

# COMP 53: Project, Part 1

## Instructions:

**In this project, we are going to focus on the design of the data structures for a specific application**

- This project should be done individually.
- At the top of your source code files have your name as a comment.
- Each student should individually submit the project in Canvsd.
- You must submit a zipped folder of your whole project.

## 1) Project focus

- The focus of this project is on the deployment of the data structures.
- Try to design the best and the most efficient structure for the given problem.
- The classes should be designed to use efficient and meaningful inheritance.
- No piece of program should be recoded. Use overriding as required.
- Pay attention to inheritance versus composition (“is a” vs. “has a” relation) and avoid unnecessary inheritance.
- Define the access level of the variables efficiently. Each variable should only be directly accessible in necessary areas.
- Any action should be followed with a reasonable message to describe the service and the result of it.
- The layout and design of the output should also be clear for the user. Check Section 3 for a recommended output format, which provides menu of choices that the user can select using single character short keys.

## 2) Project description

The main goal of this project is to create a bank and service the customers with basic operations.

The direct user of this program is a bank employee which uses the program to provide services to the bank customers. In the following, different entities that this application deals with are described.

**a) Bank**

- i) Bank has a *name*.
- ii) It has an *address*
- iii) The bank has *working hours*
- iv) Each customer can open a *bank account* in the bank.
- v) Each bank account consists of potentially multiple **saving sub-accounts** and **checking sub-accounts**.
- vi) Bank offers a *\$100 bonus* to the first saving sub-account of each customer.
- vii) Customers should be able to *deposit* to or *withdraw* from their sub-accounts.
- viii) A bank should be able to tell the *number of bank accounts* that it has
- ix) A bank should be able to tell the *number of saving sub-accounts* that it has
- x) A bank should be able to tell the *number of checking-accounts* that it has
- xi) It should be able to show the information of its accounts *sorted* based on their balances
- xii) It should provide a menu for the bank employee to choose from different services
  - (1) See the number of bank accounts
  - (2) See the number of saving accounts
  - (3) See the number of checking accounts
  - (4) Open a bank account
  - (5) Close a bank account using its bank account number.
  - (6) See information of an account and modify it based on its account number
  - (7) See detailed information of all of the accounts
  - (8) See brief information of all of the accounts sorted based on their aggregated balance. Just show the account number and the aggregated balance for each account.

**b) Bank account**

- i) A bank account has an unique *account number* starting from *BNK10000*
- ii) A bank account has the information of the customer like *first name*, *last name*, and *SSN*
- iii) It can have none, one, or multiple *saving sub-accounts*
- iv) It can have none, one, or multiple *checking sub-accounts*
- v) While modifying a bank account, the following services should be provided:
  - (1) Open saving sub-account
  - (2) Open checking sub-account
  - (3) Modify a sub-account
  - (4) Close a sub-account
  - (5) Detailed bank account info with its sub-accounts sorted based on their balances
  - (6) Brief bank account info

**c) Saving sub-account**

- i) A saving sub-account has a *saving sub-account number*
- ii) Each saving sub-account number is *unique* and starts from *SAV1000*
- iii) It has a *balance* that a customer can *deposit* to or *withdraw* from
- iv) While modifying a saving sub-account the following services should be provided:
  - (1) Deposit
  - (2) Withdraw

**d) Checking sub-account**

- i) A checking sub-account has a *checking sub-account number*
- ii) Each checking sub-account is *unique* and starts from *CHK6000*
- iii) A *maximum capacity* can be set on it defined by the customer
- iv) A checking sub-account can be *locked* or unlocked by user request
- v) It has a balance that a customer can *deposit* to or *withdraw* from
- vi) If the account is locked, no deposit or withdraw must be allowed

vii) If a deposit would cause the balance to exceed the maximum capacity, it should be denied

viii) While modifying a checking sub-account the following services should be provided:

- (1) Deposit
- (2) Withdraw
- (3) Set max capacity
- (4) Lock sub-account
- (5) Unlock sub-account

### **3) Possible output**

In the following a demo of the application is given, which describes the following actions in a step by step fashion.

1. First, a bank is created by setting its name, address and working hours.
2. A bank account is created for customer Bill Stevenson, with a hypothetical SSN.
3. A saving account with initial balance \$100 is opened for this customer. In addition, a locked checking account is opened for the same customer with initial balance \$100, and maximum capacity \$120.
4. Brief and detailed bank account info is printed for the aforementioned account.
5. Saving account is modified by depositing \$100 and then withdrawing \$75.
6. Checking account is modified by depositing \$45 and then withdrawing \$20. Since the checking account is locked, both of these operations are rejected.
7. Checking account is unlocked. Then, depositing \$50 and withdrawing \$23 is done successfully.
8. For the same customer, a second saving account with initial balance \$240 is created and then closed.
9. Brief and detailed bank account info is printed for the aforementioned account.
10. Next, a second bank account is created for customer Andy Scott, with a hypothetical SSN. A saving account with initial balance \$350 is opened for this account.
11. Finally, general information about the bank is queried. These information include
  - a. Total number of bank accounts
  - b. Total number of saving accounts
  - c. Total number of checking accounts
  - d. Brief and detailed information about the existing bank accounts within the bank.

```
Enter the name of the bank: Student Bank Co.
Enter the address of the bank: 1 Main St., Stockton, CA 95201
Enter the working hours: Mon - Fri 8:00am - 5:00pm

Eligiable services for Student Bank Co.
  A -- Number of Bank-Accounts
  S -- Number of Saving-Accounts
  H -- Number of Checking-Accounts
  O -- Open Bank-Account
  C -- Close Bank-Account
  M -- Modify Bank-Account
  D -- Detailed Bank-Accounts
  B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
  X -- Exit
Please enter your selection:o

  Enter the first name of the account holder: Bill
  Enter the last name of the account holder: Stevenson
  Enter the SSN of the account holder: 000-00-0000

  | A new Bank Account BNK10000 was successfully created.

Eligiable services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:s
  Enter the initial balance: 100
  | A new Saving Sub-Account SAV1000 was successfully created.

Eligiable services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:c
  Enter the initial balance: 100
  Enter the desired maximum capacity: 120
  Define initial state: (L - Locked, Otherwise - Unlocked) 1
  | A new Checking Sub-Account CHK6000 was successfully created.
```

```
Eligible services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:b
  | Aggregated Balance of the bank account : BNK10000 with 2 Sub-Accounts is 300

Eligible services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:d

  | Sub-account number: SAV1000
  | Balance: 200

  | Sub-account number: CHK6000
  | Balance: 100

  | The maximum capacity is: 120
  | The sub-account is locked.
```

```
Eligiable services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:m
  Enter the sub-account number to modify:SAV1000

Eligiable services for sub-Account SAV1000
  D -- Deposit
  W -- Withdraw
  X -- Exit
Please enter your selection:d
  Enter the amount to deposit:100
  | Deposit was successful.
  | The current balance is 300

Eligiable services for sub-Account SAV1000
  D -- Deposit
  W -- Withdraw
  X -- Exit
Please enter your selection:w
  Enter the amount to withdraw:75
  | Withdraw was successful.
  | The current balance is 225

Eligiable services for sub-Account SAV1000
  D -- Deposit
  W -- Withdraw
  X -- Exit
Please enter your selection:x
  | End of service for sub-account SAV1000
```

```
Eligiable services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:m
  Enter the sub-account number to modify:CHK6000

Eligiable services for sub-account CHK6000
  D -- Deposit
  W -- Withdraw
  C -- Max Capacity
  L -- Lock Sub-Account
  U -- Unlock Sub-Account
  X -- Exit
Please enter your selection:d
  Enter the amount to deposit:45
  | The account is currently locked!
  | The deposit was unsuccessful.

Eligiable services for sub-account CHK6000
  D -- Deposit
  W -- Withdraw
  C -- Max Capacity
  L -- Lock Sub-Account
  U -- Unlock Sub-Account
  X -- Exit
Please enter your selection:w
  Enter the amount to withdraw:20
  | The account is currently locked!
  | The withdraw was unsuccessful.

Eligiable services for sub-account CHK6000
  D -- Deposit
  W -- Withdraw
  C -- Max Capacity
  L -- Lock Sub-Account
  U -- Unlock Sub-Account
  X -- Exit
Please enter your selection:u
  | The sub-account CHK6000 is unlocked now!
```



Eligiable services for sub-account CHK6000

- D -- Deposit
- W -- Withdraw
- C -- Max Capacity
- L -- Lock Sub-Account
- U -- Unlock Sub-Account
- X -- Exit

Please enter your selection:d

Enter the amount to deposit:50

| Deposit was successful.  
| The current balance is 150

Eligiable services for sub-account CHK6000

- D -- Deposit
- W -- Withdraw
- C -- Max Capacity
- L -- Lock Sub-Account
- U -- Unlock Sub-Account
- X -- Exit

Please enter your selection:w

Enter the amount to withdraw:23

| Withdraw was successful.  
| The current balance is 127

Eligiable services for sub-account CHK6000

- D -- Deposit
- W -- Withdraw
- C -- Max Capacity
- L -- Lock Sub-Account
- U -- Unlock Sub-Account
- X -- Exit

Please enter your selection:x

| End of service for sub-account CHK6000

Eligiable services for Bank-Account BNK10000

- S -- Open Saving Sub-Account
- C -- Open Checking Sub-Account
- M -- Modify a Sub-Account
- E -- Close a Sub-Account
- D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
- B -- Brief Bank Account Info
- X -- Exit

Please enter your selection: \_

```
Eligible services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:s
  Enter the initial balance: 240
  | A new Saving Sub-Account SAV1001 was successfully created.

Eligible services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:e
  Enter the sub-account number to be closed: SAV1001
  | Sub-account SAV1001 was successfully closed.
```

```
Eligible services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:b
  | Aggregated Balance of the bank account : BNK10000 with 2 Sub-Accounts is 352

Eligible services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:d

  | Sub-account number: SAV1000
  | Balance: 225

  | Sub-account number: CHK6000
  | Balance: 127

  | The maximum capacity is: 120
  | The sub-account is not locked.
```

```
Eligiable services for Bank-Account BNK10000
S -- Open Saving Sub-Account
C -- Open Checking Sub-Account
M -- Modify a Sub-Account
E -- Close a Sub-Account
D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
B -- Brief Bank Account Info
X -- Exit
```

Please enter your selection:x

| End of service for bank-account BNK10000

```
Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
X -- Exit
```

Please enter your selection:

```
Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
X -- Exit
Please enter your selection:o

Enter the first name of the account holder: Andy
Enter the last name of the account holder: Scott
Enter the SSN of the account holder: 111-11-1111

| A new Bank Account BNK10001 was successfully created.

Eligiable services for Bank-Account BNK10001
S -- Open Saving Sub-Account
C -- Open Checking Sub-Account
M -- Modify a Sub-Account
E -- Close a Sub-Account
D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
B -- Brief Bank Account Info
X -- Exit
Please enter your selection:s
Enter the initial balance: 350
| A new Saving Sub-Account SAV1002 was successfully created.

Eligiable services for Bank-Account BNK10001
S -- Open Saving Sub-Account
C -- Open Checking Sub-Account
M -- Modify a Sub-Account
E -- Close a Sub-Account
D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
B -- Brief Bank Account Info
X -- Exit
Please enter your selection:x

| End of service for bank-account BNK10001

Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
```

```
Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
X -- Exit
```

Please enter your selection:a

| The number of Bank-Account is 2

```
Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
X -- Exit
```

Please enter your selection:s

| The number of Saving-Account is 3

```
Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
X -- Exit
```

Please enter your selection:h

| The number of Checking-Account is 1

```
Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
X -- Exit
```

```
Eligiable services for Student Bank Co.
A -- Number of Bank-Accounts
S -- Number of Saving-Accounts
H -- Number of Checking-Accounts
O -- Open Bank-Account
C -- Close Bank-Account
M -- Modify Bank-Account
D -- Detailed Bank-Accounts
B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
X -- Exit
```

Please enter your selection:b

```
| Bank Name: Student Bank Co.
| Bank Address: 1 Main St., Stockton, CA 95201
| Bank Working Hours: Mon - Fri 8:00am - 5:00pm
| Aggregated Balance: 802
| Consists of 2 Banks-Accounts
| Aggregated Balance of the bank account : BNK10000 with 2 Sub-Accounts is 352
| Aggregated Balance of the bank account : BNK10001 with 1 Sub-Accounts is 450
```

```
Eligiable services for Student Bank Co.
  A -- Number of Bank-Accounts
  S -- Number of Saving-Accounts
  H -- Number of Checking-Accounts
  O -- Open Bank-Account
  C -- Close Bank-Account
  M -- Modify Bank-Account
  D -- Detailed Bank-Accounts
  B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
  X -- Exit
Please enter your selection:d
```

```
| Bank Name: Student Bank Co.
| Bank Address: 1 Main St., Stockton, CA 95201
| Bank Working Hours: Mon - Fri 8:00am - 5:00pm
| Aggregated Balance: 802
| Consists of 2 Banks-Accounts
```

```
| Bank Account Number: BNK10000
| Account Holder Full Name: Bill Stevenson
| Account Holder SSN: 000-00-0000
| Aggregated Balance: 352
| Consists of 2 Sub-Accounts
```

```
| Sub-account number: SAV1000
| Balance: 225
```

```
| Sub-account number: CHK6000
| Balance: 127
```

```
| The maximum capacity is: 120
| The sub-account is not locked.
```

```
| Bank Account Number: BNK10001
| Account Holder Full Name: Andy Scott
| Account Holder SSN: 111-11-1111
| Aggregated Balance: 450
| Consists of 1 Sub-Accounts
```

```
| Sub-account number: SAV1002
| Balance: 450
```

```
Eligiable services for Student Bank Co.
  A -- Number of Bank-Accounts
  S -- Number of Saving-Accounts
  H -- Number of Checking-Accounts
  O -- Open Bank-Account
  C -- Close Bank-Account
  M -- Modify Bank-Account
  D -- Detailed Bank-Accounts
  B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
  X -- Exit
Please enter your selection:m
  Enter the bank account number to be modified: BNK10000

Eligiable services for Bank-Account BNK10000
  S -- Open Saving Sub-Account
  C -- Open Checking Sub-Account
  M -- Modify a Sub-Account
  E -- Close a Sub-Account
  D -- Detailed Bank Account Info Sorted Based on Balances of Sub-Accounts
  B -- Brief Bank Account Info
  X -- Exit
Please enter your selection:x
  | End of service for bank-account BNK10000

Eligiable services for Student Bank Co.
  A -- Number of Bank-Accounts
  S -- Number of Saving-Accounts
  H -- Number of Checking-Accounts
  O -- Open Bank-Account
  C -- Close Bank-Account
  M -- Modify Bank-Account
  D -- Detailed Bank-Accounts
  B -- Brief Bank-Accounts Info Sorted Based on Aggregated Balances
  X -- Exit
Please enter your selection:x
  | End of service for bank Student Bank Co.
Press any key to continue . . . █
```