

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

DEPARTAMENTO
DE COMPUTAÇÃO

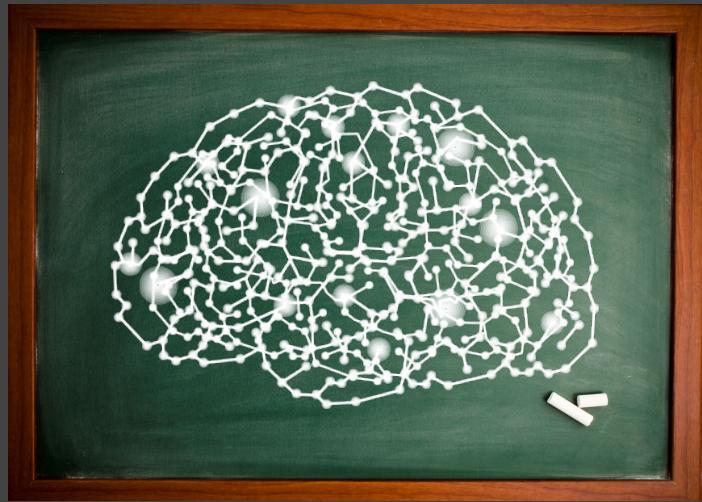
CRAb

COMPUTER GRAPHICS VIRTUAL REALITY AND ANIMATION

MINHA PESQUISA

youtu.be/JTNZCX01r2Y

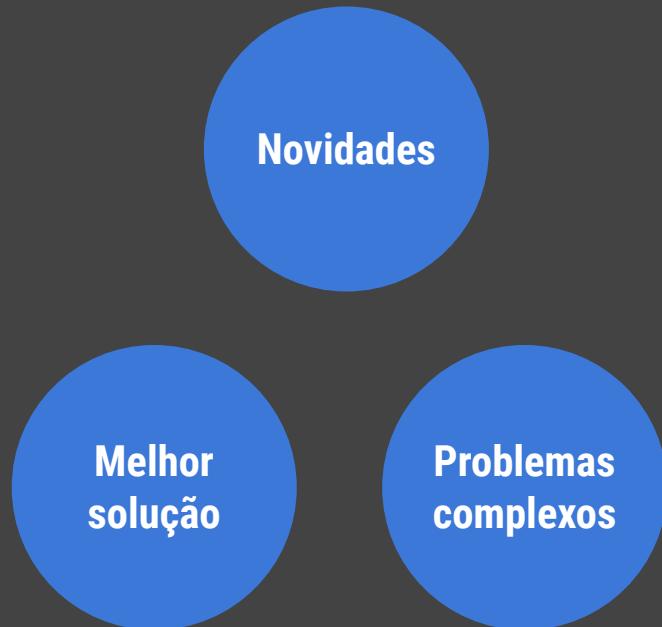




VS



Academia

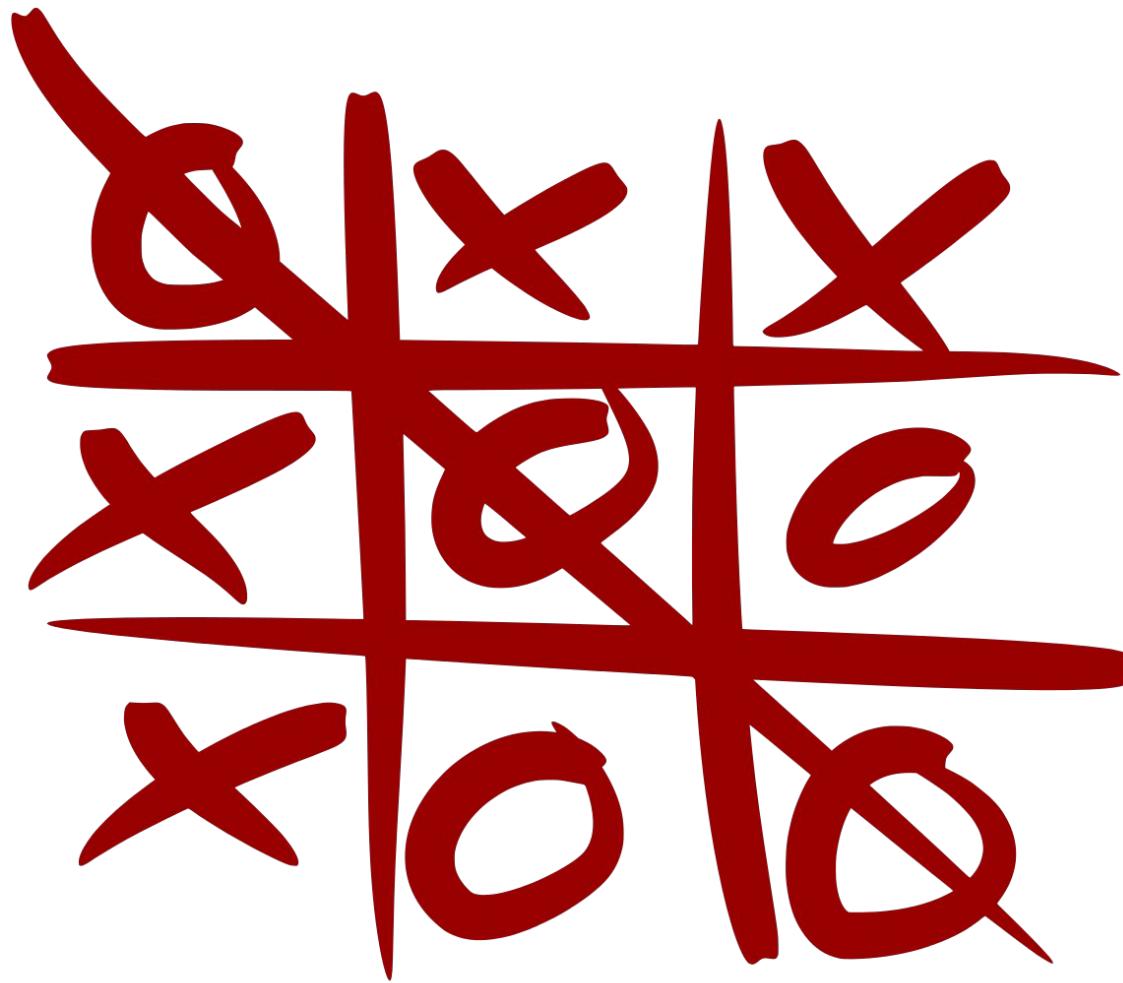


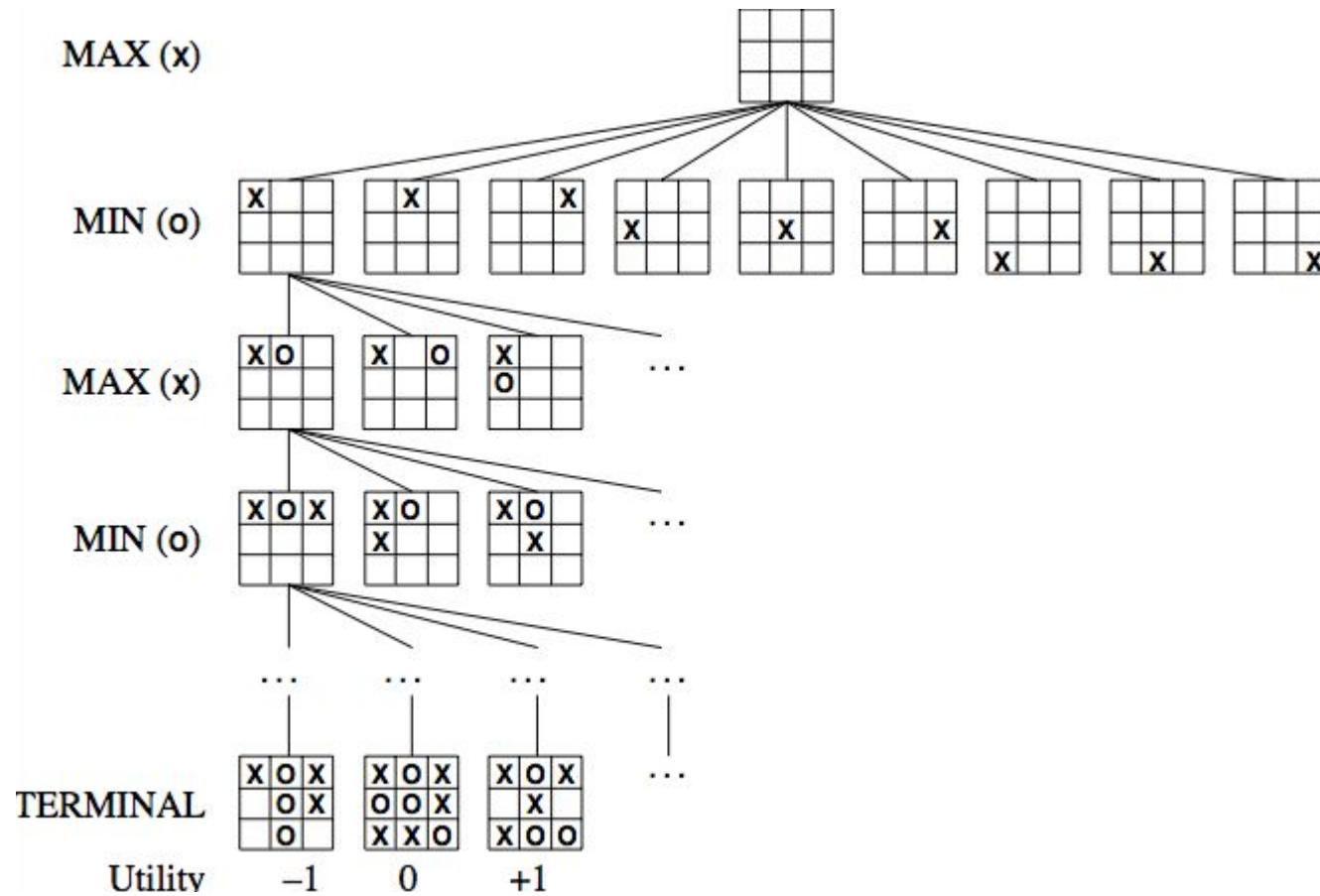
Indústria



A man with dark, curly hair and a beard is shown from the side, leaning over a chessboard. He is wearing a dark suit jacket. His reflection is visible in the mirror behind him, creating a symmetrical scene. The chessboard is made of wood and is set up with pieces. The background is a plain, light-colored wall.

Jogos de tabuleiro









Chinook (Jonathan Schaeffer) vs Marion Tinsley (1994)

Silicon Graphics





GM Kasparov 2.5 vs 3.5 Deep Blue (1997)



Komodo Chess Engine 2.5 x 1.5 GM Nakamura (2016)





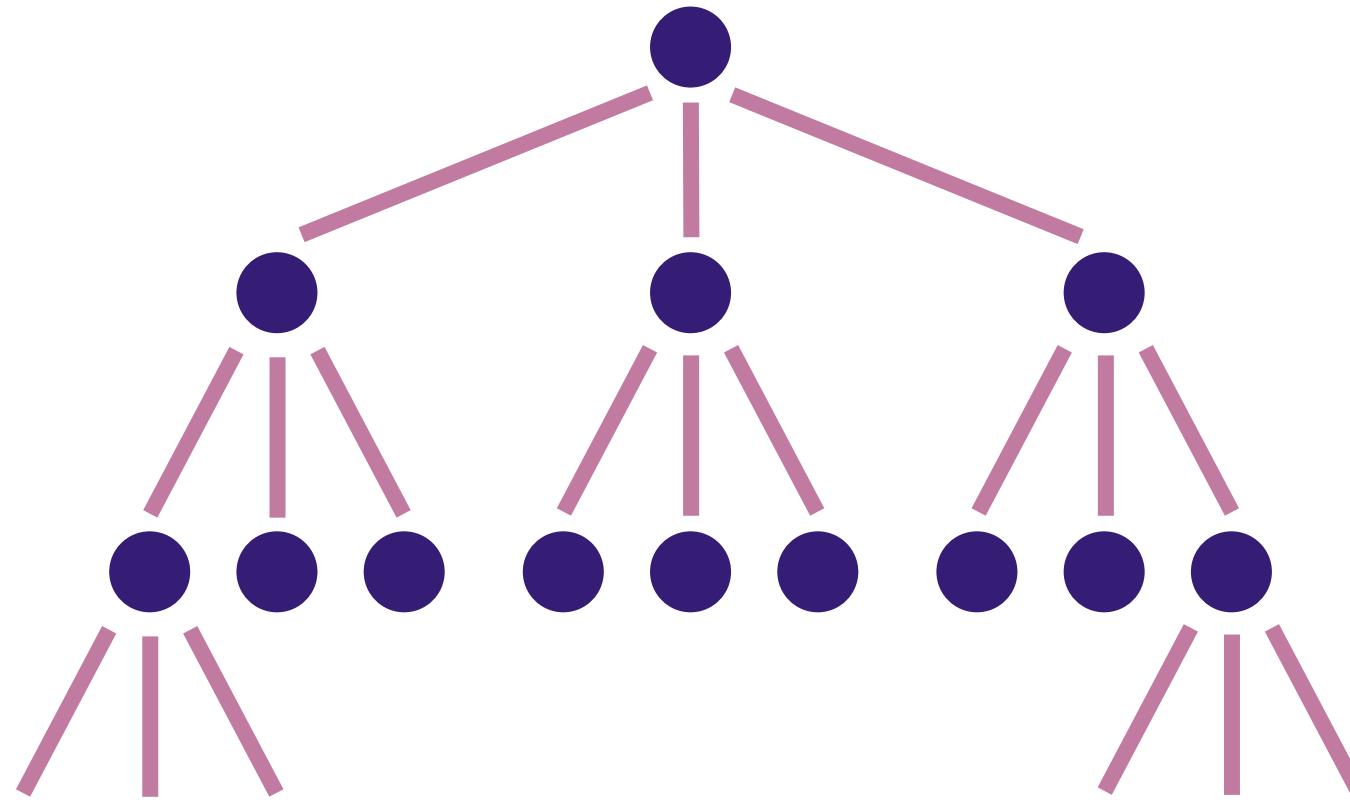
AlphaGo

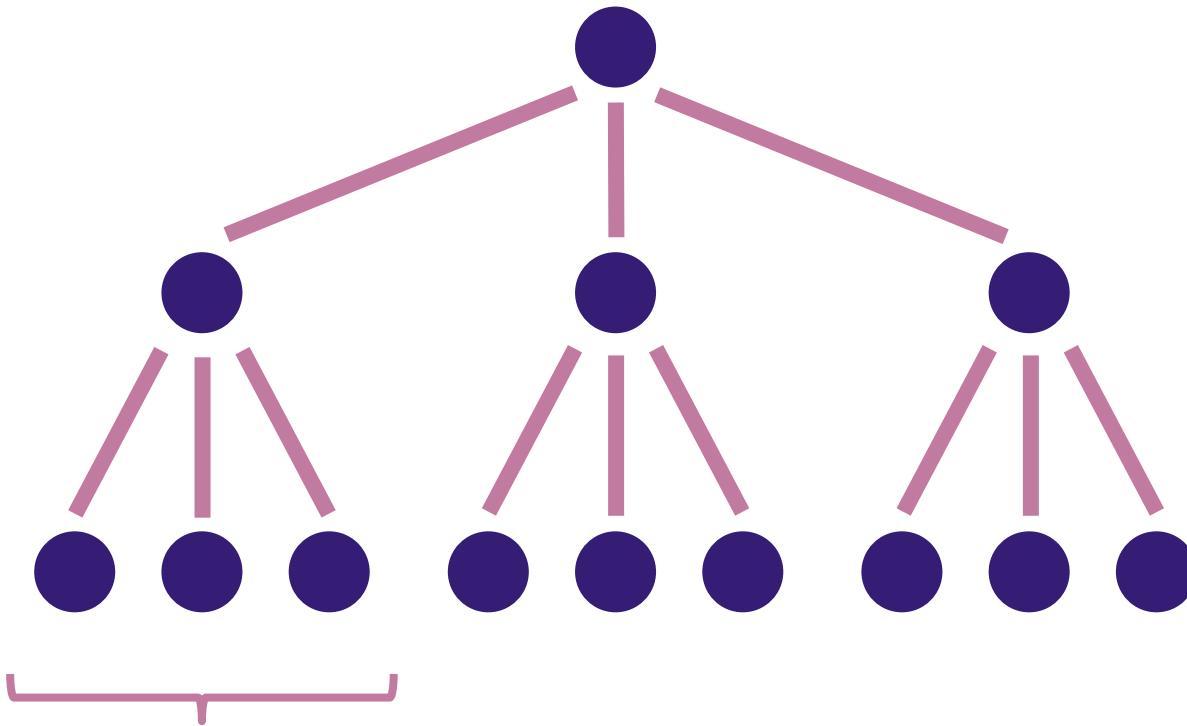


Lee Sedol

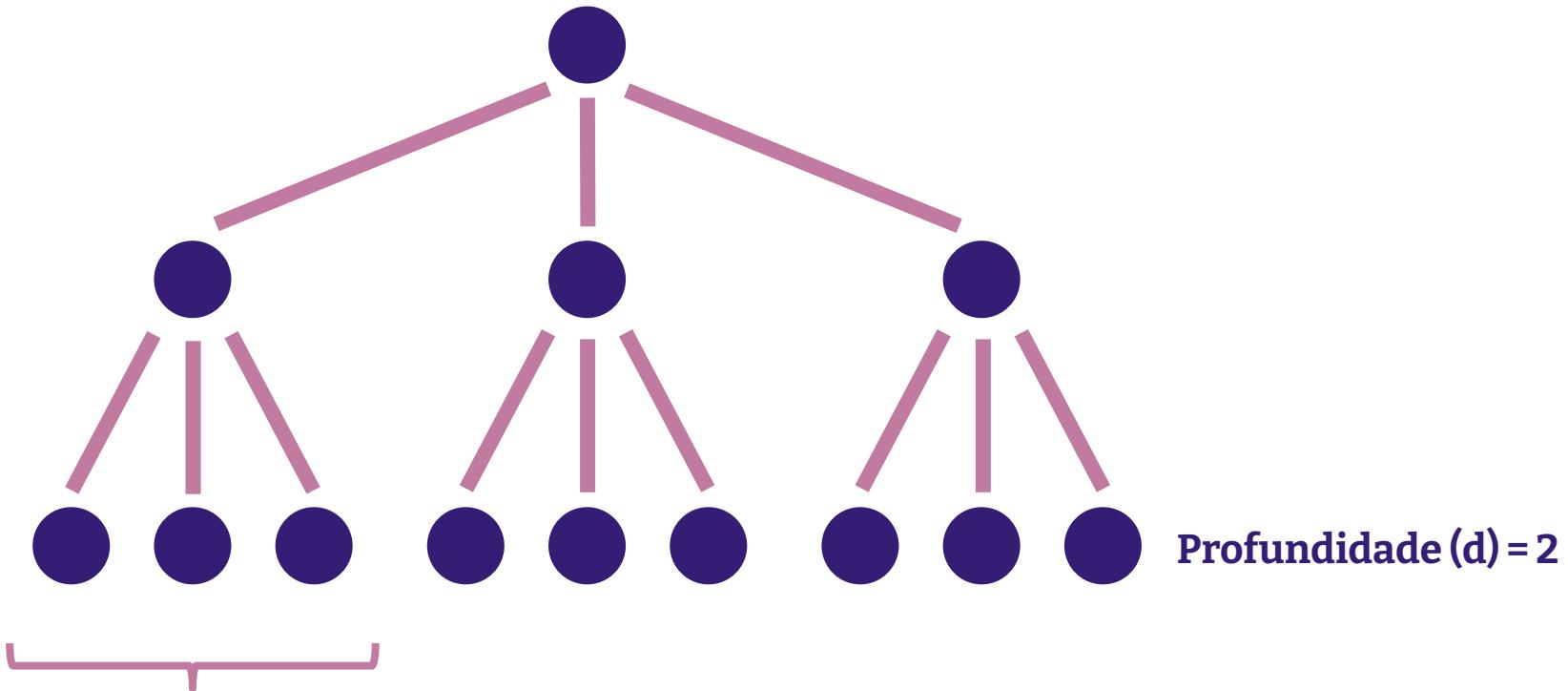


AlphaGo 4 vs 1 Lee Sedol



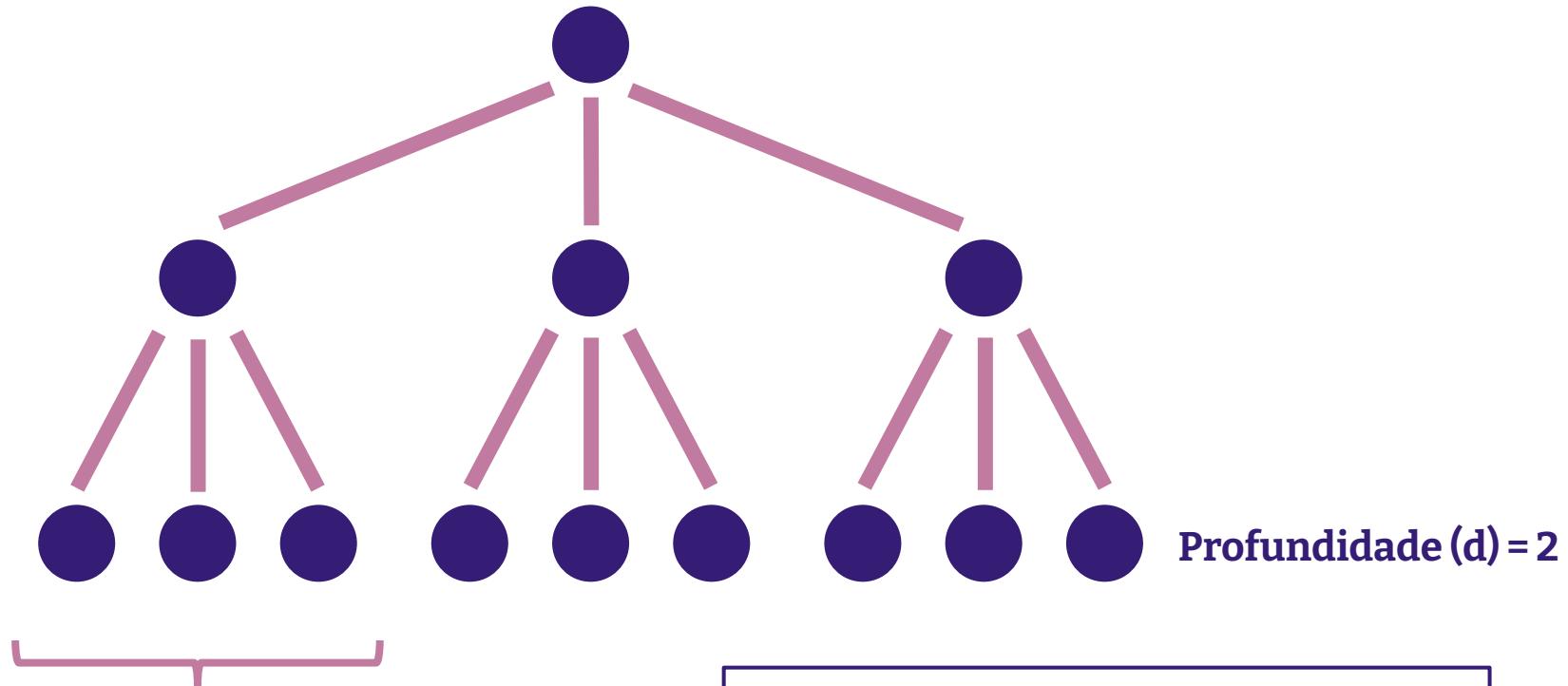


Fator de ramificação (b) = 3



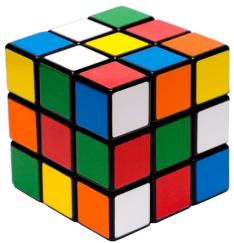
Fator de ramificação (b) = 3

Profundidade (d) = 2



Fator de ramificação (b) = 3

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



b = ~13.34

d = ~18

Espaço de busca = $\sim 10^{19}$



b = ~35

d = ~100

Espaço de busca = $\sim 10^{120}$



b = ~300

d = ~150

Espaço de busca = $\sim 10^{360}$



b = $\sim 10^{100}$

d = ?

Espaço de busca = ???

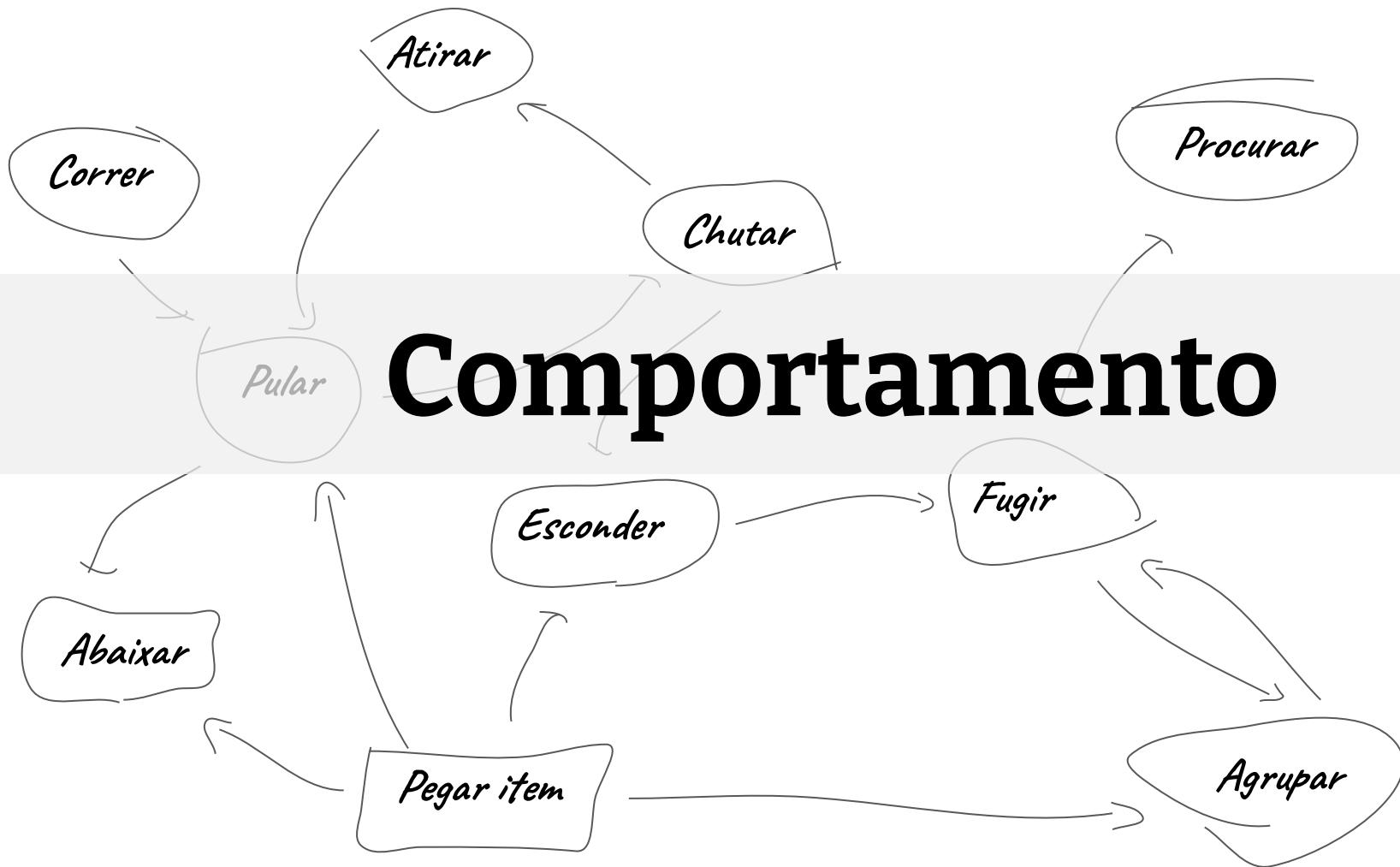


O que é
**inteligência
Artificial**
para
JOGOS?

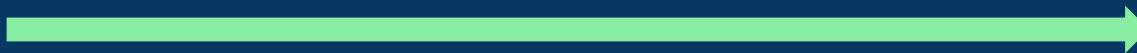
(comerciais)



Comportamento



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Dificuldade

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Fácil

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Fácil

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Fácil



Difícil



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Fácil



Difícil



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Fácil

Ideal

Difícil



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Fácil



Ideal



Difícil

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Fácil



Ideal



Difícil

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Fácil

Ideal

Difícil

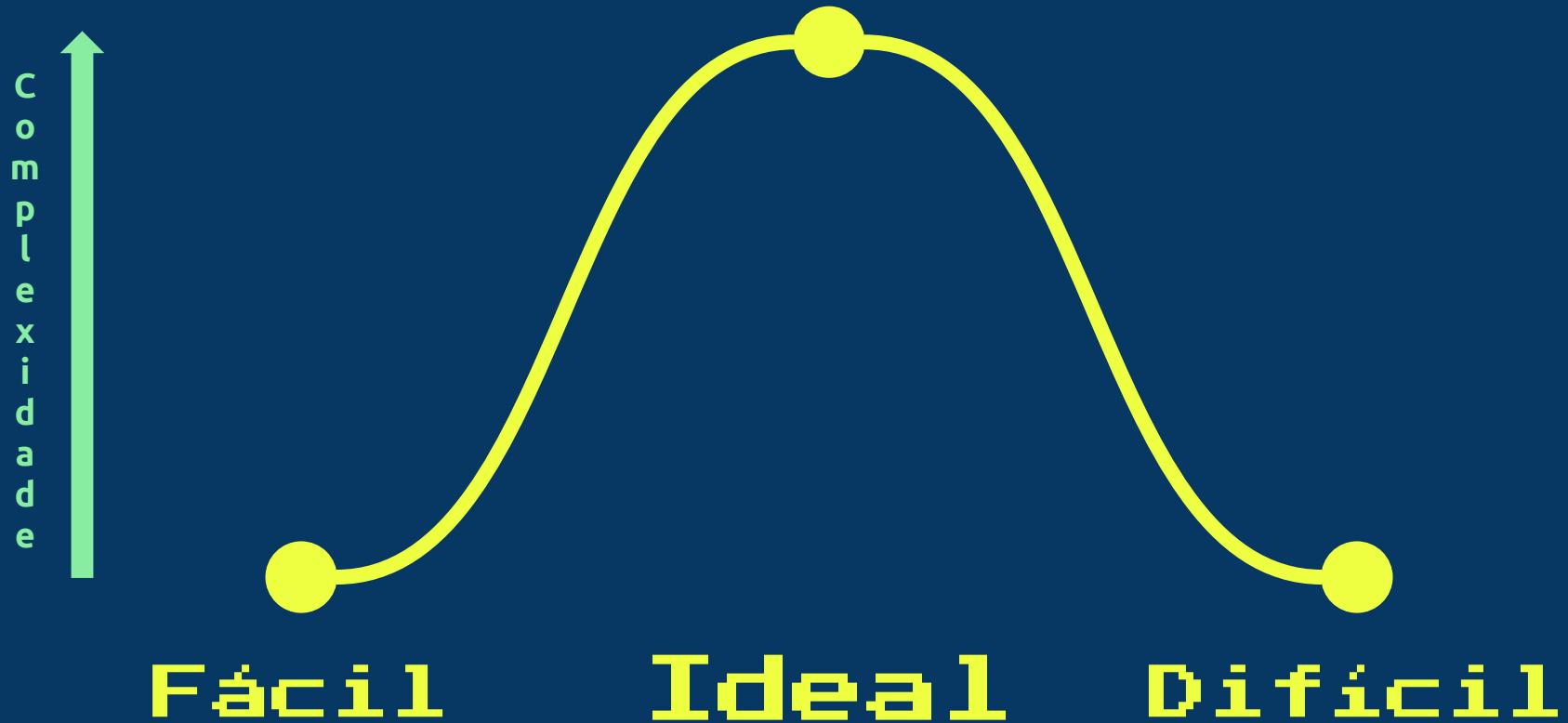


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Fácil



Difícil



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pode ser
"burro"

Fácil Ideal Difícil

pode ser
"roubado"

Desafio

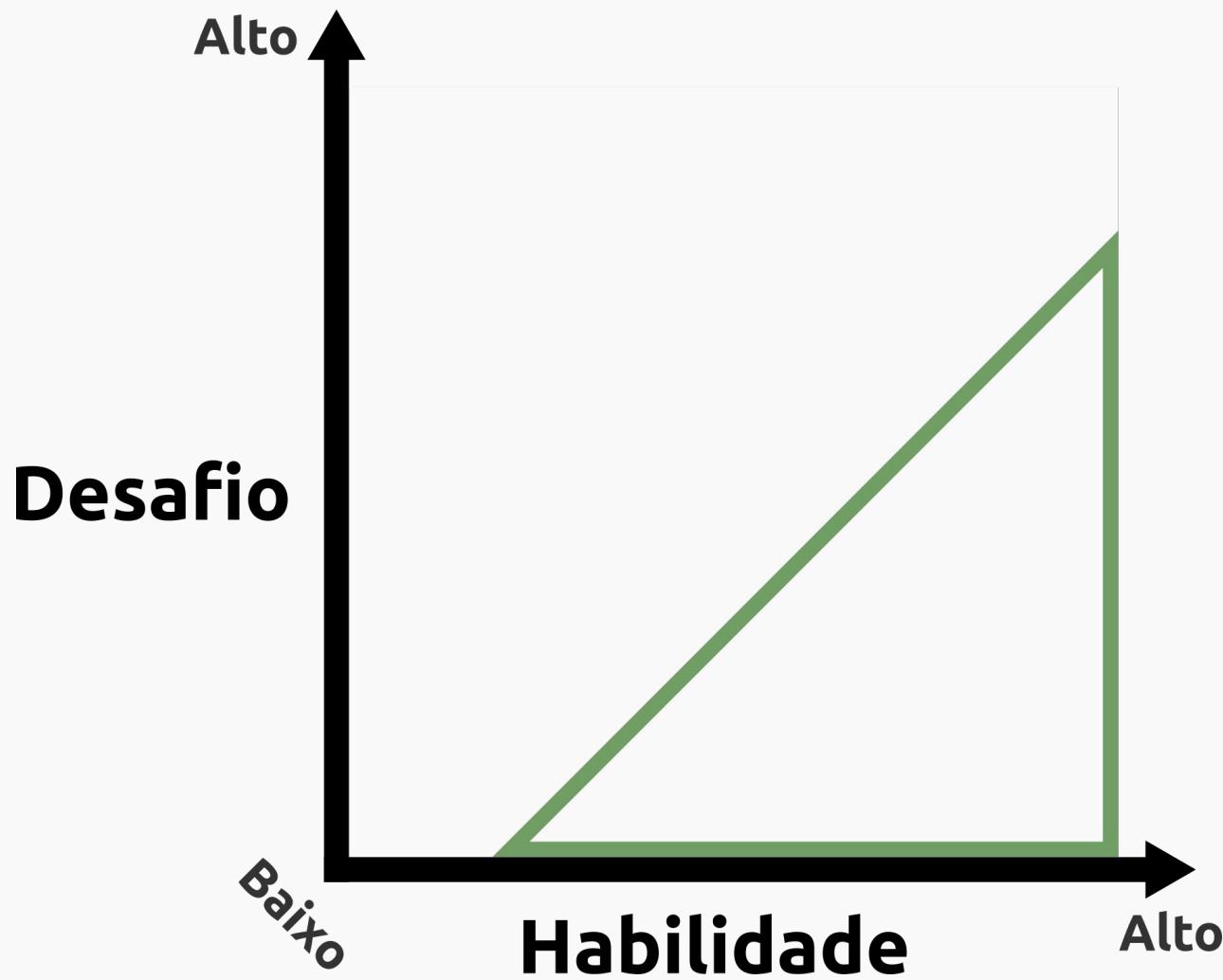
vs.

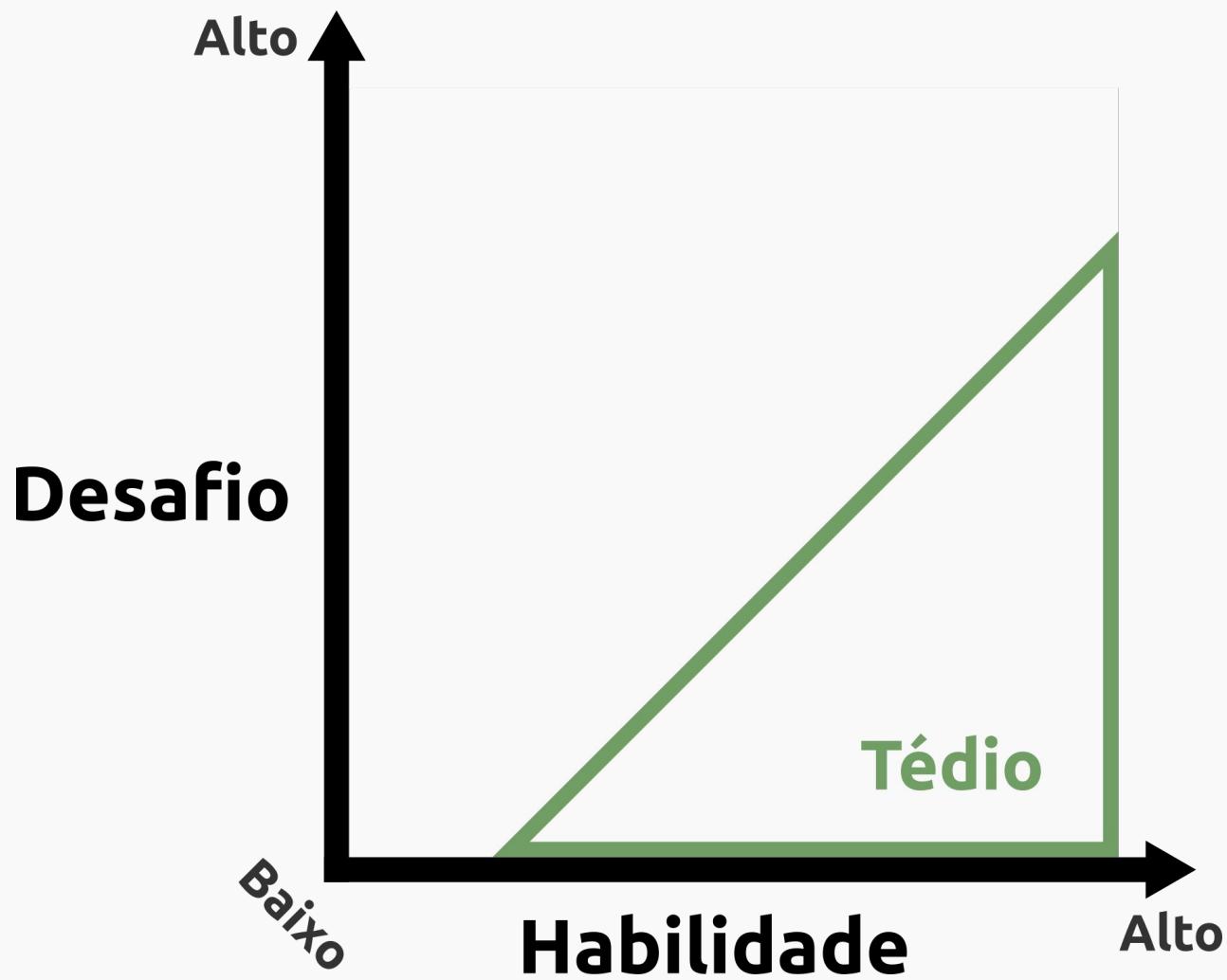
Habilidade

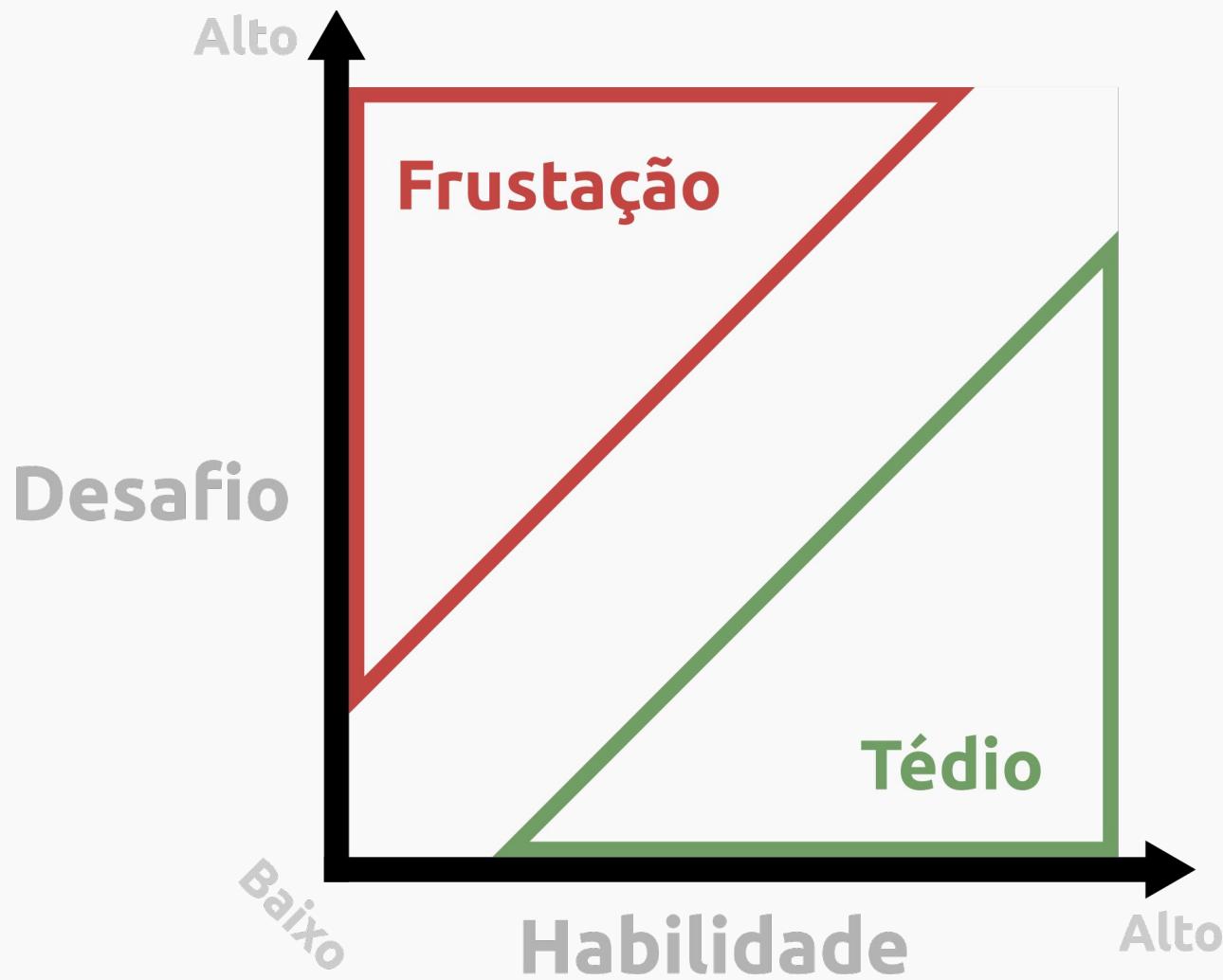


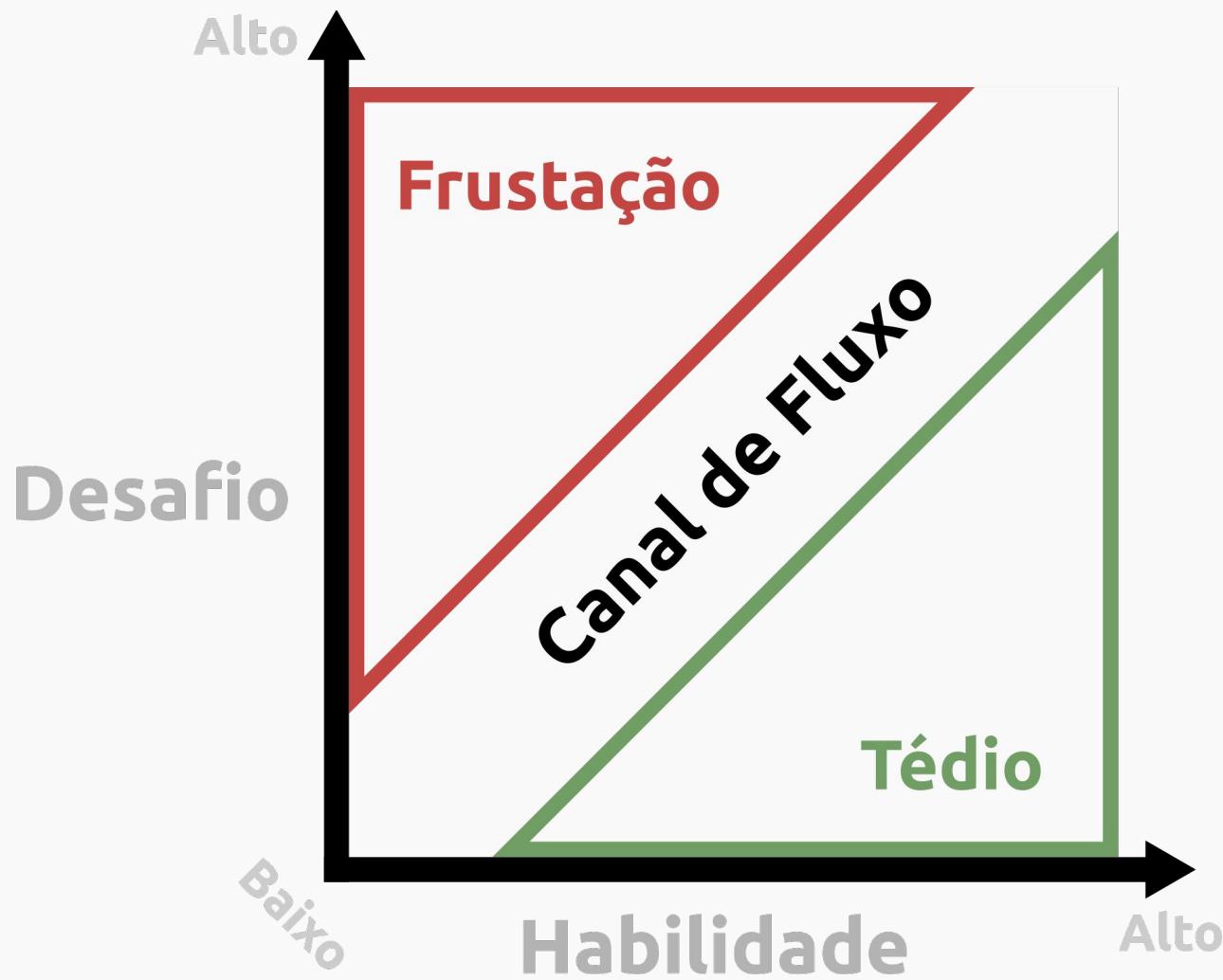


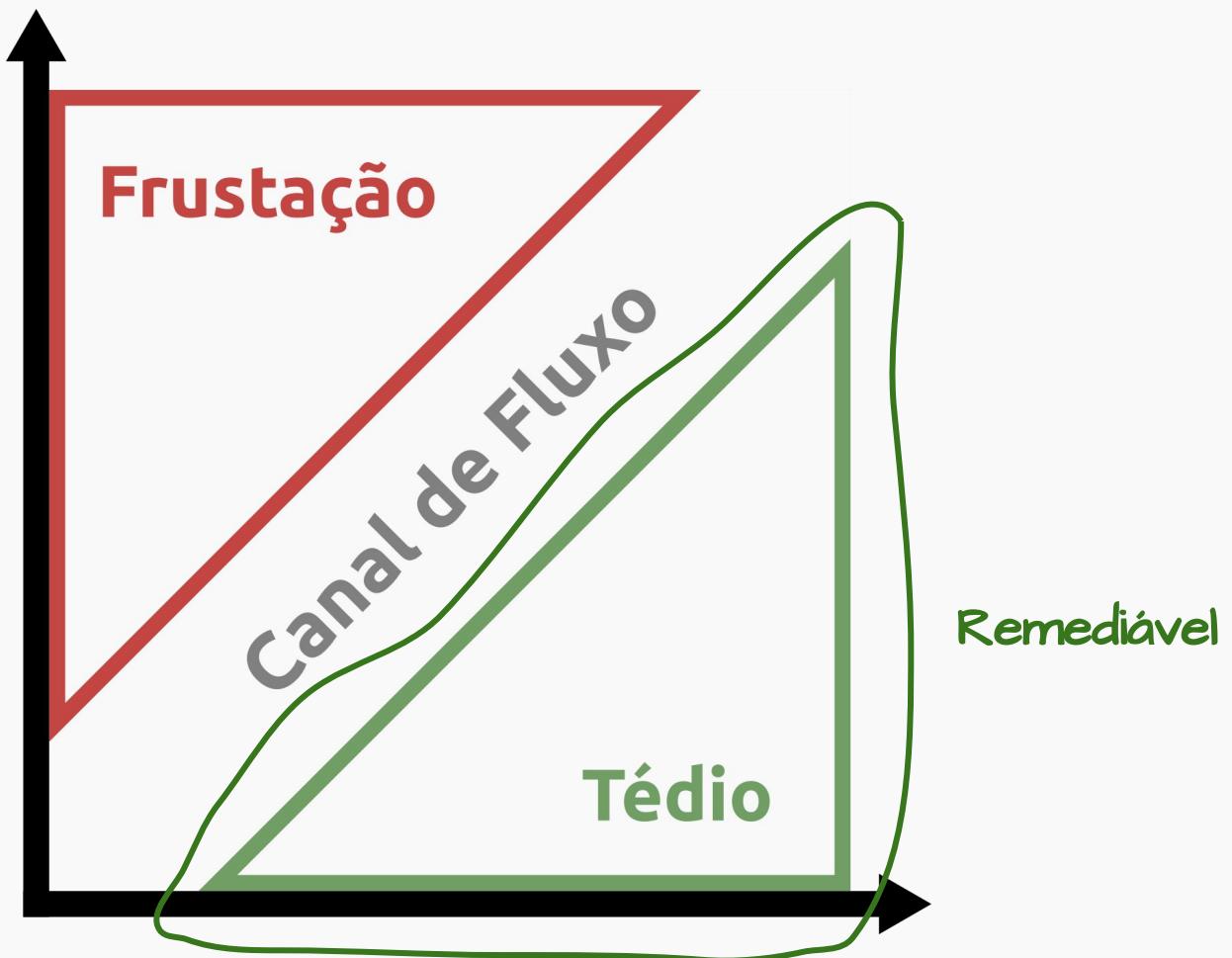


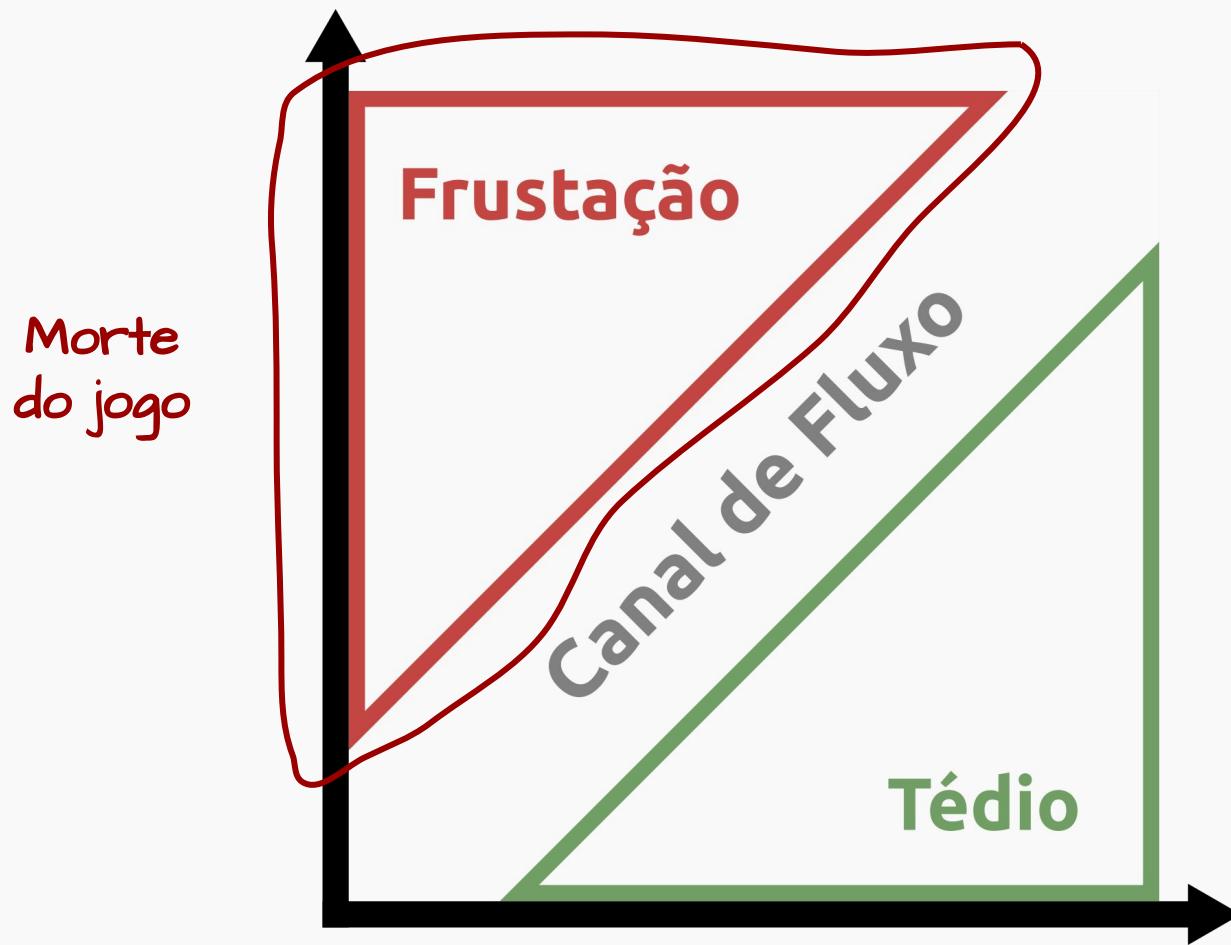




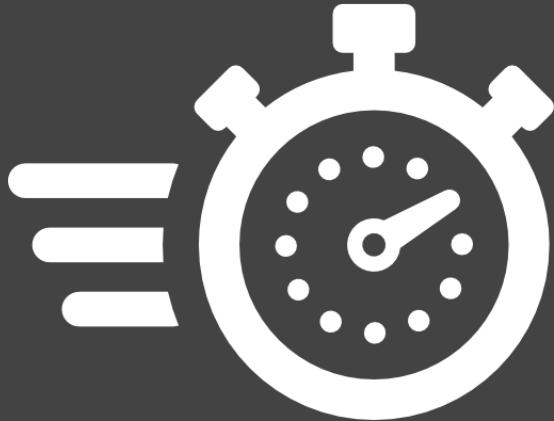








**“Boa o suficiente para ser desafiadora,
Ruim o suficiente para ser divertida”.**



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

60 Frames
Per Second

60 Frames
Per
Second

60

**Frames
Per
Second**

= $\frac{60 \text{ frames}}{1 \text{ segundo}}$

1 segundo

1000 milissegundos



x

60 frames

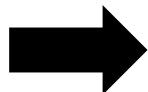
1 segundo

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

1 frame →

1000 milissegundos
—
60 frames

1



16.7

frame

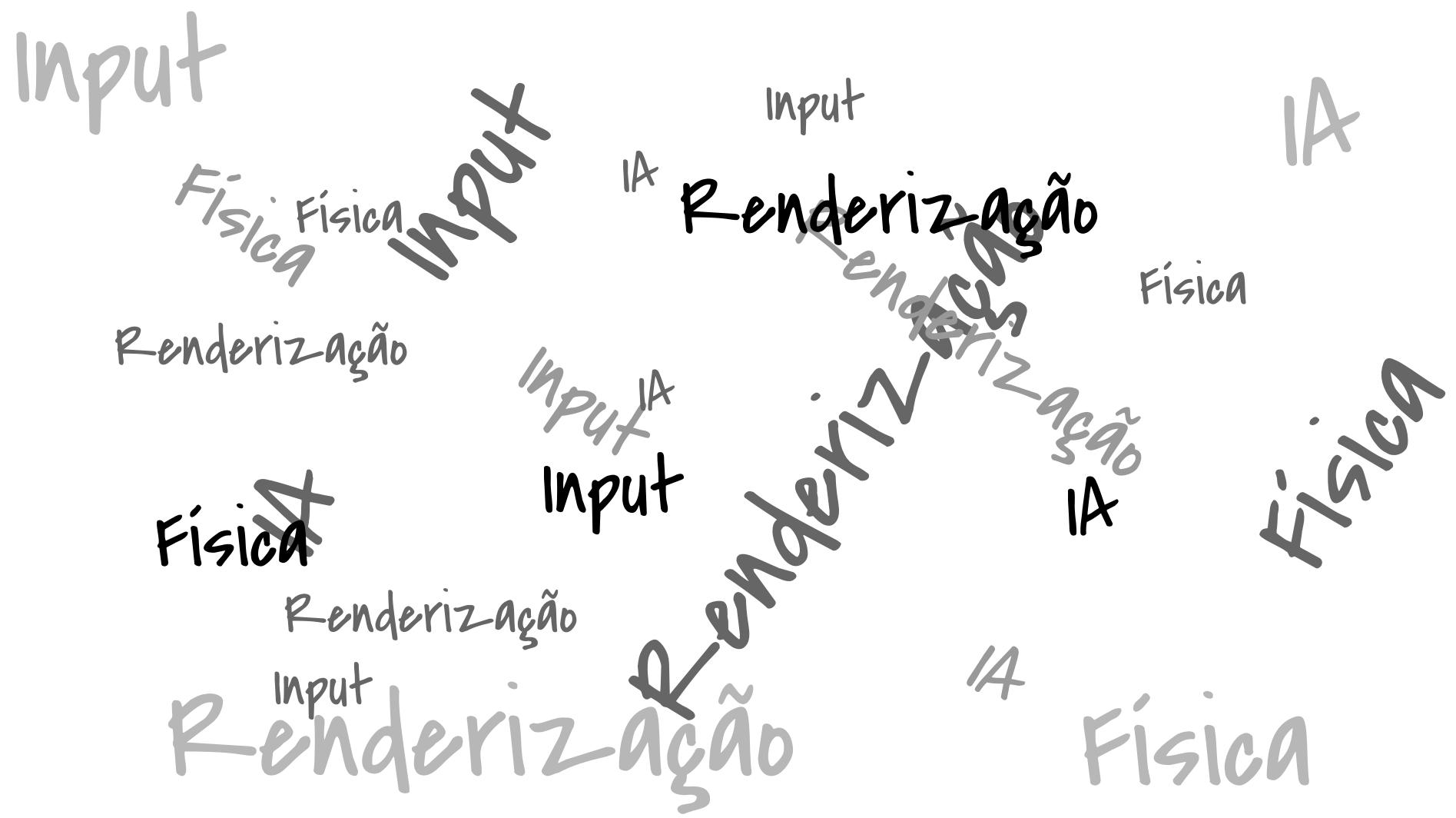
milissegundos

Input

IA

Física

Renderização



16.7

milissegundos

Input

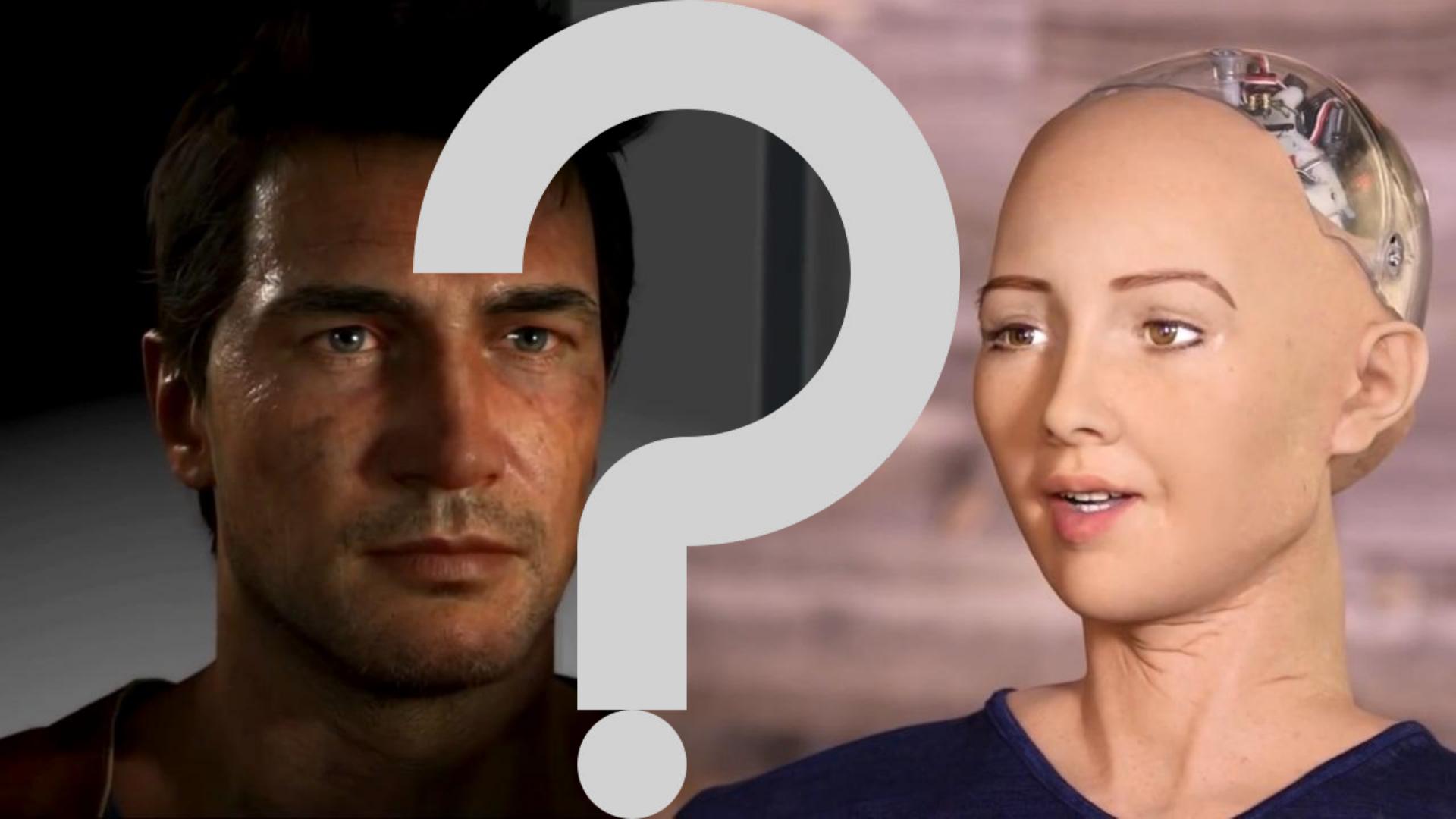
IA

Física

Renderização

Gráficos

IA

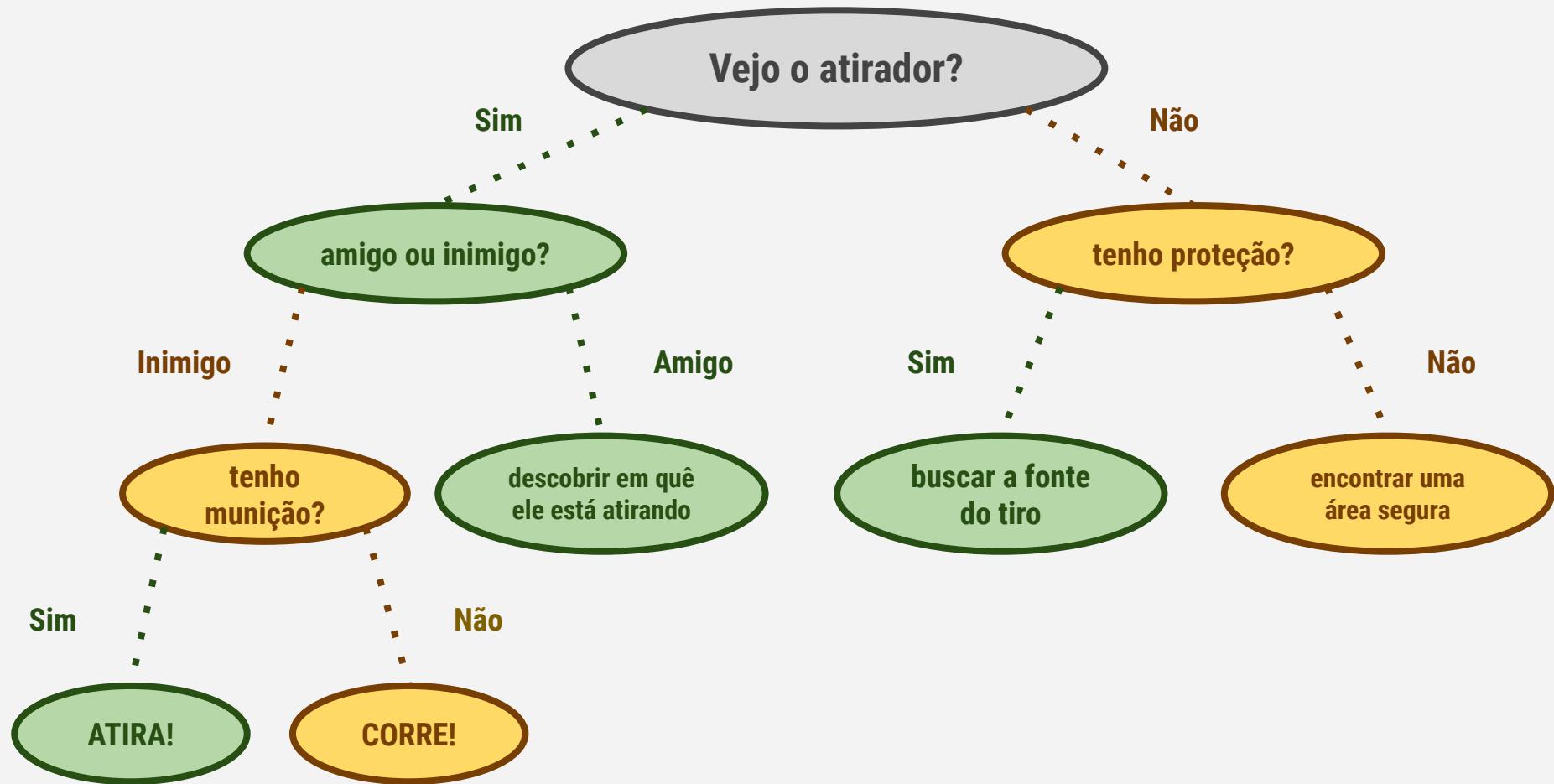




Exemplos de Técnicas utilizadas



Árvores de decisão



ALERT



危險

Máquina de
Estados
Finitos



99.99



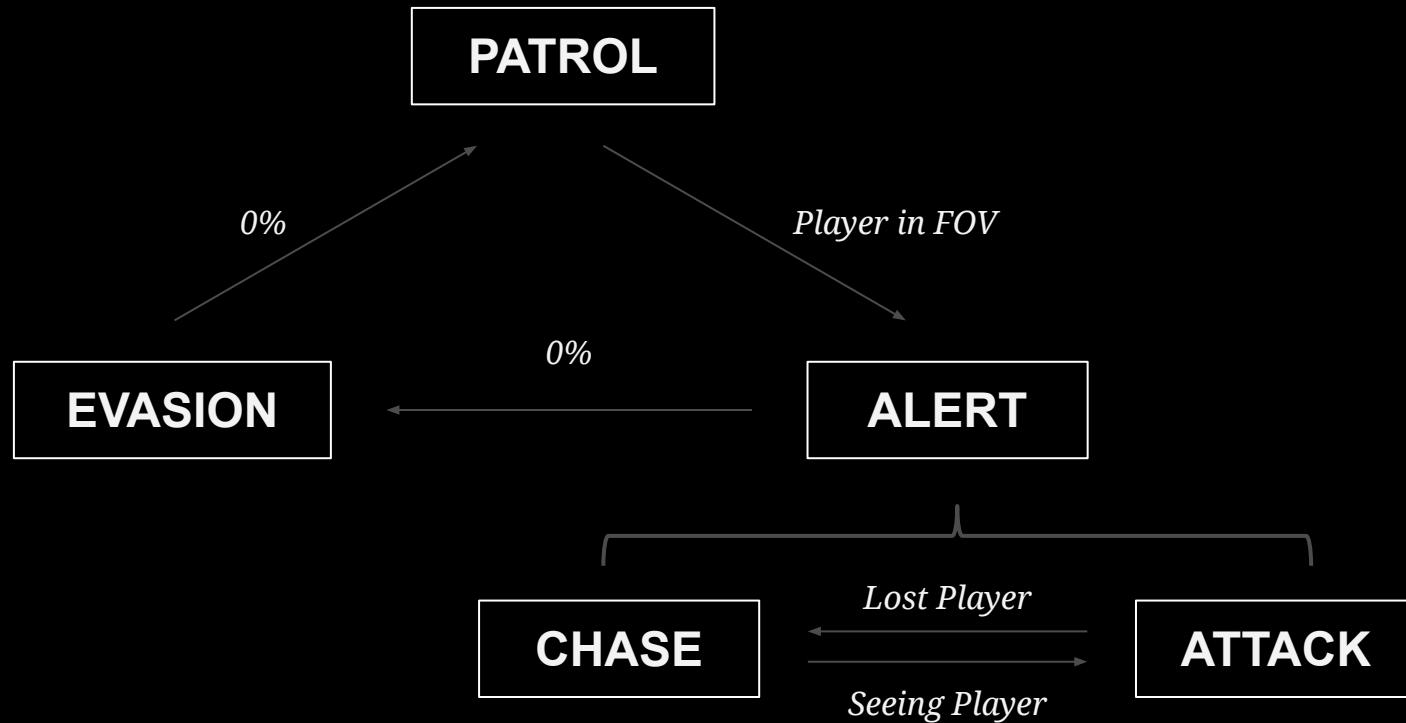
TACTICAL ESPIONAGE ACTION

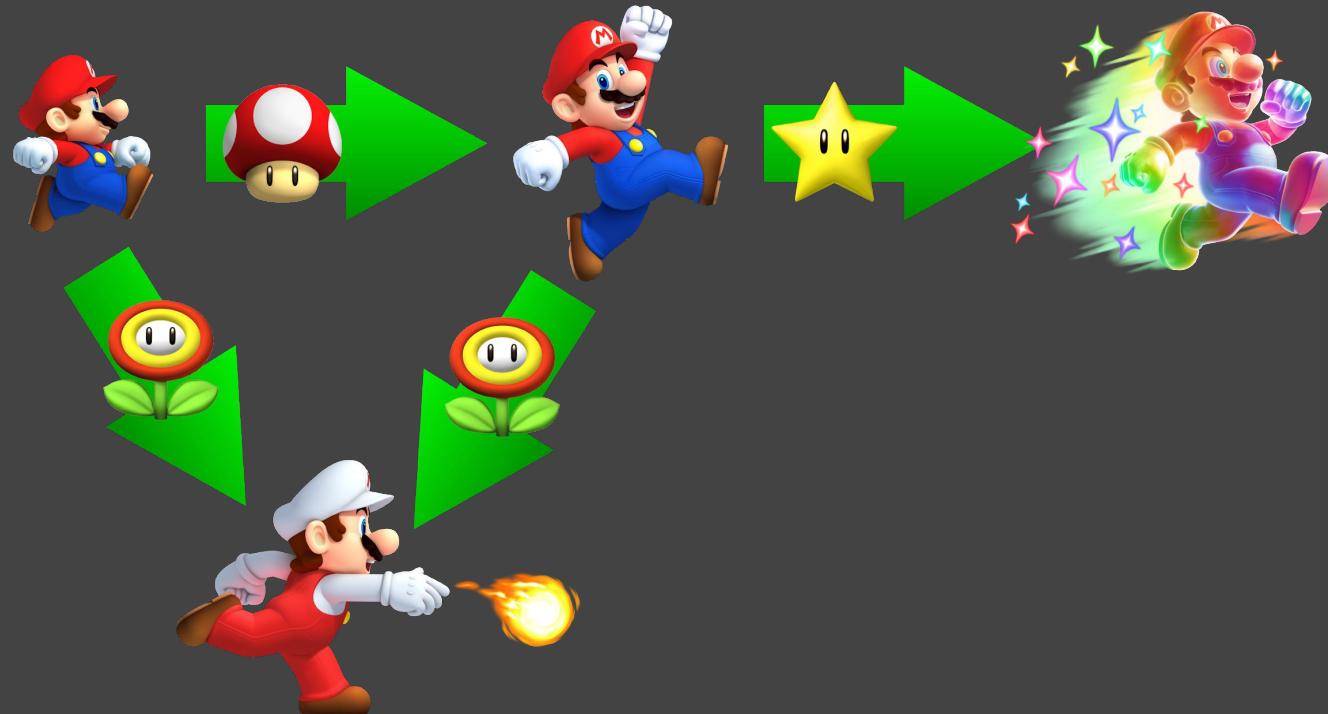
METAL GEARTM

S O L I D

The image features a large, high-contrast silhouette of a soldier in a crouching position, holding a rifle, set against a light gray background. The silhouette is composed of dark red and black shapes. To the right of the silhouette, the title "METAL GEAR" is displayed in a bold, red, sans-serif font. Above "METAL GEAR", the words "TACTICAL ESPIONAGE ACTION" are written in a smaller, red, all-caps font. Below "METAL GEAR", the word "SOLID" is written in a smaller, red, all-caps font. A small "TM" symbol is located at the top right of the "G".







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:

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

Árvore de decisões (Decision Trees)

Máquinas de Estado (FSM)

Funções de Utilidade

Árvores de Comportamento (Behavior Trees)

Ótimos Fuzzy

Sistemas de Markov

...

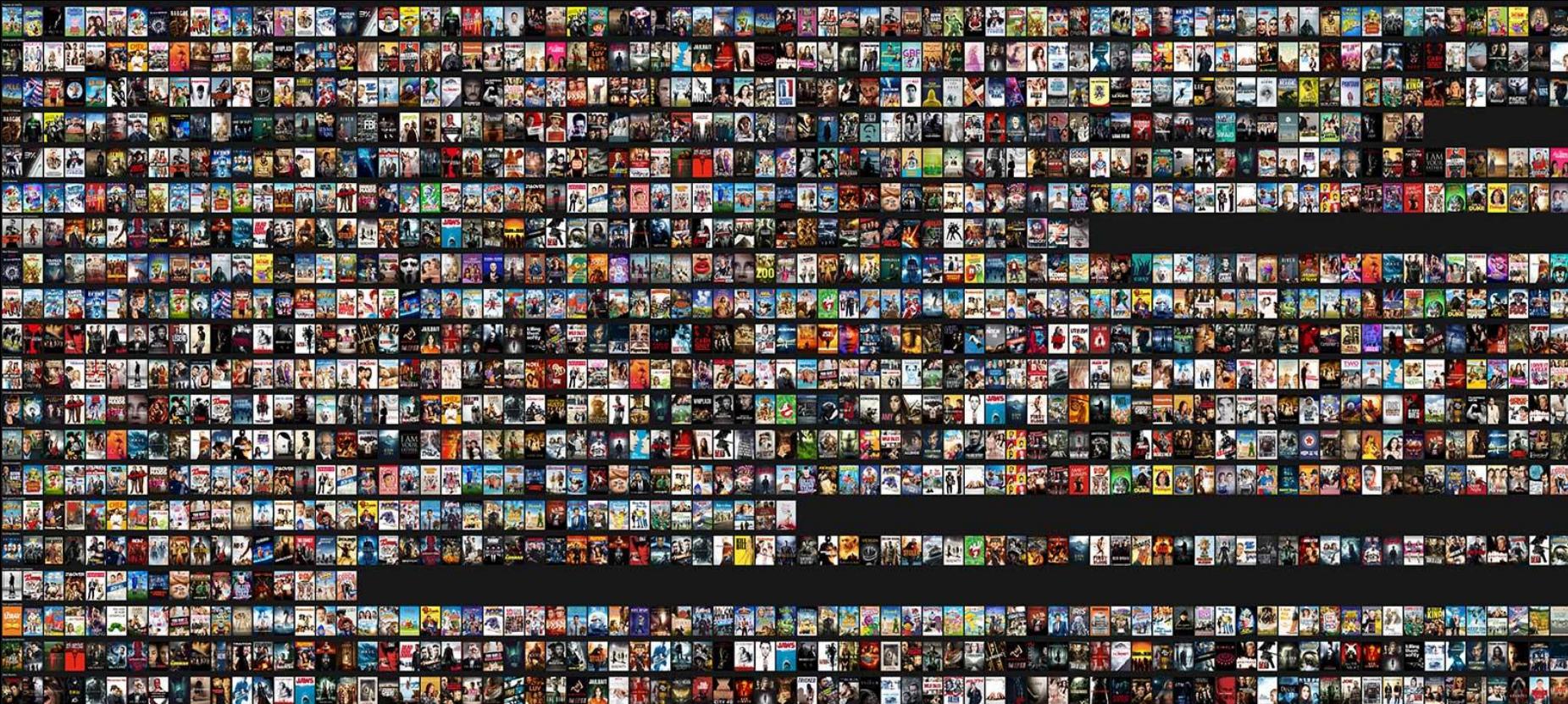
No mundo
real

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

Imagenes

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-himsel-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_DPiOPmF0

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