



BUILDING A GAME AI FOR CLASH ROYALE

Helsinki Data Science Meetup

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Game AI

what?

Computer controlled characters



Game AI

what?

Computer controlled characters

why?

Game content, player tutoring, game testing, ...



Game AI

what?

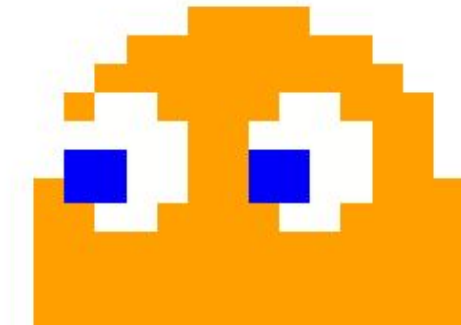
Computer controlled characters

why?

Game content, player tutoring, game testing, ...

how?

Rule-based systems



Game AI

what?

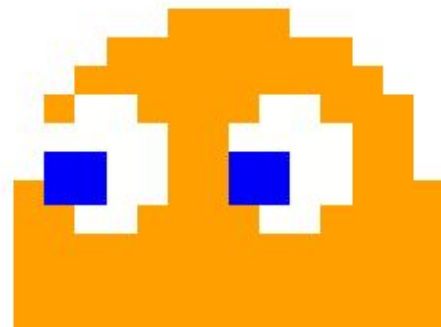
Computer controlled characters

why?

Game content, player tutoring, game testing, ...


how?

~~Rule-based systems~~ **Imitation learning from game replays**






**Casual & fun
game experience**



**Casual & fun
game experience**

Player vs player

The image features two stylized, 3D-rendered cartoon kings. The king on the left is blue-themed, wearing a blue crown with gold accents and a blue tunic. He has a large black mustache and a goatee, and is smiling. The king on the right is red-themed, wearing a red crown with gold accents and a red tunic. He also has a large black mustache and goatee, but has a more serious expression. A bright, glowing yellow lightning bolt strikes the ground between them. The background is split vertically: the left side is blue with a subtle diamond pattern, and the right side is red with a similar pattern.

Casual & fun
game experience

Player vs player

Activity Log



DEFEAT

VICTORY

DEFEAT

VICTORY

DEFEAT

DEFEAT

VICTORY

DEFEAT

VICTORY

DEFEAT

Activity Log



VICTORY

VICTORY

DEFEAT

VICTORY

VICTORY

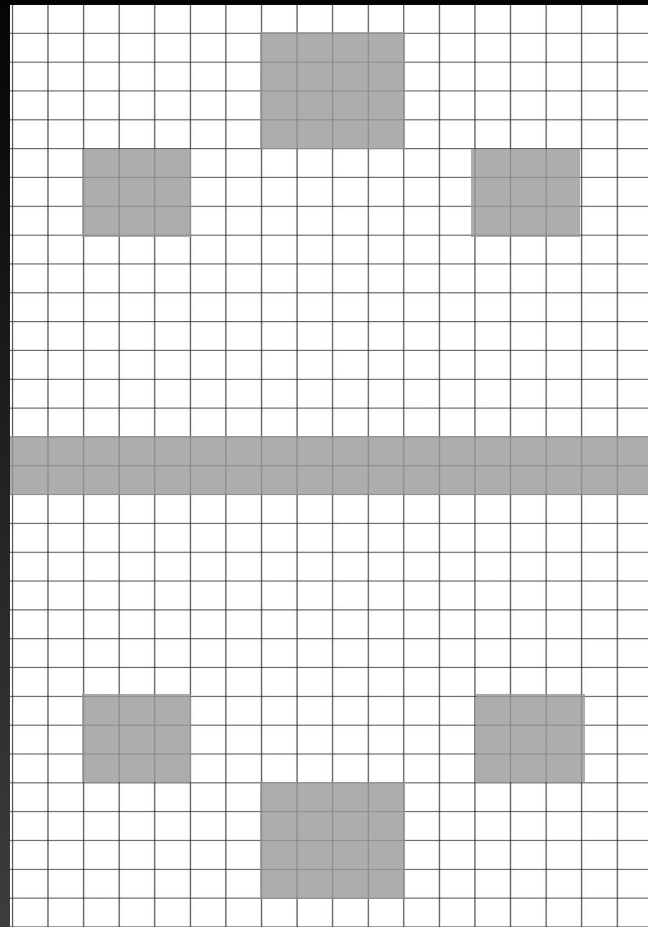
DEFEAT

VICTORY

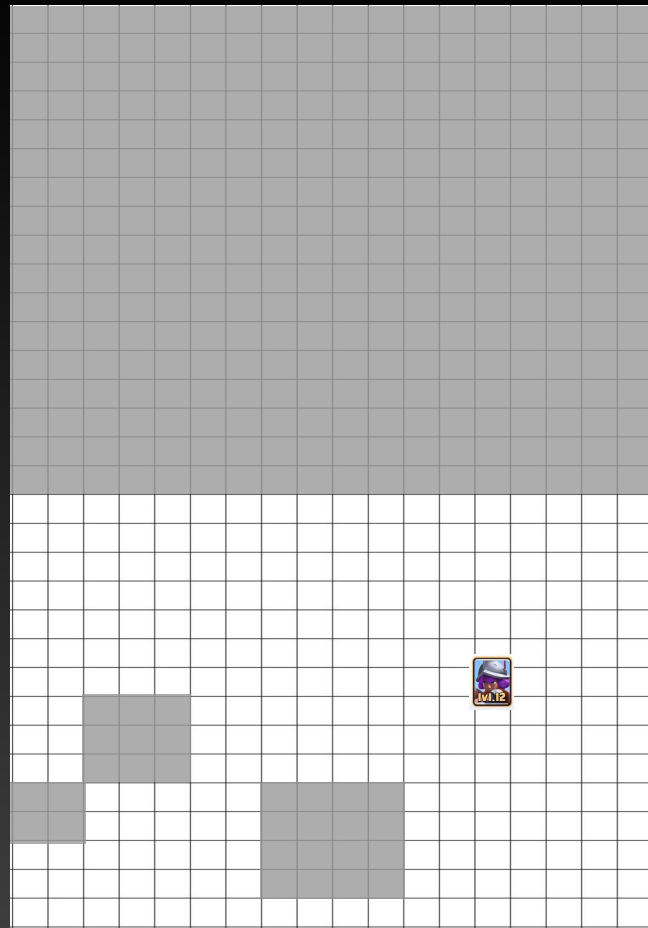
VICTORY

VICTORY

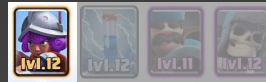
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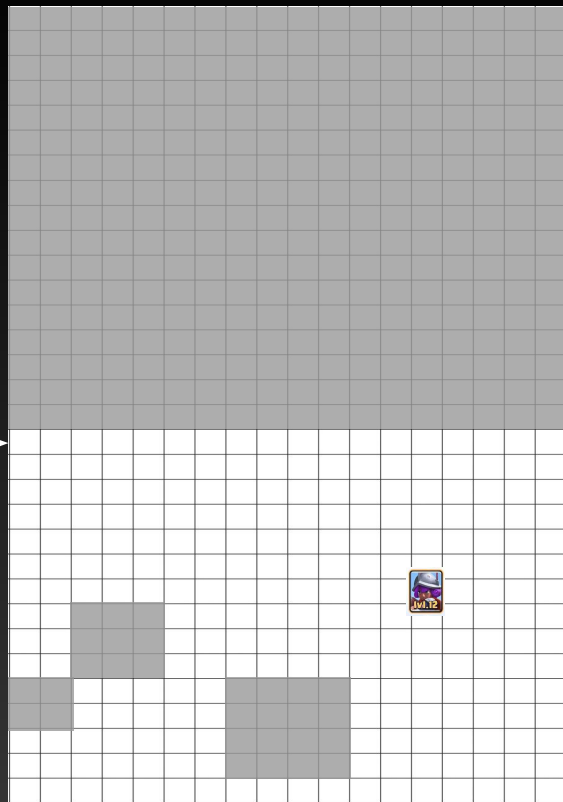
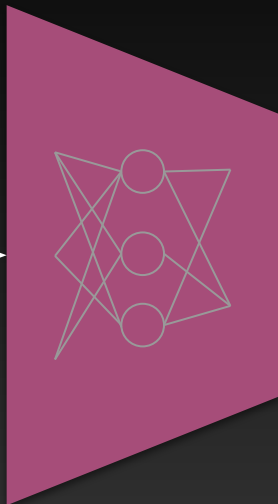


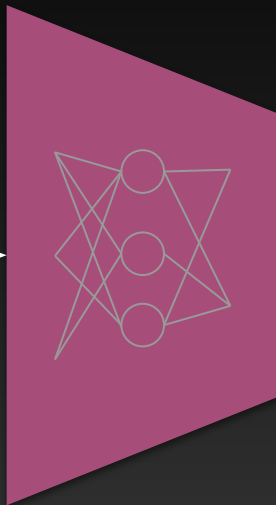
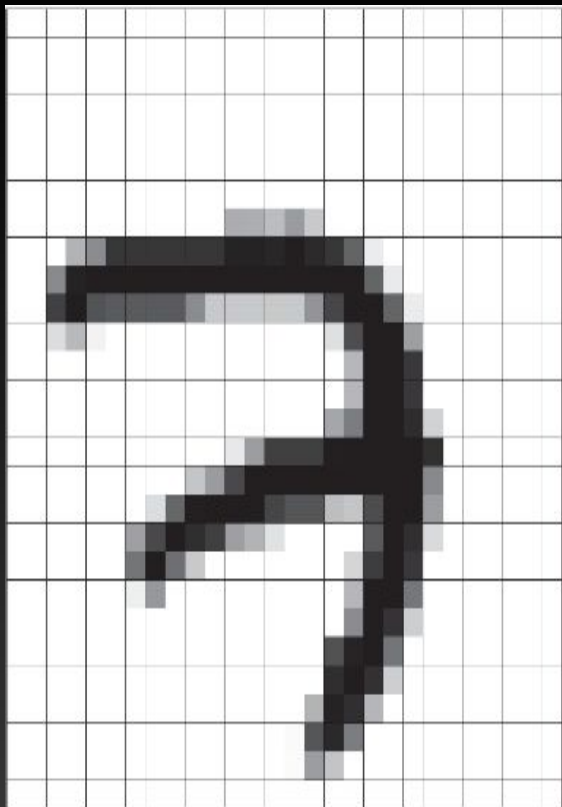
wait



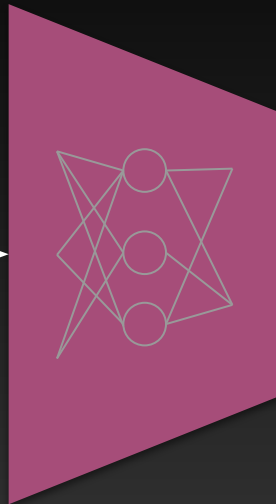
wait



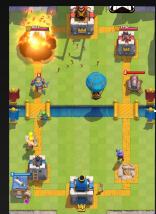




0	zero
1	one
2	two
3	three
4	four
5	five
6	six
7	seven
8	eight
9	nine



0	wait
1	musketeer, 0, 0
2	musketeer, 0, 1
3	musketeer, 0, 2
...	...
157	musketeer, 13, 8
...	...
2302	giant skeleton, 17, 29
2303	giant skeleton, 17, 30
2304	giant skeleton, 17, 31



board (32×18)

Embed

1×1

Resblk

...

Resblk

+

Resblk

...

Resblk

MLP

action
(2305)

×5

×5



context (21)

Embed

Concat

MLP

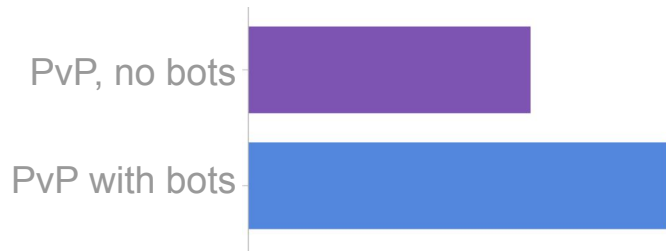
Results

Quantitative evaluation 🙄(ツ)🙄

Empirical playtesting 👍

A/B testing 🎉

Net win rate: 72%



Live system

Trained on 70M frames of game replays

In production since 2018

Live for low/mid trophies

Memoryless = stateless ❤️

Served more than 10^{12} frames



THANKS!