Game AI
Game Programming

- Rendering
- Looping and control
- Math
- Animation
- Physics
- Behaviour and navigation (AI)
- Effects
- Networking
Game Programming

- Rendering
- Looping and control
- Math
- Animation
- Physics
- **Behaviour and navigation (AI)**
- Effects
- Networking
Artificial Intelligence (AI)

- Based on the current conditions, which actions should an entity take?
Artificial Intelligence (AI)

- Based on the current conditions, which actions should an entity take?
- The goal of AI
  - Looks like a real player?
  - Beat the player?
Considerations

- Performance
  - 60 FPS?
  - The scale of quantities?
Considerations

- Performance
- Explainability
  - AlphaGo ?
Considerations

- Performance
- Explainability
- Editability
  - Human readable format?
  - Structured representation?
Considerations

- Performance
- Explainability
- Editability
- Flexibility
  - Easy to expand
How to design / implement a Breakout AI?
How to design / implement a Breakout AI?
How to design / implement a Breakout AI?

DeepMind: DQN Breakout

- Environment
- Policy
- Action

Goal? (Reward)
How to design / implement a Breakout AI?

DeepMind: DQN Breakout
How to design / implement a Breakout AI?

DeepMind: DQN Breakout
How to design / implement a Breakout AI?

DeepMind: DQN Breakout
Decision trees

DeepMind : DQN Breakout
How to design / implement the turtle’s AI?
How to design / implement the turtle’s AI?

Try to draw the decision tree?
Finite state machines

Try to draw the FSM?
Animator controller

Diagram showing the animator controller with states and transitions.
State machine behaviours
DEMO: 3D Game Kit

● Steps:
  ○ Open scene “Level2”
  ○ Show the Animator of “Chomper”
  ○ Explain the State machine behaviour system of 3D Game kit
  ○ Explain “ChomperBehaviour”
  ○ Explain “AttackBegin” event
Unity Asset Store : Bolt  [Free]

"Fantasy MOBA" by Ludiq, 2018

#madewithBolt
How to design / implement Hornet’s AI?
How to design / implement Hornet’s AI?

Try to draw the decision tree?
How to design / implement Hornet’s AI?

Try to draw the decision tree?

Try to draw the FSM?
Hierarchical state machines

Try to draw the decision tree?

Try to draw the FSM?

Try to draw the HFSM?
DEMO: 3D Game Kit

- Steps:
  - Open scene “Level2”
  - Show the Animator of “Ellen”
  - Explain the Hierarchical state machines
  - Explain the “Any” state
Behaviour trees
Selector (fallback) nodes
Selector (fallback) nodes

```
for i from 1 to n do
    childstatus ← Tick(child(i))
    if childstatus = running
        return running
    else if childstatus = success
        return success
end
return failure
```
Sequence node

```
for i from 1 to n do
    childstatus ← Tick(child(i))
    if childstatus = running
        return running
    else if childstatus = failure
        return failure
end
return success
```
DEMO: 2D Game Kit

- Steps:
  - Open scene “Zone 5”
  - Show the animator of Gunner
  - Explain the state topology
  - Explain “Missle Golem” component
    - OnEnable
ai = BT.Root();
ai.OpenBranch(
  //First Round
  BT.SetActive(beamLaser, active: false),
  BT.Repeat(rounds.Length).OpenBranch(
    BT.Call(NextRound),
    //grenade enabled is true only on 2 and 3 round, so allow to just test if
    BT.If(GrenadeEnabled).OpenBranch(
      BT.Trigger(animator, name: "Enabled")
    ),
    BT.Wait(delay),
    BT.Call(ActivateShield),
    BT.Wait(delay),
    BT.While(ShieldIsUp).OpenBranch(
      BT.RandomSequence(weights: new int[] { 1, 6, 4, 4 }).OpenBranch(
Unity Asset Store: Node Canvas

nodeCanvas

v3.x

START

Design

Develop

The Complete Framework

Behaviour Trees | State Machines | Dialogue Trees
Navigation
Navigation
Path finding
Path finding

- Common algorithms:
  - BFS / DFS
Path finding

- Common algorithms:
  - BFS / DFS
  - A*
  - Dijkstra's algorithm
Hierarchical path finding

- **Common algorithms:**
  - BFS / DFS
  - A*
  - Dijkstra's algorithm
- **Global / Local**
Navmesh

NavMeshAgent

OffMeshLink

NavMeshObstacle

NavMesh
Build a navmesh

1. Select the Scene geometry that should affect the navigation.

2. Check the Navigation Static box, under the Object tab of the Navigation Window, to mark the GameObjects that you selected to be used in the NavMesh baking process.
Build a navmesh

3. Adjust the bake settings, under the Bake tab of the Navigation Window.

4. Click Bake to build the NavMesh.
Walking

Walkable area
Walking

Walkable area

Finding paths
Walking

Global to local
Avoid agents/ obstacles

Local avoidance
Avoid agents/obstacles

Local avoidance
reciprocal velocity obstacles
Avoid agents/ obstacles
Avoid agents/ obstacles

Carving
Off-mesh link

Jump / Climb / Teleport / ...
DEMO: 3D Game Kit

- Steps:
  - Create new **Scene**
  - Add “**Chomper**”
    - Select agentType “**Humanoid**”
  - Bake **Navmesh**
Planning

- BFS / DFS, A* algorithms, ...
Monte Carlo tree search
Q & A