

The impact of AI on the practice of medicine: disentangling fact from fiction

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Introduction



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A quick summary of this talk ...

- Artificial intelligence: a machine performs a task typically understood to require human intelligence to undertake
- Underlying technology: mixture of symbolic and stochastic machine-learning techniques, of which 'Deep Learning' is the most well-known
- Many opportunities for AI in medicine: triage/screening, diagnostics (especially image analysis), healthcare in the community, clinical decision-support for therapy
- Constraints will impact rate of adoption: data issues (availability, quality, standards, control), other demands on resources, regulatory concerns, market inertia, and limitations in the technology itself

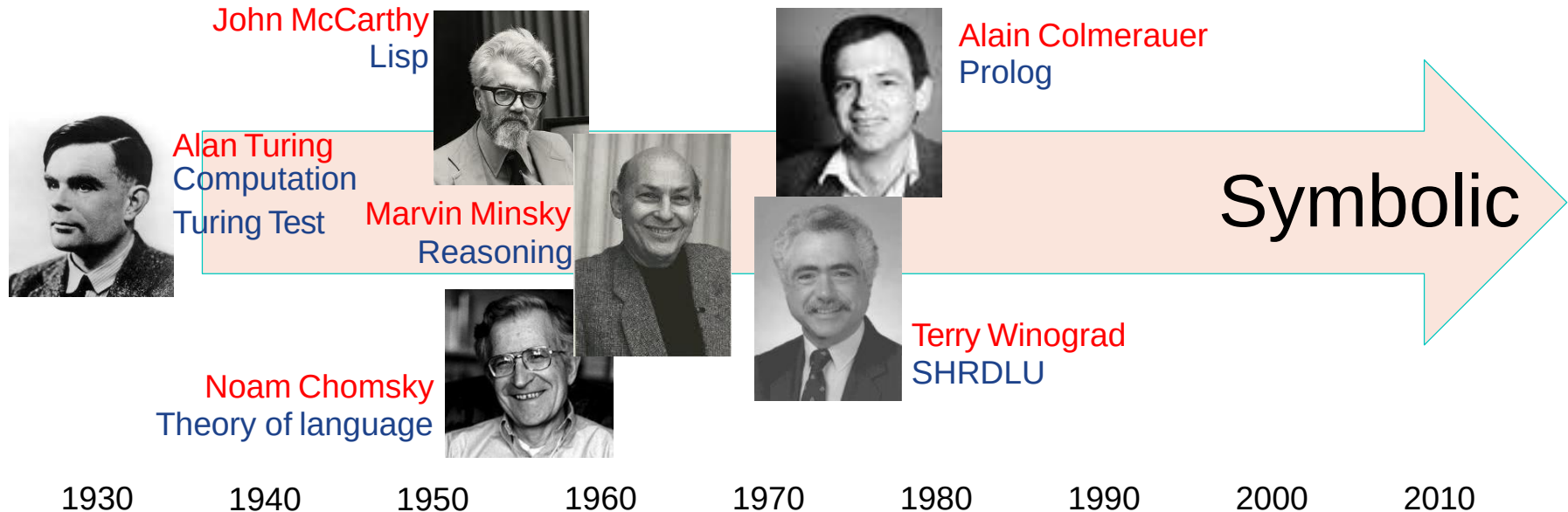
Agenda

- What is Artificial Intelligence ?
- How AI can be applied to medicine
- Issues and constraints

Competing ideas in AI

- Current AI research is still working through the implications of formative ideas established by the 1980s
- Two paradigms have defined the path:
 - Symbolic processing paradigm
 - Stochastic paradigm (aka statistical, learning from data)
- Ideas have been slow to achieve due to limits in: processing power, memory and data. These constraints have eased over the past decade
- For some areas, AI capabilities have reached a 'tipping point' where they have become practically useful
- Current limits of capability are far below those of popular imagination though

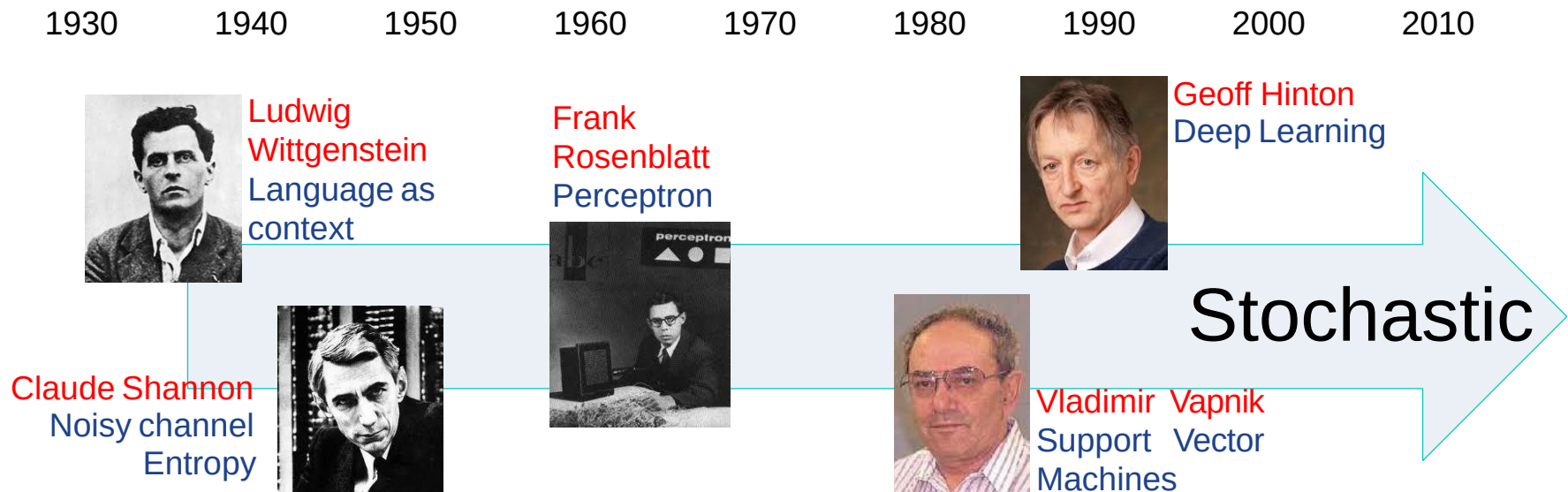
Symbolic paradigm: Intelligence through Reasoning



- Computers can demonstrate sophisticated “intelligent” behaviour through the application of logical reasoning rules to symbols
- These symbols represent ‘things’ in the real world, and the results of the rule applications can be meaningfully translated back into the real world

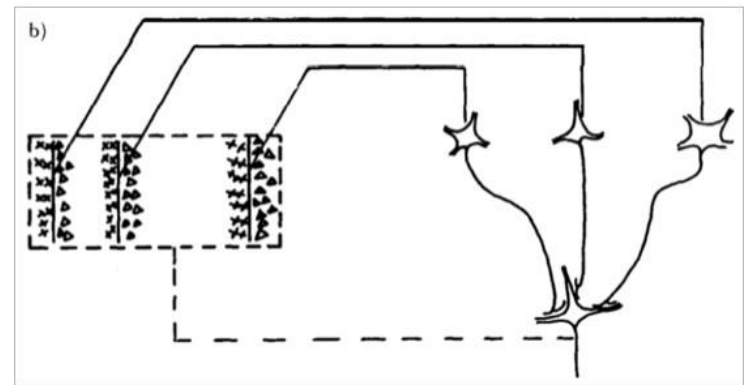
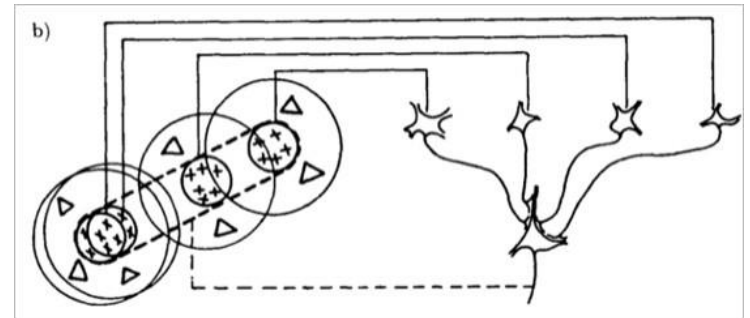
Stochastic paradigm: Intelligence through contrast and context

- Computers can demonstrate sophisticated “intelligent” behaviour by sensing statistical regularities in data, and inferring properties in new data based on the presence of such regularities

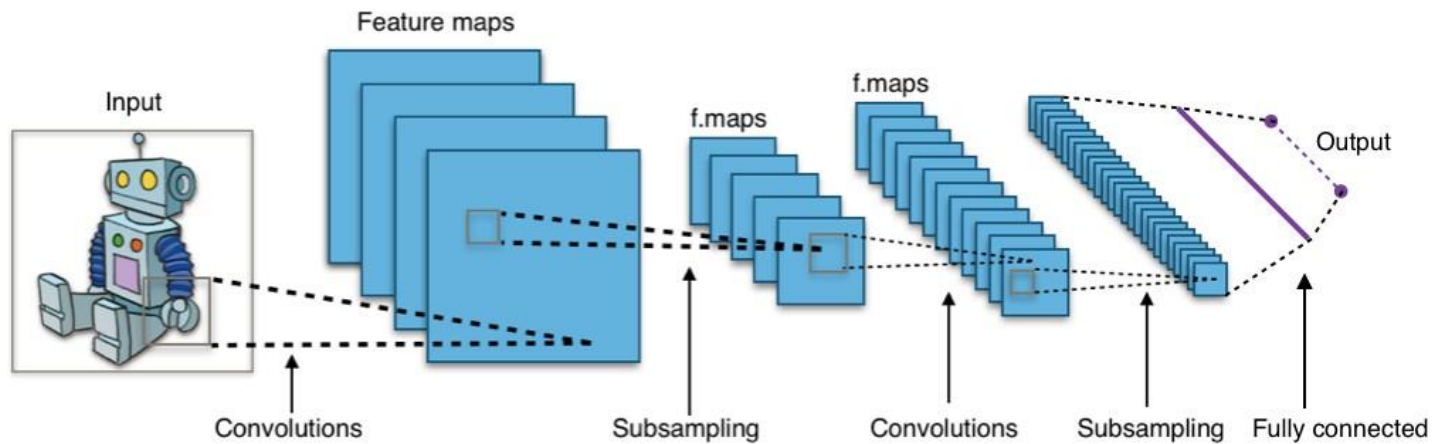
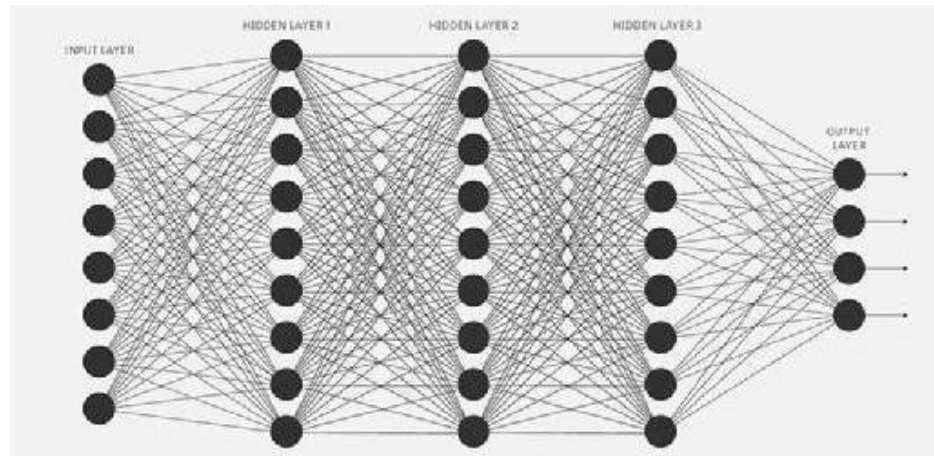


Stochastic paradigm: Intelligence through contrast and context

The old man was thin and gaunt with deep **wrinkles** in the back of his neck. The brown **blotches** of the benevolent skin cancer the sun brings from its reflection on the tropic sea were on his cheeks. The **blotches** ran well down the sides of his face and his hands had the deep-creased **scars** from handling heavy fish on the cords. But none of these **scars** were fresh. They were as old as **erosions** in a fishless desert.

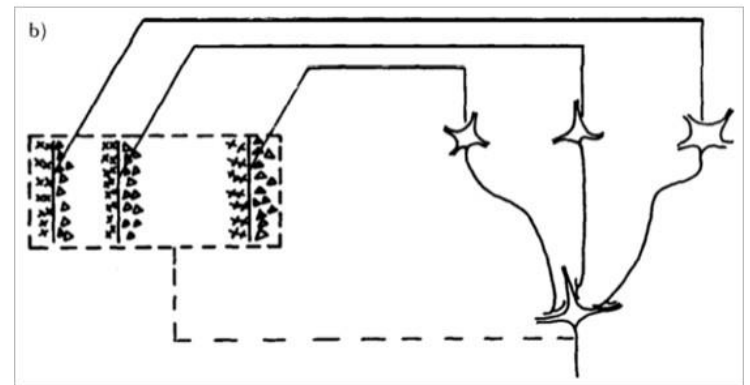
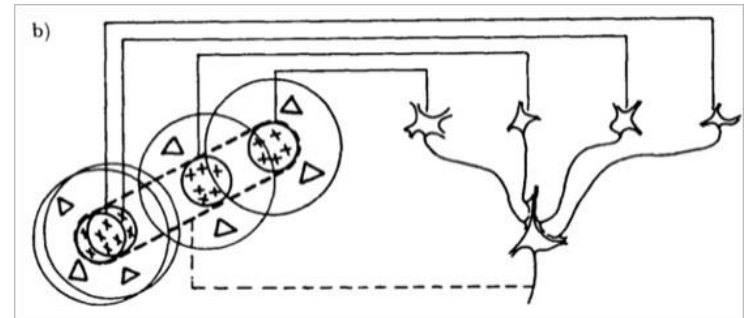


Stochastic paradigm: Intelligence through contrast and context

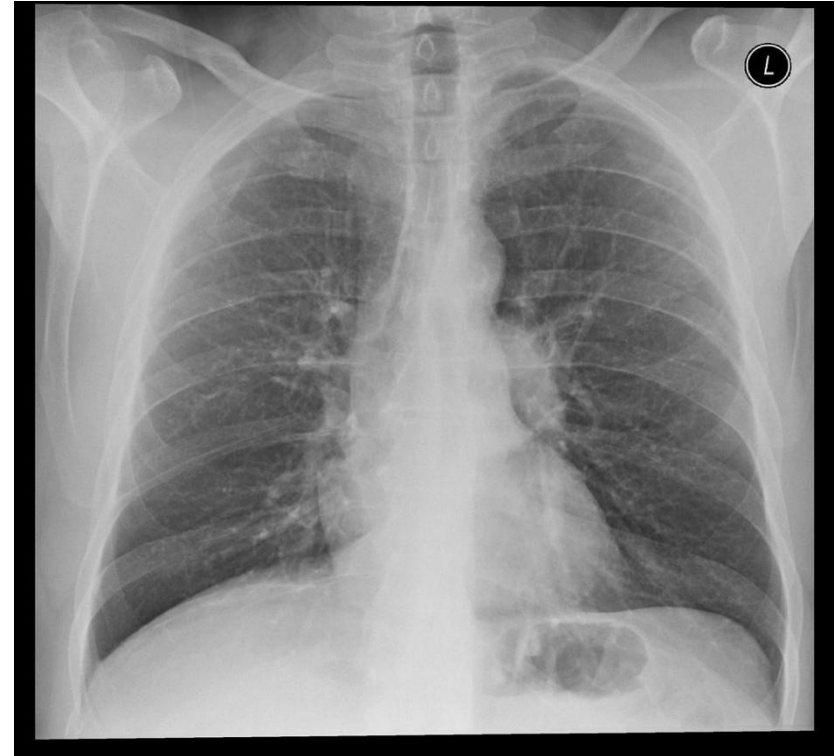
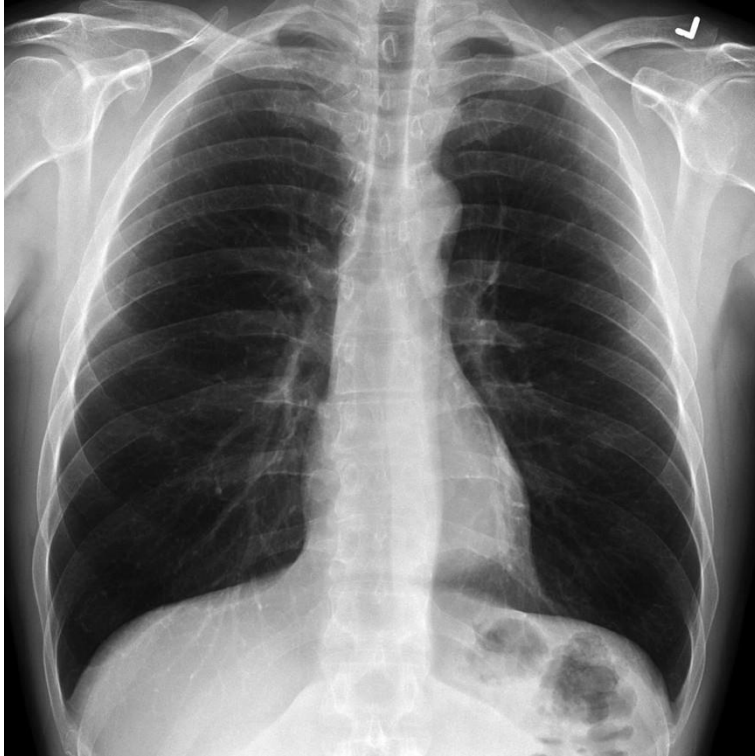


Stochastic paradigm: Unsupervised vs Supervised Learning

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Stochastic paradigm: Unsupervised vs Supervised Learning



Current AI systems are symbolic programs with stochastic cores



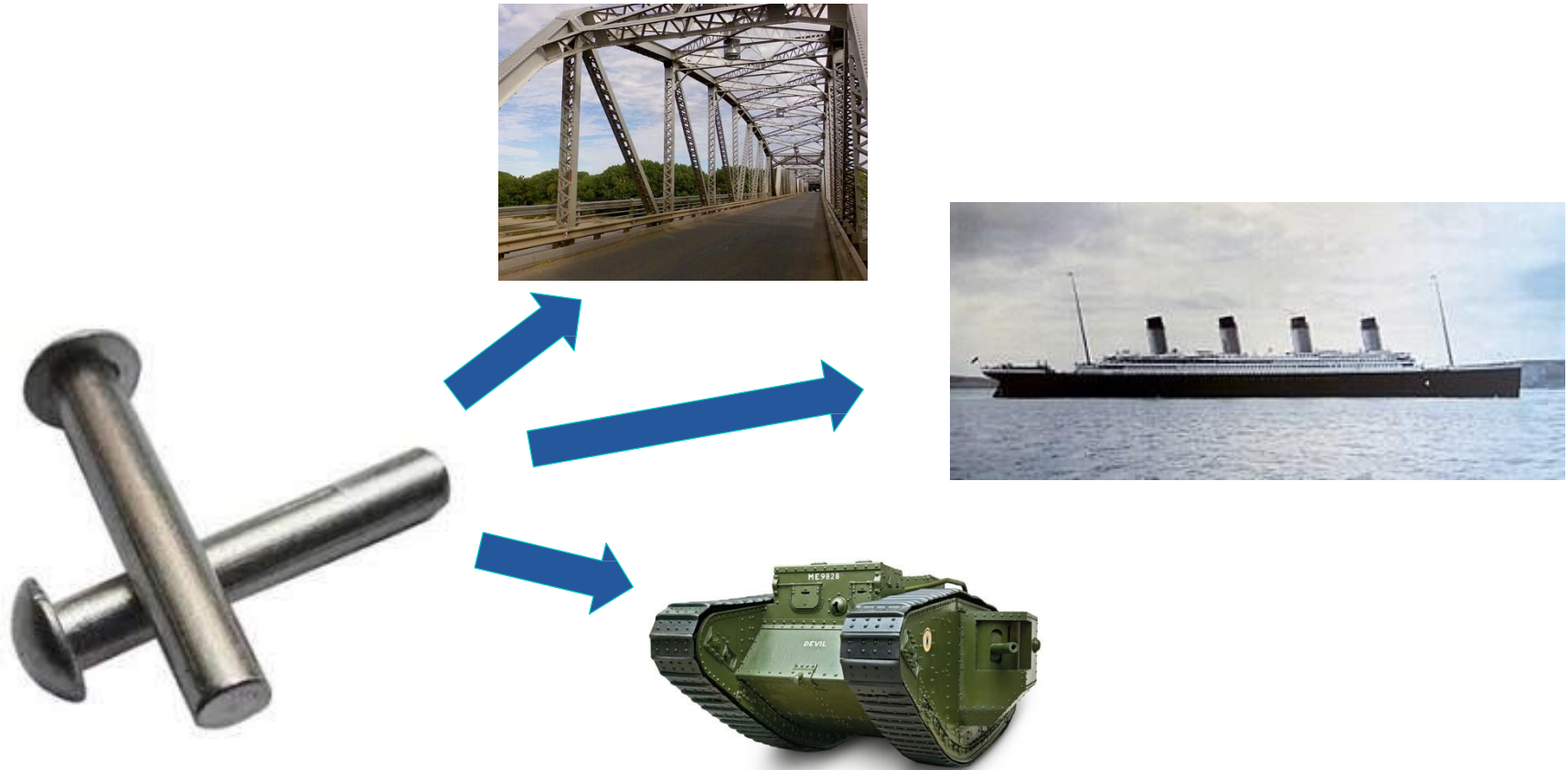
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How AI can be applied to medicine: AI is the rivet of the 21st century



How AI can be applied to medicine

**Diagnosis /
Screening**

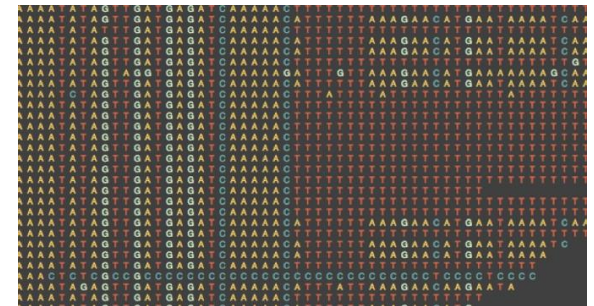
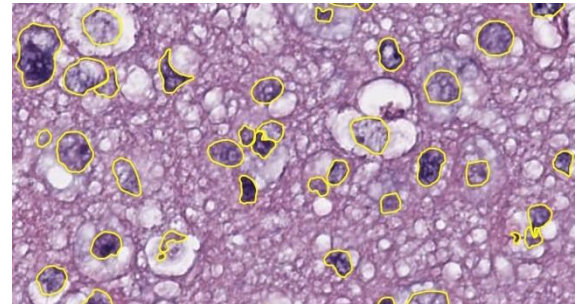
**Health in
Community**

**Therapeutics &
Decision Support**

How AI can be applied to medicine: Diagnosis / Screening

Diagnosis / Screening

- Radiology image analysis
- Pathology image analysis
- Evaluation of textual data
- Analysis of genomics data
- Integration of multiple sources



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Diagnosis / Screening

- Skin cancer lesion detection
- Diabetic eye disease from photos
- AMD from OCT images
- Breast cancer from mamograms
- Colon cancer from CT scans
- Pulmonary nodules from X-rays
- X-ray analysis (emphysema, edema, effusion, mass, hernia, nodule, fibrosis)
- Categorise liver lesions from CT scans
- Tissue histopathology image classifier
- Heart failure diagnosis from EHRs
- Automatic monitoring alerts in EHRs
- OsteoDetect: Wrist fractures from X-ray
- Arterys: lesions in CT & MRI scan
- IDx-DR: diabetic retinopathy photos

How AI can be applied to medicine : Health in Community



Health in Community

- Promotion of healthy lifestyle
- Monitor for independent living
- Disease management
- Mental health support

How AI can be applied to medicine : Health in Community



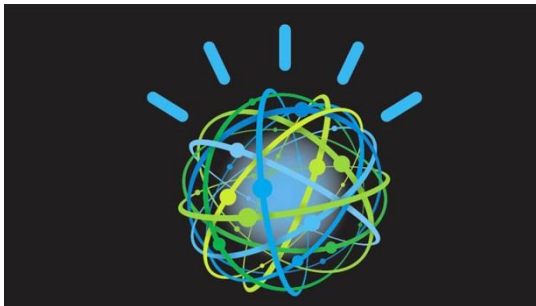
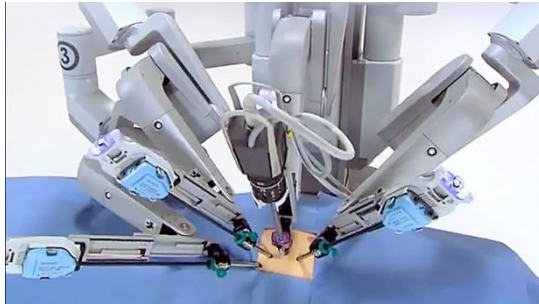
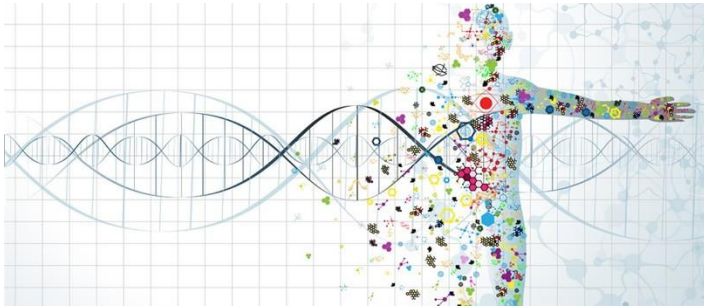
Health in Community

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Health in Community

- Fitness and health tracking
- Medical adherence assistance
- Chronic disease monitoring
- Continuous glucose monitoring
- Remote consultation
- AI-backed CBT for depression
- AI-backed assisted living monitoring

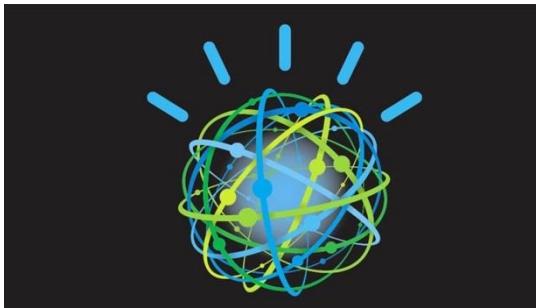
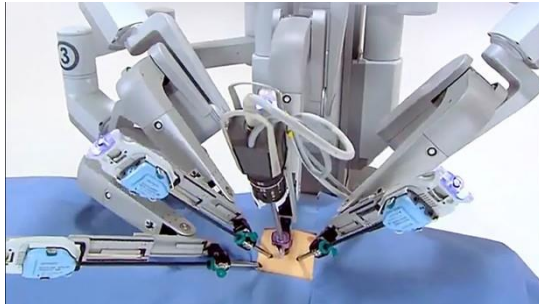
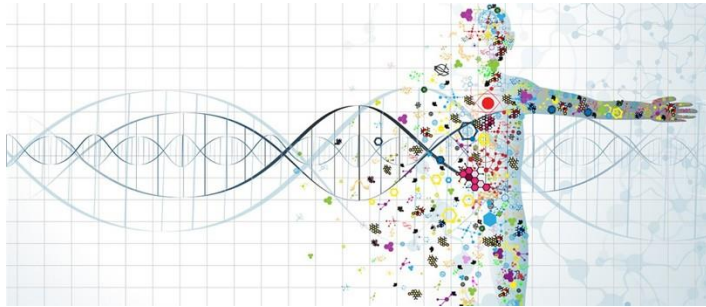
How AI can be applied to medicine : Therapeutics & Decision Support



Therapeutics & Decision Support

- Predicting outcomes
- Precision therapy
- Robotic surgery
- Treatment advice

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Therapeutics & Decision Support

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Therapeutics & Decision Support

- Cardiovascular risk calculation
- Predicting cancer outcomes from histology and genomics
- Autonomous robotic soft tissue surgery
- Prediction of AAA surgery outcomes
- Watson: cancer trial matching
- Watson: Cancer treatment advice

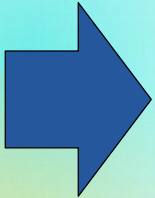
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Issues and constraints

- Data issues
 - availability, quality, control
- Other demands on resources
- Regulatory requirements
- Market inertia
- Limitations of the technology

Issues and constraints: where AI will make progress first

- Data issues
 - availability, quality, control
 - Other demands on resources
 - Regulatory requirements
 - Market inertia
 - Limitations of the technology
- 

- Data abundant and well controlled
- Technology works well
- Confers large benefit
- Overwhelmed with increasing volumes
- Poorly served area
- Required for therapeutic advance
- Consumer led
- Private pay

Over-estimating Potential: Rodney Brooks' 6 Rational Explanations

Imagining magic



Performance vs Competence

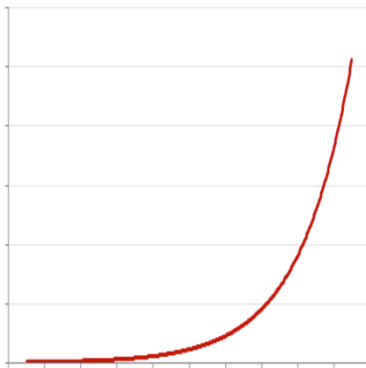


Suitcase words



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Exponentials



Hollywood Futures



Deployment Rate



Thank you



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