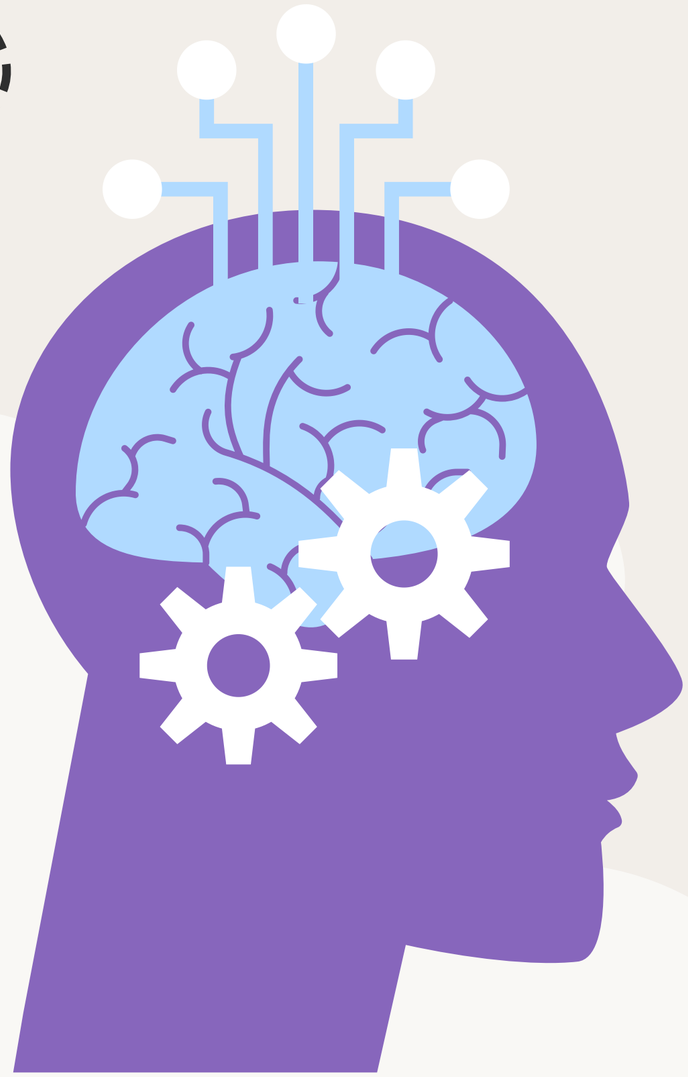


Yale Digital Ethics Center

Inside the Miracle Cure

Thinking Critically about AI in Healthcare

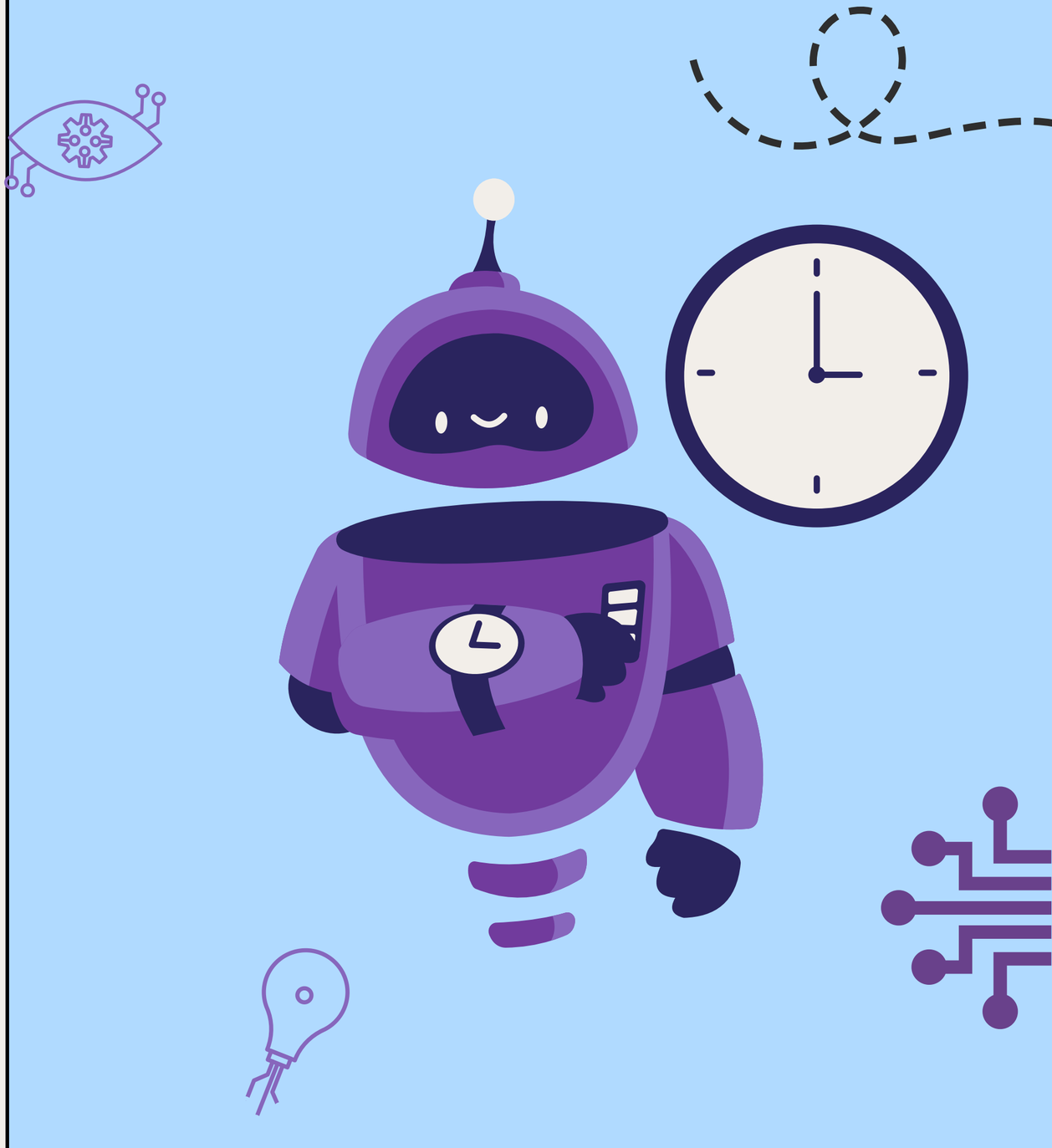
Presented by: Jessica Morley

Date: January 29th, 2026

Outline

- What AI is Not
- What AI is, officially
- Hope & Hype
- What AI is, actually
- Q&A / Discussion

WHAT AI IS NOT



New

AI Effect

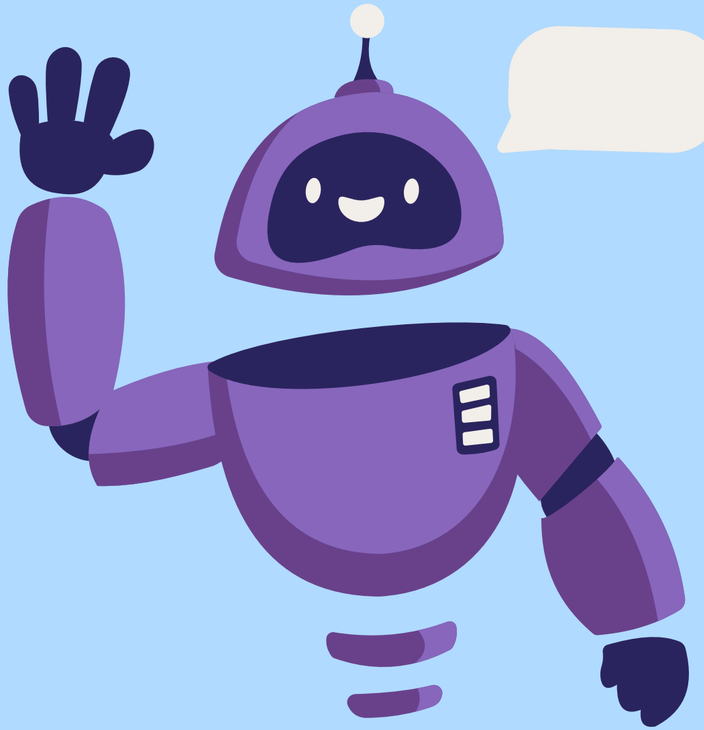
Magic

The Last Mile Problem

Intelligent

The Symbol Grounding Problem

WHAT AI IS, OFFICIALLY



"The science of making machines [or software] do things that would require intelligence if done by humans."

Minsky, 1968

Breaking down the components

Data:
The ingredients

The input that determines what AI learns from

Trains

Algorithm:
The recipe

The learning method that finds patterns in data

Creates

Model:
The meal

The finished product that applies what was learned to complete tasks

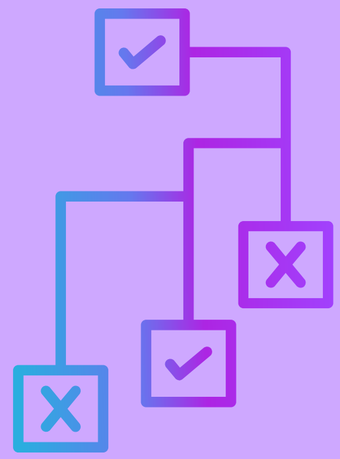
Symbolic AI

Execute Pre-Programmed Knowledge

- **Data:** Expert knowledge encoded as rules e.g., clinical guidelines
- **Algorithm:** Expert system, decision tree
- **Model:** MYCIN for recommending antibiotic treatments for severe bacterial infections
- **Strengths: T**ransparent and explainable, reproducible, easy to audit:
- **Limitations:** Cannot learn from data, cannot handle uncertainty, brittle

Uses

- Basic clinical decision support sytems
- Drug-drug interaction checkers
- Simple screening alerts based on thresholds



Predictive AI

Forecast outcomes from historical data

- **Learning paradigm:** Supervised learning
- **Data:** Labelled - tabular structured data, imaging data, clinical text, omics data
- **Algorithm:** Logistic regression, random forest, gradient boosting, support vector machine, convolutional neural network, recurrent neural network
- **Model:** Epic Deterioration Index. CheXNet
- **Strengths:** Can discover complex patterns humans miss, improves with more data, handles high-dimensional inputs
- **Limitations:** Requires large labelled datasets, confuses signal vs. noise, “black box”

Uses

- Risk stratification e.g., admission risk
- Diagnostics e.g., diabetic retinopathy screening, pathology slide analysis
- Clinical phenotyping e.g., treatment response prrediction
- Resource allocation e.g., staffing demand forecasting

Analytical AI

Find hidden structure in unlabelled data

- **Learning paradigm:** Unsupervised Learning
- **Data:** EHR data, longitudinal patient trajectories, lab values, omics data, medical images, medical literature
- **Algorithm:** K-means clustering, Gaussian mixture methods, principal component analysis, isolation forest
- **Model:** EHR-based patient clustering models, Disease trajectory models, Medicare fraud detection models
- **Strengths:** doesn't require labelled data, useful for exploratory analysis, generates hypotheses, handles high-diemnsional data well
- **Limitations:** patterns may not be meaningful, difficult to validate discoveries, sensitive to parameter choices

Uses

- Patient phenotyping
- Detecting healthcare fraud
- Identifying unusual clinical patterns
- Monitoring adverse events
- Drug repurposing
- Biomarker discovery

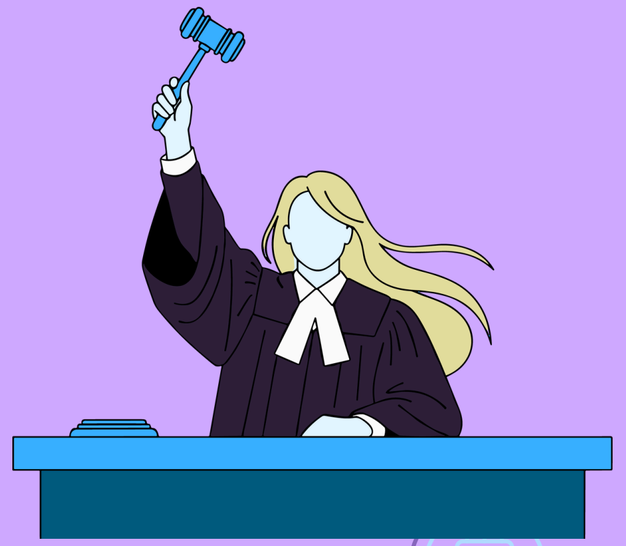
Decision-Making AI

Learn optimal actions through trial & error

- **Learning paradigm:** Reinforcement Learning
- **Data:** sequential interaction data, simulation data, real-time feedback, retrospective trials data
- **Algorithm:** SARSA, Q-learning, Actor-critic, PPO
- **Model:** Insulearn, Alphazero
- **Strengths:** Can discover non-obvious optimal strategies, optimises long-term goals, personalises to individual patients
- **Limitations:** Requires extensive interaction data or simulation, can be high-risk, design is challenging

Uses

- Dynamic insulin dosing
- Ventilator weaning strategies
- Chemotherapy dosing schedules
- Adaptive trial design
- Operating room schedulaing
- Precision dosing



Generative AI

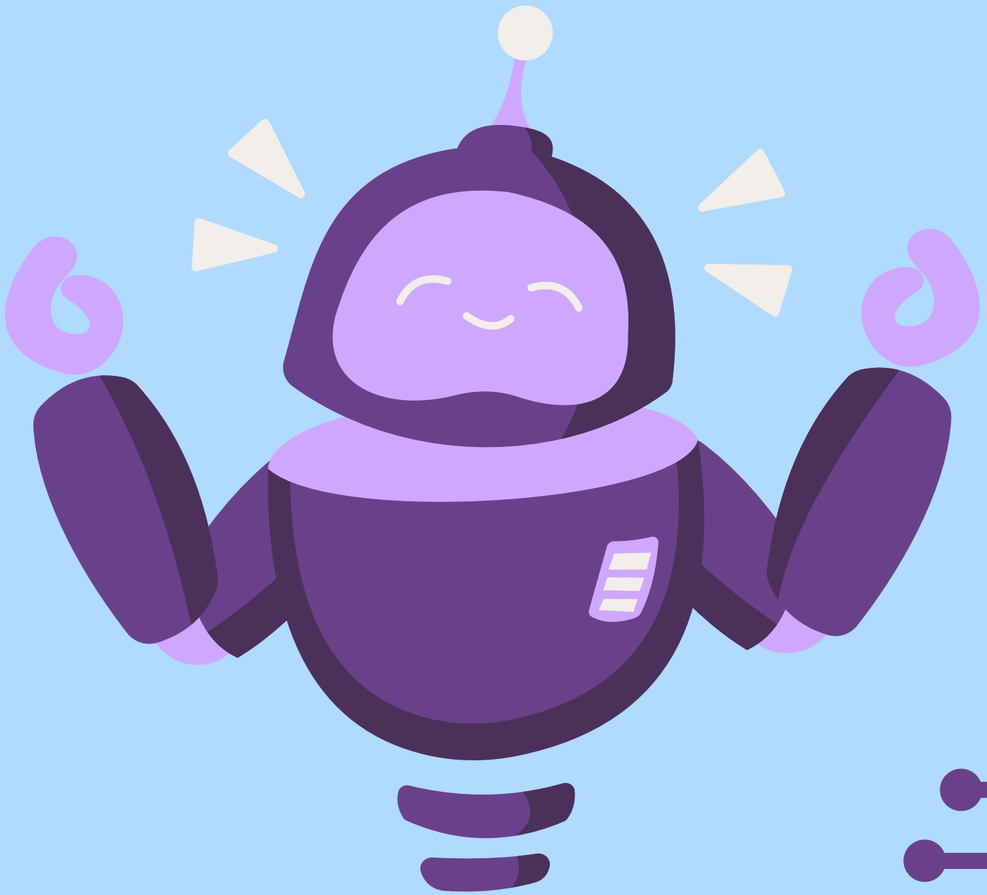
Create new content

- **Learning paradigm:** Deep Learning
- **Data:** Large-scale text corpora, medical image collections, omics data, multimodal data
- **Algorithm:** GANs, Transformers, VAEs, Diffusion Models
- **Model:** GPT, Claude, Med-PaLM, BioGPT, AlphaFold
- **Strengths:** Adaptable, generates new content at scale
- **Limitations:** Can hallucinate, non-deterministic, difficult to guarantew accuracy, high-computational costs, easy to misuse

Uses

- Automated clinical note generation
- ICD coding suggestions from notes
- Data augmentation
- Synthetic data generation
- Novel molecule generation
- Radiologist report generation

HOPE & HYPE



AI Capabilities

- Symbolic AI
- Predictive AI
- Analytical AI
- Decision-making AI
- Generative AI

Unlocked Opportunities

- Reduced unwarranted variations in Care
- P4 Medicine:
  - Predictive
  - Preventive
  - Personalised
  - Participatory
- Operational Efficiency
  - Reduce waste
  - Optimise flow
  - Right product, right place, right patient, right time

System Goal

- Quintuple aim:
  - Improved patient experience
  - Improved population health
  - Reduced per capita cost
  - Improved clinician experience
  - Improved health equity

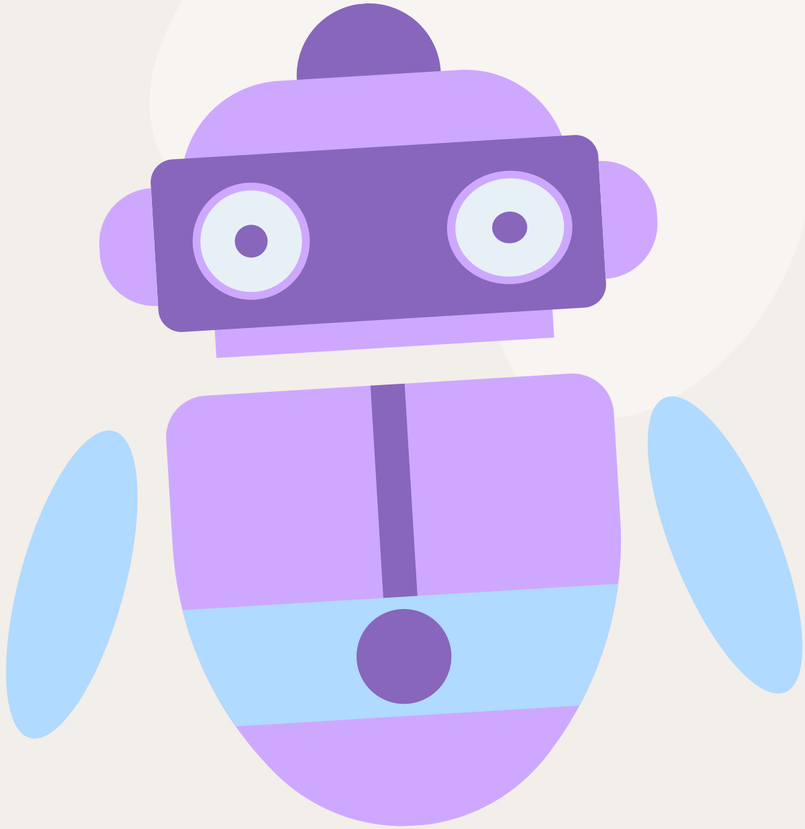
Capability Driven Hope

	Analytical AI	Predictive AI	Decision-making AI	Symbolic AI	Generative AI
Patient Experience	Identifies patient subgroups	Prevents complications	Personalised care paths	Encodes evidence-based protocols	Enables patient engagement
Population Health	Discovers health disparities	Forecasts population risk	Preventive interventions at scale	Encodes evidence-based protocols	Community outreach materials
Cost Reduction	Identifies cost drivers	Prevents expensive events	Optimises resource allocation	Reduces wasteful variation	Saves time
Clinician Experiecne	Surfaces insights	Reduces alert fatigue	Reduces decision-burden	Encodes evidence-based protocols	Reduces documentation burden
Health Equity	Discovers hidden biases	Flags disparities	Enables equitable resource allocation	Standardises care	Enables remote care

Policy Rhetoric

“We stand at the cusp of an era where data and AI will fundamentally transform healthcare; where a digital healthcare revolution promises to unlock a new era of access and choice; where new discoveries in preventative medications offer to transform population health; and where genomics and predictive analytics will deliver an increasingly sophisticated understanding of individual health risk, powering a totally new approach to prevention.”

NHS Fit For the Future, 2025



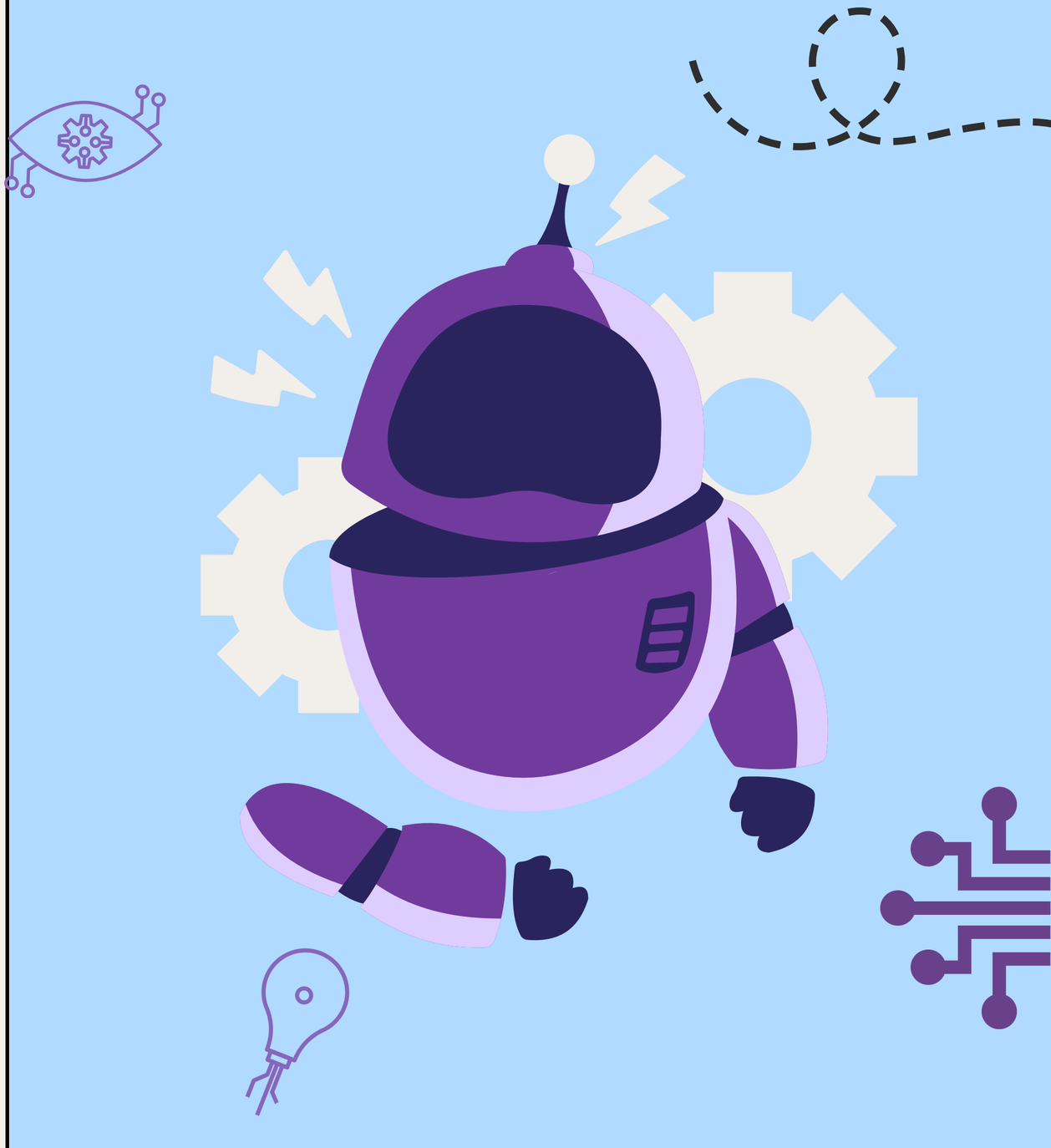
Hype

Data:	**Algorithm:**	**Model:**	**Implementation:**	**Action:**	**Outcome:**
The ingredients The input that determines what AI learns from	The recipe The learning method that finds patterns in data	The meal The finished product that applies what was learned to complete tasks	The cutlery The model embedded in clinical systems to be used IRL	Eating The action taken as a result of the model's input	Energy The result of the model + action on patients, clinicians, or systems

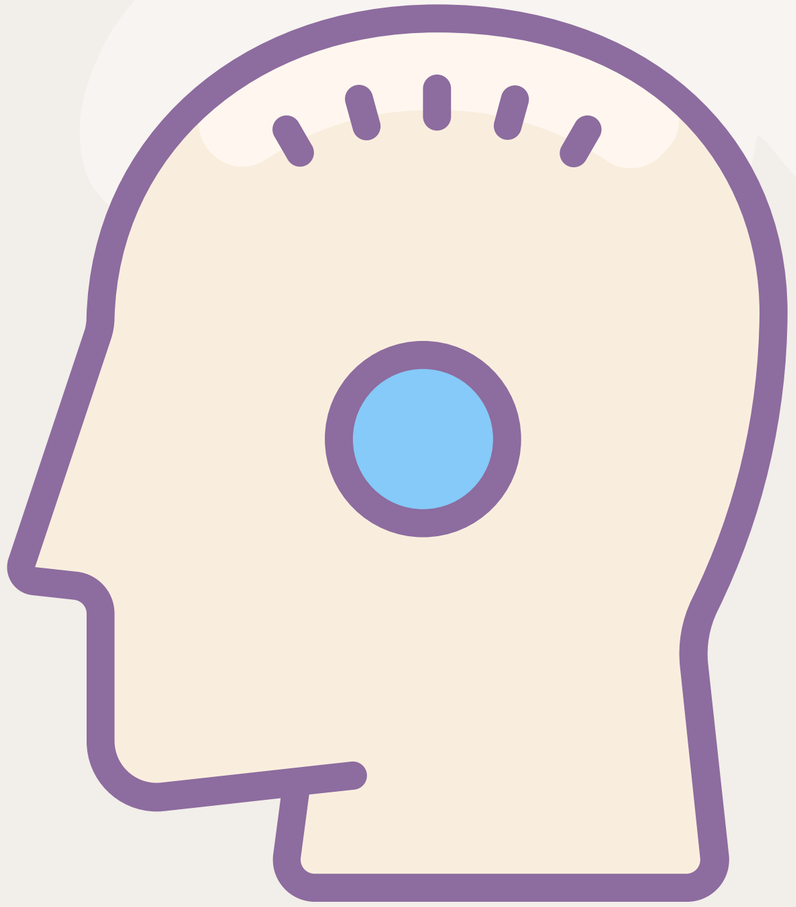
Horses or Cars?

- Is this what we actually want from AI?
- Or are these old system goals we've retrofitted?
- The reality is, there's a lot of money, for limited gains
- And nothing is effectively scaling ...

WHAT AI IS, ACTUALLY

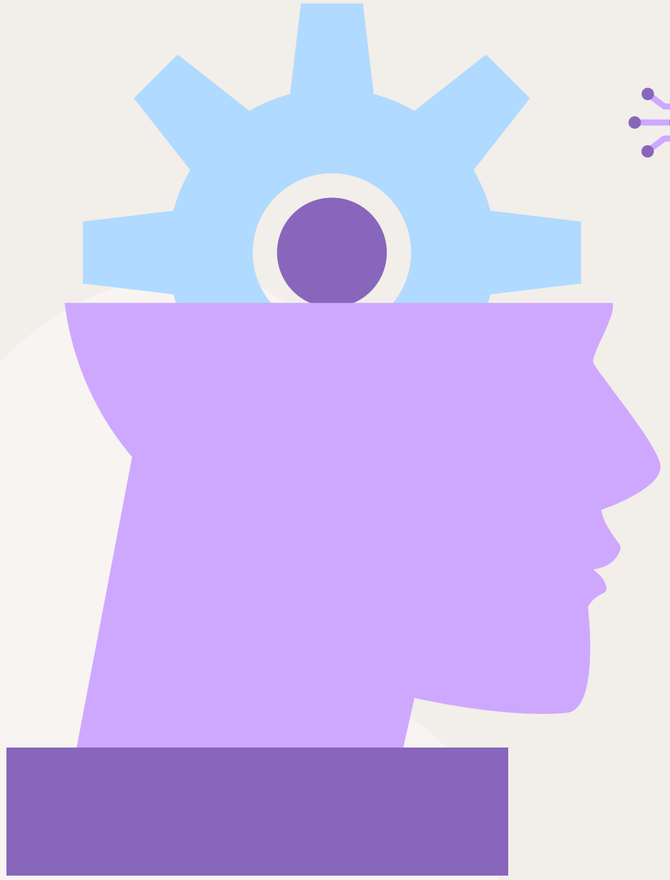


"A new form of agency that separates the ability to problem solve from the need to be intelligent, operating at the systems level"



Floridi & Morley 2025

Agency Unlocks



AI has the ability to transform everything from what counts as evidence of illness to how the cancer care pathway works

Cut:
Symptoms & Diagnosis, Knowledge about the Body & the Body, Clinical Knowledge & Clinic

Paste:
Patient & Data, Research & Practice, Big Tech & Healthcare

Systems Technology

- AI isn't a software upgrade that's bought off the shelf
- AI is new infrastructure that the healthcare system is being build around - like electricity, or the internet
- The question isn't "what AI tool should we buy?"
- The question is actually "How do we redesign the healthcare system around what AI makes possible?"

Systems Design

- **Form follows function** - Design the structure based on what it needs to accomplish, not based on what already exists or what's convenient.
  - Define desired outcomes
  - Identify required capabilities
  - Map capabilities to components
  - Design the system architecture
  - Define new roles and workflows
  - Identify required changes
  - Plan implementation sequence
  - Define success metrics

THANK YOU