My Research Plan for Ph.D

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About Me

I am now a third-year graduate student from **China Institute of Atomic Energy**(CIAE). My main research interests are the optimization of AI methods based on interdisciplinary thinking(including physics, biology and other fields of science), the applications of AI in scientific research, and robotics.

What do I plan to study when I am a Ph.D.

Although I know a Ph.D can only do research in one or two directions, I still try to do the following researches:

- The fusion of semantics and vision based on virtual environment;
- Intelligent formulas derivation and knowledge graph of scientific research papers;
- Robotics in scientific research and industry;
- Quantitative trading method based on statistical physics;

The fusion of semantics and vision based on virtual environment

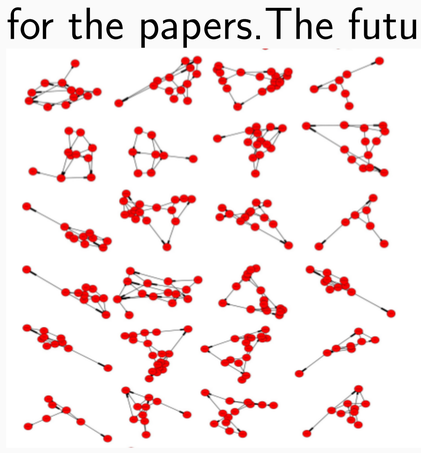
The human brain mechanism inspired us to use a combination of visual signals and semantic information to optimize learning algorithms. Based on this idea, I have done a lot of research work in cooperation with the **Institute of Automation, Chinese Academy of Sciences** Institute of Automation of Chinese Academy of Sciences. At present, I have developed an enhanced learning environment based on 3D virtual environment to train agents to complete high-level logic tasks.

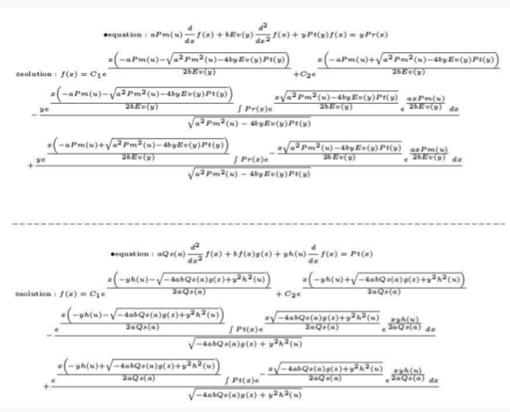
The future work:

- Research on long-range logical reasoning based on semantic network based on the current 3D virtual environment;
- New reinforcement learning algorithm combining visual and semantic information;
- Extend the viable approach in the virtual environment to real-world tasks;

Intelligent formulas derivation and knowledge graph of scientific research papers

During my graduate studies I tried to use the reinforcement learning algorithm for symbolic calculations (automatic formula derivation), and I plan to continue this research and will also do researches about the knowledge graph generation for the papers.The future work:

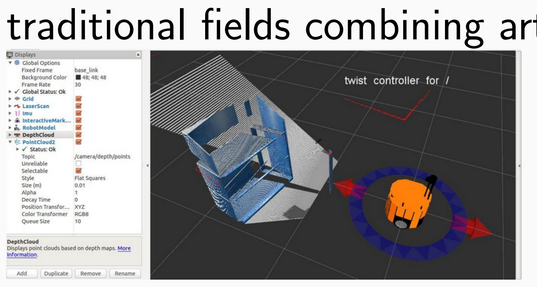




- Large-scale and high precision automatic formula derivation;
- knowledge graph generation of scientific research papers, which makes sense for knowledge engineering and automated reasoning;

Robotics in scientific research and industry

Based on the ROS system, I plan to study how to implement robots in place of human advanced engineering skills in some traditional fields combining artificial intelligence algorithms.

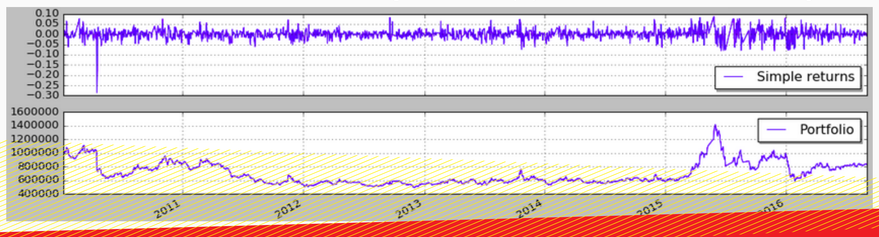


- Robot maintenance engineering in high-risk scenarios(Such as nuclear power plant reactors);
- Robots for some repetitive experimental sciences (such as some chemical experiments);

Quantitative trading method based on statistical physics

I have begun to study some physics-based interpretable stock market trend models. In the future work, I plan to make this theory more rigorous and perform better on real trading.Now I use the Gibbs Free Energy model for the stock market:

$$\mathbf{\Delta H_{system} = \Delta G + T\Delta S_{system}}$$
$$\mathbf{\Delta G \sim P(\Delta G|X_h) = \mathcal{N}(u(X_h), \delta^2(X_h))}$$
$$\mathbf{T \sim P(\Delta S|X_s) = \mathcal{F}(\theta(X_s))}$$
$$\mathbf{\Delta S \sim P(\Delta S|X_v) = \mathcal{N}(u(X_v), \delta^2(X_v))}$$
$$\mathbf{\Delta H > 0 \Leftrightarrow price \uparrow, \Delta H < 0 \Leftrightarrow price \downarrow}$$



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