



ProGAN on Satellite images

Openlab Lightning talk

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Why?

Do we want to generate images?

UNOSAT:

- Satellite images for:
 - humanitarian relief,
 - human security,
 - strategic territorial
 - development planning
- Machine learning
 - Crisis & Situational Mapping
 - Damage and Impact Assessment
 - Etc...
- Generating images?
 - Need of large inputs for training
 - Satellite images are expensive



Rukban desert

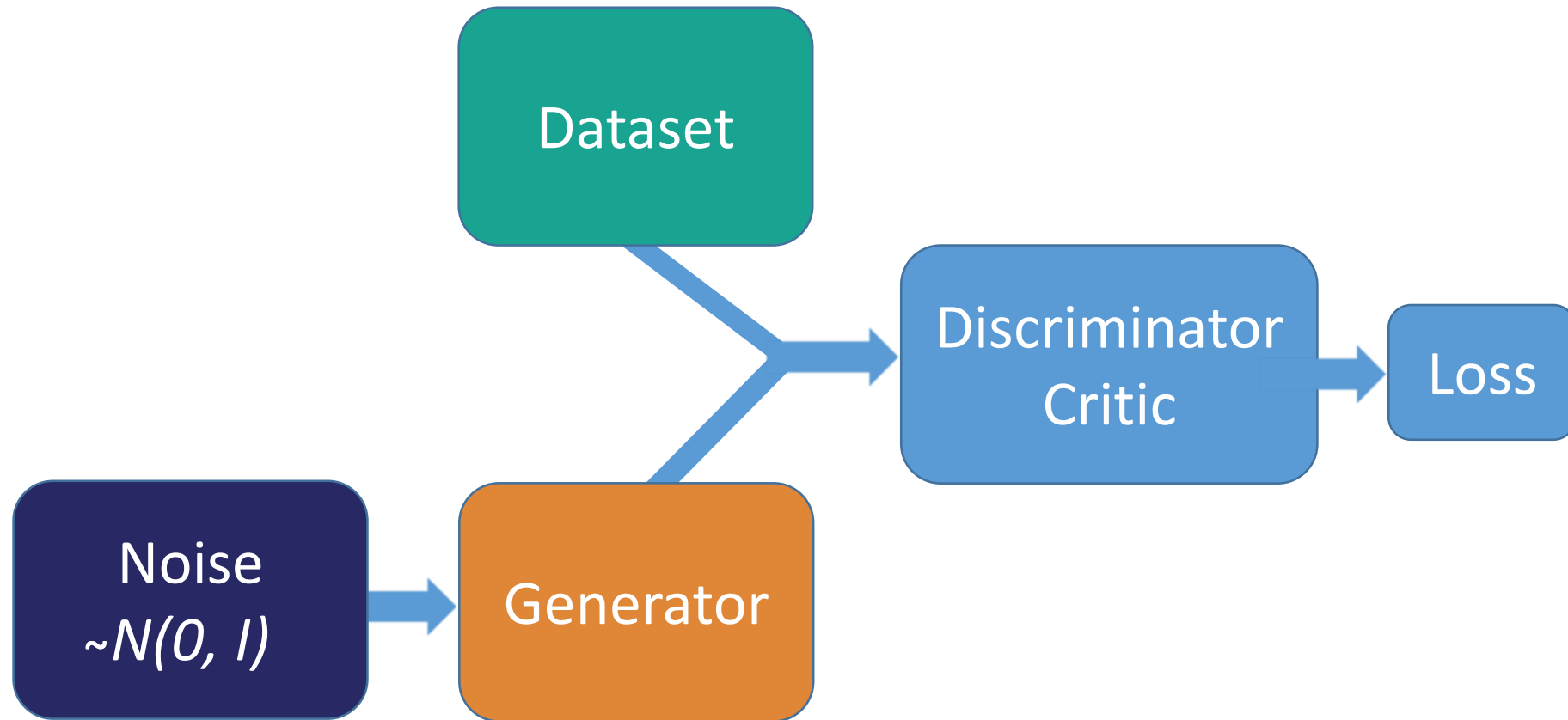
The dataset: around 50k images. Size: 256x256x3



1. Image generation with the ProGAN

Generative Adversarial Network (GAN)

We have seen it, you should have listen...



ProGAN

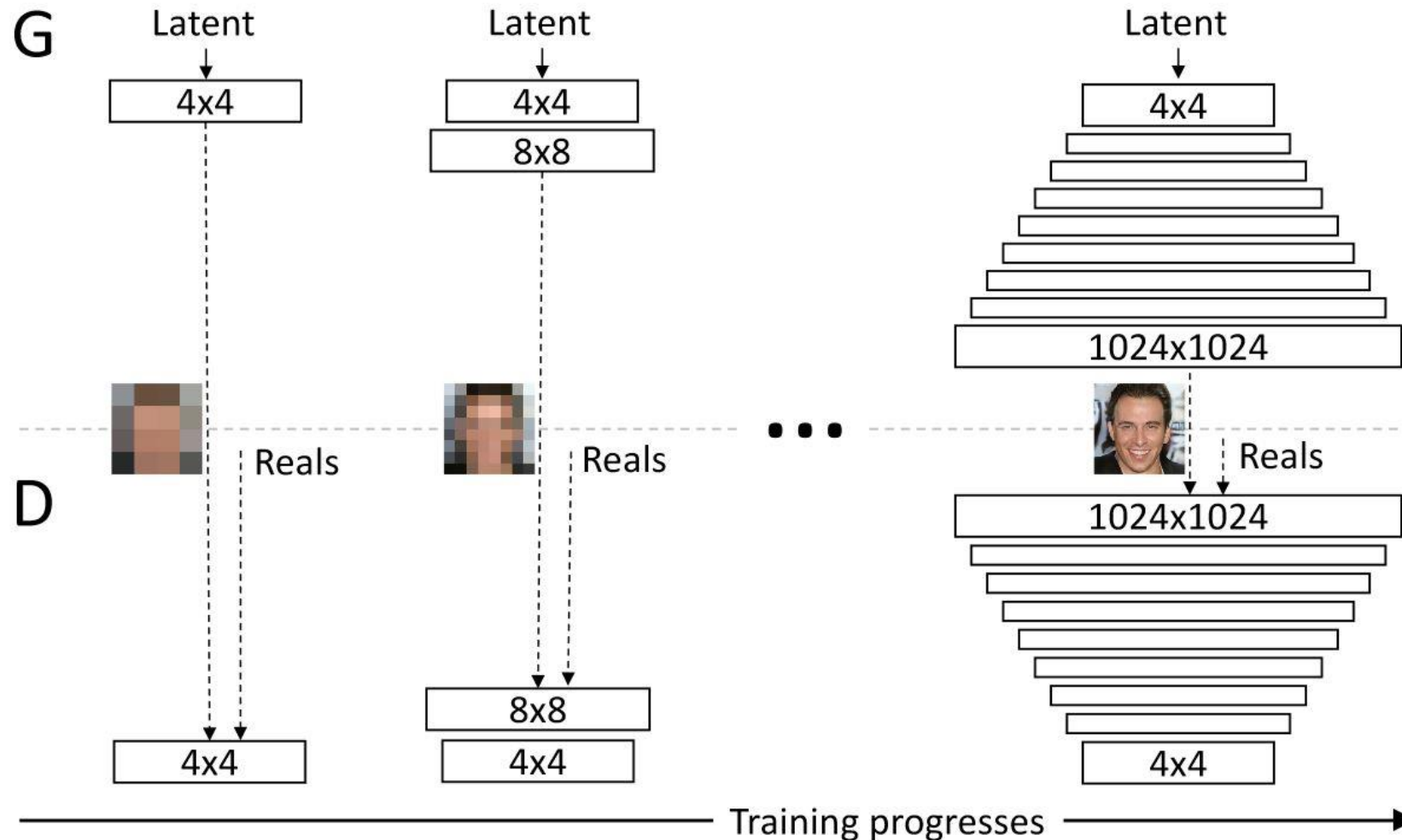
The state-of-the-art GAN for images



Tero Karras and *al.*, *Progressive growing of GANs for improved quality, stability and variation*, conference paper at ICLR 2018. Images credit: Nvidia

ProGAN

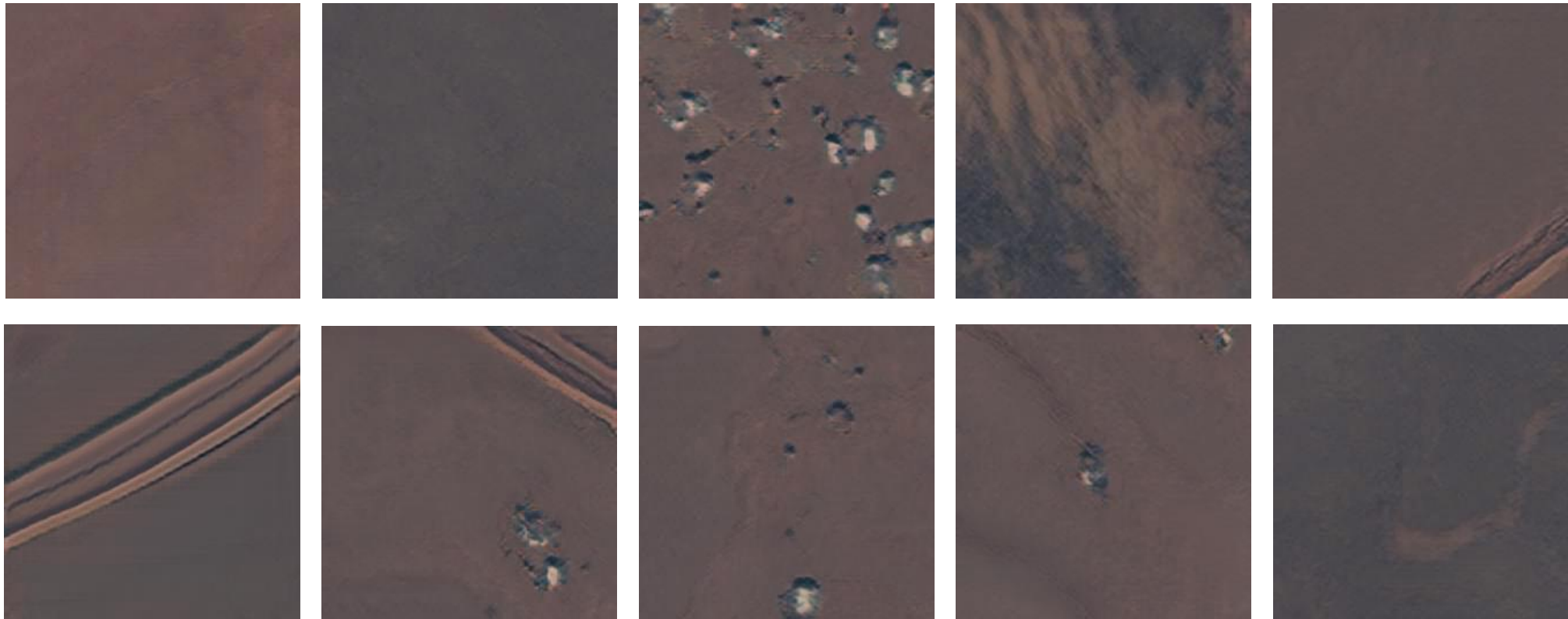
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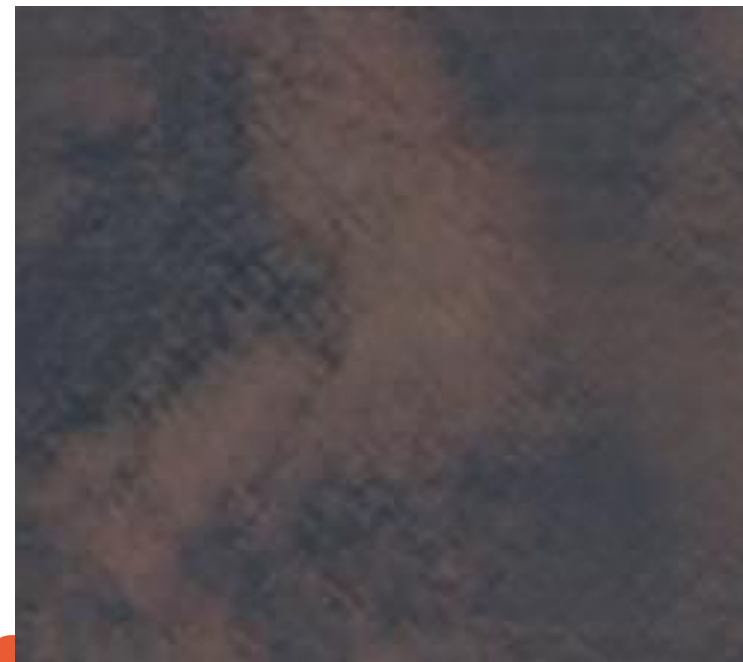
Generated images

Size: 256x256x3



Generated images

Size: 1024 x 1024 x 3



Generated images on CPU

... wait on CPU!?!

Generated images on CPU

... wait on CPU!?!



2. Quality of the generated sample

Failure 1: Estimate the size of the support?

Which metrics to assess the quality of the generated sample

The Birthday paradoxe

Base on Birthday Paradox: Sample of size about \sqrt{n} from a discrete distribution of size N 'would be quite likely to have a duplicate'

The test procedure:

- Draw a sample of size S (here 100).
- Take the closest pairs (here using pixelwise MSE)
- Inspect visually and look for duplicate

Sanjeev Arora and Yi Zhang *Do GANs actually learn the distribution? An empirical study*, arXiv:1706.08224v2, 2017.

Failure 1: The Birthday paradoxe

Closest real images from a sample of size 100

But... there are pictures of the desert!!!



Failure 2: SSIM (structural similarity index)

4 random samples (size 100): 2 from real, 2 from generated data

Sample 1	Sample 2	SSIM
Real 1	Real 2	0.91078
Generated 1	Generated 2	0.91763
Real 1	Generated 1	0.9138
Real 1	Generated 2	0.9196
Real 2	Generated 1	0.90801
Real 2	Generated 2	0.91411

Fréchet Inception Distance

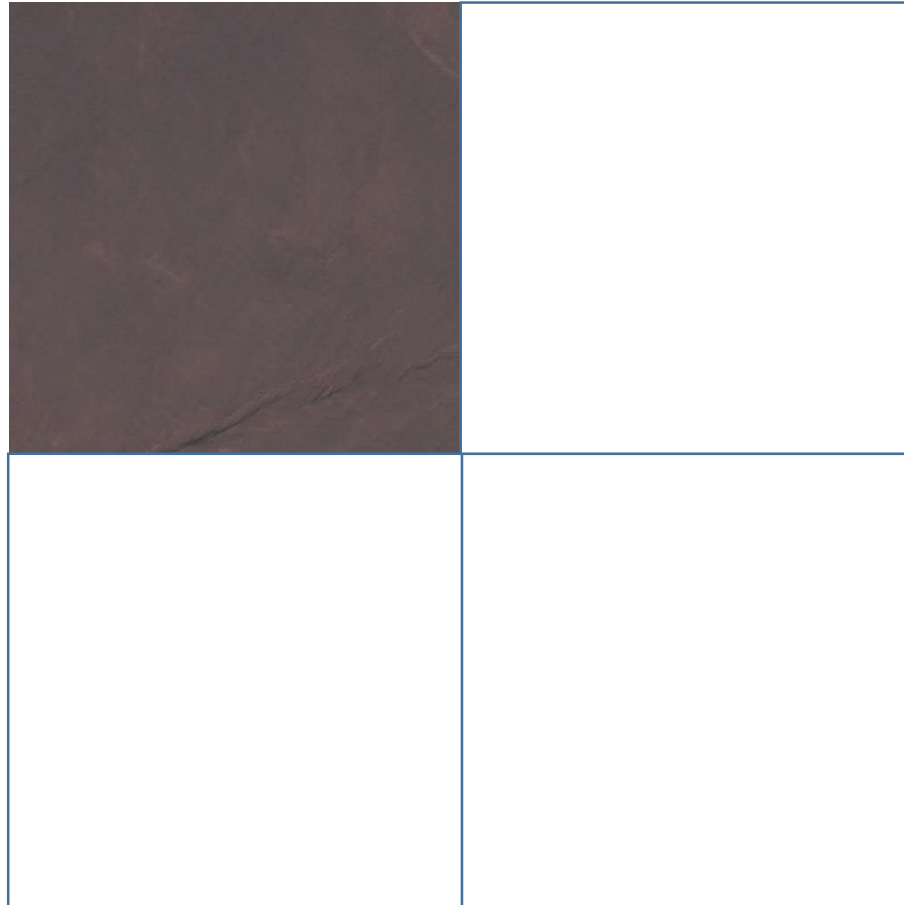
4 random samples (size 100): 2 from real, 2 from generated data

Sample 1	Sample 2	FID
Real 1	Real 2	74.6
Generated 1	Generated 2	72.8
Real 1	Generated 1	201.1
Real 1	Generated 2	200.3
Real 2	Generated 1	198.8
Real 2	Generated 2	199.0

3. The challenge: extend the image

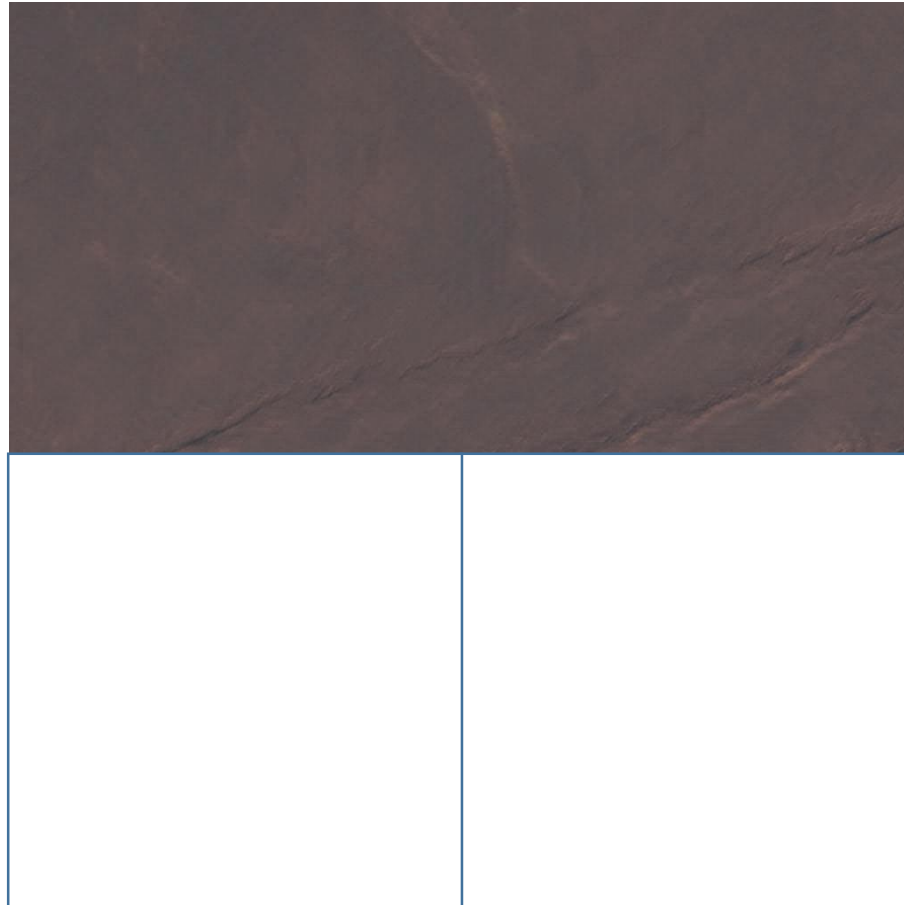
3. Conditional Progressive GAN

The aim: we want to generate images depending on previous images



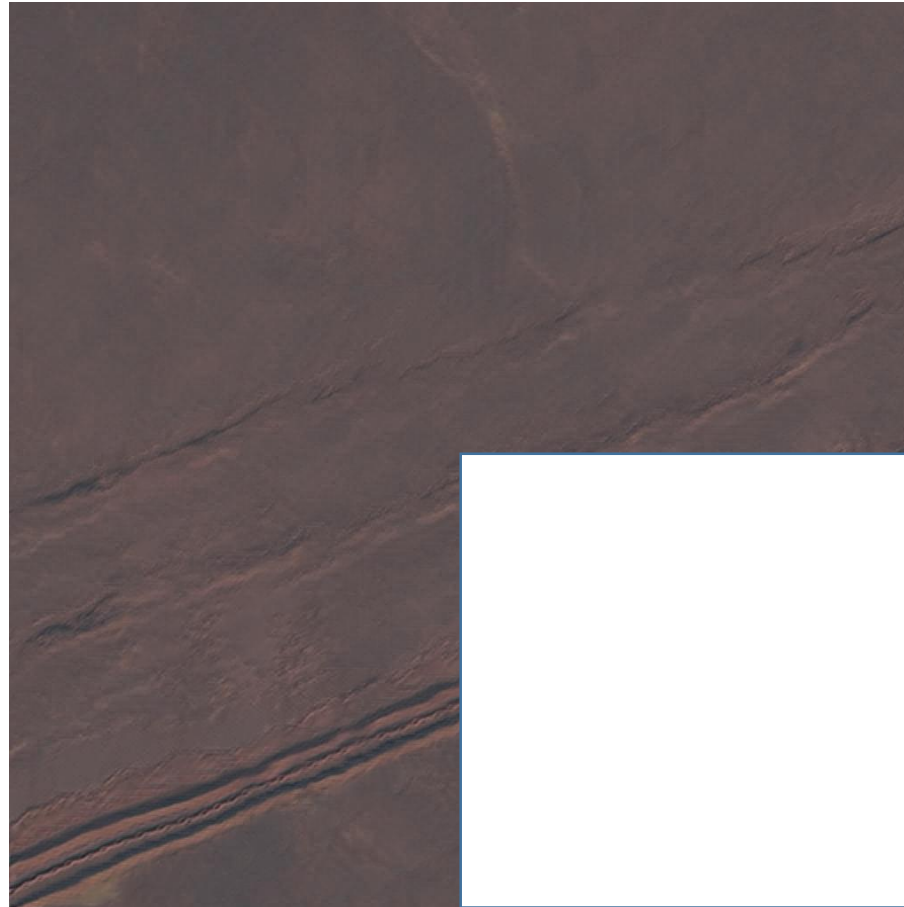
3. Conditional Progressive GAN

The aim: we want to generate images depending on previous images



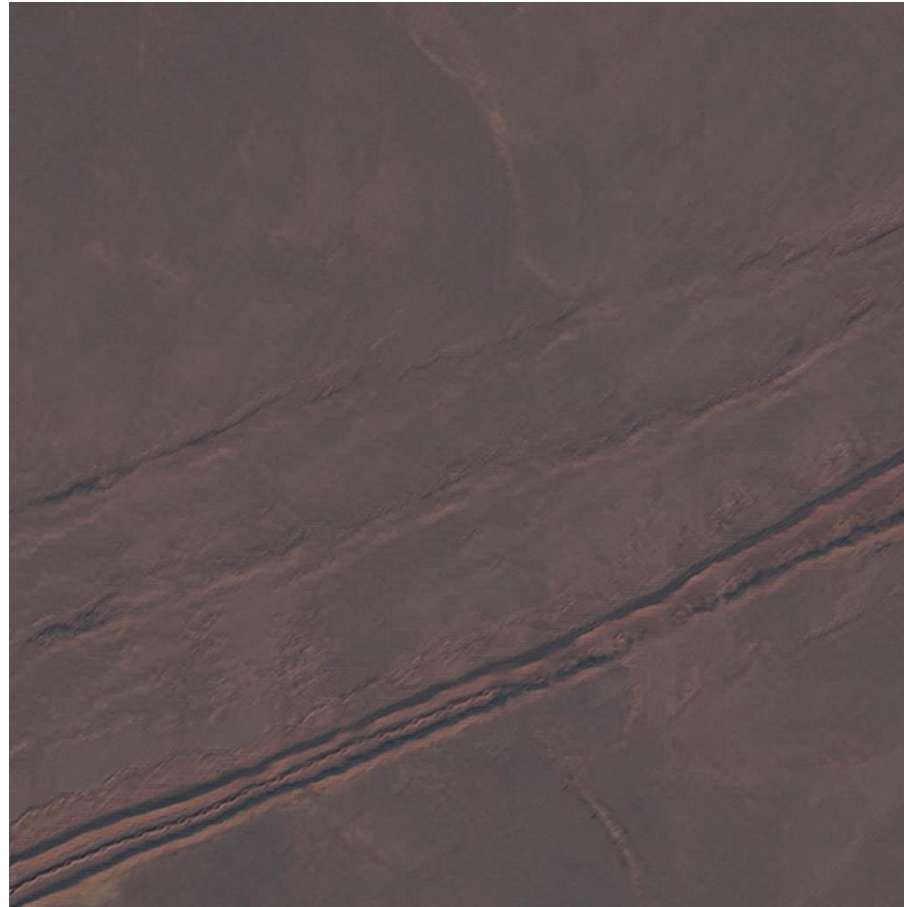
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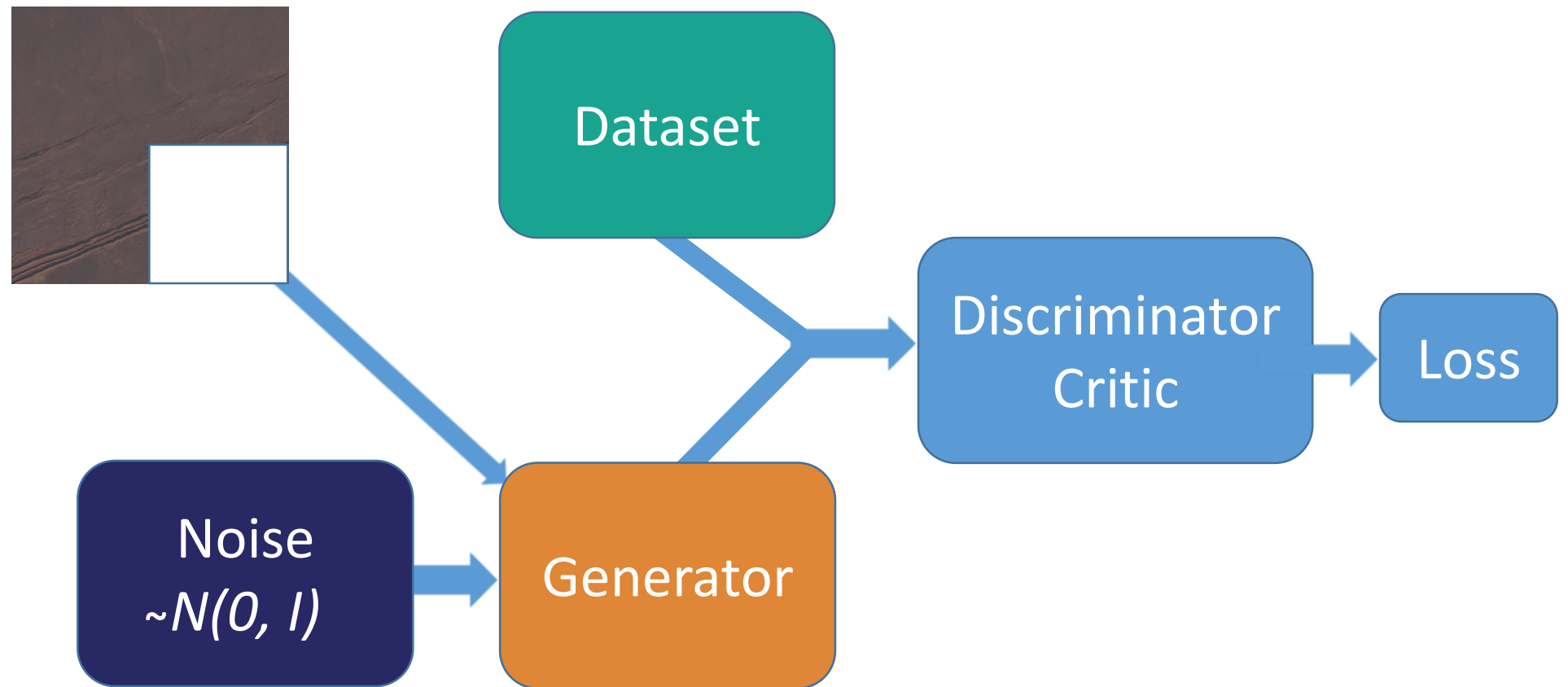


3. The challenge

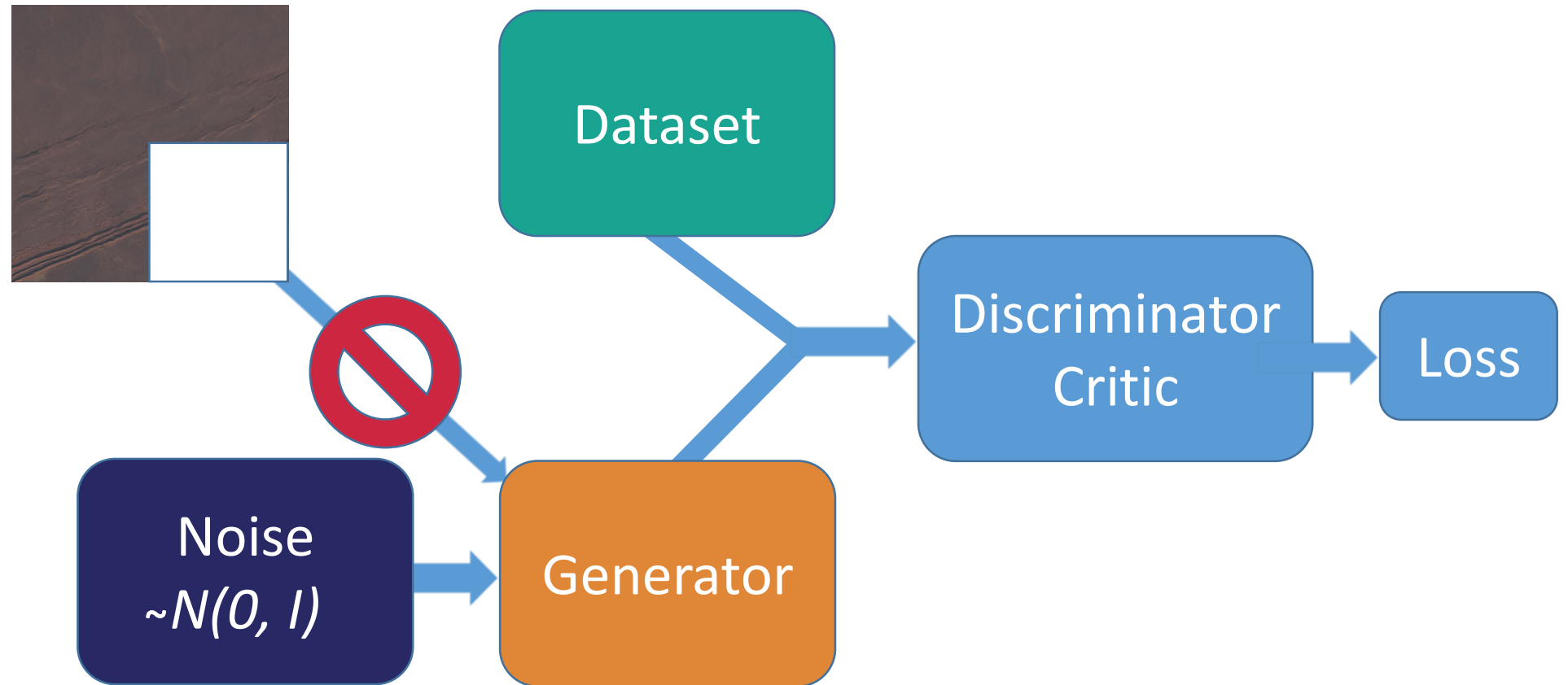
The aim: we want to generate images depending on previous images



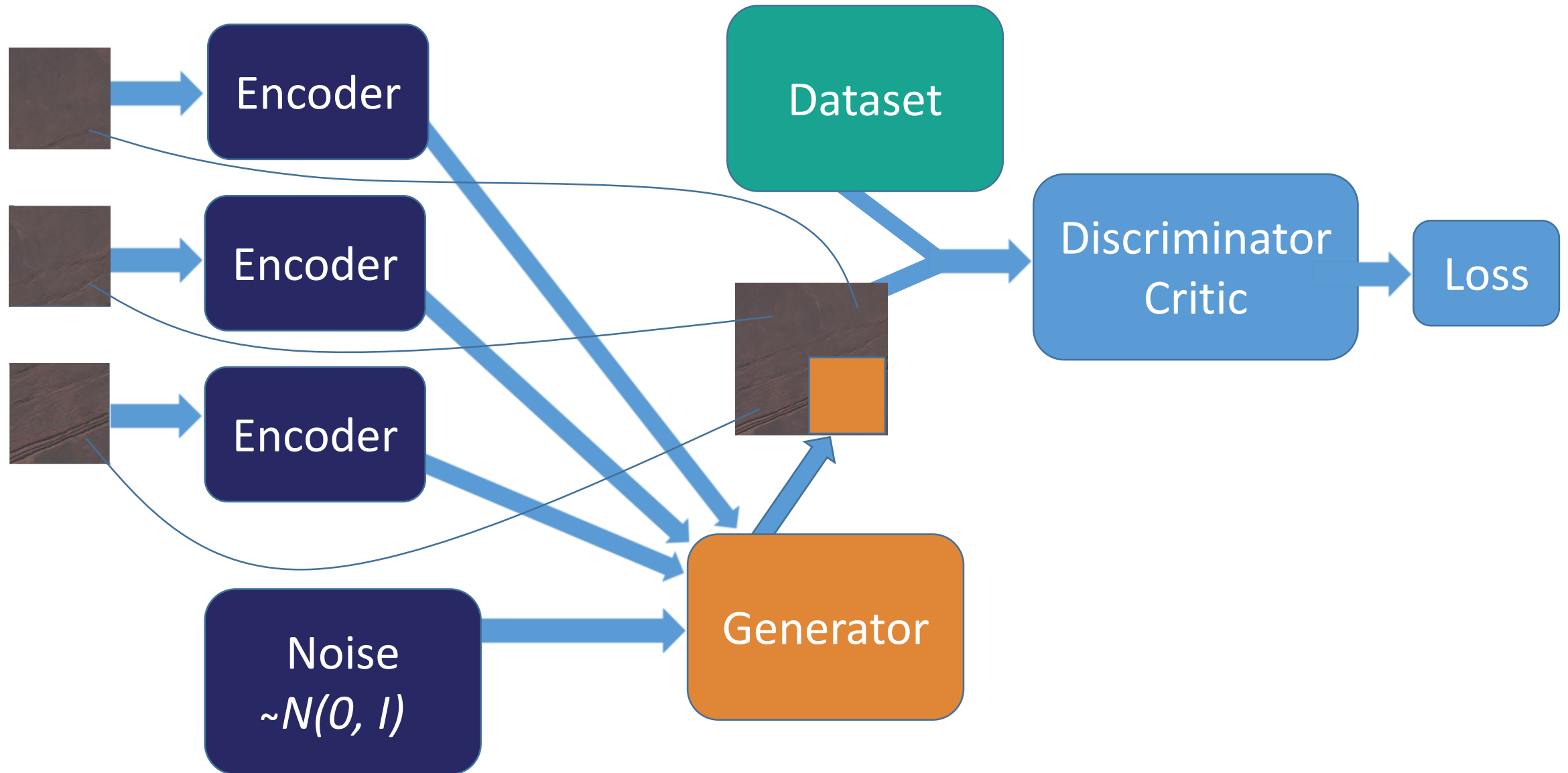
Progressive Conditional GAN



Conditional GAN



Progressive Conditional GAN



Generated images

Size: 256x256x3



Generated images

Size: 256x256x3



Generated images

Size: 256x256x3



Work must go on...

I have time and ideas...

Ideas:

- Add spatially discounted reconstruction loss
- Add Contextual Attention Layer

Time:

- 2 weeks



**QUESTIONS?
COMMENTS?
INTERESTED?**

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Thank you