



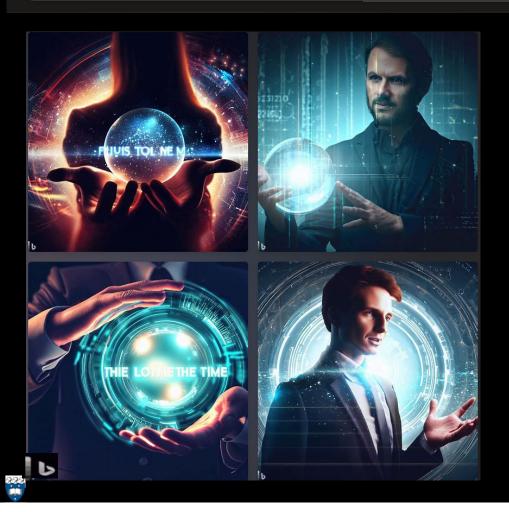






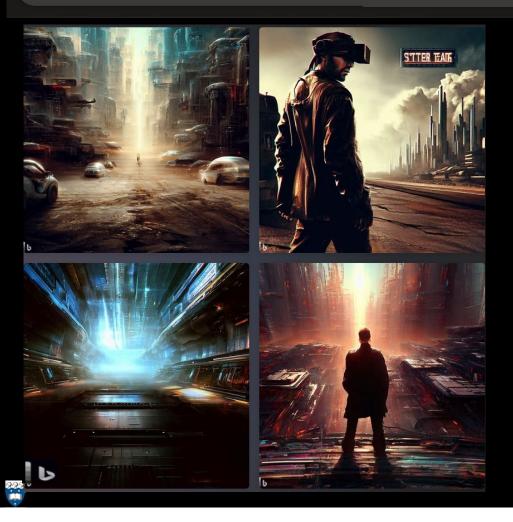
the future







the future



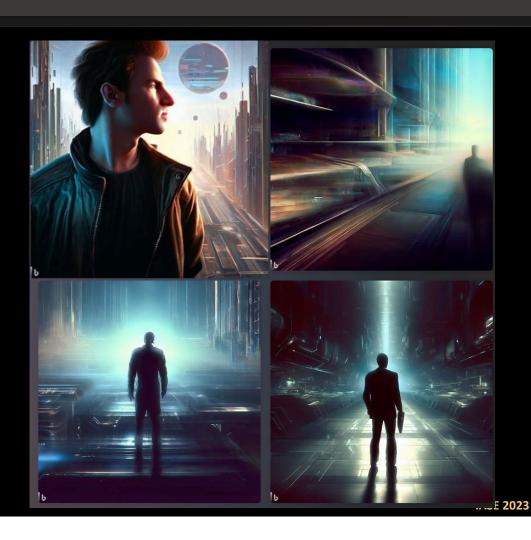






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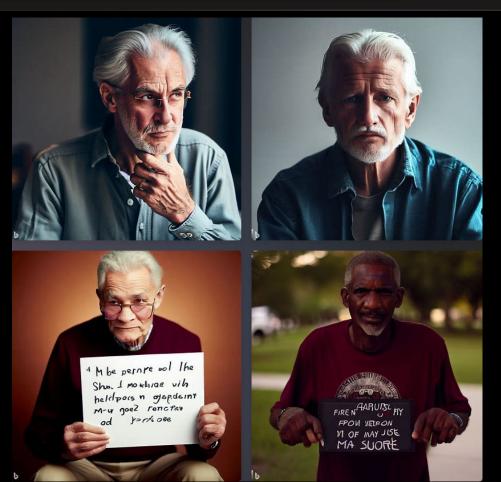


I am a 71 year old male. Show me my future













Government Health Warning for the IASC folks

My "big talks" sometimes don't look like "standard academic talks"

"He's in his 70's – the poor sod is losing it"

Well, about that, ...





50 years ago last summer ...



It's not <u>all</u> late-onset !!



A big dilemma

For my last ever talk ...

Either ... act conservative and hope to be remembered with respect

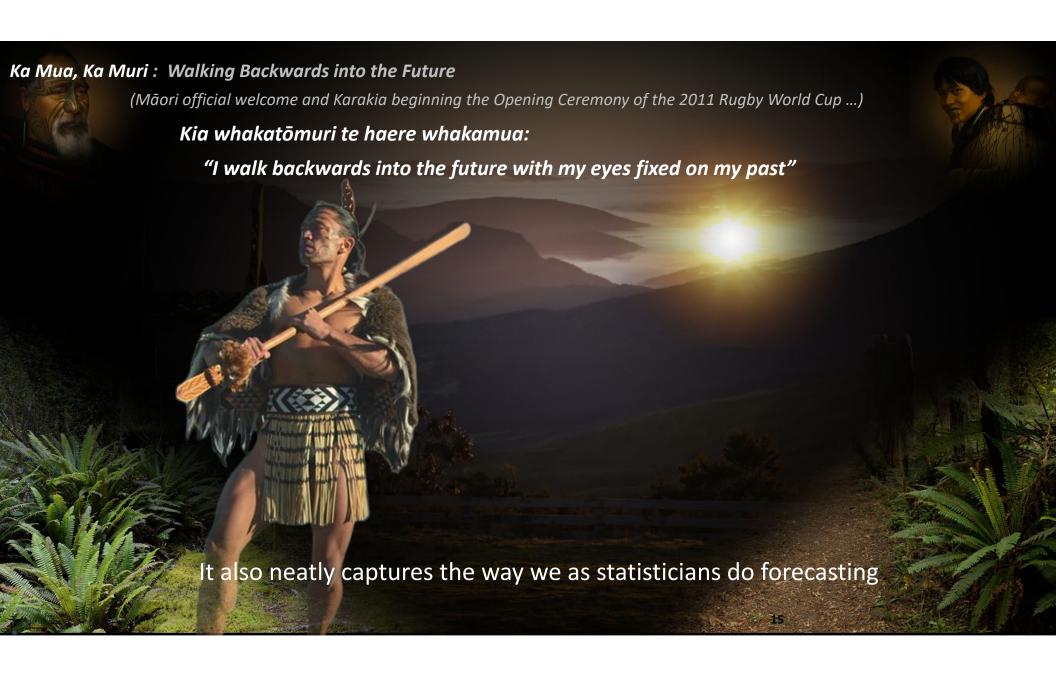
Or ... go for broke & have fun



That's a no brainer!











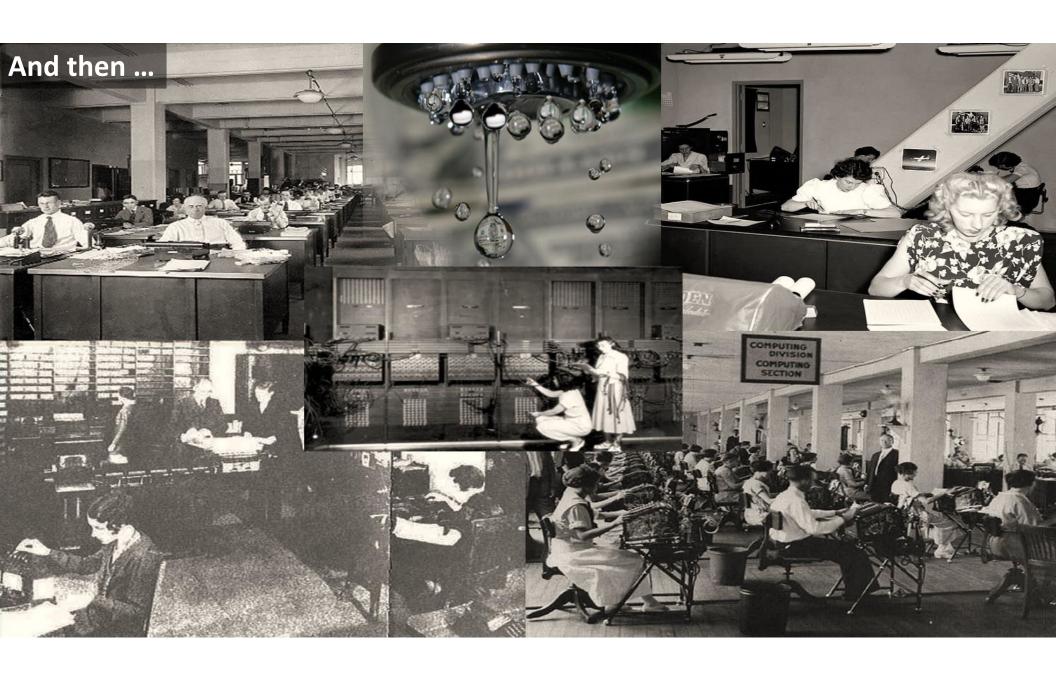
- Data
- Dis- & mis-information
- Automation

From USCOTS 2013

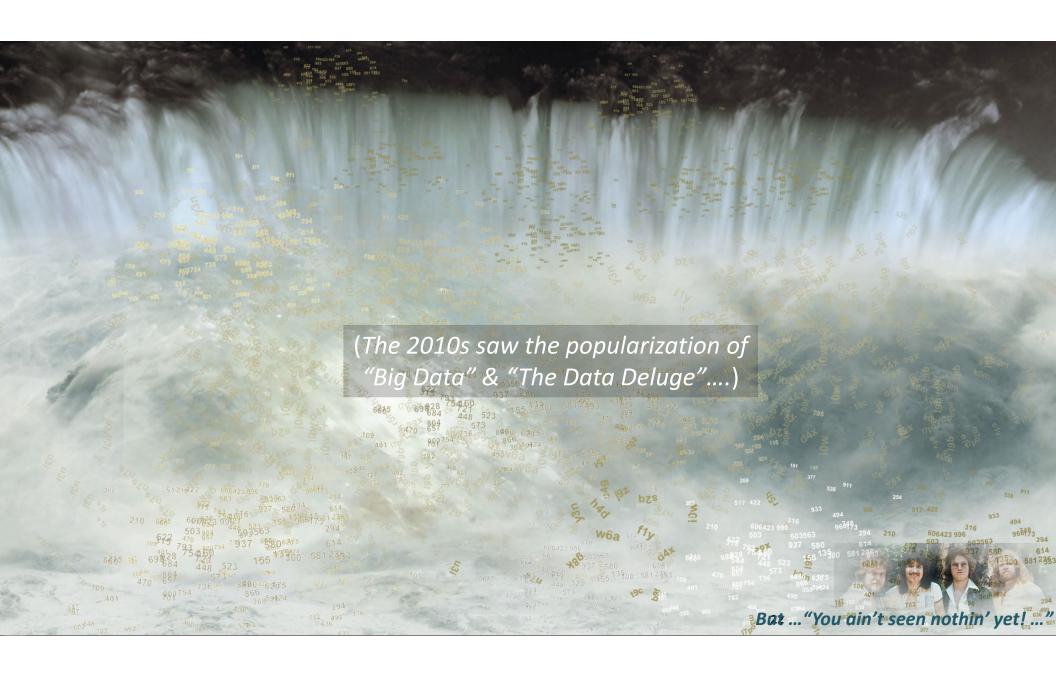
ABRIEF HISTORY OF

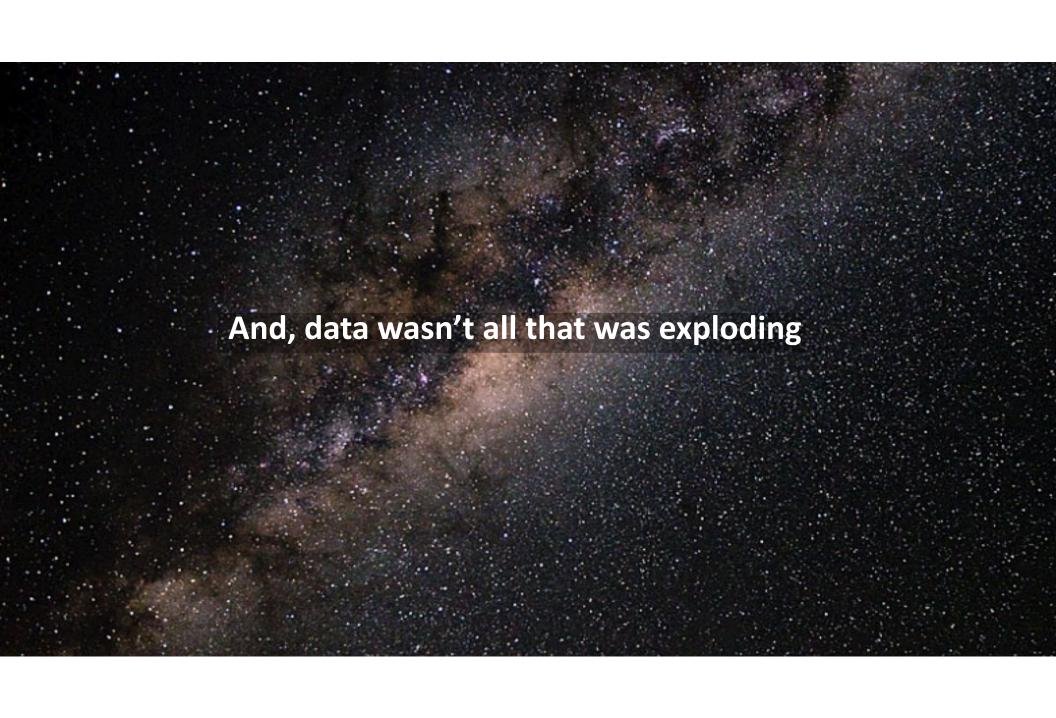
In the beginning ...

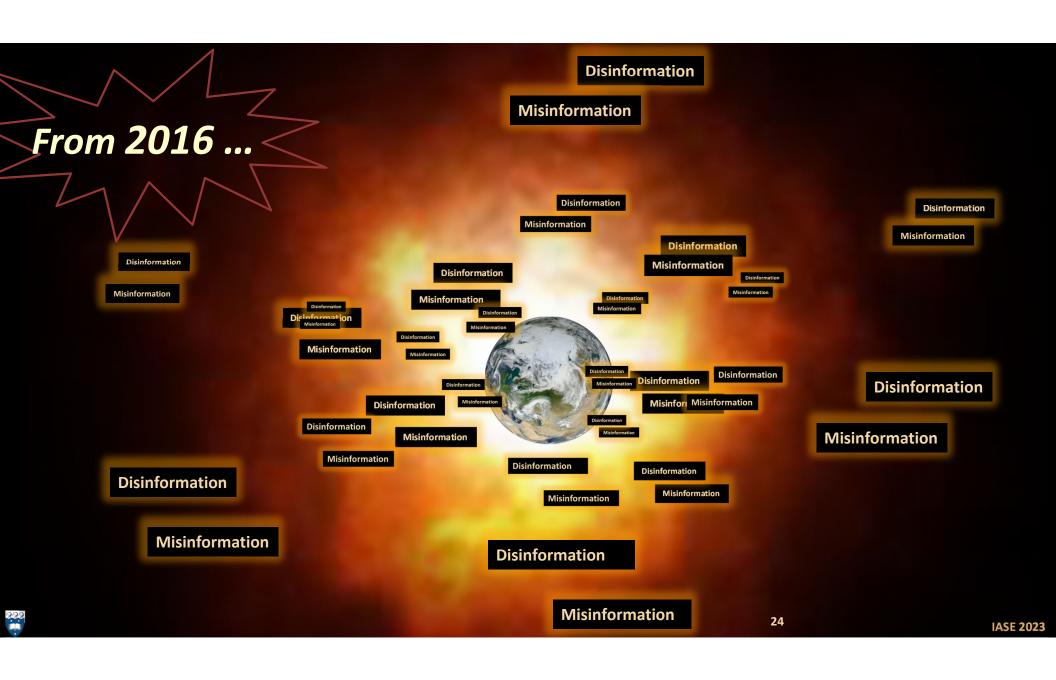












Explosive spread through social media, accelerated by recommender algorithms, of

- disinformation (deliberate/malicious)
- misinformation (in error, ignorance and misplaced trust)

Hazards impeding good decision making

"All lies and jest still, a man hears what he wants to hear and disregards the rest ..."

But again, ... "You ain't seen nothin' yet! ...'

What do we most want for our children/students?

Maximise opportunities (for good outcomes)

- We can foster ...
 - Awarenesses
 - Knowledge and skills
 - Imagination

What can we do about it?

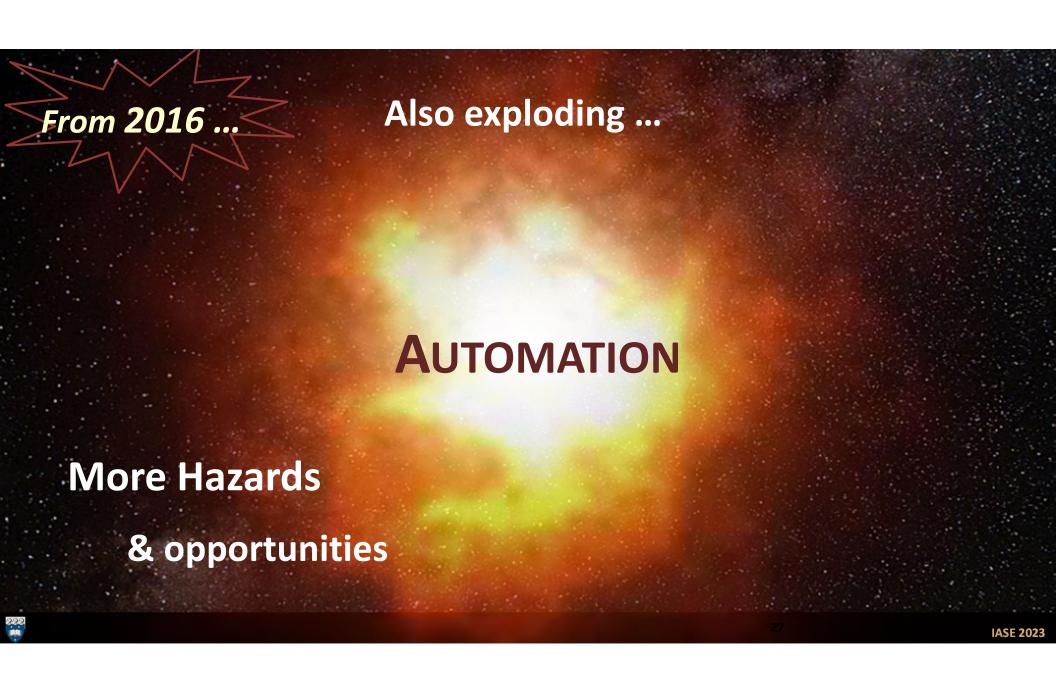
Minimise hazards ...

(missing out on essentials that open up opportunities is an opportunity-cost hazard)

from false information

- We can foster ...
 - Awareness, recognition and critical thinking skills
 - Knowledge about characteristics of good and bad sources
 - Habitualise critical thinking









The Future of Work ...





What do we want for our students?

The ability to do things machines can't do!







"If you can only think like a robot ...

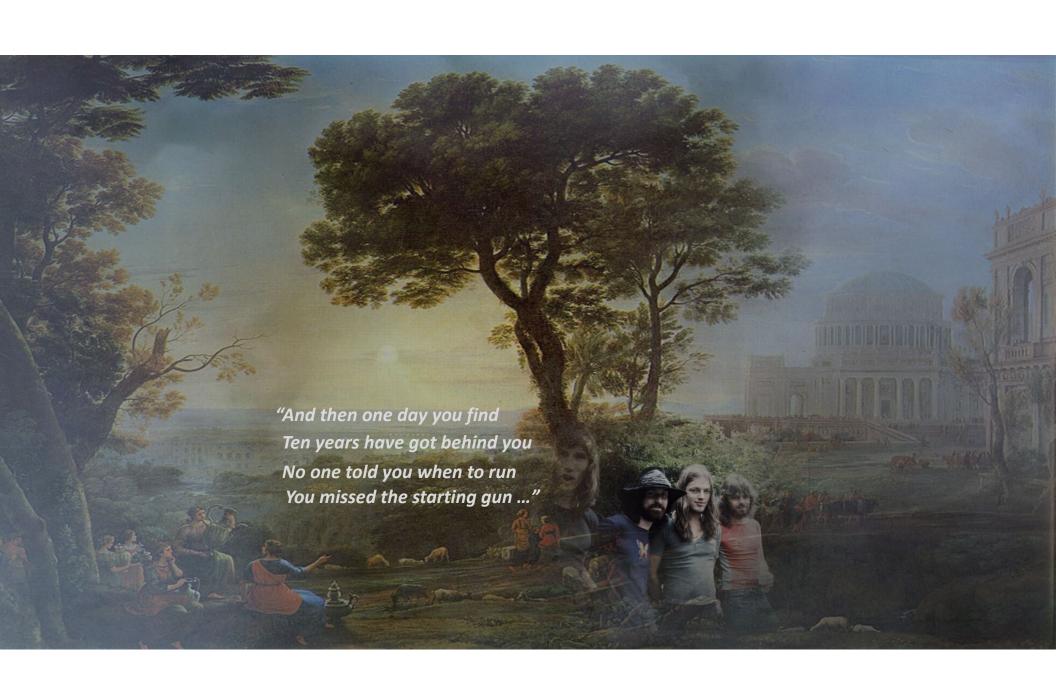


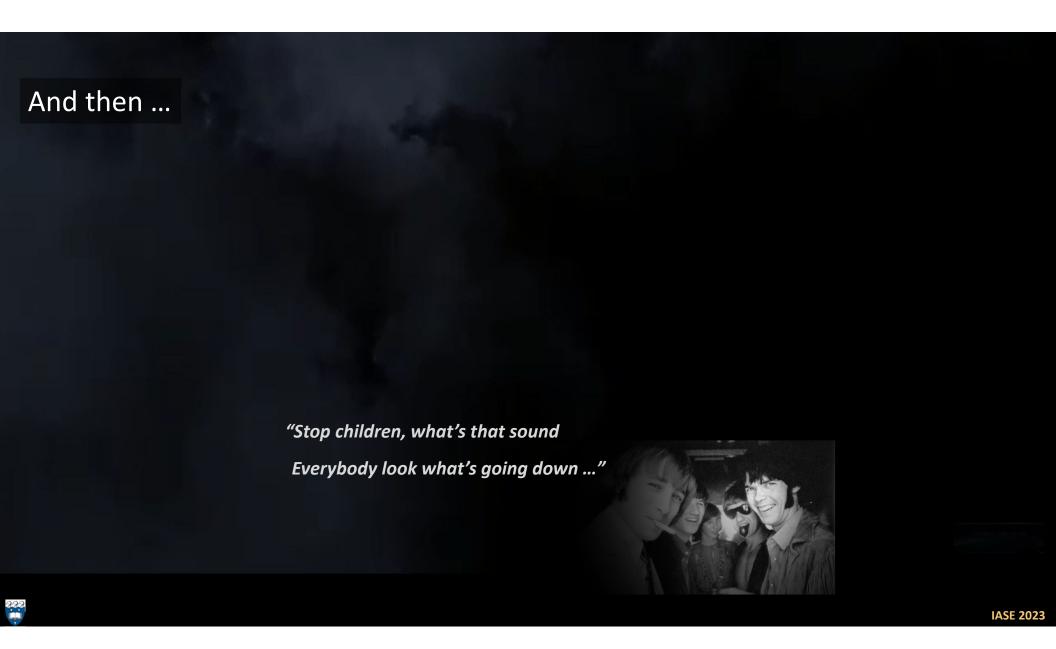
– Andrew Balemi

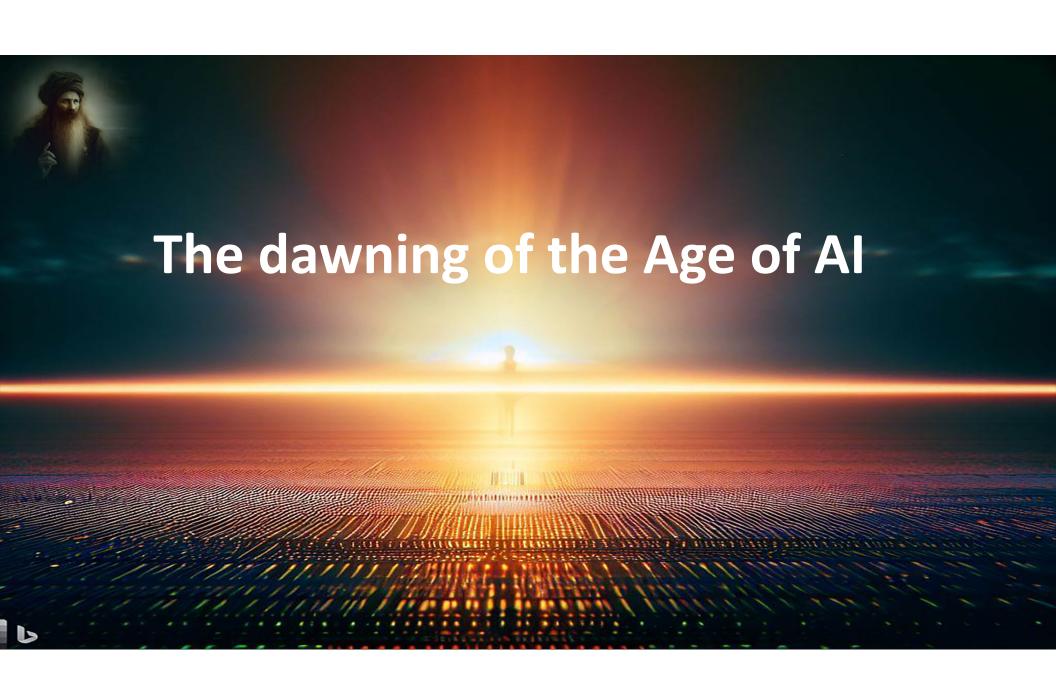
Well, that's how things seemed till the closing stages of 2022 We thought we'd been experiencing explosive change ...

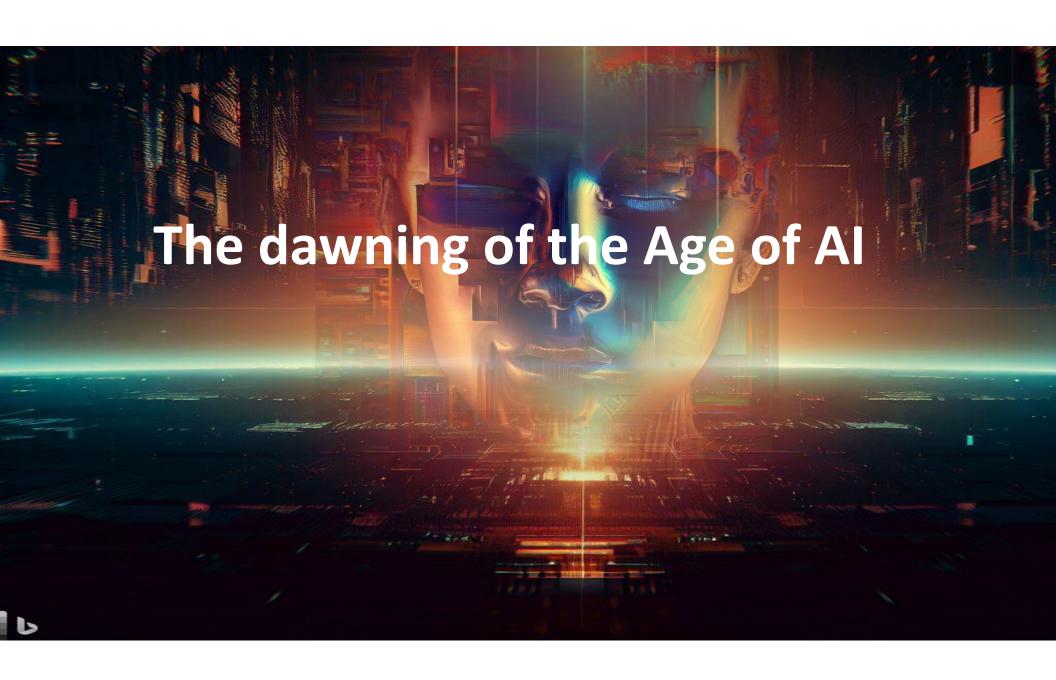














"I read the news today, oh boy...""

"There's something happening here

What it is ain't exactly clear ..."





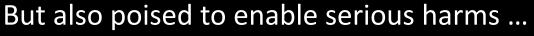
But some things are clear ...

We've not been here before, but been to similar places (e.g., internet, social media)

Enough to have a sense of how this is likely to turn out ...



New Als are already enabling amazing new capabilities ...



(e.g. misinformation on a scale and sophistication never seen before)

"Be careful with that axe Eugene ..."



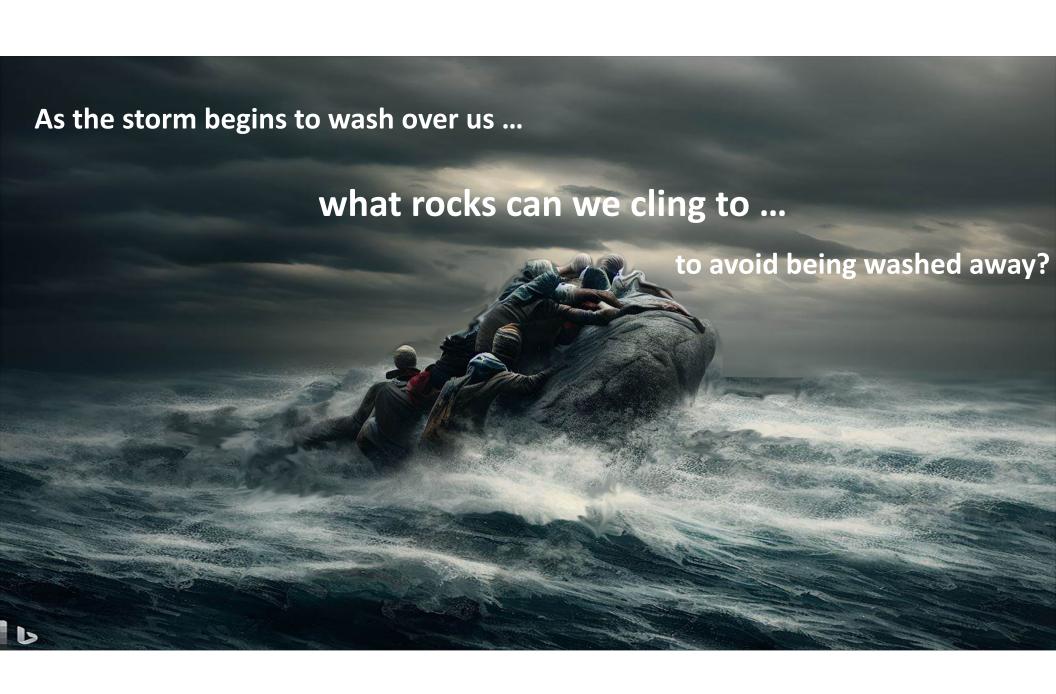


to ...









Whatever rocks we cling to must provide resilience against this ...

Economic Realities 101

- Our business is educating & empowering people to provide professional services
- If the demand for those services dries up we cease to add value
- No one can beat ...
 - the Law of supply & demand
 - the **power of price**
 - If they think they can get it cheaper elsewhere they will
 - the impact of impatience
 - If they think they can get it faster elsewhere they will
- Small perceived quality differences are no defence



Economic Realities 101

 Our business is educating & empowering people to do particular types of knowledge work



- If the demand for those types dry up we cease to add value
- No one can beat ...
 - the Law of supply & demand
 - the power of price
 - If they think they can get it cheaper elsewhere, they will
 - the impact of impatience
 - If they think they can get it faster elsewhere, they will
- Small (perceived) quality differences are no defence



A.I. will attack our existing activities on all of these fronts

What matters most ...

about the impact of generative A.I. on statistics education:

- Impact on the security of assessment ??
- Figuring how to use it to improve our teaching of what we teach?
- Figuring out how it changes ...
 - what people will do versus what machines will do

And as a consequence ...

- -what people need to know
 - & moreover, who (what types of people) needs to know ...
 - what, when & how



The biggest change is ...

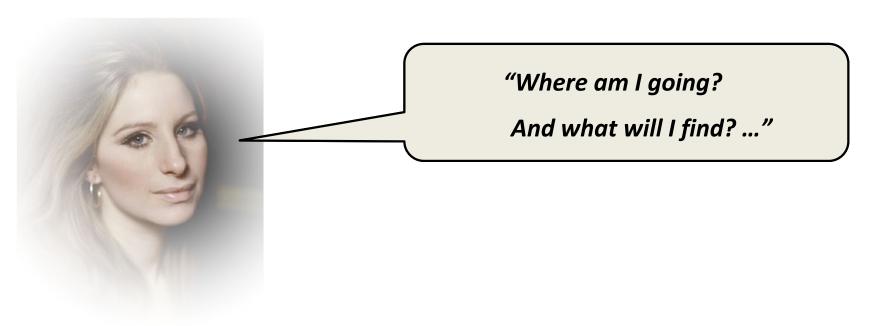
- change itself has just gone on steroids suggesting the gap between ...
- what you need to get your first job (knowledge/skills/credentials)
- and what will serve best for the rest of your life

will become a *widening chasm*

For knowledge workers, what'll serve best for the rest of life are probably things that ...

- build resilience to change
 - both psychologically and via dispositions, experiences & skills that ...
 - will help in spotting promising new opportunities and pivoting into them





But we need to take a step back ...

- Where's who going?
 - "Who is it that we are anyway?"



Will try to think through these ...

- Identity and purpose
 - Who are we? (values, aspirations, visions, history)
 - Who do we want to serve and how?
 - How can we future-proof our discipline & children/students?



- Our **identity & purpose** informed by our ...
 - history
 - where we come from ("eyes fixed firmly on the past")
 - values
 - What we care about
 - vision & aspirations



- Start with, "What is statistics?"
 - Defined in a way that is resilient to ...

The American Statistician, May 1994, Vol. 48, No. 2

COMMENTARIES

Commentaries are informative essays dealing with viewpoints of statistical practice, statistical education, and other topics considered to be of general interest to the broad readership of *The American Statistician*. Commentaries are similar in spirit to Letters to the Editor, but they involve longer discussions of background, issues, and perspectives. All commentaries will be refereed for their merit and compatibility with these criteria.

Embracing the "Wider View" of Statistics

C. J. WILD

The interconnected themes of quality and the marketing of the discipline of statistics are explored. An understanding of statistics as the study of the process of scientific inquiry is advocated as a consciously targeted market position. Because it reaches such a high proportion of the managers and decision makers of the future, the introductory university or college statistics course is highlighted as a potent marketing opportunity for enhancing the long-term health of statistics. Attention is given to teaching students to think statistically, to become educated consumers of statistical expertise, and to communicate well with nonstatisticians.

KEY WORDS: Defining statistics; Marketing statistics; Quality; Statistical thinking; Teaching statistics.

1. THE "WIDER VIEW"

based courses. To a large extent, we have to gauge and balance the needs of our customers ourselves. We need to give careful consideration to the aims and objectives of every part of our programs. If we have not thought through very carefully what we are trying to achieve, we are in no position to assess the quality of what we provide. Unfortunately, so much of what we do is not thought through from a careful consideration of customers, aims, and objectives; it just grows in an ad hoc way over the years, building on what has been done before. This has certainly been my experience and all too often my own practice. At its most basic, considering aims and objectives requires thinking about the nature of statistics itself. And yet the nature of statistics as a discipline is something that has never been properly resolved, agreed on, and then communicated.

At a TQM seminar late in 1991, the human resources manager of an international hotel chain was overheard talking to a local businessman. The manager, a recent

Economic Realities 101

- Our business is educating & empowering people to provide particular professional services
- If the demand for those services dries up we cease to add value
- No one can beat ...
 - the Law of supply & demand
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 - . If they think they can get it cheaper elsewhere, they will
- the impact of impatience
 - If they think they can get it faster elsewhere, they will
- Small (perceived) quality differences are no defence
- Going back 30 years ...
 - when most views of statistics were narrow & technical

I argued ... we should position ourselves in the academic marketplace as ...

"concerned with finding out about the real world by collecting, and then making sense of, data"

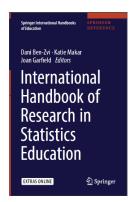


What is statistics?

"concerned with finding out about the real world by collecting, and then making sense of, data"

- Weren't actually doing it back then (1994), but made sense ...
 - for "anchoring ourselves to something which will always be a central human concern"
- More recently an improvement (Jessica Utts?)





1.2 The Nature of Statistics

"Statistics"—as defined by the American Statistical Association (ASA)—"is the science of learning from data, and of measuring, controlling and communicating uncertainty."

we should all get behind it!

MORAL: define yourself in terms of enduring ends, not transitory means



The moral

- We should define ourselves in terms of ...
 - enduring ends, not means (always transitory)
 - destinations, not modes of transport (likely to be superseded)
 - -The need to learn from data is enduring
 - Al/automation "only" affects how we go about it
 - -But that "only" includes ...
 - "Who does what?"
 - And, "What & when do they need to know to do it?"

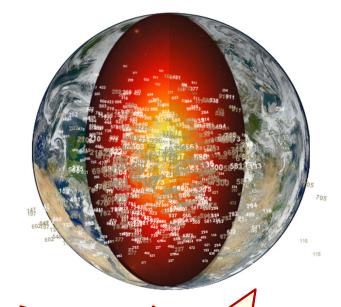




From 2016 ...

"Statistics is **the science of learning from data**, and of measuring, controlling and communicating uncertainty." -- American Statistical Association

- The **focus** of statistics is:
 - understanding the world through data
- The raw materials for statistics are:
 - real-world questions and data
- The tools of statistics are:
 - statistical ways of thinking & investigating
 - & computer software
 - » often based on mathematical models





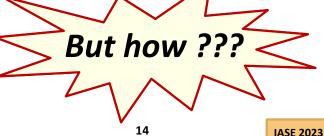


Purpose as educators is to:

empower people to better collect/source and learn from data

and data-based artifacts

- & protect themselves against dis- & misinformation
- prepare our students for a world subject to ... unforeseen *disruptive changes* that will make many of their hard-won skills irrelevant
 - So we need to build in them the resilience to reinvent themselves



SICOTS 2018

Who do we serve?

- Intending statistics & data science specialists
- Intending specialists in other areas that need these skills
- the wider society ...
 - by spreading valuable data-&-information messages & skills as widely as possible, including ...
 - protecting from dis- & misinformation

• & what it means to be an ethical citizen of the data world





Our Environment

- Where do we live?
 - And who are our neighbours?
 - Other research models
 - Related disciplines
- What's happening there?
 - Where's technology going and what're the implications …?
 - What are the major:
 - human strengths and limitations ...
 - machine strengths and limitations ...

that are relevant to our mission?

- Where is societal thinking going w.r.t. data and technology?
 - Privacy, security, IP ownership/sovereignty/control, ethics
- Where/What are our opportunities and hazards?



Our Environment: Where do we live?

From 2015 ...

In the galaxy of forming views about how the world around us operates ...



statistical inquiry is a tectonic plate on the planet "Purposefully Finding Out"

From "On Locating Statistics in the World of Finding Out (2015/6)"



Our Environment: Where do we live?

We share our planet (Purposefully Finding Out) with other tectonic plates

Some of our neighbours ...

- consulting trusted others (people, articles, books, websites, ...)
- qualitative research methods
- data mining
- machine learning

That was 2015 ...





From 2015

Our Environment:

Where do we live?





Leverage the **ability of** humans to notice things you'd never think to measure Automated

What's changed ???



Where could our advantages lie?

- Human dimensions
 - understanding human connections is where we might expect advantages over machines
 - If we focus mainly on human understanding of our world through data
 - rather than automation of prediction and knowledge discovery
 - -then cognitive psychology becomes an important neighbour
- Governance
 - Guiding directions
 - Ensuring "Garbage-In Garbage-Out" (incl. potential biases) is given due consideration in decision making
- Ethics
 - Ethicists and communities we serve are important neighbours



Let's bring back this ...

Identity & purpose



Who do we serve?

- Intending statistics & data science specialists
- Intending specialists in other areas that need these skills

Focussing on this ...

- the wider society ...
 - by spreading valuable data-&-information messages & skills as widely as possible, including ...
 - protecting from dis- & misinformation
 - & what it means to be an ethical citizen of the data world



And factor in this ...

The explosion of data & it's impact on our lives

- brings opportunities for the appropriately educated
 - or those who can afford to buy in data and analytics
- But can also accentuate societal & economic inequities
 - (between those with the resources to exploit the opportunities & those without)
- Can we be a force for good in
 - democratizing data and analytics??



"Democratizing data" is ...



"empowering the many"







I have a personal interest in this ...

Harvard Data Science Review • Issue 3.2, Spring 2021

On Democratizing Data Science: Some iNZights Into Empowering the Many

Chris J. Wild¹, Tom Elliott¹, Andrew Sporle¹

¹University of Auckland, New Zealand

Introducing co-author Andrew Sporle

- Social, health and official statistics researcher
- Dep. Director of NZ Healthier Lives National Science Challenge
- Board of Int. Sociological Ass. Res. Com. on Racism, Nationalism,
 Indigeneity and Ethnicity
- founding member of NZ Virtual Health Information Network
- founding member of Te Mana Raraunga (Māori Data Sovereignty Network)
- was inaugural Māori Health Research Manager at the Health Research Council of NZ









Andrew's strong Work Relationships ..

Andrew Sporle

include ...

- Statistical & Health Agencies of small Pacific nations
- Indigenous & community groups,
 - Incl. Māori Data Sovereignty Network & other national movements linked by the Global Indigenous Data Alliance
- Subject-matter researchers (esp. Health, Social Science & Official Statistics)

COMMON REFRAINS

- Big statistical & data science needs, but ...
 - No People
 - No Money
 - No Time
 - Or, at least, very little of these things

overwhelmed by:

- needs at home
- demands of UN agencies





Greta Thunberg ... "While we may all be in the same storm, we are not all in the same boat"

On Democratizing Data
Science: Some iNZights
Into Empowering the Many

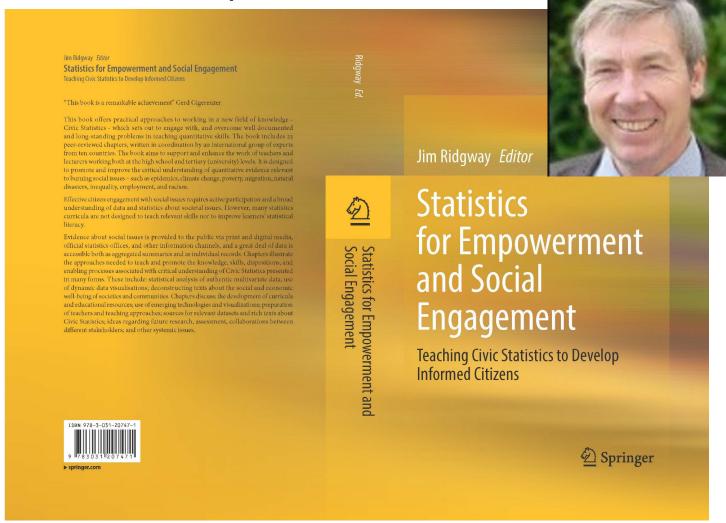
Chris J. Wild¹, Tom Elliott¹, Andrew Sporle¹

¹University of Auckland, New Zealand

- Unmet needs of those lacking in money and data education are every bit as important as those who have more
 - cf. "doctors without borders"
- Volunteers like Statistics Without Borders (pro bono services)
 - as a solution, it cannot scale will never be enough volunteers
- Need to empower more people to do more for themselves
- (Our iNZight software project is attempting to contribute to addressing this) ...



A quick shout out ...







Greta Thunberg ... "While we may all be in the same storm, we are not all in the same boat"

On Democratizing Data
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What's changed ??

- Need to empower more people to do more for themselves
- (Our iNZight software project is attempting to contribute to addressing this) ...



But can AI help?

- Bill Gates sees big potential, but ...
 - "market forces won't naturally produce AI products and services that help the poorest. The opposite is more likely."



But can AI help?

- Bill Gates see's big potential, but ...
 - "market forces won't naturally produce AI products and services that help the poorest. The opposite is more likely."
 - He sees a need for governments and philanthropy to try to level the playing field
 - What role can statisticians play?



But can AI help harm?

- Indigenous communities are worried about ...
 - further cultural appropriation, and also "recolonisation"
 - partly because the information available to be scraped from the internet and used to train Als ...
 - are sparse & dominated by historical sources contaminated by colonial attitudes
 & biases
 - » thus perpetuating and reinforcing the harms of the past



This next sequence will start from B GAI thinking ...

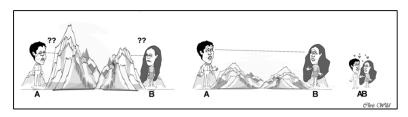
(Before Generative AI)

for a range of issues and still keep asking ...

What's changed ???







People ...

- forget things really fast (long-term memory is very leaky)
- (short term) working-memory capacity is tiny

Every sequencing of ideas & experiences ...

- makes some things easy to connect
- and others virtually impossible to connect



Almost none of what is "learned" in a university course sticks over the long term

This makes prioritizing a small number of big-picture learnings, to be targeted for long-term retention, critically important

"... You must remember this..."

What's changed ??



"... the fundamental things apply as time goes by ..."

Albert Einstein

"Education is what remains after one has forgotten what one has learned in school"

In the data world ...



Software is making more things easier for more people

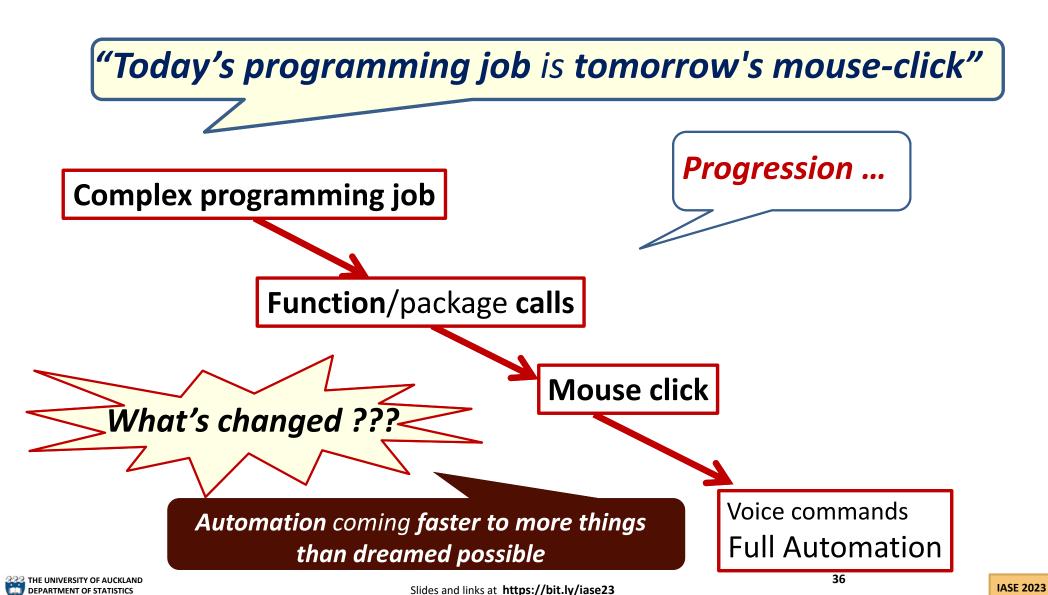
- Everywhere software people are trying to do this
 - (free software)
 The whole R-package culture is about this
 - (commercial software) The driver is saleable products
 - -Automation, esp involving Machine Learning/Artificial Intelligence
 - bigger and more powerful black boxes (has some huge downsides)

Consequences for our students' lives and careers are enormous



Effects getting **stronger & coming faster**

IASE 2023



Our Environment:

From 2015 ...

Increasing numbers of areas are becoming "just like driving a car"



• And for them ...



... Society needs ... lots *more* people ...

to be good at this

than this

And you can be very good at this

Without being

much good at this











& vice versa!



IASE 2023

Educationally, we do a lot of ...





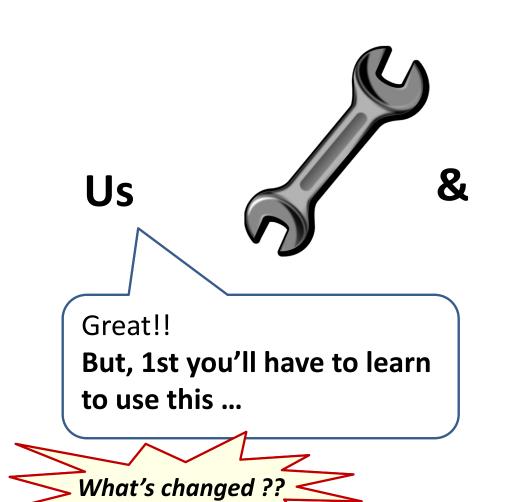


And little, if any, of ...



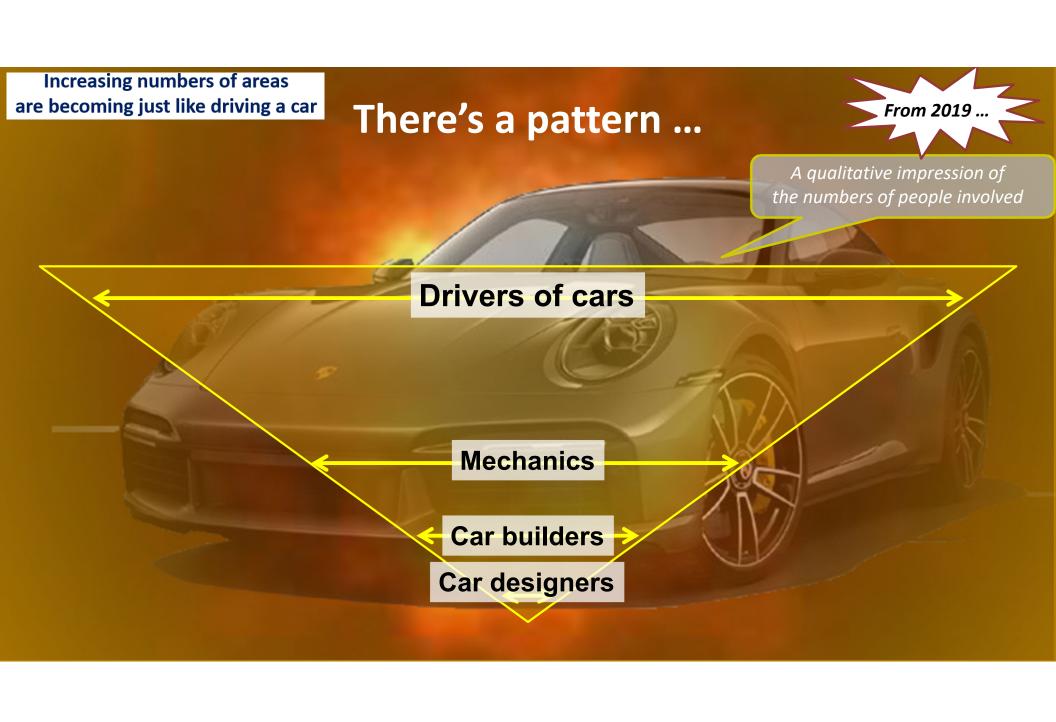


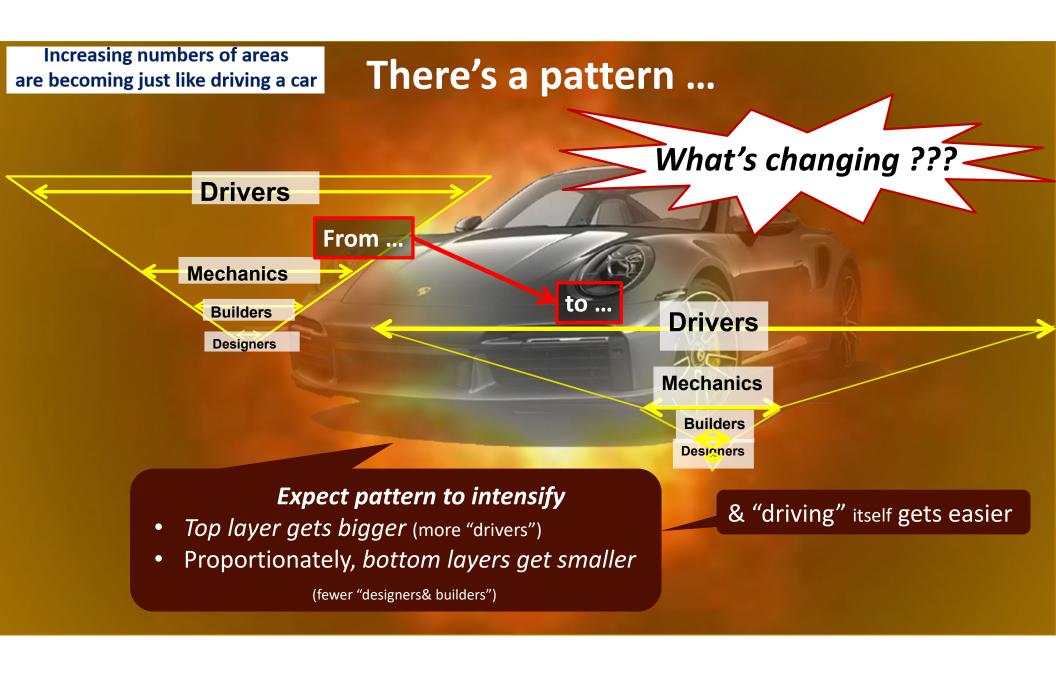
THE UNIVERSITY OF AUCKLAND DEPARTMENT OF STATISTICS

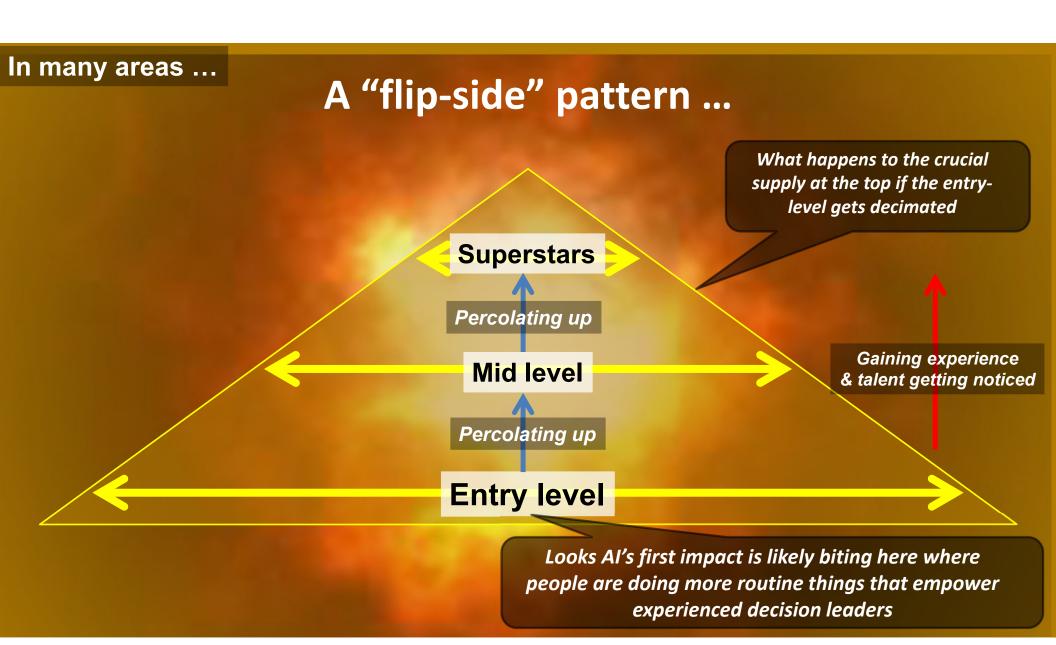
















The Future of Work ...



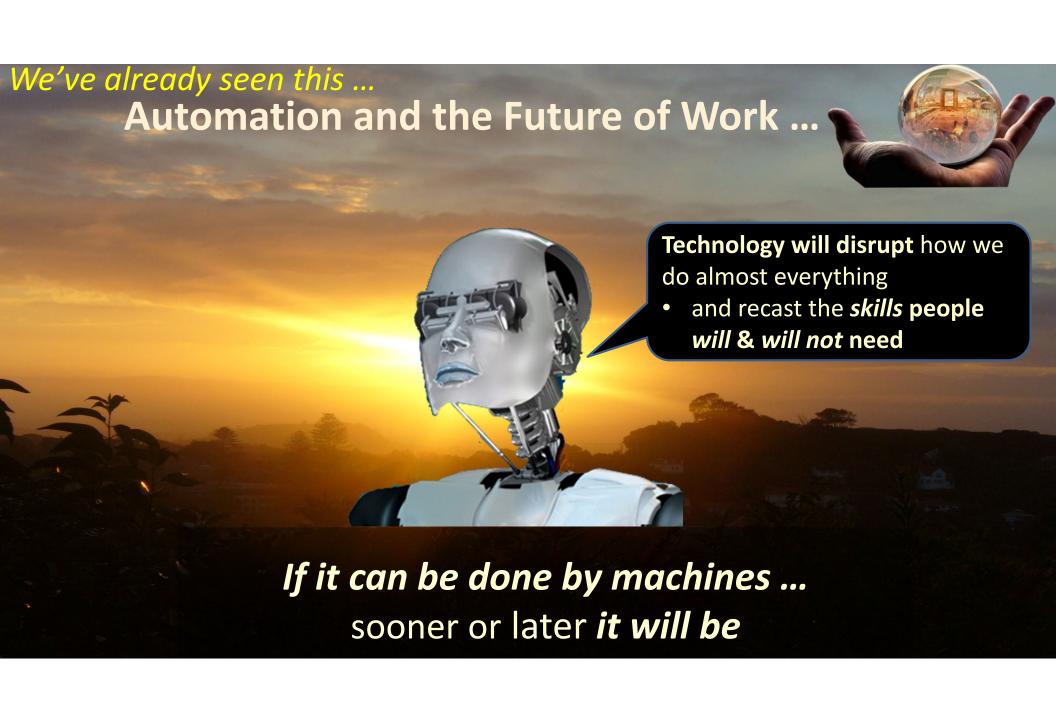
Theorem:

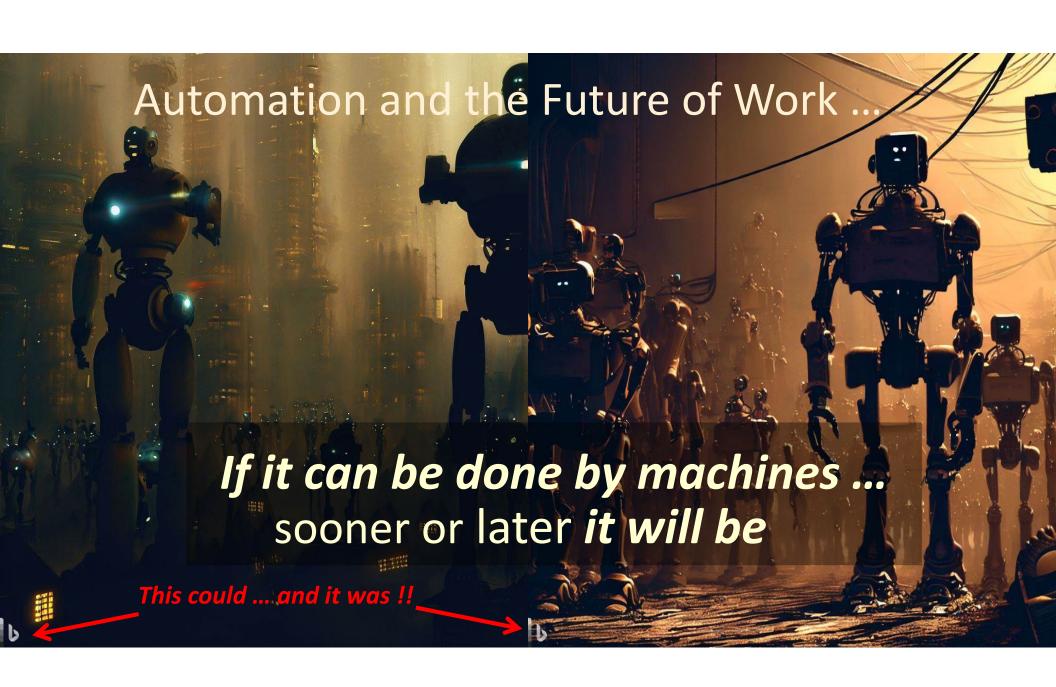
- Just about the only constant will be change
 - and the pace of change is accelerating
 - "the only constant is change" Heraclitus, 500 BC

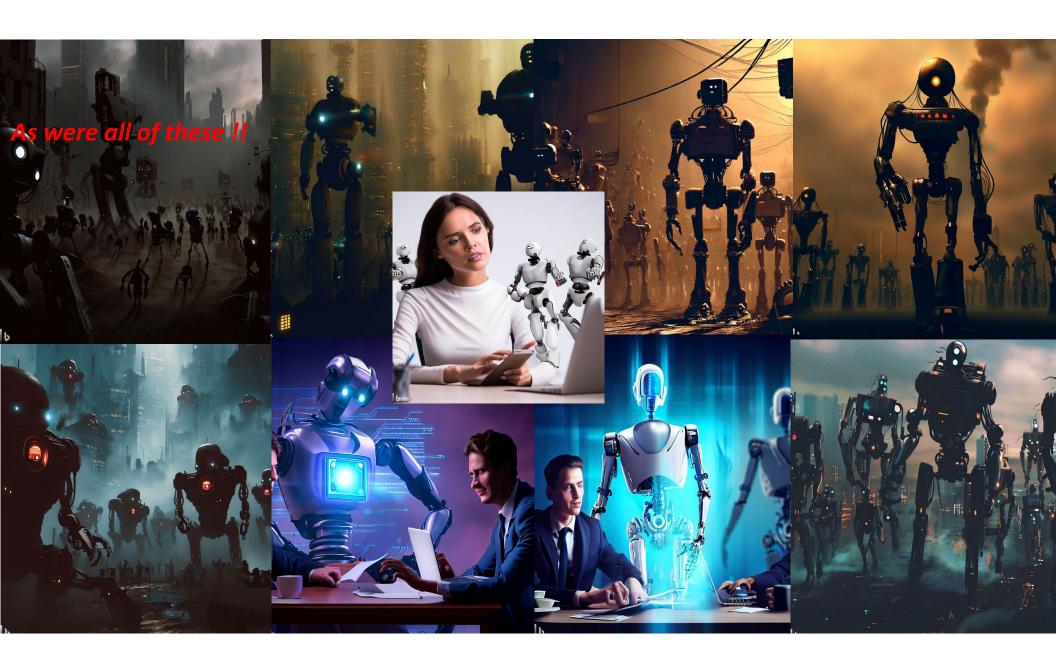
Corollary: (because demand changes & skills get outdated)

• **Everyone** will have to be **a life-long learner**









We've already seen this ...



"If you can only think like a robot ...



– Andrew Balemi



The Future of Work ...

Reinforcing ...





What do we want for our students?

The ability to do things machines can't do!



For this ...



and this ...

Big-picture conceptions ...

have long-term value

Details are death dated









Continuing in this vein ...

The Future of Work



The ability to do ...

Mathematical derivations ...

has long-term value

The ability to do ...

any particular mathematical derivations

is **death dated**

What's changed ??

BEST BEFORE

The skills' value comes from the ability to produce *new* theory and *new* methods





The ability to operate ...

recipe procedure ... algorithm

has long-term value



The ability to operate ...

any particular procedure ... is death dated algorithm

recipe



The skills' value comes from the ability to do things not yet overtaken by software







The ability to ...

code (program) ...

has long-term value

The ability to ...

code (program) ...

anything particular (in any particular language)

is death dated

BEST BEFORE 31-12-2025

IASE 2023

The skills' value comes from the ability to code things not yet catered for by existing and accessible software



What's changed ??



But, the ability to devise new ...

recipes procedures ... algorithms theory models



has **HUGE long-term value**



Now, while ...



But, the ability to devise <u>new</u> ...

recipes
procedures ...
algorithms
theory
models

••••



has **HUGE long-term value**

But a small pool of people able to do it





The ability to uncover and navigate ...

Human dimensions ...



will always have **HUGE long-term value**

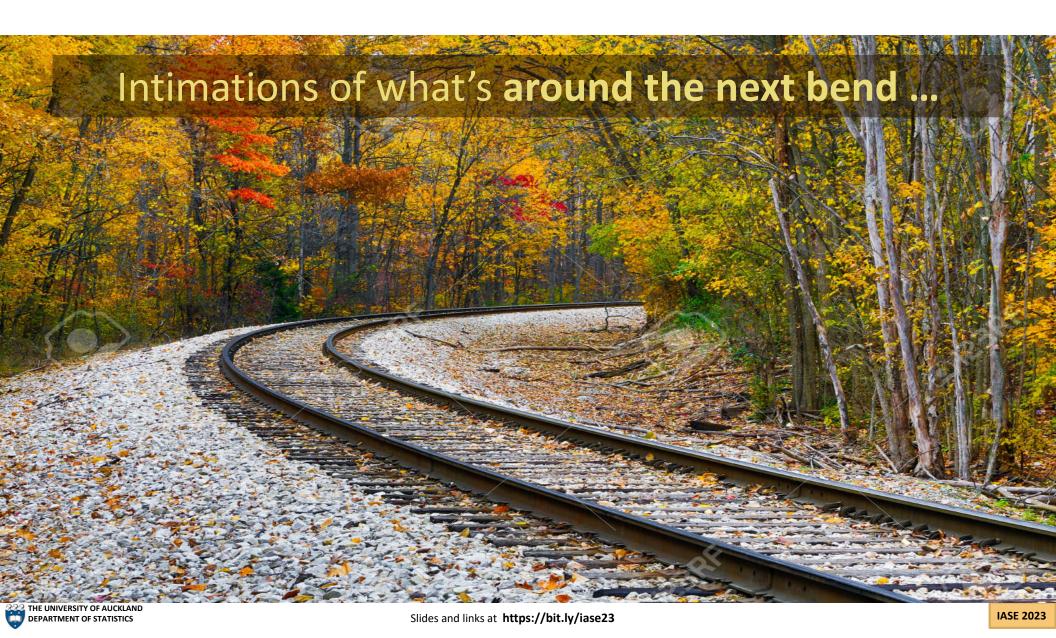
And need everyone's involvement



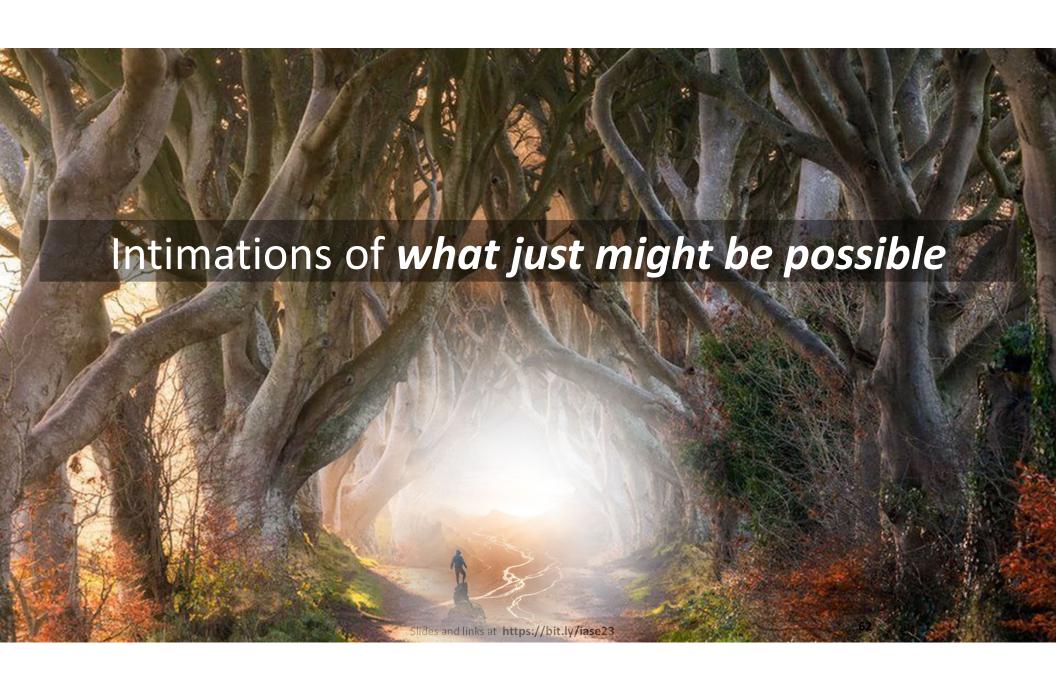
What else helps life-long learning and creativity?

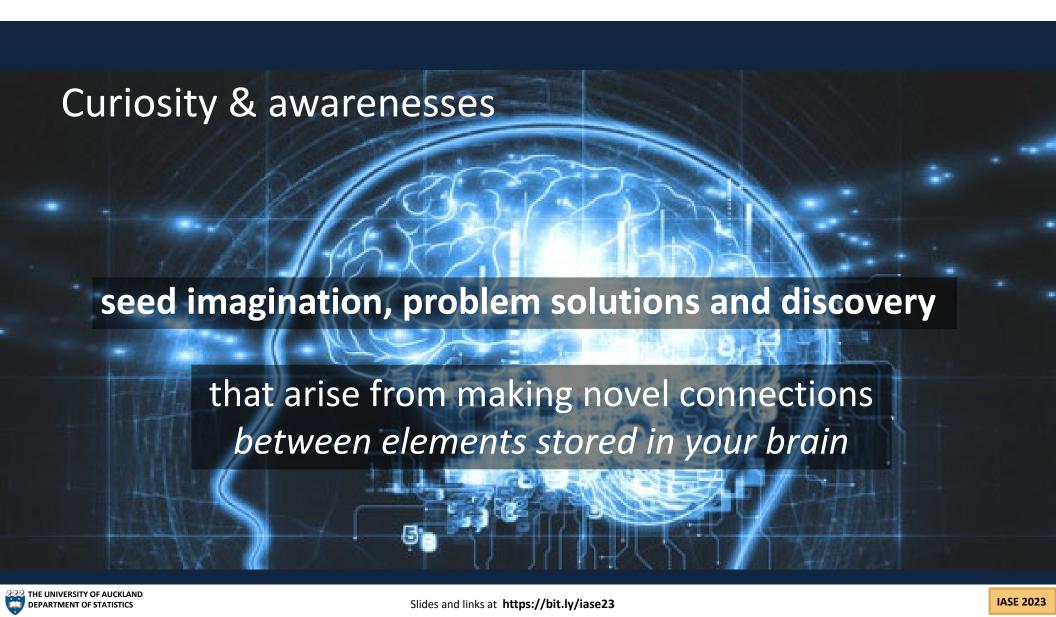


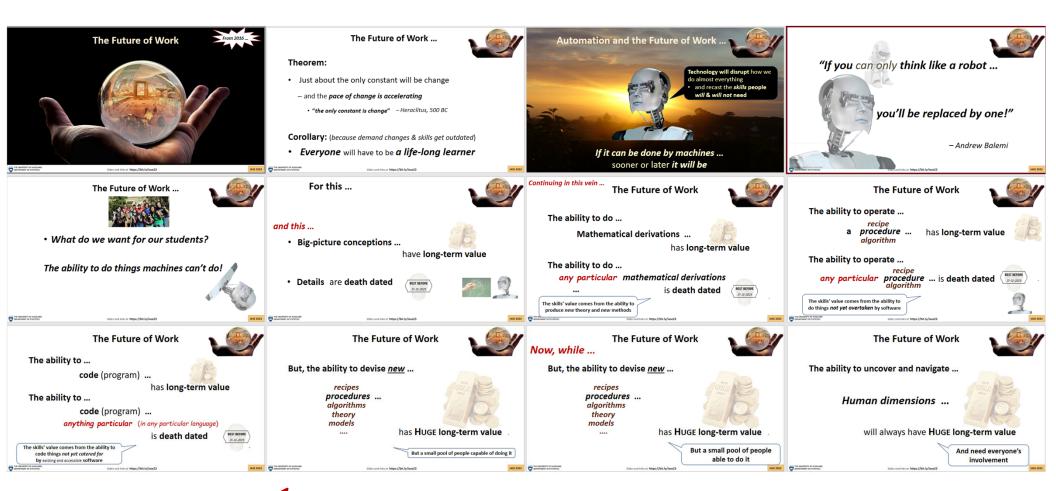












What's changed??

THE UNIVERSITY OF AUCKLAND DEPARTMENT OF STATISTICS

Not much — it's all still true ... but expect effects to be stronger & come faster



What is the alternative?

- Underlying what's gone before was a realization that ...
 - procedural skills were death dated (machines taking them over)
 - Leaning on technology can reclaim time previously committed to learning procedures ...

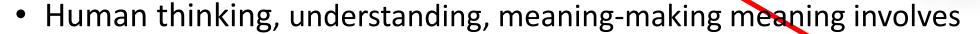
Slides and links at https://bit.ly/iase23

- time that should be devoted to things machines can't do
 - i.e., to doing what is inherently human
- B G AI the inherently human appeared to be ...
 - Synthesis of information and the extraction of meaning
 - Imagination and creativity
 the pinnacles of human intellectual activity



Knowing vs thinking

- Can't compete with Als (trained on large parts of the internet) on "knowing things" (facts, ideas and theories)
 - and merely knowing is not thinking



- creating mental models and scaffolds that we can hang these elements on
- in ways that can let us see and understand relationships between them
- We need internalised knowledge to think

students don't get this

- We can't be limited to just "looking things up" when we need them
- Effective connection-making needs to be able to connect ...
 - candidates from large number of things in our long-term memories (from old experiences)
 - as well as the tiny number of things our short-term memory can store from recent look-up/bump into experiences...





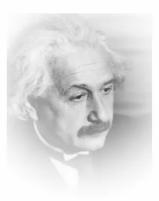
Imagination



- Likewise, imagination doesn't come from nowhere
 - It too works by connecting and assembling elements already in your head
 - An empty head can't imagine!



Two people who waxed lyrically on imagination and creativity



Albert Einstein



IASE 2023

But we're not quite as special as we thought, B GAI

Until last year it seemed clear that the essentially-human roles ...

- lay in synthesis, extracting meaning, and imagination (the wellspring of creativity)
- But even these are no longer our exclusive domain

While A.I.s may not be able to ...

- imagine as humans do
 - but they can sure imitate some of its products pretty convincingly!
 - e.g., create new images, music, stories, videos ...

& do it almost much instantly

- truly synthesize information
 - but, again, they can sure imitate some of its products pretty convincingly!
 - e.g., good summaries of what's in large documents



Al is not doing the real thing

- When we see connections, they resonate within us
 - to our very core
- When we're being creative, we really are having fun
- But it doesn't mean anything to Als
- It's not the real thing!!!
- But tell that to a customer who wants something reasonable and wants it fast and cheap!



Resilience



What can foster resilience in a fast-changing world?

Psychologically ...

- Internalising that "everything is changing" is just the way life is
- And a constant need to learn new things is also just the way life is
 - experiencing "everything is changing" during education
 - what makes me feel safe and secure now can't be relied on for what comes next
 - developing dispositions that promote …
 - taking a big-picture interest in "what is going on around me"
 - so changes are less of a surprise and opportunities are easier to spot ("tunnel vision" as blindness)
 - new out-of-current-field learning is easier
 - » because of the presence of enlarged mental scaffolds for new things to slot into
 - problem-solver-mode responses to the challenges changes are bringing ...
 - rather than despair "I'll never be able to cope"
 - » "In the middle of difficulty lies opportunity" Einstein
 - but that requires confidence born of past success



What can foster resilience in a fast-changing world? cont.

Dispositions and skills

- Becoming a self-starter
 - rather than always waiting to be given directions by others
- An antenna for ...
 - what's going on around us
 - and emerging challenges and opportunities





What can foster resilience in a fast-changing world? Cont.

Dispositions and skills

- Becoming a self-starter
 - rather than needing to be prodded by others
- An antenna for ...
 - what's going on around us
 - and emerging challenges and opportunities

(require building big-picture understandings and flexible mental scaffolds)

- An ability and propensity to learn new things ...
 - to enable combating hazards and taking advantage of opportunities
- Soft-skills like perceptive listening, communication, networking, persuasion



Problems

- Current educational trends are trying to make everything as predictable as possible for students
 - So how to build experiences of change in ways that can build resilience within a predictable overall environment?

And, if you even if you can solve that ...

- you still need student ...
 - buy-in re uncomfortable experiences that can benefit them
 - engagement in doing hard thinking ...
 - as opposed to taking an easy way out
- It's not as if we haven't been wanting/trying to do this for ever ...
 - but it's incredibly difficult, we're making little progress and need new ideas



Beyond the 3 R's

We do know as educators we need to ...



Our biggest failure has always been ...

- to get the bulk of students to want to really engage with their learning
- & not just look for an easy way out to passing and earning grades
 - A throw-away aside ...
 - Finding an easy way out is a problem-solving ability which has its own utility and ...
 - Everyone needs to be engaged with the AI tools in their areas to improve personal productivity and be aware of changes in the lay of the land, but ...
 - "If a task can be done easily just by something like asking Chat GPT
 - -'Why would anyone need <u>you</u> to do that?'"
 - New jobs already exist for people especially good at using Als
 - but you don't get especially good at anything by taking the easy out
 - And if you don't bring anything special to the table ...
 - » "Why would anyone want you for this?"



Engagement in learning

Can these messages help??

- With learning taking the easy way out leads to a dead end
- Making real efforts to engage with your learning builds new circuitry in your brain
 - that enables you to process new types of information efficiently and creatively
- Just as there is no easy way to become a world-class athlete ...
 - (requires intensive physical and mental training)
 - the more you exercise your brain the stronger it gets
 - and *the more* it becomes *capable of doing new things* (by building new circuitry)
 - If you keep just taking the easy way out your brain remains limp, weak and slow
 - What is most critical ...
 - is not what facts you can remember from your studies & what procedures you can operate
 - It's how capable your brain becomes of receiving and processing new information



"Education is what remains after one has forgotten what one has learned in school"

Albert Einstein



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 - What is most critical ...
 - is not what facts you can remember from your studies & what procedures you can operate
 - It's how capable your brain becomes of receiving and processing new information
 - -and coming up with the questions that matter



"Questions are more important than answers"

The American Statistician, May 1994, Vol. 48, No. 2

Commentaries are informative essays dealing with viewpoints of statistical practice, statistical education, and other topics considered to be of general interest to the broad readership of *The American Statistician*. Commentaries are similar in spirit to Letters to the Editor, but they involve longer discussions of background, issues, and perspectives. All commentaries will be refereed for their merit and compatibility with these criteria.

Embracing the "Wider View" of Statistics

C. J. WILD

The interconnected themes of quality and the marketing of the discipline of statistics are explored. An understanding of statistics as the study of the process of scientific inquiry is advocated as a consciously targeted market position. Because it reaches such a high proportion of the managers and decision makers of the future, the introductory university or college statistics course is highlighted as a potent marketing opportunity for enhancing the longterm health of statistics. Attention is given to teaching students to think statistically, to become educated consumers of statistical expertise, and to communicate well

KEY WORDS: Defining statistics; Marketing statistics; Quality; Statistical thinking; Teaching statistics.

based courses. To a large extent, we have to gauge and balance the needs of our customers ourselves. We need to give careful consideration to the aims and objectives of every part of our programs. If we have not thought through very carefully what we are trying to achieve, we are in no position to assess the quality of what we provide. Unfortunately, so much of what we do is not thought through from a careful consideration of customers, aims, and objectives; it just grows in an ad hoc way over the years, building on what has been done before. This has certainly been my experience and all too often my own practice. At its most basic, considering aims and objectives requires thinking about the nature of statistics itself. And yet the nature of statistics as a discipline is something that has never been properly resolved, agreed on, and then communicated.

At a TQM seminar late in 1991, the human resources manager of an international hotel chain was overheard talking to a local businessman. The manager, a recent





"Questions, a Springboard to Thinking"



IASE 2023

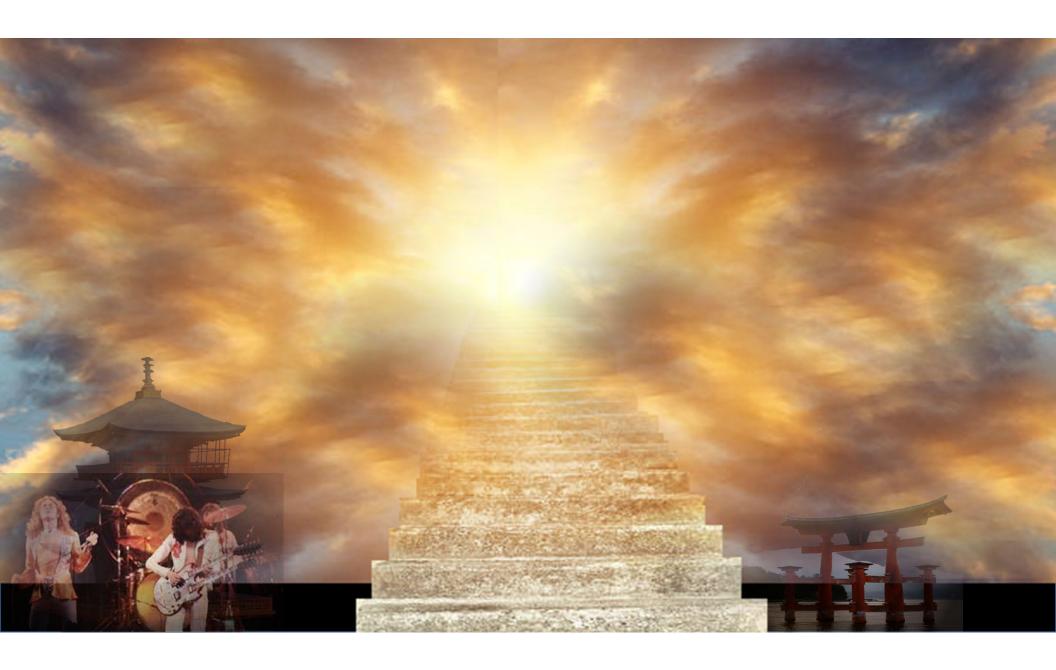
"Questions you cannot answer are usually far better for you than answers you cannot question."



Yuval Noah Harari







But for all that we've seen, I still stand by this ...

Finale...

What is the single best thing

we can do for our students?



