Stock Trading Strategies by Genetic Network Programming with Flag Nodes

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ABSTRACT

Genetic Network Programming (GNP) has been proposed as a graph-based evolutionary algorithm. GNP works well especially in dynamic environments due to its graph structures. In addition, a stock trading model using GNP with Importance Index (GNP-IMX) has been proposed. IMX is one of the criterions for decision making. However, the values of IMXs must be determined by our experience/knowledge. Therefore in this paper, IMXs are adjusted appropriately during the stock trading in order to determine buying or selling stocks. Moreover, newly defined flag nodes are introduced to GNP, which can appropriately judge the current situation, and also contributes to the use of many kinds of nodes in GNP programs. In the stock trading simulations, the effectiveness of the proposed method is confirmed.

Categories and Subject Descriptors

I.2 [**Artificial Intelligence**]: Miscellaneous

General Terms

Algorithms

Keywords

Genetic Programming, Stock trading model, Decision making, Technical analysis

1. INTRODUCTION

Genetic Network Programming[1] has been proposed as a new graph-based evolutionary algorithm and its effectiveness has been confirmed. Recently, research on stock price prediction and stock trading models using softcomputing methods has been carried out[2, 3], and the stock trading models using GNP have been also proposed in [4, 5]. In this paper, the stock trading algorithm of GNP is enhanced by introducing newly defined flag nodes (GNP with Flag Nodes, GNP-FN). The aim of introducing the flag function is to judge the current situation appropriately based on the past judgments and buying/selling actions, and to use many kinds of nodes efficiently. In addition, the values of Importance Index (IMX) which is introduced in the previous paper[4] can be adjusted during the trading, while in the previous paper, IMX values are fixed.

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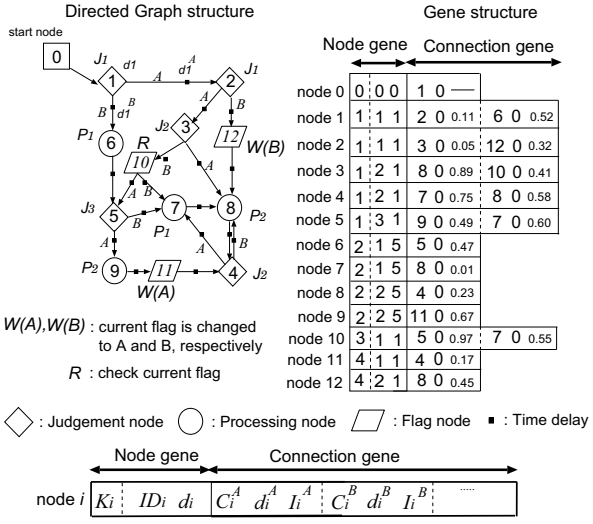

Figure 1: Basic structure of GNP-FN

2. GNP WITH FLAG NODES (GNP-FN)

Fig. 1 shows a basic structure of GNP-FN. GNP-FN consists of a start node, plural judgment nodes, processing nodes, flag read nodes and flag write nodes. Judgment nodes have if-then type branch decision functions. Each judgment node determines the next node based on the the judgment results on the technical index, and also saves the IMX value

Table 1: Judgment results for the values of rate of deviation of stock price

judgment result	A	B	C	D	E
value of rate of deviation of stock price	$[-1, -0.1]$	$(-0.1, -0.05]$	$(-0.05, 0.05)$	$[0.05, 0.1)$	$[0.1, \infty)$

assigned to the judgment results. Processing nodes determine the agent buying and selling actions based on the IMX values saved by the judgment nodes. Flag read nodes also have branch decision functions and determine the next node based on the current flag. In this paper, there are five kinds of flags (A, B, C, D, E) and one of them is always set as a current flag. Each flag write node sets a flag whose flag symbol is assigned to the node in advance. The technical indexes which judgment nodes judge are rate of deviation of stock price, rate of deviation of volume, Relative Strength Index (RSI), Rate of change (ROC), Volume ratio, Stochastics, Rank Correlation Index (RCI), Psychological line, Golden/Dead cross, Moving average convergence and divergence (MACD) and candle chart. The values of each technical index are divided into some spaces which correspond to the judgment results. Table 1 shows the judgment results of rate of deviation of stock price. Each judgment result also has its own IMX value which is used at the next processing node. At a processing node, GNP-FN calculates the average value (A_t) of the IMXs saved in the node transition from the previous processing node to the current processing node, then if $A_t \geq THRESHOLD(= 0.55)$, GNP-FN buys stocks as much as possible, and if $A_t < THRESHOLD$, GNP-FN sells all the stocks in hand. Next, all the IMX values ($IMX(i')$, $i' \in I'$) are updated based on whether or not the stock price at the next trading day is higher than the current price.

$$IMX(i') \leftarrow IMX(i') + \alpha \left\{ r - IMX(i') \right\} \qquad (1)$$

I' shows a set of judgment node numbers in the node transition from the previous processing node to the current processing node. $IMX(i')$ shows a IMX value saved at the node i'. When the stock price rises, $r = 1$, when it falls, $r = 0$ and when it does not change, $r = 0.5$. $\alpha(= 0.1)$ is a step size parameter. From Eq. 1, we can see that $IMX(i')$ shows the estimated rise probability of the stock price. The graph structures of GNP-FN are evolved by selection, crossover and mutation based on the fitness.

3. SIMULATION

Stock trading simulations are carried out using 20 companies selected from the first section of Tokyo exchange in Japan. The programs are evolved using the training data (2001–2003) and then tested using the testing data (2004). The initial fund is five million Japanese yen and the buying/selling order is executed at the opening of the trading day. The fitness is the profit obtained in the trading term. The number of nodes in one individual is 72, the number of individual is 601 and the number of generation is 500. Table 2 shows the profits in the testing term which are the average over 20 independent simulations.

From Table 2, the proposed method shows higher profits than the conventional GNP in the trading of 13 companies and than buy&Hold in those of 12 companies. Especially, while Buy-&Hold is the effective trading method in the up trend, it always makes loss in the down trend. However, the proposed method can obtain profits or reduce the loss.

Table 2: profits in the test simulations

stock	GNP-FN profit	(profit rate[%])	GNP profit	(profit rate [%])	Buy&Hold profit	(profit rate [%])
A	204,200	(4.1)	-226,900	(-4.5)	-632,000	(-12.6)
B	185,600	(3.7)	115,150	(2.3)	32,000	(0.6)
C	-55,450	(-1.1)	-137,600	(-2.8)	-189,000	(-3.8)
D	313,750	(6.3)	241,850	(4.8)	336,000	(6.7)
E	-212,400	(-4.2)	-307,050	(-6.1)	-576,000	(-11.5)
F	130,250	(2.6)	172,950	(3.5)	408,000	(8.2)
G	222,350	(4.4)	244,700	(4.9)	451,000	(9.0)
H	134,300	(2.7)	320,100	(6.4)	664,000	(13.3)
I	256,050	(5.1)	348,950	(7.0)	240,000	(4.8)
J	132,850	(2.7)	3,350	(0.1)	-1,026,000	(-20.5)
K	-245,065	(-4.9)	-294,235	(-5.9)	-985,500	(-19.7)
L	411,200	(8.2)	231,650	(4.6)	399,000	(8.0)
M	24,900	(0.5)	-38,600	(-0.8)	-264,000	(-5.3)
N	624,200	(12.5)	404,750	(8.1)	510,000	(10.2)
O	328,745	(6.6)	201,390	(4.0)	319,200	(6.4)
P	18,500	(0.4)	33,000	(0.7)	150,000	(3.0)
Q	728,900	(14.6)	606,900	(12.1)	644,000	(12.9)
R	111,500	(2.2)	183,150	(3.7)	262,500	(5.3)
S	133,150	(2.7)	134,450	(2.7)	408,000	(8.2)
T	399,700	(8.0)	335,050	(6.7)	520,000	(10.4)
mean	192,362	(3.8)	128,650	(2.6)	83,560	(1.7)

4. CONCLUSIONS

In this paper, newly defined flag nodes and the adjustment method of IMX are introduced to GNP, and a stock trading model is created. From the stock trading simulations, it is clarified that the proposed method shows higher profits than the conventional methods. In the future, we will build portfolio systems where the effective investment could be carried out by selecting stocks automatically.

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