

SAMSUNG SDS

Realize your vision

Techtonic 2019

Partner



Foresee

Disrupt

2019.11.14 • SAMSUNG SDS Tower B1F
{ Magellan Hall / Pascal Hall }

Track 3 | AI/Analytics

DefogGAN : GAN을 활용한
스타크래프트 게임의 상대 정보 유추

정용현 프로 (SAIDA Lab) / 삼성SDS

AGENDA

1. Game AI
2. Background
3. DefogGAN
4. Result
5. Conclusion

1

Game AI

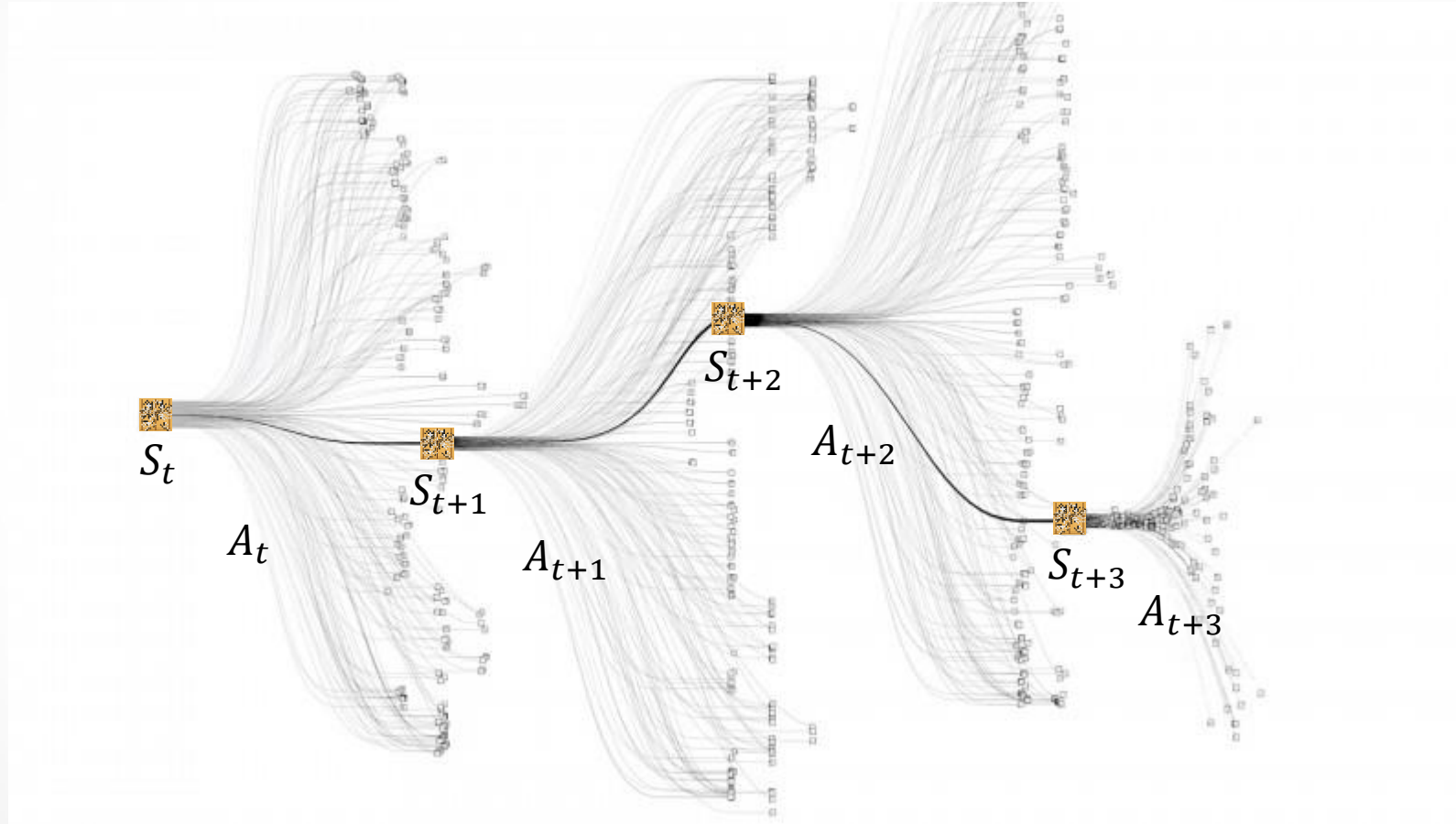
Game AI

Google DeepMind Challenge match (2016년 3월)



Game AI

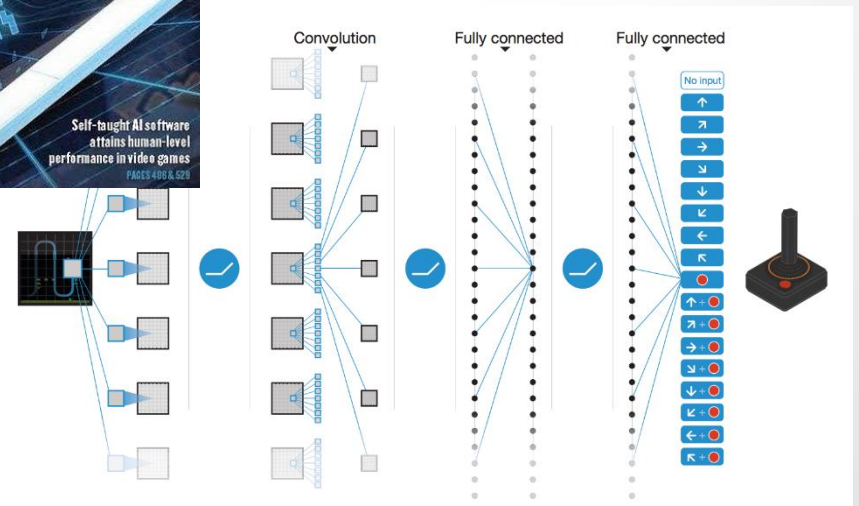
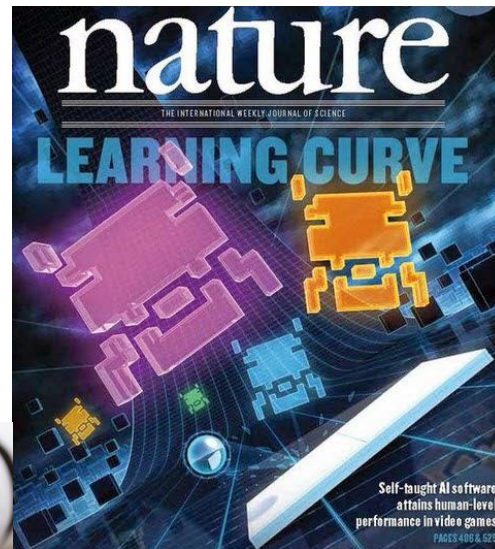
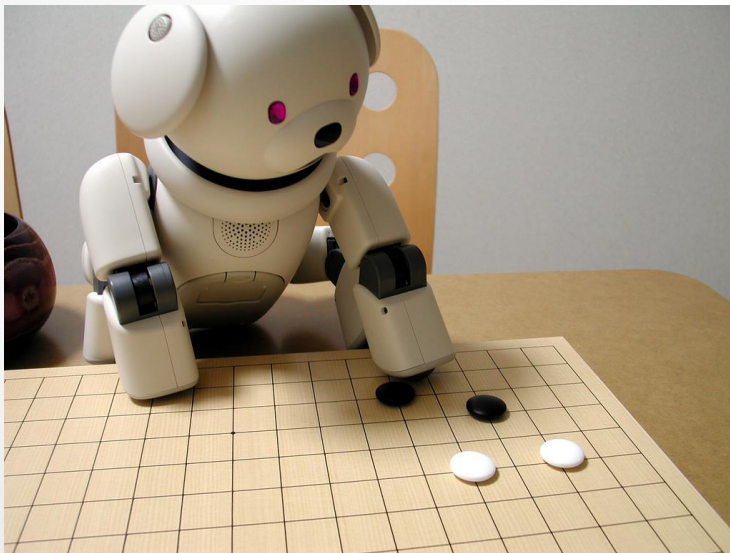
Markov Decision Process (MDP)



Game AI

Agent가 지속적으로 게임을 하면서 스스로 학습 함

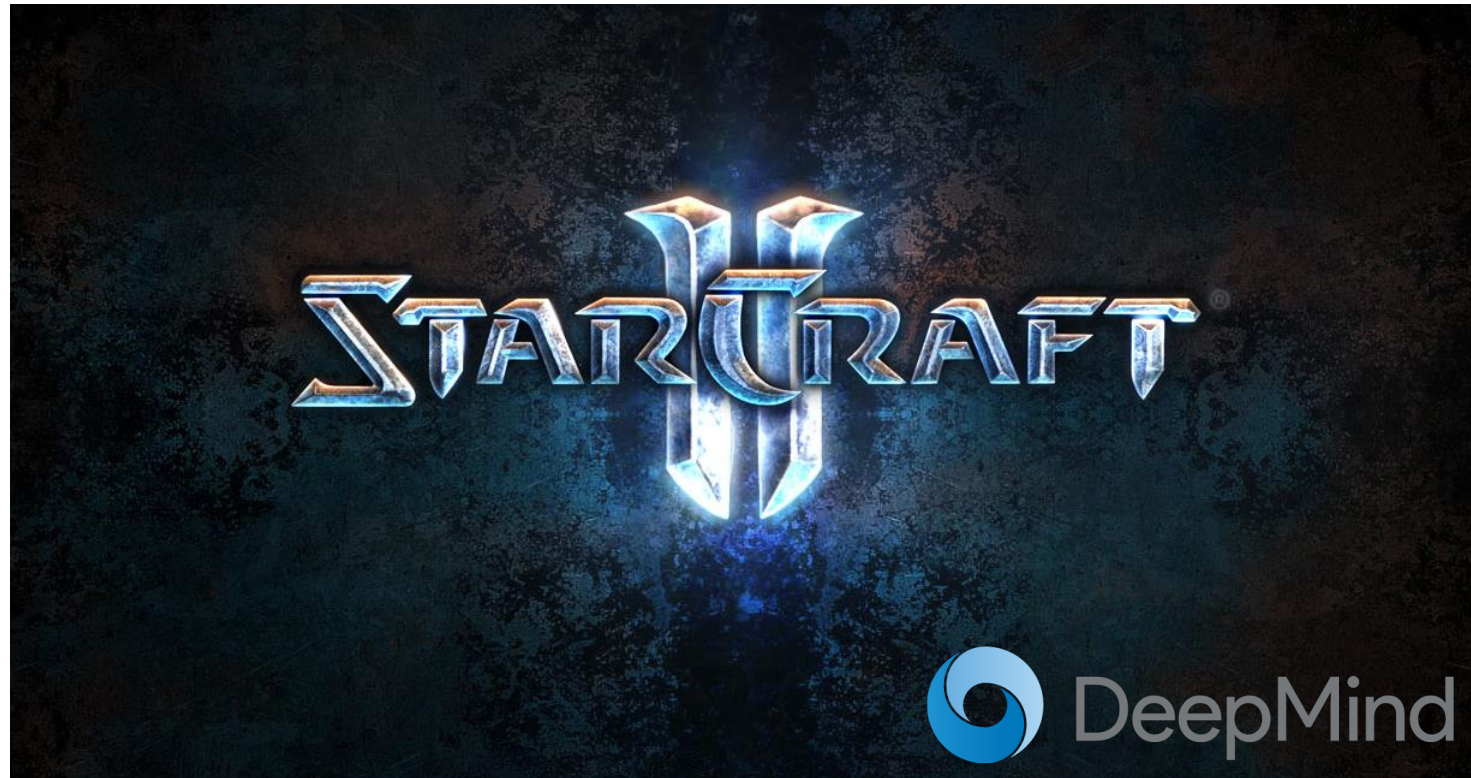
Deep Reinforcement Learning



출처 : <http://anewdomain.net/robots-vs-migrants-the-dilemma-of-japans-stagnating-economy/>
<https://www.smithsonianmag.com/innovation/google-ai-deepminds-alphazero-games-chess-and-go-1809709>
<https://www.nature.com/nature/volumes/518/issues/7540>
<https://www.kdnuggets.com/2016/11/deep-learning-research-review-reinforcement-learning.html>

Game AI

DeepMind의 다음 목표는 스타크래프트



- ▶ 무한한 데이터 :
AI agent를 활용하면 데이터를
무한정 생산 가능

- ▶ 저비용 :
소프트웨어 시뮬레이터의 환경을
이용한 실험

- ▶ 병렬 처리:
학습을 위한 컴퓨팅 병렬화

- ▶ 명확한 승리 조건 :
게임의 승리 조건이 주어져 있으며,
평가의 객관성을 보장

StarCraft AI

1. 자원을 캐서 자원 저장소에 모은다.



StarCraft AI

2. 모은 자원을 이용해서 병력 생산 시설을 짓는다.



StarCraft AI

3. 전략에 따라 여러 종류의 병력을 생산하여 모은다.



StarCraft AI

4. 상대를 찾아 싸워 이기면 승리!



StarCraft AI는 fog-of-war 문제를 갖는다.

Partially Observable Markov Decision Process (POMDP)

상대방이 무엇을 하고 있는지 알 수 없다. (fog-of-war)



Map 내에서
나의 유닛이나 빌딩이 있는 곳만
시야가 밝혀 지고
나머지는 안개로 가려져 있다!

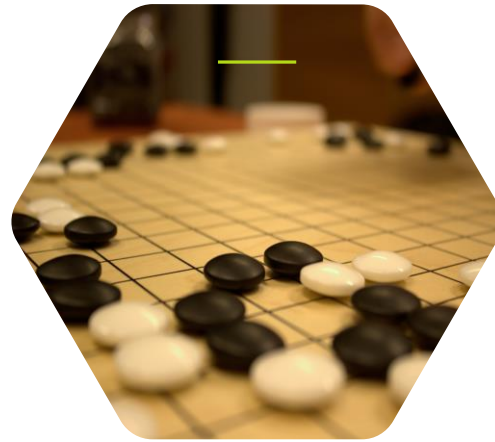
StarCraft 게임의 복잡성

StarCraft는 Atari, 바둑보다 더 복잡하고 어려운 문제를 가지고 있음



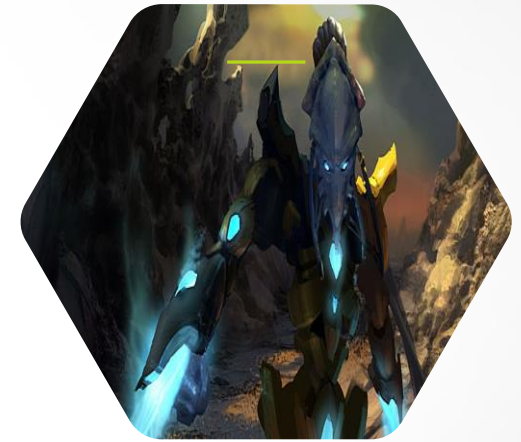
쉬움
Atari

- Action space : 17
- Single player
- Near-Perfect



어려움
바둑

- Action space : 361
- Multi player
- Perfect



매우 어려움
StarCraft

- Action space : $\sim 10^{26}$
- Multi player
- Imperfect

Defog 문제

상대 정보를 모르는 fog-of-war 상황에서 상대의 정보를 유추해보자!

Fog가 존재하는 게임 (주어진) 상황



Fog가 없는 실제 (정답) 상황



부분적으로 관찰되는 상대 유닛을 통해 가려진 상대 유닛을 추론

2

Background

불완전 정보 (예. Inpainting)

상자 안에는 어떤 그림이 있을까요?



출처 : <https://medium.com/emergent-future/simple-reinforcement-learning-with-tensorflow-part-6-partial-observability-and-deep-recurrent-q-68463e9aeefc>

불완전 정보 (예. Inpainting)

주변의 흐름을 통해 유추



출처 : <https://medium.com/emergent-future/simple-reinforcement-learning-with-tensorflow-part-6-partial-observability-and-deep-recurrent-q-68463e9aeefc>

불완전 정보 (예. Inpainting)

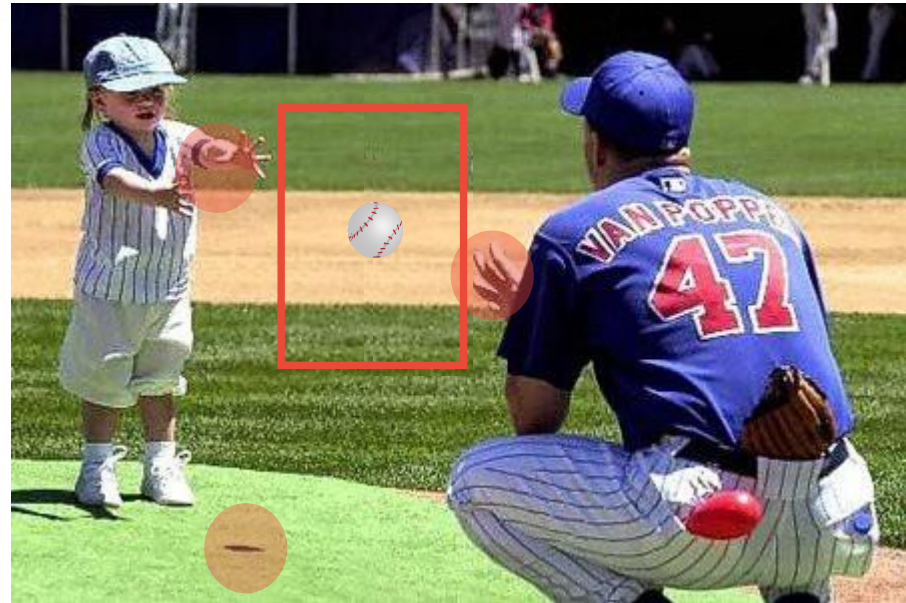
범인은 증거를 남긴다...



출처 : <https://medium.com/emergent-future/simple-reinforcement-learning-with-tensorflow-part-6-partial-observability-and-deep-recurrent-q-68463e9aeefc>
<https://www.flickr.com/photos/181721868@N06/47956349788/in/photolist-djgVhT-2g4JQ23-jJzGqJ-qJYpiS>

불완전 정보 (예. Inpainting)

공의 위치는 정확한가?



출처 : <https://medium.com/emergent-future/simple-reinforcement-learning-with-tensorflow-part-6-partial-observability-and-deep-recurrent-q-68463e9aeefc>

불완전 정보 (예. Inpainting)

공의 크기나 위치, 이동 방향, 속도를 알기 위해 과거의 정보가 필요 함



출처 : <https://medium.com/emergent-future/simple-reinforcement-learning-with-tensorflow-part-6-partial-observability-and-deep-recurrent-q-68463e9aeefc>

Inpainting vs Defog

Inpainting

가려진 그림



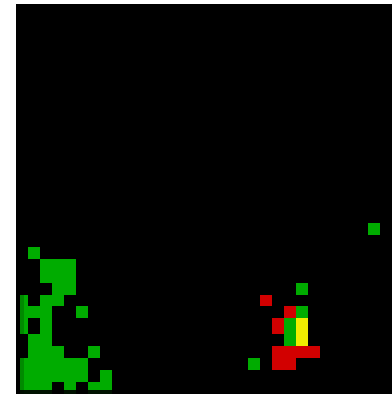
채워 넣은 그림



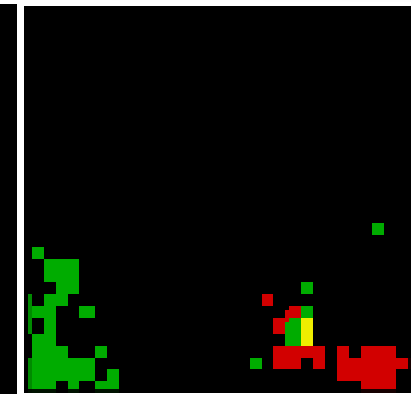
- ▶ 가려진 부분 (Masked part)
- ▶ 주변의 그림을 기반
- ▶ 진짜 같은 그림을 그린다.

Defog

안개 상황



안개 속 유추 상황



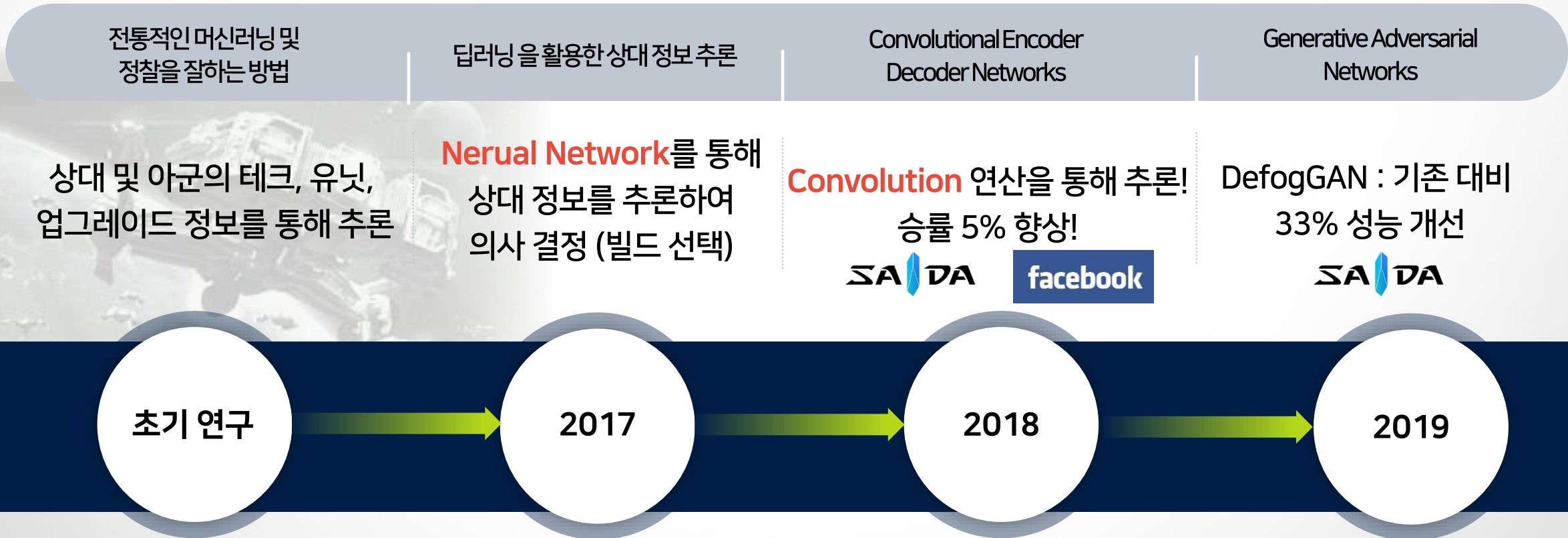
녹색 : 아군, 붉은색 : 적군, 노란색 : 둘다 존재

- ▶ 전체 부분
- ▶ Partial observation을 기반
- ▶ 공간상 유닛이 존재할 위치를 찾고 개수를 추론

StarCraft AI 연구의 역사와 Defog 연구

2010년부터 스타크래프트를 기반으로 다양한 인공지능 연구 (2020 AAI Oral-Accept)

2011년부터 스타크래프트 인공지능 대회가 매년 개최 (2018 AIIDE 우승)



Defog를 통한 에이전트 성능 개선

Defogger는 전투 가치 판단을 도와준다

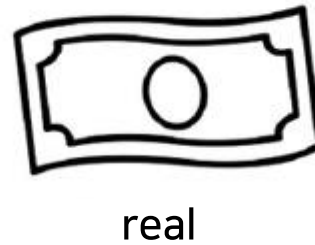


GAN

Generative Adversarial Networks

위조 지폐 제조 (Generator)

위조 지폐 감별 (Discriminator)



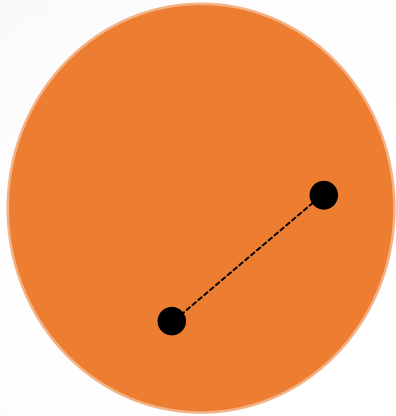
GAN

Generative Adversarial Networks

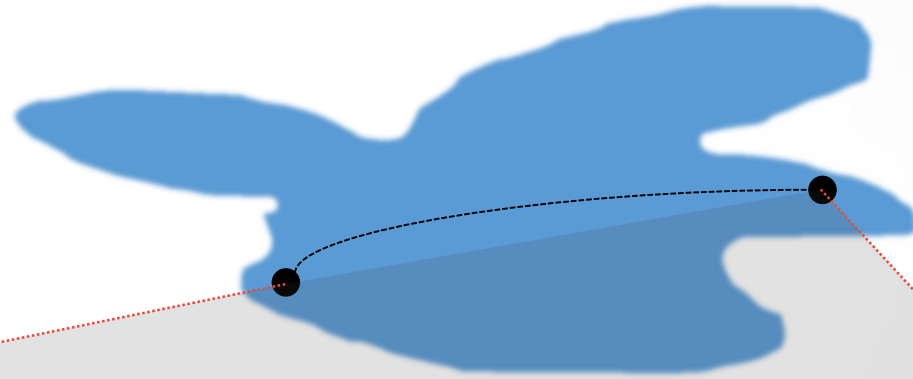


GAN

잠재 공간
(가우시안)

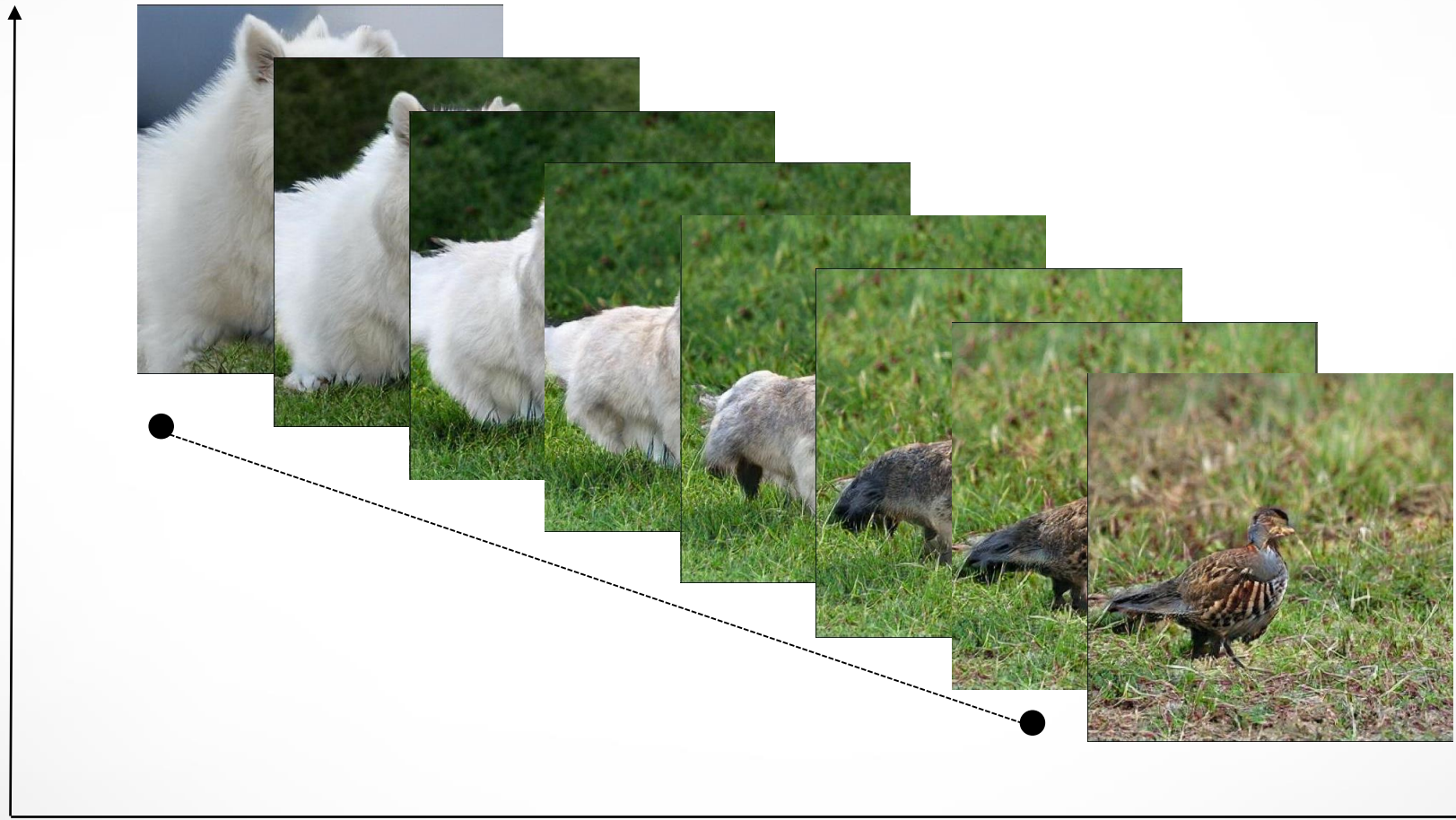


데이터 공간
(Natural Image)



GAN

Interpolation in Latent Space



3

DefogGAN

DefogGAN

Generative Adversarial Networks for Defogging

그럴듯한 상황을 재현 (Generator)

재현된 상황을 감별 (Discriminator)



Fogged data



Generator



fake



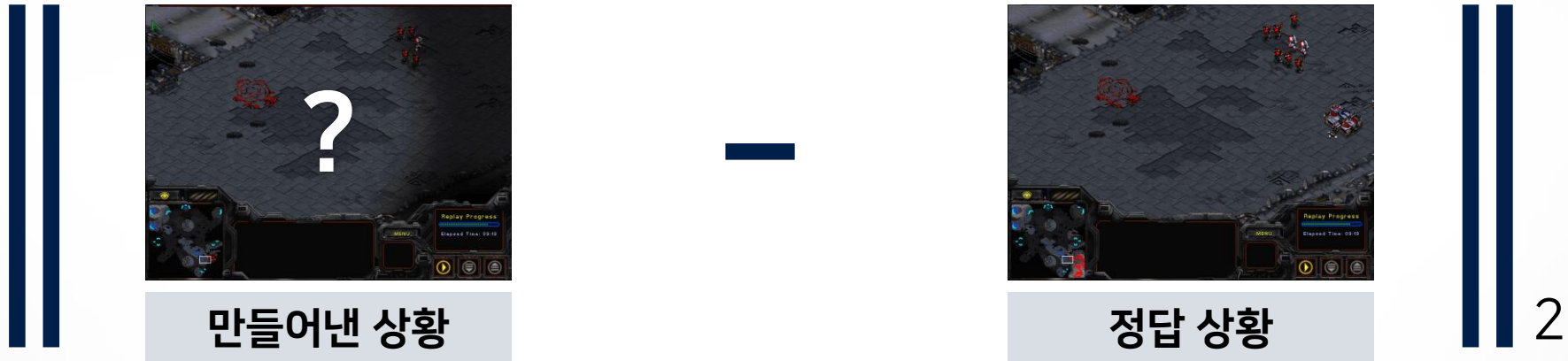
real



Discriminator

DefogGAN - 손실 함수 (Generator ①)

실제 상황과 그럴듯하게 만들어 낸 상황이 얼마나 다른가?



손실함수 = (실제상황과 픽셀 별로 비교하여 그 차이만큼)

DefogGAN - 손실 함수 (Generator ②)

그렇듯하게 만들어낸 상황이 Discriminator를 잘 속이고 있는가?

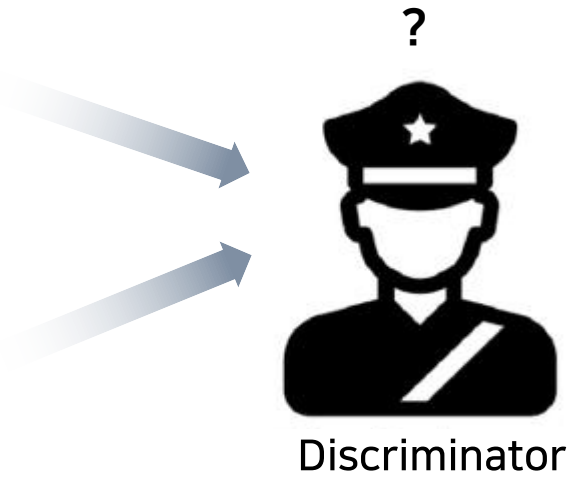


Discriminator

손실함수 = (Discriminator를 잘 못 속이는 만큼)

DefogGAN - 손실 함수 (Discriminator)

Discriminator가 그럴듯하게 만들어낸 상황과 실제를 얼마나 구분해내는가?



손실함수 = (정답 상황과 그럴듯한 상황을 구별 못하는 만큼)

DefogGAN - Data

데이터 구성 방법 (이미지를 사용하지 않고, 유닛 맵을 만들어 사용)



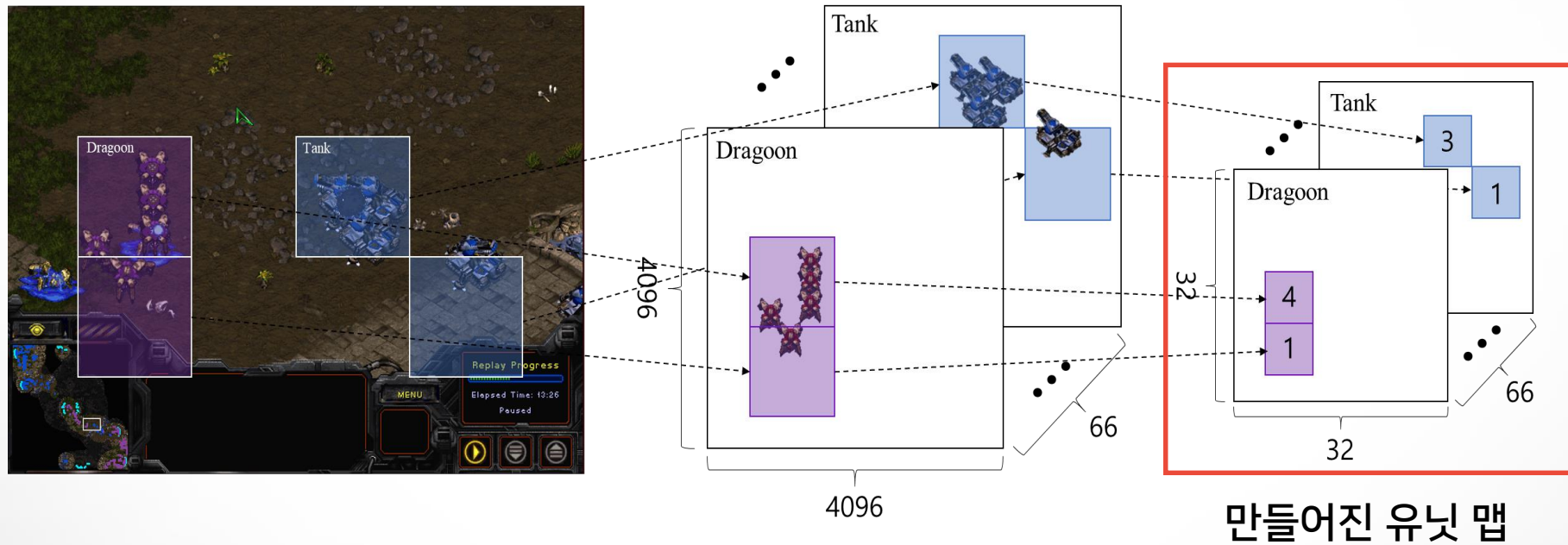
스타크래프트 화면

유닛 타입 별로 나누기

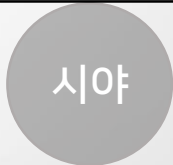
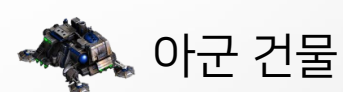
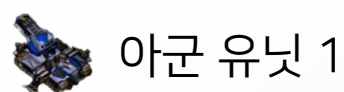
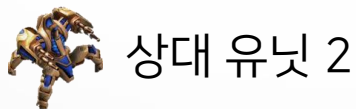
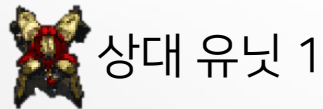
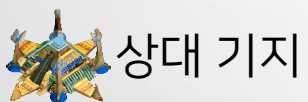
유닛 맵

DefogGAN - Data

Unit data map (Protoss vs Terran 기준 66개의 유닛 타입)



DefogGAN - 과거 Data (관찰 기억)



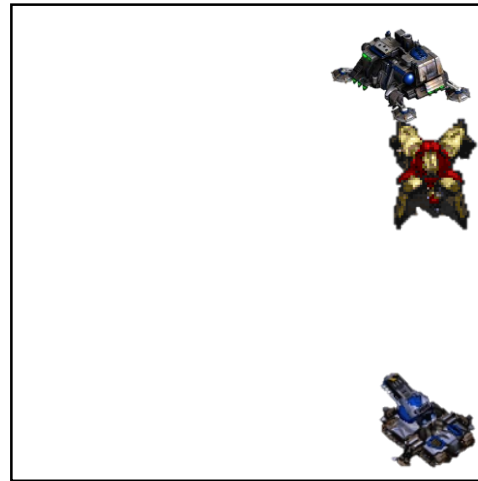
DefogGAN - Data

관찰 기억을 통해 더 많은 상대 유닛 정보를 활용



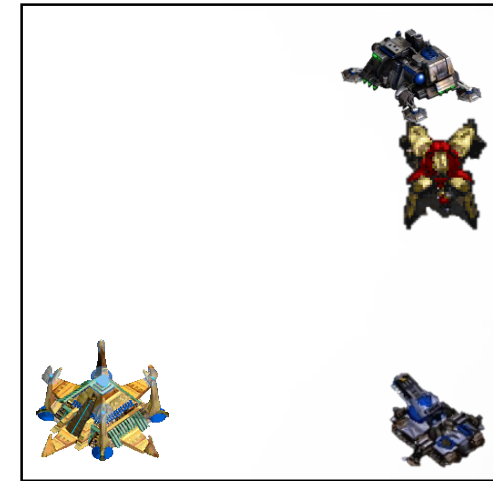
실제 게임 상황

상대 유닛 3개



실제 관찰 (현재)

관찰 중인 상대 유닛 1개

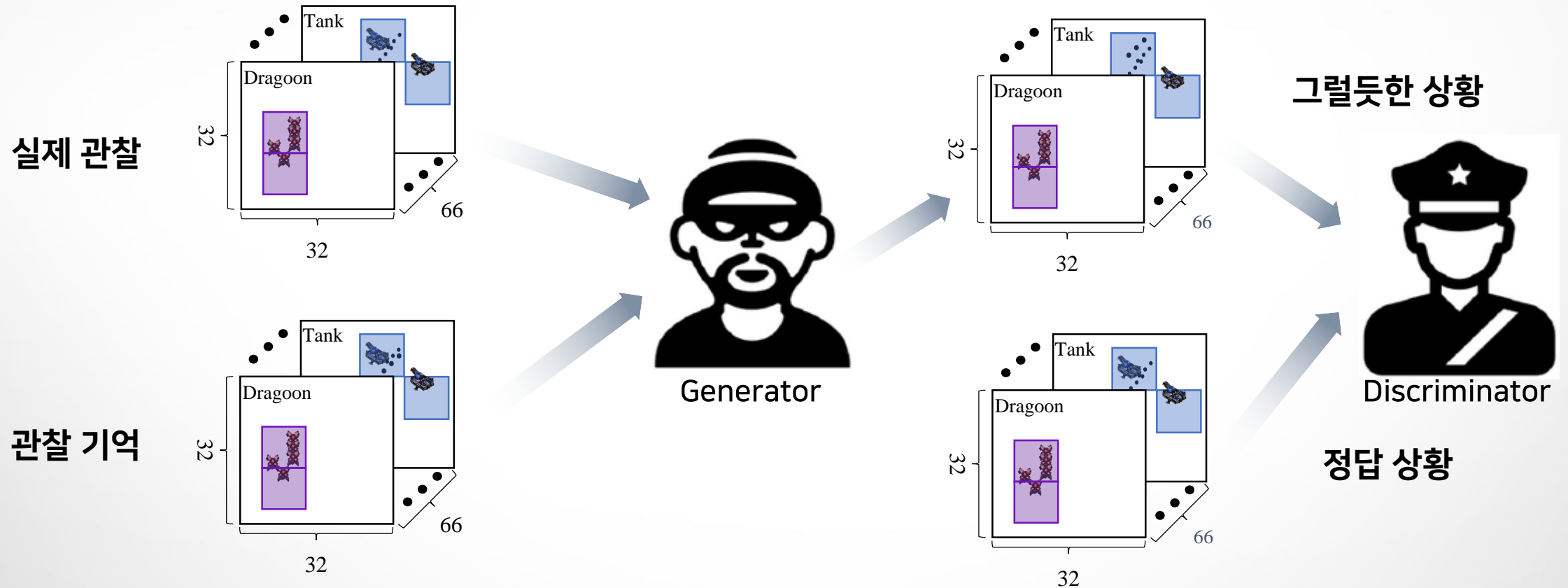


관찰 기억 (과거)

관찰 중인 상대 유닛 1개
, 기억 된 상대 유닛 1개

DefogGAN

실제 관찰 정보와 관찰되었던 과거 정보를 같이 학습



4

Result

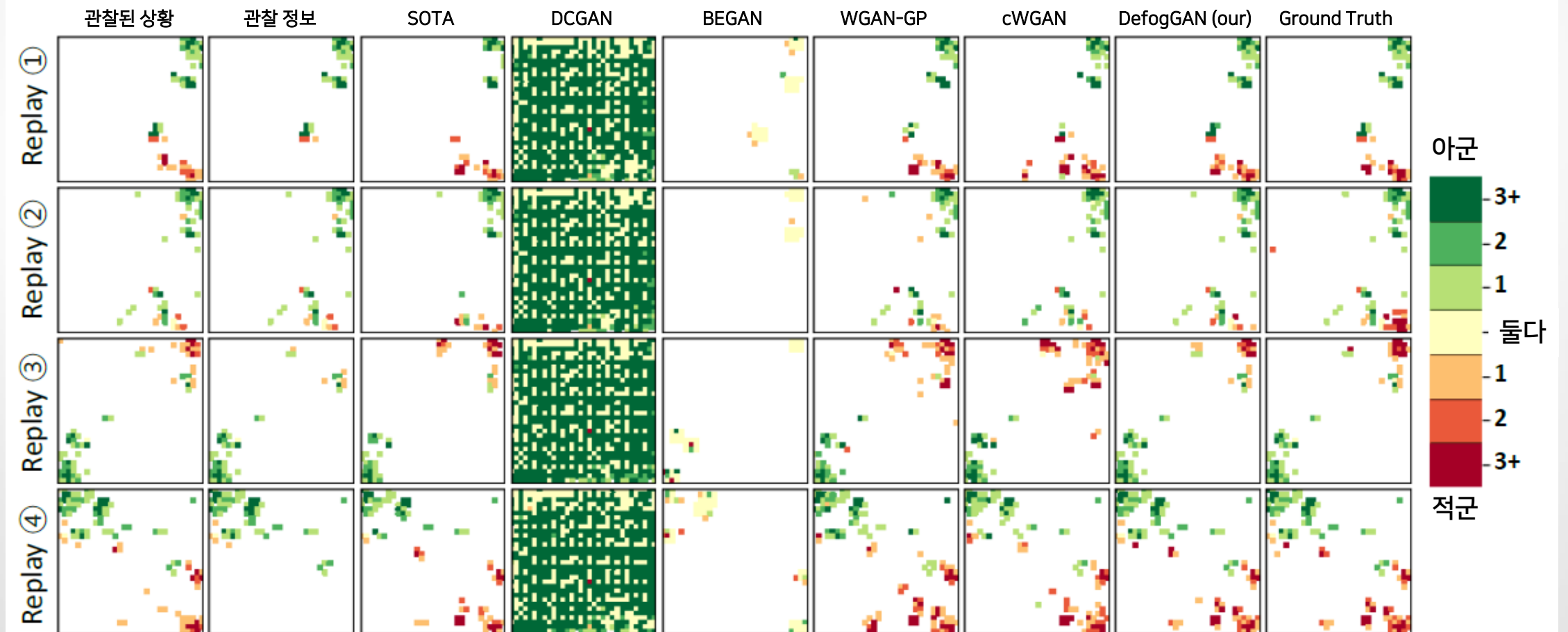
비교 결과

다른 방법들 (GAN과 이전의 Defogger)과 비교

	MSE	Accuracy	F1 score	Recall	Precision
Convolutional Encoder-Decoder(SOTA)	0.00311	0.99896	0.682	0.538	0.933
DCGAN	2.16007	0.94844	0.019	0.239	0.010
BEGAN	0.01578	0.99353	0.024	0.039	0.018
WGAN-GP	0.00348	0.99885	0.701	0.648	0.763
cWGAN	0.00372	0.99878	0.688	0.644	0.737
DefogGAN	0.00208	0.99944	0.856	0.807	0.913

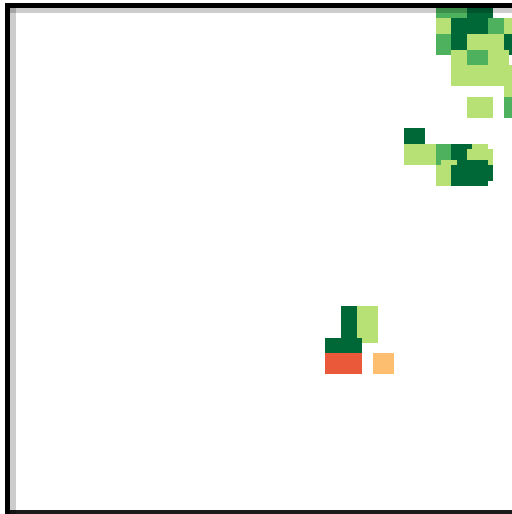
비교 결과

다른 방법들 (GAN과 이전의 Defogger)과 비교

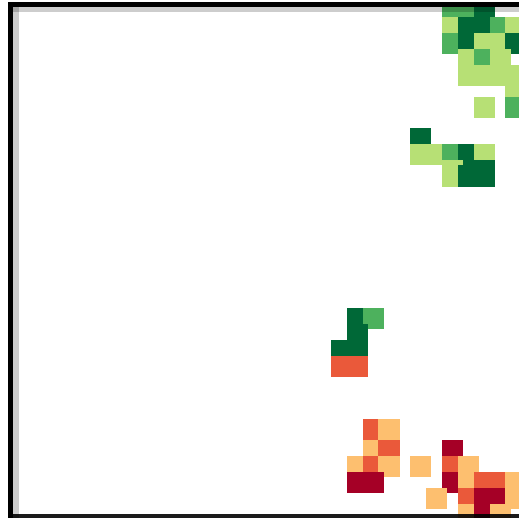


비교 결과

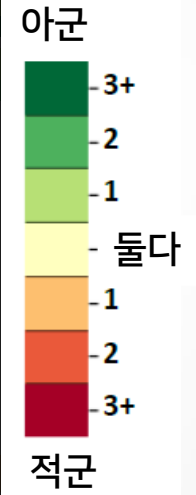
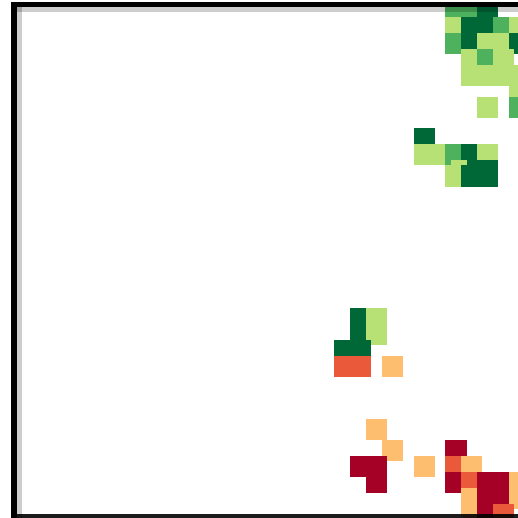
관찰된 상황



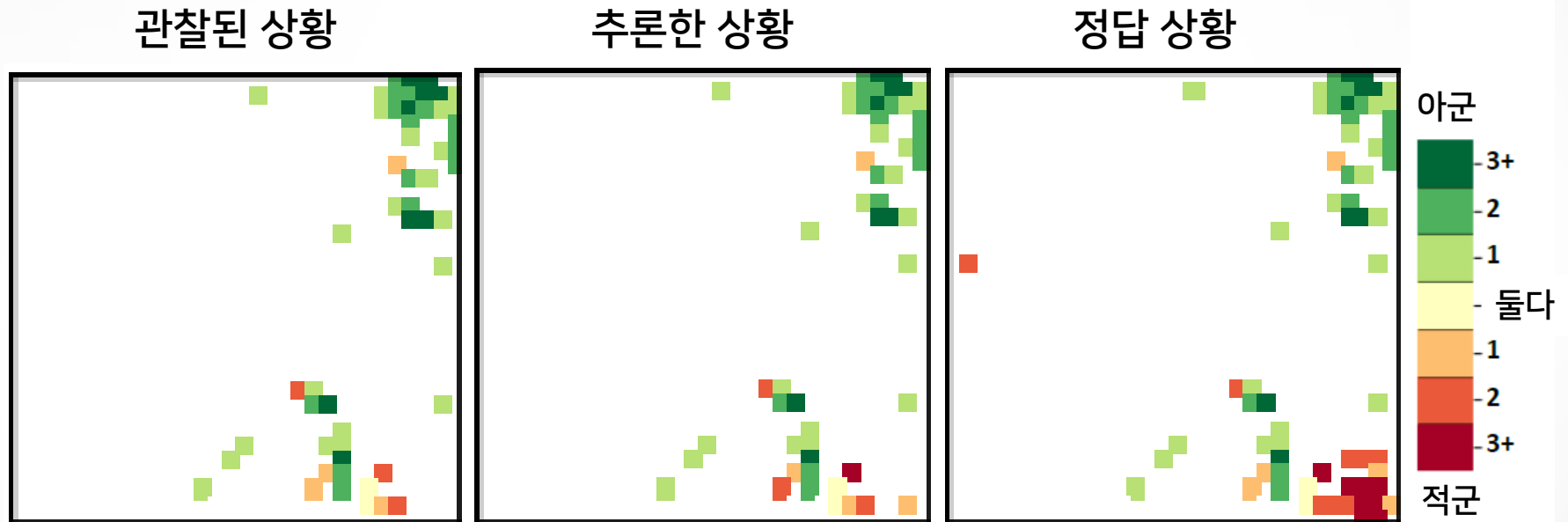
추론한 상황



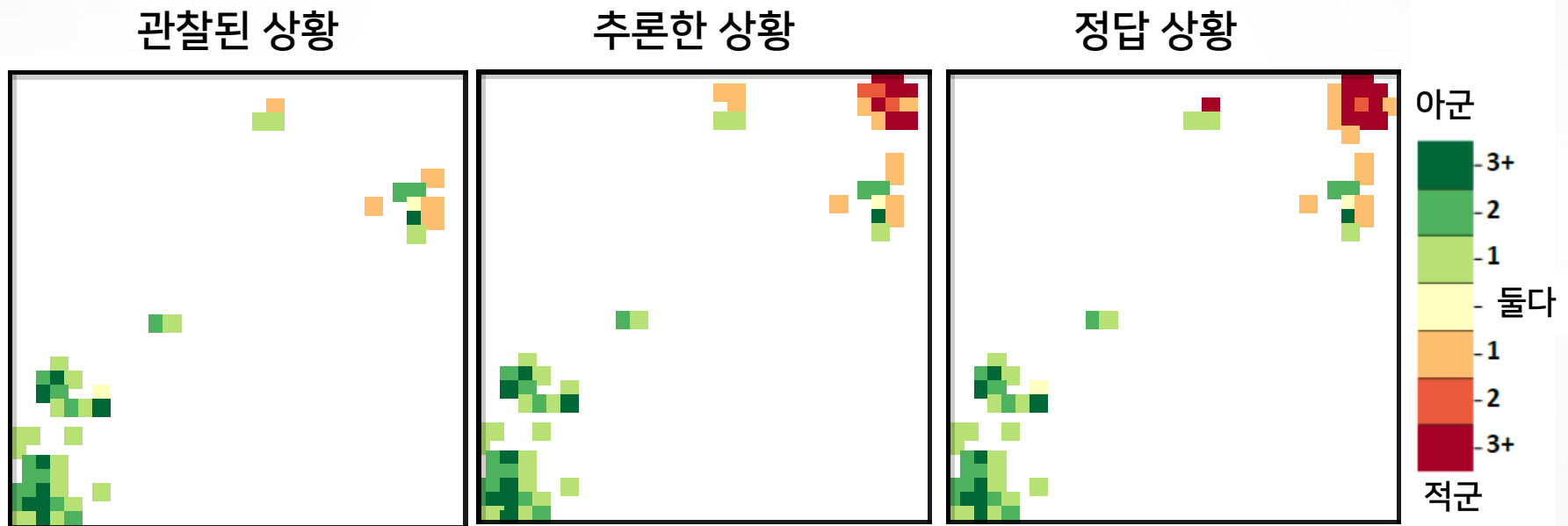
정답 상황



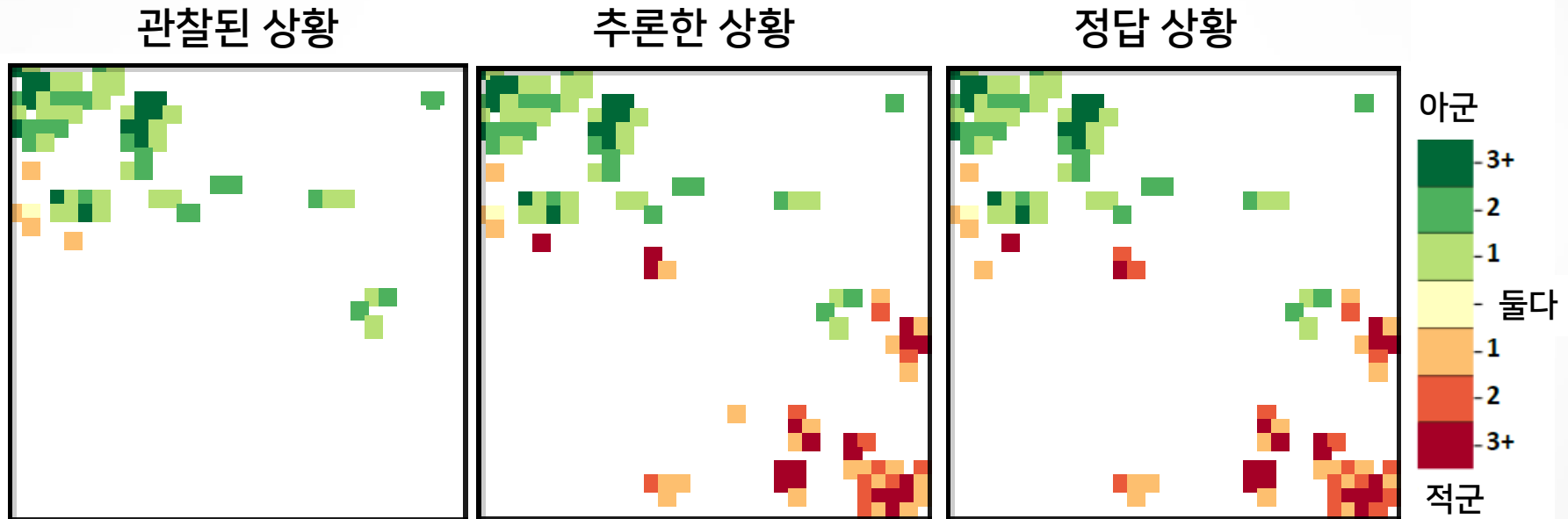
비교 결과



비교 결과



비교 결과

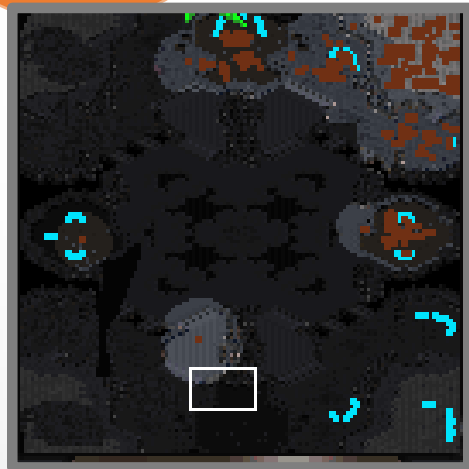
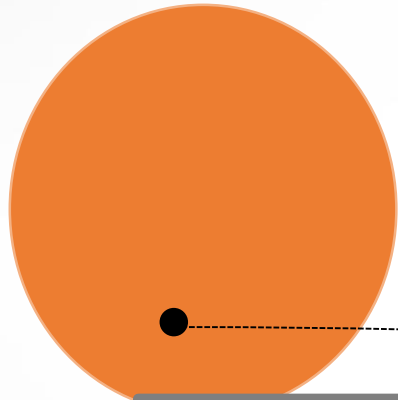


5

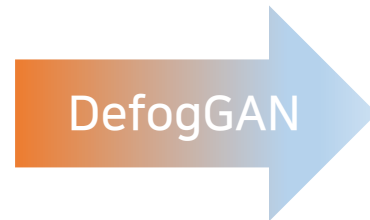
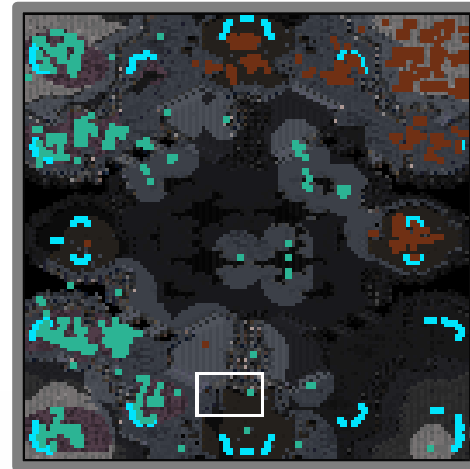
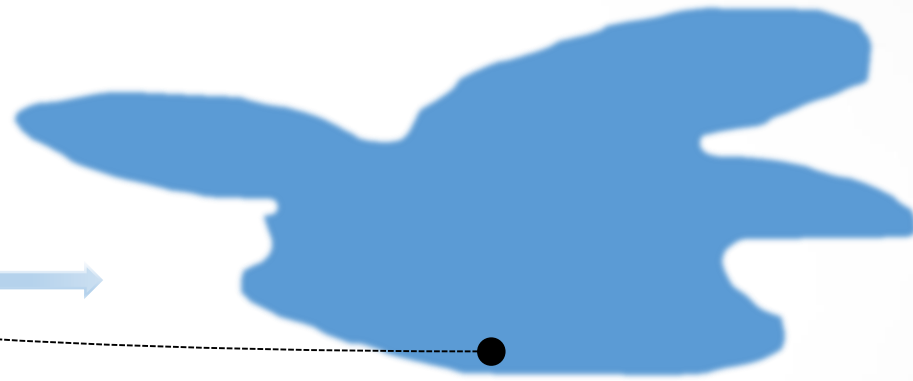
Conclusion

DefogGAN

부분적 관찰 공간
(Fog state)



재현되는 공간
(Real state)



DefogGAN



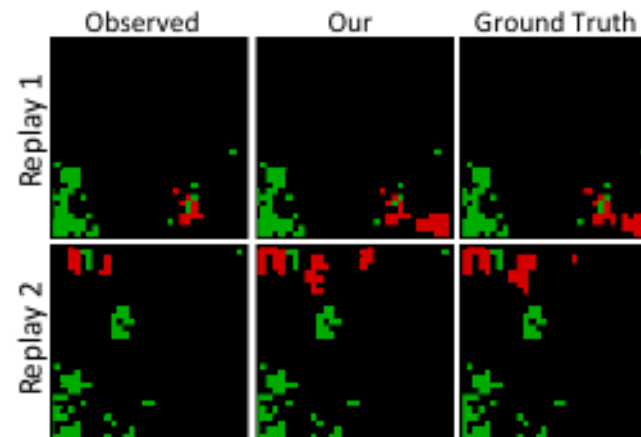
AAAI 2020 학회 (2020.02.07~12, 구두 발표)

DefogGAN: Predicting Hidden Information in the StarCraft Fog of War with Generative Adversarial Nets

Yonghyun Jeong, Hyun-Jin Choi, Byoungjip Kim, Youngjune L. Gwon
Samsung SDS AI Research, Seoul, South Korea

Abstract

We propose DefogGAN, a generative approach to the problem of inferring state information hidden in the fog of war for real-time strategy (RTS) games. Given a partially observed state, DefogGAN generates defogged images of a game as predictive information. Such information can be used to create a powerful AI agent for the game. DefogGAN can be thought as a conditional GAN variant featuring pyramidal reconstruction loss to optimize on multiple feature resolution scales. We empirically validate DefogGAN using a large dataset of professional StarCraft replays. Our StarCraft AI created from DefogGAN can predict the enemy buildings and combat units as professional players can do. DefogGAN can





Thank You



The graphic features the text 'Q & A' in a clean, sans-serif font. The 'Q' and 'A' are white, while the ampersand is a vibrant lime green. To the right of the text, two orange triangles point towards a large, dark blue circle on the far right. The background is a dark blue gradient with a pattern of lighter blue circles on the left side.

Q & A

Partner Disrupt Foresee