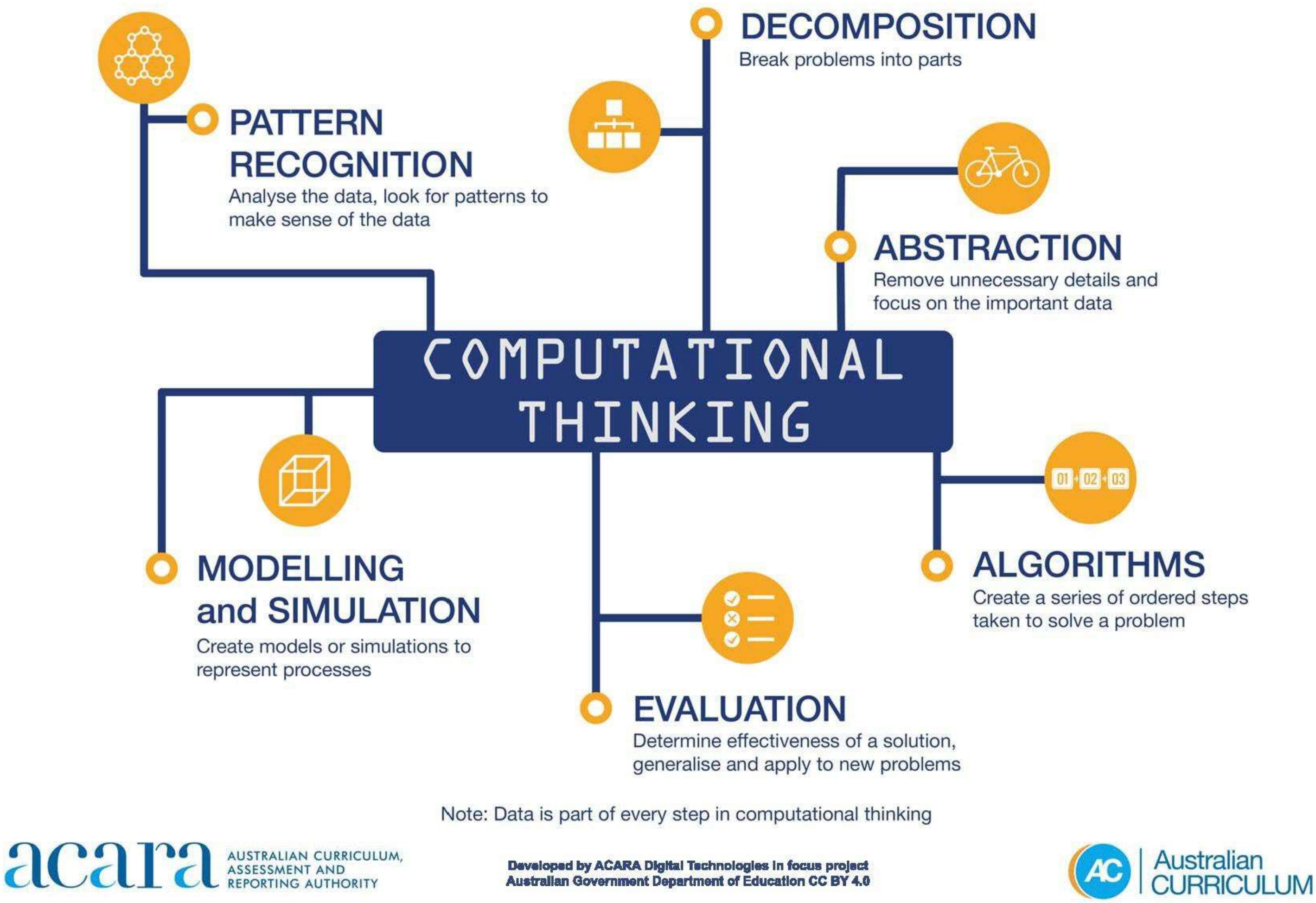
PS: Computer Science Focused Computational Thinking

In the general problem solving exploration, we looked at a four component model of computational thinking ("CT").

Here, we will refine that model.

Early in the national initiative around K-12 computer science education, Jeannette Wing, then at Carnegie Mellon and now at Columbia, published a seminal article entitled "Computational Thinking". The article is one of the most cited references in CS Education, and is viewed by many as one of the most effective articles describing computational thinking and the importance of computer science education to non-computer scientists. You may **read the article (https://iu.instructure.com/courses/1903143/files/101996148/download?wrap=1)** **(https://iu.instructure.com/courses/1903143/files/101996148/download?wrap=1)** to see if you agree.

As more computer science educators begin to think about computational thinking, an enriched CT framework began to emerge. Consider an example of this enriched framework below, taken from K-12 Computer Science standards in Australia. The chart is available as a download from a link in the module resource section. [Note: the *IndianaComputes!* curriculum deliberately includes a wide range of resources. But seriously, Australia? Yes: you are traveling with us not only on a CS Teaching journey, but also on an educational leadership journey. *IndianaComputes!* wants to build a critical mass of teachers familiar with state, national, and international best practices who can help shape the direction of Computer Science education locally and beyond. Australia is one of a growing list of countries with national CS programs and freely available and relevant materials.]



What's different between the original, four part computational model and subsequently developed models? Two additional parts were added: Modelling and Simulation, and Evaluation. And there is a note: Data is a part of every step in computational thinking. This richer model, and models like it, made the computational thinking process **iterative**, and explicitly called out the **pervasiveness of data** in computer science focused computational thinking.

The growing conversation around Computational Thinking attracted the attention of many Computer Science educators, and numerous CT papers were (and continue to be) published on the topic. To standardize the vocabulary and establish a more comprehensive model, **SIGCSE (https://sigcse.org/sigcse/)** created a task force to produce benchmark CT content. SIGCSE stands for Special Interest Group in Computer Science Education, and the annual SIGCSE convention is the crown jewel conference for Computer Science Educators. (By the way, the professional academic governing body of Computer Science is the **ACM (https://www.acm.org/)**, which stands for the Association for Computing Machinery. Special Interest Groups, including the one for Computer Science education, are an arm of the ACM. Part of furthering your journey as a computer science educator includes learning the "Who's Who" list of organizations driving CS Education; the ACM and related special interest groups are a key professional organization. We will add to this list along the way.)

The SIGCSE task force published a comprehensive treatment of computational thinking in K-12 education. (The task force report is available on the Resources page at the end of this module.) Computational Thinking was given this operational definition:

CT is a problem-solving process that includes (but is not limited to) the following characteristics:

- Formulating problems in a way that enables us to use a computer and other tools to help solve them
- Logically organizing and analyzing data
- Representing data through abstractions such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing and transferring this problem-solving process to a wide variety of problems

The skills are supported and enhanced by a number of dispositions or attitudes that are essential dimensions of CT.

These dispositions or attitudes include:

- Confidence in dealing with complexity
- Persistence in working with difficult problems
- Tolerance for ambiguity
- The ability to deal with open-ended problems
- The ability to communicate and work with others to achieve a common goal or solution

Along with the expanded operational definition, a K-12 scope and sequencing document was developed that categorizes CT activities into 9 strands:

- Data collection
- Data analysis
- Data Representation
- Problem Decomposition
- Abstraction
- Algorithms and Procedures
- Automation
- Simulation
- Parallelization

In the next few pages of this exploration, we will look at components of the SIGCSE expanded CT model in greater detail. (In other words, we will apply CT to CT!)