A Brief Intro to AI and CS

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What is Artificial Intelligence (AI)?

History of Computers/Programming/AI 1

1822 Babbage built the difference engine

1837 Babbage designs first general purpose computer

1842 Ada Lovelace writes first program

1942 Zuse creates first high-level programming language - Plankalkül

1947 First transistor

1949 Random access memory

1950 Turing test proposed

1956 Birth of Artificial Intelligence as discipline

1958 Perceptron created – a step towards neural networks

1959 First microchip

History of Computers/Programming/AI 2

1960 Holland proposed the genetic algorithm

1965 First deep learning system

1967 Amdahl invented the basis for the supercomputer

1969 C invented by Ritchie and Thompson

1969 ARPANET - Precursor to Internet

1971 First microprocessor

1975 Werbos developed back-propagation algorithm to train a neural network

1993 World Wide Web

1995 Java invented by SUN Microsystems

2001 IBM creates multi-core chip

Computer Programming 1

- Computer programs are sets of instructions given to machines to perform specific tasks.
  - Written in precise programming languages.
  - Classically: take in input, process it, produce output.

```
sub get_pos ()
{
   my ($headings, $field) = @_;
   for ( my $i=0; $i<=$#$headings; $i++ )
   {
      if ($headings->[$i] eq $field)
      { return $i; }
   }
   undef;
}
```

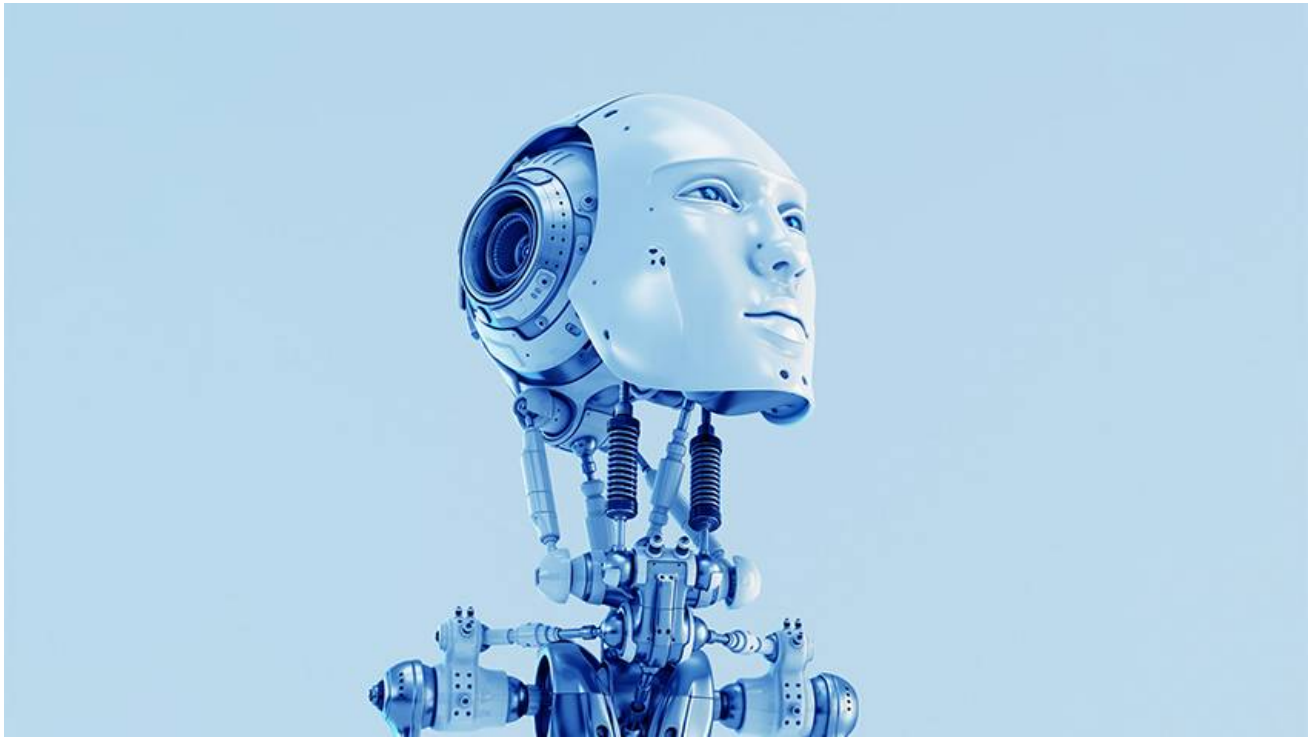

Computer Programming 2

- Goal: Write instructions for machine.
  - But this is difficult.

- How can we create programs without writing programs:
  - Use a solution space search (Prolog)
  - Learn patterns from data (Machine Learning)
  - Evolve programs (Evolutionary Computing)

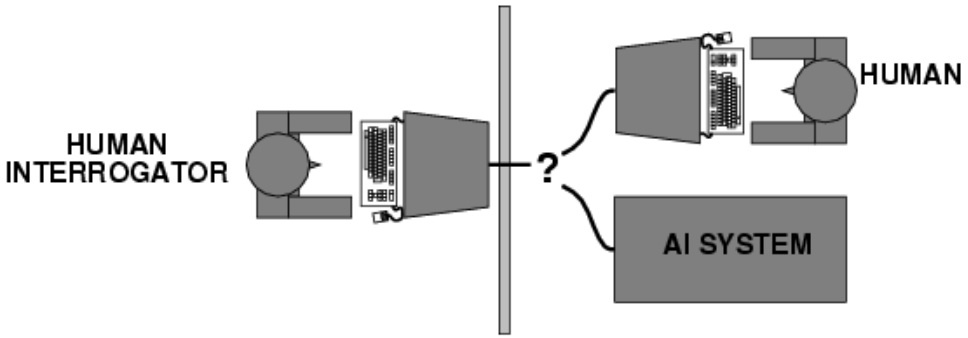
Artificial Intelligence – Popular View

- Replacement for a human.



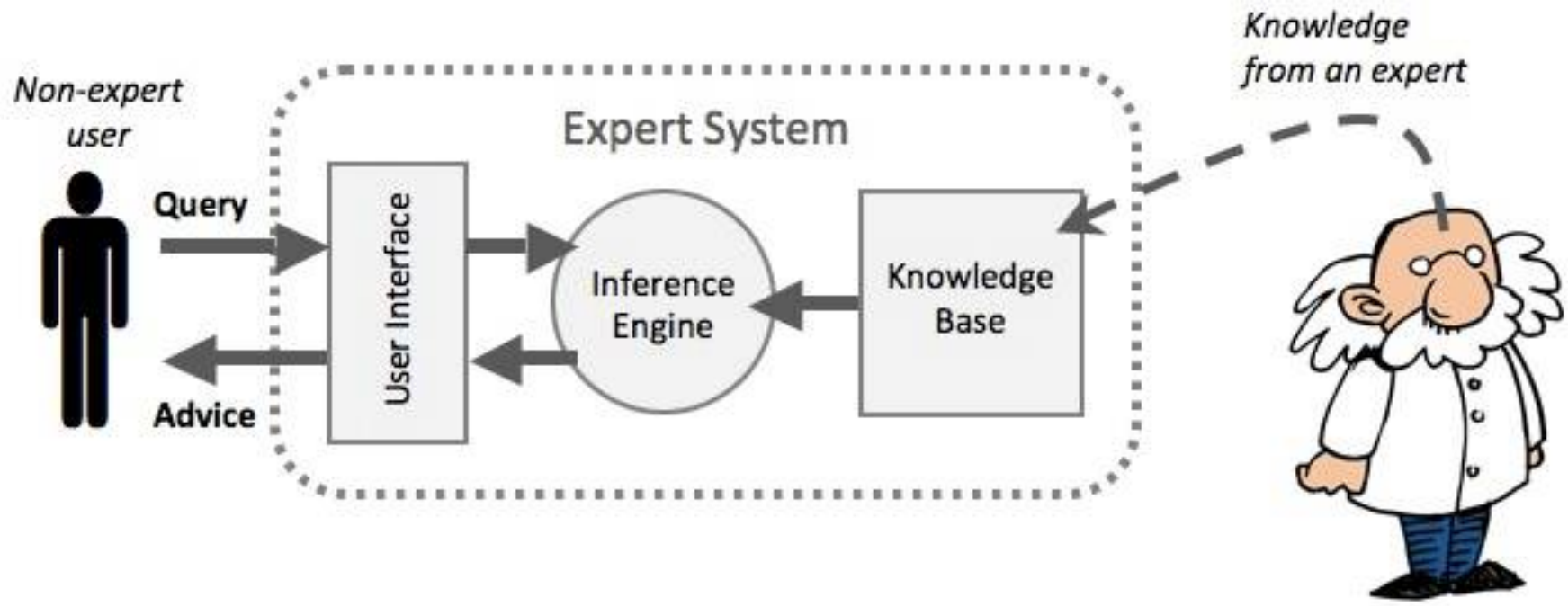
Turing Test

- Turing (1950) "Computing machinery and intelligence"
  - Operational test for intelligent behavior: the Imitation Game



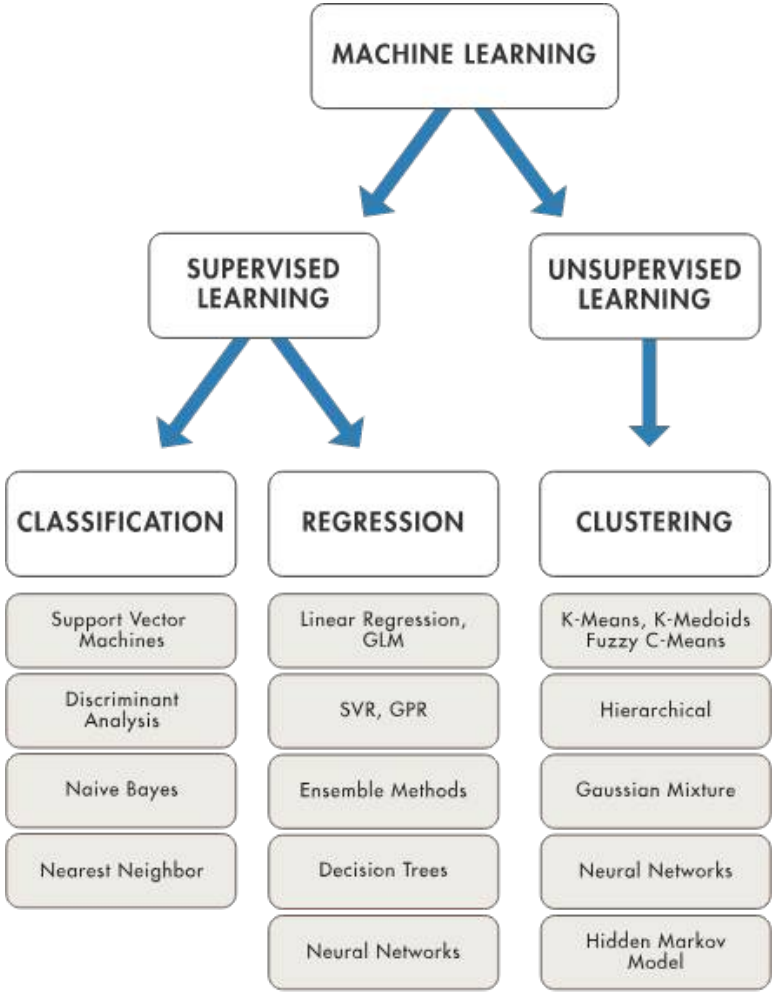
Artificial Intelligence – Classical (KRR)

- Based on capturing knowledge in a symbolic representation, and reasoning over the knowledge bases.



Artificial Intelligence – Practical (ML)

- Machine Learning (ML) entails a software system that can statistically encode patterns and thereafter match patterns.



Supervised Learning

- We have input+output data pairs, and lots of them.
- Learning:
  - ML engine derives statistical relationship between input and output.
- Querying:
  - When given arbitrary known input, produce output.
  - *When given unseen input, infer output based on what else it saw.*

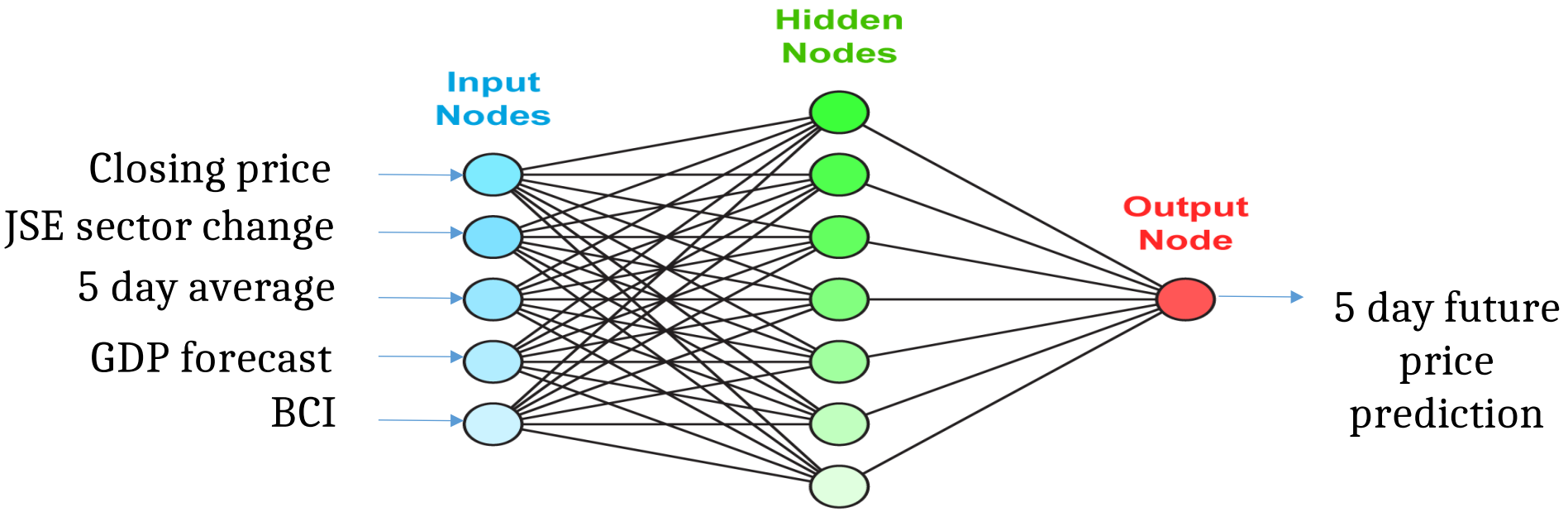
Unsupervised Learning

- We have data items, and lots of them.
- Learning:
  - ML engine derives statistical relationships among data items.
- Querying:
  - Users can explore relationships among data items.

Some AI approaches

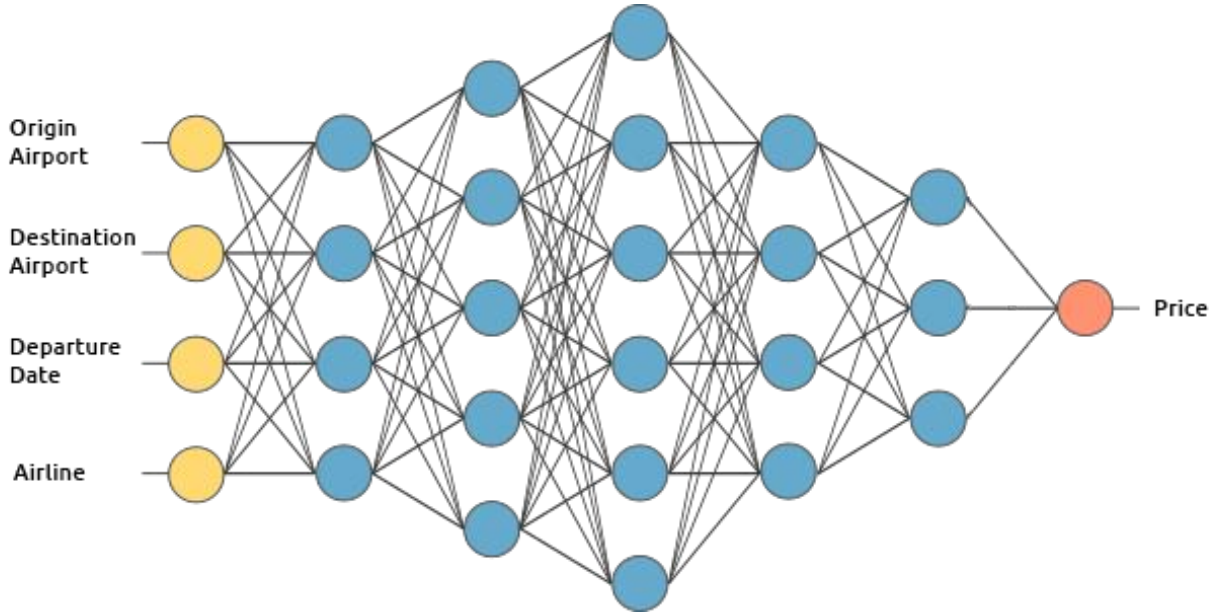
Artificial Neural Network (ANN)

- Model of brain's neurons and interconnections to models events and probabilities of relationships.



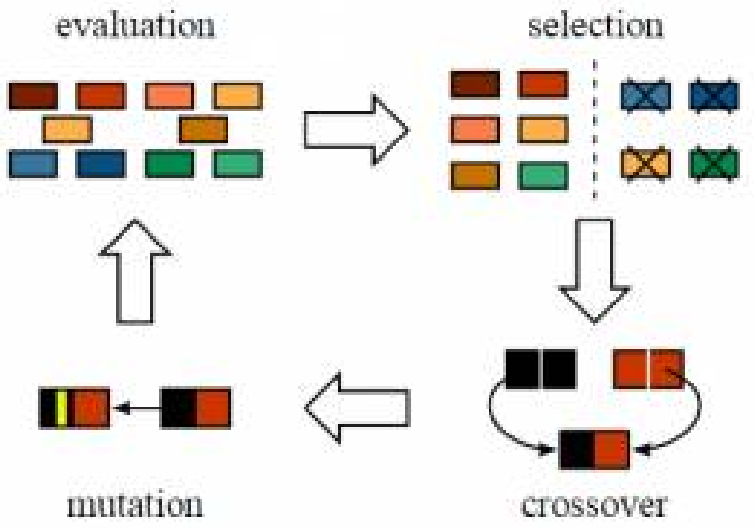
Deep Learning

- ANN with lots of intermediate layers to learn complex and abstract concepts.
- Learn both the structure and the weights.



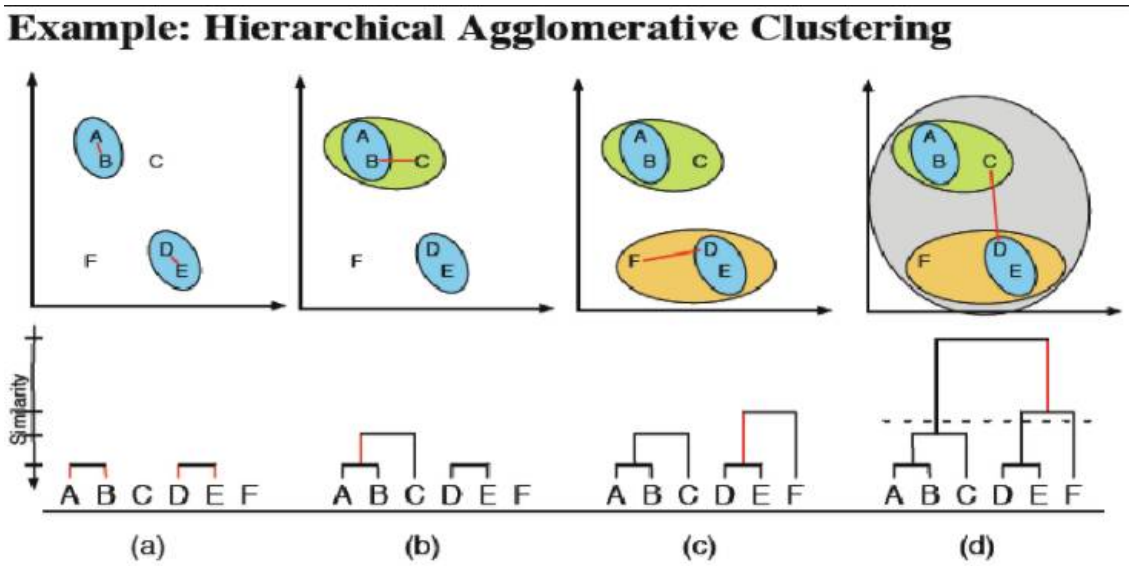
Evolutionary Computation

- Simulating evolution (natural selection, survival of the fittest, mutation) to find solutions to unsolvable problems.



Hierarchical Agglomerative Clustering

- Creating clusters of data without prior knowledge, built by repeatedly combining clusters that are most similar.



Modern AI Applications

- Computer vision – face recognition
- Speech recognition – Alexa, SIRI
- Natural language processing – translation services, question answering systems
- Information retrieval – Google
- Recommender systems – Netflix, Take-A-Lot
- Autonomous robots
- Computer games
- Self-driving cars - Uber

Exemplars at the intersection of AI and Humanities

Digital Libraries Lab @UCT

- Making information available to people
- Context-sensitive: low resource environment, different languages, different skills/culture, etc.
- Collaborations with librarians, archivists, linguists, historians, etc.
- 5 areas of interest:
  - Information Retrieval (IR) – HS
  - Digital Libraries (DL) - HS
  - Educational Technology – HS
  - Ontologies/Knowledge engineering – CMK
  - NLP - CMK

Digital Bleek and Lloyd Collection

THE DIGITAL BLEEK AND LLOYD HOME

This digital publication is part of a Llarec project to digitise, research and publish the Bleek and Lloyd Archive. The Digital Bleek and Lloyd includes scans of every page of the 110 Lucy Lloyd |xam notebooks, 17 Lloyd (mostly) !kun notebooks and 28 Wilhelm Bleek |xam notebooks. It also includes Jemima Bleek's solitary Korana and !kun notebook and four Lloyd Korana notebooks in the Maingard collection of the Library at the University of South Africa, as well as Dorothea Bleek's 32 notebooks. All the drawings and watercolours made by |han≠kass'o, Dia!kwain, Tamme, |uma, !nanni and Da are also in the digital collection. The digital archive includes a 280 000-word searchable index, cross-referenced and including notes and summaries for each of the stories listed. Notes in italics are direct quotes from the reports of Bleek and Lloyd in which they detailed the progress of their research.

Llarec (the Lucy Lloyd Archive, Resource and Exhibition Centre) is part of the Centre for Curating the Archive, a University of Cape Town research centre directed by Pippa Skotnes and located at the Michaelis School of Fine Art. The initial "Digital Bleek and Lloyd" accompanied the publication "Claim to the Country: the Archive of Wilhelm Bleek and Lucy Lloyd" by Pippa Skotnes (2007), published by Jacana Media and Ohio University Press. Subsequently Jemima Bleek's and Dorothea Bleek's notebooks have been added, as well as the Digital Stow, featuring the rock art copies of George Stow. The search index and summaries have also been extended and currently the Bleek and Lloyd dictionaries are being digitised. Please refer to the CCA website at http://www.cca.uct.ac.za for updates.

The project has been made possible by funding provided by the Andrew W. Mellon Foundation and De Beers; and is the result of the cooperation of the four curating institutions: University of Cape Town, Unisa, Iziko South African Museum and The National Library of South Africa.

These scans of the documents and images that comprise the Bleek and Lloyd archive may not be used or reproduced for any purpose without permission of the copyright holders.

Books
Cover to cover | Contributor | Story | Category | Keyword

Drawings/Watercolours
Contributor | Category | Keyword

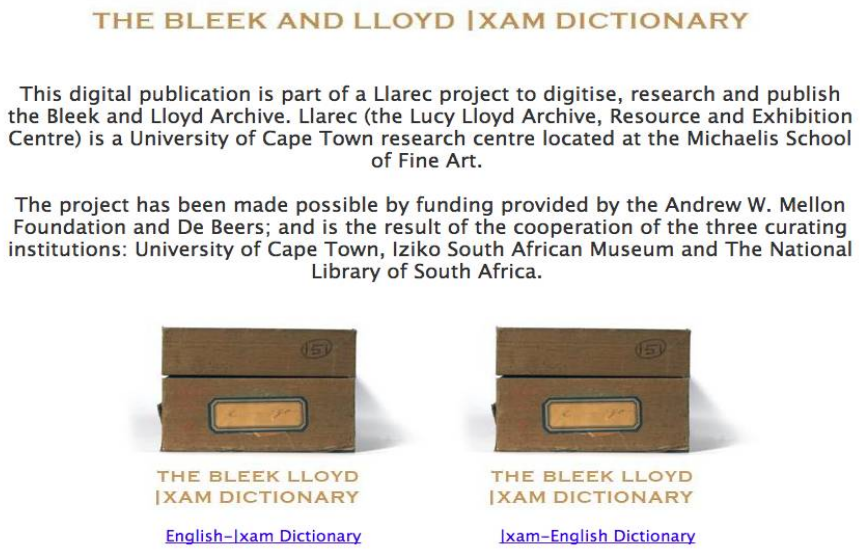
Digital George Stow
Images

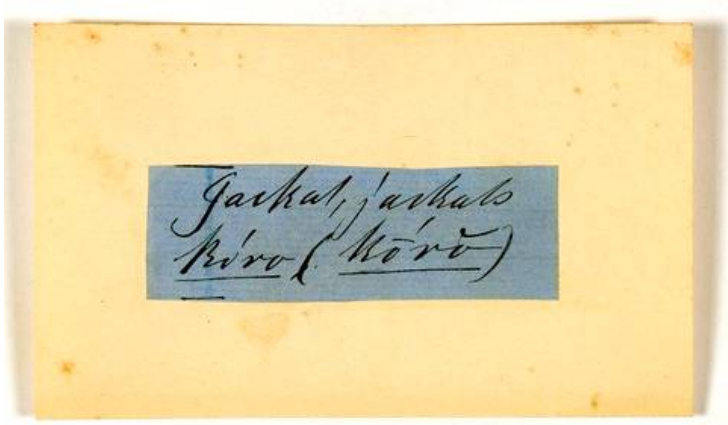
Contributors
|xam | !kun | Researchers

Bleek and Lloyd: Dictionary

Lebogang Molwantoa, Sanvir Manilal, Kyle Williams, BSc(Hons)

- Visual dictionary – pictures of words.
- Find meanings of words in stories by image search.





Bleek and Lloyd: Transcription

Kyle Williams, MSc; Ngoni Munyaradzi, MSc

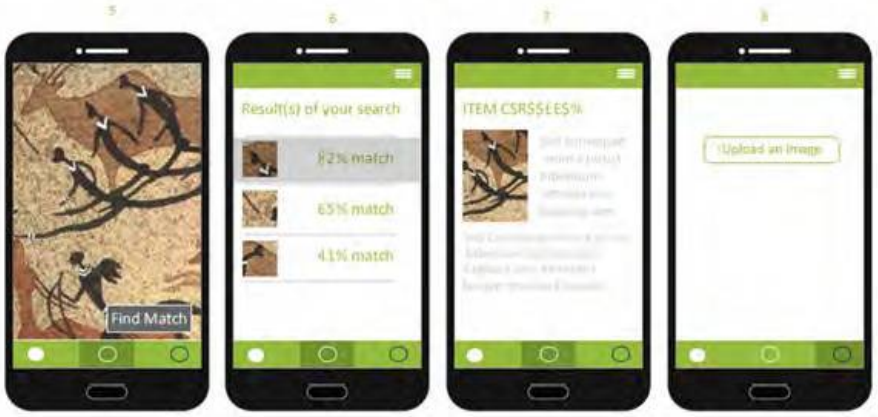
- Using machine learning to transcribe |Xam.
- Training data manually generated.
- 45% accuracy at best.

- Crowdsourcing had 10% better performance.
  - Answer determined by agreement among 3 amateur transcribers.

Rock Art: Navigation Guides

Ayodeji Olojede, MSc

- Mobile tool to help users get information on rock art when in the field.
- Using machine learning techniques to perform image search on archived rock art images.
- Excellent results on typical phones.



African Language IR: Learning

Mantombi Manqele, U/G

- SeSotho Search Engine.
  - Can we improve search results using word embeddings for query expansion?

African Language IR: Similar Languages

Catherine Chavula, PhD (current);
Sinead Urisohn, Andre Lopes, BSc(Hons)

- Exploit language similarity for those who can read multiple languages.
  - Reranking to emphasize language similarity in addition to relevance.
  - Universal language group text pre-processing, such as stemming.

IR for Development

Selvas Mwanza, PhD (current)

- Can we use Twitter data to evaluate developmental measures in society (e.g., level of free speech)?

Concluding perspectives

The Tool Perspective

- Machine Learning only provides a set of coarse tools.
- How we use the tools and what we use them for are both crucial.
- Toyama: Technology amplifies intent.
  - It is not a replacement for human intent or lack of human capacity.

The Data Perspective

- Machine Learning only works with what you give it.
  - Just fancy statistics and patterns.

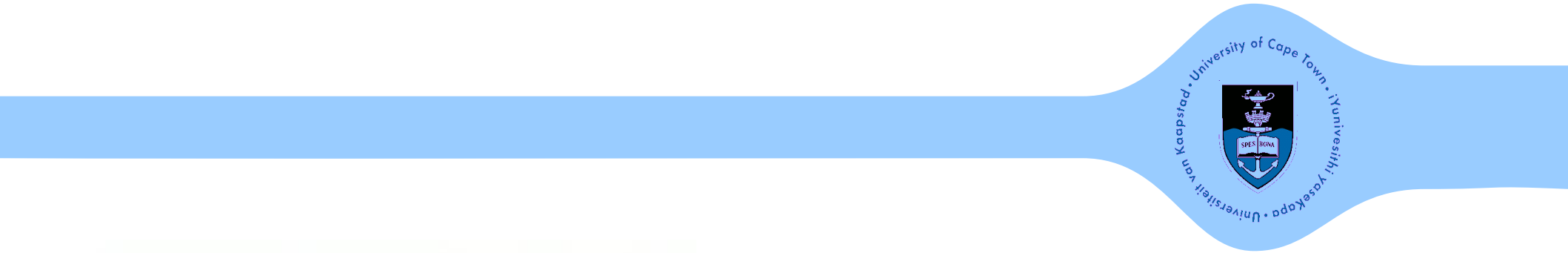
- Bias is a human issue.
  - It is almost always the human being who chooses inadequate data or the wrong approach or extrapolates where we should not.

The Scale Perspective

- Machine Learning is not new.

- What is new:
  - Massive data.
  - Massive computational power.

questions, comments, ...



Interviewer: What's your biggest strength?

Me: I'm an expert in machine learning.

Inteviewer: What's 6 + 10?

Me: Zero.

Interviewer: Nowhere near, it's 16.

Me: It's 16.

Interviewer: Ok... What's 10 + 20?

Me: It's 16.

enkosi
hamba kakuhle
thank you and go well

http://dl.cs.uct.ac.za/