

Callysto Computational Thinking test (CCTt) (Student Version)

The questions in this test are intended to measure your computational thinking skills and attitudes. You may not know the answer to some of the questions. If you do not know the answer to a question, please answer with your best guess.

The test will take approximately 45 minutes to complete.

DEMOGRAPHICS

Gender:

- Male
- Female
- Other
- I prefer not to report

Age (years):

- Younger than 10
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- Older than 17
- I prefer not to report

Grade:

- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

PART 1

Indicate how well each of the following statements describes you:

	Strongly Disagree	Disagree	Agree	Strongly Agree
I enjoy using technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find it easy to use new technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident I can fix a computer myself when it is not working	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People ask me for help with their computer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

When answering the following questions, it may be helpful to think about how you would solve a complex problem. For example:

- planning a surprise birthday party for a friend
- repairing a flat tire on a bicycle
- designing a parachute and container that will protect an egg when it is dropped from the roof of your school

Indicate how well each of the following statements describes you:

	Strongly Disagree	Disagree	Agree	Strongly Agree
I can figure out the steps to solve a complex problem	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I am solving a complex problem, I try to break it up into smaller or simpler problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I am solving a complex problem, I think about other problems I've solved before to see if I can solve this problem in a similar way	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain the steps of how I solved a complex problem	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have any prior experience with coding/programming a computer?

- Yes
- No

If you selected Yes in the previous item:

Please describe your experience with coding and/or computational thinking. Please list what languages and/or tools you have used and what experiences you have.

For example, "I made a game in Scratch in class last year" or "I learned to program in Java in my CTS class" or "I built and programmed LEGO robots in my school's robotics club."

Indicate how well each of the following statements describes you:

	Strongly Disagree	Disagree	Agree	Strongly Agree
The challenge of coding appeals to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am comfortable writing code to solve problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel frustrated and want to give up when I encounter an error in my code	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When my code has a bug, I try to fix it myself rather than ask someone else to fix it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In the following section, we will be asking you questions about "data".

Data means facts or information about the world collected for study or analysis. Data can be numbers, text, videos, images, or sounds. For example, data might be the heights of all the students in a class, pictures of all the birds in your neighbourhood, or the names of all the people who live in your city.

Indicate how well each of the following statements describes you:

	Strongly Disagree	Disagree	Agree	Strongly Agree
Presenting data in different ways (for example: a pie chart, a table of numbers, or a paragraph) can change the conclusions I draw from the data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would rather explore data myself than have someone tell me what it means	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel frustrated when trying to make sense of data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In the following section, we refer to “*computational thinking*” using the following definition:

Computational thinking is a problem-solving process that includes:

- formulating problems in a way that enables us to solve them using a computer
- 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 solutions to achieve the most efficient and effective combination of steps and resources
- generalizing and transferring this problem-solving process to a wide variety of problems

- Barr, D., Harrison, J., & Conery, L. (2011). Computational thinking: A digital age skill for everyone. *Learning & Leading with Technology*, 38(6), 20-23.

Indicate how well each of the following statements describes you:

	Strongly Disagree	Disagree	Agree	Strongly Agree
It is important to develop computational thinking	●	●	●	●
I have the skills to teach others about computational thinking	●	●	●	●
I know how to make learning about computational thinking interesting	●	●	●	●
I am excited by the idea of learning and/or using computational thinking in school	●	●	●	●

PART 2*

INSTRUCTIONS

The following questions have 4 answer options (A, B, C, or D) from which only one is correct. If you do not know the answer to a question, enter your best guess.

If you need to zoom in on any question to enlarge it, press 'Ctrl+' (or 'Command+' on a Mac computer) on your keyboard. To zoom out, press 'Ctrl-' (or 'Command-').

Before starting Part 2, we present you with an example so you can familiarize yourself with the kind of questions that you will encounter.

* The questions in Part 2 are based on the Computational Thinking Test (CTt) designed by Marcos Román-González (2015).

EXAMPLE

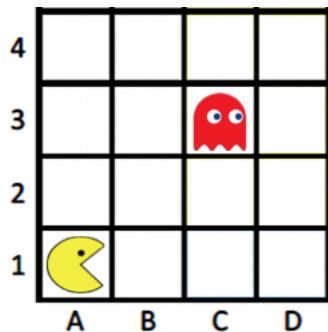
In this example, you are asked which instructions “Pacman” (👾) should follow to get to the “Ghost” (👻).

The “Move Forward” (move forward) instruction tells Pacman to move **one step** in the **direction** it is currently facing. Pacman can be facing left, right, up, or down.

Currently Pacman is starting at position **A1** on the grid.

Example Question:

Which instructions will take Pacman to the Ghost located at position **C3**?



Select the correct answer (in this example, the correct answer is **C**):

- (a) move forward
 move forward
 turn left
 turn right
 turn left

- (b) turn right
 turn right
 turn left
 move forward
 move forward

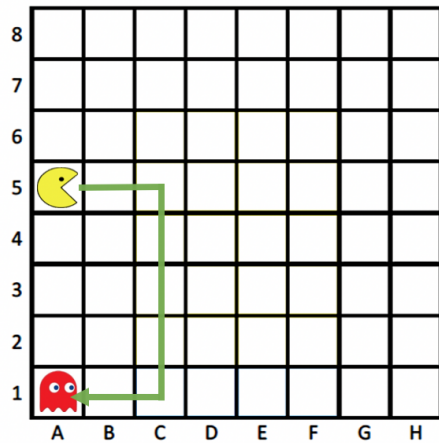
- (c) move forward
 move forward
 turn left
 move forward
 move forward

- (d) move forward
 move forward
 turn right
 move forward
 move forward

Now, you will answer some questions on your own.

Question 1:

Pacman is starting at position **A5** on the grid.



Which instructions will take Pacman to the Ghost located at position **A1**?

- (a)
- turn right
 - turn right
 - move forward
 - move forward
 - move forward
 - move forward
 - turn left
 - turn left

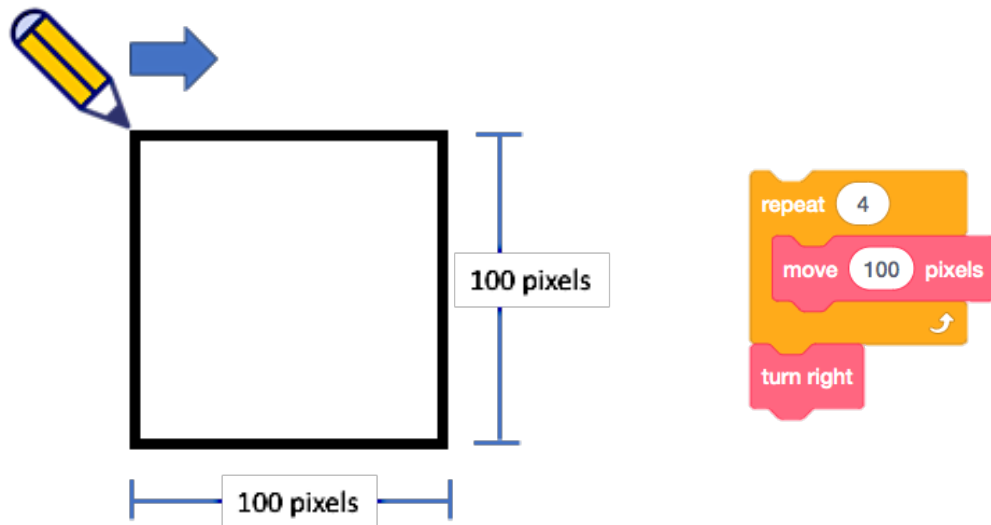
- (b)
- turn right
 - turn right
 - move forward
 - move forward
 - move forward
 - move forward
 - turn right
 - turn right

- (c)
- move forward
 - move forward
 - turn right
 - move forward
 - move forward
 - move forward
 - move forward
 - turn left
 - move forward
 - move forward

- (d)
- move forward
 - move forward
 - turn right
 - move forward
 - move forward
 - move forward
 - move forward
 - turn right
 - move forward
 - move forward

Question 2:

The instructions below should make the pencil draw the square **once**. The pencil starts at the upper-left corner position and moves in the direction of the arrow.

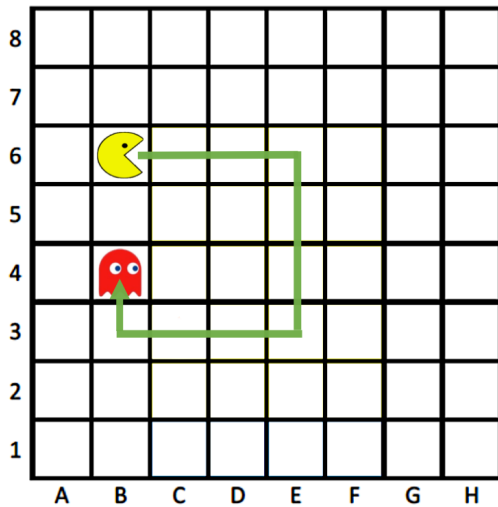


What is the ***error*** in the instructions?

- (a) The “*repeat*” loop should repeat 2 times.
- (b) The “*move*” block should be outside the loop.
- (c) The “*turn right*” block should be inside the loop, after the “*move*” block.
- (d) The “*turn right*” block should be inside the loop, before the “*move*” block.

Question 3:

Which instructions take the “Pacman” (**B6**) to the “Ghost” (**B4**) using the path marked out?



(a)

```

repeat 3
  repeat 3
    move forward
  turn right
  move forward
  
```

(b)

```

repeat 4
  repeat 3
    move forward
  turn right
  move forward
  
```

(c)

```

repeat 4
  repeat 3
    move forward
    turn right
  move forward
  
```

(d)

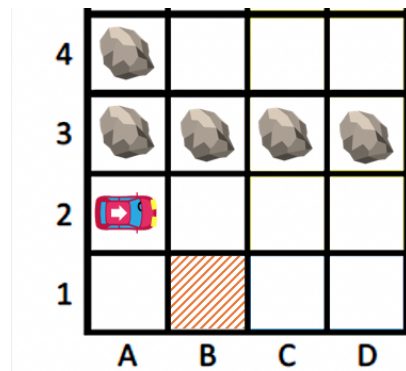
```

repeat 3
  move forward
  repeat 3
    turn right
    move forward
  
```

Question 4:

A car starts at position **A2** and faces in the *right* direction as shown by the white arrow on the roof of the car. The car can never pass through a rock or share the same position as a rock.

Which instructions correctly take the car to the orange patterned tile (**B1**)?



(a)

```

if path to the left then
  turn left
  move forward
else
  if path to the right then
    turn right
    move forward
  else
    move forward

```

(b)

```

if path to the left then
  turn left
  move forward
else
  if path to the right then
    turn right
    move forward
  else
    move forward

```

(c)

```

if path to the right then
  turn right
  move forward
else
  if path to the left then
    turn left
    move forward
  else
    move forward

```

(d)

```

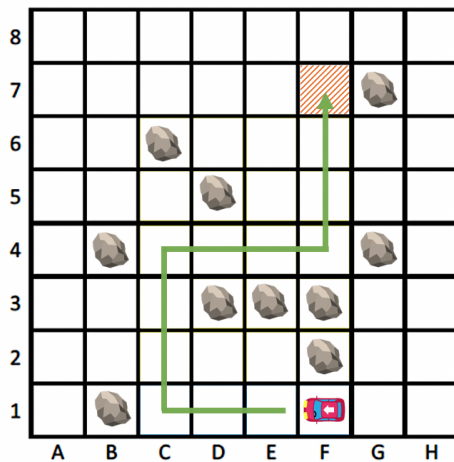
if path to the right then
  turn right
  move forward
else
  if path to the left then
    turn left
  else
    move forward

```

Question 5:

A car starts at position **F1** and faces in the *left* direction as shown by the white arrow on the roof of the car. The car can never pass through a rock or share the same position as a rock.

Which instructions correctly take the car to the orange patterned tile (**F7**) using the green path marked out?

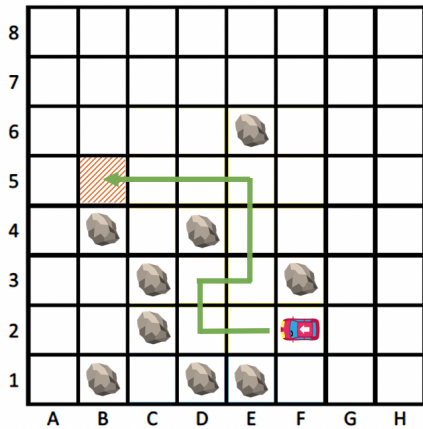


- (a) 
- (b) 
- (c) 
- (d) 

Question 6:

A car starts at position **F2** and faces in the *left* direction as shown by the white arrow on the car. The car can never pass through a rock or share the same position as a rock.


Which instructions correctly take the car to the orange patterned tile (**B5**) using the path marked out?



(a) repeat until 

```

if path to the left then
  turn left
  move forward
else
  turn left
  move forward
  
```

(b) repeat until 

```

if path to the left then
  turn left
else
  turn right
  move forward
  
```

(c) repeat until 

```

if path ahead then
  move forward
if path to the right then
  turn right
  move forward
turn left
  
```

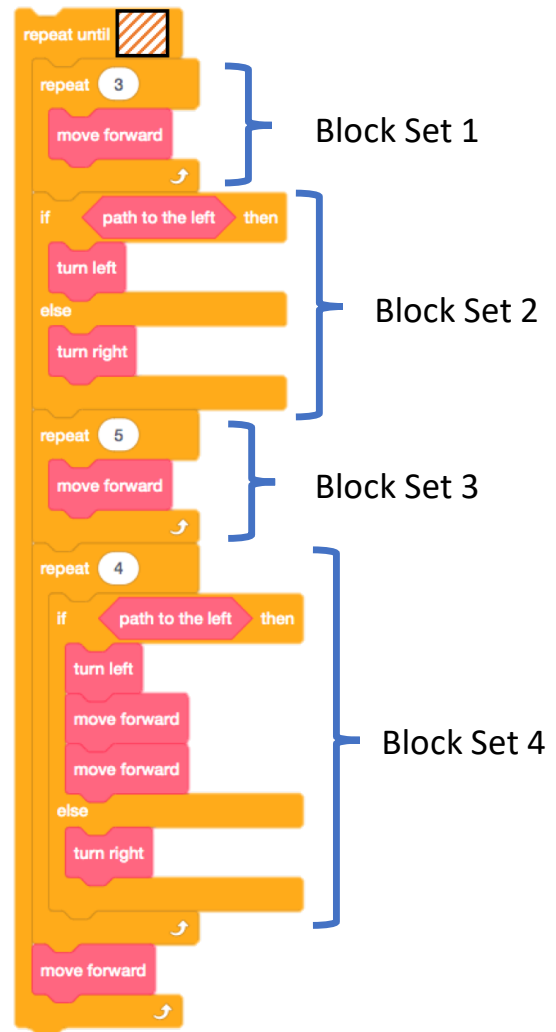
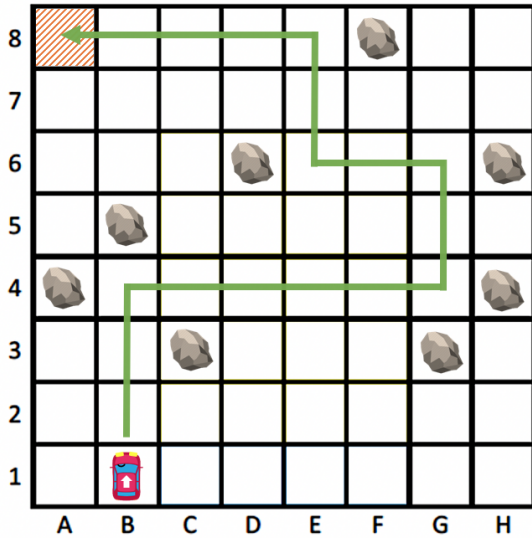
(d) repeat until 

```

if path ahead then
  move forward
else
  if path to the left then
    turn left
  else
    turn right
  
```

Question 7:

The following instructions should move the car from **B1** to the orange patterned tile (**A8**) using the path marked out.

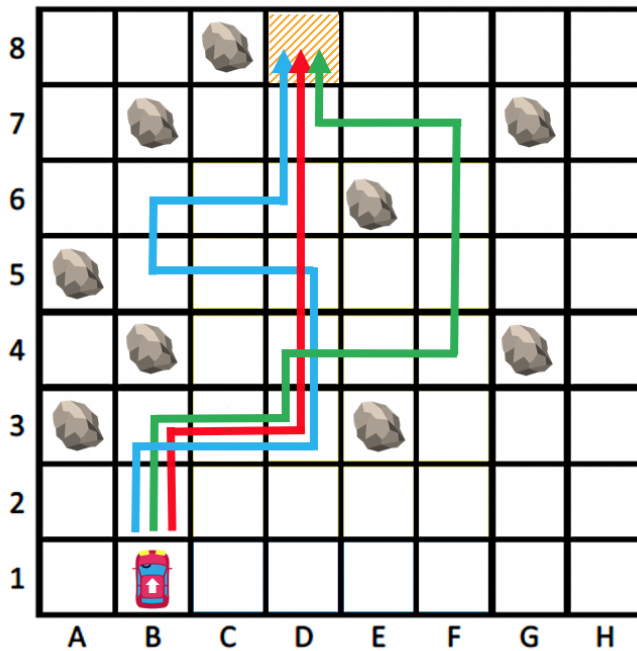


Which instructions contain a ***mistake***?

- (a) Block Set 1 & 2
- (b) Block Set 2 & 3
- (c) Block Set 3 & 4
- (d) Block Set 4 only

Question 8:

The following instructions move the car (**B1**) to the orange patterned tile (**D8**) using one of the paths marked out.



```

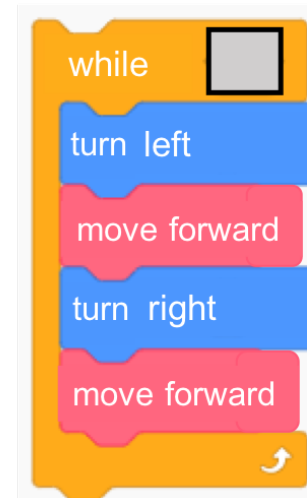
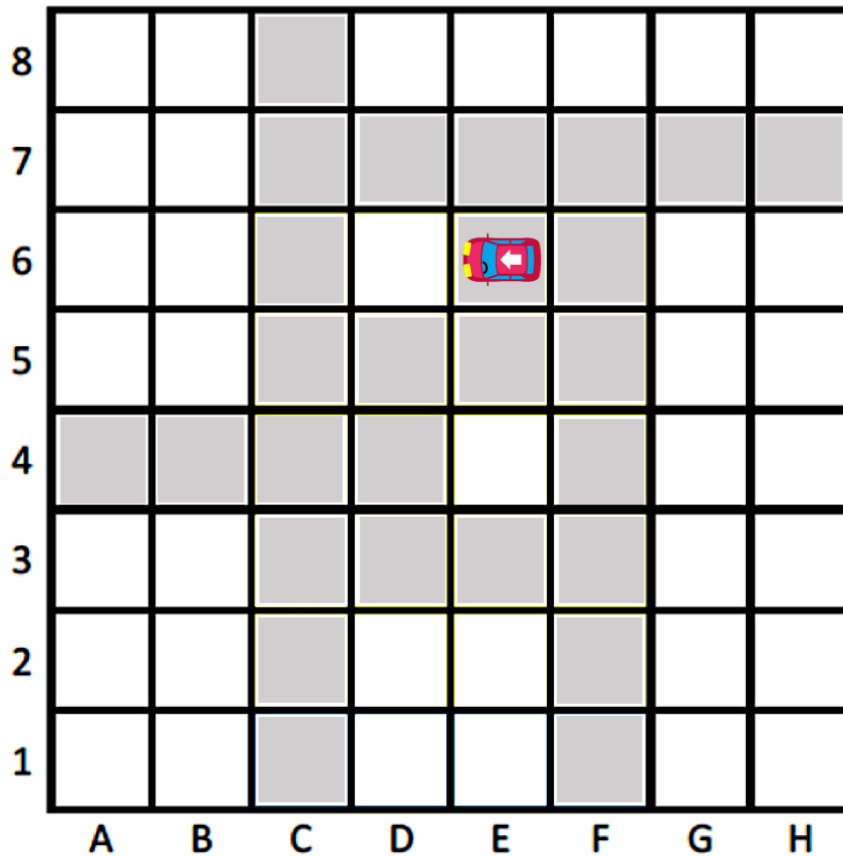
repeat until 
  if path ahead then
    move forward
  else
    if path to the left then
      turn left
    else
      turn right
  
```

According to the instructions, which coloured path will the car take?

- (a) The red path
- (b) The blue path
- (c) The green path
- (d) None of the above

Question 9:

A car starts at position E6, facing left.



If the car follows the instructions above, where will it end up?

- (a) B3
- (b) C3
- (c) D4
- (d) E4

Question 10:

At the end of the instructions, which direction will the car face?

- (a) Up
- (b) Left
- (c) Right
- (d) Down

Question 11:

You are flipping through a deck of cards following this simple rule: Flip a card. If the card is a heart, you discard (without looking at) a number of cards equal to the total number of heart cards you have already flipped. You continue repeating this step until you run out of cards.

Which of the following algorithms implements your rule?

(a)

```
n = 0
while there are cards in the deck:
  flip card
  if card is a heart:
    n = n + 1
  repeat n times:
    discard card
```

(b)

```
while there are cards in the deck:
  flip card
  while the current card is a heart:
    discard card
```

(c)

```
n = 0
while there are cards in the deck:
  flip card
  repeat n times:
    discard card
  if card is a heart:
    n = n + 1
```

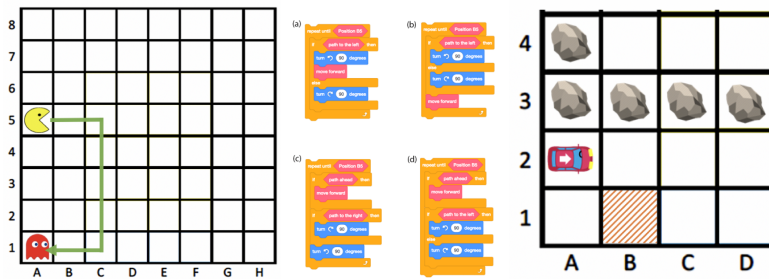
(d)

```
n = 0
while there are cards in the deck:
  flip card
  while the current card is a heart:
    n = n + 1
  discard card
  flip card
```

FEEDBACK

From 0 to 10, how do you think you did on the questions in Part 2?

Note: Part 2 includes all the questions where you were asked to solve coding problems like this:



0 1 2 3 4 5 6 7 8 9 10

Awful

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

Excellent

PART 3

Please answer the following long-form questions.

Question 1:

There are two nearby cities. In the larger city, about forty-five (45) babies are born each day. In the smaller city, about fifteen (15) babies are born each day.

Of the children born each day, about 50 percent are girls. However, the exact percentage of baby girls varies from day to day. Sometimes it may be higher than 50 percent, sometimes lower.

For one year, each city recorded the days in which more than 60 percent of babies born on that day were girls.

(a) Which city do you think **recorded more such days**?

- The larger city
- The smaller city
- About the same (within 5% of each other)

(b) Why do you think so? Please explain or support your answer above.

Question 2:

You have ten (10) coins. Nine (9) of them weigh the same amount. One (1) is lighter. You have a balance scale (like in the picture below) that you can use to weigh the coins. How would you **find the lighter coin** by using the scale the **fewest** number of times?



Thank You for Participating!

Please enter any comments you have about the test:

Acknowledgements:

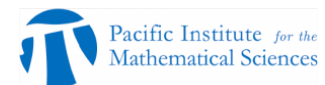
The authors from the University of Alberta wish to thank the *Callysto Project* and the Government of Canada (*Innovation, Science and Economic Development Canada*) *CanCode* program. We also wish to extend thanks to our partner organizations, *Cybera* and the *Pacific Institute for the Mathematical Sciences (PIMS)*. We would also like to thank Dr. Marcos Román-González, as Part 2 of this instrument was inspired by his work on the *Computational Thinking Test (CTt)*. Our *Callysto CTt (CCTt)* instrument was made available on the *Callysto* website to provide easy and open access for researchers around the world. Researchers can freely use it to track and analyze changes in CT among teachers and students, and subsequently publish their results. All uses of the instrument should include the appropriate references provided here in addition to the instrument website.

Citation:

Cutumisu, M., Adams, C., Yuen, C., Hackman, L., Lu, C., & Samuel, M. (2019). *Callysto Computational Thinking Test (CCTt) Teacher Version* [Measurement instrument]. Available: <https://callysto.ca>

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With funding from

Canada