



# How to Improve Divergent Thinking Capability by Information Technology and Extenics

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# outlines

- ◆ Introduction
- ◆ Methods
  - ◆ Information collection
  - ◆ extending
  - ◆ Transformation
- ◆ Results
- ◆ Future work



# Introduction

- ◆ divergent thinking typically occurs in a spontaneous, free-flowing manner
- ◆ most of the current methods are rely on one's experience and thinking ability
- ◆ information technology, especially the World Wide Web and its applications can support divergent thinking potentially.
- ◆ However, there is no enough research to explore the method to improve divergent thinking capability by information technology systematically.



# Information Preparing

- ◆ Collection
- ◆ structure

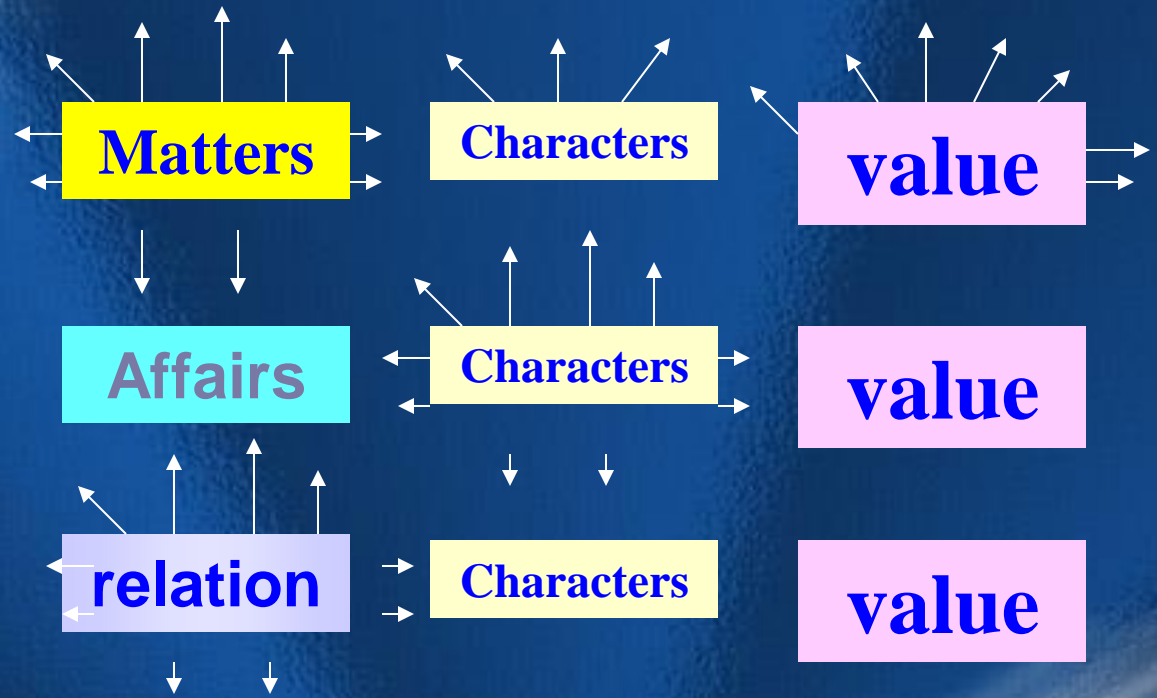


# What is Extenics?

- ◆ Extenics is a science which studies the possibility of extending things and rules and methods of developing innovation with formalized models, and is used to resolve contradictory problems.
- ◆ The research object of Extenics is contradictory problems.
- ◆ It includes extension theory, extension innovation method and extension logic;
- ◆ its applications form the extension engineering.



All things



**1. Basic Element Theory**  
Collecting information and structuring is the basis of innovation



# Use n-dimensional matrix to describe information

$$M_1 = \begin{bmatrix} \textit{personA}, & \textit{height}, & 170\text{cm} \\ & \textit{weight}, & 60\text{kg} \\ & \textit{father} & M_p \\ & \textit{office}_1 & M_2 \\ & \dots & \dots \end{bmatrix}$$

$$M_2 = \begin{bmatrix} \textit{deskB}, & \textit{length}, & 100\text{cm} \\ & \textit{width}, & 60\text{cm} \\ & \textit{weight}, & 15\text{kg} \end{bmatrix}.$$



# Systematic Information Collecting Method--Conjugacy of objects

- ◆ By physical, systematic, dynamic and antithetic properties :
- Materiality——**Imaginary Part and Real Part**
- Systematicness ——**Soft Part and Hard Part**
- Antagonism ——**Negative Part and Positive Part**
- Dynamism ——**Latent Part and Apparent Part**





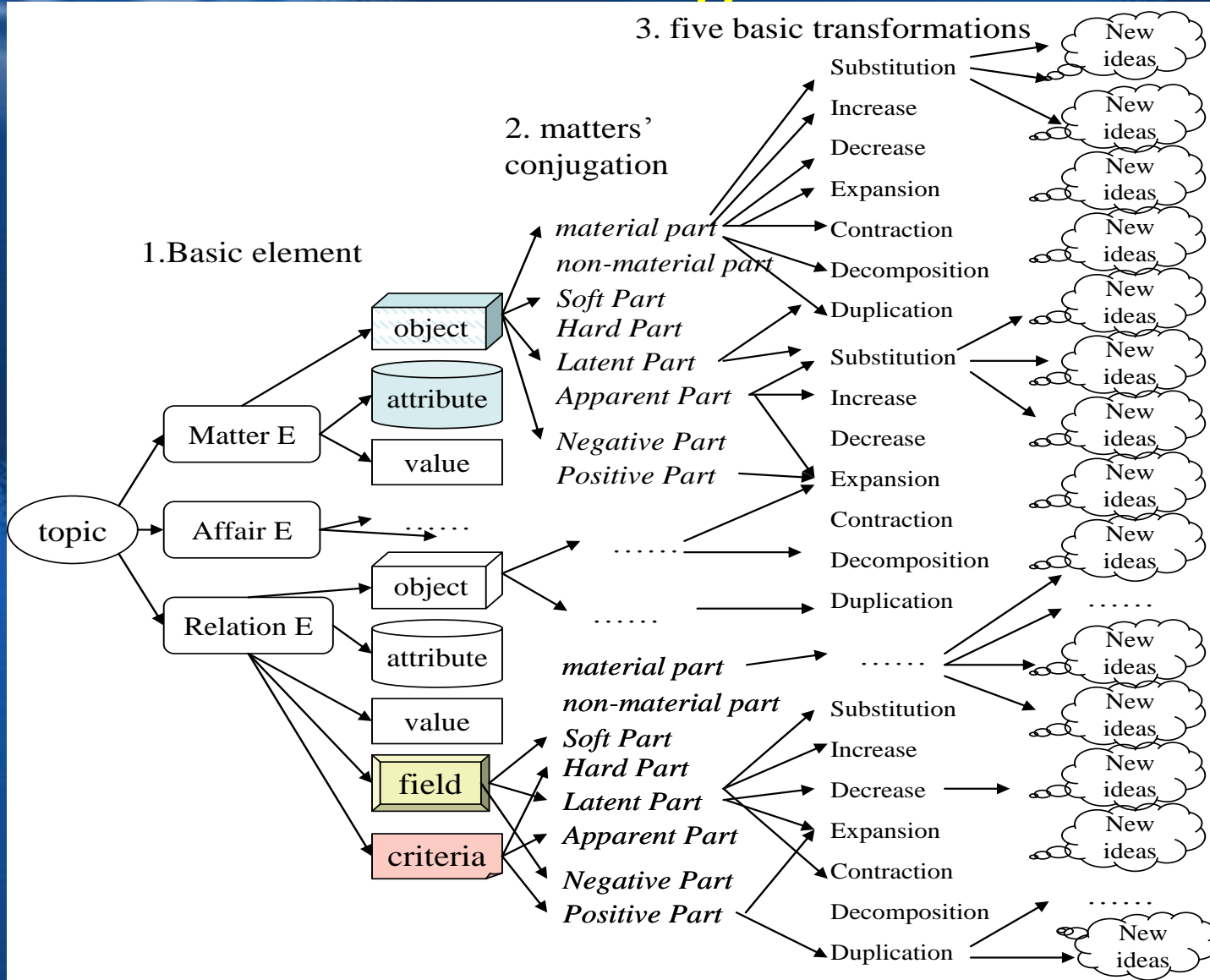
# Basic Extension Transformations

1. Substitution
2. Increasing/Decreasing
3. Expansion/Reducing
4. Decomposition/Combination
5. Duplication





# Framework of Divergent Thinking Model





## *Steps to Obtain new Ideas by Basic Transformation Methods*

- ◆ **Step 1.** Build basic-element model as the base for transformation by methods introduced in section 3.
- ◆ **Step 2.** Collect as many as values for certain attributes.
- ◆ **Step 3.** Try to do five basic transformations on each attributes one by one, and write down innovation ideas.

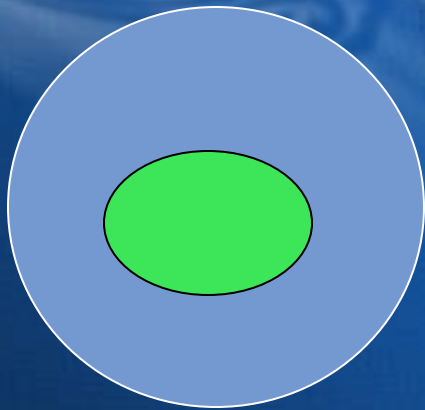


# Conclusions and future work

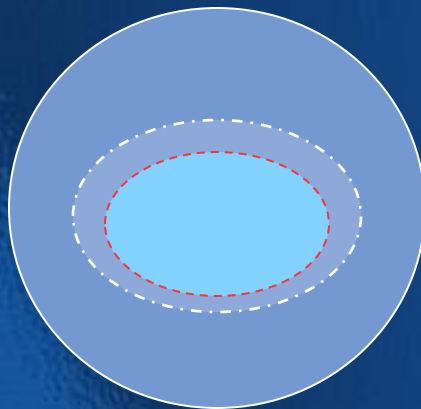
- ◆ It helps us think from 3 directions and 8 aspects by conjugate analysis.
- ◆ Based on the model, we successfully helped students think in formularized expression rely little on their experience and enlarge their view with support of a thinking tool.
- ◆ The practices in class proved its effectiveness. By testing on 185 students in NIT, Zhejiang University, The average lifting ratio is 157.82%.
- ◆ However, we only use a small part of Extenics. More theories will be applied further in innovation educations.



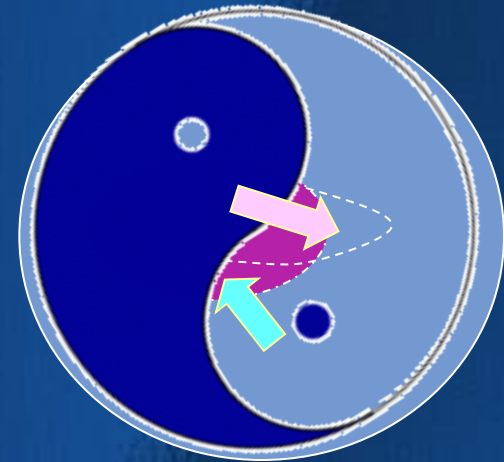
# Extension set



**Cantor set**



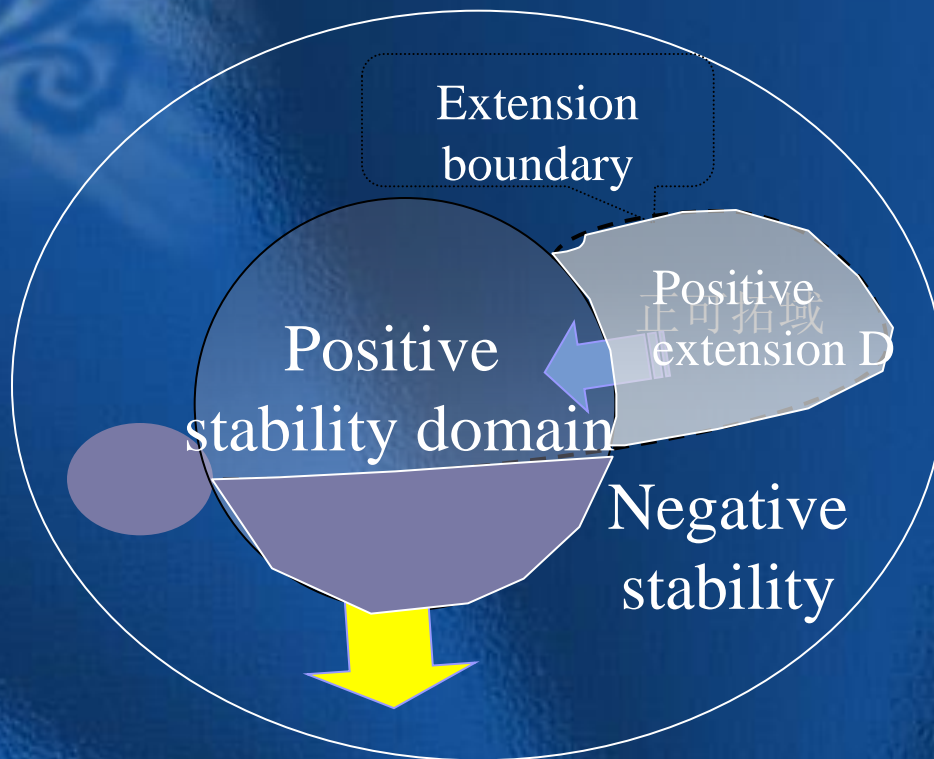
**Fuzzy set**



**Extension set**



# Extension Set and its Domains



Things change, in transforming



# International Extenics Research Scholars

- ◆ So far four groups of international Extenics research scholars have been recruited.
- ◆ In May, 2012, Professor Florentin Smarandache came to Research Institute of Extenics and Innovation Methods, Guangdong University of Technology to learn and study Extenics for three months.
- ◆ During his stay in China, he participated in the proofreading of the monograph *Extenics: Theory, Method and Application* of English version, composed Extenics theses and took part in “2012 Extenics Software Development Seminar” organized by Extension Engineering Society of Chinese Association for Artificial Intelligence and Research Institute of Extenics and Innovation Methods, Guangdong University of Technology.
- ◆ After going back, Professor Florentin Smarandache composed the Extenics monograph *Extenics in Higher Dimensions* which was published by American Education Press in America at the end of 2012.





# Acknowledgements

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# Thanks!

- ◆ <http://web.gdut.edu.cn/~extenics/>
- ◆ Website of Extenics:  
<http://web.gdut.edu.cn/~extenics/i.htm>
- ◆ Search “Extenics” on Google, Baidu or more