Interactive Evolutionary Computation - IEC

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Content

1. Evolution and evolutionary Algorithm

2. Interactive Evolutionary Computation(IEC)

3. Applications of IEC

Evolution

Evolution is the change in heritable character of biological population.

- Charles Darwin

Types:

- Natural Selection.
- Artificial Selection.

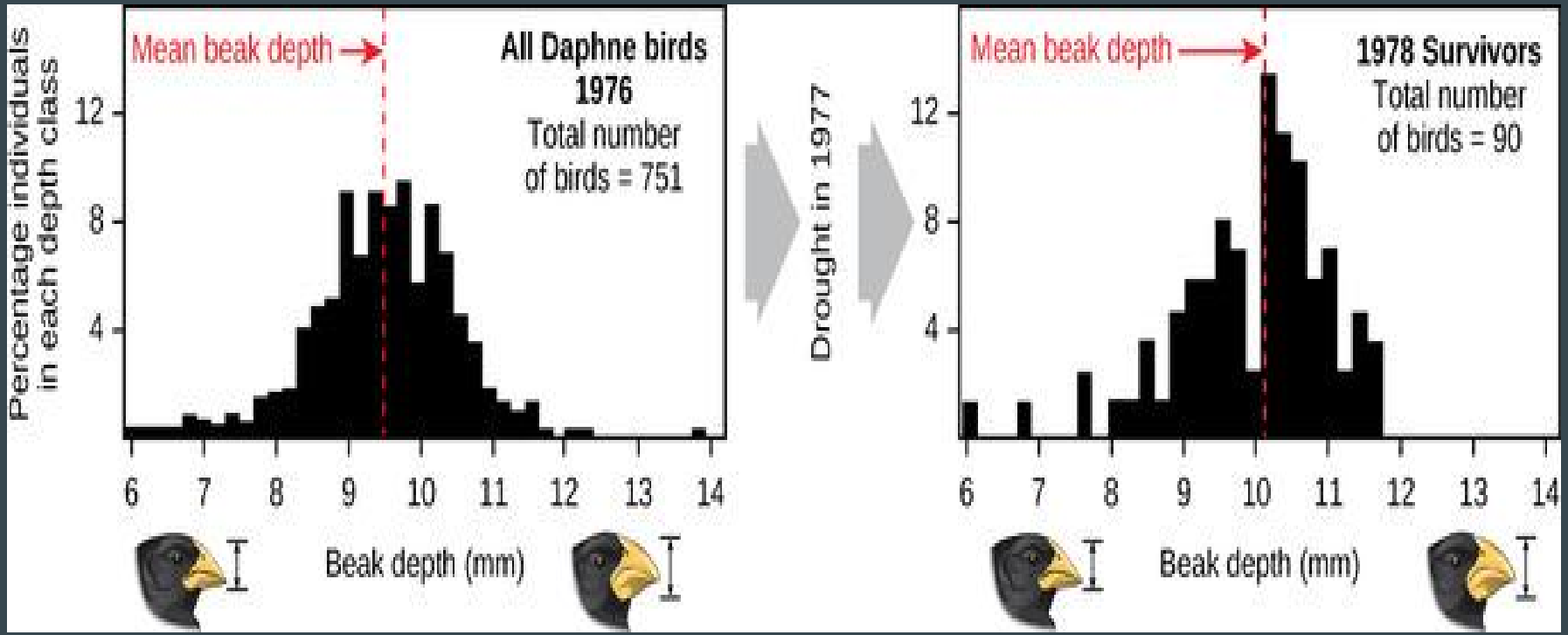
Natural Selection

Natural Selection is a process by which the organism adapts to the environment survives.

Three main point in this type:

- Resource
- Inherit qualities
- Varies from others in same generation

Natural Selection (Cont.)



Source:https://www.boundless.com/biology/textbooks/boundless-biology-textbook/evolution-and-the-origin-of-species-18/understanding-evolution-124/the-galapagos-finches-and-natural-selection-496-13095/

Artificial Selection

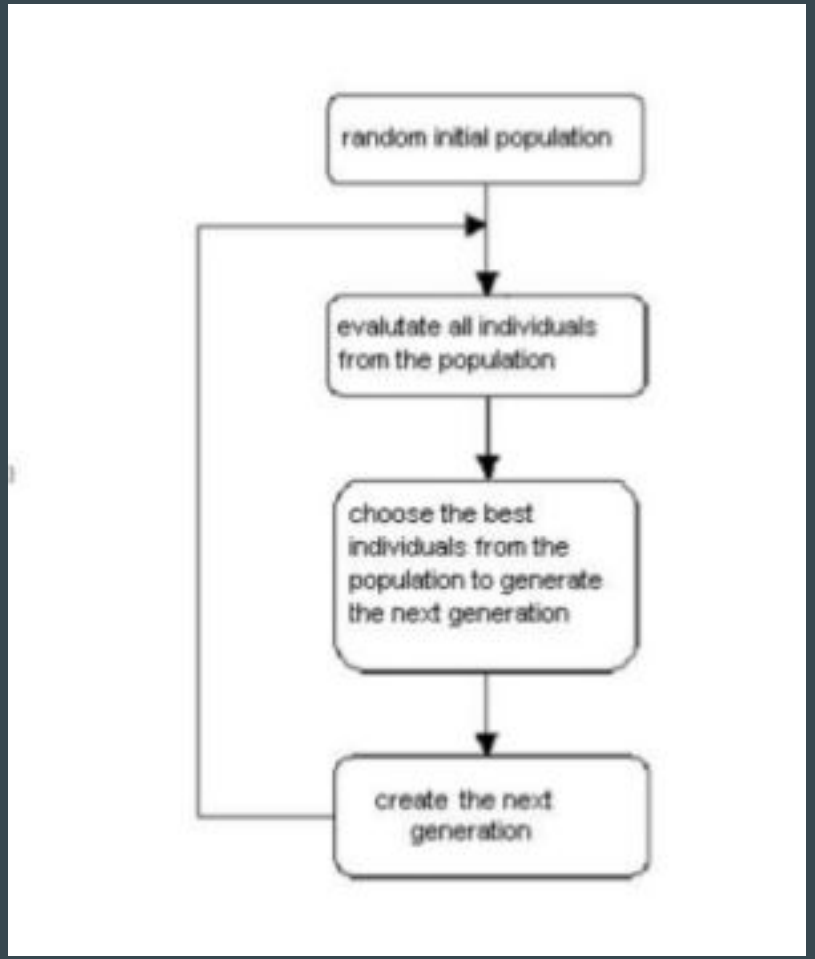
The breeding of plants and animals for different traits.

Examples:

- Flower
- Animals

Evolutionary Computation

- Selection
- Crossover
- Mutation

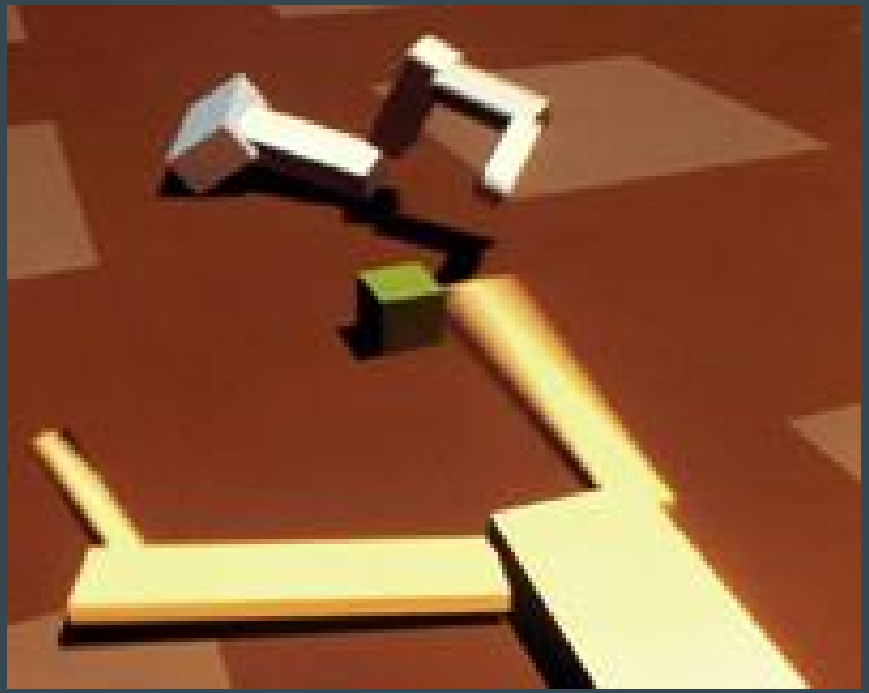


Evolutionary Creatures

Karl Sims

Environment

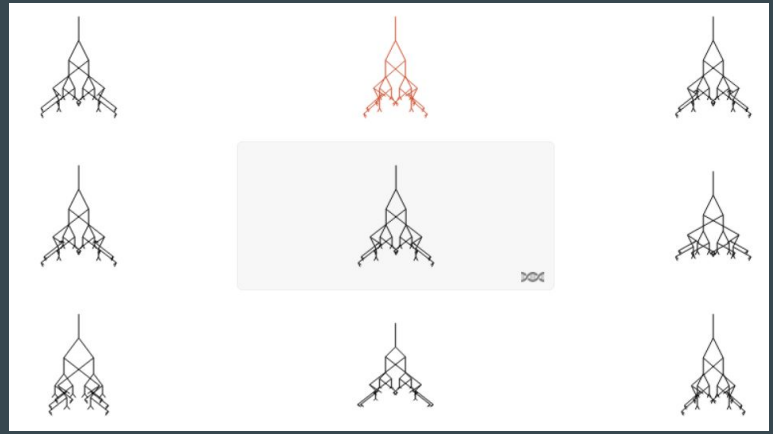
- land
- water

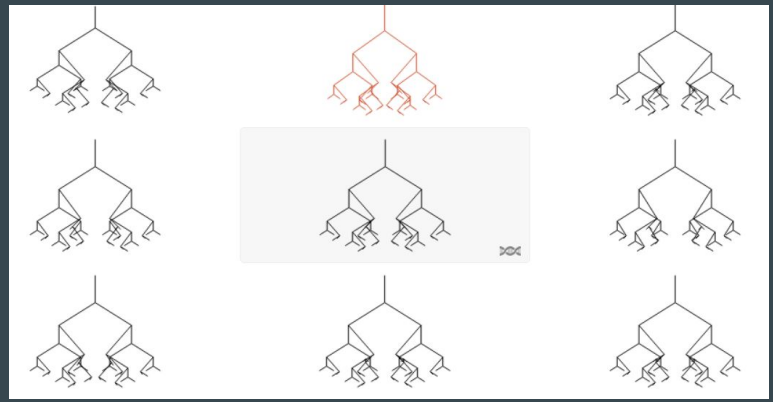


Source:http://www.karlsims.com/evolved-virtual-creatures.html

Description of the Interactive Algorithm

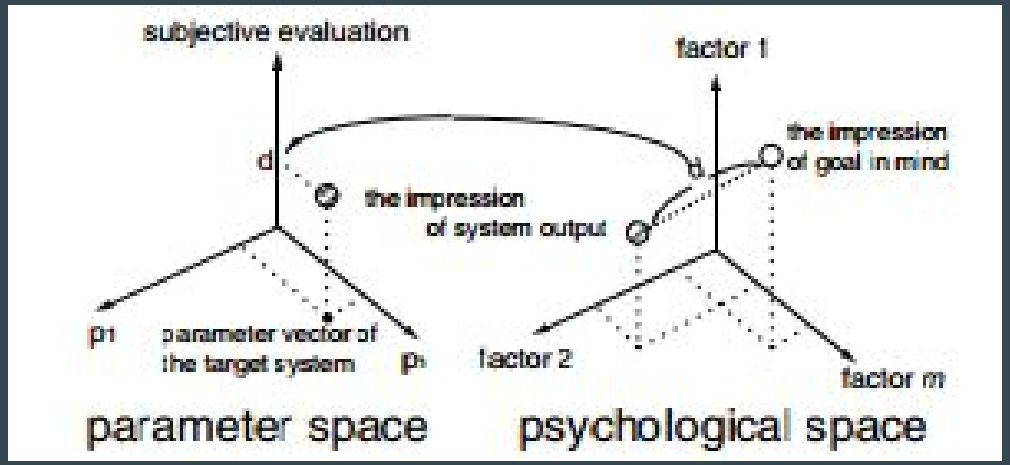
- Individuals evaluated by the user
- Example: Emergent Mind
- Significant results in few generations





Objective Function

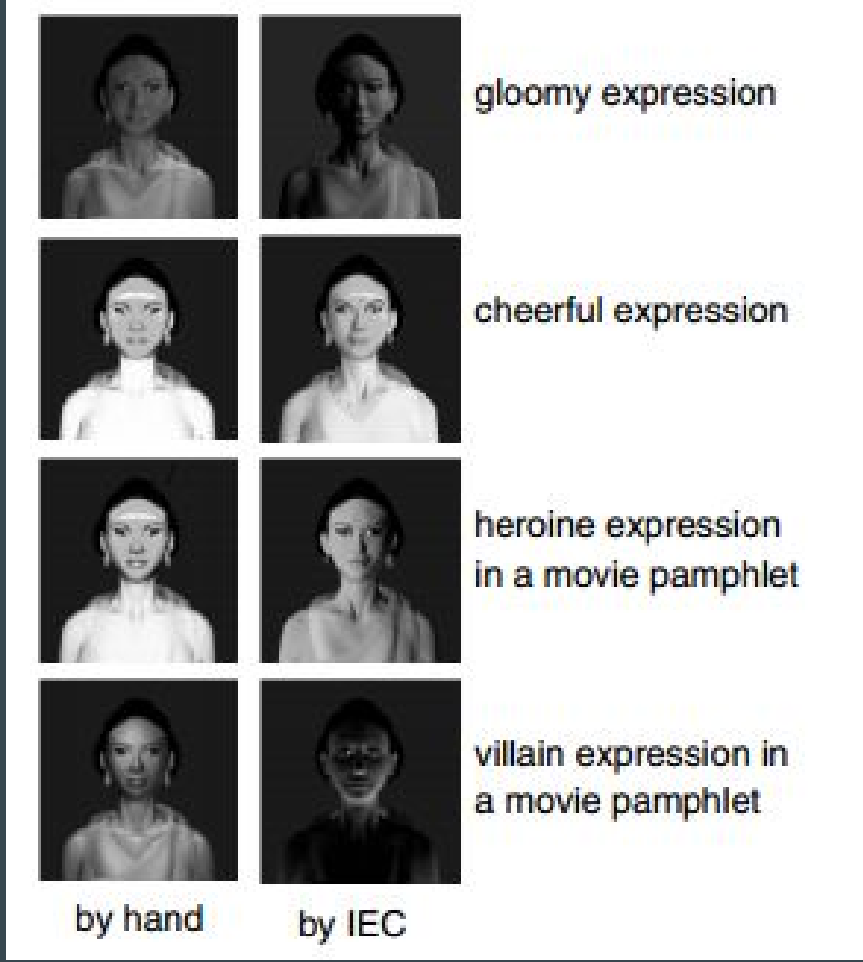
- Hideyuki Takagi sees two aspects:
- Knowledge: That which can be quantified
- Kansei: Intuition, subjectivity, preference
- Optimal solution exists in a psychological space



Source: Takagi, H."Interactive Evolutionary Computation: Fusion of the Capabilities of EC Optimization and Human Evaluation" Fig. 2

Example: CG-Lighting

- IECs mainly used in art and design
- Hideyuki Takagi performed an experiment in CG-lighting
- The subjects consisted of professionals and amateurs
- The algorithm was of great help to amateur designers



Source: Takagi, H.”Interactive Evolutionary Computation: Fusion of the Capabilities of EC Optimization and Human Evaluation” Fig. 4

User Fatigue

- Evaluating large populations can be quite tedious
- Limits in display and human memory
- Usually limited to a maximum of 10-20 generations
- Smaller populations result in slower convergence

Predicting Values

- Calculate the euclidean distance in parameter space to predict fitness values
- Only display the most fit individuals to the user
- Allow the user to predict his own fitness values

Robot Choreography

- What constitutes a good dance is subjective
- SIEC algorithm to counter user fatigue
- Uses Neural Network to evaluate

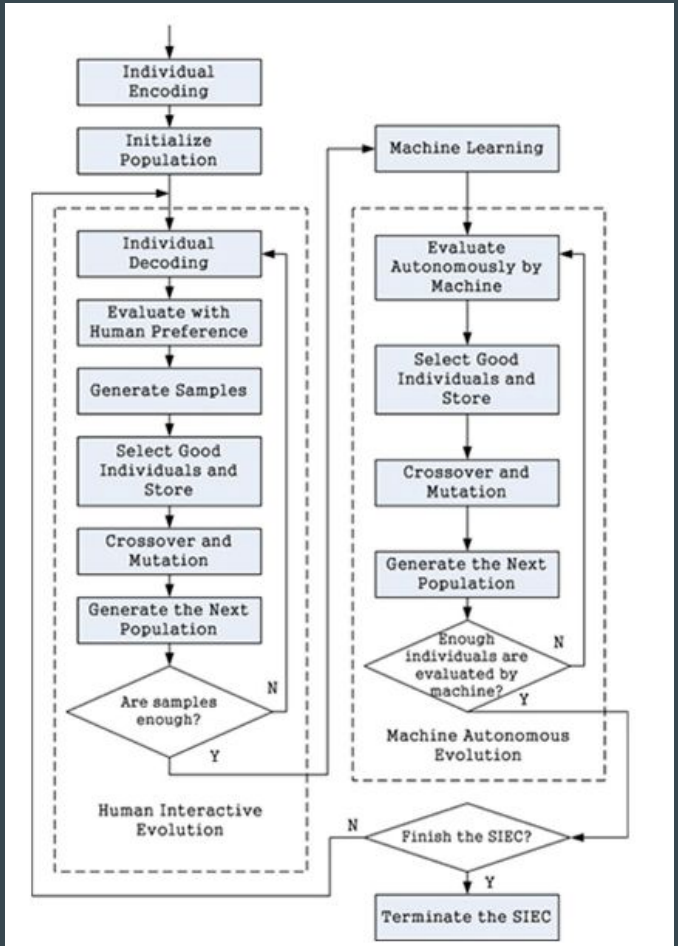
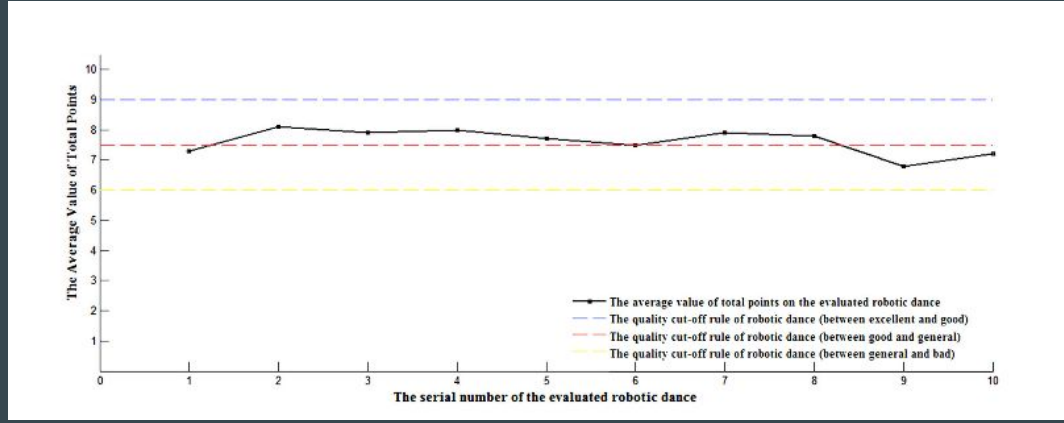


Fig. 1 The schematic diagram of semi-interactive evolutionary computation

Source: Peng, H., Hu, H., Chao, F. et al. “Autonomous Robotic Choreography Creation via Semi-interactive Evolutionary Computation”

Robot Choreography

- Degree of conformity 80%
- Dance evaluated by experts



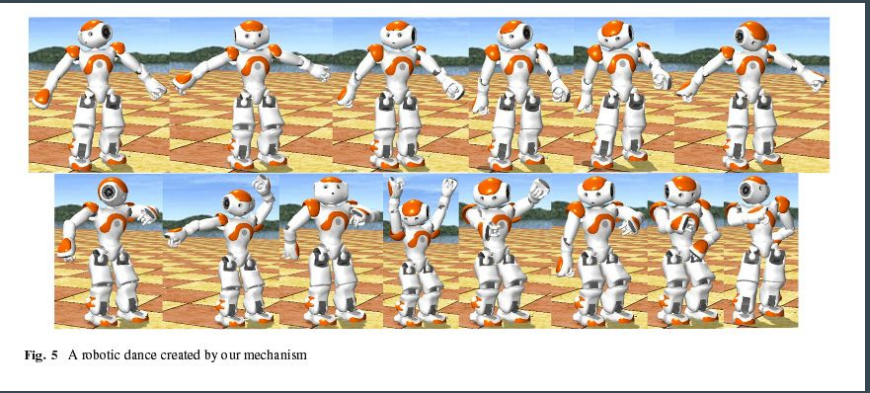


Fig. 5 A robotic dance created by our mechanism

Source: Peng, H., Hu, H., Chao, F. et al. “Autonomous Robotic Choreography Creation via Semi-interactive Evolutionary Computation”

Hearing Aid Fitting

- Fitted to individual characteristics
- Usually communicated to experts
- IEC allows patients to interactively fit

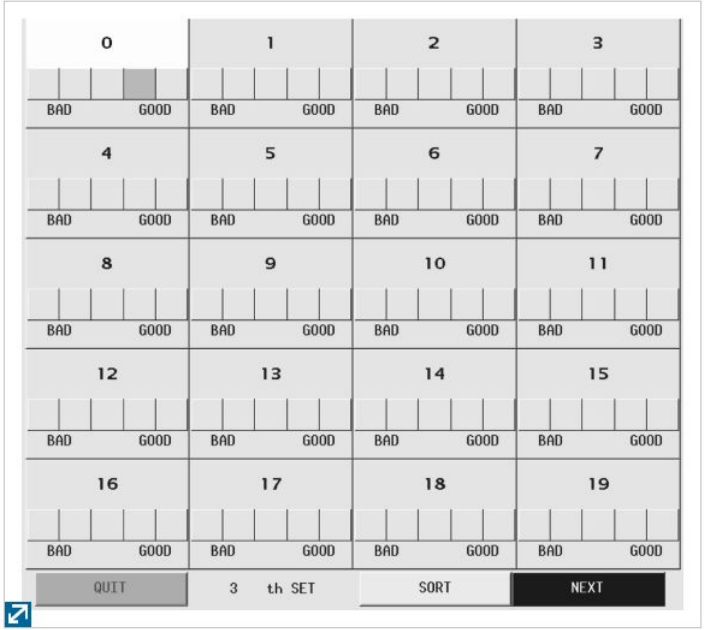


Fig. 6.
Interface screen in the user interface module.

Source: H. Takagi and M. Ohsaki, “Interactive evolutionary computation-based hearing aid fitting,”

Hearing Aid Fitting

- Parameters decoded from 3D surface
- Surface shape is modified by GA
- Outperformed traditional methods
- However, very small sample size
- User fatigue was a problem

TABLE II
GA CONDITIONS USED IN OPTIMIZATION MODULE

optimizer	simple GA
coding	binary
selection	roulette wheel with 4 elites
crossover rate	One point (80%)
mutation rate	2%
initialization	random
number of parameters	$1 + 5 \times 7 = 36$
population size	20
number of generation	maximum 20
fitness function	user's evaluations in 5 levels

Source: H. Takagi and M. Ohsaki, "Interactive evolutionary computation-based hearing aid fitting,"

Questions

1. How would natural selection influence the future of mankind, considering that we spend most of our time on electronic devices?

2. Will the user-machine interaction ever become optimal or will it become obsolete?

3. What are everyday products that have to become personalized in the future? Why?