REINFORCEMENT LEARNING BASED ON DISCRETE COGNITION

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ABSTRACT

I show in this paper that the information system of a computer and the cognition of human must be discrete, which is equivalent to a system based on integers. There are two mainly arguments to support this: 1) we can't construct a real number system with finite integers and 2) the system of real numbers is logically not measurable. Besides, I believe that the integer is more suitable for deep learning networks as they are originally discrete. To prove this, I conduct a series of experiments on the deep reinforcement learning.

Keywords Reinforcement Learning · Deep Learning · Discrete Cognition

1 The Cognition must be Discrete

I want to show two Phenomenons firstly.

The first one is that we can't construct a real number system from a discrete number system when we don't have infinite integers. The book PRINCIPLES OF MATHEMATICAL ANALYSIS wrote by Rudin Rudin [1986] shows a process of constructing the set of real numbers R from the set of real number Q. (And Q is equivalent to Z.) In that process, we need infinite subsets of Q to construct a real number, which means we need infinite elements of Q to construct a real number. So we can say that we need infinite integers to construct a real number. But in the real world, there is no infinite integers in a computer and (may) in our brains. We can't construct a true real number from a finite discrete system, not to say a information system of true real numbers.

On the other hand, let's suppose that there is a bit containing a real number. How can we know what it is exactly? One way is measuring it with a exact precision, but it appears nothing beyond a discrete finite system. With a exact precision means we don't know what it real is at the same time. Besides, how can a such bit be copied exactly? They have infinite precision, there seems no logic imaginable way to copy a real bit q1 to another real bit q2, or check if q1=q2. So, if such a information system of real number exists, it even can't be measurable. When we measure it with exactly precision, it downgrade to a discrete system. When we don't measure it, we will never know what it is.

It is no doubt that the information system of a computer is finite discrete which is equivalent to a system based on integers. And the cognition of human, which is based on the measurement as I believed, must also be a discrete system.

2 Experiment on Deep Reinforcement Learning

As what we discussed above, any calculation system of a computer program is equivalent to a system based on integers, I don't think the default number type of the most deep learning networks should be float-point number. For most systems, a too small precision pays a lot and doesn't make much sense. The unevenness of float-point numbers may also caused the system unstable. Anyway, I think a decimal learning network shouldn't be what it original look likes.

As a result, I'd like to conduct a series of experiments of deep reinforcement learning to show what we talk above exactly. And I have reasons to expect that the discrete learning networks can be more stable, understandable, controllable and adjustable.

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For the reason to choose deep reinforcement learning is that it is an algorithm that aims to simulate the basic learning process of human and animals. And the learning networks which are applied to basic Reinforcement learning problems such as class-control problems or Atari 2600 games have suitable sizes for detailed research.

For now, I am processing the problems of class-control in OpenAI Gymnasium and I'm not doubt that the result will come out soon.

References

W. Rudin. *Principles of Mathematical Analysis*. McGraw - Hill Book C., 1986. URL `https://books.google.de/books?id=frdNAQAACAAJ`.