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Patenting Artificial Intelligence (AI)

Chair: Mike Jennings, AA Thornton

Speakers: Ben Hoyle Hoyle IP Services

& Anita Shaw, IBM

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We will try to cover:

- AI developments – why now?
- IBM's Watson cognitive computing system
- Patentability of AI solutions at the EPO
  - "specific technical applications" and
  - "specific technical implementations"
- Patentability at UKIPO
- US, China & Japan
- Other IP rights

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Why AI, why now?

- Differentiable compute graph + back-propagation + optimisation (gradient descent)
- “Deep” Neural Networks
- 3 Core Areas:
  - Image Processing (CNNs)
  - Sequence and Natural Language Processing (RNNs)
  - Reinforcement Learning (DQN, MDPs)

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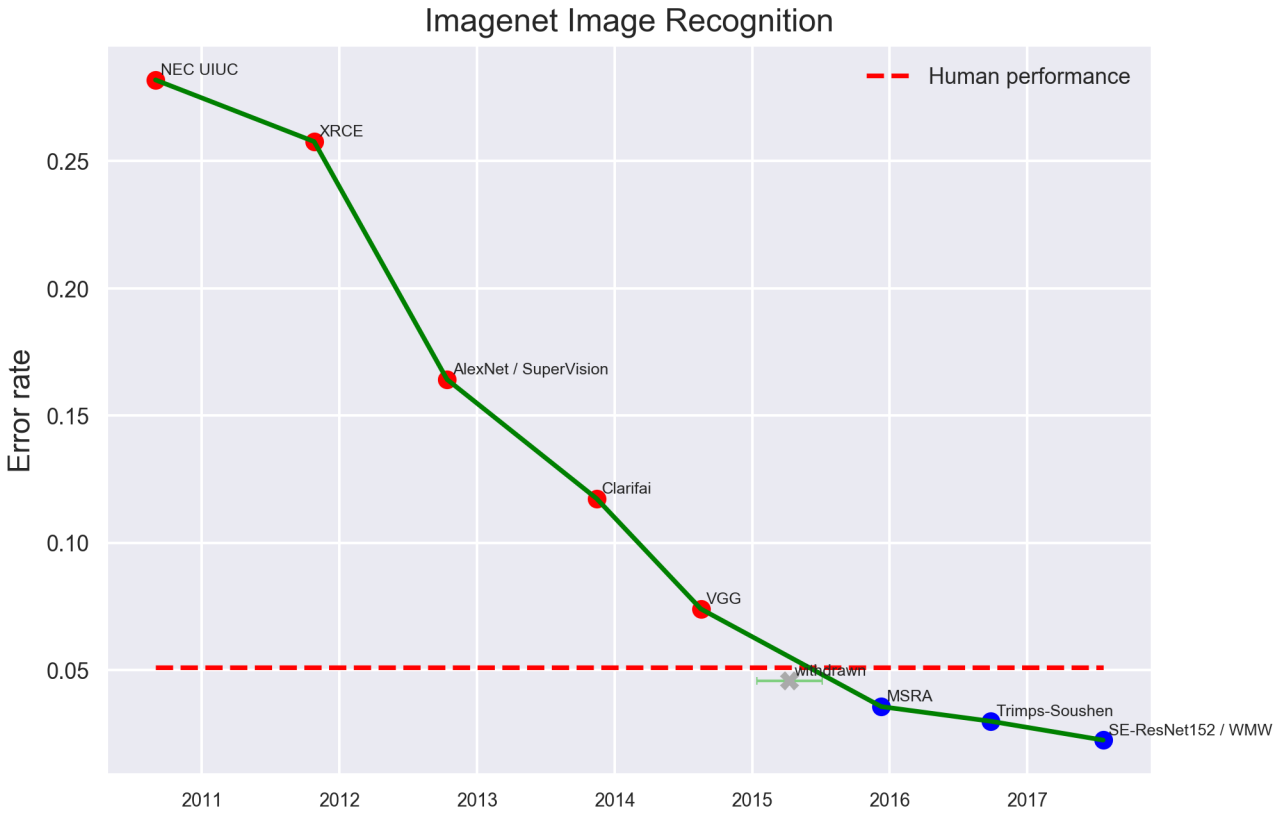
Why AI, why now?

- Watson & Jeopardy - 2011
- ImageNet - 2012 (error – 25% > 16%)
- Word Embeddings - 2013
- Machine Translation (Seq2Seq) - 2014
- GANs - 2014
- TensorFlow - 2015
- Atari Game & AlphaGo - 2015-17
- Into Industry - 2017/18+

Why AI, why now?



Electronic Frontier Foundation – AI Progress Measurement

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Why AI, why now?

- Software 2.0?
- Train Your Own Function Approximator
- Shift from Rules > Data (Good for Industry)
- Bayesian Approaches still Chugging Along
- Still lots of gaps:
  - Explainability
  - Robustness
  - Multi-task learning

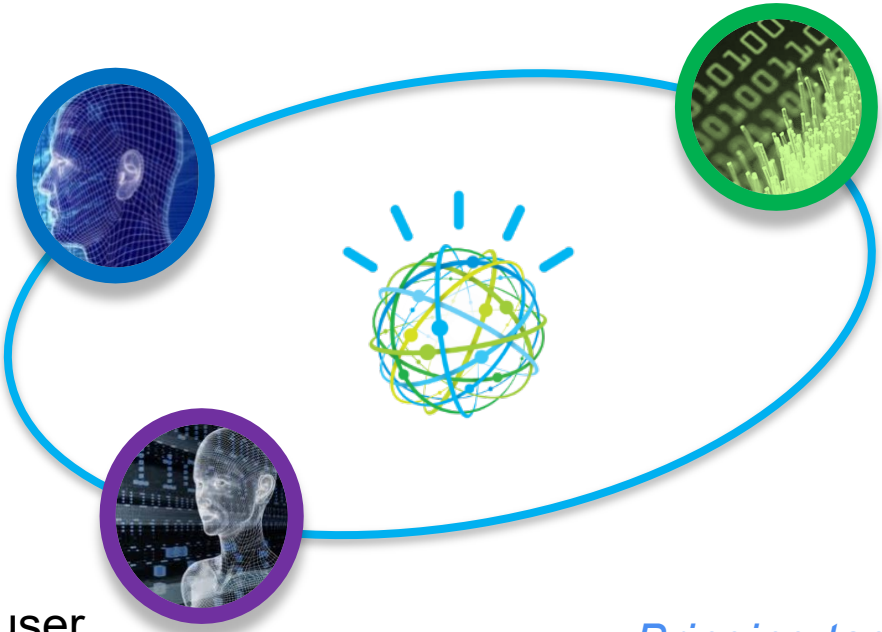
IBM and AI

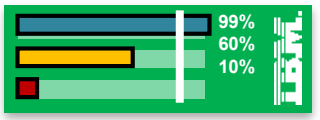
- **Watch Ginni Rometty (IBM CEO) at the World Economic Forum in Davos 2017:** https://www.youtube.com/watch?v=j98rY3vhPhE
- Related technology: Cloud, Data, Mobility [& Security/Privacy]
- Technologies to augment human intelligence/cognitive

IBM's cognitive system is known as IBM Watson

1 Understands natural language and human speech

2 Generates and evaluates hypothesis for better outcomes





3 Adapts and Learns from user selections and responses

…. Bringing together transformational technologies to drive optimized outcomes

IBM Watson Health – focus areas

Oncology and genomics
Allowing cancer patients to benefit from cognitive knowledge

Imaging
Expanding the role of medical imaging for better patient care

Life sciences
Accelerating targeted and effective therapies

Payer / Provider
Reducing costs and addressing quality

Government
Improving the value of health and human services

Consumer
Empowering individuals to be proactive and self advocate for healthier lives

EPO Guidelines

G-II, 3.3.1 – AI & machine learning

- “Artificial intelligence and machine learning are based on computational models and algorithms …... Such computational models and algorithms are *per se* of an abstract mathematical nature, irrespective of whether they can be "trained" based on training data.

- Hence, the guidance provided in G-II, 3.3 generally applies also to such computational models and algorithms”

EPO Guidelines

G-II, 3.3 – Mathematical methods

Two ways to qualify:

"A mathematical method may contribute to the technical character of an invention, i.e. contribute to producing a technical effect that serves a technical purpose,

- by its application to a field of technology and/or
- by being adapted to a specific technical implementation.

EPO Guidelines

G-II, 3.3 – Mathematical methods

1. Specific Technical applications

- When assessing the contribution made by a mathematical method to the technical character of an invention, it must be taken into account whether the method, in the context of the invention, serves a technical purpose

- The claims must be functionally limited to the technical purpose – establishing a link between the technical purpose and the method steps

“specific technical application” - yes

- X-ray apparatus
- Steel cooling
- Compaction machine
- Digital A/V (detecting people)
- Speech2Text
- Encoding data for transmission / storage
- Crypto
- Load balancing
- Physiological sensors
- Genotype estimate
- Medical diagnosis
- Simulating “technical” things

“specific technical application” - no

- Linguistics
- Marketing
- IT administration
- Logical / abstract data processing
- Advertising
- Finance
- Commerce

Examples

- Vicom still rules (T 208/84)
- matrices & kernels (very deep learning)
- technical process was carried out on a physical entity if it provided, as its result, a certain change in that entity
- image stored as an electrical signal was considered to be a physical entity
- claim with image = allowable

Examples

- T 2049/11
- a processing method for use with forestry equipment
- novel features = computation of a "characteristic value" by splitting data into several tree "trunk size classes“
- Board: how to make the monitoring of the performance of a forest machine more accurate and reliable?

Examples

- T 1793/12
- searching a dictionary on a mobile phone
- driven by "subjective and by linguistic considerations“
- Boards generally do not think “words” = technical

Examples

- T 1909/08
- determining the optimum helix angle of a helical formation for a conduit
- invention embodied within a method of determining a particular technical matter
- the invention was not defined solely by presentation of a number which had no technical significance

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Examples

- T 531/09
- simulation of a security checkpoint
- modelled as probabilistic events
- not inherently technical
- probabilistic equations referred to technical devices (e.g. metal detectors and x-rays), but modelled no differently from non-technical tasks (e.g. queuing of people)

Examples

- T 1028/14
- reputation-based spam filter
- filtering of SIP or email messages > underlying technical problem
- Board criticised the Examining Division for not indicating "why and in which way [the] scheme served a purely non-technical purpose"

Examples

- T 0912/12
- method to generate “expanded [search] snippets”
- differences = rules that were independent of the technical implementation or presentation of information

Examples

- T 12/08
- in-game characters appear randomly during a game in progress by varying the probability of the character's appearance with time
- technical problem = how to modify the gaming device so that it generated character encounters in a less predictable manner
- "innately technical" (?) - purely technical problem of realizing in the physical world (?)

Examples

- T 629/11
- personalisation of data services
- manipulating information and its presentation, in order to affect the perceptions or behaviour of users
- applied psychology > non-technical

T 1358/09

- cited a lot
- classification of text documents
- vector representation of a document and the documents were classified by separating the vector space into a plurality of subspaces
- SVMs (hello my old friend!)
- did not go beyond a particular mathematical formulation of the task of classifying documents

T 1358/09

- Length won't help you!

"A method for the computerized classification of an unclassified text document into one of a plurality of predefined classes based on a classification model obtained from the classification of a plurality of preclassified text documents which respectively have been classified as belonging to one of said plurality of classes, said document and said documents respectively comprising a plurality of terms which respectively comprise one or more symbols of a finite set of symbols; a) wherein said method involves the computerized building of said classification model, comprising the following method steps: a1) representing each of said plurality of text documents, which are digitally represented in a computer, by a vector of n dimensions, said n dimensions forming a vector space, whereas the value of each dimension of said vector corresponds to the frequency of occurrence of a certain term in the document corresponding to said vector, so that said n dimensions span up a vector space; a2) representing the classification of said already classified documents into classes by separating said vector space into a plurality of subspaces by calculating one or more hyperplanes, such that each subspace comprises one or more documents as represented by their corresponding vectors in said vector space, so that said each subspace corresponds to a respective class; a3) calculating a maximum margin surrounding said hyperplanes in said vector space such that said margin contains none of the vectors contained in the subspaces corresponding to said classification classes; b) wherein said method further involves, on basis of said classification model, the computerized classification of said unclassified text document as belonging to one of said plurality of classes, comprising the following method steps: b1) representing said text document, which is digitally represented in a computer, by a vector of n dimensions, said n dimensions spanning up said vector space, whereas the value of each dimension of said vector corresponds to the frequency of occurrence of a certain term in the document corresponding to said vector; b2) classifying said document into one of said plurality of classes by determining into which of said plurality of subspaces of said vector space said vector falls and identifying said document as belonging to a certain class which corresponds to the subspace into which said vector falls; b3) calculating a confidence level for the classification of said document as belonging to said certain class based on the distances between the vector representing said document and all hyperplanes surrounding said subspace which corresponds to said certain class normalized by the corresponding margins such that a document which lies outside said margins is assigned a confidence level of '1' and a document which falls into said margins is assigned a value between '0' and '1'."

T 1358/09

- Downfall?
  - words
  - general disclosure
  - detailed description only provided a very high level description of the claimed features (which led separately to a sufficiency objection)

EPO Guidelines

G-II, 3.3 – 2. Specific technical implementations

- "A mathematical method may also contribute to the technical character of the invention independently of any technical application when the claim is directed to a specific technical implementation of the mathematical method and the mathematical method is particularly adapted for that implementation in that its design is motivated by technical considerations of the internal functioning of the computer (T 1358/09 )."
- 2nd example is a positive one: adaptation of polynomial reduction algorithm – matched to word size of computer hardware (T1925/11 )
- "If the mathematical method does not serve a technical purpose and the claimed technical implementation does not go beyond a generic technical implementation, the mathematical method does not contribute to the technical character of the invention. In such a case, it is not sufficient that the mathematical method is algorithmically more efficient than prior-art mathematical methods."

EPO Guidelines G-II, 3.3

Specific technical implementations

Approved claim 1 of T 1925/11:

"1. A computer hardware-implemented cryptographic method comprising a modular polynomial reduction operation in a binary finite field, the modular polynomial reduction operation comprising:

precomputing and storing in memory a polynomial constant u(x) representing a bit-scaled reciprocal of a multi-word polynomial modulus m(x) having a length defined by a number of words;

estimating an approximate polynomial quotient q(x) for a polynomial p(x) to be reduced modulo m(x), wherein said estimating is executed upon p(x) in a computation unit by a polynomial multiplication over the binary finite field by said constant u(x);

characterized by:

generating in a random number generator a random polynomial error value E(x) having a degree that falls within a predetermined range and applying said polynomial error value to said approximate polynomial quotient to obtain a randomized polynomial quotient q'(x) = q(x) + E(x); and

calculating a polynomial remainder r'(x) = p(x) + q'(x)?m(x) in said computation unit by performing word-size shifts, said remainder r'(x) being of higher degree than said modulus m(x) but congruent to p(x) modulo m(x) and where the degree of p(x) is less than or equal to 2k+w, w being a word size in bits of the computer hardware and k being the length in bit number of the words representing the modulus m(x)."

EPO Guidelines

G-II, 3.5 -Schemes, rules and methods for performing mental acts, playing games or doing business

1. Eligibility (technical implementation)
2. Then passes to novelty/inventive step

Mental acts
- steps contribute to the technical character if they contribute to producing a technical effect serving a technical purpose.

Business methods
- now a substantial subset of the GL (> decisions); examples
- technical implementation; results of technical implementation choices
- flags: circumventing a technical problem; mere use of real world data; mere possibility of serving a technical purpose; useful, practical or saleable

EPO Guidelines

G-II, 3.6 - Programs for computers

Technical character – further technical effect (going beyond the "normal" physical interactions between the program (software) and the computer (hardware) on which it is run) e.g., control of a technical process or of the internal functioning of the computer itself or its interfaces

Further technical effect is assessed without reference to the prior art.

Examples: certain aspects of information modelling; programming environments; functional data vs. activity of programming; programming languages; cognitive data

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To Watch Out For

- High velocity of academic publications (~5000 papers submitted per conference)
- Open Access Preprints (arXiv)
- Many general concepts will be known
- Lots of theory but production is hard
- Concentrate on industry-specific problems and the real world

UKIPO

- Computer-program as such – can be deadly
- Control of real-world object – may be okay
- A change in the wind?
- Policy & government rhetoric clashes with practice?

Geo updates: USA

- **No current laws, guidance or regulations specific to AI and patents**
- **Upcoming USPTO seminar on Dec 5 2018 – livestream:**

https://www.uspto.gov/about-us/events/artificial-intelligence-intellectual-property-policy-considerations

Geo updates: Japan

- **JPO clarified the following items in the Examination Guidelines**
  - **Subject matter eligibility: when a trained model is a "program", it shall be handled as a "program"**
  - **Inventive step: inventions may provide advantageous effects e.g., brought about by utilization of information obtained from "Things" connected to the network**
    - **Output information obtained from specific trained models**
    - **Information processing defined by data having specific structure**
  - **Several examples**

- **JPO invited public comments on patentability of AI related inventions in early Nov 2018**

https://www.jpo.go.jp/tetuzuki_e/t_tokkyo_e/pdf/iot_examination_e/01.pdf
https://www.jpo.go.jp/tetuzuki_e/t_tokkyo_e/pdf/revision_history_e/point_of_update_1803.pdf

Geo updates: China

- **Current examination practice: No substantial difference between AI/business model related inventions and other inventions (e.g., computer programs), in terms of:**
  - **Subject matter eligibility: needs "technicity" =**
    - **a) technical problems**
    - **b) technical measures**
    - **c) technical effects**
  - **Novelty/inventive step:**
    - **If a claim includes both technical features and non-technical features, only those technical features in the claim will be considered when assessing novelty/inventive step.**

Consider all forms of IP

- **Patents v trade secrets**
  - Platforms; applications; [algorithms]
  - Transparency of AI v black box/bias v crown jewels

- **Copyright and related issues**
  - Code; some elements of data; tangible reports; UI
  - Text and Data Mining (TDM) [European Directive]

- **Database rights**
  - Knowledge bases

- **Trademarks, Designs**

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Questions ?