
AWS
re:Invent

AIM207

Getting started with generative AI with AWS DeepComposer

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Software Development Manager

AWS

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Agenda

Introduction to Machine Learning (ML) and generative Artificial Intelligence (AI)

Generative Adversarial Networks (GAN)

Autoregressive models

Transformers

Music creation with AWS DeepComposer



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Our mission at AWS

Put machine learning in the
hands of every developer

Enabling the next ML developers

ML educational devices

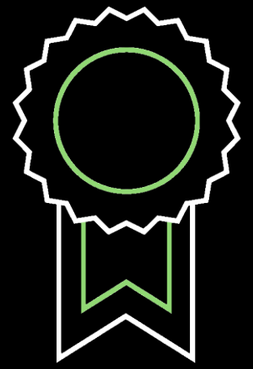
AWS DeepLens
Deep Learning

AWS DeepRacer
Reinforcement Learning



AWS DeepComposer
Generative AI

Training and certification



AWS ML training and certification

UDACITY
coursera
edX

Partnerships with Massive Open Online Courses (MOOCs)

Enabling the next ML developers

ML educational devices

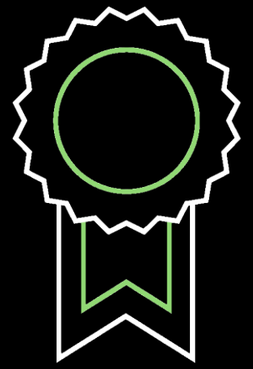
AWS DeepLens
Deep Learning

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AWS DeepComposer
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Introduction to ML and generative AI



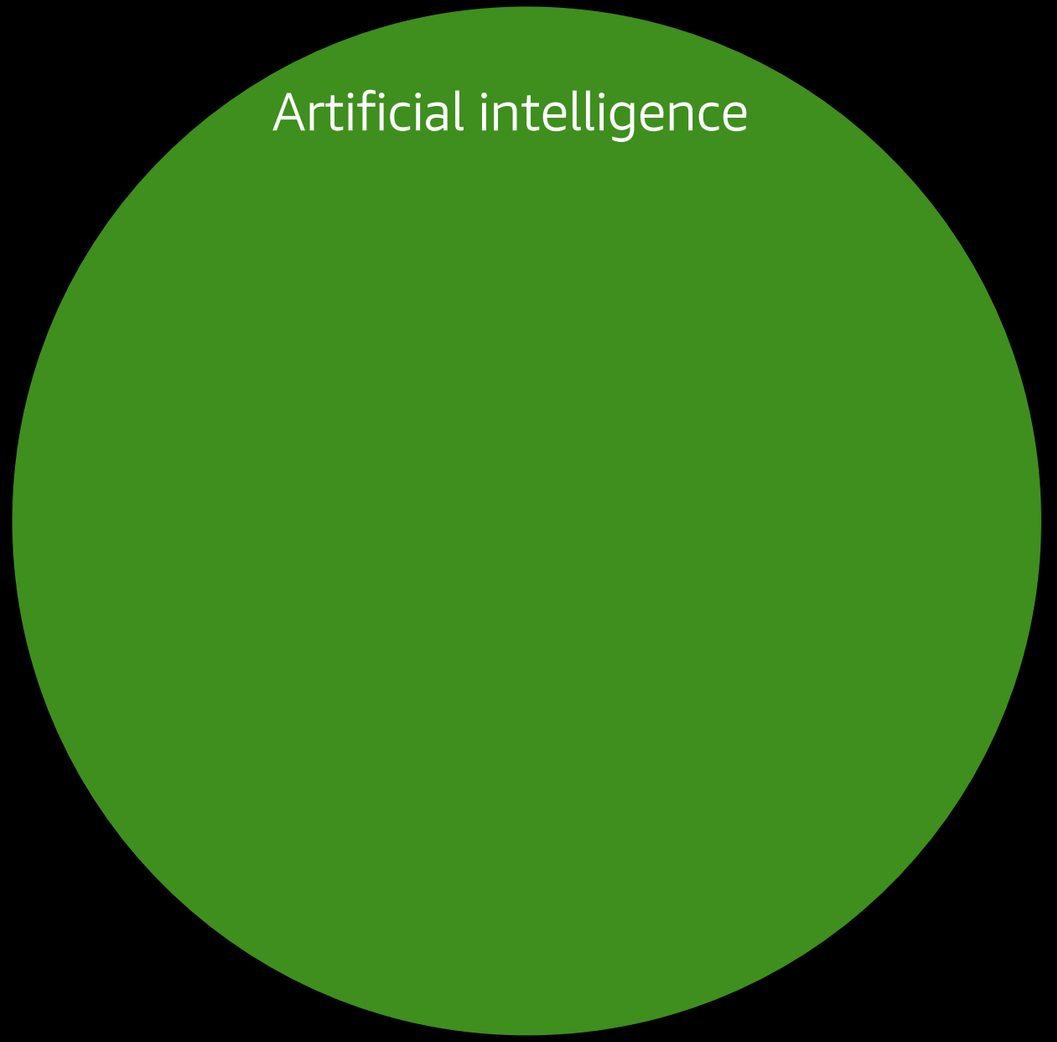
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Artificial intelligence

Artificial intelligence

- Human-type intelligence on a machine



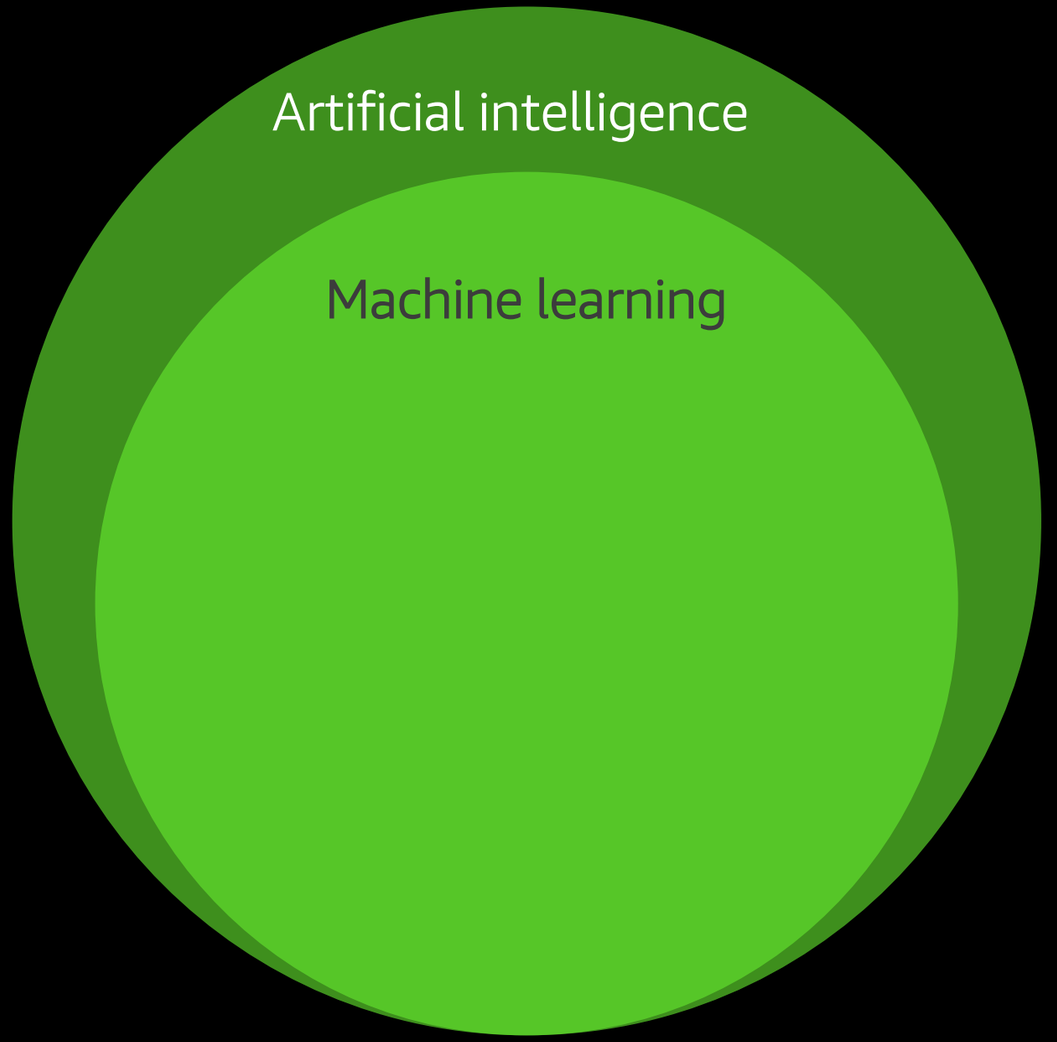
Types of ML techniques

Artificial intelligence

- Human-type intelligence on a machine

Machine learning

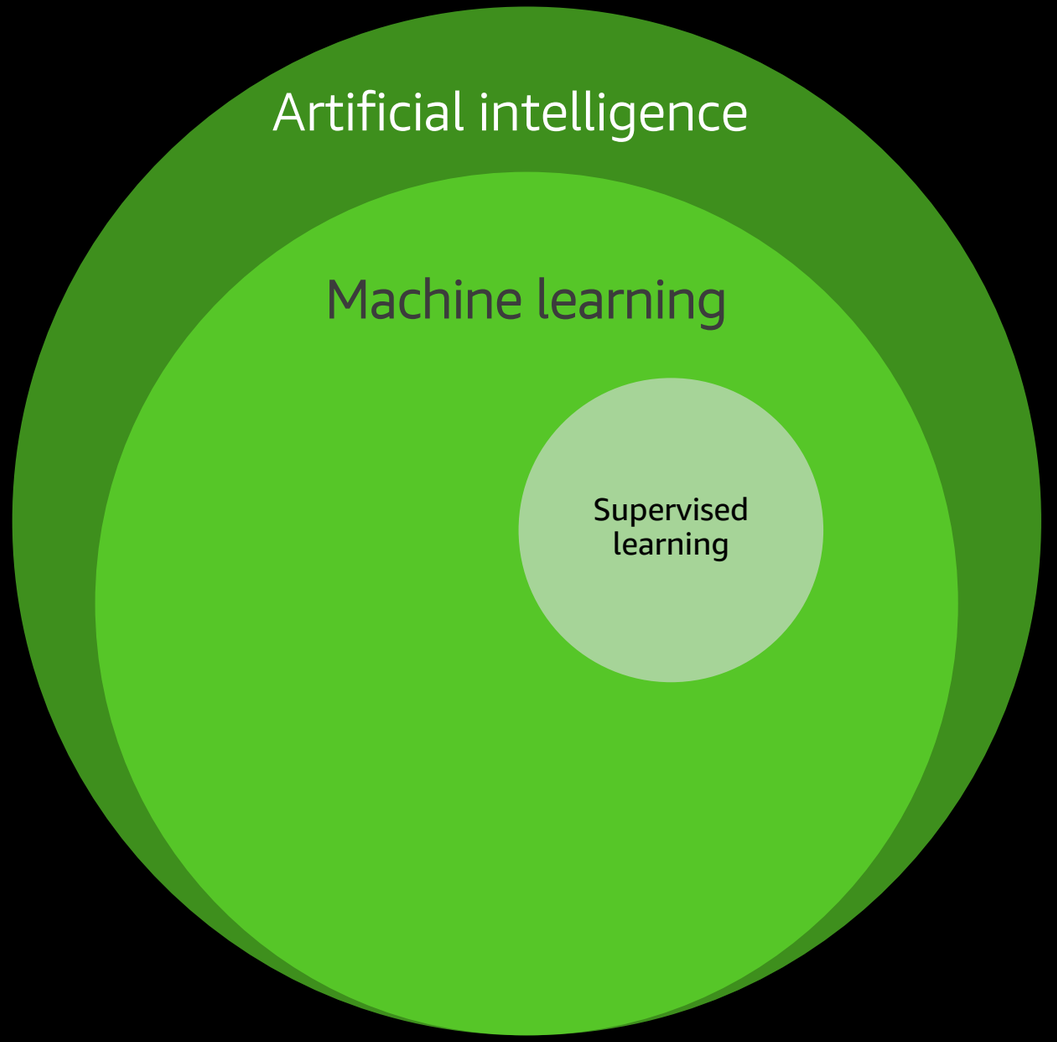
- Machine learns to improve itself without being explicitly programmed to do so
- Achieved through mining data or interaction with a dynamic environment



Types of ML techniques

Supervised learning

- Every training example has a corresponding label



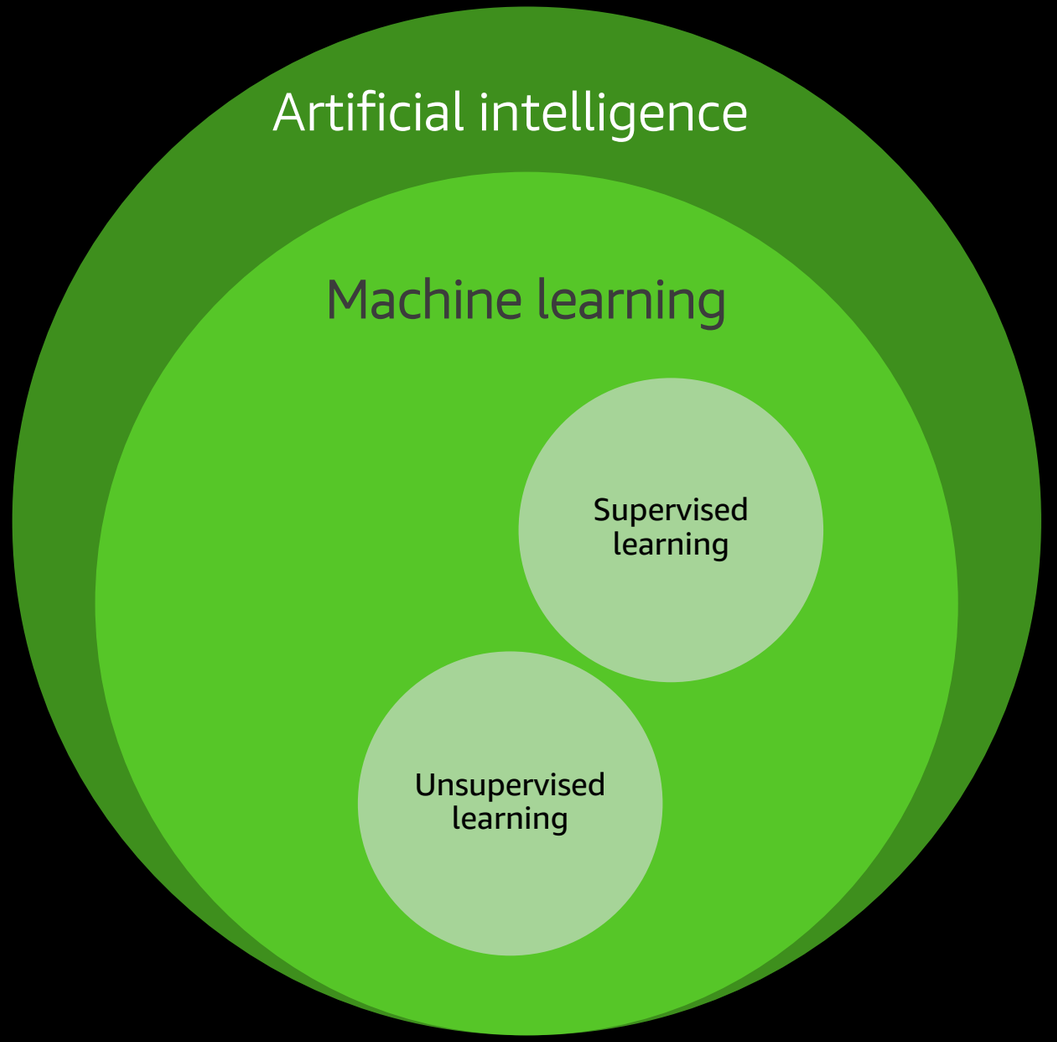
Types of ML techniques

Supervised learning

- Every training example has a corresponding label

Unsupervised learning

- No labels for training data
- Most generative AI is unsupervised learning



Types of ML techniques

Supervised learning

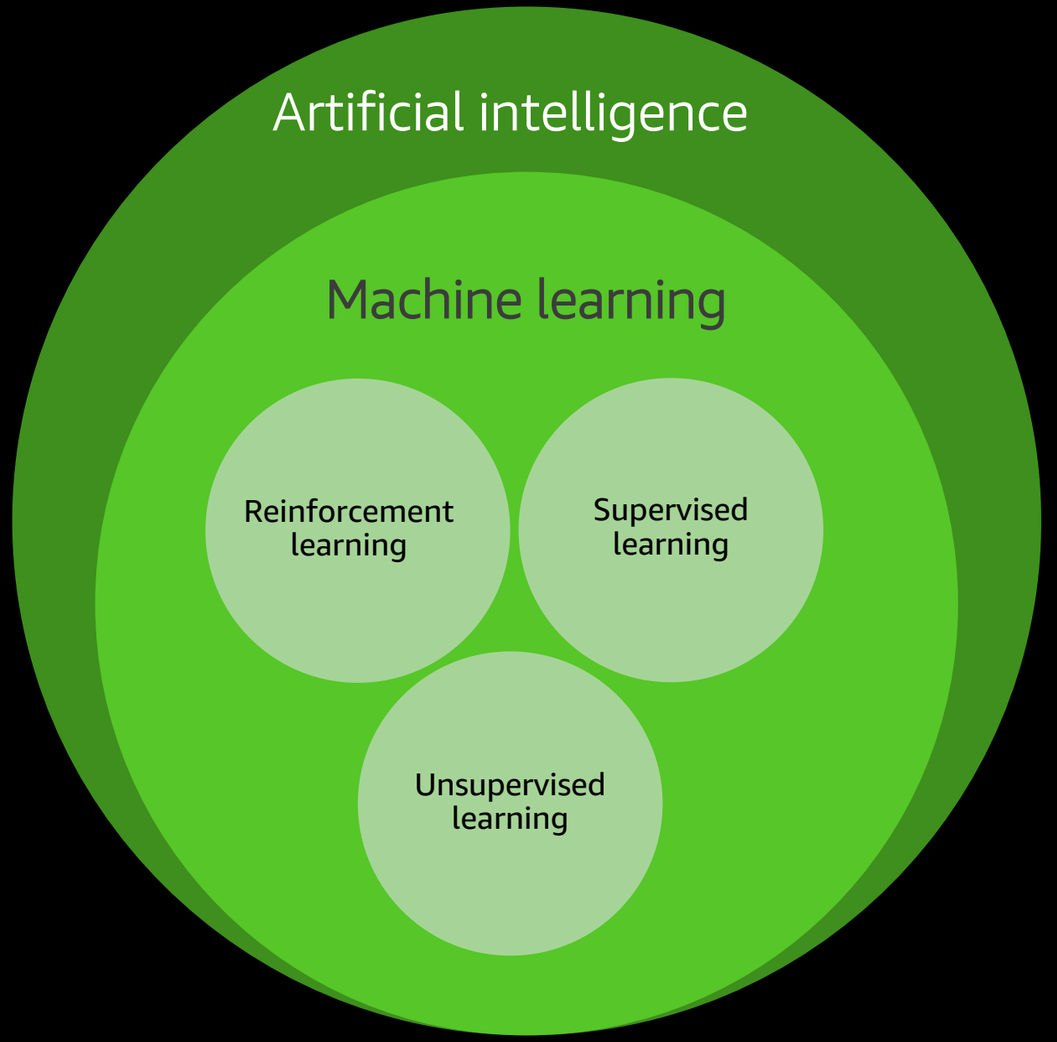
- Every training example has a corresponding label

Unsupervised learning

- No labels for training data
- Most Generative AI is unsupervised learning

Reinforcement learning (RL)

- Learns through consequences of action in specific environment



Discriminative versus generative algorithms

Discriminative model
(cat-dog detector)

Discriminative versus generative algorithms



Classify

Discriminative model
(cat-dog detector)

Discriminative versus generative algorithms



Classify

Discriminative model
(cat-dog detector)

Cat

Discriminative versus generative algorithms



Classify

Discriminative model
(cat-dog detector)

Cat

Generative model
(generate cat images)

Discriminative versus generative algorithms



Classify

Discriminative Model
(Cat-dog Detector)

Cat

Start

Generate

Generative Model
(Generate cat images)

Discriminative versus generative algorithms



Classify

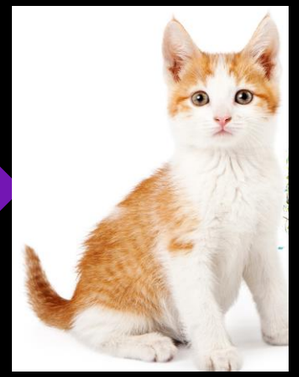
Discriminative Model
(Cat-dog detector)

Cat

Start

Generate

Generative Model
(Generate cat images)



Generative AI

"One of the most promising advances in AI in the past decade"

MIT Technology Review

Types of generative AI techniques

GANs
Autoregressive algorithms
Transformers

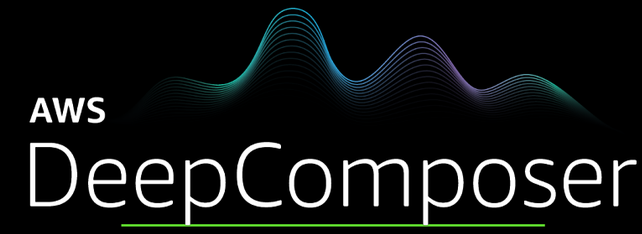
AWS DeepComposer

Learn about machine learning and generative AI in a fun and hands-on way

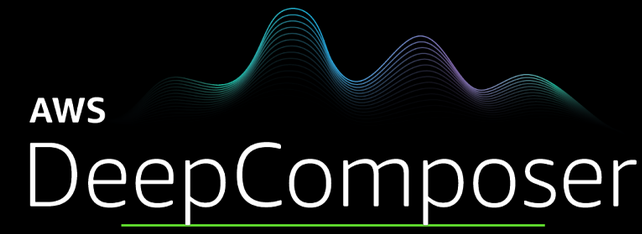


AWS DeepComposer

- **Create your own melodies using Music studio**



- Create your own melodies using Music studio
- **Make your music Bach-like using an autoregressive convolutional neural network (AR-CNN)**



- Create your own melodies using Music studio
- Make your music Bach-like using AR-CNN
- **Add accompaniment tracks to your melody using generative adversarial networks (GANs)**

AWS DeepComposer

- Create your own melodies using Music studio
- Make your music Bach-like using AR-CNN
- Add accompaniment tracks to your melody using GANs
- **Extend your melody using transformers**

AWS DeepComposer

- Create your own melodies using Music studio
- Make your music Bach-like using AR-CNN
- Add accompaniment tracks to your melody using GANs
- Extend your melody using transformers
- **Edit your compositions using the Edit Melody feature**

Generative Adversarial Networks (GANs)



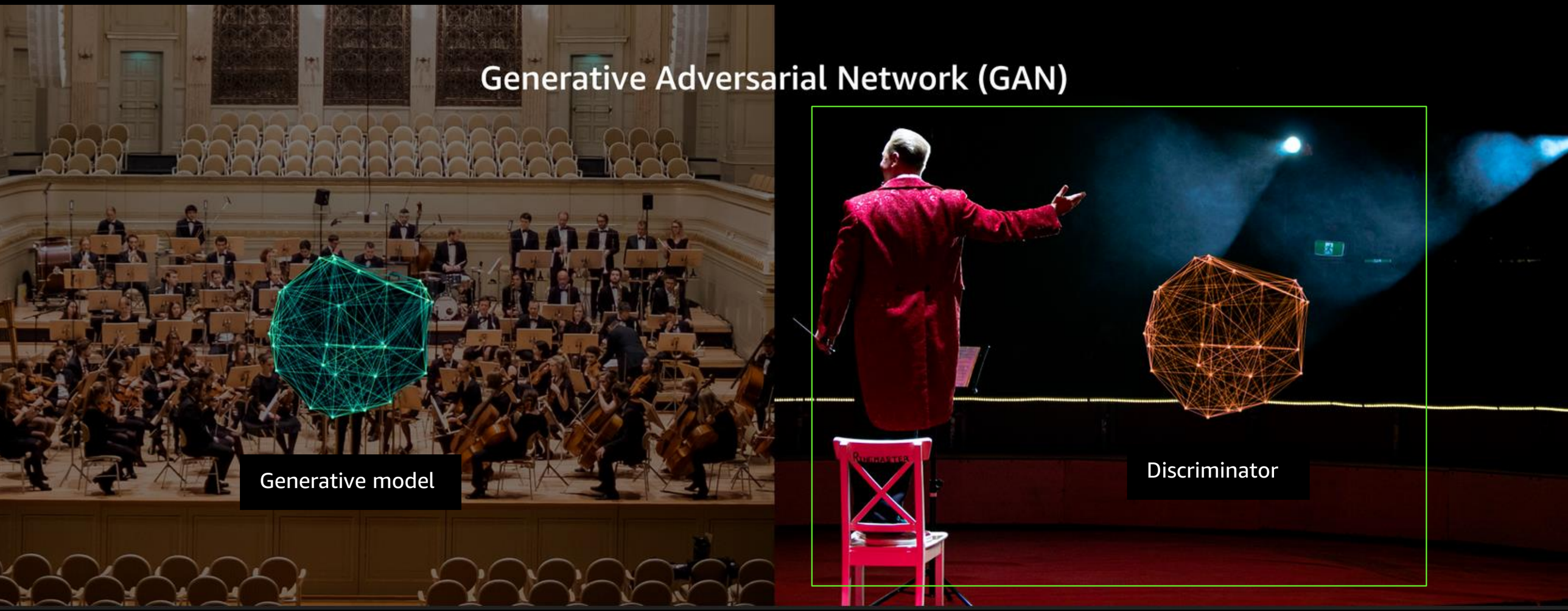
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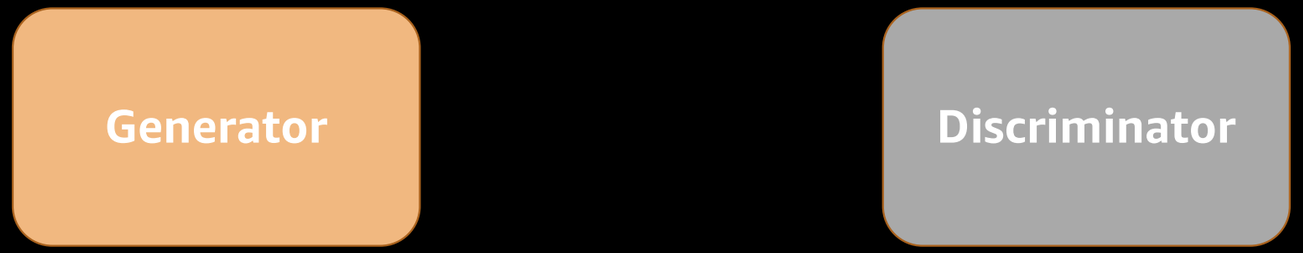
Generative Adversarial Network (GAN)



Generative Adversarial Network (GAN)

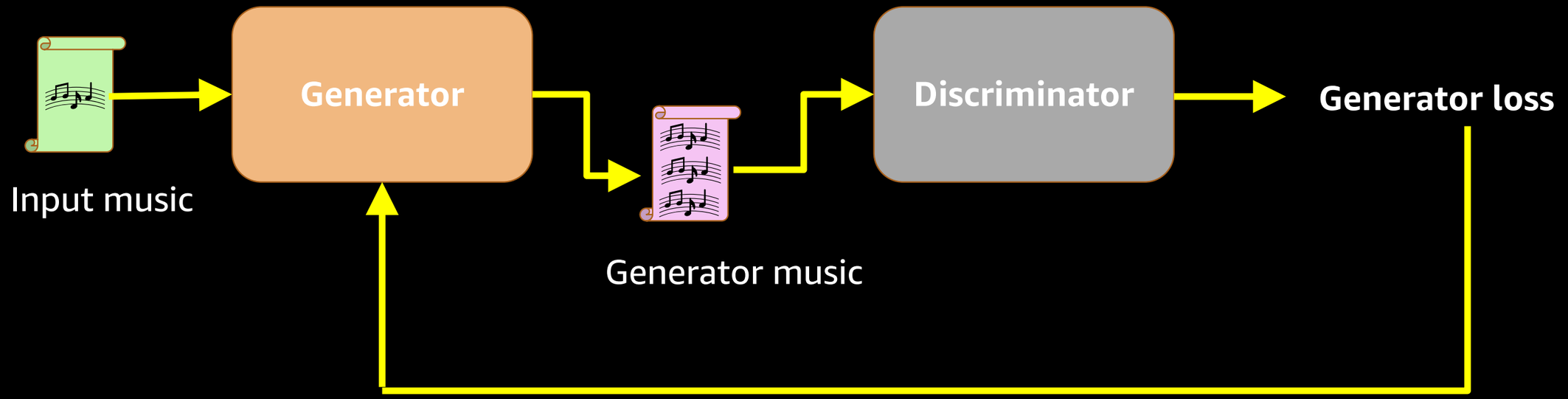


GANs in AWS DeepComposer



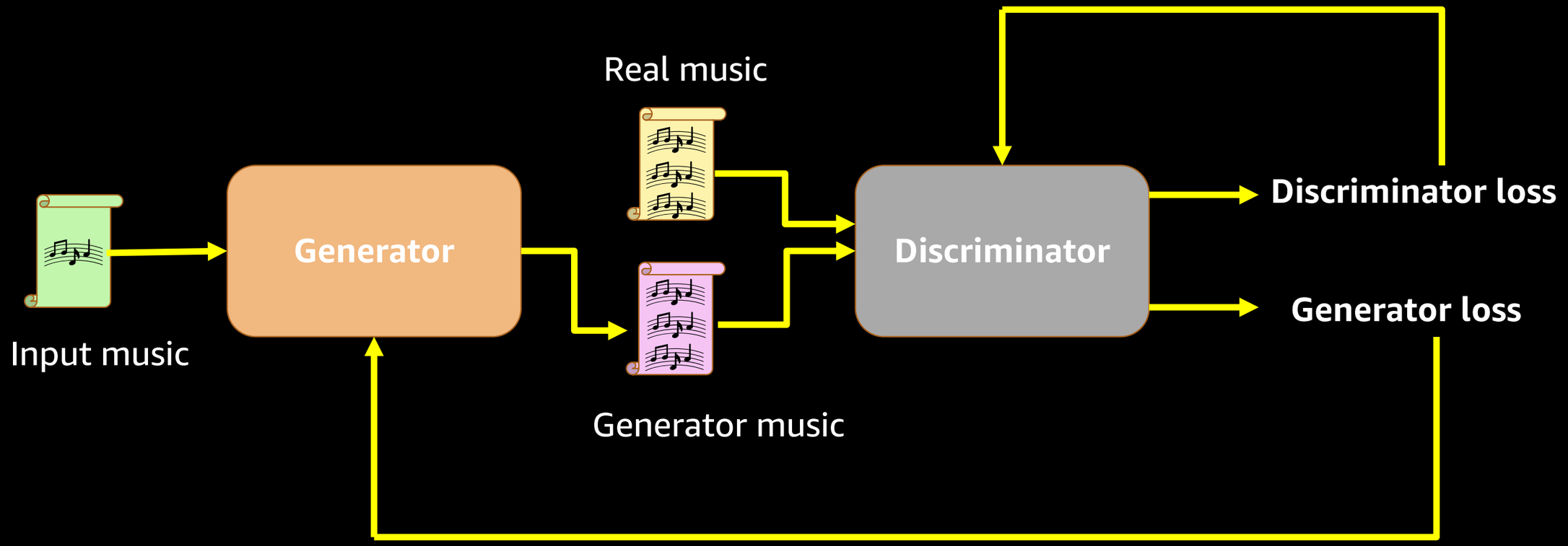
The 2 networks compete with each other continuously to create new music.

GANs in AWS DeepComposer



The 2 networks compete with each other continuously to create new music

GANs in AWS DeepComposer



The 2 networks compete with each other continuously to create new music

GANs in AWS DeepComposer



Input melody: Twinkle, twinkle, little star



Output composition: Twinkle, twinkle, little star in Rock genre

Practical uses of GANs

- **Drug design and discovery**
- Creating original art pieces
- Cancer detection

Practical uses of GANs

- Drug design and discovery
- **Creating original art pieces**
- Cancer detection

Practical uses of GANs

- Drug design and discovery
- Creating original art pieces
- **Cancer detection**

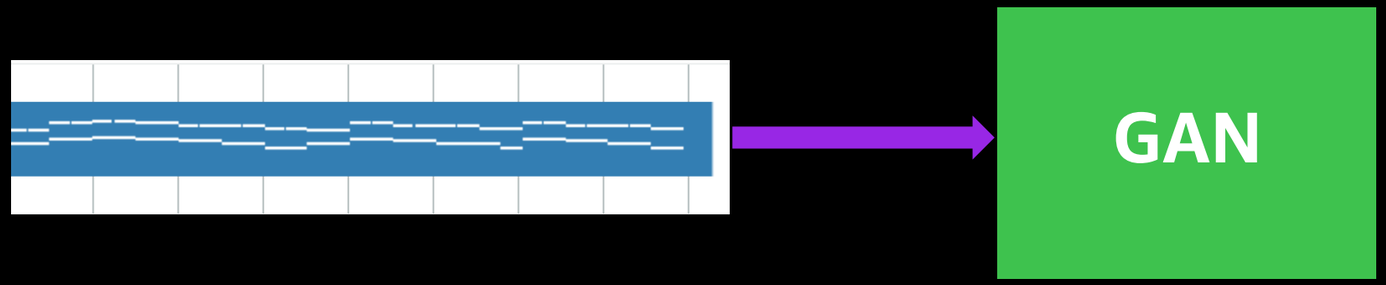
Autoregressive models



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Autoregressive algorithms

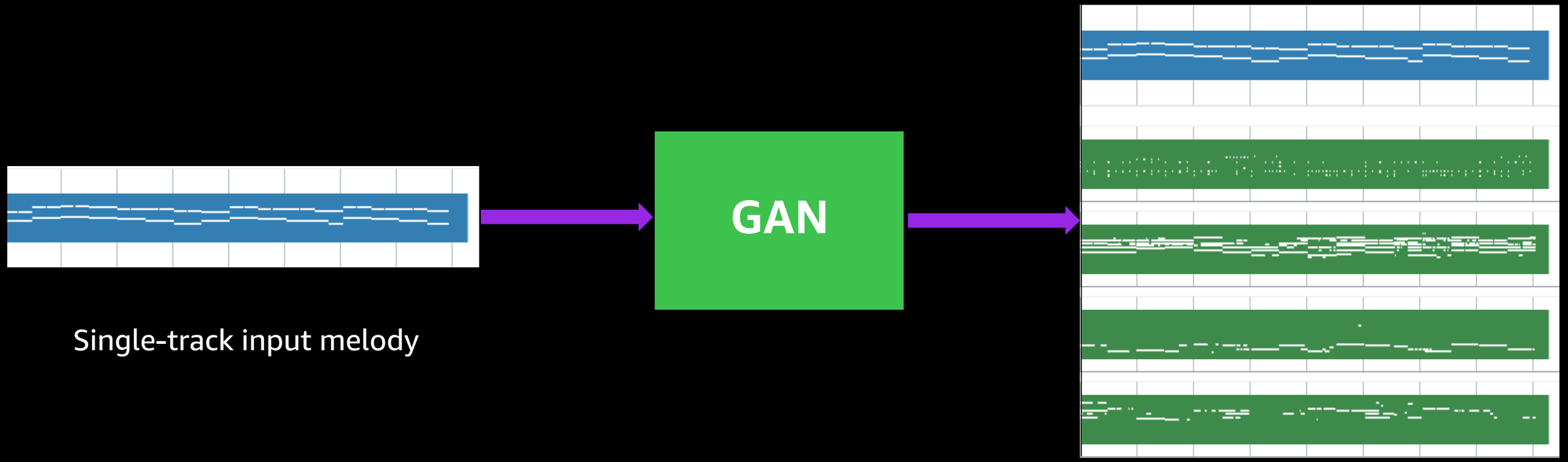
In GANs, the entire output data (e.g., image) is generated in one shot



Single-track input melody

Autoregressive algorithms

In GANs, the entire output data (e.g., image) is generated in one shot.

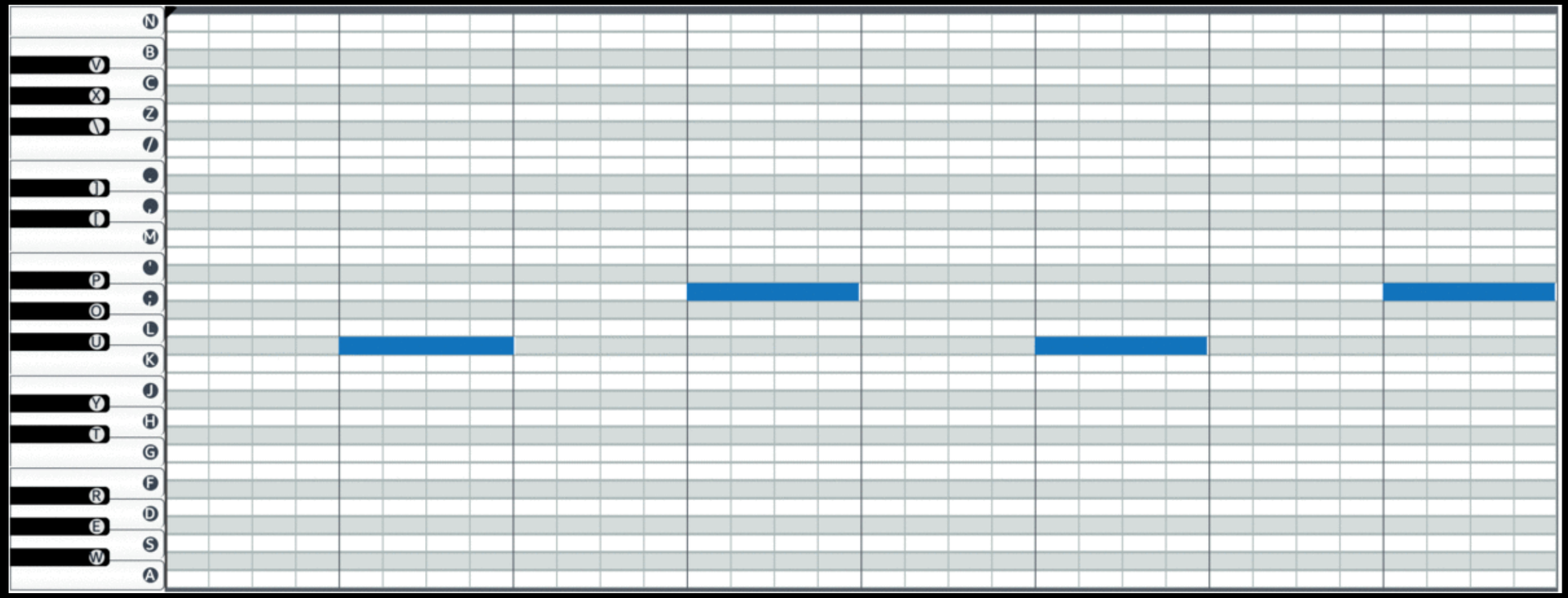


Autoregressive algorithms

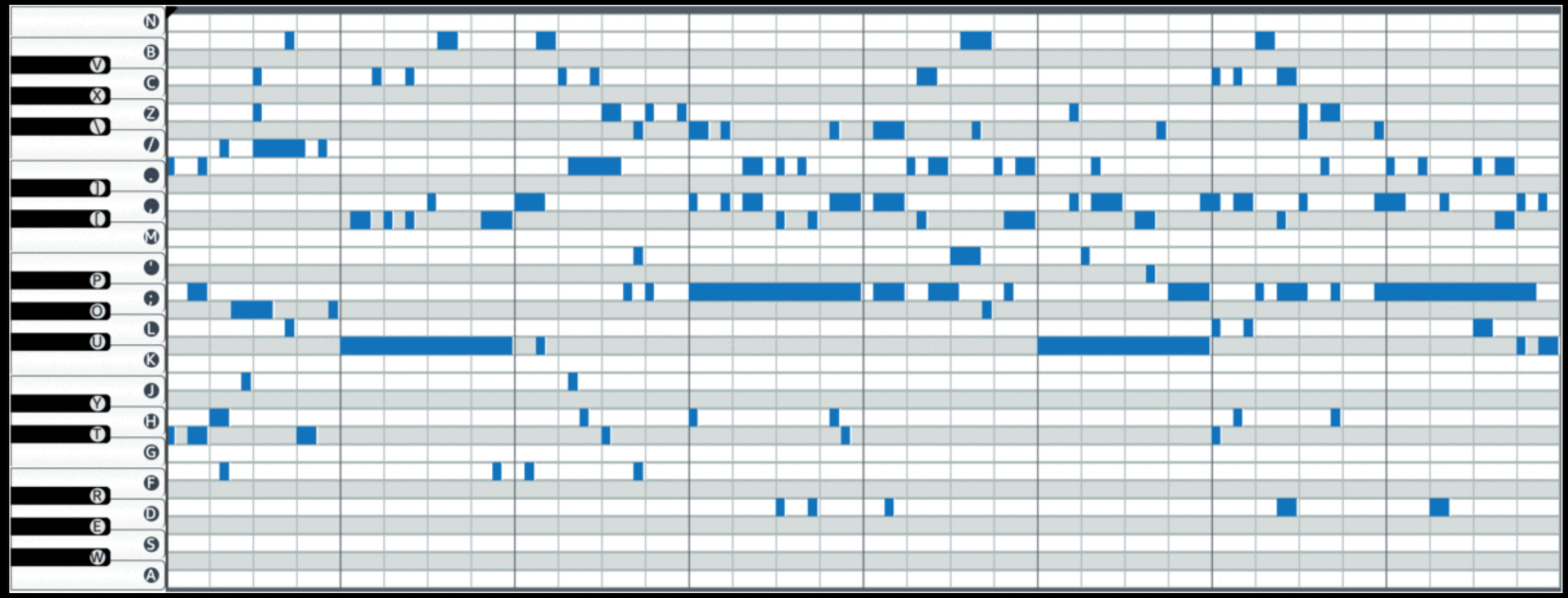
Unlike GANs, autoregressive models generate data in a sequential way

New data generated depends on the previous data that was generated

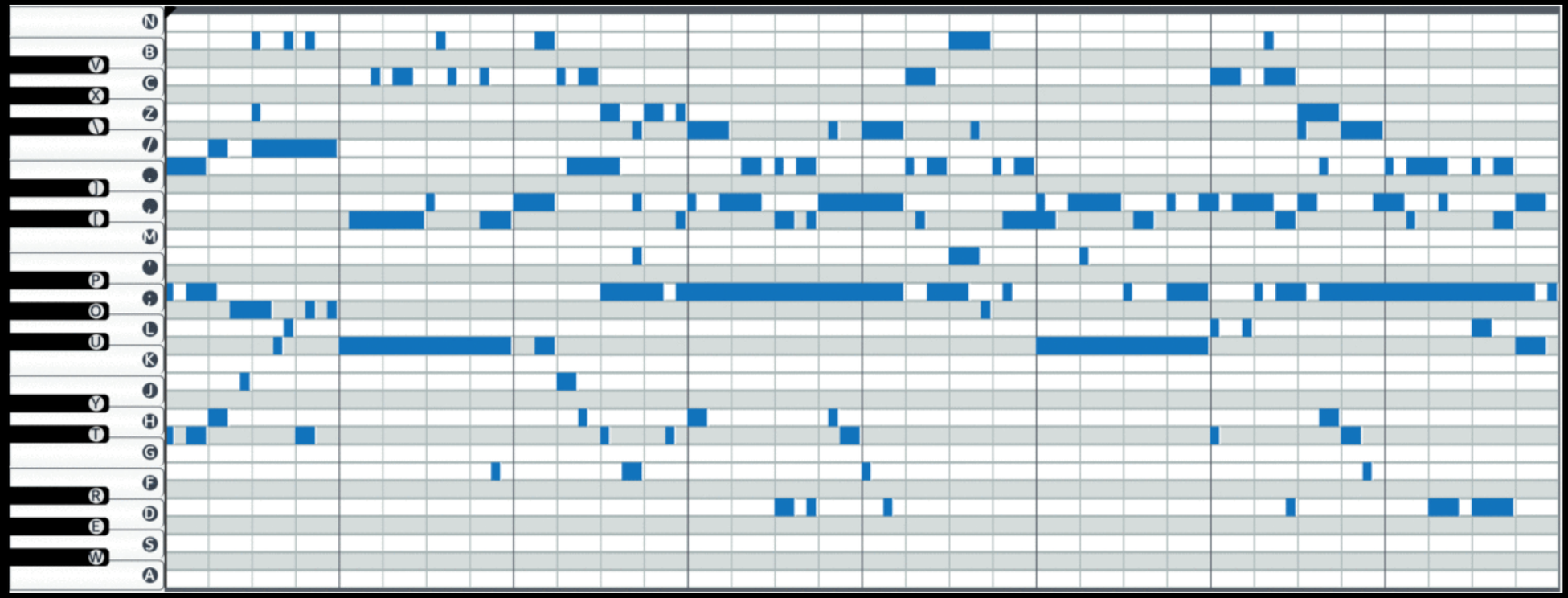
Autoregressive CNN



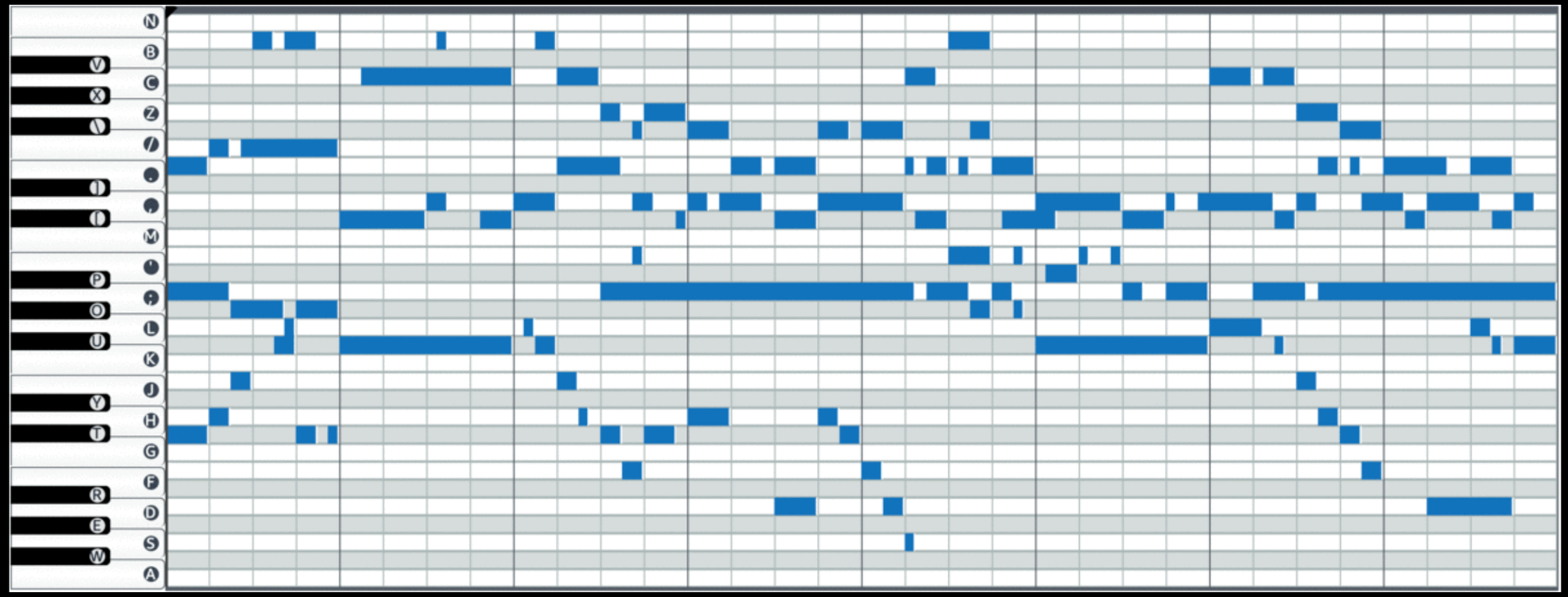
Autoregressive CNN



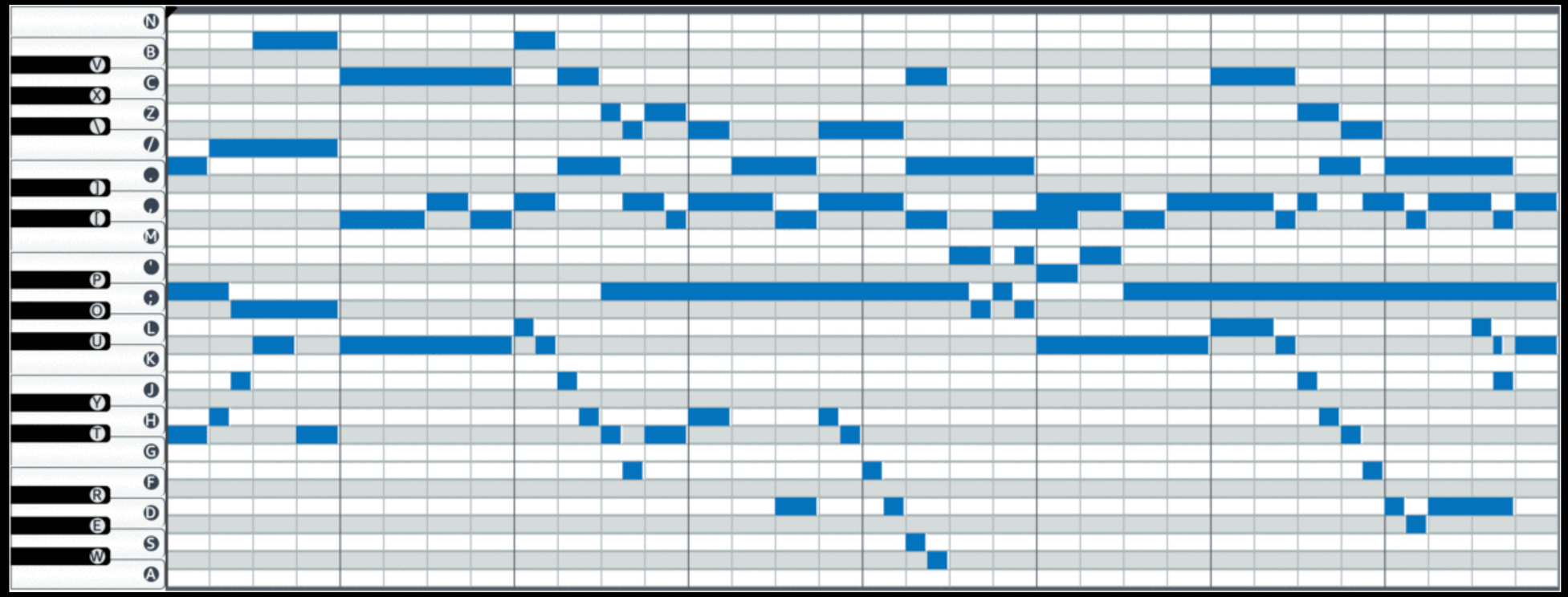
Autoregressive CNN



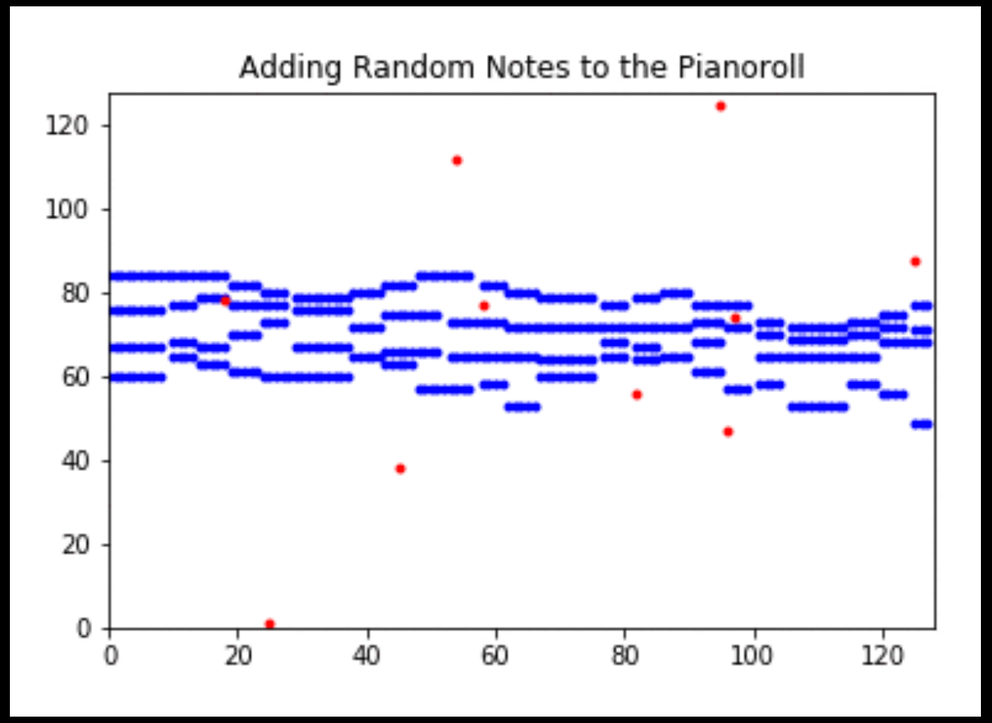
Autoregressive CNN

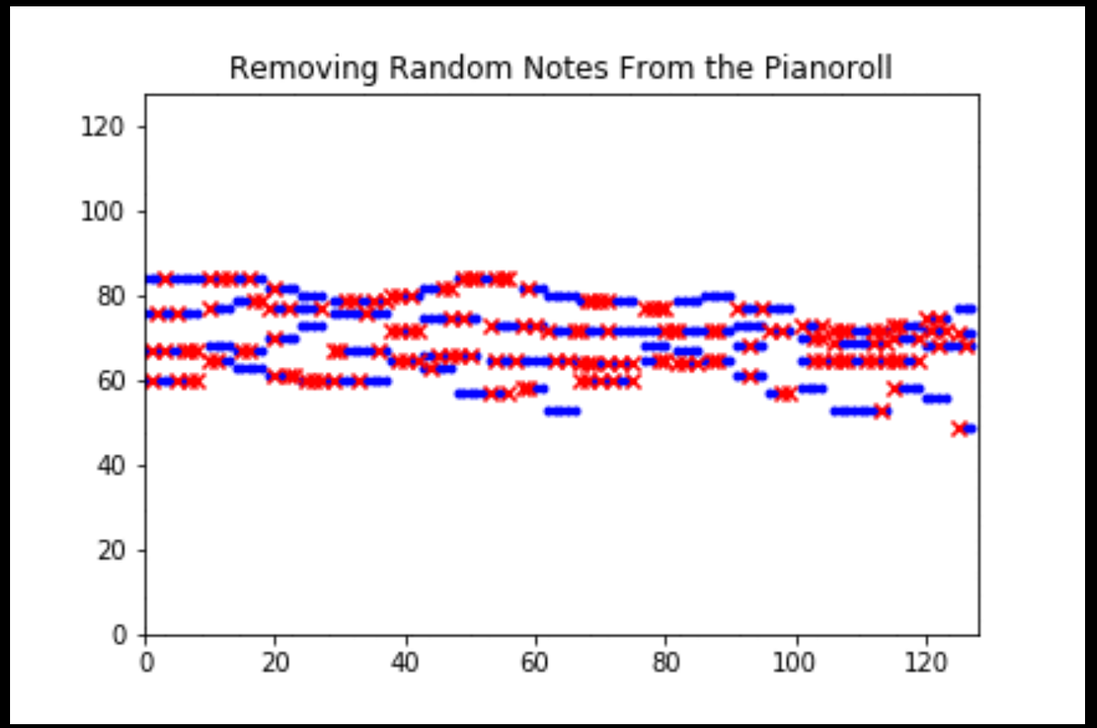


Autoregressive CNN



Autoregressive CNN





To train the model, we add and remove notes from piano rolls

Autoregressive CNN



Ex1: Input melody with off-tune notes



Ex1: Output with melody corrected



Ex2: Input melody



Ex2: Output with harmonies added

Transformers



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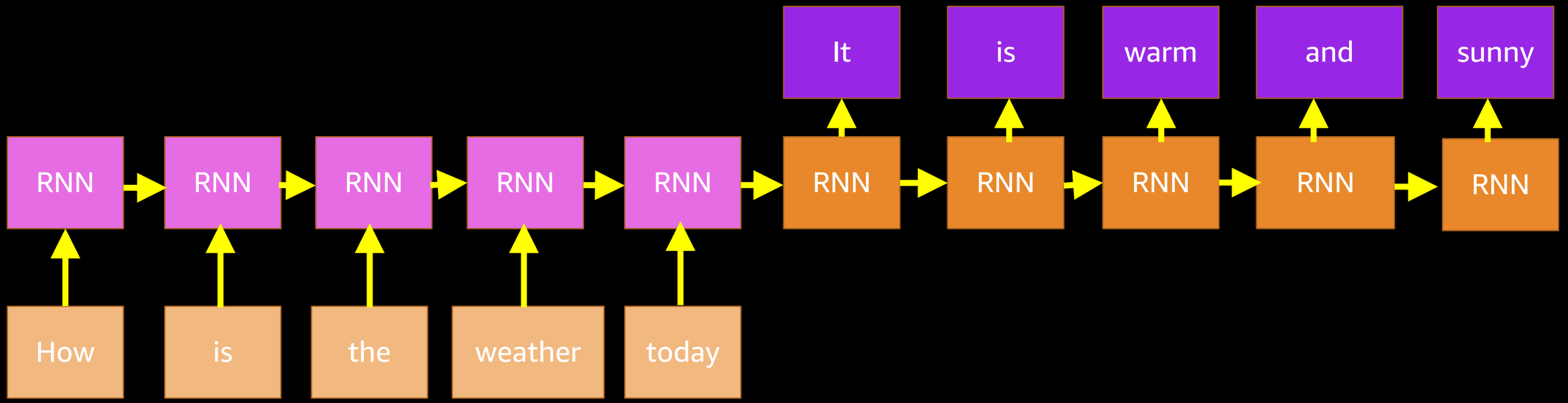
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Transformers

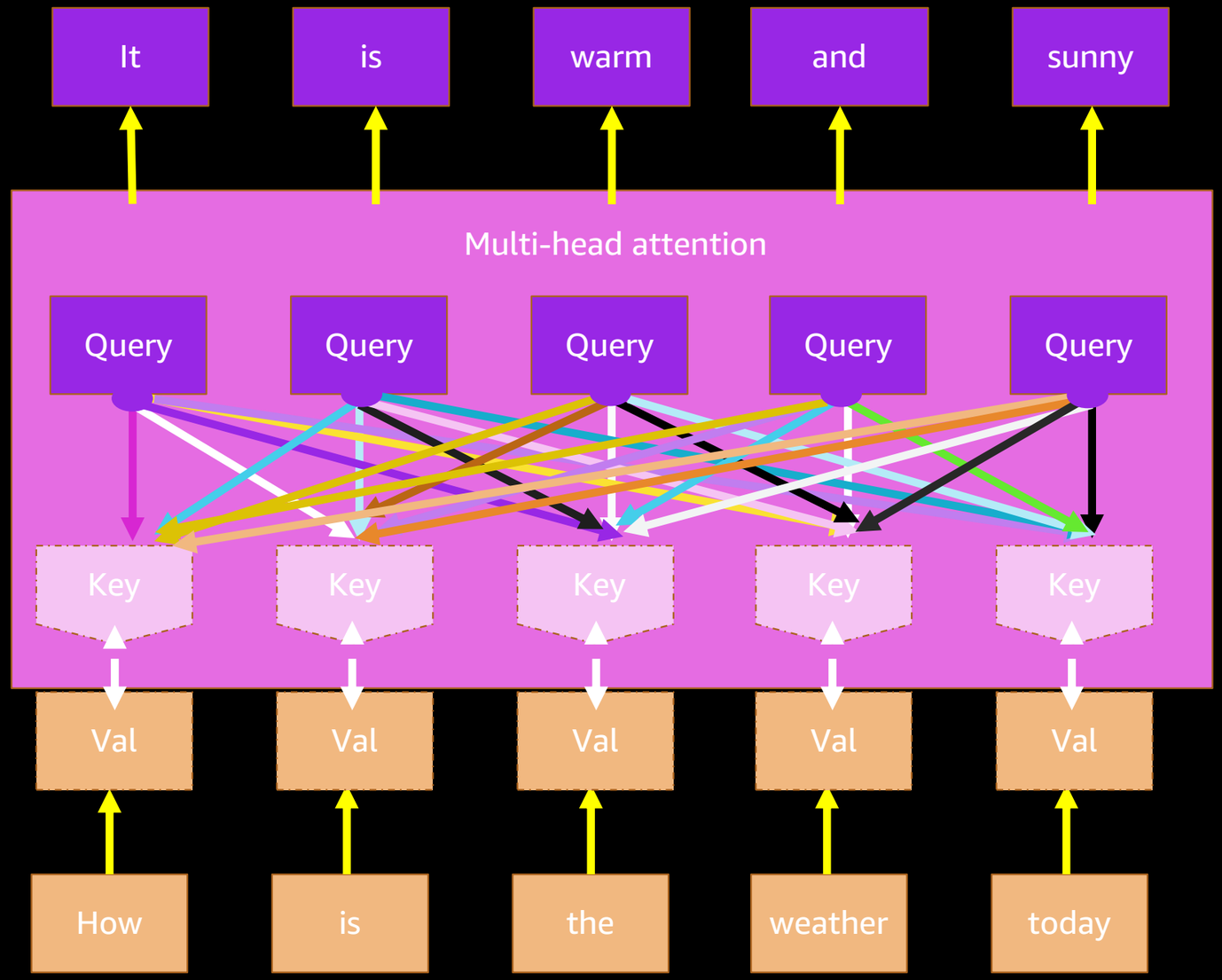
Transformers are state-of-the-art models in generating sequential data such as text, music, and other time series data



Recurrent Neural Networks



Transformers



Transformers in AWS DeepComposer



Output extending Bach input



Output extending Mozart input



Output extending Beethoven input

Practical uses of transformers

Natural Language Processing (NLP)

- Conversational AI
- Language translation
- Text summarization

Stock prediction

Genome sequencing

Practical uses of transformers

Natural Language Processing (NLP)

- Conversational AI
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Genome sequencing

Practical uses of transformers

- Natural Language Processing (NLP)
  - Conversational AI
  - Language translation
  - Text summarization
- Stock prediction
- **Genome sequencing**

Compete in our global Chartbusters challenge

AWS DEEPCOMPOSER WALL OF FAME







- Compete in re:Invent special Chartbusters challenge
  - **Open until 02/01/2021**
- Go to aws.amazon.com/deepcomposer/chartbusters to participate

Let’s hear from our customers!



“As someone with very little experience in AI and machine learning, it was a great feeling of accomplishment to be able to train a custom AR-CNN model and actually generate results.

I think AWS DeepComposer is such a great tool for reducing the barrier of entry into machine learning and making those concepts accessible to more people."

Lena Taupier

Winner of the AWS DeepComposer Chartbusters “Spin the Model” Challenge

Let’s hear from our customers!



"The challenge inspired me that machine learning can bring up some ideas on composing new and creative music. I will keep joining the next challenges to learn something new and advanced about machine learning.”

Catherine Chui

Winner of the first AWS DeepComposer Chartbusters “Bach to the Future” Challenge

Conclusion



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What you learned today

What are generative AI algorithms?

What are GANs?

What are autoregressive models?

What are transformers?

How does AWS DeepComposer music creation work?

Special offer for you*

CONTINUE YOUR LEARNING JOURNEY



Get 25% off AWS DeepComposer device with the code REINVENT2020

With the purchase of the AWS DeepComposer keyboard, get an additional 3 months of free trial that covers 4 training and 40 inference jobs per month.

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