Junior edition
without answers

UK Bebras
Computational Thinking Challenge

www.bebras.uk

2014
The UK Bebras Computational Challenge could not have been run this year without the generous support of the following sponsors:

- The Raspberry Pi Foundation
- ARM Holdings Ltd
- BCS
- CAS

and our National Organising body Oxford University Computer.

The Raspberry Pi Foundation have also funded the production of this booklet.

Finally it is important to recognise all the National Coordinators and members of the International Bebras community who have been immensely generous in their support and help in getting this competition off the ground in the UK as well as of course developing the challenges.

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The UK Bebras Computational Challenge is an online competition open to students in the UK and English speaking International Schools around the world. It requires intelligence, but no previous knowledge. It is hoped it will raise general interest in youngsters in Computer Science and help them to understand that Computational Thinking has wide application in solving all sorts of problems they might meet in life. The philosophy emphasises participation whilst celebrating achievement.

This competition is anything but unique to the UK. Last year the International Bebras Competition celebrated its 10th year. For the UK it was its first official year. That being said, we entered over 21,000 students. In 2013 in total 680,000 students from 26 countries participated.

On the following pages you will find the 30 tasks used in the UK Bebras 2014. Above each question is noted which age groups and at what level the questions were used.

After each question there is an answer, an explanation of how the answer could be obtained plus a section on how the tasks are related to Computational Thinking. (FYI the rest of the world call this Informatics.) We have also mapped the tasks to the Computational Thinking Concepts that feature in the Progression Pathways Assessment Framework created by Mark Dorling. It is our sincere hope that this Computational Thinking information provided will enhance the usefulness of this booklet for Computer Science teachers and their students whether in the Primary or Secondary phase. It is for this reason that this booklet is being distributed to as many schools as possible and made freely available as a PDF that can be distributed freely.

The 2014 competition was conducted in six age groups:

<table>
<thead>
<tr>
<th>England and Wales</th>
<th>Scotland</th>
<th>Northern Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elite: Years 12 &amp; 13</td>
<td>Elite Years S5 &amp; S6</td>
<td>Elite: Years 13 &amp; 14</td>
</tr>
<tr>
<td>Higher: Years 10 &amp; 11</td>
<td>Higher: Years S3 &amp; S4</td>
<td>Higher: Years 11 &amp; 12</td>
</tr>
<tr>
<td>Intermediate: Years 8 &amp; 9</td>
<td>Intermediate: S1 &amp; S2</td>
<td>Intermediate: Years 9 &amp; 10</td>
</tr>
<tr>
<td>Junior: Years 6 &amp; 7</td>
<td>Junior: Years P6 &amp; P7</td>
<td>Junior: Years 7 &amp; 8</td>
</tr>
<tr>
<td>Castors*: Years 4 &amp; 5</td>
<td>Castors*: Years P4 &amp; P5</td>
<td>Castors*: Years 5 &amp; 6</td>
</tr>
<tr>
<td>Kits*: Years 2 &amp; 3</td>
<td>Kits*: Years P2 &amp; P3</td>
<td>Kits*: Years 3 &amp; 4</td>
</tr>
</tbody>
</table>

* pilot year for these groups – Castors and Kits can enter individually or as small teams (up to 4)
Introduction

The contest is completed online in schools under the supervision of teachers.

For Elite, Higher, Intermediate and Juniors there were 15 multiple-choice questions to be attempted in 40 minutes.

Castors had 10 questions to attempt in 40 minutes.
Individuals or small teams were allowed to enter.

Kits had 6 questions to attempt in 40 minutes.
Individuals or small teams were allowed to enter.

The organisers wish to pass on a special thanks to all the teachers who have made it possible for their students to enter into this competition by taking on a huge amount of the necessary administration for us. We invite schools to participate again in November 2015.

Keep informed by visiting bebras.uk
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Each problem in this booklet has a flag indicating the country of origin. However, many people were involved in the further editing, translating and providing additional material. The UK team are indebted to the generosity of spirit and community of Computer Scientists around the world!
The windows of a boat are either clear or lightly tinted. Standing beside the boat you can look through two opposite windows at once. Depending on the colours of both windows they will appear to have a new colour:

Captain Krysta has given you drawings of her boat showing which windows are clear and which are lightly tinted:

Click on the windows of the boat below to show what you would see if you stood beside it and looked through opposite windows.
At the LIFO ice cream parlour the scoops of ice cream are stacked on your cone in the exact order in which you ask for them.

**What do you have to say in order to get the ice cream shown in the picture?**

I would like to get an ice cream with ...

... Chocolate, Smurf and Strawberry!
... Strawberry, Smurf and Chocolate!
... Chocolate, Strawberry and Smurf!
... Strawberry, Chocolate and Smurf!
A princess has a magical bracelet that looks like this:

![Magical Bracelet Image]

When she stores her bracelets in her drawer she first opens them.

**Which of the four bracelets in her drawer is the magical one?**

![Four Bracelet Images]
Daniel is sending text messages from his old phone.
For every letter he has to press the proper key once, twice, three or four times, followed by a short pause.
In order to type 'C' he has to press the number 2 key three times because 'C' is the third letter written on this key.
In order to type 'HIM' he has to press the number 4 key twice, followed by the number 4 key 3 times and finally the number 6 key once.
Daniel presses exactly six times to enter the name of a friend.

What is the name of his friend?

Miriam
Iris
Emma
Ina
The diagram shows how a watering system is connected. The system consists of tubes and valves. Open and closed valves are shown in the diagram by the direction of the switch. Water only flows through open valves.

Which of the flowers (if any) will receive water when the valves are in the positions shown below.

Click on the flowers that will receive water so that they look bright and fresh. Leave the flowers that will not get any water looking wilted.
You are playing a game of tic-tac-toe with your friend. First your friend has to place an 'O', then you place your 'X'. You continue taking turns in this way. The player who places their three marks in a horizontal, vertical or diagonal line wins.

It is your turn to put an 'X' in the grid below:

**Click on the grid to place your 'X' so that you have the best chance of winning.**
A number is represented on a Chinese abacus by the position of its beads.  

The value of a bead on the top part is 5; the value of a bead on the bottom part is 1. The abacus is reset to zero by pushing the beads away from the centre.

To represent the number 1 746 503 the appropriate beads are moved towards the centre of the abacus:

What number does the following abacus represent?
Johnny has 8 photos. He wants to give one to Bella.
He asks Bella three questions to help him select the best picture.

Johnny’s Question

- Do you want a photo with a beach umbrella?  
  Bella’s Answer: Yes

- Do you want a photo where I wear something on my head?  
  Bella’s Answer: No

- Do you want a photo where you can see the sea?  
  Bella’s Answer: Yes

Which photo should Johnny give to Bella?

[Images of different photos with Johnny and Bella]
It is time for bed! Every beaver should have a toothbrush that matches their size. But look at the picture to see what has happened.

“Not so fast!” sighs mother beaver. “Eve and Chad, swap your brushes! Ann and Chad, you too!” But then she does not know how to continue.

Which two beavers still need to swap their toothbrushes so that all the beavers have the correct brushes?

Ben and Chad
Ann and Eve
Ben and Dan
Nobody
A village is receiving a new wireless network consisting of several network towers. The network will offer WiFi to all the villagers.

Every network tower has the coverage area shown below. The red star represents the network tower. Only in the twelve shaded squares surrounding the tower will a house get a WiFi signal.

The picture below shows a map of the village divided into squares. Every triangle ▲ represents a house. A network tower cannot be built inside a square, only on the cross point of the village squares. The coverage areas may overlap.

**What is the minimum number of network towers required to provide coverage to every house?**
The clinging robot walks along the road, always clinging to one side of the road. The clinging robot knows four commands:

<table>
<thead>
<tr>
<th>Command</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>START</td>
<td>Start walking along the side where you are standing</td>
</tr>
<tr>
<td>CONTINUE</td>
<td>Keep walking along the side where you are walking</td>
</tr>
<tr>
<td>SWITCH</td>
<td>Switch to the other side of the road and keep walking</td>
</tr>
<tr>
<td>STOP</td>
<td>Stop walking</td>
</tr>
</tbody>
</table>

A command is executed when setting off and whenever the robot walks across one of the grey magnetic devices on the road. All these devices are indicated on the map.

The clinging robot is given the following instruction set:

```
START  SWITCH  CONTINUE  CONTINUE  CONTINUE  STOP
```

The robot starts as indicated in the picture. Click on the grey spiky circle where the robot stops.
The robot 'Drawbot' can drive and draw at the same time!
You can give the drawbot the following instructions: square, triangle, forward, turn.

The instructions work as follows:

<table>
<thead>
<tr>
<th><strong>square:</strong> Drawbot draws a square. At every corner he turns right.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Square Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>triangle:</strong> Drawbot draws a triangle. At every corner he turns right.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Triangle Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>forward:</strong> Drawbot drives forward on a line that has been drawn until the next corner.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Forward Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>turn:</strong> Drawbot turns to the right until the next drawn line.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Turn Diagram" /></td>
</tr>
</tbody>
</table>

You can also give a sequence of commands to drawbot:
For instance: **square, forward, triangle**
The image on the right shows what will happen.

**Which sequence of instructions causes this to happen?**
- square, turn, forward, triangle
- triangle, turn, square
- triangle, turn, forward, square
- square, forward, square, turn, triangle
- square, forward, square, turn, triangle
Two fishermen own two boats, named "Lisa 1" and "Lisa 2". Each boat can hold a maximum cargo of 300kg.

The fishermen are given barrels filled with fish to transport. On each barrel is a number that shows how heavy the barrel is in kilograms.

You must make sure that neither boat is overloaded.

**Drag barrels onto the two boats so that the maximum possible load of fish is carried.**

```
220 130 120 100 90 90 60
```

Lisa 1

Lisa 2
In the basement of a castle lives a monster. The monster is hiding in one of the yellow rooms. The monster can only stay in yellow rooms.

You want to catch the monster. Click on any yellow room. This will reduce the total number of yellow rooms by half. Click again on another yellow room, etc.

When there is only one yellow room left you have caught the monster.

Find the lowest number of rooms you need to click to trap the monster.

**Save the lowest number of clicks required as your answer.**
The beaver family have three mobile phones but none of the batteries have any charge. It takes 1 hour to fully charge a mobile phone but this does not need to be done all in one go. The beaver family only have two mobile phone chargers in the house.

**What is the shortest time they need to fully recharge the three phones?**

- 3 hours
- 2 hours
- 1 hour and a half
- 1 hour
Sponsors

The UK Bebras is free to enter in 2014 thanks to the sponsorship of the following organisations.

Oxford University is now the National Organising Body of the competition. The University’s support for the UK section of this international competition will include hosting events for top achieving students.

www.cs.ox.ac.uk/

The Raspberry Pi Foundation is a registered charity dedicated to the advancement of education in computing and the use computing technology across other subjects, including STEM and the creative arts. In pursuit of its charitable mission the Foundation designs and sells the Raspberry Pi computer, a small credit card sized Linux computer that retails for $35. Proceeds from selling Raspberry Pis are ploughed back into supporting educational projects aligned to the Foundations goals via the Raspberry Pi Education Fund. Through this fund, the Raspberry Pi Foundation is a proud sponsor of the Beaver UK informatics competition.

www.raspberrypi.org

ARM Holding PLC is the world’s leading supplier of energy efficient microprocessor technology and it’s technology is at the heart of the world’s most advanced digital products. ARM designs scalable, energy efficient-processors that deliver the intelligence in applications ranging from sensors to servers, including smartphones, tablets, enterprise infrastructure and the Internet of Things. It’s technology enables the creation of new markets and the transformation of industries and society. If you have an portable digital product, you have an ARM powered device. As a FTSE 40 company, with headquarters in Cambridge UK, ARM is pleased to sponsor the UK chapter of the international Beavers informatics competition.

www.arm.com

The Computing at School (CAS) Working Group aims to promote the teaching of computer science at school. The support and encouragement of this organisation and its members have been of great importance in enabling the UK to enter the Bebras community successfully this year.

www.computingatschool.org.uk
Join us again next November

UK Bebras 2015

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