

 Google Cloud

Large Language Models in Healthcare

Module 2
April 2024

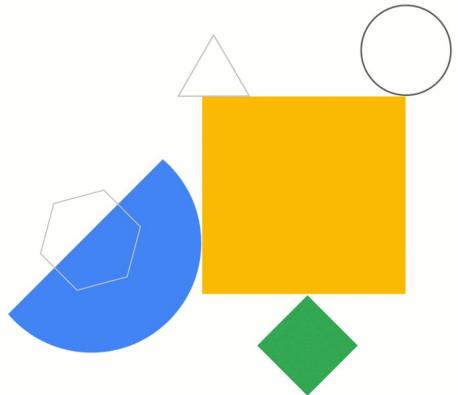
COURSE TITLE

Video 1

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Disclaimer

The information in this course is for educational purposes only, and does not serve as Google's approval for use of its generative AI service for any diagnostic or therapeutic purpose, or for direct patient care.



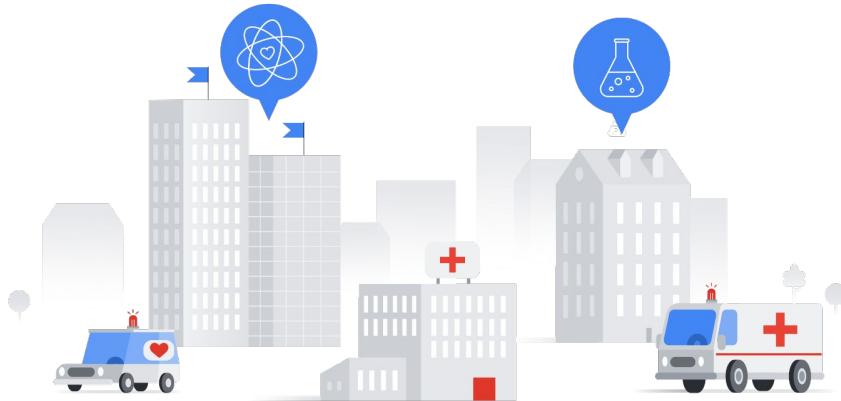
Large language models



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Large language models

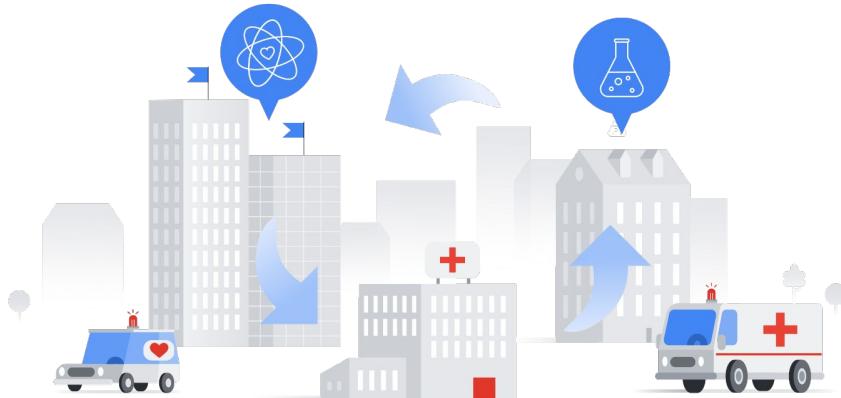
Large language models



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are rapidly reshaping the healthcare landscape,

Large language models



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introducing unprecedented possibilities for improving patient care and streamlining operations.



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In this section, titled “Large Language Models in Healthcare”, you’ll learn to:



Describe domain-specific foundation models

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- Describe domain-specific foundation models.



Describe domain-specific foundation models



Design effective prompts specific to healthcare

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- Design effective prompts specific to healthcare.



- Describe domain-specific foundation models
- Design effective prompts specific to healthcare
- Describe multimodal LLMs and recognize how they can be used for healthcare

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- And describe multimodal LLMs and recognize how they can be used for healthcare.

Deck unlocked

V02

Domain-specific Foundation Models

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Introducing the Cymbal Health team



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To understand how generative AI can be used in healthcare, let's introduce four key team members of Cymbal Health, a fictional company, and analyze their needs and challenges.



Saskia

Tech-curious
clinician

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Saskia is a tech-curious clinician.



Background:

- Tech-curious
- Passionate about improving patient care
- Overwhelmed by technical jargon

Saskia

Tech-curious
clinician

Google Cloud

She's passionate about improving patient care, but overwhelmed by technical jargon.



Saskia

Tech-curious
clinician

Background:

- Tech-curious
- Passionate about improving patient care
- Overwhelmed by technical jargon

Gen AI Goals:

- Diagnosis assistance
- Treatment planning
- Patient education

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Saskia wants to understand the potential impact of generative AI on diagnosis, treatment planning, and patient education.



Micah

Medical imaging
specialist

Google Cloud

Micah is Cymbal's medical imaging specialist.



Background:

- Understands image analysis concepts
- Experience with AI-powered image processing tools

Micah

Medical imaging specialist

Google Cloud

He understands image analysis concepts and has experience with AI-powered image processing tools.



Micah

Medical imaging
specialist

Background:

- Understands image analysis concepts
- Experience with AI-powered image processing tools

Gen AI Goals:

- Augment existing workflows
- Improve image interpretation
- Develop novel imaging techniques
- Generate and enhance images

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Micah seeks to augment existing workflows, improve image interpretation, and potentially develop novel imaging techniques.

Micah's interested in using generative AI for image generation and enhancement, and in understanding and mitigating bias in imaging datasets.



Claire

Data-driven
researcher

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Next is Claire, the team's data-driven, MD/PHD medical researcher.



Background:

- MD/PhD
- Comfortable with statistics
- Basic coding skills
- Familiar with traditional ML in research
- New to generative AI

Claire

Data-driven
researcher

Google Cloud

She's comfortable with statistics and has basic coding skills. She's familiar with traditional machine learning in research, but new to generative AI.



Claire

Data-driven
researcher

Background:

- MD/PHD
- Comfortable with statistics
- Basic coding skills
- Familiar with traditional ML in research
- New to generative AI

Gen AI Goals:

- Accelerate drug discovery
- Generate synthetic medical data
- Improve research methodology
- Fine-tune models
- Examine application data requirements
- Evaluate model outputs

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Claire wants to explore how generative AI can accelerate drug discovery, generate synthetic medical data, and improve research methodology.

Because she's familiar with machine learning and basic coding, she's also interested in the technical aspects of fine-tuning models, data requirements for healthcare applications, and model output evaluation.



Lucas

Healthcare
administrator

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Finally, Lucas is Cymbal's healthcare administrator.



Lucas

Healthcare
administrator

Background:

- Business experience
- Minimal technical experience
- Understands the need to innovate and streamline processes

Google Cloud

His background is in business and he has minimal technical experience. Lucas understands the need to innovate and streamline processes.



Lucas

Healthcare
administrator

Background:

- Business experience
- Minimal technical experience
- Understands the need to innovate and streamline processes

Gen AI Goals:

- Identify potential cost savings
- Improve efficiency
- Generate new patient service offerings

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He wants to identify potential cost savings, efficiency improvements, and new patient service offerings using generative AI.

Can a **single large language model** be
fine-tuned to help **each member** of the
Cymbal Health team?

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Now, here's the challenge. Can a single large language model be fine-tuned to help each member of the Cymbal Health team?

Fine-tuning a large language model is a powerful way to tailor its capabilities to the **specific needs of each Cymbal team member.**

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The answer is yes. Fine-tuning a large language model is a powerful way to tailor its capabilities to the specific needs of each team member.

Tech-curious clinician



Fine-tune an LLM to translate complex research papers or technical documentation into language a clinician easily understands.

Develop a chatbot interface powered by the fine-tuned LLM to generate patient-friendly explanations of diagnoses, procedures, and medication instructions.

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For Saskia, the tech-curious clinician, technical jargon can be simplified..

Tech-curious clinician



Fine-tune an LLM to translate complex research papers or technical documentation into language a clinician easily understands.

Develop a chatbot interface powered by the fine-tuned LLM to generate patient-friendly explanations of diagnoses, procedures, and medication instructions.

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An LLM can be fine-tuned to translate complex research papers or technical documentation into language a clinician can easily understand.

Also, a chatbot interface can be powered by the fine-tuned LLM to generate patient-friendly explanations of diagnoses, procedures, and medication instructions.

Tech-curious clinician



Fine-tune an LLM to translate complex research papers or technical documentation into language a clinician easily understands.

Develop a chatbot interface powered by the fine-tuned LLM to generate patient-friendly explanations of diagnoses, procedures, and medication instructions.

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Also, a chatbot interface can be powered by the fine-tuned LLM to generate patient-friendly explanations of diagnoses, procedures, and medication instructions.

Medical imaging specialist



Fine-tune a model to generate realistic medical images with specific conditions or variations, and to assist with training and dataset expansion.

Generate comprehensive and accurate descriptions of medical images to assist in diagnosis and reporting.

Google Cloud

For Micah, the medical imaging specialist,

Medical imaging specialist



Fine-tune a model to generate realistic medical images with specific conditions or variations, and to assist with training and dataset expansion.

Generate comprehensive and accurate descriptions of medical images to assist in diagnosis and reporting.

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a model can be fine-tuned to generate realistic medical images with specific conditions or variations, and to assist with training and dataset expansion.

Medical imaging specialist



Fine-tune a model to generate realistic medical images with specific conditions or variations, and to assist with training and dataset expansion.

Generate comprehensive and accurate descriptions of medical images to assist in diagnosis and reporting.

Google Cloud

And comprehensive, accurate descriptions of medical images can be generated to assist in diagnosis and reporting.

Data-driven researcher



Fine-tune a model to summarize key insights and potential research directions from large volumes of medical publications.

Suggest novel research hypotheses or connections between seemingly disparate studies.

Google Cloud

For Claire, the data-driven researcher,

Data-driven researcher



Fine-tune a model to summarize key insights and potential research directions from large volumes of medical publications.

Suggest novel research hypotheses or connections between seemingly disparate studies.

Google Cloud

the model can be fine-tuned to summarize key insights and potential research directions from large volumes of medical publications.

Data-driven researcher



Fine-tune a model to summarize key insights and potential research directions from large volumes of medical publications.

Suggest novel research hypotheses or connections between seemingly disparate studies.

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The model can also suggest novel research hypotheses or connections between seemingly disparate studies.

Healthcare administrator



Train the LLM to identify patterns in administrative data that deviate from norms or indicate potential inefficiencies.

Teach the LLM relationships between different process steps to identify bottlenecks.

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Finally, Lucas, Cymbal's healthcare administrator, can enhance decision-making by using a fine-tuned large language model.

Healthcare administrator



Train the LLM to identify patterns in administrative data that deviate from norms or indicate potential inefficiencies.

Teach the LLM relationships between different process steps to identify bottlenecks.

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For example, the LLM can be trained to identify administrative data patterns that deviate from norms or indicate potential inefficiencies. This is known as anomaly detection.

Healthcare administrator



Train the LLM to identify patterns in administrative data that deviate from norms or indicate potential inefficiencies.

Teach the LLM relationships between different process steps to identify bottlenecks.

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The LLM can also learn relationships between different process steps to identify bottlenecks. This practice is known as “root cause analysis.”

How can an LLM help Lucas?



01

The LLM analyzes patient scheduling data and identify procedures with unusually long wait times.

02

The LLM cross-references these procedures with staffing schedules and equipment maintenance logs.

03

The LLM provides an output: "Wait times for [procedure X] may be caused by understaffing on Tuesdays or equipment needing calibration."

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Let's take Lucas' use case and examine how an LLM can help Lucas achieve his goals.

How can an LLM help Lucas?



01

The LLM analyzes patient scheduling data and identify procedures with unusually long wait times.

02

The LLM cross-references these procedures with staffing schedules and equipment maintenance logs.

03

The LLM provides an output: "Wait times for [procedure X] may be caused by understaffing on Tuesdays or equipment needing calibration."

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First, the LLM will analyze patient scheduling data and identify procedures with unusually long wait times.

How can an LLM help Lucas?



01

The LLM analyzes patient scheduling data and identify procedures with unusually long wait times.

02

The LLM cross-references these procedures with staffing schedules and equipment maintenance logs.

03

The LLM provides an output: "Wait times for [procedure X] may be caused by understaffing on Tuesdays or equipment needing calibration."

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Then it will cross-reference these procedures with staffing schedules and equipment maintenance logs.

How can an LLM help Lucas?



01

The LLM analyzes patient scheduling data and identify procedures with unusually long wait times.

02

The LLM cross-references these procedures with staffing schedules and equipment maintenance logs.

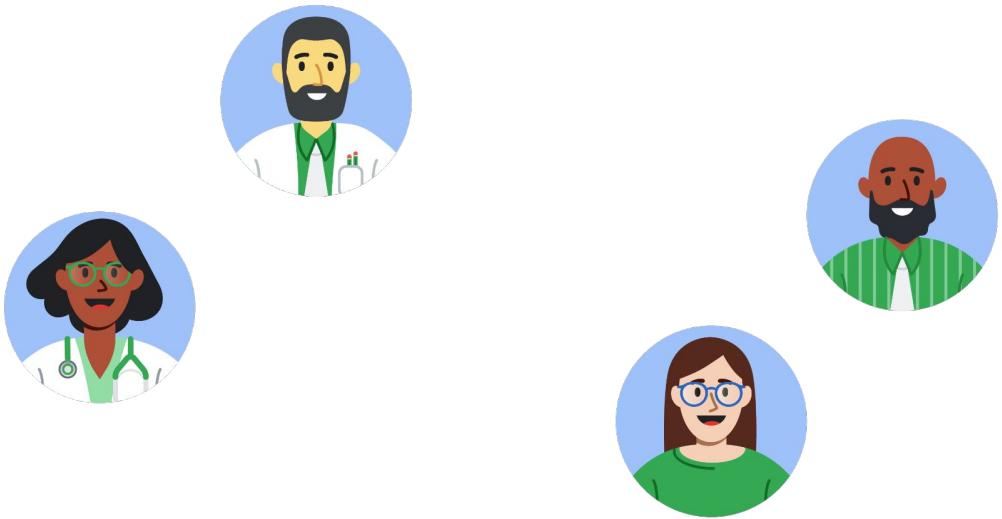
03

The LLM provides an output: "Wait times for [procedure X] may be caused by understaffing on Tuesdays or equipment needing calibration."

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Finally, it will provide an output: "Wait times for [Procedure X] may be caused by understaffing on Tuesdays or equipment needing calibration."

With the help of an LLM and generative AI, Lucas is able to quickly identify and improve upon clinical inefficiencies.



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Recall that the needs of all team members



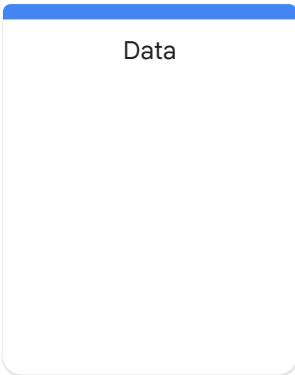
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can be addressed with a single fine-tuned LLM.



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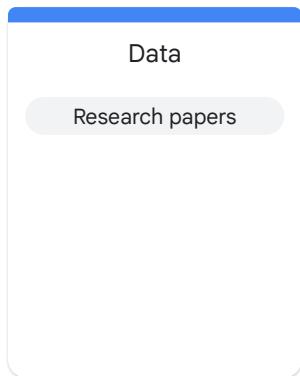
This is referred to as a multi-persona LLM.



New data

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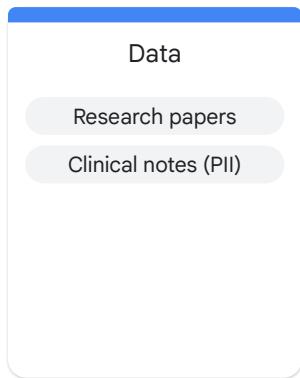
To implement a multi-persona LLM, you first need to build a comprehensive healthcare dataset from sources such as:



New data

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- Research papers like PubMed.



New data

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- Clinical notes that are ideally de-identified.

Data

Research papers

Clinical notes (PII)

Medical textbooks and
reference materials

New data

Google Cloud

- Medical textbooks and reference materials.

Data

Research papers

Clinical notes (PII)

Medical textbooks and
reference materials

Healthcare reports

New data

Google Cloud

- Healthcare news and reports.

Data

Research papers

Clinical notes (PII)

Medical textbooks and
reference materials

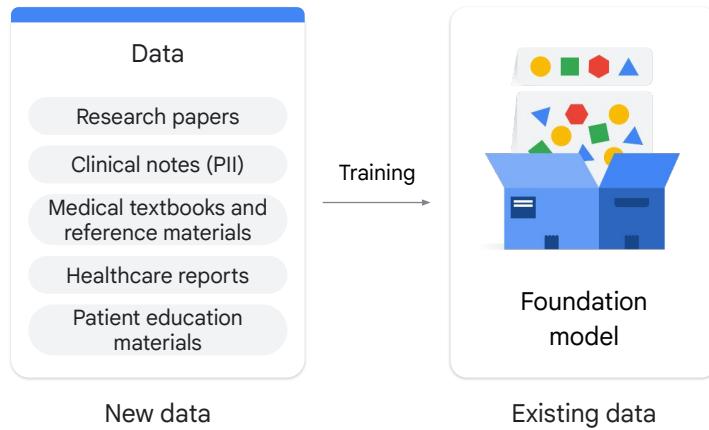
Healthcare reports

Patient education
materials

New data

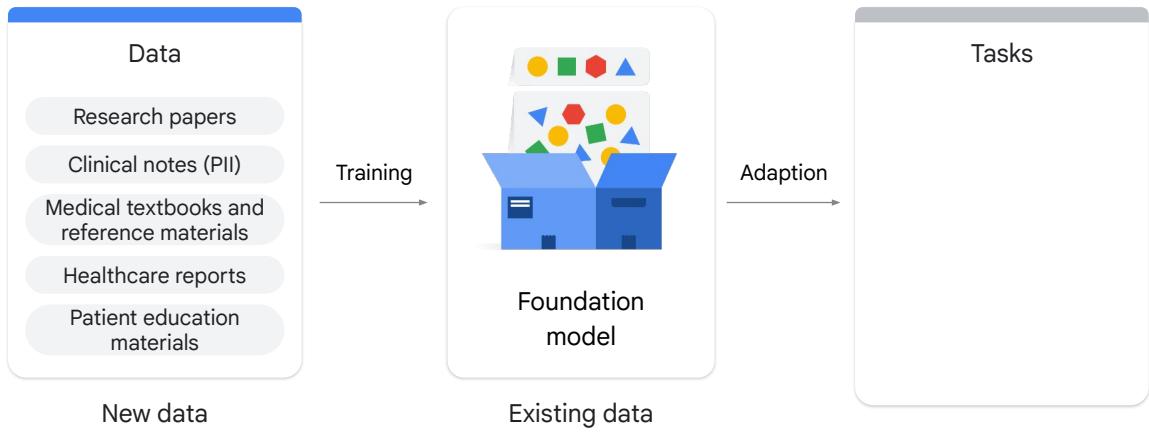
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- And patient education materials.



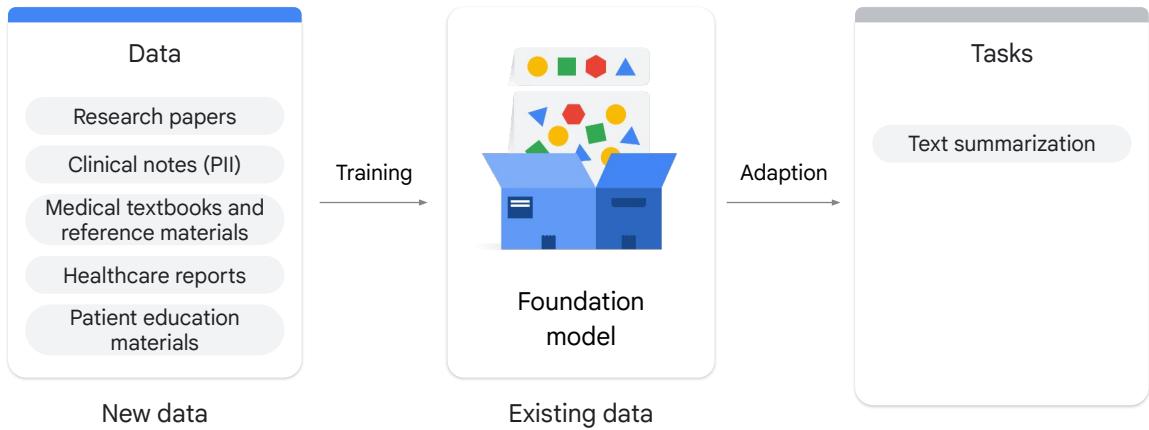
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Then, you can use this broad dataset to fine-tune the base model. The primary objective is to impart in-depth healthcare knowledge and terminology.



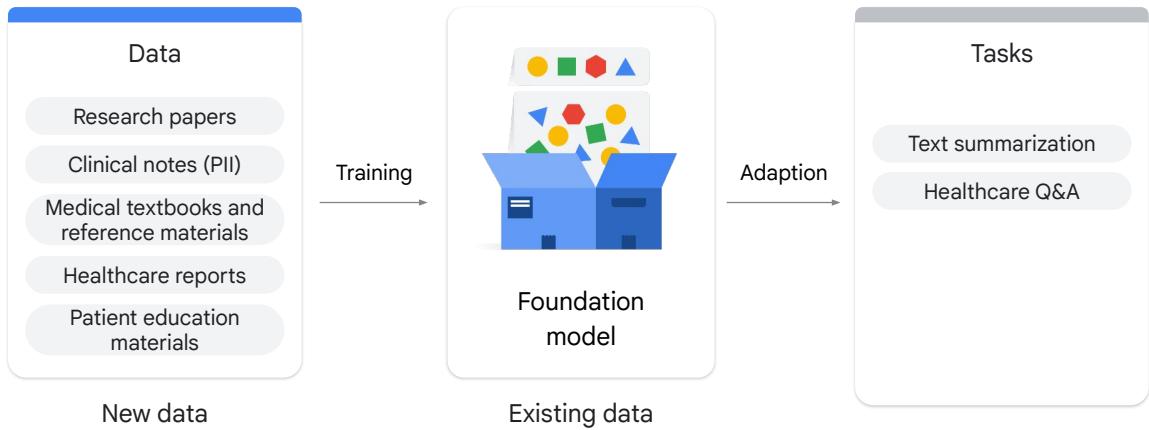
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Once you've fine-tuned the base model, your team can achieve several different tasks including:



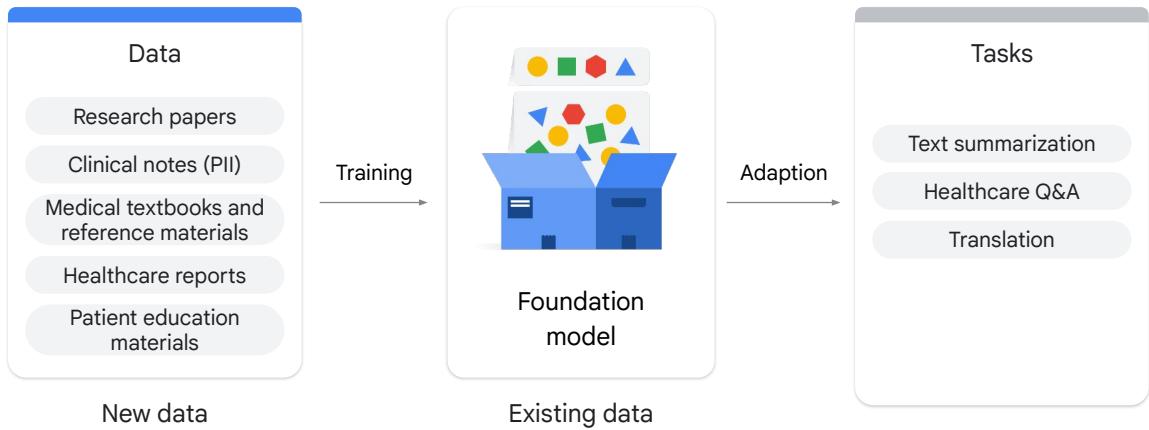
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- Text summarization of medical concepts.



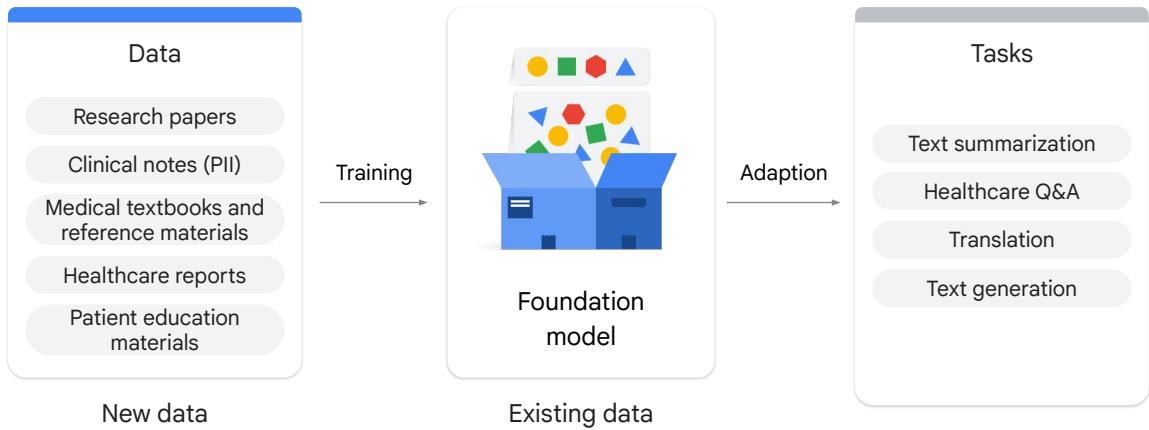
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- Q&A on healthcare topics.



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- Translation between technical and patient-friendly language.



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- And text generation.

Deck unlocked

V03

Designing prompts for healthcare purposes

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Prompt design

The process of creating prompts that elicit the desired response from a language model.

Enter a prompt in here



This brings us to prompt design. Prompt design is the process of creating a prompt that will generate a desired output from a large language model.

Prompting

e.g.

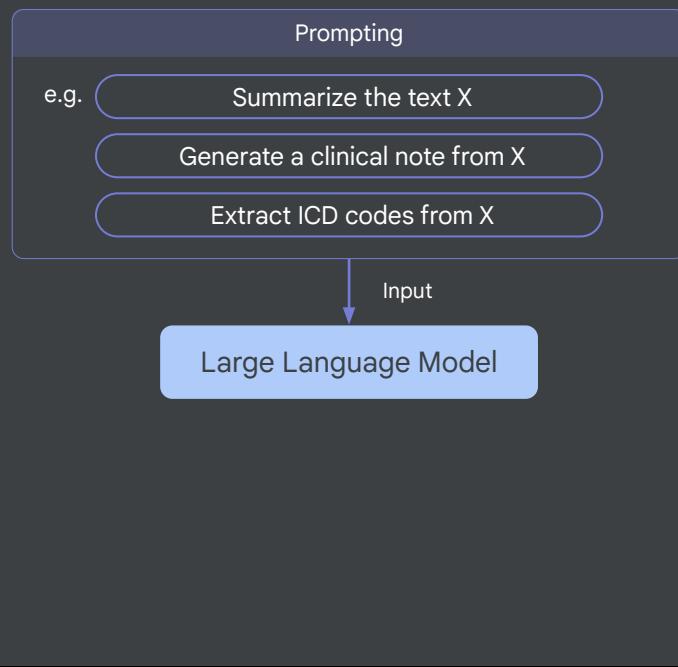
Summarize the text X

Generate a clinical note from X

Extract ICD codes from X

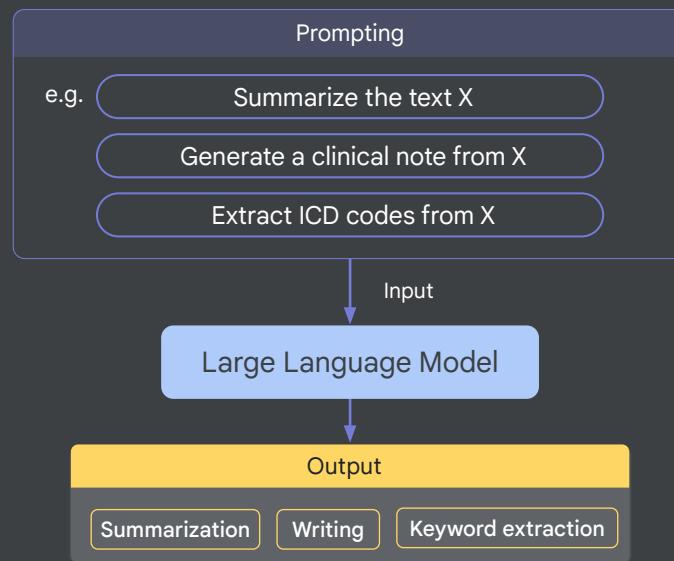
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A short piece of text



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(an input) is given to the LLM,



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and it can be used to control the output in several different ways.

The **answers** you get depend on the
questions you ask.

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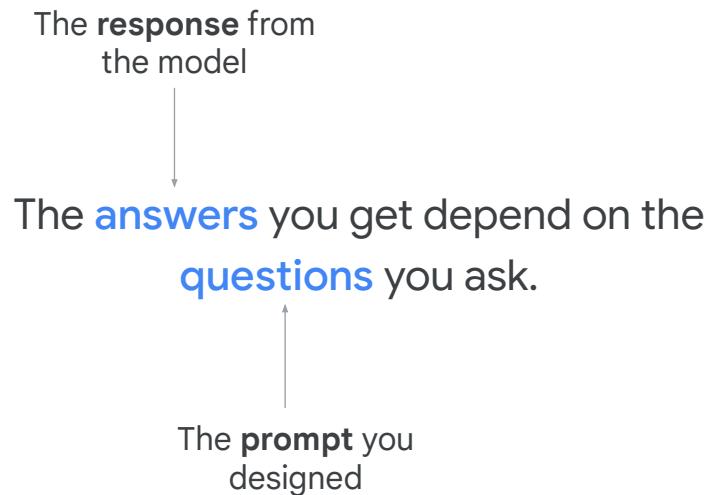
Prompt design is critical

The **answers** you get depend on the
questions you ask.

The **prompt** you
designed

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because the quality of the input prompt



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determines the quality of the output response. After asking a question or giving instructions, the model will provide a response based on how you structured your prompt. Therefore, the returned answers depend on the questions you ask.



Prompt design:

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Prompt design allows for



Prompt design:



Fast experimentation

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fast experimentation



Prompt design:

- Fast experimentation
- Fast customization

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and customization.



Prompt design:

- Fast experimentation
- Fast customization
- No coding knowledge required

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Because you're not writing any complicated code, you don't need to be a machine learning expert to get started.

Prompt design methods

Zero-shot prompting

One-shot prompting

Few-shot prompting

Google Cloud

Generally, there are three methods that you can use to shape the model's response:

Prompt design methods

Zero-shot prompting

One-shot prompting

Few-shot prompting

Google Cloud

zero-shot,

Prompt design methods

Zero-shot prompting

One-shot prompting

Few-shot prompting

Google Cloud

one-shot,

Prompt design methods

Zero-shot prompting

One-shot prompting

Few-shot prompting

Google Cloud

and few-shot.

Prompt design methods

Zero-shot prompting

Give the LLM a single command without any examples of the task.

One-shot prompting

Few-shot prompting

Google Cloud

The first method is zero-shot prompting, where the LLM is only given a prompt that describes a specific task and no additional information.

Prompt design methods

Zero-shot prompting

Give the LLM a single command without any examples of the task.

Example prompt:

[Task] Generate a list of common medical conditions.

One-shot prompting

Few-shot prompting

Google Cloud

If you want the LLM to answer a question, you just prompt the question. For example, "Generate a list of common medical conditions."

Prompt design methods

Zero-shot prompting

Give the LLM a single command without any examples of the task.

Example prompt:

[Task] Generate a list of common medical conditions.

One-shot prompting

Give the LLM a single example of the task.

Few-shot prompting

Google Cloud

Then, there's one-shot prompting, where you give the LLM a single example of the task that it's being asked to perform.

Prompt design methods

Zero-shot prompting

Give the LLM a single command without any examples of the task.

Example prompt:

[Task] Generate a list of common medical conditions.

One-shot prompting

Give the LLM a single example of the task.

Example prompt:

[Task] Generate a list of common medical conditions. Simplify them to a 6th grade reading level.

[Single Example] Here is an example: Arthritis: When your joints get swollen and sore.

Few-shot prompting

Google Cloud

For example, if you want the LLM to generate a list of common medical conditions and then simplify them to a 6th grade reading level, you could provide an example of a medical condition along with its definition, like arthritis.

Prompt design methods

Zero-shot prompting

Give the LLM a single command without any examples of the task.

Example prompt:

[Task] Generate a list of common medical conditions.

One-shot prompting

Give the LLM a single example of the task.

Example prompt:

[Task] Generate a list of common medical conditions. Simplify them to a 6th grade reading level.

[Single Example] Here is an example: Arthritis: When your joints get swollen and sore.

Few-shot prompting

Give the LLM a few examples of the task.

Google Cloud

Few-shot prompting is a method where the LLM is given a few examples of the task.

Prompt design methods

Zero-shot prompting

Give the LLM a single command without any examples of the task.

Example prompt:

[Task] Generate a list of common medical conditions.

One-shot prompting

Give the LLM a single example of the task.

Example prompt:

[Task] Generate a list of common medical conditions. Simplify them to a 6th grade reading level.

[Single Example] Here is an example: Arthritis: When your joints get swollen and sore.

Few-shot prompting

Give the LLM a few examples of the task.

Example prompt:

[Task] Generate a list of common medical conditions. Simplify them to a 6th grade reading level. Display it in a table.

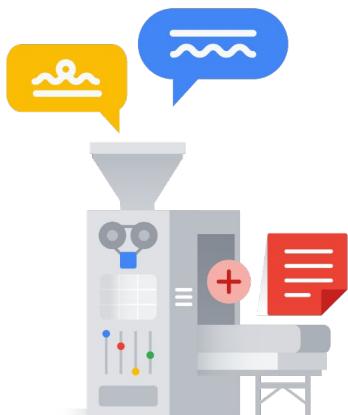
[Multiple examples] Here are some examples:

- Arthritis: When your joints get swollen and sore.
- Asthma: When your airways get tight, making it hard to breathe.
- Eczema: When your skin gets dry, itchy, and red.

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For instance, instead of only giving the model arthritis as an example, you could provide multiple examples, like arthritis, asthma, and eczema.

Few-shot prompting provides context for the model to learn from.



Generative language models learn about patterns in language through training data.

Then, given some text, they **predict what comes next.**

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Generative language models are pattern-matching systems. They learn patterns based on the data you provide, and when prompted, they predict what comes next.

Let's explore a few examples of effective prompts.

Text summarization

Prompt example

Explain this paragraph in one sentence:

Antibiotics are a type of medication used to treat bacterial infections. They work by either killing the bacteria or preventing them from reproducing, allowing the body's immune system to fight off the infection. Antibiotics are usually taken orally in the form of pills, capsules, or liquid solutions, or sometimes administered intravenously. They are not effective against viral infections, and using them inappropriately can lead to antibiotic resistance.

Model output

- ◆ Antibiotics are medications used to kill or inhibit the growth of bacteria to treat bacterial infections, often taken orally or intravenously, but are ineffective against viruses and can lead to antibiotic resistance when misused.

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In this example, the model is being asked to summarize the paragraph in a single sentence. This is a fairly straightforward use case, and the instructions are clear and specific.

Question answering

Prompt example

Answer the question based on the context below. Keep the answer short and concise. Respond "Unsure about answer" if not sure about the answer.

Context: In 1847, Ignaz Semmelweis, a doctor in Vienna, noticed a significant difference in death rates between two maternity clinics. He observed that doctors in one clinic often went directly from autopsies to deliveries. Semmelweis suspected that "cadaverous particles" from autopsies were transferred to maternity patients via their hands, causing puerperal fever. He introduced a handwashing protocol using a chlorinated lime solution before patient contact. This intervention reduced mortality rates in the affected clinic.

Question: What was the solution used for handwashing?

Model output



Chlorinated lime solution.

Google Cloud

You can also prompt the model to answer a question based on provided context. The model has done a good job following the instructions, and the answer is short and concise.

Question answering

Prompt example

Answer the question based on the context below. Keep the answer short and concise. Respond "Unsure about answer" if not sure about the answer.

Context: In 1847, Ignaz Semmelweis, a doctor in Vienna, noticed a significant difference in death rates between two maternity clinics. He observed that doctors in one clinic often went directly from autopsies to deliveries. Semmelweis suspected that "cadaverous particles" from autopsies were transferred to maternity patients via their hands, causing puerperal fever. He introduced a handwashing protocol using a chlorinated lime solution before patient contact. This intervention reduced mortality rates in the affected clinic.

Question: What was the solution used for handwashing?

Model output



Chlorinated lime solution.

Google Cloud

Notice that, in the prompt, the model is instructed to respond with “unsure” if it’s not sure of the answer. This is a tactic for reducing hallucinations, which we’ll define in this section.

Text classification

Prompt example

Classify the text into neutral, negative or positive.

Text: I think the hospital staff was ok.

Model output

★ Neutral

Google Cloud

Text classification is an example of sentiment analysis. Recall that LLMs are capable of performing classifications without needing additional examples.

Text classification

Prompt example

Classify the text into neutral, negative or positive.

Text: I think the hospital staff was ok.

Zero-shot prompt

Model output

Neutral

Google Cloud

Therefore, this is considered zero-shot prompting.

Prompt example

Focused Visit: "15 year old history of asthma. Sore throat and fever for 2 days. No cough. Temperature 101.5F, tonsillar exudates. Otherwise unremarkable exam. Possible strep pharyngitis. Modified Centor criteria: rapid strep test and symptom management."

Please rewrite this into a medical note using exclusively the information above.

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This prompt instructs the model to create clinical notes. This prompt and the model's response are available in the course resources.

Prompt example

Summarize this:

Paragraph 1: Understanding Diabetes

Diabetes mellitus is a complex group of metabolic disorders characterized by chronic hyperglycemia (high blood sugar) resulting from defects in insulin secretion, insulin action, or both. There are several types of diabetes. Type 1 diabetes typically involves autoimmune destruction of insulin-producing beta cells in the pancreas, leading to absolute insulin deficiency. Type 2 diabetes, the most common form, arises from a combination of insulin resistance (the body's cells not responding effectively to insulin) and progressive beta-cell dysfunction. Other specific types include gestational diabetes (occurring during pregnancy) and forms caused by genetic defects, diseases, or medications. Uncontrolled diabetes leads to serious long-term complications including cardiovascular disease, kidney failure, blindness, nerve damage, and an increased risk of amputations.

Paragraph 2: The Challenges of Diabetes Management

Effective diabetes management is a multifaceted and lifelong challenge. While medications,

And this prompt instructs the model to summarize two long paragraphs on diabetes. This prompt and the model's response are available in the course resources.

Hallucinations are words or phrases that
are generated by the model that are
nonsensical or grammatically incorrect.

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When you input data into a large language model, you may experience hallucinations. Hallucinations are words or phrases generated by the model that are nonsensical or grammatically incorrect.

The grounding problem (hallucinations)

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This issue is also known as the grounding problem.

The grounding problem (hallucinations)

LLMs can only understand:

-  The information that they were trained on.
-  They may not know domain-specific data.
-  They do not have access to real-time information.

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LLMs can only understand the information they were trained on. This means that they might not be aware of your business's proprietary or domain-specific data. Nor do they have access to real-time information.

The grounding problem (hallucinations)

LLMs can only understand:

- The information that they were trained on.
- They may not know domain-specific data.
- They do not have access to real-time information.
- The information that is explicitly given in the prompt.
- They often assume that the prompt is true.
- They do not have the ability to ask for context.

Google Cloud

To make matters worse, LLMs only understand the information that is explicitly given to them in the prompt. In other words, they often *assume* that the prompt is true. They also do not have the ability to ask for more context information.

The grounding problem (hallucinations)

LLMs can only understand:

- The information that they were trained on.
- They may not know domain-specific data.
- They do not have access to real-time information.
- The information that is explicitly given in the prompt.
- They often assume that the prompt is true.
- They do not have the ability to ask for context.

An LLM does not know anything outside of what it was trained on, and it cannot truly know if that information is accurate.

Google Cloud

Ultimately, an LLM does not know anything outside of what it was trained on, and it cannot truly know if that information is accurate.

Best practices for prompt design



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Let's wrap up this section by exploring prompt design best practices.

Best practices for prompt design

- Be concise.



Google Cloud

- Be concise.

Best practices for prompt design

 Be concise.

 Be specific and define prompts clearly.



Google Cloud

- Be specific and define prompts clearly.

Best practices for prompt design

- ✓ Be concise.
- ✓ Be specific and define prompts clearly.
- ✓ Ask one task at a time.



Google Cloud

- Ask one task at a time.

Best practices for prompt design

- ✓ Be concise.
- ✓ Be specific and define prompts clearly.
- ✓ Ask one task at a time.
- ✓ Ask to classify instead of generate.



Google Cloud

- Turn generative tasks into classification tasks. For example, instead of asking what programming language to learn, ask if Python, Java, or C is a better fit for a beginner in programming.

Best practices for prompt design

- ✓ Be concise.
- ✓ Be specific and define prompts clearly.
- ✓ Ask one task at a time.
- ✓ Ask to classify instead of generate.
- ✓ Include examples.



Google Cloud

- And include examples to improve response quality.

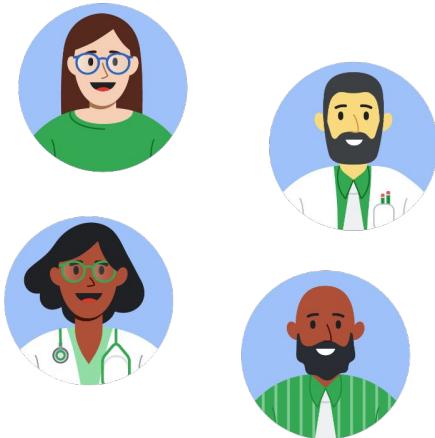
There isn't a single best way to write a prompt, but adding a few examples in addition to instructions tends to yield good results. You may need to experiment with different structures, formats, and examples to see what works best for your use case. For more information about prompt design, refer to the course resources.

Deck unlocked

V04

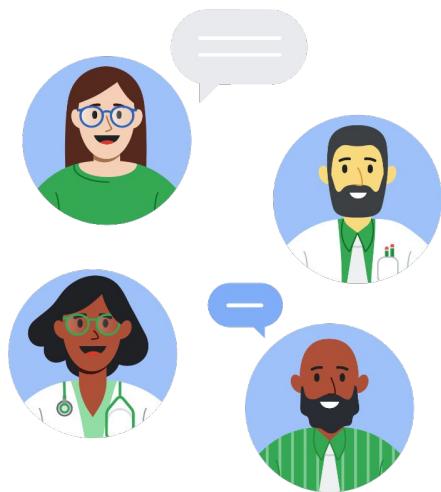
Medical Multimodal Large Language Models

Google Cloud



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Now let's transition back to the Cymbal Health team and see how they're doing.



Are there large language
models available that are
**already fine-tuned for
healthcare?**

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Now that team members have gained a stronger understanding of generative AI, large language models, and prompt design, they ask a very insightful question. Are there large language models available that are already fine-tuned for healthcare?

BioGPT

ClinicalBert

PubMed Bert



MedLM

BioMedLM

SciBert

ImageBert

General-purpose and specialized medical large language models

Google Cloud

The answer is yes. General-purpose LLMs like BioGPT, ClinicalBert, and PubMed Bert are already fine-tuned for healthcare.

There are also specialized medical large language models like MedLM, BioMedLM, SciBert, and ImageBert.

Multimodal medical LLMs
are **tailored for handling and understanding**
various types of medical data.

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Multimodal medical large language models are specifically tailored for handling and making sense of various types of medical data.

What makes them unique?

Types of Medical Data They Handle



Text data



Image data



Structured data



Videos

Google Cloud

Well, they can handle:

Types of Medical Data They Handle



Text data

- Clinical notes
- Research papers
- Patient instructions
- Medical coding terminology



Image data



Structured data



Videos

Google Cloud

- Text data, such as clinical notes, research papers, patient instructions, and medical coding terminology.

Types of Medical Data They Handle



Text data

- Clinical notes
- Research papers
- Patient instructions
- Medical coding terminology



Image data

- X-rays
- CT scans
- MRI scans
- Microscopic pathology slides



Structured data



Videos

Google Cloud

- Image data, such as X-rays, CT scans, MRI scans, and microscopic pathology slides.

Types of Medical Data They Handle



Text data

- Clinical notes
- Research papers
- Patient instructions
- Medical coding terminology



Image data

- X-rays
- CT scans
- MRI scans
- Microscopic pathology slides



Structured data

- Lab results
- Biosignals (ECG and EEG)
- Demographic data



Videos

Google Cloud

- Structured data, such as lab results, biosignals (ECG and EEG), and demographic data.

Types of Medical Data They Handle



Text data

- Clinical notes
- Research papers
- Patient instructions
- Medical coding terminology



Image data

- X-rays
- CT scans
- MRI scans
- Microscopic pathology slides



Structured data

- Lab results
- Biosignals (ECG and EEG)
- Demographic data



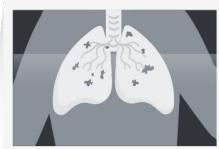
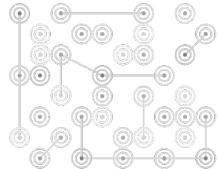
Videos

- Surgical recordings
- Patient gait analysis
- 3D medical models

Google Cloud

- And videos, like surgical recordings, patient gait analyses, and 3D medical models.

Key capabilities of multimodal medical LLMs



Google Cloud

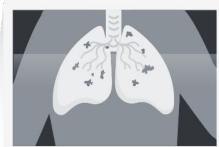
Next, let's explore the capabilities of multimodal medical LLMs. They can:

Key capabilities of multimodal medical LLMs



Discover relationships across data types

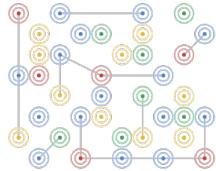
Correlate findings in an image with text descriptions in the corresponding report.



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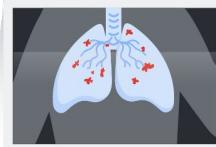
- Draw connections between different data types. For example, they can correlate findings in a radiology image with text descriptions in the corresponding report.

Key capabilities of multimodal medical LLMs



Discover relationships across data types

Correlate findings in an image with text descriptions in the corresponding report.



Improve Diagnosis

Detect subtle abnormalities or suggest differential diagnoses.



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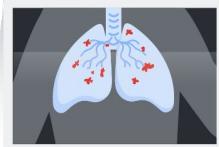
- Improve diagnosis by combining information from diverse sources. For example, they can aid in detecting subtle abnormalities or suggest differential diagnoses.

Key capabilities of multimodal medical LLMs



Discover relationships across data types

Correlate findings in an image with text descriptions in the corresponding report.



Improve Diagnosis

Detect subtle abnormalities or suggest differential diagnoses.



Streamline radiologist workflows

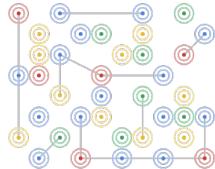
Create textual reports from medical images, provide patient-friendly explanations, analyze medical datasets to identify patterns, therapeutic targets, or risk factors.



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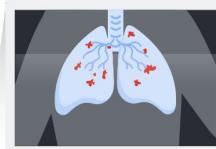
- Streamline radiologist workflows by creating textual reports from medical images. They can also provide patient-friendly explanations and analyze large medical datasets to identify patterns, therapeutic targets, or risk factors.

Key capabilities of multimodal medical LLMs



Discover relationships across data types

Correlate findings in an image with text descriptions in the corresponding report.



Improve Diagnosis

Detect subtle abnormalities or suggest differential diagnoses.



Streamline radiologist workflows

Create textual reports from medical images, provide patient-friendly explanations, analyze medical datasets to identify patterns, therapeutic targets, or risk factors.



Generate synthetic medical images with specific conditions or variations

Useful for dataset augmentation and training.

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- And generate synthetic medical images with specific conditions or variations. This is useful for dataset augmentation and training purposes.

Cymbal Health



Google Cloud

Let's check back in with the Cymbal Health team.

Cymbal Health

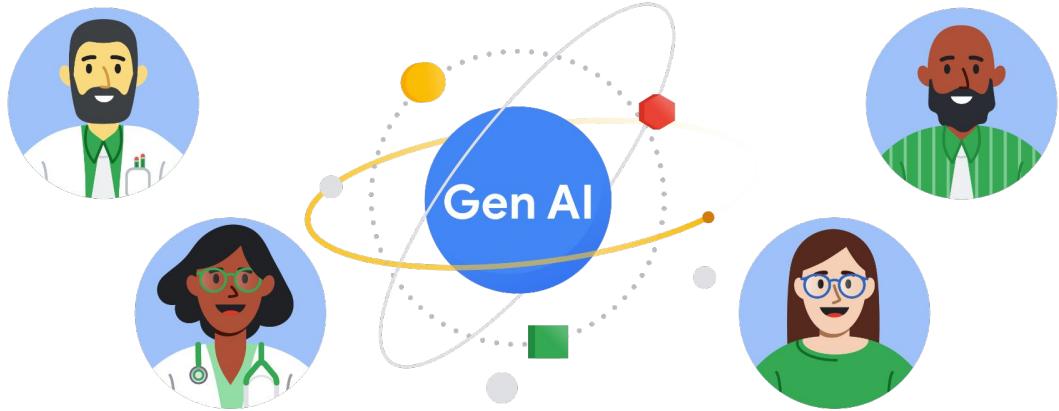


“Let’s **incorporate Gen AI** into existing workflows and applications.”

Google Cloud

They now recognize the power of generative AI for healthcare and have decided to create a small project team

Cymbal Health



Google Cloud

to incorporate Gen AI into their existing workflows and applications.

Step 1: Compile a list of unstructured medical data to use as a baseline.

Compile a list of types of medical data, including examples and descriptions.



The team decides that they should first compile a list of unstructured medical data to use as a baseline before fine-tuning a Medical LLM. They could set up a meeting and brainstorm some ideas for where to find the data they need. But why not enter a simple prompt and have Gen AI do the rest?



“Compile a list of types of medical data, including examples and descriptions.”



Absolutely! Here's a table organizing the provided information on unstructured medical data:

Data Types	Examples	Content Description
Clinical Notes	Progress notes, discharge summaries, radiology reports	Patient symptoms, diagnoses, exam findings, treatment plans, conversations
Medical Images	X-rays, CT scans, MRIs, pathology slides	Visual representations of body structures, potential abnormalities
Patient-Generated	Wearable device	Health metrics, symptoms tracked over time

Enter a prompt in here



Google Cloud

Once the model returns the results, they can request that the results be formatted into a table.



“Compile a list of types of medical data, including examples and descriptions.”



Patient- Generated Data	Wearable device data, patient-reported outcomes, social media posts	Health metrics, symptoms tracked over time, patient experiences
Voice and Audio Data	Transcribed conversations, telemedicine recordings	Nuances in speech, emotional state, details beyond written text
Email and Text	Appointment reminders, medication instructions, patient inquiries	Logistical information, potential gaps in care
Other Sources	Genomic data, research papers, handwritten notes	Complex genetic informations, medical knowledge, historical records

Export to Sheets

Enter a prompt in here



Google Cloud

The table can then be



“Compile a list of types of medical data, including examples and descriptions.”



Patient- Generated Data	Wearable device data, patient-reported outcomes, social media posts	Health metrics, symptoms tracked over time, patient experiences
Voice and Audio Data	Transcribed conversations, telemedicine recordings	Nuances in speech, emotional state, details beyond written text
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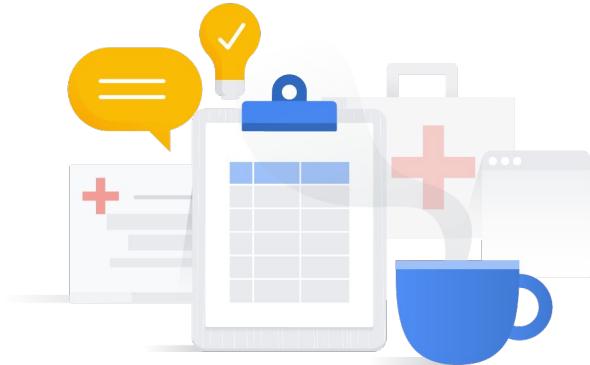
Export to Sheets

Enter a prompt in here



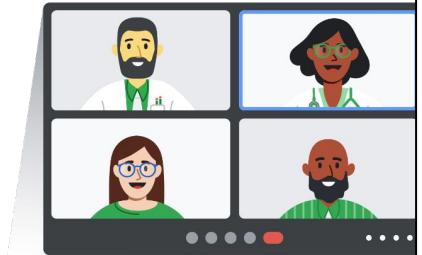
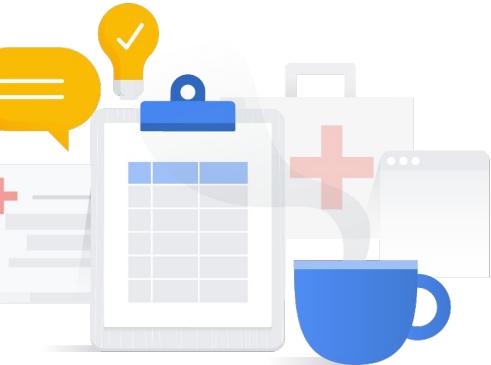
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exported to Google Sheets and modified for Cymbal's data requirements.



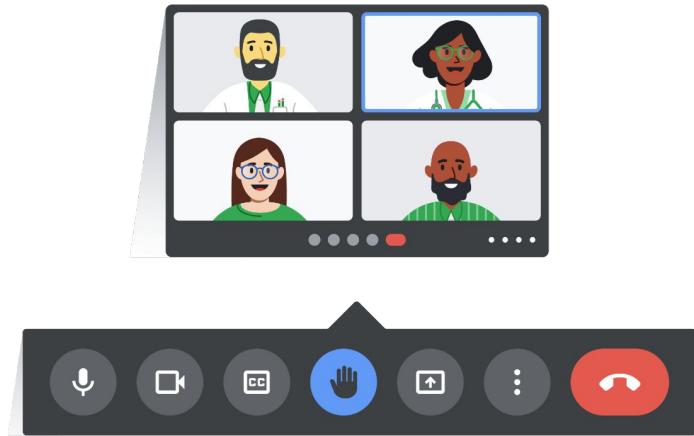
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Now, the team has a table of data sources



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to use as a starting point.



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Time to set up that meeting.