

Al Behavior Editing and Debugging in Tom Clancy's The Division

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This presentation

4

- More context
 - Archetypes
 - Architecture
- Evolution
 - Intentional workflow change
 - New workflow almost reverted
- Examples
 - Debug Intro
 - BT Intro
 - BT Edit
 - Real Debug



Combat NPC Overview

- 36 unique combat AI split into 11 archetypes
- 5 enemy factions and 1 friendly faction
- Detection system, threat system, scripted control, reaction to player Abilities, dynamic objective-handling, reactions to civilians and wildlife, idle activities
- Used in both systemic open world and linear, scripted story missions
- Behavior Tree architecture

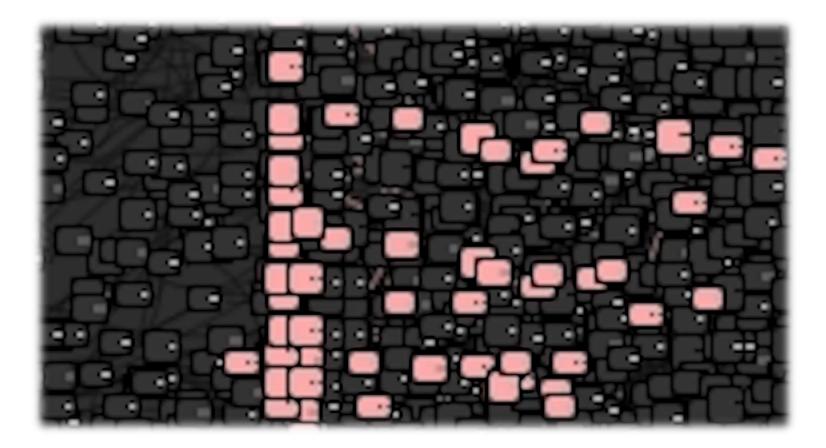






Architecture

- Behavior Tree architecture
 - Good info out there
- Server side
 - Different constraints for another talk
- Right to Left
 - There are reasons
 - Do get used to it
 - Not good enough
 - First impression
 - When to make the change
 - Ask me next time



Evolution

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In the beginning

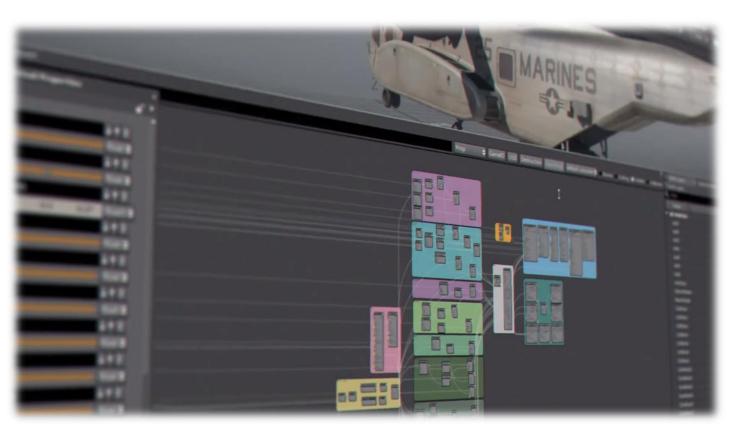
- Al is for programmers
 - Creates, links and manages state
- Designers design
 - Might tweak inputs





• Enter Visual Scripting

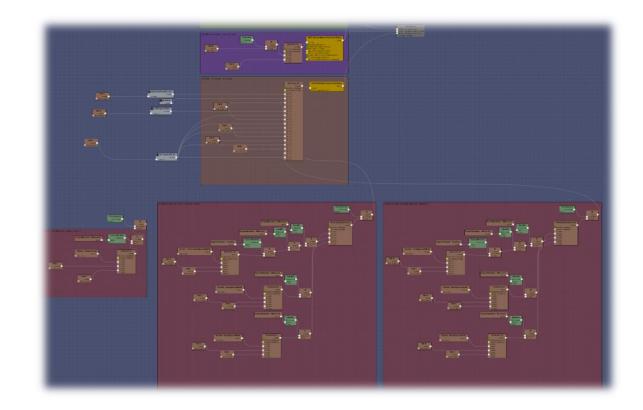
- Node graphs for art
- Empower content creators
- Without programmers
- Empower designers
 - Free up code time





Early days

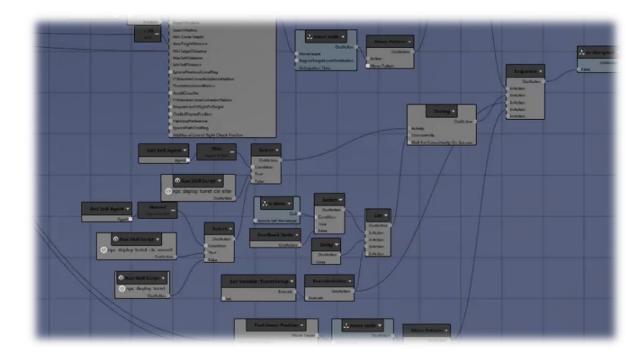
- Edit behaviors as node graphs
- Left to designers
 - Asking for nuts and bolts
- Visual edit not enough
 - No shared code Reimplement
 - No reusable subgraphs Copy pasta
- Restart on edit
 - Not fun with complex graphs
- Increasingly hard to manage





We can rebuild it...

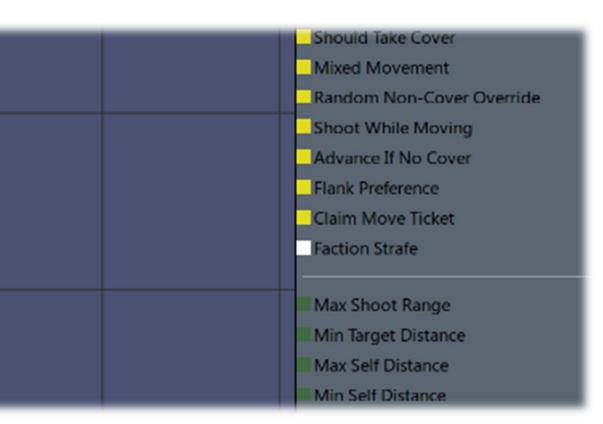
- Proper node graph
- Use common nodes
 - Less redundant work
- Reusable subgraphs Compounds
 - Less copy paste
- Reloading
 - Faster trial & error





Still not enough

- Rewrite a bit late
- BT Graphs unreadable mess for programmers
- Despite best efforts square one
- Nodes are for programmers
- Designers tweak inputs
 - Just slightly more of them
- Managed to work through it





A visual behavior debugger

- Programmers need debuggers
- Own workflow gets a bit more love
- Success Green
- Failure Red
- In Progress Blue
- Inactive Gray
- Interrupted Orange

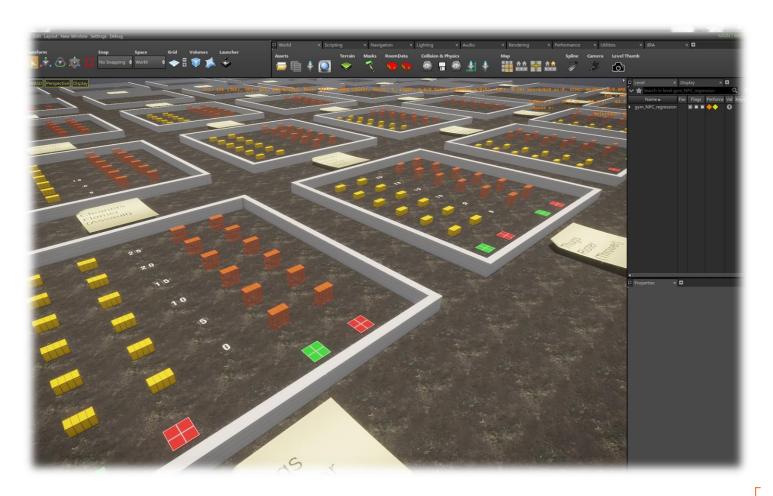
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• Debug Intro

- Regression test map
- Area for archetypes
- Easy bug repro
- Rioter Sniper



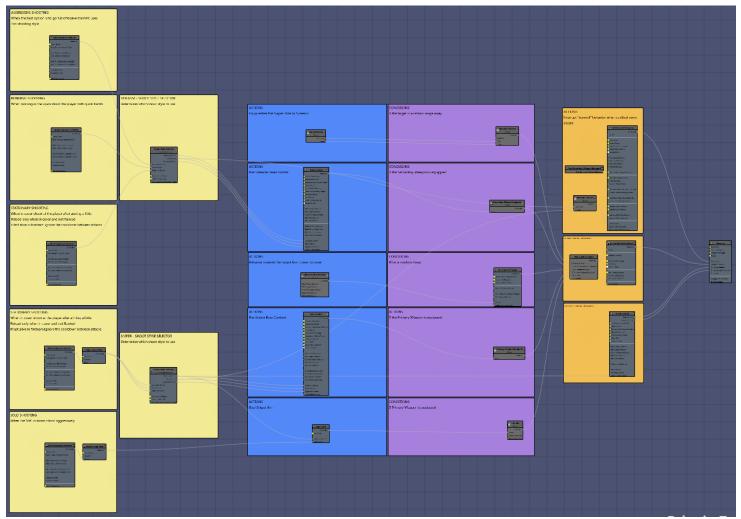






Behavior Tree System

- Rioter Sniper
- Right to Left
 - Top to Bottom
- Color coded
 - By design
- Layer connections
 - Multiple parents
 - Slimmer bottom
- Not the details
 - But clear intent





Base Npc

V

- Far right
- Used for all human combat NPCs

				A rest and a rest



Critical Events

- Top input for Base Npc
- Higher priority than
 normal combat
- From Direct orders to Seeker Mines and Team Mate reactions

			ALIONS	
			Example, "Income" Johnson of the child over. OCUTS	
			And an and an An and an an an and an	
			Market State	



Normal Combat

• Connects to the right conditions

			Image: State	

BEHAVIOR TREE



Initial Combat

- Often special
- Logically executes before, but slightly less important and the bottom

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indiana Image: Participant State Sta				1
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Conditions

- Picks from actions (next layer)
- Allows reuse instead of reimplementation in Critical Events/Normal Combat

		CONDITIONS			
		It the larget is a certain range away			
			- New Gener		
			Come Come Come Come Come Come Come Come		
		CONDITIONS			
		It the Secondary Weapon is equipped			
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		If Primary Weapon is equipped			
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			Anta Ku		
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Actions

- What they do
- Also link to shooting

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	A contraction of the contraction			
	ACTIONS Uwer Solger Alm	CONDITIONS If Primarty Waspuer Is equilational		



Shooting

- Handle all variations
 - Range, primary, secondary, aggressive etc
- Most things link here
 - Multiple parents is slimming

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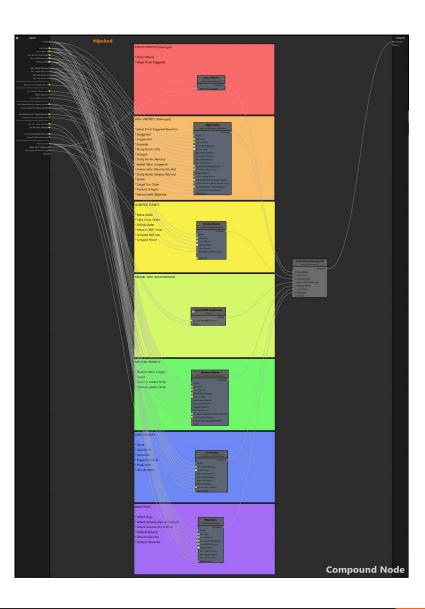


Graphs in graphs

- Reusable subgraphs
 - Compounds
- Top level
 - Mostly compounds

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- Critical Events
 - Mostly compounds
- This adds up





Seeker Mine

- Simple non human
 - Prioritylist
- Font size & color
- Comment colors

BLOCK MOV	EMENT Market Market Ma	
MOVE TO: PLAYER SE		
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MOVE TO: PL	AYER SELECTED TARGET	
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	CHASE ENEMY	These
	FIND CLOSEST TARGET	
	FOLLOW THE PLAYER	



No CRUCI Charles for stat ---------mark -----Martin ... NACES CONTRACTOR **BehaviorTree**

Weapon anrifle_mosinnagant_default_soundvariation_1 NPCConfig me system data/juice/ai/npc/gen_scout.mnpc Level 18 \$ In Combat Attributes Custom Visuals rogue/game system data/juice/ai/behavior/gen_scout.mbehi

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Resource Name N/A Position x 130

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AgentDebug

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Game Debug History																															
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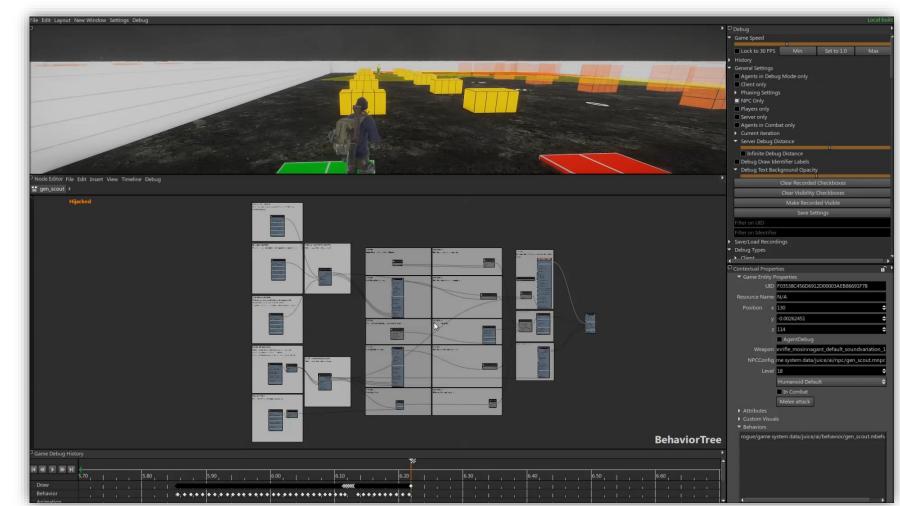
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Animation																															



Rapid iterations

- More iterations
 - 360 spider sense
- Quick/Easy edit
- Easy to debug
- Regain confidence
 - One edit at a time
- Not enough





Not enough

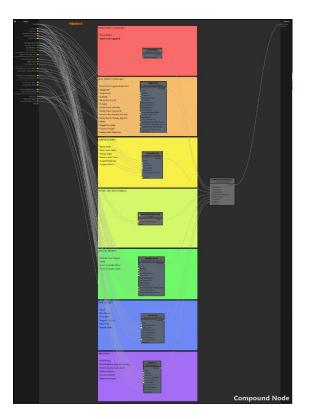
- Break old habits
- Improve communication
 - Seating
 - Working closely together
- Iterate on responsibilities/layout
- Flexible graphs
 - Adapt abstraction level to the team
- Now who does what?





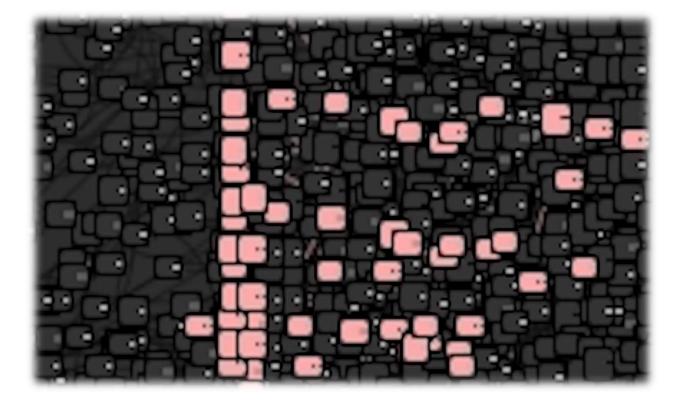
Now who does what?

- Powerusers wrapped in compounds
- What nodes to make?
- High level of detail





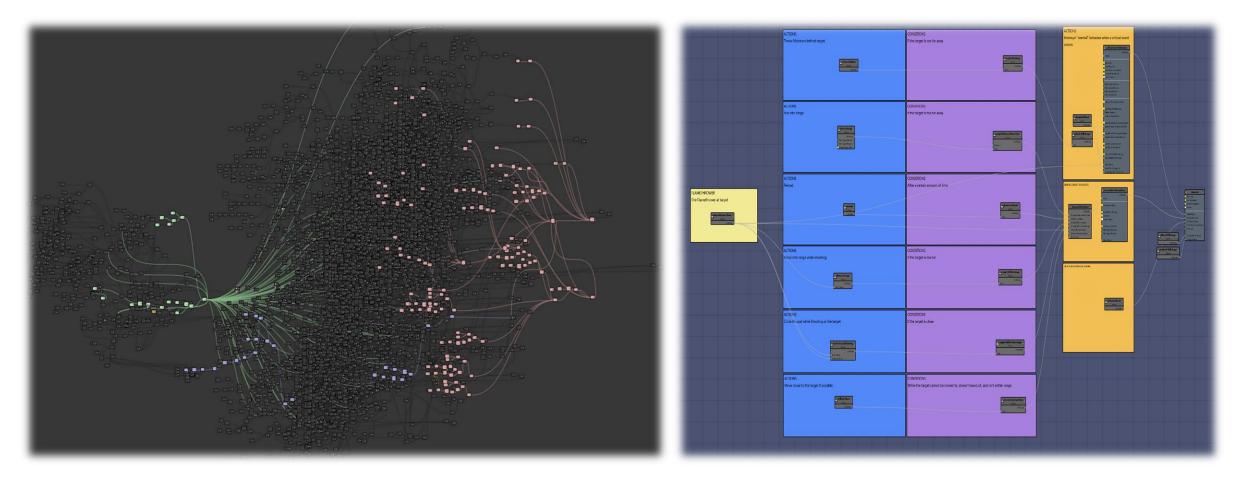
Remember this?







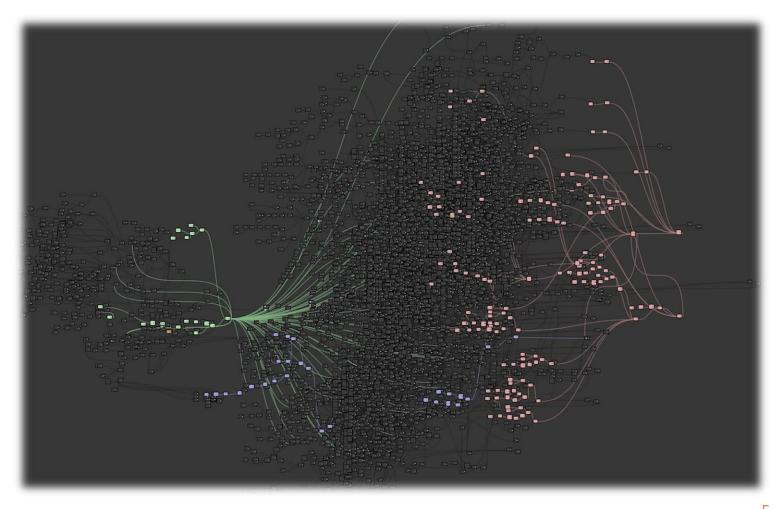
Not quite true





With great power...COMES reviews...

- Spaghetti
 - Impossible like that
- Node Reviews
 - Code Design
 - Design Code
- Input sanitation
 - Easy edit
 - Easy error
- Real Example

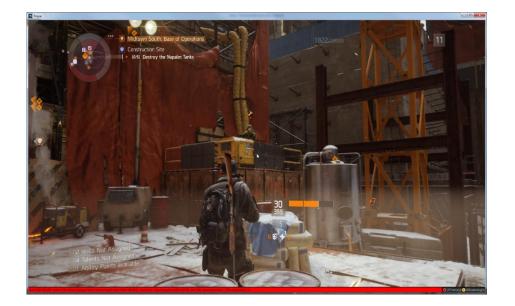




Cleaner Mechanic doesn't deploy the turret

We've created a little vantage point for it in Hope it would provide a focused turret gameplay section to the beat but sadly the NPC never places a turret.

- Archetype that spawns a Mech
- How to set up for real debugging
- Combine multiple debug sources



File Edit Layout New Window Settings Debug



File Edit Layout New Window Settings Debug





Turret Bug

- First issue
- Cover Depth Calculation
 - Includes the the napalm tank
- Why such a big issue?





Turret Bug

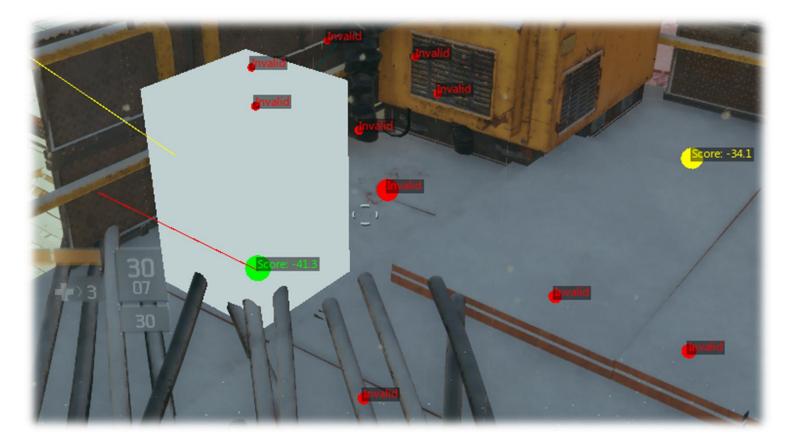
- Second issue
- Two different tests
 - At different times
 - Assumed match
 - When it works, yes

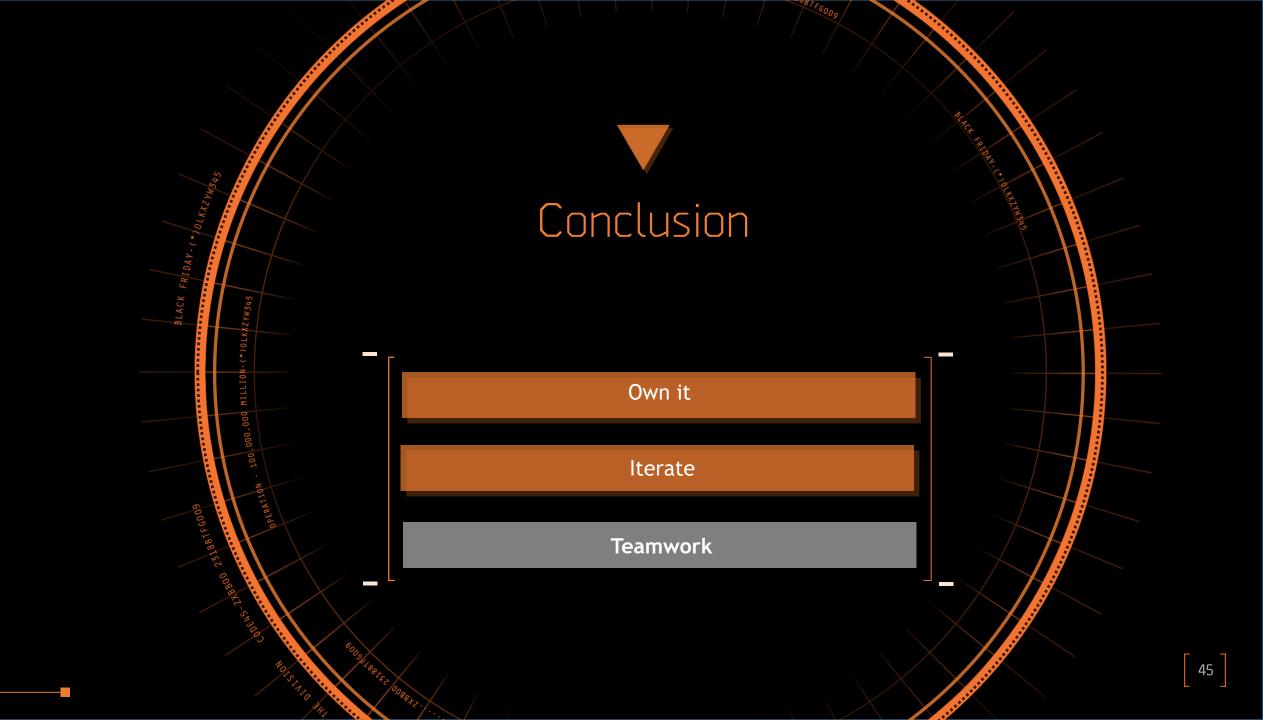


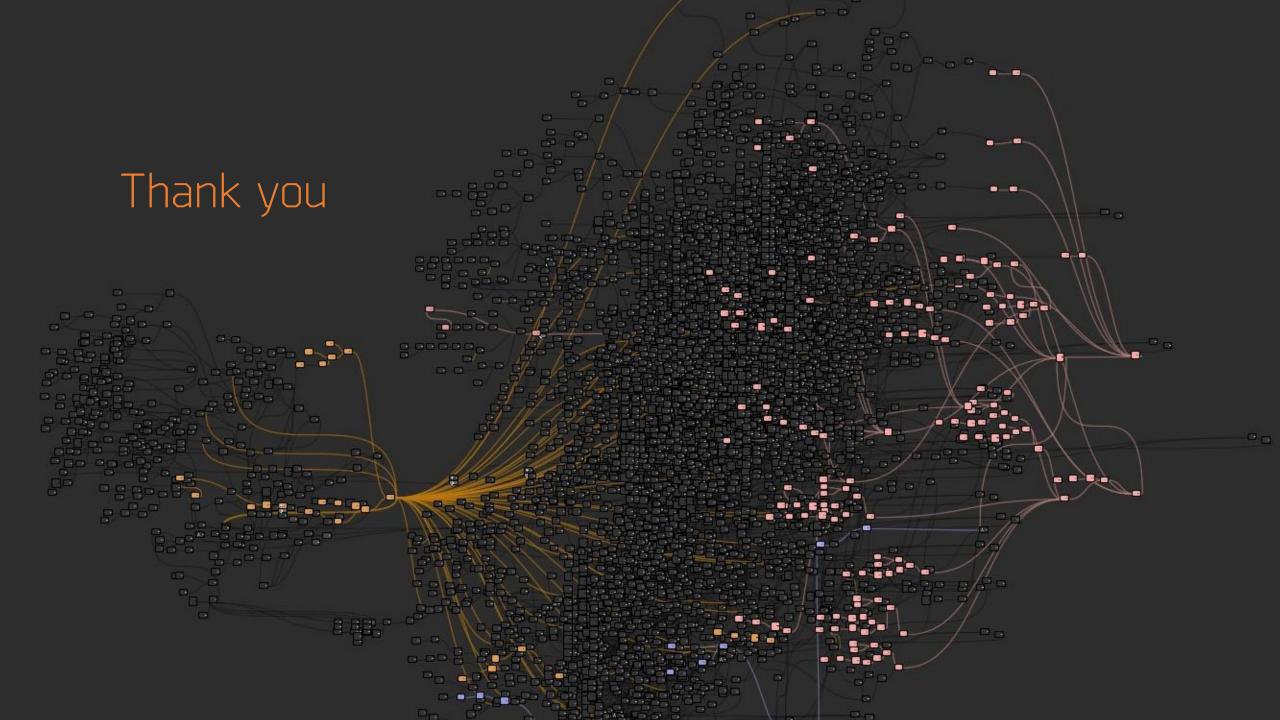


Turret Bug

- What does this mean?
- Hides the real position
- Behavior picks the wrong one and fails.
- Pragmatic solution
- Future iterations









Friday March 18, 2016 1:30pm - 2:30pm Room 2016, West Hall

Global Illumination in Tom Clancy's The Division

Nikolay Stefanov Technical Lead, Ubisoft Massive



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MORE QUESTIONS? Meet me on the ubisoft lounge



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