PDST

Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

An Roinn Oideachais
Department of Education

National Workshop 2

Sept 2022

Schedule

10:00 - 11:30	Introduction Computer Systems 1
11:30 - 12:00	Tea/Coffee
12:00 - 13:30	Computational Thinking
13.30 - 14.30	Lunch
14:30 - 16:30	PRIMM and Curriculum Planning

Key Messages

All learning outcomes (LOs) are interwoven.

This means that the specification can be used in many different ways.

Group work is a key feature in the teaching, learning and assessment of LCCS.

ALTs

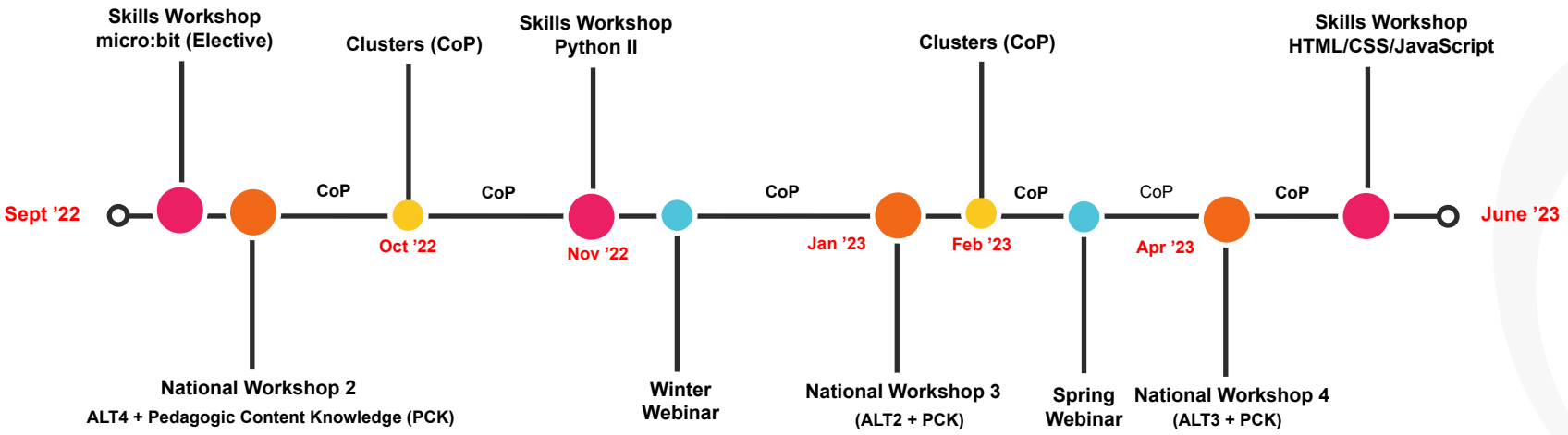
ALTs provide an opportunity to teach theoretical aspects of LCCS.

Digital technologies can be used to enhance collaboration, learning and reflection.

LCCS can be mediated through a constructivist pedagogical approach.

LCCS is a subject for everyone

Dates for your Diary for 2021/22



Next CPD event: Community of Practice cluster meetings – online early November

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Session 1

Number systems

By the end of this session :

Participants will be enabled to:

- Develop an understanding of Computational Thinking concepts such as abstraction, decomposition, algorithmic thinking and pattern recognition
- Develop a shared understanding of how *programming as a process* can be used to mediate CT in the classroom

Computational Thinking

"… the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent." (Wing 2011)

Decomposition of a decimal number

	4	3	2	1	0	
						powers of 10
Most Significant Digit	7	0	2	8	4	Least Significant Digit

Units	4×10^0	= 4
Tens	8×10^1	= 80
Hundreds	2×10^2	= 200
Thousands	0×10^3	= 0
Ten Thousands	7×10^4	= 70000

etc.

What about a binary number?

70,000 + 0,000 + 200 + 80 + 4 = 70,284

Decomposition of a binary number

Most Significant Bit (MSB)

4	3	2	1	0
1	0	0	1	1

powers of 2

Least Significant Bit (LSB)

Units	1×2^0	= 1
Twos	1×2^1	= 2
Fours	0×2^2	= 0
Eights	0×2^3	= 0
Sixteens	1×2^4	= 16

etc.

Can we do this in Python?

16 + 0 + 0 + 2 + 1 = 19

$$10011_2 = 19_{10}$$

Convert 19_{10} to base 2

$$\frac{\text{Dividend}}{\text{Divisor}} = \text{Quotient} + \text{Remainder}$$

1. Divide by 2 …. note the remainder
2. The quotient becomes the new dividend
3. Keep dividing …
4. Stop when the quotient reaches zero
5. Read the answer from the bottom up

$$\frac{19}{2} = 9 + 1$$

$$\frac{9}{2} = 4 + 1$$

$$\frac{4}{2} = 2 + 0$$

$$\frac{2}{2} = 1 + 0$$

$$\frac{1}{2} = 0 + 1$$

So, $19_{10} = 10011_2$

2	19	
2	9	+ 1
2	4	+ 1
2	2	+ 0
2	1	+ 0
2	0	+ 1

Convert 19_{10} to base 2 (again!)

1. Divide by 2 …. note the remainder
2. The quotient becomes the new dividend
3. Keep dividing …
4. Stop when the quotient reaches zero
5. Read the answer from the bottom up

2	19	
2	9	+ 1
2	4	+ 1
2	2	+ 0
2	1	+ 0
2	0	+ 1

So, $19_{10} = 10011_2$

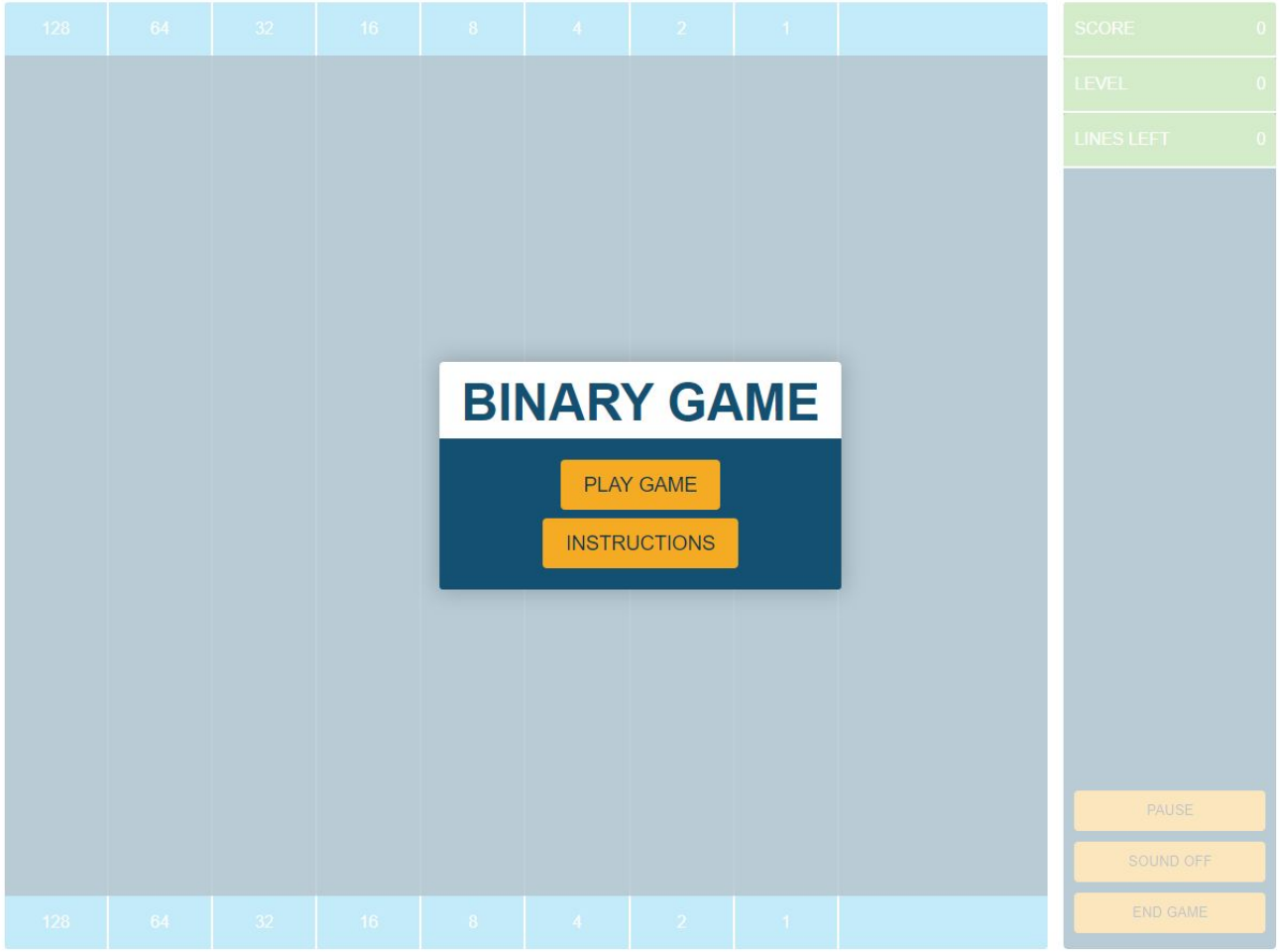
Decimal -> Binary (another example)

1. Divide by 2 …. note the remainder
2. The quotient becomes the new dividend
3. Keep dividing …
4. Stop when the quotient reaches zero
5. Read the answer from the bottom up

Convert 47_{10} to base 2

2	47
2	23 + 1
2	11 + 1
2	5 + 1
2	2 + 1
2	1 + 0
2	0 + 1

$$47_{10} = 101111_2$$

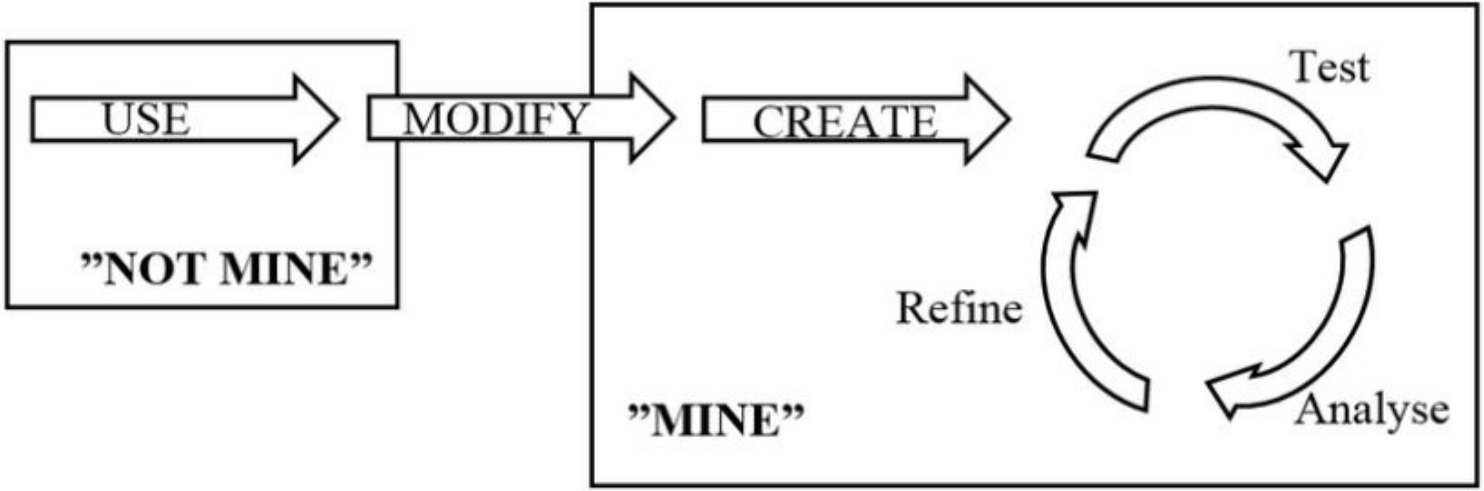


https://learningcontent.cisco.com/games/binary/index.html

5 minute stretch break

Code Along Activity

Use Modify Create



Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
print(quotient, remainder2)
# Once ...
quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

Program Tracing / Debugging

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The Notional Machine / Working Memory

```
1.  quotient = 19//2
2.  remainder1 = 19%2
3.  print(quotient, remainder1)
4.
5.  # copy+paste ...
6.  quotient = 9//2
7.  remainder2 = 9%2
8.  print(quotient, remainder2)
9.  # Once ...
10. quotient = 4//2
11. remainder3 = 4%2
12. print(quotient, remainder3)
13. # Twice ...
14. quotient = 2//2
15. remainder4 = 2%2
16.
17. # Three times ...
18. quotient = 1//2
19. remainder5 = 1%2
```

This is what is displayed ….

Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
print(quotient, remainder2)
# Once ...
quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

The Notional Machine / Working Memory

quotient: 9

This is what is displayed ….

Program Tracing / Debugging

```
1.  quotient = 19//2
2.  remainder1 = 19%2
3.  print(quotient, remainder1)
4.
5.  # copy+paste ...
6.  quotient = 9//2
7.  remainder2 = 9%2
8.  print(quotient, remainder2)
9.  # Once ...
10. quotient = 4//2
11. remainder3 = 4%2
12. print(quotient, remainder3)
13. # Twice ...
14. quotient = 2//2
15. remainder4 = 2%2
16.
17. # Three times ...
18. quotient = 1//2
19. remainder5 = 1%2
```

The Notional Machine / Working Memory

```
quotient:    9
remainder1:  1
```

This is what is displayed ….

Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
print(quotient, remainder2)
# Once ...
quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

The Notional Machine / Working Memory

```
quotient:    9
remainder1:  1
```

This is what is displayed ....

```
>>> 9 1
```

Program Tracing / Debugging

```
1.  quotient = 19//2
2.  remainder1 = 19%2
3.  print(quotient, remainder1)
4.
5.  # copy+paste ...
6.  quotient = 9//2
7.  remainder2 = 9%2
8.  print(quotient, remainder2)
9.  # Once ...
10. quotient = 4//2
11. remainder3 = 4%2
12. print(quotient, remainder3)
13. # Twice ...
14. quotient = 2//2
15. remainder4 = 2%2
16.
17. # Three times ...
18. quotient = 1//2
19. remainder5 = 1%2
```

The Notional Machine / Working Memory

quotient: ~~9~~ 4

remainder1: 1

This is what is displayed ....

>>> 9 1

Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
print(quotient, remainder2)
# Once ...
quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

The Notional Machine / Working Memory

quotient: ~~9~~ 4

remainder1: 1

remainder2: 1

This is what is displayed ....

```
>>> 9 1
```

Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
print(quotient, remainder2)
# Once ...
quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

The Notional Machine / Working Memory

quotient: ~~9~~ 4

remainder1: 1

remainder2: 1

This is what is displayed ....

```
>>> 9 1
>>> 4 1
```

Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
print(quotient, remainder2)
# Once ...
quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

The Notional Machine / Working Memory

quotient: ~~9~~ ~~4~~ 2

remainder1: 1

remainder2: 1

This is what is displayed ....

```
>>> 9 1
>>> 4 1
```

Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
print(quotient, remainder2)
# Once ...
quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

The Notional Machine / Working Memory

quotient: ~~9~~ ~~4~~ 2

remainder1: 1

remainder2: 1

remainder3: 0

This is what is displayed ….

```
>>> 9 1
>>> 4 1
```

Program Tracing / Debugging

```
quotient = 19//2
remainder1 = 19%2
print(quotient, remainder1)

# copy+paste ...
quotient = 9//2
remainder2 = 9%2
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quotient = 4//2
remainder3 = 4%2
print(quotient, remainder3)
# Twice ...
quotient = 2//2
remainder4 = 2%2

# Three times ...
quotient = 1//2
remainder5 = 1%2
```

The Notional Machine / Working Memory

quotient: ~~9~~ ~~4~~ 2

remainder1: 1

remainder2: 1

remainder3: 0

This is what is displayed ....

```
>>> 9 1
>>> 4 1
>>> 2 0
```

Group Activity: Breakout

Binary -> Decimal (1 of 2)

```
binary_number = 10011
decimal_number = 0

digit0 = 10011 % 10 # lsb
stem = 10011 // 10
print(stem, digit0)
```

How could we develop the this Python code to a general solution?

Binary -> Decimal

```
# ... convert binary 10011 to decimal ...
# ... the initial number is a string
binary_number = "10011"
# index:          01234

units    = int(binary_number[4])*1
twos     = int(binary_number[3])*2
fours    = int(binary_number[2])*4
eights   = int(binary_number[1])*8
sixteens = int(binary_number[0])*16
decimal = units+twos+fours+eights+sixteens
```

How could we develop the this Python code to a general solution?

20 minute breakout

Break

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