Assessing computational thinking

What is it?

Why is it important?

How can we assess it?
It's a loop of bronze where the arm used to connect.

Walk to bronze loop

<table>
<thead>
<tr>
<th>Give</th>
<th>Pick up</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>Talk to</td>
<td>Push</td>
</tr>
<tr>
<td>Close</td>
<td>Look at</td>
<td>Pull</td>
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</tbody>
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Walk to bronze loop

Give  Pick up  Use
Open  Talk to  Push
Close  Look at  Pull

[Icons for various actions and items]
From machine code to programmatic language

- Abstraction of machine code to programmatic language
- Programmatic language to explore concepts (movement, rotation and angles)
From programmatic language to narrative-based problem solving

- Abstraction from programmatic language to conceptual language (open, close, pick up, use, push, pull)
- Conceptual language to engage with rich narrative-based problem solving
What is computational thinking?

- The logo program and the adventure game both require basic computational thinking to explore, create or progress
- CT is a way of thinking about problems in terms of:
  - Abstraction
  - Decomposition
  - Algorithm design
  - Iteration
  - Generalisation
Abstraction

• Create a representation of a goal or objective
• Filter out irrelevant characteristics
Decomposition

• Break a problem/system down into smaller parts (task objectives)
  • Four equal sides
  • Four 90 degree angles
Algorithm design

• Four move commands
• Three 90 degree rotation commands
Iteration

• Create reusable bits of logic
• FD 100, RT 90
  • Repeat x 4
Generalisation

• Reuse solutions across problems
Definition #1

“Computational thinking is the mental skills and practices for:

• designing computations that get computers to do jobs for us
• explaining and interpreting the world as a complex of information processes”

- Matti Tedre and Peter J. Denning, MIT Press
Definition #2

“Computational thinking is the process of recognizing aspects of computation in the world that surrounds us, and applying tools and techniques from Computer Science to understand and reason about both natural and artificial systems and processes”

Royal Society 2012, p. 29
Computational thinking

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Scientific thinking vs computational thinking

• Pure science is exploratory and explanatory
• CT is explanatory and productive
Why is CT important?

• More tools in the toolbox
• Perceiving the world as systems of information
• New 21st century jobs
• Responsible and safe use of digital technologies
“I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail.”

- Abraham Maslow
(a) 21 units  
(b) 127 units  
(c) 3 units  

Objective: measure out exactly 100 units
Objective: measure out exactly 22 units as with the fewest pours
Objective: measure out exactly 22 units as *with the fewest pours*
Perceiving the world as systems of information

• CT can clear the fog
• CT can equip us to re-engineer systems
• CT principles can be applied to any type of information
Computational thinking and poetry

Let us go then, you and I,
When the evening is spread out against the sky
Like a patient etherized upon a table;
Let us go, through certain half-deserted streets,
The muttering retreats
Of restless nights in one-night cheap hotels
And sawdust restaurants with oyster-shells:
Streets that follow like a tedious argument
Of insidious intent
To lead you to an overwhelming question ...
Oh, do not ask, “What is it?”
Let us go and make our visit.

Decomposition

• Meter
• Rhyme
• Imagery
• Structure
• Tone
• Diction (word choice)
Computational thinking and cooking

To make brownie dough, use an electric mixer to beat butter and sugar in a bowl until and creamy.

**Algorithm design**
1. Add butter to bowl
2. Add sugar to bowl
3. Mix with electric mixer
4. Stop when creamy
Computational thinking and psychology

Exposure and Response Prevention Therapy (ERP) and is designed to systematically desensitize one to their fears.

**Iteration**
1. Expose a patient to a manageable level of fear
2. Address thoughts, impulses and fears
3. Interrupt ritualistic responses
4. Increase level of exposure
5. Repeat
Computational thinking and making hard choices

Generalisation
- I like sci-fi movies
- Star Trek is a sci-fi movie
- I might like Stark Trek
Computational thinking and making informed choices

Generalisation

• Stone buildings withstand the weather
• I’ll make my sculpture from stone (marble)
Some jobs that didn’t exist 10 years ago

• Mobile app developer
• Conversational UI designer
• Social media manager
• YouTube/Twitch streamer
• Cloud computing specialist
• Machine learning engineer
• Autonomous vehicle engineer
Refer to report: The New Basics
©2017 Foundation for Young Australians (FYA)
Responsible and safe use of digital technologies

• Technology for good and bad
• Using ICT appropriately
• Building safe systems and ethical technologies
Building safe systems
Ooops, your files have been encrypted!

What Happened to My Computer?

Your important files are encrypted.

Many of your documents, photos, videos, databases and other files are no longer accessible because they have been encrypted. Maybe you are busy looking for a way to recover your files, but do not waste your time. Nobody can recover your files without our decryption service.

Can I Recover My Files?

Sure. We guarantee that you can recover all your files safely and easily. (But you have not so enough time.)

You can try to decrypt some of your files for free. Try now by clicking <Decrypt>.

If you want to decrypt all your files, you need to pay.

You only have 3 days to submit the payment. After that the price will be doubled. Also, if you don't pay in 7 days, you won't be able to recover your files forever.

How Do I Pay?

Send $300 worth of bitcoin to this address:

15zGqZCTcys6eCjDkE3DypCjXi6QWRV6V1

Contact Us
How can we assess computational thinking?

- Australian Curriculum
- Definition of CT for assessment
- Some examples
Digital technologies learning area

• ICT from subject area to general capability
• Digital technologies Foundation to Year 10
• CT is the method to study digital technologies
• Digital competence as a general capability?
Computational thinking construct

- International Computer and Information Literacy Study (ICILS) 2018
  - Strand 1: Conceptualising problems
  - Strand 2: Operationalising solutions
Assessing the conceptualisation of problems
Core gameplay mechanics
(2D sideways scroller on a touch device)

Jump
The player jumps when the right side of the screen is pressed. The player can jump 2 body-lengths forward and ¾ of a body upwards. The player cannot jump over enemy ninjas.
If the player presses JUMP again while the ninja is in the air, the first jump continues until the player hits the ground, and then the player can jump again.
Computational Thinking
Lesson Assessment

Look at the problems below. Circle the matching sections and underline the places where there are differences. Once you've done that, write a template to create more phrases with the same pattern.

The first one has been done for you.

1) Triangles have three sides. Squares have four sides.

   have ______ sides

2) It's fun to read books. It's fun to read magazines.

3) I love my cat's whiskers. I love my dog's tail.
   I love my horse's tail. I love my cat's tail.

4) There is a cloud in the sky that looks like a dragon.
   There is a leaf in the water that looks like a heart.
   There was a rock in the yard that looks like a heart.
Use the fill command to fill only the empty bottles with purple liquid.

Use as few commands as possible.

- move forward hero
- move forward hero
- hero action Fill with purple
- move forward hero
- move forward hero
- hero action Fill with purple
- repeat 4 times
- do move forward hero
- if Empty bottle do hero action Fill with purple
Evolution of CT tasks

- Programmatic language (syntax)
- Algorithm design
- Programmatic language (syntax)
- Algorithm design
- Narrative based problem solving
- Programmatic language (syntax)
- Algorithm design
- Narrative based problem solving

Source: SoNET Systems
Assessing coding tasks

• Completeness of solution
  • Number of objectives/targets (the empty bottles)
• Precision of solution
  • Irrelevant objectives/targets (the full bottles)
• Efficiency of solution
  • Number of code blocks
Assessing computational thinking

• Depth of problem formulation
• Precision of designed systems
• Completeness of solution
• Precision of solution
• Efficiency of solution
Achievement scale of computational thinking

• Coming soon
Concluding thoughts

• CT fosters systematic thinking and principled problem solving
• CT can be done without computers
• CT is teachable and assessable
Research Conference 2019
Preparing students for life in the 21st Century: Identifying, developing and assessing what matters

Assessing computational thinking

Thank you

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