

STEM Education
Learning Activity Exemplar
Belilios Public School

Learning Activity: 2D Pattern Decoder Level/ Key Stage: S3

<input checked="" type="checkbox"/> Based on topics of a KLA	<input type="checkbox"/> Project learning
KLA: <input type="checkbox"/> SE <input type="checkbox"/> ME <input checked="" type="checkbox"/> TE	

Major L&T mode/ strategies (more than 1 could be chosen):

- Enquiry learning
 Problem-based learning
 e-Learning
 Cooperative learning
 Design & make
 Direct teaching
 Others: _____

Learning objectives (include generic skills, e.g. creativity, collaborative and problem-solving skills):

Students should be able to:

1. understand the significance of encoding and decoding in information processing;
2. understand the binary representation of data in bitmap graphics;
3. integrate and apply knowledge and skills of ME KLA (number system) and TE KLA (information processing and information processing tools - spreadsheet) to design and make a 2D pattern decoder; and
4. explore the multiple uses of the spreadsheet.

Prerequisite knowledge:

1. Number system
2. Basic features of the spreadsheet

Learning difficulties:

1. Convert denary numbers to the corresponding binary numbers and vice versa
2. Master new features of the spreadsheet, e.g. MOD, RUNDOWN, conditional formatting, etc.

	Learning focus	Curriculum content/ elements involved	KLA		
			SE	ME	TE
1.	<ul style="list-style-type: none"> • Understand the binary number system and the denary number system 	Laws of integral indices		✓	
2.	<ul style="list-style-type: none"> • Information processing and information processing tools <ul style="list-style-type: none"> ▪ Spreadsheet features ▪ Multimedia elements 	(K16) Information Processing and Presentation			✓

Remarks: The school joined the STEM Education support service provided by the SBCDS Section of the EDB. This exemplar is one of the school-based learning and teaching materials developed by the school in collaboration with the Section.

Assessment:

Assessment	Assessor
<p>Students’ performance in worksheets to show their mastery of knowledge and skills</p> <ul style="list-style-type: none"> • Convert denary numbers to the corresponding binary numbers and vice versa. • Make the 2D pattern decoder using the spreadsheet. <ul style="list-style-type: none"> ▪ Adjust the correct height to width ratio to form square cells. ▪ Set the colours of the cells by conditional formatting. ▪ Make the 8x8 pattern. ▪ Test the 2D pattern decoder. • Make a “negative” 2D pattern decoder. 	<ul style="list-style-type: none"> • Teachers

<p>Brief:</p>	<p>Design and make a 2D pattern decoder using the spreadsheet.</p> <p>Tasks:</p> <ol style="list-style-type: none"> 1. Introduce the bitmap image, encoding and decoding. 2. Perform denary to binary conversions by short division and then using appropriate functions (“ROUNDDOWN” and “MOD”) of the spreadsheet. 3. Make the 2D pattern decoder using the spreadsheet. <ul style="list-style-type: none"> • Adjust the correct height to width ratio to form square cells. • Set the colours of the cells by conditional formatting. • Make the 8x8 pattern by copying and pasting the quotient row and reminder row, and hiding the quotient rows. 4. Test the 2D pattern decoder with the codes given. 5. Design own patterns and convert the patterns to codes. 6. Make a “negative” 2D pattern decoder, i.e. converting white to black and vice versa.
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Code

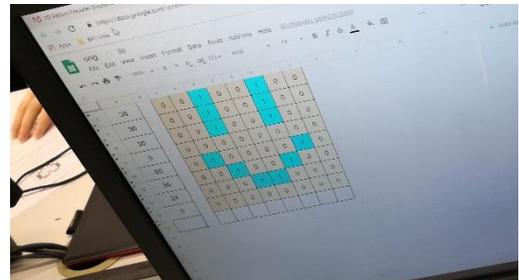
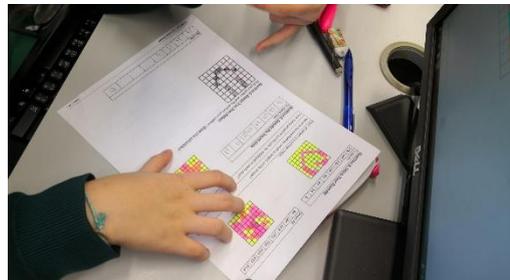
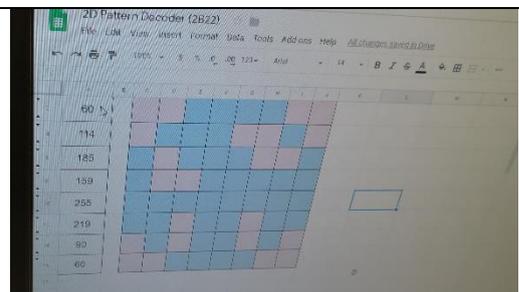
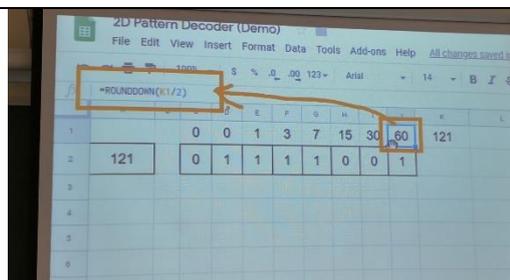
60, 102, 102, 6, 28, 24, 0, 24

Decode

The 2D pattern is decoded here

Enter the codes here

60							
102							
102							
6							
28							
24							
0							
24							



Original Pattern

Negative Pattern

How to create the negative pattern?
There are two different ways!

Class: _____ No.: _____ Name: _____

Date: _____

Question 1: Denary Number to Binary Digits ConversionConvert the denary number **49** to binary digits.

The binary digits are:

--	--	--	--	--	--	--	--

* add zero(s) at the beginning to make it a 8-digit binary number.

Question 2: Conversion by Using Spreadsheet

- a) Write down the formula for each in the following cells, and match the corresponding operation for the formula.

Cell	Formula	Operation*
K1		
J1		
J2		

* Available descriptions of operations:

- A - Compare the value in A2 with that of this cell
- B - Copy the value in A2 to this cell
- C - Show the quotient when the value in K1 is divided by 2
- D - Show the rounded-off result of the value in K1 divided by 2
- E - Show the remainder when the value in K1 is divided by 2

- b) Do you know how the functions `ROUNDDOWN` and `MOD` work? Try writing down the results of the following formulas.

Formula	Result	Formula	Result
<code>=ROUNDDOWN (3 . 5)</code>		<code>=MOD (7 , 2)</code>	
<code>=ROUNDDOWN (9 . 9)</code>		<code>=MOD (17 , 5)</code>	

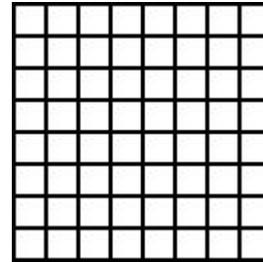
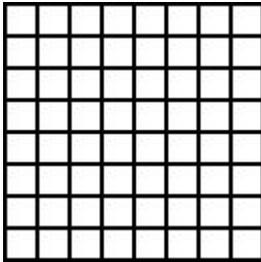
Question 3: Building a 2D Pattern Decoder

What is the row height of row 2?	
What is the column width of columns C to J?	
Are the cells C2 to J2 squares?	

Question 4: Using Your Decoder

Codes #1:							
108	146	130	130	68	40	16	0

Codes #2:							
60	126	153	221	255	255	255	219

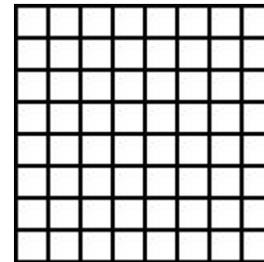


Each 2D pattern is an bitmap image...

What is the resolution (<i>width x height</i>) of the image?	
How many possible colors can be displayed in each pixel?	

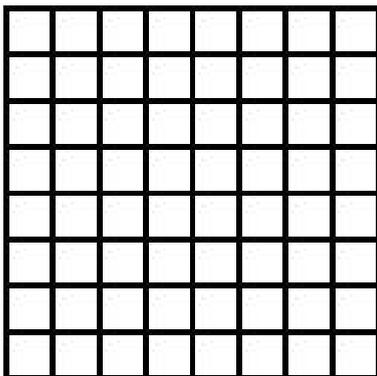
Question 5: Decode the Secret Code

The Secret Code:							



Question 6: Design Your Own Pattern

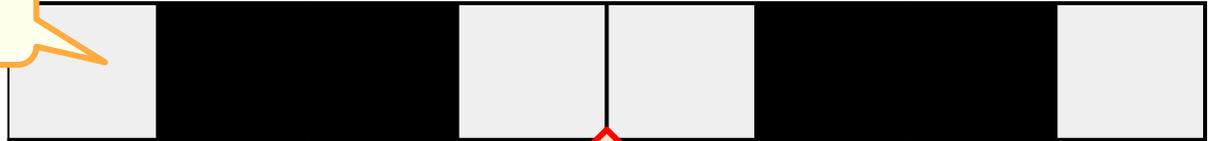
Draft your pattern and then encode your pattern! (Show your calculation)



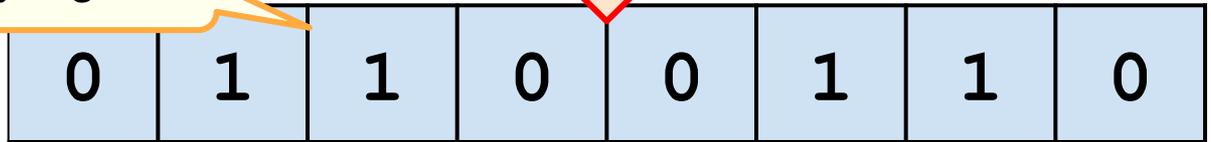
My Codes:							

Level 1 Hint (Basic)

Pick a row to encode



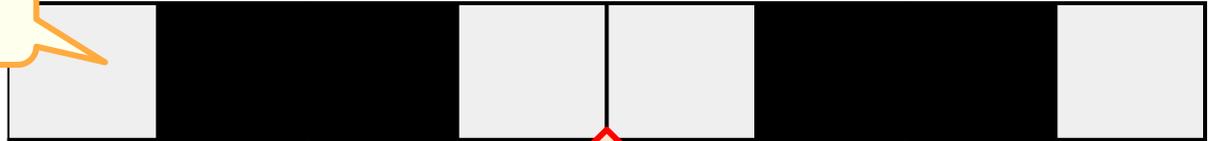
Write down the binary digits



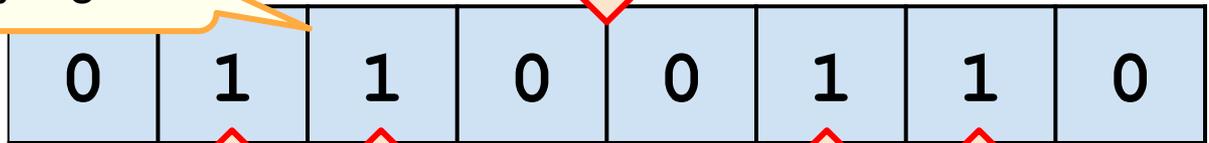
Then convert this binary number to a denary number!

Level 2 Hint (More)

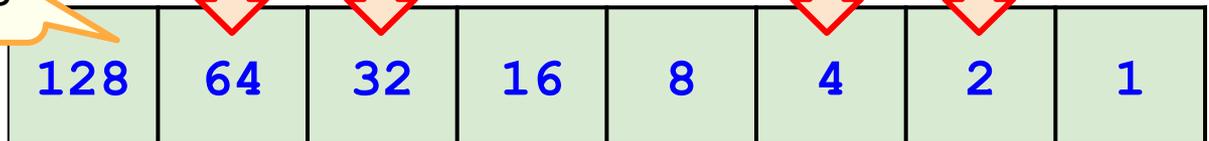
Pick a row to encode



Write down the binary digits



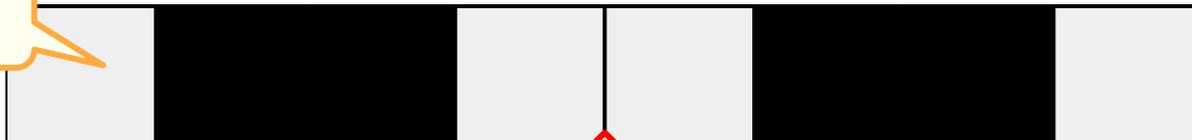
Recall the place values



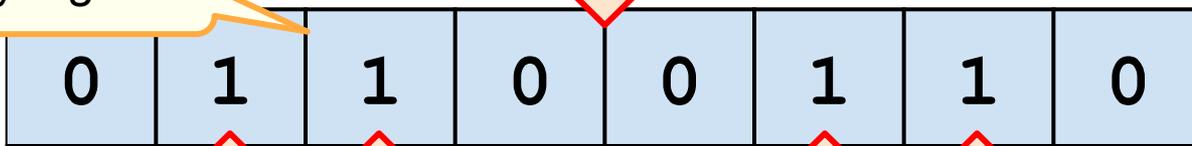
How to get the corresponding denary number?

Level 3 Hint (Complete)

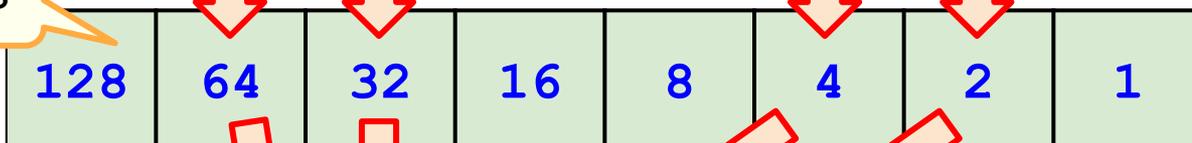
Pick a row to encode



Write down the binary digits



Recall the place values



Calculation: $64 + 32 + 4 + 2 = 102$