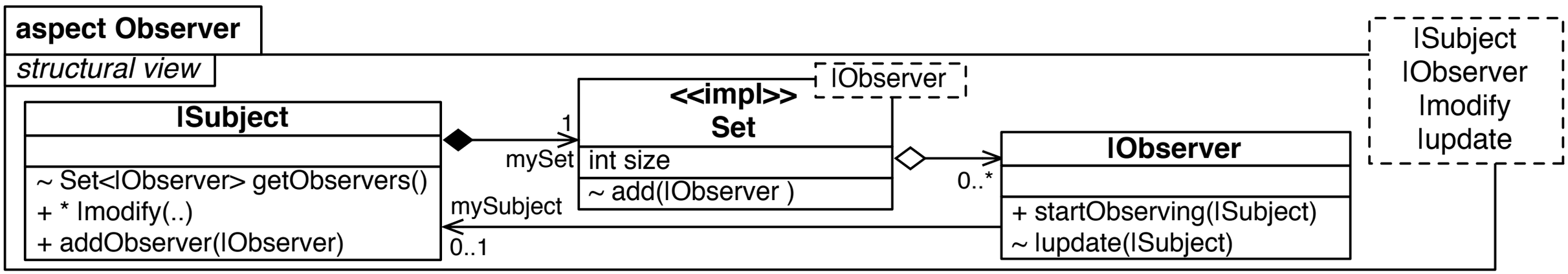
mySubject
StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
~ startObserving(Stock s)


aspect Observer
structural view
ISubject
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+ addObserver(IObserver)
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IObserver
int size
~ add(IObserver)
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mySubject
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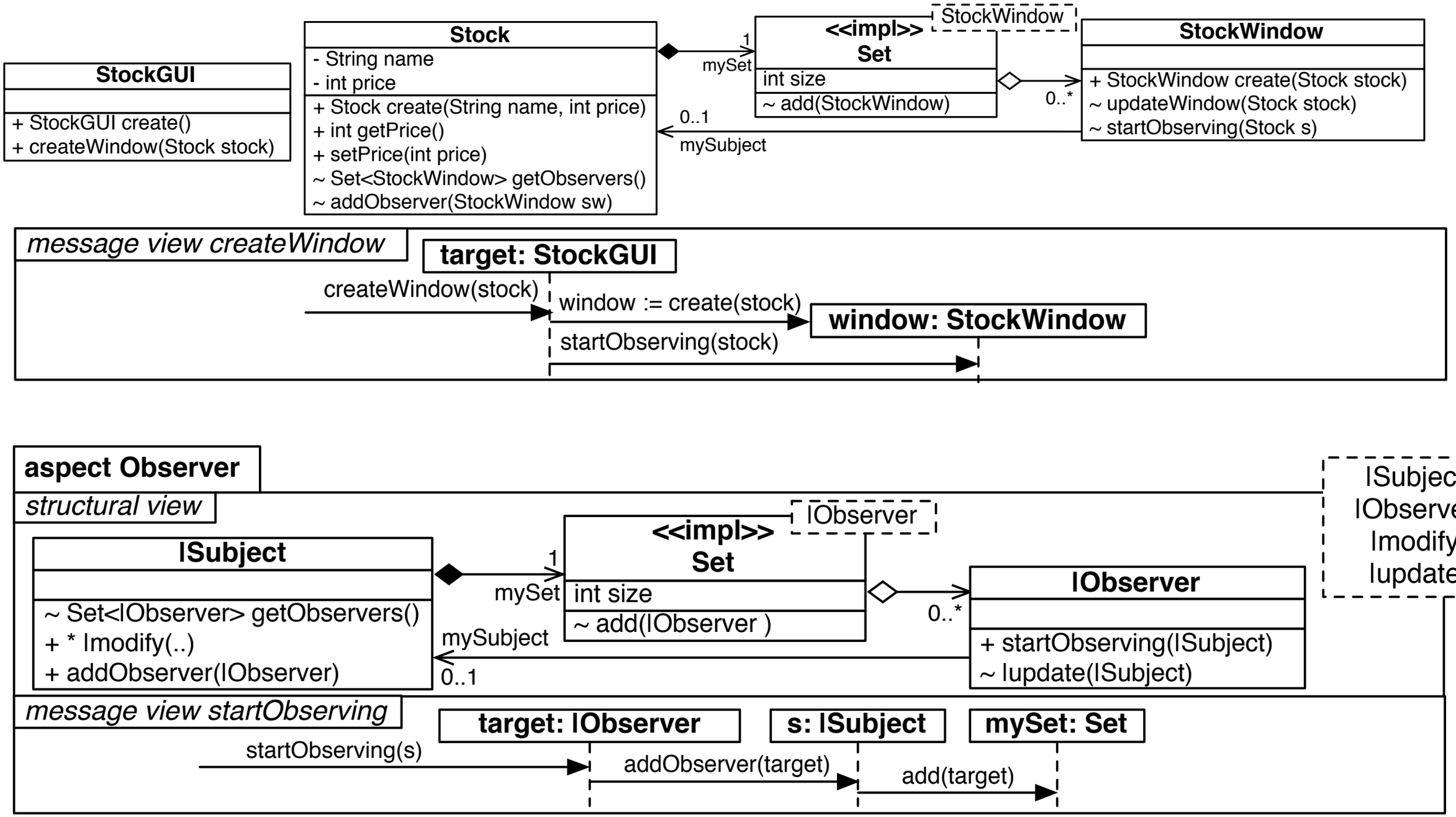
IObserver
+ startObserving(ISubject)
~ Iupdate(ISubject)
ISubject
IObserver
Imodify
Iupdate

RAM: Weaving


StockGUI
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Stock
- String name
- int price
+ Stock create(String name, int price)
+ int getPrice()
+ setPrice(int price)
~ Set<StockWindow> getObservers()
~ addObserver(StockWindow sw)
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mySet
<<impl>>
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StockWindow
int size
~ add(StockWindow)
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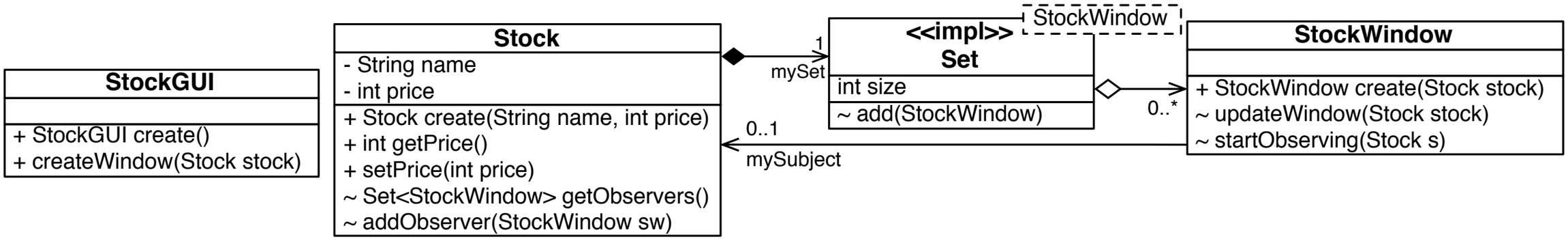
StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
~ startObserving(Stock s)
0..1
mySubject
message view createWindow
target: StockGUI
createWindow(stock)
window := create(stock)
window: StockWindow
startObserving(stock)
aspect Observer
structural view
ISubject
~ Set<IObserver> getObservers()
+ * Imodify(..)
+ addObserver(IObserver)
1
mySet
<<impl>>
Set
IObserver
int size
~ add(IObserver)
0..*
IObserver
+ startObserving(ISubject)
~ Iupdate(ISubject)
mySubject
0..1
ISubject
IObserver
Imodify
Iupdate
message view startObserving
target: IObserver
s: ISubject
mySet: Set
startObserving(s)
addObserver(target)
add(target)

RAM: Weaving


StockGUI
+ StockGUI create()
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Stock
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StockWindow
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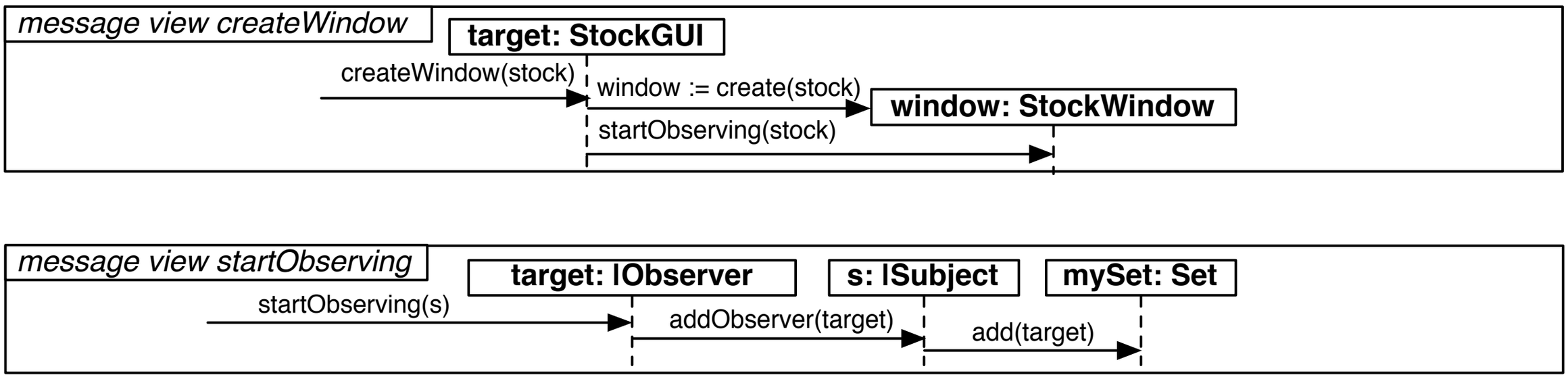
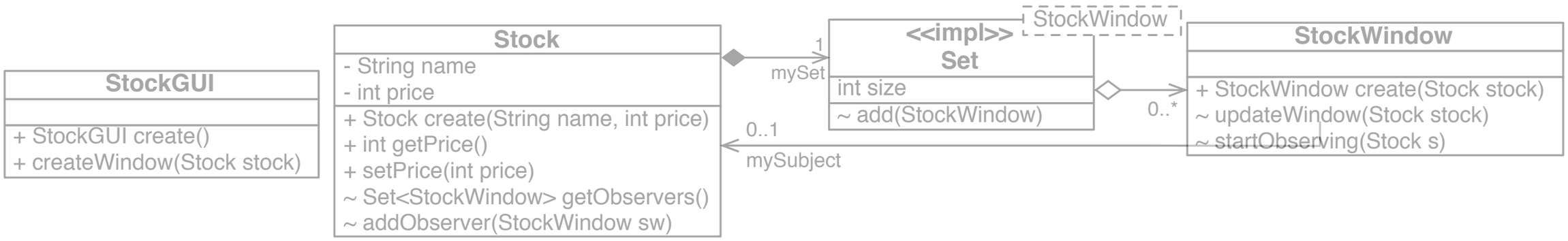
0..1
mySubject
StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
~ startObserving(Stock s)


message view createWindow
target: StockGUI
createWindow(stock)
window := create(stock)
window: StockWindow
startObserving(stock)
message view startObserving
target: IObserver
s: ISubject
mySet: Set
startObserving(s)
addObserver(target)
add(target)

RAM: Weaving


StockGUI
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mySet
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StockWindow
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StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
~ startObserving(Stock s)
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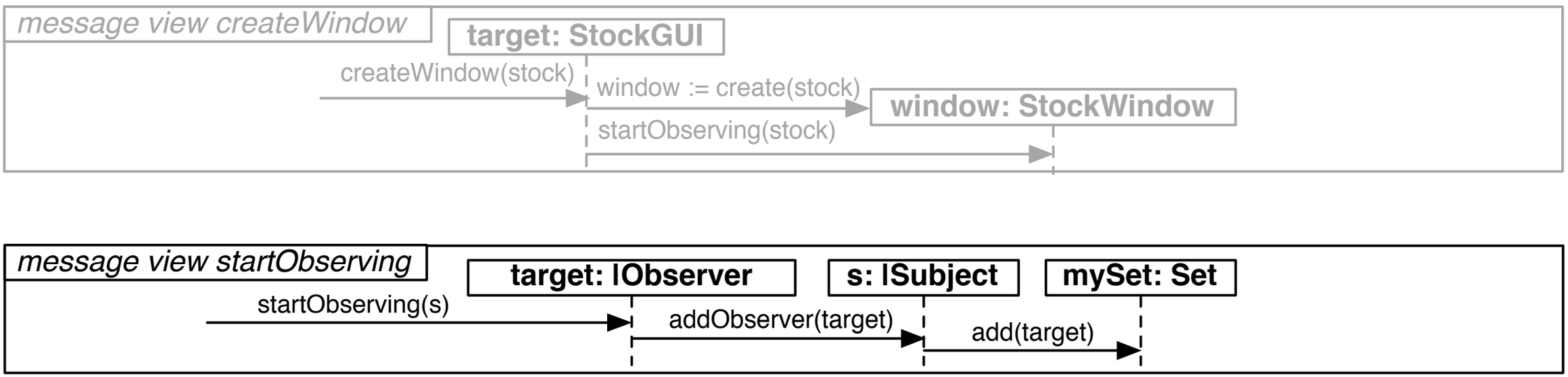
mySubject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window := create(stock)
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startObserving(stock)
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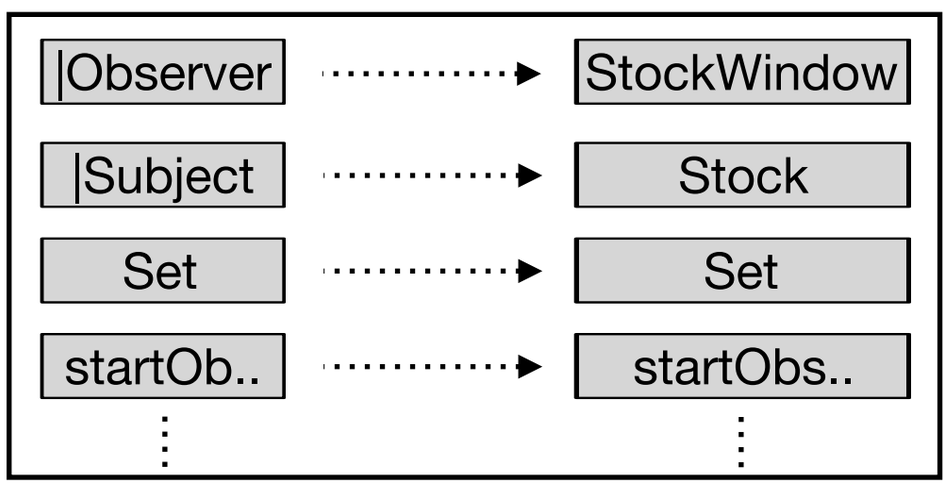
target: IObserver
s: ISubject
mySet: Set
startObserving(s)
addObserver(target)
add(target)


IObserver
StockWindow
ISubject
Stock
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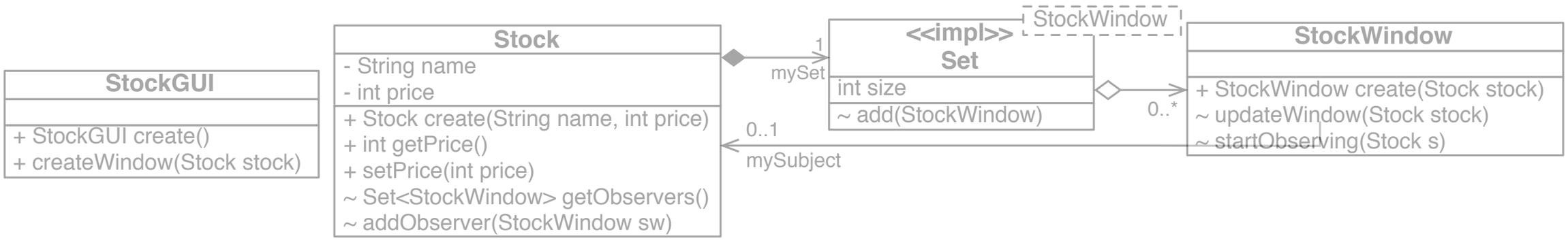
startObs..

RAM: Weaving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<<impl>>
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StockWindow
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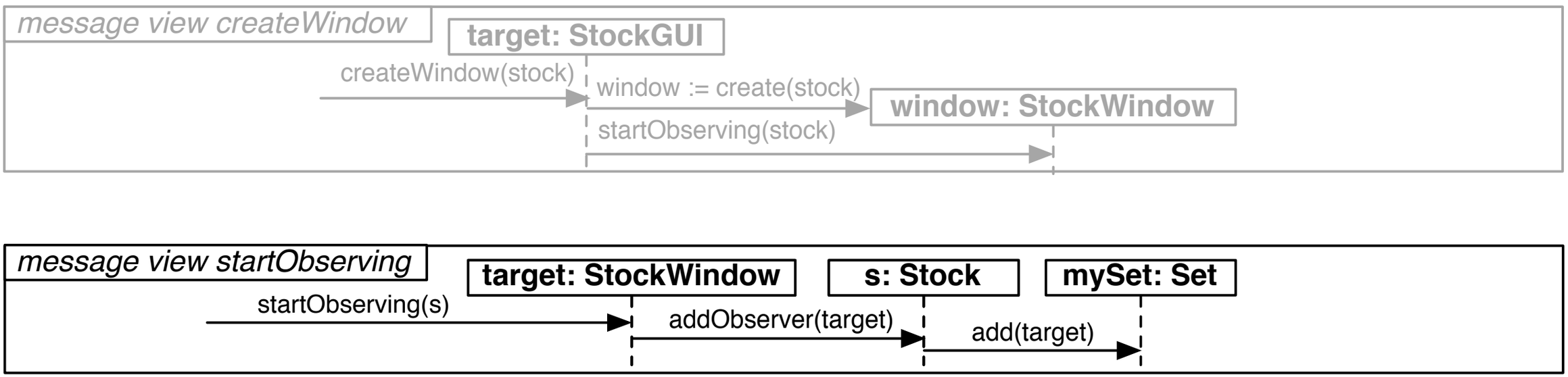
0..*
StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
~ startObserving(Stock s)
0..1
mySubject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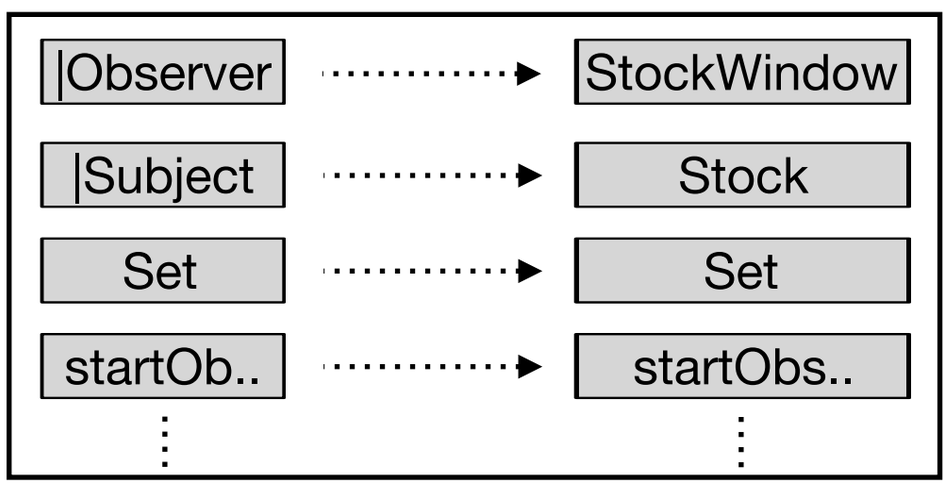
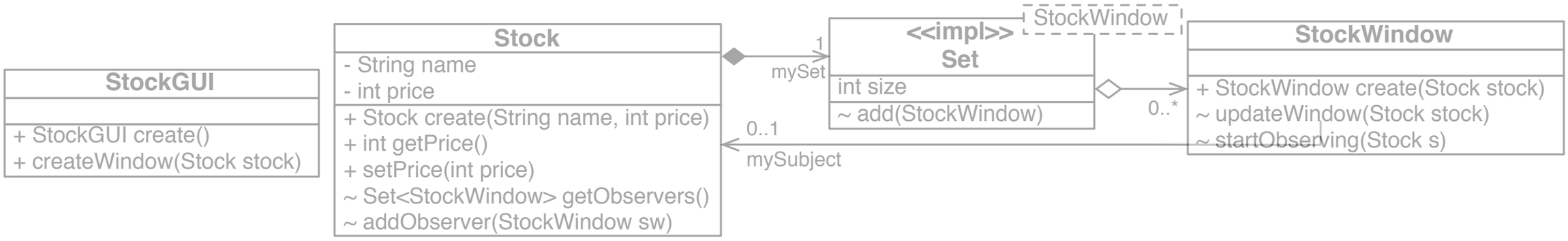
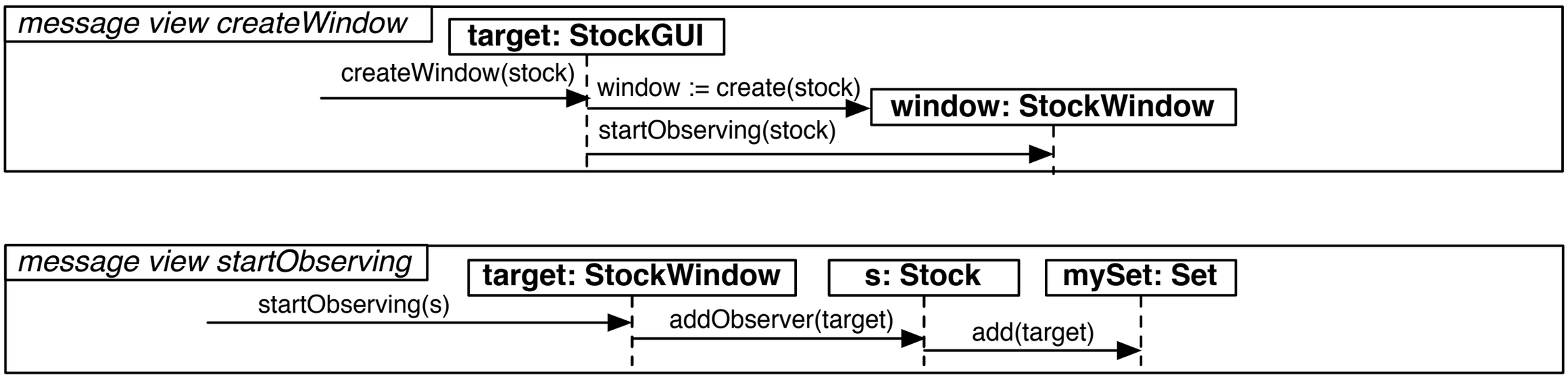
startObserving(stock)
message view startObserving
target: StockWindow
s: Stock
mySet: Set
startObserving(s)
addObserver(target)
add(target)

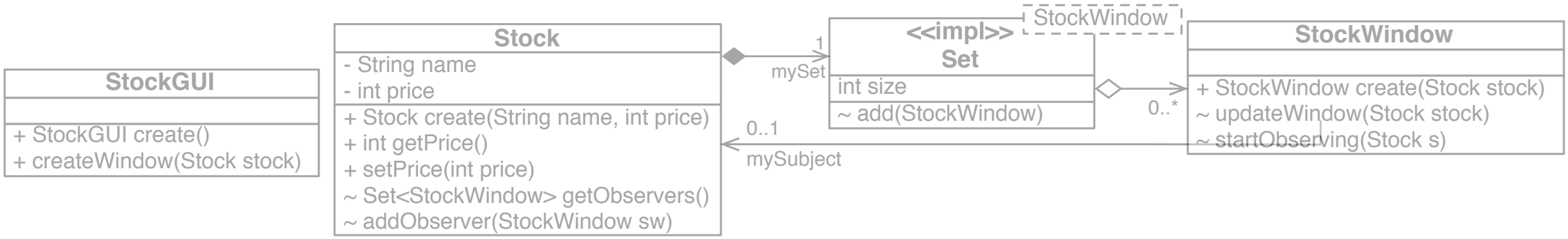

Observer
StockWindow
Subject
Stock
Set
Set
startOb..
startObs..

RAM: Weaving


StockGUI
+ StockGUI create()
+ createWindow(Stock stock)
Stock
- String name
- int price
+ Stock create(String name, int price)
+ int getPrice()
+ setPrice(int price)
~ Set<StockWindow> getObservers()
~ addObserver(StockWindow sw)
1
mySet
<<impl>>
Set
StockWindow
int size
~ add(StockWindow)
0..*
StockWindow
+ StockWindow create(Stock stock)
~ updateWindow(Stock stock)
~ startObserving(Stock s)
0..1
mySubject


message view createWindow
target: StockGUI
createWindow(stock)
window := create(stock)
window: StockWindow
startObserving(stock)
message view startObserving
target: StockWindow
s: Stock
mySet: Set
startObserving(s)
addObserver(target)
add(target)

RAM: Weaving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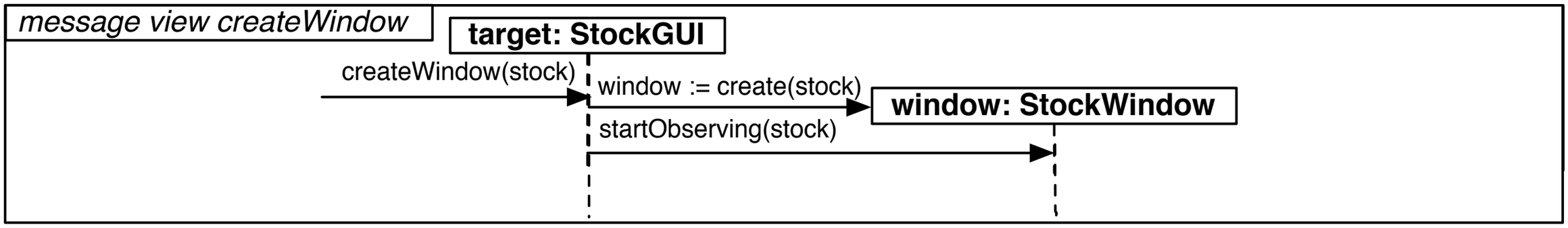
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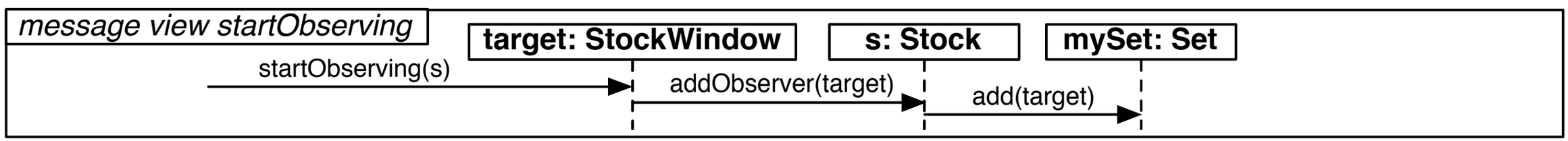
window := create(stock)
window: StockWindow
startObserving(stock)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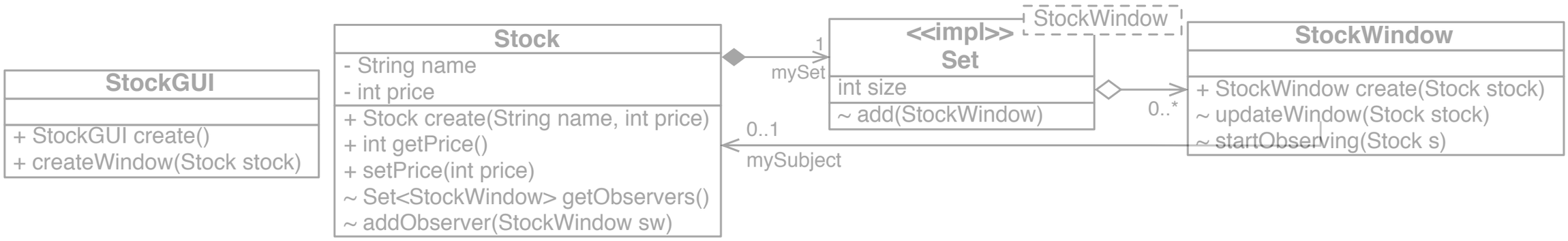
RAM: Weaving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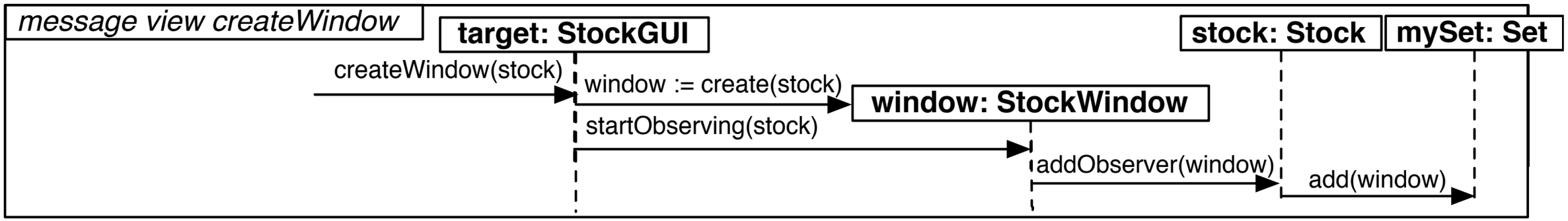
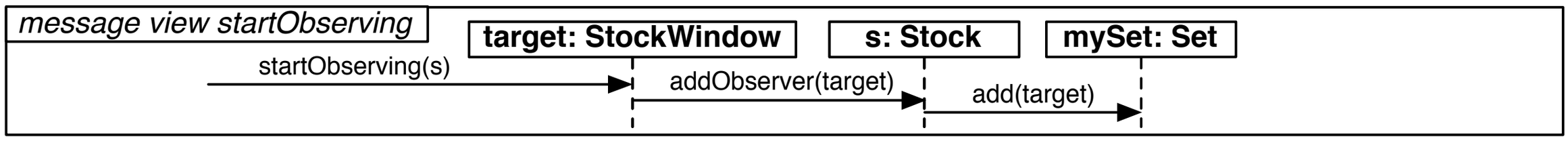
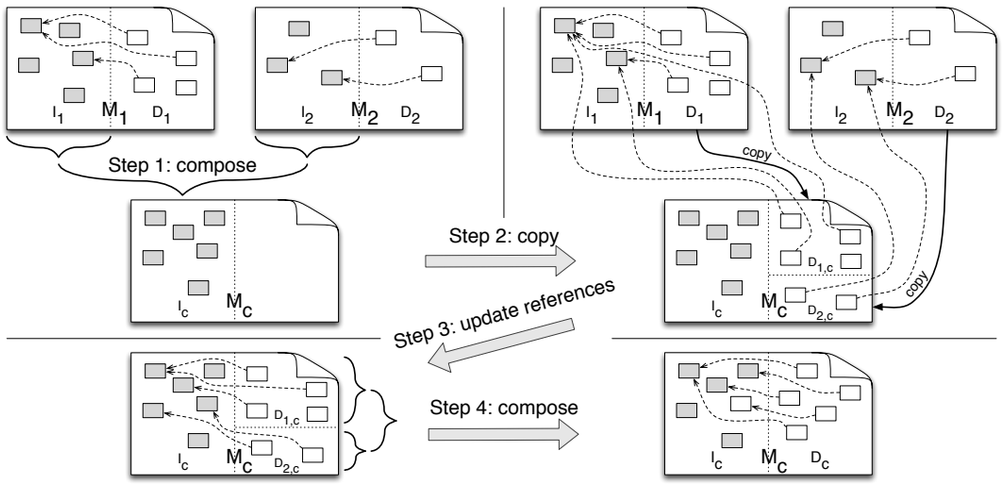

message view createWindow
target: StockGUI
stock: Stock
mySet: Set
createWindow(stock)
window := create(stock)
window: StockWindow
startObserving(stock)
addObserver(window)
add(window)

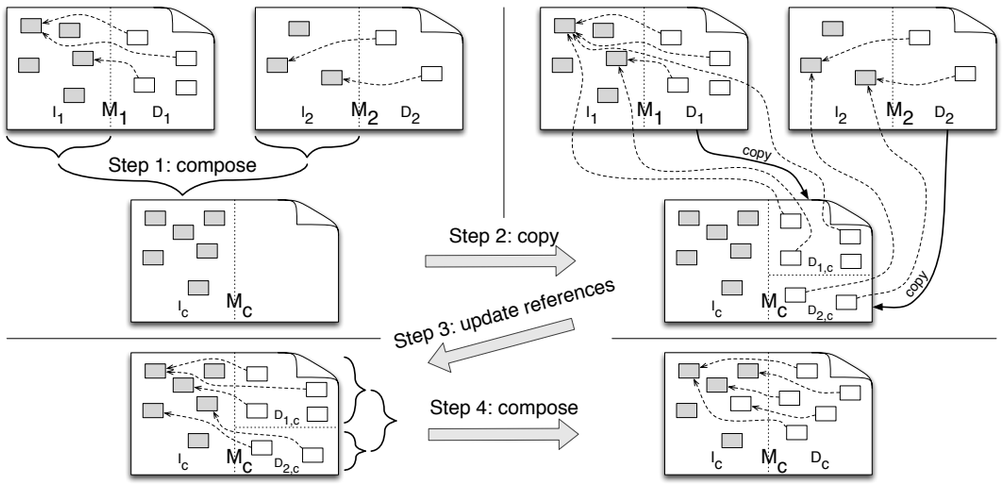

message view startObserving
target: StockWindow
s: Stock
mySet: Set
startObserving(s)
addObserver(target)
add(target)

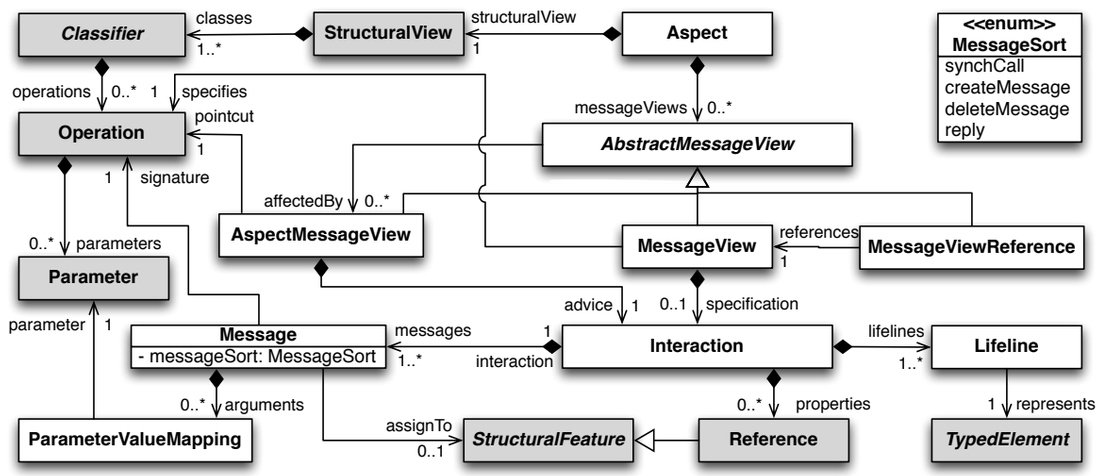
Challenges

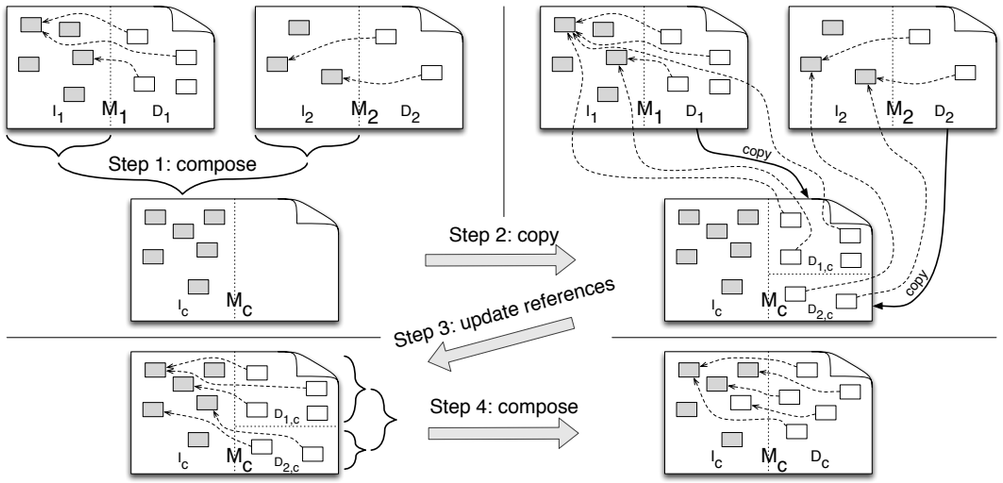
- Complexity of integration depending on shared concepts
  - MM_I might have to be modified
- High dependencies
- Testing very important

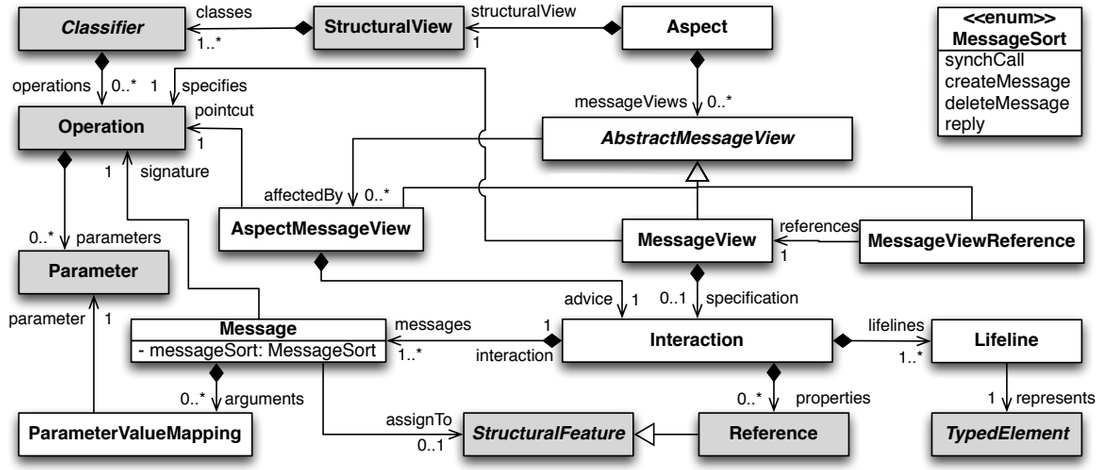
Demo


I1
M1
D1
I2
M2
D2
Step 1: compose
Ic
Mc
Step 2: copy
copy
copy
D1,c
D2,c
Step 3: update references
Step 4: compose
Dc


Step 1: compose
Step 2: copy
Step 3: update references
Step 4: compose
copy
copy


Classifier
classes
1..*
StructuralView
structuralView
1
Aspect
<<enum>>
MessageSort
synchCall
createMessage
deleteMessage
reply
operations
0..*
1
specifies
Operation
pointcut
1
messageViews
0..*
AbstractMessageView
1
signature
affectedBy
0..*
AspectMessageView
0..*
parameters
Parameter
MessageView
references
1
MessageViewReference
advice
1
0..1
specification
parameter
1
Message
- messageSort: MessageSort
messages
1..*
1
interaction
Interaction
lifelines
1..*
Lifeline
0..*
arguments
assignTo
0..1
0..*
properties
1
represents
ParameterValueMapping
StructuralFeature
Reference
TypedElement


Step 1: compose
Step 2: copy
Step 3: update references
Step 4: compose
copy
copy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0..*
1
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1
1
signature
messageViews
0..*
AbstractMessageView
affectedBy
0..*
AspectMessageView
0..*
parameters
Parameter
MessageView
references
1
MessageViewReference
advice
1
0..1
specification
parameter
1
Message
- messageSort: MessageSort
messages
1..*
1
interaction
Interaction
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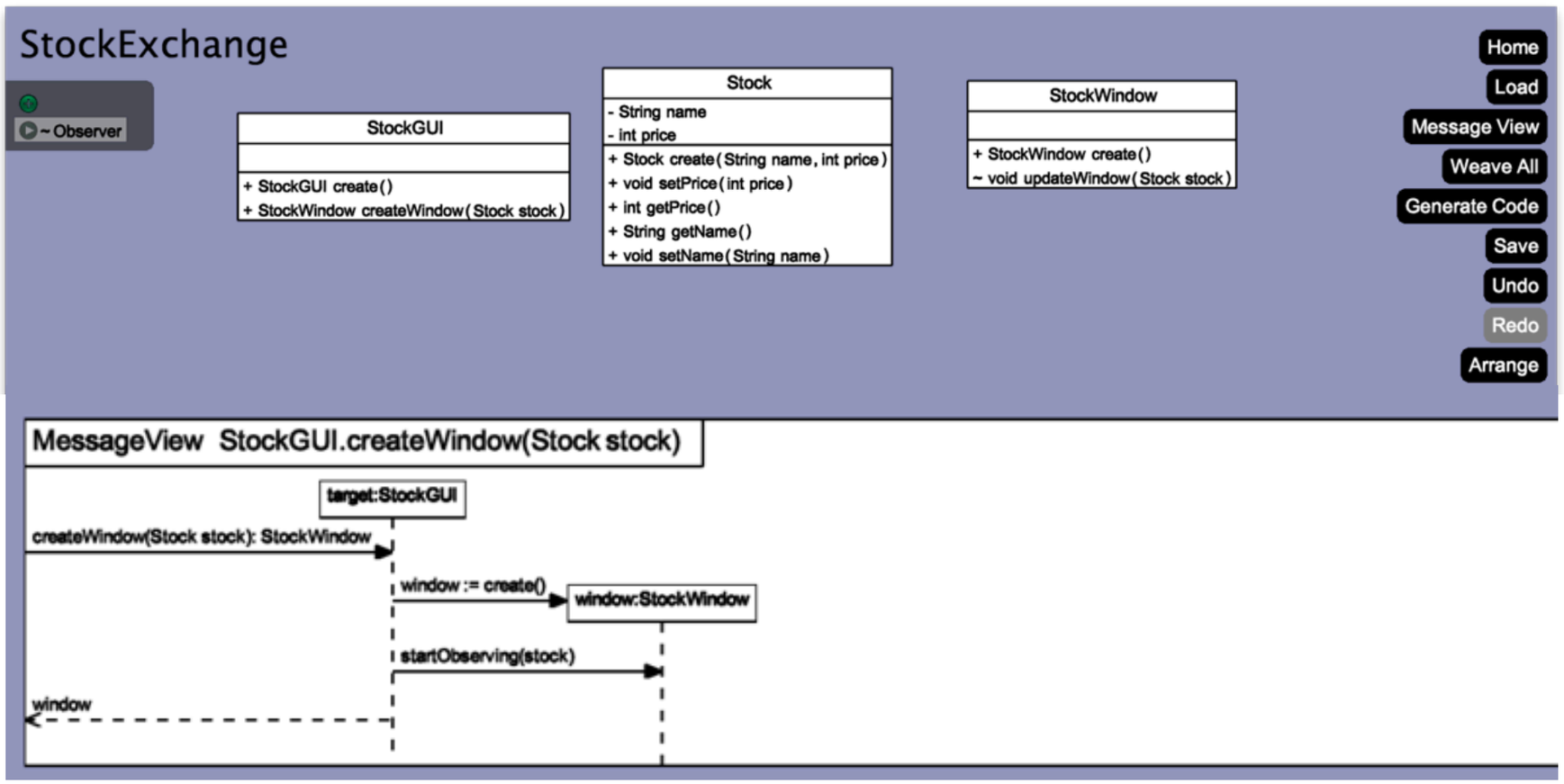
StockExchange
~ Observer
StockGUI
+ StockGUI create()
+ StockWindow createWindow(Stock stock)
Stock
- String name
- int price
+ Stock create(String name, int price)
+ void setPrice(int price)
+ int getPrice()
+ String getName()
+ void setName(String name)
StockWindow
+ StockWindow create()
~ void updateWindow(Stock stock)
Home
Load
Message View
Weave All
Generate Code
Save
Undo
Redo
Arrange
MessageView StockGUI.createWindow(Stock stock)
target:StockGUI
createWindow(Stock stock): StockWindow
window := create()
window:StockWindow
startObserving(stock)
window