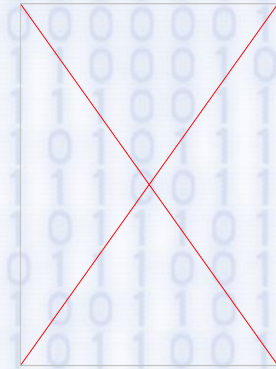


Military Flight Training

Digital Technology Disruption Ahead?

Andy Fawkes



A Digital Perspective

Arthur C. Clarke

1917-2008



“I don't pretend we have all the answers. But the questions are certainly worth thinking about.”

Some Questions

- Do new Recruits think so differently?
- Why so much talk about Big Data?
- How might AI affect Training?
- Will we need Human Instructors?
- What is the impact of more Autonomous Systems?
- Is there more to learn from computer games?
- Will Virtual Reality become a reality?
- How much more Simulation?

Recruits



A Short Intermission...





RAF Age Distribution - 2018

38% of the RAF is ≤ 29

and 75% ≤ 39

UK REGULAR FORCES BY AGE

Full-time trained and untrained personnel, at 1 April 2018

	Army Service	Naval Service	RAF Service	All services
Under 18-24	21,720	7,440	5,530	34,710
Under 18	1,630	230	160	2,030
18-24	20,090	7,210	5,370	32,680
25-34	34,770	13,550	13,220	61,530
25-29	19,250	7,540	6,830	33,610
30-34	15,520	6,010	6,390	27,920
35-44	19,640	7,490	9,330	36,470
35-39	12,760	4,650	5,790	23,210
40-44	6,880	2,840	3,540	13,260
45 and over	4,970	4,010	4,860	13,850
45-49	3,270	2,360	2,790	8,420
50-54	1,510	1,390	1,740	4,640
55-59	190	250	330	770
60 and over	~	10	~	20



“Digital Native”

generally considered a person born in the 1980s and after growing up in the digital age with day to day access to computers, games, Internet, etc.

Broadly, 55% of the RAF now are Digital Natives and 85% by 2030

Changing Technology and Training Needs



- Panavia Tornado (1970s on)
- Analogue
- Knobs, Dials



- Lockheed Martin F-35 (2010s on)
- Digital
- Touch Screen - “Glass Cockpit”

F-35 - “Digital Engineering”



Picture: MoD



RAF Marham - Maintenance and Finishing Facility -
Picture: Cpl Ashley Keates

**UK Children aged 12 to 15
spend 12.2 hours a week
gaming in 2017**

**and 11 to 64 year-olds
8.9 hours**

Air Chief Marshal Sir Stephen Hillier Jan 18

**“teenagers playing on
their Xbox at home should
take their gaming to the
next level and join the RAF
to operate real drones”**

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Join the RAF for the real thing, Xbox teenagers are told: Head of the air force says young gamers should take it to the next level by operating drones

- Air Chief Marshal Sir Stephen Hillier wants more young people to join the RAF
- The service will be celebrating their 100th anniversary with events this year
- Among the major events planned is a flypast along the Mall before the Queen
- RAF chiefs hope a display of military might could provide a boost to recruitment

By LARISA BROWN FOR THE DAILY MAIL
PUBLISHED: 00:32, 12 January 2018 | UPDATED: 00:53, 12 January 2018

Share

387 shares

194 View comments

Teenagers playing on their Xbox at home should take their gaming to the next level and join the RAF to operate real drones, the head of the air force said yesterday.

Air Chief Marshal Sir Stephen Hillier said the RAF's next 100 years will see a huge shift towards unmanned flying machines as he outlined plans for centenary celebrations.

A portrait of Air Chief Marshal Sir Stephen Hillier, a man with short grey hair, smiling. He is wearing a dark blue RAF uniform with a white shirt and tie. The background is slightly blurred, showing an indoor setting.

12

THINKE

What's Next?



~~Digital Native~~
Digital Native



AI Native?

Big Data

Big Data in the Economy

GOV.UK

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Departments Worldwide How government works Get involved
Policies Publications Consultations Statistics **Announcements**

[Home](#)
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New national innovation centre to put UK at forefront of big data

A new £30m National Innovation Centre for Data (NICD) aims to see the next Google or Facebook started in the UK and help the country capitalise on a potential £40bn a year boost to the economy.

Published 14 September 2017
From: [Department for Digital, Culture, Media & Sport](#) and [The Rt Hon Matt Hancock MP](#)



Related content

Policy
[Business enterprise](#)
[Cyber security](#)

“We’re determined to unlock the huge potential of big data which could add billions of pounds to our economy - from powering price comparison sites to improving the flow of transport around cities.”

Minister of State for Digital
Matt Hancock MP
14 Sep 2017

What is Big Data?

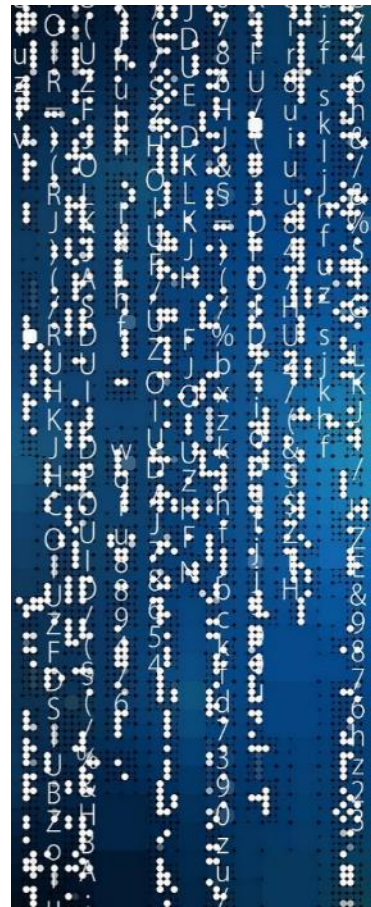
“data sets that are so voluminous and complex that traditional data-processing application software are inadequate to deal with them”

Big Data - Ultimately it's...

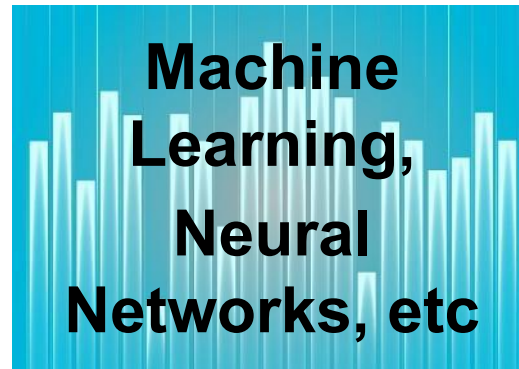


Creating Added Value at the Right Time

Exploiting Big Data



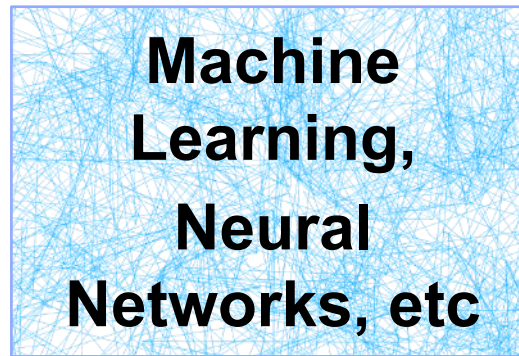
Big Data



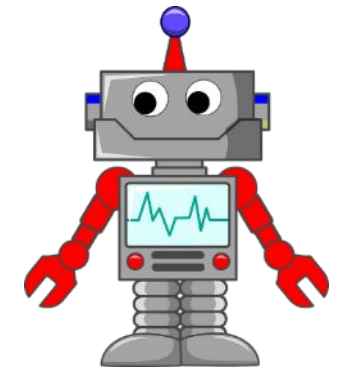
Analysis



Human Decisions



“Training”



Automation

Why Big Data in Analytics?

Prescriptive Analytics

- seeks to determine the best course of action

Predictive Analytics

- identify past patterns to predict the future

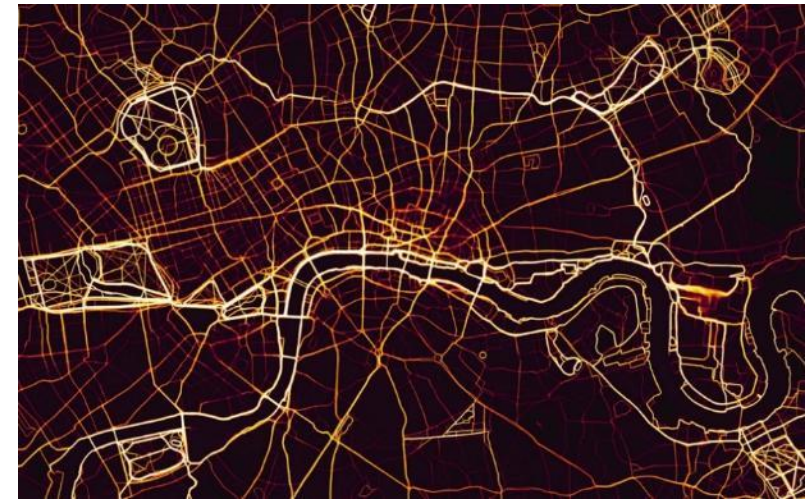
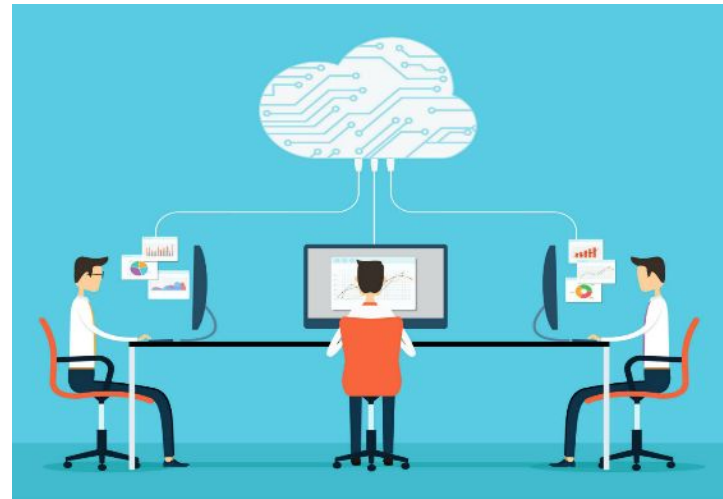
Diagnostic Analytics

- used to determine why something happened

Descriptive Analytics

- what is happening now based on incoming data

Training Data Generators



Big Data in Training

Prescriptive Analytics

- eg. cost effective balance of investment in training

Predictive Analytics

- eg. linking recruitment data to pilot success rates

Diagnostic Analytics

- eg. why are failure or success rates so high?

Descriptive Analytics

- eg. linking readiness to humans and aircraft

What is Your Approach to Enterprise Training Data?



Unconnected Small Data?

or



Big Data?

Manager



Aviator



Analyst



Ops

Training

HR



FlightPro

Sim/xAPI

DLMC

TAFMIS

JP
A

Data Misjudgements



Google Street View

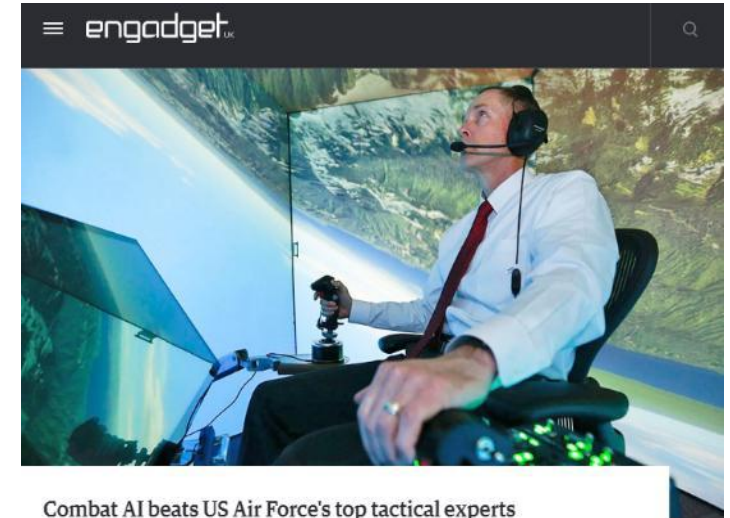
Artificial Intelligence

Military Autonomous Systems



**US Navy
X-47B**

**US AFRL
“ALPHA”**



Combat AI beats US Air Force's top tactical experts

And it only requires the processing power of a Raspberry Pi.



Andrew Dalton , @dolftown
06.28.16 in Robots



**US Army
Manned-Un
manned
Teaming
(MUM-T)**

**US Navy
Autonomous
Craft**



Military AI

IT and Networks

DARPA's new \$2 billion initiative for next-level AI

By: Mike Gruss September 9



DARPA leaders hope a new initiative focus on artificial intelligence could help improve day-to-day processes within the Department of Defense. (U.S. Air Force photo by Staff Sgt. Alexander Riedel)

ACQUISITION, CONGRESS, INTEL & CYBER, STRATEGY & POLICY

Joint Artificial Intelligence Center Created Under DoD CIO

"The major challenge for the US is China," CNA analyst Larry Lewis said. "They are approaching the use of AI just like the US approached going to the moon in the sixties."

By SYDNEY J. FREEDBERG JR.

on June 29, 2018 at 1:37 PM

17 Comments



Simulation CGFs/SAFs

SAF - Semi-Autonomous Forces

CGF – Computer Generated Forces

Some examples

- **BDS-D CGF**
- **IFOR/WISSARD**
- **ModSAF**
- **CCTT SAF**
- **Janus**
- **OneSAF**
- **Strive**
- **VR Forces**

Global AI Research Investment (Mar 18)

- \$24 billion spending forecast for 2018 on AI
- Reaching \$78 billion in 2022
 - 37% compound annual growth rate



Worldwide Semiannual Artificial Intelligence Systems Spending Guide

AN IDC SPENDING GUIDE

IDC's *Worldwide Semiannual Artificial Intelligence Systems Spending Guide* examines the cognitive computing opportunity from a region, industry, use case, and technology perspective. This comprehensive database delivered via pivot table format or IDC's Customer Insights query tool allows the user to easily extract meaningful information about the cognitive/artificial intelligence systems market by viewing data trends and relationships and making data comparisons.

Markets Covered

This product covers the following segments of the cognitive/artificial intelligence systems market:

- **9 regions:** The United States, Canada, PRC, Japan, Western Europe, Central and Eastern Europe, Middle East and Africa, Latin America, and AsiaPacific.
- **19 industries:** Banking, insurance, securities and investment services, discrete manufacturing, process manufacturing, construction, resource industries, retail, wholesale, professional services, personal and consumer services, transportation, healthcare provider, federal/central government, state/local government, education, telecommunications, media, and utilities.
- **20+ use cases including:** Automated customer service agents, automated threat intelligence and prevention systems, fraud analysis and investigation, expert shopping advisors and product recommendations, and others.
- **6 technology markets:** Business Services, Cognitive Applications, Cognitive Platform, IT Services, Server, and Storage.

Subjects Analyzed

Throughout the year, this product will address the following topics:

- Artificial intelligence systems market definition
- Key industry use cases
- Market drivers impacting cognitive/artificial intelligence systems growth

Key Questions Answered

Our research addresses the following issues that are critical to your success:

1. What are the different elements of the artificial intelligence systems landscape?
2. How will artificial intelligence systems adoption vary by region, country, use case, and industry?
3. How will the artificial intelligence systems market grow over the forecast period by industry and use case?
4. Which industries present the greatest growth opportunity for artificial intelligence systems technology?

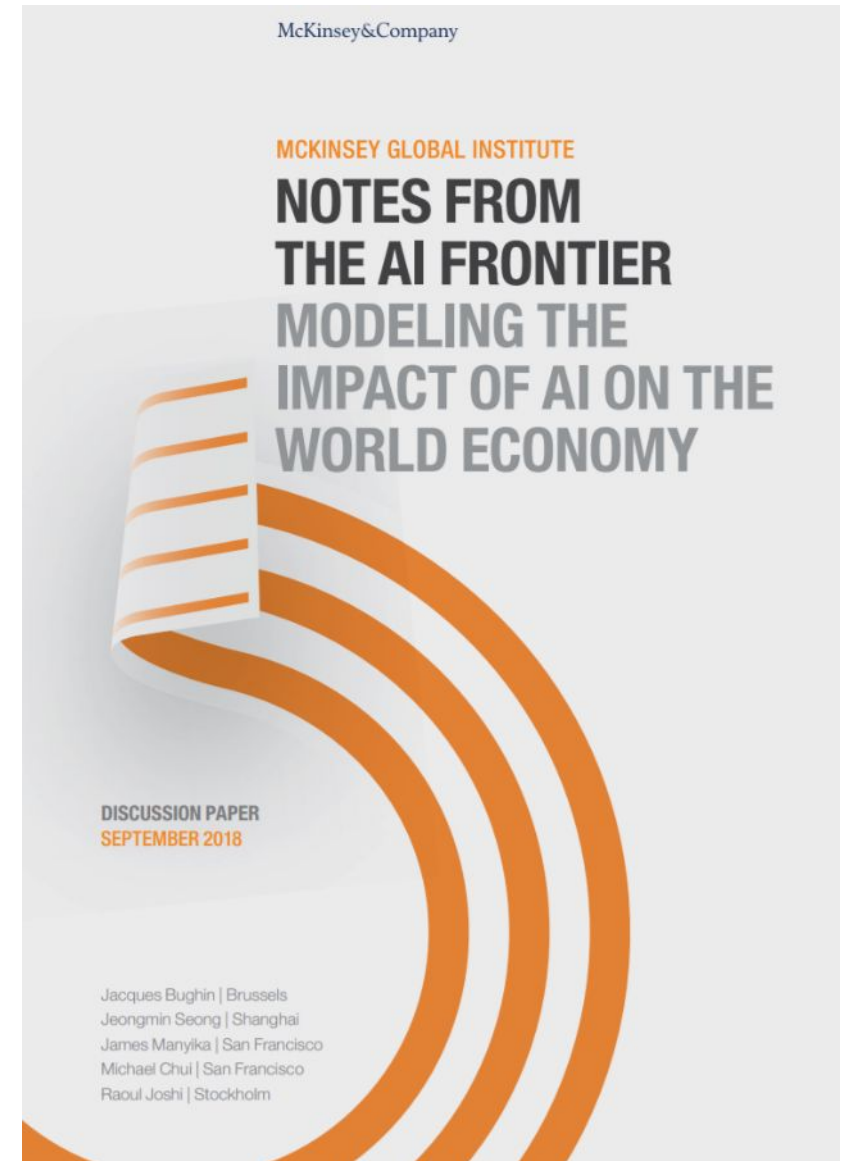
Global Program Overview



Source: IDC

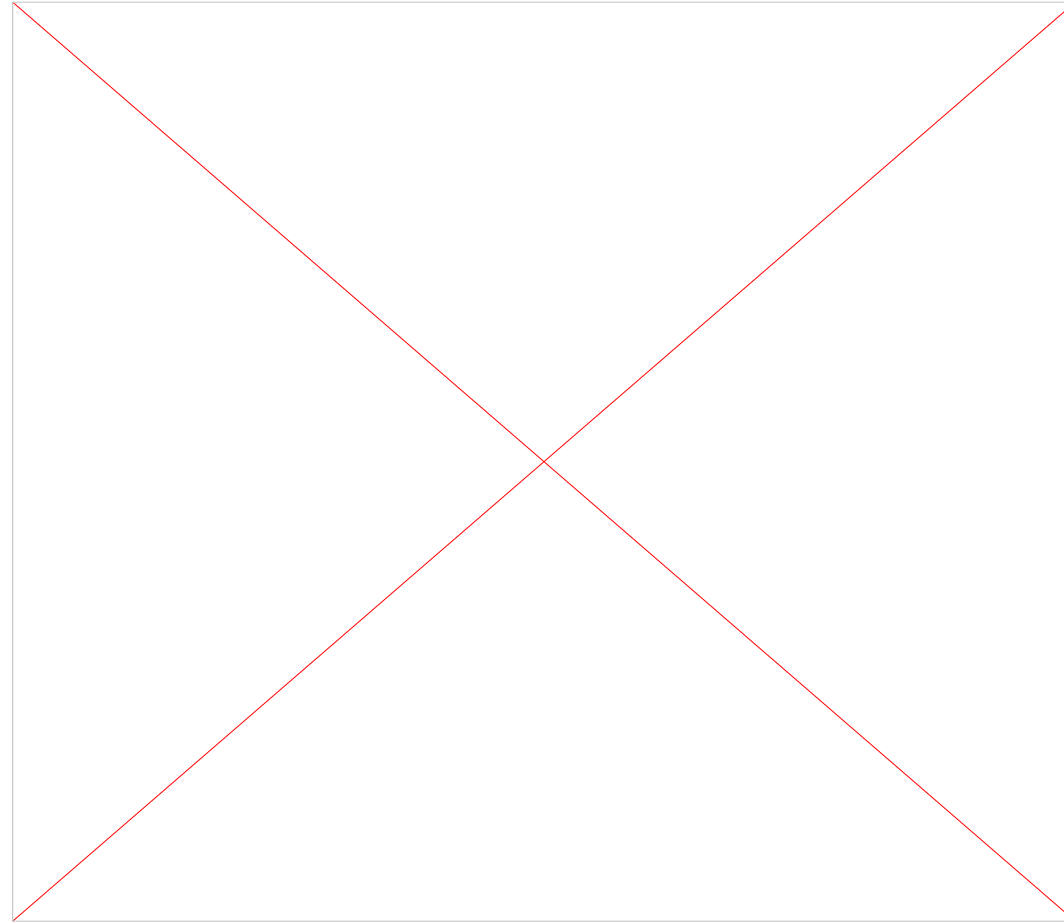
Impact of AI on the World Economy – Sep 18

- AI has the potential to deliver additional global economic activity of around \$13 trillion by 2030
- By 2030, some 70% of companies might have adopted at least one type of AI technology
- A key challenge is that adoption of AI could widen gaps among countries, companies, and workers



Current AI R&D Investment

Military



Civilian

What is Artificial Intelligence?

AI Origins



Turing did not ask whether a machine can “think”; he asked whether a machine can act indistinguishably from the way a thinker acts

VOL. LIX. No. 236.]

[October, 1950

MIND

A QUARTERLY REVIEW

OF

PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND INTELLIGENCE

By A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

The new form of the problem can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either 'X is A and Y is B' or 'X is B and Y is A'. The interrogator is allowed to put questions to A and B thus:

C: Will X please tell me the length of his or her hair?
Now suppose X is actually A, then A must answer. It is A's

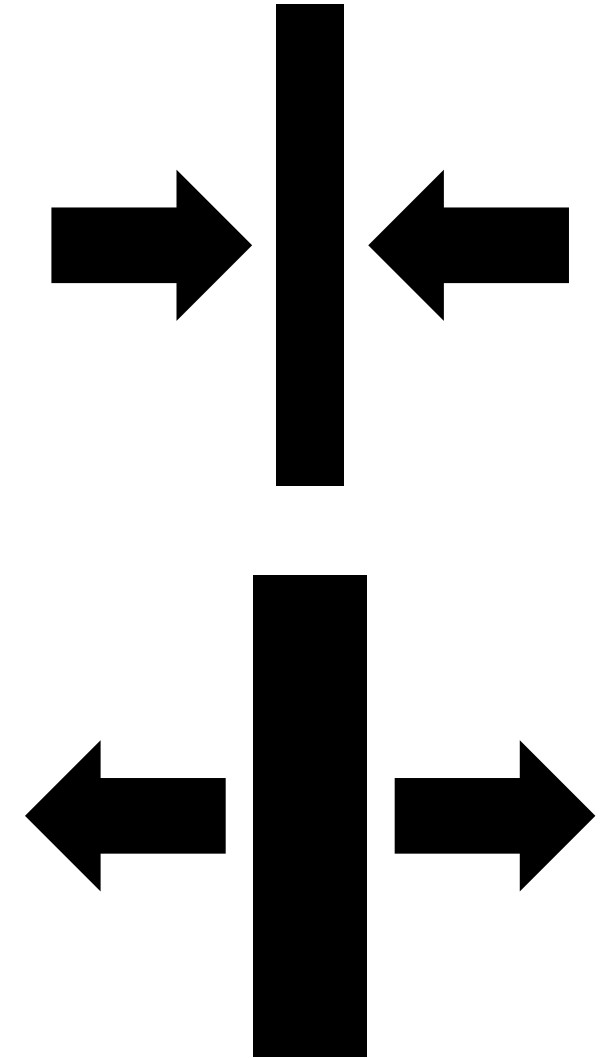
28

433

AI Scope

the nature of the intelligence can be:

- “narrow” intelligence which is highly tailored or specialised through to
- artificial “general” intelligence which is flexible, adaptive and inventive, much like the human brain



AI Techniques

- Many approaches to AI, eg:
 - decision trees
 - fuzzy logic
 - neural nets
 - machine learning
 - deep or reinforcement learning

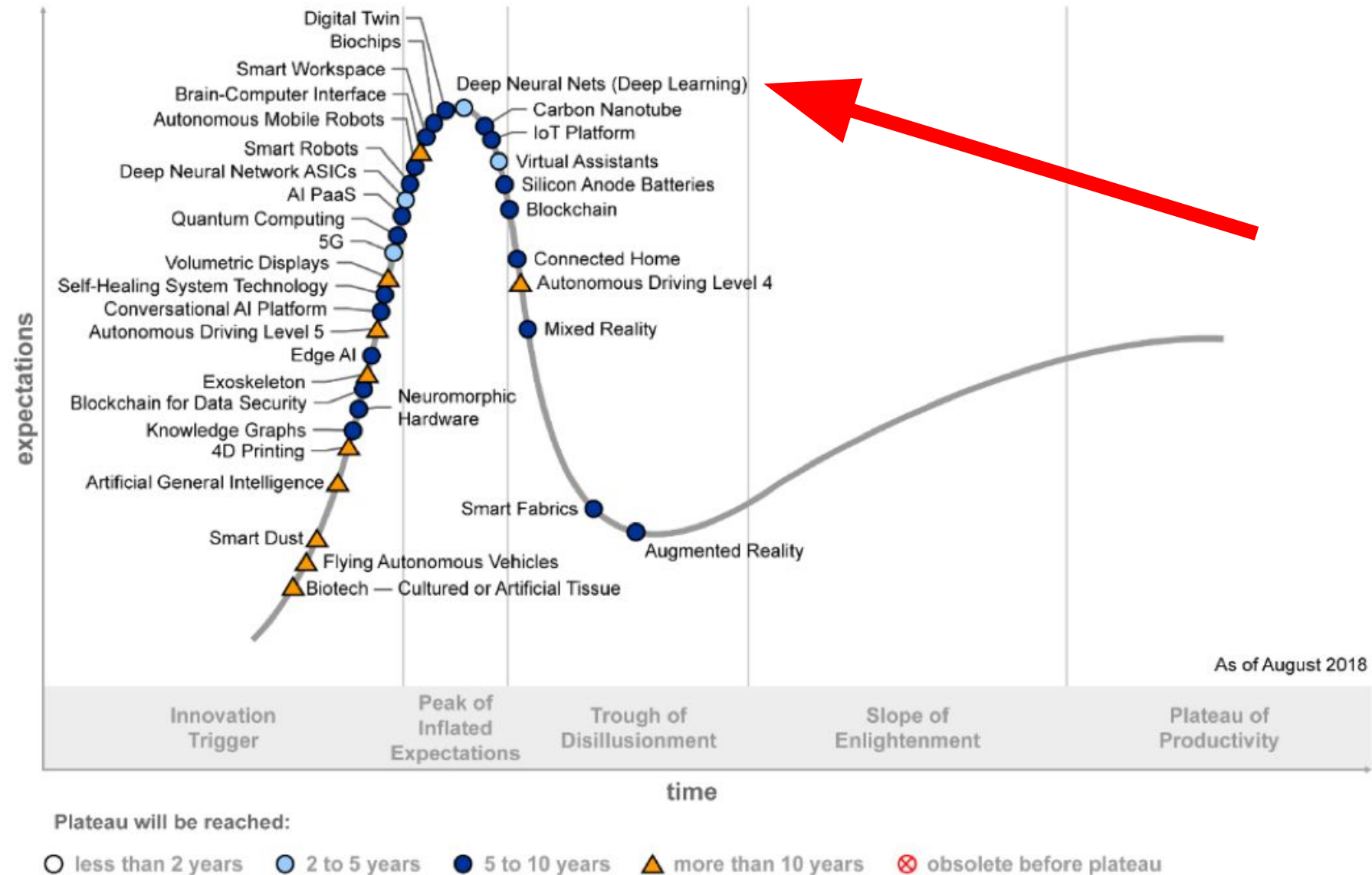


Feasts and Famines

- Early successes in areas such as mathematical problem solving with some of the ideas being central to modern AI, such as those behind neural networks
- Funding for AI research ebbed and flowed with hype cycles in the 1970s, 80s and 90s
- In 1984 the term “AI Winter” was coined describing a period of reduced funding and interest in AI research

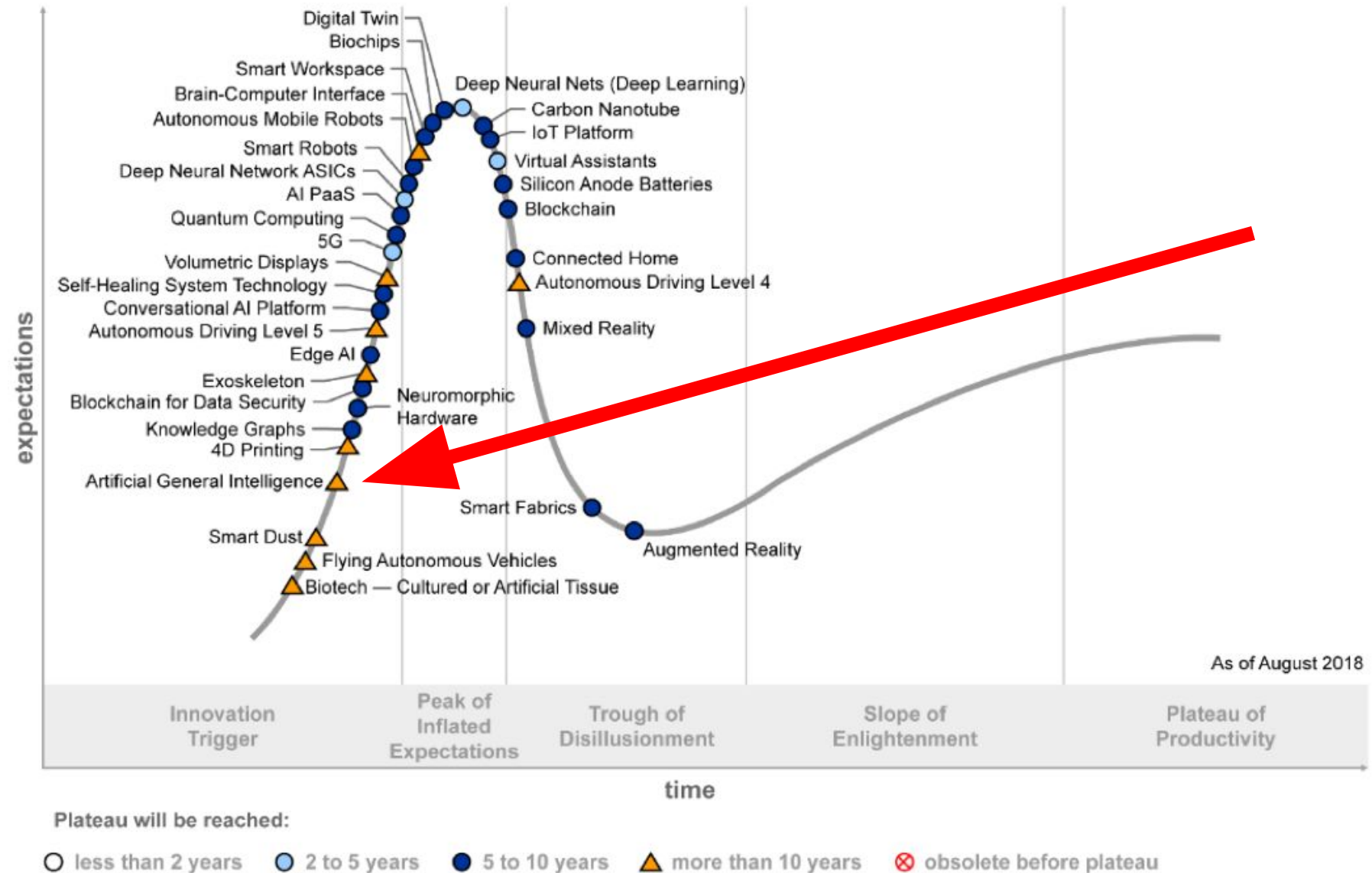


Hype?



© 2018 Gartner, Inc.

Hype?



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Some Current Developments

Driving Factors in Artificial Intelligence

1. Hardware

- Faster Processors hosted locally or in the cloud
- Synergies of AI programming (eg. solving matrices) and graphics cards

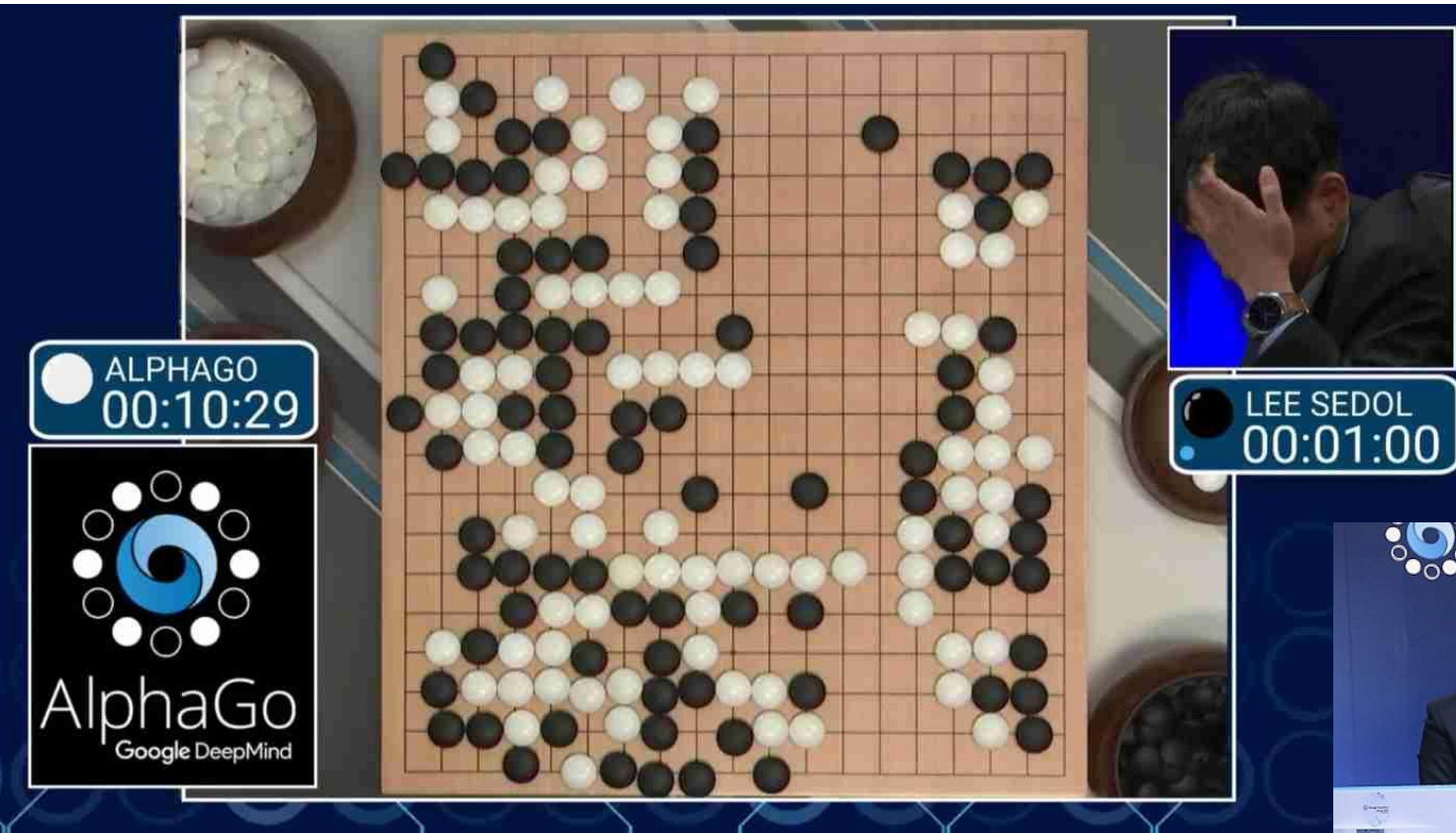
2. Data

- Explosion of data, online and real time, to train AI programs

3. Algorithms

- Algorithms such as deep learning are a major force driving AI

Board Games and AI



AlphaGo (2016)



“AlphaGo Zero” (Oct 2017)

- The next DeepMind incarnation was “AlphaGo Zero”, with a new neural net design
- Trained in 3 days, no human intervention except Go rules
- Result:
 - “AlphaGo Zero” beats “AlphaGo” – 100 to 0



AI Learning in Games/Simulation

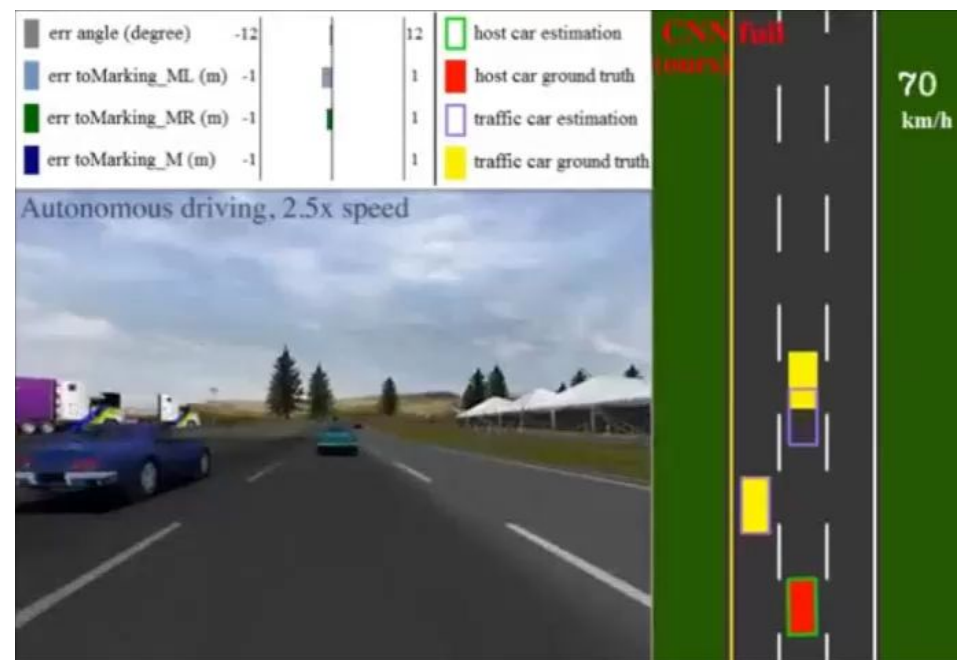
Google DeepMind's Deep Q-learning

The algorithm will play Atari breakout.

The most important thing to know is that all the agent is given is sensory input (what you see on the screen) and it was ordered to maximize the score on the screen.

No domain knowledge is involved! This means that the algorithm doesn't know the concept of a ball or what the controls exactly do.

Google DeepMind (Atari Breakout)



Princeton University (TORCS Racing Simulator)



Machine Learning Agents



Introducing: Unity Machine Learning Agents

Arthur Juliani, September 19, 2017

Unity Games Engine Machine Learning Agents (Sep 2017)



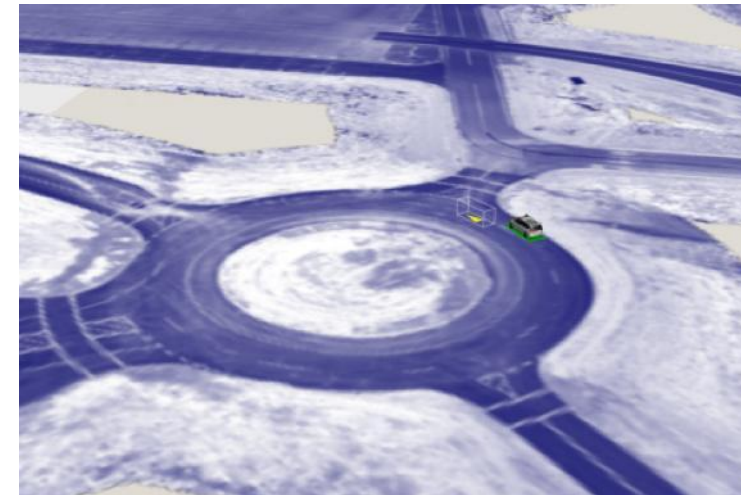
Machine Learning Agents

Simultaneous Training Demo

Alphabet (Google) Waymo



3 Million Real Miles (2016)



**2.5 Billion Simulated Miles
(2016)**

Games & AI Technology Synergies

[Tom's Guide](#) / [Tom's Hardware](#) / [Laptop Mag](#) / [TopTenReviews](#) / [AnandTech](#) / [shopsavvy](#)

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[GRAPHICS](#) > [FEATURE](#)

Nvidia's Turing Architecture Explored: Inside the GeForce RTX 2080

25 COMMENTS

by [Chris Angelini](#) September 14, 2018 at 6:00 AM

[f](#) [t](#) [r](#) [c](#) [u](#) [s](#)

Page 14: **Ray Tracing And AI: Betting It All on Black** [v](#) [<](#) [>](#)

Ray Tracing And AI: Betting It All on Black

Nvidia could have poured *all* of its efforts into features that make Turing faster than the Pascal architecture in today's games, rather than splitting attention between immediate speed-ups and investments in the future. But the company saw an opportunity to drive innovation and took a calculated risk. And why not? Its performance and efficiency lead over AMD's Vega RX series creates a comfortable margin to push next-gen technology more than we've seen in years.



Artificial Intelligence Technology Challenges

- Large volumes of data are required, especially for modern neural net AI approaches
 - *Favours the large Tech companies and some Countries?*
- AI programs typically can only do one task
 - *"there is no neural network in the world, and no method right now that can be trained to identify objects and images, play Space Invaders, and listen to music" (DeepMind)*
- AI programs can be difficult to understand and verify after programming
 - *DARPA's Explainable Artificial Intelligence (XAI)*
- Cyber Security and Privacy
- Ethical Considerations

Still Some Way to Go



Tom Clancy's Rainbow Six: Vegas

Virtual Reality?

Different Realities

Reality

The real world



Augmented Reality

Information layered over vision



Mixed Reality

Blend of real and digital information to enhance reality



Virtual Reality

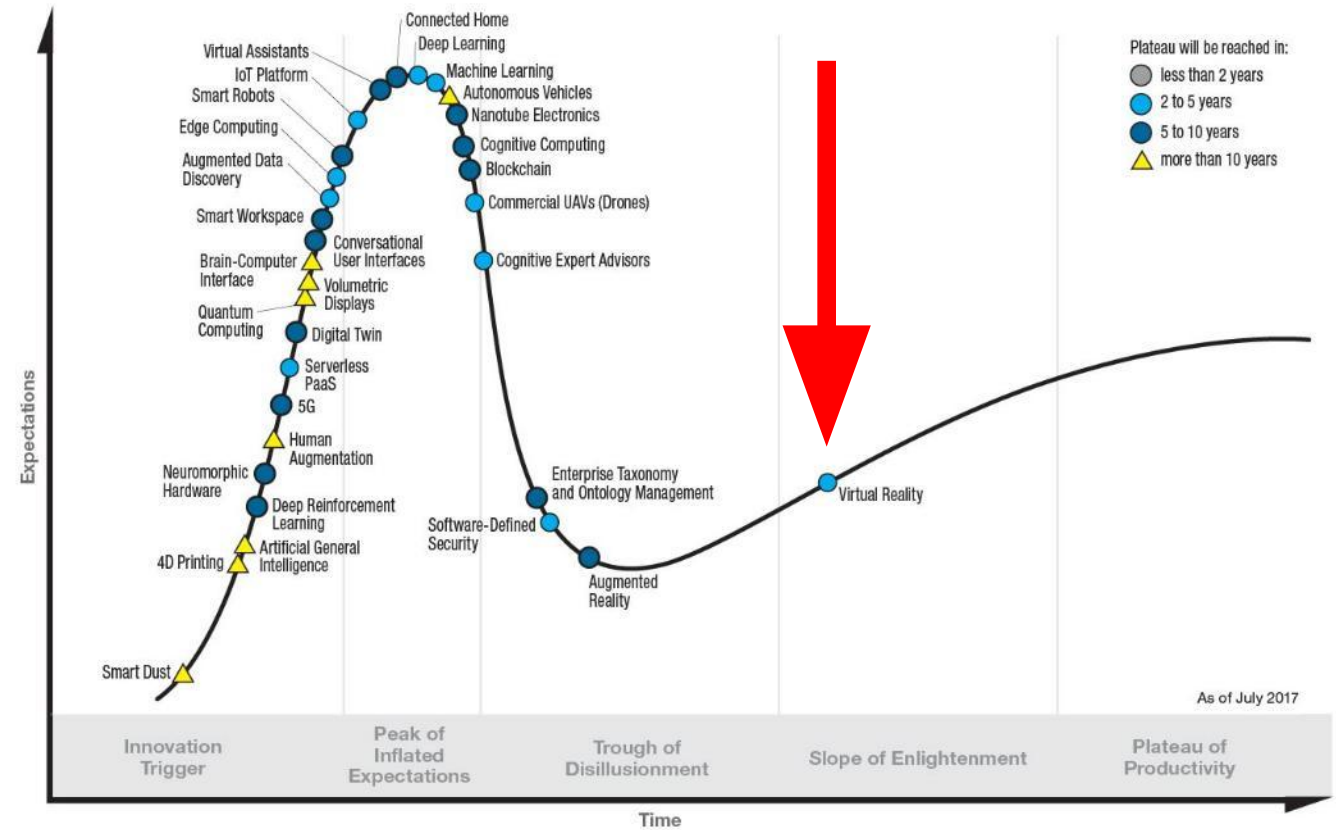
Fully virtual world



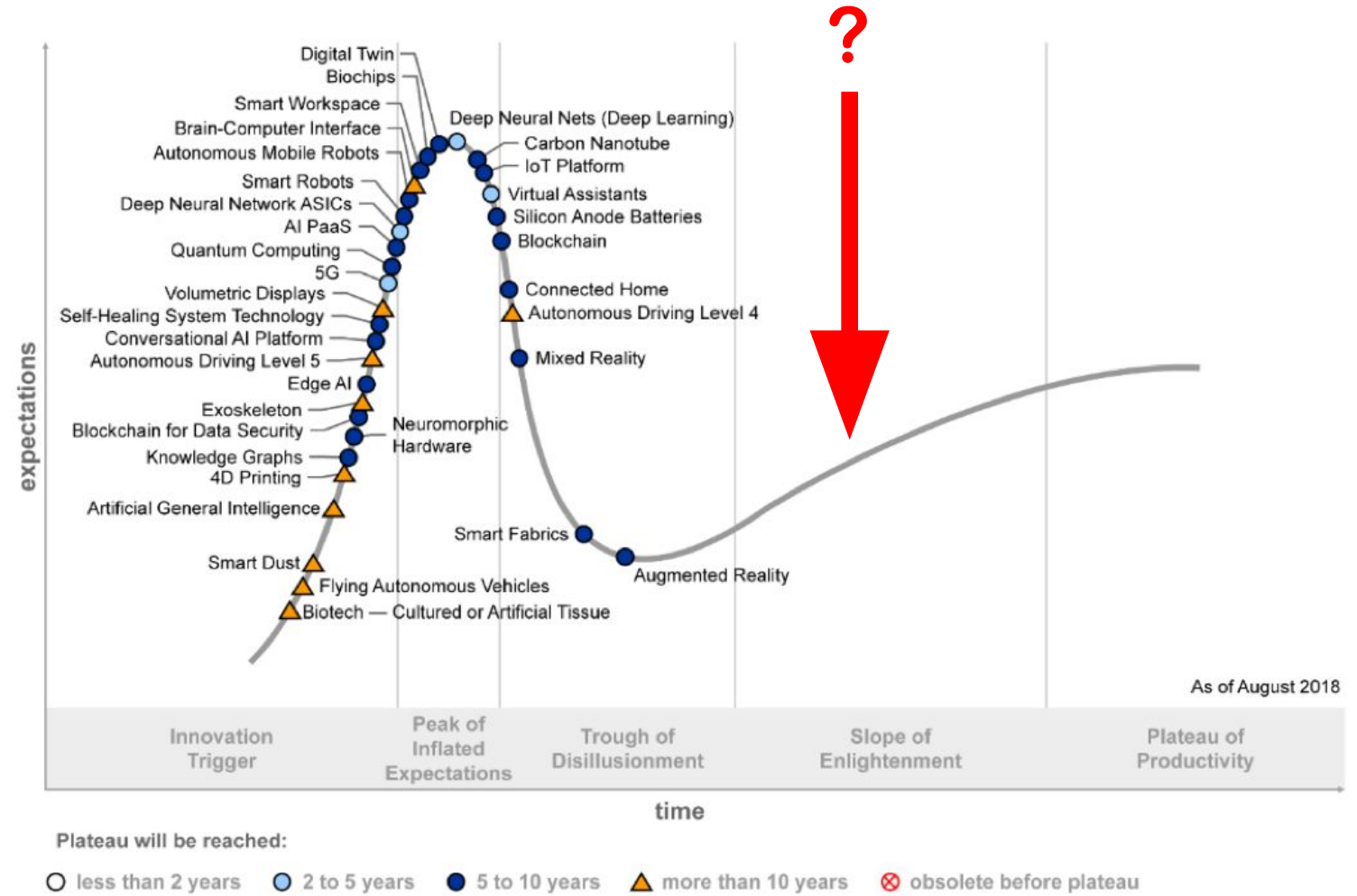
UK Parachute Training - VR in Use (RAF Brize Norton - 2011)



Gartner Hype Cycle 2017



Gartner Hype Cycle 2018



© 2018 Gartner, Inc.

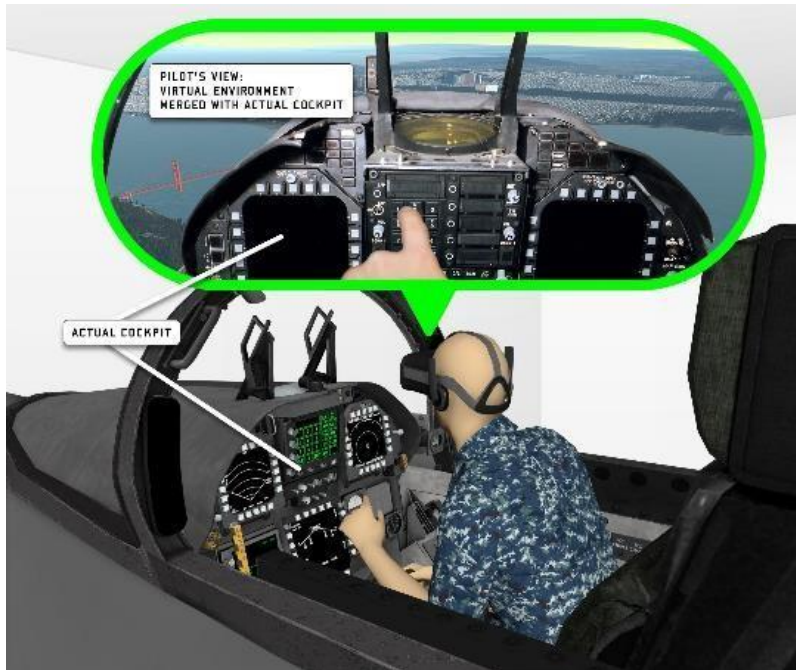
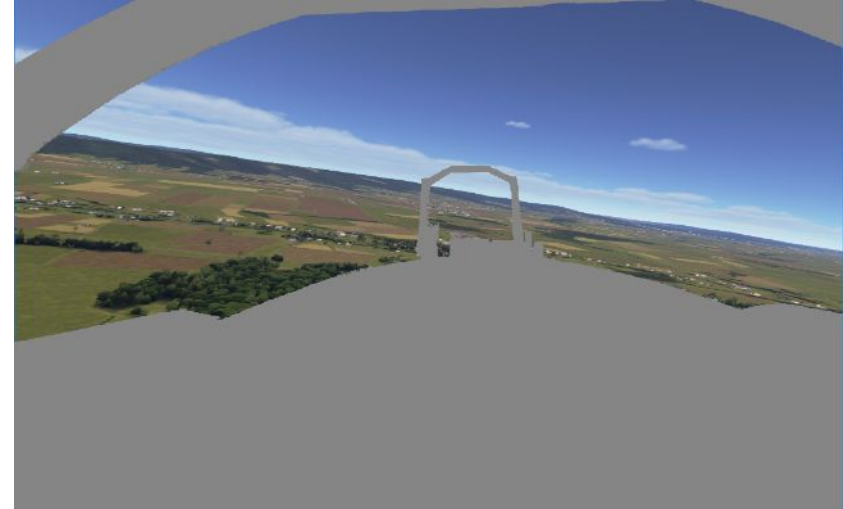
Huey Flight Simulator with Oculus Rift



VR + Virtual Cockpit Interaction



Mixed Reality Visual System (MRVS)



Whats about Games?

Realism...

Home News Arma 3

Russian TV station mistakenly airs footage of ARMA 3 during report on war in Syria

Blames archiving mix-up.

Games in this article



Arma 3
PC

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By [Matt Wales](#) Published 26/02/2018

A Russian television station has mistakenly aired footage from a video game during a report on the war in Syria.

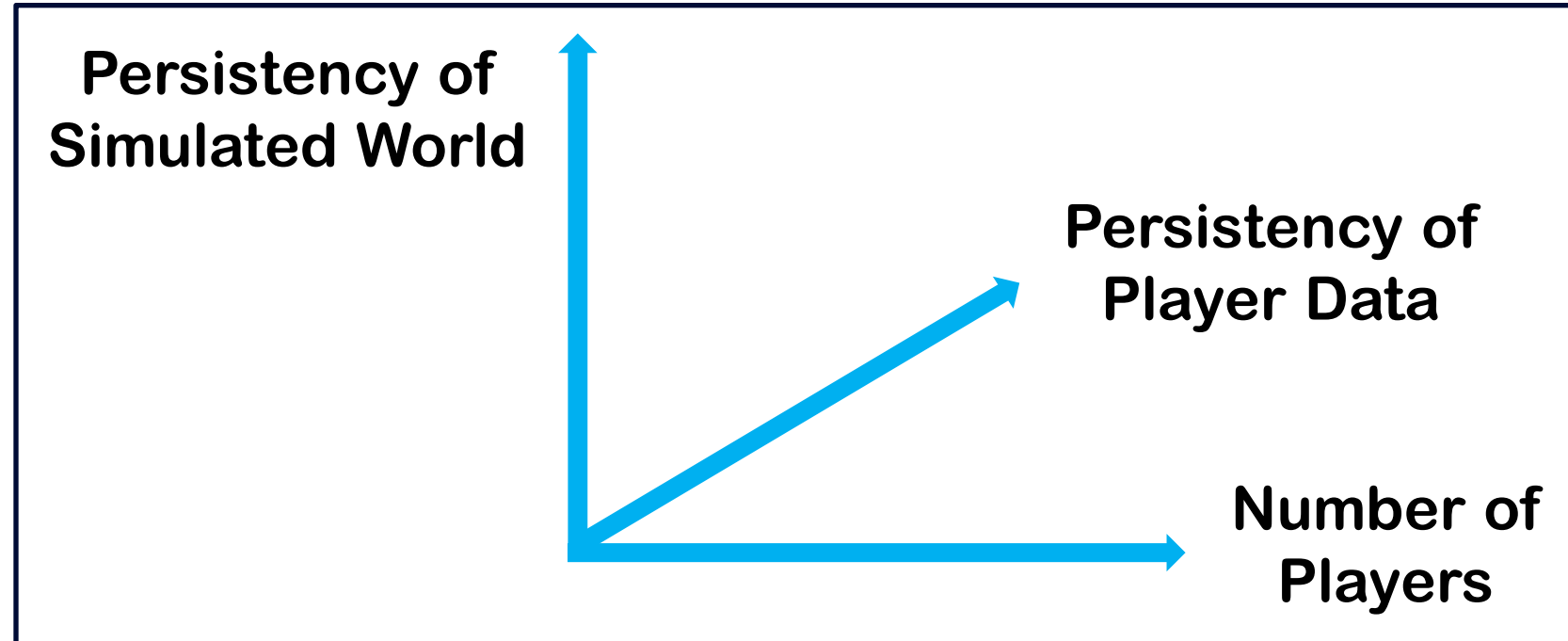
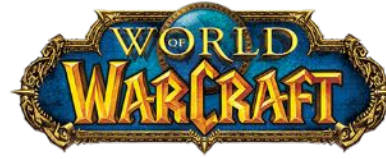
As [noted by the BBC](#), the suspicious footage was edited into a segment celebrating members of the country's armed forces on weekly programme Voskresnoye Vremya, which airs on Russia's state-run Channel One TV.

At one point in the video, a truck is shown being targeted through a gun sight. While the clip's appearance was brief enough to pass unnoticed by most, users of [Russia's Reddit-like community site Pikabu](#) were a little more observant, quickly identifying the footage as being from developer Bohemia Interactive's ARMA 3.

Video game clip being used on Russia state TV



Massively Multiplayer Online Games (MMOGs)



**MMOGs offer a way of thinking
about data and communities**

Typical MMOG Characteristics

- Persistent interactive world that can be accessed 24/7
- Millions of Concurrent Users
- Player data that tracks and rewards performance
- In game communication and interaction with other players
- Online Communities and Support
- Supports thin client approach
- Secure login
- Ranked/Unranked Worlds

PlayerUnknown's Battlegrounds - Dec 17



Fortnite Battle Royale

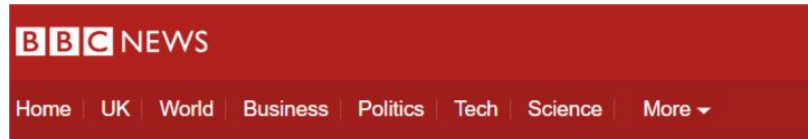


- Online video game released Mar 17
- As of July 2018, the game had seen over 125 million players and estimated to have earned more than US\$1 billion in microtransactions
- The goal is to be the last player alive out of 100 by eliminating or avoiding other players
- Nearly all objects in the game can be harvested for materials (e.g. wood), to build fortifications, such as walls and ramps, which can be used for protection, to help move, or slow down progression of other players

Fortnite Battle Royale



Fortnite Battle Royale - Addictive?



Fortnite is now even being blamed for divorce

17 September 2018 | Newsbeat



Fortnite has been blamed for violence, students missing school and now apparently divorce.

The survival video game's been cited in a number of recent break-ups, according to a new survey.

According to research by divorceonline.co.uk, 200 divorces since January 2018 mentioned addiction to Fortnite and other online games as one of the reasons for the relationship breakdown.



Fortnite

Why can't people stop playing Fortnite?

How the latest video game craze mixes up the fundamentals of game design and human psychology to make itself compelling

Will Luton

Wed 29 Aug 2018 12:00 BST



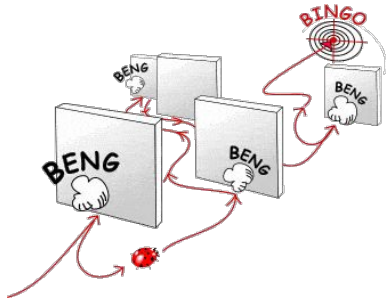
▲ Keeps you coming back for more ... Fortnite. Photograph: Epic Games

Fortnite Battle Royale - Addictive?



Random Rewards

- Random “loot” or “variable-ratio schedule”, like a slot machine
- The hope of finding something desirable paired with occasional reward is exciting
- The gap between high- and low-skill players is also reduced making the game less punishing and more difficult to dominate



Finding Order in Chaos

- The instinctive need to find order in chaos
- Players must build a mental model of the game’s mechanics building their intuitive judgement
- If their intuition leads to success this is pleasurable whilst unexpected failure leads to a need to learn and play more



Social Status

- The need to signal social status
- Impressing other players through “skins” or visual customisations of player’s avatars or weapons, that are also restricted to “Seasons”, signalling success, much like in Fashion

Fortnite Battle Royale – “Cross Platform Play”

- The ability of an online video game to allow players using different video game hardware to play with each other simultaneously
- Games typically designed to be deployed on different platforms and gaming network protocols considered straightforward
- Challenges:
 - Linking different networks (e.g. Steam, Xbox) that securely managing player's credentials, digital store purchases, friend lists, messaging and other social features, and online matchmaking for multiplayer games
 - Different game builds
 - Keyboard-and-mouse controls typically gives computer players an unfair advantage over consoles and handhelds (“fair fight”)



Simulation - Are We There Yet?

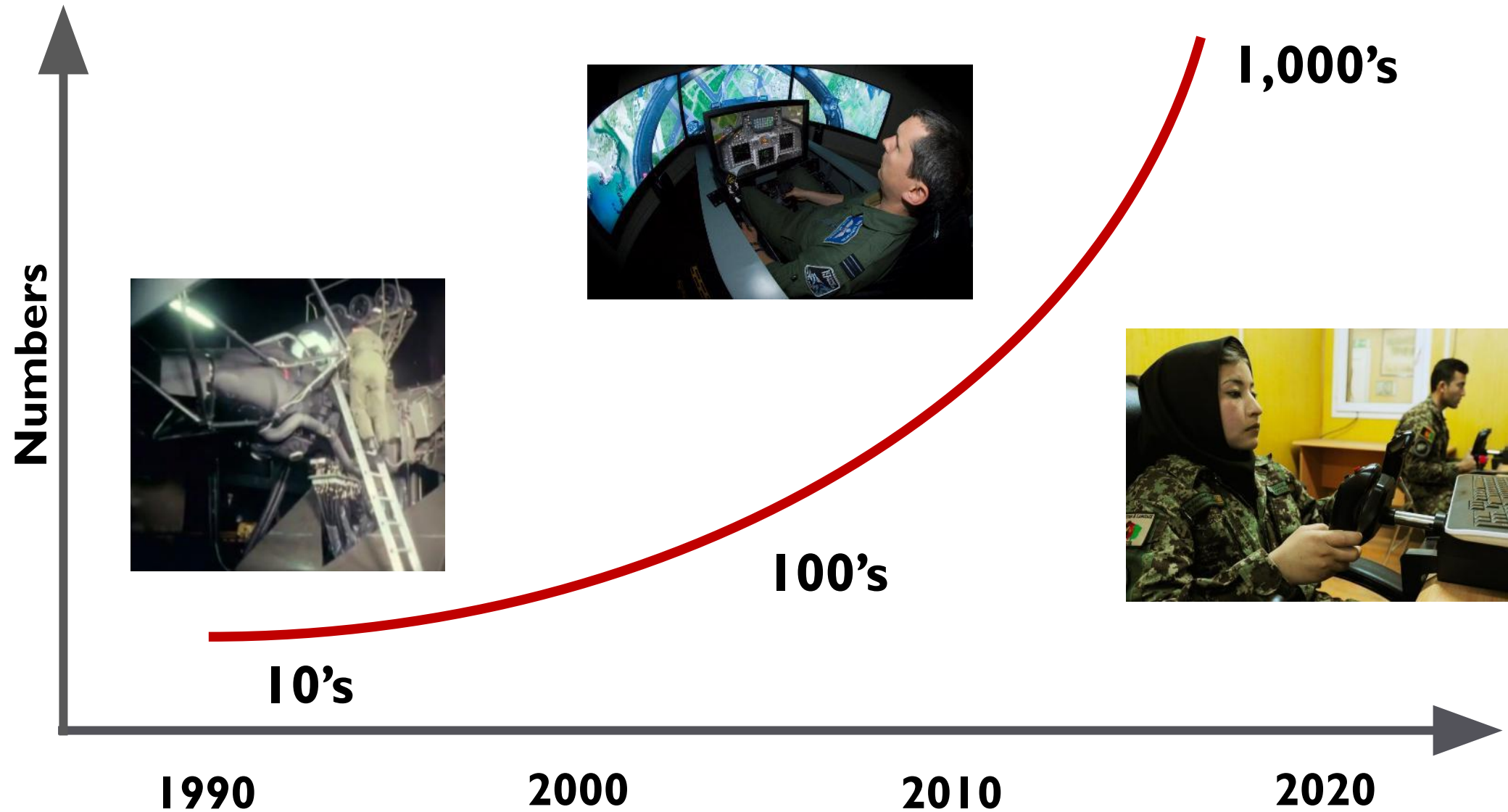


Why Simulation?

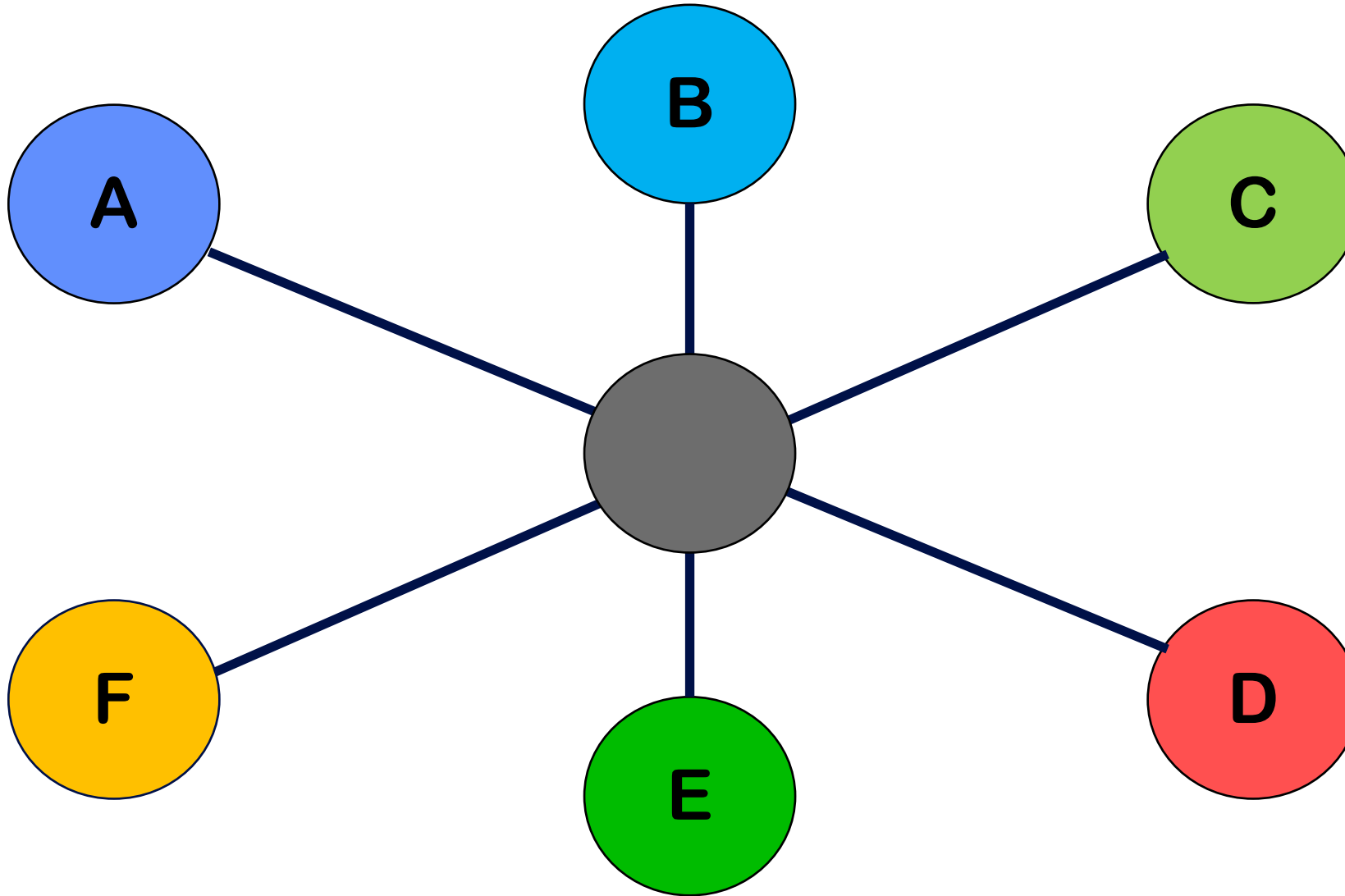


THINKE

Military Access to Simulation



How Important is Networked Flight Simulation?



Training Challenge of the Next Decade?

C2



4th Gen



+

5th Gen



Vs

Anti-Air



THINKE

Back to the Questions



Some Questions

- Do new Recruits think so differently?
- Why so much talk about Big Data?
- How might AI affect Training?
- Will we need Human Instructors?
- What is the impact of more Autonomous Systems?
- Is there more to learn from computer games?
- Will Virtual Reality become a reality?
- How much more Simulation?

**The Human Component
of Warfare may change,
but it will always be
there, and we need to
provide relevant, timely
and cost effective
training and education**



**Logic, Adaptability
& Imagination**

Questions?

