

# ECLab 2002 Summer Lecture Series

*Introductory Lectures in Basic Evolutionary Computation Theory*

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Jeff Bassett

Thomas Jansen

R. Paul Wiegand

<http://www.cs.gmu.edu/~eclab/summerlectureseries.html>

**EC**Lab

Department of Computer Science

George Mason University

# Summer Lecture Series

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- The summer lecture series idea
- Why *theory*?
- Hierarchy of EC theory
- 2002 Summer lecture schedule
- Continuing the effort in the future

# The Summer Lecture Series Idea

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## ■ Contributors

- Thomas Jansen
- Jeff Bassett
- R. Paul Wiegand

Rafal Kicinger  
Bill Liles

## ■ Purpose

- Give students (& post-docs) experience
- Provide a service to GAG members
- Facilitate GAG activity during summer

# Why *Theory*?

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- Personal interests
- Background material for frequent GAG topics
- Challenging subjects to teach

# Why *Theory*?

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- Personal interests
- Background material for frequent GAG topics
- Challenging subjects to teach
- Everyone should know a little theory!

# Hierarchy of EC Theory

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- Problems Landscapes for EAs
  - Landscapes for Analysis
  - Analysis of Problems/Landscapes
  - Problem Transformation
- Component Analysis
- Algorithm Analysis
  - Local Analysis
  - Global Analysis
  - Models of EA Dynamics
  - Algorithm Design
- No Free Lunch

<http://www.cs.gmu.edu/~pwiegand/ectheory.html>

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## Examples:

- NK-Landscapes
- N-Peak Landscapes
- OneMax
- Royal Road
- HIFF
- Long Path

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## Examples:

- Fitness Distance Correlation
- Separability / Decomposability
- Walsh Analysis
- Epistasis
- Deception

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Examples:

- Analysis of Gray versus binary coding

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## Examples:

- Evolvability
- Operator
  - Correlation/Correlation length
- Population Sizing
- Mutation Probability
- Convergence Velocity of Operators
- Fixed point sizes of variable length genomes
- Selection/Takeover analysis
- Selection Analysis in Spatially Embedded Populations

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## Examples:

- Local Performance Measure
- Traditional Schema Theory
- Construction and Survival Theory
- Exact/Correct Schema Theory

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## Examples:

- Runtime Analysis
- Analysis of "Convergence"
- Convergence Velocity
- Measuring Coevolutionary Progress / Dynamics

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## Examples:

- **Dynamical Systems Models of the Simple GA**
- **Markov Models and Expected Behavior Analysis**
- Evolutionary Game Theory
- Teaching/Test Set Analysis
- Statistical Mechanics

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## Examples:

- Messy GAs
- Linkage Learning
- Graphical Models
- Adaptive Rates of Mutation and the 1/5th Rule
- Partial Restart Theory

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# 2002 Summer Lecture Schedule

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- July 2 (Tue, 3p-5:30p): **No Free Lunch** [Thomas Jansen]
- July 18 (Thu, 3p-5:30p): **Schema Theory** [Bill Liles & Paul Wiegand]
- August 1 (Thu, 3p-5:30p): **Global Analyses** [Thomas Jansen]
- August 15 (Thu, 3p-5:30p): **Walsh Analysis & Deception** [Paul Wiegand]
- August 29 (Thu, 3p-5:30p): **Vose Explained** [Rafal Kicinger]

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- July 2 (Tue, 3p-5:30p): **No Free Lunch** [Thomas Jansen]
  - Intro to the lecture series
  - Original NFL
  - Whitley NFL
  - NFL Assumptions and the NFL Debate
  - The utility of NFL
- July 18 (Thu, 3p-5:30p): **Schema Theory** [Bill Liles & Paul Wiegand]
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- August 15 (Thu, 3p-5:30p): **Walsh Analysis & Deception** [Paul Wiegand]
  - Introduction to Walsh Functions
  - Walsh Coefficients and the BBH
  - Defining Deception using Walsh Functions
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- August 29 (Thu, 3p-5:30p): **Vose Explained** [Rafal Kicinger]
  - Introduction to Vose's Dynamical Systems model of SGA
  - Defining Mixing matrices for variation
  - Markov Models

# Continuing the Effort in the Future

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- Annual summer lecture series?
- Student organized, student lead
- Topics depend on organizers

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(Doesn't have to always be theory!)