Level 6 – More complex variables: Stopwatch

Overview

In this lesson, pupils will be introduced to the concept of Booleans and how these can be helpful. They will apply this understanding to make a stopwatch, where Boolean values are affected by the stop, start and reset buttons. Their stopwatch includes both analogue and digital displays.

Learning objectives

- To create a stopwatch with stop, start, and reset buttons, and both digital and analogue displays.

Links to CAS progression pathways

Programming and development

- Executes, checks and changes programs. (AL)
- Understands that programs execute by following precise instructions. (AL)
- Understands what an algorithm is and is able to express simple linear (non-branching) algorithms symbolically. (AL)
- Detects and corrects errors, i.e. debugging in algorithms. (AL)
- Designs simple algorithms using loops and selection, i.e. if statements. (AL)
- Designs solutions (algorithms) that use repetition and two-way selection, i.e. if, then, and else. (AL)
- Uses diagrams to express solutions. (AB)
- Declares and assigns variables. (AB)
- Uses post-tested loop, e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement. (AL)

Links to Curriculum for Excellence

- I understand that sequences of instructions are used to control computing technology. (TCH 0-14a)
- I can develop a sequence of instructions and run them using programmable devices or equivalent. (TCH 0-15a)

Success criteria

ALL I can create a stopwatch that counts seconds and records minutes every 60 seconds.

MOST I can add stop, start and reset buttons to my stopwatch.

SOME I can explain how the code for my stopwatch works, including both analogue and digital displays.

Key vocabulary

Boolean, analogue, digital, variable, loop, condition

Starter

Play a game to introduce pupils to the concept of Booleans, and the idea that variables can be used to store information about whether a particular condition is true or false. Give them a piece of card and have them write 'True' on one side and 'False' on the other. Make a series of statements (e.g. I have brown hair; I was born in July; I am 11 years old), and have them hold up the card to indicate whether for them, this statement is true or false.

Ask several questions that can't be answered this way (e.g. 'What is your favourite colour?') and have pupils convert them to true/false statements (e.g. 'My favourite colour is green.').

Finally, add a condition to the game and write this on the board: 'if answer=TRUE, clap three times'; 'if answer=FALSE, sit down'. Have pupils respond to further statements accordingly.

Key questions

- Is this statement true or false?
- How could you turn this question into a true or false statement?

Main learning

If you have stopwatches in school, give pupils an opportunity to handle and use these in a variety of circumstances (e.g. they could time how long it takes a partner to do twenty star jumps, or to walk once around the classroom backwards). If this is not possible, show pupils a finished version of an app made with step 7 of the lesson, and have the class watch as you use this to time a pupil doing these actions.

Work through the first lesson step with pupils, then challenge them to think about how they could create an analogue version of the timer. Draw out that they could use code to make the angle of the second hand change, and have them help you complete this lesson step. Have them explain to a partner why the operator 'multiply by six' needs to be used.

Remind pupils of the game they played at the start of the lesson, and discuss how this idea can be applied to the stopwatch – if the timer is 'on' (i.e. the variable 'timer running' is TRUE), then the seconds and minutes will change, but if it is 'off' (the variable is FALSE), they won't. Discuss when these things should happen. Elicit from pupils that this needs to be true at the start, and false when the 'stop' button is pressed.

Consolidate understanding by having students help you finish the code for the 'start' and 'reset' buttons, before giving them the opportunity to create a timer themselves.

Using the Build step

Use the Build step to let more confident pupils build their own timer from scratch.

Key questions

- What is making the numbers change?
- What happens after 60 seconds?
- How could we use code to create this stopwatch?
- How can we make the second hand move?
- Why do we need to multiply by 6?
- When should 'timer running' be true?
- When should it be false?
- What should happen when each button is pressed?

Plenary

Repeat the timer challenges from earlier, with pupils using their own stopwatches to time their partner completing a certain task. Have them explain their code to a partner, or annotate a screenshot of the finished app, explaining the code that makes each part work.

Key questions

- How did you make the app?
- Which part of the code makes the second hand work? How?
- Can you explain your code to a partner?