

Generalization of GNP with Credits

- Credit GNP with Evolution
- Credit GNP with Learning

1. Introduction

Research note No. 911 describes the generalization of GNP with Credits, whose features are

- Credit GNP with Evolution and Credit GNP with Learning are unified.
- Each judgment node or processing node has a credit branch whose usage means that the node is non-existent
- The credit branch is taken by probability, which improves the exploration probability of GNP
- It could be applied to judgment nodes and processing nodes
- It could be applied to GNP and GNP with Rule Accumulation

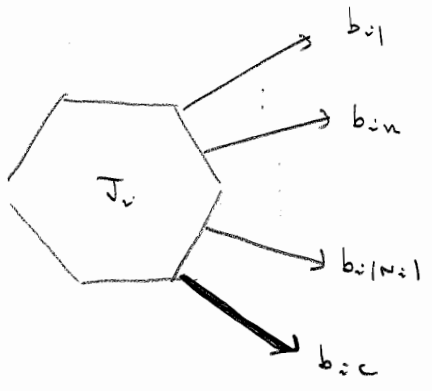
2. Basic Concept of Credit GNP

Judgment nodes and processing nodes have another branch, that is, credit branch b_{ic} , whose probability P_{ic} to take is determined by evolution (Credit GNP with Evolution) or learning (Credit GNP with Learning) (see Fig. 1).

When credit branch b_{ic} is taken, judgment node i or processing node i is regarded as non-existent.

Other conventional branches are taken by the probability of

$1 - P_{ic}$.



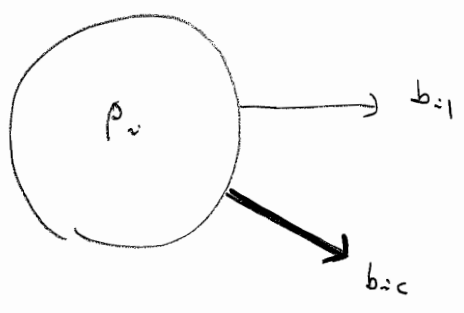
< Judgment node i >

b_{in} : the n th branch of node i

N_i : set of numbers of branches of node i

b_{ic} : credit branch of node i

P_{ic} : probability of taking branch b_{ic}



< Processing node i >

Fig. 1 Credit Branch of Judgment and Processing Node

• Credit GNP with Evolution

P_{ic} is determined by evolution

• Credit GNP with Learning

P_{ic} is determined by the following Temporal Difference (TD) Learning

$$P_{ic} = \frac{e^{V(b_{ic})/T}}{e^{V(b_{ic})/T} + \sum_{n \in N_i} e^{V(b_{in})/T}} \quad (\text{Boltzmann Distribution})$$

$$V(b_{in}) \leftarrow V(b_{in}) + \alpha (r_i + \gamma V(b_{jn}) - V(b_{in}))$$

$$V(b_{ic}) \leftarrow V(b_{ic}) + \alpha (r_i + \gamma V(b_{jn}) - V(b_{ic}))$$

b_{jn} includes b_{ic}
(see Fig. 2)

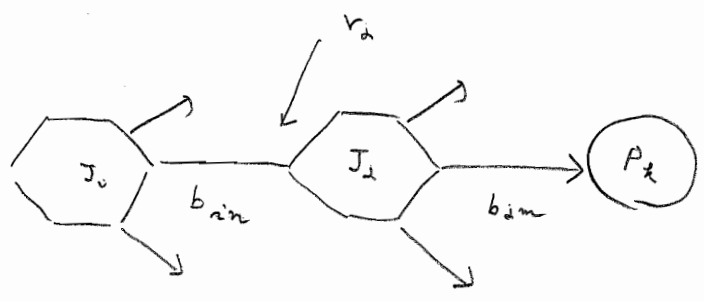


Fig. 2 Transition of GNP

where

T : temperature parameter of Boltzmann Distribution

$V(b_{in})$: V value of branch b_{in}

r_i : return obtained by connecting branch b_{in} to node j