"From bits to information"

Cyber and Intelligence

Outline

- Understanding job roles in cybersecurity.
- Understand what intelligence is.
- Heuristics and decision making.
- Types of intelligence.
- Differences between human and machine intelligence.

Outline

Analogue world

Light, heat, movement

Sensors

ADC (Analogue to Digital) Convertor

DAC (Digital to Analogue) Convertor

Actuators (Motor)

Digital world

1010101..
0010

Outline

Industry 1.0
Mechanization
(1760-1820)

Steam-power or water-powered engines

Industry 2.0
Electrification
(1870-1914)

Railways, factories, telegram

Industry 3.0
Automation
(20th Century)

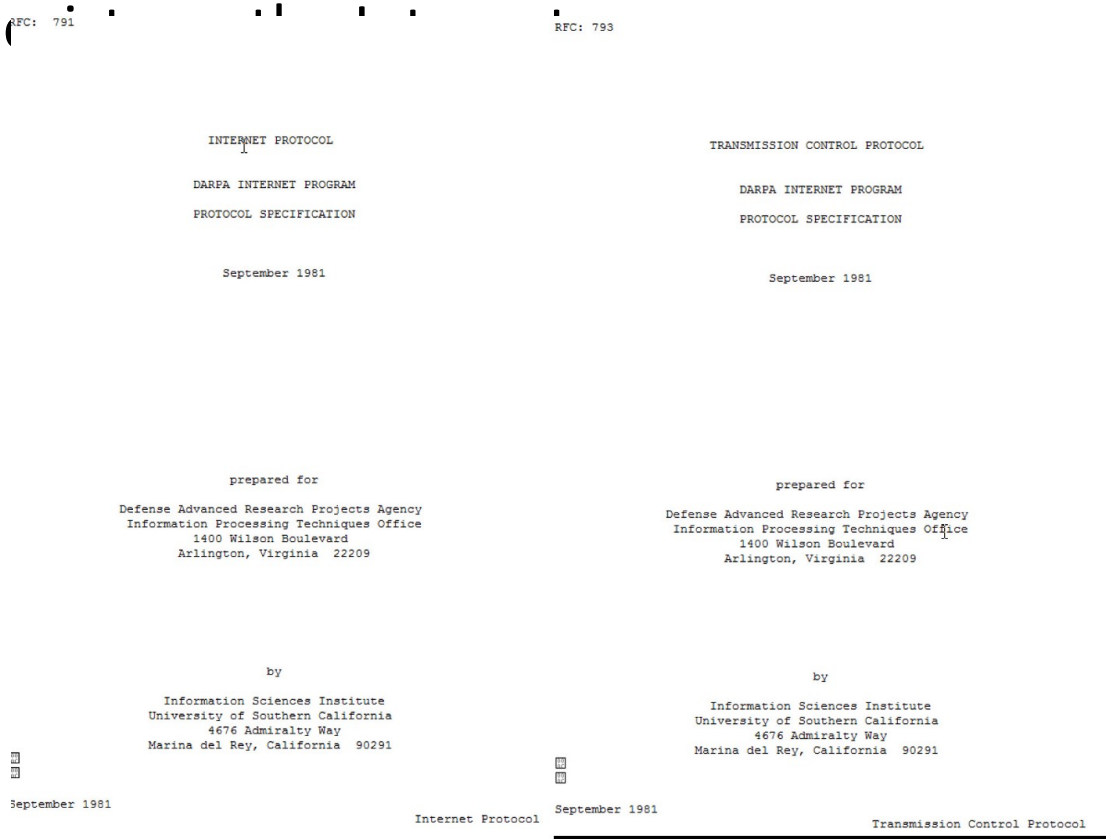
Electronics, Electrical generator, CPU, Internet, Web

Industry 4.0
Digitization
(21st Century)

Virtualization, AI, Cyberphysical, IoT

Outline

- RFC 791. Defines the format of IP packets (IPv4)
- RFC 793. Defines TCP (Transport Control Protocol), which provides the foundation of the virtually all of the traffic that


RFC: 791

INTERNET PROTOCOL

DARPA INTERNET PROGRAM

PROTOCOL SPECIFICATION

September 1981

prepared for

Defense Advanced Research Projects Agency
Information Processing Techniques Office
1400 Wilson Boulevard
Arlington, Virginia 22209

by

Information Sciences Institute
University of Southern California
4676 Admiralty Way
Marina del Rey, California 90291

September 1981

Internet Protocol

RFC: 793

TRANSMISSION CONTROL PROTOCOL

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Transmission Control Protocol

cyber & data

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Industry 4.0

6vs and 6Cs

Industry 4.0 brings:

- 6 Cs: **Connection** (sensor and networks); **Cloud** (computing and data on demand); **Cyber** (model and memory); **Content/context** (meaning and correlation); **Community** (sharing and collaboration); and **Customization** (personalization and value).
- 6 Vs: **Volume**; **Velocity**; **Variety**; **Variability**; **Veracity**; and **Value**.

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Cybersecurity

Cybersecurity

NIST define Cybersecurity as:

- Prevention of damage to, protection of, and restoration of computers, electronic communications systems, electronic communications services, wire communication, and electronic communication, including information contained therein, to ensure its availability, integrity, authentication, confidentiality, and non-repudiation.

and information security as:

- the protection of information and information systems from unauthorized access… to provide confidentiality, integrity, and availability.

Cybersecurity

NIST define NICE framework. Within this, they outlined seven core categories; 33 specialty areas; and 52 work roles, and then mapped these to 1,007 tasks, 374 skills, 630 knowledge areas, and 176 abilities. The categories were:

- Securely Provision (SP);
- Operate and Maintain (OM);
- Oversee and Govern (OV);
- Protect and Defend (PR);
- Analyze (AN);
- Collect and Operate (CO); and
- Investigate (IN).

&cyber data

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Intelligence

Intelligence

Industry 4.0 brings: physical systems, IoT, Cloud Computing and Cognitive computing.

Neisser defines:

- Individuals differ from one another in their ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, and to overcome obstacles by taking thought.
- Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience.

Types of intelligence

- **Naturalist Intelligence (nature smart).** This involves the ability to discriminate between living things and their interaction with the natural world.
- **Musical Intelligence (sound smart).** This involves the ability to understand pitch, rhythm, and tone, especially focused on the ability to create, analyse and reproduce music, such as in stimulating emotions around music.
- **Logical-Mathematical Intelligence (number/reasoning smart).** This involves the ability to calculate, hypothesize, and quantify using mathematical operations. Key skills are to: abstract; define reasoned approaches; and to apply inductive and deductive thinking methods.
- **Existential Intelligence (life smart).** This involves the ability to search for deep meanings to life, such as why we exist, and why we must die.
- **Inter-personal Intelligence (people smart).** This involves the ability to understand other people using both verbal and non-verbal communications. Those with the best abilities for this are typically strong communicators and can understand the feelings and motivations of others.

Types of intelligence

- **Intra-personal Intelligence (self smart).** This involves the ability to understand yourself, and how you relate to others.
- **Bodily-Kinesthetic Intelligence (body smart).** This involves the ability to move, manipulation or influence physical objectives, normally with the use of physical body movements. Athletes typically have good levels of this type of intelligence, but it might also involve those who are expert in computer games.
- **Linguistic Intelligence (word smart).** This involves the ability to create and manipulate language in order to express and define meaning. Great writers and public speakers often have this ability.
- **Spatial Intelligence (picture smart).** This involves the ability to abstract into three dimensions. Architects normally have good abilities in this area, such as where they are able to abstract 2D drawings into a 3D space.

Humans v Computers

- Learning. Humans adapt to changing situations, and generally quickly learn tasks. Unfortunately, once these tasks have been learnt, this can often lead to boredom if they are repeated repetitively.
- Strategy. Humans are excellent at taking complex tasks and splitting them into smaller, less complex, tasks. Then, knowing the outcome, they can implement these in the required way, but can make changes depending on conditions.
- Enterprise. Computers, as they are programmed at the present, are an excellent business tool. They generally allow for better decision making, but, at present, they cannot initiate new events.
- Creativity. As with enterprise, humans are generally more creative than computers. This is likely to change over the coming years as they could programmed with the aid of psychologists, musicians, and artists, and will could include elements which are pleasing to the human senses.

Humans v Computers

Human

Increasing levels of intelligence (and uncertainty)

Computer

Machines capable of logical deduction	As yet, there are few applications of this
Machine capable of conducting a melody	As yet, computers have failed to create music which is pleasing to human ears
Machines for making strategic decisions in simplifying military operations	Computers are beginning to be used in making strategic decisions, but these are often still checked by humans.
Machines capable of translating from one language to another	Computers now act as translators between languages
Machines for performing symbol (non-numeric) mathematical operations	Computers now operate on data which is not numeric, such as with images and video.
Machines capable of routing telephone calls based on circumstances	Computer has performed this task for many decades, and there is no way that a human could perform it better.
Machines designed for relay and switch circuits	Systems for the design of digital logics have been around for decades, and can create circuits which humans could never achieve.
Machines for designing filters, equalizers, and so on.	Computer-aided design (CAD) has long been the default method in the design of electronic circuits.

Break-through level

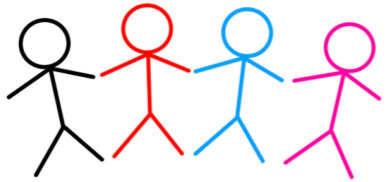
Expertise

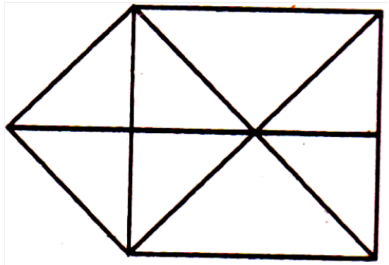
Knowledge

Rules

Skills

Humans v Computers





- **Spatial**. This is the ability to differentiate between two- and three- dimensional objects. Computers, even running powerful image processing software, often have difficulty in differentiating between two-dimensional objects and three-dimensional ones. Humans, though, find this easy, but can be tricked by optical illusions, where a two-dimensional object is actually a three-dimensional object. The objects in left-hand side of figure are a mixture of a two-dimensional and three-dimensional object. Humans can quickly determine objects which are defined in 2D and which in 3D.
- **Perception**. This is the skill of identifying simple shapes from complex ones. For example, humans can quickly look at a picture and determine the repeated sequences, shapes, and so on. For example, look at the picture on the right-hand side of figure and determine how many triangles it contains? It is relatively easy for a human to determine this, as they have good perception skills. This is because the human brain can easily find simple shapes from complex ones. But, imagine writing a computer program which would determine all of the triangles in an object, then modifying it so it finds other shapes, such as squares, hexagons, and so on?
- **Memory**. This is the skill of memorizing and recalling objects which do not have any logical connection. Humans have an amazing capacity for recalling objects, typically by linking objects, and from one to the next. Computers can implement this with a linked-list approach, but it becomes almost impossible to manage when the number of objects becomes large.

Humans v Computers

- **Numerical**. Most humans can manipulate numbers in various ways. Humans are by no-way as fast as computers, but humans can often simply complex calculations, either by approximating, or by eliminating terms which have little effect on the final answer. For example, we may have a tasks to find the approximate area for a room that is 6.9 metres and 9.1 meters? Many humans just approximate this to 7 times 9, and find the answer of 63 meters squared.
- **Verbal**. This involves the comprehension of language, and while there has been great advances in the way that machines are able to process speech, they are often still weaker than humans in extracting meaning.
- **Lexical**. This is a manipulation of vocabulary. Machines can generally analyse the lexical structure of written work, but they often still struggle to create their own lexical structures, and which lack interest or even meaning. They are thus generally good at spotting spelling mistakes and at grammar checking.
- **Reasoning**. This is induction and deduction. Humans can often deduce things when they are not given a complete set of information.

Humans v Computers

Attribute	Machine	Human
Speed	Superior	Comparatively slow
Power Output	Superior in level in consistency	Comparatively weak
Consistency	Ideal of consistency, repetitive action	Unreliable learning and fatigue factors
Information capacity	Multi-channel	Primarily single channel
Memory	Idea of literal reproduction, access restricted, and formal	Better for principles and strategies, access is versatile and innovative
Reasoning computation	Deductive, tedious to program, fast and accurate, poor error correction	Inductive, easier to program, slow, accurate, and good error correction
Sensing	Good at quantitative assessment, poor at pattern recognition	Wide ranges, multifunction, judgement
Perceiving	Copes with variation poorly	Copes with variation better, susceptible to noise

Cybercrime Motivations

- Entertainment. This is basically the thrill of performing an attack.
- Hacktivists. This relates to those who are motivated by political, religious, and social causes.
- Financial gain. This relates to those attackers who are motivated by financial gain.
- Spying. This relates to the stealing of information from others, typically in the form of Intellectual Property (IP).
- Revenge. This relates to those who have motivations around revenge, such as a disgruntled employee/customer, or who might be someone who has been humiliated in the past.

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