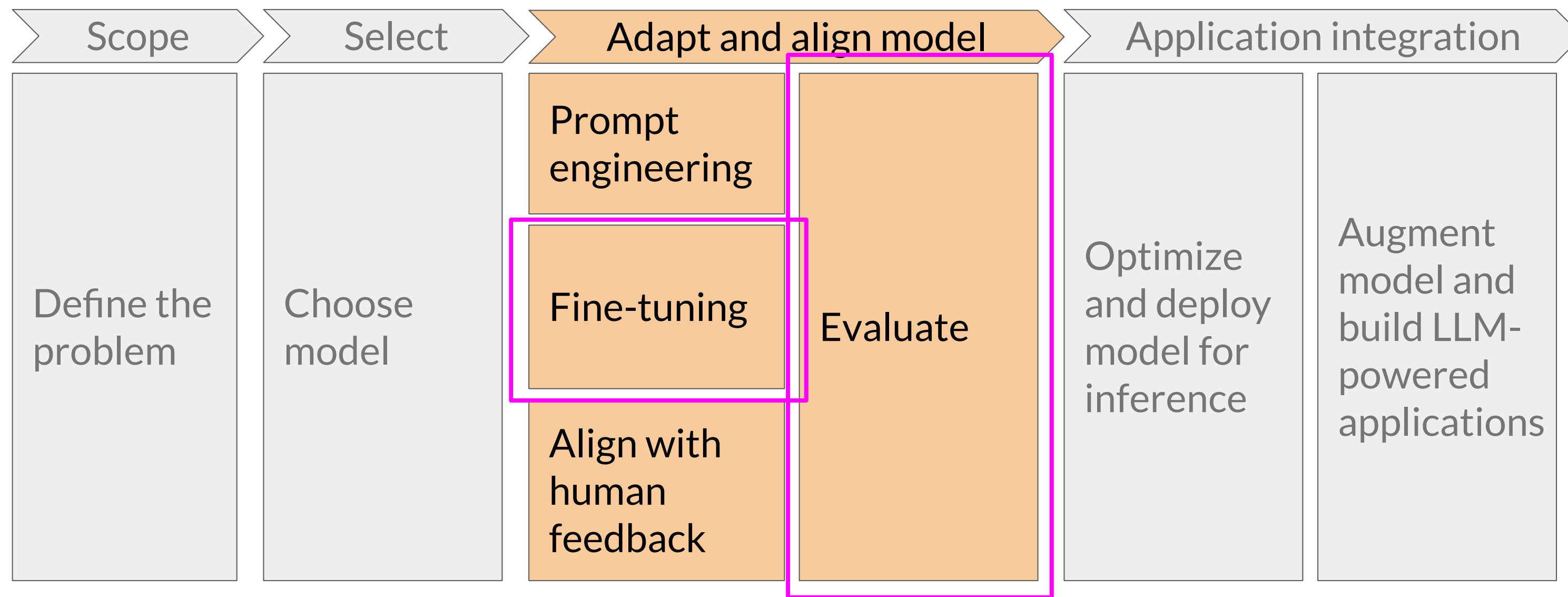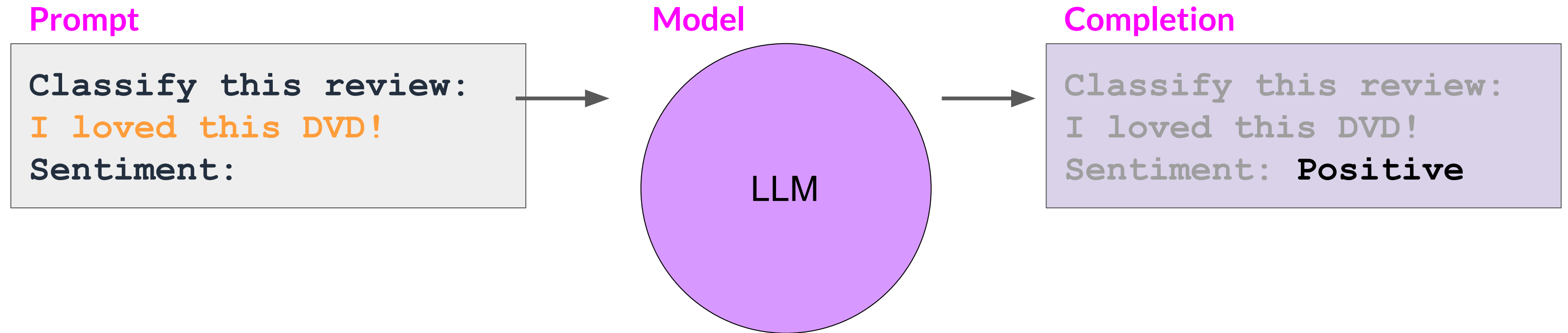# Generative AI and large-language models (LLMs)

FINE-TUNING, INSTRUCTION PROMPTS, AND PARAMETER EFFICIENT FINE-TUNING

GenAI project lifecycle
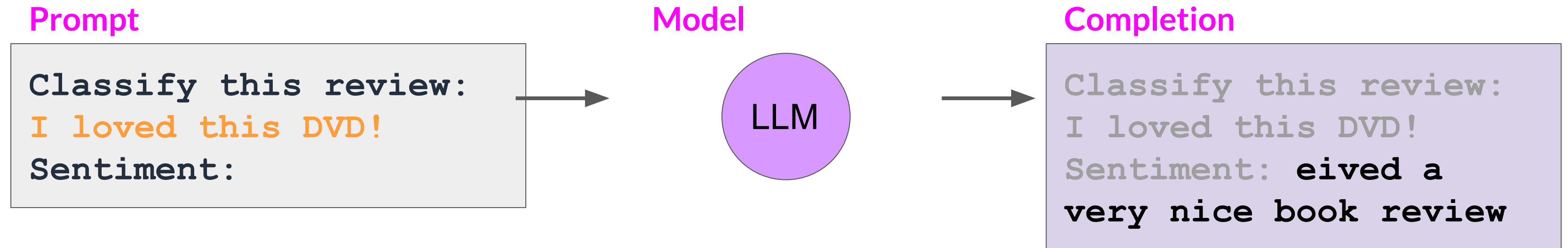
In-context learning (ICL) - zero shot inference

Prompt

```
Classify this review:
I loved this DVD!
Sentiment:
```

Model

LLM

Completion

```
Classify this review:
I loved this DVD!
Sentiment: Positive
```

DeepLearning.AI

aws

In-context learning (ICL) - zero shot inference

Prompt

```
Classify this review:
I loved this DVD!
Sentiment:
```

Model

LLM

Completion

```
Classify this review:
I loved this DVD!
Sentiment: eived a
very nice book review
```

DeepLearning.AI

aws

In-context learning (ICL) - one/few shot inference

Prompt

Model

Completion

```
Classify this review:
I loved this DVD!
Sentiment: Positive

Classify this review:
I don't like this
chair.
Sentiment:
```

LLM

```
Classify this review:
I loved this DVD!
Sentiment: Positive

Classify this review:
I don't like this
chair.
Sentiment: Negative
```
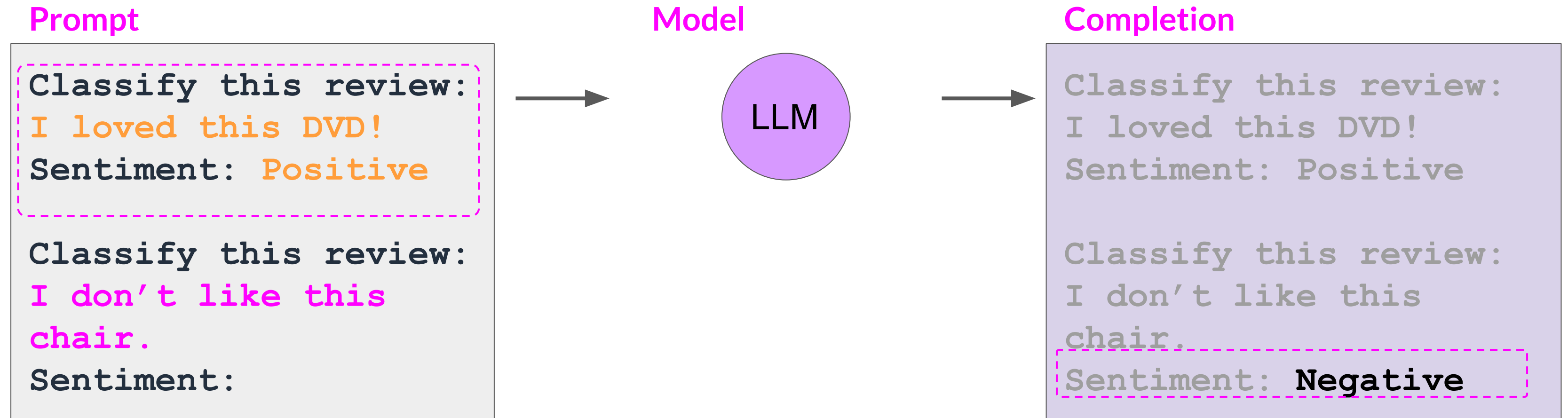
One-shot or Few-shot Inference

Limitations of in-context learning

```
Classify this review:
I loved this movie!
Sentiment: Positive

Classify this review:
I don't like this chair.
Sentiment: Negative

Classify this review:
This sofa is so ugly.
Sentiment: Negative

Classify this review:
Who would use this product?
Sentiment:
```
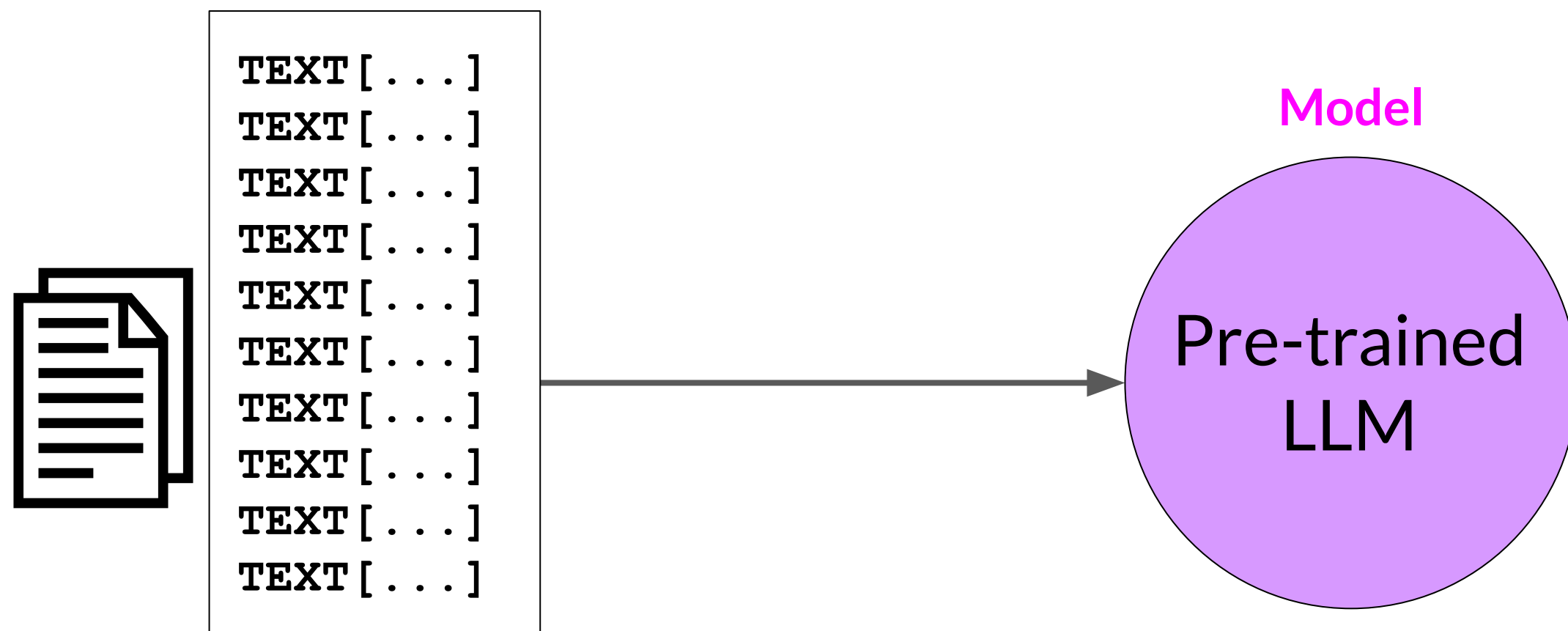
Context Window

Even with multiple examples

- In-context learning may not work for smaller models LLM

- Examples take up space in the context window

Instead, try **fine-tuning** the model

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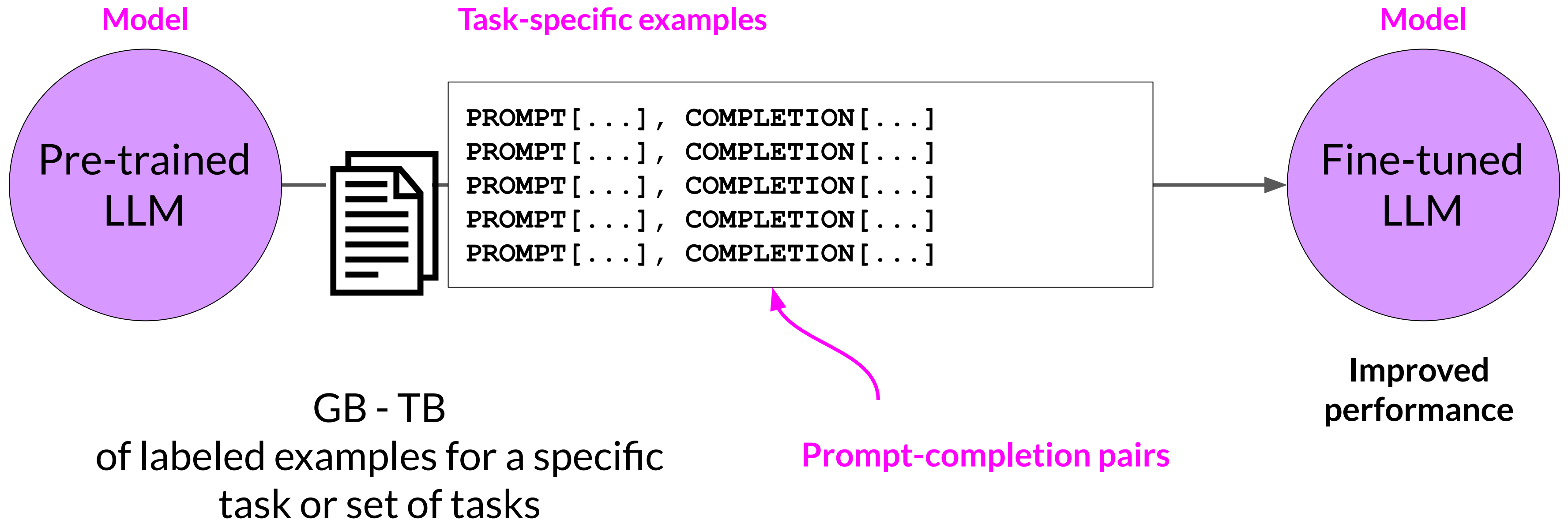# LLM fine-tuning at a high level

```
TEXT[...]
TEXT[...]
TEXT[...]
TEXT[...]
TEXT[...]
TEXT[...]
TEXT[...]
TEXT[...]
TEXT[...]
TEXT[...]
```

Model

Pre-trained
LLM

GB - TB - PB
of unstructured textual data

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aws

LLM fine-tuning at a high level

LLM fine-tuning

Model

Task-specific examples

Model

Pre-trained LLM

```
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
```

Fine-tuned LLM

Improved performance

GB - TB
of labeled examples for a specific
task or set of tasks

Prompt-completion pairs

aws

Using prompts to fine-tune LLMs with instruction

LLM fine-tuning

Model

Model

Pre-trained LLM

Fine-tuned LLM

```
Classify this review:
I loved this DVD!
Sentiment: Positive

Classify this review:
I don't like this
chair.
Sentiment: Negative
```

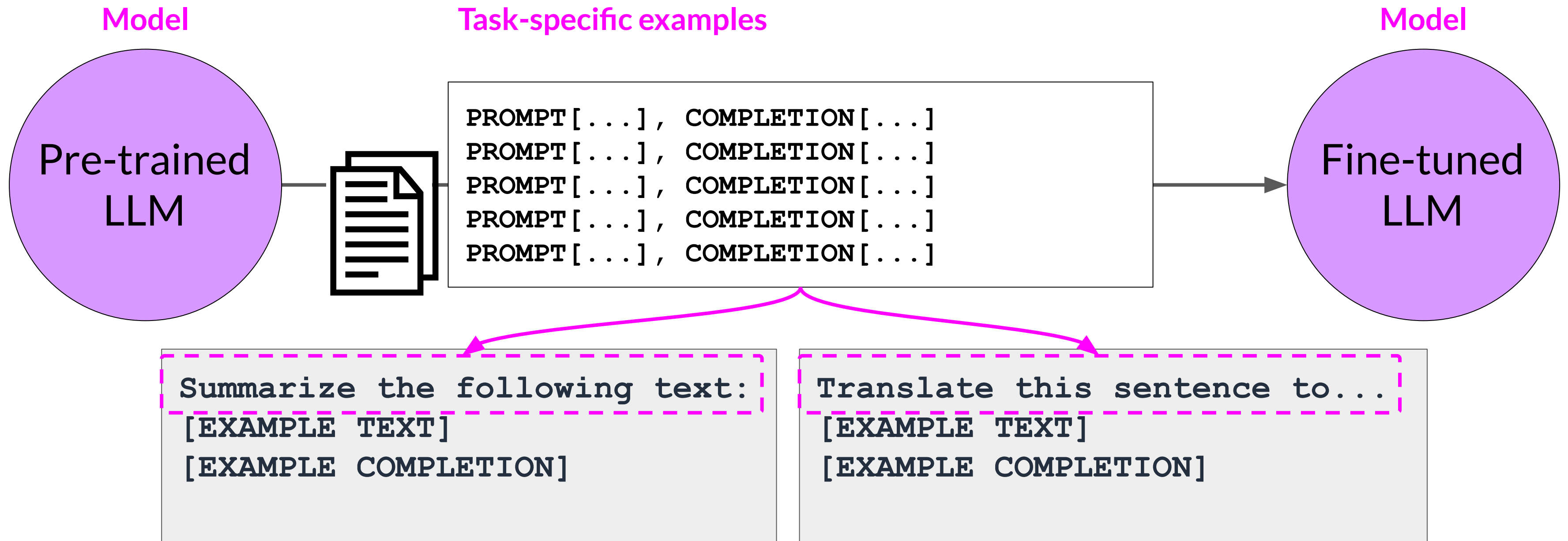**Each prompt/completion pair includes a specific "instruction" to the LLM**

Using prompts to fine-tune LLMs with instruction

LLM fine-tuning

Model

Task-specific examples

Model

Pre-trained LLM

```
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
```

Fine-tuned LLM

```
Summarize the following text:
[EXAMPLE TEXT]
[EXAMPLE COMPLETION]
```

```
Translate this sentence to...
[EXAMPLE TEXT]
[EXAMPLE COMPLETION]
```

DeepLearning.AI

aws

Using prompts to fine-tune LLMs with instruction

LLM fine-tuning

Model

Task-specific examples

Model

Pre-trained LLM

```
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
```

Fine-tuned LLM

Full fine-tuning updates all parameters

Improved performance

DeepLearning.AI

aws

Sample prompt instruction templates

Classification / sentiment analysis

```
jinja: "Given the following review:\n{{review_body}}\npredict the associated rating\
 \ from the following choices (1 being lowest and 5 being highest)\n- {{ answer_choices\
 \ | join('\\n- ') }} \n||||\n{{answer_choices[star_rating-1]}}"
```

Text generation

```
jinja: Generate a {{star_rating}}-star review (1 being lowest and 5 being highest)
 about this product {{product_title}}.          ||||          {{review_body}}
```

Text summarization

```
jinja: "Give a short sentence describing the following product review:\n{{review_body}}\
 \ \n||||\n{{review_headline}}"
```

DeepLearning.AI   aws

LLM fine-tuning process

LLM fine-tuning

Prepared instruction dataset   **Training splits**


```
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
```
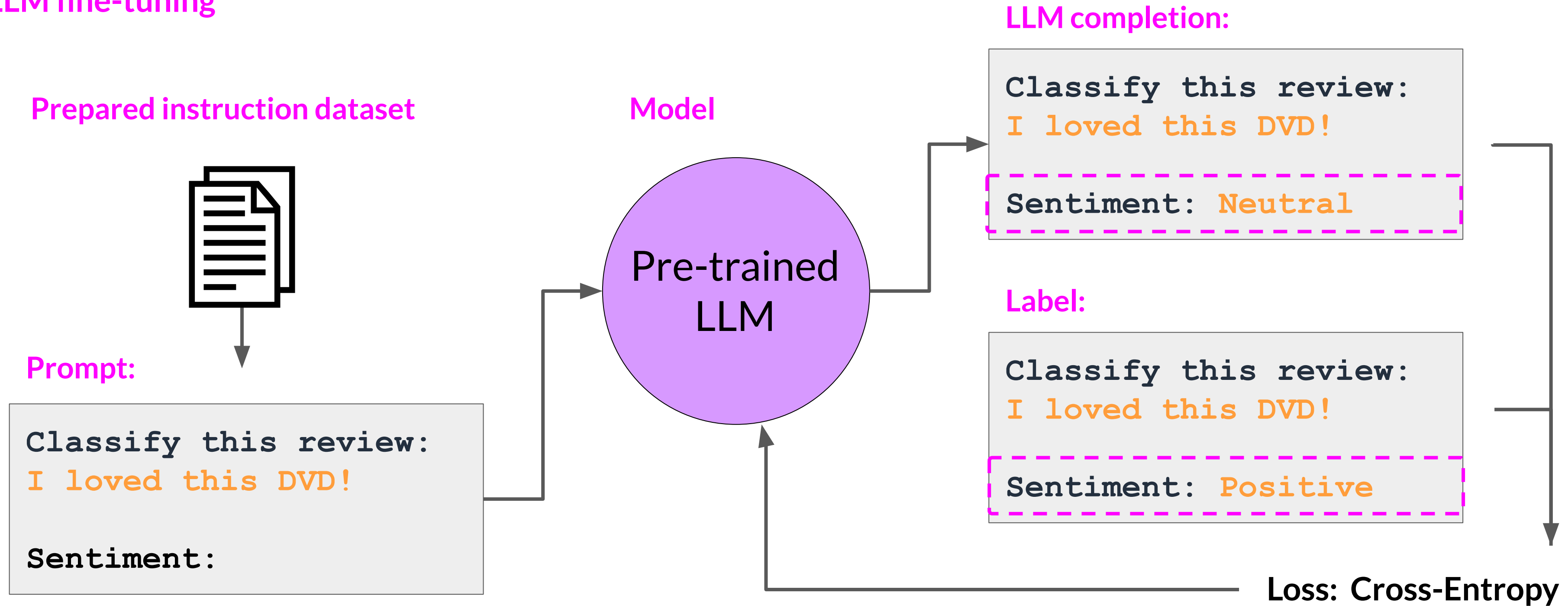**Training**

```
PROMPT[...], COMPLETION[...]
...
```
Validation

```
PROMPT[...], COMPLETION[...]
...
```
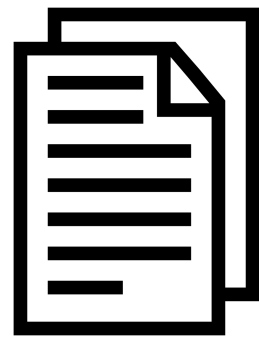**Test**

LLM fine-tuning process

LLM fine-tuning

Prepared instruction dataset

Model

LLM completion:

```
Classify this review:
I loved this DVD!

Sentiment: Neutral
```

Pre-trained LLM

Prompt:

```
Classify this review:
I loved this DVD!

Sentiment:
```

Label:

```
Classify this review:
I loved this DVD!

Sentiment: Positive
```

Loss: **Cross-Entropy**

LLM fine-tuning process

LLM fine-tuning

Prepared instruction dataset

Training splits


```
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
```
Training

```
PROMPT[...], COMPLETION[...]
...
```
Validation

validation_accuracy

```
PROMPT[...], COMPLETION[...]
...
```
Test

LLM fine-tuning process

LLM fine-tuning

Prepared instruction dataset

Training splits

```
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
PROMPT[...], COMPLETION[...]
```
Training

```
PROMPT[...], COMPLETION[...]
...
```
Validation

```
PROMPT[...], COMPLETION[...]
...
```
Test   **test_accuracy**

LLM fine-tuning process