Behaviour Trees

Seminar

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Outline

1. Behaviour Trees
2. Extensions
3. vs HFSM
4. Handling Complexity in the Halo 2 AI

Motivation

- Behaviour Trees are reusable
- =>BTs scale well
- BTs are easily authored

Behaviour Trees

- Directed tree
- Nodes are either *composites* or *leaves*
- Root is *ticked* every time step

Behaviour Trees 2

- *Ticks* traverse down towards leaves
- Results traverse up towards the root
- Possible results: *Success*, *Failure*, *Running*

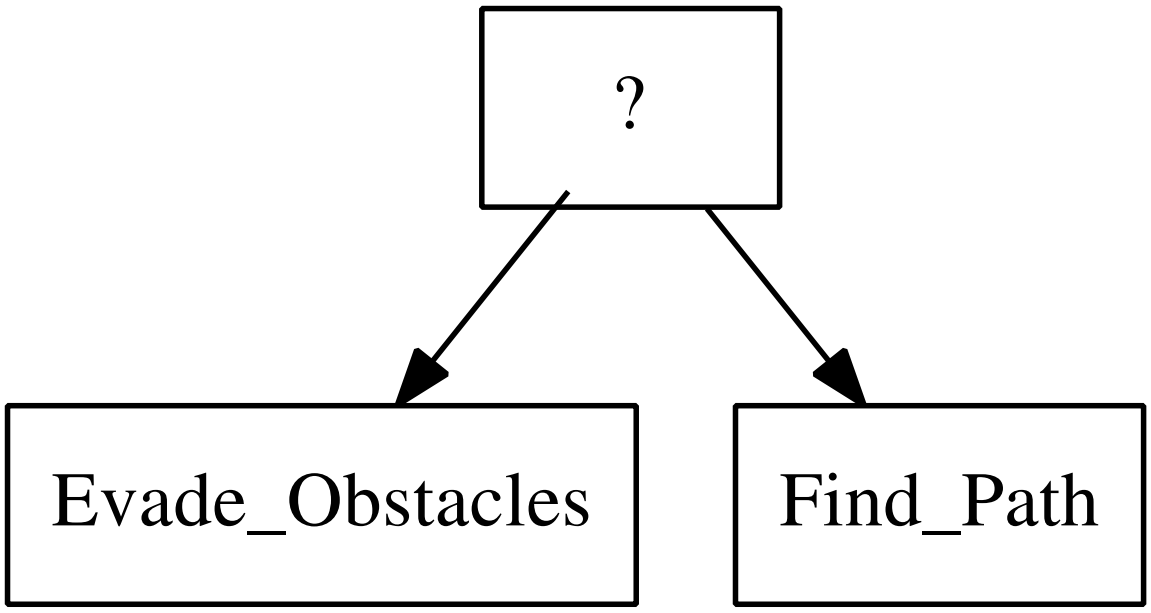
Composites

- Selector
- Sequence
- Parallel
- Decorator

Selector

- Behaves similar to logical OR
- Returns Success (Running) if any child returns Success
- Returns Failure if all children return Failure

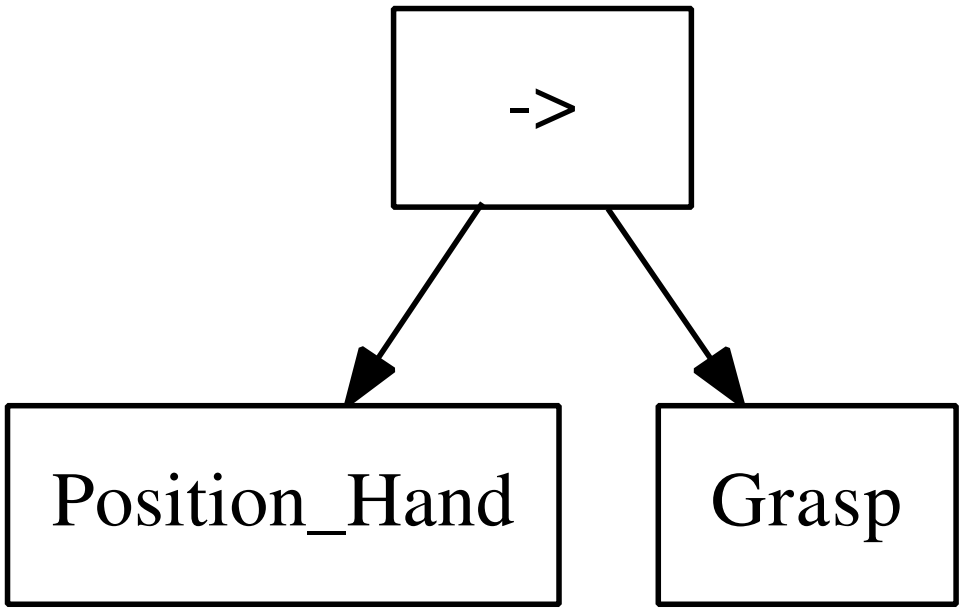
Selector 2



Sequence

- Behaves similar to logical AND
- Returns Success if all children return Success
- Returns Failure (Running) otherwise

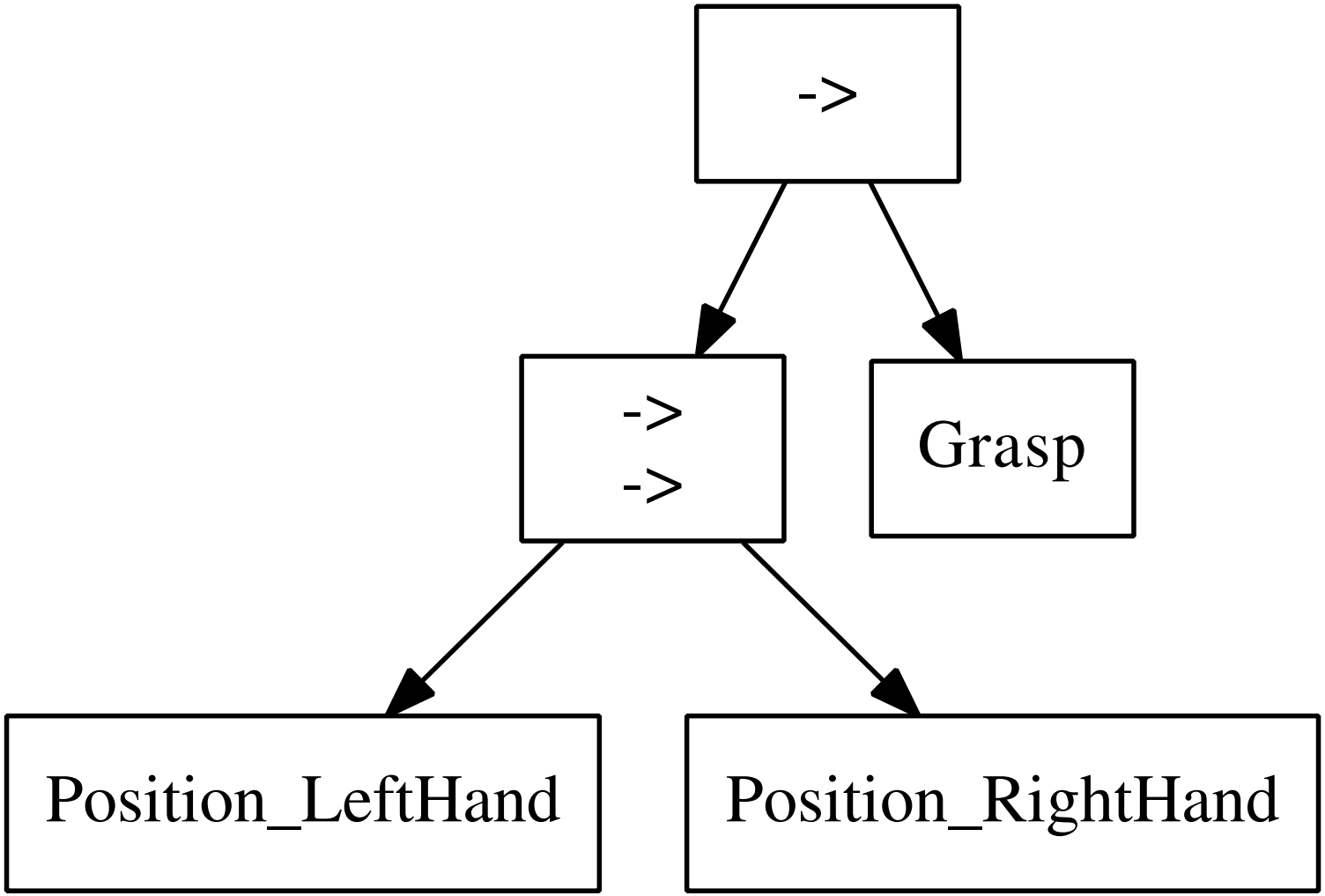
Sequence 2



Parallel

- Allows parallel execution of behaviours
- Returns Success if $>= S$ children succeed
- Returns Failure if $>= F$ children succeed
- Returns Running in any other case

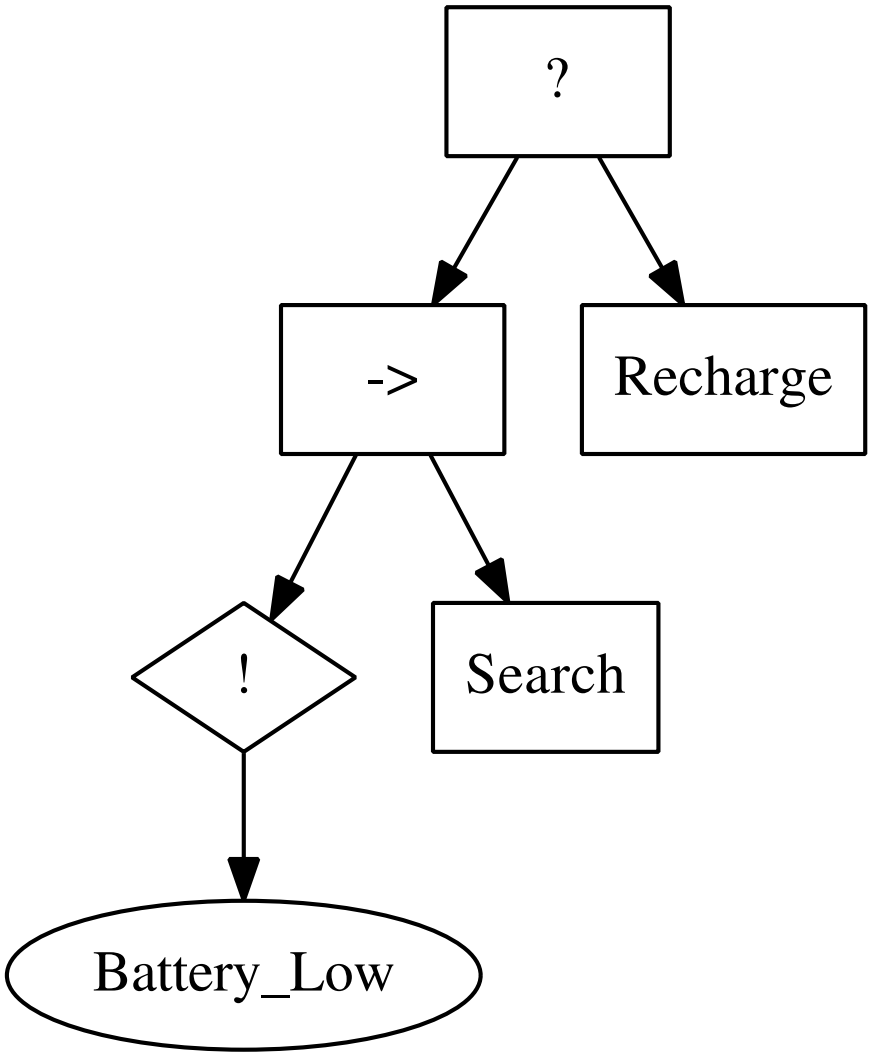
Parallel 2



Decorator

- Can only have **ONE** child
- Manipulate return value of child
- e.g. Inverter, Counter, Timer ...

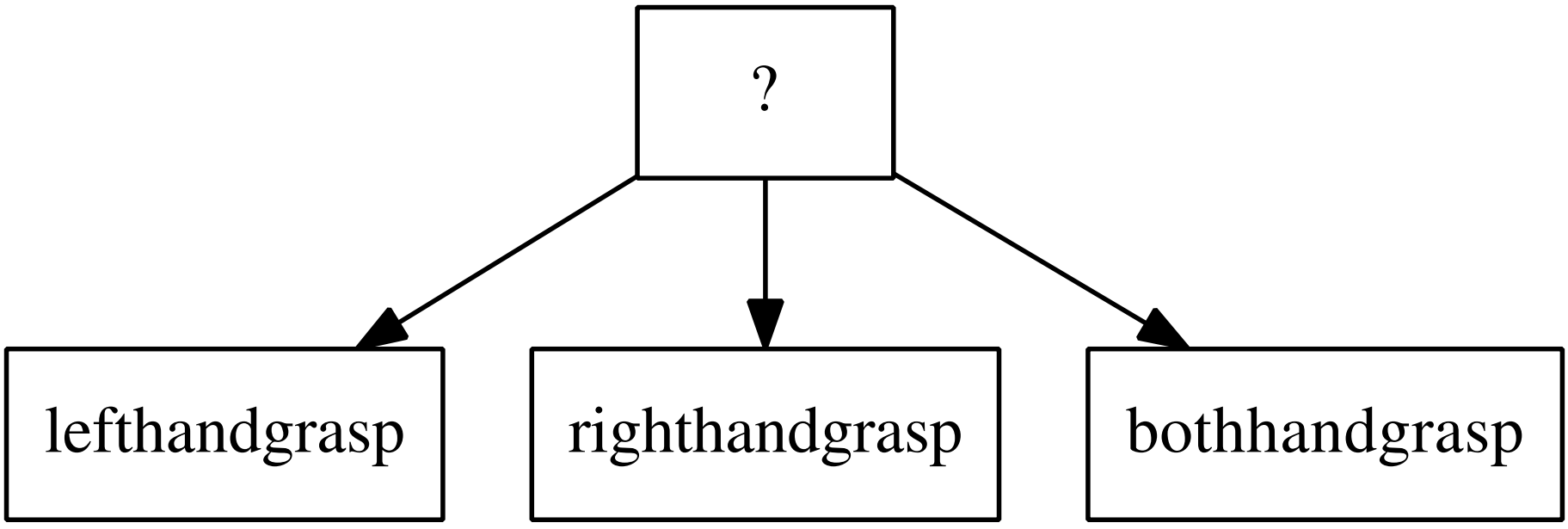
Decorator 2



Leaves

- Actions
- Conditions
- Leave can be another BT

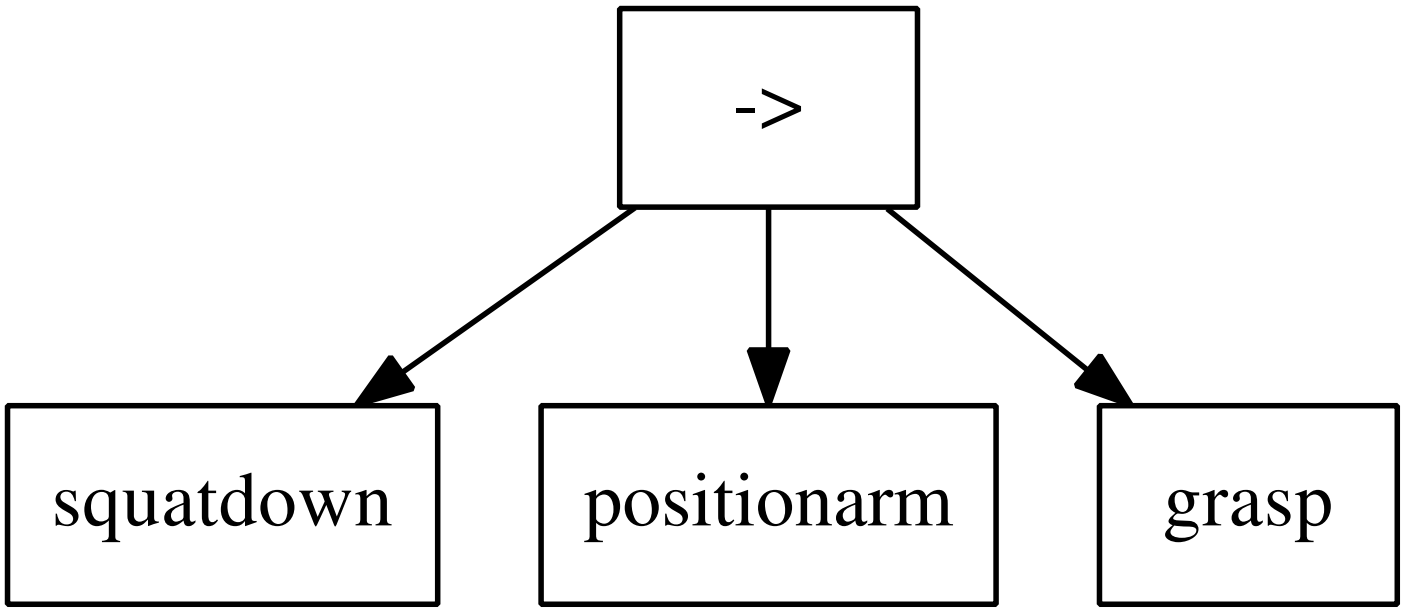
Behaviour Tree in Action



Behaviour Tree in Action 2

First Experiment (0:00 - 1:15)
`http://www.youtube.com/watch?v=kEd2YxysBtI`

Behaviour Tree in Action 3



∼Decorator

- used to synchronize actions with other agents
- one agent broadcasts intended bevahiour
- other agents can respond if interested

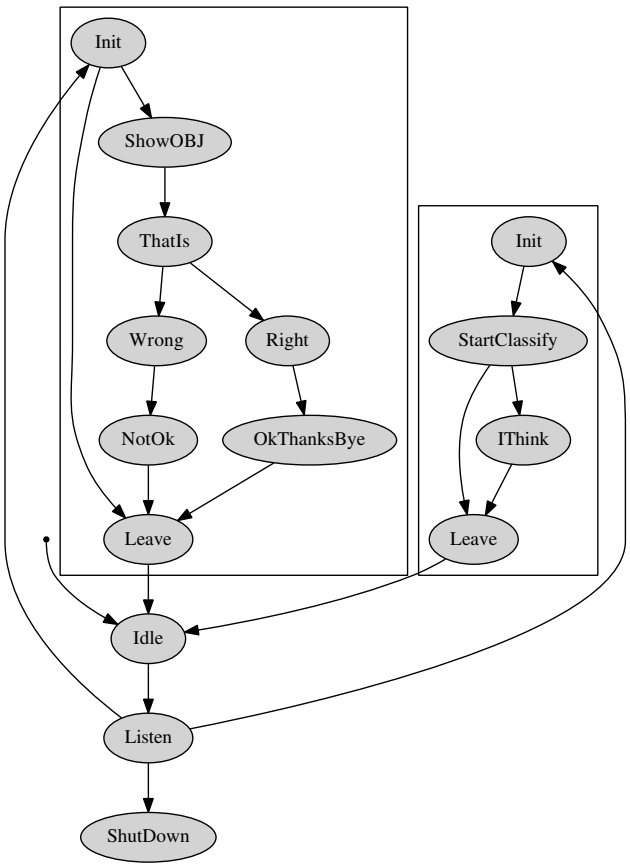
Parametrized Behaviour Trees

- Subtrees can be parametrized
- SmartEvents contain parametrized Behaviour Tree
- Agents involved in SmartEvent will execute the BT once, then restart personal BT

HFSM

- Large FSM can be hard to handle
- HSFM allows to use FSM as nodes...
- ... but still has the same problems

HFSM Example



Implicit vs Explicit State Transitions

- BT state transition similar to procedure call
- (H)FSM state transition similar to GoTo

General Ideas

- Behaviour Trees are shared between characters
- Characters have a memory pool (e.g. Grenade Cooldown)
- Bitvectors represent characters world-knowledge and can lock behaviours

Impulses & Stimuli

- Impulses reference other parts of BT
- Stimuli are inserted into BT when certain events happen
- Because of priority sorting stimuli only interrupt certain behaviours

Orders

- Orders group Firing Positions
- Orders are assigned to Squads
- Trigger (e.g. Squadleader died) may assign new Orders

Styles

- Styles can be assigned to Orders
- Styles can block certain behaviours (e.g. aggressive style prevents fleeing behaviour)

The End

Thank you for your attention.

Any questions?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