Computational Creativity: Path to Future Civilization

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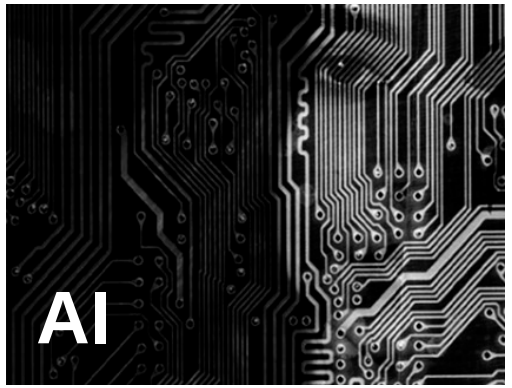
My journey in Computational Creativity and A.I.

- 1973 – 1983: AI system Pulsar to create novel methods of signal detection in space communication and SETI project
- 1987 – 2001: Invention Machine software to create novel ideas in technical areas
- 2001 – 2014: White Sparrow: AI platform to automatically create investment strategies. Currently in implementation phase by New York-based fund
- 2010 – 2014: “AICreates club” and training course in Machine Learning, Predictive Analytics, general Creative AI
- 2013+ : AI platform to create novel ideas of photos, generative art and films Research phase

Artificial Intelligence vs. Human Brain

Key facts:

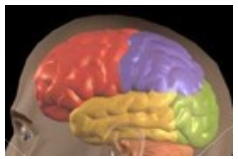
- AI evolves *exponentially*
- Human brain structure remains unchanged



Artificial Intelligence is entering exponential phase of evolution

Human brain stopped evolving
20 000 years ago

humans



Main Messages: AI Creates All

- Computational Creativity is a new Mega-trend, which will have big impact of every aspect of human life

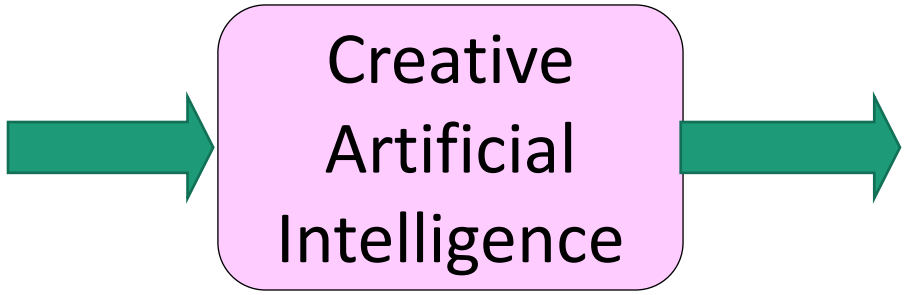
- Human civilization is transforming itself into new form of civilization, where human creativity is overtaken by more productive Creative AI
  Two civilizations will co-exist for some time

- Humans will benefit from this Mega-trend, but they won't be able to understand how new civilization functions

Computational Creativity: Automatic Creation of Novelty

Input

Tech cases
Samples of art, music
Trends
Models
Theories
Needs
Common sense
True and wrong concepts
News



Novel content:

New texts
Mathem. models
Inventions
Music
Images
Videos
Discoveries
Predictions
Plans and projects

Why is power of AI rapidly increasing?

- First, modern AI understands the meaning of words, images, and can learn by using semantic networks or predictive analytics

- Second, microprocessors still double their performance every 18 month (Moore's law)

- Third, AI is able to run Darwinian-type concept creation-selection process with Monte-Carlo method and Genetic Algorithms
  = Fast artificial evolution of ideas

New phase: Computational Creativity as Mega-trend

- Infrastructure, hardware, mathematics are ready or almost ready
- Growing demand from industries for Creative AI as productivity tool
- Can be applied everywhere:
  - medical
  - technical
  - art, music, films
  - architecture
  - education

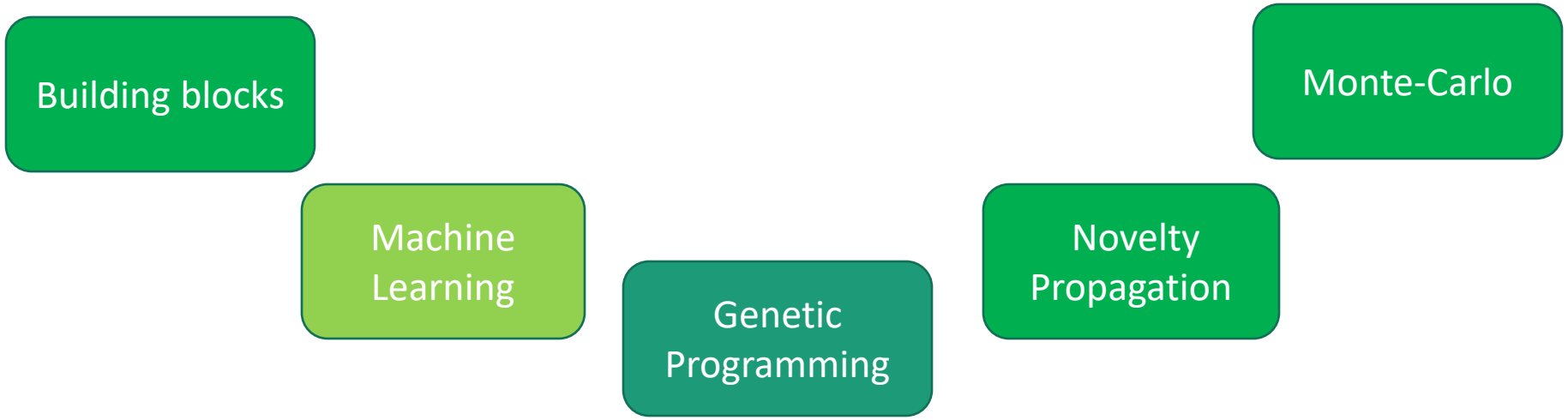
Automatic content creation as productivity tool

- Sverker Johansson has created more than 3 million (!) Wikipedia articles, or 10% of entire Wikipedia volume
- He spent wrote Lsjbot - the bot, that finds necessary information on the Internet and then creates a short summary for Wikipedia
- Creative productivity of one person with AI bot is several orders of magnitude greater than any human can reach

Recent important advances in A.I. technologies

- Algorithms: Combinatorial Intelligence and Genetic Algorithms
- Mathematics: Machine Learning and Predictive Analytics
- Hardware: Computer chips that mimic human brain, for example TrueNorth by IBM
- Applications in non-technical areas: Generative Art, Generative Music, more…

AI Creates: different approaches



AI can mimic human creativity and also has its own unique creativity tools

GP: Genetic Programming

GP belongs to evolutionary methods of optimization

- Chromosomes
- Crossover
- Mutations

Example: Bill Gross
used Genetic Programming to develop adaptive solar heater,

See TED.com

Monte-Carlo

Is used to evaluate idea or new model

- Normal creativity cycle:
  - create concept, then
  - evaluate concept

- Monte-Carlo
  - creates artificial world first,
  - create many concepts, than
  - evaluates quality of new concepts

  by running zillions of tests on new concepts behavior in artificial world

TrueNorth: August 2014

- One million individually programmable neurons
- 256 million individually programmable synapses on chip, which is a new paradigm
- 5.4B transistors. By device count, largest IBM chip ever fabricated
- 4,096 parallel and distributed cores, interconnected in an on-chip mesh network

AI is a very broad area

European Union finances R&D projects:

- AI cognitive systems
- Machine Learning
- Brain-Machine Interface
- Self-organizing systems
- Artificial Life
- Neuro-IT
- Ambient Intelligence
- Emotional/Affective Interfaces
- Semantic Modeling
- Knowledge discovery
- Computer vision
- more in AI...

Generative Art. Computer generates different modifications of an image. Artist selects the best

Substrate. By Jared Tarbell http://complexification.net/gallery/machines/substrate/index.php

AI in art. By Aaron - Harold Cohen. Completely created by AI

http://www.usask.ca/art/digital_culture/wiebe/paint.html

Challenges in AI Creates

- At certain point in time humans will not able to understand the value of novel content created by AI
- Combinatorial nightmare. Creative AI needs very fast computers
- Cost of building domain specific knowledge-bases remains high

Challenges and probable solutions

- Humans are not able to understand the value of novel content created by A.I. → Humans will be further removed from the creativity cycle
- Combinatorial nightmare → Everything computes, Everything is AI, AI-Universe
- Cost of building domain knowledge-bases remains high → Self-evolving algorithms, new standards: global semantic net

Phases of Civilization: knowledge creation, saving and transfer

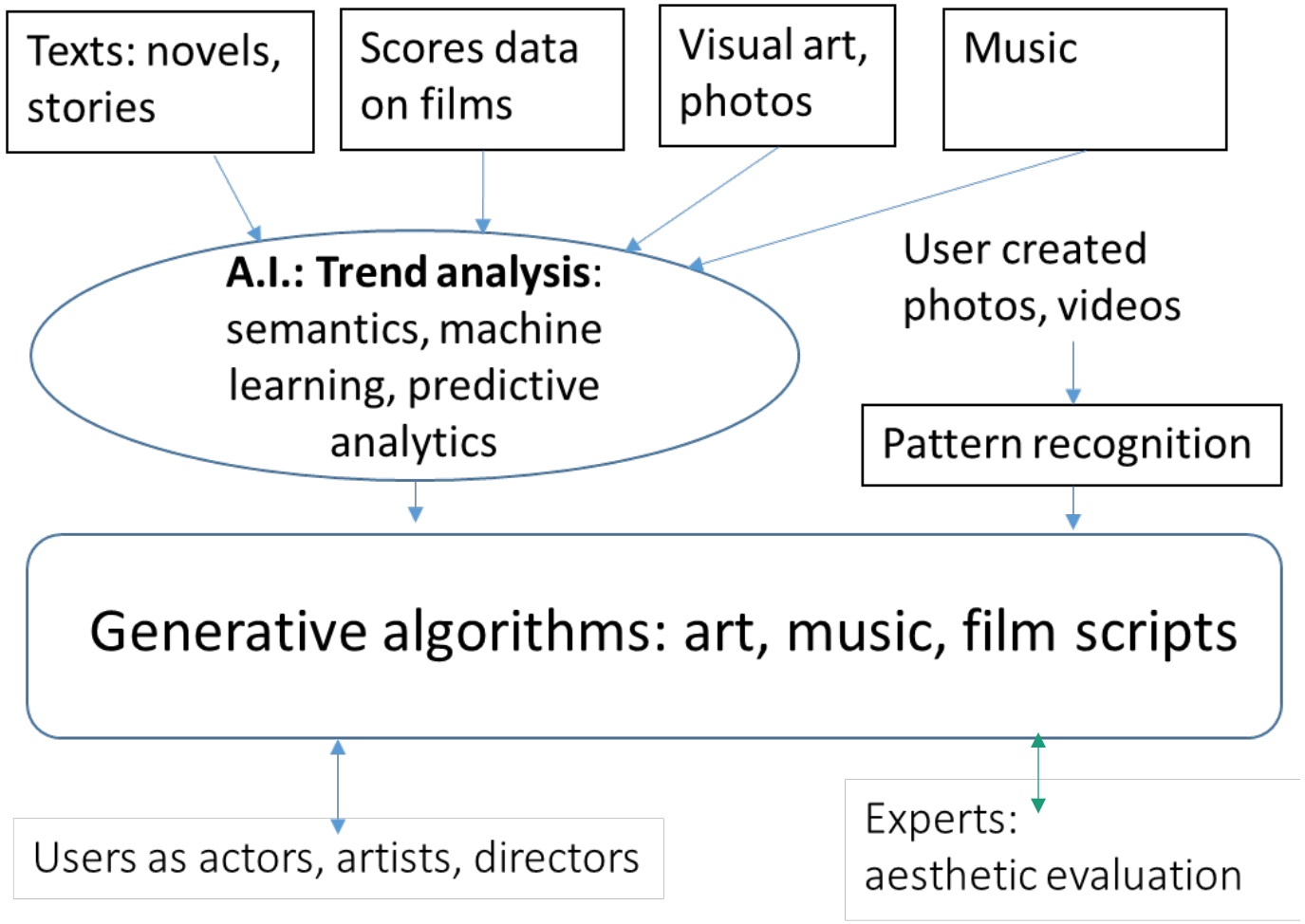
Phase 1. Printed books: save and slowly transfer knowledge

Phase 2. Telephone, radio, TV, Internet: quickly transfer knowledge

Phase 3. Creative AI, Computational Creativity: AI quickly creates new knowledge

In previous phases technology played passive role, helping save and transfer knowledge. In Phase 3 technology plays active role by creating new knowledge. Faster, cheaper, better than humans

AI Platform for generative art and films



- Users are excited to be creators

A.I.
-Discovers or helps users discover new opportunities
-Greatly reduces barriers to create novel and valuable art, music, films

United States Patent # 6,167,370
Tsourikov V. , et al. December 26, 2000,
filed May 27, 1999

Document semantic analysis/selection with
knowledge creativity capability
utilizing subject-action-object (SAO) structures

In this revolutionary patent the idea of AI inventor was described

US006167370A

United States Patent [19]
Tsourikov et al.

[11] **Patent Number: 6,167,370**
[45] **Date of Patent: Dec. 26, 2000**

[54] **DOCUMENT SEMANTIC ANALYSIS/ SELECTION WITH KNOWLEDGE CREATIVITY CAPABILITY UTILIZING SUBJECT-ACTION-OBJECT (SAO) STRUCTURES**

[75] Inventors: **Valery M. Tsourikov**, Boston; **Leonid S. Batchilo**, Belmont, both of Mass.; **Igor V. Sovpel**, Minsk, Belarus

[73] Assignee: **Invention Machine Corporation**, Boston, Mass.

[21] Appl. No.: **09/321,804**

[22] Filed: **May 27, 1999**

Related U.S. Application Data

[60] Provisional application No. 60/099,641, Sep. 9, 1998.

[51] **Int. Cl.**[7] **G06F 17/27**
[52] **U.S. Cl.** **704/9**; 707/4; 707/531
[58] **Field of Search** 704/1, 9, 10, 8, 704/7; 707/2, 3, 4, 5, 104, 530, 531, 532

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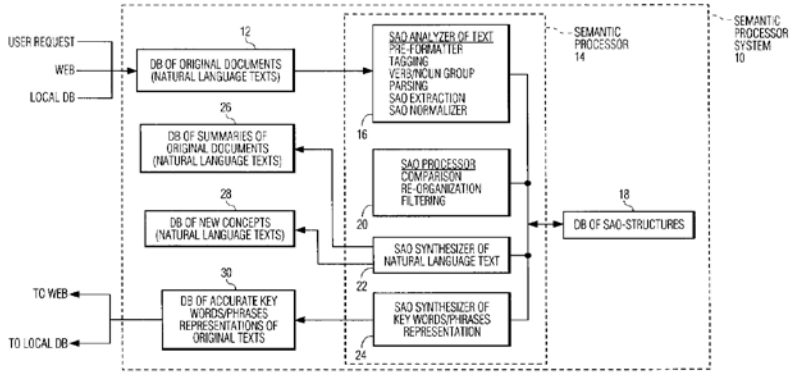
Primary Examiner—Joseph Thomas
Attorney, Agent, or Firm—Edward Dreyfus

[57] **ABSTRACT**

A computer based software system and method for semantically processing a user entered natural language request to identify and store linguistic subject-action-object (SAO) structures, using such structures as key words/phrases to search local and web-based databases for downloading candidate natural language documents, semantically processing candidate document texts into candidate document SAO structures, and selecting and storing only relevant documents whose SAO structures include a match with a stored request SAO structure. Further features include analyzing relationships among relevant document SAO structures and creating new SAO structures based on such relationships that may yield new knowledge concepts and ideas for display to the user and generating and displaying natural language summaries based on the relevant document SAO structures.

18 Claims, 12 Drawing Sheets



AI Creates club in Minsk

AI Creates training class
for Ph.D. students in Minsk

Anticipating coming revolution in Creative AI, we started special training class AI Creates for grad students, engineers and IT professionals. So far, more than 150 students attended the course. Topics include: machine learning, semantics, causal reasoning, combinatorial AI.