

AN6007 ADVANCE PROGRAMMING

Nov 2025 – Feb 2026

Group Project (20%)

Presentation (5%), Class Participation(In-class group discussions 5%+Peer Appraisal 5%)

Release Date : 8 Jan 2026 Due: 12 Feb 2025 (Thursday) 8 pm (no way for extension)

Please note that all members will receive the same group project score for this project, however, if any member's peer appraisal grading falls below satisfactory level, the member will only get a portion of the group score. Hence groups are to maintain the group dynamics well. There is also 15% individual components on top of the group project score, namely 5% for individual during project presentation(student will get 0 for this if absent on presentation day, no remote allowed) , 5% for participations in class during project group discussions and 5% from Peer Appraisal.

Points to Note:

1. You are supposed to use data structures and algorithms to solve this business case
2. You are supposed to include OOP in your solution.
3. You are supposed to maintain in-memory data structures and flat-files (or json or noSQL) to support any server reboot, SQL databases are not required in this project.
4. Generative AI may be used for improvements on proposed solution only and NOT to generate the solution.

Submission instructions:

1. Only 1 submission is required for every group.
2. Each group supposed to submit all programs and installation guides. Any project that is not able to implement on the testing platform will have marks deducted.
3. Each group should prepare a report in .docx format to outline the solution features, any current inefficient operations detected in the current system; and proposals to resolve the issues. Should the group has made use of generative AI in the improvements on their very own solutions, documentations on justification of the use, original codes, print screens of the generative AI platform suggested codes and the learning reflections on the use must be attached for assessment.
4. Everyone must keep a copy of the final version of the group submission and be prepared to answer queries on the submission or provide it upon request.
5. Any student or entire group may be invited for code verification or further demos

The University treats outsourcing, plagiarism, collusion, theft of other group's work and other forms of dishonesty in assessment seriously.

Case Background (continue with individual assignment):

As announced in Budget 2025, all Singaporean households will receive an additional \$800 in CDC Vouchers to help with daily expenses. The vouchers are distributed in two tranches — \$500 in May 2025 and \$300 in January 2026.

This is in addition to the \$300 CDC Vouchers given on 3 January 2025. Therefore, all Singaporean households will receive a total of \$800 CDC Vouchers in 2025.

The process for claiming and spending the vouchers remains the same. Only one household member with a Singpass account needs to claim the vouchers on behalf of the entire household. Visit go.gov.sg/cdcv, select CDC Vouchers Scheme 2025 (May), and login with Singpass to claim the vouchers.

Both the CDC Vouchers 2025 (January) and CDC Vouchers 2025 (May) are valid till 31 December 2025.

To learn more details, you may [get started](#) here.



You are tasked to

1. You are required to design appropriate classes and design the in-memory data structure for the CDC redemption. You may assume that the memory is huge enough to support all objects. You are encouraged to design an appropriate data structure so that the house redemption balance may be retrieved quickly.
2. Design and implement APIs to support the following:
 - a. Household Account Registration
 - You are required to design both the class and the file structure for persistence storage; you may consider using MongoDB for data retention

b. Merchant Account Registration

- The data is to be stored as a .txt file, the meta data is given before as:

Meta data and Sample of Merchant.csv

Merchant_ID : Unique identifier for the merchant

Merchant_Name: Name of the merchant

UEN: Unique transaction reference

Bank_Name : Full name of the bank

Bank_Code : Unique code assigned to each bank (used in GIRO/FAST systems)

Branch_Code: Code for the specific branch (used for account activation)

Account_Number : Bank account number for reimbursement

Account_Holder_Name: Registered name of the account holder

Registration_Date : Date the merchant registered with CDC

Status: Current status (e.g., Active, Pending, Suspended)

Merchant_ID,Merchant_Name,UEN,Bank_Name,Bank_Code,Branch_Code,Account_Number,Account_Holder_Name,Registration_Date,Status

M001,ABC Minimart,201234567A,DBS Bank Ltd,7171,001, 123-456-789,ABC Minimart Pte Ltd,2025-10-01,Active

M002,XYZ Bakery,201234568B, DBS Bank Ltd,7171,001, 987-654-321,XYZ Bakery LLP,2025-10-01,Active

M003,Happy Mart,201234569C, DBS Bank Ltd,7171,001, 456-789-123,Happy Mart Pte Ltd,2025-10-02,Active

M004,Sunshine Grocers,201234570D,Maybank Singapore,7091,001,4567890123,Sunshine Grocers Pte Ltd,2025-10-02,Active

M005,Green Leaf Cafe,201234571E,Standard Chartered,7302,001,5678901234,Green Leaf Cafe LLP,2025-10-03,Active

...

M050,Fresh Picks Market,201234616Z,HSBC Singapore,7375,146,9876543210,Fresh Picks Market Pte Ltd,2025-10-31,Active

-

c. Voucher Claim

- Take note that the vouchers are distributed in tranches, hence, the registered household will claim the vouchers for use by tranches.

- Any one of the members in a family can claim the vouchers, but anyone in the family with the link can redeem the vouchers.

For the May 2025 tranche (\$500), households received vouchers in \$2, \$5, and \$10 denominations. For the January 2026 tranche (\$300), households also received vouchers in \$2, \$5, and \$10 denominations. The exact breakdown by denomination (how many vouchers of each value) was specified by the CDCs and People's Association.

Here's the detailed breakdown:

Here's the detailed breakdown:			
Tranche	Total Value	Denominations	Number of Vouchers
May 2025	\$500	\$2	50 vouchers
		\$5	20 vouchers
		\$10	30 vouchers
January 2026	\$300	\$2	30 vouchers
		\$5	12 vouchers
		\$10	15 vouchers

d. Extracting Redemption Balance

- Depending on your design in (a) & (c), the implementation may differ.

e. Redemption

- Update any data you think is appropriate to ensure data accuracy for subsequent (d)
- The redeemed data is to be stored as a .txt file to be processed for payment to merchant(practical assignment), the meta data is given before as:

Meta data and Sample of Redemptions.csv

This file contains the vouchers being used every hour in a csv file with naming RedeemYYYYMMDDHH.csv:

Transaction_ID : Unique transaction reference

Household_ID: Unique identifier for the CDC voucher household

Merchant_ID: Unique merchant identifier

Transaction_Date_Time: Date/time in YYYYMMDDhhmmss of voucher redemption

Voucher_Code: Code of the redeemed voucher (voucher code will not be unique by itself unless concatenate with Household_ID)

Denomination_Used: Specific voucher denomination used (for non supermarket vendor is \$2, \$5, \$10)

Amount_Redeemed: Total amount redeemed in the transaction

Payment_Status: Status of reimbursement (e.g., Completed, Pending)

Remarks: Notes (e.g., “Final denomination used” for the last voucher used within same transaction, otherwise serialise starting with 1,2,3 ...)

Transaction_ID,Household_ID,Merchant_ID,Transaction_Date_Time,Voucher_Code,Denomination_Used,Amount_Redeemed,Payment_Status,Remarks

TX1001,H52298800781,M001,2025-11-02-081532,V0000001,\$2.00,\$6.00,Completed,1

TX1001,H52298800781,M001,2025-11-02-081533,V0000002,\$2.00,\$6.00,Completed,2

TX1001,H52298800781,M001,2025-11-02-081540,V0000003,\$2.00,\$6.00,Completed,Final denomination used

TX1002,H43300200219,M002,2025-11-02-095533,V0000022,\$5.00,\$5.00,Completed,Final denomination used

TX1003,H42801000000,M003,2025-11-02-095953,V0000030,\$10.00,\$10.00,Completed,Final denomination used

TX1004,H57951400202,M004,2025-11-02-121533,V0000004,\$2.00,\$8.00,Completed,1

TX1004,H57951400202,M004,2025-11-02-141018,V0000005,\$2.00,\$8.00,Completed,2

TX1004,H57951400202,M004,2025-11-02-151520,V0000006,\$2.00,\$8.00,Completed,3

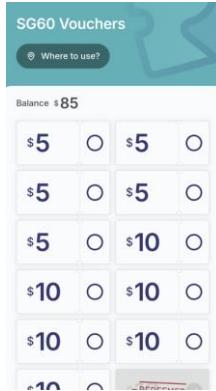
TX1004,H57951400202,M004,2025-11-02-235512,V0000007,\$2.00,\$8.00,Completed,Final denomination used

TX1005,H09004006377,M005,2025-11-02-235907,V0000005,\$5.00,\$5.00,Completed,Final denomination used

TX1006,H09004006377,M001,2025-11-02-235908,V0000004,\$2.00,\$2.00,Completed,Final denomination used

TX1007, H57951400202,M005,2025-11-02-235927,V0000008,\$2.00,\$2.00,Completed,Final denomination used

3. A mobile application that can load the redemption balance of a registered household and allow selection of balanced denominations for redemptions



*The generation of QR code and scanning of the QR code is **NOT** in the scope of this project, however, to ensure the scanning of QR code by merchant is successfully carried out, you are required to do a study on how QR codes are generated and perform any required coding to ensure the merchant's scanning and API call for redemption.*

In this development you DO NOT have to implement a 'call-back' after the merchant scanned the redemption, you may make use of a 're-fresh' to ensure the redemption is successful.

An equivalent implementation on barcode is as follows :



Generate a Barcode (EAN13) in Python

Install

```
pip install python-barcode
```

Code

Pybeginners

```
from barcode import EAN13
from barcode.writer import ImageWriter

code = EAN13("5901234123457", writer=ImageWriter())
filename = code.save("ean13_barcode")
```

EAN13 Barcode

5901234123457

4. A backend server program to host all APIs and re-instate any in-memory data structure in case of system re-start.
5. A simple relevant dashboard for any 1 stakeholder to obtain some insight from the available data.

Deliveries :

1. All programs with the corresponding installation guides if any.
2. A documentation containing:
 - a. Job distribution and contribution within group members
 - b. The project milestones, the completion status, any issues and recommendations to improvements
 - c. API definitions
 - d. Sub solutions features and illustrations
 - e. The analytics goal and illustrations.

- f. Generative AI consultations Logs:
 - i. The need
 - ii. The original codes
 - iii. The suggested codes from generative AI platform
 - iv. The final amendments and adopted codes with learning take-aways.

Presentation :

The entire group is given 10 mins to present on the last lesson. Each member has at most 10 mins. In your presentation, you are required to demo your solutions and focus on explaining:

- 1. how and why, you have selected on the data structure that will support this business case.
- 2. how do you perform testing to ensure your solution is working fine.
- 3. how do you ensure the system continue to work if the server restarts
- 4. who is your analytics target audience? What is the value of the analytics?

You should illustrate that your solution works.

You also required to share the challenges you encountered and how you overcome the issues.

The duration of the presentation should not be more than 10 mins per group (or 2 mins per person).

You are advised to adhere to the time limit strictly.

Please note that if you are not able to complete the entire assignment, you are still required to share your assignment journey as it is graded separately from the codes.

Each of you are required to take part in the presentation, with appropriate presentation materials or illustrations. You are advised NOT to read out from scripts while presenting.

Marking Guide : please refer to appendix below

Project Guide Book

Week 7 Project Kick Off / Prepare Use cases - Partial submission required

Week 8 API design and development - Partial submission required

Week 9 Front end Application Development

Week 10 Mobile Application Development

Week 11 Project Integrated testing

Week 12 Project Presentation

Appendix 1 – Group Project

Traits	Performance										
Demonstrates understanding in algorithms and advance data structures.	Not Yet Does not demonstrate understanding of advanced data structures and not able to implement correct algorithm to the given class.	Substantially Developed Able to implement optimised algorithms with the use of advance data structures to solve the given problem.									
	Evaluation: Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed										
Devise strategies to construct proper solutions	Not Yet No suitable solution was developed to suitably address the requirements.	Substantially Developed Well-constructed solution and code and formed comprehensive analysis which examine the requirements from different perspectives.									
	Evaluation: Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed										

Appendix 2 – Group Project Presentation

Traits	Performance														
Communication	Not Yet Central message is not explicitly stated in the report. Main points are not clearly identified.	Substantially Developed Central message is precisely stated; main points are clearly identified.					Effectively communicate the ideas.								
Outcome	Audience unsure of the direction of the message.														
	Evaluation:														
	Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed														
Communication	Not Yet No clear structure, no explanation for solution.	Substantially Developed Organizational pattern is clearly and consistently observable and makes the													
Structure	Organizational pattern (specific introduction and conclusion, sequenced materials within the body, and transitions) is not observable.					content of the report cohesive.									
	Evaluation:														
	Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed														

Appendix 3 – Peer Evaluation

Teamwork & Interpersonal Skills Rubric (For Peer Rating)

Learning Objective: The ability to work effectively with others in a group setting.

Traits	Performance										
	Evaluation: Not Yet 1 2 3 4 5 6 7 8 9 10 Substantially Developed										
	Not Yet					Substantially Developed					
<u>Roles and Responsibility</u> Behaves professionally by upholding responsibility and assuming accountability for self and others in progressing towards the team's goal.	Unclear about his/her own role; refuses to take a role in the group; insists to work individually and has limited coordination or communication with others.					Always fulfills responsibilities; performs his/her role within the group with enthusiasm and demonstrates willingness to work collaboratively.					
<u>Communication</u> Identifies appropriate mechanisms to coordinate and correspond with team members.	Modes of communication are not appropriate, causing confusion and miscommunication among team members.					Modes of communication are appropriate, and maintain timely communication and correspondence with team members.					
<u>Conflict Resolution</u> Resolves conflicts using a variety of approaches.	Does not recognize conflicts or is unwilling to resolve conflicts.					Consistently resolves conflicts through facilitating open discussion and compromise.					
<u>Contributions</u> Contributes positive input for the team; effectively utilizes one's knowledge and expertise.	Largely disinterested in working in a group and refuses to participate; observes passively or is unwilling to share information with other team members.					Actively attends and participates in all activities and provides meaningful contribution in articulating ideas and opinions.					
<u>Relationship</u> Maintains cooperative interaction with other team members regardless of individual /cultural differences and respects diverse perspectives.	Rarely listens to others and does not acknowledge the opinions that differ from his/her own.					Engages in respectful relationships with all other members in the team. Embraces and accepts diverse points of view without prejudice.					

References:

- *Teamwork Value Rubric - Association of American Colleges and Universities.* Retrieved from <http://www.aacu.org/value/rubrics/pdf/teamwork.pdf>

Appendix 4

Sample Bankcode.csv

Bank_Code : Unique code assigned to each bank (used in GIRO/FAST systems)

Bank_Name : Full name of the bank

Branch_Code: Code for the specific branch (used for account activation)

Branch_Name: Name of the branch

SWIFT_Code: International identifier for wire transfers

Remarks: Notes on transaction support (e.g., FAST/GIRO enabled)

Bank_Code,Bank_Name,Branch_Code,Branch_Name,SWIFT_Code,Remarks

7171,DBS Bank Ltd,001,Main Branch,DBSSSGSG,FAST/GIRO Enabled

7339,OCBC Bank,501,Tampines Branch,OCBCSGSG,FAST/GIRO Enabled

7761,UOB Bank,001,Raffles Place,UOVBSGSG,FAST/GIRO Enabled

7091,Maybank Singapore,001,Main Branch,MBBESGSG,FAST/GIRO Enabled

7302,Standard Chartered Bank,001,Main Branch,SCBLSGSG,FAST/GIRO Enabled

7375,HSBC Singapore,146,Orchard Branch,HSBCSGSG,FAST/GIRO Enabled

7171,POSB Bank,081,Toa Payoh Branch,DBSSSGSG,FAST/GIRO Enabled

9465,Citibank Singapore,001,Main Branch,CITISGSG,FAST/GIRO Enabled

7083,RHB Bank Berhad,001,Main Branch,RHBBSGSG,FAST/GIRO Enabled

7012,Bank of China Singapore,001,Main Branch,BKCHSGSG,FAST/GIRO Enabled

Merchant.csv

Merchant_ID : Unique identifier for the merchant

Merchant_Name: Name of the merchant

UEN: Unique transaction reference

Bank_Name : Full name of the bank

Bank_Code : Unique code assigned to each bank (used in GIRO/FAST systems)

Branch_Code: Code for the specific branch (used for account activation)

Account_Number : Bank account number for reimbursement

Account_Holder_Name: Registered name of the account holder

Registration_Date : Date the merchant registered with CDC

Status: Current status (e.g., Active, Pending, Suspended)



Nanyang Business School

Merchant_ID,Merchant_Name,UEN,Bank_Name,Bank_Code,Branch_Code,Account_Number,Account_Holder_Name,Registration_Date,Status

M001,ABC Minimart,201234567A,DBS Bank Ltd,7171,001, 123-456-789,ABC Minimart Pte Ltd,2025-10-01,Active

M002,XYZ Bakery,201234568B, DBS Bank Ltd,7171,001, 987-654-321,XYZ Bakery LLP,2025-10-01,Active

M003,Happy Mart,201234569C, DBS Bank Ltd,7171,001, 456-789-123,Happy Mart Pte Ltd,2025-10-02,Active

M004,Sunshine Grocers,201234570D,Maybank Singapore,7091,001,4567890123,Sunshine Grocers Pte Ltd,2025-10-02,Active

M005,Green Leaf Cafe,201234571E,Standard Chartered,7302,001,5678901234,Green Leaf Cafe LLP,2025-10-03,Active

...

M050,Fresh Picks Market,201234616Z,HSBC Singapore,7375,146,9876543210,Fresh Picks Market Pte Ltd,2025-10-31,Active

Redemptions.csv containing the vouchers being used every hour in a csv file with naming RedeemYYYYMMDDHH.csv:

Transaction_ID : Unique transaction reference

Household_ID: Unique identifier for the CDC voucher household

Merchant_ID: Unique merchant identifier

Transaction_Date: Date of voucher redemption

Voucher_Code: Code of the redeemed voucher (voucher code will not be unique by itself unless concatenate with Household_ID)

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Amount_Redeemed: Total amount redeemed in the transaction

Payment_Status: Status of reimbursement (e.g., Completed, Pending)

Remarks: Notes (e.g., "Final denomination used" for the last voucher used within same transaction, otherwise serialise starting with 1,2,3 ...)

Transaction_ID,Household_ID,Merchant_ID,Transaction_Date,Voucher_Code,Denomination_Used,Amount_Redeemed,Payment_Status,Remarks

TX1001,H52298800781,M001,2025-11-02,V0000001,\$2.00,\$6.00,Completed,1

TX1001,H52298800781,M001,2025-11-02,V0000002,\$2.00,\$6.00,Completed,2

TX1001,H52298800781,M001,2025-11-02,V0000003,\$2.00,\$6.00,Completed,Final denomination used

TX1002,H43300200219,M002,2025-11-02,V0000022,\$5.00,\$5.00,Completed,Final denomination used

TX1003,H4280100000,M003,2025-11-02,V0000030,\$10.00,\$10.00,Completed,Final denomination used

TX1004,H57951400202,M004,2025-11-02,V0000004,\$2.00,\$8.00,Completed,1

TX1004,H57951400202,M004,2025-11-02,V0000005,\$2.00,\$8.00,Completed,2

TX1004,H57951400202,M004,2025-11-02,V0000006,\$2.00,\$8.00,Completed,3

TX1004,H57951400202,M004,2025-11-02,V0000007,\$2.00,\$8.00,Completed,Final denomination used

TX1005,H09004006377,M005,2025-11-02,V0000005,\$5.00,\$5.00,Completed,Final denomination used

Singapore district Information:

Postal District	Postal Sector (1st 2 digits of postal codes)	General Location
01	01, 02, 03, 04, 05, 06	Raffles Place, Cecil, Marina, People's Park
02	07, 08	Anson, Tanjong Pagar
03	14, 15, 16	Queenstown, Tiong Bahru
04	09, 10	Telok Blangah, Harbourfront
05	11, 12, 13	Pasir Panjang, Hong Leong Garden, Clementi New Town
06	17	High Street, Beach Road (part)
07	18, 19	Middle Road, Golden Mile
08	20, 21	Little India
09	22, 23	Orchard, Cairnhill, River Valley
10	24, 25, 26, 27	Ardmore, Bukit Timah, Holland Road, Tanglin
11	28, 29, 30	Watten Estate, Novena, Thomson
12	31, 32, 33	Balestier, Toa Payoh, Serangoon
13	34, 35, 36, 37	Macpherson, Braddell
14	38, 39, 40, 41	Geylang, Eunos
15	42, 43, 44, 45	Katong, Joo Chiat, Amber Road

Postal District	Postal Sector (1st 2 digits of postal codes)	General Location
16	46, 47, 48	Bedok, Upper East Coast, Eastwood, Kew Drive
17	49, 50, 81	Loyang, Changi
18	51, 52	Tampines, Pasir Ris
19	53, 54, 55, 82	Serangoon Garden, Hougang, Punggol
20	56, 57	Bishan, Ang Mo Kio
21	58, 59	Upper Bukit Timah, Clementi Park, Ulu Pandan
22	60, 61, 62, 63, 64	Jurong
23	65, 66, 67, 68	Hillview, Dairy Farm, Bukit Panjang, Choa Chu Kang
24	69, 70, 71	Lim Chu Kang, Tengah
25	72, 73	Kranji, Woodgrove
26	77, 78	Upper Thomson, Springleaf
27	75, 76	Yishun, Sembawang
28	79, 80	Seletar

* Source – Urban Redevelopment Authority (URA) of Singapore

[District Code and District Map of Singapore with Postal Codes as reference](#)

Appendix 5: QR codes

How QR Codes Are Generated:

QR codes are essentially **2D barcodes** that encode data (text, numbers, or binary).

- **Structure:** They use black and white squares arranged in a grid.
- **Encoding:** Data is converted into binary, then mapped into the grid with error correction (Reed–Solomon codes).
- **Capacity:** A QR can hold up to ~4,296 alphanumeric characters.
- **Error Correction:** QR codes can still be read if partially damaged, thanks to redundancy.

👉 Example of encoded data:

ID: 12345 Total: 56.00 Items: 1. Pen, Qty: 2, Unit: 1.50 2. Notebook, Qty: 1, Unit: 5.00 3. Bag, Qty: 1, Unit: 48.00

This text (or JSON/XML format) is converted into binary and embedded in the QR grid.

◆ 2. How QR Codes Are Generated

- **Libraries/Tools:** In Python, you can use qrcode or segno.
- **Process:**
 1. Prepare the data (string, JSON, or URL).
 2. Pass it to the QR generator.
 3. Output an image (PNG, SVG, etc.).

👉 Example in Python:

```
import qrcode
data = { "transaction_id": "TXN12345", "total": 56.00, "items": [ {"id": "001", "name": "Pen", "qty": 2, "unit_price": 1.50}, {"id": "002", "name": "Notebook", "qty": 1, "unit_price": 5.00}, {"id": "003", "name": "Bag", "qty": 1, "unit_price": 48.00} ] }
qr = qrcode.make(str(data))
qr.save("payment_qr.png")
```

This produces a QR image that encodes the transaction details.

◆ 3. How QR Codes Are Implemented for Scanning

- **Scanning Device:** A phone camera or POS scanner reads the QR.
- **Decoding:** The scanner extracts the encoded text/JSON.
- **Integration:** The payment app or POS system interprets the data:
- Identifies the **transaction ID**.
- Reads the **items, quantities, and prices**.

- Confirms the **total**.
- Initiates payment (e.g., via wallet, bank, or card).
- ◆ 4. Illustration: QR Payment Workflow

Imagine you're at a bookstore checkout:

1. Merchant System Generates QR:

- Transaction ID: TXN12345
- Items: Pen ×2, Notebook ×1, Bag ×1
- Total: \$56.00

2. QR Code Displayed:

- Printed on receipt or shown on POS screen.

3. Customer Scans QR:

- Their mobile wallet app decodes the QR.
- It shows:

Transaction: TXN12345 Items: Pen (2 × \$1.50) Notebook (1 × \$5.00) Bag (1 × \$48.00) Total: \$56.00

4. Payment Confirmation:

- Customer approves payment.
- Merchant receives confirmation.

◆ 5. Why QR Works Well for Payments

- **Offline-friendly:** No need for internet at the merchant side.
- **Secure:** Encodes transaction IDs, not sensitive card data.
- **Flexible:** Can include itemized bills, discounts, or loyalty points.
- **Universal:** Works across wallets, banks, and POS systems.

💡 So in short: QR codes are just **encoded strings/images**. For payments, they carry structured transaction data (ID, items, prices). The scanner decodes it, and the payment system processes it.