COMP 3111: Software Engineering

Course Project Problem Statement

BACKGROUND

Hong Kong Electronic Investments LLC (HKeInvest) requires a software system to allow its clients to manage the securities that they own (i.e., their securities portfolio) and to trade these securities (i.e., buy and sell stocks, bonds and unit trusts) through the Web. In this project you will analyze the requirements for, design and implement a web-based securities portfolio management system (the system) for ***HKeInvest***.

SYSTEM REQUIREMENTS

1. Account application

   To use the services provided by the web site, an account application (see Appendix A), available from the ***HKeInvest*** web site, should first be completed and either taken to or mailed to ***HKeInvest***'s office for processing. It is not possible to apply online for an account since government regulations require that a person's identity must be verified and supporting documents provided before an account can be created. Once an account application is approved, a ***HKeInvest*** employee should enter the account information for the client and a securities account number should be assigned to the account consisting of 10 characters of which the first two characters are the first letters, in uppercase, of the client's last (family) name and the remaining 8 characters are digits (e.g., CH26733588). If an applicant has only one letter in the last (family) name, then this letter should be used twice.

   It is mandatory to provide the following information on the account application form for both the primary account holder and the co-account holder, if any.

   - For **1 Account Type**, **4 Disclosures and Regulatory Information** and **5 Investment Profile**, all information should be provided. Where there are multiple check boxes for one question or multiple options, only one box should be checked.

   - For **2 Client Information**, Title, First name, Last name, Date of birth, Email address, Home address, Country of citizenship and Country of legal residence should be provided. At least one of Home phone, Business phone or Mobile phone should be provided. One of either HKID, or both passport number and Passport country of issue, should be provided.

   - For **3 Employment Information**, Employment status should be provided and, if employment status is "employed", then all of the remaining information should be provided.

2. Client login accounts

   Someone who has been successfully registered as a client should be able to create a login account to access the client services of the web site. To create a login account, a client should provide the securities account number, first name, last name, date of birth, email address and HKID/passport number of the primary account holder as stated on the account application, as well as a user name and password. A user name should be between 6 and 10 characters and should contain only letters and digits. A password should be between 8 and 15 characters and should contain at least two non-alphanumeric characters. The user name should be case insensitive while the password should be case sensitive. Each securities account should have at most one login account. Upon successfully creating a login account, a confirmation email should be sent to the primary account holder.

   Once a login account has been successfully created, either a client or an ***HKeInvest*** employee should be able to change any of the account and client information except for account type, date of birth and HKID, which should never be changed. A client's name, country of citizenship, country of legal residence passport number and passport country of issue should be able to be changed by an ***HKeInvest*** employee, but only if the client has made a request in writing with supporting documentation. A securities account number and a user name should never be changed.

3. Securities searching

Anyone (not just **HKeInvest** clients) should be able to search the securities (stocks, bonds and unit trusts) available to buy through **HKeInvest**[1]. Searching should be by specifying one of the following.

1. The type of security (i.e., bond, unit trust or stock) only.

2. The type of security (i.e., bond, unit trust or stock) *and* all or part of the name of the security. While the full name of a security is unique within a security type, partial names may not be unique.

3. The type of security (i.e., bond, unit trust or stock) *and* the code of the security. Security codes are one to four digits and are unique within a security type.

The search result should list all securities that meet the search criteria ordered alphabetically by the name of the security. It should be possible to reorder the search result by the security code. The information in the search result should depend on the type of security.

- *For stocks*, the information should be the stock code, the stock name, the stock's most recent closing price per share in Hong Kong dollars, the last trading day change in the stock price in Hong Kong dollars (which can be positive or negative), the last trading day percentage change in the stock price (which can be positive or negative), the last trading day volume of shares of the stock traded, the high and low price of the stock in Hong Kong dollars during the preceding 52 weeks, the price earnings (P/E) ratio of the stock, if any, and the yield of the stock, if any.

- *For bonds*, the information should be the bond code, bond name, the date the bond was first offered for sale (the launch date), the base currency of the bond (e.g., HKD, USD, EUR, GBP, etc.), the size of the bond in the base currency (i.e., its total monetary value), the current price per share in the base currency and the compound annual growth percentage increase/decrease in the monetary value of the bond over the last six months, one year, three years and since the bond was launched.

- *For unit trusts*, the information should be the unit trust code, the unit trust name, the date the unit trust was first offered for sale (the launch date), the base currency of the unit trust (e.g., HKD, USD, EUR, GBP, etc.), the size of the unit trust in the base currency (i.e., its total monetary value), the current price per share in the base currency, the risk/return rating of the unit trust (L-low, M/L-medium/low, M-medium, M/H-medium/high, H-high) and the compound annual growth percentage increase/decrease in the monetary value of the unit trust over the last six months, one year, three years and since the unit trust was launched.

4. Buying and selling securities

The buying or selling of securities should be available only to **HKeInvest** clients (i.e., those persons who have a **HKeInvest** securities account). To buy or sell securities clients should first login using their login account. Thereafter, they should be able to place an order to buy securities provided they have sufficient cash in their account or they should be able to place an order to sell any securities they own.

An order to buy or sell bonds or unit trusts should require the following information.

- the bond/unit trust code.

- *for buying*, the dollar amount to be bought in Hong Kong dollars.

- *for selling*, the quantity of shares of the bond or unit trust to sell, which can be any amount up to the number of shares of the bond or unit trust held by the account.

An order to buy or sell stocks should require the following information.

- the stock code.

- the order type, which should be one of
  - *market order* - An order to buy/sell a stock at the current market price of the stock.
  - *limit order* - An order to buy/sell a stock in which the highest buying price/lowest selling price of the stock is specified. For buying, an order will execute when the market price is at or lower than the specified highest buying price. For selling, an order will execute when the market price is at or higher than the specified lowest selling price.

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[1] The security information is not maintained by **HKeInvest**, but is obtained from an external system.

o   *stop order* - An order to buy/sell at the current market price of the stock, but only when the stock trades at or past a specified price (called the stop price). Once the stock price moves to or through the stop price, a stop order is executed as a market order.

o   *stop limit order* - An order to buy/sell at a specified price or better, but only after a specified stop price has been reached or passed. Once the stock price moves to or through the stop price, a stop limit order is executed as a limit order.

- the quantity of shares to buy, which must be a multiple of 100, or to sell, which can be any amount up to the number of shares of the stock held by the account.

- the expiry date of the buy/sell order, which can be up to seven days from the current date where the current date counts as the first day. The order will be retried from the order date until it is either fully executed or the expiry date has passed at which time any remaining, unexecuted part of the order will be cancelled.

- whether the order is "all or none". An "all or none" order will only be executed if *all* of the specified quantity can be bought/sold. If all of the specified quantity cannot be bought/sold before the expiry date of the order, then the entire order will be cancelled; the order will not be executed partially.

A client should not have simultaneous sell orders for the same security whose total quantity exceeds the amount of shares that the client owns.

Every buy or sell order will be sent to an external system to be executed (see External Systems section). The external system will execute an order in one or more transactions. For each transaction of an order the external system will generate a transaction record consisting of a transaction number[2], date executed, quantity executed and price per share at which the transaction was executed. To determine if an order has generated any transactions, the securities portfolio management system will need to periodically query the external system. Moreover, the securities portfolio management system will need to keep a record of all the transactions for an order since the external system will archive these records on a regular basis so that they will no longer be available to be queried online.

For a bond or unit trust, an order will always execute[3] and will require at most one transaction. For a stock, an order may or may not execute and, if it executes, may do so in several transactions unless it is specified to be "all or none". Thus, a stock order can either execute completely, execute partially and be cancelled or not execute at all and be cancelled when it expires. A security will always be bought/sold at the current price of that security when an order is executed, either partially or completely, which may be different than the price of the security when the order is placed.

After the processing of an order ends, an invoice should be generated. The invoice should be sent to the email address of the primary account holder and should show the order reference number[4], the account number, whether the order is a buy or sell order, the security code, the security name, if an order for stocks, then the stock order type, the date the order was submitted, the total number of shares bought/sold, the total executed dollar amount of the order, the fee charged for the order and, for each transaction, the transaction number, date executed, quantity of shares executed and price per share. The invoice should be paid automatically from the account's Free Credit Balance at the time that it is generated.

The fees for *HKeInvest*'s services, which all users of the web site should be able to view, are shown in Table 1. Fees should be charged for both buying and selling securities. Percentage fees should apply to the total monetary value of all transactions executed for the order. The assets of an account should include the total current value (in Hong Kong dollars) of all the security holdings (stocks, bonds and unit trusts) plus the Free Credit Balance.

5. Client support tools

    The securities management system should provide the following client support tools.

(a) Profit/loss tracking

A client should be able to display the current profit/loss as both an absolute dollar amount (in Hong Kong dollars) and as a percentage. The profit/loss either for an individual security, for all securities of

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[2]   A transaction number is a character string consisting of 8 unique numeric digits (e.g., 00002222).
[3]   To execute an order means to carry out or accomplish the order (i.e., to either actually buy or sell a security).
[4]   An order reference number is a character string consisting of 8 unique numeric digits (e.g., 00000055).

Table 1: *HKeInvest* service fees.

Stock Order	Assets less than HK$1,000,000	Assets HK$1,000,000 or more
Minimum fee	$150	$100
Market order	0.4%	0.2%
Limit or stop order	0.6%	0.4%
Stop limit order	0.8%	0.6%
Bond/Unit Trust Order	*Assets less than HK$500,000*	*Assets HK$500,000 or more*
Buying fee	5%	3%
Selling fee	$100	$50

a given type or for all securities should be able to be displayed. For an individual security, the security type, security code, security name, shares held, total dollar amount for buying, total dollar amount from selling, total fees paid and profit/loss should be shown. For all securities of a given type, the total dollar amount for buying, total dollar amount from selling, total fees paid and profit/loss should be shown. For all securities, the total dollar amount for buying, total dollar amount from selling, total fees paid and profit/loss should be shown. All dollar amounts should be stated in Hong Kong dollars.

The profit/loss for a security should be calculated as follows.

(current value of the shares of the security *plus* any amount obtained from selling any shares of the security)

minus

(total amount paid to buy all shares of the security *plus* total amount of transaction fees paid).

All amounts paid to buy and all amounts obtained from selling a security should be included in all profit/loss calculations even if a client no longer holds any shares of the security (i.e., has sold all the shares of that security).

(b) Currency conversion

A client should be able to show any total monetary value in any of the currencies available from an external system that maintains currency exchange rates. Values should be rounded down to the nearest smallest currency unit (e.g., cents) after conversion.

(c) Alerts

For each security held, a client should be able to set an alert, which should cause an email to be sent to the primary account holder when the price of the security trades at or passes through a specified value. The value should be able to be specified either as a low value or a high value. For a low value, the alert should be triggered when the security price trades at or passes through the alert price on its way down. For a high value, the alert should be triggered when the security price trades at or passes through the alert price on its way up. For any one security that a client holds, at most two alerts should be able to set at the same time—a low value alert and a high value alert. Each alert should be triggered at most once per day. The email should state the type, code and name of the security, indicate what triggered the alert (i.e., low price reached or high price reached) and the price that triggered the alert.

6. Report generation

In addition to any outputs described previously, the system should produce the following reports.

Report	Description	Accessible to
(a)	A summary of the overall security holdings in a specified account identified by the account number. The summary should show the account number, clients first and last name(s), the total monetary value of the securities held in Hong Kong dollars, the account free balance and, for each type of security (i.e., stocks, bonds and unit trusts) held, its total monetary value in Hong Kong dollars, the submission date of the last executed order and the total monetary amount in Hong Kong dollars of the last executed order. From this summary, it	*HKeInvest* employees; the account holder

should be possible to display the details of the holdings for each type of security (see Report (b)).

(b) A listing of the details for a given security type in a specified account. The listing should show for each security held, the code, name, quantity of shares held, current price per share in the base currency and total monetary value of the security in the base currency. By default, the listing should be ordered by security name. Moreover, it should also be possible to order the listing by security code, quantity of shares held or total monetary value.

HKeInvest employees; the account holder

(c) A listing of the status of any active orders[5] (buy and/or sell) for a specified account identified by the account number. The listing should show for each order, the order reference number, whether the order is a buy or sell order, the security type, code and name, the date the order was submitted and the current status of the order, which can be one of pending execution or partially executed. For bond/unit trust orders, the listing also should show the dollar amount in Hong Kong dollars for buy orders or the quantity of shares for sell orders. For stock orders, the listing also should show the following.

HKeInvest employees; the account holder

- The quantity of shares requested.
- If it is a limit order, then the highest buying price/lowest selling price in Hong Kong dollars.
- If it is a stop order, then the stop price in Hong Kong dollars.
- If it is a stop limit order, then both the stop price and the highest buying price/lowest selling price in Hong Kong dollars.
- The expiry date.

By default, the listing should be ordered by submission date (latest to earliest).

(d) A listing of the order history for a specified account identified by the account number over a given date range. The listing should show for each order, the order reference number, whether the order is a buy or sell order, the security type, code and name, date the order was submitted and status of the order. If there are any transactions for the order, then the listing should also show the total number of shares bought/sold, the total executed dollar amount of the order, the fee charged and, for each transaction, the transaction number, date executed, quantity of shares executed and price paid per share in the base currency. Optionally, it should be possible to specify that the listing be only for a certain type of order (buy or sell), security type and code or order status, or any combination of these. By default, the listing should be ordered by submission date. Moreover, it should be possible also to order the listing by security type, security name or status. The default start and end date should be the current date. If no date range is specified, then all dates should be included.

HKeInvest employees; the account holder

For all reports, it is only necessary to be able to view them as a web page.

OTHER REQUIREMENTS

Employee Login Accounts

Employees of *HKeInvest* will also require login accounts to manage client accounts and to generate certain reports. Employee login accounts should be different and separate from client login accounts and should be created directly by the system administrator. If an *HKeInvest* employee wants to use the securities services of *HKeInvest*, then he should apply for a securities account and create a client login account as described previously.

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[5] An active order is one that is still awaiting execution either in full or in part.

External Systems

To obtain securities information, currency conversion information and to execute orders, the securities portfolio management system will need to interact with external systems that provide these capabilities (e.g., Hong Kong Exchanges and Clearing Limited for stocks). That is, the securities portfolio management system obtains securities information, currency conversion information from external systems and sends orders to an external system for execution. The documentation and implementation of the functions needed to interact with these systems will be provided as they are required.

INVESTMENT INFORMATION

Definitions of securities terms and background information on securities services can be found at Investopedia.com (http://www.investopedia.com/).

WEB-BASED INVESTMENT SERVICE WEB SITES

There are securities service web sites you can browse to see how they provide Web access. While they require an account and password to use their services, you can browse much of their web site without registering. As these are real businesses, *please be considerate in your access to their web sites*.

- Charles Schwab, Hong Kong, Ltd. (http://www.schwab.com.hk/)
- Fidelity Investments Management (Hong Kong) Limited (http://www.fidelity.com.hk/)
- HSBC Investment Services (http://www.hsbc.com.hk/ → select the "Investing" tab)

HKeInvest

Your Investment Home

Application Instructions

To open your *HKeInvest* account, please complete all sections below.

Each account application must include the following:

- A minimum initial deposit of HK$20,000 to open your account.
- A photocopy of your Hong Kong Identity Card or the inside pages of your passport(s), including photo, signature and personal information for each account applicant.
- One bank (or financial institution) statement and one utility bill dated within the last six months. One of the documents must be an original. In lieu of a bank statement and utility bill, you may provide a verifiable letter from a known bank or financial institution.
- Additional documents may be required if your application is not submitted in person.

Please submit the completed application and all required documents to *Hong Kong Electronic Investments LLC*, **Suite 8801, 3 IFC, Central, Hong Kong**.

We respect your privacy. *HKeInvest* will use the information you provide to verify your identity, to open and service your account, communicate with you and provide information about products and services.

1   Account Type

☐ Individual	☐ Joint Tenants with Rights of Survivorship If one owner dies, his/her interest passes to the surviving owner.	☐ Joint Tenants in Common If one owner dies, his/her interest passes to his/her estate.

2   Client Information

Security industry regulations require that we collect the following information.

Primary Account Holder	**Co-Account Holder, if applicable**
Title: ☐ Mr. ☐ Mrs. ☐ Ms. ☐ Dr.	Title: ☐ Mr. ☐ Mrs. ☐ Ms. ☐ Dr.
First name:	First name:
Last name:	Last name:
Date of birth (dd/mm/yyyy):	Date of birth (dd/mm/yyyy):
Email address:	Email address:
Home address (cannot be a PO box):	Home address (cannot be a PO box):
Building (if any):	Building (if any):
Street:	Street:
District:	District:
Home phone:	Home phone:
Home fax:	Home fax:
Business phone:	Business phone:
Mobile phone:	Mobile phone:
Country of citizenship:	Country of citizenship:
Country of legal residence:	Country of legal residence:
HKID/passport number:	HKID/passport number:
Passport country of issue:	Passport country of issue:

3   Employment Information

Security industry regulations require that we collect the following information.

<table>
<tr><td>Primary Account Holder</td><td>Co-Account Holder, if applicable</td></tr>
<tr><td>

Employment status:

☐ Employed ☐ Self-employed ☐ Retired
☐ Student ☐ Not Employed ☐ Homemaker

Specific occupation:

Years with employer:

Employer name:

Employer phone:

Nature of business:

</td><td>

Employment status:

☐ Employed ☐ Self-employed ☐ Retired
☐ Student ☐ Not Employed ☐ Homemaker

Specific occupation:

Years with employer:

Employer name:

Employer phone:

Nature of business:

</td></tr>
</table>

4   Disclosures and Regulatory Information

Security industry regulations require that we collect the following information.

<table>
<tr><td>Primary Account Holder</td><td>Co-Account Holder, if applicable</td></tr>
<tr><td>

Are you employed by a registered securities broker/dealer, investment advisor, bank or other financial institution?

☐ No
☐ Yes   (you must submit a compliance letter with this application)

Are you a director, 10% shareholder or policy-making officer of a publicly traded company?

☐ No
☐ Yes

</td><td>

Are you employed by a registered securities broker/dealer, investment advisor, bank or other financial institution?

☐ No
☐ Yes   (you must submit a compliance letter with this application)

Are you a director, 10% shareholder or policy-making officer of a publicly traded company?

☐ No
☐ Yes

</td></tr>
</table>

Describe the primary source of funds deposited to this account:

☐ salary/wages/savings   ☐ investment/capital gains   ☐ family/relatives/inheritance   ☐ Other (describe below)

_____

5   Investment Profile

Security industry regulations require that we collect the following information. For joint accounts, please include combined amounts.

Investment objective* for this account:

☐ capital preservation   ☐ income   ☐ growth   ☐ speculation

Investment knowledge: Investment experience:

☐ none   ☐ limited   ☐ good   ☐ extensive   ☐ none   ☐ limited   ☐ good   ☐ extensive

Annual income:

☐ under HK$20,000   ☐ HK$20,001 - HK$200,000   ☐ HK$200,001 - HK$2,000,000   ☐ more than HK$2,000,000

Approximate liquid net worth *(cash and securities)*:

☐ under HK$100,000   ☐ HK$100,001 - HK$1,000,000   ☐ HK$1,000,001 - HK$10,000,000   ☐ more than HK$10,000,000

* Investment objective definitions

Capital preservation: The objective of a capital preservation strategy is to protect your initial investment by choosing investments that minimize the potential of any loss of principal. The long-term risk of capital preservation is that the returns may not be adequate to offset inflation.

Income: The objective of an income strategy is to provide current income rather than long-term growth of principal.

Growth: The objective of a growth strategy is to increase the value of your investment over time while recognizing a high likelihood of volatility.

Speculation: The objective of a speculation strategy is to assume a higher risk of loss in anticipation of potentially higher than average gain by taking advantage of expected price changes.

6	**Account Feature**

Earn Income on Your Cash Balance

The Free Credit Balance in your *HKeInvest* account is not interest bearing. However, you may choose to earn interest on the Free Credit Balance in your account by having daily automatic investment in or redemption of ("sweep') shares of our sweep fund ("Fund"). (The Free Credit Balance is the sum of the cash balances in your Cash Account and Margin Account (if applicable) offset by any debit balances and/or cash retained as collateral in the accounts.)

On any Exchange Business Day, the Free Credit Balance will be automatically invested in shares of the Fund on the following Exchange Business Day. Shares of the Fund will be automatically redeemed to satisfy a debit balance in your *HKeInvest* account, to provide necessary cash collateral in your Margin Account (if applicable) or to the extent necessary to settle securities transactions.

☐ Yes, sweep my Free Credit Balance into the Fund.

7	**Initial Account Deposit**

A *HK$20,000 minimum deposit* is required to open an account.

Check one or more:

☐ A cheque for HK$ _____ made payable to *Hong Kong Electronic Investments LLC* is enclosed.

☐ A completed Account Transfer Form for HK$ _____ is attached.

8	**Declaration and Signature**

I am of legal age to enter into this contract. I acknowledge that I have received, read and agree to be bound by the terms and conditions as currently set forth in the HKeInvest Customer Agreement and as amended from time to time. I authorize HKeInvest to inquire from any source, including a consumer reporting agency, as to my identity, creditworthiness and ongoing eligibility for the account at account opening, at any time throughout the life of the account and thereafter for debt collection or investigative purposes.

I acknowledge that *HKeInvest* does not provide investment, tax or legal advice.

Account Holder's Signature	Co-Account Holder's Signature, if applicable
Date:	Date: