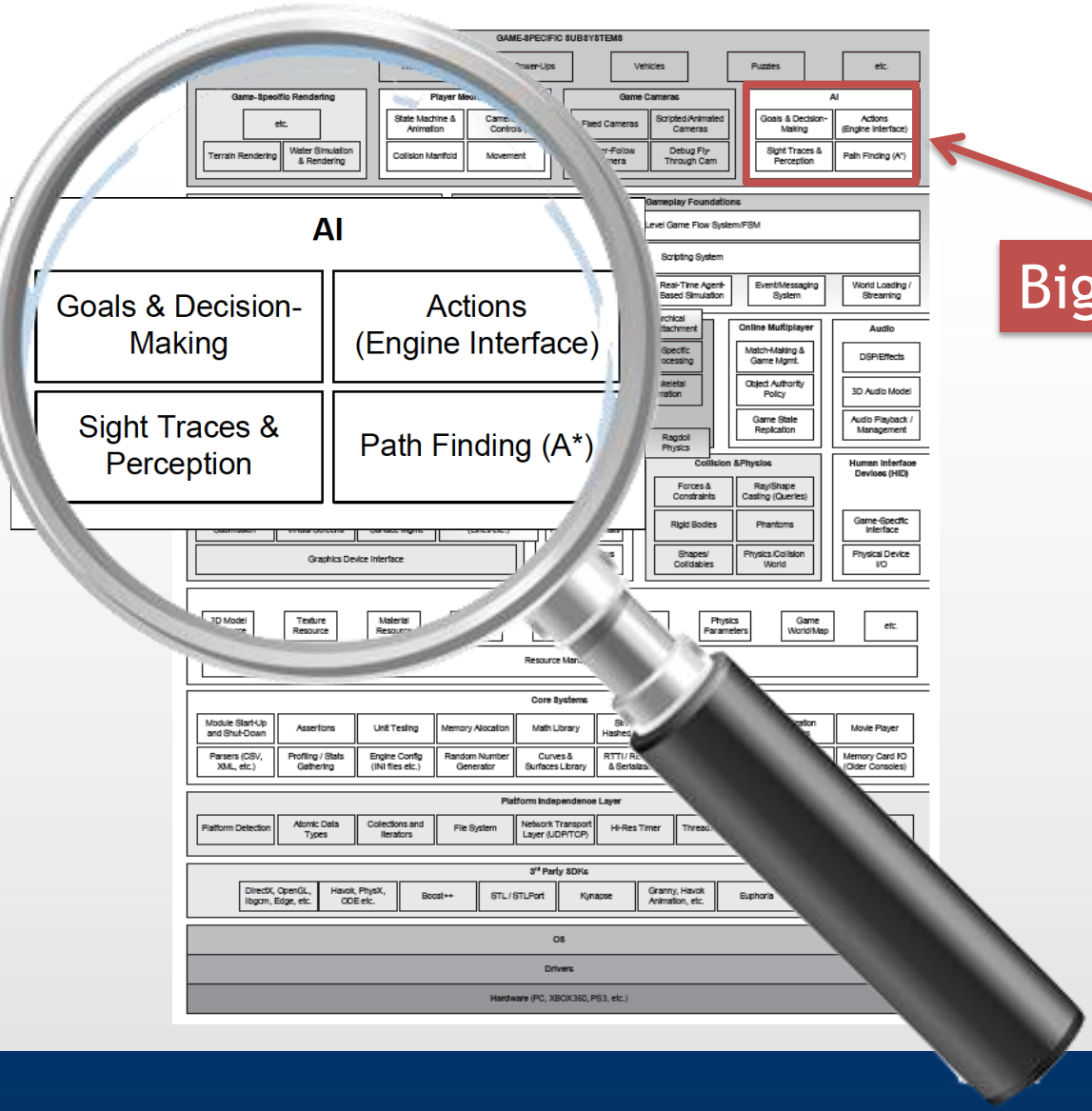
UNIVERSITÀ DEGLI STUDI
DI MILANO

Game Engines for AI

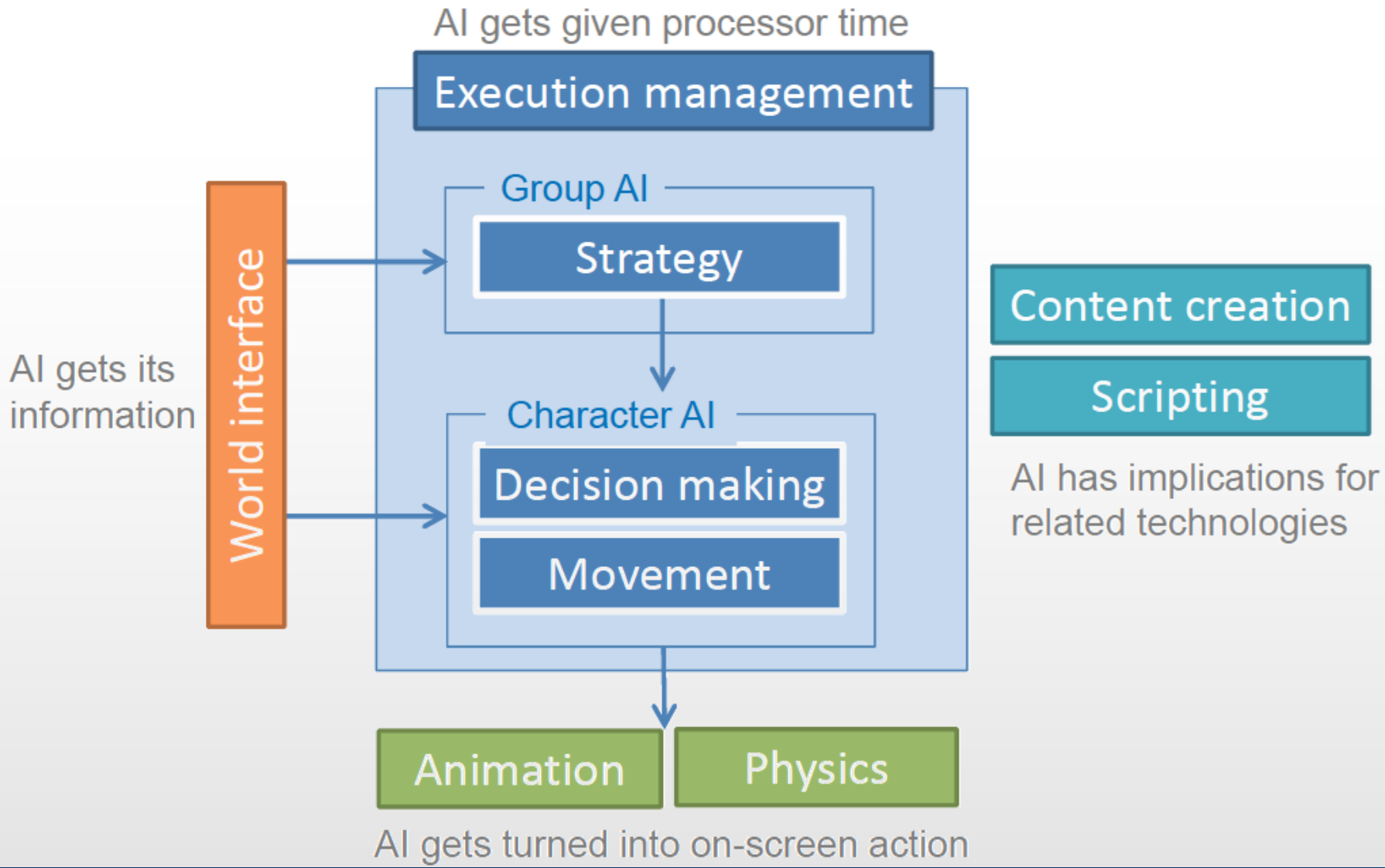
Lesson AI02

Dario Maggiorini (dario@di.unimi.it)

Now … About the A.I.?



A Generic A.I. Engine Architecture



What is Inside that A.I. Black Box?

- A collection of tools (a module) to help produce the illusion of intelligence in the behavior of non-player characters (NPCs)
  - The term “game A.I.” is often used to refer to a broad set of algorithms that also include techniques from control theory, robotics, computer graphics and computer science in general

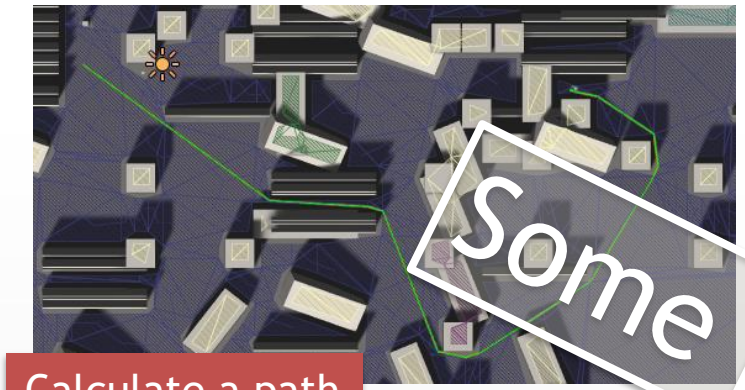
A.I. Implementation in Games

- At the core, there are basic techniques for planning and decision making
  - (Not just) Path finding/A*
  - Decision/Behaviour trees
  - Finite States Machines

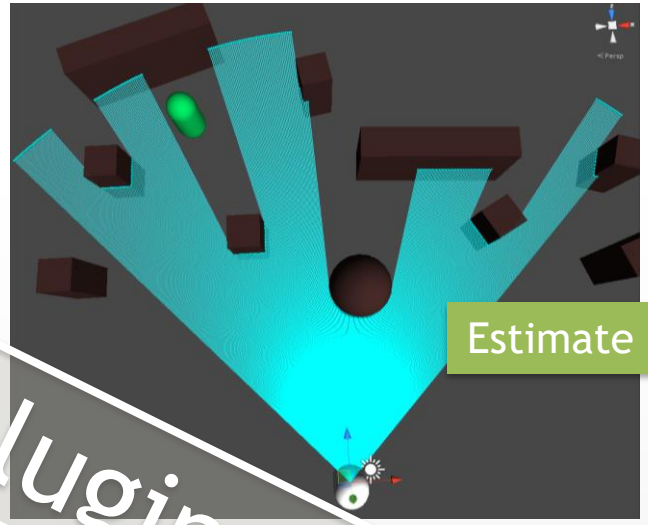
- Plus … something bonus to make your life easier
  - Perception
    - Line of sight
    - Cone of vision
    - Knowledge of the environment
  - Some form of (possible faulty) memory

- Core technologies might be already available in your engine or not
  - Remember, you are supposed to **select** the right engine for your game

In Unity and Unreal we Have Them Ready (!)

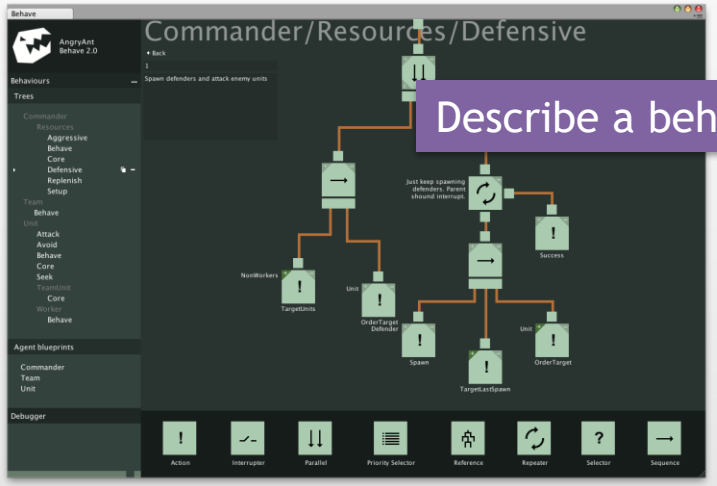


Calculate a path

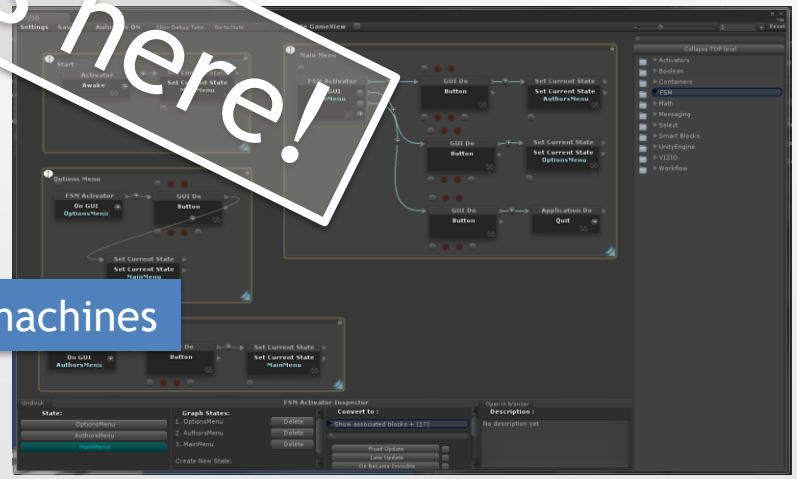


Estimate a field of View

Some plugins here!



Describe a behavior



State machines

… But it Was NOT Always There!

- At the beginning, A.I. was not considered as a rightful part of the game engine

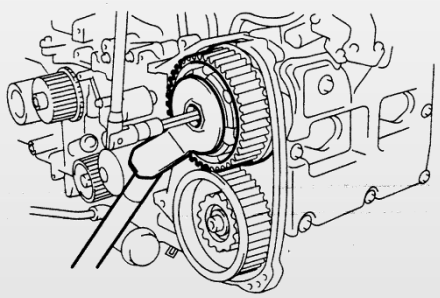
- Only recently, companies understood there are patterns belonging to A.I. and coming up in many games
  - Those parts, are slowly being integrated in game engines as core technologies
  - Will we talk about “patterns for A.I.” in the future?

A.I. Engine Architecture for Dummies

This is, as before, the engine core providing basic functionalities

Low level programmers

Core Technologies



More A.I. Implementation in Games

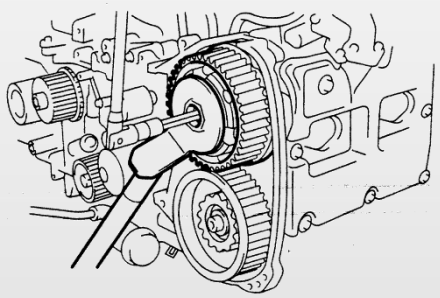
- On top of the core technologies, we can build character control systems
  - Locomotion
  - Navigation
  - Driving
  - Using weapons
- Everything … defining rules in your A.I.
- Think to them as “general services” which are useful for more than one game

A.I. Engine Architecture for Dummies

Gameplay programmers

Character Control

Core Technologies

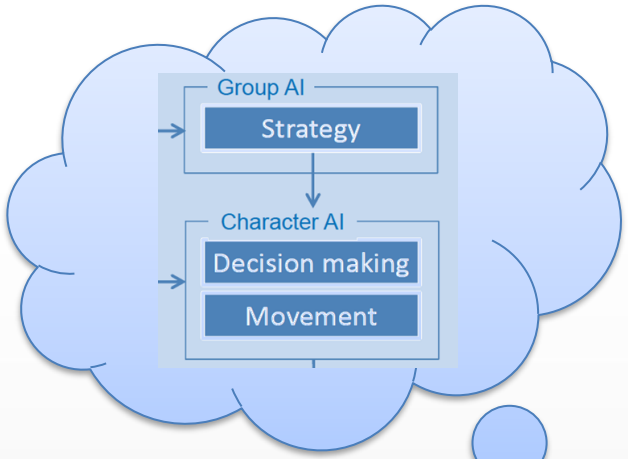


Even More A.I. implementation in Games

- Above the character control system the A.I. take care of goal settings and decision making
  - Emotional states
  - Group behaviors
    - Coordination
    - Cooperation
    - Flocking
  - Expert systems

- These, can be game-specific

A.I. Engine Architecture for Dummies

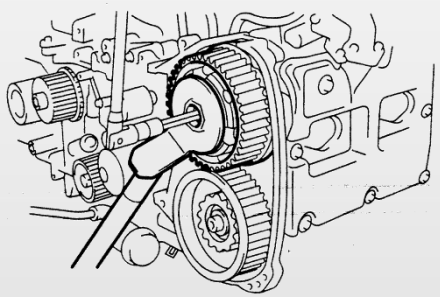


A.I. programmers

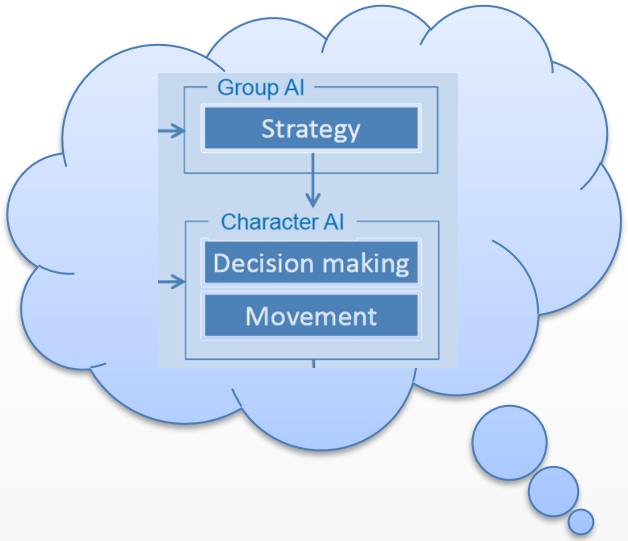
Goals & Decisions

Character Control

Core Technologies



A.I. Engine Architecture for Dummies



As before, layer distinction is blurry
You might end up mixing Decision and Character Control or completely splitting Goals from Decisions

Water level will vary depending on engine

Goals & Decisions

Character Control

Core Technologies

Forget About Fast CPUs and Huge Memory

- Always remember
  - You run on CPU, memory, and energy budget
    - A **SMALL** budget if the console is portable
  - You MUST update all the world each frame

- Just forget about
  - Complex (and looooooong to run) algorithms
  - Cutting edge A.I. techniques

Simply put: do we have enough resources to keep pace with the rest of the game and provide believable NPCs?

However …

- Games A.I. is focused on (possibly good) gameplay and its approach is very different from that of traditional A.I.
  - Workarounds and cheats are acceptable
  - NPCs skills must be toned down to give human players a sense of fairness

What about an FPS where NPCs perfect aiming is very far beyond any human skill?

NO ONE will play your game!

… but Life is not so Bleak

- Faster processors and bigger (cache) memories are hitting the shelves in waves
  - And, if you have a cloud, you can have nearly-infinite power
- GPU are an excellent way to decentralize data processing (using a SIMD approach)
  - In the last 5 years, processing power available for A.I. computation has increased by 20 to 50%
- In-CPU parallel processing is more and more available
  - Such as multi-core and hyper-threading
- Nevertheless … “optimal” (read “conventional”) A.I. algorithms are still too time demanding to be run

And New Technologies are Emerging

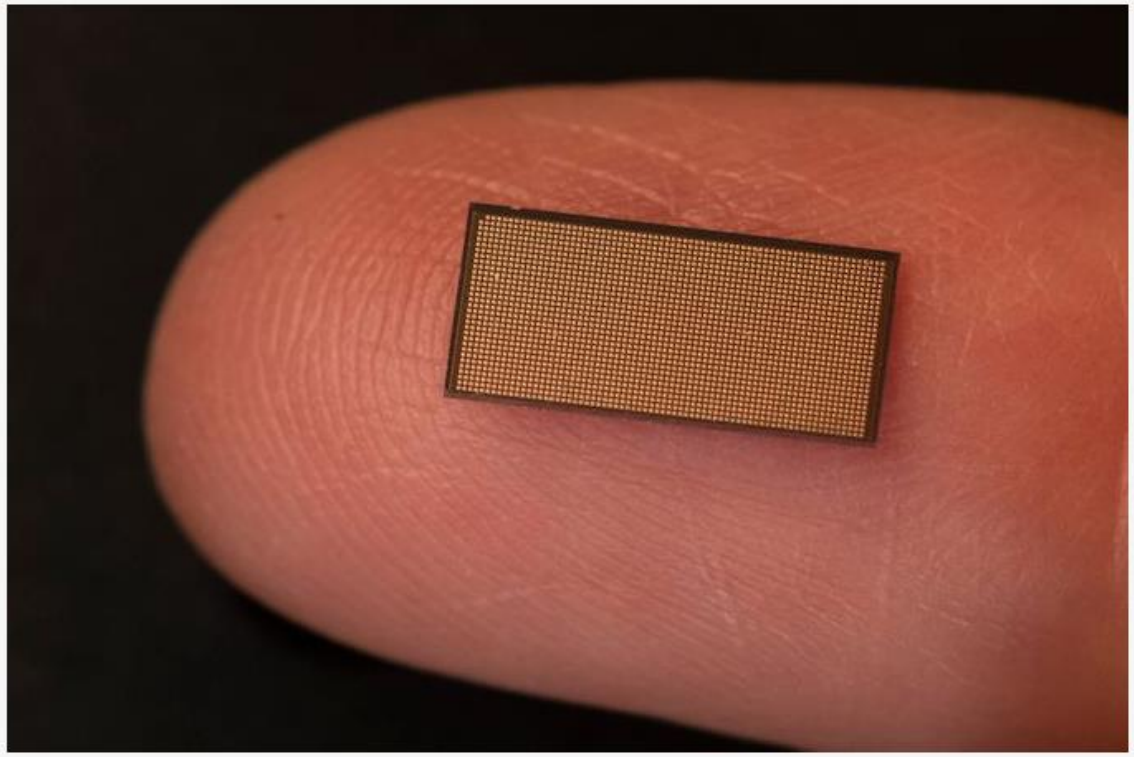
Intel Rolls Out New Loihi 2 Neuromorphic Chip: Built on Early Intel 4 Process

64 Comments

+ Add A Comment

by Dr. Ian Cutress on September 30, 2021 11:00 AM EST

Posted in CPUs Intel Labs Neuromorphic Intel 4 Intel 4nm Loihi Loihi 2 Neurons Synapses



Beware of Low-End Machines

- In low-end machines you simply have less time and less computational power
  - It is true also for handheld devices
- Graphics
  - You switch off details
- A.I.
  - You make it dumber

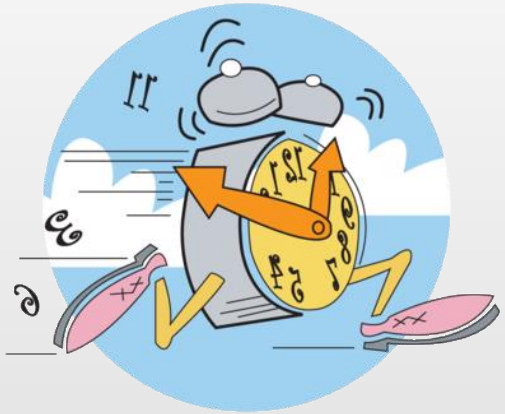
The game designer will NOT let you do this!

Updating A.I. (A.I. Framerate)

- A.I. might need to be serviced by the game loop only once or twice per seconds
  - The game loop is the scheduler in charge to update system status inside a game engine

- A.I. does NOT need to be synchronized with the rendering loop
  - No need to re-take all decisions 60 times each second

You will NEVER make it in time, anyway



Study Material

- Game Engine Architecture
  3rd edition, ISBN 1138035459
  by Jason Gregory
  Chapter 1, up to § 1.7.4 included

- Textbook
  § 1.2, up to 1.2.5 included