Division of Electrical, Electronic and Information Engineering, Osaka University

Systems Analysis and Optimization

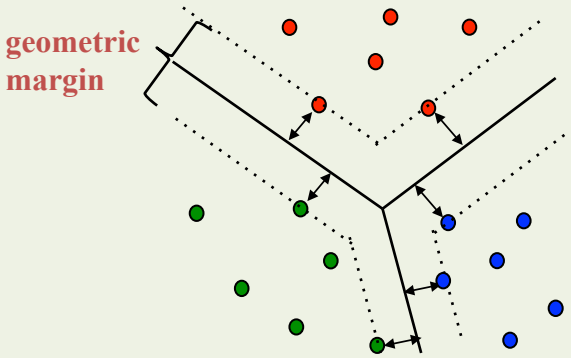
In our laboratory, we are developing new mathematical methods for systems analysis on the basis of theories in optimization and decision making; **mathematical programming**, **game theory**, **soft computing** (fuzzy theory, support vector machine, chaos theory, and rough set theory), and **knowledge information processing**. Moreover, we apply them to some practical problems.

Research Themes

- Cooperative game theory and some applications
- Cooperative games with some types of uncertainties
- Multiobjective multiclass support vector machines
- Particle swarm optimization
- Data analysis using logical functions
- Cluster analysis based on graph theory

Multiclass Classification by Multiobjective Support Vector Machine

Using a training data set (red, blue, green), find a **piecewise linear function (hyper planes)** which partitions the data space into 3 classes.



Support vector machine: find a linear function which discriminates 2 classes by maximizing the unique **geometric margin**.

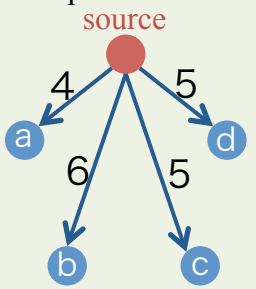
How to approach to the **multiclass** (more than 2) case?

Maximize all geometric margins simultaneously

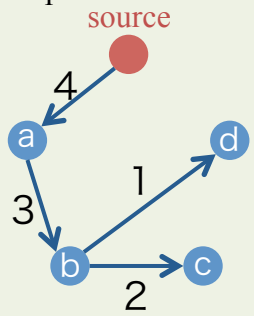
Studies on Cooperative Games and Their Solutions

Clients (a,b,c,d) can reduce the cost by constructing the network **cooperatively**.

non-cooperation: cost 20



cooperation: cost 10



Number: the cost of the corresponding edge

How to share the total cost among the agents?

Propose reasonable cost allocation rule based on cooperative game theory

Data Analysis Based on Rough Set Theory

A data set of medical diagnosis

Conditions: Temperature (T), Headache (H), Weakness (W), Nausea (N)
Decision: Flu (F)

P	T	H	W	N	F
1	high	yes	yes	no	yes
2	normal	no	no	no	no
3	normal	yes	yes	yes	yes
4	high	no	no	no	no
5	normal	no	yes	no	no
6	normal	no	yes	no	yes

Contradiction (because these are the same under the conditions but diagnosed differently)

P	T	H	W	F
1	high	yes	yes	yes
2	normal	no	no	no
3	normal	yes	yes	yes
4	high	no	no	no
5	normal	no	yes	no
6	normal	no	yes	yes

The contradiction preserved without "N"

The necessary sets of conditions for preserving the contradiction

{T, W, N} {H, W}

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Important sets of conditions

Attribute reduction based on inconsistency in the data set

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