



DAC ESS #105

Using ChatGPT and OpenAI to Write Embedded Software

Mark B. Kraeling
Wabtec, Inc.



Author Information and Agenda

- Mark Kraeling, Solutions Architect, Wabtec Inc.
- Agenda
 - Understanding “the exponential”
 - Artificial Intelligence – just a summary
 - The world of ChatGPT
 - Application of ChatGPT to Embedded Software





Let's Talk Exponentials...

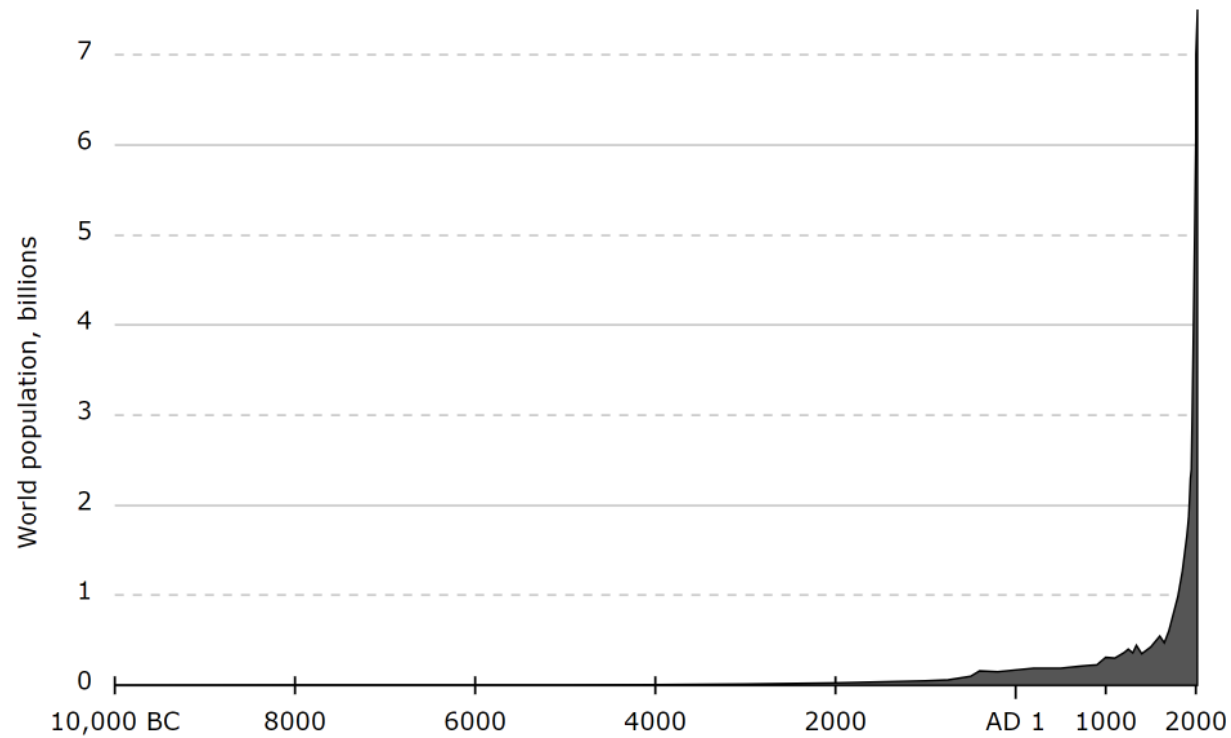


“The greatest shortcoming of the human race is our inability to understand the exponential function”

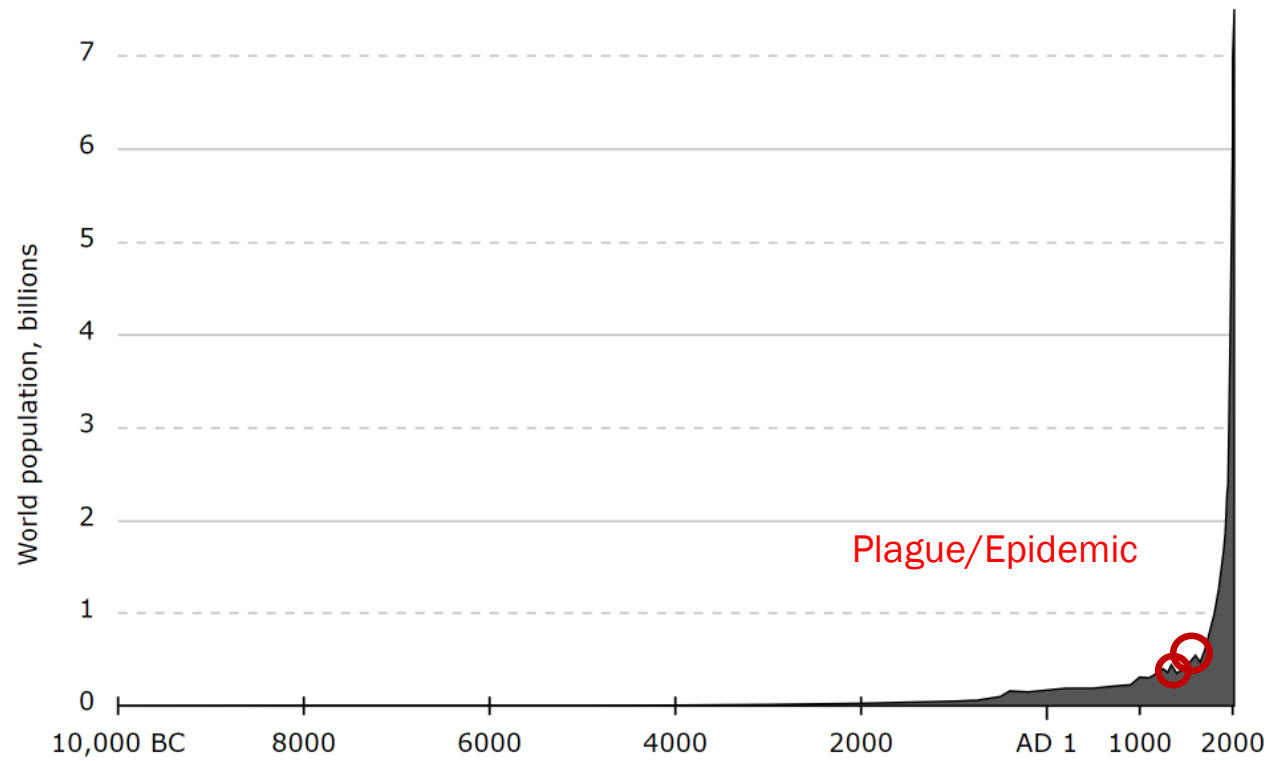
- Albert A. Bartlett



Human Population Timeline

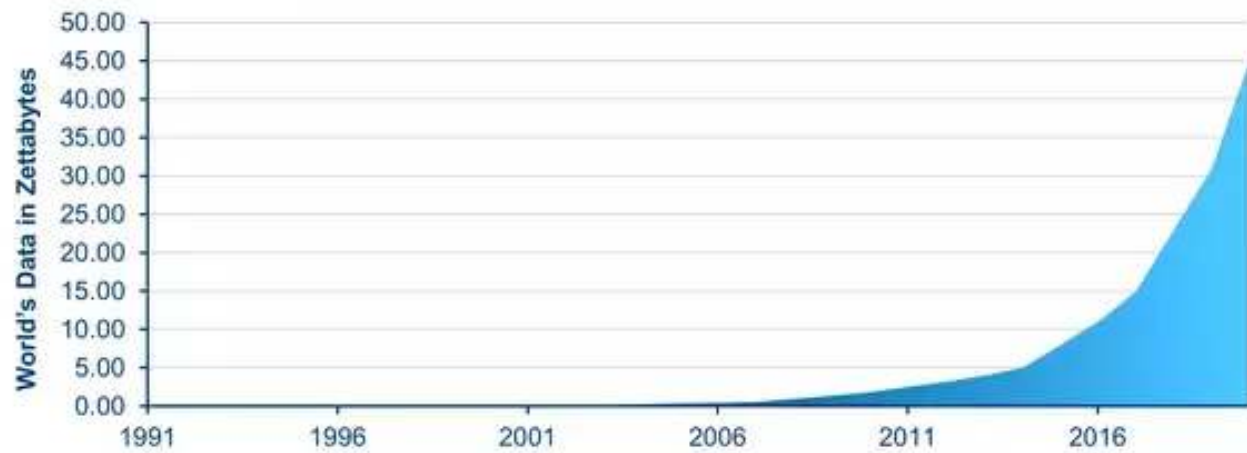


Human Population Timeline



Exponentials Everywhere

Data growth

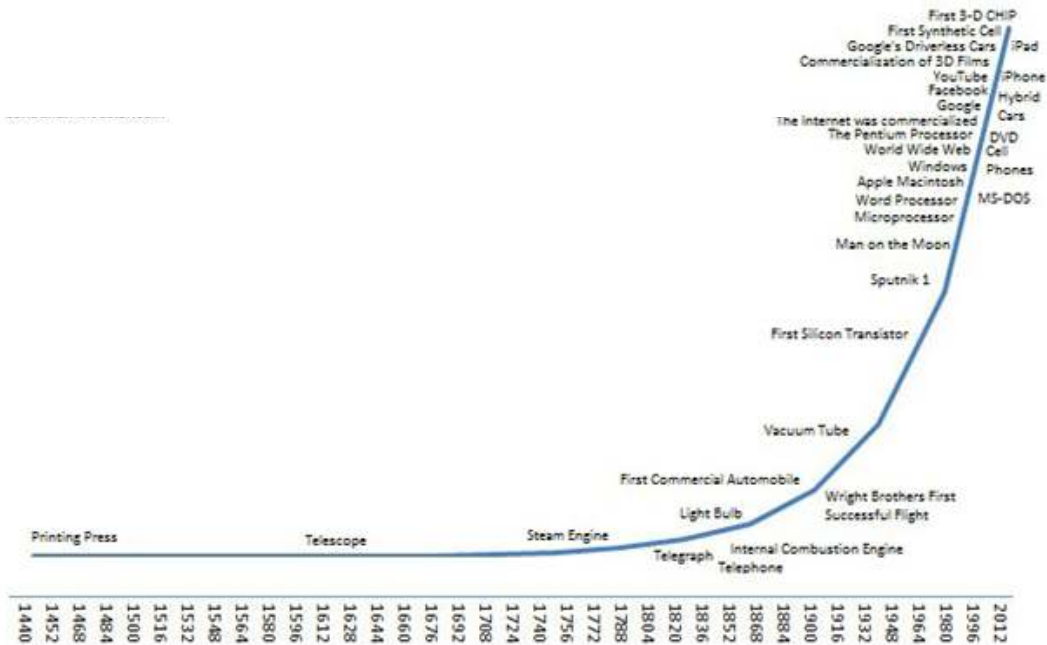


SOURCE: Oracle 2012

sas | The Cloud Company



Exponentials Everywhere



<http://lgpapertrru.duos.me/development-in-print-technology-over-last-100-years.html>



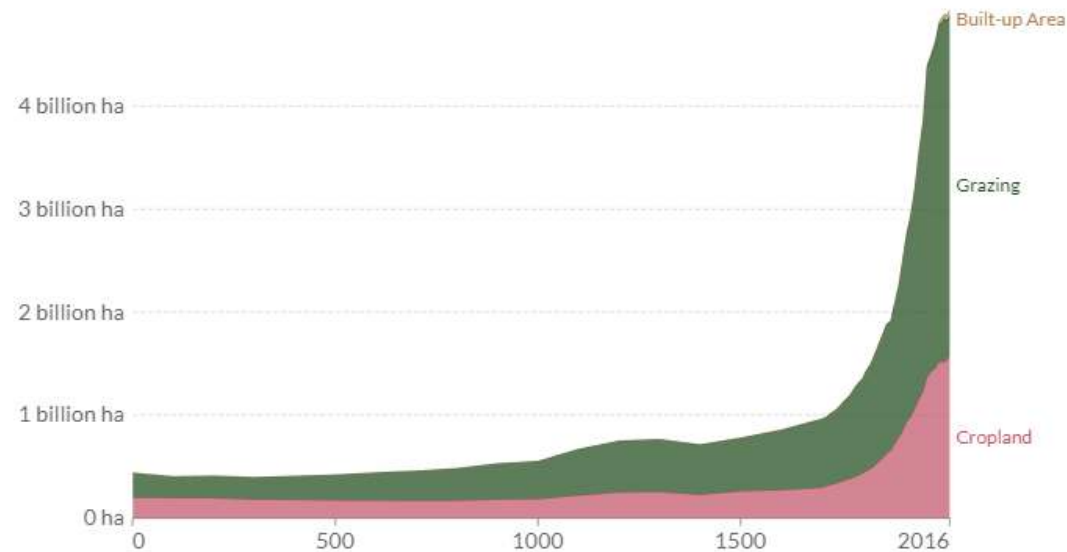
Exponentials Everywhere

Land use over the long-term, World, 0 to 2016

Total land area used for cropland, grazing land and built-up areas (villages, cities, towns and human infrastructure).

Our World
in Data

+ Add country/region ☐ Relative



Source: History Database of the Global Environment (HYDE)

OurWorldInData.org/land-use • CC BY

<https://ourworldindata.org/land-use>

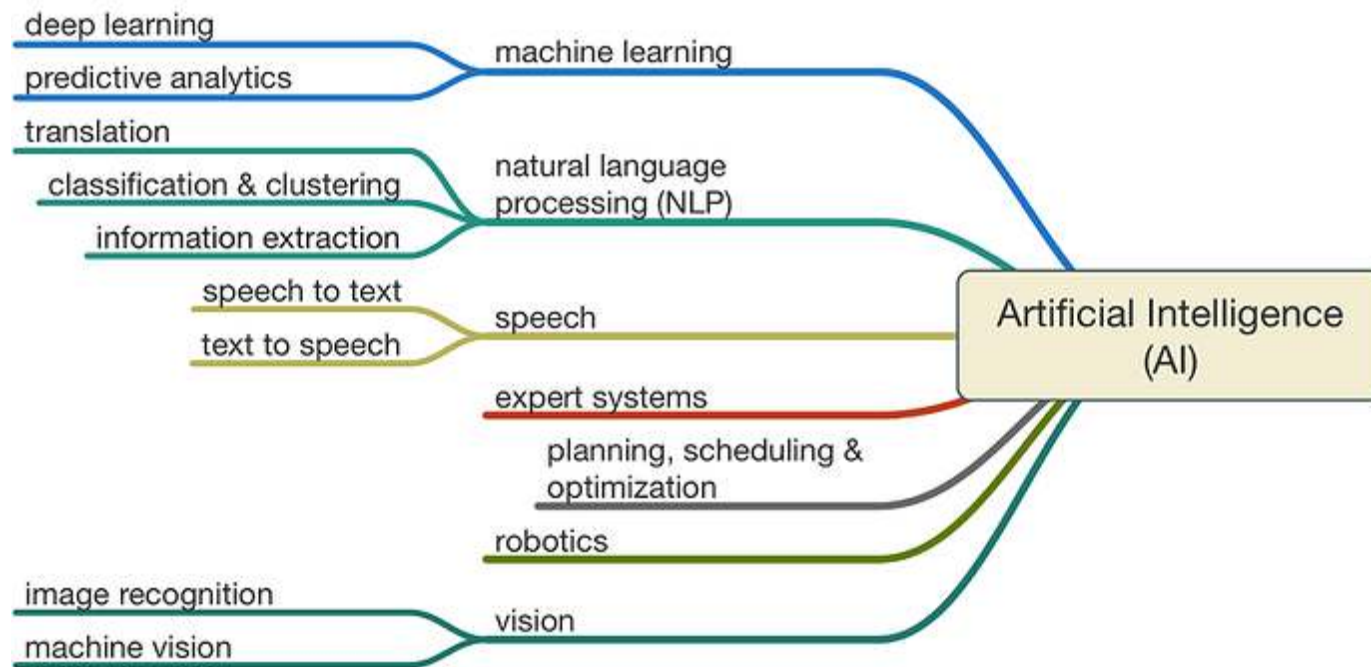




Artificial Intelligence – just a summary...



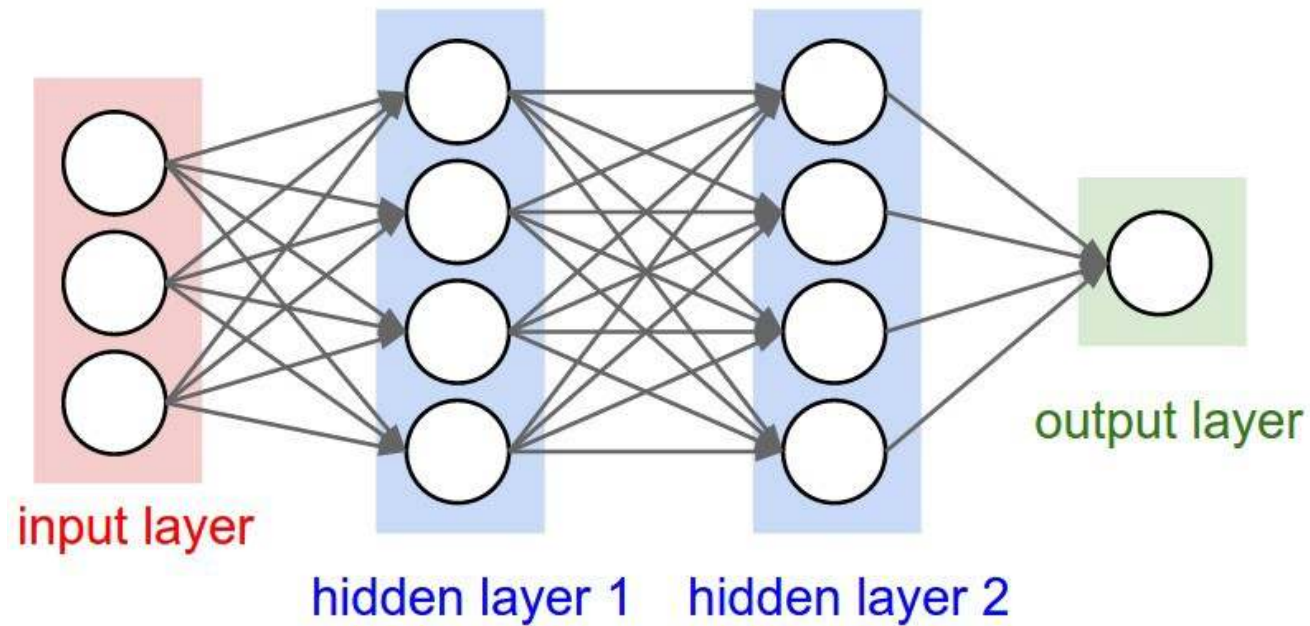
Artificial Intelligence (AI)



<http://www.futurearchi.org/t/artificial-intelligence-ai-in-architecture-what-are-the-practical-applications/364>



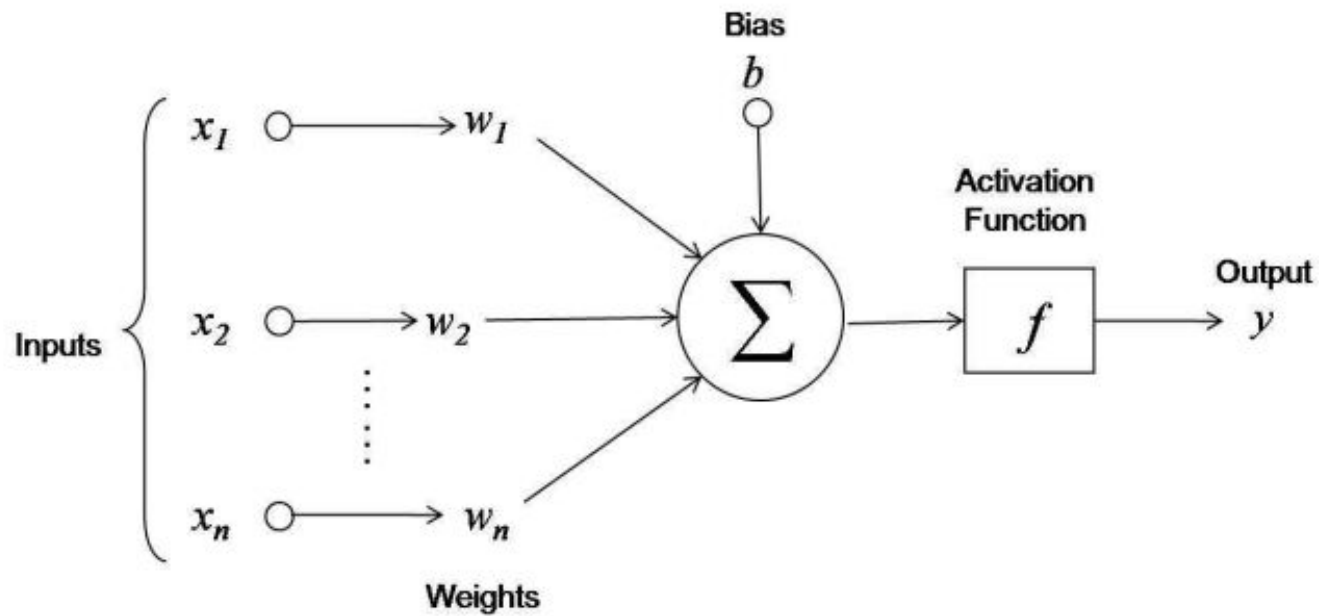
Neural Network



<https://medium.com/getting-started-with-neural-network-for-regression-and-tensorflow-58ad3bd75223>



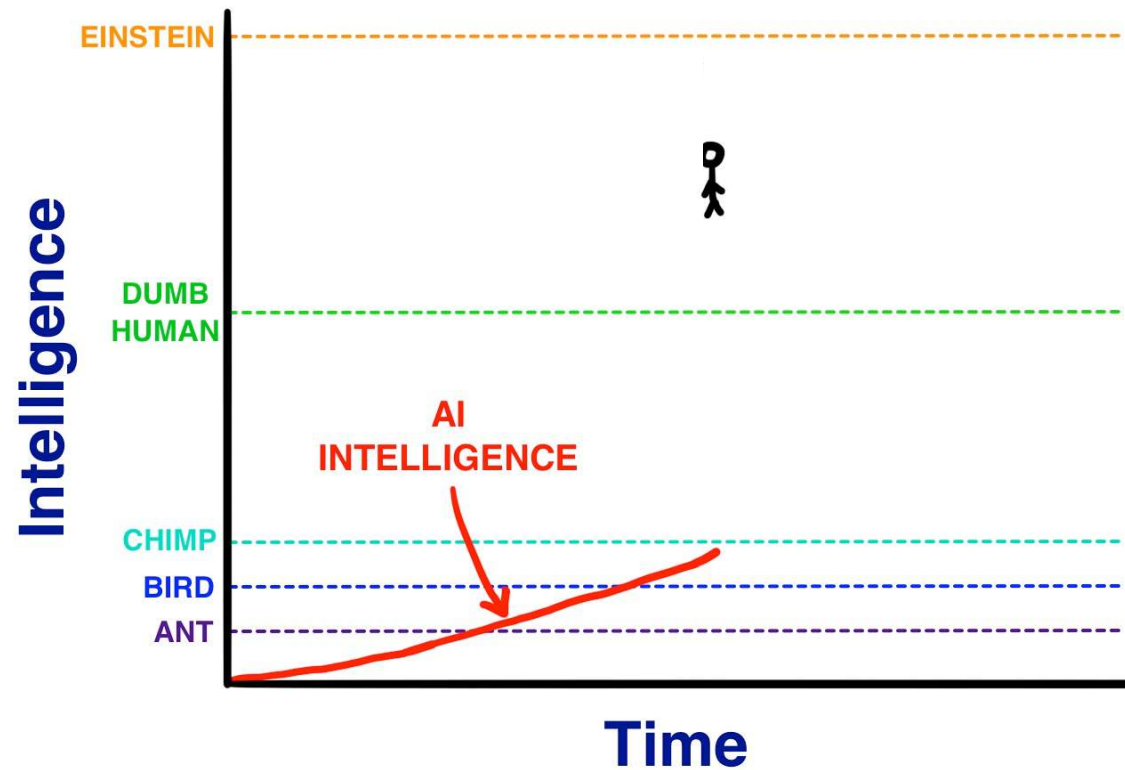
Computer Model



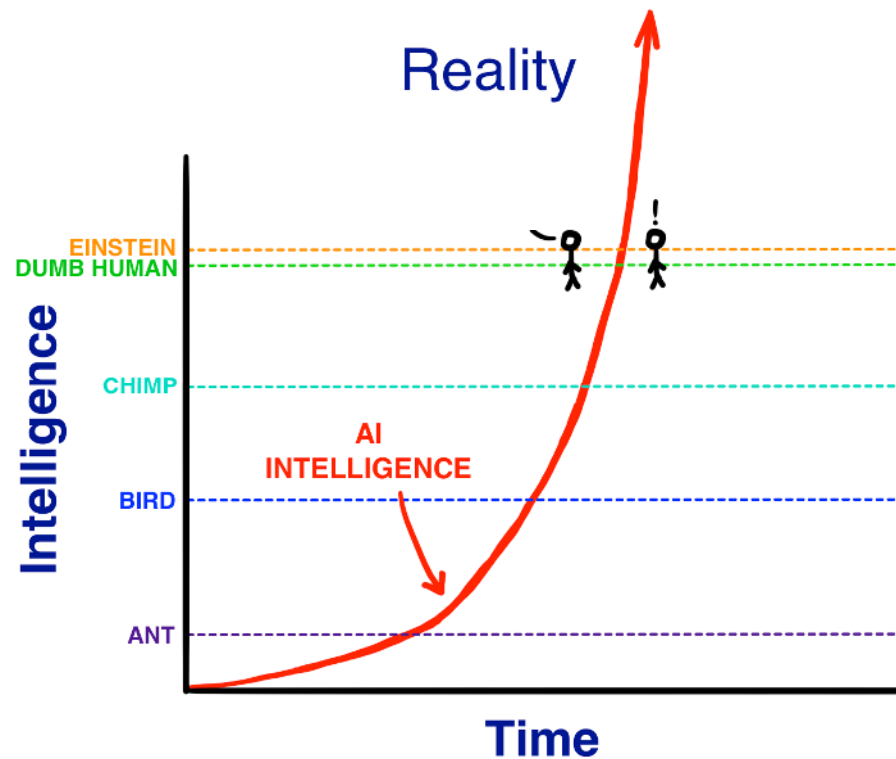
<https://tex.stackexchange.com/questions/132444/diagram-of-an-artificial-neural-network>



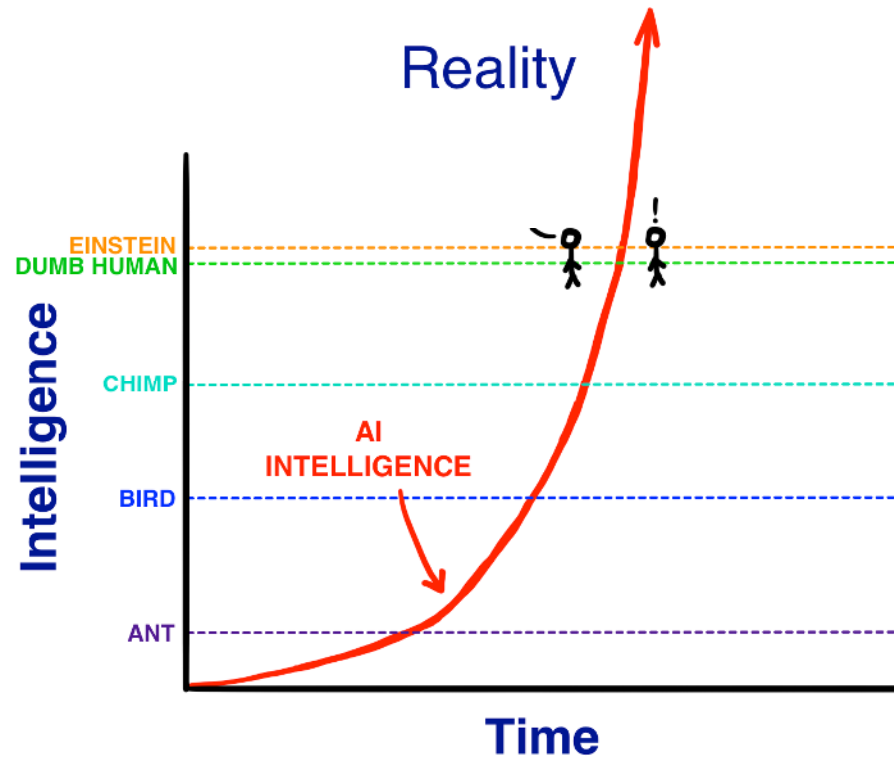
Functions vs Intelligence Levels



Functions vs Intelligence Levels



Functions vs Intelligence Levels



The Exponential !





The World of ChatGPT



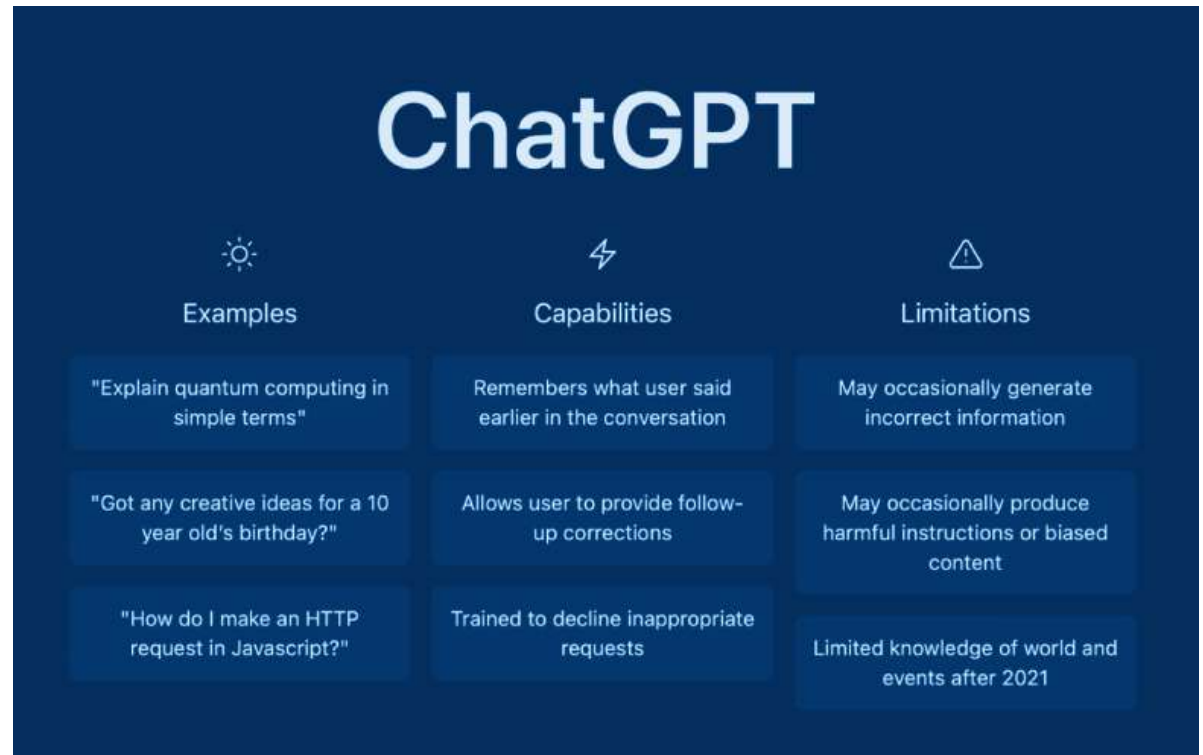
ChatGPT

OpenAI Initiative

Generative AI – Capable of generating conversation as opposed to static “found” data

"ChatGPT is scary good. We are not far from dangerously strong AI" – Elon Musk

“Fastest growing app of all time”
- SwissBank UBS



<https://www.softwebsolutions.com/resources/everything-you-want-to-know-about-chatgpt.html>



ChatGPT

“Write a book report on Gulliver’s Travels in 150 words or less”



Gulliver's Travels is a classic satirical novel written by Jonathan Swift, first published in 1726.



The novel tells the story of Lemuel Gulliver, a ship's surgeon, who goes on four voyages to different imaginary lands. In each of these lands, he encounters bizarre and fantastical creatures and societies that serve as a commentary on the politics, society, and culture of Swift's time.

In the first voyage, Gulliver finds himself in Lilliput, a land of tiny people. He becomes embroiled in their political disputes and helps them fight a war against their rival nation of Blefuscu. In the second voyage, he encounters Brobdingnag, a land of giants, where he is treated as a curiosity and becomes disgusted by the physical imperfections of the human body. In the third voyage, he visits the floating island of Laputa, where the intellectuals are detached from reality and obsessed with useless inventions. In the final voyage, he visits the land of the Houyhnhnms, a society of intelligent horses, and the savage Yahoos, who resemble humans.

Through Gulliver's encounters with these strange societies, Swift uses satire to criticize various aspects of society, including government, religion, science, and human nature itself. The novel is both entertaining and thought-provoking, and its influence can be seen in many later works of science fiction and fantasy. Overall, Gulliver's Travels is a timeless classic that remains relevant and enjoyable to read today.



ChatGPT

“Write a Linux iptables instruction that sets up a firewall for all traffic except for UDP port 1234 and TCP port 5678”



To set up a firewall using iptables in Linux that allows traffic for UDP port 1234 and TCP port 5678 while blocking all other traffic, you can use the following command:



CSS

Copy code

```
sudo iptables -A INPUT -p udp --dport 1234 -j ACCEPT
sudo iptables -A INPUT -p tcp --dport 5678 -j ACCEPT
sudo iptables -A INPUT -j DROP
```

This will add rules to the INPUT chain of the firewall. The first two rules allow incoming traffic for UDP port 1234 and TCP port 5678, respectively. The "-j ACCEPT" option specifies that traffic matching the rule should be accepted. The third rule drops all other incoming traffic using the "-j DROP" option.

Note that this configuration will only apply to incoming traffic, and that outgoing traffic will not be affected. Also, if you have any existing iptables rules, make sure to add these rules at the appropriate position in the chain so that they are applied correctly.



ChatGPT

“Provide a 100 word biography for Mark Kraeling, software engineer, that resides in Melbourne, Florida”



Mark Kraeling is a skilled software engineer based in Melbourne, Florida. He has years of experience working with different programming languages and tools to create innovative software solutions for various clients. Mark has a deep understanding of software development methodologies and always stays up-to-date with the latest trends and technologies in the industry. He has a passion for problem-solving and enjoys working in a collaborative environment to deliver high-quality products. Mark is a motivated individual who thrives on challenges and has a proven track record of delivering complex projects on time and within budget. In his free time, he enjoys hiking and exploring the beautiful landscapes of Florida.



ChatGPT

“Write an email to local farmers in my area to focus on soil conservation in a nice way”



Subject: Let's Work Together for Sustainable Soil Conservation



Dear [Farmers' Name],

As a member of this community, I am writing to express my concern about the declining health of our soil. Our land is the foundation of our agricultural system, and we need to take care of it for the long-term sustainability of our farming practices.

I am writing to encourage you to join me in focusing on soil conservation in our local area. By taking simple steps to protect and improve the quality of our soil, we can ensure that it remains fertile and productive for generations to come.

There are several ways we can work together to achieve this goal. First, we can adopt sustainable farming practices, such as crop rotation, reduced tillage, and the use of cover crops. These practices can help to prevent soil erosion, maintain soil fertility, and reduce the need for synthetic fertilizers and pesticides.



ChatGPT

“Write an email to local farmers in my area to focus on soil conservation in a nice way”

Second, we can work to reduce our reliance on synthetic inputs by transitioning to organic farming practices. Organic farming methods promote soil health by building up organic matter, increasing soil biodiversity, and improving soil structure.

Finally, we can work to raise awareness about the importance of soil conservation in our community. By sharing our experiences and successes, we can inspire others to adopt sustainable farming practices and help to create a culture of soil conservation in our area.

I believe that by working together, we can make a real difference in the health and productivity of our soil. I encourage you to join me in this effort and to take action to protect and improve our land for future generations.

Thank you for your time and consideration.

Sincerely,

[Your Name]



ChatGPT

There is much discussion around ChatGPT leading to other alternatives...

ChaosGPT



TruthGPT



FreedomGPT





ChatGPT in the Embedded Software space -



ChatGPT Embedded Opportunities


- ChatGPT has yet to write deeply embedded software code... however...
- We are on the exponential for this development! Months away...
- Key advancements made for cybersecurity opportunities – news May ‘23
- ChatGPT works well writing Python code – consider using plain language to generate test scripts to evaluate the embedded software
- Consider these examples...



ChatGPT

“Write python software code that sorts a list of numbers”

python

 Copy code

```
def bubble_sort(numbers):  
    n = len(numbers)  
    for i in range(n - 1):  
        for j in range(n - i - 1):  
            if numbers[j] > numbers[j + 1]:  
                numbers[j], numbers[j + 1] = numbers[j + 1], numbers[j]  
  
# Example usage:  
my_list = [5, 2, 9, 1, 7]  
bubble_sort(my_list)  
print(my_list)
```



ChatGPT

“Write C software code that sorts a list of numbers”

```
c Copy code

#include <stdio.h>

void bubbleSort(int arr[], int n) {
    int i, j, temp;
    for (i = 0; i < n - 1; i++) {
        for (j = 0; j < n - i - 1; j++) {
            if (arr[j] > arr[j + 1]) {
                // Swap arr[j] and arr[j+1]
                temp = arr[j];
                arr[j] = arr[j + 1];
                arr[j + 1] = temp;
            }
        }
    }
}

int main() {
```

Regenerate response

ChatGPT

“Write an interrupt that could be used on an MSP430 processor in C”

```
#include <msp430.h>

// Interrupt Service Routine (ISR) for Port 1
#pragma vector = PORT1_VECTOR
__interrupt void Port1_ISR(void)
{
    // Your code here
    // This is the interrupt handler for Port 1
    // Add your code to handle the interrupt event

    // Clear the interrupt flag
    P1IFG &= ~BIT0;
}

int main(void)
{
    // Initialize the MSP430

    // Set up Port 1
    P1DIR |= BIT0; // Set P1.0 as an output
    P1REN |= BIT0; // Enable internal resistor for P1.0
    P1OUT |= BIT0; // Set P1.0 pull-up resistor
}
```



ChatGPT

“Write TPM microcode that creates a basic waveform”

```
vbnet
Copy code

; TPM Microcode for Basic Waveform Generation
; Assumes the TPM has a single GPIO pin available

; Define constants
; You may need to modify these values based on your TPM's GPIO pin assignment
GPIO_PIN_NUMBER    equ 0      ; GPIO pin number to be used
WAVEFORM_PERIOD    equ 100    ; Waveform period in milliseconds
WAVEFORM_HIGH_TIME equ 50     ; High time of the waveform in milliseconds

; Define register addresses
GPIO_DIR_REG       equ 0x100   ; GPIO direction register
GPIO_DATA_REG      equ 0x104   ; GPIO data register

; Initialize TPM
INIT_TPM:
    ; Configure GPIO pin as an output
    mov r0, 1 << GPIO_PIN_NUMBER ; Set bit corresponding to GPIO_PIN_NUMBER
    mov [GPIO_DIR_REG], r0        ; Set GPIO pin as output

; Generate the waveform
GENERATE_WAVEFORM:
    ; Set GPIO pin high
    mov r0, 1 << GPIO_PIN_NUMBER ; Set bit corresponding to GPIO_PIN_NUMBER
    mov [GPIO_DATA_REG], r0       ; Set GPIO pin high

    ; Delay for the high time of the waveform
```

```
; Generate the waveform
GENERATE_WAVEFORM:
    ; Set GPIO pin high
    mov r0, 1 << GPIO_PIN_NUMBER ; Set bit corresponding to GPIO_PIN_NUMBER
    mov [GPIO_DATA_REG], r0       ; Set GPIO pin high

    ; Delay for the high time of the waveform
    mov r1, WAVEFORM_HIGH_TIME    ; Load high time value
DELAY_HIGH:
    sub r1, 1                      ; Decrement the counter
    cmp r1, 0                      ; Check if counter reached zero
    jne DELAY_HIGH                ; Jump if counter not zero

    ; Set GPIO pin low
    mov r0, 0                      ; Clear bit corresponding to GPIO_PIN_NUMBER
    mov [GPIO_DATA_REG], r0       ; Set GPIO pin low

    ; Delay for the remaining period of the waveform
    mov r1, WAVEFORM_PERIOD - WAVEFORM_HIGH_TIME ; Load remaining period value
DELAY_LOW:
    sub r1, 1                      ; Decrement the counter
    cmp r1, 0                      ; Check if counter reached zero
    jne DELAY_LOW                ; Jump if counter not zero

    ; Repeat the waveform generation indefinitely
    jmp GENERATE_WAVEFORM
```



In Conclusion...

