Artificial Intelligence: A Brief Introduction

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Artificial Intelligence: A Brief Introduction

1. What the hell is Artificial Intelligence?
2. The Aim of the Game, Approaches and Varieties to Reach it
3. One of my research projects with Japanese Universities that I currently run: Segmentation of MRT images by intelligent evolutionary methods
4. Outlook: Where does AI bring us to?

After the talk (informal):

Smalltalk on potential upcoming collaborations: projects, internships, Theses writing in Japanese enterprises, … – whatever

1 What the hell Artificial Intelligence (AI)?

- "… the science of making machines do things that would require intelligence if done by humans." (Marvin Minsky, 1968)
- "… the study of mental faculties through the use of computational models" (Eugene Charniak, 1986)
- "… the study of how to make computers do things which at the present, people do better." (Elaine Rich, 1983)
- "… novel computing technology that solves problems not otherwise easily solved." (Avelino Juan Gonzalez, 2003)
- "… the set of all measures to perform or outperform human cognitive abilities by artificial creatures." (Rainer Knauf, 2018)

2 The Aim of the Game, Approaches and Varieties to Reach it

Ultimate objective: **Mechanizing the Processes of Thinking**

How to adapt a skill that is performed by natural creatures such as humans to artificial creatures such as machines?

1. Adopting the same or similar technology
   - **Sub-symbolic approaches of AI**

     such as Artificial Neuronal Networks and others
2. Developing a different technology that performs the same skill similar or better than humans
   - **Symbolic approaches of AI**

     such as deductive / inductive Inference and others

... my teaching and research background

Father in spirit of symbolic AI

Gottfried Wilhelm Leibnitz

(*1646 †1716)

... probably the last German Universal Genius

Basic Idea *(according to G.W. Leibniz)*

1. **lingua characteristica**
   Knowledge Representation Language
2. **calculus ratiocinator**
   Knowledge Processing Calculus

Subfields of symbolic AI *(to be continued all the time)*

- Knowledge Representation
- Knowledge Processing
  - Deductive Inference (Machine Proofs)
  - Inductive Inference (Machine Learning)
  - Knowledge Processing Technologies
    (Search Technologies, Case Based Reasoning, Multi- Agent Systems, Evolutionary Approaches, Fuzzy Reasoning, …)
- Data Mining (= “inconsistent Machine Learning”)
  - eager (building models) / lazy (keeping data like kNN) Data Mining Approaches
- Appropriate Programming Languages for AI
- Human-like Interfaces
  - Natural Language Processing and Semantic Modelling
  - Image Processing
- Particularities of Special Applications
  - Planning
  - Cognitive Robotics
  - Modelling Human Behavior
  - Games (including Modelling Human Behavior in Games)
- **…. (many others)**

3 One of my current collaborative research projects

Learning a better and better image segmentation of MRT images by Genetic Algorithms

Japanese / German collaborators:

Setsuo Tsuruta

School of Information Environment
Tokyo Denki University,
Inzai, Japan

Syoji Kobashi

Department of Computer Engineering
Hyogo University
Himeji, Japan

Yoshitaka Sakurai

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Introduction

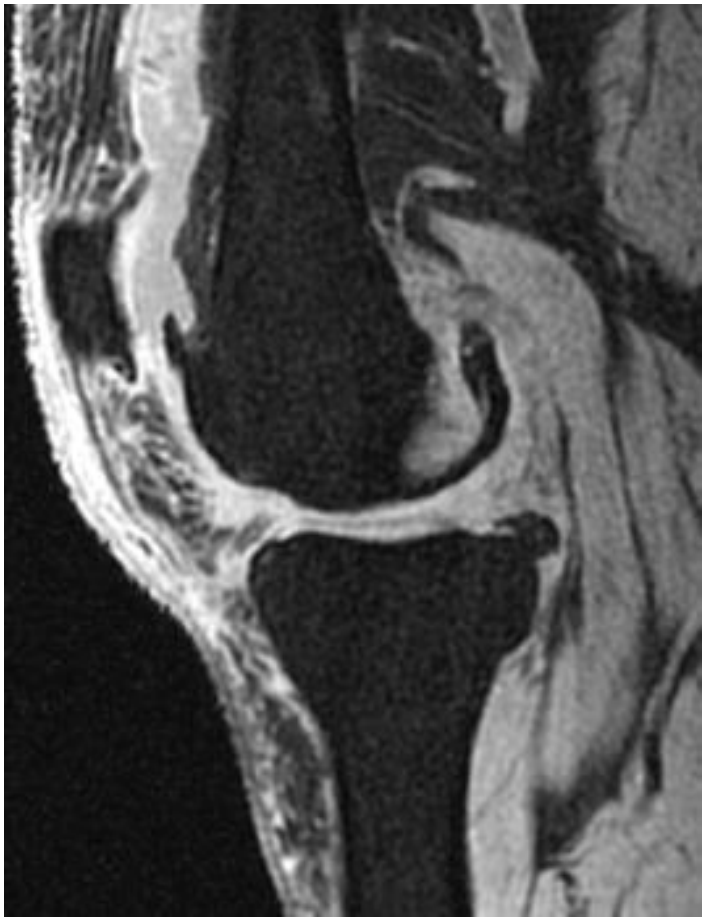
Image segmentation technologies so far:

- thresholding
- k-means
- fuzzy c-means: FCM
- Bayesian classification
- Location-Dependent Image Classification: LDIC (best so far)

Our new approach:

an efficient classification method by combining LDIC with a Genetic Algorithm (**GA**) and combined with Case Based Reasoning (**CB**R) towards a **C**ase **B**ased **G**enetic **A**lgorithm **L**ocation-**D**ependent **I**mage **C**lassification (CBGA-LDIC)

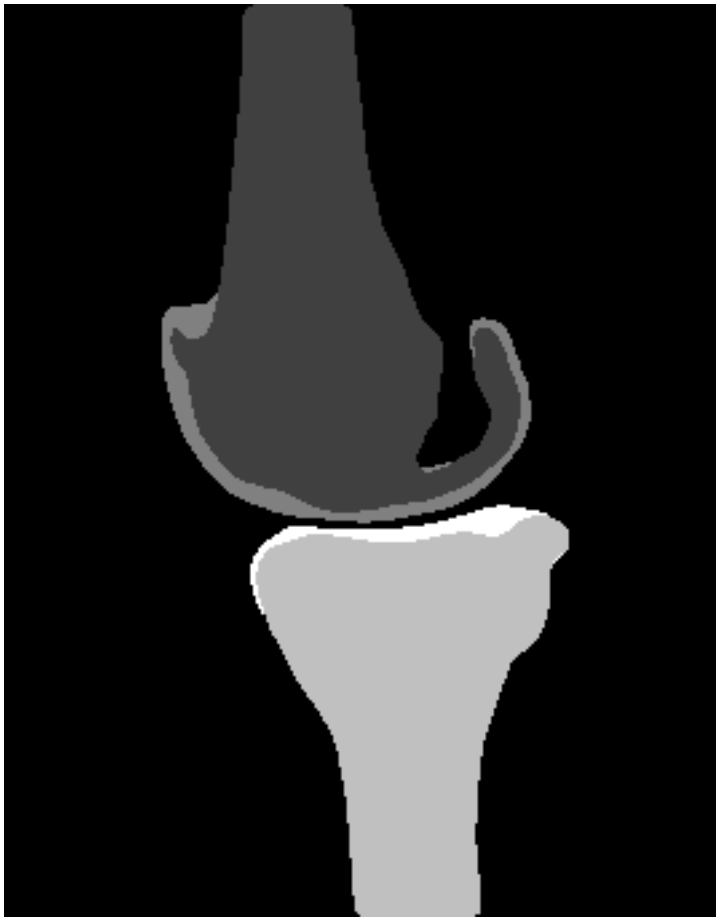
One of the raw sagittal MR images



?

solution

corresponding ROI image, to be derived from it



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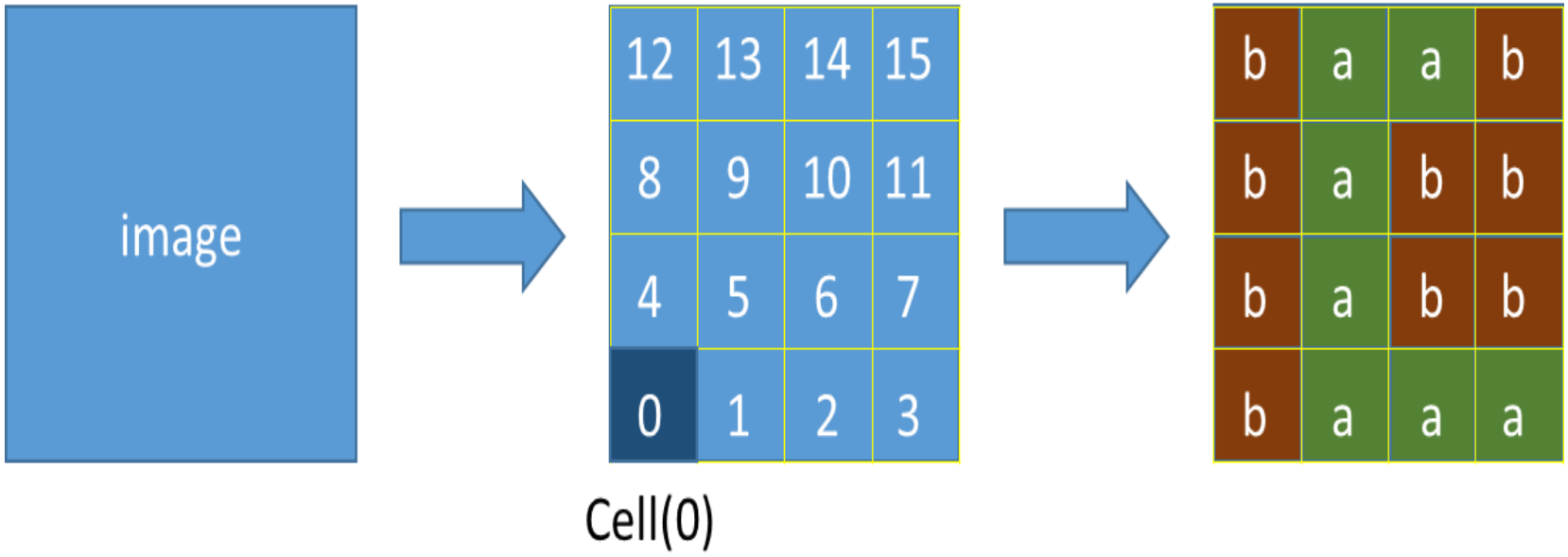
Splitting the image into cells

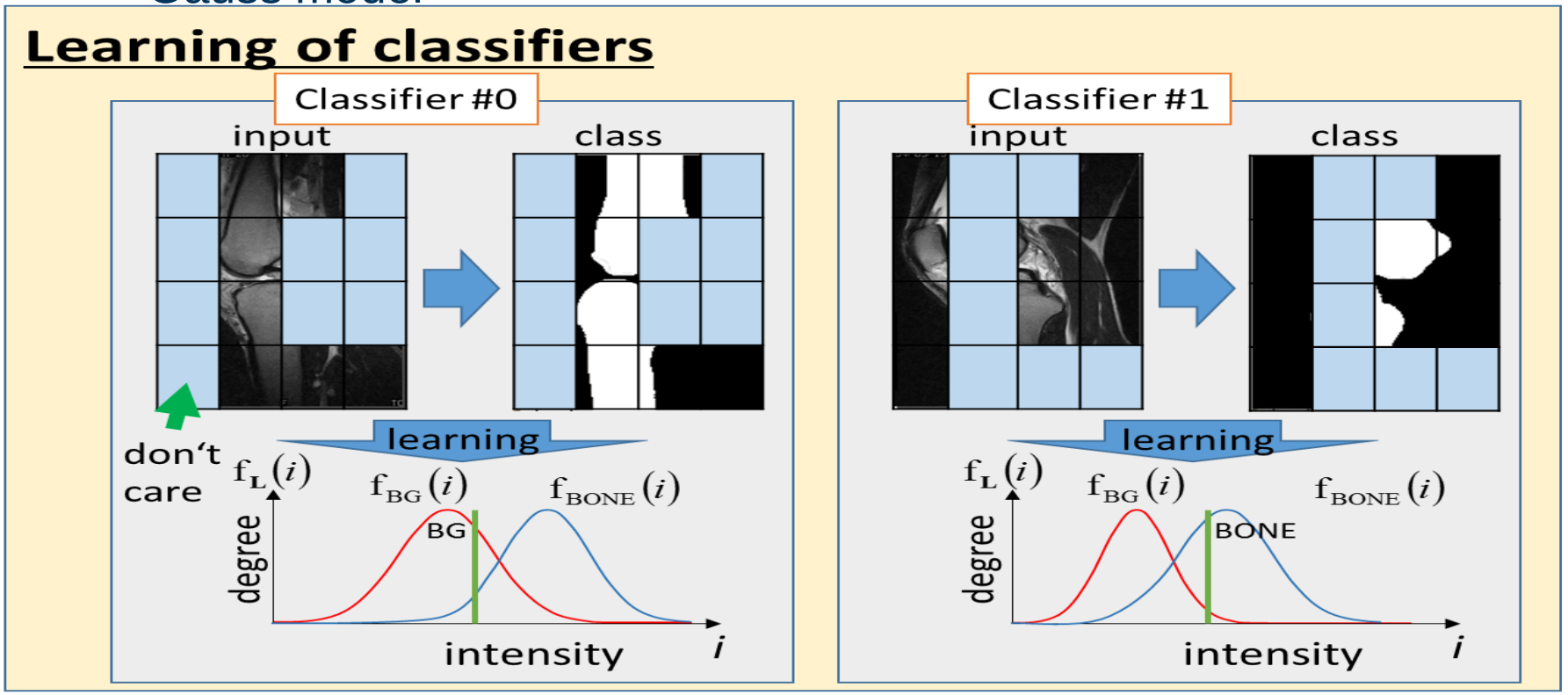
- 1st, LDIC decomposes the image into N cubic cells with Ix * Iy * Iz voxels
- 2nd, the cells are aggregated and groups are obtained
- example with 16 cells and 2 groups:



in our experiment: 20 * 20 * 10 = 4.000 cells, 30 groups

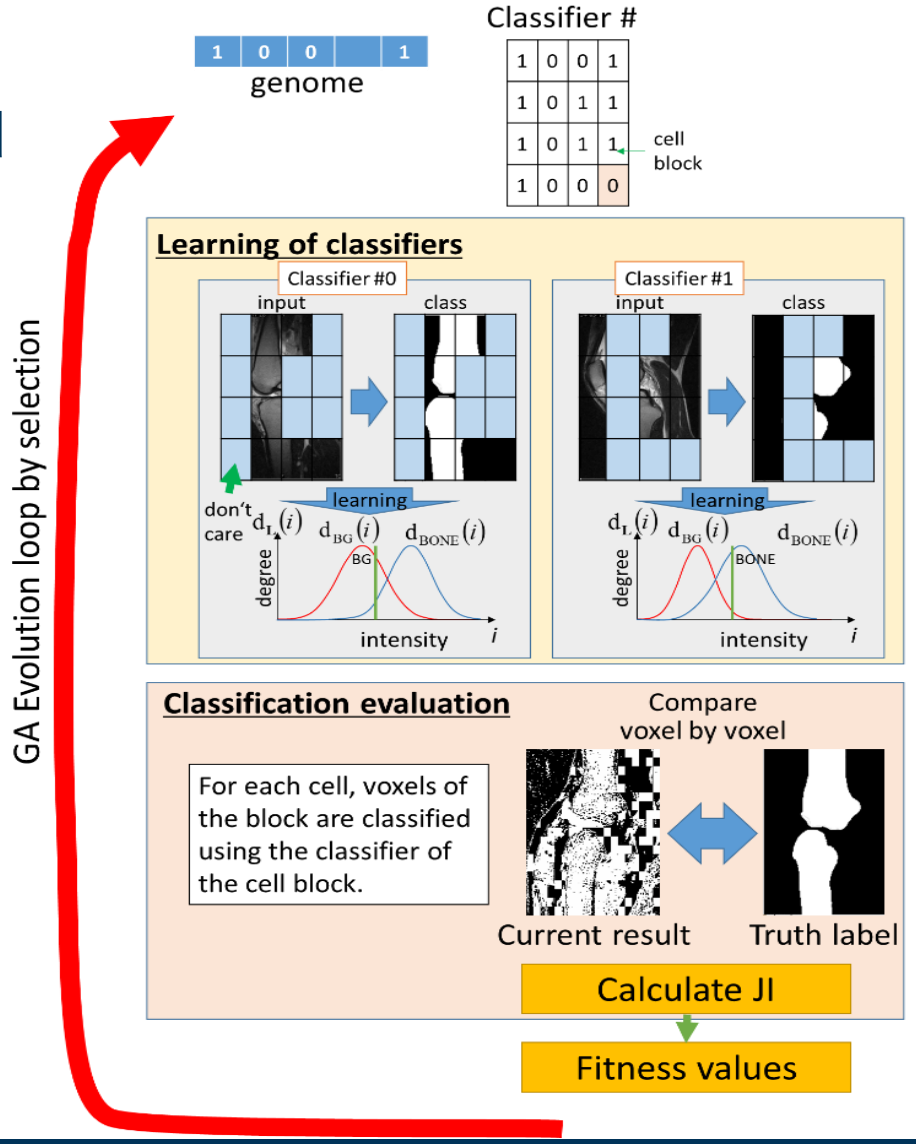
Classifying the cells

- 3rd, LDIC defines regions and classifiers for each region by
  1. **Feature extraction** (intensity of voxels)
  2. **Machine learning** by a Gaussian Mixture Model (GMM) based classification: for each group and each class, the intensity distribution of the training subjects is approximated by using a Gauss model



Fitness estimation

- each individual is a cell block (called classifier map) trained by GMM using voxels at the classifier number's cells of training subjects
- The GMMs are derived by using the mean and standard deviation of MR signals
- Example: classifier #0 is trained by using MR signals and truth class (bone or background)
- Similarly, classifier #1 is trained



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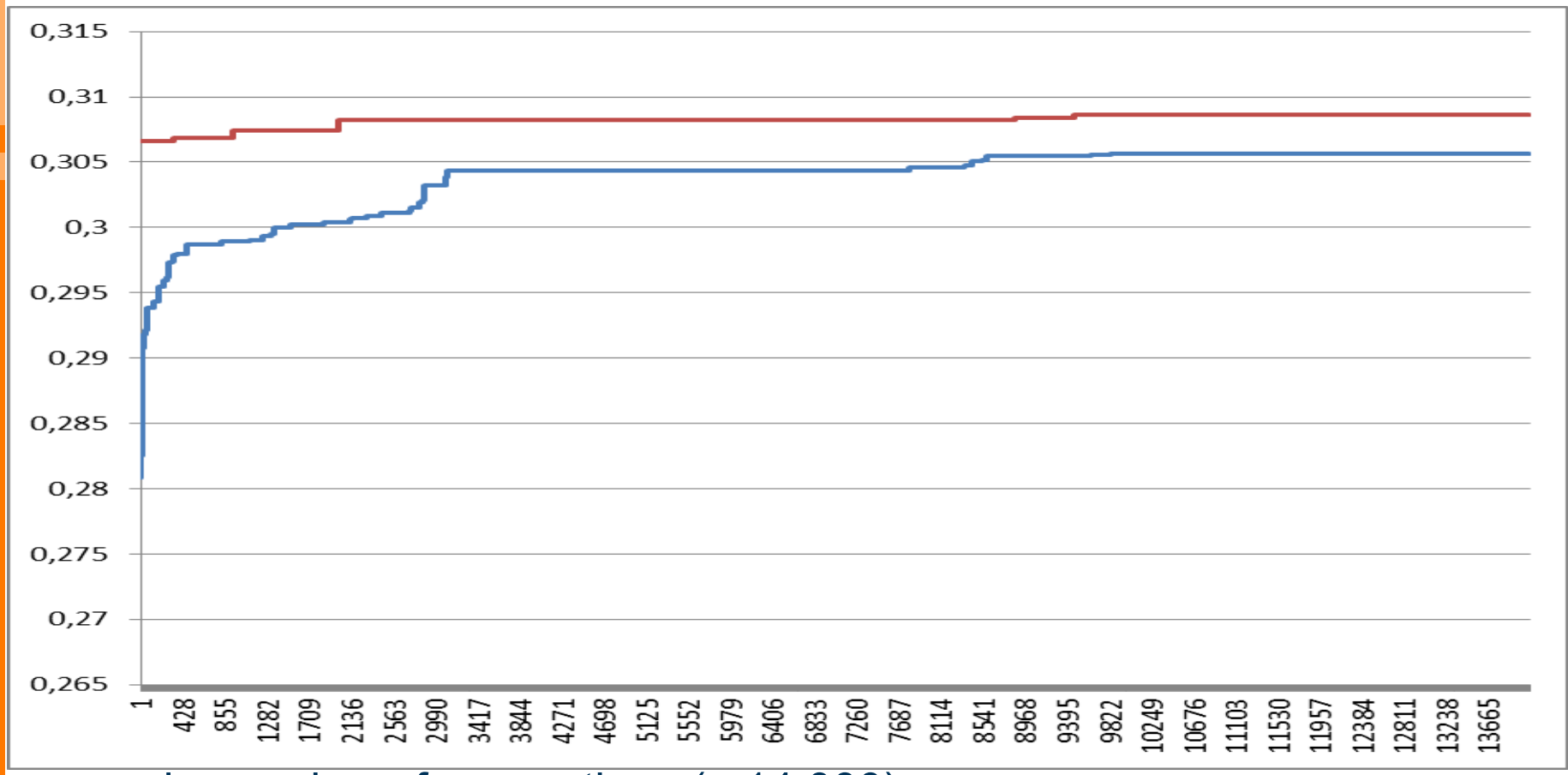
One of the experiments: GA-LDIC vs. CBRGA-LDIC



- x-axis: number of generations (≈ 14.000)
- y-axis: fitness values (Jaccard-indices)
- stop and restart with initial individuals by merging a variety of good cases after every 1000 generations

4 Outlook: Where does AI lead us to?

Aspects to take into account ⇒ three thesis

1. **What should we learn from former perspectives to the future?**
   - *Remember ~ 50 years ago: Could you imagine nowadays achievements such as Internet, mobile phones, navigation systems 50 years ago already?*

   ⇒***There will be applications that we even can't dream about today.***
2. **What should we take care for when developing AI applications?**
   - *Did you ever check in into a flight with a luggage check-in machine?*
   - *Did you ever perform a self check-out in a supermarket by scanning all the items by your own?*

   Some technical "achievements" make our daily life worse. They are just driven by the objective of saving money.

   ⇒***AI should serve humans' convenience, not humans' greed.***
3. **How about military AI applications?**
   - *In the US, most of the money for AI research comes from the DoD.*
   - *Do you accept weapons that search their destination based on AI?*

   ⇒***Dilemma: If we don't do that others will do. We need to develop a political climate, in which nobody wants that.***

Visions / Speculations for upcoming AI applications

- **Autonomous Driving** – *not a vision anymore*
- **Face Recognition** – *not a vision anymore, but will gain much more application fields (PINs and signatures for identification are history)*
- **Data Mining on informal data such as text, audio, and images**
  - **Social applications**, e.g. estimating the credibility of news and messages (as I currently work on for Twitter messages in collaboration with Tokyo Denki University)
  - **Economy**: more and marketing research applications
  - **Medicine**, i.e. discovering of reasons of pathologic apperiances, mining of optimal therapy sequences based on big databases, finding genetic patterns of diverse kinds of sickness, …
  - **Science**, e.g. interpretation von geo data to predict natural disasters
  - **…**
- **Solving more and more "NP hard" problems by AI approaches such as Genetic Algorithms**, e.g. in traffic logistics including data traffic in the www (such as a Japanese PhD student of mine did)

Visions / Speculations for upcoming AI applications cntn'd

- **Robotics gains more and more application fields**
  - **Medicine**: More and more surgeries will become more precise, if done by robots than by humans
  - **Disaster Management**: Robots doing work that is dangerous for humans (in destroyed buildings, contaminated regions, …)
  - **Social Applications**: Assistants in shops, restaurants, hotels, senior residents, institutions, at home as done at my university as well:

Visions / Speculations for upcoming AI applications cntn'd

- **Machine Translation between different natural languages**

  Recently, this has been performed for English ↔Chinese by this guy at human translator's level**:** Xuedong Huang is Microsoft's Manager for Languages and Machine Translations

  public source:

  https://www.heise.de/newsticker/meldung/Historischer-Meilenstein-Microsoft-KI-uebersetzt-Chinesisch-so-gut-wie-Menschen-3995552.html

  - There are reasonably priced products of this kind at the Japanese market already, as I figured out in my frequent Breakfast Restaurant when staying in Japan

  Human Translators should worry about their job, since they are not needed any more quite soon ;-)

Thank you so much for your patience to listen to me!

I'm looking forward to get interesting information on AI research and applications in German and Japanese enterprises and especially in collaboration issues in this field between our countries.

Whenever I can contribute something to such collaboration you can count on me!

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