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Will Artificial Intelligence in healthcare bring about a Gutenberg moment? - AI & Humans

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Points of Discussion

- 01 Meet the presenters
- 02 AI & Humans – Changing Workforce Dynamics
- 03 Healthcare Reinvention
- 04 Navigating AI - Responsible AI by design
- 05 How to get started?
- 06 Case Studies & Demos





Meet the presenters



Dalibor Ivkovic

Dalibor is an leader (& practitioner!) at Accenture, specialising in advanced analytics, artificial intelligence, cloud data computing and automation. He has delivered complex data and AI programs across Health & a range of other industries. Currently he specialises in developing industry solutions with data and AI, with a special focus on healthcare.



Anatoly Tulchinsky

Anatoly is an experienced Data & Applied AI leader at Accenture, helping healthcare businesses and Government agencies drive their next wave of digital transformation and unlock strategic growth using emerging technologies and AI. He helps businesses to thrive in the new AI era by creating innovative strategies and delivering strategic transformation programs.



"Computers are incredibly fast, accurate, and ~~stupid~~ intelligent. Human beings are incredibly slow, inaccurate, and brilliant. Together they are powerful beyond imagination."

Albert Einstein

Adaption by Authors: Time changes the words but not the implications



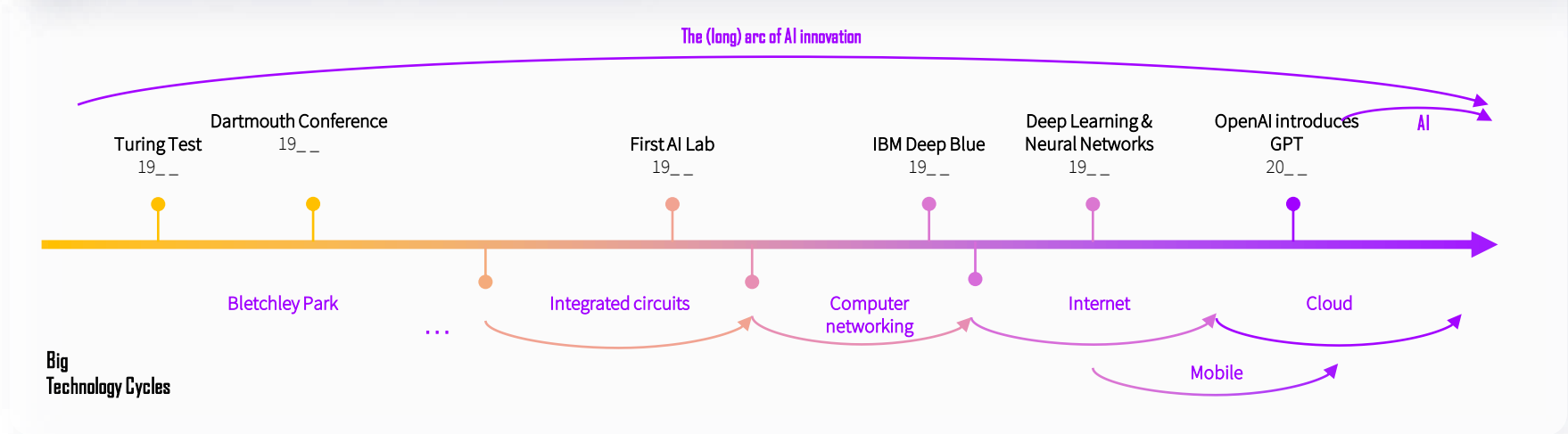
Image created by AI – "Robot leaping across rocks"



Will artificial intelligence in healthcare bring about a Gutenberg moment? Revolutionising the industry.



Quiz: Can you guess the key dates in Big Tech & AI over the last century?





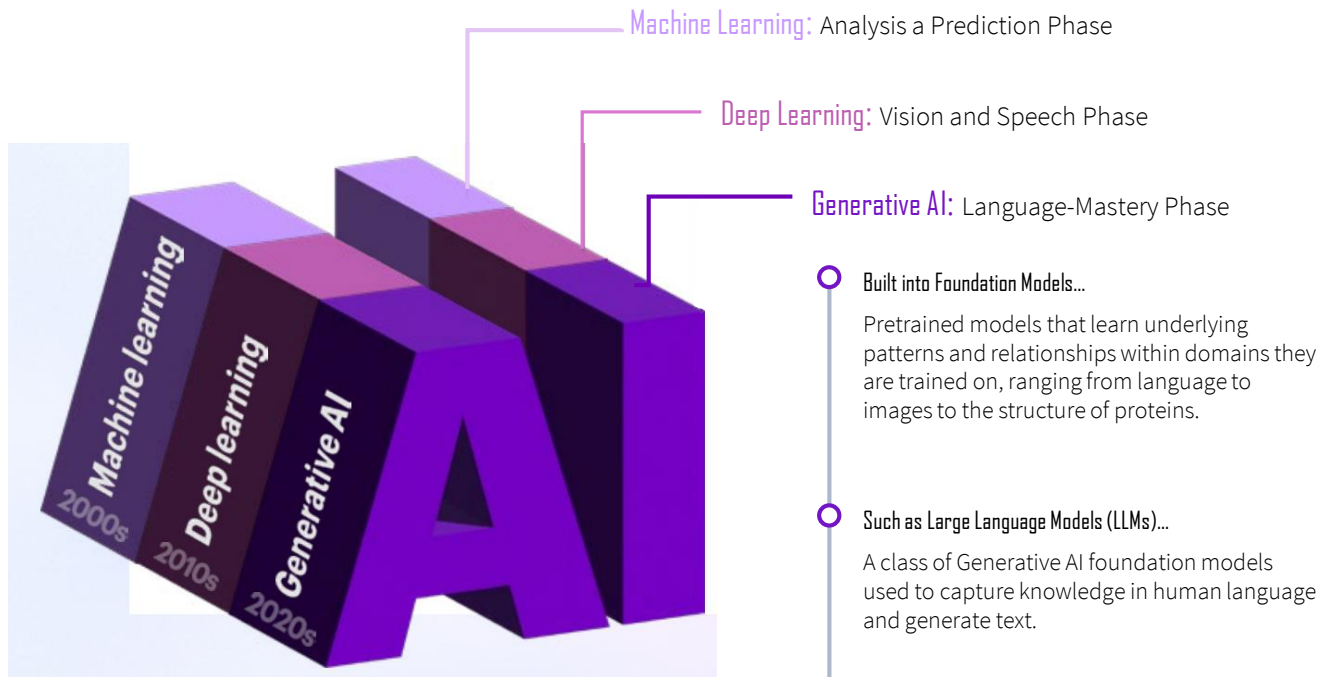
Workforce dynamics have evolved over the centuries...AI as a worker?

- The First to Third Industrial Revolutions - humdrum manual tasks automation using machines.
- Today, AI is seamlessly integrated into many things we do - social media, virtual assistants, and various mobile apps.
- **But what about in the workplace with the current level of technology change?**
Potential AI workforce to share intelligence and joint participation.





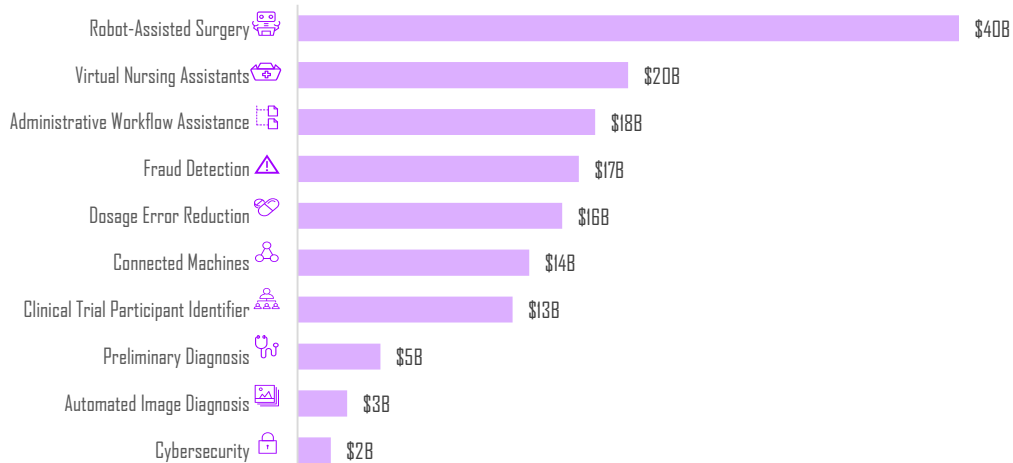
Generative AI is a **step change** in the evolution of AI





AI represents a significant opportunity for health enterprise to drive better business outcomes, while capitalizing on new growth potential

Top 10 Artificial Intelligence Applications in Health¹



Estimated potential annual benefit for each application by 2026

According to Accenture analysis, when combined, key clinical health AI applications can potentially create **\$150 billion** in annual savings for the United States healthcare economy by 2026.

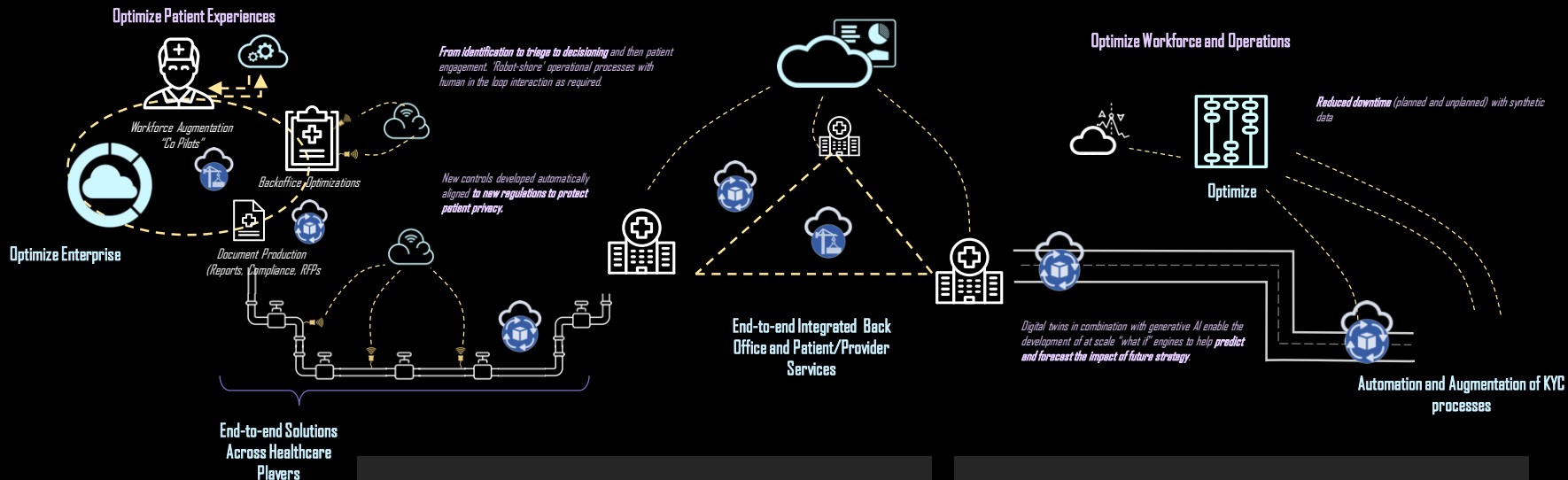


Future Healthcare Ecosystem powered by AI

Value to Patients. Transformation to personalized experience and outcomes. AI makes every experience custom for every individual patient, across text, audio and visual channels.

360 View Generative models derived from enterprise data "graphs" across all dimensions of patient services and provider/payer operations

Value to Payers/Providers. AI improves the workforce's efficiency, quality, and performance and optimizes resource utilization.



BackOffice. AI saves time in producing regular reports, document processing, risk analysis, even writing RFPs and or Regulatory Filings, and Resource and Supply Chain.

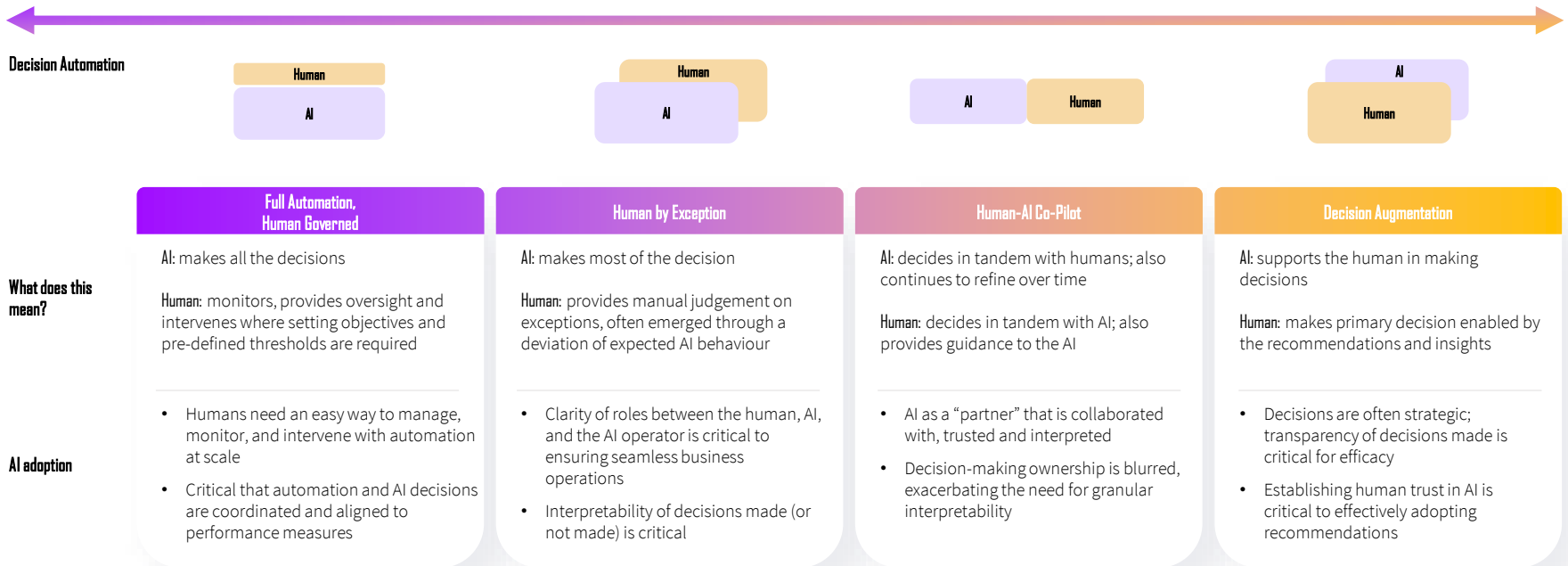
Interactive Patient Services. AI improves patient engagement, reduces medical errors, and improves financial efficiency.

Enterprise Abstraction / Semantic Layer



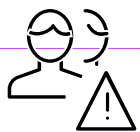


AI & Humans, a workforce...combined and changing roles



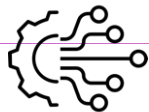


While AI offers enormous potential, healthcare orgs will need to understand and carefully navigate its risks



Workforce Displacement

- GenAI's impact viewed as more possible and direct for roles that were initially viewed as outside of AI's immediate reach (creatives, lawyers, etc.)



Unreliable Outputs

- Hallucinations
- Explainability and traceability
- Quality, accuracy, interpretability
- Relevancy / consistency
- Disclosure & transparency



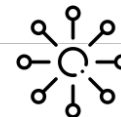
Confidentiality & Security

- Unauthorized disclosure of confidential information
- Security vulnerabilities



Liability & Compliance

- Copyright, IP and content ownership
- Regulatory compliance
- Contractual liability
- Product liability
- Consumer protection concerns



Bias & Harm

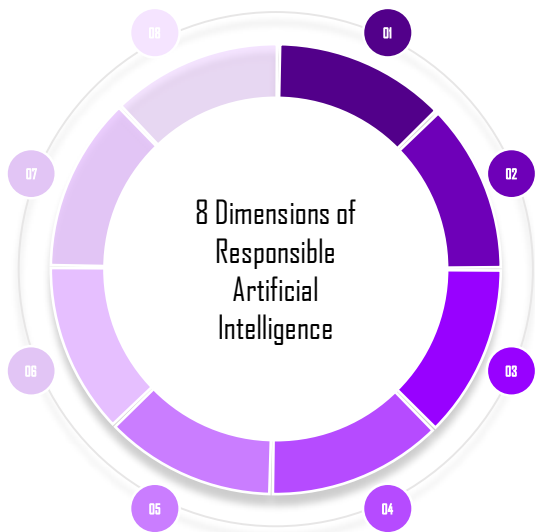
- Representational harm
- Misinformation
- Toxicity
- Fraudulent attacks
- Disinformation spread
- Harmful content generation at scale





Responsible AI encompasses more than just fairness and bias

The dimensions of Responsible AI are interconnected and require broad business and technical capabilities across dimensions



01 Fairness

- Anticipating bias
- Encouraging Diversity

02 Robustness

- System Security & Safety
- System Resilience
- Response Plan

03 Accountability

- Governance
- Human Oversight
- Auditability

04 Liability and Compliance

- IP Ownership Concerns
- Contractual and Product Liability
- Consumer Protection
- AI Regulatory Compliance
- Disclosure of Confidential Information

05 Sustainability

- Environmental Sustainability
- Human-centric design
- Socio-economic wellbeing
- Disinformation and distortion of truth
- Fraud at scale

06 Privacy

- Data Ethics
- Human Rights
- PII Privacy & Regulation

07 Transparency

- Interpretability & Explainability
- Understanding
- Traceability

08 Soundness

- Context & Comprehension
- Data Quality
- Model Performance & Validation
- Inconsistent outputs
- Language toxicity

Key: Orange items may be amplified by Generative AI



Technology Approach: Responsible by Design

Unlocking Responsible AI value starts with building on existing capabilities & growing in maturity over time



Providing Tooling & Enablers

Adopting tools to ensure AI systems are responsible by design; empower developers to address ethical considerations of models (e.g., fairness, transparency) while also enabling regulatory readiness



AI/ML Capabilities

Building the foundational AI capabilities that are needed to execute AI across the organization



Establishing Culture & Training

Embedding good practice for AI in day-to-day operations, through continuous functional and technical training as well as communications, will foster key AI components for creating an environment of diverse thought and inclusivity



Enabling Risk, Policy & Controls

Defining policies, procedures and controls through design, deployment and monitoring of AI systems that will enable the organization to continually mitigate and manage AI risks



Activating Principles & Governance

Executing on robust firm governance structures & mechanisms for AI oversight that will empower individuals and systems to practice Responsible AI principles



Data Foundations

Establishing fundamental data capabilities that are needed to support analytics across the organization



Defining Responsible Data & AI Principles

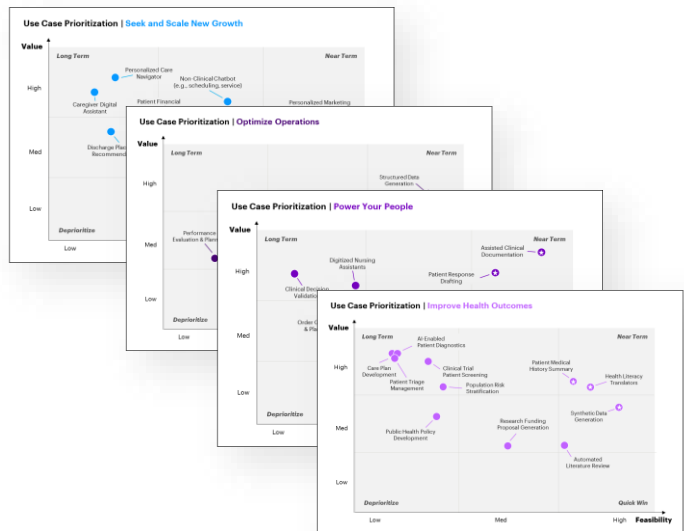
Creating and defining Responsible Data & AI principles that leverage existing organizational core values and align to an organization's code of conduct, and priorities





How to get started?

Assess business value and feasibility when prioritizing AI investments



Assessing Business Value...

- What is the projected financial impact?
- What is the projected impact to access, experience and outcomes?

Assessing Feasibility...

- Are there tested solutions and models available in the market?
- What regulatory constraints are present?
- What degree of people, process and technology change is required to successfully implement?





What's next?

To deeply understand AI technology, ecosystems and opportunities for your company and industry, a 3-step approach

01

Explore

Define vision and assess value chain to identity prioritized use cases for Generative AI.

02

Experiment

Rapidly prototype AI use cases. Experiment to measure impact, adoption and overall readiness.

03

Execute

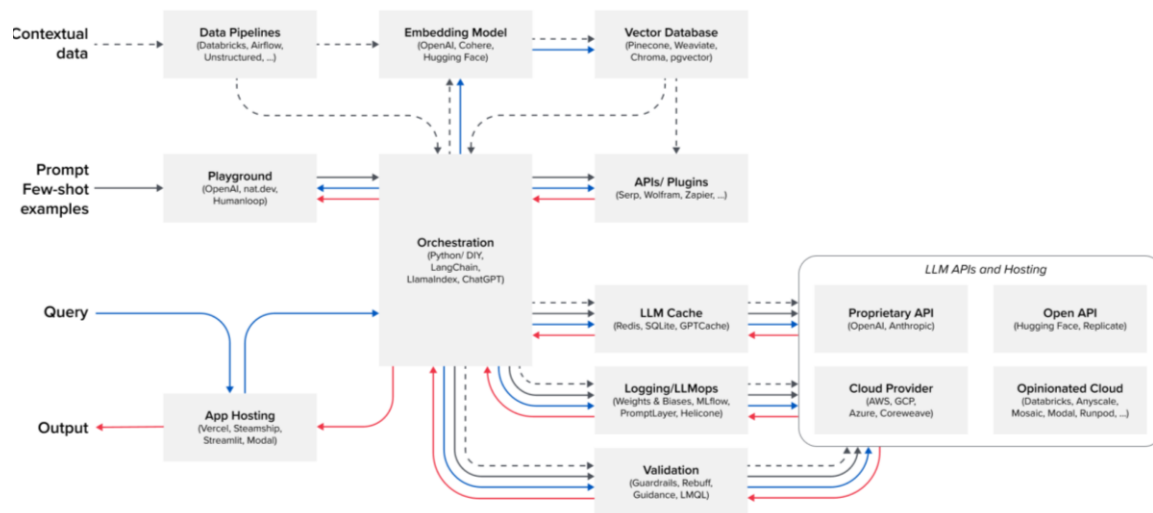
Set out comprehensive activation strategy with a practical implementation roadmap, detailed reference architecture for deployment.





Emerging Architectures for LLM Applications

- **Enhanced Data Privacy:** sensitive data can remain within the secure confines of a private cloud or local infrastructure.
- **Efficient Resource Utilization:** LLM models offer significant cost savings by eliminating the need to train and share extensive datasets within the model.
- **Intelligent Query Routing:** LLM models can be equipped with the capability to intercept questions and intelligently route them to specific vector databases or private knowledge bases.
- **Scalability and Flexibility:** LLM models can be deployed in a distributed and scalable manner.
- **Continuous Learning and Adaptation:** LLM models can be fine-tuned and updated over time to adapt to changing user needs and preferences.





Summary of what we learned today

- AI, Gen AI and advanced data techniques that are applicable to healthcare and how they can be used and utilized today and in the future
- Major trends, challenges and opportunities in Healthcare and some specifics on how the future way of working of humans and AI can evolve
- How to navigate AI responsibly and have responsible AI elements embedded as part of the solution design.
- Steps to get started and key considerations and advantages of using Gen AI LLM Models
- Real solutions demos and case studies



MEDINFO23

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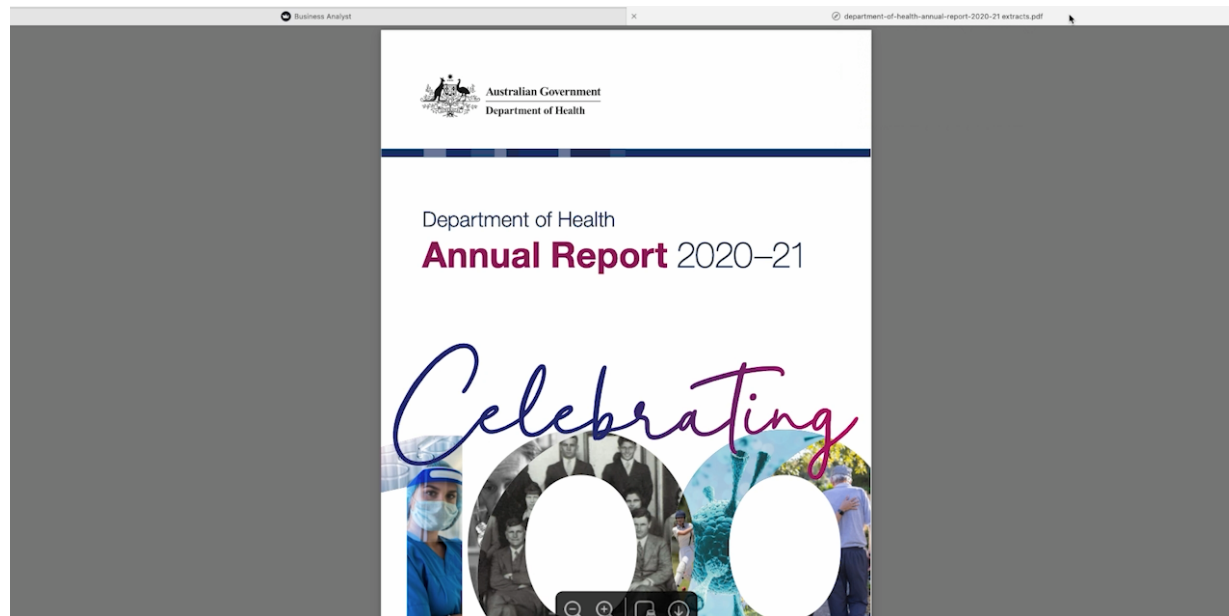
Case Studies & Demos





Citizen customer service & access to knowledge

Rapid test on Department of Health unstructured data





Fake Patients, Real Insights

Leveraging synthetic patient data to fuel AI



The company is working with Google Cloud to create a **synthetic data platform** of approximately 1.5 to 2 petabytes of synthetic data, including artificially generated data sets of medical histories, healthcare claims and other key medical data. This will allow Elevance to validate and train AI algorithms on large amounts of data, while reducing privacy issues surrounding personal medical information.





Healthcare provider assistance

Patient case & care summaries drawing on EHR/medical notes

1

MA The patient has not had screening mammograms. She felt a lump in her left breast in February 2017. She did not immediately seek care, but did start an evaluation (through *****) in June 2017. Her work-up and treatment to date are as follows: February 2017 Felt lump in her left breast 06/17 Diagnostic mammogram: irregular spiculated mass in left upper outer quadrant corresponding to palpable abnormality; irregular mass in posterior, inferior, subareolar region of right breast Targeted left breast ultrasound: irregular hypoechoic mass (1.8 x 2.3 x 2.7 cm) at 1:30 position, 10 cm from nipple Targeted right breast ultrasound: lobulated hypoechoic mass (1 x 1.1 x 1.2 cm) at 8:00 position, 6 cm from nipple 06/17/17 US-guided left breast core biopsy at 8:00 position, 6 cm from nipple: 0.75 cm grade 1 IDC with ER+ 100%, PR+ 75%, HER2- (IHC 1+; FISH ratio 1.1) US-guided right breast core biopsy at 1:30 position, 10 cm from nipple: 0.6 cm grade 1 IDC with ER+ 100%, PR+ 75%, HER2+ (IHC 2+; FISH ratio 2.0 with HER2 copy # per cell 4.4); intermediate nuclear grade DCIS 07/07/17 Breast MRI: right - irregular homogeneously enhancing mass (2.3 x 1.4 x 1.1 cm) corresponding to right breast index mass (at 8:00 position, 13 cm from nipple); left - irregular homogeneously enhancing mass (2.2 x 3.3 x 2.6 cm) corresponding to left breast index mass (at 2:00 position, 10 cm from nipple); multiple prominent low level 1 left axillary LN with thickened cortex, asymmetric compared to right 07/11/17 US-guided left axillary LN core biopsy (3:00 position, 19 cm from nipple): multiple foci metastatic adenocarcinoma (largest 1.5 mm) with tumor cells present in adipose tissue adjacent to fibrous tissue, unclear whether this represents extracapsular invasion; HER2- (IHC 1+; FISH ratio 1.2) 08/13/17 Left breast partial mastectomy and axillary lymph node dissection: 6.2 cm grade 1 IDC; ER+ 99%, PR+ >95%, HER2- (1+; FISH ratio 1.0); suspicion for LVI, margins negative, focal high grade DCIS within tumor; 0/8 LN+ (0.7 mm micrometastasis with no extracapsular extension); MP high risk (-0.614) Right breast partial mastectomy and axillary lymph node dissection: 2.0 cm grade 1 IDC with ER+ 99%, PR+ 90%, HER2- (IHC 0; FISH ratio 1.5); 0/8 LN+; MP Low Risk (+0.321) (Surgeon: Dr. *****) Presents to clinic with her husband and sister (*****). She reports that she has felt a lot healthier since having her breast surgery. She has some mild joint stiffness, in particular in her knees. ***** has met with Dr. ***** and Dr. ***** who have both recommended adjuvant chemotherapy (she states that they have specifically recommended TC). She states that when she saw Dr. ***** he recommended that her tumor (presumptively left) be sent for Oncotype. She is not yet aware of a result. She is concerned that the benefits of chemotherapy will not outweigh its long-term risks. Past Medical History: Diagnosis Date Breast cancer Diabetes 08/09/2017 HbA1c of October 20 on 08/09/17 Obesity Past Surgical History: Procedure Latent fertility Date AXILLARY LYMPH NODE DISSECTION Bilateral 10/09/2017 8 LN ON RL ... ; 12 LN ON LEFT M J ECTOV PARTIAL Bilateral 08/13/2017 WITH BILATERAL REDUCTION Family History Problem Relation Name Age of Onset Breast cancer Maternal Grandmother 58

Give me all cancer biomarkers

2

The cancer biomarkers for the patient in the case are:

- ER (Estrogen Receptor): ER+ 100% in left breast mass and ER+ 99% in right breast mass
- PR (Progesterone Receptor): PR+ 75% in left breast mass and PR+ 90% in right breast mass
- HER2 (Human Epidermal growth factor Receptor 2): HER2- (IHC 1+) in left breast mass, HER2+ (IHC 2+; FISH ratio 2.0 with HER2 copy # per cell 4.4) in right breast mass, and HER2- (IHC 1+; FISH ratio 1.2) in left axillary lymph node
- MP (Mammprint): high risk (-0.614) in left breast and low risk (+0.321) in right breast

Output - Formatted

3

MA Can you give me that in a table form?

AI Sure, here is a table summarizing the biomarkers mentioned in the case:

Biomarker	Left breast biopsy	Right breast biopsy
ER	100% positive	100% positive
PR	75% positive	90% positive
HER2	-(IHC 1+, FISH ratio 1.1)	2+ (IHC 2+, FISH ratio 2.0, HER2 copy # per cell 4.4)

Note: The table is based on the information provided in the case, which may not be comprehensive or fully up-to-date.





Transcript of Physician-Patient Encounter from Dataset for Automated Medical Transcription

Here is the transcript of a conversation between a doctor and a patient:

--

Clinician: (259A) Please have a seat Meg. Thank you for coming in today. Your nutritionist referred you. It seems that she and your mom have some concerns. Can you sit down and we will take your blood pressure and do some vitals?

Patient: (259B) I guess. I do need to get back to my dorm to study. I have a track meet coming up also that I am training for. I am runner.

Clinician: (260A) How many credits are you taking and how are classes going?

Patient: (260B) 21 credits. I am at the top of my class. Could we get this done. I need to get back.

Clinician: (261A) How often and far do you run for training now? You are 20, correct?

Patient: (261B) Yes. I run nine miles every day.

Clinician: (262A) Your BP is 100/50. Your pulse is 52. Meg how much have you been eating?

Patient: (262B) I have been eating fine. I talked to the nutritionist about this earlier.

Clinician: (263A) Let's have you stand up and face me and I will back you onto the scale. Eyes on me please. Thank you, and now for a height. Ok looks like 5'5". Go ahead and have a seat.

Patient: (263B) How much? Can I please see what the scale says? I'm fat.

Clinician: (264A) Please sit up and I will listen to your heart and lungs.

Patient: (264B) Fine.

Clinician: (265A) You know that is not a positive part of your treatment. We have discussed this before. You are here today because your nutritionist and your mom are both very concerned about you. You are very ill, Meg.

Patient: (265B) I am fine. I am eating. I tell my mom what I eat. Just because I am not fat like she is.

Clinician: (266A) How have you felt? Are you feeling sad or depressed? Last time we talked, you were quite unhappy. Are you feeling suicidal?

Patient: (266B) I am busy and not concerned about happiness. I need to train and I am tired of everyone nagging me about what I eat and how much I exercise. I am the smartest in my class and one of the best runners on the team. I don't have time for all of this. I am only here to keep my mom off my back.

Clinician: (267A) When you were here last, you agreed to keep working with your nutritionist and being open with your mom and me. We need to work together to help you get well. There are irregular rhythms in your heart. And I noticed the downy hair on your back and arms.

Patient: (267B) I will work with all of you. I know. I don't want to be like this. I need to run though. It helps me.

Clinician: (268A) When you were in treatment, we were working toward some goals with your cognitive behavioral therapy. We need to revisit these goals. First thought, we need to bring your mom in and have a discussion about the next step to help you get well. I would like to do more tests to check your electrolytes and your blood count.

Patient: (268B) Ok. I do want to be better.

Clinician: (269A) I want you to feel better and be healthy. Let's have your mom come in, ok?

Patient: (269B) Yeah.

--

Please summarize this encounter in the form of the doctor's medical note.

Patient: Meg, 20 year-old female

Chief Complaint: Referred by nutritionist and mother due to concerns about eating habits and health status

Vitals: BP 100/50, Pulse 52

Physical Exam: Height 5'5", irregular heart rhythms, downy hair on back and arms

Social History: College student taking 21 credits, track team member, running 9 miles daily

Discussion: Patient reports eating fine but expresses body image concerns. Reports feeling busy and not concerned about happiness, not suicidal. Admits to needing to run to cope. Agreed to work with nutritionist, doctor, and mother, and open to further tests to check electrolytes and blood count. Goals with cognitive behavioral therapy to be revisited. Mother to be brought into discussion about next steps in treatment.



GPT-4 in Action

Medical notetaking

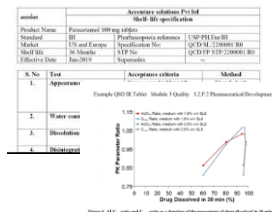




Regulatory Compliance

Registration for new drugs

Complicated Un-Structured Source Data



Near Real-Time Accurate Written Summary

Physical Properties:
 Acetaminophen Form II has been identified and reported to literature as having three crystalline forms with different solubility and melting point properties. The most stable form (Form III) has the highest melting point. It is a white to off-white, crystalline powder with poor wettability and a particle size distribution of d₅₀ = 3.5 μm, d₉₀ = 13 μm, d₉₅ = 30 μm. It is insoluble in water and has low solubility in aqueous media, with both initial and apparent dissolution rates of 0.27 and 0.26 mg, respectively. Its thermodynamic solubility is low (solubility coefficients of 0.99 and 1.00 at 25°C and 37°C, respectively) and its solubility is enhanced through a specific energy of 12 kcal/mol.

Chemical Properties:
 Acetaminophen is a weak base with a pKa of 9.5. Stereo isomerism was carried out on it to study its regulatory profile, enantiomeric purity, and to provide a stability-indicating method. Samples were analyzed using HPLC equipped with a peak purity analyzer, with peaks well resolved from the main peak. The primary degradation products were RC1 (ACE-13141) and RC2 (ACE-13142). RC1 was not with prolonged exposure to extreme heat (110°C/90% RH), whereas RC2 was observed. Acetaminophen is susceptible to dry heat, UV light and oxidation.

Biological Properties
 Acetaminophen has a Caco-2 permeability greater than the reference standard metoprolol, indicating

- The registration process for new drugs involves the manual authoring of detailed dossiers and is very time consuming, up to 18,000 hours per certain modules (ex: CTD-1, 2, 3)
- Accenture built an AI-based solution that automatically generates the output document in the required format along with the flexibility for users to review and edit the generated content
- Preliminary value estimated at a 60-65% reduction in authoring time, shortened lead time of 6-9 weeks, and \$1.2m - \$2.3m in cost savings
- For a \$1b drug, every day that is faster to market is approximately **\$3m in revenue per day**. And so, reducing the lead time can result in a range from \$124m to \$189m in faster (“get there sooner”) & additional (“get more”) revenue



A close-up photograph capturing a tender moment between two women. On the right, an elderly woman with short, wavy white hair is shown in profile, her face pressed against the shoulder of a younger woman. Her eyes are closed, and her expression is one of deep emotion, possibly tears or a smile. She is wearing a dark and light striped top with a white lace collar and a small gold hoop earring. Her hands are gently clasped around the younger woman's shoulder. On the left, the back of the younger woman's head and her long, straight brown hair are visible. She is wearing a dark top with a pearl necklace. The background is softly blurred, suggesting an indoor setting. The text "Thank you" is written in a clean, white, sans-serif font across the center of the image. A white chevron symbol is positioned at the bottom center, pointing to the right.

Thank you

