WIPO Standing Committee on the Law of Patents (SCP): Presentations by AI technology experts

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Agenda

• Intro: Artificial Intelligence (AI) algorithms and technologies
• AI concepts and their developments, including a state-of-the-art discussion on generative AI
• Large Language Models (LLMs) such as ChatGPT
• Beyond ChatGPT
Dictionary: **AI** (Artificial Intelligence)

Creating systems capable of performing tasks that typically require human intelligence:
Dictionary: ML (Machine Learning)
Dictionary: ML

algorithms and models that enable computers to learn from data without being explicitly programmed
Dictionary: **ML**

- **AI** algorithms and models that enable computers to learn from data **without being explicitly programmed**.
Dictionary: *practically speaking*

AI ~ ML
AI history in thirty words

mid-20th century: emergence of academic discipline; rule based (expert systems); some limited success, but life is just too complex
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1990ties: ML, statistical approach, compute probabilities of various outcomes; still dominant approach
AI history in thirty words

mid-20th century: emergence of academic discipline; rule based (expert systems); some limited success, but life is just too complex

1990ties: statistical approach, compute probabilities of various outcomes; still dominant approach

dog 60%
mop 20%
alien 9%
other 1%
mop 60%
dog 20%
alien 9%
other 1%
Learning from data
Learning from data

X - input

Y - output
Dictionary: **Model**

![Diagram of a model with parameters: slope and height](image-url)
Dictionary: **Neural networks**

model (MANY parameters)
Dictionary: **Neural networks**

Training = find suitable parameters

Input

Output

Dog 100%
Dictionary: Neural networks

training = find suitable parameters

input

output

mop 100%
Dictionary: **Neural networks**

Training = find suitable parameters

input

output
cat 100%
Dictionary: **Neural networks**

![Input Image](image)

**Model (MANY parameters)**

- **Input:**
  - Dog: 60%
  - Mop: 20%
  - Alien: 9%
  - Other: 1%

- **Output:**
  - Dog 60%
  - Mop 20%
  - Alien 9%
  - Other 1%
Intelligence and AI Problem Statement

Artificial Intelligence

- Logical Systems
  - $A \lor B = \neg(\neg A \land \neg B)$
  - $A \Rightarrow B = \neg A \lor B$
  - $A \land B = (A \land \neg B) \lor (\neg A \land B)$
  - $A \equiv B = (A \lor B) \land (\neg A \lor \neg B)$
- Knowledge-Based Systems

Machine Learning

Deep Learning

- Uncertainty
- Vagueness
- Incompleteness
- Resource Boundedness
Working definition

A software / hardware is intelligent if it:
- Performs an intelligent function
- Can solve problems autonomously
- Reacts in real-time

Measures of AI:
- Degree of autonomy
- Degree of task complexity (degree of freedom)
- Degree of efficiency and effectiveness of problem solving method
OPTICAL COHERENCE TOMOGRAPHY (OCT)
Foundation models
We collect ~ 55 datasets with ~1.3 million medical images: capturing the structural constraints of feature embeddings through a combinatorial graph matching. They can be trained efficiently end-to-end using modern gradient estimation techniques for black-box solvers.
Submitted/Accepted Papers Per Keyword

- Machine Learning: 142 (Accepted), 1304 (Submitted)
- Computer Vision: 148 (Accepted), 994 (Submitted)
- Data Mining: 503 (Accepted), 49 (Submitted)
- Multidisciplinary Topics and Applications: 295 (Accepted), 34 (Submitted)
- Natural Language Processing: 281 (Accepted), 37 (Submitted)
- Game Theory and Economic Paradigms: 210 (Accepted), 52 (Submitted)
- Agent-based and Multi-agent Systems: 210 (Accepted), 38 (Submitted)
- AI Ethics, Trust, Fairness: 180 (Accepted), 19 (Submitted)
- Knowledge Representation and Reasoning: 155 (Accepted), 33 (Submitted)
- Humans and AI: 105 (Accepted), 16 (Submitted)
- Planning and Scheduling: 88 (Accepted), 18 (Submitted)
- Constraint Satisfaction and Optimization: 77 (Accepted), 23 (Submitted)
- Search: 67 (Accepted), 17 (Submitted)
- Uncertainty in AI: 54 (Accepted), 11 (Submitted)
- Robotics: 43 (Accepted), 4 (Submitted)
Generative AI

• The release of ChatGPT in November 2022 has brought so-called generative AI into the spotlight and to mainstream attention.
• Traditional AI systems are primarily used to analyze data and make predictions.
• Generative AI goes a step further by being able to create new data similar to its training data.
• Generate text of all sort and length.
• Generate multimedia content from text, or from text + images.
• Underlying network architectures are based on methods such as **transformers** (GPT for example stands for Generative Pre-trained Transfomer) or GANs (generative adversarial networks).
• These methods make it possible for generative AI to create new content, including audio, code, images, text, simulations, and videos.
ChatGPT (OpenAI)

Input

My    house  was  painted

GPT

Word    Probability
blue   29%
red    21%
white  7%
...

also cf. LLaMA (Meta), Sparrow (DeepMind), Bard / LaMDA (Google)
The GPT family – Numbers and facts

<table>
<thead>
<tr>
<th>Version</th>
<th>Year</th>
<th>Data</th>
<th>Dataset size</th>
<th># Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPT</td>
<td>2018</td>
<td>BookCorpus</td>
<td>4.5 GB</td>
<td>117.000.000</td>
</tr>
<tr>
<td>GPT-2</td>
<td>2019</td>
<td>WebText (Reddit)</td>
<td>40 GB</td>
<td>1.500.000.000</td>
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<tr>
<td>GPT-3</td>
<td>2020</td>
<td>Multiple datasets</td>
<td>570 GB</td>
<td>175.000.000.000</td>
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<tr>
<td>GPT-4</td>
<td>2023</td>
<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
</tr>
</tbody>
</table>

Brown et al. (2020). Language Models are Few-Shot Learners.  
## Prompt patterns/templates for roles

<table>
<thead>
<tr>
<th>Define ChatGPT role</th>
<th>Explanations</th>
<th>Chained Prompting</th>
</tr>
</thead>
</table>
| - Act as a Linux terminal  
- Act as "position" Interviewer  
- Act as a JavaScript Console  
- Act as an Excel Sheet  
- Act as an English Teacher  
- Act as a Plagiarism Checker  
- Act as an Advertiser | - Explain clearly  
- Explain uniquely  
- Explain detailed  
- Explain like I’m 5  
- Explain with examples  
- Explain to 5th graders  
- Explain like Noam Chomsky  
- Explain detailed with examples  
- Explain to high school students | Write an article ..  
First give me the outline, which consists of a headline, a teaser, and several subheadings.  
[Output]  
Now write 5 different subheadings.  
[Output]  
Add 5 keywords for each subheading.  
[Output] |

Adapted from various user blogs
Multilingual, multimodal prompting and non-trivial variations

MultiFusion: Fusing Pre-Trained Models for Multi-Lingual, Multi-Modal Image Generation (2023), DFKI, HessianAI, University of Darmstadt et al.
Questions?
Can you make both plots have the same range in the y axis? And the legend has each model name twice.

Is there a way to make the ‘Human’ bar more distinctive, to separate it from the other 3?
Python code for image generation

```html
<html>
<head>
<title>Kandinsky Generator</title>
</head>
<body>
<button id="generate-button">Generate Kandinsky Painting</button> <canvas id="kandinsky"></canvas>
<script>
const canvas = document.getElementById('kandinsky'); const ctx = canvas.getContext('2d');
function generateKandinsky() {
  // Set the canvas size to a random value between 500 and 800 pixels
  canvas.width = Math.floor(Math.random() * 300 + 500); canvas.height = Math.floor(Math.random() * 300 + 500);
  // Set the background color to a random pastel color
  ctx.fillStyle = `hsl(${Math.random() * 360}, 50%, 90%)`;
  ctx.fillRect(0, 0, canvas.width, canvas.height);
  // Draw a random number of circles with random sizes, positions, and colors
  const numCircles = Math.floor(Math.random() * 20 + 10); for (let i = 0; i < numCircles; i++) {
    const x = Math.random() * canvas.width; const y = Math.random() * canvas.height; const radius = Math.random() * 100 + 50; ctx.beginPath();
    ctx.arc(x, y, radius, 0, 2 * Math.PI);
    ctx.fillStyle = `hsl(${Math.random() * 360}, 50%, 50%)`;
    ctx.fill();
  }
  // Add an event listener to the button to generate a new Kandinsky painting when clicked
  const button = document.getElementById('generate-button');
  button.addEventListener('click', generateKandinsky);
  // Generate an initial Kandinsky painting
  generateKandinsky();
</script>
</body>
</html>
```

“Produce javascript code which generates random images in the style of the painter Kandinsky”

Sparks of Artificial General Intelligence: Early experiments with GPT-4, Microsoft Research 2023
Beyond ChatGPT

Languages: English
Beyond ChatGPT

Languages: English
Beyond ChatGPT

Languages: English
Beyond ChatGPT – What is a language?

formal language  alphabet  well-formed sequences
grammar
Beyond ChatGPT – What is a language?

formal language alphabet well-formed sequences

grammar

SMILES

CC1CCC(C(C)=C1/C=C/C(C)=C/C=C/C(C)=C/C=C/C=C/C=C/C=C/C=C(C)/C=C/C=C(C)/C=C/C=C/C=C/C=C/C=C(C)/CCCC2(C)C
Thanks for your attention!