

Software Design, Modelling and Analysis in UML
 Lecture X: Active vs. Passive Objects
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Active and Passive Objects (Harel and Gery, 1997)

What about non-Active Objects?

Recall:

- We're still working under the assumption that all classes in the class diagram (and thus all objects) are **active**.
- That is, each object has its own thread of control and is (if stable) at any time ready to process an event from the ether.

But the world doesn't consist of only active objects. For instance, in the crossing controller from the exercises we could wish to have the whole system live in one thread of control.

So we have to address questions like:

- Can we send events to a non-active object?
- And if so, when are these events processed?
- etc.

Active and Passive Objects: Nomenclature

- [Harel and Gery, 1997] propose the following (orthogonal) notions:
- A class (and thus the instances of this class) is either **active** or **passive** as declared in the class diagram.
 - An **active** object has (in the operating system sense) an own thread: an own program counter, an own stack, etc.
 - A **passive** object doesn't.
 - A class is either **reactive** or **non-reactive**.
 - A **reactive** class has a (non-trivial) state machine.
 - A **non-reactive** one hasn't.
- Which combinations do we understand?
- | | | |
|--------------|--------|---------|
| reactive | active | passive |
| non-reactive | ✓ | ✓ |
| | ✓ | ✓ |

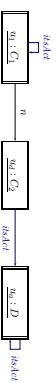
Passive and Reactive

- So why don't we understand passive/reactive?
 - Assume passive objects u_1 and u_2 , and active object u_3 , and that there are events in the ether for all three.
 - Which of them (can) start a run-to-completion step...?
 - Do run-to-completion steps still interleave...?
- Reasonable Approaches:**
- Avoid** — for instance, by
 - requiring that **reactive implies active** for model well-formedness.
 - requiring for model well-formedness that events are **never sent** to instances of non-reactive classes.
 - Explain** — here: (following [Harel and Gery, 1997])
 - Delegate all dispatching of events to the active objects.

Passive Reactive Classes

- Firstly, establish that each object u knows, via (implicit) link $u \text{ knows } u$, the **active object** u_{active} which is responsible for dispatching events to u .
 - If u is an instance of an active class, then $u_{\text{active}} = u$.
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- Firstly, establish that each object u knows, via (implicit) link $link(u)$, the active object u_{local} which is responsible for dispatching events to u .
- If u is an instance of an active class, then $u_{local} = u$.



Sending an event:

- Establish that of each signal we have a version EC with an association $dest : C_{n1}, C \in \mathcal{V}$.
- Then nID in $n1 : C1$ becomes
- Create an instance u_n of EC_n and set u_n 's $dest$ to $u_d := \sigma(u_n)(n)$.
- Send to $u_n := \sigma(u_n)(n)(dest)$, i.e. $z^i = \varepsilon \oplus (u_n, u_n)$.

Dispatching an event:

- Observation: the other only has events for active objects.
- Say u_n is ready in the ether for u_n .
- Then u_n asks $\sigma(u_n)(dest) = u_d$ to process u_n — and waits until completion of corresponding RTC.
- u_d may in particular discard event.

[Harel and Gery, 1997] Harel, D. and Gery, E. (1997). Executable object modeling with statecharts. *IEEE Computer*, 30(7):31–42.