



INTELLIGENT REASONING SYSTEMS (IRS)

MID-PROJECT PRESENTATION By Group 8

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CPF Investment Advisor (CIA)

Interactive Robotic Advisory Service for your CPF Savings

OVER
6,250 GRADUATE
ALUMNI

OFFERING OVER
150 ENTERPRISE IT, INNOVATION
& LEADERSHIP PROGRAMMES

TRAINING OVER
135,000 DIGITAL LEADERS
& PROFESSIONALS

CPF Investment Opportunity & Challenges

All Singaporeans are **mandatorily** required to **contribute** some of their earning to the **CPF** towards building their **retirement savings**. These contributions are split into 3 accounts:



1. **(OA) Ordinary Account:** Used for Housing & Education. Lower Interest (2.5%). Invest 35% in SGX Stocks
2. **(SA) Special Account:** Locked in till Retirement. Higher Interest (4%). Very limited Investment options.
3. **(MA) Medical Account:** Used to cover medical expenses. No investment options.

We all want to **maximize** our hard-earned CPF savings, but there is a **trade-off** between the **flexibility** offered in OA versus the **higher returns** in SA. The OA returns can be **boosted** by investing some part of this balance (upto 35%) in SGX stocks (among other things). However there is a significant **market risk** associated with taking this Investment option.

We have to make **several crucial decisions** in context:

1. **Should I transfer** my OA balance to the SA account **or** should I **invest** it in the market?
2. **How much risk** should I take with my retirement savings? **Can I afford** this risk?
3. **How much** should I invest? **Which shares** should I buy? **What amount** do I invest in each share?
4. What **returns can I expect** to get? How much could I **potentially lose** on this investment?



*CPFIS OA Criteria: Age > 18 AND OA balance > \$20K; Interest Rate : OA = 2.5% ; SA = 4% (ignore + 1% upto \$60K);
CPFIS OA : Shares = 35% of Investible Savings (OA Bal + Housing & Education); Share portfolio limited to SGX listed shares only.

CPF Investment Advisor (CIA)

CIA is an Expert Advisory Service that helps you answer many of the above questions & secure your retirement! It:

1. **Appraises** how much **risk** you can afford to take based on your personal & financial profile
2. **Recommends** **stocks** that match your preference and are within your risk appetite.
3. **Advises** how much to **transfer** to SA versus how much to **invest** in the stock market.
4. **Evaluates** which **stocks** to buy and how much to **invest** in each specific stock
5. **Predicts** the expected **performance** of the portfolio and quantifies the potential for **loss**



CIA Hybrid Reasoning Model

CIA has three modules that **work together as hybrid system** to provide the advisory services:



1. Rule Based System to evaluate the users Risk Profile & Recommend stock selection

- Interviews** the user leveraging industry recognized **expert rules** to determine their financial profile & tolerance for risk
- Classifies** the users's **risk profile** into 3 categories – Conservative, Neutral & Aggressive (which converts to a risk range)
- Determines** if the user is eligible to invest in stocks the investible amount (35% of OA balances)
- Recommends** specific industry sectors and helps user select stocks based on their investment preferences.



2. Decision Tree that predicts the performance of the selected stocks

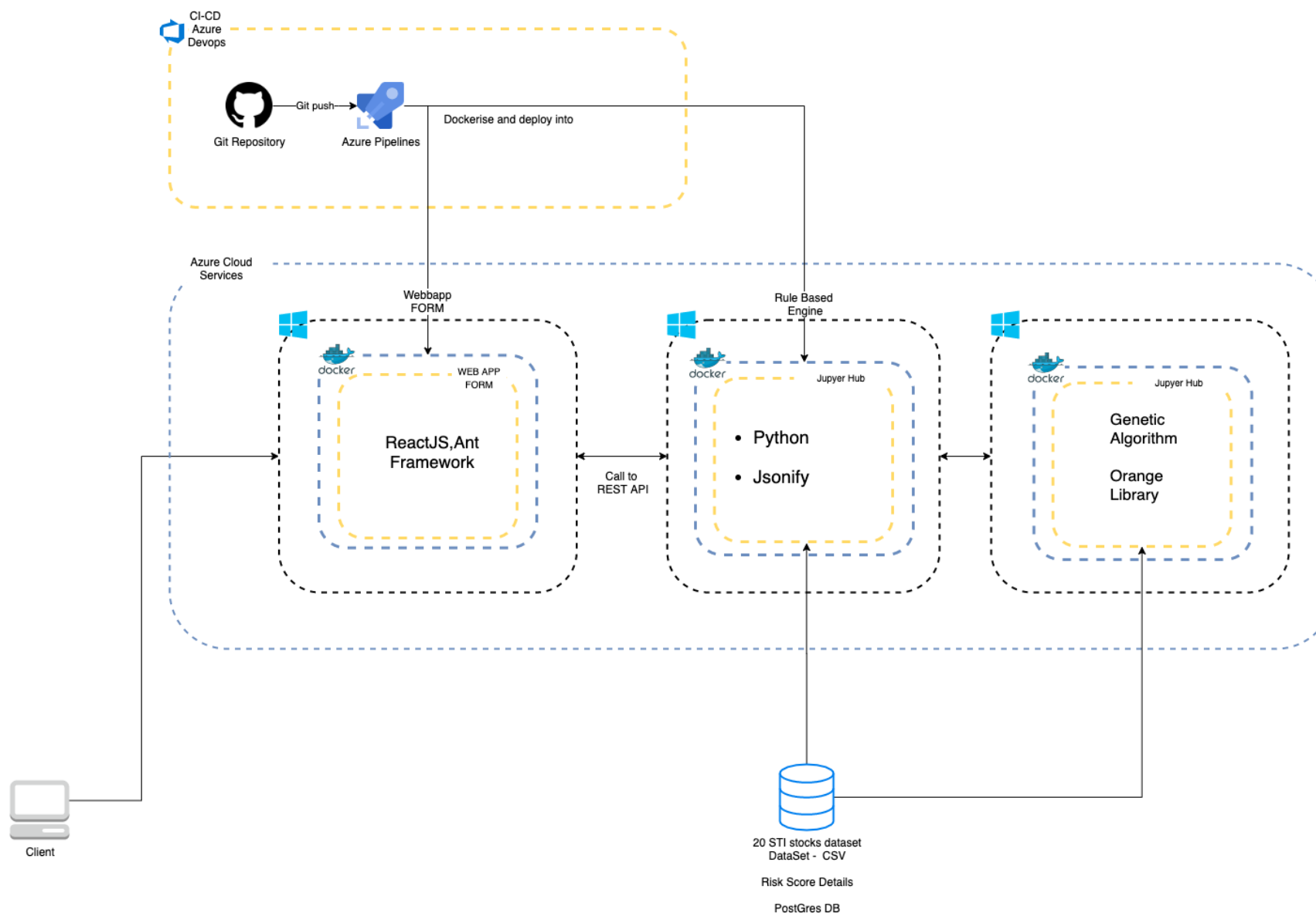
- Supervised learning** on historical stock performance (52 weeks) to learn the significant financial attributes that are key predictors of stock performance and to classify them into three categories – High, Medium & Low performance.
- Predicts** the performance of the initial stocks selected by the user & helps them evaluate, and if required, substitute their selection with higher performance stocks from the same sector. (upto 5 stocks)



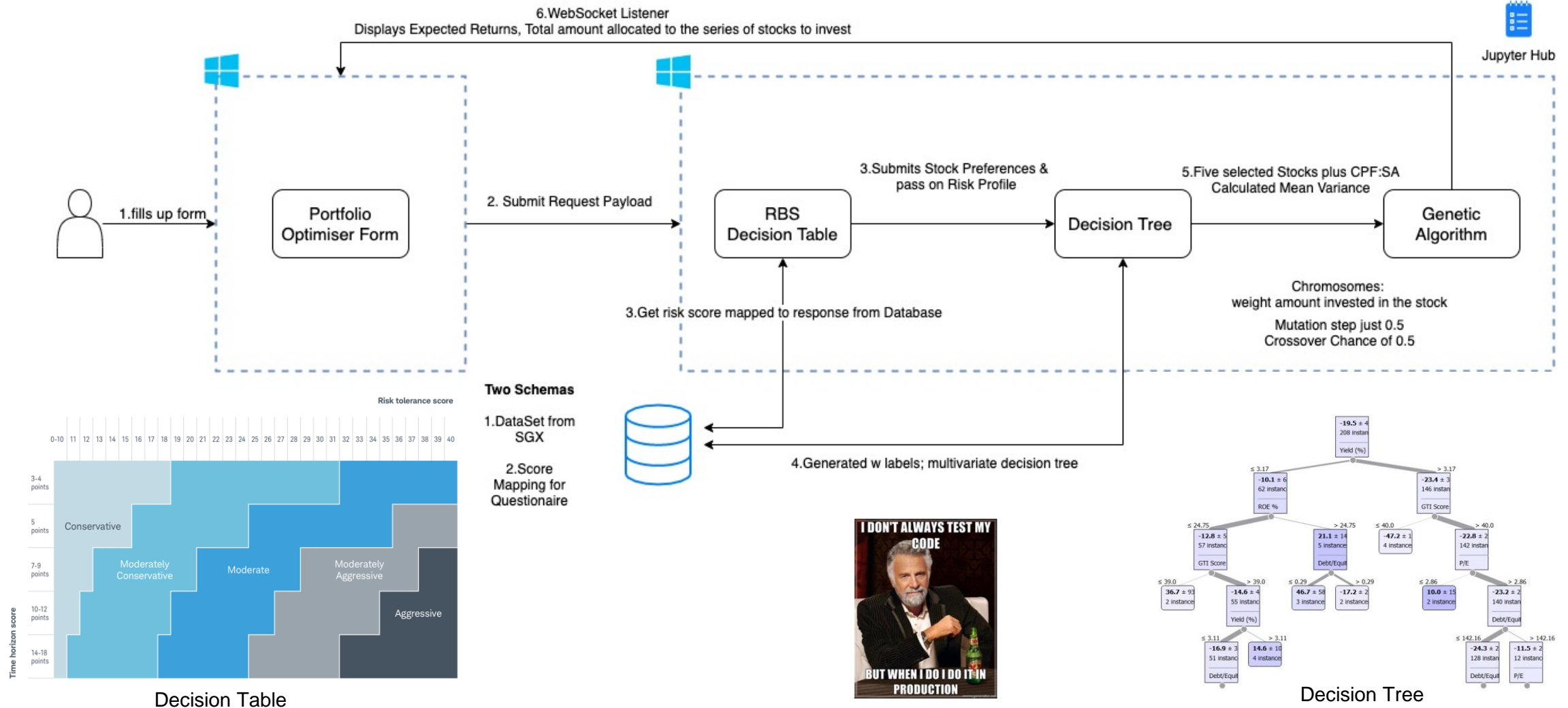
3. GA Optimizer determines how much to invest in each stock and the amount to be transferred to SA.

- Search space** is modeled using the **Markowitz Mean-Variance** algorithm that maximizes total returns of the portfolio while minimizing the overall variance (ie variance = risk).
- GA Search** is used to find the optimal amounts to be invested in each of the (upto) 5 stocks + uses the CPF-SA to anchor the risk-free benchmark.
- Chromosome** is modelled as the \$ weight of each investment (incl the SA) in the portfolio.
- Objective function** is to maximize the overall return of the portfolio.
- Constraints** is to keep the return variance ie risk within the range of the users risk profile.

CIA Hybrid Reasoning Infrastructure



CIA Hybrid Reasoning Flow



Infra Set-up

- Code Repository & Code Template Set Up (100%)
- Azure Pipelines (Initial Integration, 50%)
- Cleaning of Data Set (100%)
- Data Sourcing (100%)
- PostgresDB (100%)
- Deployment of Jupyterhub and setting up of proxy endpoints (WIP)
- Deployment onto Cloud Services & Docker-compose of different modules (WIP)

Backend Development

- Rules Based Engine (WIP, 50%)
- Generation of Decision Tree (75%; pending integration on code level)
- Genetic Algorithm (WIP; fine tuning of GA for optimisation)

Frontend Development

- 3 Pages ($\frac{1}{3}$ completed)

Completion : 40% - Mostly engineering work left

The three CIA modules work seamlessly together to provide the user with an Interactive Advisory Service:

1. **Welcome** the user and outline the **objective** of the advisory service he will be provided today (an audio-visual??)
2. Ask the user a series of **questions** to build his personal, financial & risk profile. Also check his **OA balances** to determine maximum investment amount in stocks.
3. Present the user with a **choice of industry sectors** and ask them to select upto 5 sectors (for diversification) they would like to invest. For each selected sector, present the user with upto 3 stocks and ask them to select any **preferences**.
4. Filter each selected stock (or all 3 if no stock preference in the sector) thru the decision tree to **identify the high performance** stock per sector to be included in the portfolio (if more than one, select the first)
5. Run the 5 selected stocks thru the GA Optimizer to determine the **amount to be invested** in each stock and the **amount to be transferred** to SA.
6. Make the final presentation to the user providing him the advise and the explanations:
 1. Your calculated **risk profile** is: <Conservative>. (can we provide an explanation for this profile?)
 2. Given you have an OA Investible Amount of <\$100,000>, you can invest upto <\$35,000> in stocks.
 3. Based on your preferences, we recommend you invest <\$25,000> in the investment portfolio outlined below and transfer <\$10,000> to SA.
S1: <\$5,000>, S2: <\$10,000>, S3: <\$0>; S4: <\$2,000>; S5: <\$8,000>
 4. The expected return of this overall portfolio is : <5%> p.a. The expected risk is within your <Conservative> risk profile (can we quantify the risk?)
 5. This improves your return by <2.5> % points over leaving your balances in OA and enhances <1>% point over transferring the entire amount to SA.
 6. (We need to decide if will only recommend for a total of 35% incl SA or for 35% only in stocks with SA transfer component added on the top)