Automated Trading System using Swarm Intelligence

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Overview

- Briefly on our project proposal by Ratchanon
- Our experiments by Papon
- Results and Discussions by Sirapop
- Application demo
- Possible future works

BRIEFLY ABOUT OUR PROPOSAL

- Importance of our work
  - Stock trading is risky.
  - Amateur investors lack of skills and experiences.
  - Human errors in decision making

BRIEFLY ABOUT OUR PROPOSAL (CONT.)

- Technical analysis?
  - An attempt to forecast stock prices on basis of market-derived data.
  - Looking for trends and patterns in the data.
  - Open, close, high and low prices are inputs
- Technical indicators?
  - To generate buy and sell signals
  - To confirm price movement.
  - Many indicators, but can't really rely on just one indicator.

BRIEFLY ABOUT OUR PROPOSAL (CONT.)

- Our new approach to trading

Generate trading signals with technical indicators → Train the swarm intelligence to weight each signal → Test and make a proper decision

$$Decision = \frac{\sum_{i=1}^{n} signal_i \, weight_i}{\sum_{i=1}^{n} weight_i}$$

If Decision $> t_D$ → Buy

Decision $< -t_D$ → Sell

Else → Hold/Do nothing

BRIEFLY ABOUT OUR PROPOSAL (CONT.)

- Technical Indicators used…
  - Simple Moving Average : SMA 100
  - Exponential Moving Average : EMA20/50, EMA20/100, EMA50/100
  - Moving Average Convergence Divergence (MACD)
  - Relative Strength Index (RSI)
  - Stochastic Oscillator (STO)
  - Commodities Channel Index (CCI)
  - William Percent Range (%R)

Briefly about our proposal (cont.)

- Swarm Intelligence?
  - consists typically of a population of simple agents interacting locally with one another and with their environment.
  - Two sample algorithms used in this project
    - PSO
    - CLONALG
  - To optimize each weight of each signal in decision equation.

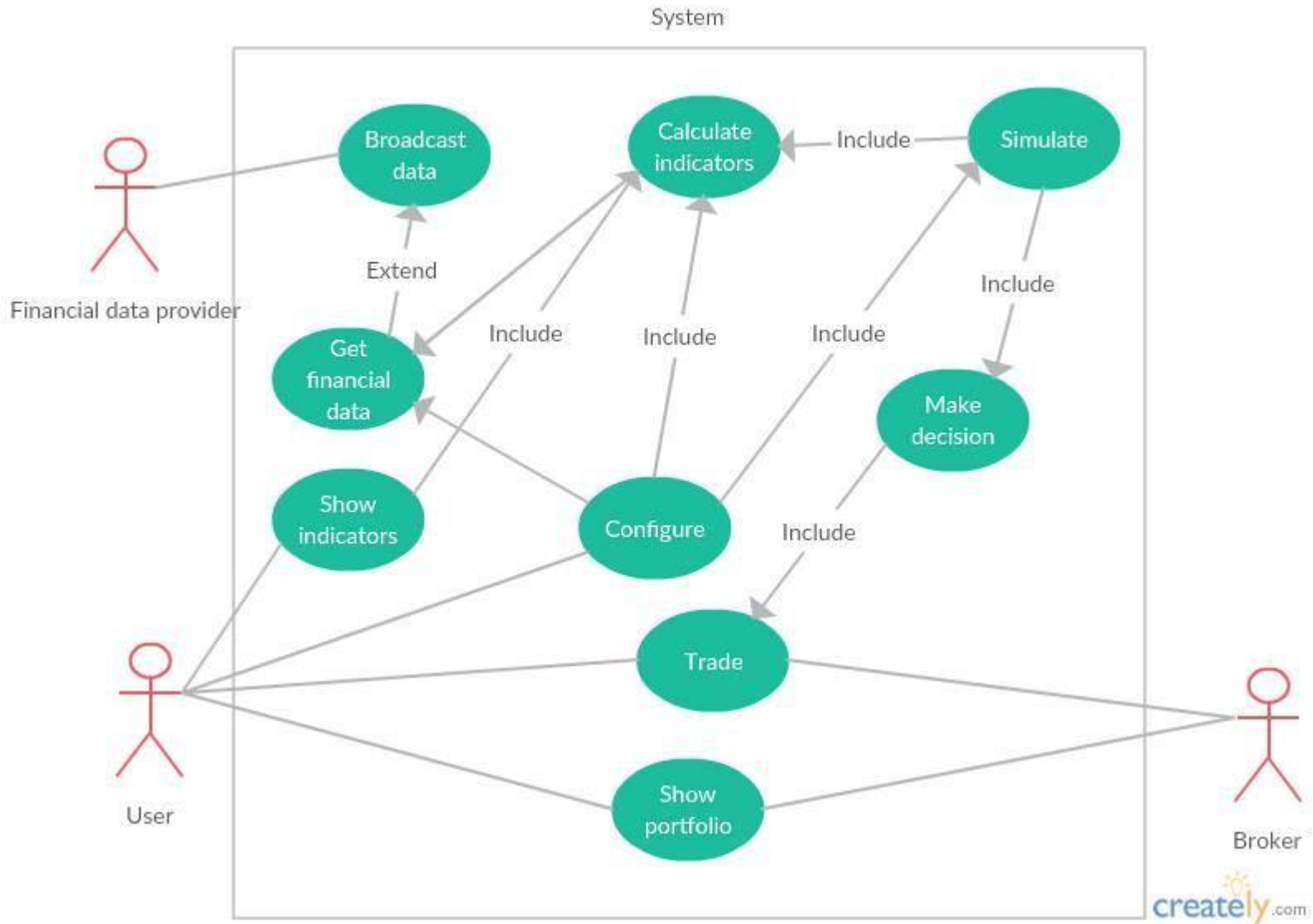
- PSO

Step 1 : Initialization
Step 2 : Evaluate the objective function values of all particles in the swarm
Step 3 : Update personal best (Pi) and global best (Pg) in the swarm
Step 4 : Calculate velocity of each particle
Step 5 : Update position of each particle
Step 6 : Redo step 2 - 5 until the stopping criteria is met.

- CLONALG

Step 1 : Initialize antibodies AB
Step 2 : Evaluate affinities of all antibodies ABi
Step 3 : Select n best antibodies according to their affinities -> SAb
Step 4 : Clone the selected antibodies for p numbers -> C
Step 5 : Mutate the clones
Step 6 : Evaluate affinities of the clones
Step 7 : Foreach Ci in C and ABi in AB
If affinity of Ci >= ABi
Replace ABi with Ci
Step 8 : Redo step 3-7 until the stopping criteria is met.

Briefly about our proposal (cont.)



Our experiments

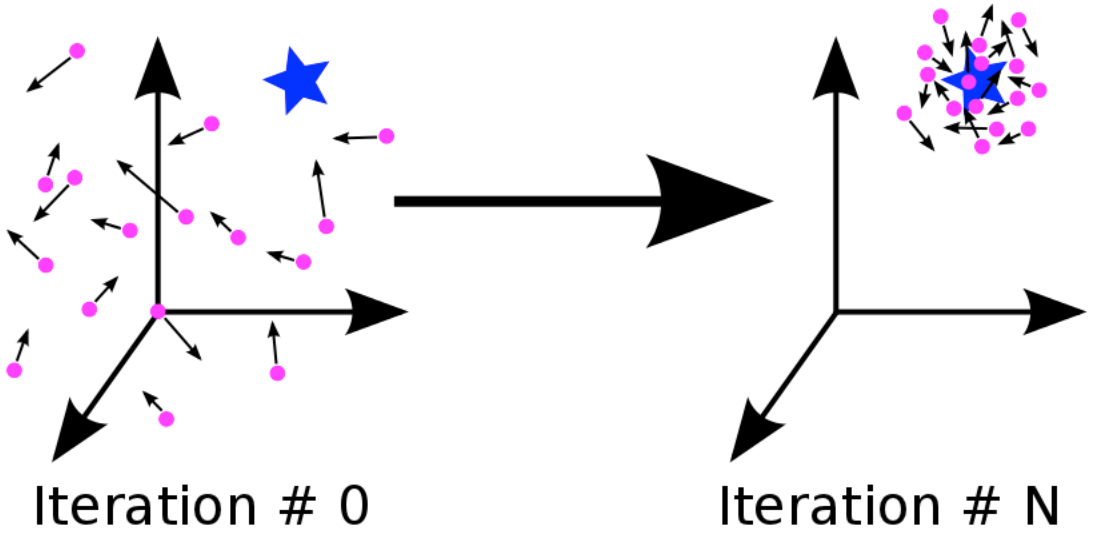
- Command line version of our application
- 10 highly active stocks from NYSE
- 10 stocks from SET
- Historical data from 2015 to 2016 downloaded from *finance.yahoo.com*.

SET

ตลาดหลักทรัพย์แห่งประเทศไทย

Our experiments

- The first experimentation
- The use of PSO to optimize weights and make decision for every experimented data record.
- The objective function : % of return/initial money
- Goals :
  - Performance comparison with Buy & Hold and signal follow strategies.
  - Study the effects of changes in *decision threshold*. (0.1, 0.3, 0.5)
  - Study the effects of changes in population number between 20 and 25.



Our experiments (cont.)

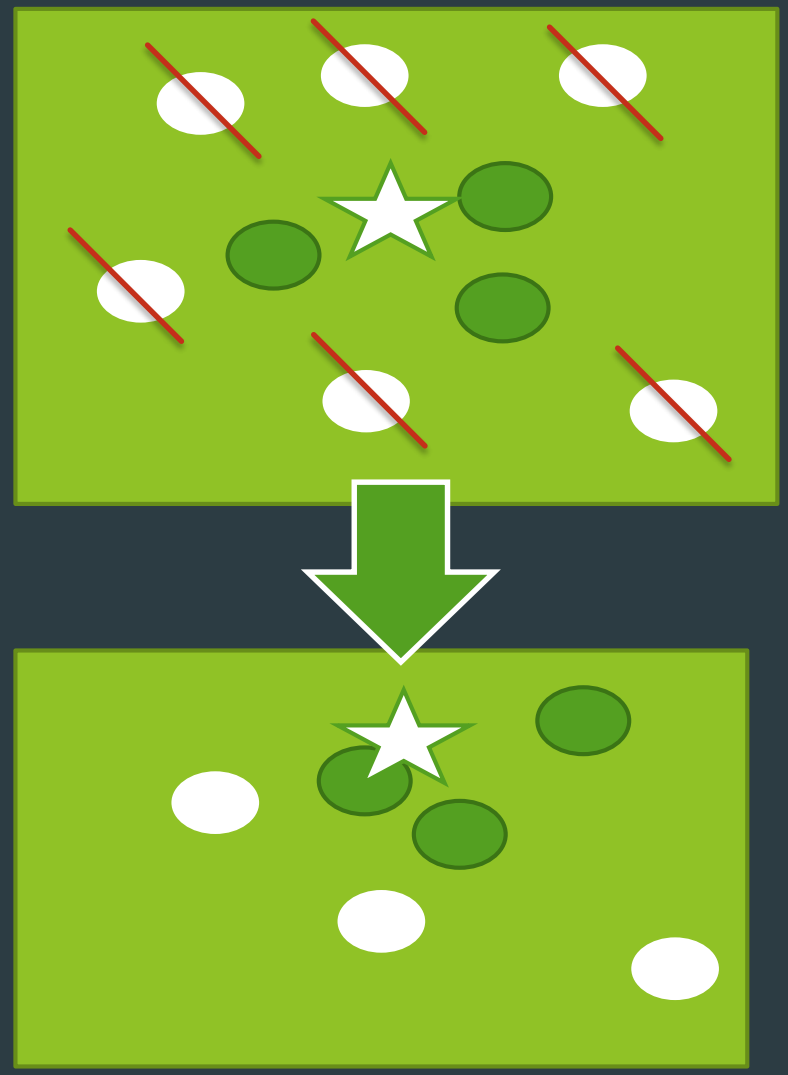
- Parameters of PSO
  - J. Kennedy and R. Eberhart version of PSO (1995)
  - c_1, c_2 from 2.5 to 0.5 and from 0.5 to 2.5, respectively
  - Inertia weight from 0.9 to 0.4
  - Refer to empirical studies by Shi and Eberhart (1999)

$$c = (c_f - c_i) * (\frac{calls}{MAXOBJCALLS}) + c_i$$

$$Inertia\ weight\ \omega = (\omega_i - \omega_f) * \left(\frac{MAXOBJCALLS - calls}{MAXOBJCALLS}\right) + \omega_f$$

Our experiments (cont.)

- The second experimentation
- The alternative algorithm
  - CLONALG
  - Performance comparison with PSO
  - Use the most effective threshold from previous experimentation.
  - The parameters follow the work of Castro, L.n. De, and F.j. Von Zuben‘s CLONALG.



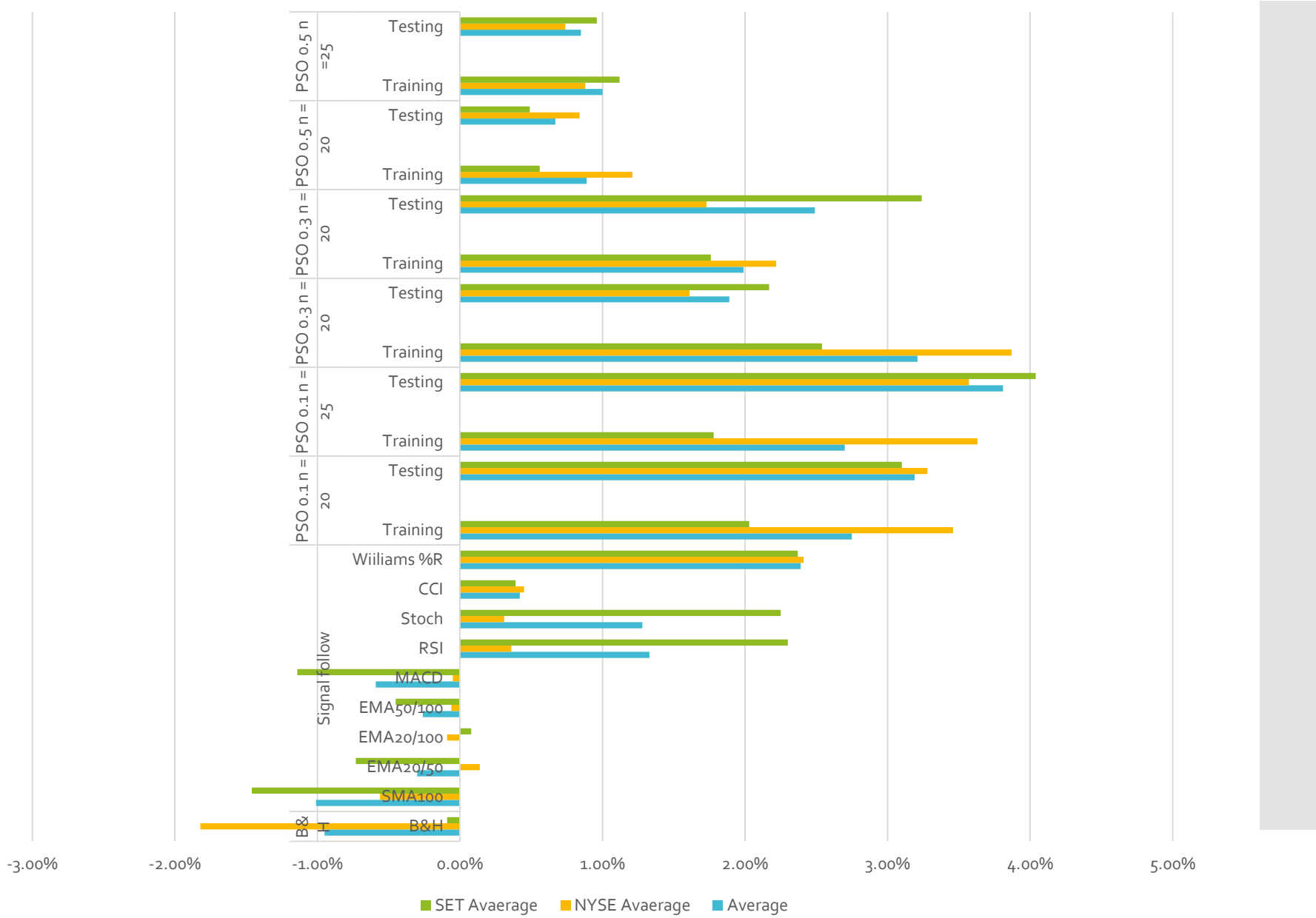
Our experiments (cont.)

- Parameters of CLONALG
  - 100% of selected antibodies with high affinity values (Objective function values)
  - 20% of antibodies with low affinity values will be replaced.
  - Multiplying factor (β) is set 1.
  - Low affinity value, high hypermutation rate. (Relation with highest affinity)

$$Number\ of\ clones = \sum_{i=1}^{n} round(\beta\ * Population\ size)$$

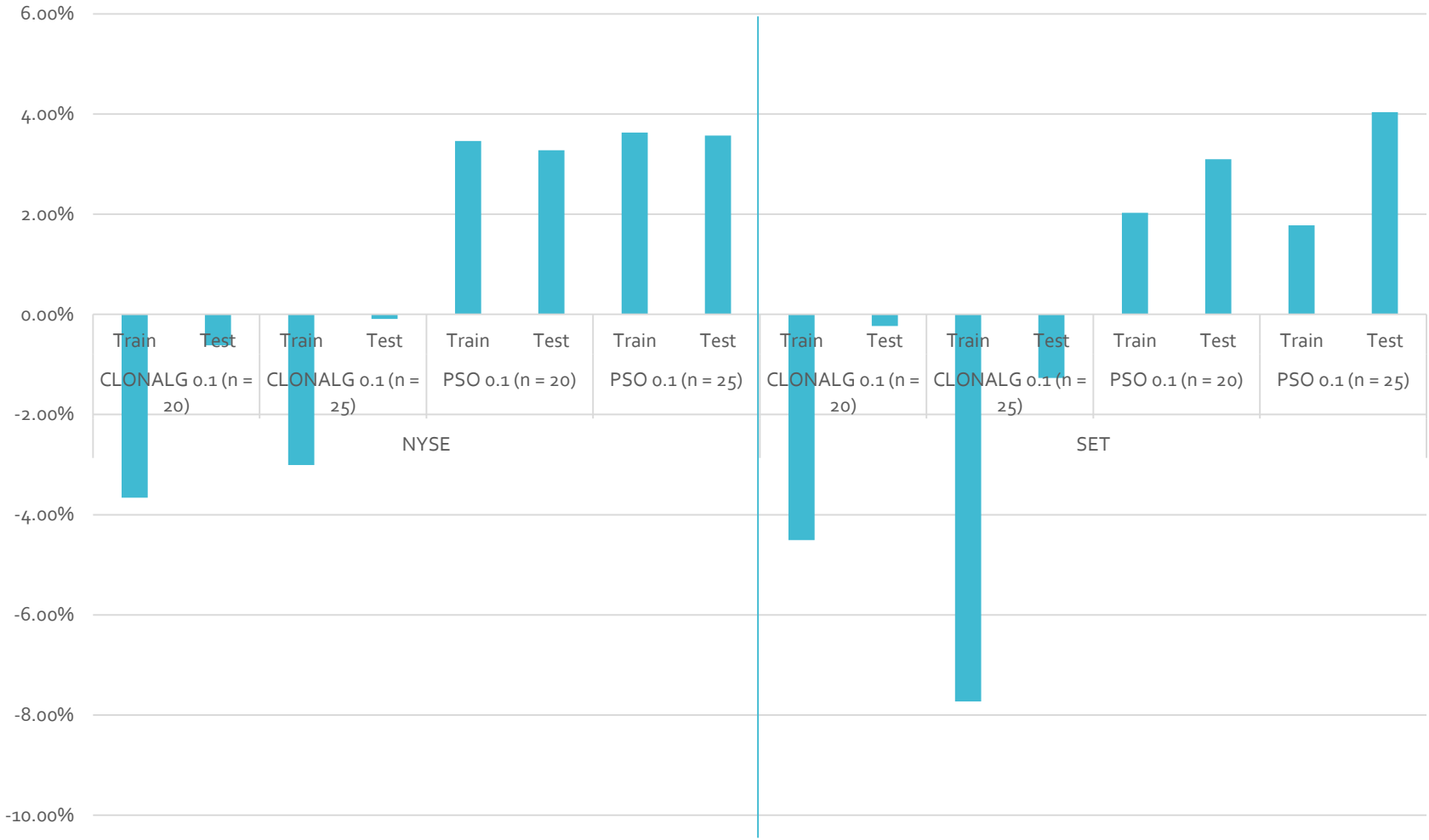
Results and Discussions

- **Experiment 1**



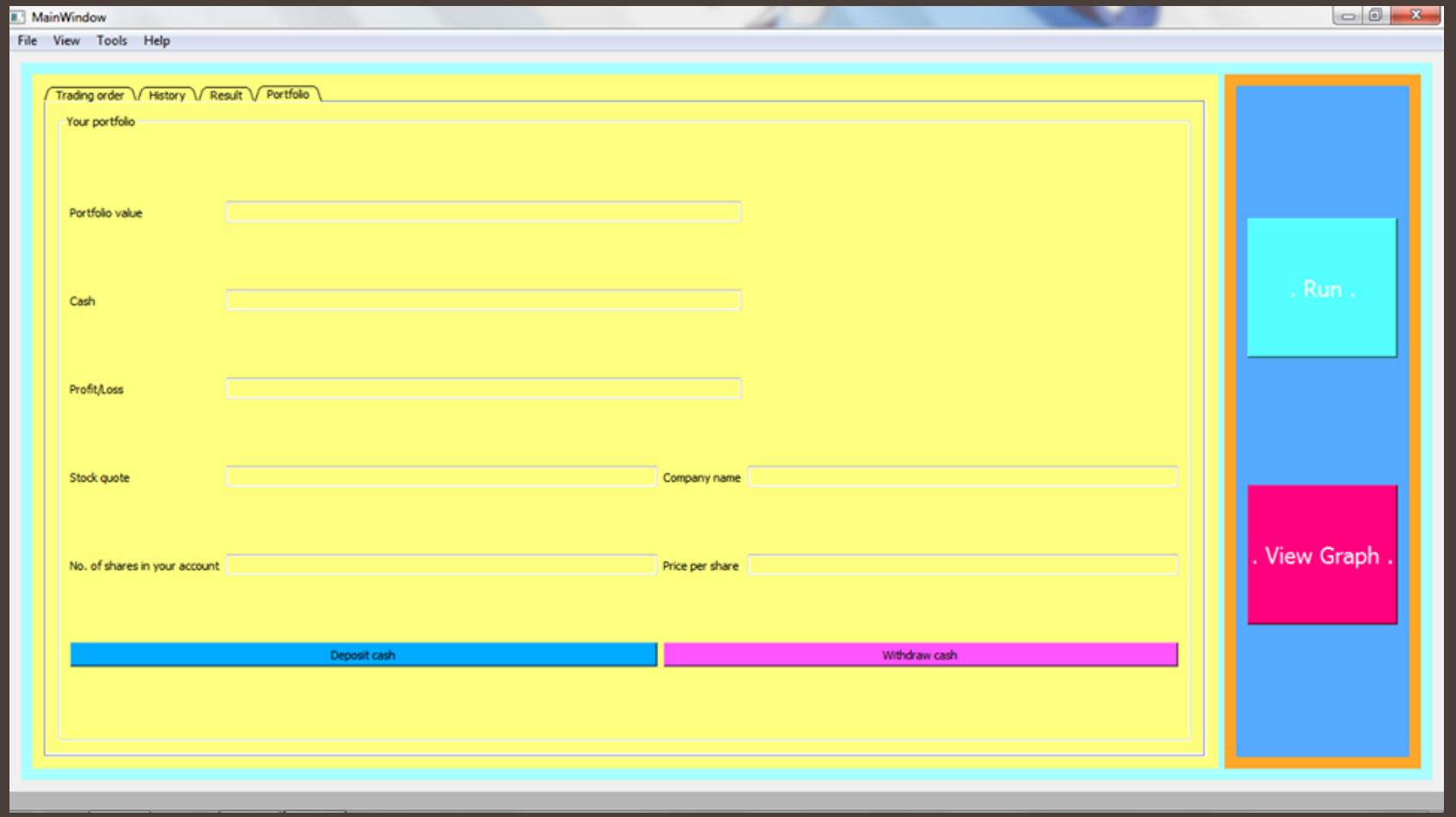
Results and Discussions (cont.)

- **Experiment 2**



Results and Discussions (cont.)

- Our GUI



Results and Discussions (cont.)

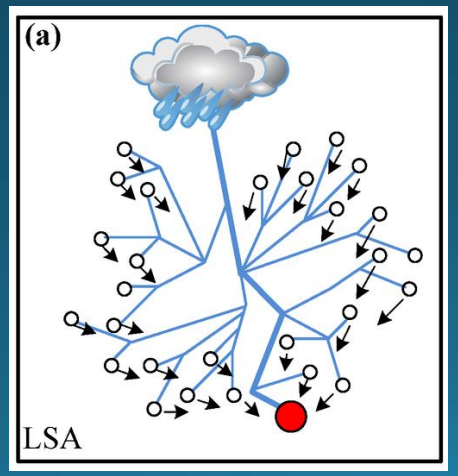
- Our program can utilize the ability of swarm intelligence to make a trading decision for users.
  - Overall, PSO works better than CLONALG
  - Both algorithms work better than Buy & Hold strategy
- Our program has user-friendly graphic user interface. General users can easily understand the steps of using this application.

Application Demo

- Minimum system requirements
  - Windows 7 32/64 bit
  - Minimum free space : 500 MB
  - Python 3.6.1
  - R Studio 1.0.143
  - Qt 5.8.0

Possible future works

- Add technical indicators to the system
- Add alternative swarm intelligence algorithms
- Better options and parameters configuration
- More add-ons for showing graphs aside from R and Python



References

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Q&A