

# Prediction of Regulatory Networks and Bio-Marker Metabolites

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Dae-Won Kim

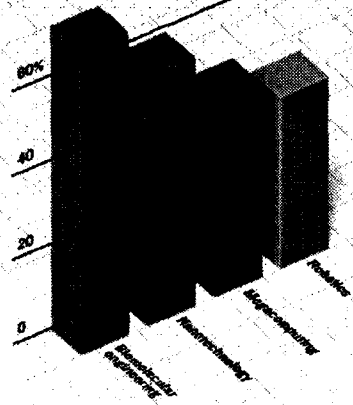
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## 1. Background

# Bio-Computing Engineering

WHICH FIELD WILL HAVE A MAJOR SOCIETAL IMPACT OVER THE NEXT 10 YEARS?

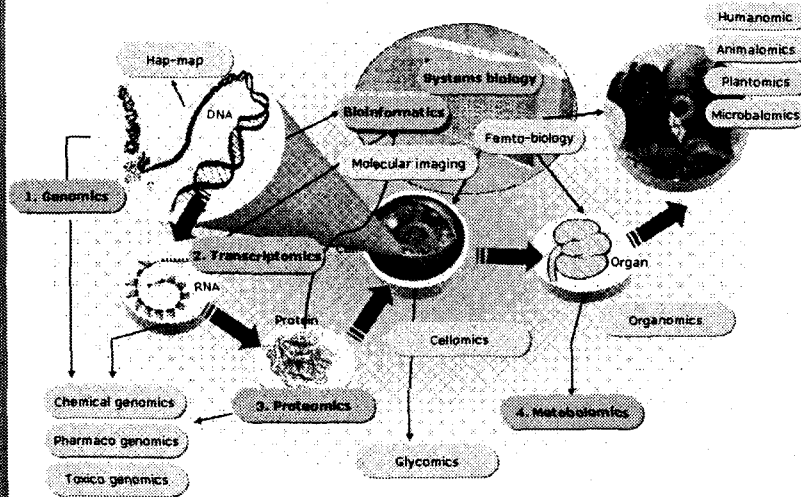


**TECHNOLOGY TRENDS 2004**

Biomolecular engineering is hot, the tech sector is turning around, and the United States will continue to dominate high-tech R&D in the coming decade. So say the IEEE Fellows in the second annual 2004 IEEE Technology Leaders Survey.

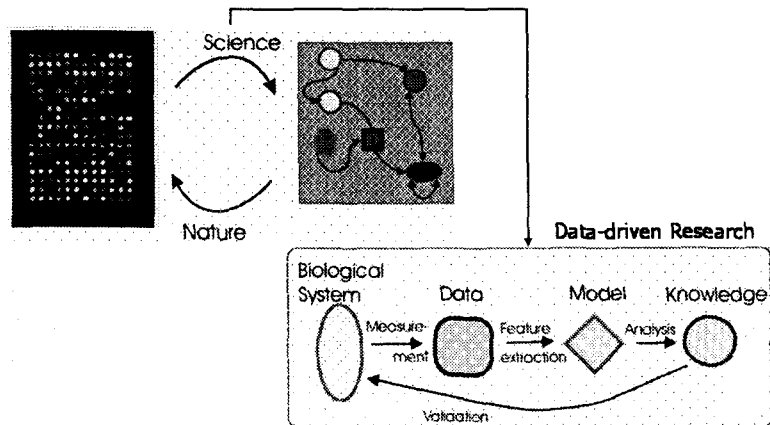
BY GUY ROBERTS FOR IEEE SPECTRUM

# 과학기술부 바이오테크 육성정책 (2004.8)



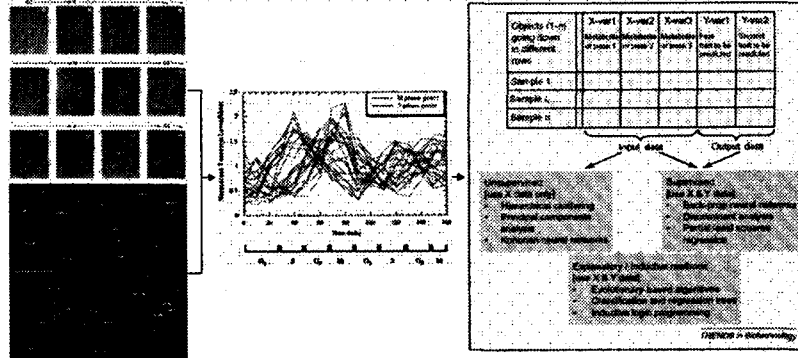
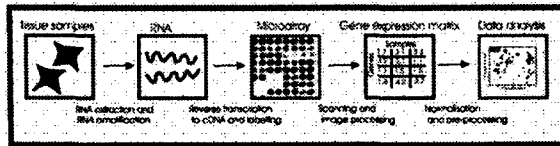
# The Cycle of Knowledge

Microarray provides hypothesis and biological mechanisms



## 1. Background

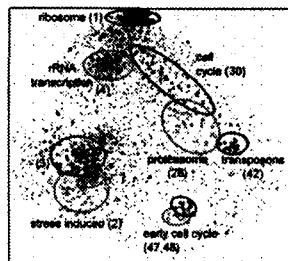
# Microarray Data Analysis



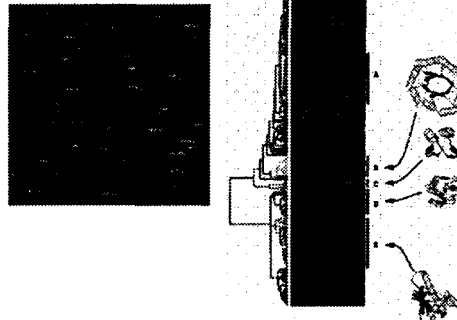
## 2. Class Discovery

# Pattern Analysis by Clustering

- Find groups of genes with similar patterns
- Infers unknown gene function from clusters



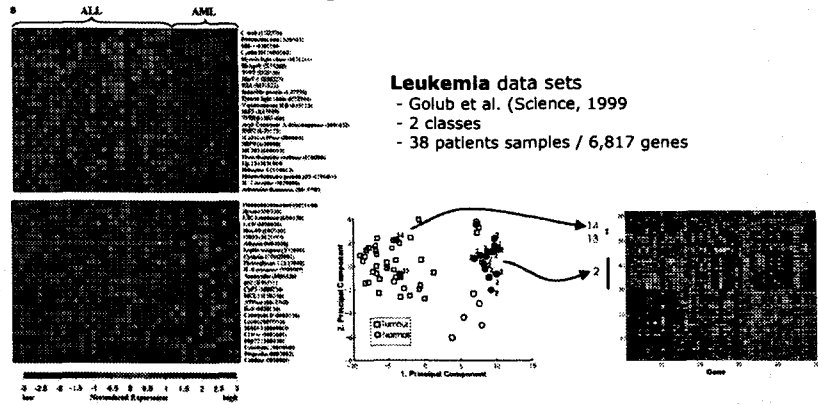
2-D PCA plot of yeast genes



• "Detecting clusters of different geometrical shapes in microarray gene expression data," *Bioinformatics* (2005)

# Tumor Classification

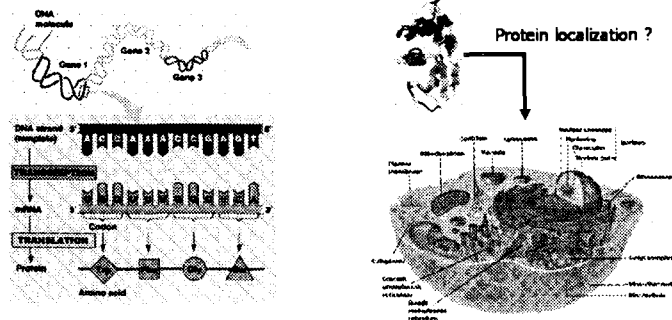
- Predicts the patients by disease subtype or response to treatment
- Offers a new way to distinguish similar-looking diseases



• "Possibilistic support vector machines," *Pattern Recognition (2005)*

# Prediction of Protein Function

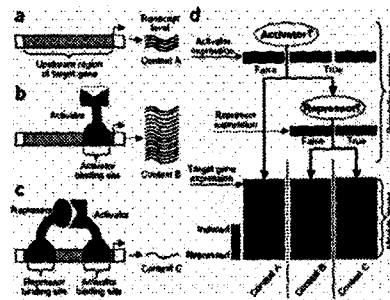
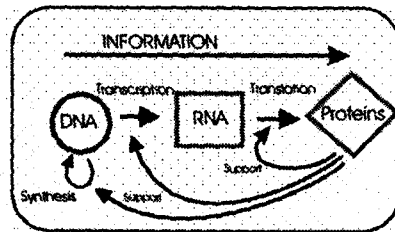
- Protein is involved in all biological process
- Localization is closely correlated with its function
- 'Lysozyme' sequence: KVFGRCELAAAMKRHGLDNY
- How to predict the localization from sequence?



• "Improving support vector data description using local density degree," *Pattern Recognition (2005)*

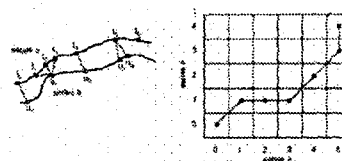
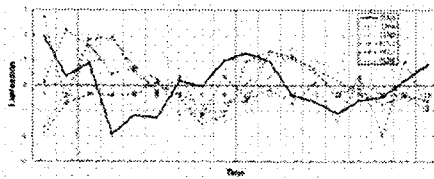
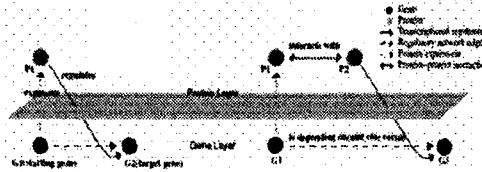
# Transcriptional Regulation

- > One gene acts as a regulator and the other as its target
- > Determines the timing of control of the target by the regulator
- > Gene therapy: knock-out of activator or repressor



# Local Time-Warped Alignment

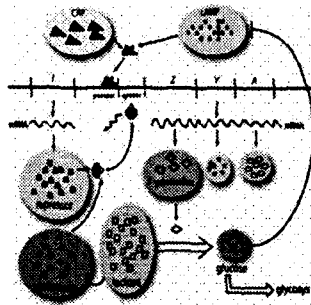
- > Finds irregular causal signals in regulation
- > Based on dynamic time-warping (DTW)



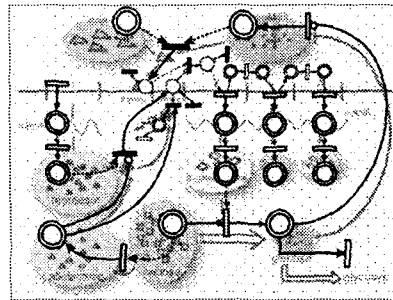
• "Exploring irregular time delays in transcriptional regulation by using a local time warped alignment," BIOSYSTEMS.

## Inference of Regulatory Networks

- Constructs a network of gene regulations from gene expression
- Learns the structural and dynamical properties of networks



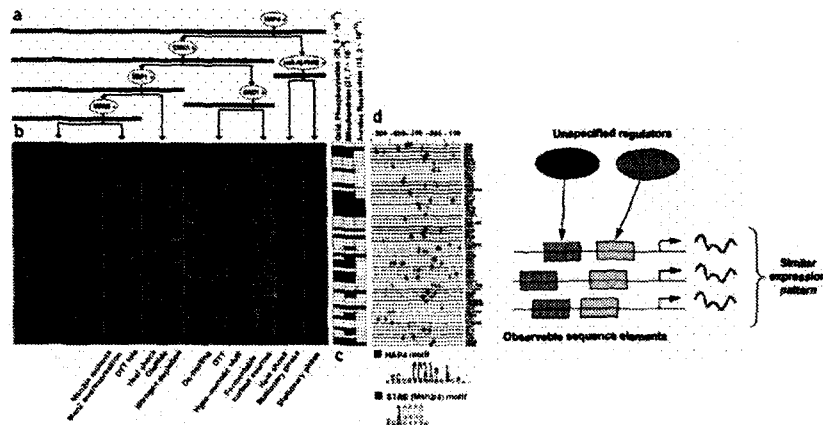
Lac operon and glycolytic pathway



Pathway modeling by "Petri Net"

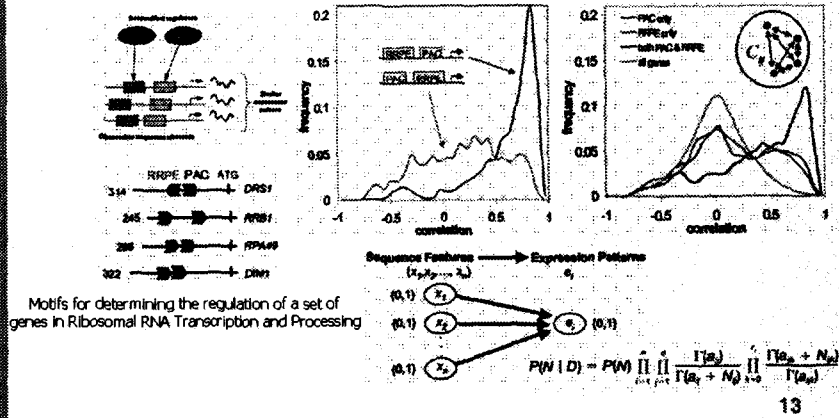
## Combinatorial Regulatory Mechanism

- Identifies motifs and their positional and combinatorial constraints
- Constructs transcriptional networks using Bayesian network



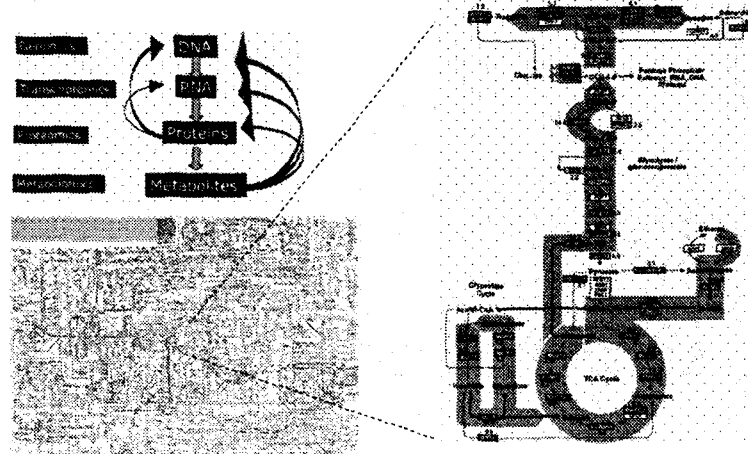
## Combinatorial Regulatory Mechanism

- Learning the combinatorial regulatory rules
- Beer, M.A., "Predicting gene expression from sequence," Cell (2004)
- Procedures: Clustering – Motif Finding – Bayesian network



## Metabolomics Comes of Age

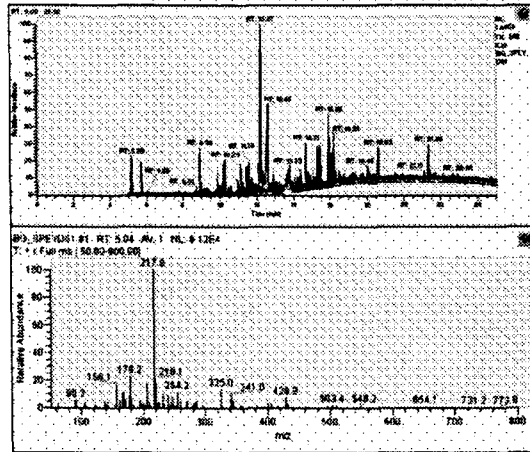
- Metabolite produces energy and basic chemicals for life



# Metabolic Networks and Drug Targets

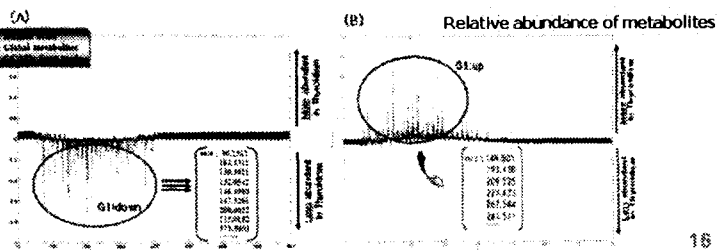
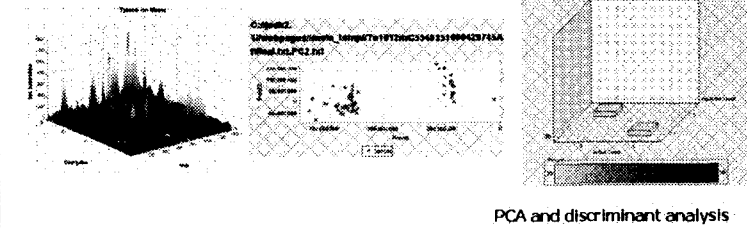
## > Finding diagnostic markers in hormone-dependent diseases

GC/MS profile of a patient with Breast cancer



# Bio-Markers Identification

GC/MS profiles of Normals vs. Breast cancer patients





**Thank you.**

**Any questions will be welcome.**