GDC
MARCH 18-22, 2024
SAN FRANCISCO, CA

Skyscraper Zombies

Advancing Call of Duty's Systems for Giant AI

By Andrew Hoyt

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2003

2008

2021

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This Talk Spans My Career

1. 4 Years at Treyarch (2020-2024)
2. Shipped 2 Call of Duty games
3. Currently leading small team as Associate Lead engineer

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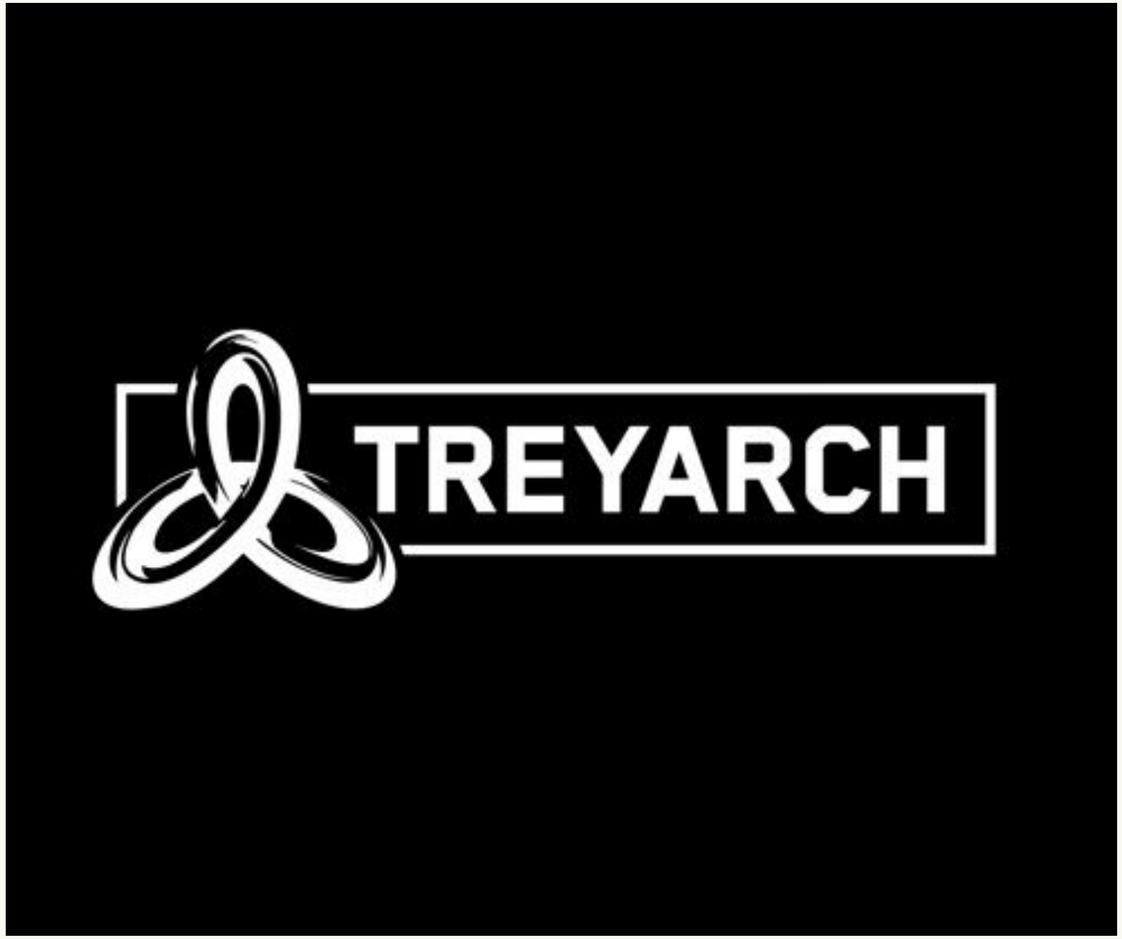
Treyarch’s Zombie AI Team

1. A handful of engineers
2. We “own” 1 or more AI types
3. Wear many hats
   - Animation engineering
   - Combat design
4. Aim for simple solutions due to tight deadlines



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Historically, COD AI…

- 72 inches height
- 15 inches radius
- 2 feet, humanoid (generally)
  - 4 feet, quadruped
- 2 eyes
- Capsule collision

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Sound Muted
Voice Muted
SW 240 255 W 285 301 NW 330 345 N 15
OMEGA OUTPOST
HAND PLACED
NOPELESS JUMP
ESS CLIMB-UP
ESS DROP-DOWN
ESS VAULT
BALCONY VAULT
MB 100%
Gain entrance to the Facili
Facility
50 m
FPS: (34- 42) 37 62%
SDR: [896x 488]
SV MS: (9-19) 13 d
POS: (326 711 61)
ANG: (10 148 0) FOV:64
VEL: 0.0 0.0
0
150
TA-AHOYT
1
30 330
XM4
t9 [local] release win64(dx12) TA-AHOYT (15506110) Fri Jan 5 09:59:23 2024

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NW 330 345 N 20 E 60 75 E
HAND-PLACED
NODELESS JUMP
NODELESS CLIMB-UP
NODELESS DROP-DOWN
NODELESS VAULT
NODELESS BALCONY VAULT
30 330
XM4
t9 [local] release win64(dx12) TA-AHOYT (15506110)

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…but how about Zombies?

28 inches radii

28 inches radii

28 inches radii

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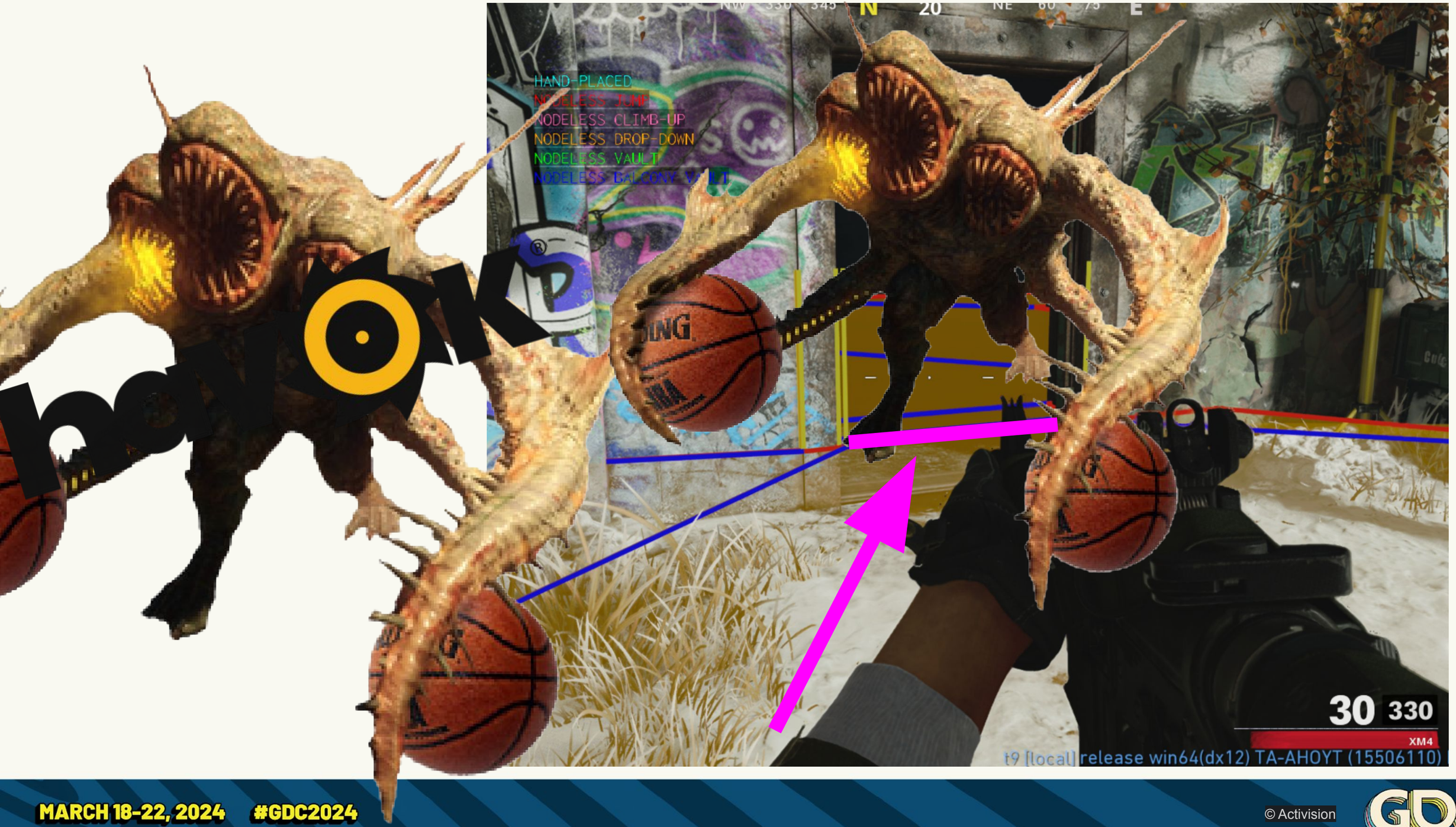
NW 330 345 N 20 NE 60 75 E
HAND-PLACED
NODELESS JUMP
NODELESS CLIMB-UP
NODELESS DROP-DOWN
NODELESS VAULT
NODELESS BALCONY VAULT
30 330
XM4
t9 [local] release win64(dx12) TA-AHOYT (15506110)

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Meet the Orda

1. Uses the same navmesh
2. Increased radius works out the box
3. It’s too tall):

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Orda Navigation

Requirements:

1. Wanders the open world
2. Don’t walk into overhangs
3. Avoids hugging walls
4. Limit combat playable space

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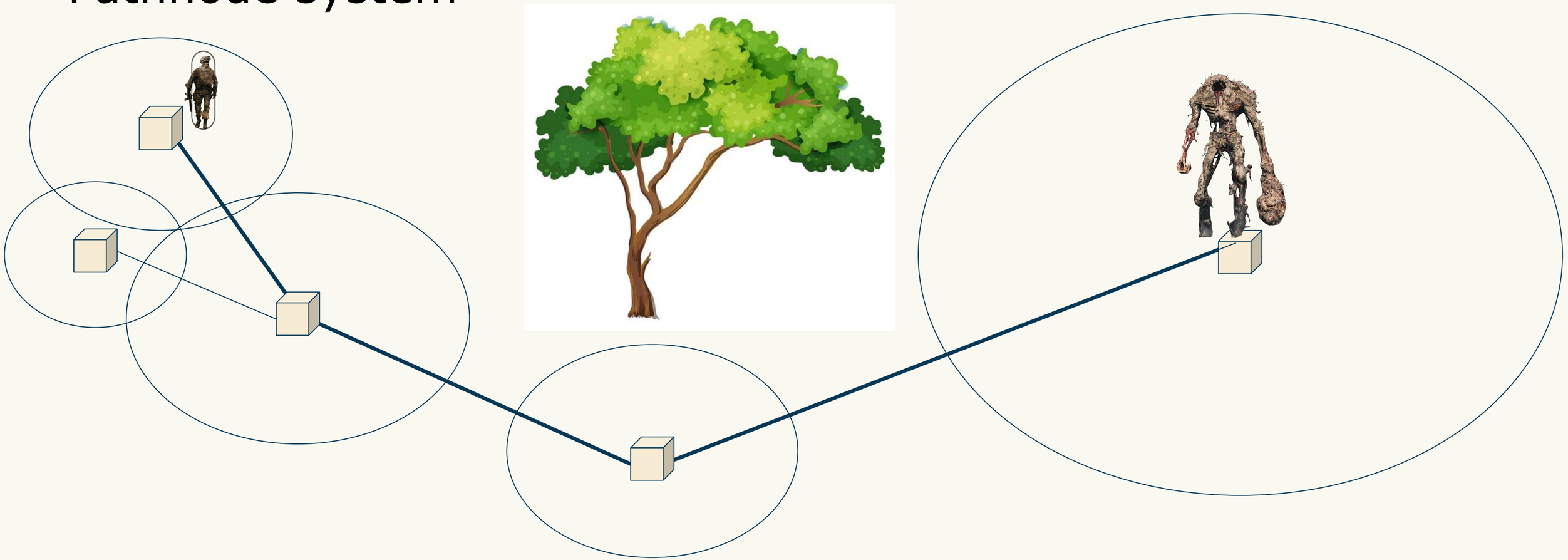
Orda Navigation System

Pathnode system



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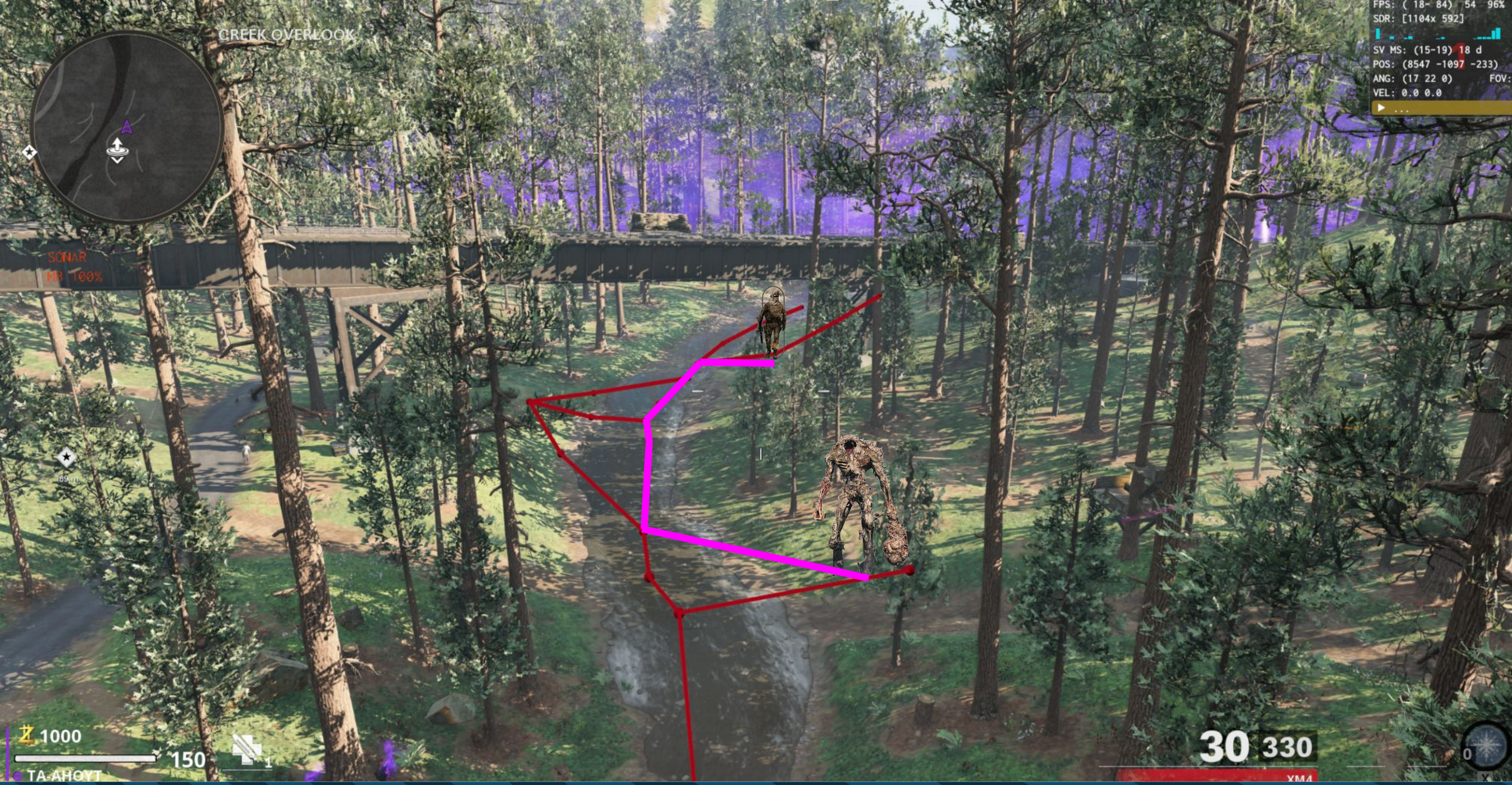
CREEK OVERLOOK
SONAR
1000
150
TA-AHOYT
30 330
FPS: (18- 84) 54 96%
SDR: [1104x 592]
SV MS: (15-19) 18 d
POS: (8547 -1097 -233)
ANG: (17 22 0)
FOV:
VEL: 0.0 0.0

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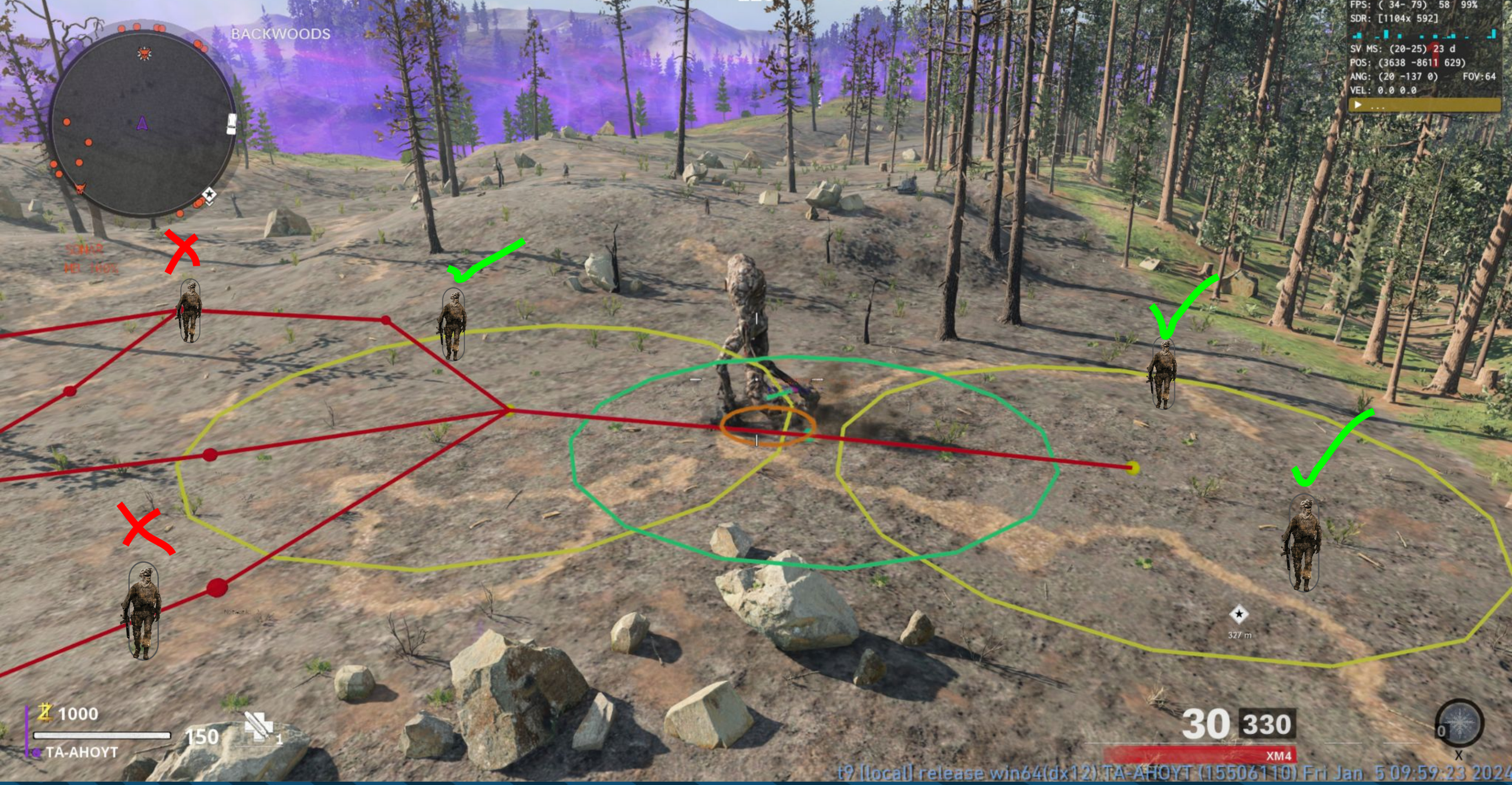
BACKWOODS
FPS: (34- 79) 58 99%
SDR: [1104x 592]
SV MS: (20-25) 23 d
POS: (3638 -8611 629)
ANG: (20 -137 0) FOV:64
VEL: 0.0 0.0
327 m
1000
TA-AHOYT
150
1
30 330
XM4
t9 [local] release win64(dx12) TA-AHOYT (15506110) Fri Jan 5 09:59:23 2024

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Let’s “Turn” to Animation

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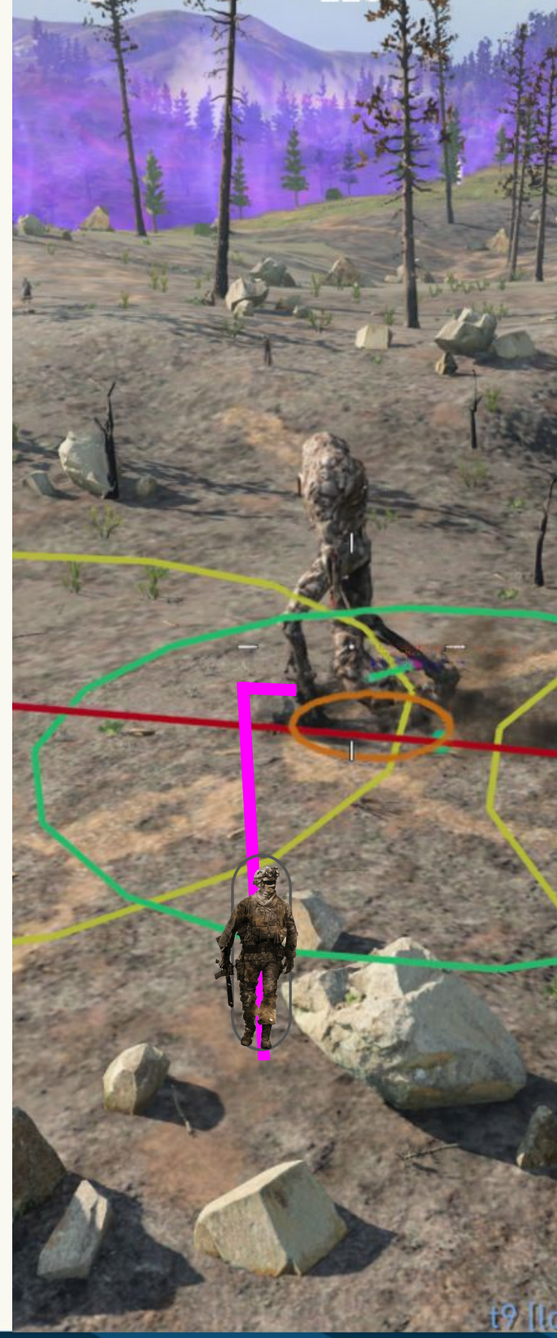
Dedicated Locomotion Turns?

Problems

1. Expensive to author animations for this AI
2. Needs lots of resulting angle turns
3. Locomotion relies on a blendspace of speeds
4. Needs to transition into melee or combat animation easily

Root Issue: Giant feet = noticeable feet sliding



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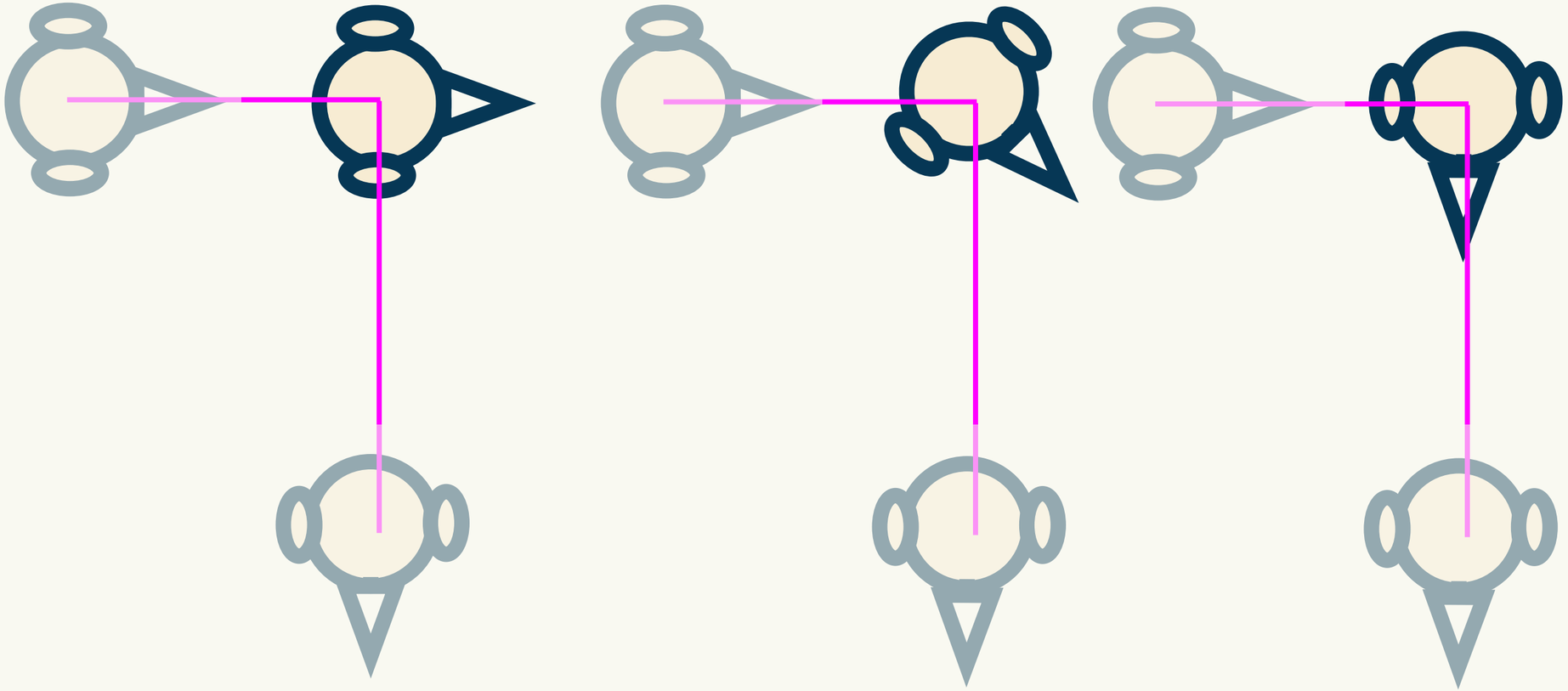
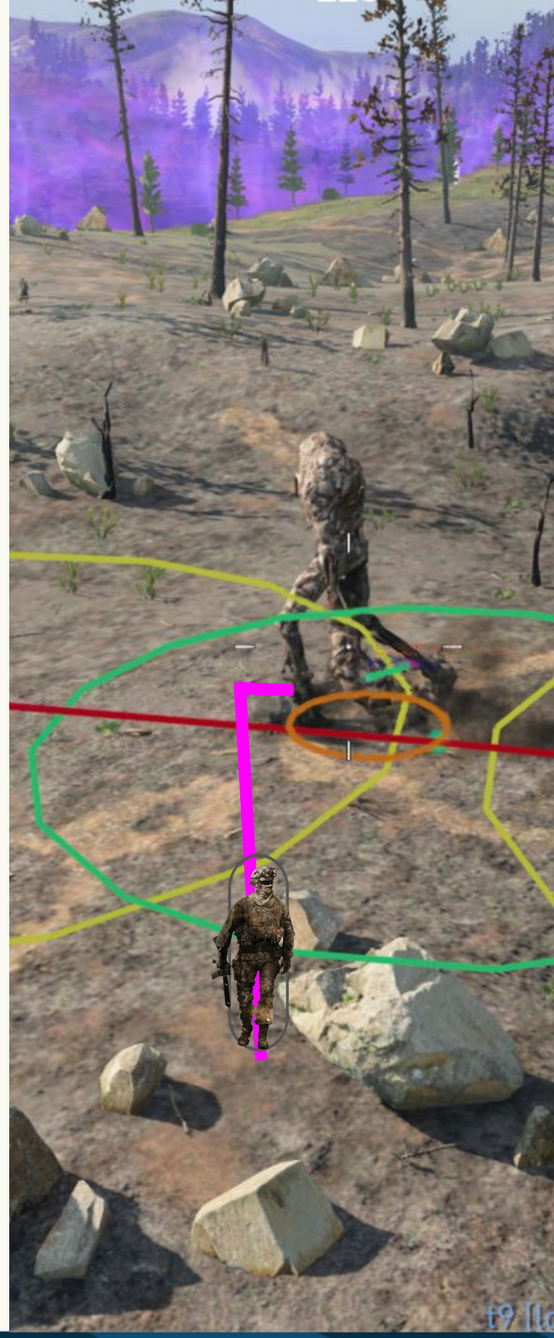
Feet Sliding):





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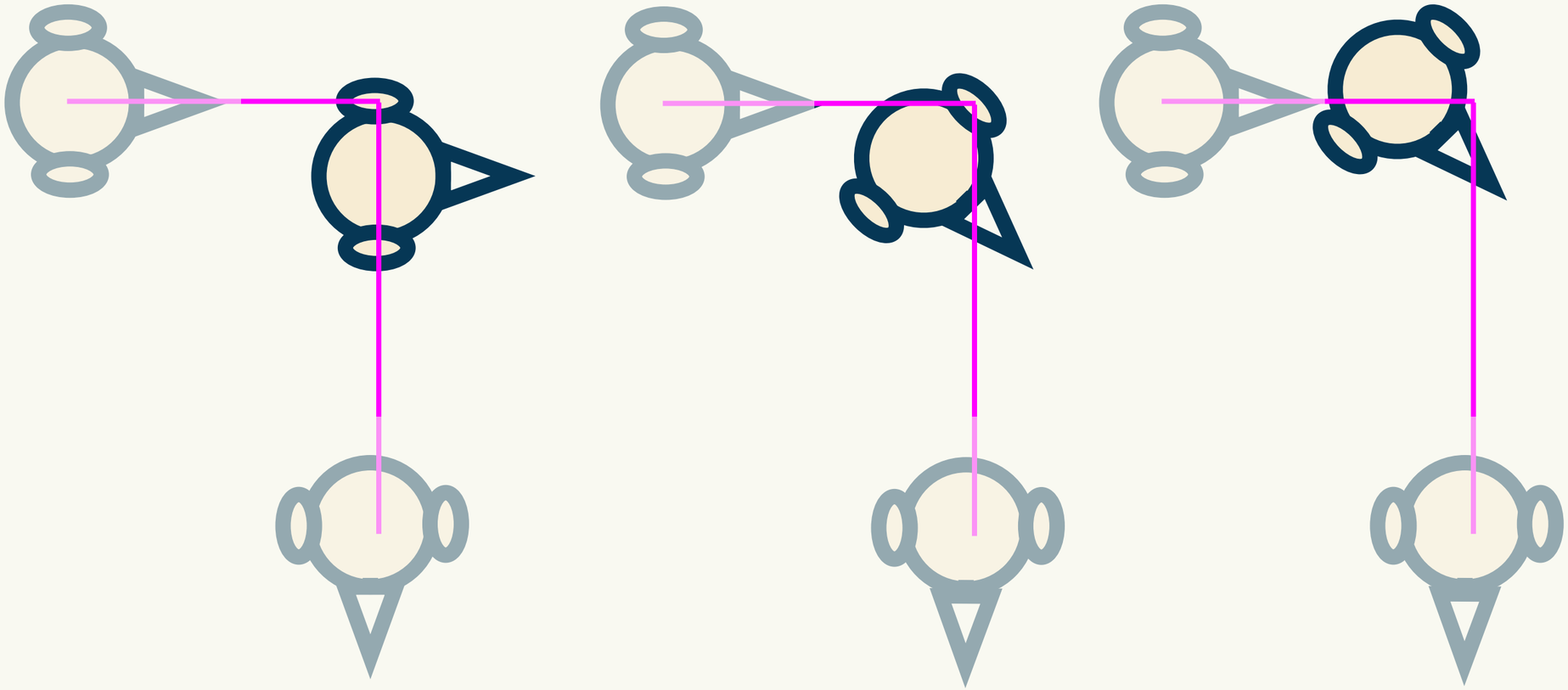
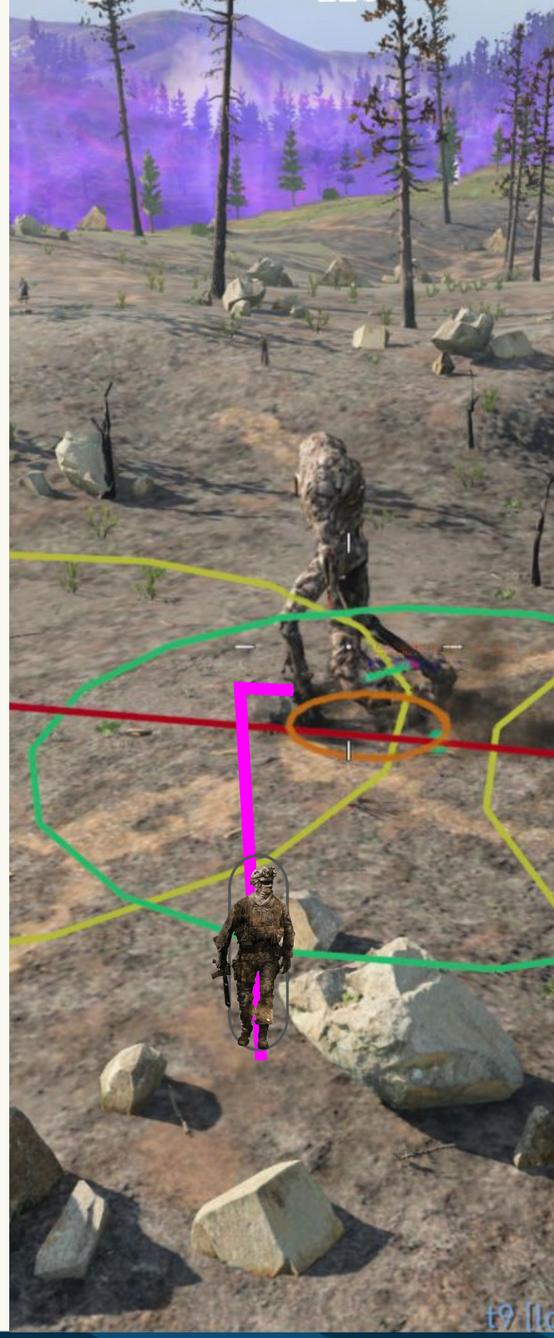
“Giant Foot Pivot”





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“Giant Foot Pivot”

Some polish:

1. Scale turn rate depending on where the foot cycle is

2. Don’t turn if both feet are on the ground

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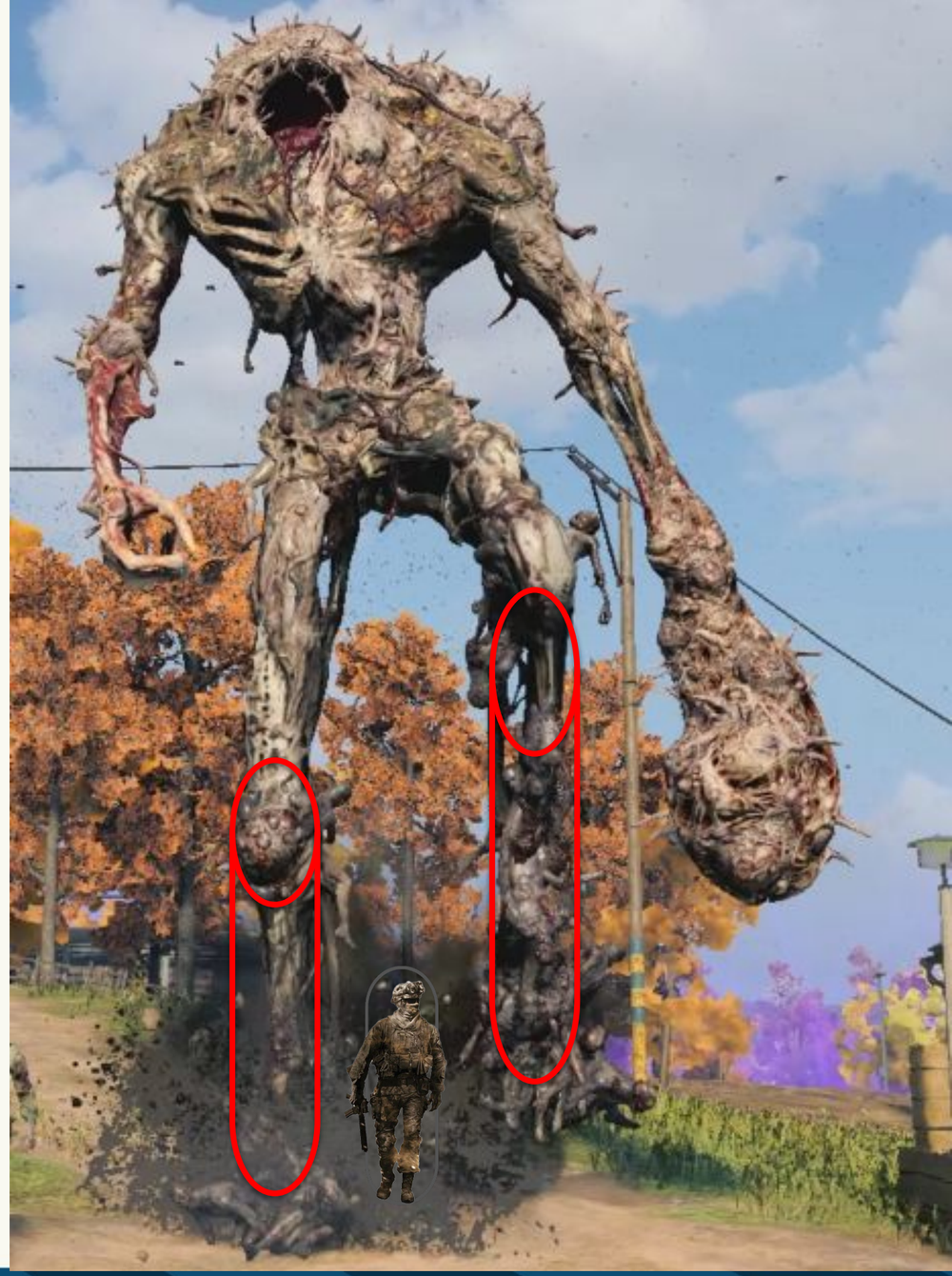
Speaking of Giant Feet

Limitation:
All characters use capsules for collision



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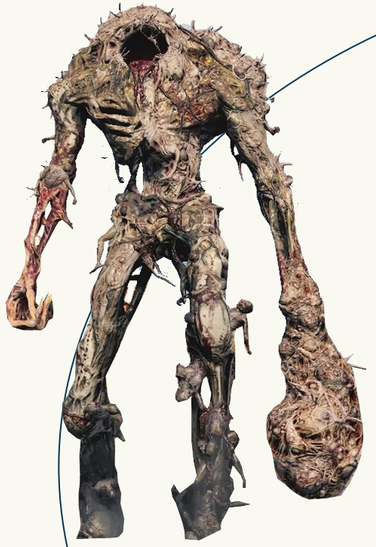
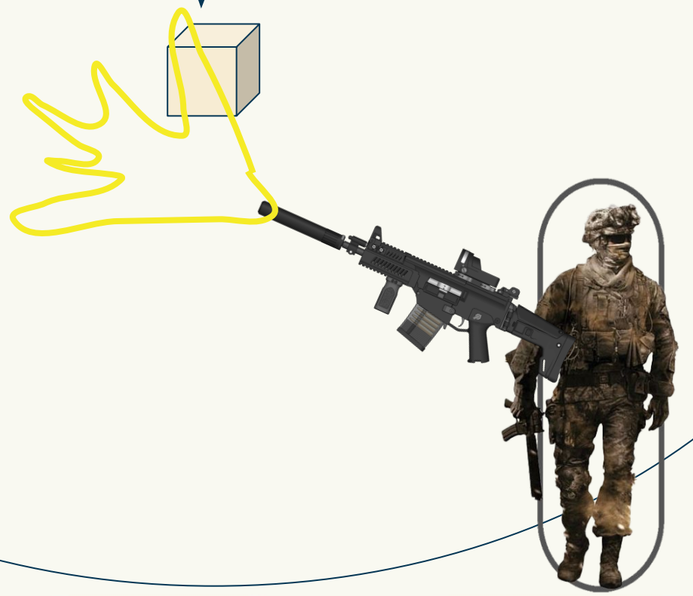
All Players Have Weapons In Call of Duty



Ok so mark center
as a healing spot



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Simulating Frustration

1. Count # of recent “hovers”
2. Score frustration
3. Players must get closer for extended periods of time

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Orda Learnings and Reception

Highlights:

1. Scale and difficulty
   a. Health
   b. Fight duration

2. Felt highly reactive to player actions
   a. Could navigate to a large portions of the map
   b. Melee at any time

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Modern Warfare 2, Warzone 2, and all future Call of Duty games will be on one "unified engine"

By Dustin Bailey last updated August 05, 2022

COD 2.0 is coming

COMMENTS

(Image credit: Activision)

One Year Later…

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Urzikstan

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Let’s Do a Worm

1. Limited time
2. 1 Coder
3. Builds on tech from Orda
4. Features burrowing + underground movement

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Digging Into That

1. Burrows
    a. Retreat, relocate, or on cooldown
2. Patrols
    a. Listens for footsteps, gunshots, explosions
3. Chases
    a. Rushes towards sound and unburrows as near as possible

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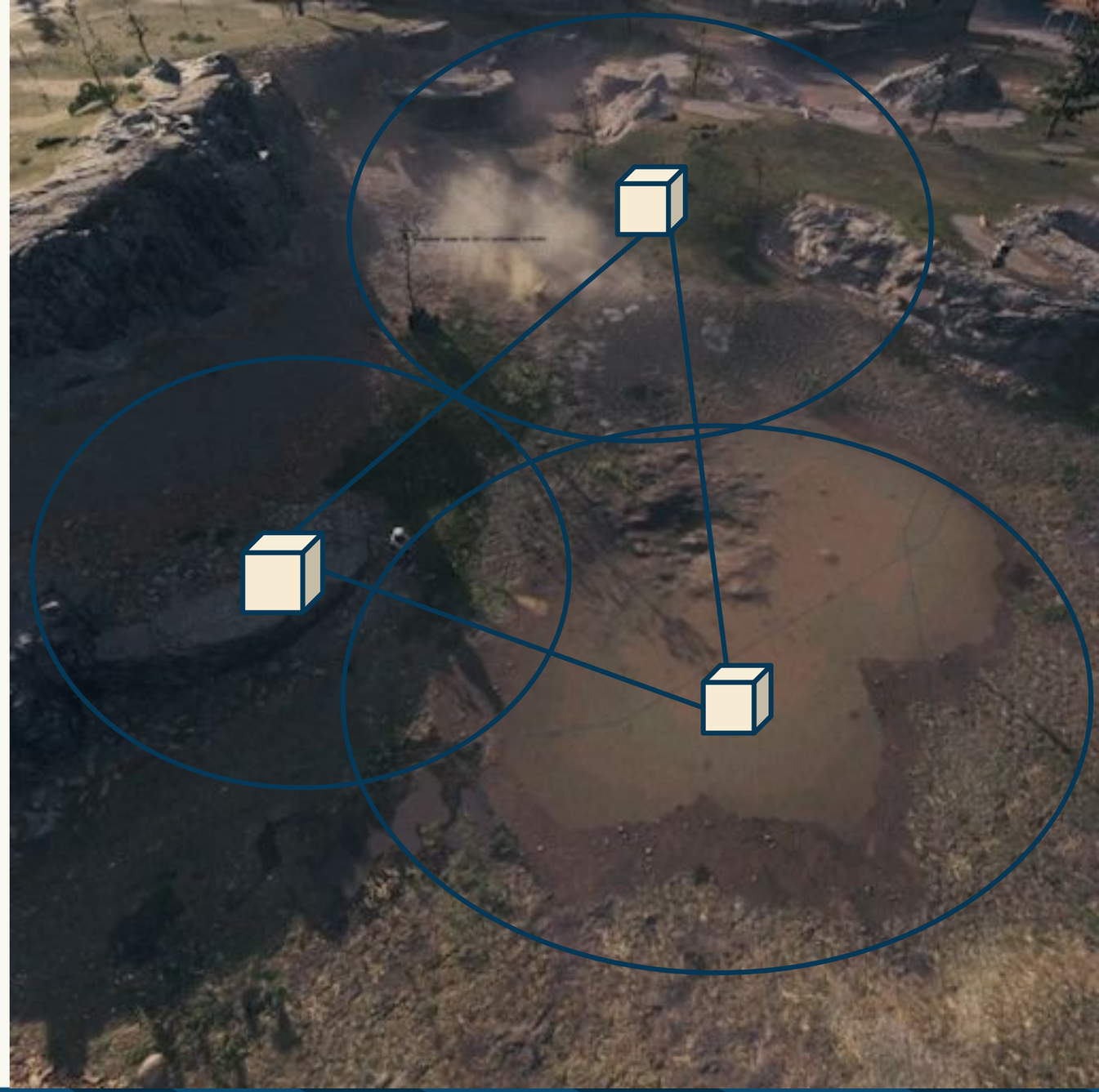
Patrolling

1. Arena is a suggestion
2. Multiplies turn rate closer to the edge of the circle
3. Stays near circle with highest “Influence”
4. Listens for footsteps or gunshots



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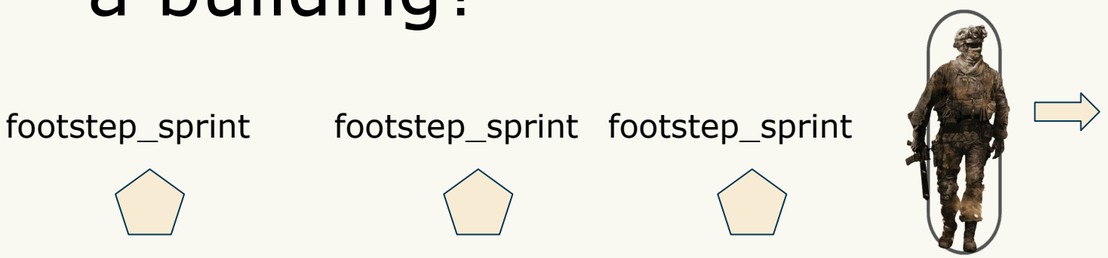
Worm Chase!

5. Upon loud sound, will chase last known position

6. Players can fool it by throwing a grenade

7. But what if the player is in a building?



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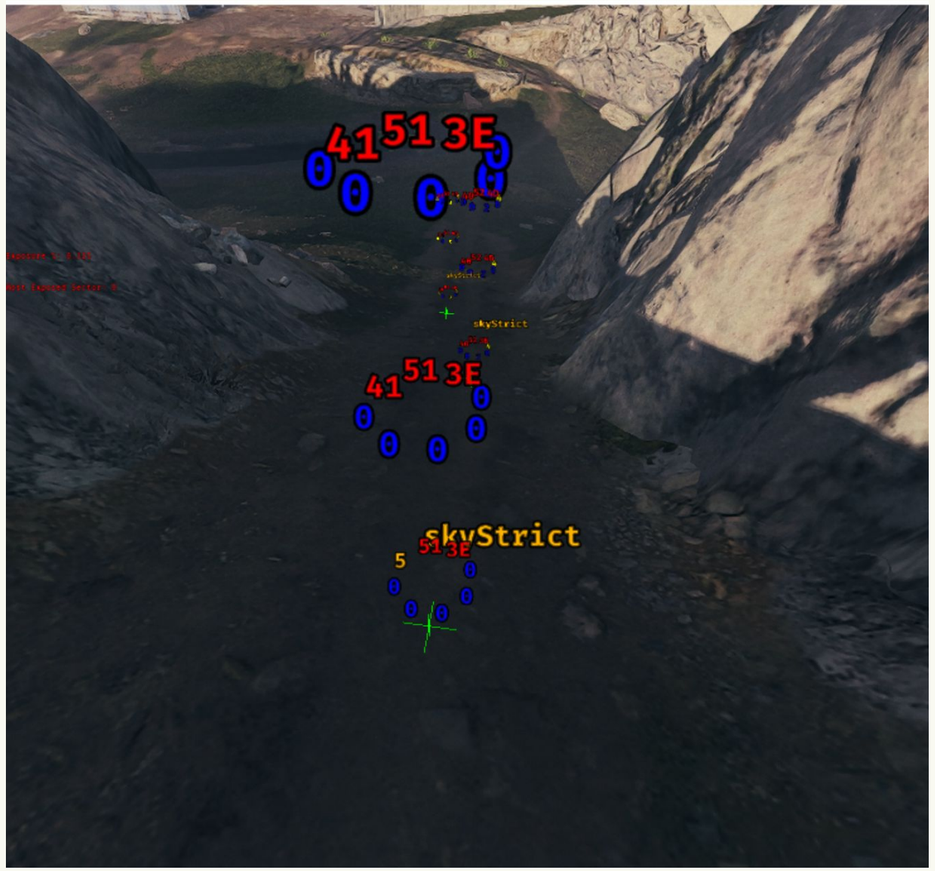
Where Can the Worm Unburrow?

1. Re-using “tacpoints”
2. Must be in exposed area
3. Has access to the sky



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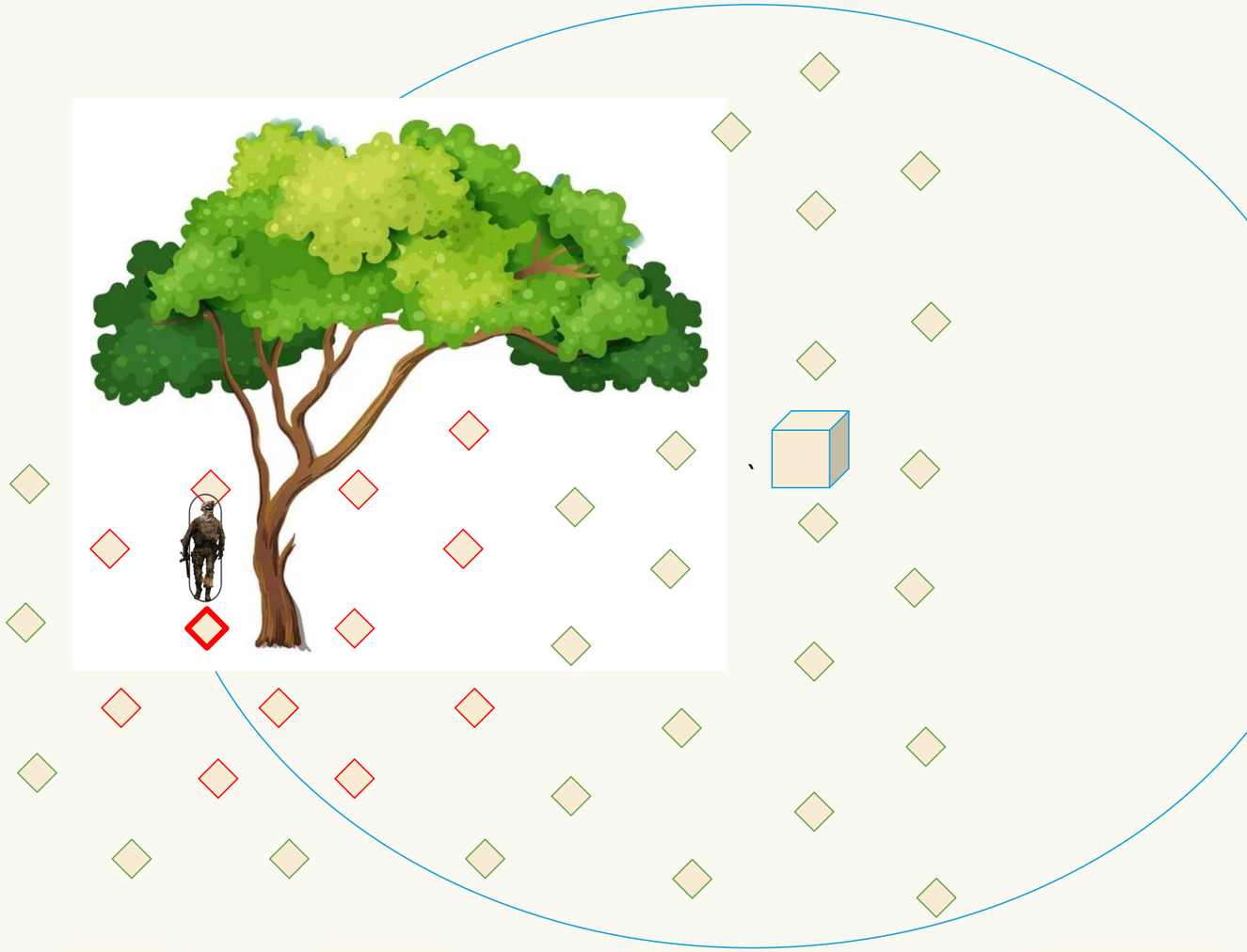
Where Can the Worm Unburrow?

1. Aim for nearest tacpoint if there is enough space
2. Otherwise, scan for highest exposed tacpoint in radius
3. Otherwise, use Arena home point



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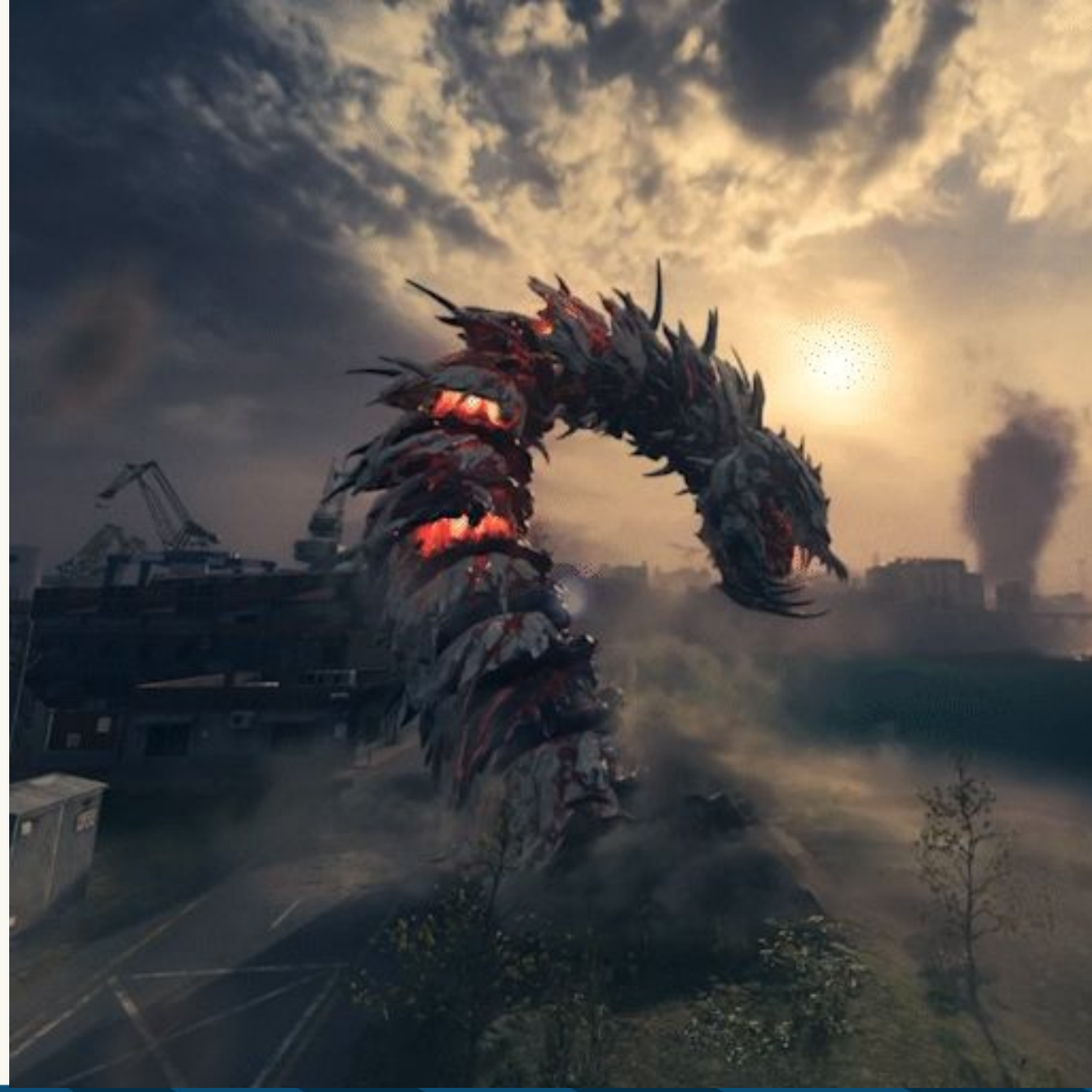
Worm Learnings and Reception

Highlights:

1. Unique Shark-like gameplay
   a. Cannot outrun
   b. Invulnerable to attacks
   c. Extreme damage
2. Easy to author arenas
   a. Provide suggestions + exclude areas was easy to understand



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Conclusion:
Simple Solutions are Underrated

1. Marked up arena with points + radius
2. Anti foot sliding is handled by some rotation math
3. Attach some collision to prevent player clipping
4. Re-use exposure data to determine unburrowing position
5. Simulate frustration to prevent players from “cheesing” the kill

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Questions?

Thank you for attending!

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