



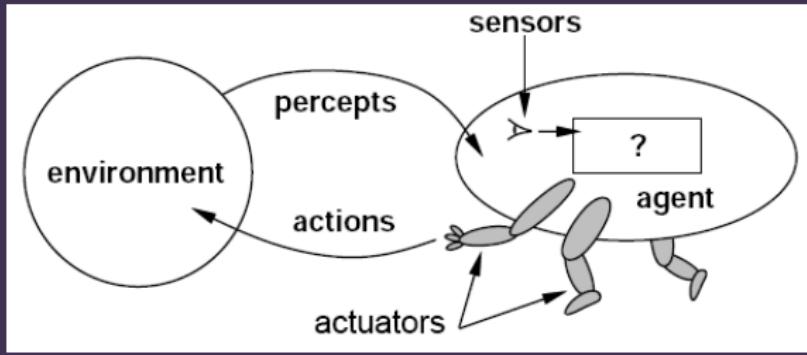
COMP702: Classical Artificial Intelligence
2: Authored Behaviour



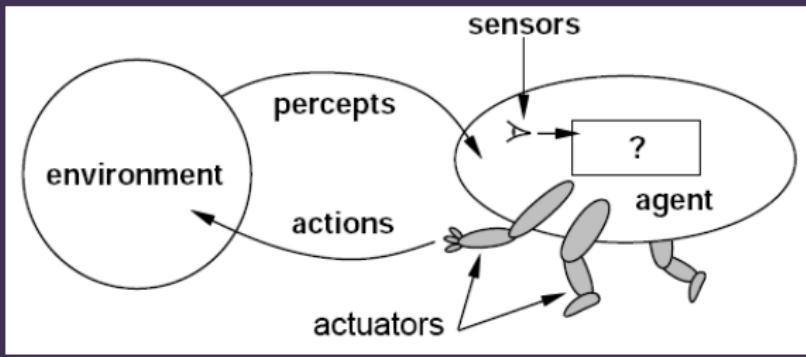
Agents



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An **agent** is anything which perceives an **environment** through **sensors**, and acts upon that environment through **actuators**.

Performance

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- ▶ The goal is an **environment state** (or a set of states)
- ▶ A **performance measure** evaluates a given state for how well it fits the goal

PEAS

For each example of an agent, what are the Performance measure, Environment, Actuators and Sensors?

Types of environment

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- ▶ These properties influence the choice of AI architecture we use to build agents

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- ▶ E.g. a chess game is fully observable, a poker game is partially observable

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- ▶ **Cooperative**: all agents share the same performance measure
- ▶ **Competitive**: agents' performance measures are in opposition to each other (i.e. if one agent "wins", another "loses")

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- ▶ E.g. chess is deterministic; any board game involving dice rolls or random card draws is stochastic

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- ▶ **Dynamic**: the environment changes constantly
- ▶ E.g. most board games are static, most (non turn-based) video games are dynamic

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- ▶ **Continuous**: at least one of these is not discrete (“float valued”)
- ▶ Continuous problems are hard so we sometimes **discretise** them

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- ▶ For a game or simulation: probably **yes** (unless someone else made it and we don't have the source code)
- ▶ For the real world: technically **no** (but we have physics, sociology, economics etc to give us good approximations)

Agents and AI

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- ▶ The ideas of agents and environments are a useful frame for designing AI
- ▶ All(?) AI problems can be expressed in terms of creating an agent that optimises some performance measure in some environment
- ▶ Agent design boils down to: given a **percept** (and possibly some **memory** of past percepts/actions), choose the best **action** to take now

Rule-based AI



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- ▶ Generally hand-coded and only modifiable by a programmer

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 - ▶ Scatter: head for a specific corner of the level
 - ▶ Frightened: move randomly

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- ▶ Orange ghost: aim for Pac-Man until 8 spaces away, then aim for corner

Ghost movement

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- ▶ Can only change direction at an intersection
- ▶ Can't reverse or stay still
- ▶ Therefore can't get stuck, despite imperfect pathfinding

Ghost behaviour

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Ghost behaviour

- ▶ Behaviour rules are very simple
- ▶ However, the combination of them leads to interesting gameplay and illusion of personality

Design lessons

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- ▶ Simple AI, when interacting with a player and each other, can give engaging results
- ▶ Bugs in AI don't always matter...

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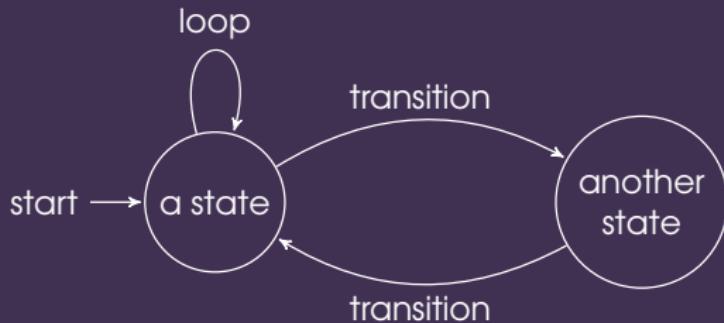
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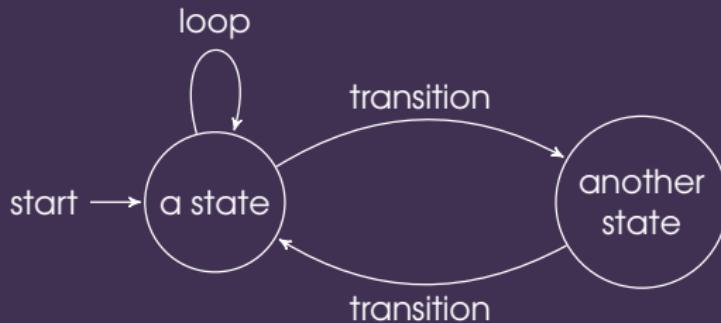
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- ▶ Which state the FSM is in dictates what **actions** the agent takes

State transition diagrams

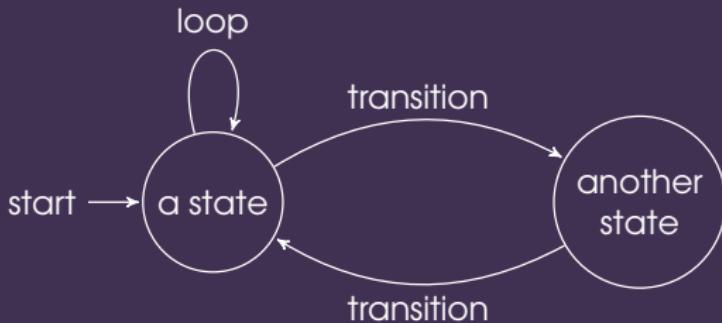


State transition diagrams



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- ▶ Reminiscent of **flowcharts** and certain types of **UML diagram**

Other uses of FSMs

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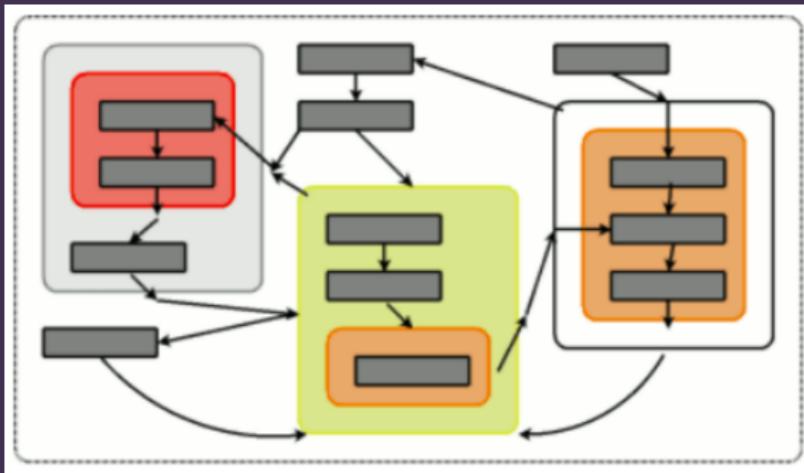
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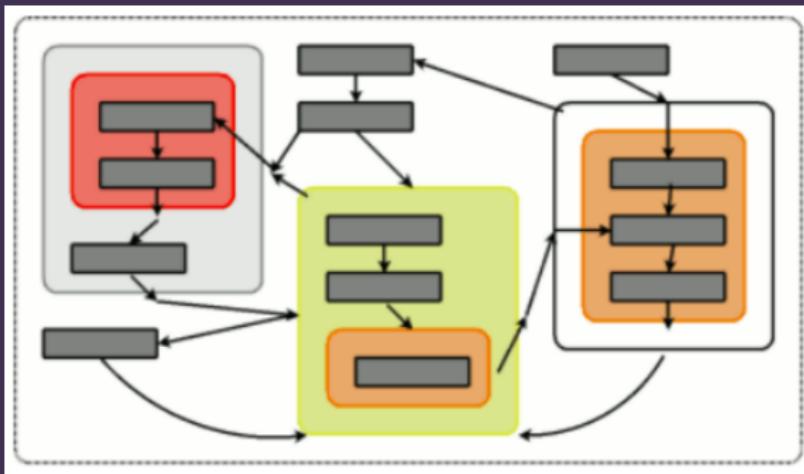
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- ▶ Functional approach: represent state by a function delegate
- ▶ Coroutine approach: encode your FSM logic as a procedure which runs as a coroutine (requires either refactoring logic into structured loops, or using `goto...`)

Hierarchical FSMs

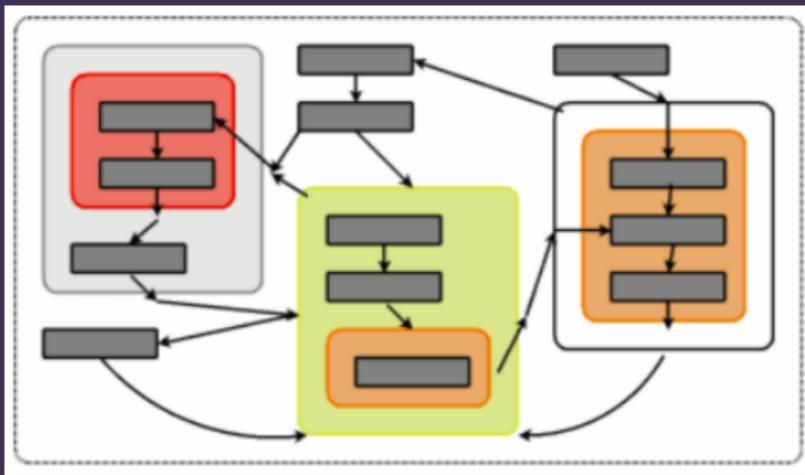


Hierarchical FSMs



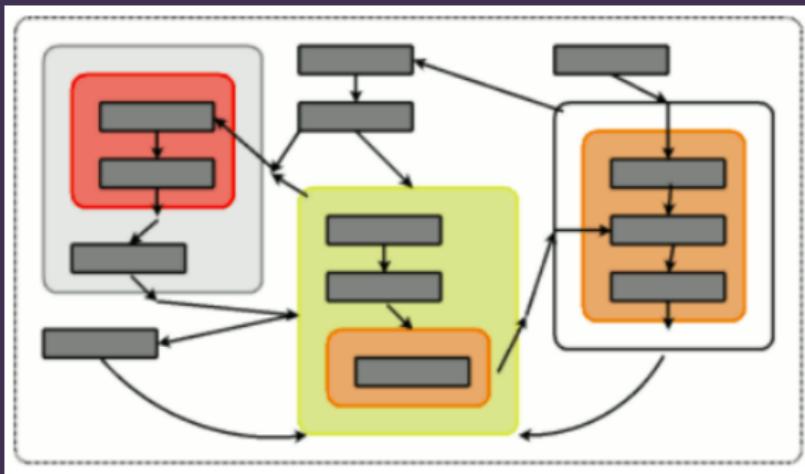
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Hierarchical FSMs



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- ▶ Designing complex behaviour with FSMs quickly gets unwieldy
- ▶ Hierarchical FSMs allow to group states into **super-states** to simplify defining transitions

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- ▶ FSMs are useful for designing simple AI behaviours
- ▶ Historically an important technique for game AI
- ▶ However other techniques such as behaviour trees are more flexible and better suited to designing complex behaviours

Behaviour Trees



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- ▶ Allow for **more complex** behaviours than FSMs
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- ▶ Also used in robotics and other non-game AI applications

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- ▶ **Unreal**: an advanced BT system is built in
- ▶ **Unity**: numerous free and paid options on the Asset Store e.g. Behavior Machine, Behavior Designer, Behave, RAIN

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- ▶ A ticked node returns one of three **statuses**:
 - ▶ Success
 - ▶ Running
 - ▶ Failure
- ▶ “Running” status allows nodes to represent operations that **last multiple frames**

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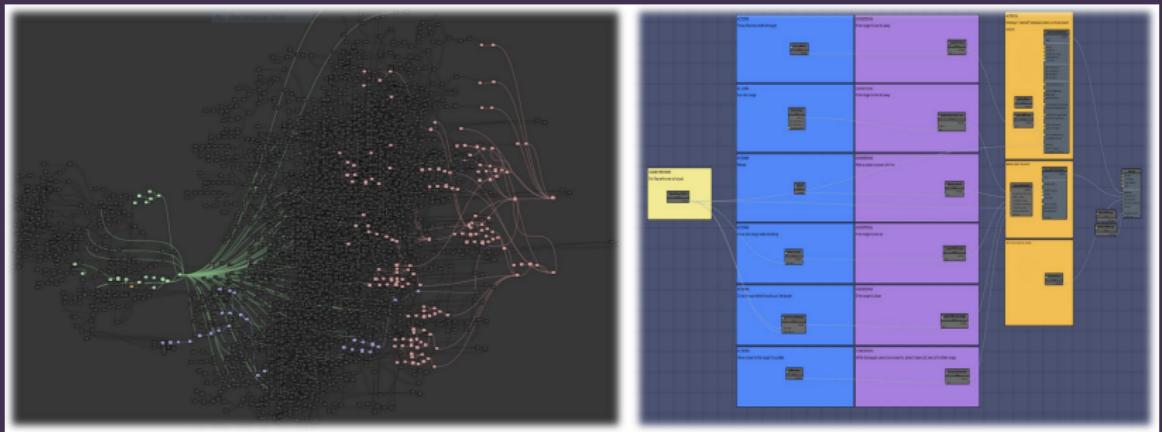
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- ▶ (Shared blackboards mean that your AI has “telepathy” — this may or may not be desirable!)

BTs in The Division



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

Workshop

