Program A Pumpkin (for A4 printers)

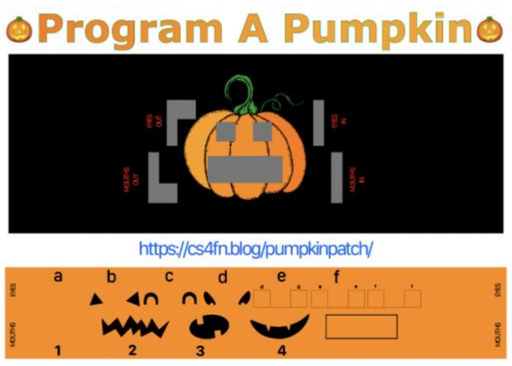
Age group:	7 - 12
Abilities assumed:	None
Time:	A few minutes (assembly) to an hour (if extension activities done)
Size of group:	1 upwards
Equipment required:	Printer, paper, scissors

Optional: black pen, jam jar or clear plastic pot, battery operated tea-light or torch & tape / blue tack

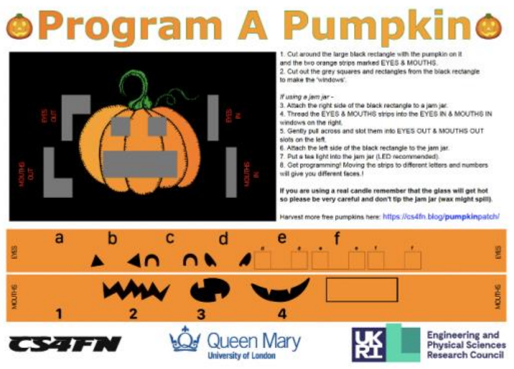
Once the pumpkin is assembled, strips of paper pass behind windows cut out for the eyes and mouth. Sliding the paper left and right displays different faces.

There are two versions **(1)** paper-based only which can be done on a table, **(2)** jam jar version which can be taped to a clean jam jar and lit with a battery operated tea light or a torch for extra spookiness (effect more dramatic in a dark room). **`Don't leave wax tea lights unattended`**.

Paper-based version



Jam jar version


Program A Pumpkin
EYES OUT
MOUTHS OUT
EYES IN
MOUTHS IN
a
b
c
d
e
f
EYES
1
2
3
4
MOUTHS
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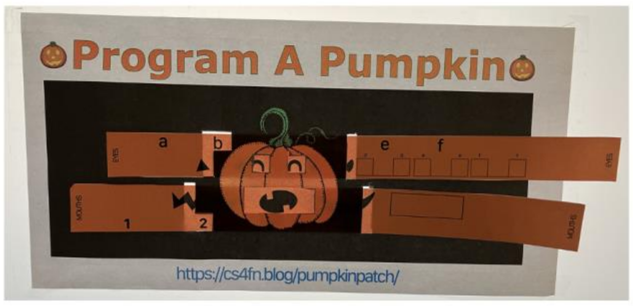
1. Cut around the large black rectangle with the pumpkin on it and the two orange strips marked EYES & MOUTHS.
2. Cut out the grey squares and rectangles from the black rectangle to make the 'windows'.

If using a jam jar -

3. Attach the right side of the black rectangle to a jam jar.
4. Thread the EYES & MOUTHS strips into the EYES IN & MOUTHS IN windows on the right.
5. Gently pull across and slot them into EYES OUT & MOUTHS OUT slots on the left.
6. Attach the left side of the black rectangle to the jam jar.
7. Put a tea light into the jam jar (LED recommended).
8. Get programming! Moving the strips to different letters and numbers will give you different faces.!

If you are using a real candle remember that the glass will get hot so please be very careful and don't tip the jam jar (wax might spill).

Harvest more free pumpkins here: https://cs4fn.blog/pumpkinpatch/



How to assemble

Give everyone a pumpkin sheet and have them do the following
1. Cut around the black rectangle with the pumpkin and the two orange strips with the features. From the black rectangle cut out all the grey shapes to make windows for the features and slots on either side for the strips.
2. Put the strips into the slot on the right and out of the slot on the left. Once that's done you can use tape or blue tack to fix the pumpkin to a desk so that the strips can be easily moved. If you're using a jam jar or clear plastic pot you'll need to tape or blue tack the pumpkin to the jar.

For younger groups you may wish to cut out the bits inside the pumpkin for them first. If using one pumpkin per pupil with a large class we also recommend cutting out a few of the window shapes beforehand as that's the most time-consuming part. Nail scissors are ideal for this.

Things you can do with your pumpkin

Just for fun version

Display different faces for your pumpkin by sliding the paper strips left or right. Draw new eyes or a mouth to make more faces.

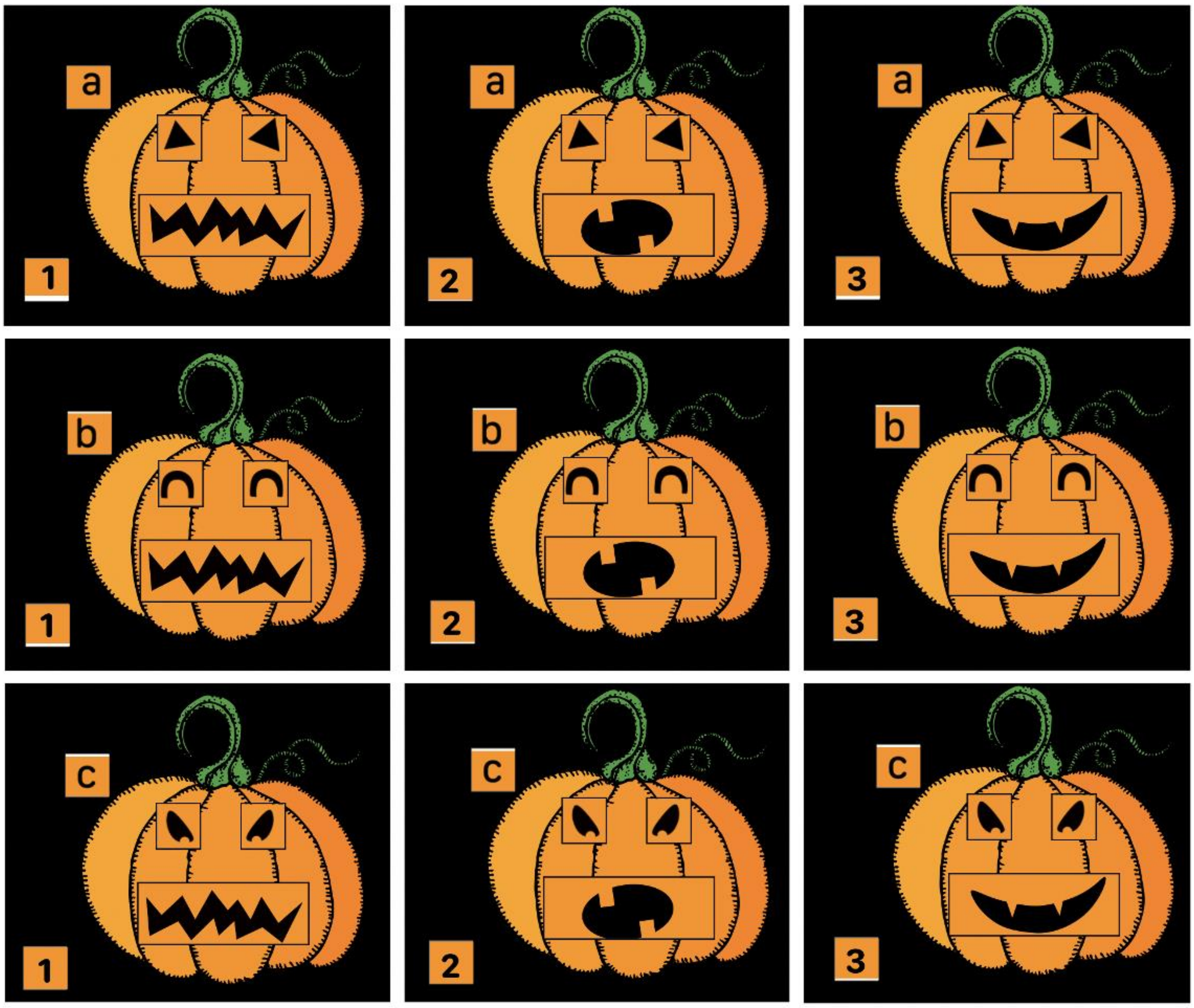
A bit of maths learning

With 3 mouths and 3 sets of eyes how many different faces can be produced? What happens if you add another set of eyes and another mouth?

A bit of CS4FN learning - program your pumpkin

Give the students a copy of the **Programming the Pumpkin - Instruction sheet** (see Appendix 1) to follow, or guide them through the steps. Also give each student or group a copy of the **Pumpkin Programming: table of codes** (see Appendix 2) to fill in.

Afterwards the class could talk about the linked computer science (Appendix 3).



All nine faces of the programmable pumpkin.

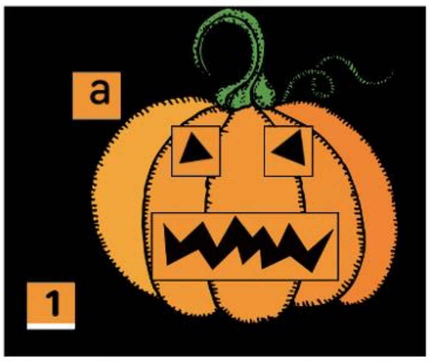
Appendix 1: Programming the Pumpkin - Instruction Sheet

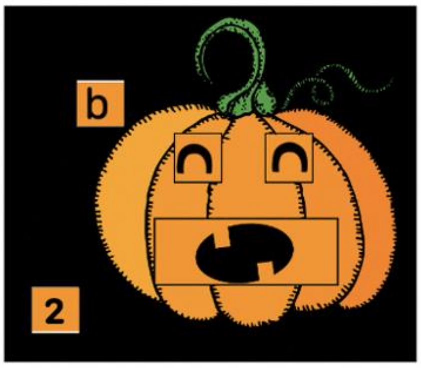
1) Assemble, then start programming your pumpkin! Slide the strips left and right to give different expressions, making the pumpkin show different expressions or emotions.

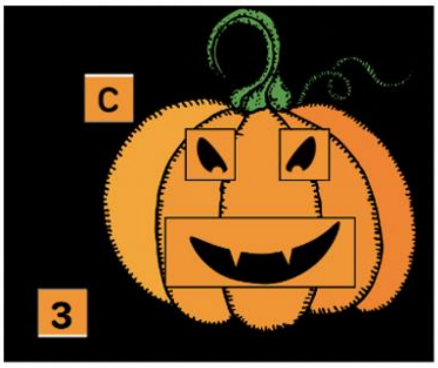
2) Note the letters and numbers appearing in the windows on the left hand side. Each strip has a letter or number corresponding to a particular mouth or set of eyes. **A1** means the ***A*** set of eyes and the ***1*** mouth are displayed, ***C2*** = the ***C*** set of eyes and the mouth labelled ***2***.

Eyes
a) triangle eyes
b) semicircle eyes
c) oval eyes
d) draw some eyes
e) draw some more eyes
f) draw even more eyes

Mouths
1) grimacing mouth
2) surprised mouth
3) toothy grin mouth
4) draw a mouth







What combination gives the pumpkin a scary or happy face?

3) What other expressions or emotions can the pumpkin display? Write a list of emotions and expressions (do you think **B2** above is bored, or sleepy?). For each one write the two letter code that makes that expression next to it, a letter for the eyes and a number for the mouth. You can draw some new features on the strips if you want to create a particular expression.

4) You now have a set of emotions or expressions in human-readable plain English and next to them a set of 'machine-readable' codes in numbers and letters that make the pumpkin work. You can use the table to look up the code for that face. You have created a simple language of **high-level commands** (English) to replace **the low-level codes** of the pumpkin machine.

This makes the instructions much easier to write and understand. You are using **abstraction** – the words like scary or happy **hide the detail** of what the actual machine (pumpkin) codes are.

5) Work out the sequence of low level codes to make the robot do the following

happy then
surprised then
scary.

This is what a **compiler** does for a programming language. It takes high-level commands that make sense to humans and translates it into low level code that makes sense to the computer (pumpkin). You can write a program – **a sequence** of high level commands – to control the pumpkin without having to worry about the codes at all when writing it. You can work them out later.

Appendix 2:
Pumpkin programming: table of codes for emotions and expressions

There are two versions on the next two pages. The first is just one table per page (time-saving, so no cutting required). The second has two copies of the table and can be cut down the middle (paper-saving, splitting in half required).

Print several of either version and distribute individually or in groups. Ask the class to decide which face best matches the expressions suggested below (there might be more than one!) and to come up with new expressions, adding new features if necessary.

Appendix 2:
Pumpkin programming: table of codes for emotions and expressions

	Code	
Emotion or expression	**Eyes**	**Mouth**
Scary	c	1
Angry		
Surprised		
Frightened		
Sleepy		
Happy		
Cross		

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Appendix 3: Class discussion and links with research

At the end summarise the computing lessons from the activity. Programs are **sequences** of instructions (like “c3” or “b2”) that when followed lead to something happening like a pumpkin face showing different expressions. Computer instructions are just **low-level codes**.

Programming languages need to be understood first by people so use high-level commands (more like “smiling” or “scary”) to make programs easier to write – this uses **abstraction** to hide the detail of the low level codes. We can take a program made of high level commands and **compile** it into a program that is used to operate the machine. Or we can use an **interpreter** that translates the instructions as we get to them.

> Read our 3 minute blog post about Fran Allen’s work making computer compilers more efficient: *Fran Allen: Smart Translation* https://bit.ly/franallen

Why are computer scientists interested in human emotions?

There are several reasons.

Recognise and understand emotions

One is so that they can design robots and things like virtual assistants that can recognise and understand different human emotions and respond in an appropriate way.

Display appropriate emotions

Another is so that the robots and virtual assistants can display natural-seeming emotions, and to do so correctly in situations where humans naturally would.

> Read our 5 minute blog post about ‘Blade’ the emotional robot made from Lego Mindstorm which learned to change its facial expression depending on the tone of voice it heard: *Blade: the emotional robot* https://bit.ly/bladerobot

Making sense of text: sentiment analysis

Another area of research is in understanding the meanings and emotion behind written text, particularly on social media posts or in customer service chats so that the assistant can determine when people are distressed or angry and respond in a way that supports and calms them (or at least doesn’t make the matter worse).

Words don’t always encode emotion (for example “thanks, that’s great” could be enthusiasm or sarcasm) and people often use smileys (emoticons) or emoji to help make their meaning clearer.

> Read our 3 minute blog post about the history of emoticons in different cultures *Emotions and Emoticons* https://bit.ly/emoticonhistory
>
> Also this 2 minute blog post about how your use of emoji can give away something about who you are. *The Emoji Crystal Ball* https://bit.ly/emojicrystalball
>
> Read our 5 minute article about making chatbots convincing *Meet the chatbots* https://bit.ly/meetthechatbots

By creating models of human emotions and the situations in which we show emotions (or how we react to others’ emotions) computer scientists can help us better understand the importance of emotions and how we use and interpret them in social situations.

Appendix 4: Variations and Extensions

Draw your own expression strips

Have the class create their own expression strips with different collections of eyes and mouths so that it can show a wider range of expressions. Perhaps draw inspiration from emoji characters which are designed to be very expressive.

Drawing new eyes and mouths is like adding an **expansion pack**, enabling more emotions or expressions to be displayed. Each new set of eyes doesn't just add one new expression but can be matched with each of the mouths to create three new pumpkin faces.

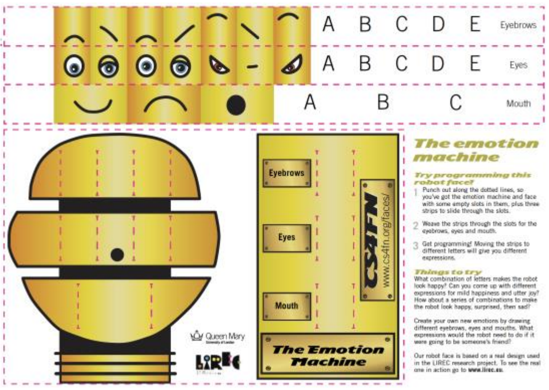
Draw your own face(s) that show expressions

Have the class / teams create a face (or even a whole puppet) of their own. As a template you can use the Program A Pumpkin or Emotion Robot for where the slots need to be. Then write and tell a story about the character changing the expressions with the story.

Download a pumpkin template: https://cs4fn.blog/pumpkinpatch/
Download an Emotion Robot template: https://bit.ly/EmotionMachineActivity

Credits

Design: Program A Pumpkin is a Hallowe'en variation of our popular Emotion Machine activity https://bit.ly/EmotionMachineActivity (developed by Paul Curzon and Peter McOwan) which lets you 'programme' different emotions. The adaptation for jam jars was inspired by Ho Huen's version using empty Pringle cans (https://bit.ly/cs4fnpringles).



The emotion machine

Try programming this robot face!

1 Punch out along the dotted lines, so you've got the emotion machine and face with some empty slots in them, plus three strips to slide through the slots.

2 Weave the strips through the slots for the eyebrows, eyes and mouth.

3 Get programming! Moving the strips to different letters will give you different expressions.

Things to try

What combination of letters makes the robot look happy? Can you come up with different expressions for mild happiness and utter joy? How about a series of combinations to make the robot look happy, surprised, then sad?

Create your own new emotions by drawing different eyebrows, eyes and mouths. What expressions would the robot need to do if it were going to be someone's friend?

Our robot face is based on a real design used in the LIREC research project. To see the real one in action go to **www.lirec.eu**.

Images: main pumpkin image (https://pixabay.com/vectors/pumpkin-winter-squash-fruits-23479/) and expressions (https://pixabay.com/vectors/pumpkins-grimaces-halloween-fall-1777667/).

Get more pumpkins from our pumpkin patch
https://cs4fn.blog/pumpkinpatch/

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