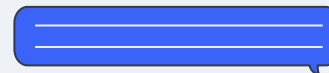# CADUCEUS

Simplify Documentation, Supercharge doctors!

June 2024

Introduction

With LLMs, like ChatGPT, Gemini and Claude, on the rise, we see new tools emerging to enhance human productivity. Such as:

- Copilot for programmers
- Grammarly for writers
- Jasper for content manager

Why not one for **doctors**?

Problem

300-500
Radiologists in Singapore

~3600
Imaging Studies per day

A niche, underserved market

A beach head for future expansion into other disciplines

Why radiologists?

Notes written by doctors after interpreting imaging studies

A brief summary of observations

EXAMINATION: LIVER OR GALLBLADDER US (SINGLE ORGAN)

INDICATION: ___ year-old female with cirrhosis, jaundice.

TECHNIQUE: Grey scale and color Doppler ultrasound images of the abdomen were obtained.

COMPARISON: None.

FINDINGS:

LIVER: The liver is coarsened and nodular in echotexture. There is no focal liver mass. Main portal vein and its major branches are patent with normal hepatopetal flow. The main hepatic artery shows normal arterial waveform. There is a small amount of ascites.
BILE DUCTS: There is no intrahepatic biliary dilation. The CBD measures 4 mm.
GALLBLADDER: The gallbladder is contracted with a shadowing gallstone.
PANCREAS: Imaged portion of the pancreas appears within normal limits, without masses or pancreatic ductal dilation, with portions of the pancreatic tail obscured by overlying bowel gas.
SPLEEN: Normal echogenicity, measuring 13.5 cm.
KIDNEYS: The right kidney measures 12.1 cm. The left kidney measures 13.4 cm. Normal cortical echogenicity and corticomedullary differentiation is seen bilaterally.
RETROPERITONEUM: Visualized portions of aorta and IVC are within normal limits.

IMPRESSION: Nodular appearance of the liver compatible with cirrhosis. Signs of portal hypertension including small amount of ascites and splenomegaly. Cholelithiasis. Patent portal veins with normal hepatopetal flow.

Intro | Problem | Solution | Market | USP | Business | Team

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AI

But, why use AI?

Saves time through automation

Reduce medical errors

Less prone to cognitive biases

Current Pain Points

We asked actual doctors and they said...

Most mainstream LLMs are not very useful as they are not medically accurate

Paid solutions LLMs that are medically trained could be quite slow

Enterprise solutions like Claude could be quite expensive

A smart, 🧠 fast, ⚡ cheap, 💲 model

CADUCEUS

Summarise patient's notes in a **single** click

🪄 Summarise

EXAMINATION: L-SPINE (AP AND LAT)

INDICATION: ___ year old woman with low back pain //
evaluate for DJD TECHNIQUE: AP and lateral views of the lumbar spine.

COMPARISON: None available

FINDINGS: There are 5 non-rib-bearing lumbar-type vertebrae. There is a mild scoliotic curve convex left centered at L3. There there is severe disc space narrowing at L4-L5 with grade 1 anterolisthesis of L4 on L5. There is moderate disc space narrowing at L5-S1 with hypertrophic changes of the left side of the articulation. Mild degenerative disc space narrowing throughout the remainder of the lumbar spine. No fracture seen. Mild degenerative changes in the bilateral hip joints. There is moderately severe vascular calcification. Surgical clips in the right upper quadrant consistent with prior cholecystectomy. Unremarkable bowel gas distribution. Phleboliths in the pelvis.

How does it work?

Database

Weaviate:
- Vector DB to store patient information as additional context

LLM

Ollama:
- Provided the base 8B Llama3 model

Unsloth:
- Optimization library to accelerate the fine-tuning process on medical data

Frontend

NextJS:
- Frontend framework for building the UI of the tool

Tailwind:
- CSS framework for styling the frontend

MLOps

Docker:
- Containerization to package the application

Kubeflow:
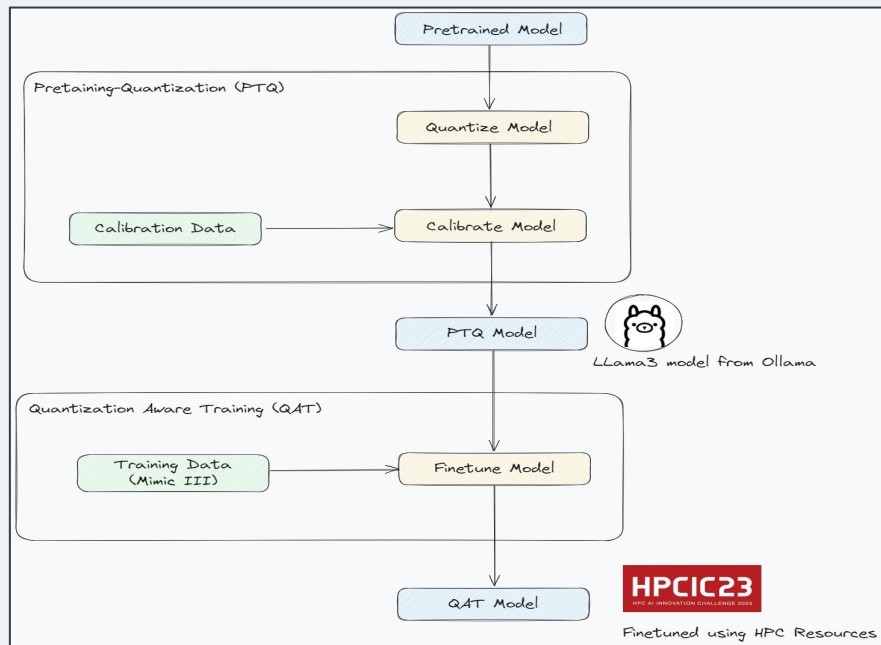- MLOps platform used to orchestrate the model training pipeline and manage HPC resources

How did we make it?

Starting with Llama3 pre-trained model

Make it <u>smaller</u> while maintaining accuracy

PTQ (Pretraining-Quantization) Quantize the model in a way that does well on the calibration data

QAT (Quantisation Aware Training) Force model to optimise quantised accuracy when finetuning

Make it train <u>faster</u>

PEFT (Parameter-Efficient Fine-Tuning) which speeds up finetuning by adjusting only a small subset of model parameters

LoRA (Low-Rank Adaptation) which decomposes the weight matrices into lower-rank matrices
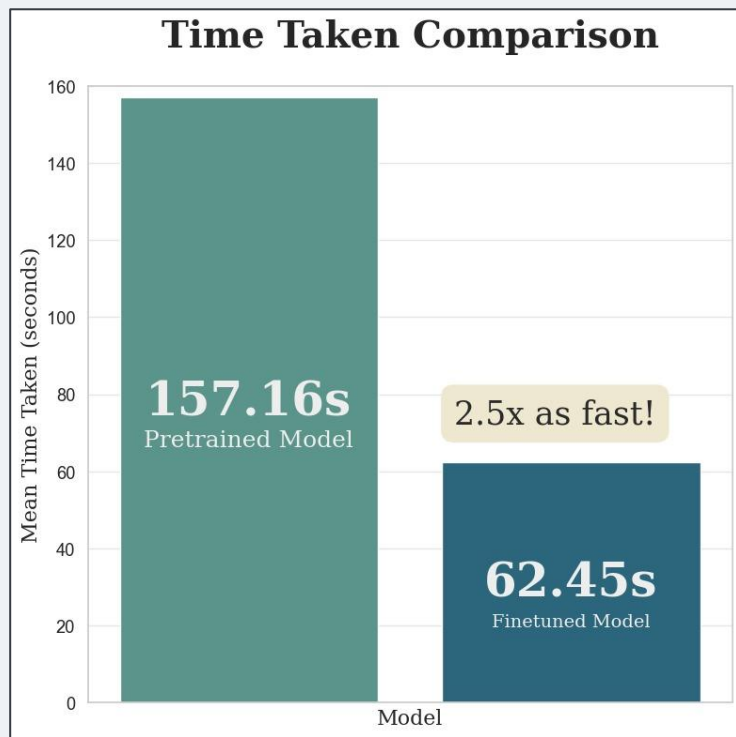
Improvements

Time Taken Comparison

Non Fine-Tuned

Radiology Impression:
A paracentesis procedure was performed on a patient with a history of alcoholic hepatitis, resulting in the removal of approximately 2.5 liters of clear ascitic fluid.
The procedure was guided by ultrasound and was well-tolerated without any immediate complications.

Fine-Tuned

IMPRESSION:
Technically successful ultrasound guided paracentesis, yielding 2.5 liters of clear ascites.

But how will doctors use it?

Optional Integration with EHR!!

Copilot-like UX

Intro   Problem   Solution   Market   USP   Business   Team

Go-to-Market Strategy

Name		2025						2026			
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Discussions with Synapxe		███████	███████	███████							
2. Build POC & POV (HX-IS)				███████	███						
3. Evaluation by Medical Experts					████						
4. Implement in H-Cloud						██					
5. Operate & Improve							███████	███████	███		
6. Further Research & Development									███	███████	███████

Intro   Problem   Solution   **Market**   USP   Business   Team

Market Strategy

Market Penetration

Use radiology notes summarisation to establish brand and market presence

Market Diversification

Expand to other medical domains and offer more products such as

- Autocompletions
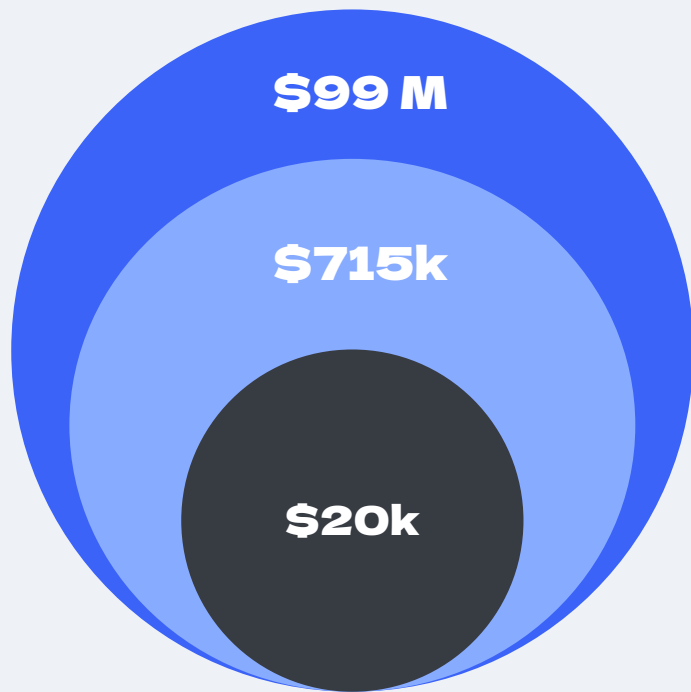- Chatbots
- AI Agents

to doctors, nurses, etc.

Market size overview

$99 M

$715k

$20k

■ **TAM**

165,000 hospitals globally represent the full potential market

■ **SAM**

Servicing all doctors in Singapore by diversifying our services to other disciplines, with a total of 10 public and 8 private hospitals in Singapore

■ **SOM**

Our goal is to service most radiologists in Singapore in 2 years by partnering with a majority of public hospitals.
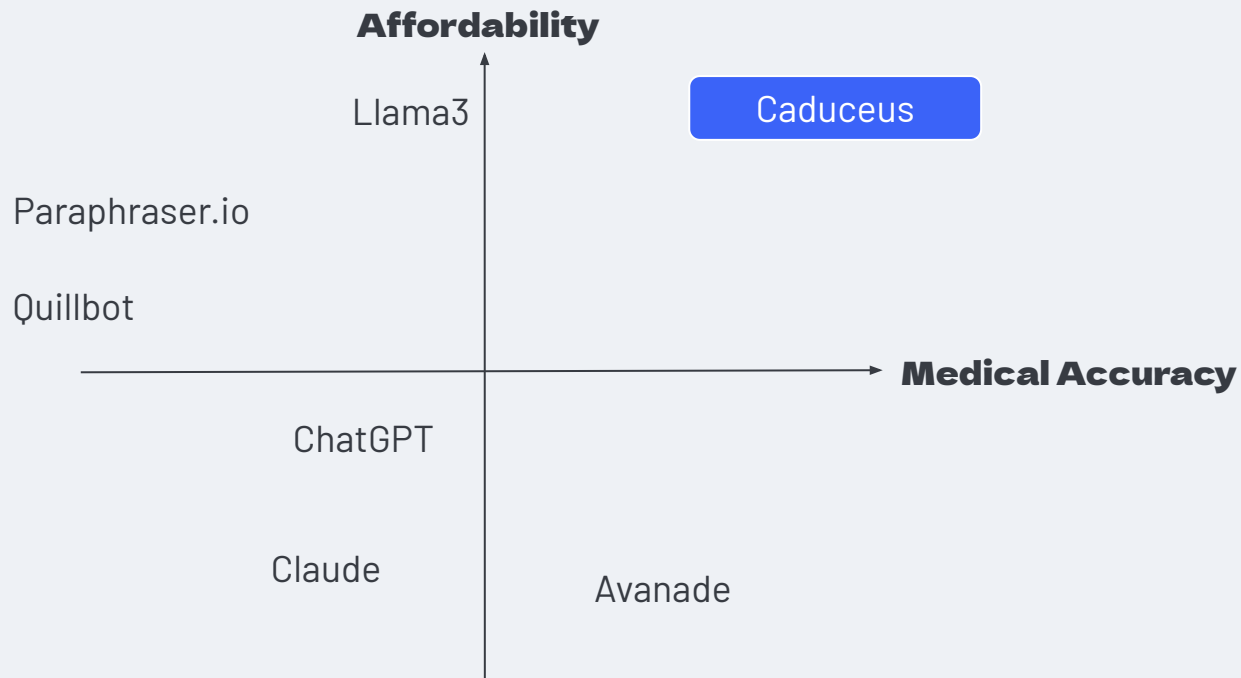
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Competitors

Unique Selling Point

Enhance doctor's productivity with LLMs

Secure On-premise hosting

Resource efficient

Domain specific

Revenue Pricing

	Basic **$9 per person/month**	**Premium** **$29 per person/month**
Support	Email, Phone	Prioritised Email, Phone
Hosting	Self-hosted	Self-hosted
Usage Type	Summarisation	Customisable use cases
Model	Default	Train on custom data

Ask

Funding

$10,000 for

- Operating costs
- HPC credits for advancing solution

Partnering

Synapxe and

- Partners for medical validation
- Medically trained consultants

The Team

Kiah Hong

- Diploma in Applied AI and Analytics
- Ex-Data Scientist at Singapore Airlines
- Google Professional ML Engineer Certified

Ram

- Diploma in Applied AI and Analytics
- AI Engineer at Cynapse
- SP Scholar
- NOAI Finalist
- Helped build a GenAI based product design startup

Wee Leong

- Diploma in Applied AI and Analytics
- Ex-AI Engineer at DSTA
- SP Applied AI Silver Medalist

Ryan

- Diploma in Applied AI and Analytics
- AI Engineer at CSIT
- NOAI Finalist
- CSIT Scholar

Key Takeaway

Empower doctors using on-premise LLM-based productivity tools that are fast, cheap and accurate.

Thus enhancing Human Health & Potential

Appendix