

Introdução à Inteligência Artificial aplicada a Jogos Digitais

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CRAb

Computação Gráfica, Realidade Virtual, Animação e Visualização Científica

Deep Reinforcement Learning para Jogos

Deep Learning + Aprendizado por Reforço



UNIVERSIDADE
FEDERAL DO CEARÁ



CRAb COMPUTER GRAPHICS VIRTUAL REALITY AND ANIMATION

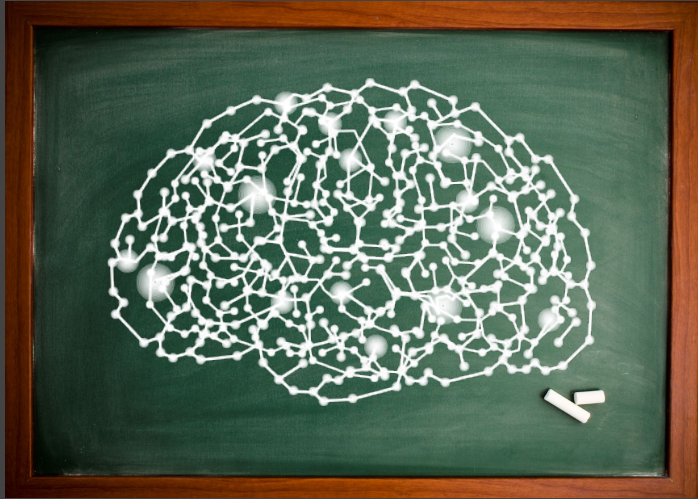
MINHA PESQUISA

youtu.be/JTNZCX01r2Y



70 100% 2 3 4 5 6 7 0% 78 0 0 0 200 50 50 300

AMMO HEALTH ARMS ARMOR



Vs



Academia

Novidades

**Melhor
solução**

**Problemas
complexos**

Indústria

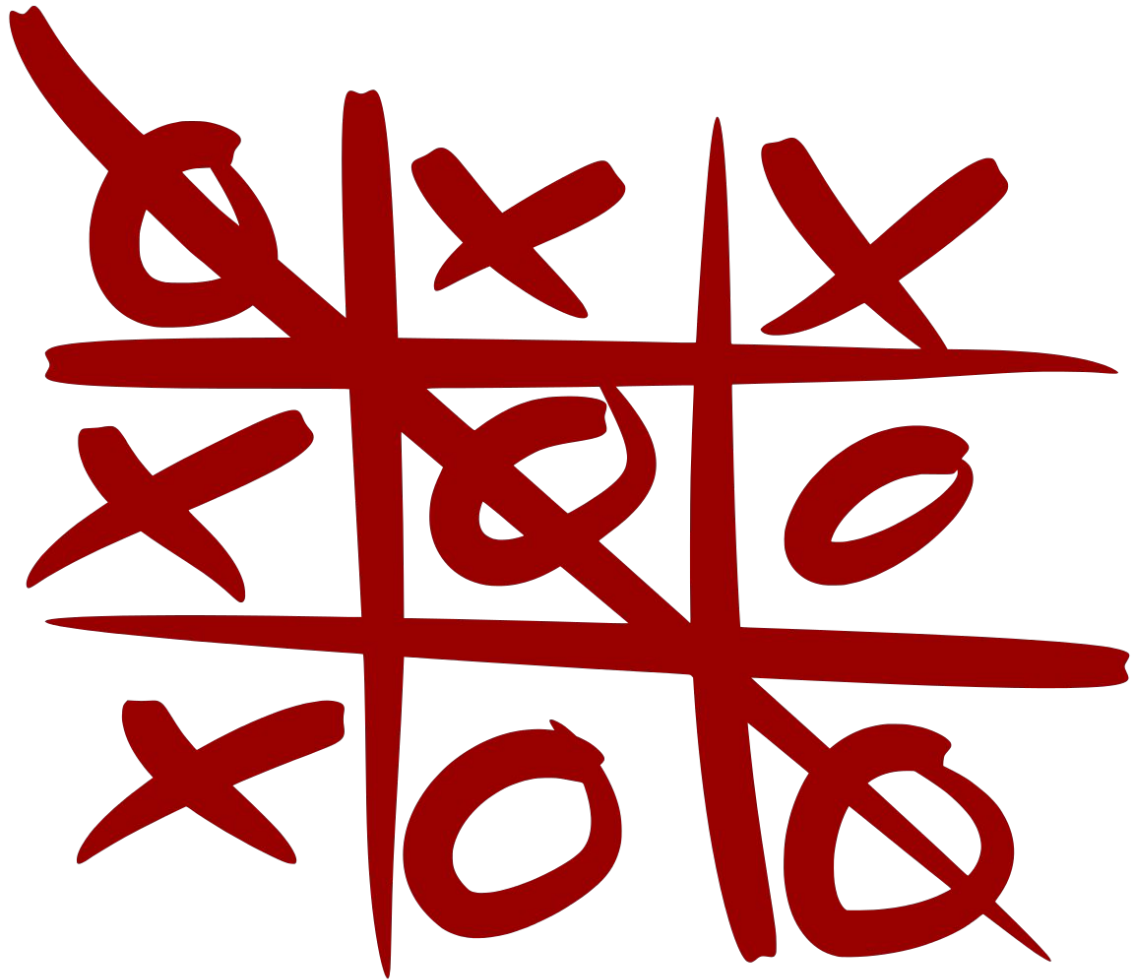
Restrições

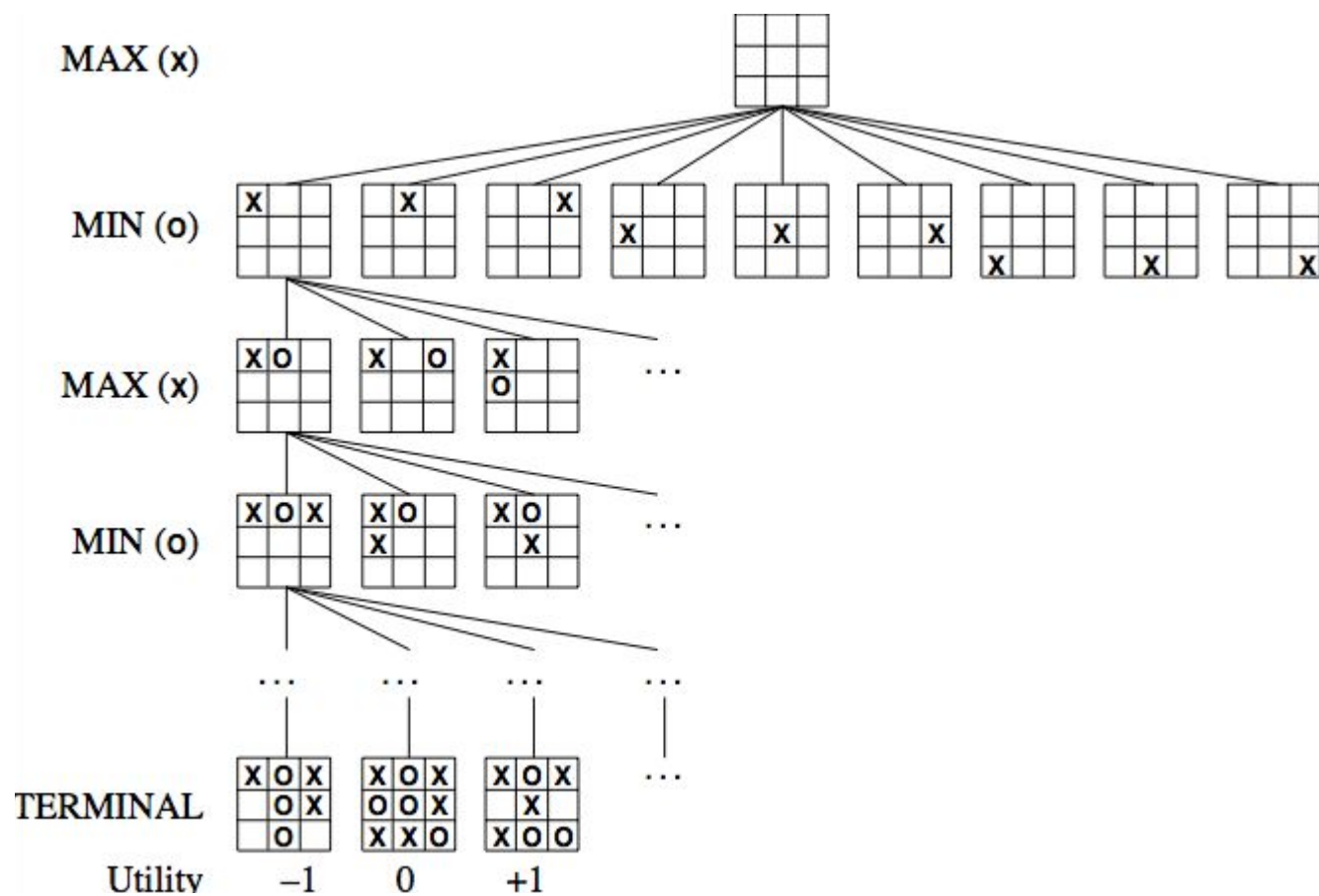
Diversão

Praticidade

A photograph of two men with curly hair and beards, dressed in dark suits, leaning over a wooden chessboard. They are in a focused, contemplative state, looking at the pieces on the board. The lighting is dramatic, highlighting their profiles and the texture of the wood and fabric. The background is a plain, light-colored wall.

Jogos de tabuleiro









Chinook (Jonathan Schaeffer) vs Marion Tinsley (1994)





GM Kasparov 2.5 vs 3.5 Deep Blue (1997)



Komodo Chess Engine 2.5 x 1.5 GM Nakamura (2016)





ALPHAGO
01:58:30

LEE SEDOL
01:59:11

Mind
Match

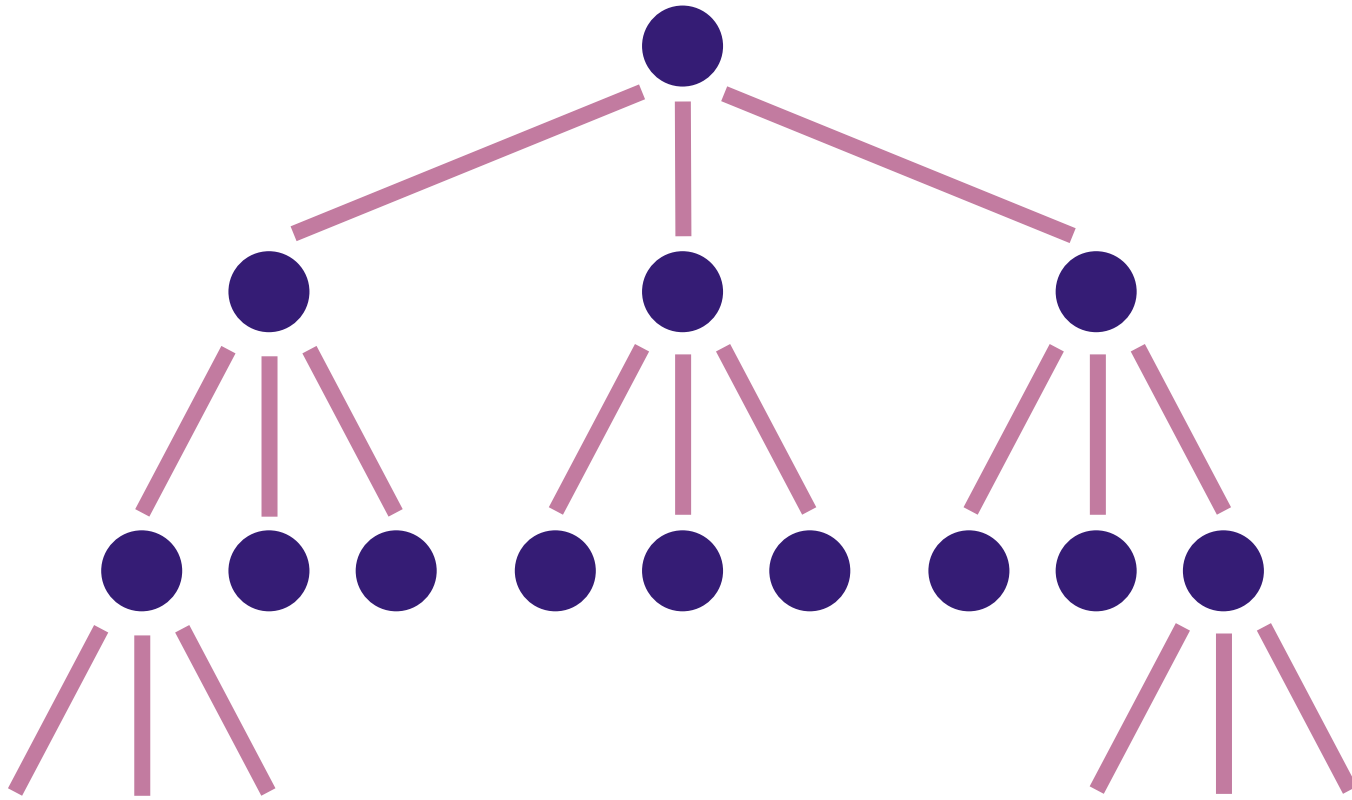
AlphaGo

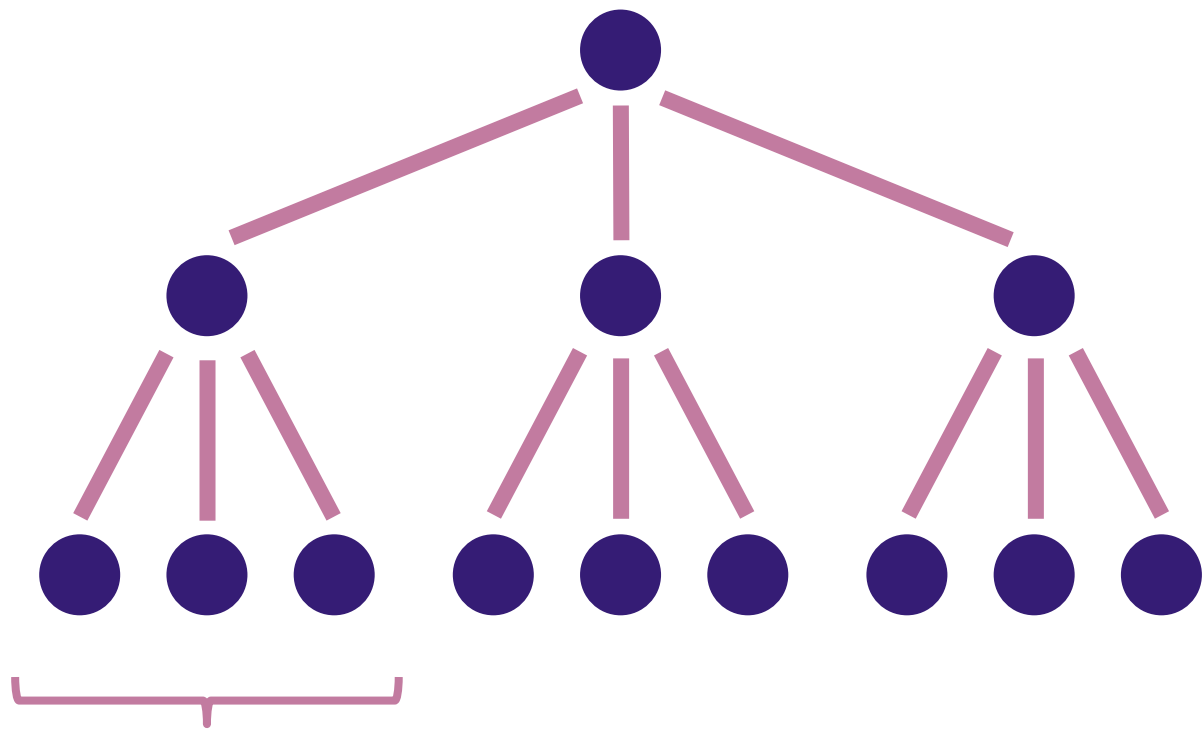


Lee Sedol

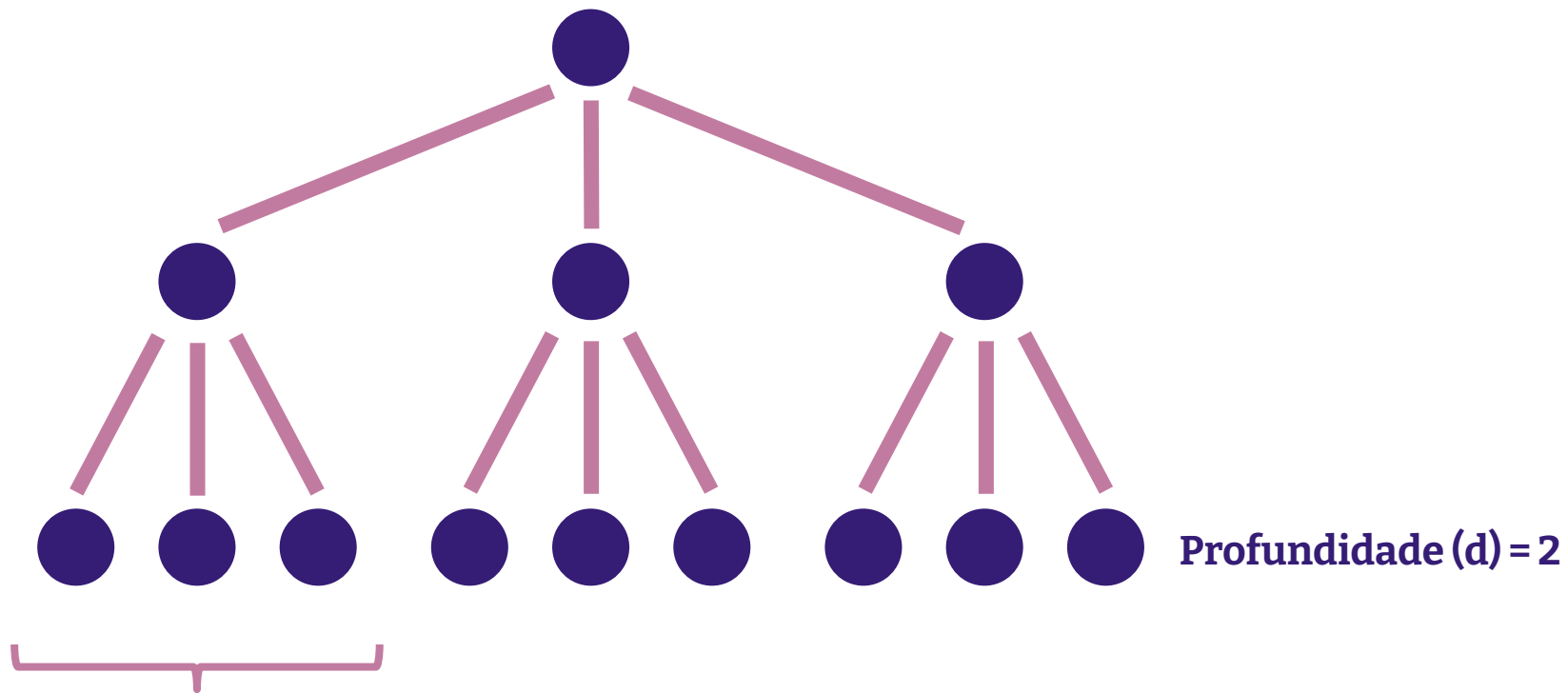


AlphaGo 4 vs 1 Lee Sedol

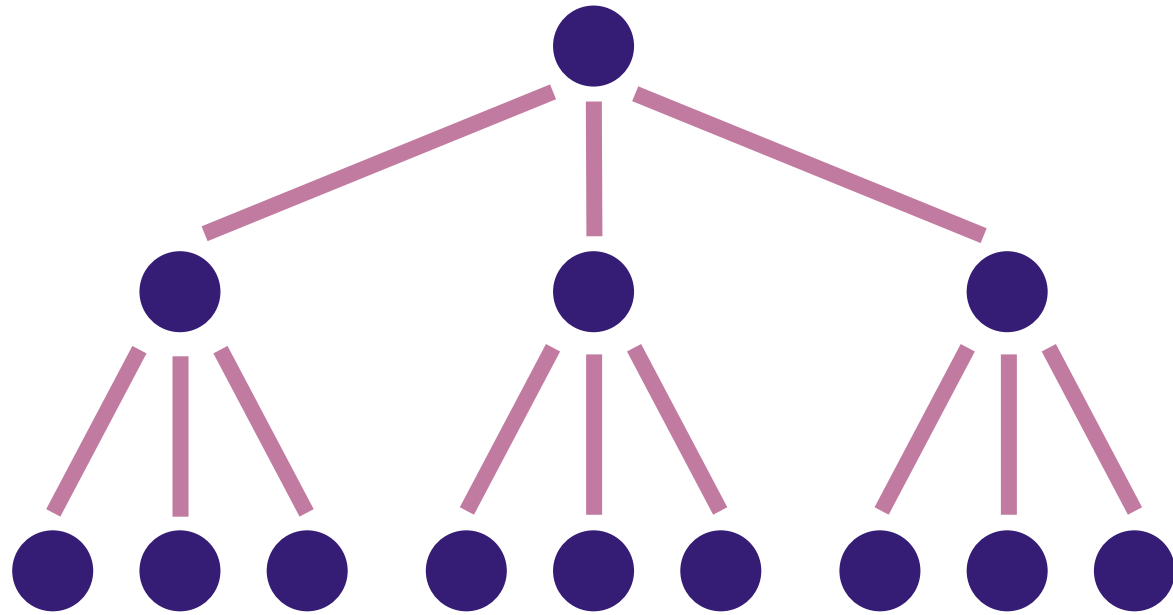




Fator de ramificação (b) = 3



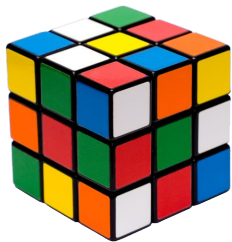
Fator de ramificação (b) = 3



Profundidade (d) = 2

Fator de ramificação (b) = 3

Complexidade em
relação ao tempo = $O(b^d)$



$b = \sim 13.34$

$d = \sim 18$

Espaço de busca = $\sim 10^{19}$



$b = \sim 35$

$d = \sim 100$

Espaço de busca = $\sim 10^{120}$



$b = \sim 300$

$d = \sim 150$

Espaço de busca = $\sim 10^{360}$



$b = \sim 10^{100}$

$d = ?$

Espaço de busca = ???

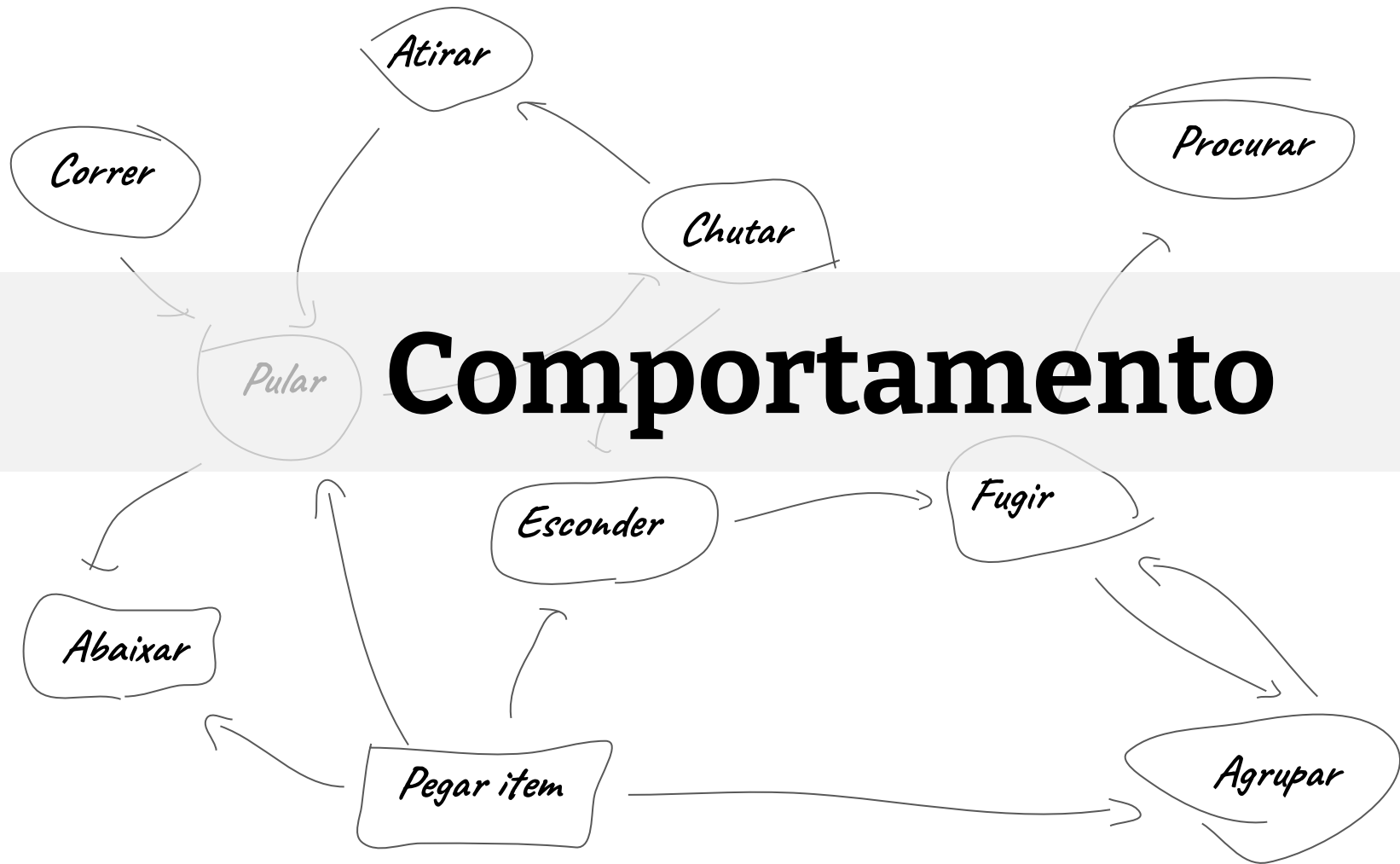


O que é
**INTELIGÊNCIA
ARTIFICIAL**

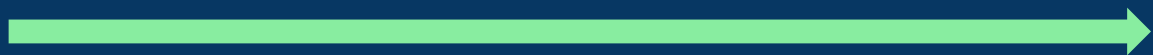
para
JOGOS?

(comerciais)





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Fácil



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Fácil



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Fácil



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Fácil

Ideal

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Fácil



Ideal



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Fácil



Ideal

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Fácil

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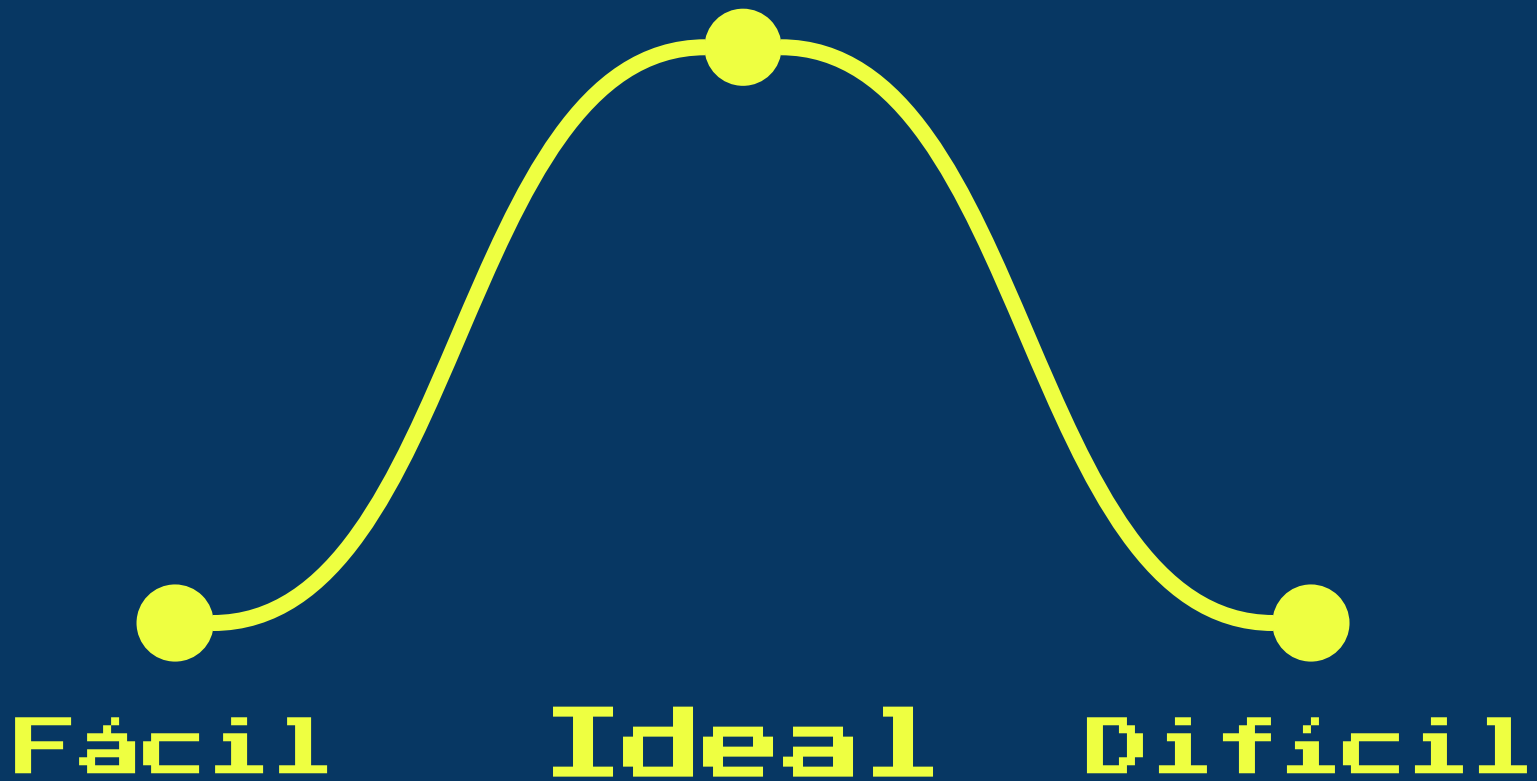


Fácil

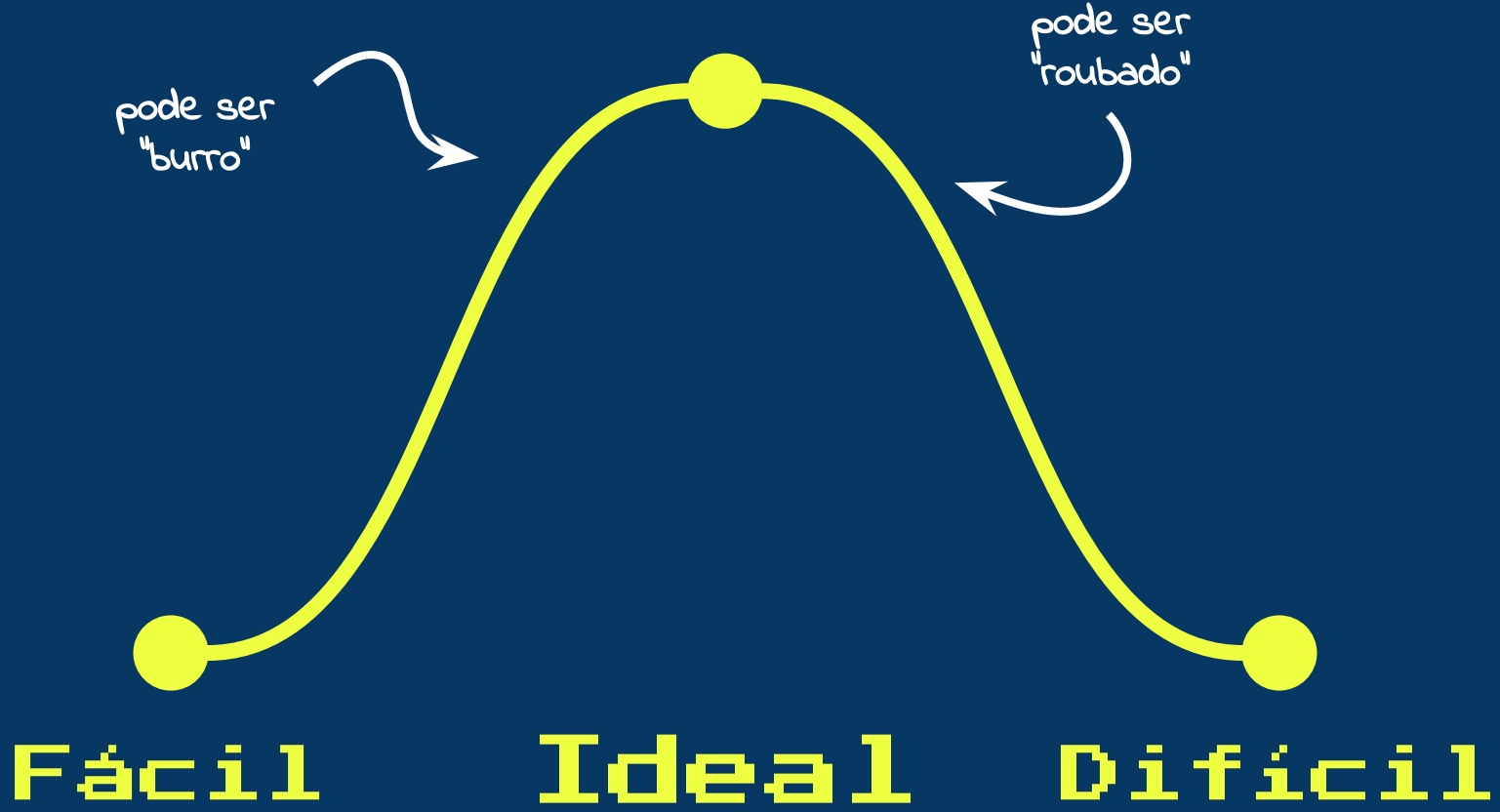
Ideal

Difícil

Complexidade



Complexidade



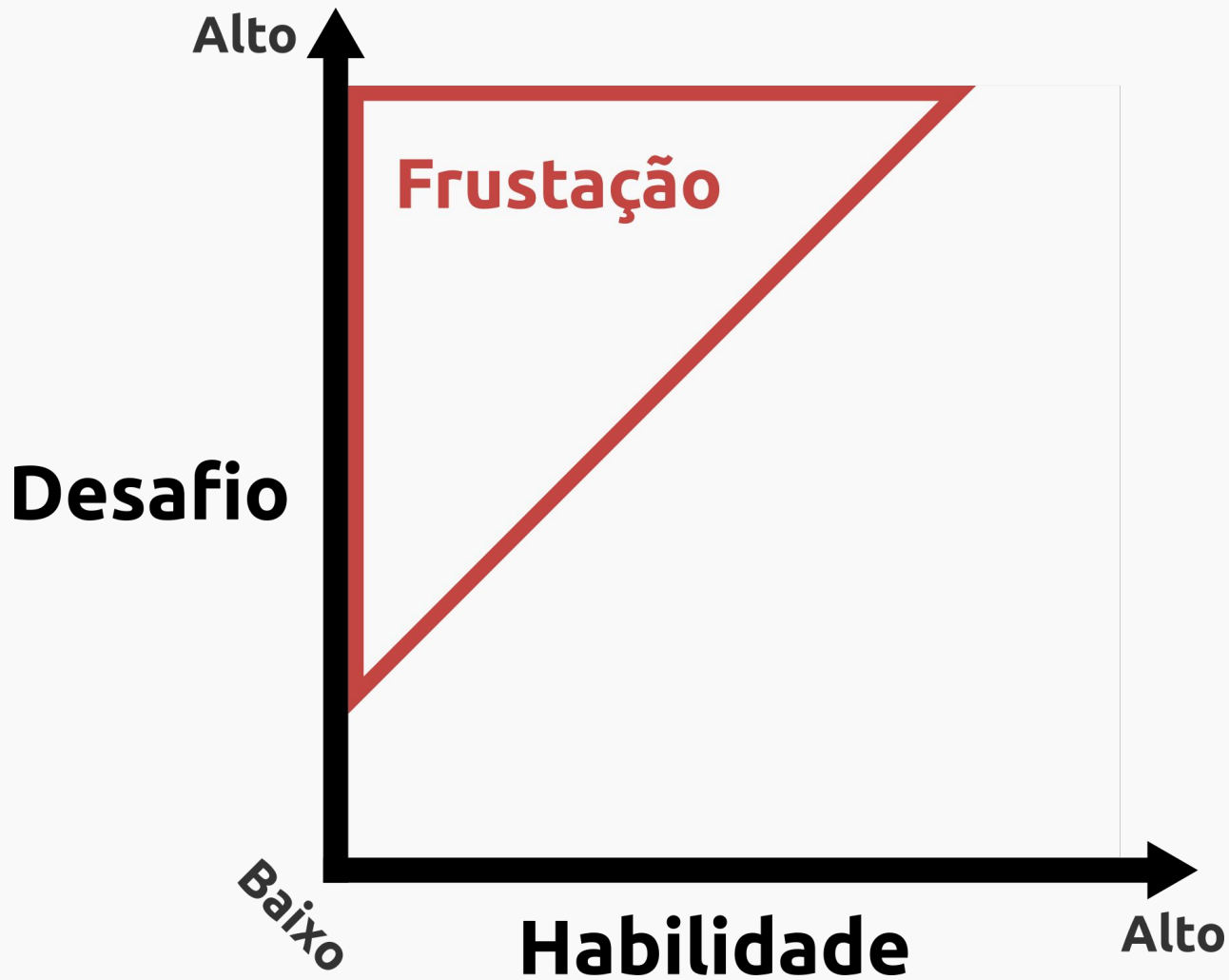
Desafio

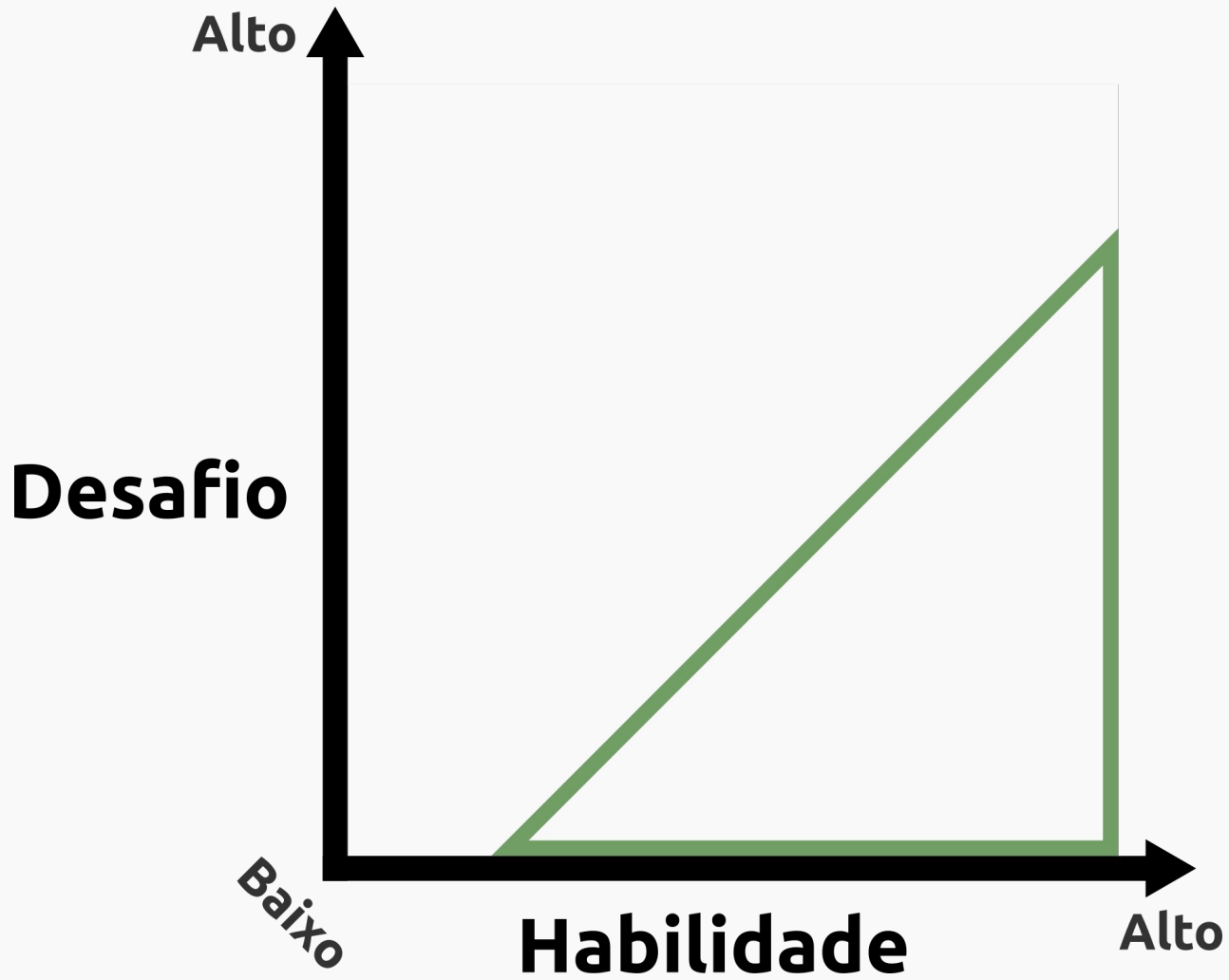
vs.

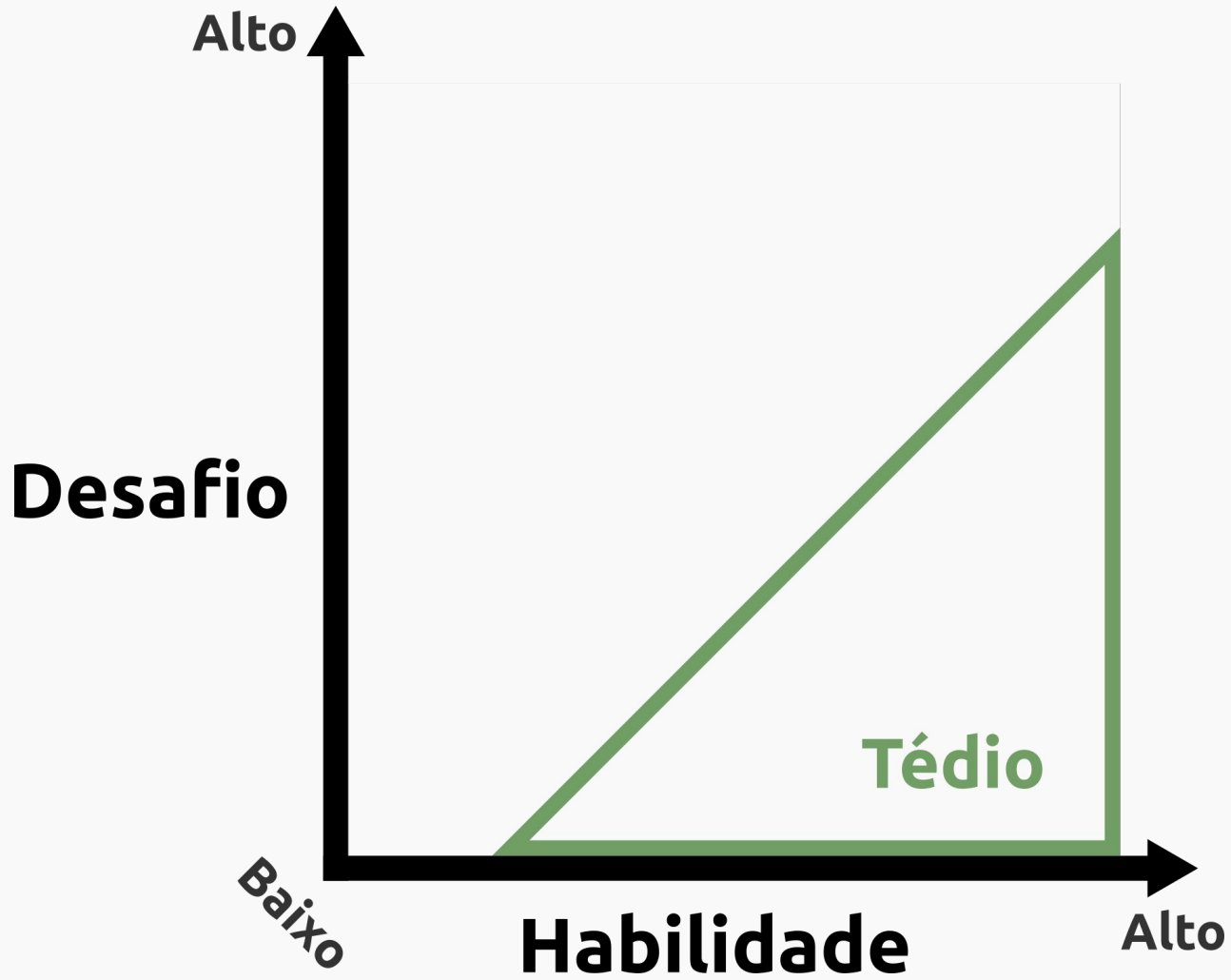
Habilidade

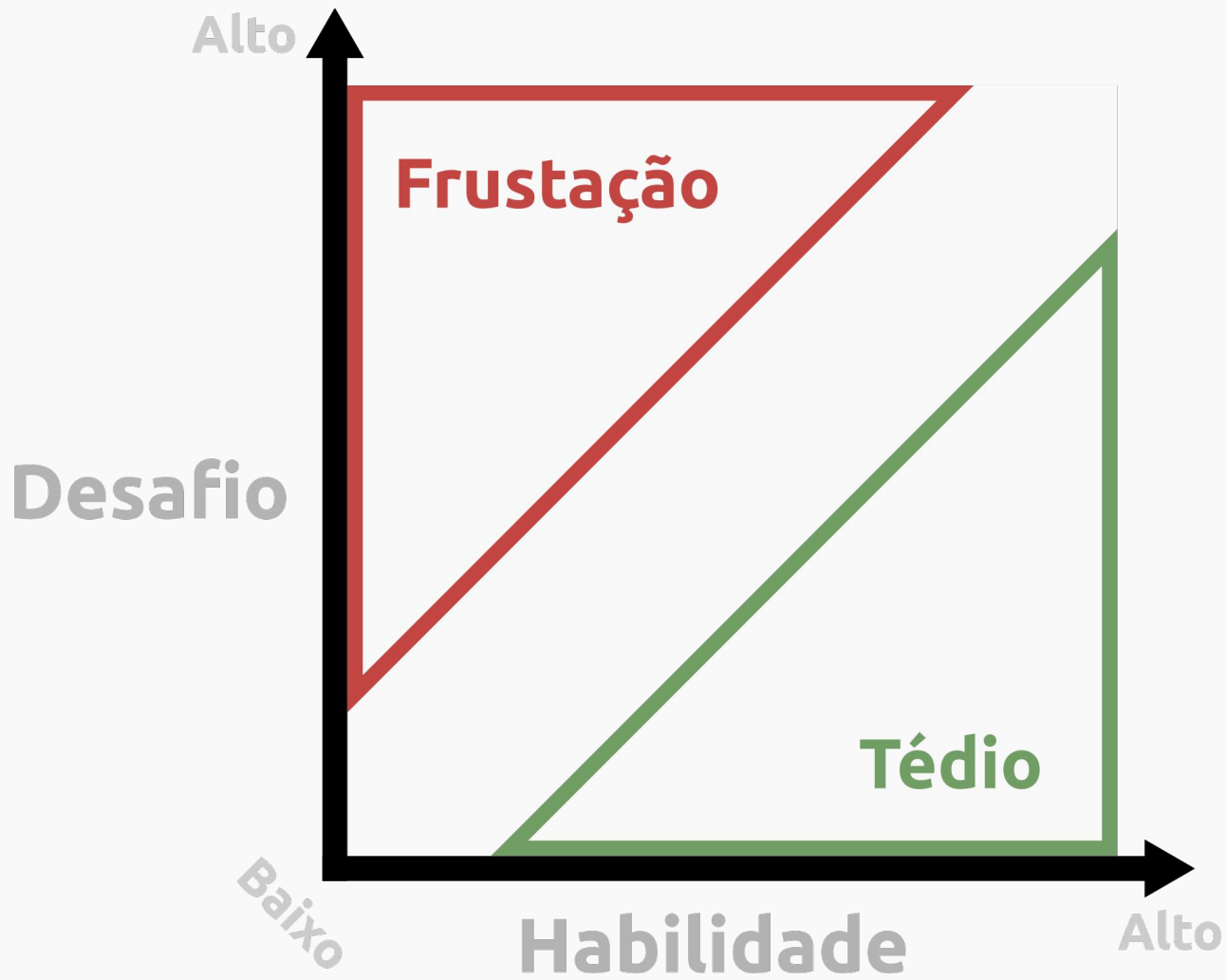


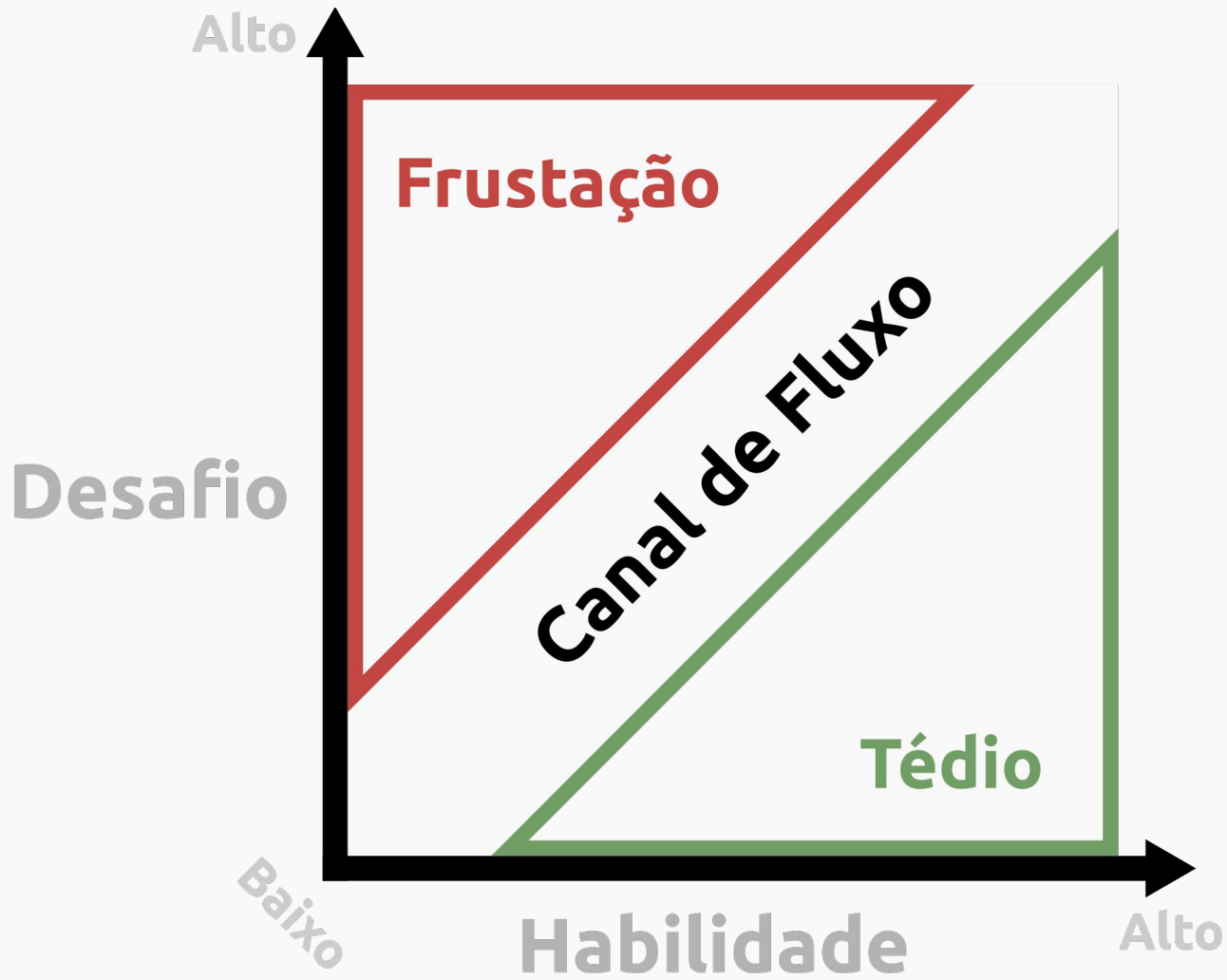


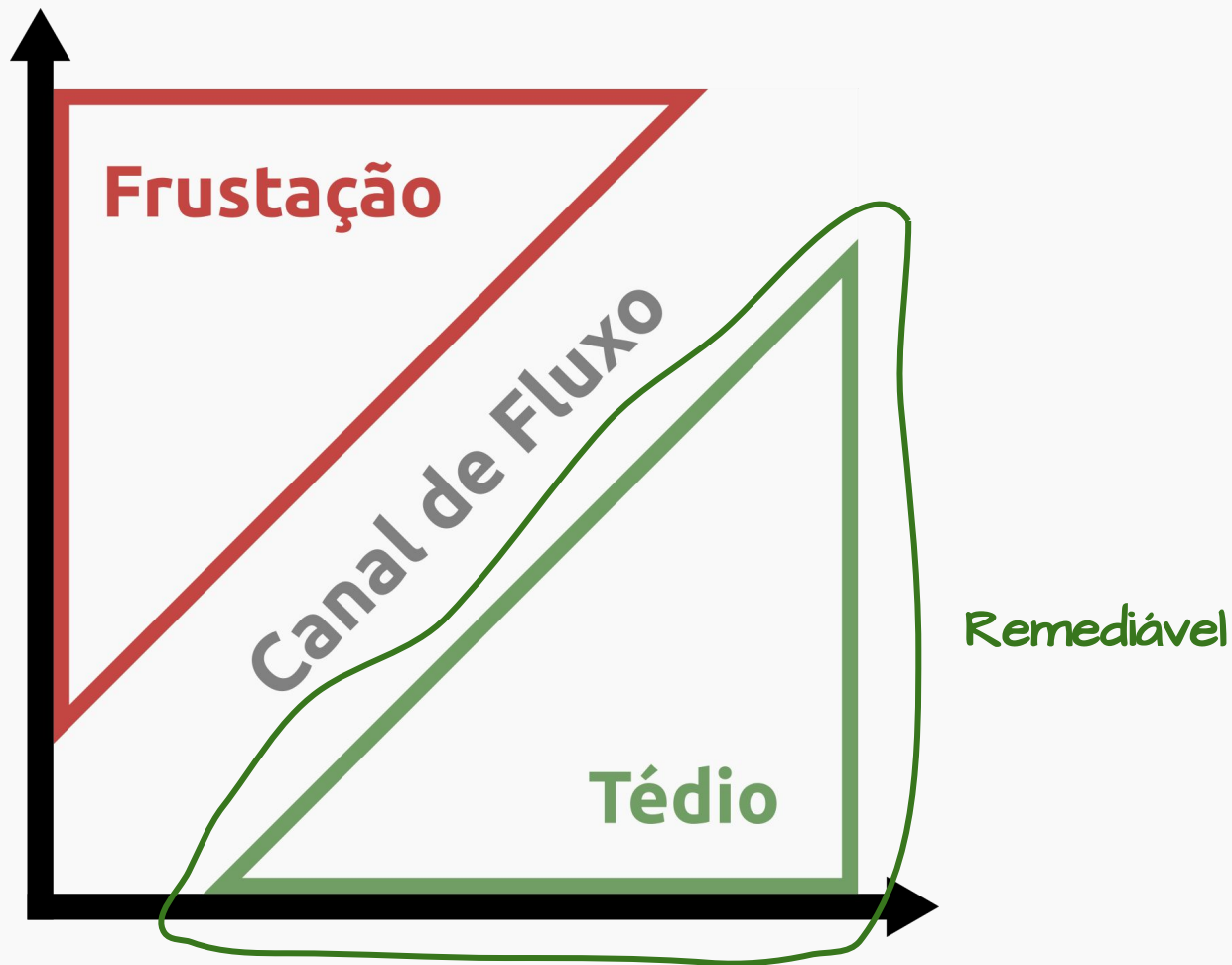




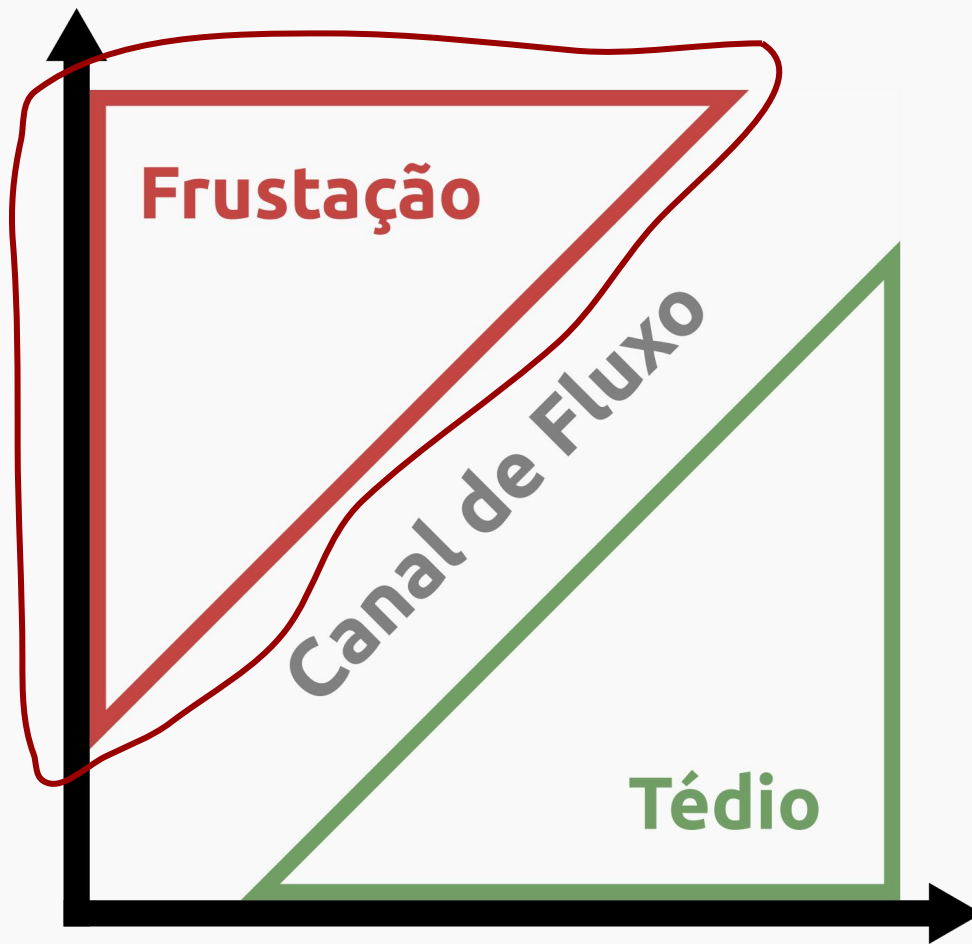




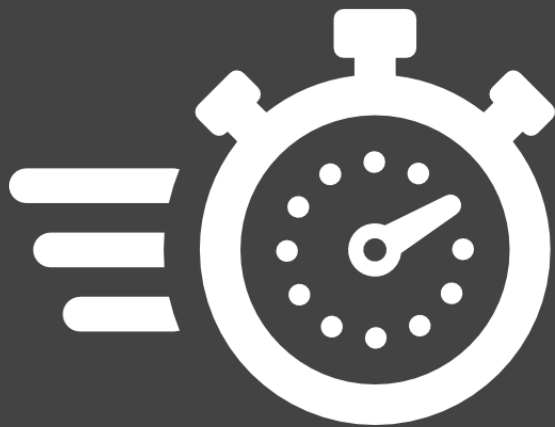




Morte
do jogo



**“Boa o suficiente para ser desafiadora,
Ruim o suficiente para ser divertida”.**



“Boa o suficiente para ser desafiadora,
Ruim o suficiente para ser divertida”.

60 **Frames**
Per
Second

60

**Frames
Per
Second**

$$60 \text{ Frames Per Second} = \frac{60 \text{ frames}}{1 \text{ segundo}}$$

$$\frac{1 \text{ segundo}}{60 \text{ frames}} \times \frac{1000 \text{ milisegundos}}{1 \text{ segundo}}$$

$$\frac{\cancel{1} \text{ segundo}}{60 \text{ frames}} \times \frac{1000 \text{ milissegundos}}{\cancel{1} \text{ segundo}}$$

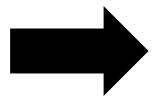
1
frame



$$\frac{1000 \text{ milissegundos}}{60 \text{ frames}}$$

1

frame



16.7

milissegundos

Input

IA

Física

Renderização

Input

Input

IA

Física Física

Input

IA

Renderização

Física

Renderização

Input IA

Input

Renderização

IA

Física

Física

Renderização

Input

Renderização

IA

Física



A dense word cloud featuring the following terms: Física, IA, Input, Rendimento, and Aprendizagem. The words are rendered in various sizes, orientations, and shades of gray, creating a complex, overlapping visual composition.

16.7

milissegundos

Input

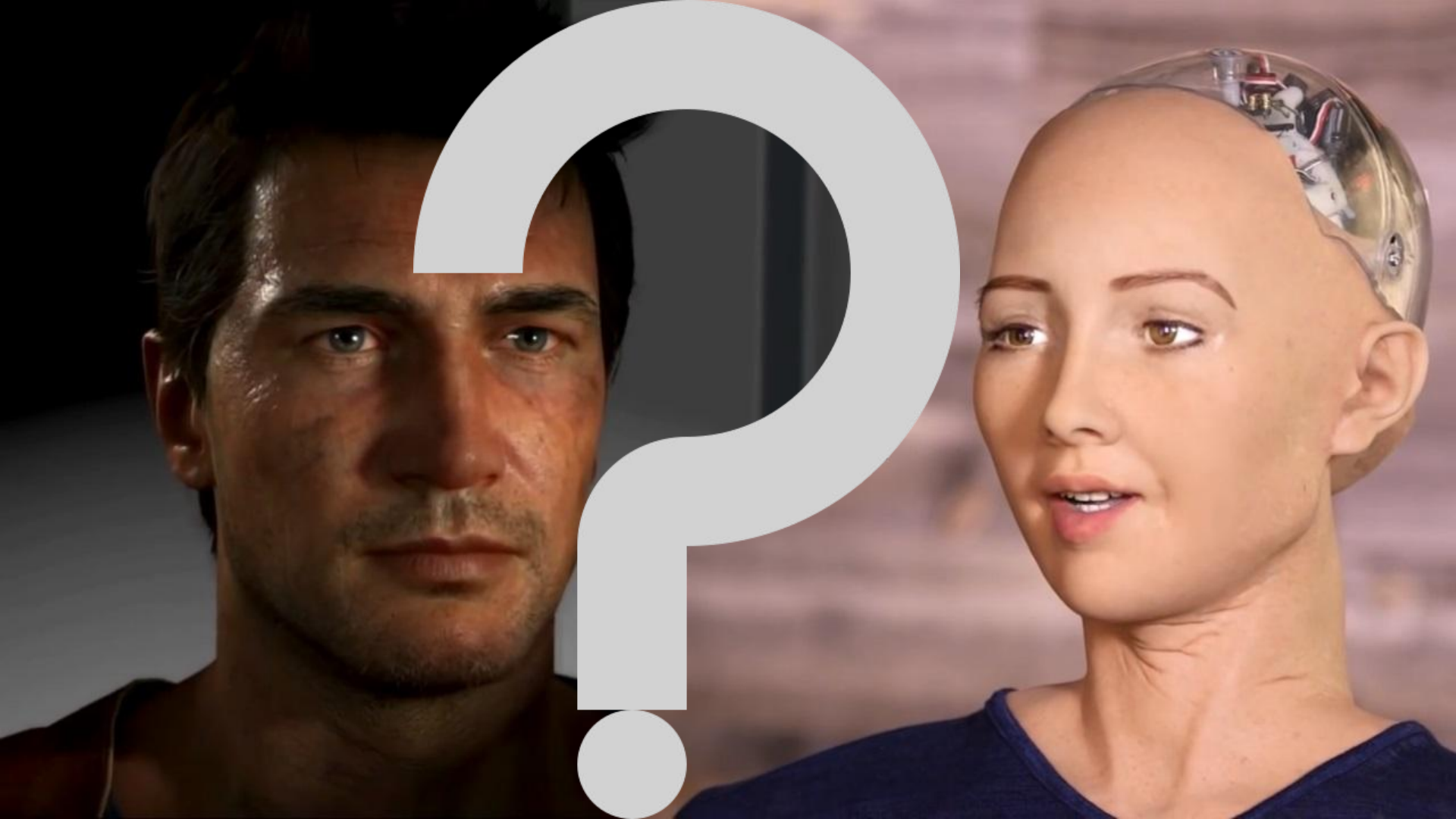
IA

Física

Renderização

Gráficos

IA

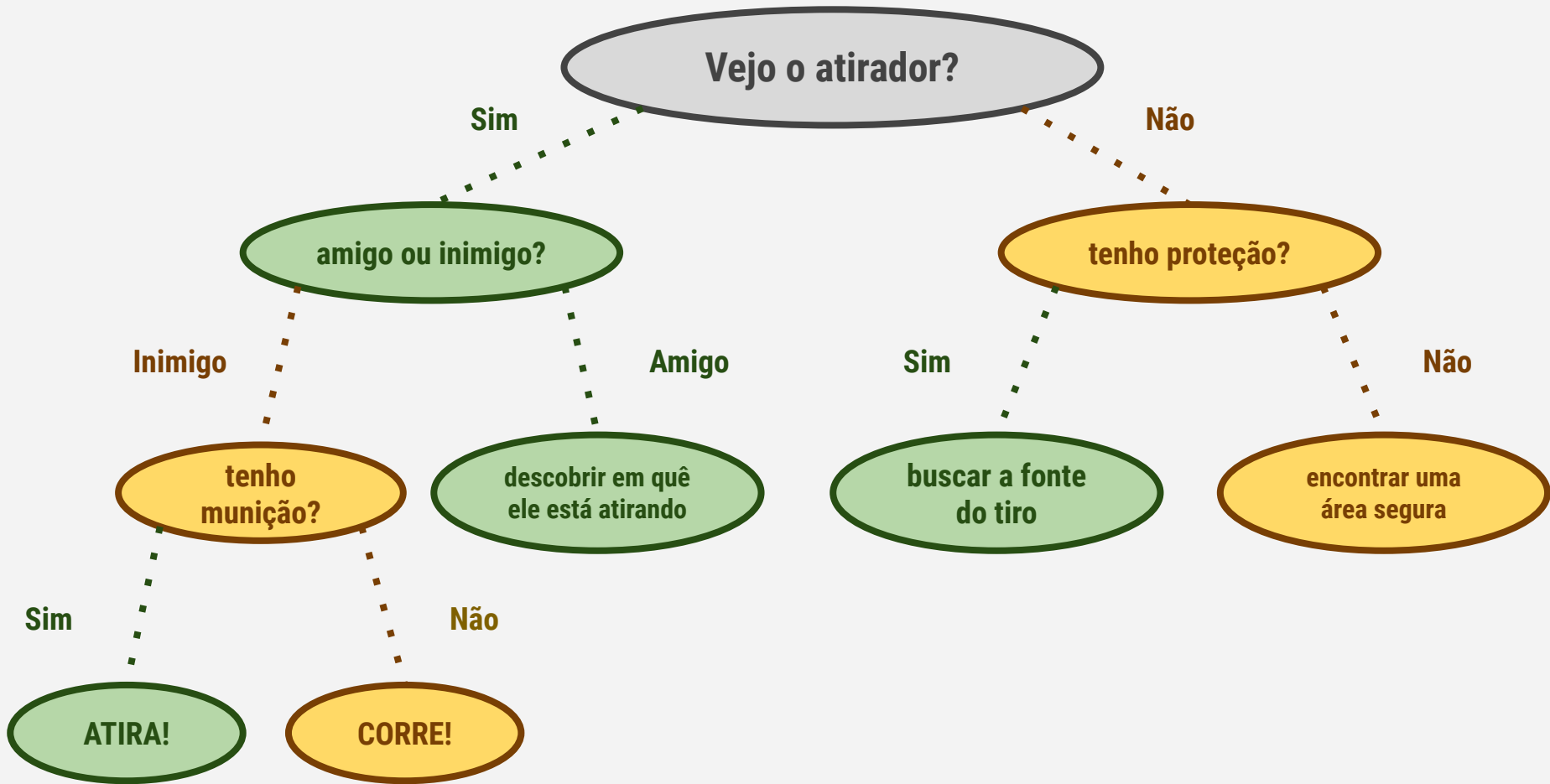




Exemplos de Técnicas utilizadas



Árvores de decisão



ALERT

危険

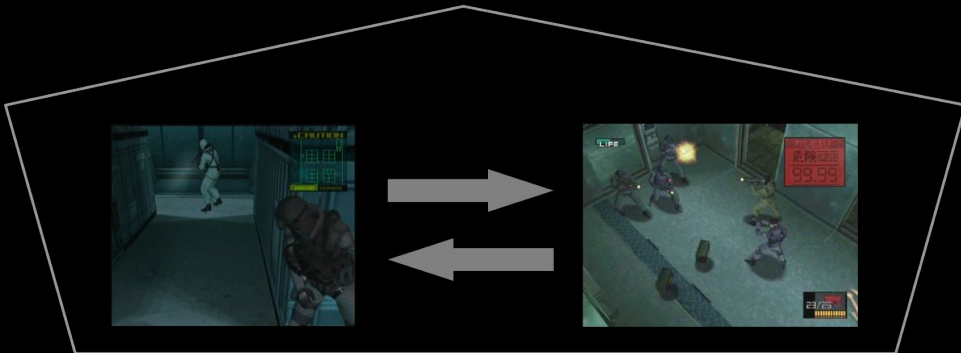
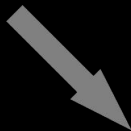
Máquina de
Estados
Finitos

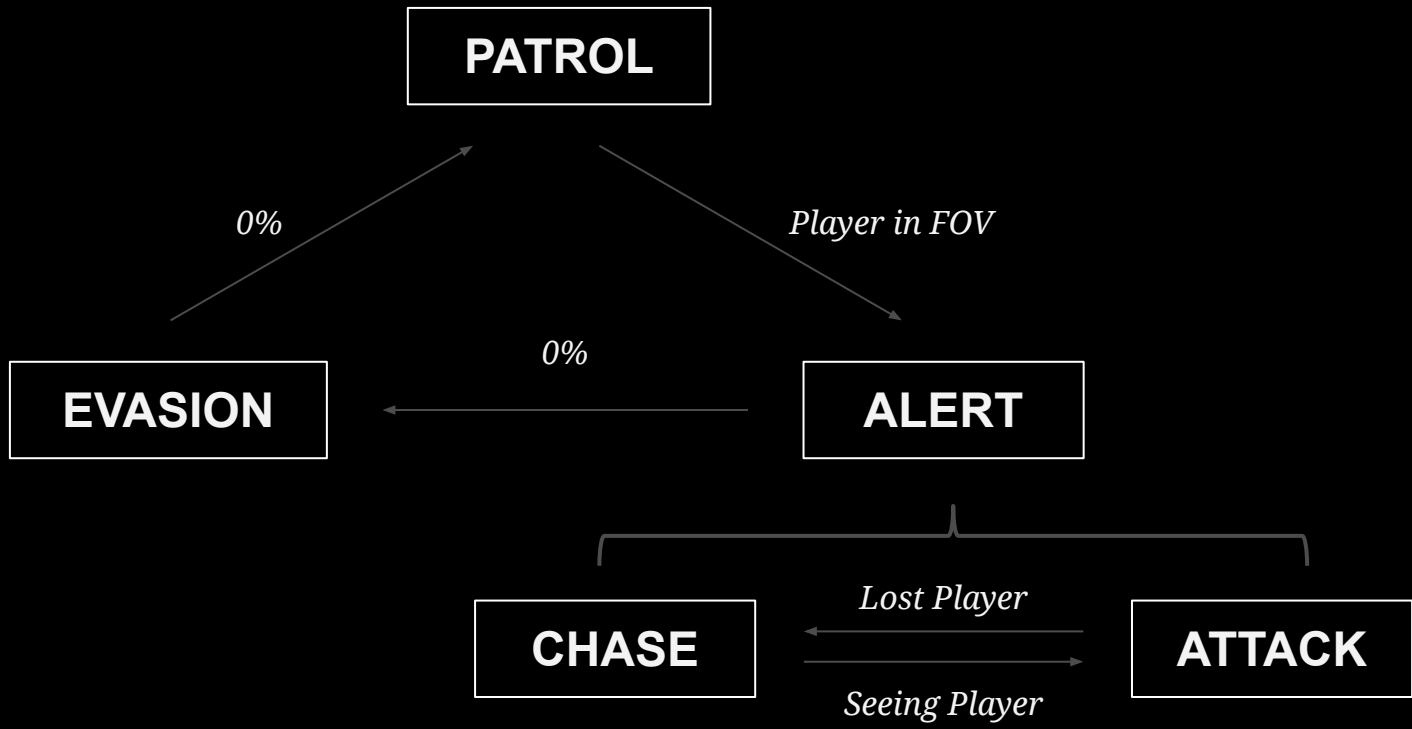
99.99

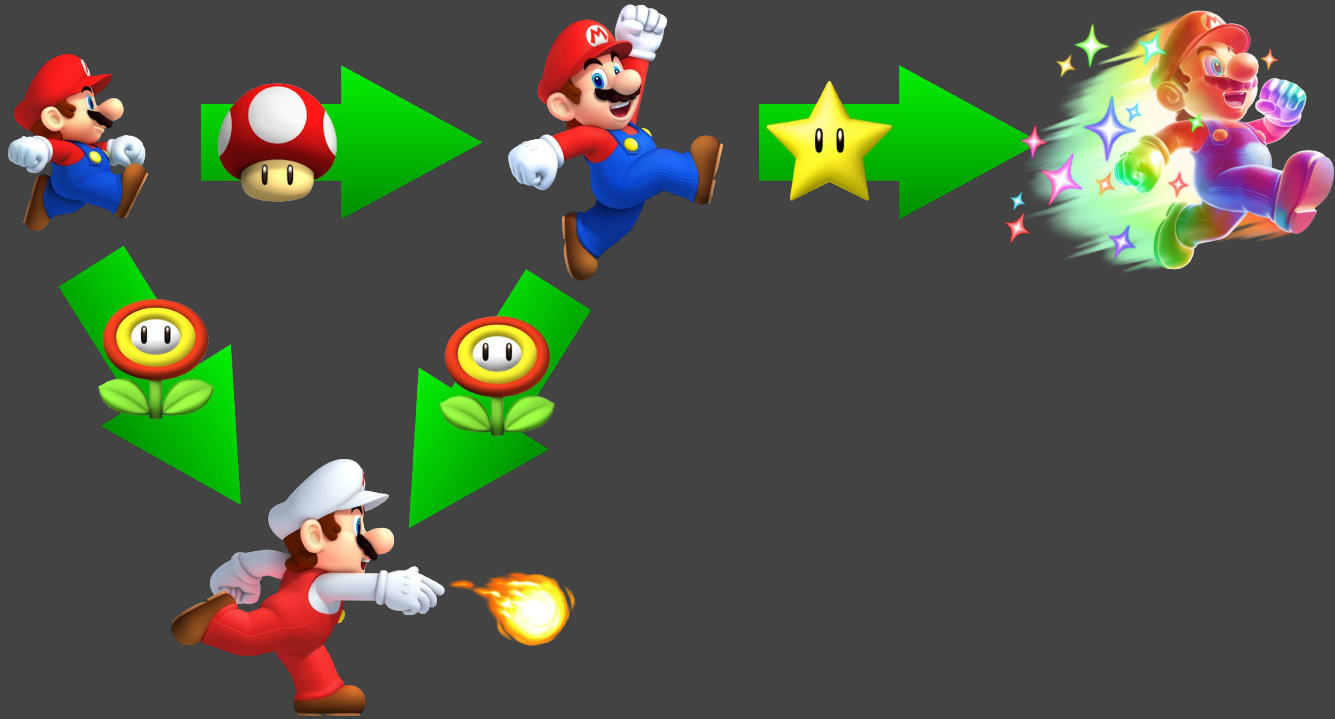


TACTICAL ESPIONAGE ACTION

METAL GEARTM
SOLID







No mundo
real

Combinação de diversas técnicas:

Árvores de decisão (Decision Trees)

Máquinas de Estado Finito (FSM)

Funções de Utilidade

Árvores de Comportamento (Behavior Trees)

Lógica Fuzzy

Sistemas de Markov

...

Combinação de diversas

técnicas:

Árvores de Decisão (Decision Trees)

Máquinas de Estado Finito (FEM)

Funções de Utilidade

Árvores de Comportamento (Behavior Trees)

Sistemas Fuzzy

Sistemas de Markov

No mundo
real

***E ISSO É SÓ PARA
TOMADA DE DECISÃO!***

...

No mundo
real

Movimentação

Pathfinding

Tática e Estratégia

Aprendizado

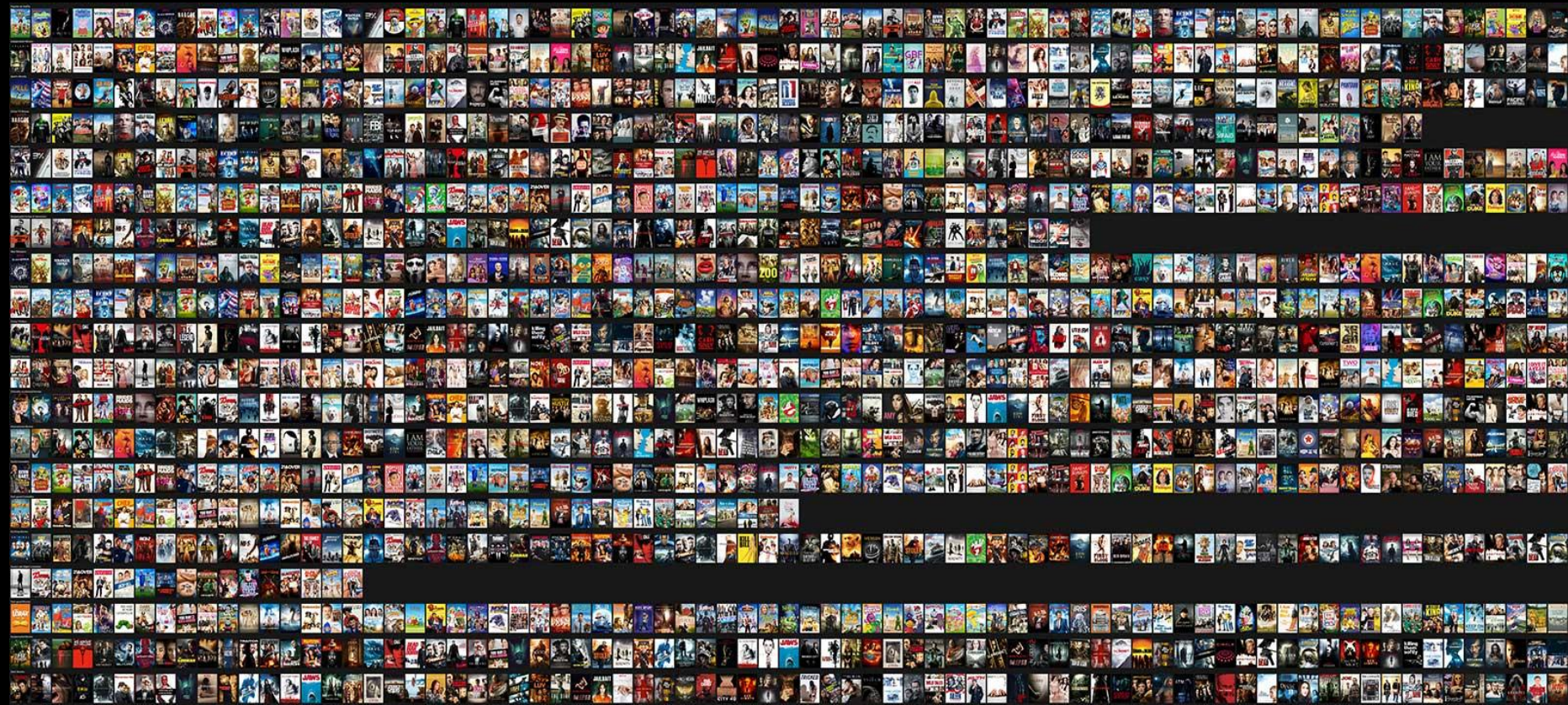
Arquiteturas de IA

...

Como fazer

a **IA** do
meu jogo





Qual filme devo assistir hoje?

Quem são os personagens?

Quantos recursos estão disponíveis?

Quais os principais objetivos?

Quais são os comportamentos esperados?

Quais são as restrições?

*Para as suas próprias perguntas,
encontre as respostas...*





Muito obrigado!

paulobruno@alu.ufc.br

Imagens

quadro: <https://vignette.wikia.nocookie.net/blogclan-2/images/c/c6/Blackboard.png/revision/latest?cb=20160519224101>

mario: <http://www.wallpapersbyte.com/wp-content/uploads/2015/07/Mario-Bros-Luigi-Yoshi-Princess-Peach-Donkey-Toad-Kong-Monkey-Game-WallpapersByte-com-1366x768.jpg>

circuit brain: <https://www.artintelgroup.com/>

cubo rubik: <http://freepngimages.com/wp-content/uploads/2015/12/rubiks-cube-transparent-image.png>
<http://freepngimages.com/rubik-cube-transparent-image/>

chess board: <http://www.stickpng.com/img/objects/chess/chess-board>

go board: <http://www.telgo.com/images/go-game.png>
<http://www.telgo.com/>

xadrez: <http://disabilitydunktank.com/wp-content/uploads/2014/01/bigstock-man-plays-chess-against-himself-50875502.jpg>

alphago: <https://www.inverse.com/article/30681-alphago-documentary-tribeca-film-festival>

Imagens

Uncharted: <https://www.youtube.com/watch?v=70jVUBnp6lQ>

starcraft: <https://criticalhits.com.br/wp-content/uploads/2017/04/starcraft-remastered-ed.jpg>

galaxy: <https://www.pexels.com/photo/sky-space-milky-way-stars-110854/>

chargin chuck: <https://vignette.wikia.nocookie.net/fantendo/images/2/2d/Solochuck.png/revision/latest?cb=20140426113928>

Red Koopa: https://en.wikipedia.org/wiki/Koopa_Troopa

[http://img1.wikia.nocookie.net/_cb20121106022729/mario/images/6/69/Koopa_New_Super_Mario_Bros_U_\(2\).png](http://img1.wikia.nocookie.net/_cb20121106022729/mario/images/6/69/Koopa_New_Super_Mario_Bros_U_(2).png)

<https://justpushb.wordpress.com/tag/mario/>

zumbi: <http://www.freepngimg.com/png/19812-zombie-picture>

crosshair: <https://pixabay.com/en/sniper-aim-crosshair-cross-hairs-297661/>

tumbleweed: <https://i.stack.imgur.com/SI6bs.jpg>

Cronômetro: icon made by Gregor Cresnar from www.flaticon.com

Imagens

Sophia: <https://www.youtube.com/watch?v=W0 DPi0PmF0>

Árvore: icon made by Freepik from www.flaticon.com

System Shock 3: <https://otherside-e.com/wp/games/system-shock-3/>

netflix: <http://cdn05.branchez-vous.com/wp-content/uploads/2016/11/netflixavailabledownload.jpg>

<http://branchez-vous.com/2016/11/30/netflix-offre-enfin-le-telechargement-de-films-teleseries/>

yoda: <http://pluspng.com/star-wars-yoda-png-2189.html>

dagobah: <https://imgur.com/gallery/2IwhB>

nuvem: Susanne Feldt @unsplash.com