pointcut operations(OperationClass o):
  target(o) && call(* turnOff()) && cflow(call(* Building.shutDown(..)));
Aspects Around Us

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Have you ever needed to change the behavior of a program, but without actually modifying it?
UC Place an Order

Basic Flow: Place an Order

1. Customer selects to place an order.
2. UC Search Products is being activated.
3. Customer confirms the product selection and adjusts its quantity.
4. If the product is available, System includes it in the order.
5. Customer continues in ordering further products.
6. Customer chooses the payment method, enters the payment data, and confirms the order.
7. Customer can cancel ordering at any time.
8. The use case ends.
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   and confirms the order.
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```java
public class Ordering {
    ...
    public void order() {
        ...
        new ProductSearch().search(product);
        ...
    }
    ...
}
```
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Extension points:

- Checking Product Availability: Step 4
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Extension points:
- Checking Product Availability: Step 4

UC Modify the Restock Plan

Alternate Flow: Modify the Restock Plan

After the Checking Product Availability extension point of the Place an Order use case:

1. System checks the available quantity of the product being ordered.
2. If the quantity is below the limit, System adds the quantity under demand to the restock plan.
3. The flow continues with the step that follows the triggering extension point.
How could we preserve the extend relationship in code?
public class Ordering {
    ...
    public void order() {
        ...
        new ProductSearch().search(product);
        ...
        if (productAvailable(product)) {
            ...
        } else...
    }
    ...
}
public class Ordering {
    ...
    public void order() {
        ...
        new ProductSearch().search(product);
        ...
        if (productAvailable(product)) {
            ...
        } else...
    }
    ...
}

public aspect RestockPlan {
    ...
    void around(Product product):
        call(* Ordering.productAvailable(..) && args(tovar)) {

            // increase the quantity in the restock plan
            ...
        }
        ...
    }
}
Peer use cases

- Customer
  - Cancel an Order
  - Place an Order
    - Search Products
      - <<include>>
  - <<extend>>
  - Modify the Restock Plan
Place an Order

OrderManager

Product

Cancel an Order

OrderManager

cancelOrder()
Symmetric aspect-oriented modularization (decomposition)

> Aspects as different views of a whole
> The whole is being composed out of the elements being at the same level
Symmetric aspect-oriented modularization (decomposition)

> Aspects as different views of a whole
> The whole is being composed out of the elements being at the same level

Asymmetric aspect-oriented modularization (decomposition)

> Aspects affect a preexisting whole
Peer use cases:
realized by a composition of the entities being at the same level

SYMMETRIC ASPECT-ORIENTED MODULARIZATION

Use cases in the extend relationship:
realized by affecting basic entities by a special entity (aspect)

ASYMMETRIC ASPECT-ORIENTED MODULARIZATION
R3: Each **alarm** bears its ID and indication whether it is connected to a special sensor.

R4: When the security system is being **shut down**, all its sensors are being turned off.

R8: **Alarms** placed in buildings and connected to special sensors are excluded from being turned off during the shut down of the whole security system.
exclude alarms connected to special sensors
<<theme>>
shut down the system

<<theme>>
alarms

Alarm

{id: Integer
-ison: Boolean
-specialSensor: Boolean
+turnOn(): void
+turnOff(): void
+hasSpecialSensor(): Sensor

Theme/uml
<<theme>>
exclude alarms connected to special sensors

<table>
<thead>
<tr>
<th>OperationClass</th>
</tr>
</thead>
<tbody>
<tr>
<td>+operation(): void</td>
</tr>
<tr>
<td>+condition(): Boolean</td>
</tr>
</tbody>
</table>

<<theme>>
Security System

<<bind>>
bind:<Building.shutDown(..), Room.shutDown(), OperationClass.turnOff(), OperationClass.condition()>

<<sd>>
Exclude alarms connected to special sensors

: MainObject
  : Part
  o : OperationClass

loop
  shutDown()
  do_shutDown()

: do_operation()
<<theme>>
exclude alarms connected to special sensors

```
OperationClass
+operation(): void
+condition(): Boolean
```

sd Exclude alarms connected to special sensors

MainObject
\_shutDown()
\_do\_shutDown()

Part

OperationClass
\_operation()
\_do\_operation()

opt (lo\_condition())
pointcut operations(OperationClass o):
   target(o) & call(* turnOff()) & cflow(call(* Building.shutDown(..))))
public abstract aspect ConditionallySkeepOperations {

    interface OperationClass {
        boolean condition();
    }

    abstract pointcut operations(OperationClass o);

    void around(OperationClass o): operations(o) {
        if (!o.condition())
            proceed(o);
    }
}
public abstract aspect ConditionallySweepOperations {

    interface OperationClass {
        boolean condition();
    }

    abstract pointcut operations(OperationClass o);

    void around(OperationClass o): operations(o) {
        if (!o.condition())
            proceed(o);
    }
}

public aspect ExcludeAlarmsConnectedToSpecialSensors extends ConditionallySweepOperations {

    declare parents: Alarm implements OperationClass;

    public boolean Alarm.condition() {
        return hasSpecialSensor();
    }

    pointcut operations(OperationClass o): target(o) && call(^ turnOff(..));
}
Aspect-oriented features are available in popular programming languages

- Traits (Scala)
- Open classes (Ruby)
- Prototypes (JavaScript)
- Decorators (Python)
> Aspect-oriented programming enables to affect existing code without having to actually change it

> Aspect-oriented modularization is natural already at the level of use cases

> UML could embrace aspect-oriented modeling

[tinyurl.com/aspects-sing](tinyurl.com/aspects-sing)