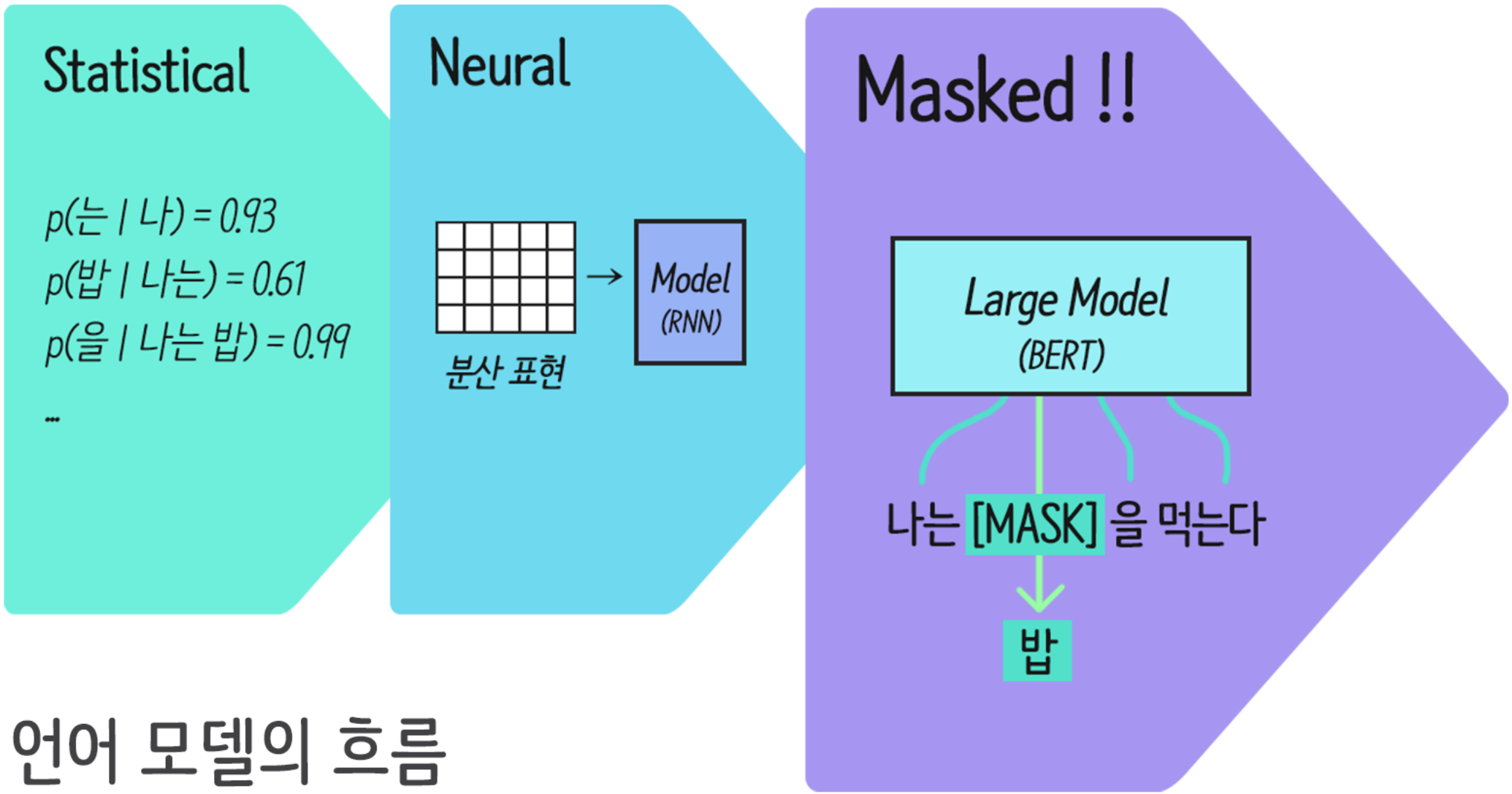
ELECTRA

: PRE-TRAINING TEXT ENCODERS AS DISCRIMINATORS RATHER THAN GENERATORS

2020. 06. 02

Moon Sungwon

INTRO

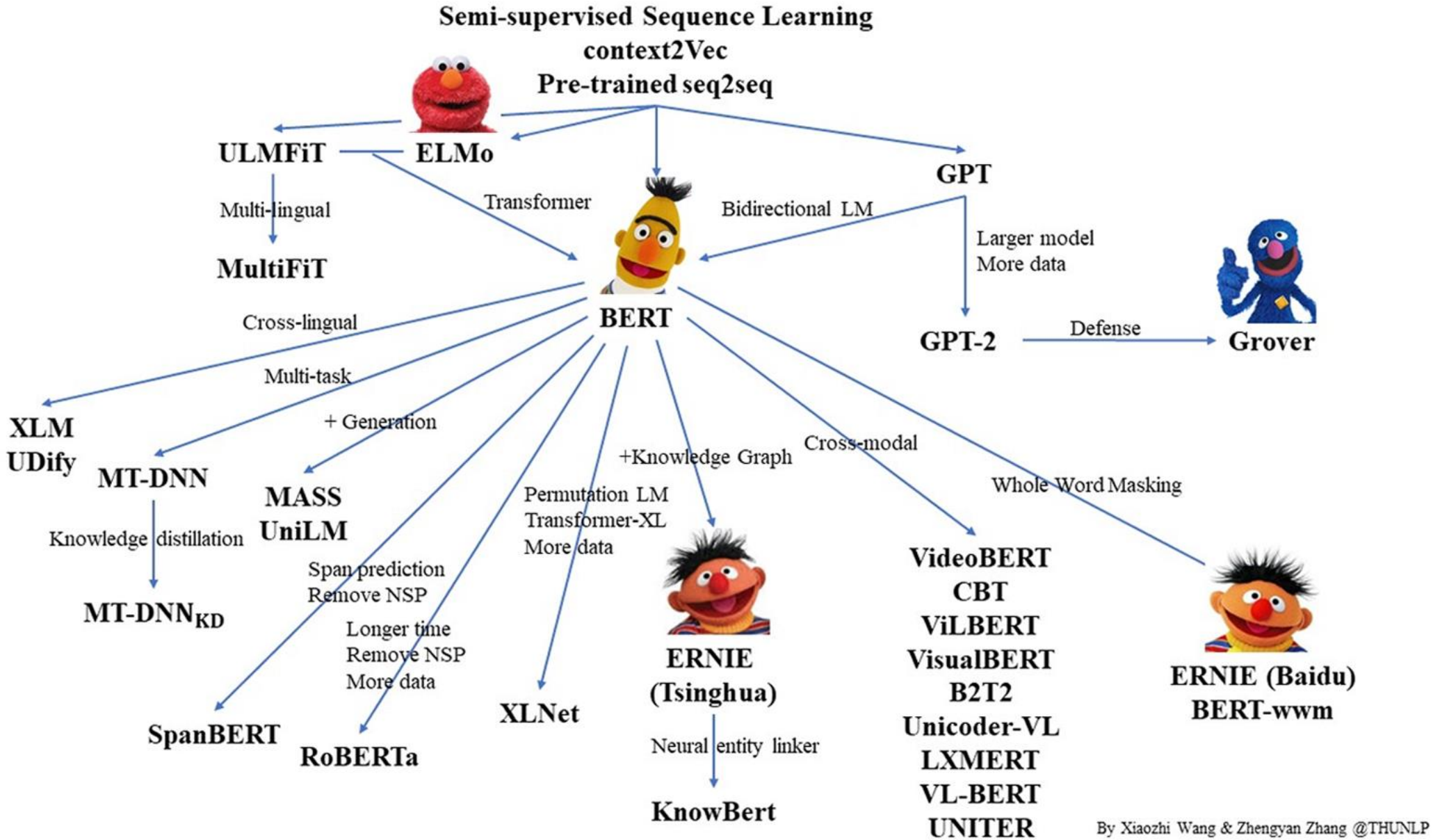


언어 모델의 흐름

MLM의 대표 주자

BERT

GPT-2


Semi-supervised Sequence Learning
context2Vec
Pre-trained seq2seq
ELMo
ULMFiT
Multi-lingual
MultiFiT
Transformer
Bidirectional LM
GPT
Larger model
More data
GPT-2
Defense
Grover
BERT
Cross-lingual
XLM
UDify
Multi-task
MT-DNN
Knowledge distillation
MT-DNN$_{KD}$
+ Generation
MASS
UniLM
Span prediction
Remove NSP
SpanBERT
Longer time
Remove NSP
More data
RoBERTa
Permutation LM
Transformer-XL
More data
XLNet
+Knowledge Graph
ERNIE
(Tsinghua)
Neural entity linker
KnowBert
Cross-modal
VideoBERT
CBT
ViLBERT
VisualBERT
B2T2
Unicoder-VL
LXMERT
VL-BERT
UNITER
Whole Word Masking
ERNIE (Baidu)
BERT-wwm
By Xiaozhi Wang & Zhengyan Zhang @THUNLP

논문 기준, 학습에 필요한 가격

* TPU는 1 device -> 4 chips -> 8 cores 입니다.

Model	Size	TPU ($ per hour)	TPU Count (device)	Training Time	Cost (USD)	CO2 emissions (lbs)
BERT	24 Layers (340M)	v2 ($4.5)	16	4 days	$6,912 (약 850만원)	1428
GPT-2	48 Layers (1542M)	v3 ($8)	32	7 days	$43,008 (약 5,100만원)	2516
XLNet	24 Layers (365M)	v3 ($8)	128	2.5 days	$61,440 (약 7,300만원)	-

* NY ↔ SF Air Travel: 1924 (lbs)

참고: https://syncedreview.com/2019/06/27/the-staggering-cost-of-training-sota-ai-models/,
Energy and Policy Considerations for Deep Learning in NLP, 2019 E Strubell

출처: Clova AI DEVIEW 2019 〈엄~청 큰 언어 모델 공장 가동기!〉

So... ELECTRA!

GPT-2

120 Days

Google AI

ELECTRA

4 Days

Masked Language Model?

최근엔

마스크

토큰

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사용하는

언어 모델

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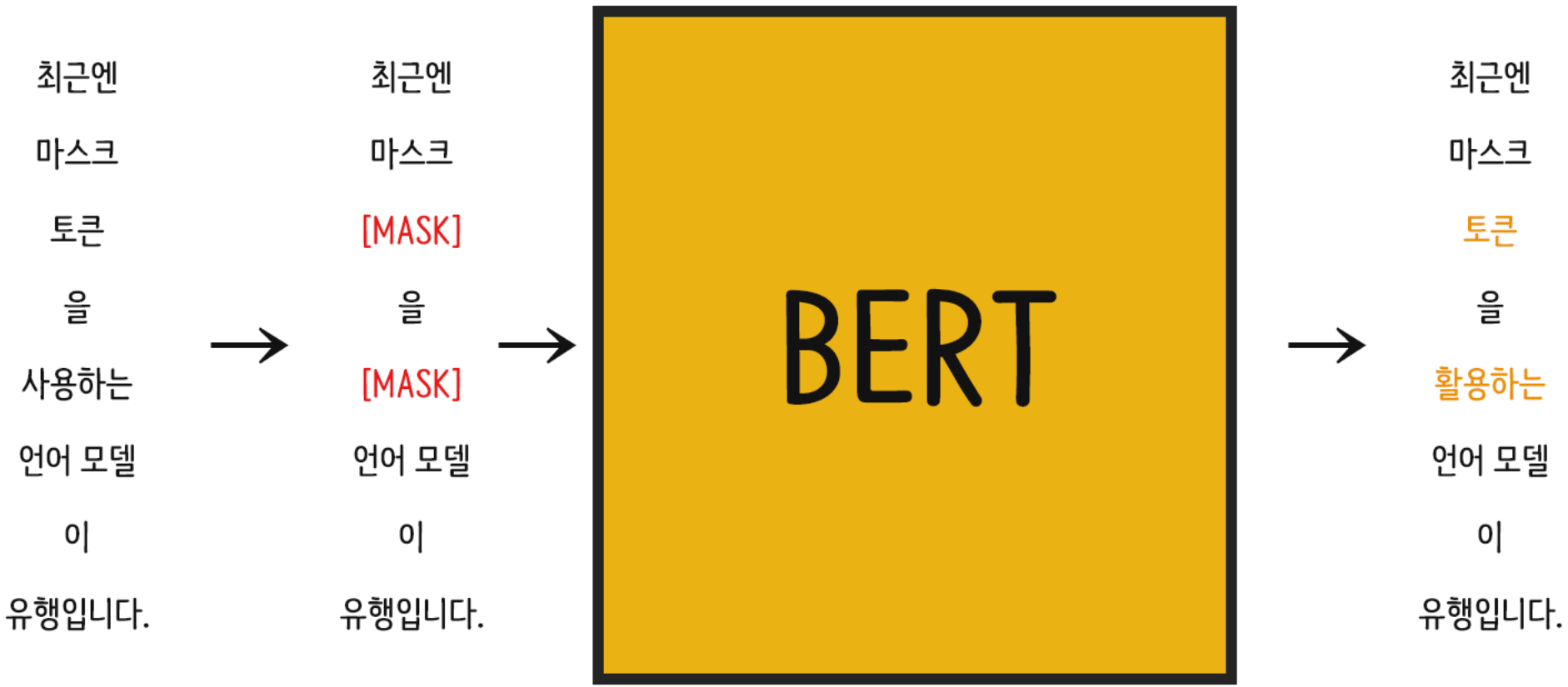
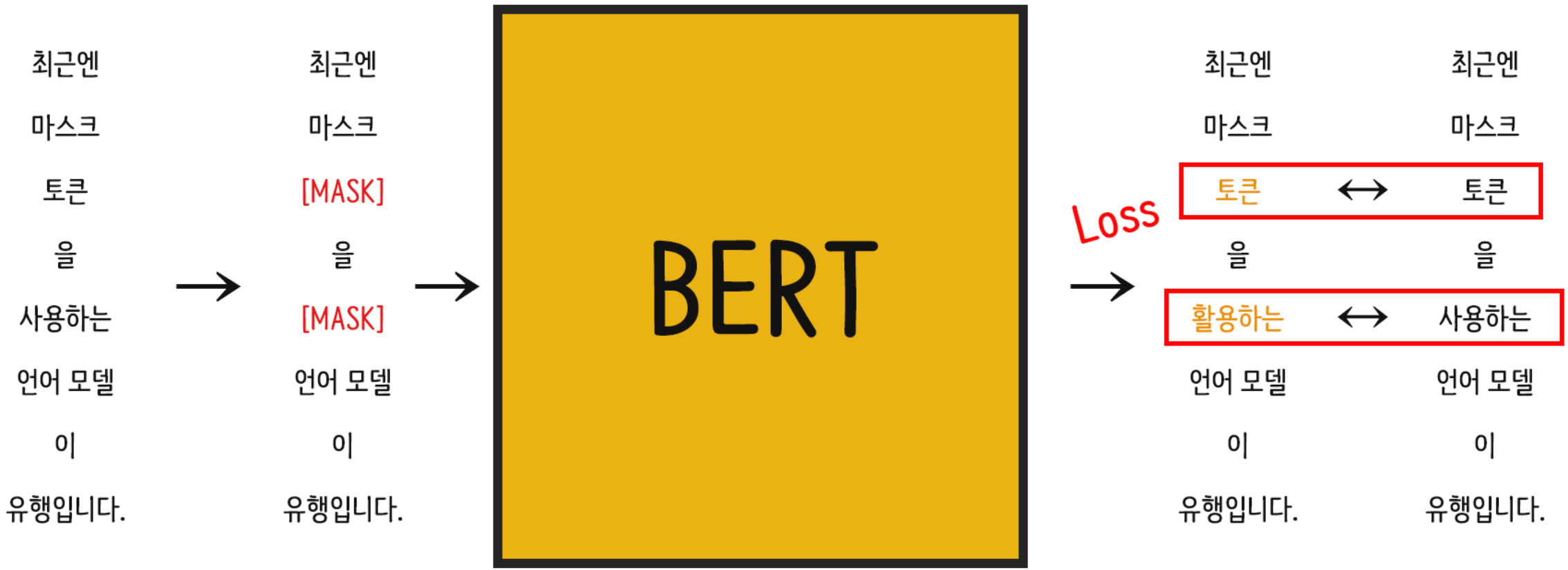
Masked Language Model?

최근엔	최근엔
마스크	마스크
토큰	[MASK]
을	을
사용하는	[MASK]
언어 모델	언어 모델
이	이
유행입니다.	유행입니다.

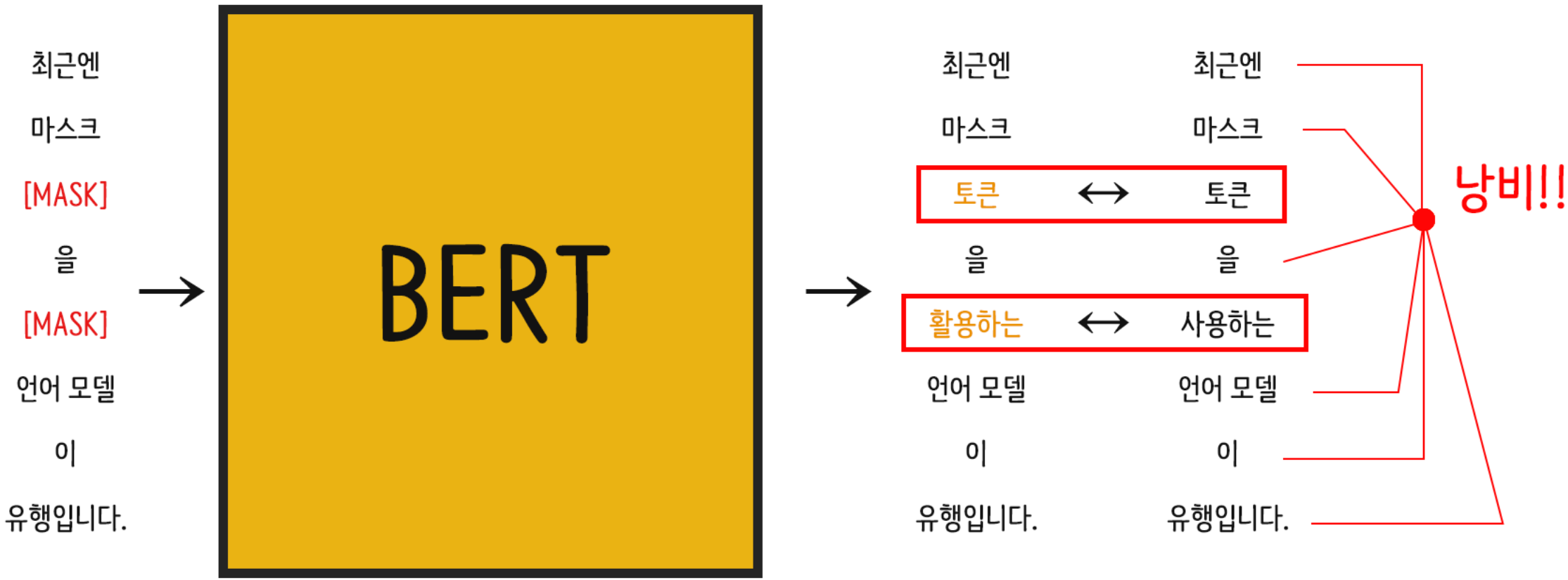
Masked Language Model?



Masked Language Model?

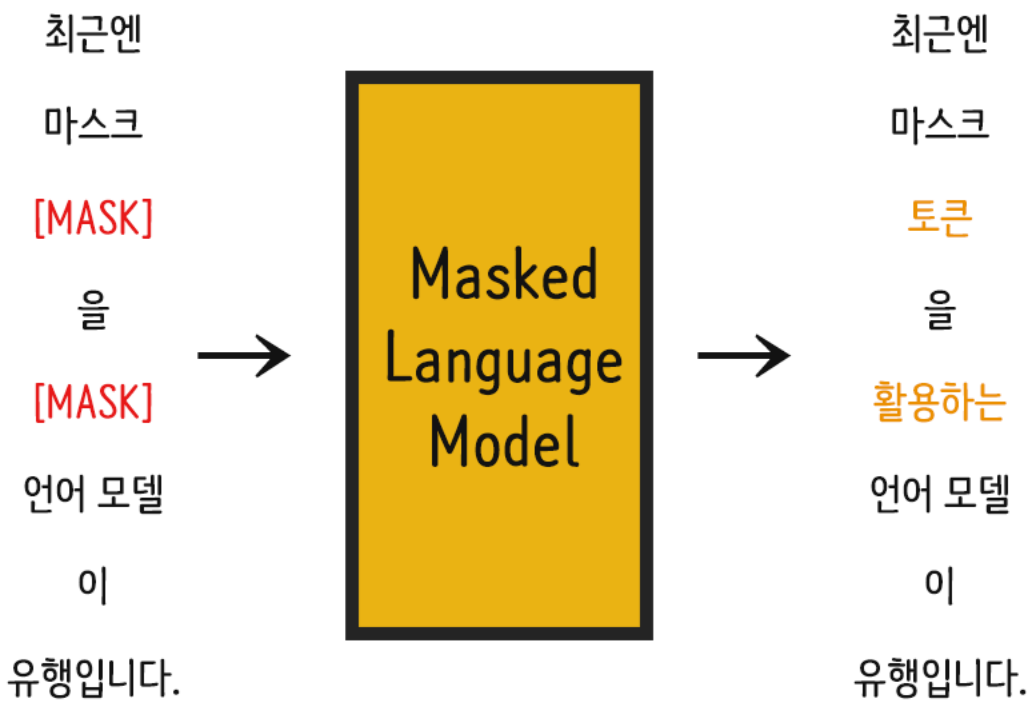


문제는 바로...

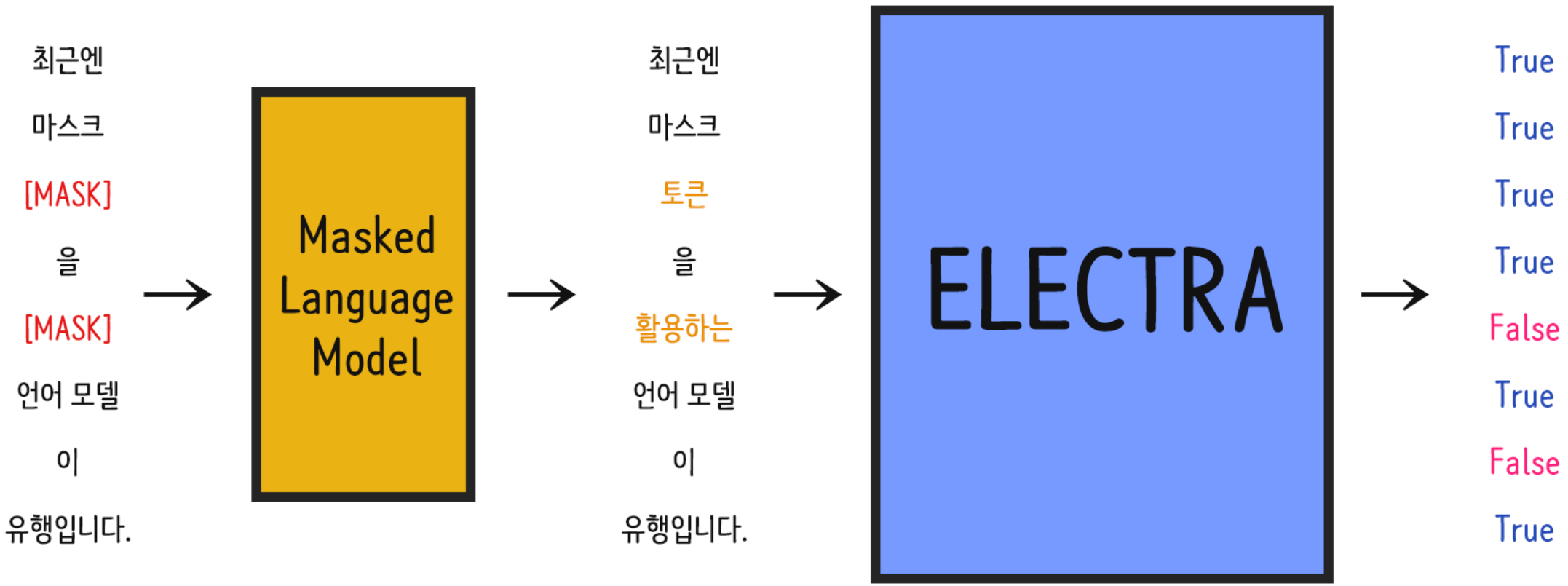


데이터의 15% 밖에 학습할 수 없다!

Replaced Token Detection

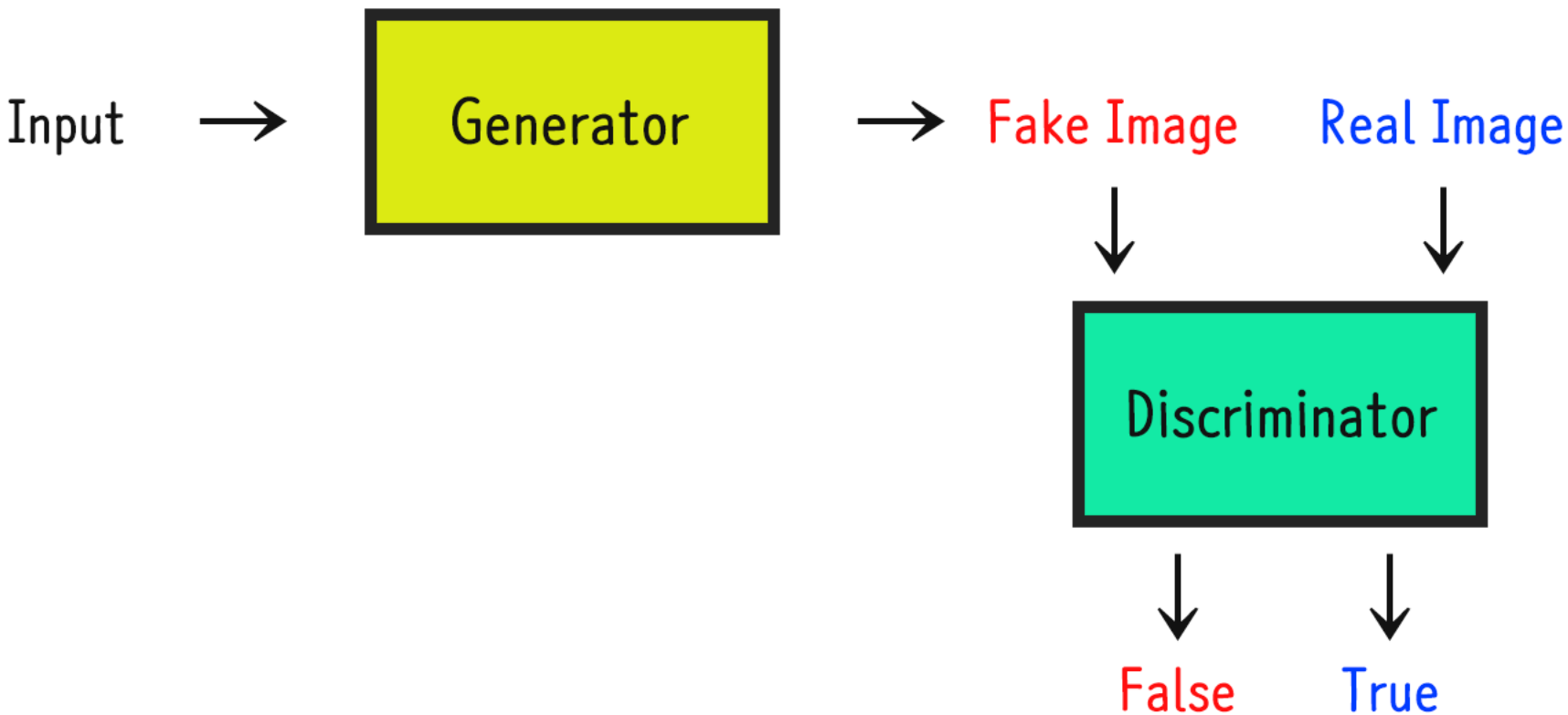


Replaced Token Detection

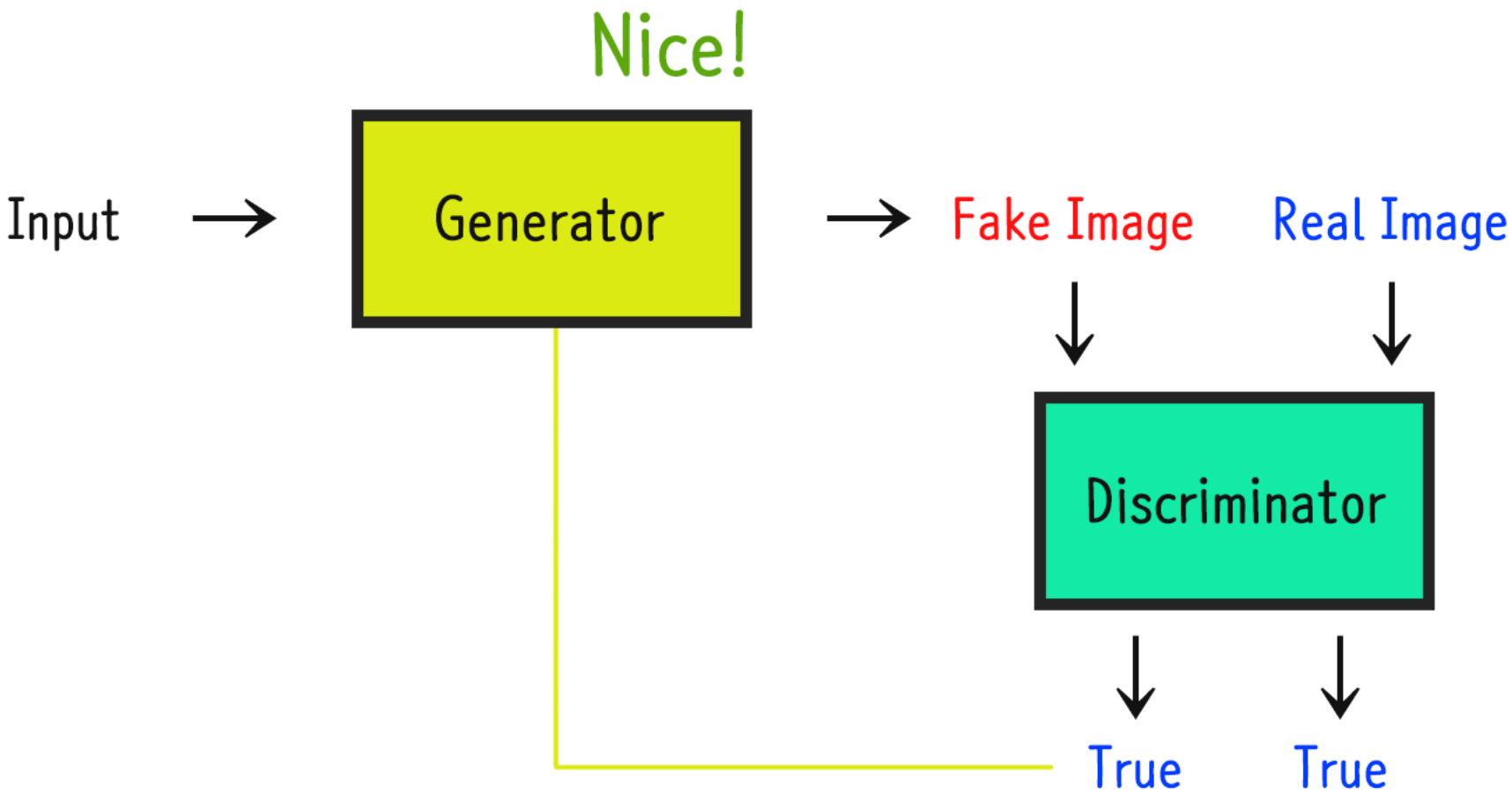


MLM이 생성한 토큰인지 여부를 판별!

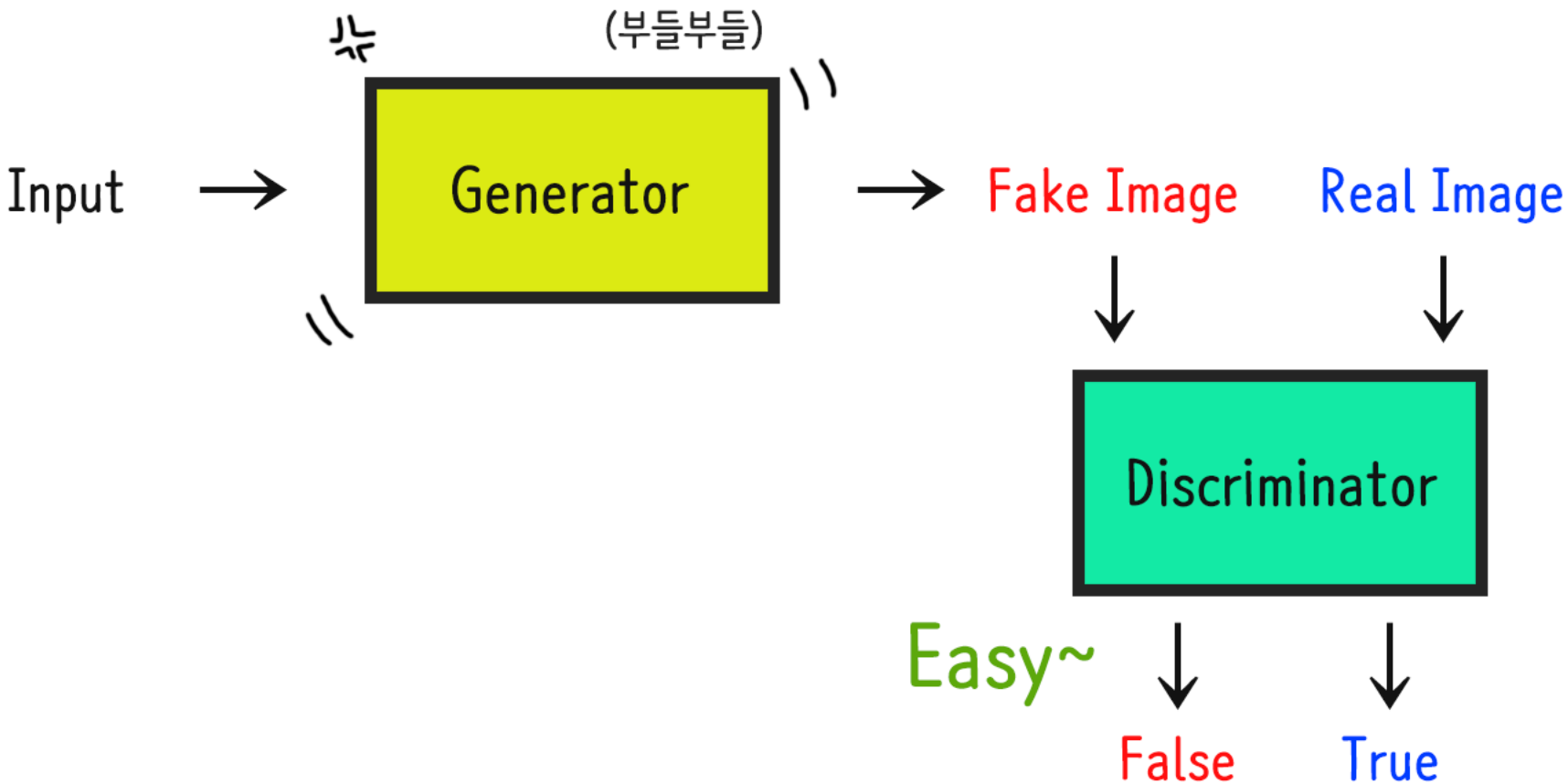
깨알상식 - GAN


Input
Generator
Fake Image
Real Image
Discriminator
False
True

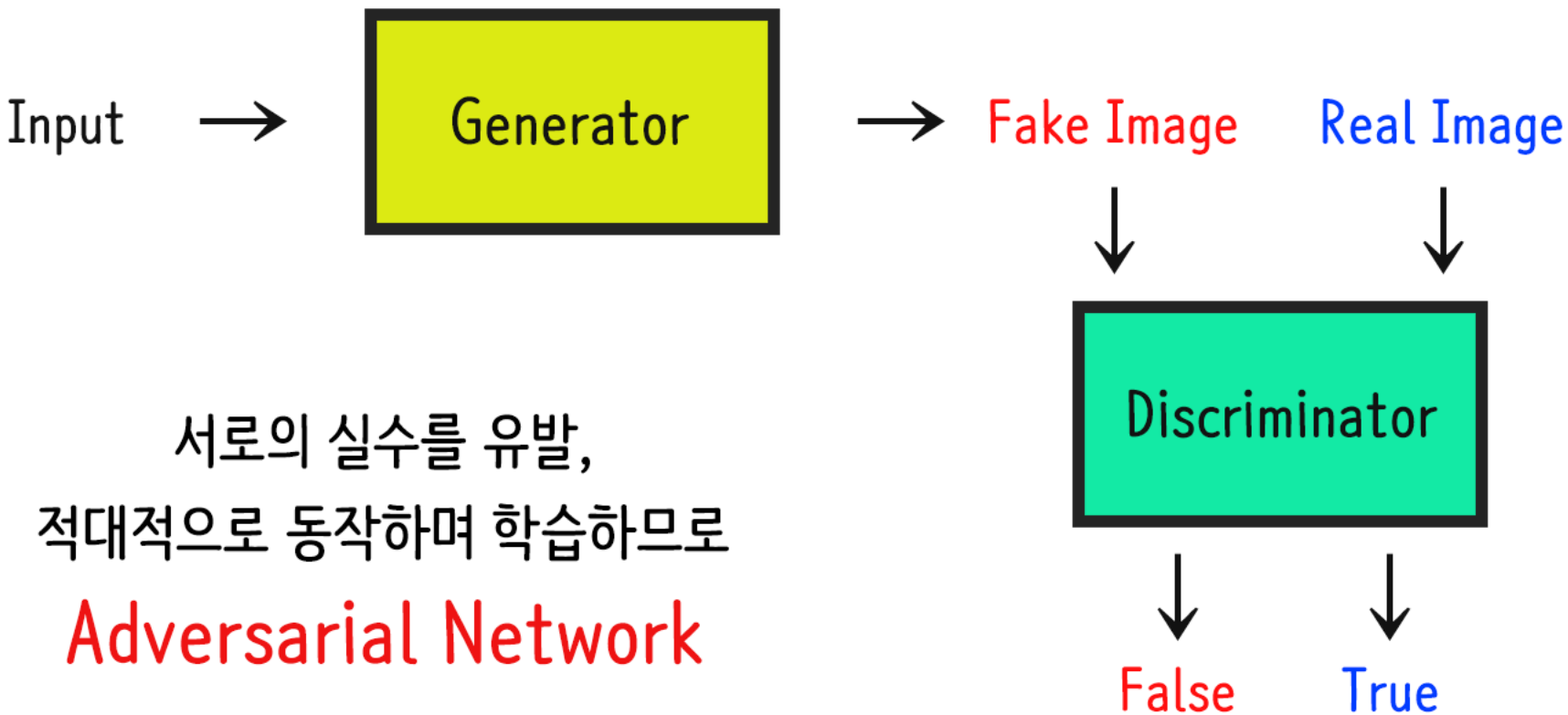
깨알상식 - GAN


Nice!
Input
Generator
Fake Image
Real Image
Discriminator
True
True

깨알상식 - GAN

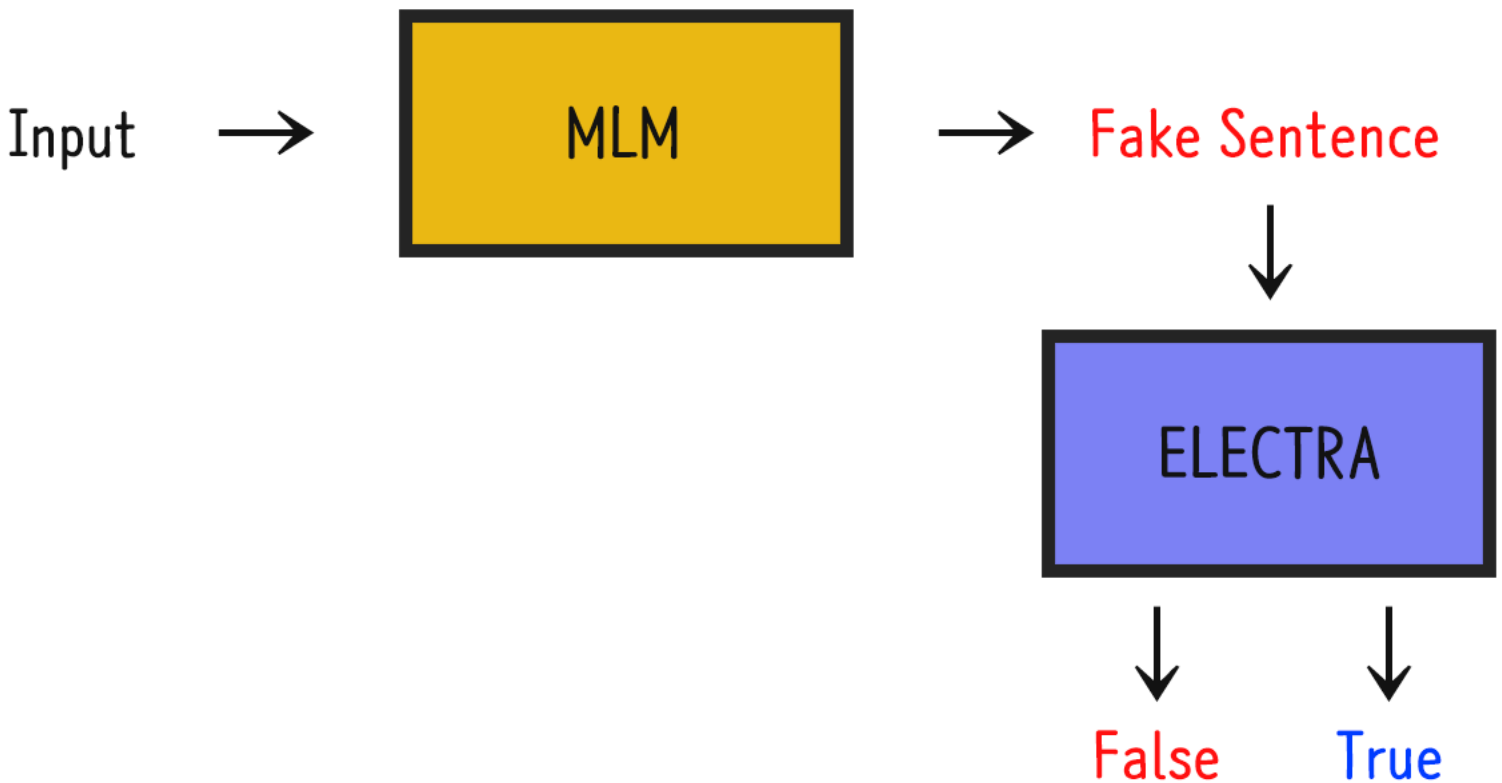

(부들부들)
Input
Generator
Fake Image
Real Image
Discriminator
Easy~
False
True

깨알상식 - GAN



서로의 실수를 유발,
적대적으로 동작하며 학습하므로
Adversarial Network

ELECTRA는 GAN?

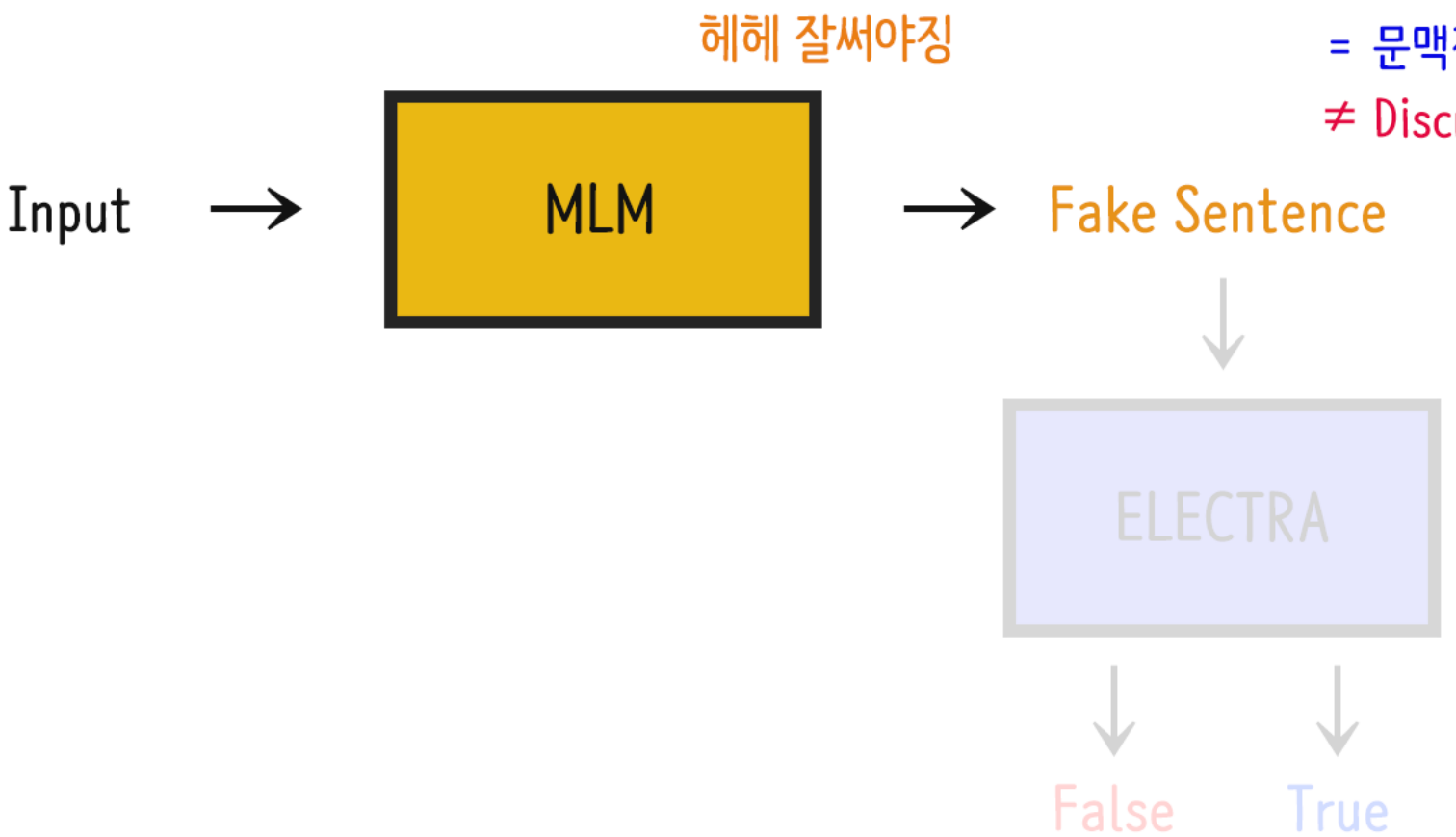


ELECTRA는 GAN?

Likelihood를 Maximize !!

= 문맥적으로 말이 되게

≠ Discriminator가 틀리게



ELECTRA는 GAN?

Input →

CAT 100%

Likelihood를 Maximize !!

= 문맥적으로 말이 되게

≠ Discriminator가 틀리게

헤헤 잘써야징

Fake Sentence

ELECTRA

False True

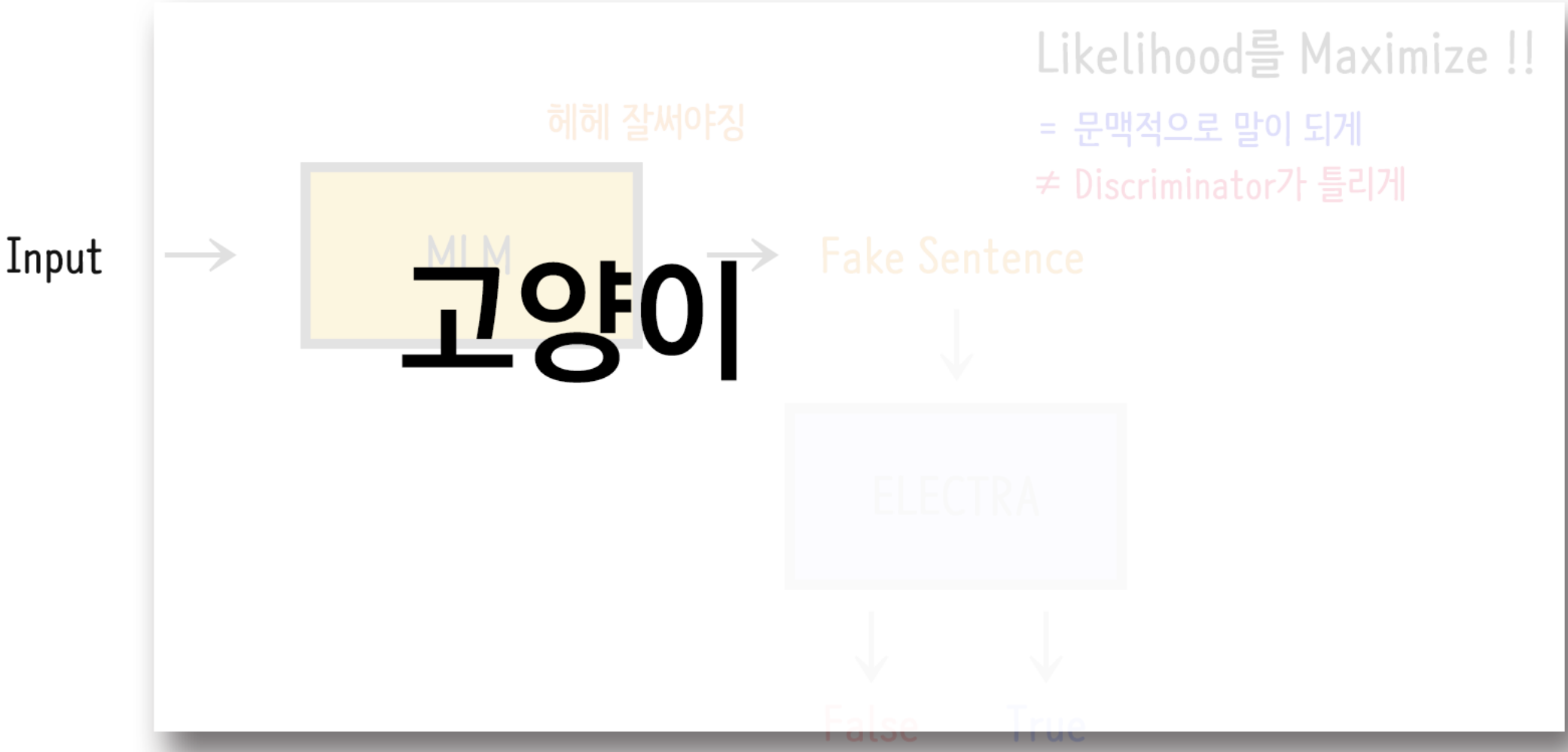
ELECTRA는 GAN?

Input →

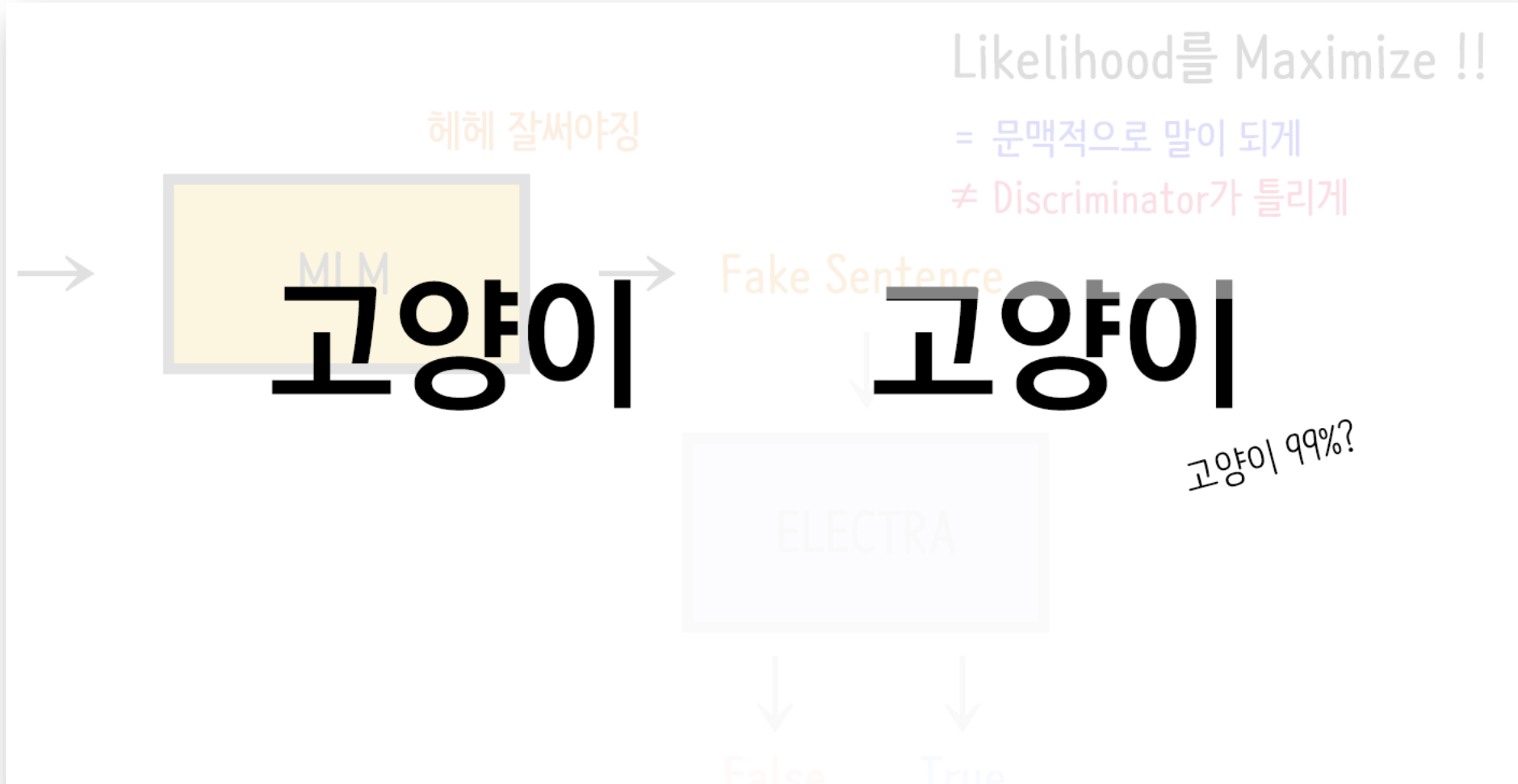
CAT 100%

CAT 35%...?

ELECTRA는 GAN?



ELECTRA는 GAN?



ELECTRA는 GAN?

Likelihood를 Maximize !!

= 문맥적으로 말이 되게

≠ Discriminator가 틀리게

헤헤 잘써야징

Input → MLM → 고양이 → Fake Sentence → 고양이

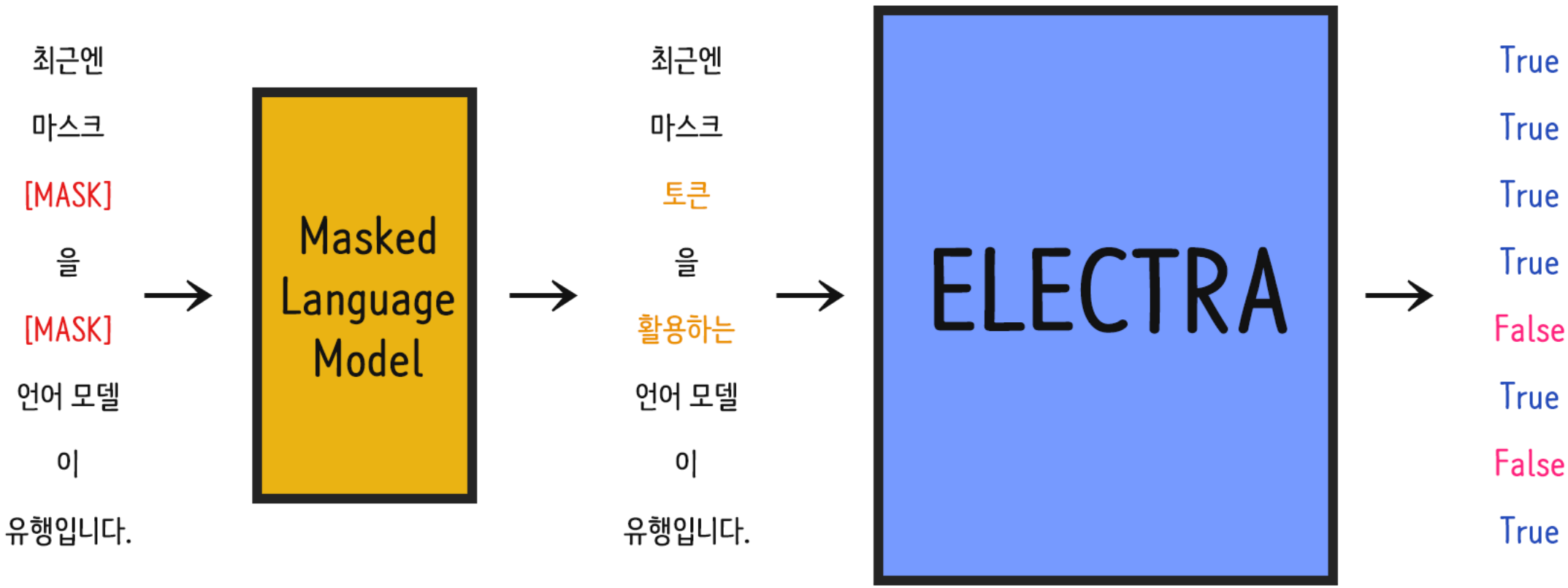
고양이 99%?

ELECTRA

고양이 + 0.1?

False True

Detail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Masked Language Model
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마스크
토큰
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언어 모델
이
유행입니다.
ELECTRA
True
True
True
True
False
True
False
True

Detail

최근엔

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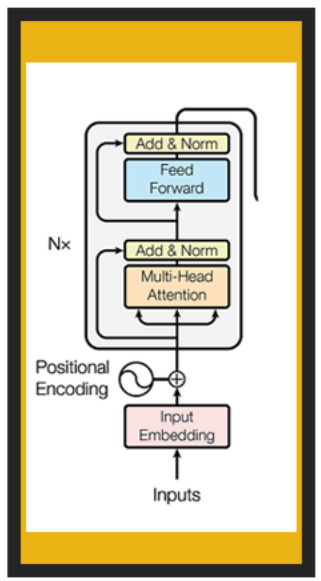
유행입니다.



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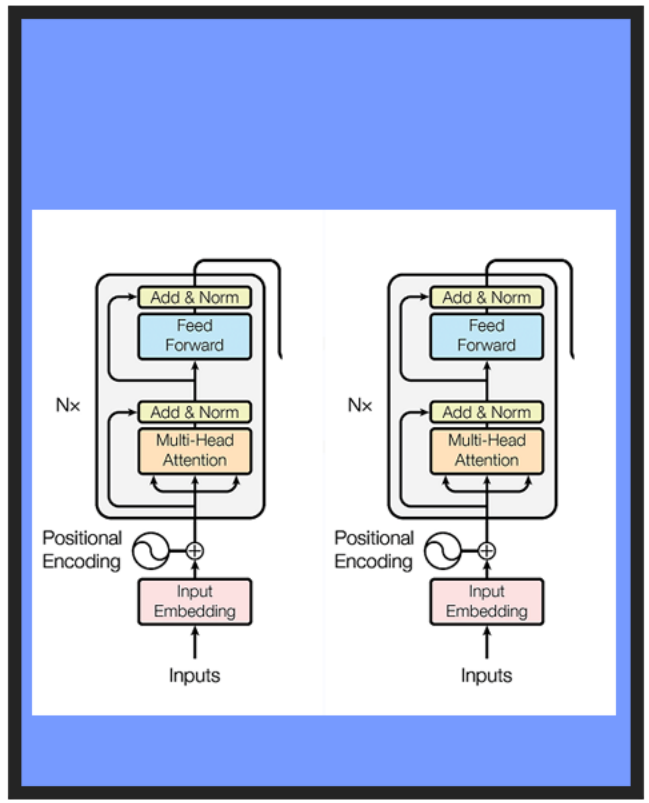


True

True

True

True

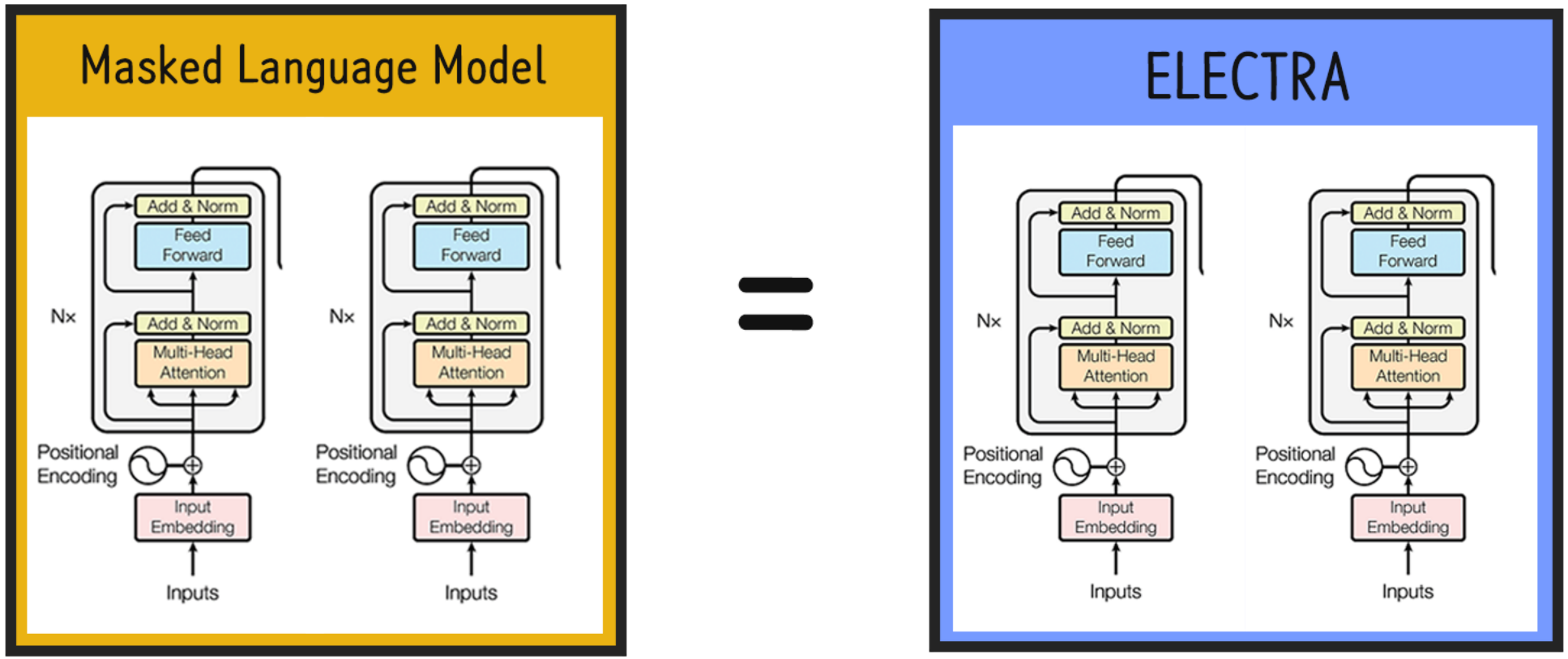
False

True

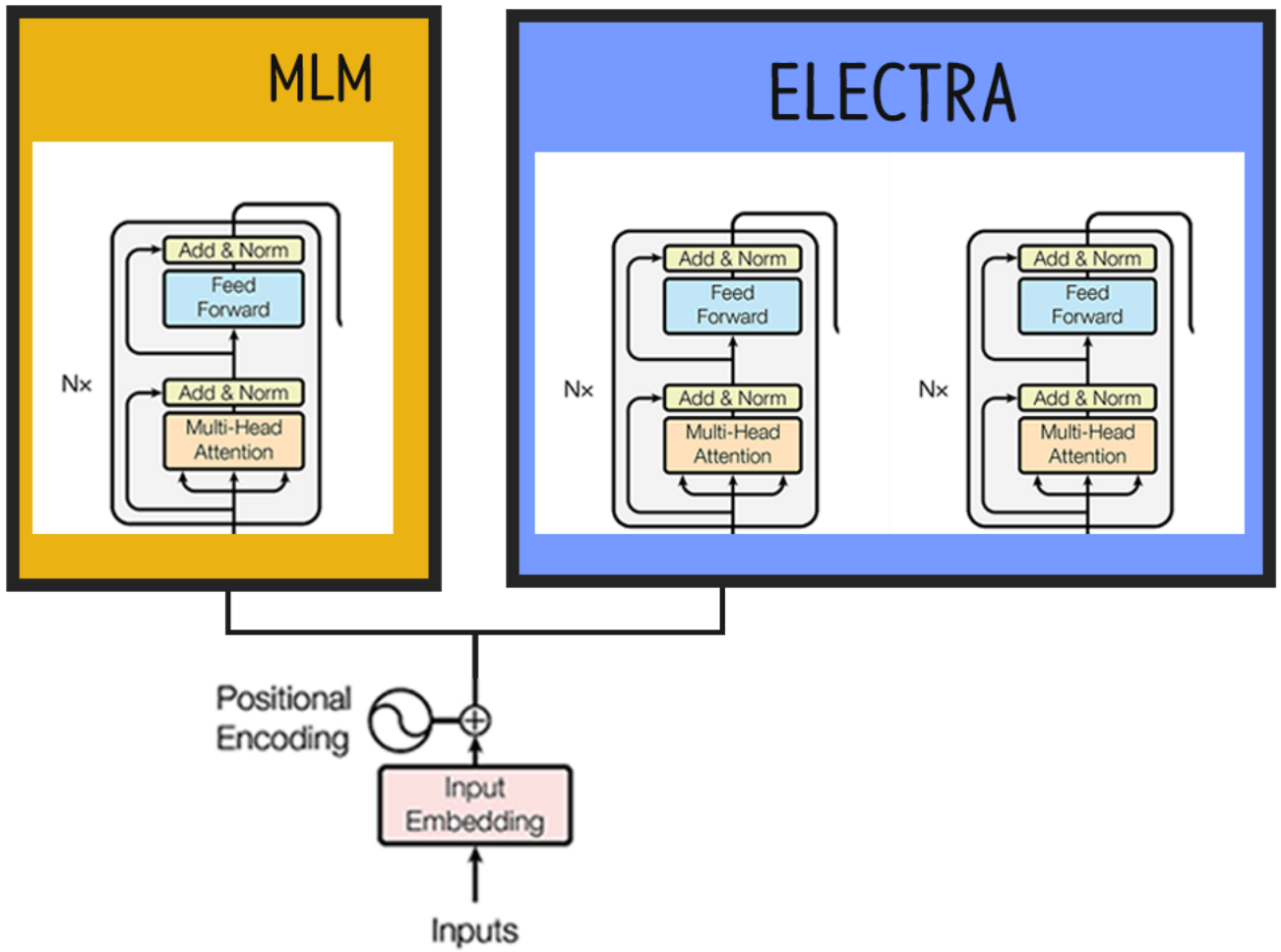
False

True

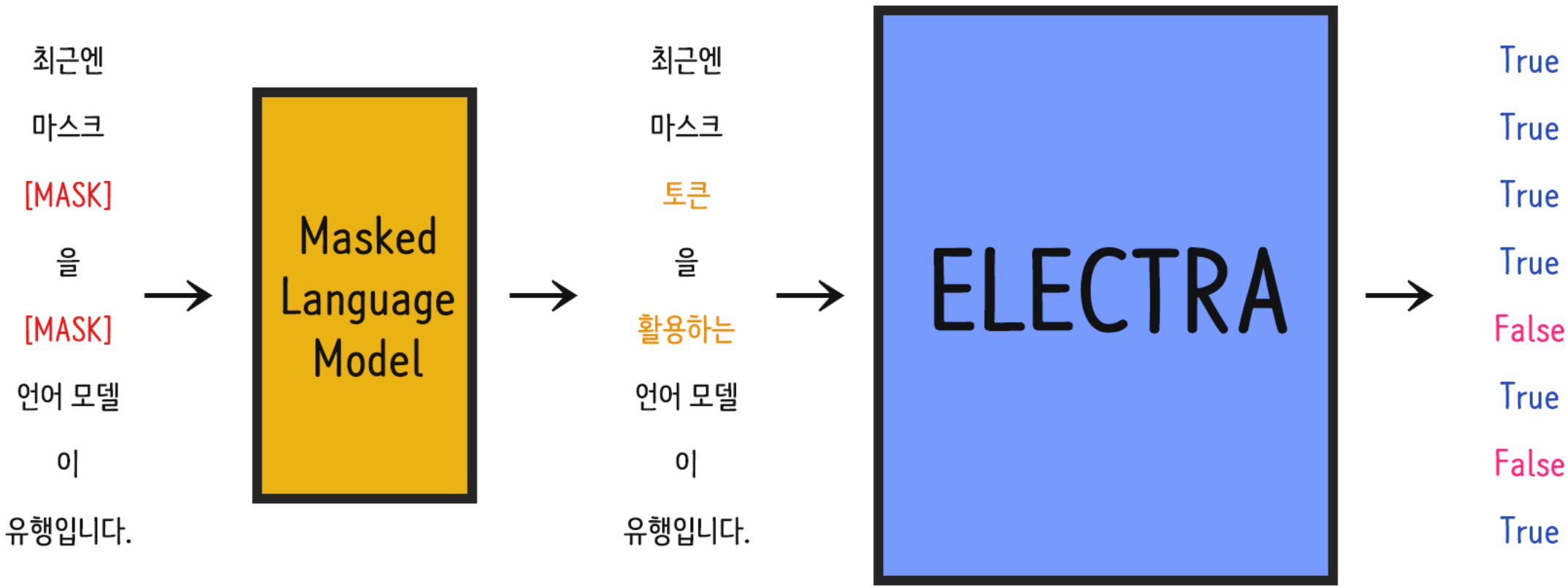
Weight Sharing



Weight Sharing (Only Embedding)



Detail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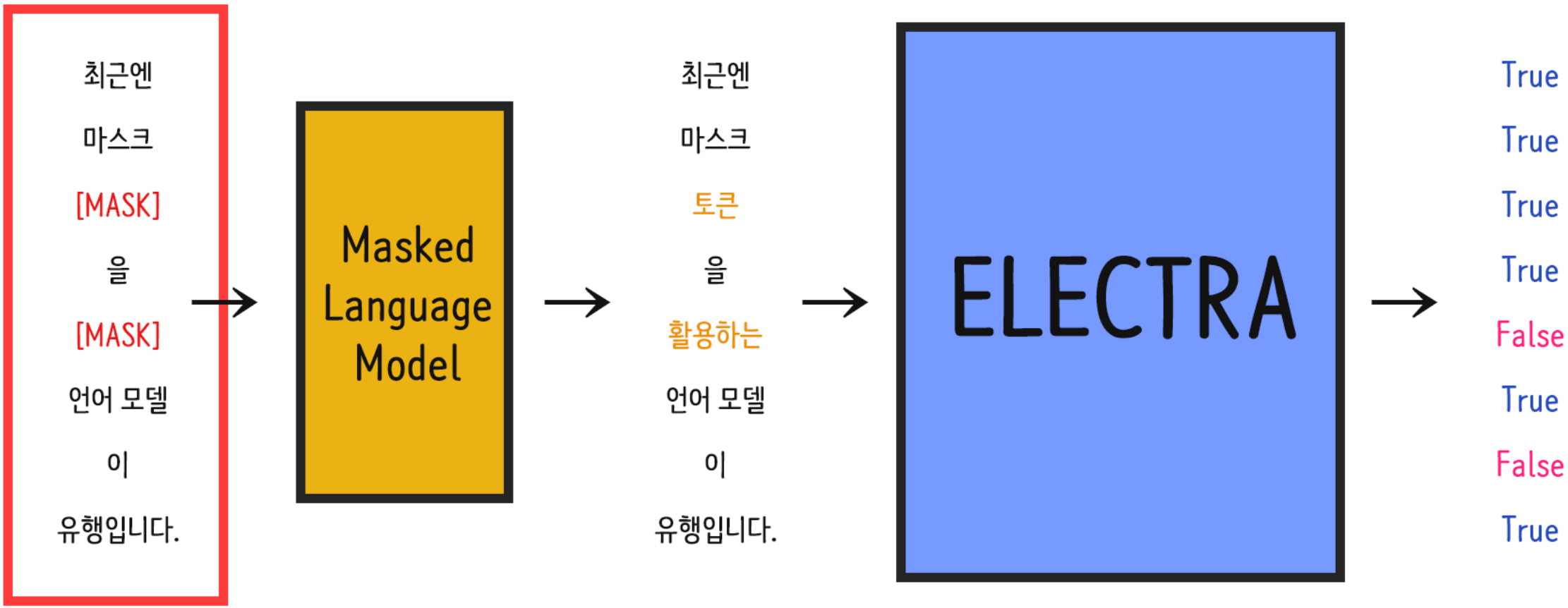
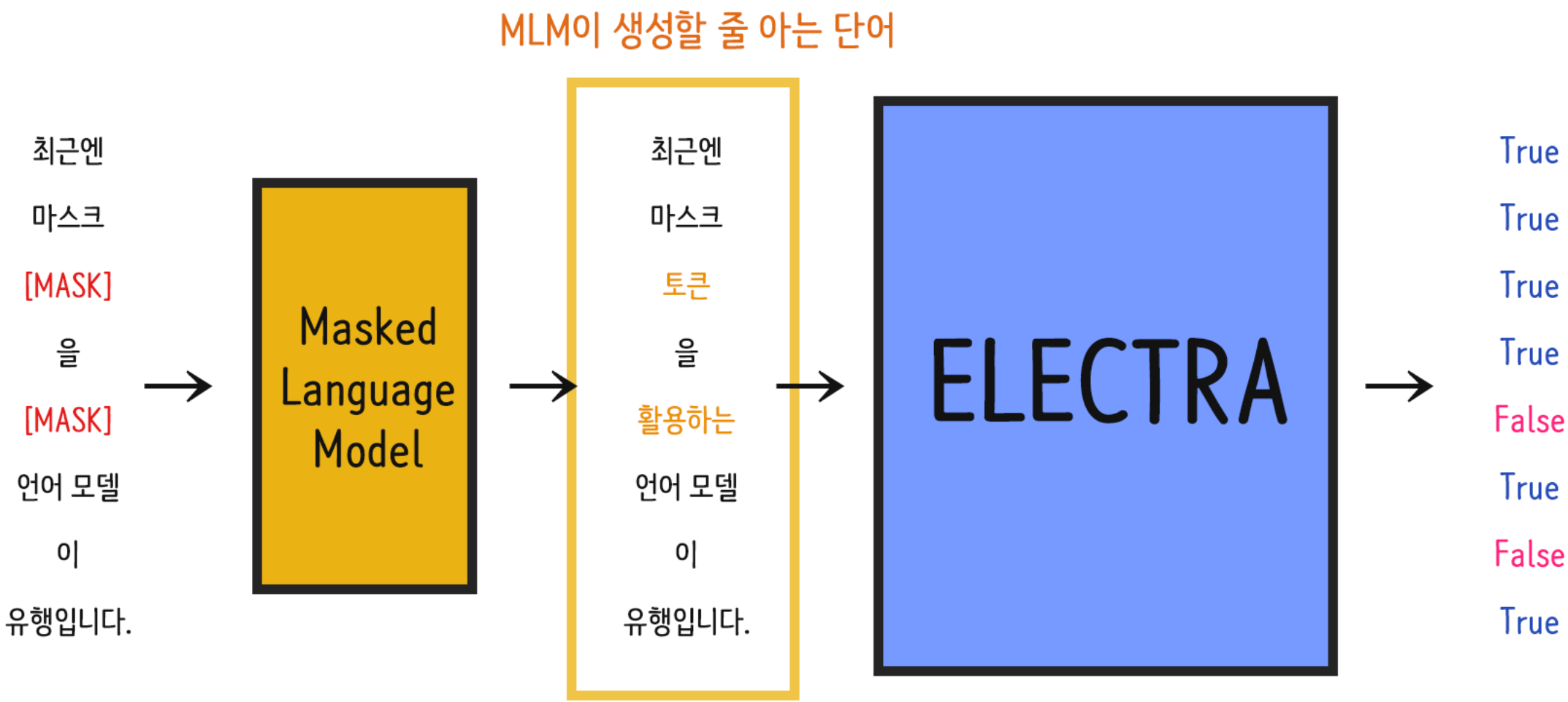
ELECTRA
True
True
True
True
False
True
False
True

Detail

자연 (데이터셋) 에 존재하는 모든 단어



Detail


MLM이 생성할 줄 아는 단어
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ELECTRA
True
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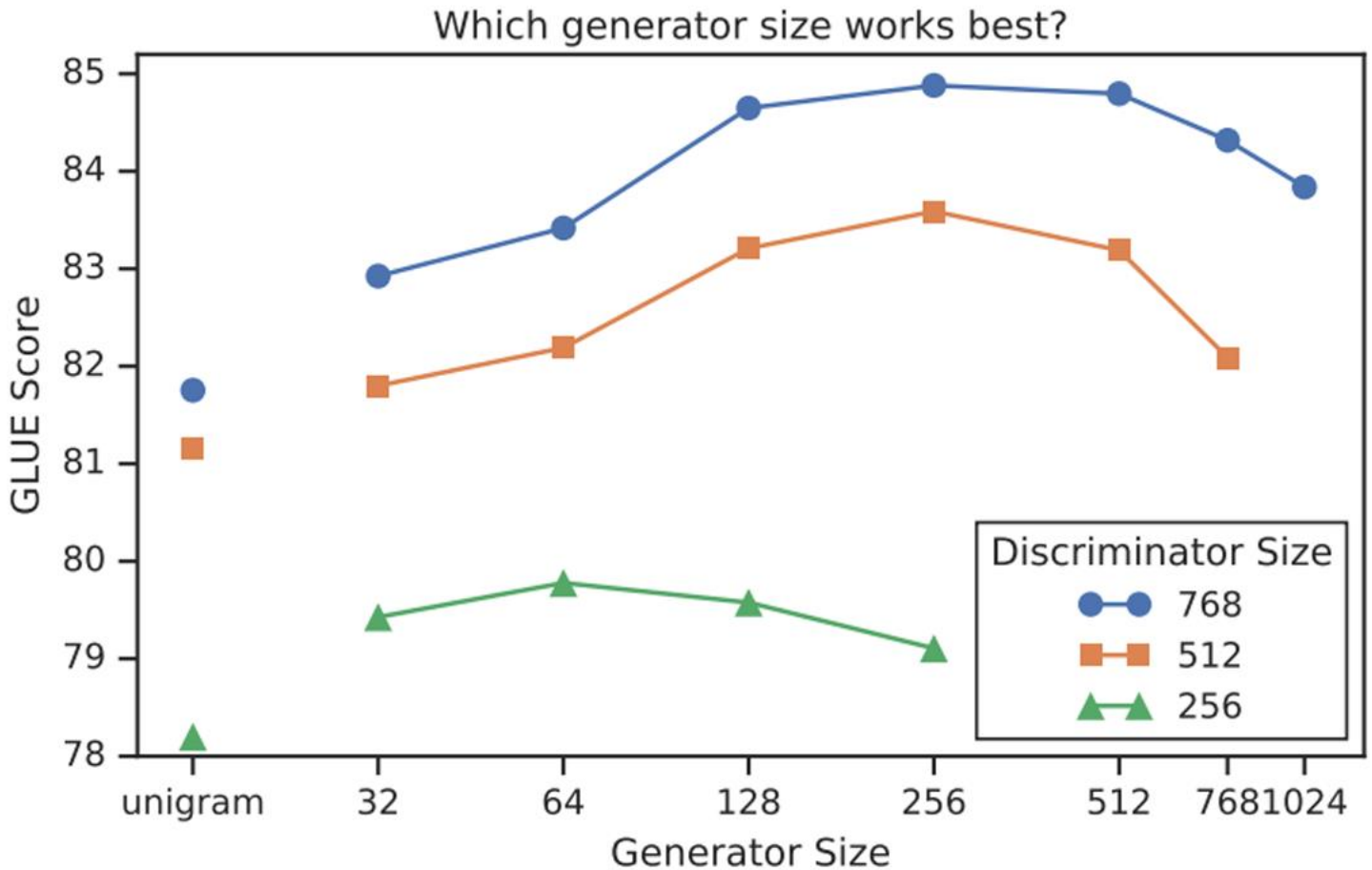
Smaller Generators



Result

Model	Train FLOPs	Params	SQuAD 1.1 dev		SQuAD 2.0 dev		SQuAD 2.0 test	
			EM	F1	EM	F1	EM	F1
BERT-Base	6.4e19 (0.09x)	110M	80.8	88.5	–	–	–	–
BERT	1.9e20 (0.27x)	335M	84.1	90.9	79.0	81.8	80.0	83.0
SpanBERT	7.1e20 (1x)	335M	88.8	94.6	85.7	88.7	85.7	88.7
XLNet-Base	6.6e19 (0.09x)	117M	81.3	–	78.5	–	–	–
XLNet	3.9e21 (5.4x)	360M	**89.7**	**95.1**	87.9	**90.6**	87.9	90.7
RoBERTa-100K	6.4e20 (0.90x)	356M	–	94.0	–	87.7	–	–
RoBERTa-500K	3.2e21 (4.5x)	356M	88.9	94.6	86.5	89.4	86.8	89.8
ALBERT	3.1e22 (44x)	235M	89.3	94.8	87.4	90.2	88.1	90.9
BERT (ours)	7.1e20 (1x)	335M	88.0	93.7	84.7	87.5	–	–
ELECTRA-Base	6.4e19 (0.09x)	110M	84.5	90.8	80.5	83.3	–	–
ELECTRA-400K	7.1e20 (1x)	335M	88.7	94.2	86.9	89.6	–	–
ELECTRA-1.75M	3.1e21 (4.4x)	335M	**89.7**	94.9	**88.0**	**90.6**	**88.7**	**91.4**

Table 4: Results on the SQuAD for non-ensemble models.

THANK YOU