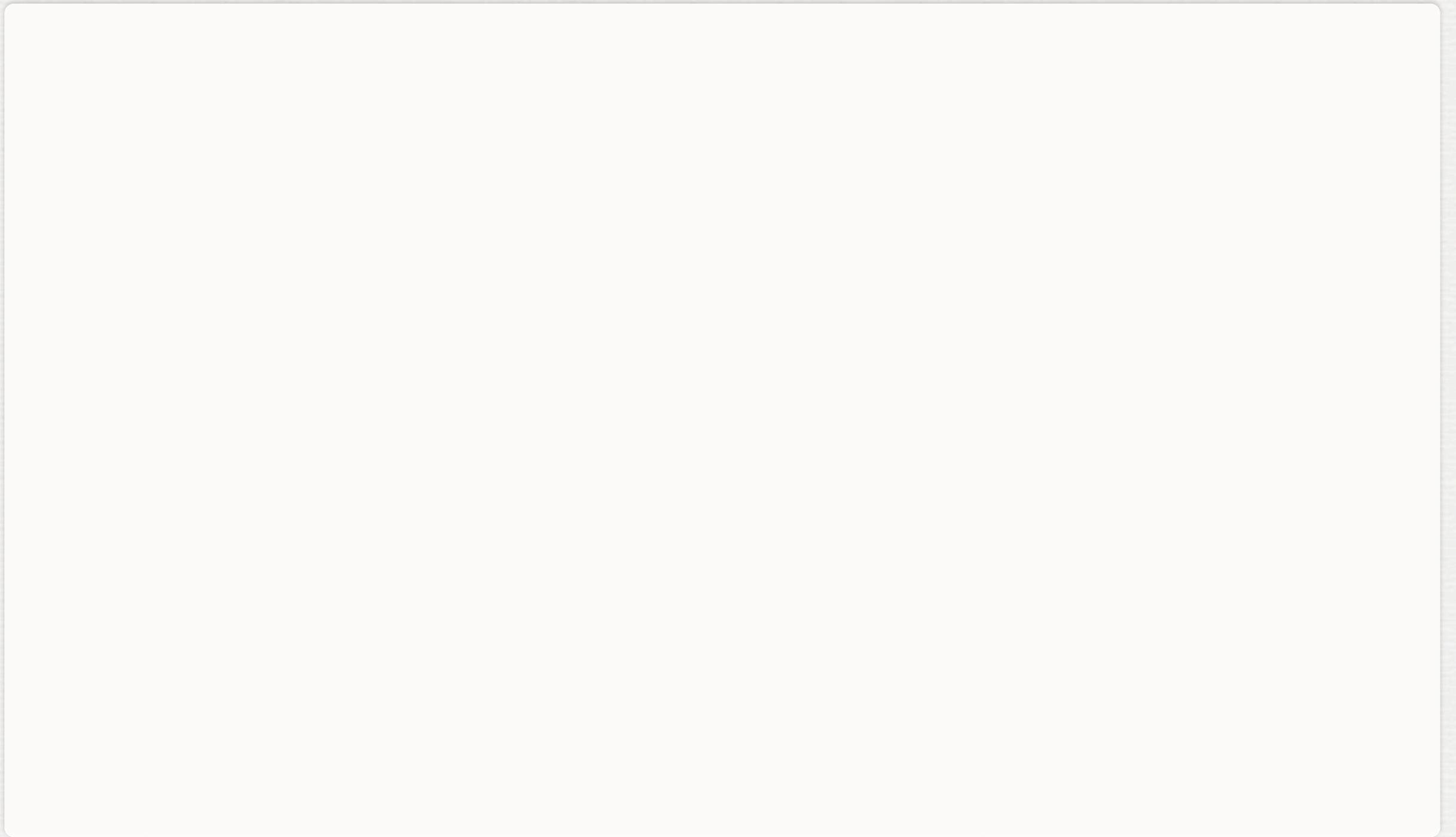# DOMAINS, DUALITIES AND THEORETICAL COMPUTER SCIENCE

Michael Mislove
Pendergraft Investiture
May 5, 2008

COMPUTER SCIENCE

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- Two views:

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  - *Engineering discipline:* Build faster machines, more robust networks,...

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    - *What* is computable? What is the *theory* of computation? Science in Computer Science

EARLY COMPUTERS

- 1940s - 1980s: The computer as gigantic calculator

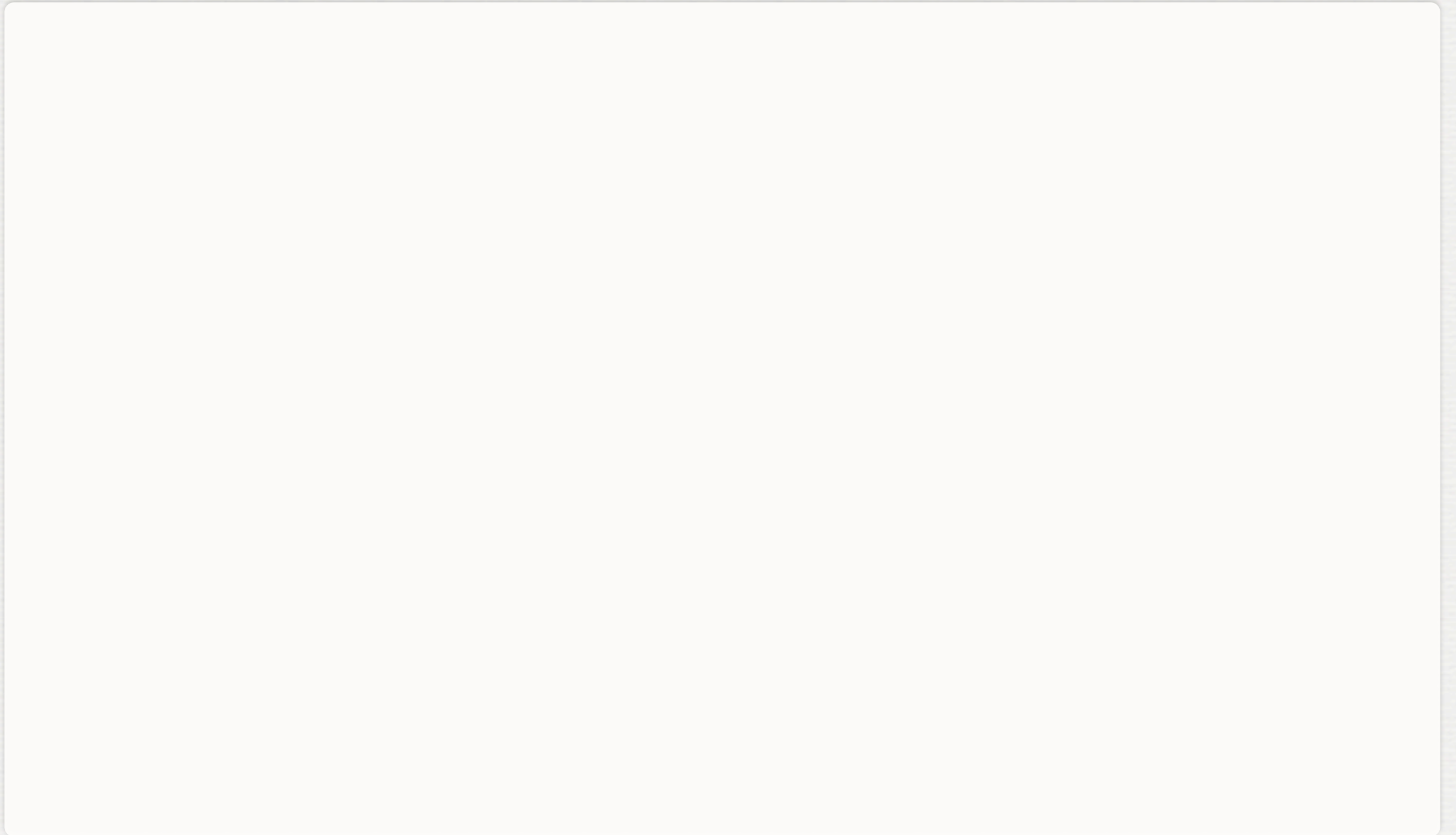 - Mainframe: input - output device

EARLY COMPUTERS

- 1940s - 1980s: The computer as gigantic calculator

  - Mainframe: input - output device

  - But: computer programs are *complicated!*

DUALITY

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  - Dualism of mind and body - Descartes

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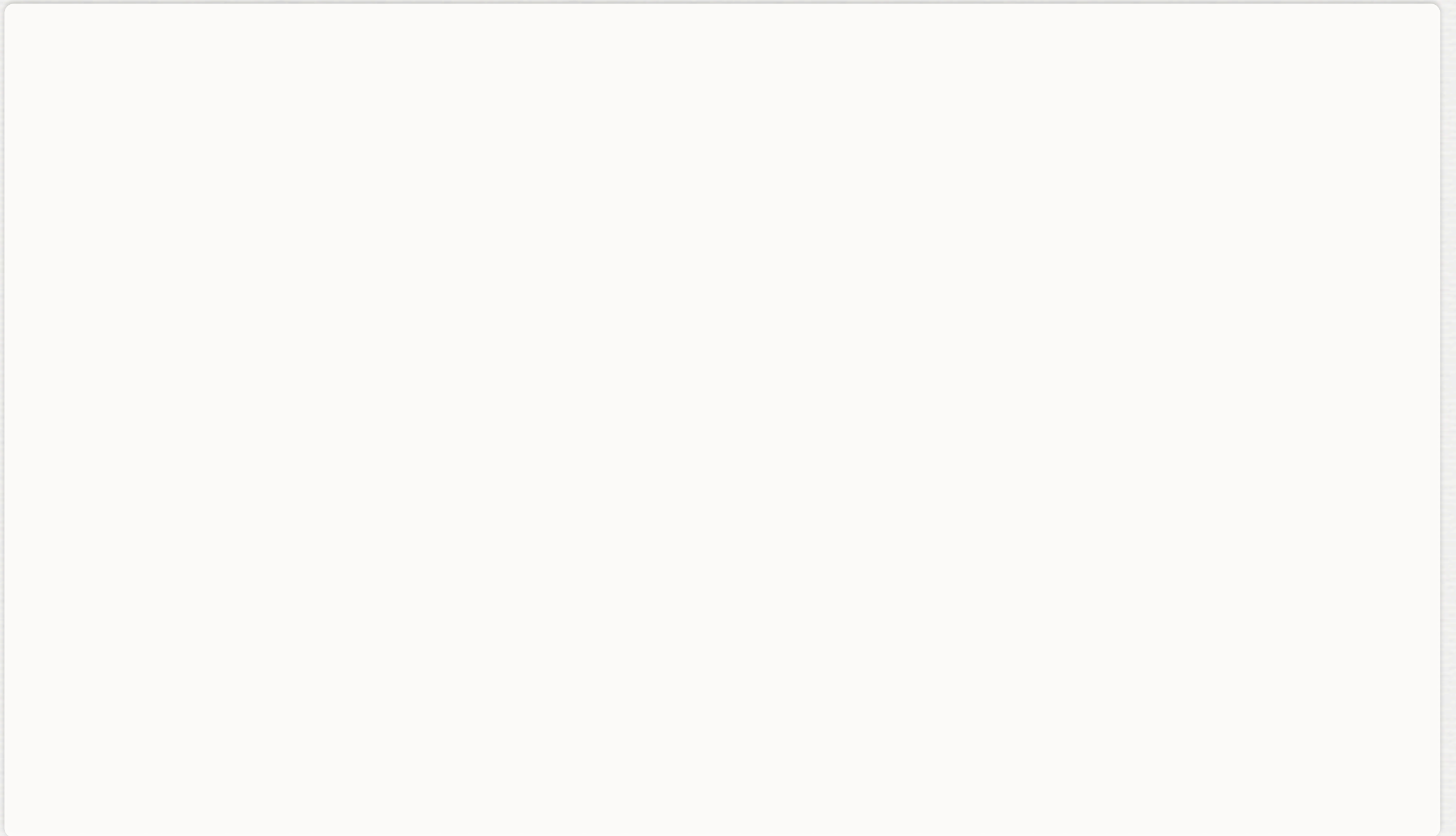 - Wave / particle duality of light - Huygens vs. Newton

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  - Wave / particle duality of light - Huygens vs. Newton

- *Mathematics:* A theory presenting two equivalent ways of looking at the same thing.

One of the principle objects of theoretical research in any department of knowledge is to find the point of view from which the subject appears in its greatest simplicity.
J. W. Gibbs

ANALYZING PROGRAMS

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```
While x < 0 do
   y := x - 5
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***Domains* model `programs as functions`**

Logical theory Inference rules for reasoning about Computer Program

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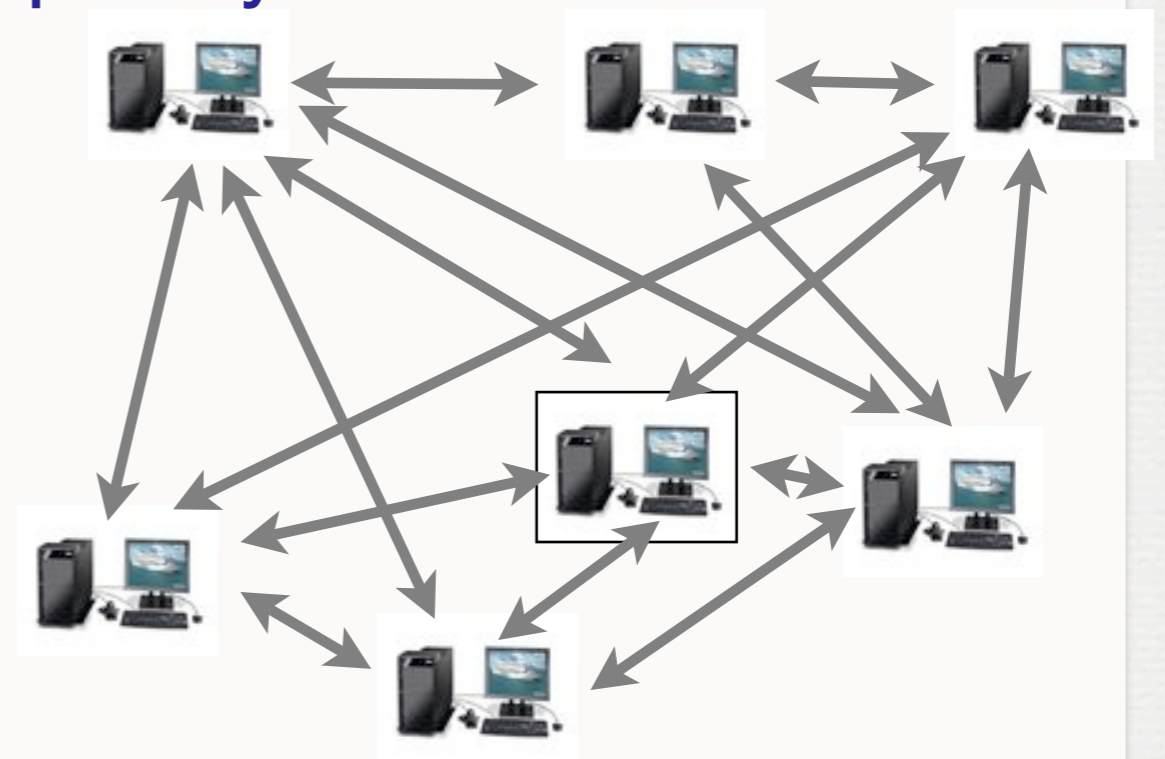
***Domains* model programs as `functions`**

HMS
Duality

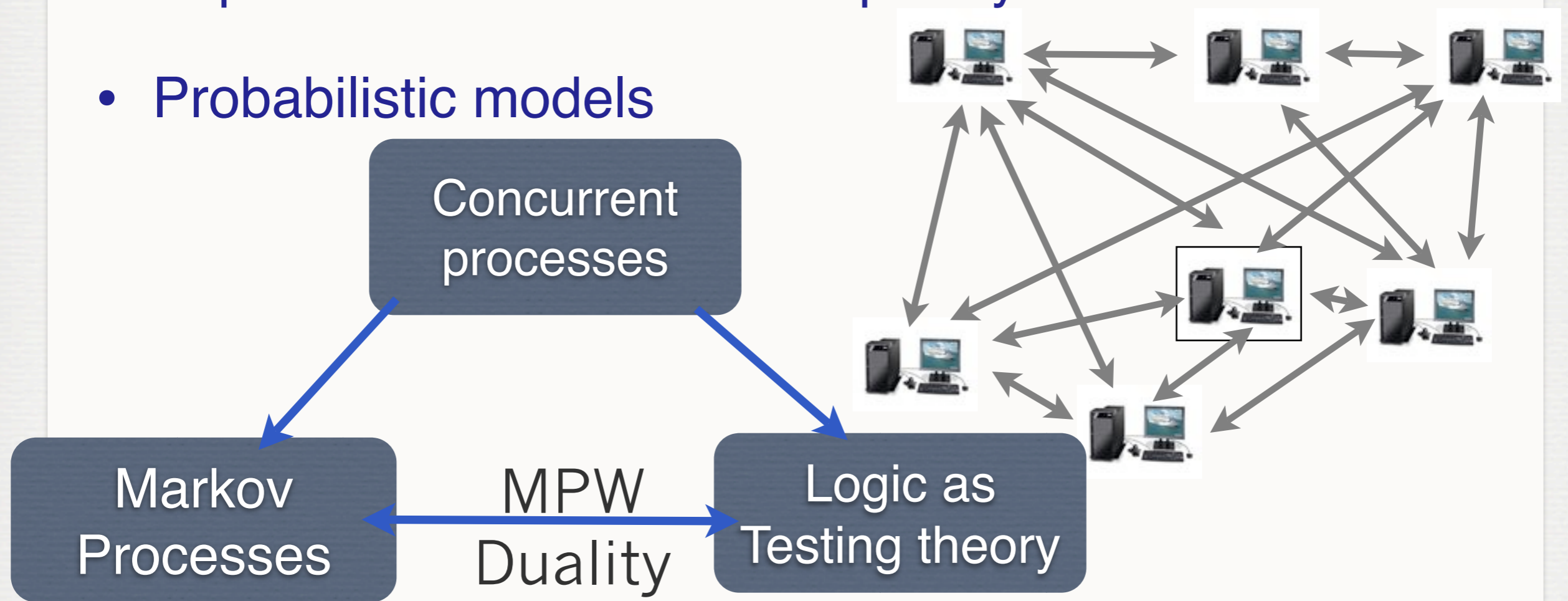Logical theory as Mathematical model

DISTRIBUTED COMPUTING

- Systems of networked computers

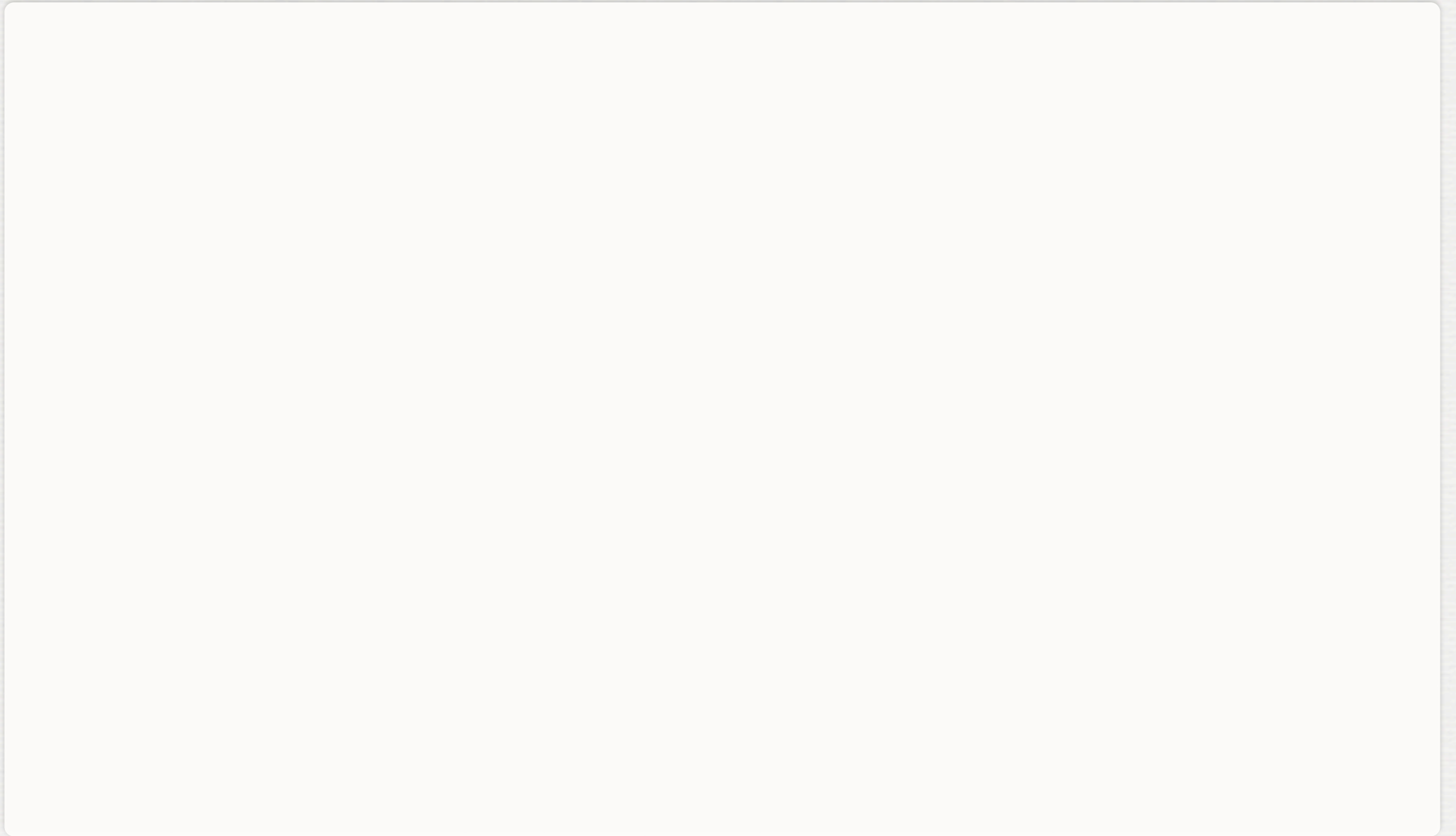- Exponential increase in complexity

- Probabilistic models

DISTRIBUTED COMPUTING

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- Exponential increase in complexity

- Probabilistic models

Concurrent processes

Markov Processes

MPW Duality

Logic as Testing theory

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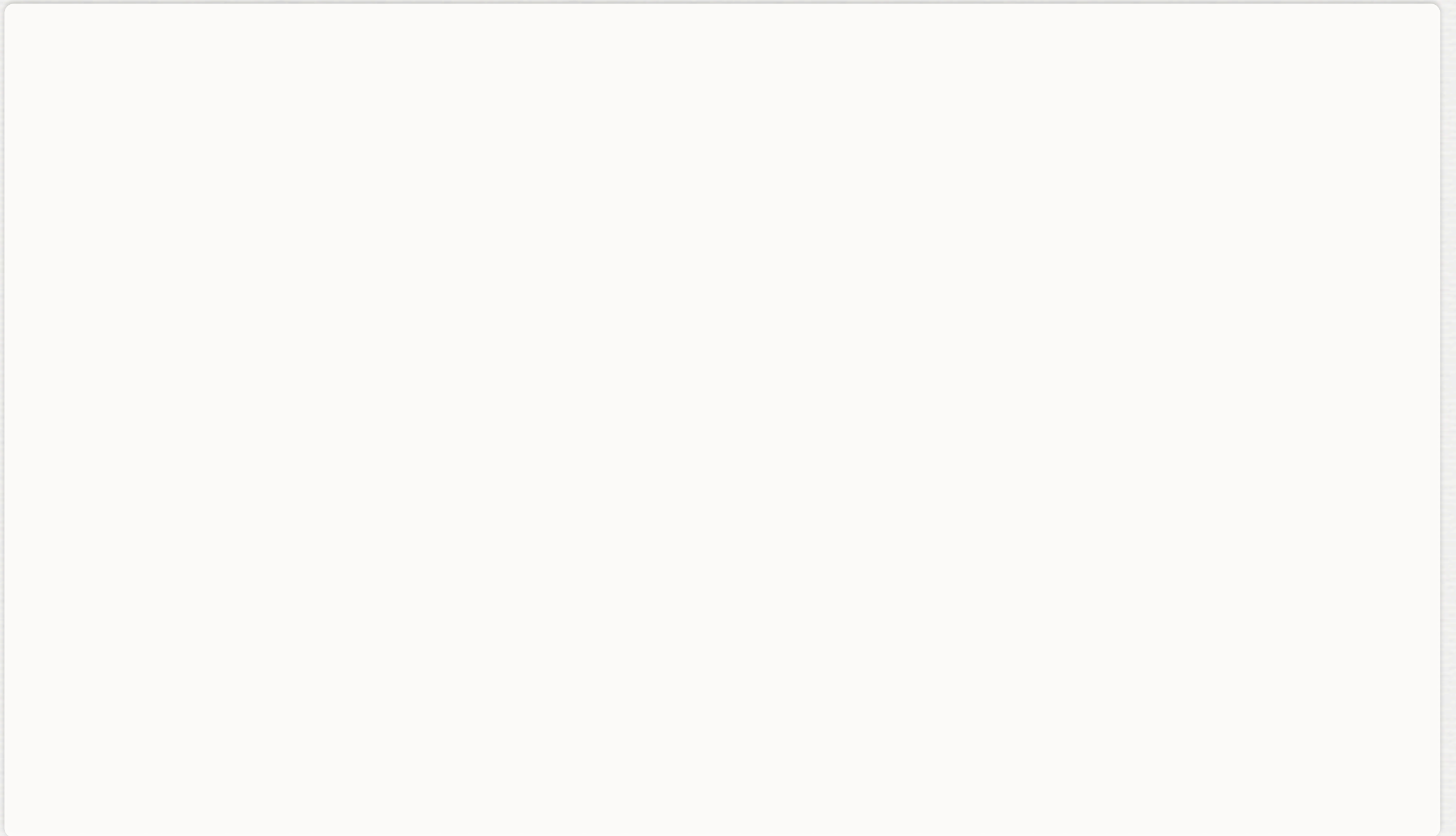   - Computers are now *interactive*

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    - No single locus of control

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    - Jeannette Wing (NSF): *Large areas of science are comprised of computational processes*

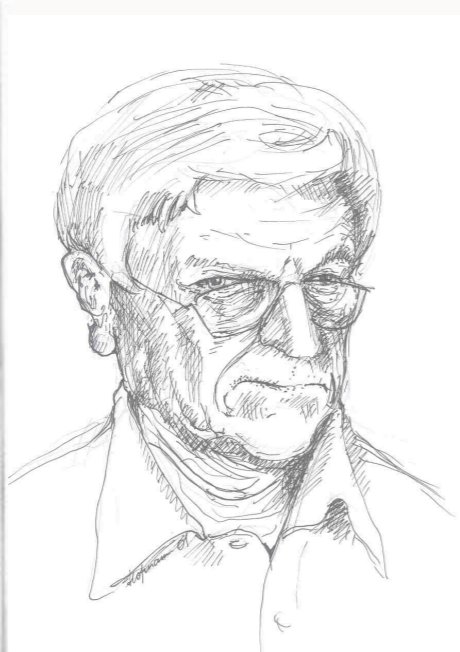# THE BRAVE NEW WORD
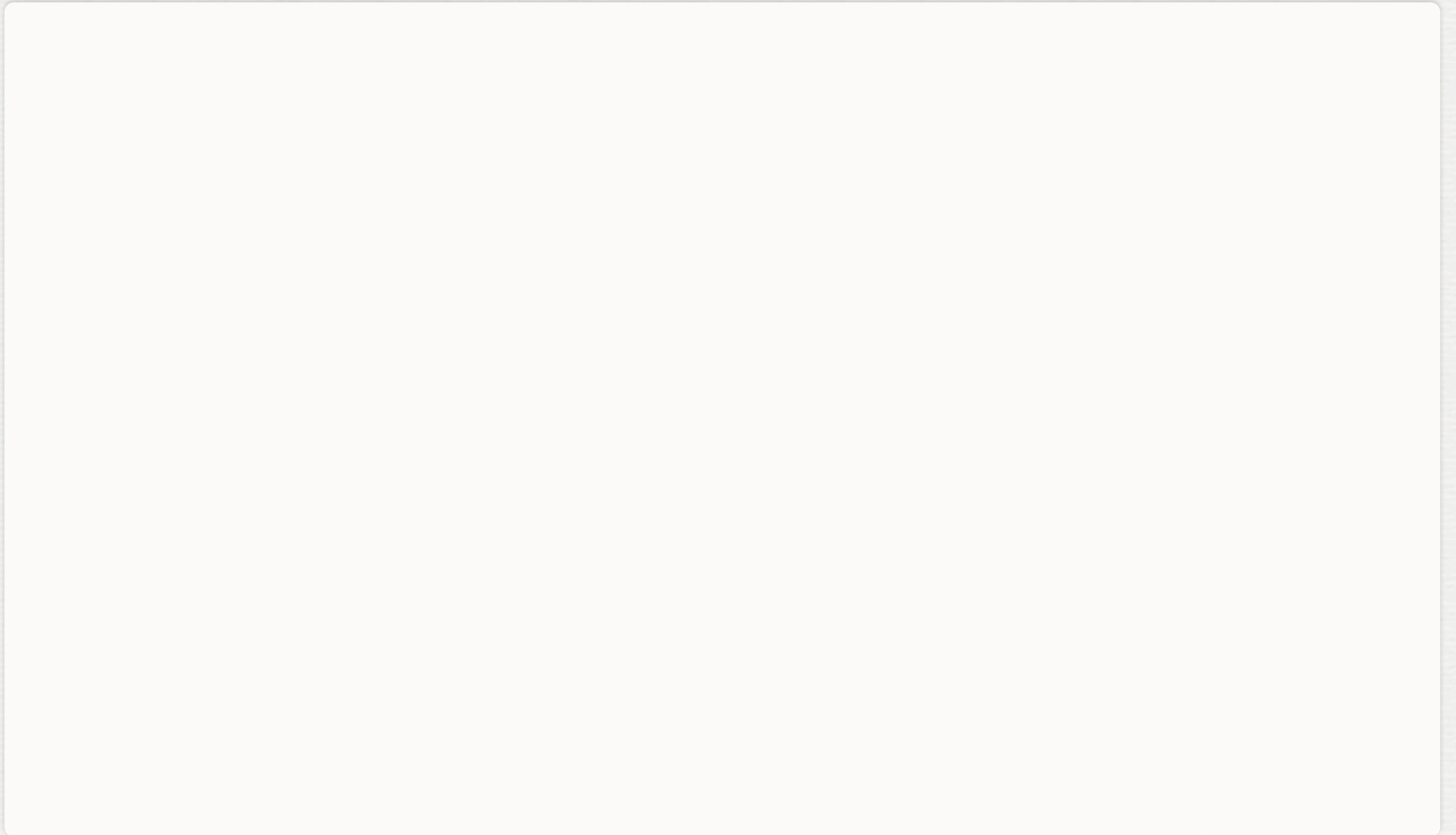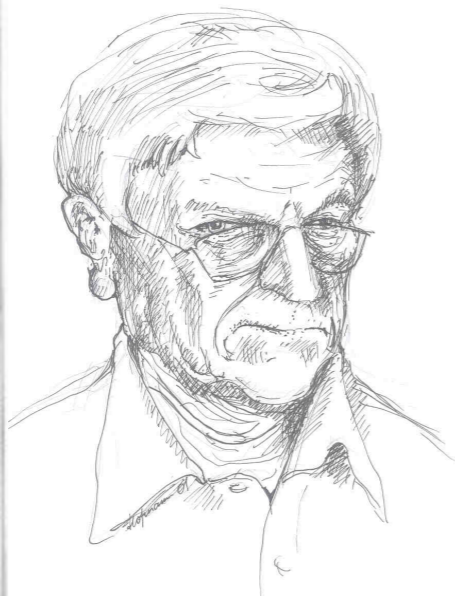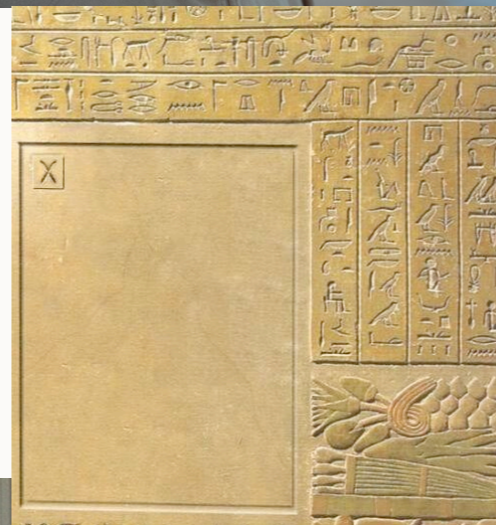
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MENTORS, STUDENTS, POSTDOCS
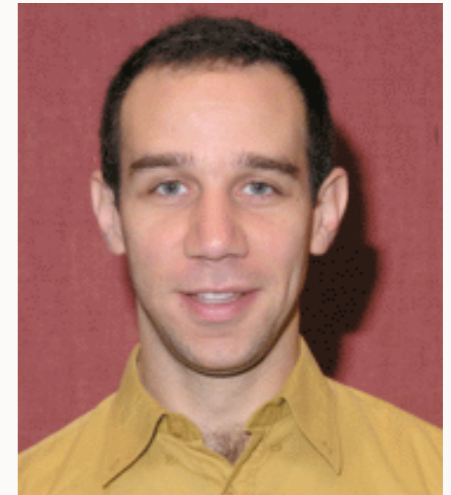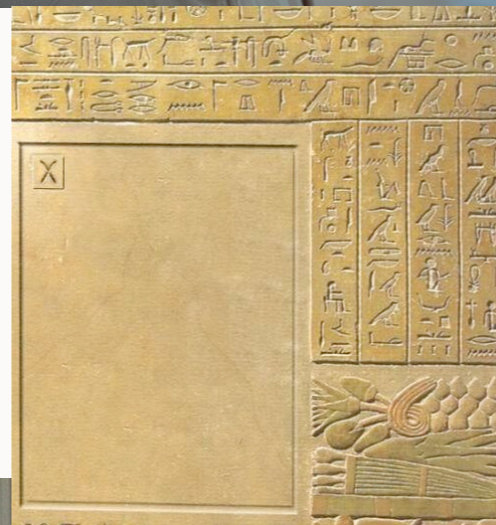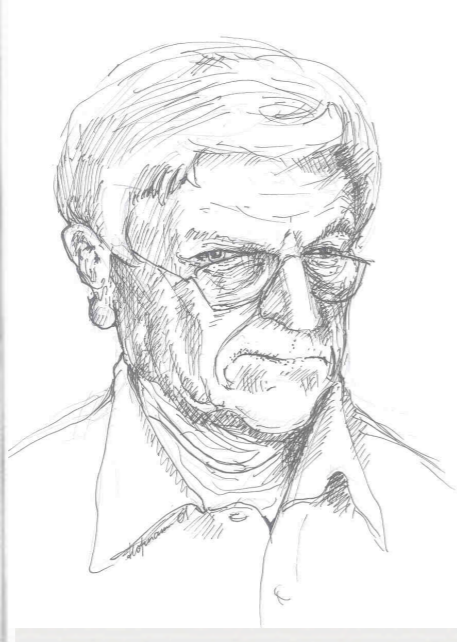
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CAROLINE, MARILYN & ALAN