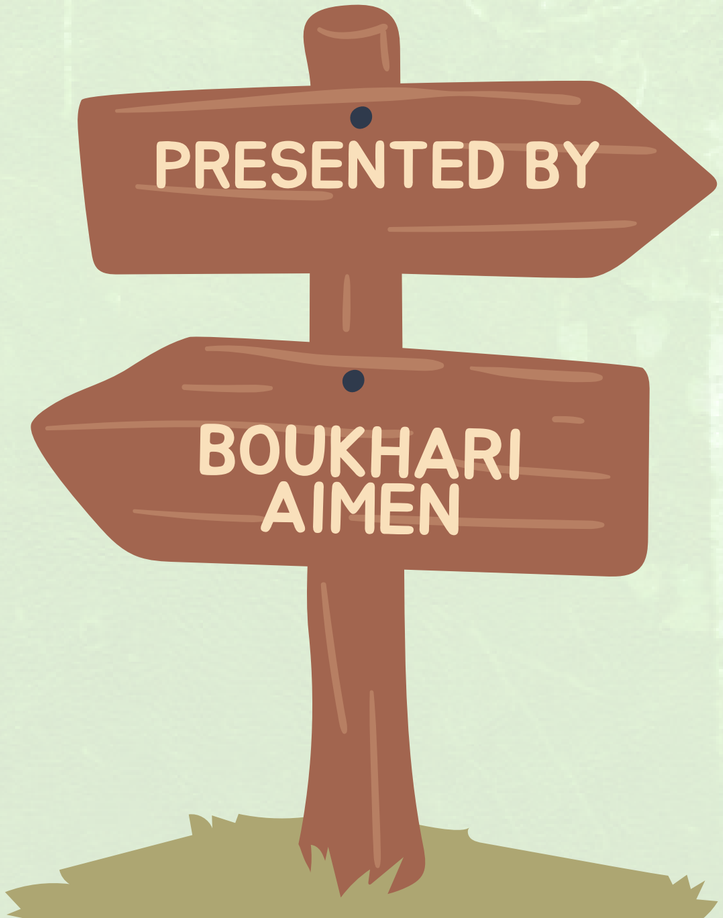
AI Camp

ADVANCED NLP TECHNIQUES

LLMs



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INTRODUCTION TO GENERATIVE MODELS:

GPT

T5

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TEXT GENERATION

USE CASE GPT 2

$$P(y_1, \ldots, y_t | \mathbf{x}) = \prod_{t=1}^{N} P(y_t | y_{<t}, \mathbf{x})$$

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TEXT GENERATION

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TEXT GENERATION

Methods of sampling

Greedy Search

Beam Search

Top-k and Nucleus Sampling

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TEXT GENERATION

Greedy search

- we can get the probability distribution over the next possible token w_i by taking the softmax :

$$P(y_t = w_i \mid y_{<t}, \mathbf{x}) = \text{softmax}(z_{t,i})$$

$$\hat{\mathbf{y}} = \underset{\mathbf{y}}{\text{argmax}}\ P(\mathbf{y} \mid \mathbf{x})$$

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TEXT GENERATION

Greedy search

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TEXT GENERATION

Beam Search

- beam search keeps track of the top-b most probable next tokens
- and the most likely sequence is selected by ranking the b beams according to their log probabilities

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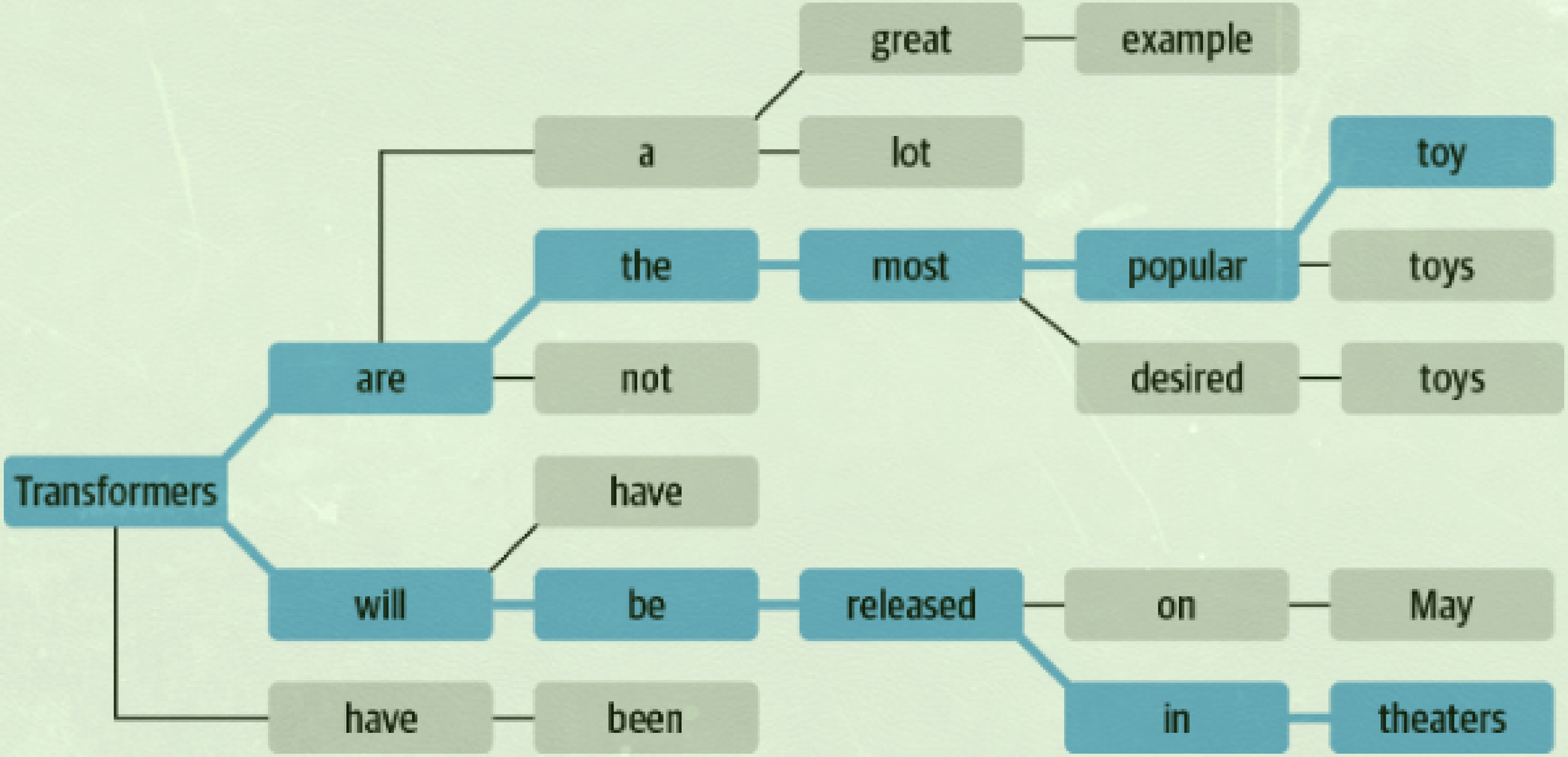

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TEXT GENERATION

Top-p and Nucleus Sampling

- the basic idea is to restrict the number of possible tokens we can sample from at each timestep

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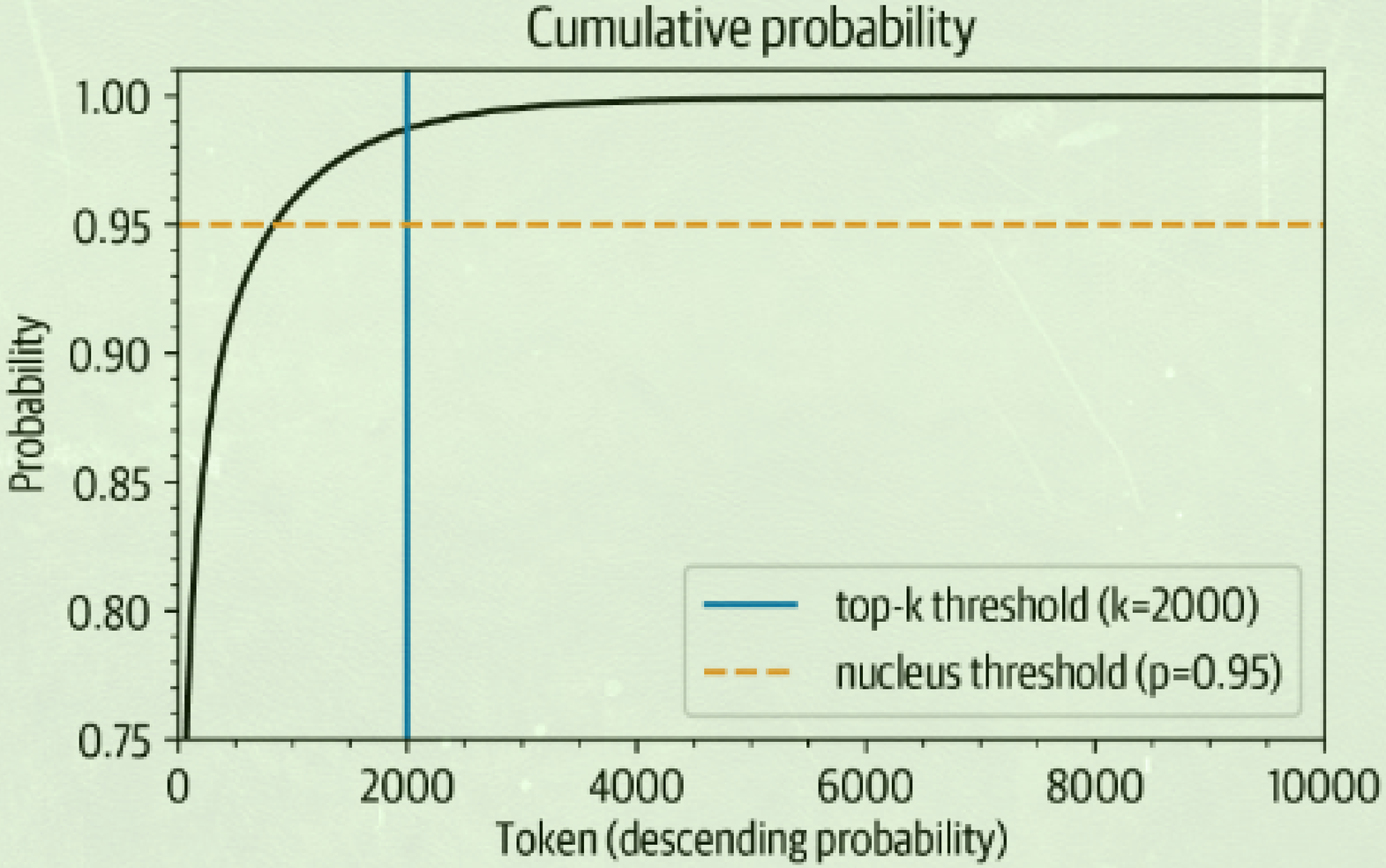
TEXT GENERATION



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BUT
HOW CAN WE EVALUATE OUR MODELS !!

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MEASURING THE QUALITY

Methods of sampling

BLEU

Perplexity

ROUGE.

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TEXT GENERATION

Bilingual Evaluation Understudy (BELU)

$$\mathrm{BP} = \begin{cases} 1 & \text{if } c > r \\ e^{(1-r/c)} & \text{if } c \leq r \end{cases}.$$

Then,

$$\mathrm{BLEU} = \mathrm{BP} \cdot \exp\left(\sum_{n=1}^{N} w_n \log p_n\right).$$

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TEXT GENERATION

ROUGE-1 Score

Model → "the hello a cat dog fox jumps"

reference text

"the fox jumps" → ['the', 'fox', 'jumps']

$$\frac{count_{match}(gram_n)}{count(gram_n)}$$

$$\frac{3}{3} = \textbf{100\%}\ \text{recall}$$

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TEXT GENERATION

ROUGE-1 Score

"the hello a cat dog fox jumps"

longest common subsequence length = **2**

"the fox jumps"

reference text

$$\frac{LCS(gram_n)}{count(gram_n)}$$

$$\frac{2}{7} = \textbf{29\%} \text{ precision}$$

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TEXT GENERATION

ROUGE-1 Score

"the hello a cat dog fox jumps"

['the', 'fox', 'jumps']

1.0 recall
0.43 precision

$$2 * \frac{0.43 * 1.0}{0.43 + 1.0} = 0.6$$

60% f1 score

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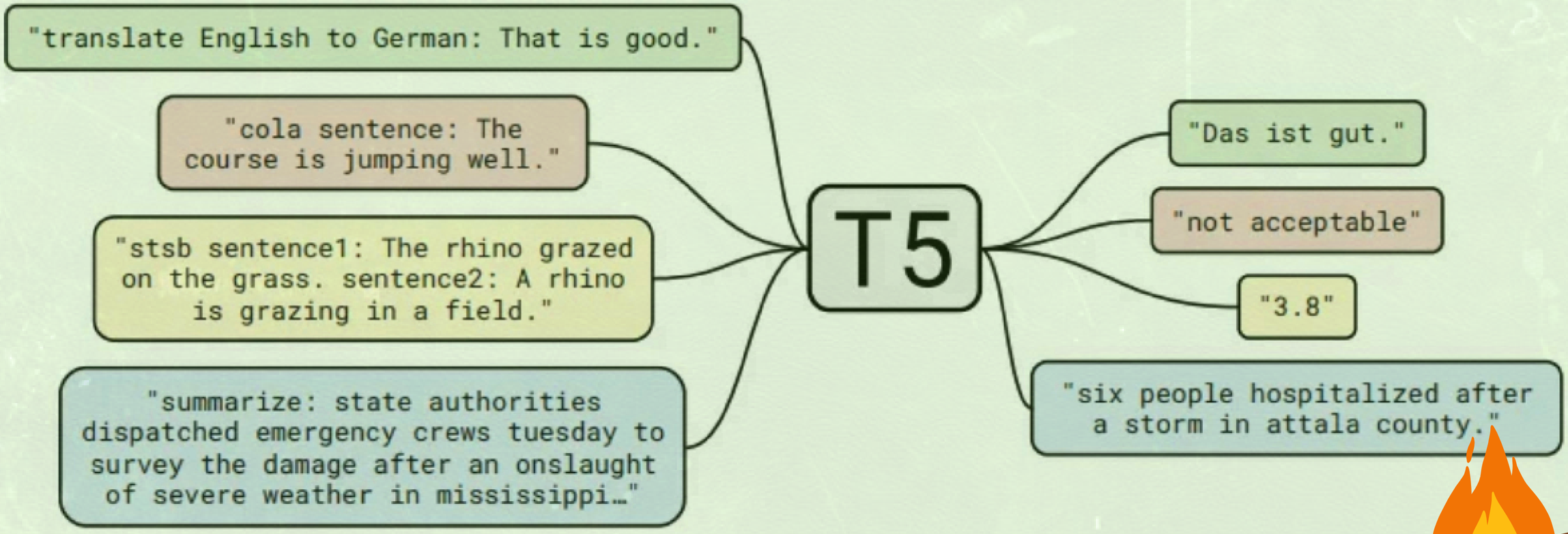
INTRODUCTION TO T5



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INTORDUCTION TO T5

FACTS ABOUT T5

- The primary idea behind T5 is to convert all NLP tasks into a text-to-text format
- T5 reformulates existing transfer learning techniques into a unified format

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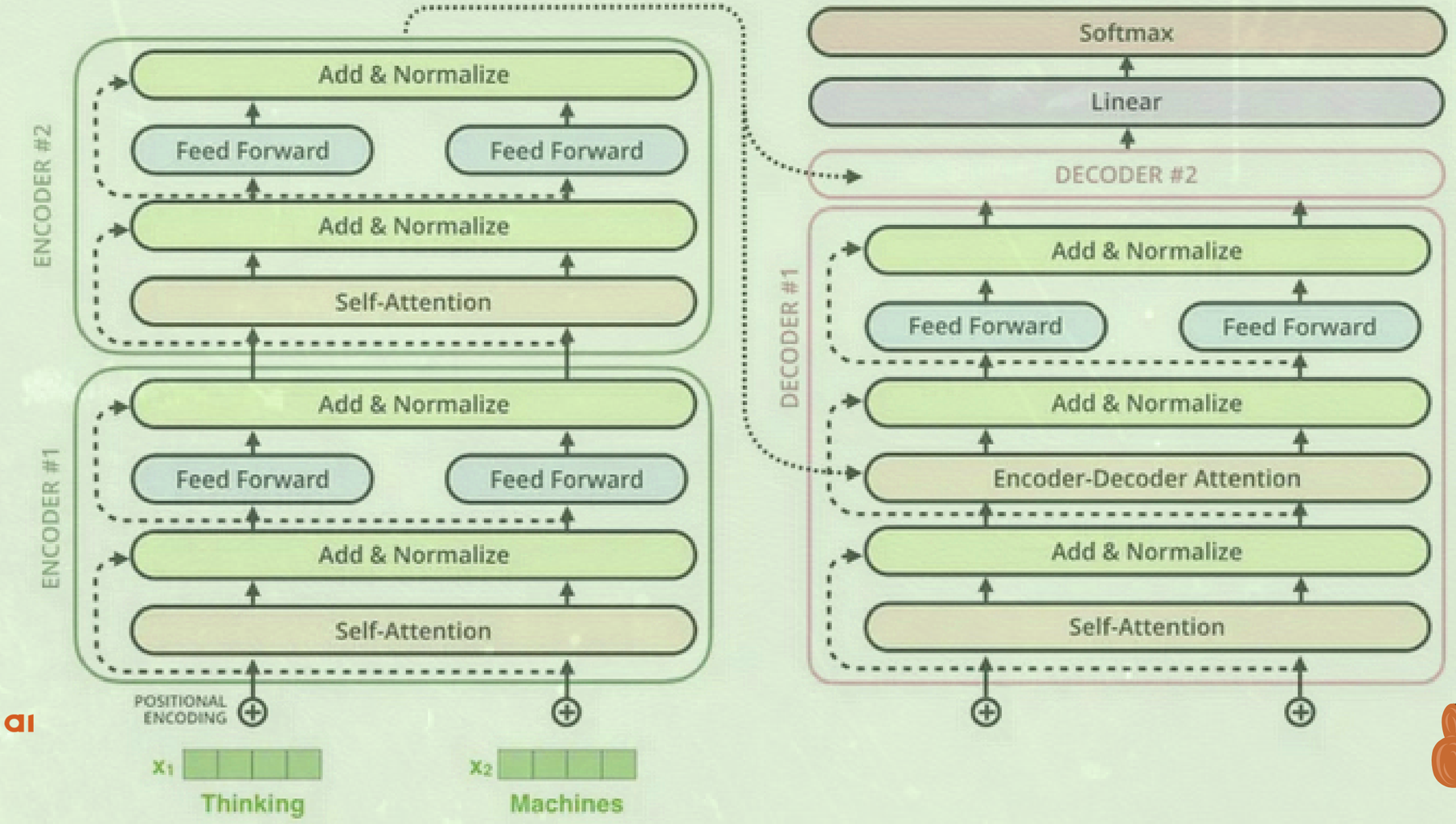
ARCHITECTURE OF THE T5 MODEL



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INTORDUCTION TO T5

attention masks

- Variants of the transformer architecture have one major distinction: the type of masking used in their attention layers
- Certain applications (e.g., language modeling) require causal self-attention during training to prevent the transformer from “looking into the future”

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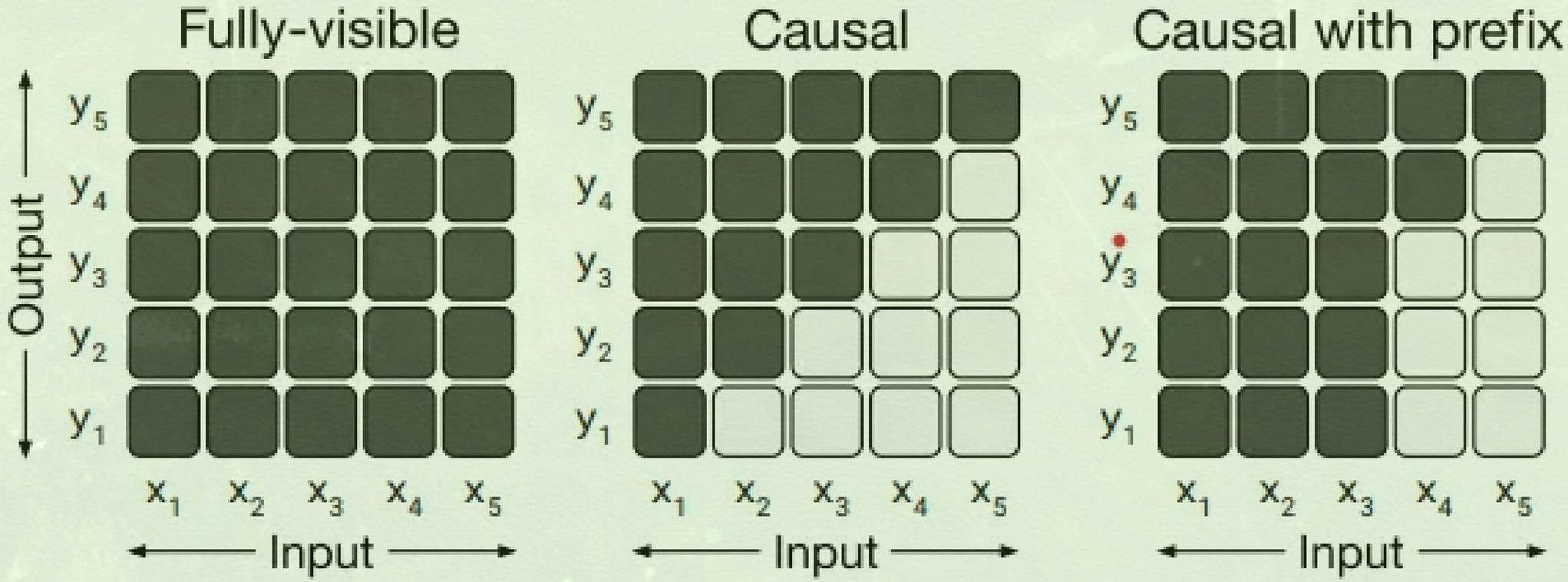
INTORDUCTION TO T5



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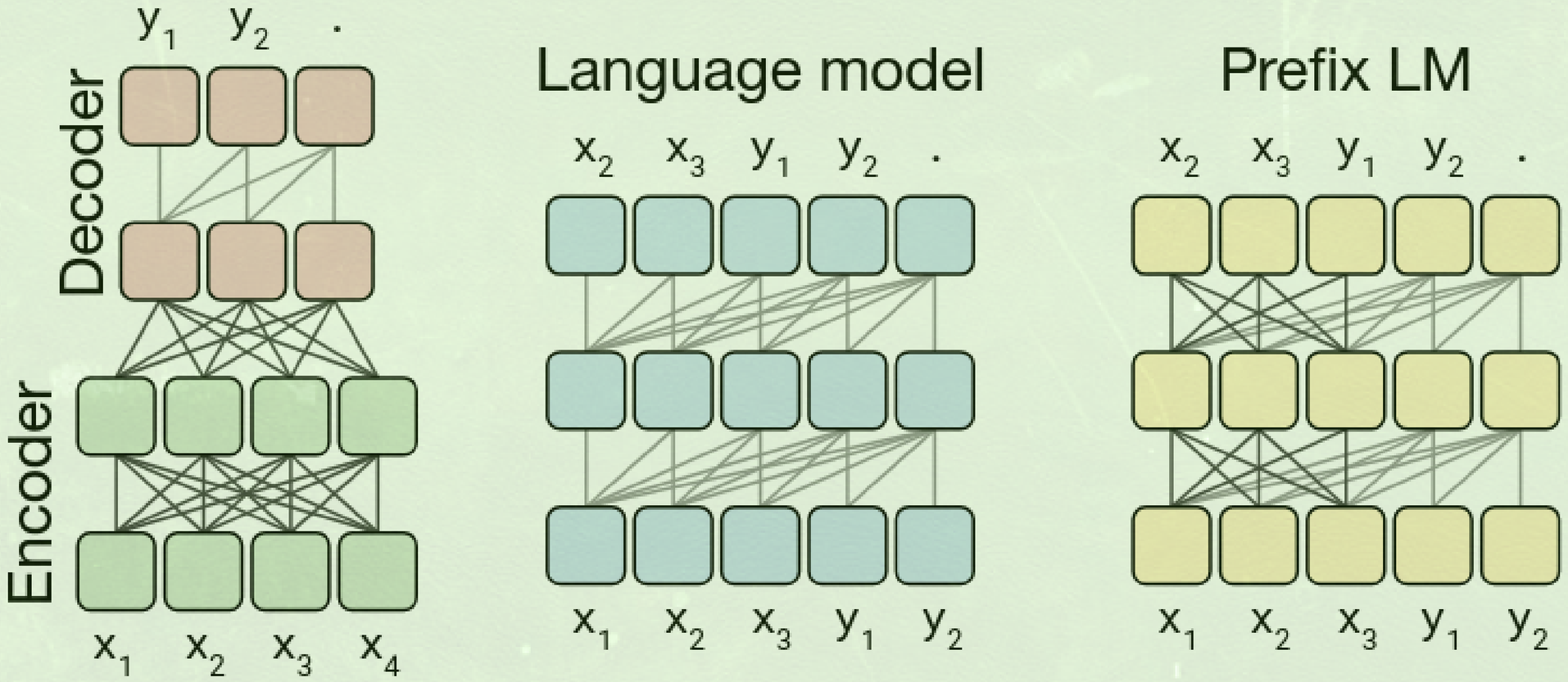
INTORDUCTION TO T5



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INTORDUCTION TO T5

	Architecture	Objective	Params	Cost	GLUE
★	Encoder-decoder	Denoising	$2P$	M	**83.28**
	Enc-dec, shared	Denoising	P	M	82.81
	Enc-dec, 6 layers	Denoising	P	$M/2$	80.88
	Language model	Denoising	P	M	74.70
	Prefix LM	Denoising	P	M	81.82
	Encoder-decoder	LM	$2P$	M	79.56
	Enc-dec, shared	LM	P	M	79.60
	Enc-dec, 6 layers	LM	P	$M/2$	78.67
	Language model	LM	P	M	73.78
	Prefix LM	LM	P	M	79.68

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INTORDUCTION TO T5

TRAINING T5

- The T5 model is pre-trained on a total of 34B tokens from the C4 corpus
- Randomly selects 15% of tokens in the input sequence and Replaces all consecutive spans of selected tokens with a single ”sentinel” token

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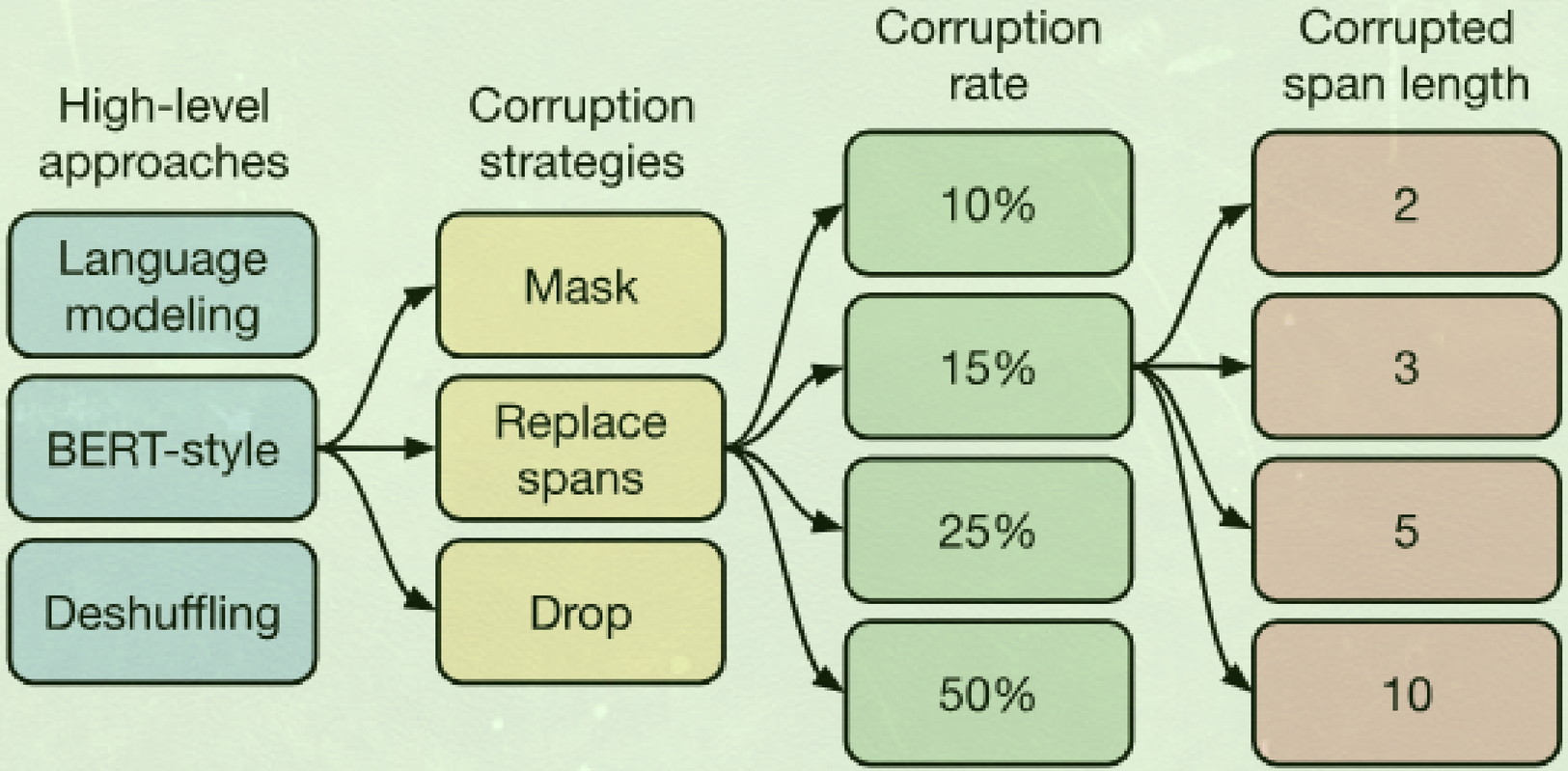
INTORDUCTION TO T5



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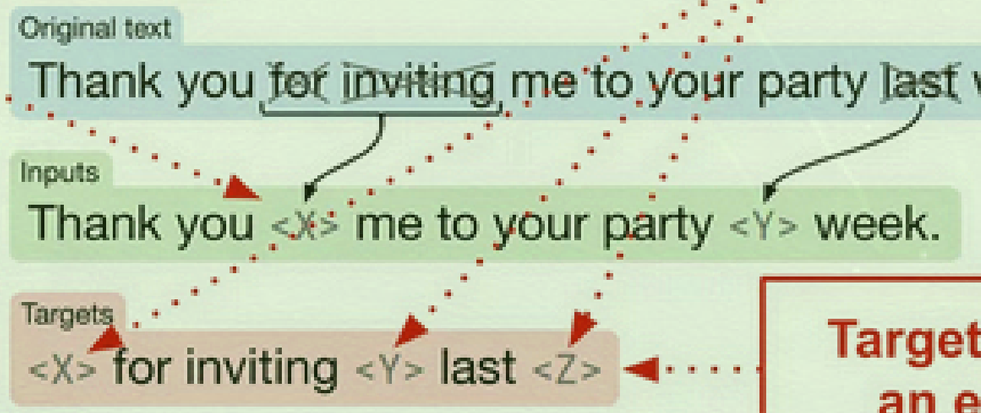
INTORDUCTION TO T5

Sequences of tokens are assigned the same sentinel token

Each sentinel token is unique within the sequence



Target sequence ends with an extra sentinel token

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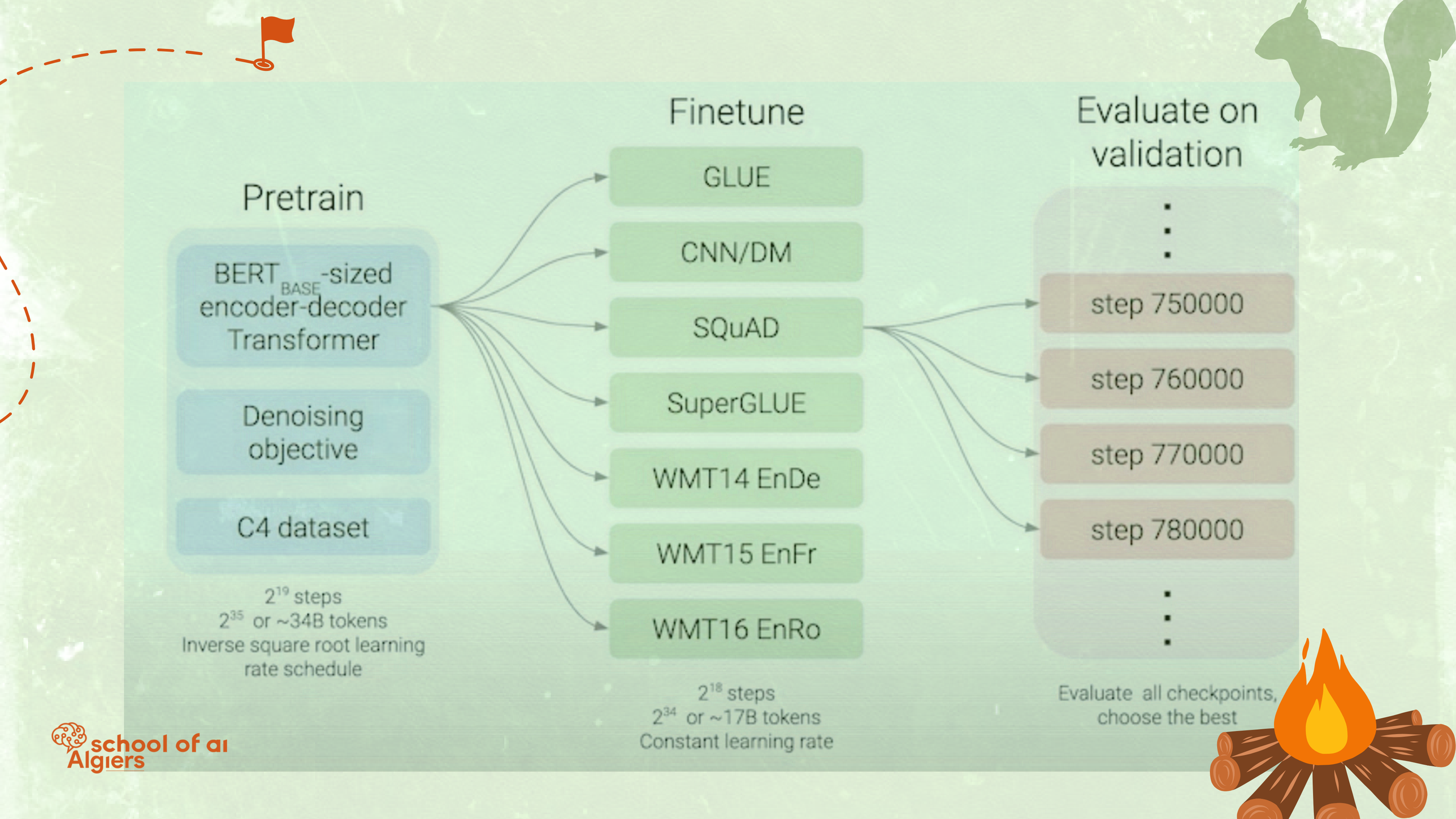
Pretrain
BERT BASE -sized encoder-decoder Transformer
Denoising objective
C4 dataset
2^19 steps
2^35 or ~34B tokens
Inverse square root learning rate schedule
Finetune
GLUE
CNN/DM
SQuAD
SuperGLUE
WMT14 EnDe
WMT15 EnFr
WMT16 EnRo
2^18 steps
2^34 or ~17B tokens
Constant learning rate
Evaluate on validation
step 750000
step 760000
step 770000
step 780000
Evaluate all checkpoints, choose the best
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THANK YOU!

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