COMP250: Artificial Intelligence

2: Designing AI behaviours

Learning outcomes

- **Explain** how finite state machines and behaviour trees are used in AI
- **Design** character behaviours using behaviour trees
- **Implement** an AI system based on behaviour trees

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Research journal check-in

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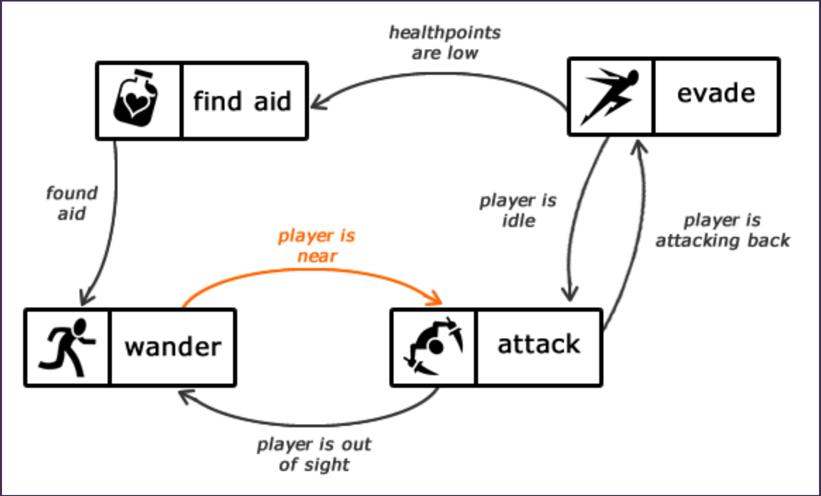
AI architectures

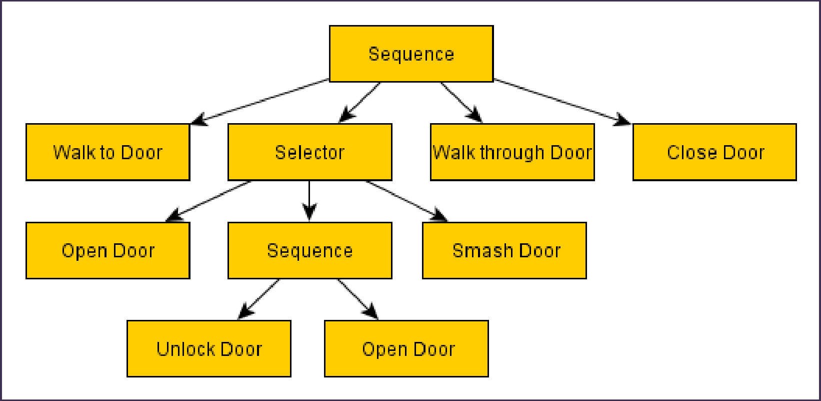
Rule-based AI

Generally implemented as `if` statements or event-based triggers

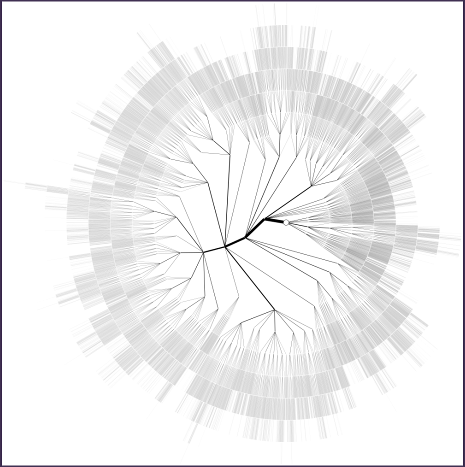
Finite state machines



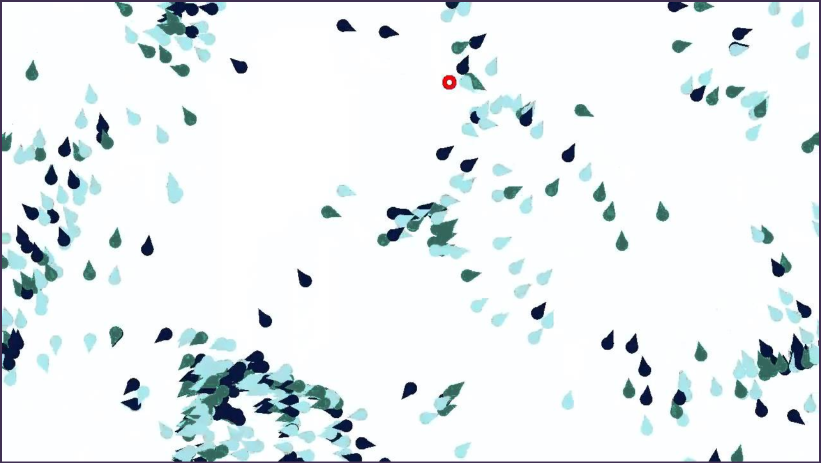
Behaviour trees



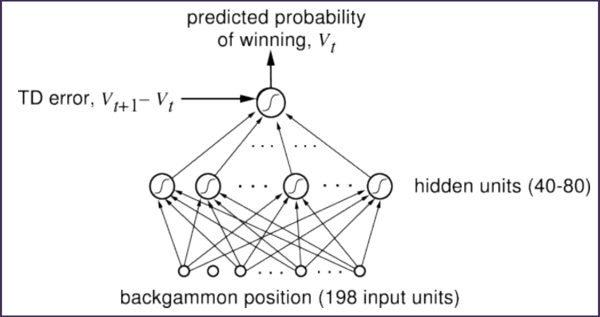
Game tree search



Multi-agent approaches (e.g. flocking)



Machine learning


predicted probability of winning, V_t
TD error, $V_{t+1} - V_t$
hidden units (40-80)
backgammon position (198 input units)

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- Predictability and authorial control versus adaptability and novelty
- Can also combine the two, e.g. use a rule-based system to constrain a CI system

Finite state machines

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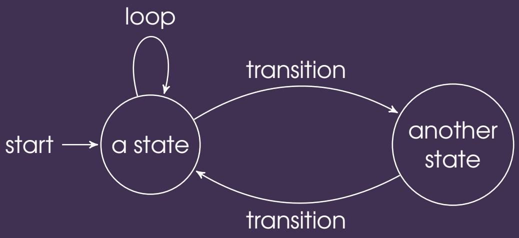
- **Inputs** or **events** can cause the FSM to transition to a different state

State transition diagrams



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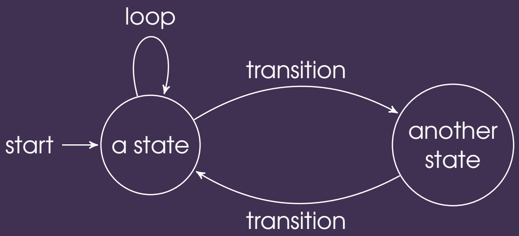

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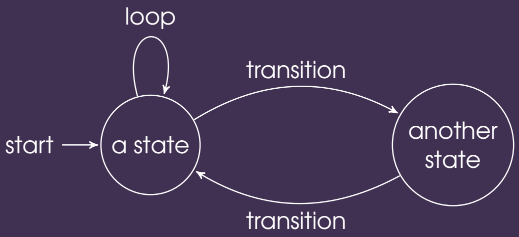

- FSMs are often drawn as **state transition diagrams**
- Reminiscent of **flowcharts** and certain types of **UML diagram**

FSMs for AI behaviour

The next slide shows a simple FSM for the following AI behaviour, for an enemy NPC in a shooter game:

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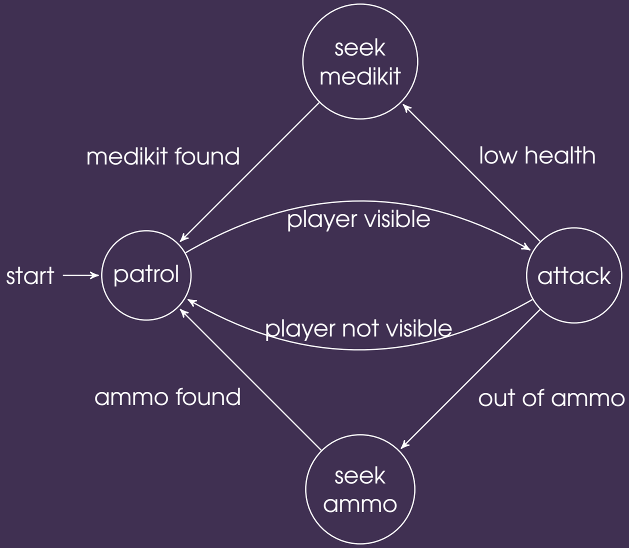
- If you are low on ammo, run away and find ammo. Then resume patrolling


seek medikit
medikit found
low health
player visible
start
patrol
attack
player not visible
ammo found
out of ammo
seek ammo

Other uses of FSMs

As well as AI behaviours, FSMs may also be used for:

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Beyond FSMs

Some topics for you to research, for when plain old FSMs aren't enough...

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- Hierarchical FSMs
- Nested FSMs
- Stack-based FSMs
- Hierarchical task networks
- ...

Plus the topic we will be looking at today: **behaviour trees**

Behaviour Trees

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- Also used in robotics and other non-game AI applications

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- **Unity**: numerous free and paid options on the Asset Store e.g. Behavior Machine, Behavior Designer, Behave, RAIN

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- "Running" status allows nodes to represent operations that **last multiple frames**

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  - Control which of the children are executed on each tick

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- Leaf nodes often have **parameters** to allow for reuse in different situations

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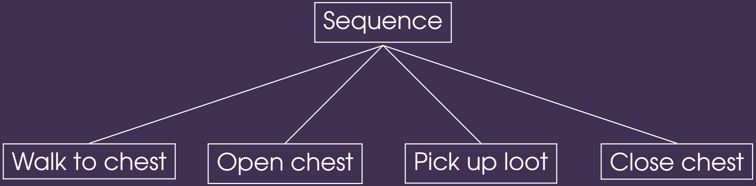

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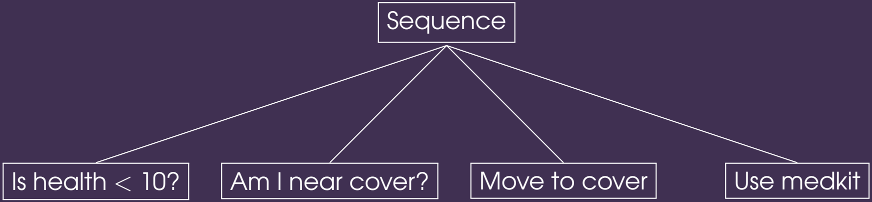

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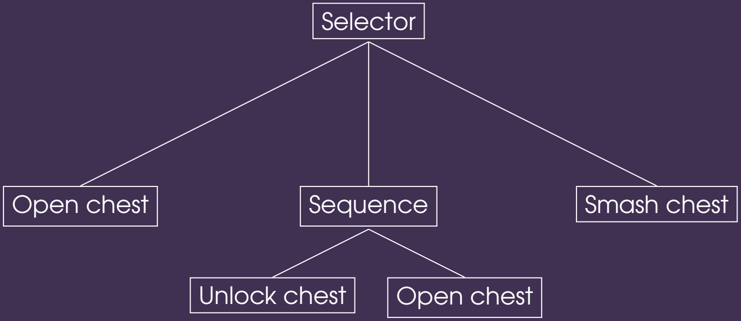

Selectors and priority

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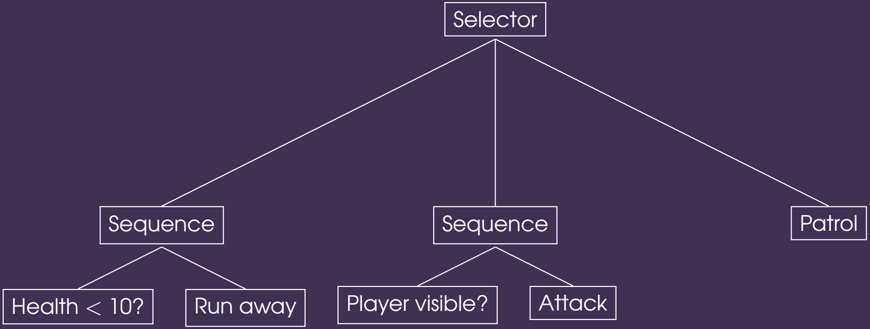

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- Selector: try a list of alternatives; stop once you find one that works
- Sequence works like `and`, selector works like `or`

Other composite nodes

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- Execute children in **random** order

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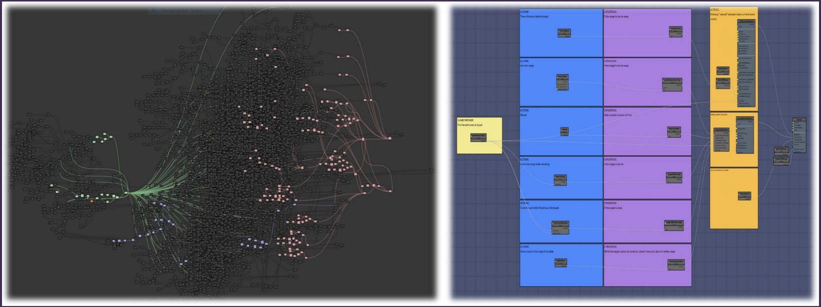
- (Shared blackboards mean that your AI has "telepathy" — this may or may not be desirable!)

BTs in The Division



http://www.gdcvault.com/play/1023382/AI-Behavior-Editing-and-Debugging

Workshop

Follow the tutorial at `https://docs.unrealengine.com/latest/INT/Engine/AI/BehaviorTrees/QuickStart/`