

Beyond AI

Jacob Friis Sherson

Director and founder of ScienceAtHome and Center for Hybrid Intelligence, Aarhus University





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to rate session
and ask questions.**



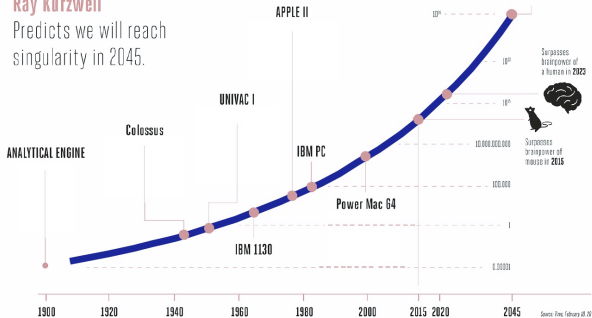
AI, intuition, creativity and innovation

The point of no return



Ray Kurzweil

Predicts we will reach singularity in 2045.



LETTER

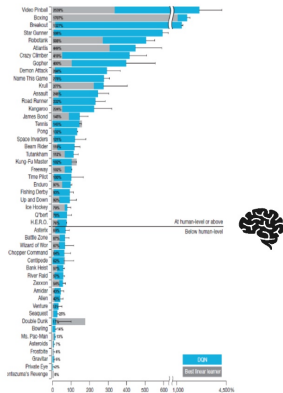
doi:10.1038/nature14236

Human-level control through deep reinforcement learning

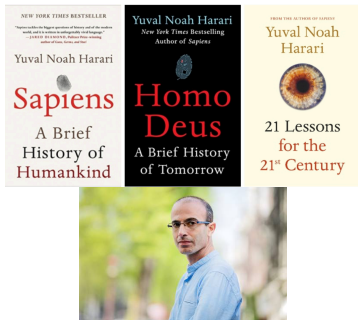
¹Google DeepMind, 5 New Street Square, London EC4A 3TW, UK.

*These authors contributed equally to this work.

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Three possible futures for human kind



- AI singularity makes humans obsolete
- We give so much data to AI suggestion engines that we let them make all our decisions:
humans are still useful for algorithms
- Small subset of humans are rich enough to become superhumans (HomoDeus) and rule the world (together with algorithms): the rest of humans are obsolete

The uncharted human mind



The uncharted human mind

- Human creativity can be influenced



The uncharted human mind

- Human creativity can be influenced



amazon echo



Google Home
Voice-activated speaker



The uncharted human mind

- Human creativity can be influenced
- How can we best exploit intuition + professional experience ?

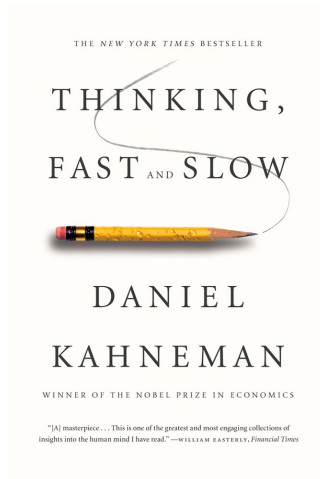


amazon echo



Google Home
Voice-activated speaker





SYSTEM 1

Intuition & instinct

95%

Unconscious
Fast
Associative
Automatic pilot



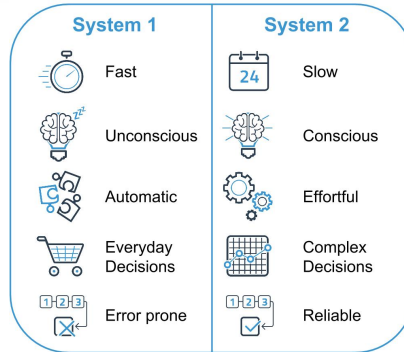
SYSTEM 2

Rational thinking

5%

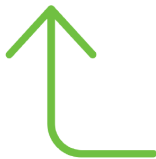
Takes effort
Slow
Logical
Lazy
Indecisive

Source: Daniel Kahneman



In a future of increasingly powerful AI, what do we need?

- Precision
- Accuracy
- Calculations

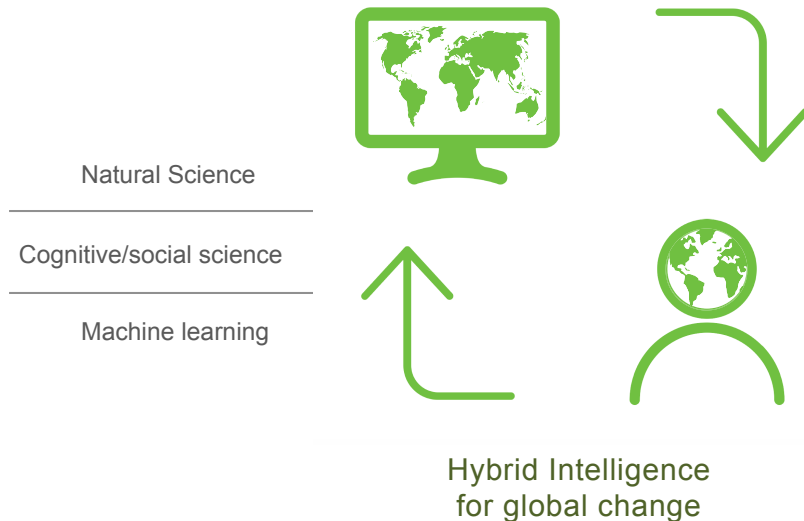


- Creativity
- Intuition
- Innovation

Hybrid Intelligence
for global change

- understand differences between **human** and **artificial intelligence**
- develop interfaces for **hybrid-interactions!**

Hybrid Intelligence: human-machine learning



Creativity in the digital world

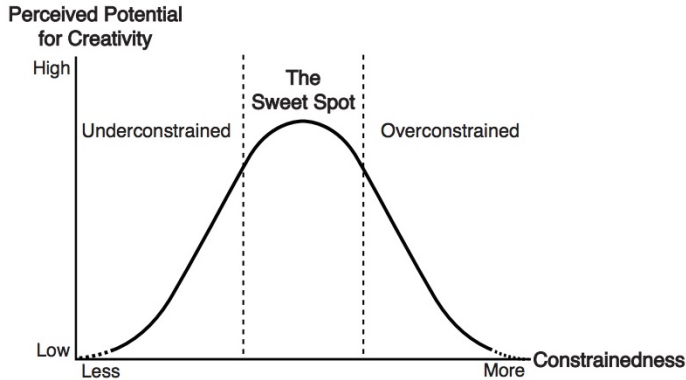
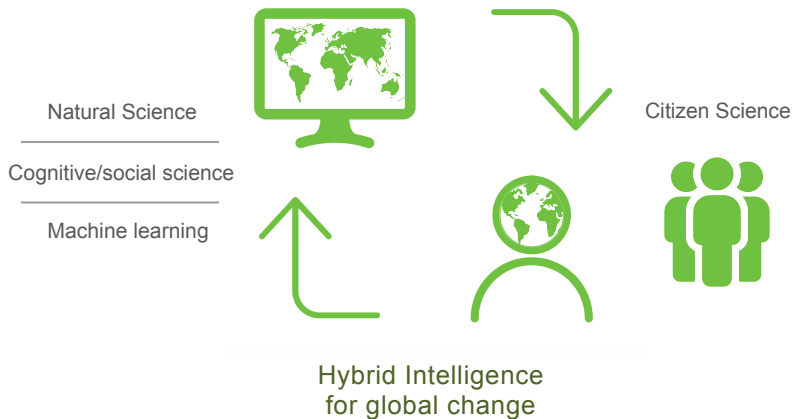


Fig. 1. The ‘sweet spot’ model of striking a desirable balance between a creative task’s constrainedness and an individual’s perceived potential for creativity (see Biskjaer 2013; Onarheim 2012b)

- Low constraints: "paradox of choice"
- High constraints: no freedom

Hybrid Intelligence: human-machine learning

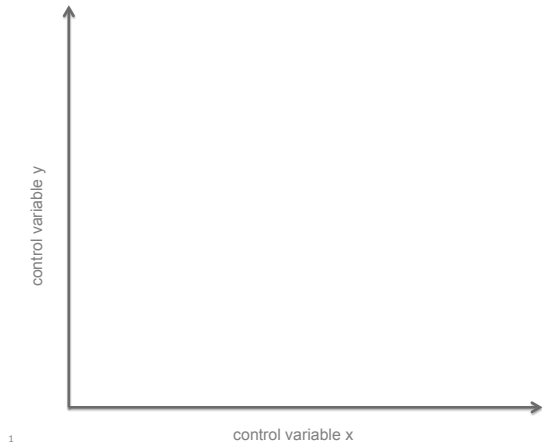


ScienceAtHome: so far 250k+ players

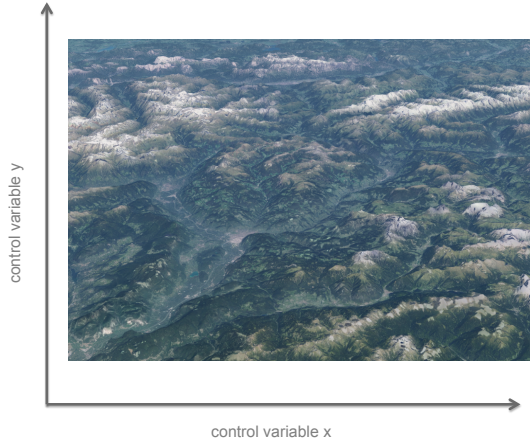


- Anyone can contribute
- Participants use the same methods for consistency in data
- Data helps researchers come to real conclusions
- Results are openly shared

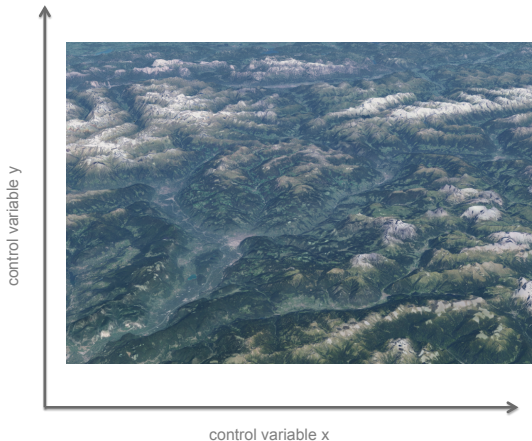
Exploration vs. Exploitation: trade off in navigating a landscape



When wandering in the alps, where's the top?

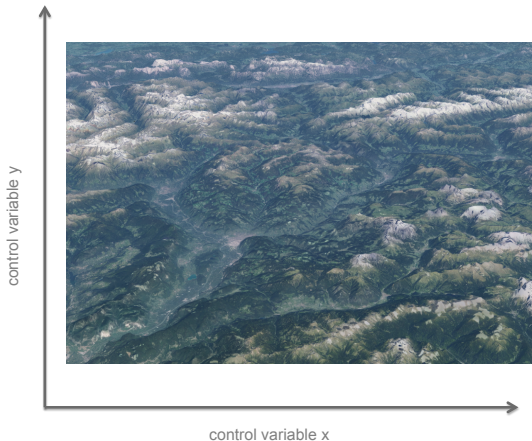


When wandering in the alps, where's the top?



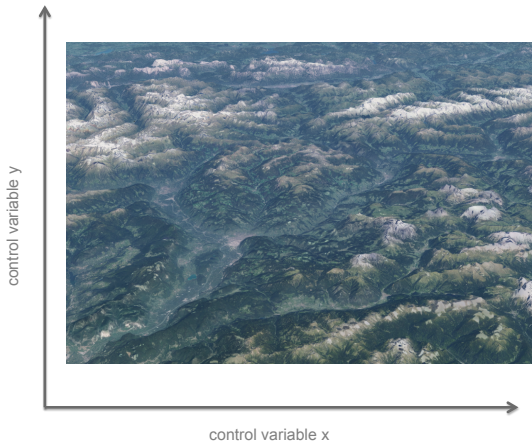
- Quick intuitive leaps vs. random exploration

When wandering in the alps, where's the top?



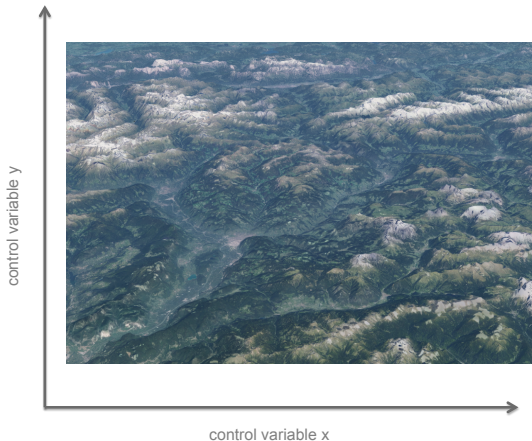
- Quick intuitive leaps vs. random exploration
- Human inspired algorithms that quickly recognize the landscape?

When wandering in the alps, where's the top?



- Quick intuitive leaps vs. random exploration
- Human inspired algorithms that quickly recognize the landscape?
- Knowing the landscape means knowing the best algorithm

When wandering in the alps, where's the top?



- Quick intuitive leaps vs. random exploration
- Human inspired algorithms that quickly recognize the landscape?
- Knowing the landscape means knowing the best algorithm
- Systematic study of creativity/innovation ?

Games exploring hybrid intelligence



Learning + Education



Design



Game development



Psychology +
Social science



Web development



Community outreach



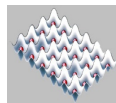
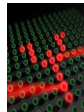
Natural science



Data science

Click!

Players (re)discovering quantum physics

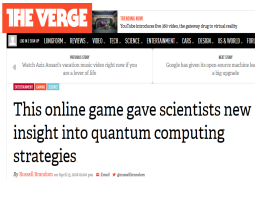
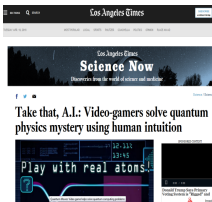


64 | WISSEN

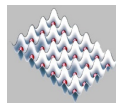
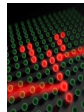
WELT ANTONIUS 18.10. | 11. APRIL 2011

Taktik eines Taxifahrers

Computer wird dem menschlichen Gehirn an hochkomplexen Aufgaben überlegen. Der Mensch löst komplexe Probleme schneller als die Maschinen. Wie kann das sein?



Players (re)discovering quantum physics

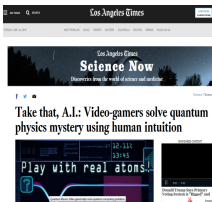


64 | WISSEN

WELT ANATOMIE 08.10. | 11. APRIL 2011

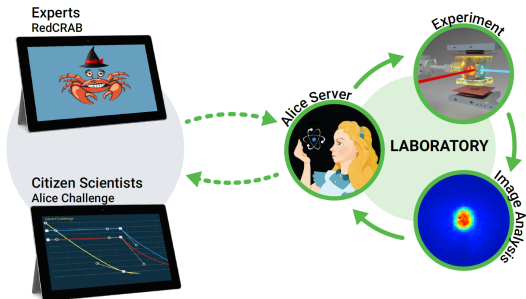
Taktik eines Taxifahrers

Computer wird dem menschlichen Gehirn an Überlebensfähigkeit überlegen. Mensch löst die Mensch komplexen Probleme schneller als die Maschinen. Wie kann das sein?



Click!

The remote controlled quantum lab



- How important was 'intuitive' visualization in quantum moves?
- 700 players in 1 week
- 7577 individual solutions submitted
- Real-time implementation

The ALICE challenge



Experimentalist



Student



Theoreticians

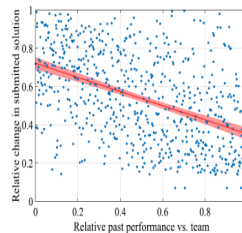
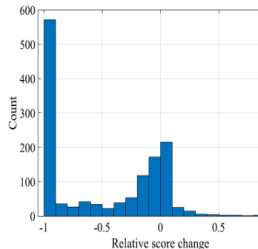
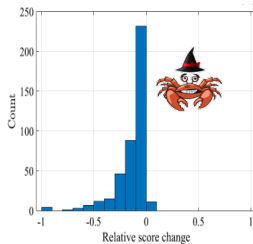


parameter optimization
 $\sim 1.9 \cdot 10^6$ atoms

remote (online) optimization
 $\sim 2.4 \cdot 10^6$ atoms

optimization with dCRAB
 $\sim 2.4 \cdot 10^6$ atoms

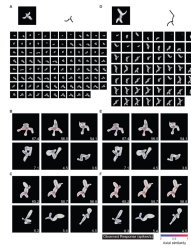
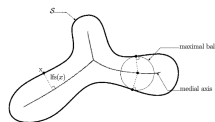
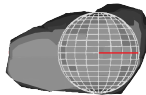
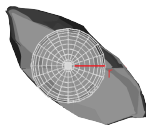
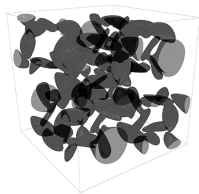
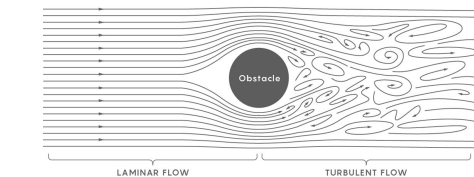
gamification
 $\sim (2.4-2.8) \cdot 10^6$ atoms



Adaptive search

- High performers **exploit**
- Low performers **explore**

Turbulence meets neurocomputation



Lescroart, M. and I. Biederman (2013). "Cortical Representation of Medial Axis Structure". In: *Cerebral Cortex* 23, pp. 629–637.

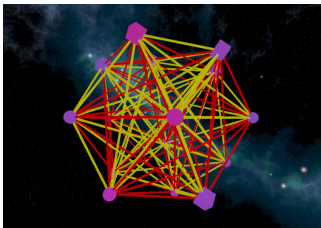
Click!



Scaling factor



Human perception



- NP-hard Spin Glass Problems + Comparison with Quantum Annealing Computer
- Color node indicates level of 'frustration'
- Graphical representations lead to new heuristics
- Result: x10-20 speed-up for finding "pretty good" solutions

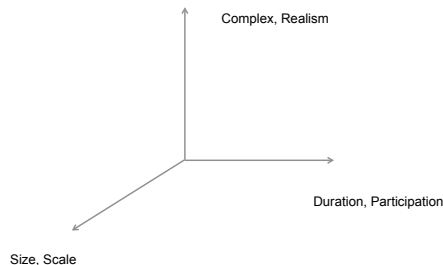
**Can we systematically test
creativity/innovation?**




Social Science Super Collider

The ScienceAtHome social science super collider

- Large scale 'virtual lab' with citizen science
- Studied longitudinally over long periods of time
- Realistic (not WEIRD*) setting for collective behavior
- Precise instrumentation + measurement
- High degree of experimental control (A/B testing)
- Creating situations which stimulate creative thinking





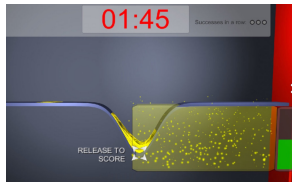
Virtual Simulated World

- Policies, economic inequality
- American vs. Danish government
- Macroeconomics, central banks

The first super collider games



Collaborative search



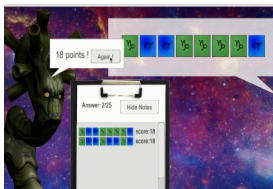
Predicting learning



Collaborative construction



Game theory
Behavioral economics

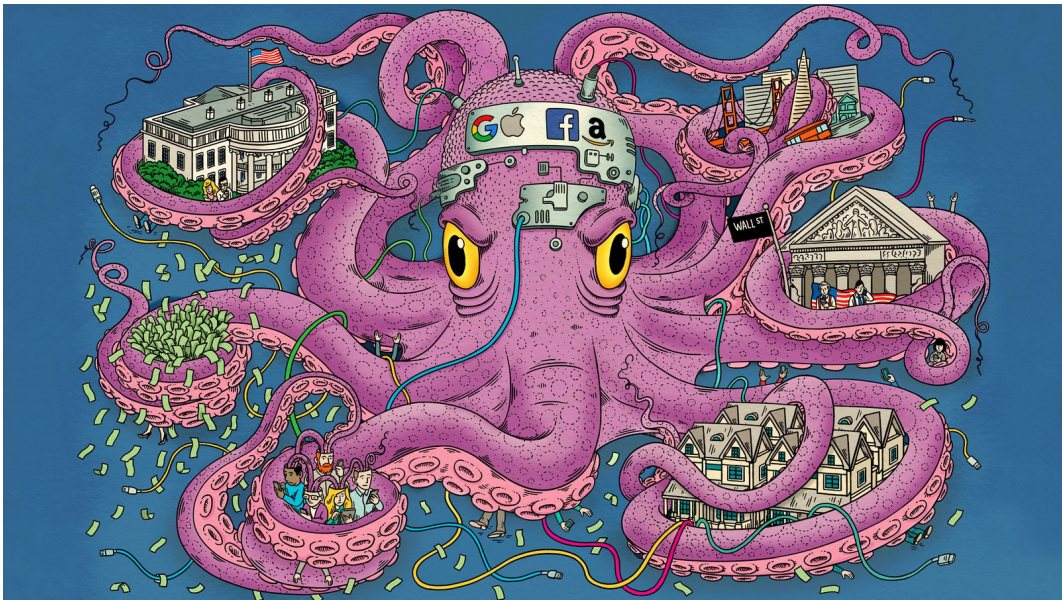


Individual strategy
selection

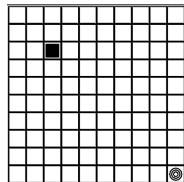


The emergence of
inequality

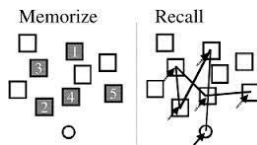
The monopoly on human data and understanding human algorithms



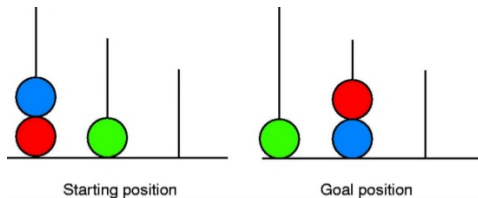
So, what do we do about it?



Groton maze learning

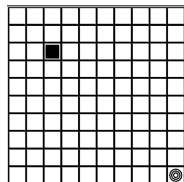


Corsi blocks

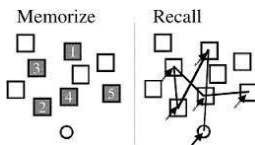


Tower of London tasks

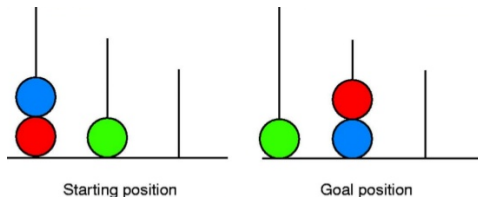
So, what do we do about it?



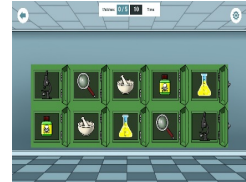
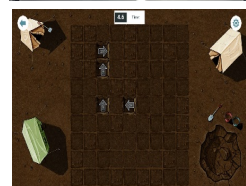
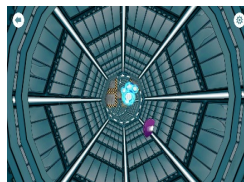
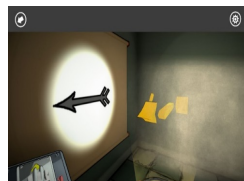
Groton maze learning



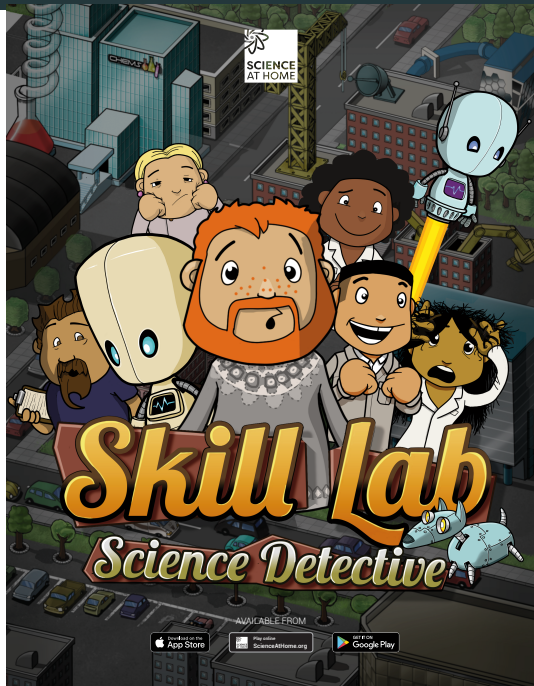
Corsi blocks



Tower of London tasks



Equal access to data brings equal access to knowledge



Applications

- Team formation
- Personalized education
- Diagnostics
- Policy advice towards equal opportunity societies

Skill Lab: Science Detective

HJÆLP VIDENSKABEN!

Spil computerspil og vær med til at skabe Danmarks nye superhjerne!

Forskere bag spillet kan lære en masse om, hvordan mennesker tænker og lever og om, hvordan de spiller spillet, desto mere kan forskerne lære.

DU ER VIDENSKARSDETEKTIV

Opklar de mystiske hændelser på universitetet med hjælp fra **robotten Allan**, og hjælp forskerne på mæder med deres problemer.

GENNEMFØR OG FÅ DIN PERSONLIGE PROFIL

Der er flere timers underholdning i spillet, men forskerne lærer noget allerede ved de første løsninger til spillet. Gennemfør spillet og find ud af hvilken type **detectiv** du er! Du får også besvaret en profil, der viser dine kognitive styrker og svagheder.

HVAD BRUGES DINE DATA TIL?

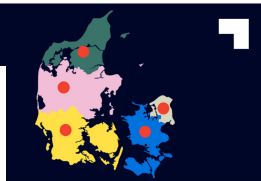
Data bliver behandlet fortroligt i henhold til persondataloven og GDPR og bruges kun til forskning.

Alle kan være med – du skal bare være fyldt 16 år.

Start the game

Impulsiv eller eftertænksom: Se hvordan I er i din landsdel

Københavnere kan ikke styre sig, og Sønderjyder følger ikke ordrer. Forskere, der vil kortlægge danskernes adfærd, er klar med de første observationer.



Superforsker får millioner til at undersøge menneskets opførsel

Aarhusianske forskere får 15 millioner kroner til at udvikle computerspil, der skal bruges til videnskabelige formål.

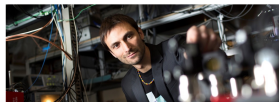


Danmarks nye superhjerne

TEKNOLOGI

Dansk superforsker: Menneskelig intuition skal gøre computere klogere

Jacob Sherson og hans kolleger vil parre intuition med rå regnekraft - og måske vinde kontrollen med vores data tilbage.



Vil du være med til at skabe Danmarks nye superhjerne?

Aarhus-forskere vil skabe fremtidens kunstige intelligens med computerspil, hvor alle kan være med- og du er hermed inviteret til at spille 'Science Detective'.

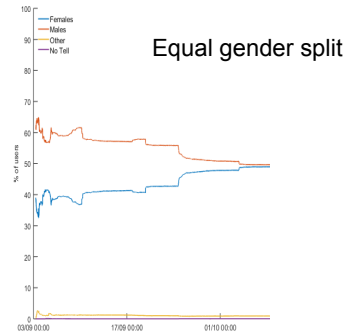
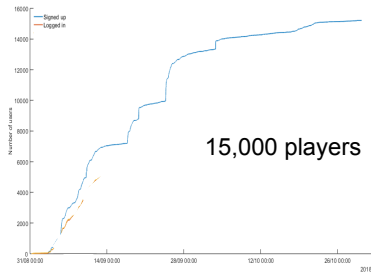
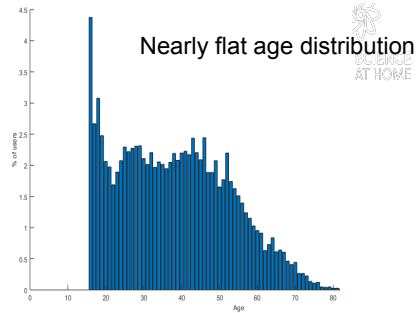
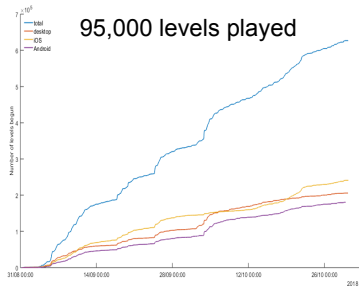


DR og Aarhus-forskere skaber Danmarks nye superhjerne

DR og Aarhus Universitet vil monstre så mange "små grå", som overhovedet muligt i et nyt forskningssamarbejde kaldet 'Danmarks nye superhjerne'.



DR og forskergruppen Science@Home fra Aarhus Universitet går sammen i et nyt forsknings-samarbejde kaldet 'Danmarks nye superhjerne'.



Danmarks nye superhjerne

VIDEN

Impulsiv eller eftertænksom: Se hvordan I er i din landsdel

Københavnere kan ikke styre sig, og Sønderjyder følger ikke ordre. Forskere, der vil kortlægge danskernes adfærd, er klar med de første observationer.

Hovedstaden



Lisbeth
Salander



Sherlock
Holmes

Du har en god hukommelse, hvis du kommer fra hovedstadsområdet. Og så har du også et skarpt øje for helt små og subtile forskelle. Til gengæld er du mindre god til at kontrollere dine impulser.



Geographic Distribution



Nordjylland



Belle
(fra Skenheden og Udyret)



Axel
Foley

Din hukommelse fejler ikke noget. Du er god til at huske. Du er også hurtig på aftrækkeren. Men du er altså mindre skarp, når du skal følge nogle instruktioner. Og så er du heller ikke så god til at inddele ting i kategorier.

Midtjylland



Lara
Croft



Indiana
Jones

Hukommelsen fejler ikke noget. Den er god. Og den kan du bruge, når du skal løse velstrukturerede problemer og gåder. Men du er ikke for god til at styre dine spontane indfald og impulser.

Exploration: creativity and learning

Education is the New Gold Standard

DISRUPTING EDUCATION

We Pay People to Learn

Imagine a world that pays refugees to equip themselves with new languages, pays workers to retrain themselves through the tide of automation, and pays the next generation to prepare for the unsolved problems of tomorrow.



Jacob Sherson

Director and Founder,
Science at Home

in

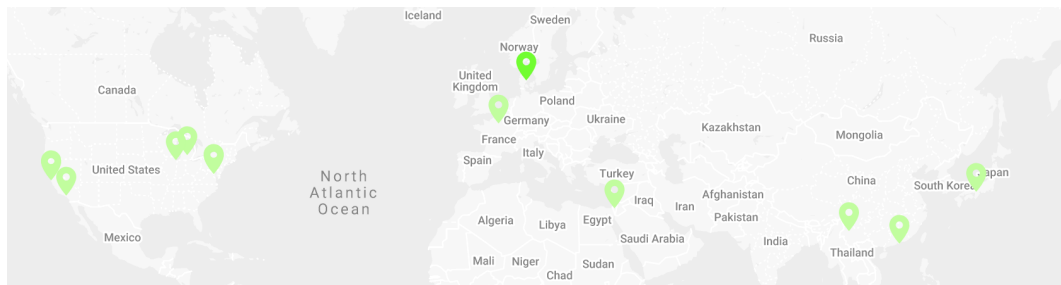


Janet Rafner

Director of Learning,
Science at Home

in

Think Like a Scientist: a global movement



- The Learning Economy, USA
- Smithsonian Science Education Center, USA
- Exploratorium, USA
- Hong Kong Academy for Gifted Education, Hong Kong
- Davidson (Weitzman) Institute, Israel
- Physics Reimagined, France
- LAMAP, France
- World in 2050, USA
- ...





- Games relate research challenges to core curriculum



- Games relate research challenges to core curriculum
- Gamification + 'extreme' citizen science to revolutionize 21st century education

Linking global challenges

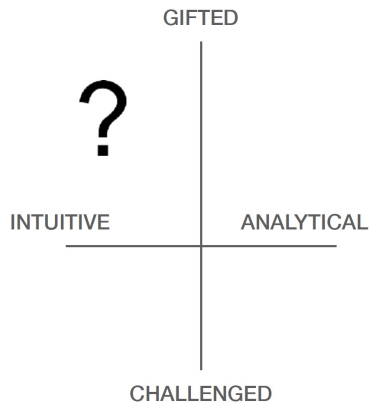


- Cutting edge research
- Informed by community driven SDGS
- Returned to public in citizen science games
- Increase responsibility for global challenges
- Increase agency for global change action
- Cultivate love of learning
- Cultivate curiosity for how the world works

In collaboration with

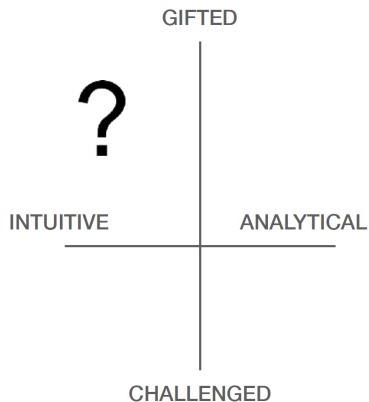


Analytical vs. Intuitive



- Nurturing students creativity and intuition

Analytical vs. Intuitive



- Nurturing students creativity and intuition
- Intuition: 'gut' decision without ability to pinpoint the cause(s)

Traditional citizen science



- Anyone can contribute
- Participants use the same methods for consistency in data
- Data helps researchers come to real conclusions
- Results are openly shared

Traditional citizen science



Hypothesis Formation



Data Generation



Data Analysis



Game Play Co-Creation



Hypothesis Formation



Data Generation



Data Analysis



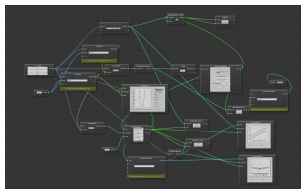
Game Play Co-Creation

Sounds cool.. but how do we actually do it?

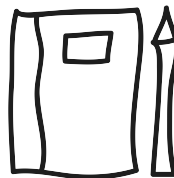
- Facilitating extreme citizen science
- Documenting the creative process



StatWorld: playful data science



Composer: scratch like interface for quantum research



Citizen Science Notebook

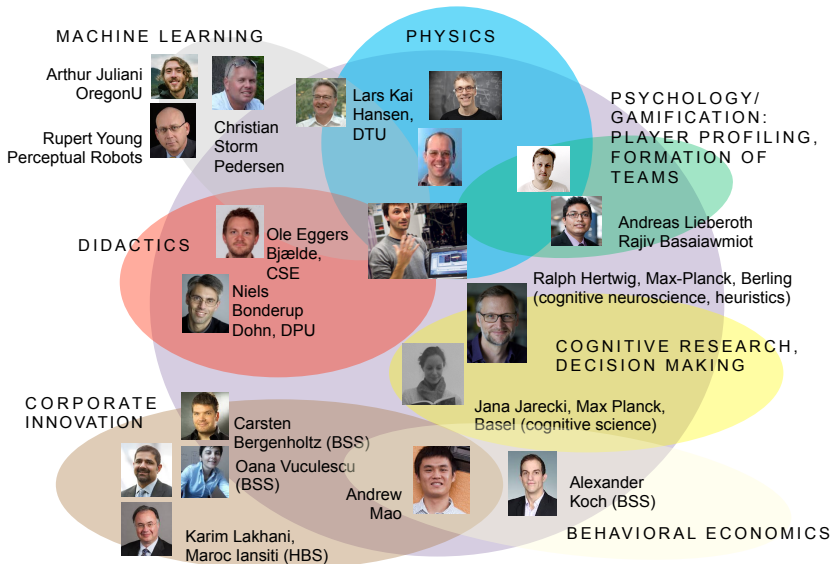
- Personalized
- Dynamic
- Multimedia
- Facilitates communication
- Facilitates mentorship
- Facilitates extreme citizen science

In collaboration with



**Big take away: In a world turning to
AI, think HI first!**

Extended scientific network





CARLSBERG FOUNDATION



Collaborations welcome !!



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