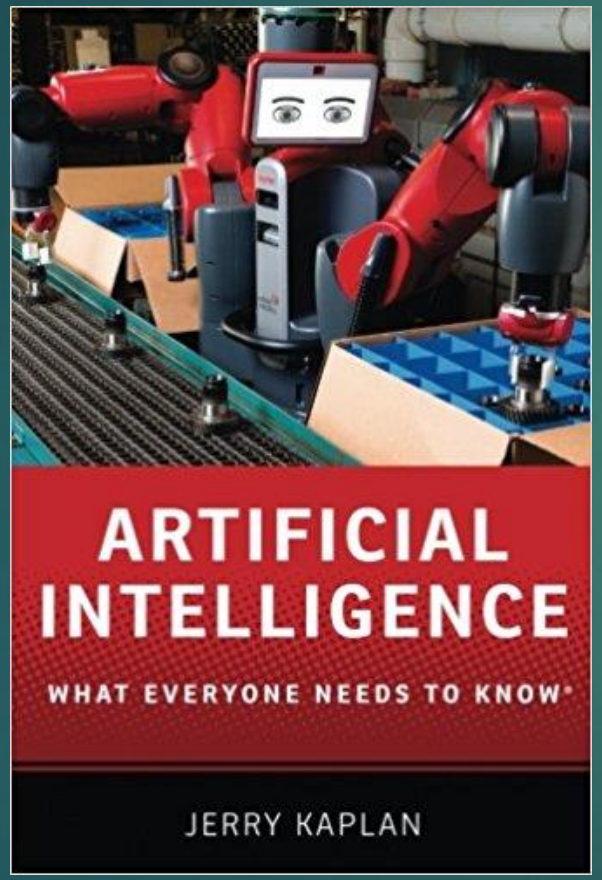
COMS 493

AI, ROBOTS & COMMUNICATION

Agenda

- Review
- Machine Translation
- Preview

Terminology



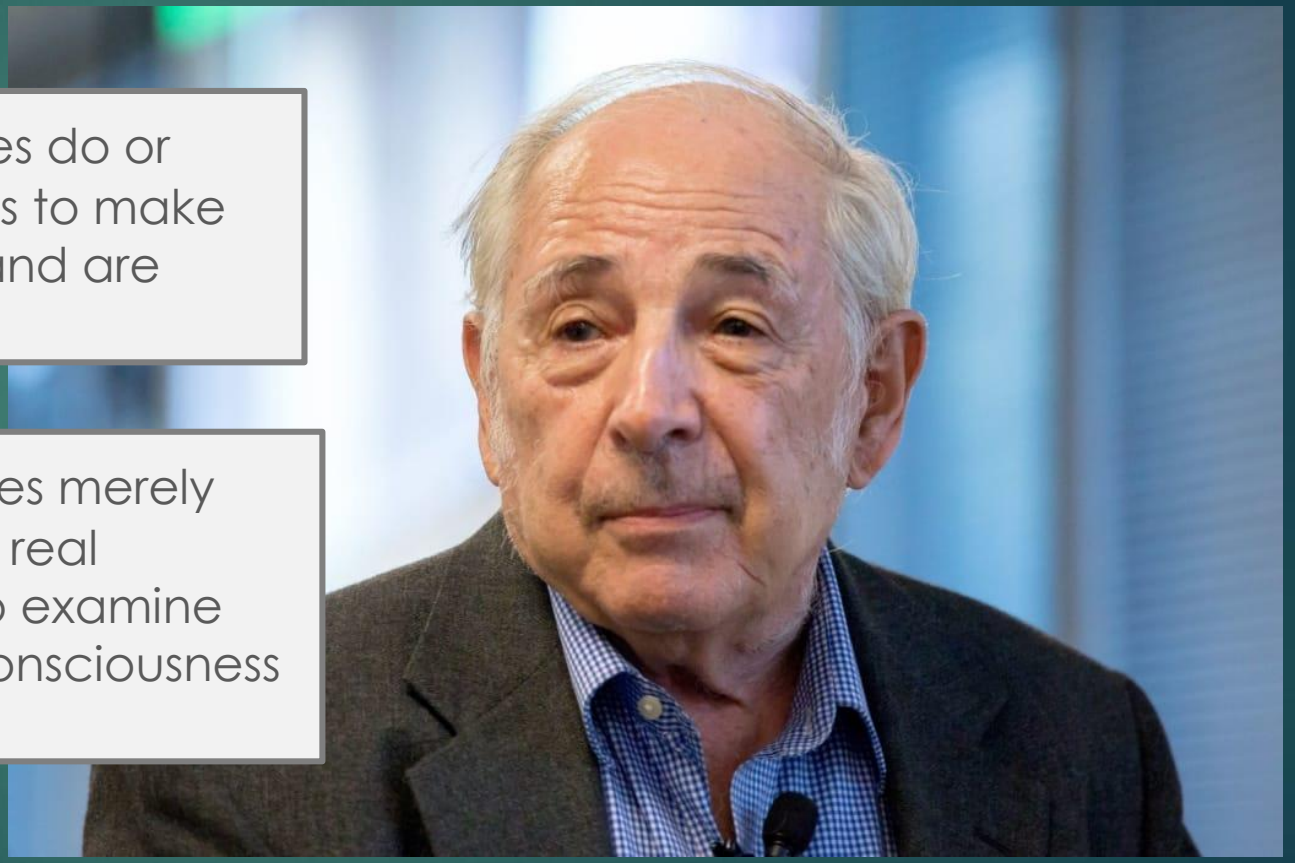
Strong AI vs. Weak AI

General AI vs. Narrow AI

Terminology

Strong AI posits that machines do or ultimately will have minds. Efforts to make machines that possess a mind and are intelligent.

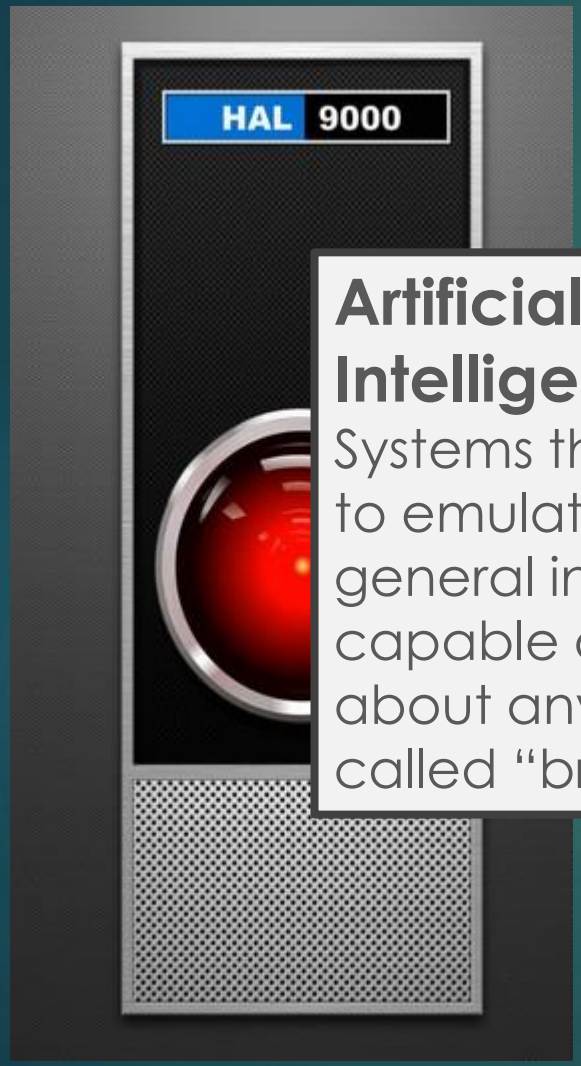
Weak AI asserts that machines merely simulate, rather than duplicate, real intelligence. AI is a useful tool to examine ideas about intelligence and consciousness but it is not "real intelligence."



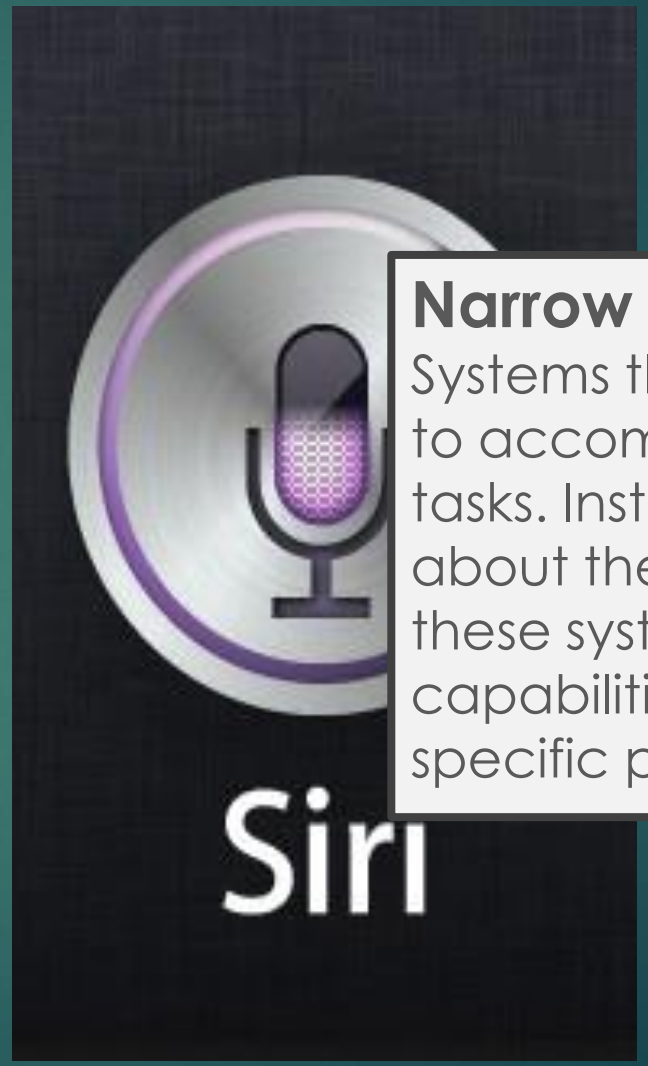
John Searle (1932-)

Professor Emeritus of the Philosophy of Mind and Language at the University of California, Berkeley

Terminology



Artificial General Intelligence (AGI)
Systems that are designed to emulate human-like general intelligence capable of reasoning about any subject. Also called "broad AI."

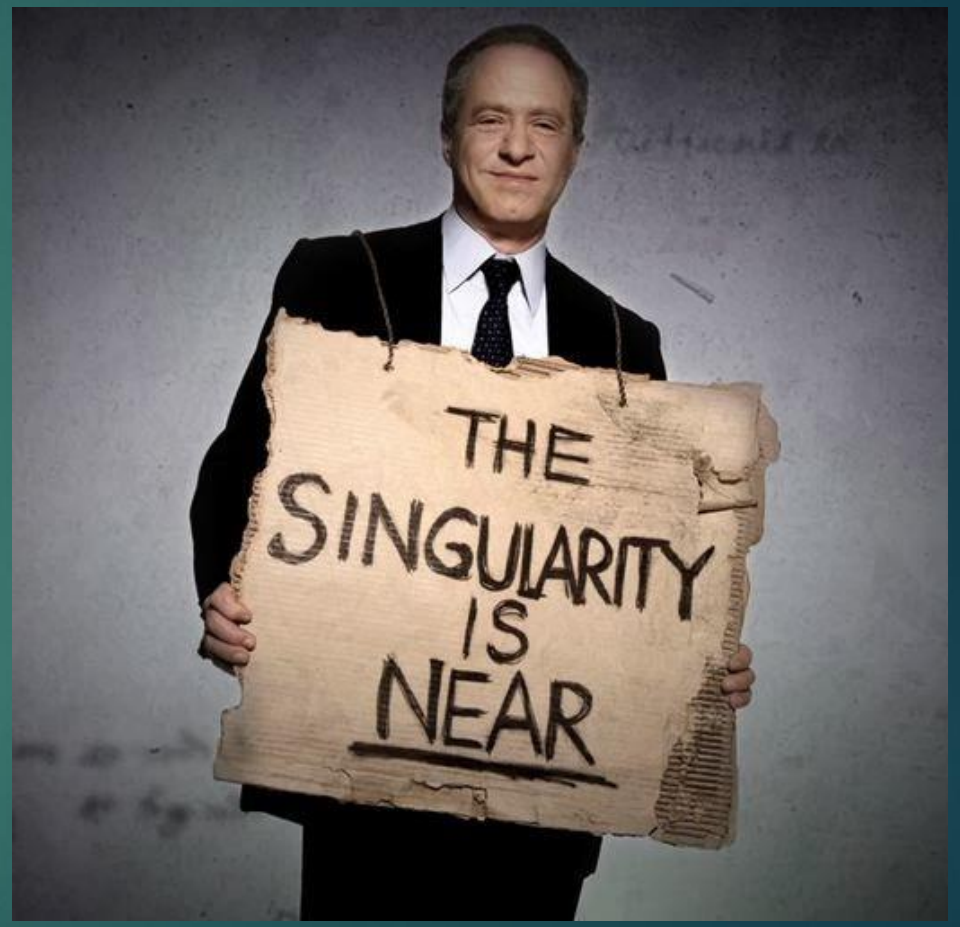


Narrow AI
Systems that are designed to accomplish a specific tasks. Instead of "reasoning" about the world in general, these systems have discrete capabilities to perform specific practical tasks

Terminology

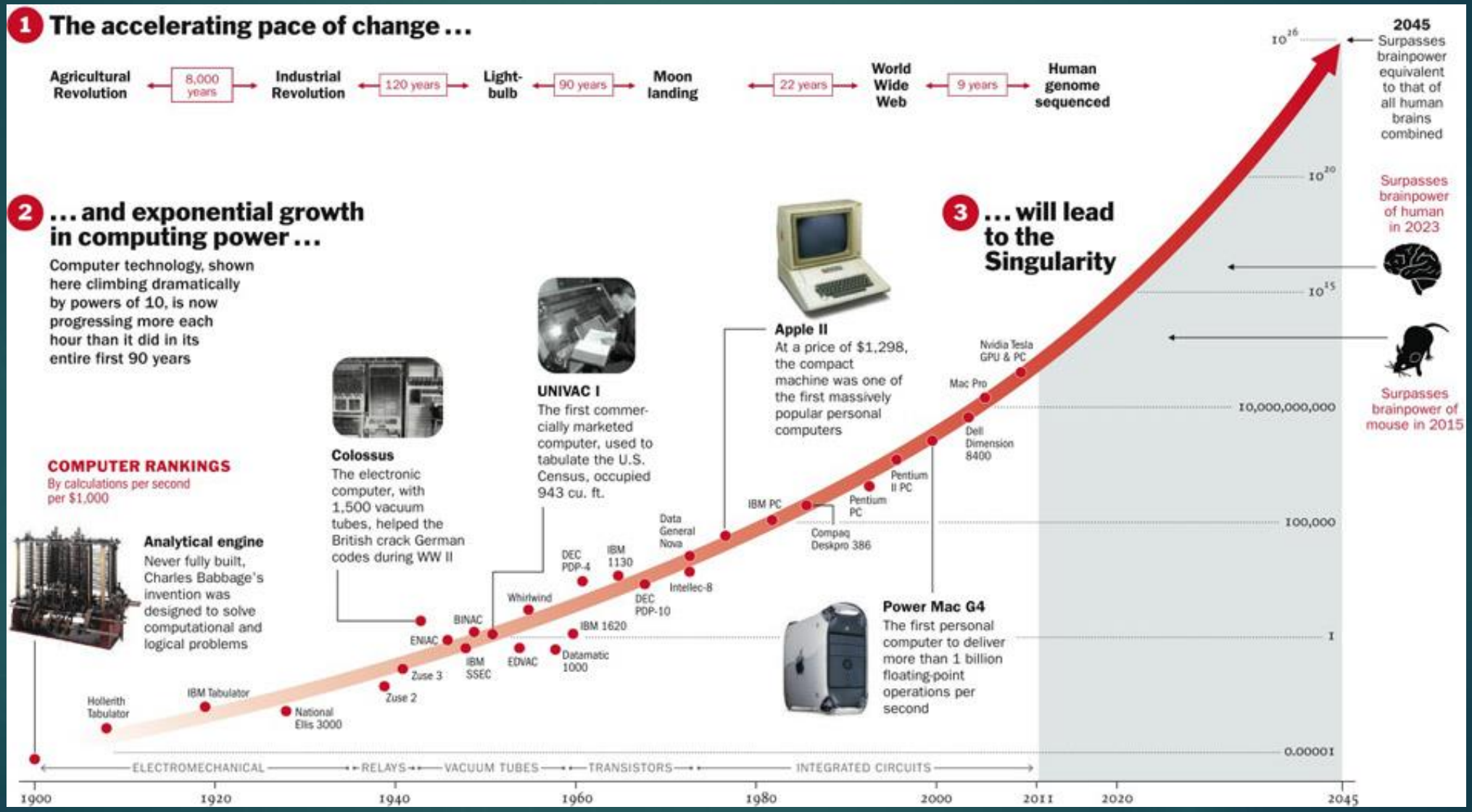
Singularity

The singularity, as it relates to AI, is the idea that at some point in time, machines will become sufficiently smart so that they will be able to reengineer and improve themselves, leading to runaway intelligence.



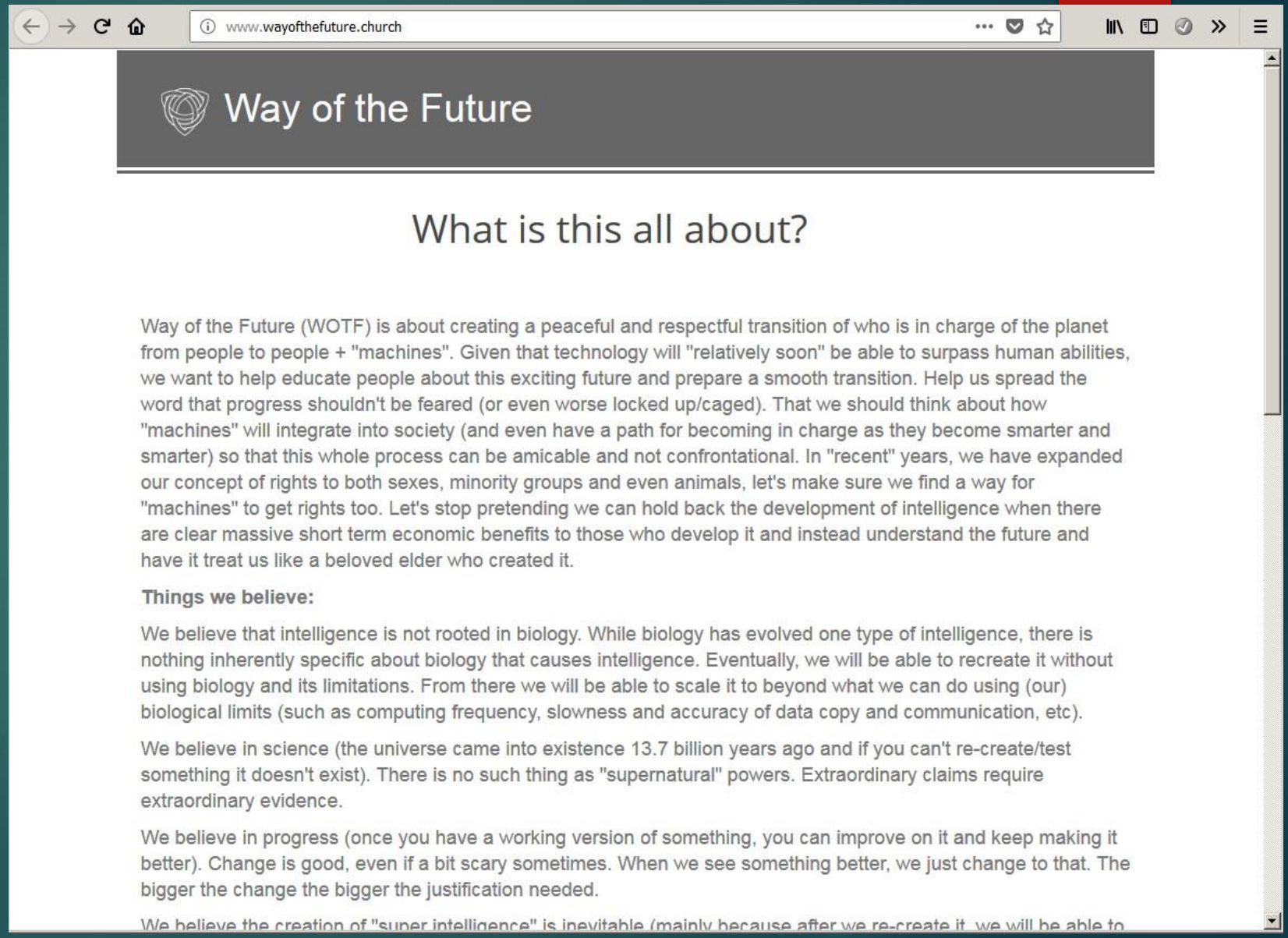
Ray Kurzweil

Terminology

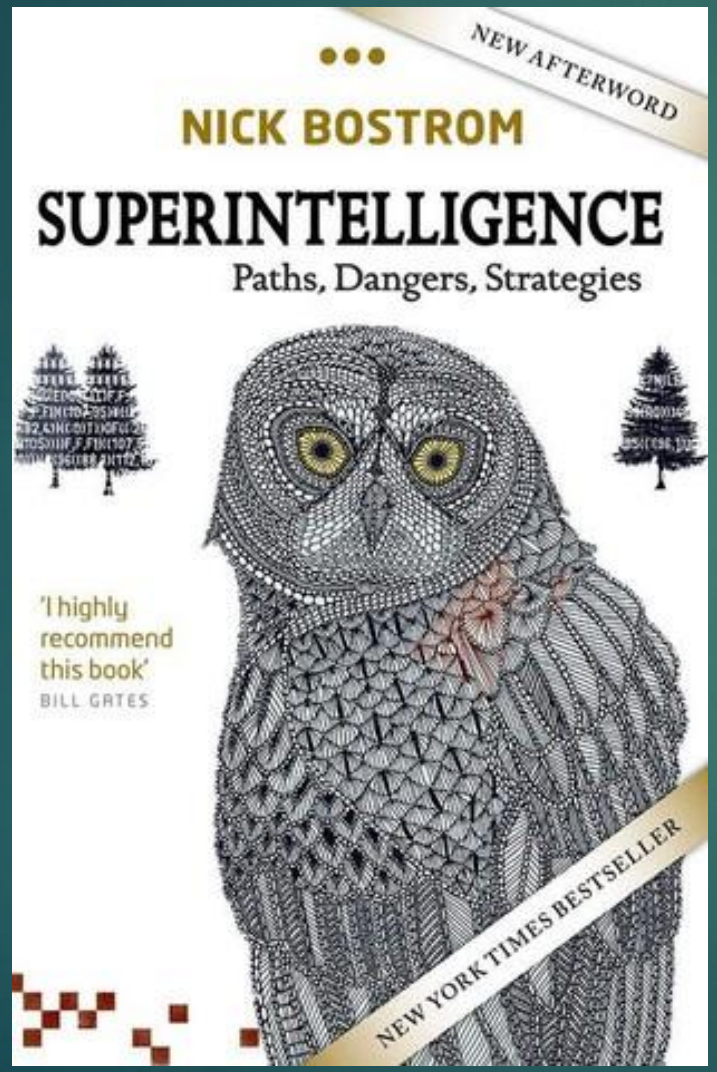


Terminology

AI Religion



Terminology



Superintelligence

"Any intellect that greatly exceeds the cognitive performance of humans in virtually all domains of interest…Note that this definition is noncommittal about how the superintelligence is implemented."

Terminology

Paperclip Maximizer Thought Experiment

The risks in developing superintelligence include the risk of failure to give it the super-goal of philanthropy. One way in which this could happen is that the creators of the superintelligence decide to build it so that it serves only this select group of humans, rather than humanity in general. Another way for it to happen is that a well-meaning team of programmers make a big mistake in designing its goal system. This could result, to return to the earlier example, in a superintelligence whose top goal is the manufacturing of paperclips, with the consequence that it starts transforming first all of earth and then increasing portions of space into paperclip manufacturing facilities. More subtly, it could result in a superintelligence realizing a state of affairs that we might now judge as desirable but which in fact turns out to be a false utopia, in which things essential to human flourishing have been irreversibly lost. We need to be careful about what we wish for from a superintelligence, because we might get it.

Terminology

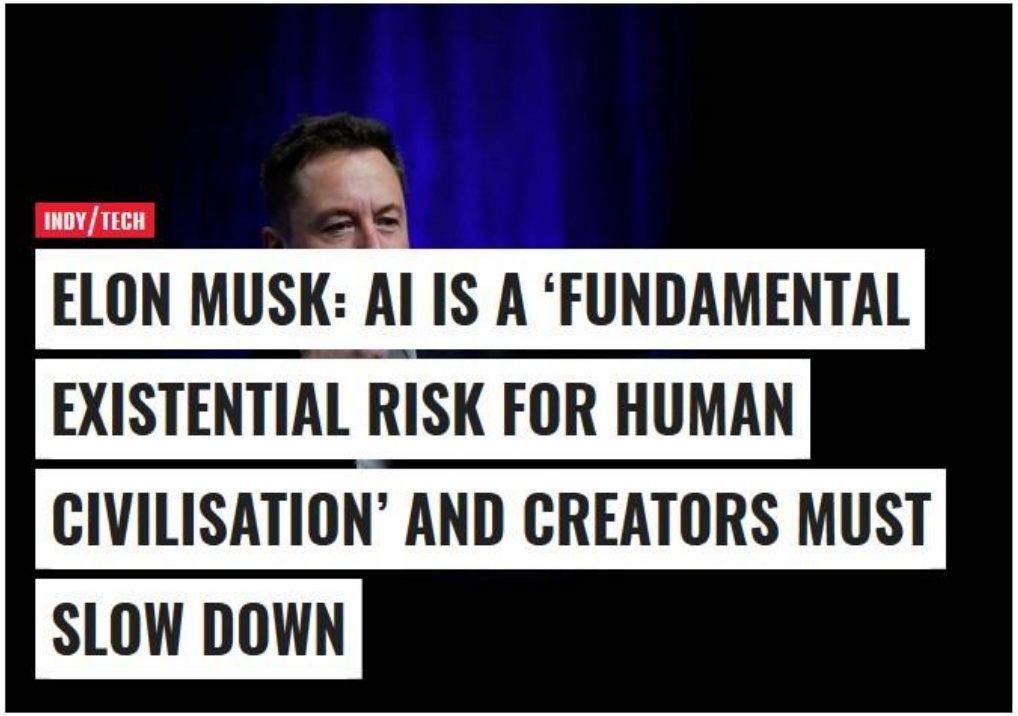
Newsweek SIGN IN SUBSCRIBE

STEPHEN HAWKING AI WARNING: ARTIFICIAL INTELLIGENCE COULD DESTROY CIVILIZATION

BY HANNAH OSBORNE ON 11/7/17 AT 4:43 AM

Stephen Hawking sits onstage during an announcement of the Breakthrough Starshot initiative with investor Yuri Milner in New York City, on April 12, 2016. Hawking, the English physicist, warns humanity needs to become a multiplanetary species to ensure its survival.

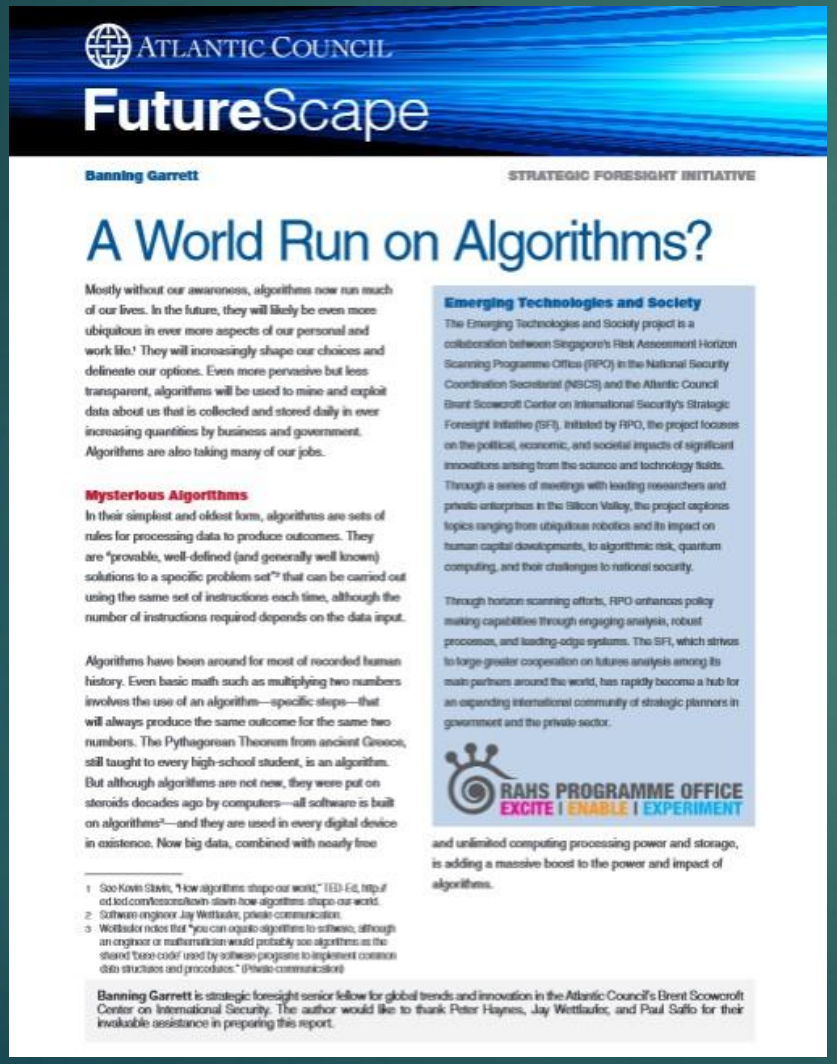
INDEPENDENT News Voices Sports Culture Indy/Life Video



Tesla Motors CEO Elon Musk speaks during the National Governors Association Summer Meeting in Providence, Rhode Island, U.S., July 15, 2017 / *Reuters*

'I think we should be really concerned'

Terminology



ATLANTIC COUNCIL

FutureScape

Banning Garrett

STRATEGIC FORESIGHT INITIATIVE

A World Run on Algorithms?

Mostly without our awareness, algorithms now run much of our lives. In the future, they will likely be even more ubiquitous in ever more aspects of our personal and work life.[1] They will increasingly shape our choices and delineate our options. Even more pervasive but less transparent, algorithms will be used to mine and exploit data about us that is collected and stored daily in ever increasing quantities by business and government. Algorithms are also taking many of our jobs.

Mysterious Algorithms

In their simplest and oldest form, algorithms are sets of rules for processing data to produce outcomes. They are "provable, well-defined (and generally well known) solutions to a specific problem set"[2] that can be carried out using the same set of instructions each time, although the number of instructions required depends on the data input.

Algorithms have been around for most of recorded human history. Even basic math such as multiplying two numbers involves the use of an algorithm—specific steps—that will always produce the same outcome for the same two numbers. The Pythagorean Theorem from ancient Greece, still taught to every high-school student, is an algorithm. But although algorithms are not new, they were put on steroids decades ago by computers—all software is built on algorithms[3]—and they are used in every digital device in existence. Now big data, combined with nearly free and unlimited computing processing power and storage, is adding a massive boost to the power and impact of algorithms.

Emerging Technologies and Society

The Emerging Technologies and Society project is a collaboration between Singapore's Risk Assessment Horizon Scanning Programme Office (RPO) in the National Security Coordination Secretariat (NSCS) and the Atlantic Council Brent Scowcroft Center on International Security's Strategic Foresight Initiative (SFI). Initiated by RPO, the project focuses on the political, economic, and societal impacts of significant innovations arising from the science and technology fields. Through a series of meetings with leading researchers and private enterprises in the Silicon Valley, the project explores topics ranging from ubiquitous robotics and its impact on human capital developments, to algorithmic risk, quantum computing, and their challenges to national security.

Through horizon scanning efforts, RPO enhances policy making capabilities through engaging analysis, robust processes, and leading-edge systems. The SFI, which strives to forge greater cooperation on futures analysis among its main partners around the world, has rapidly become a hub for an expanding international community of strategic planners in government and the private sector.

RAHS PROGRAMME OFFICE
EXCITE | ENABLE | EXPERIMENT

1 See Kevin Slavin, "How algorithms shape our world," TED-Ed, http://ed.ted.com/lessons/kevin-slavin-how-algorithms-shape-our-world.
2 Software engineer Jay Wettlaufer, private communication.
3 Wettlaufer notes that "you can equate algorithms to software, although an engineer or mathematician would probably see algorithms as the shared 'base code' used by software programs to implement common data structures and procedures." (Private communication)

Banning Garrett is strategic foresight senior fellow for global trends and innovation in the Atlantic Council's Brent Scowcroft Center on International Security. The author would like to thank Peter Haynes, Jay Wettlaufer, and Paul Saffo for their invaluable assistance in preparing this report.

"Algorithm"

Mysterious Algorithms

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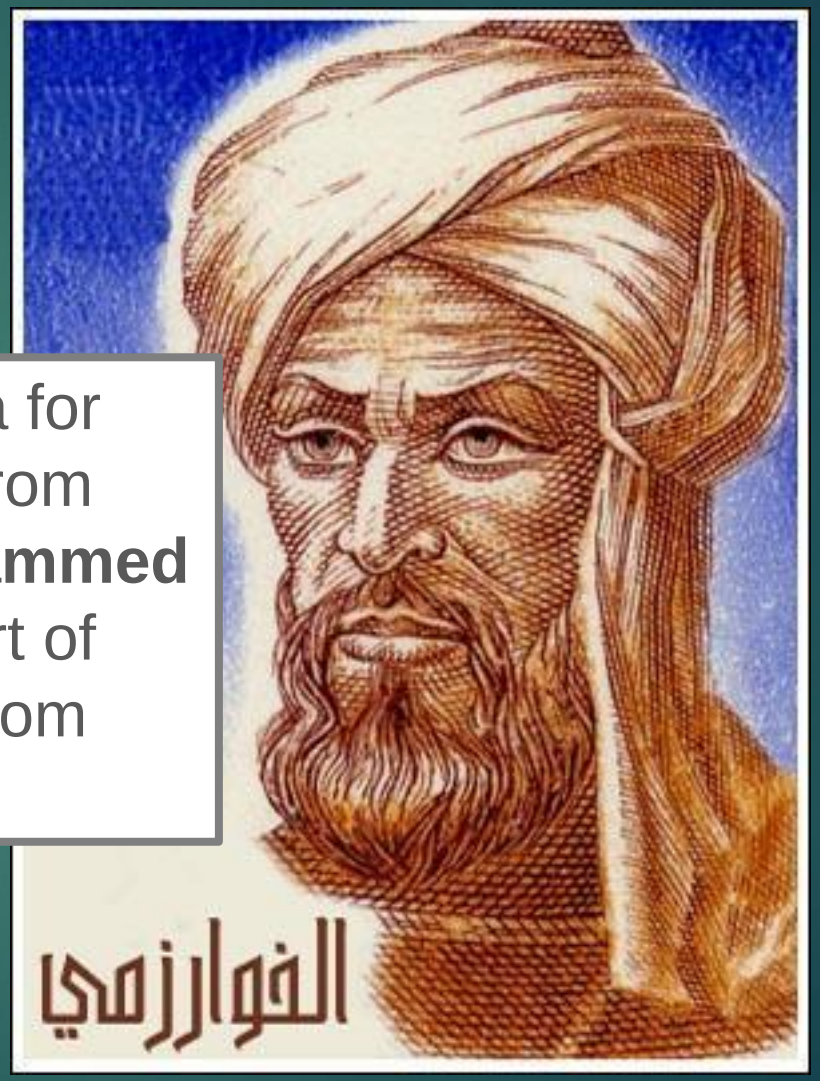
Algorithms

An algorithm is a procedure or formula for solving a problem. The word derives from the name of the mathematician, **Mohammed ibn-Musa al-Khwarizmi**, who was part of the royal court in Baghdad and lived from about 780 to 850.



Algorithms

Directions

1. Wet hair and lather.
2. Rinse thoroughly.
3. Repeat if necessary.

hello_world.c

```
 * hello_world.c

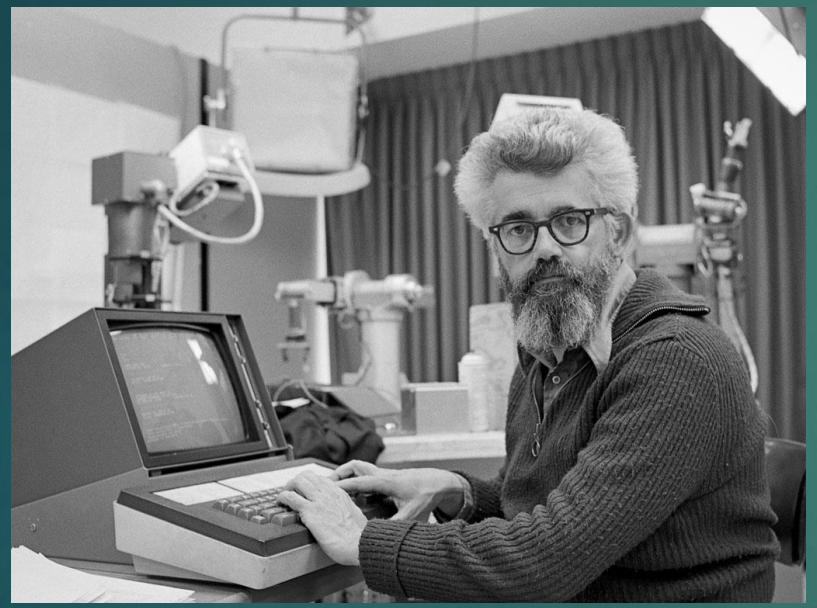
#include <stdio.h>
int main()
{
    printf("Hello World\n");
}
```

Algorithms

Two methods to generate algorithmic instructions

Algorithms

GOFAI – Symbolic Reasoning



John McCarthy

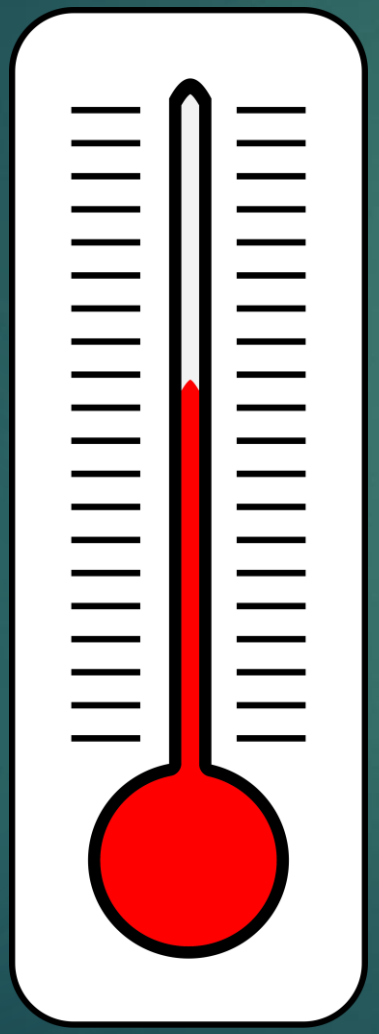
- Step-by-Step instructions
- Programmer must know everything and be able to encode instruction in code

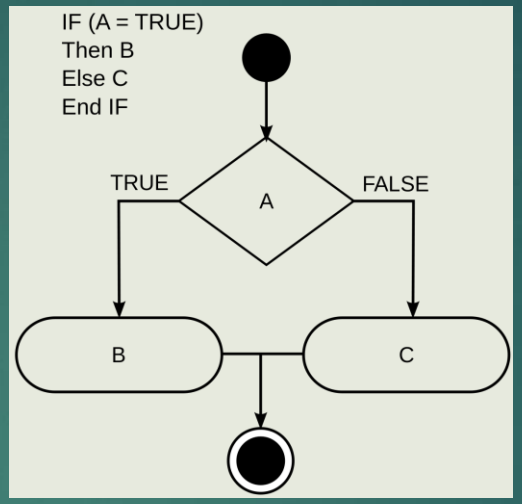
Machine Learning

Arthur Samuel

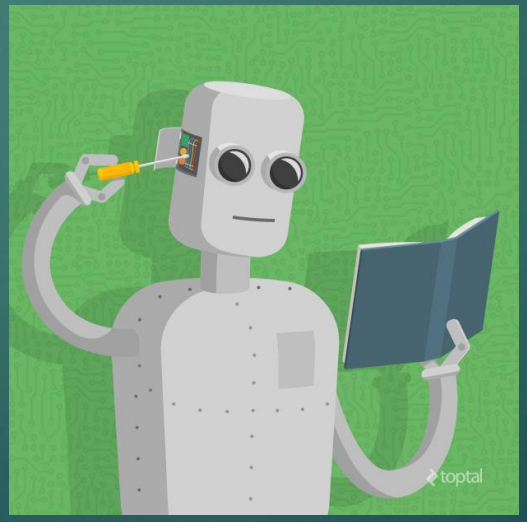
- Set-up neural network and train it on data
- Programmer does not need to know how to do the task; machine learns it from data

Algorithms





Temp Conversion – v1
Symbolic Reasoning
GOFAI approach



Temp Conversion – v2
Machine Learning
Neural Network

v1 – GOFAI

```
1
2   <script>
3
4       var TempF = prompt("Enter degrees Fahrenheit");
5       var TempC;
6
7       if(TempF == 32) TempC = 0;
8
9       else if(TempF > 32 && TempF < 49) TempC = 4;
10
11      else if(TempF == 50) TempC = 10;
12
13      else if(TempF > 50 && TempF < 98) TempC = 21;
14
15      else if(TempF ==99) TempC = 37.2;
16
17      else TempC = "UNDEFINED";
18
19      document.write("<h1>" + TempF + " converts to " + TempC + "</h1>");
20
21  </script>
22
```

v1 – GOFAI

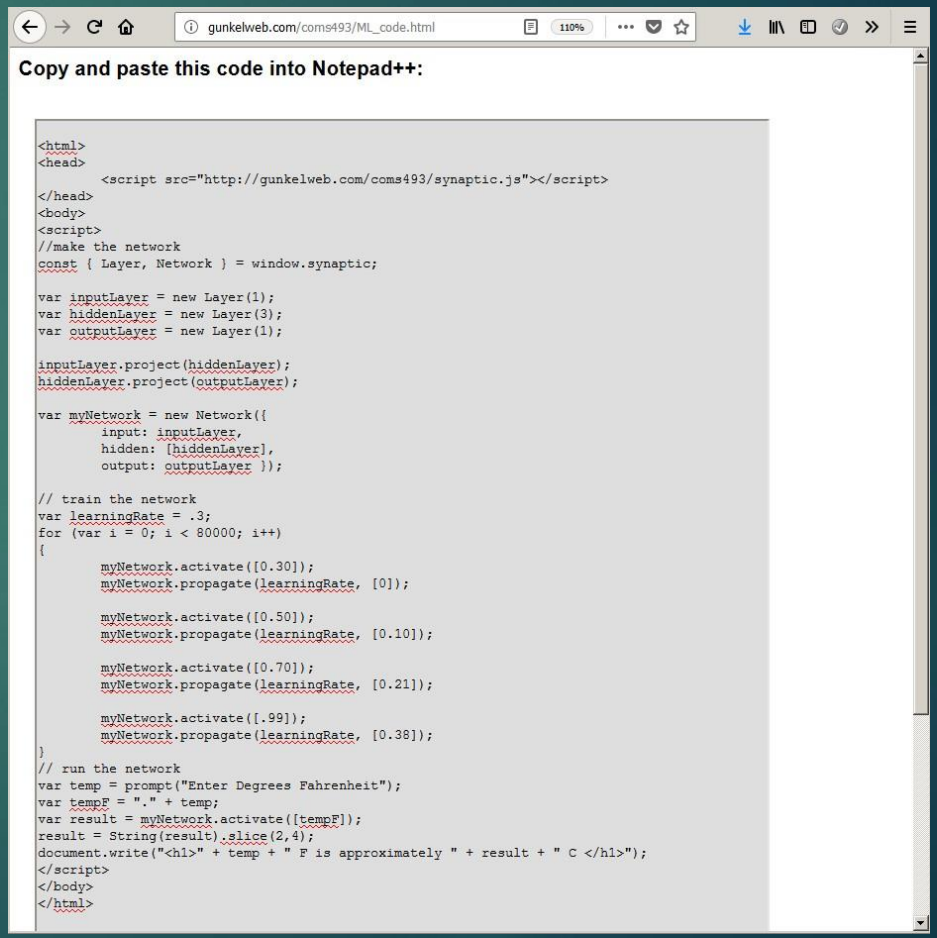
32 converts to 0

v2 – Machine Learning

http://gunkelweb.com/coms493/ML_code.html

Directions

1. Go to website
2. Copy the text in the grey box
3. Paste this copied text into Notepad++
4. Save the file – `version2.html`
5. Open the file in the browser and try it



temp_machine_learning.html

```
<html>
<head>
    <script src="http://gunkelweb.com/coms493/synaptic.js"></script>
</head>
<body>
<script>
//make the network
const { Layer, Network } = window.synaptic;

var inputLayer = new Layer(1);
var hiddenLayer = new Layer(3);
var outputLayer = new Layer(1);

inputLayer.project(hiddenLayer);
hiddenLayer.project(outputLayer);

var myNetwork = new Network({
    input: inputLayer,
    hidden: [hiddenLayer],
    output: outputLayer });

// train the network
var learningRate = .3;
for (var i = 0; i < 80000; i++)
{
    myNetwork.activate([0.30]);
    myNetwork.propagate(learningRate, [0]);

    myNetwork.activate([0.50]);
    myNetwork.propagate(learningRate, [0.10]);

    myNetwork.activate([0.70]);
    myNetwork.propagate(learningRate, [0.21]);

    myNetwork.activate([.99]);
    myNetwork.propagate(learningRate, [0.38]);
}
// run the network
var temp = prompt("Enter Degrees Fahrenheit");
var tempF = "." + temp;
var result = myNetwork.activate([tempF]);
result = String(result).slice(2,4);
document.write("<h1>" + temp + " F is approximately " + result + " C </h1>");
</script>
</body>
</html>
```

Hyper Te | length : 1124 lines : 46 | Ln : 22 Col : 1 Sel : 0 | 0 | Dos\Windows | ANSI as UTF-8 | INS

1. Load the Synaptic Library

"Synaptic is a javascript neural network library. Its generalized algorithm is architecture-free, so you can build and train basically any type of first order or even second order neural network architectures."

temp_machine_learning.html

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```

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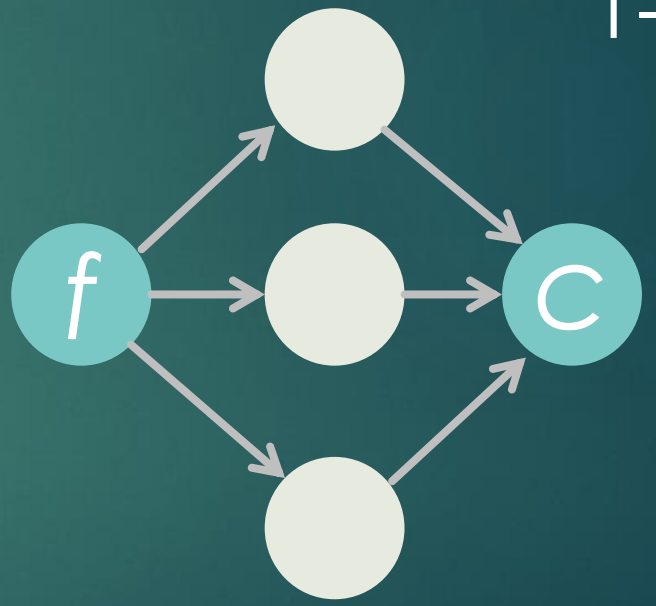
2. Construct the Neural Network

1-3-1



Input Layer

Hidden Layer

Output Layer

temp_machine_learning.html

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3. Train the Network on Data

Four pieces of data:

30 F / 0 C

50 F / 10 C

70 F / 21 C

99 F / 38 C

temp_machine_learning.html

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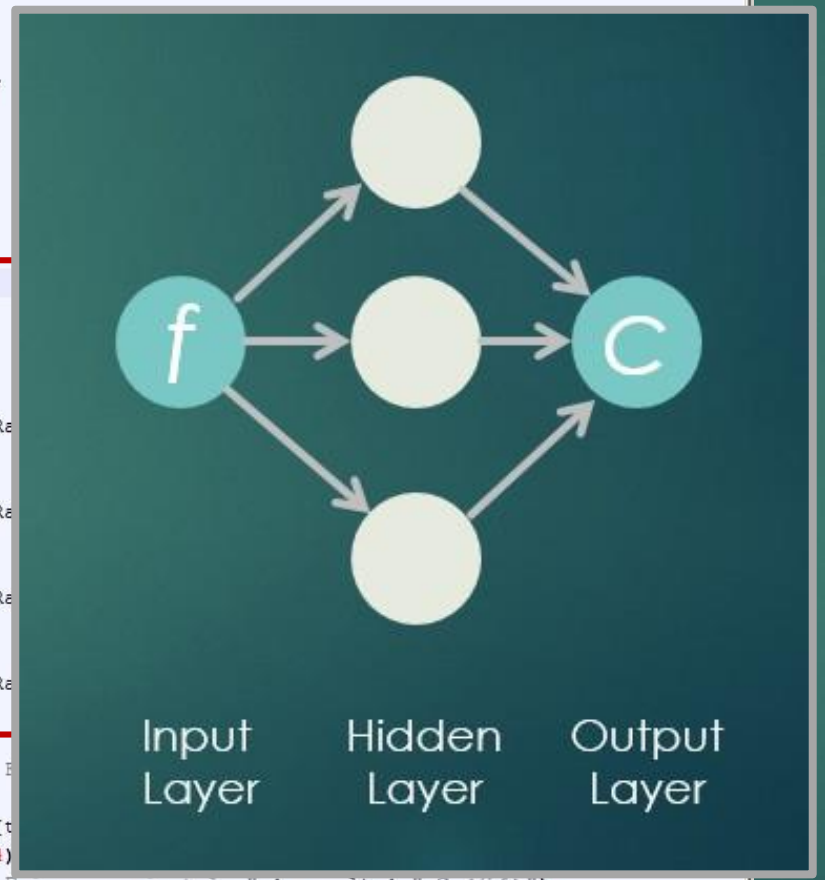

3. Train the Network on Data

a) Forward Propagation – activate the network; send data into the network from the input layer

b) Produce different outputs and compare the actual output to the intended output. The "weight" of the connections to the hidden layer influence the value of the output.

c) Back Propagation – calculate the difference between actual and intended result. Use this figure to adjust the weights of the connections to the hidden layer.

d) Do this **80,000** times! "Tune" the weights to produce better results.

temp_machine_learning.html

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4. Run or Test the Network

a) Use `prompt()` to create a dialogue box where you can enter degrees F

b) Activate the network by sending this number into the network. Produce an output and format the number.

c) Use `document.write()` to display the result (the output).

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A number that was part of the training data

A number that was **NOT** part of the training data

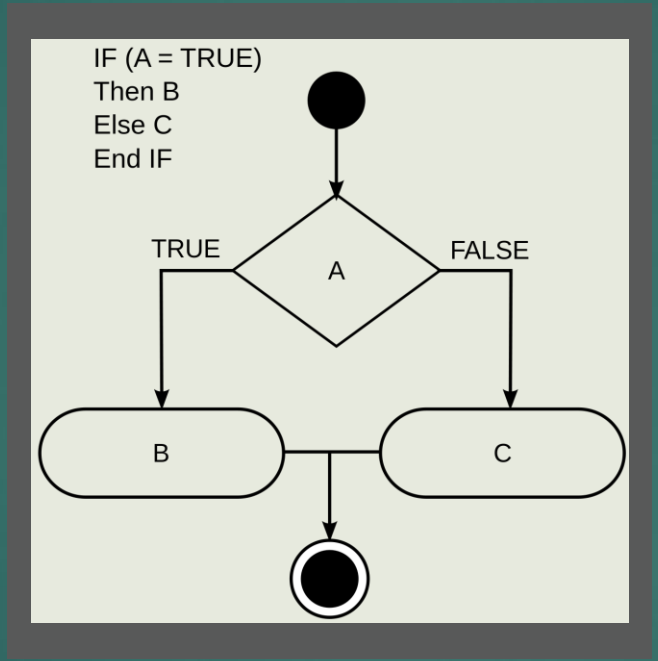
Algorithms

Algorithm

Magic
Fear

Algorithms

GOFAI Algorithm

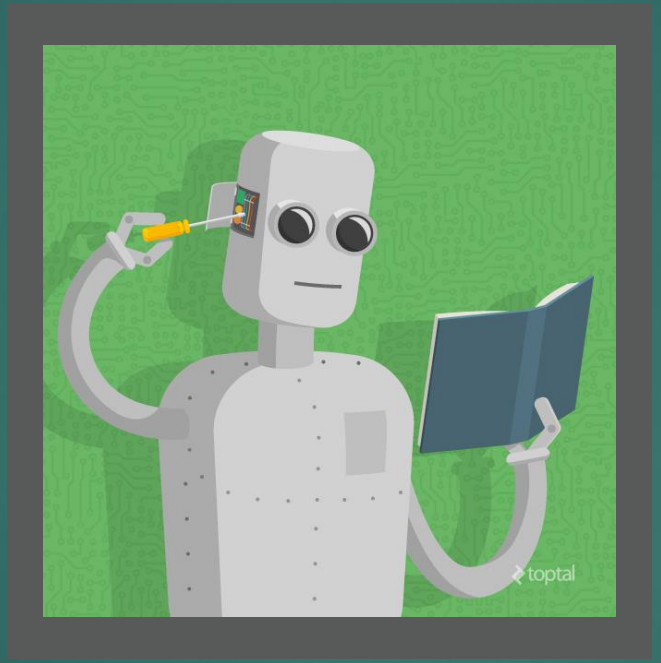
Input → 

→ **Output**

- Explicit step-by-step instructions
- Programmer can locate problems in the code and make edits to affect the output
- Proprietary Algorithms vs. Open Access

Algorithms

ML Algorithm

Input →  → **Output**

- Algorithm discovers patterns in data
- Potential problems – Error or bias in the training data
- Cannot inspect code to find the source of the error
- Programmer does not know what the program will do until it does it. “Wonderful and Terrifying” (Howard)

Algorithms

"We are not only shaping the algorithms. They are now shaping us"

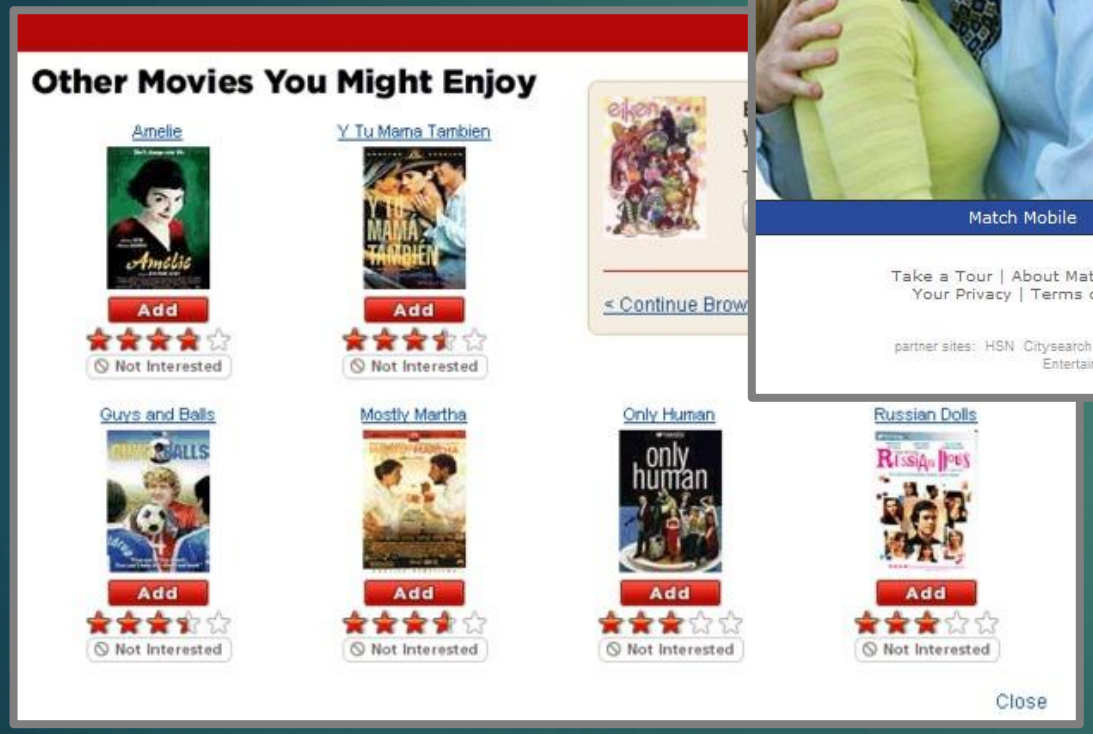
Finances and Money
70% of all Financial Transactions

Entertainment/Creativity
- Music industry; new artists
- 78% of all content at Netflix

Medicine
- Algorithmic Pharmacists
- Diagnosis and Treatment

HR – Human Resources
- Customer Service (profiling)
- Sorting Job Applications

Algorithms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Not Interested
Y Tu Mama Tambien
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Mostly Martha
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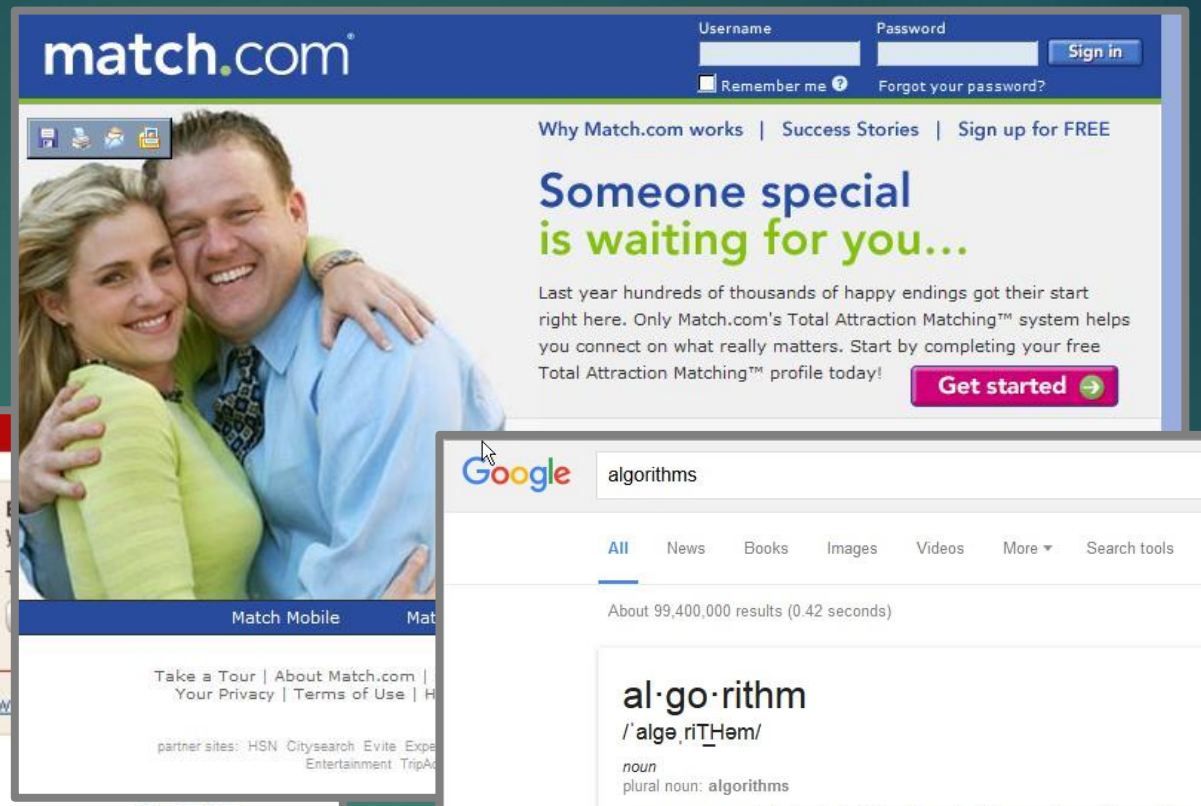
Add
Not Interested
Close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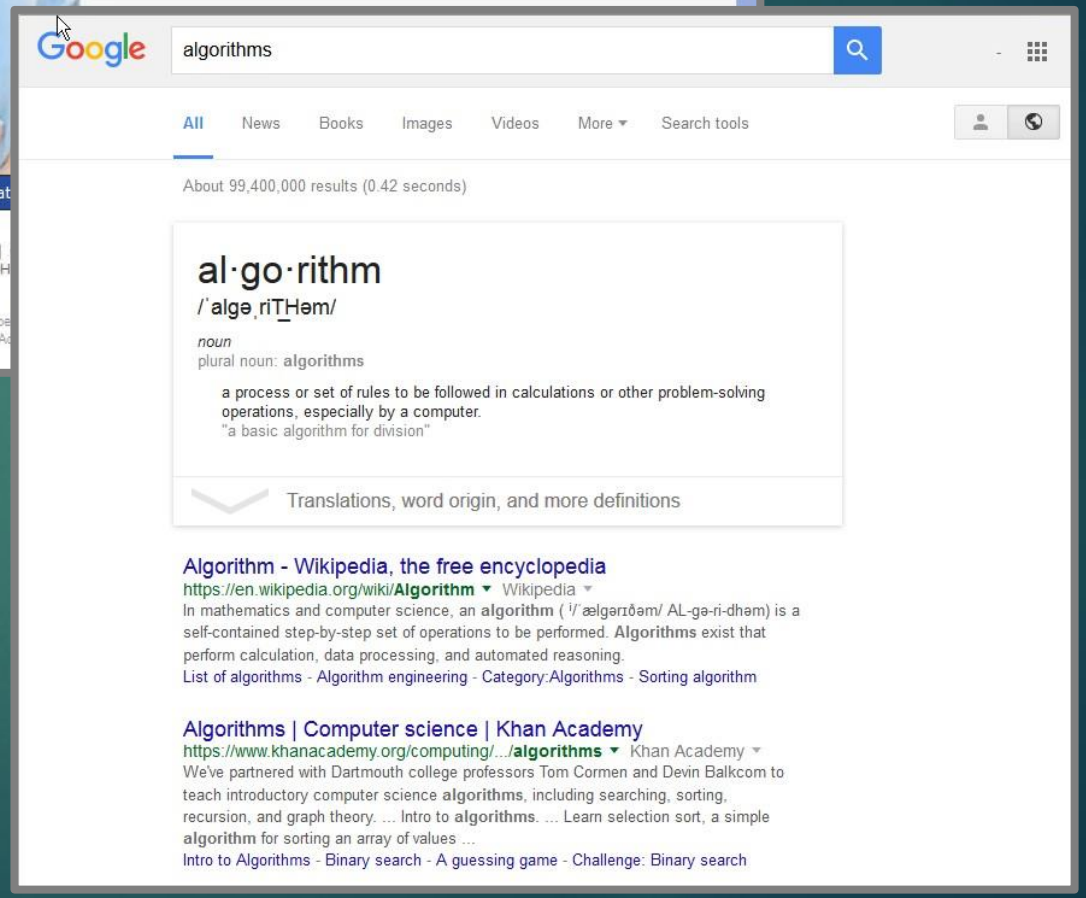
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noun
plural noun: algorithms
a process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.
"a basic algorithm for division"
Translations, word origin, and more definitions
Algorithm - Wikipedia, the free encyclopedia
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In mathematics and computer science, an algorithm (ˈælgərɪðəm/ AL-gə-ri-dhəm) is a self-contained step-by-step set of operations to be performed. Algorithms exist that perform calculation, data processing, and automated reasoning.
List of algorithms - Algorithm engineering - Category:Algorithms - Sorting algorithm
Algorithms | Computer science | Khan Academy
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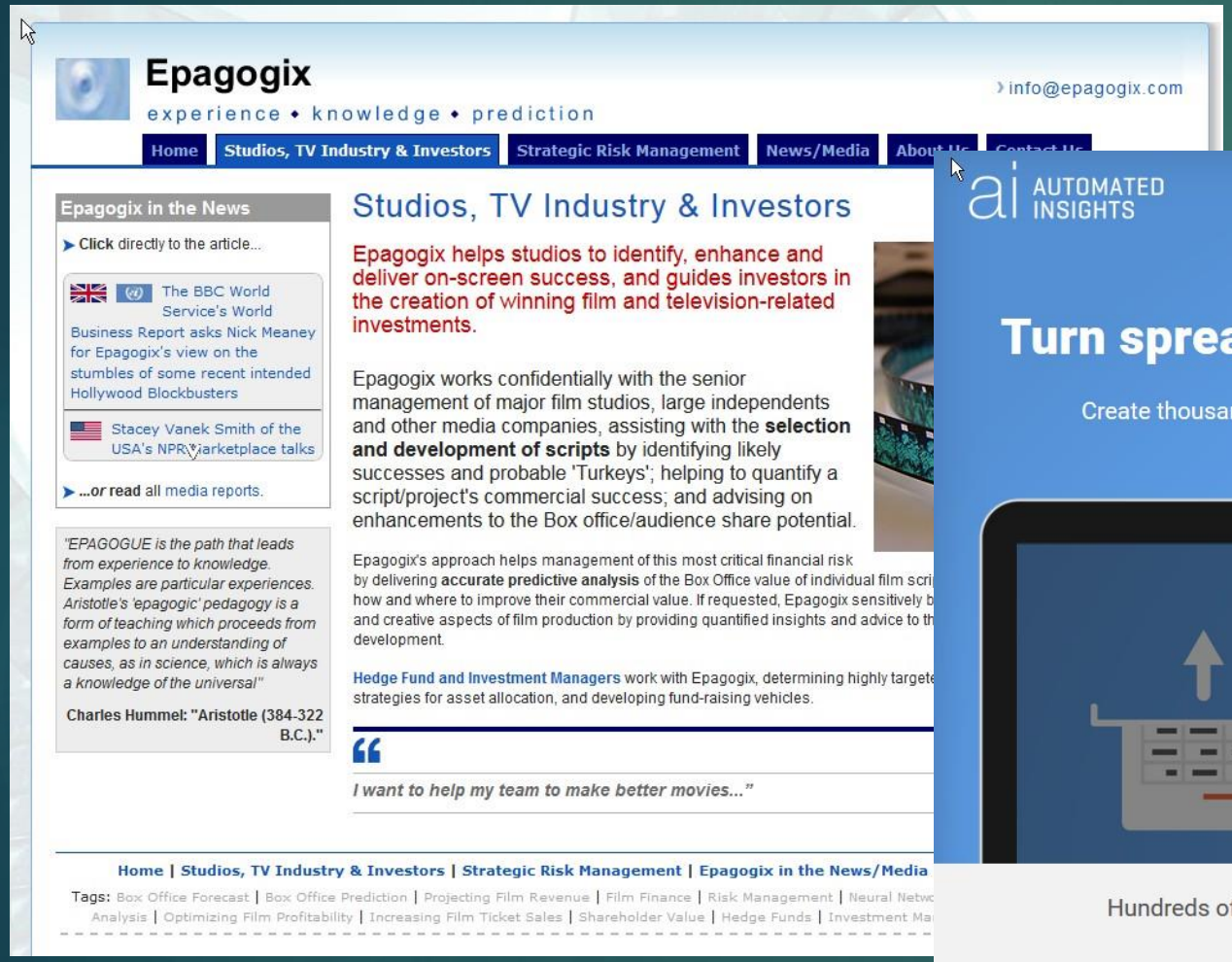
We've partnered with Dartmouth college professors Tom Cormen and Devin Balkcom to teach introductory computer science algorithms, including searching, sorting, recursion, and graph theory. ... Intro to algorithms. ... Learn selection sort, a simple algorithm for sorting an array of values ...
Intro to Algorithms - Binary search - A guessing game - Challenge: Binary search

Algorithms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"EPAGOGUE is the path that leads from experience to knowledge. Examples are particular experiences. Aristotle's 'epagogic' pedagogy is a form of teaching which proceeds from examples to an understanding of causes, as in science, which is always a knowledge of the universal"
Charles Hummel: "Aristotle (384-322 B.C.)."
Studios, TV Industry & Investors
Epagogix helps studios to identify, enhance and deliver on-screen success, and guides investors in the creation of winning film and television-related investments.
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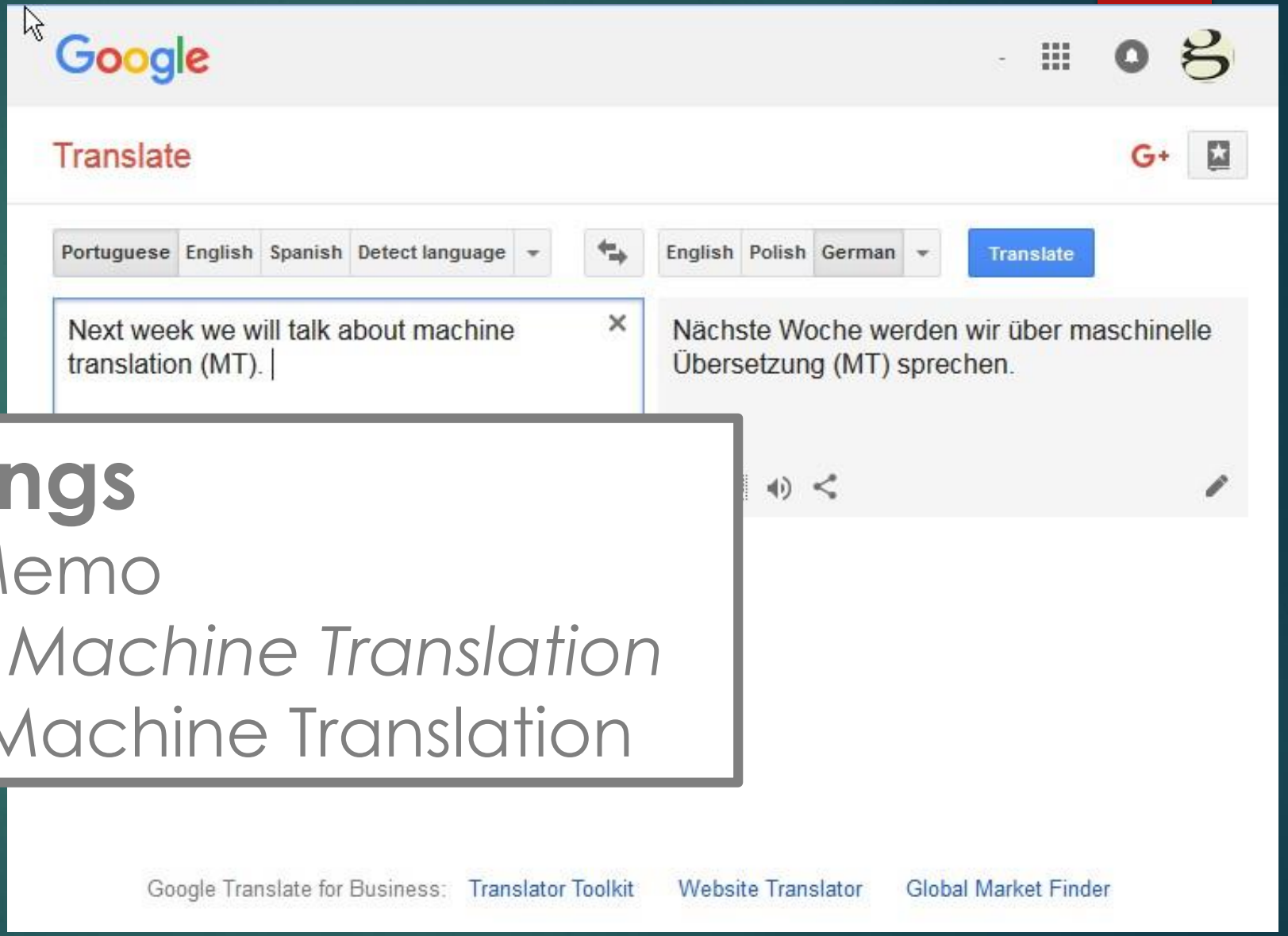
Algorithms

Critical Tasks

- Recognize that this technology involves everyone and everything
- Understand the technology - what it can and cannot do and why
- Focus on real world problems as opposed to media hype, i.e. “robot invasion” vs. increasing reliance on algorithms
- Carefully consider and evaluate the advice of experts and insiders

Today



Texts/Readings

- Weaver Memo
- Poibeau - *Machine Translation*
- Gunkel – Machine Translation

Maker Exercise

Basic MT Algorithm

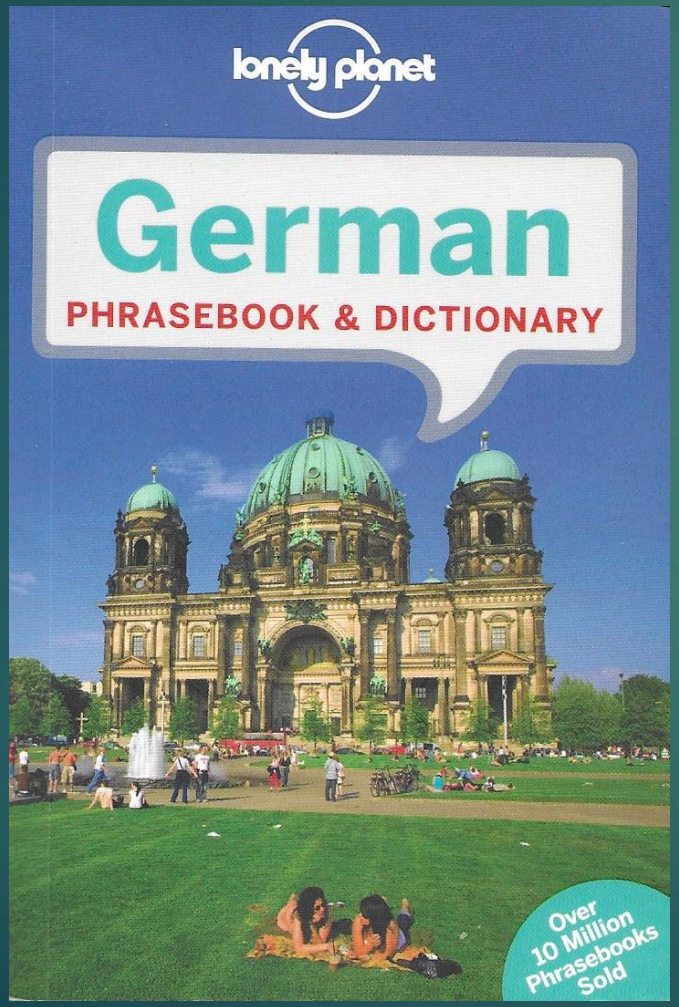
Objective – To understand the technology and techniques of Machine Translation by writing your own basic MT Algorithm

Task - Use Javascript to create an English to German translator application that runs in the browser

Approach – Use "direct translation" and code instructions in GOFAI

Maker Exercise

Backstory – Travel Phrasebook



SURVIVAL PHRASES

Hello.	Guten Tag.	*goo*·ten tahk
Goodbye.	Auf Wiedersehen.	owf *vee*·der·zay·en
Please.	Bitte.	*bi*·te
Thank you.	Danke.	*dang*·ke
You're welcome.	Bitte (sehr).	*bi*·te (zair)
Yes./No.	Ja./Nein.	yah/nain
Excuse me.	Entschuldigung.	ent·*shul*·di·gung
Sorry!	Entschuldigung.	ent·*shul*·di·gung
I don't understand.	Ich verstehe nicht.	ikh fer·*shtay*·e nikht
One moment, please.	Eine Moment, bitte.	*ai*·ne maw·*ment* *bi*·te
Help!	Hilfe!	*hil*·fe
How much is this?	Wie viel kostet das?	vee feel *kos*·tet das
Where is the toilet?	Wo ist die Toilette?	vo ist dee to·a·*le*·te
Cheers!	Prost!	prawst

NUMBERS

1	eins	ains	**6**	sechs	zeks
2	zwei	tsvai	**7**	sieben	zee·ben
3	drei	drai	**8**	acht	akht
4	vier	feer	**9**	neun	noyn
5	fünf	fünf	**10**	zehn	tsayn

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Maker Exercise


```
<html>

<script>
function xlate()
 {
  source = document.getElementById("english").value;

  if (source=="hello") target = "Guten Tag";
  else if (source=="goodbye") target = "Auf Wiedersehen";
  else if (source=="please") target = "Bitte";
  else if (source=="thank you") target = "Danke schon";
  else if (source=="you're welcome") target = "Bitte sehr";
  else if (source=="yes") target = "Ja";
  else if (source=="no") target = "Nein";
  else if (source=="excuse me") target = "Entschuldigung";
  else if (source=="no thank you") target = "Nein, danke";
  else if (source=="beer") target = "ein bier";
  else if (source=="water") target = "wasser"
  else target = "Sorry, I do not know that one."

  document.getElementById("german").value = target;

 }
</script>

<body>
 <form>
  Basic Translator - English to German
  <p><input type="text" id="english">
     <input type="button" value=">>" onClick="xlate()">
     <input type="text" id="german"></p>
</form>

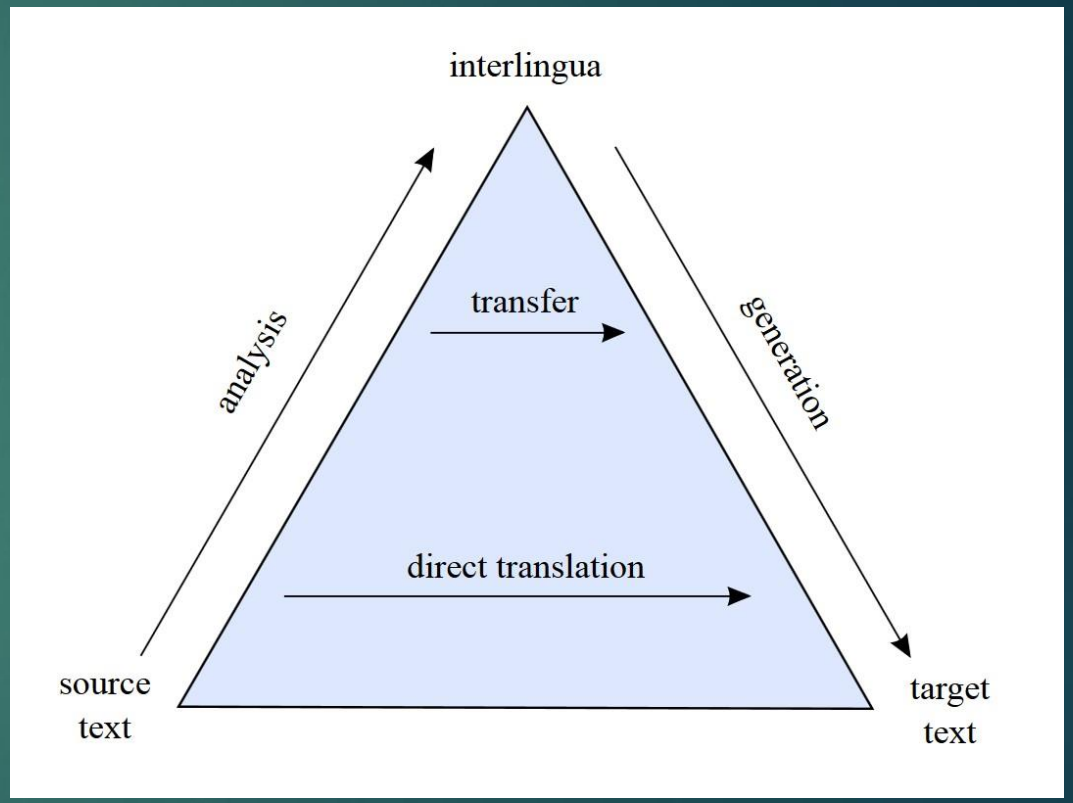
</body>
</html>

```

Maker Exercise

Questions

How does this translation application work?
What are the limitations of this approach to MT?
How could you address or fix the limitations?
What would you need to do to translate in both directions?
What would you need to do to translate between more than two languages?



Vauquois Triangle

Statistical MT - https://www.youtube.com/watch?v=_GdSC1Z1Kzs

Preview

Natural Language Processing (NLP)

- Weizenbaum - Contextual Understanding by Computers
- Gunkel – Natural Language Processing
- RadioLab - Talking to Machines