

Understanding Computational Thinking

Technologies Education

Everybody in this country should
learn how to program a computer...

Systems Thinking

Computational Thinking

Design Thinking

Futures Thinking

Strategic Thinking

Systems Thinking

Computational Thinking

Project Based Learning

Systems Thinking

Computational Thinking

Understanding the problem to be solved?

Systems Thinking

Computational Thinking

**Thinking about the problem as
a system**



Vehicle Example

Design a better, faster and cooler
F1™ car of the future





Clothing Example

Systems Thinking

Stocks

Flows

Causal Loops

Flow Maps

Connection Circles

Simulations

Computational Thinking

Abstraction

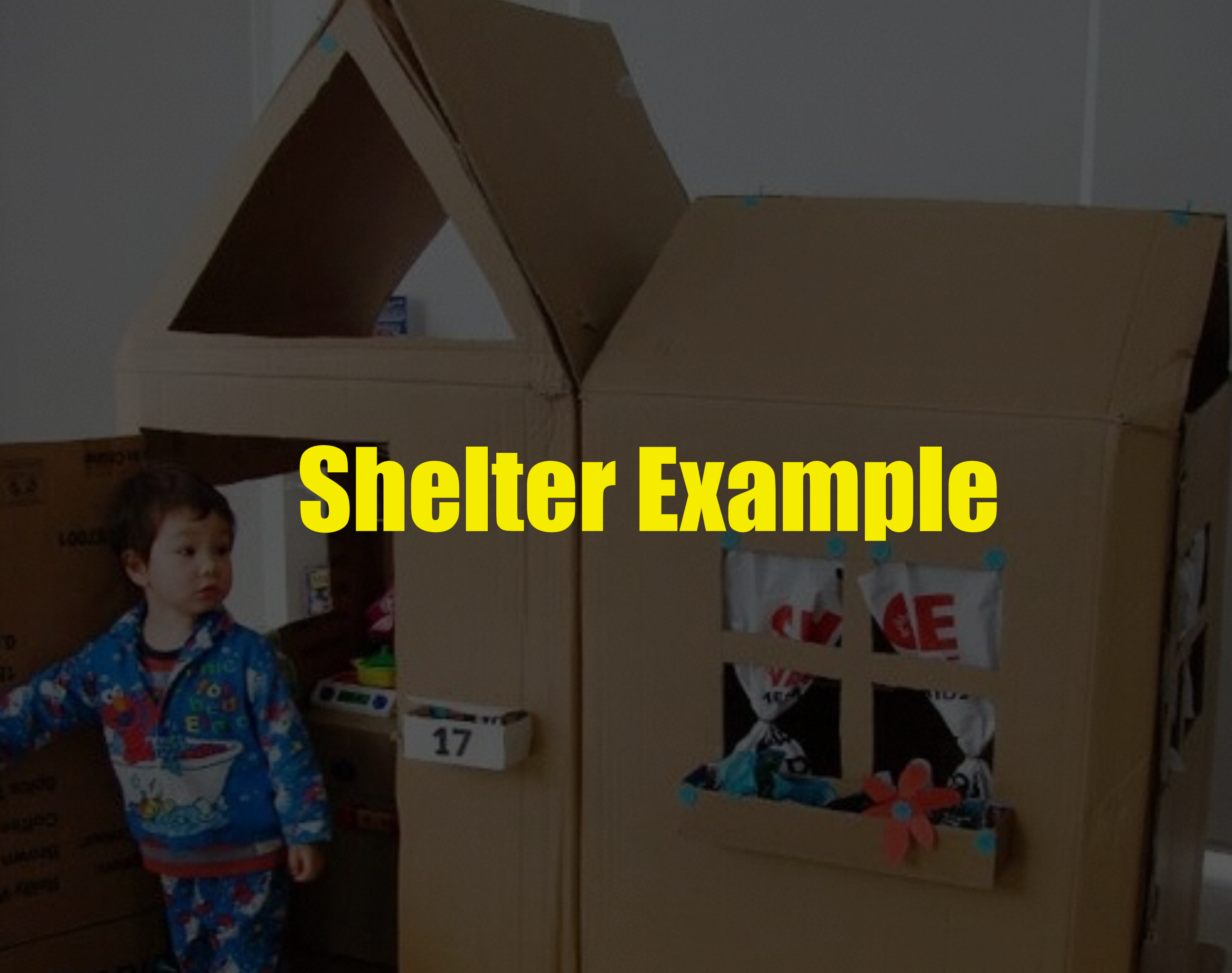
Data & Information Systems

Algorithms and Programming

Digital Systems

Implications and Impacts

Shelter Example



Garden Example



Systems Thinking

Computational Thinking

**Other ways of thinking about
the problem and possible
solutions**

Computational Thinking

Abstraction

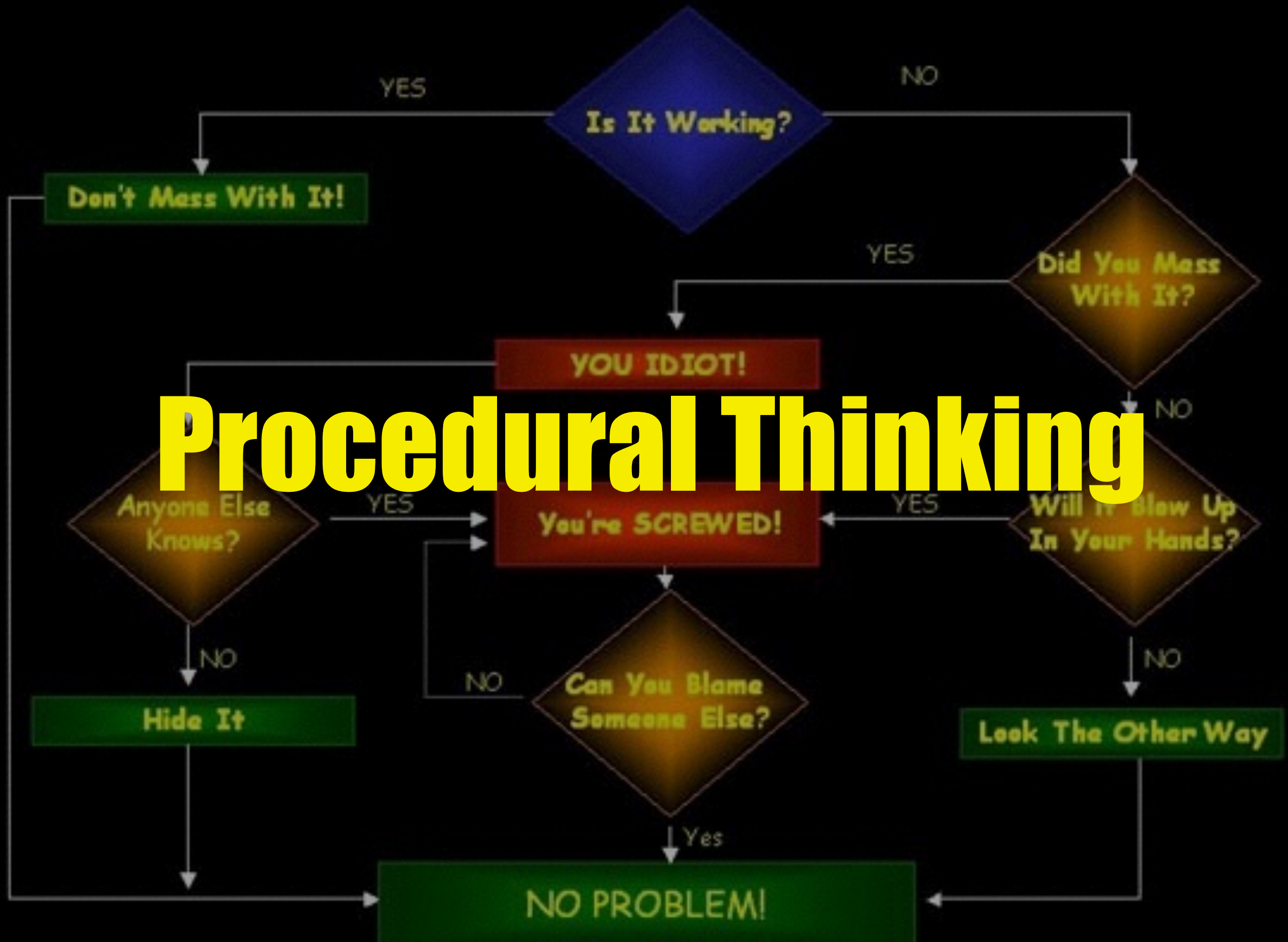
Data & Information Systems

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Flowchart For Problem Resolution



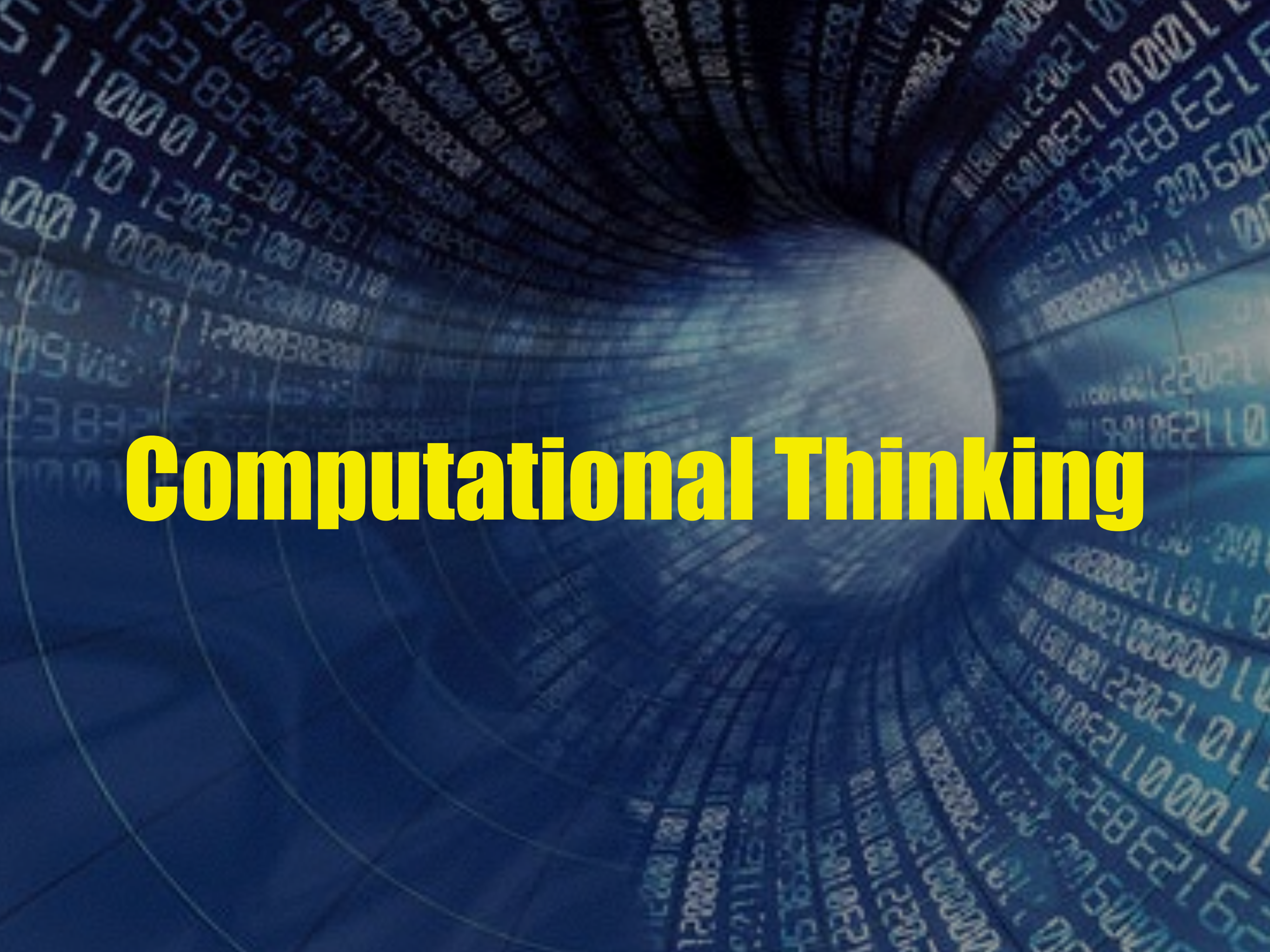


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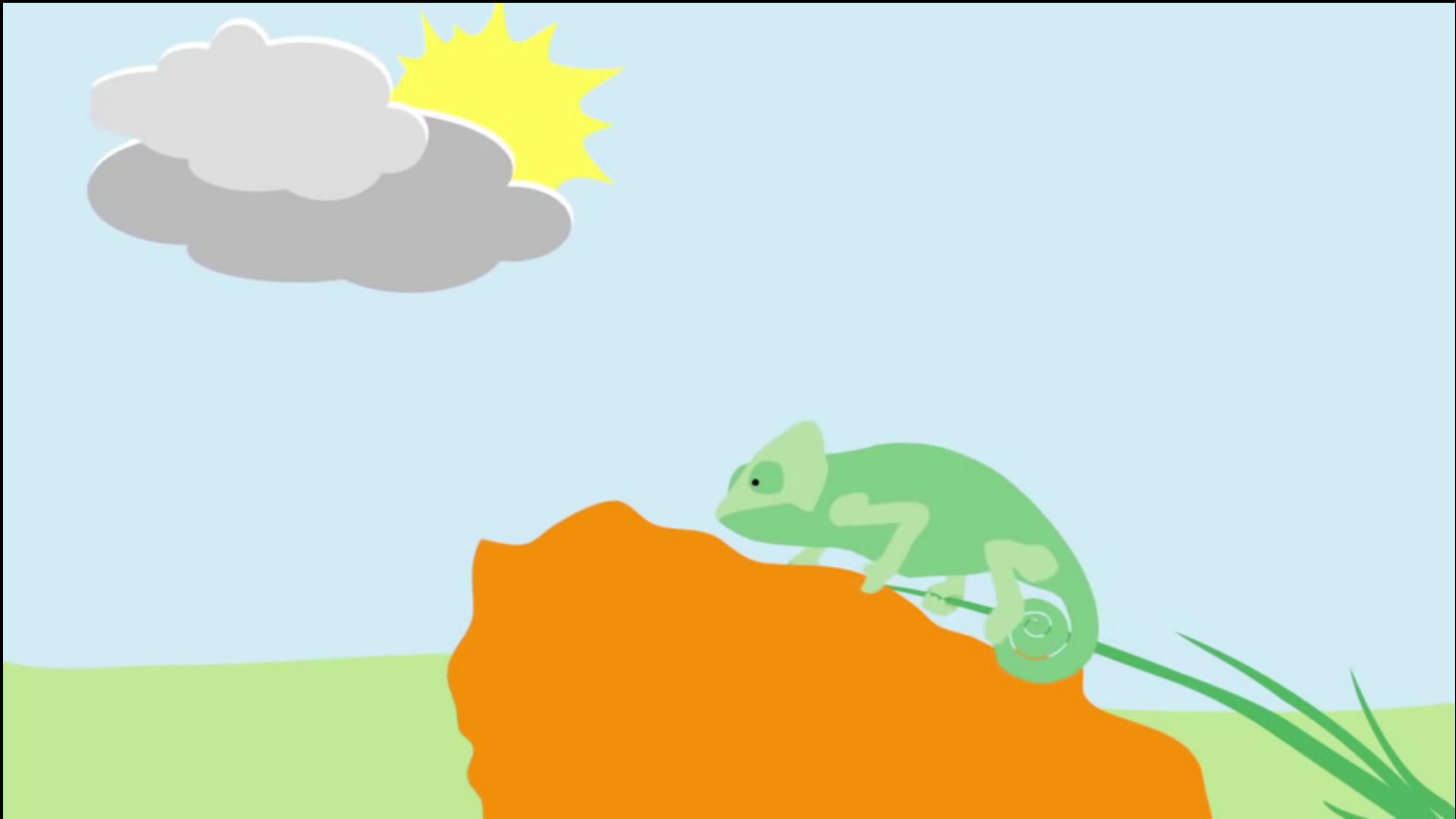
Digital Technologies

Intellectually challenging and engaging problems remain to be understood and solved. The problems and solutions are limited only by our own curiosity and creativity





Computational Thinking



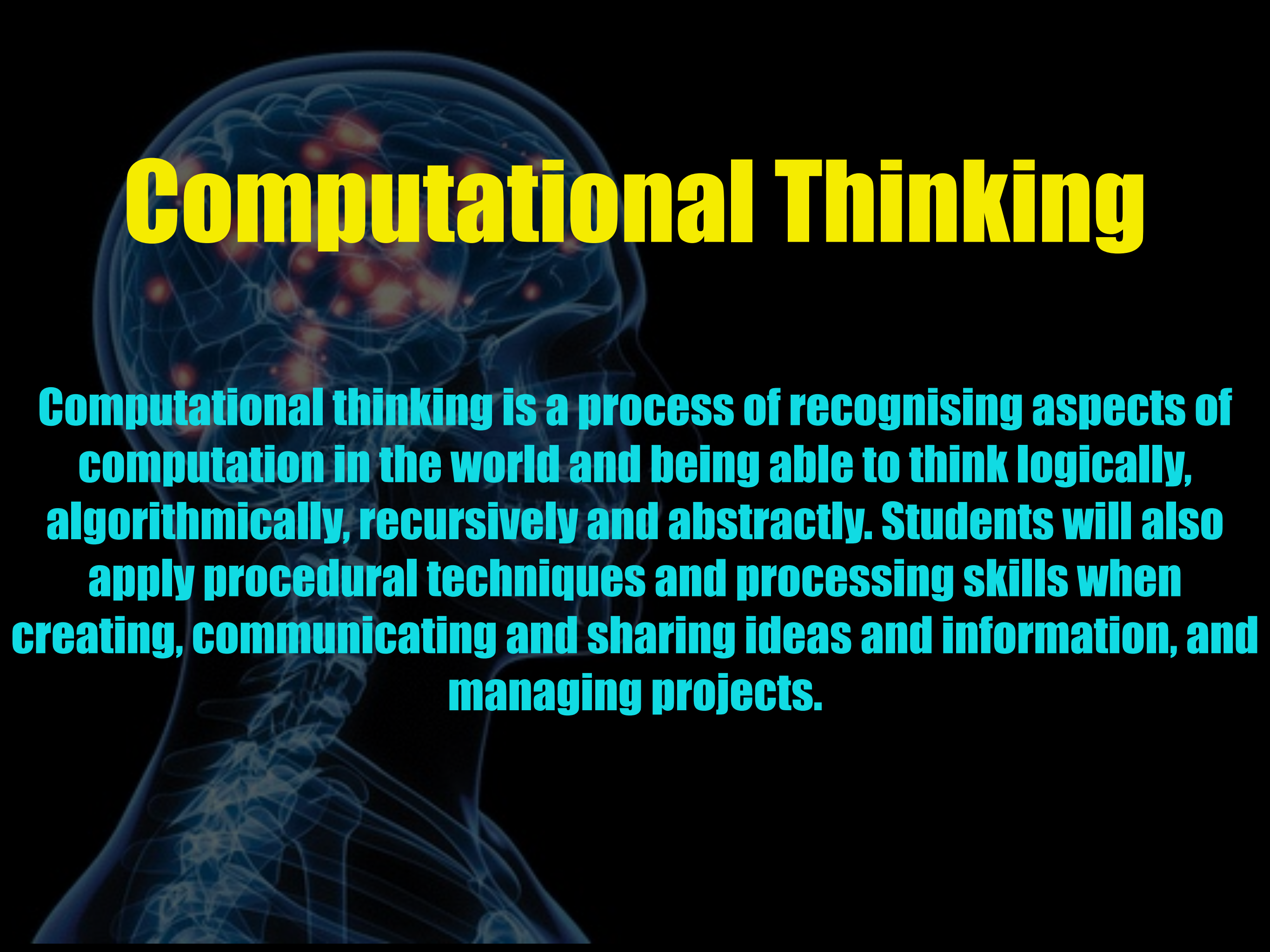
Computational Thinking

The curriculum is designed so that students will develop and use increasingly sophisticated computational thinking skills, and processes, techniques and digital systems to create solutions to address specific problems, opportunities or needs.



"Computational Thinking is the new literacy
of the 21st Century"

—Jeannette M.Wing



Computational Thinking

Computational thinking is a process of recognising aspects of computation in the world and being able to think logically, algorithmically, recursively and abstractly. Students will also apply procedural techniques and processing skills when creating, communicating and sharing ideas and information, and managing projects.

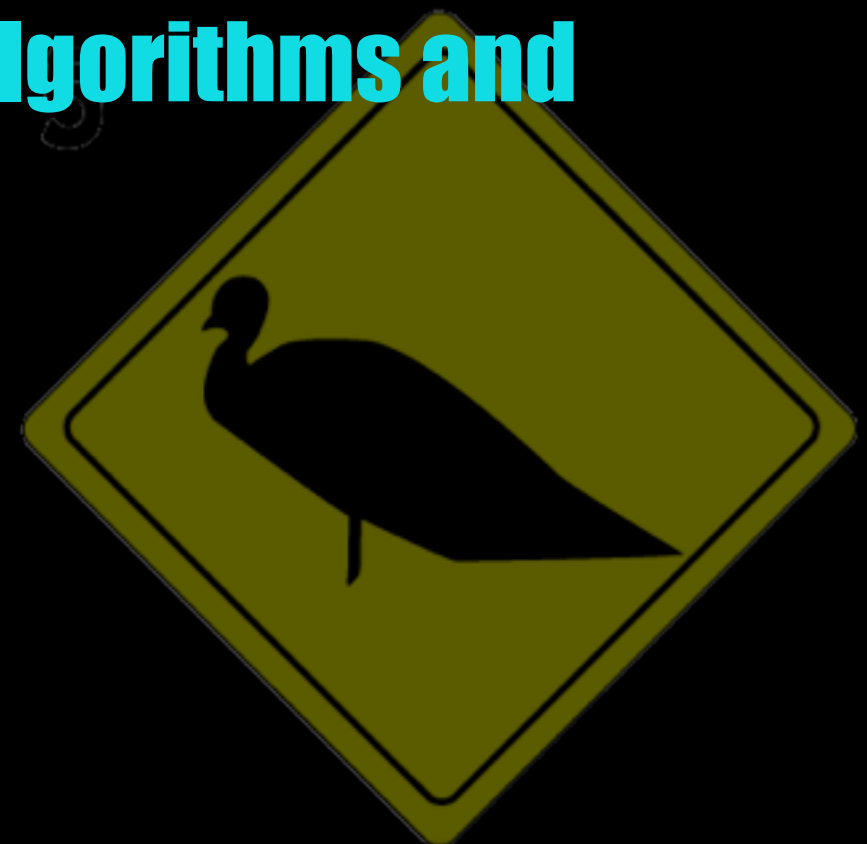
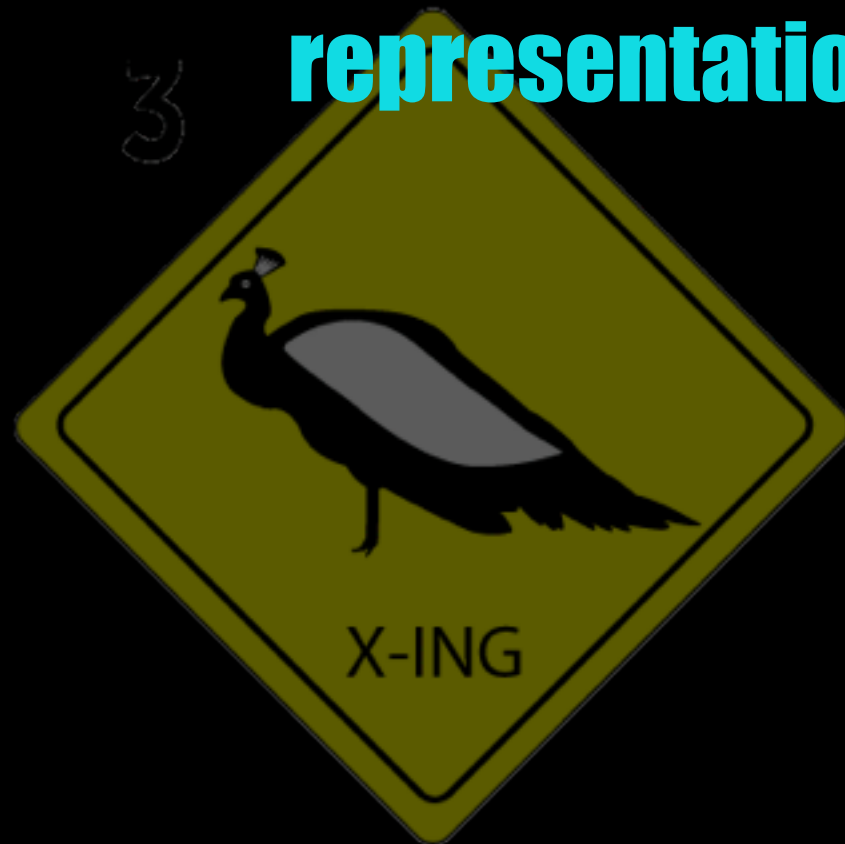
Key Concepts





Abstraction

Abstraction, which underpins all content, particularly the content descriptions relating to the concepts of data representation and specification, algorithms and implementation



Abstraction

Abstraction involves hiding details of an idea, problem or solution that are not relevant, to focus on a manageable number of aspects. Abstraction is a natural part of communication: people rarely communicate every detail, because many details are not relevant in a given context. The idea of abstraction can be acquired from an early age. For example, when students are asked how to make toast for breakfast, they do not mention all steps explicitly, assuming that the listener is an intelligent implementer of the abstract instructions.

Abstraction

Central to managing the complexity of information systems is the ability to 'temporarily ignore' the internal details of the subcomponents of larger specifications, algorithms, systems or interactions. In digital systems, everything must be broken down into simple instructions.



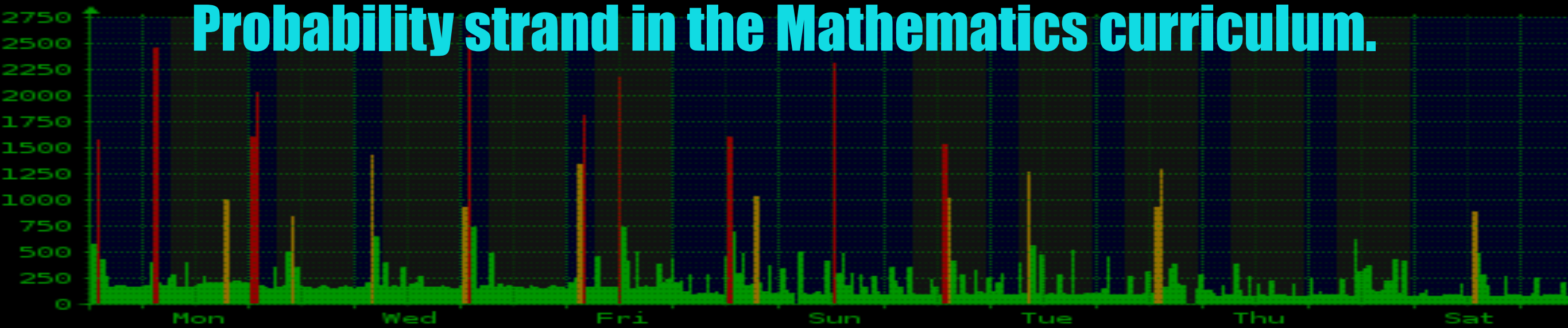
Data collection, representation and interpretation

Data collection (properties, sources and collection of data), data representation (symbolism and separation) and data interpretation (patterns and contexts)



Data collection, representation and interpretation

The concepts that are about data, focus on the properties of data, how they are collected and represented, and how they are interpreted in context to produce information. These concepts in Digital Technologies build on a corresponding Statistics and Probability strand in the Mathematics curriculum.



Data collection, representation and interpretation

The Digital Technologies curriculum provides a deeper understanding of the nature of data and their representation, and computational skills for interpreting data. The data concepts provide rich opportunities for authentic data exploration in other learning areas while developing data processing and visualisation skills.

Data collection, representation and interpretation

Data collection describes the numerical, categorical and textual facts measured, collected or calculated as the basis for creating information and its binary representation in digital systems.

Data collection, representation and interpretation

Data collection is addressed in the processes and production skills strand. Data representation describes how data are represented and structured symbolically for storage and communication, by people and in digital systems, and is addressed in the knowledge and understanding strand.

Data collection, representation and interpretation

Data interpretation describes the processes of extracting meaning from data and is addressed in the processes and production strand.

Specification, algorithms and implementation

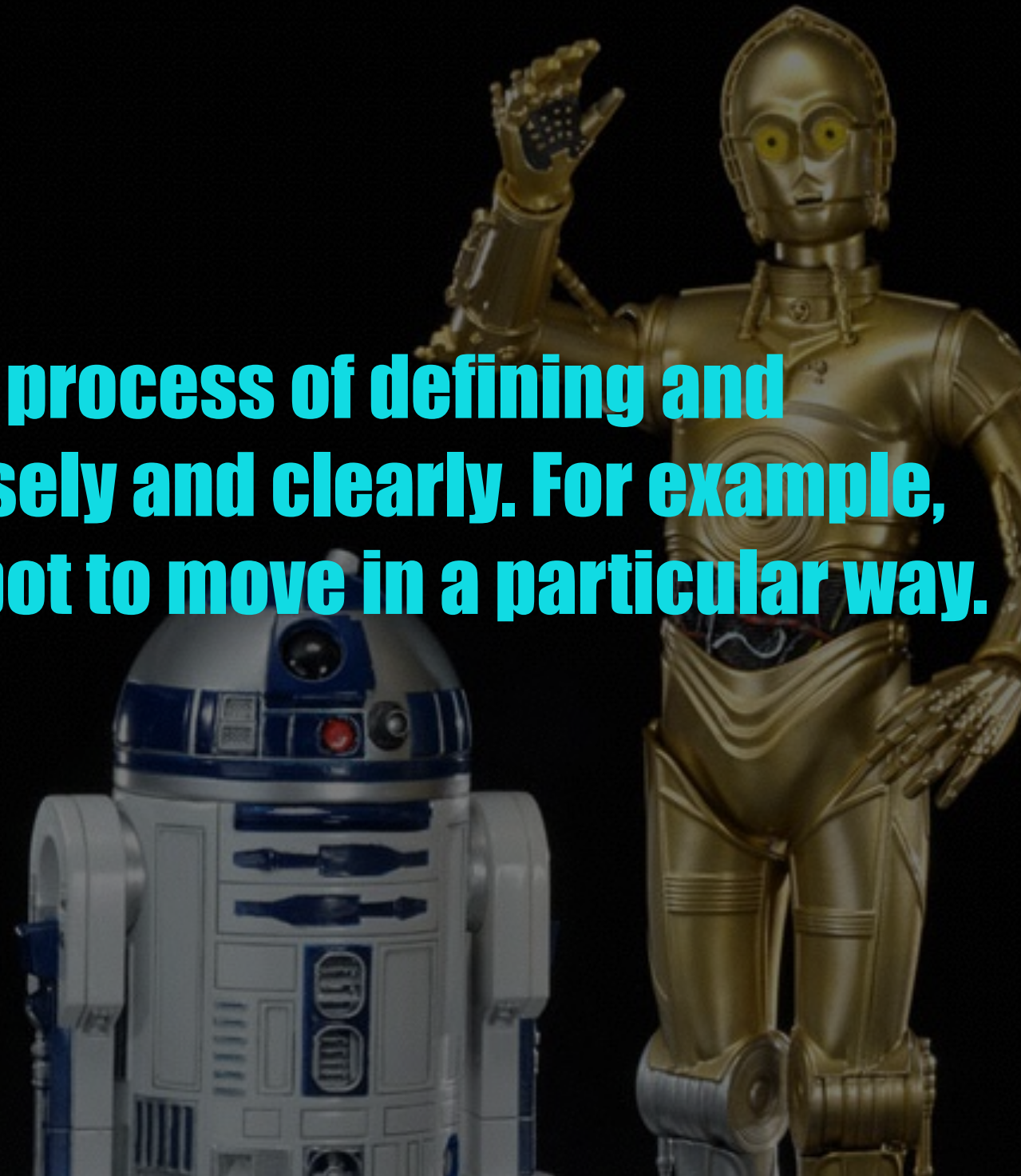
Specification (descriptions and techniques), algorithms (following and describing) and implementation (translating and programming)

Specification, algorithms and implementation

The concepts specification, algorithms and implementation focus on the precise definition and communication of problems and their solutions. This begins with the description of tasks and concludes in the accurate definition of computational problems and their algorithmic solutions. This concept draws from logic, algebra and the language of mathematics, and can be related to the scientific method of recording experiments in science.

Specification, algorithms and implementation

Specification describes the process of defining and communicating a problem precisely and clearly. For example, explaining the need to direct a robot to move in a particular way.



Specification, algorithms and implementation

An algorithm is a precise description of the steps and decisions needed to solve a problem. Algorithms will need to be tested before the final solution can be implemented. Anyone who has followed or given instructions, or navigated using directions, has used an algorithm.



Specification, algorithms and implementation

These generic skills can be developed without programming. For example, students can follow the steps within a recipe or describe directions to locate items. Implementation describes the automation of an algorithm, typically by using appropriate software or writing a computer program. These concepts are addressed in the processes and production skills strand.

Digital systems

Digital systems (hardware, software, and networks and the internet)

A photograph of the NASA Mission Management Center (MCC) control room. The room is filled with rows of computer workstations, each with multiple monitors displaying various data, maps, and satellite imagery. Several people are seated at the desks, working. The background wall is covered with NASA logos and mission patches. The overall atmosphere is one of a high-tech, professional environment.

Digital systems

The digital systems concept focuses on the components of digital systems: hardware and software (computer architecture and the operating system), and networks and the internet (wireless, mobile and wired networks and protocols).

Interactions and impacts

**Interactions (people and digital systems, data and processes)
and impacts (sustainability and empowerment).**



Interactions and impacts

The interactions and impacts concepts focus on all aspects of human interaction with and through information systems, and the enormous potential for positive and negative economic, environmental and social impacts enabled by these systems. Interactions and impacts are addressed in the processes and production skills strand.

Interactions and impacts

Interactions refers to all human interactions with information systems, especially user interfaces and experiences, and human–human interactions including communication and collaboration facilitated by digital systems. This concept also addresses methods for protecting stored and communicated data and information.

Interactions and impacts

Impacts describes analysing and predicting the extent to which personal, economic, environmental and social needs are met through existing and emerging digital technologies; and appreciating the transformative potential of digital technologies in people's lives. It also involves consideration of the relationship between information systems and society and in particular the ethical and legal obligations of individuals and organisations regarding ownership and privacy of data and information.

Error Correction Example

YOU KNOW THIS METAL
RECTANGLE FULL OF
LITTLE LIGHTS?

YEAH.



I SPEND MOST OF MY LIFE
PRESSING BUTTONS TO MAKE
THE PATTERN OF LIGHTS
CHANGE HOWEVER I WANT.

SOUNDS
GOOD.



BUT TODAY, THE PATTERN
OF LIGHTS IS *ALL WRONG!*

OH GOD! TRY
PRESSING MORE
BUTTONS!
*IT'S NOT
HELPING!*



Search Example

Google



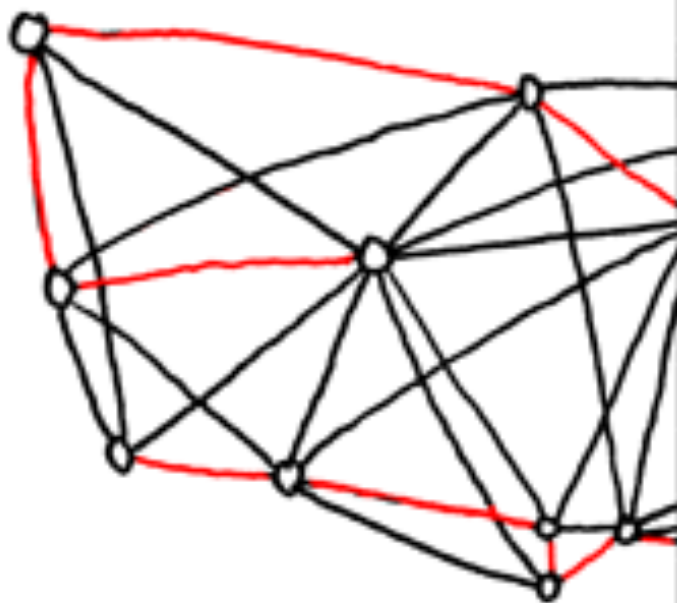
Google Search

I'm Feeling Lucky

Travelling Salesman

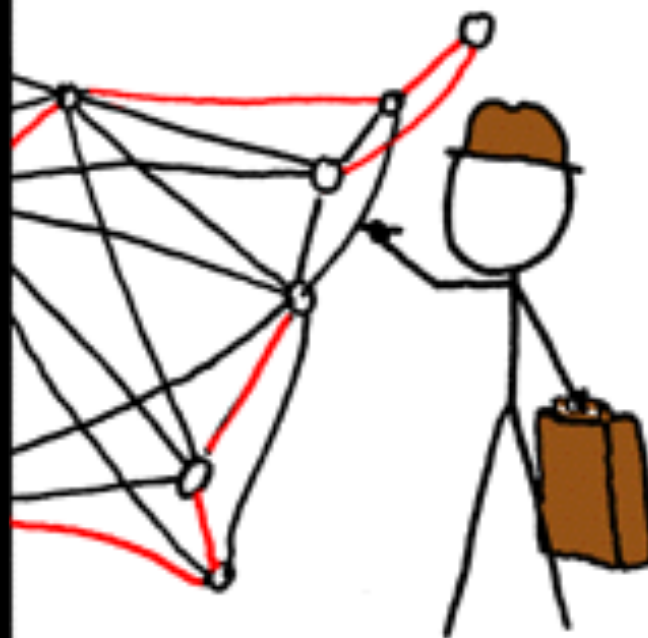
BRUTE-FORCE
SOLUTION:

$$O(n!)$$



DYNAMIC
PROGRAMMING
ALGORITHMS:

$$O(n^2 2^n)$$



SELLING ON EBAY:

$$O(1)$$

STILL WORKING
ON YOUR ROUTE?

SHUT
UP.



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Implications and Impacts



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