Elective 2C:

COMPUTATIONAL THINKING, ALGORITHM & PROGRAMMING

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Curriculum Framework

- Proposed Curriculum Framework (2025 HKDSE onward)

The Compulsory Part (144 hours)			
A. Information Processing	(37 hours)	B. Computer System Fundamentals	(20 hours)
C. Internet and its Applications	(31 hours)	D. Computational Thinking and Programming	(48 hours)
E. Social Implications	(8 hours)		

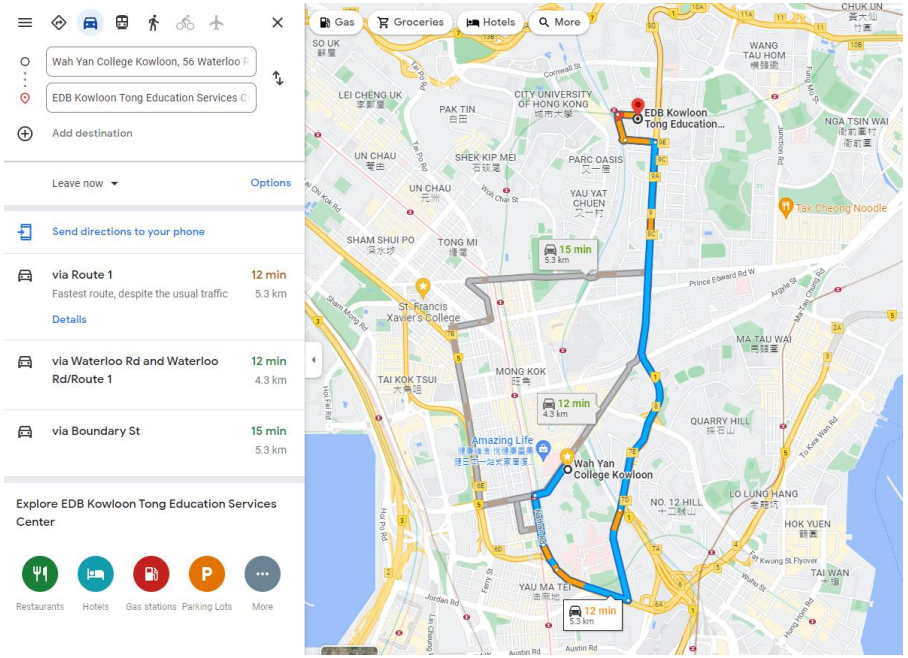
+

= 40% Lesson time + SBA

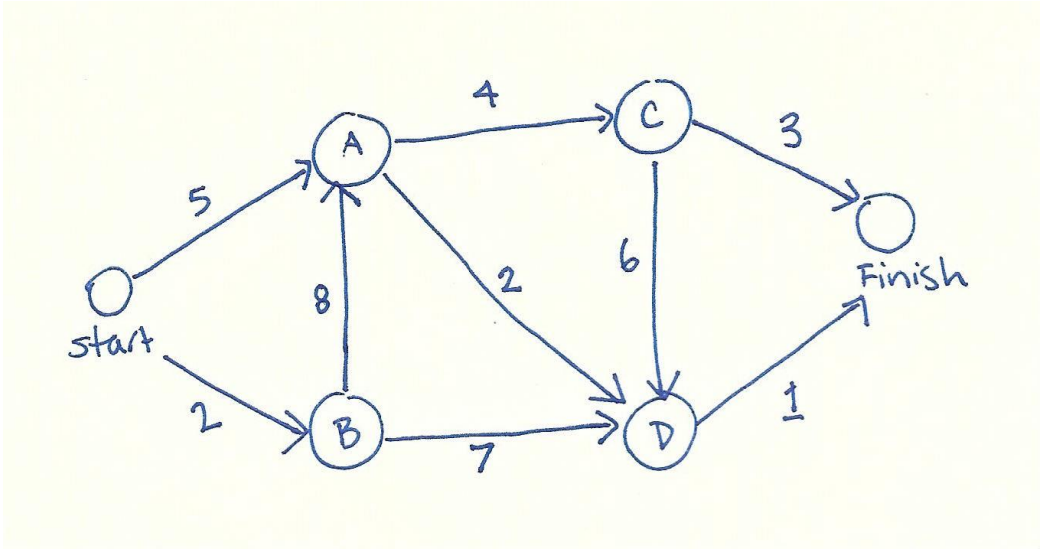
The Elective Part (76 hours) (Choose any two)		
A. *Databases*	B. *Web Application Development*	C. *Algorithm and Programming*

Reference: https://www.edb.gov.hk/attachment/en/curriculum-development/kla/technology-edu/resources/computer-edu/Curriculum_Renewal_on_SS_ICT.pdf

COMPUTATIONAL THINKING AND ALGORITHM



Google Map



Dijkstra Algorithm

(Finding the Shortest Path)

Reference: https://medium.com/@yk392/dijkstra-algorithm-key-to-finding-the-shortest-path-google-map-to-waze-56ff3d9f92f0

PROGRAMMING LANGUAGES

	Python	C++
Simplicity of language	 Simple and easy to kickstart	 A bit more difficult than Python Easier than C, VB, Java Similar to Pascal
Run time speed	 Slower as an interpreted language	 Faster as a compiled language
Usage	 Machine Learning, AI, project-based competitions	 System software, Drivers, Game development, Olympiad in informatics contests
Considerations	 May have wrong programming concept like: swapping (a,b = b,a) for loop (for x in alist:)	 More difficult to kickstart: Syntax like ‘;’ ‘{‘ ‘}’ Include libraries Declaration of variables

NUMBER OF ELECTIVE CANDIDATES

2021	Number Sat	%		2025	Number Sat	%
All	5355	100%	→	All	5355	100%
2A	710	13%	→	2A	3570	83%
2B	78	1%	→	2B	3570	40%
2C	3151	59%	↗	-	-	-
2D	1429	27%	→	2C	3570	76%

By HKEAA

By Polling & Forecasting

Reference: https://www.hkeaa.edu.hk/en/HKDSE/hkdse_subj.html?A2&2&16&A2&2&16

PROGRAMMING IN HKDSE 2025+ (2022-23 F4 ICT)

	Core	Elective 2C
Lesson time	24 hours ➔ 48 hours	75 hours ➔ 38 hours
Changes	* C++, Python, Pascal + Programming development + Testing and Debugging	* C++, Python, Pascal - Programming Languages - Systems Development + Applications of Programming in Real Life
Topics	• Variable & Constant • Data types • Input & Output • Selection (If-Then-Else) • Iteration (Single layer loop) • Array (1D) • String Manipulation • Sub-program • Basic Algorithms (Max & Min, Linear Search, etc.) • Testing & Debugging	• All topics in Core • Iteration (Nested loop) • Array (2D+) • File handling • Sub-program with parameter passing • Algorithms (Binary Search, Sorting, etc.) • Data Structures (Stack, Queue, Linked list) • Event handler • Extended modules (Sensors and devices)

Reference:
https://www.edb.gov.hk/attachment/en/curriculum-development/kla/technology-edu/resources/computer-edu/Curriculum_Renewal_on_SS_ICT.pdf
https://www.edb.gov.hk/attachment/en/curriculum-development/kla/technology-edu/curriculum-doc/ICT_C&A_Guide_e_final.pdf

PSEUDOCODE ORIENTED

[Modified from 2021 DSE ICT1B Q.3]

3. Peter designs an algorithm to encrypt an array of binary digits, A, as shown below:

```
I ← 5
while A[I] <> 1
        I ← I - 1
        A[I] ← 1 - A[I]
```

(a) Suppose that the initial content of A is:

A[1]	A[2]	A[3]	A[4]
0	0	1	1

What is the content of A after executing the algorithm?

A[1]	A[2]	A[3]	A[4]

(b) Suppose that the content of A after executing the algorithm is:

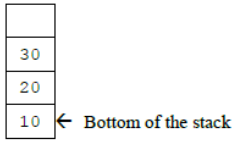
A[1]	A[2]	A[3]	A[4]
1	0	1	0

What is the initial content of A?

A[1]	A[2]	A[3]	A[4]

[DSE 2019 ICT P2D Q.1]

13. Peter uses stacks to manage boxes. Each box stores some apples. In the following example, a stack contains 3 boxes with 10, 20 and 30 apples.



Below are the operations on the stacks:

Operation	Description
Push(S, k)	Pushes a box with k apples into stack S.
Pop(S)	Removes a box from stack S and returns the number of apples in the box.
Empty(S)	Returns TRUE if stack S has no boxes in it; otherwise, returns FALSE.

(a) (i) Initially there is an empty stack A. Write down the final content of A after executing the following pseudocode. (2 marks)

```
Push(A, 10)
Push(A, 20)
TMP ← Pop(A)
if Empty(A)  then Push(A, 30)
```

(ii) Initially there is an empty stack B. Write down the final content of B after executing the following pseudocode. (2 marks)

```
Push(B, 10)
Push(B, 20)
Push(B, 30)
Push(B, Pop(B)+Pop(B))
```

Reference: HKEAA ICT 2025 Sample paper

SOME PYTHON / C++ CODE REQUIRED

(b) Complete the following program segment ALG1 to calculate the total amount, TOTAL, that Mary has spent.

(3 marks)

[Python version]

```
TOTAL = [          ]
I = 1
while I [          ] 10:
    TOTAL = [                    ]
    I = I + 1
```

[C++ version]

```
TOTAL = [          ];
I = 1;
while (I [         ] 10) {
    TOTAL = [                    ];
    I = I + 1;
}
```

Reference: HKEAA ICT 2025 Sample paper

PROBLEM 1: TECHNICAL SUPPORT

“I have no PC at home.”

“I cannot setup the IDE/SDK.”

“I am using MacOS but not Windows.”

PROBLEM 2:
DEBUGGING FOR INDIVIDUALS

“Please debug my program.”

“I don't know what's going on.”

PROBLEM 3: LEARNER DIVERSITY

“Too easy. I have finished.”

“Too difficult. I can’t finish.”

OTHER PROBLEMS:

- Cannot keep track of the learning progress
- Difficult to collect and mark the assignments
- Lack of DSE level exercises
- Etc.

Introduction to HKOI Online Judge

https://hkoi.org/

Organizer:

教育局
Education Bureau

Co-organizer:

CityU

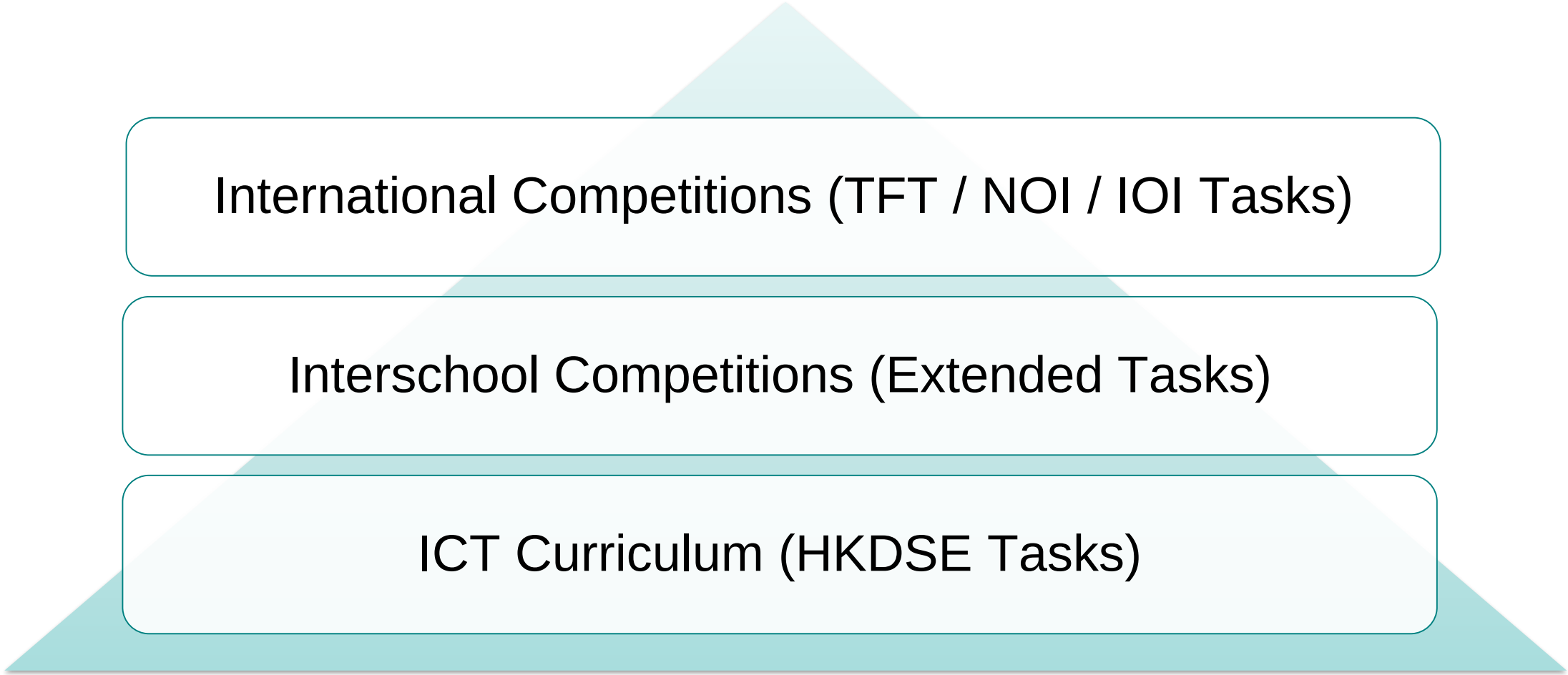
What is an Online Judge

- Interactive tool to learn programming
- Submit programs to **solve programming tasks**
- Instant automated feedback whether the program is correct
  - Black-box testing using test cases (input and expected output)
- Available **24/7**
- Can be used to host contests

Popular online judges

- Codeforces (Russia)
- CodeChef / HackerRank (India)
- AtCoder (Japan)
- TopCoder (United States)

- However, none of these are tailored for / suitable for Hong Kong secondary school curriculum



Professional Ladder

HKOI Online Judge

Schools can subscribe to HKOI Online Judge to make the platform available to the students.

2020/21 subscribers:

44 schools

Free license available for full-time teachers

	Trial (Unlimited time)	Individual Student License	School License (Basic version)	School License (Full version)
License Fee for Year 2021/22	Free	Refer to www.hkoi.org		
Student licenses	N/A			
Full-time teacher licenses	Up to 3			
Instructor licenses	N/A			
Features	All existing features that were available in 2020/21			+ Task hosting

DEMO