COMP250: Artificial Intelligence

3: Behaviour trees

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Finite state machines

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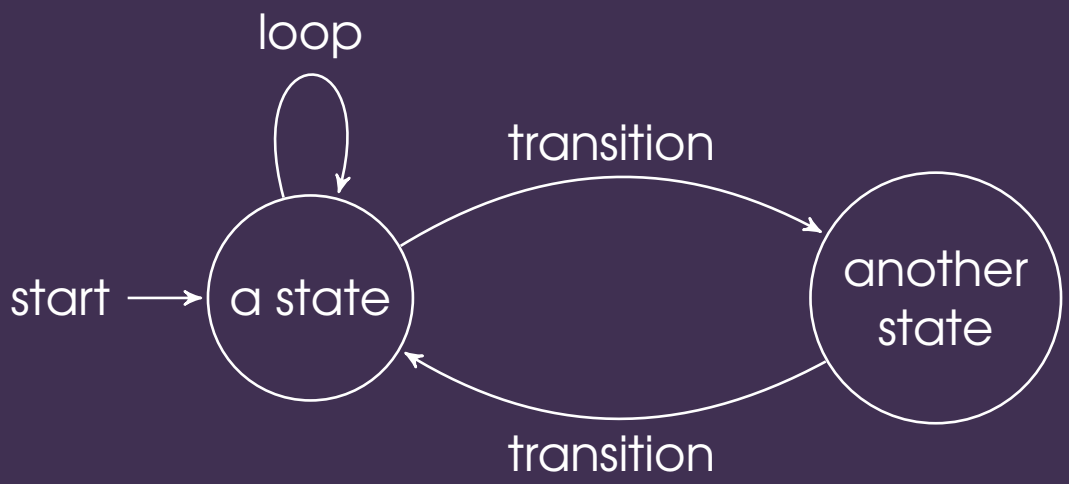
- At any given time, the FSM is in a **single state**
- **Inputs** or **events** can cause the FSM to transition to a different state

State transition diagrams



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

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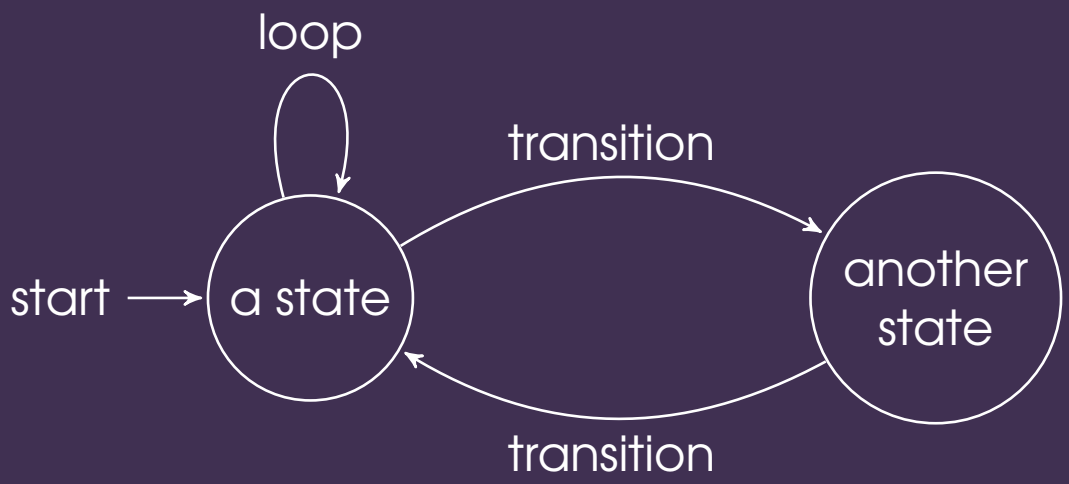

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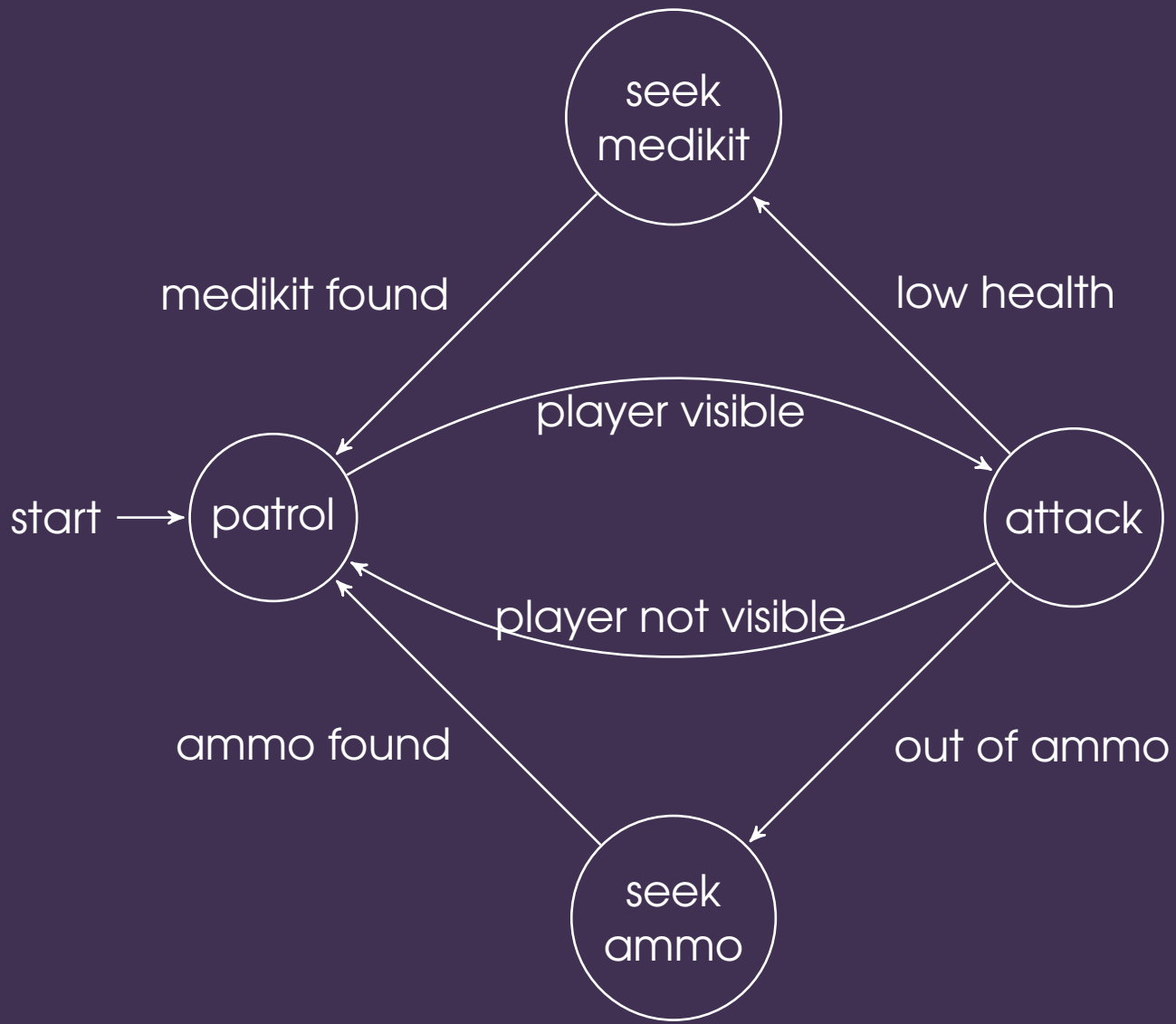
seek
medikit
medikit found
low health
player visible
start
patrol
attack
player not visible
ammo found
out of ammo
seek
ammo

Other uses of FSMs

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Beyond FSMs

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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**

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Behaviour Trees

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- First used in Halo 2 (2005), now used extensively
- Also used in robotics and other non-game AI applications

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- We will be using the free **Behaviour Machine** library for Unity

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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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  - Returns success for true, failure for false
- Leaf nodes often have **parameters** to allow for reuse in different situations

Leaf node example

```
using UnityEngine;
using System.Collections;
using BehaviourMachine;

public class GoTo : ActionNode
{
    public GameObjectVar objectToMove;
    public Vector3Var target;
    public FloatVar speed;

    public override Status Update()
    {
        float distance = (objectToMove.Value.transform.position - target.Value).
            magnitude;
        float step = speed.Value * Time.deltaTime;
        if (distance < step)
        {
            objectToMove.Value.transform.position = target.Value;
            return Status.Success;
        }
        else
        {
            objectToMove.Value.transform.position = Vector3.MoveTowards(
                objectToMove.Value.transform.position, target.Value, step);
            return Status.Running;
        }
    }
}
```

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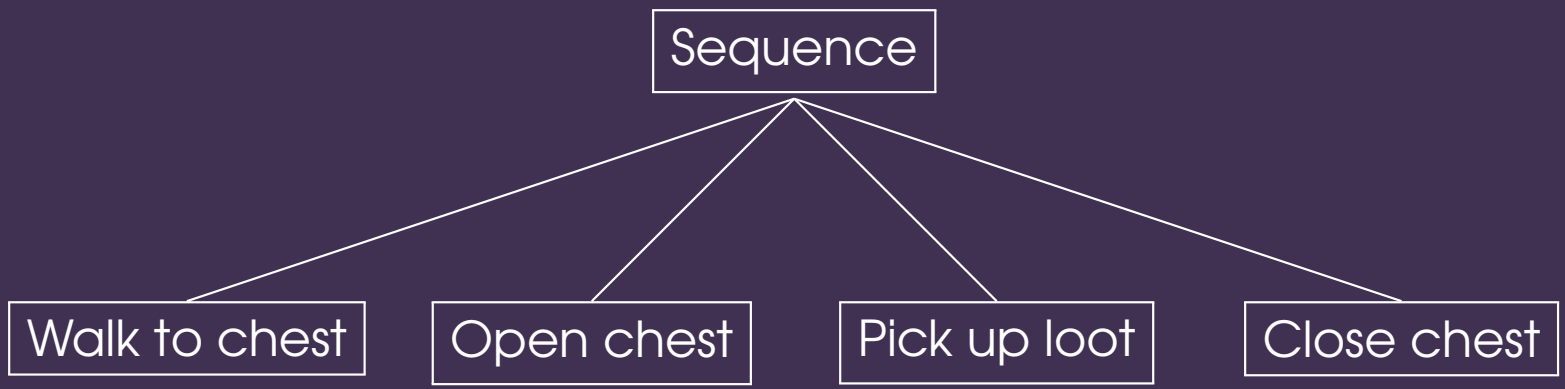

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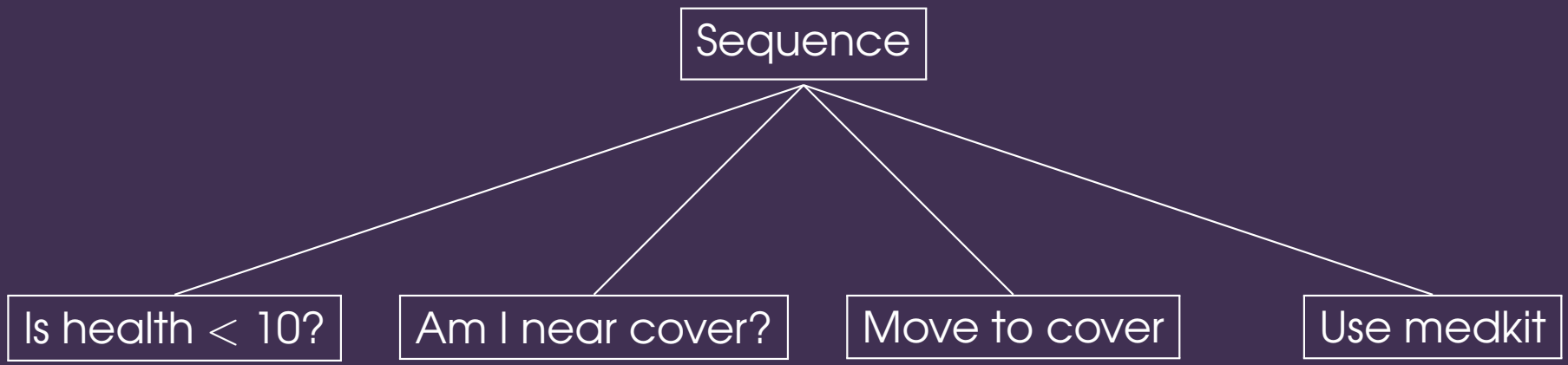

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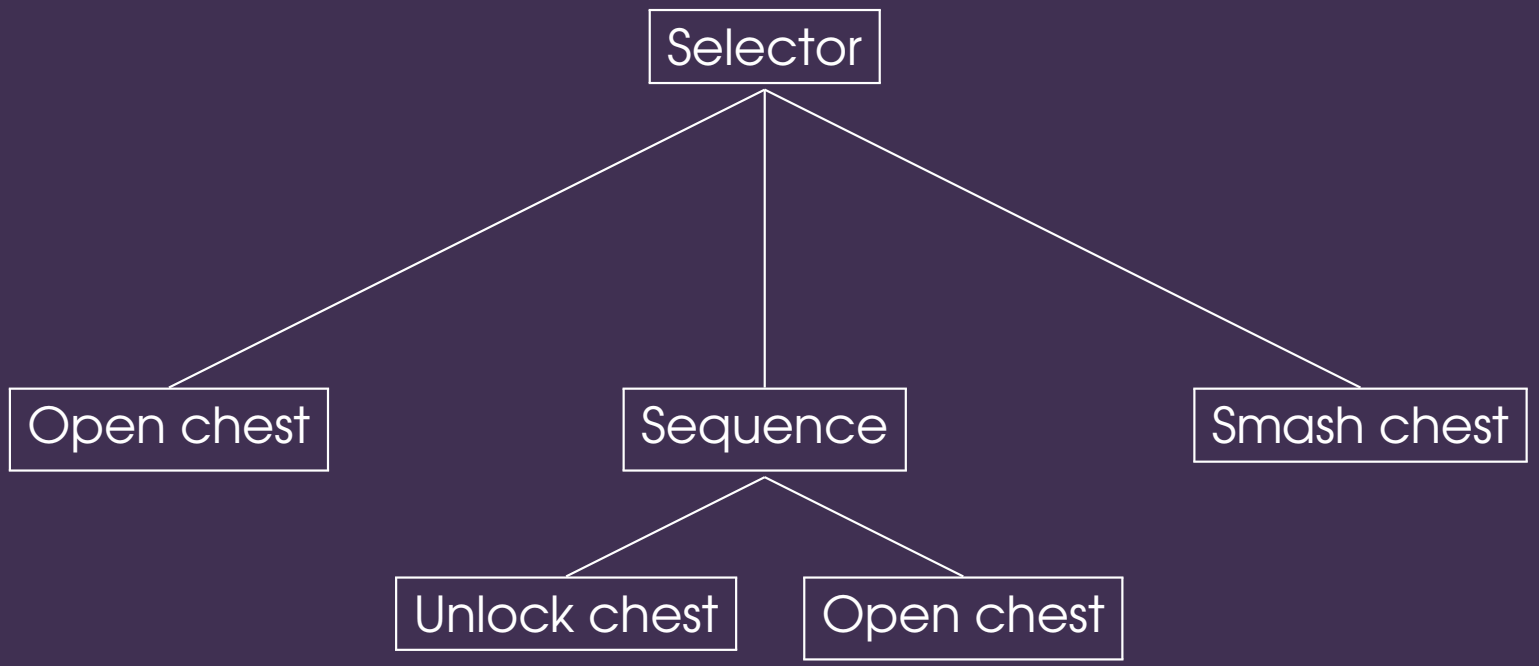

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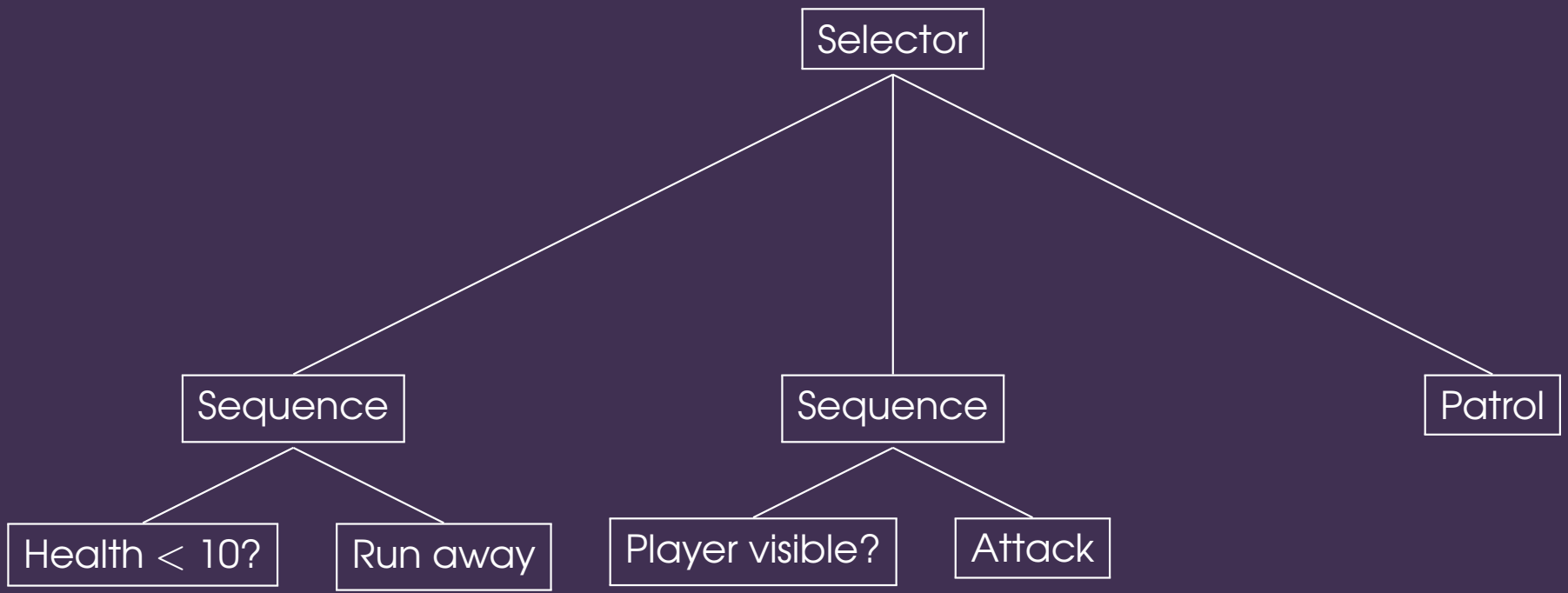

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- Sequence works like `and`, selector works like `or`

Other composite nodes

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- Most BT frameworks allow programmers to create custom composite nodes

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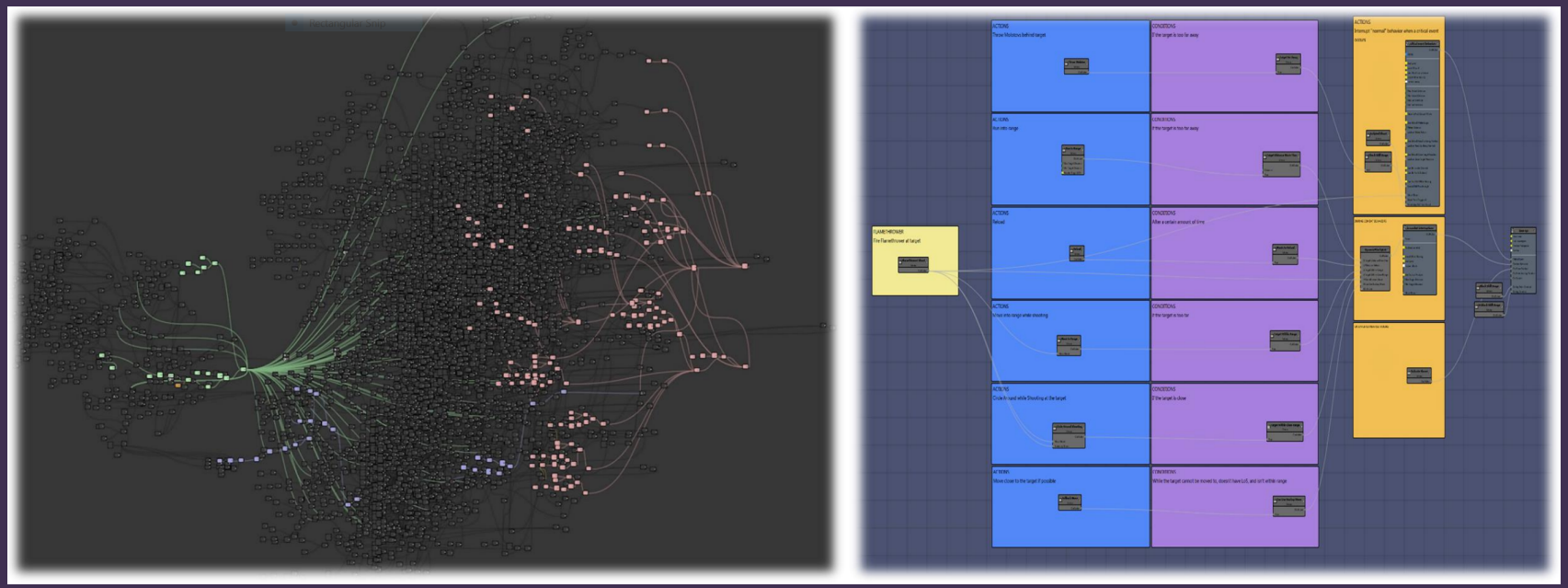
- (Shared blackboards mean that your AI has "telepathy" — this may or may not be desirable!)

BTs in The Division



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

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Portfolio task proposals