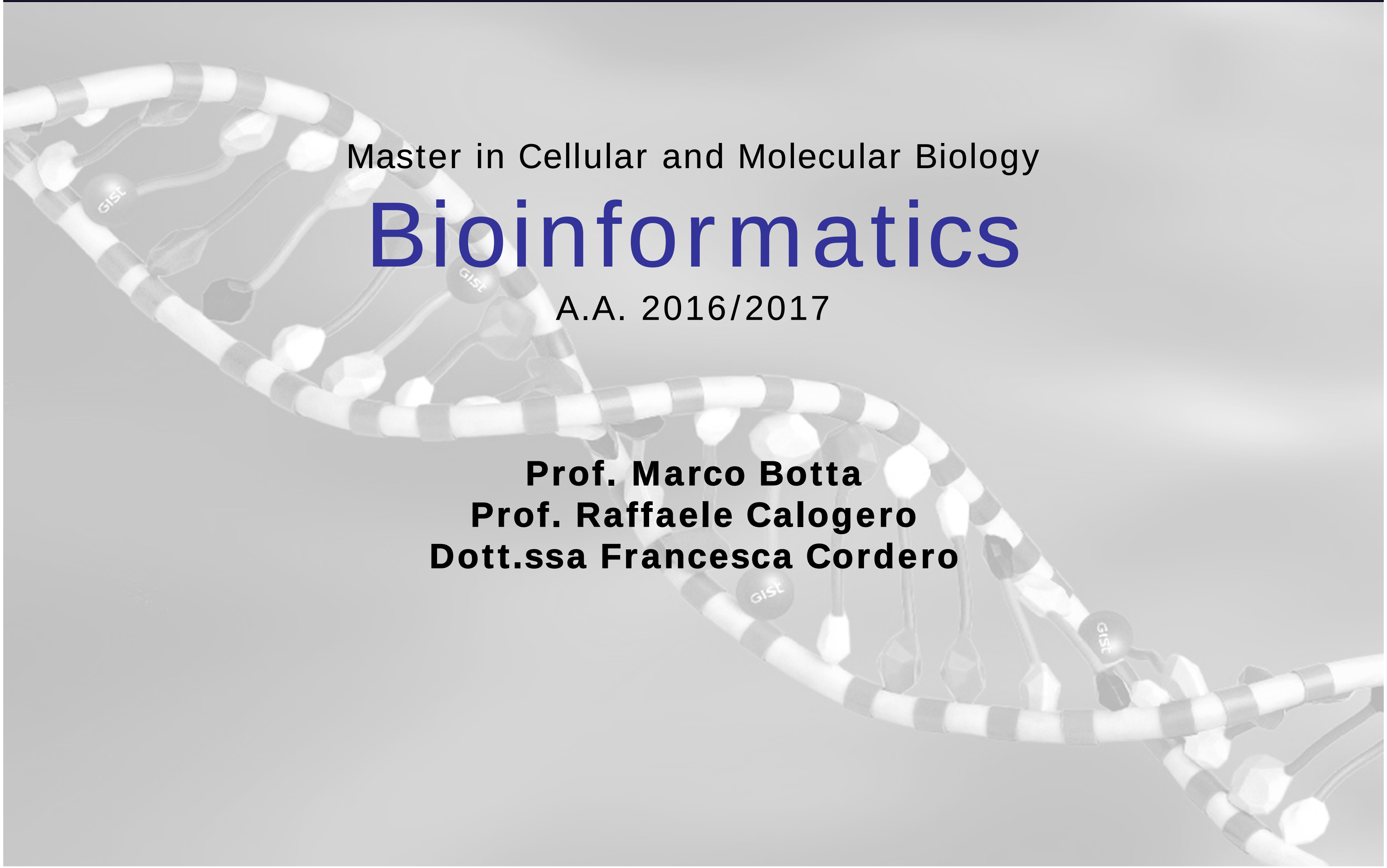

Master in Cellular and Molecular Biology

Bioinformatics

A.A. 2016/2017

Prof. Marco Botta
Prof. Raffaele Calogero
Dott.ssa Francesca Cordero

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- Prof Raffaele Calogero

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Lecture schedule

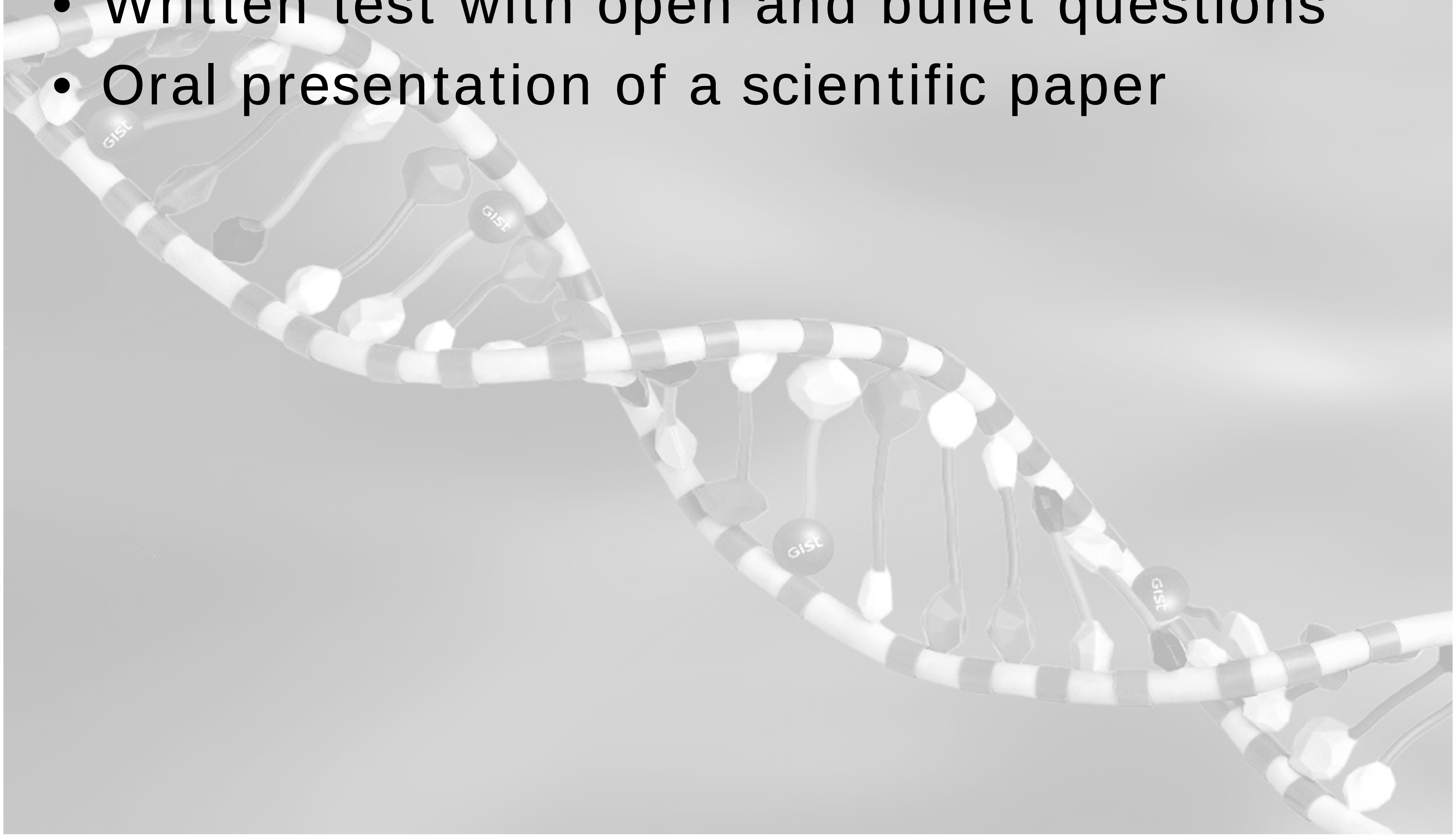
- From today
  - Mondays 11-13
  - Tuesdays 9-11
  - Wednesdays 11-13

- From October 31
  - Mondays 9-11
  - Tuesdays 9-11
  - Wednesdays 11-13

  - Aula B – Fisiologia, Corso M. D’Azeglio 50

Learning Assessment

- Written test with open and bullet questions
- Oral presentation of a scientific paper



Study Material

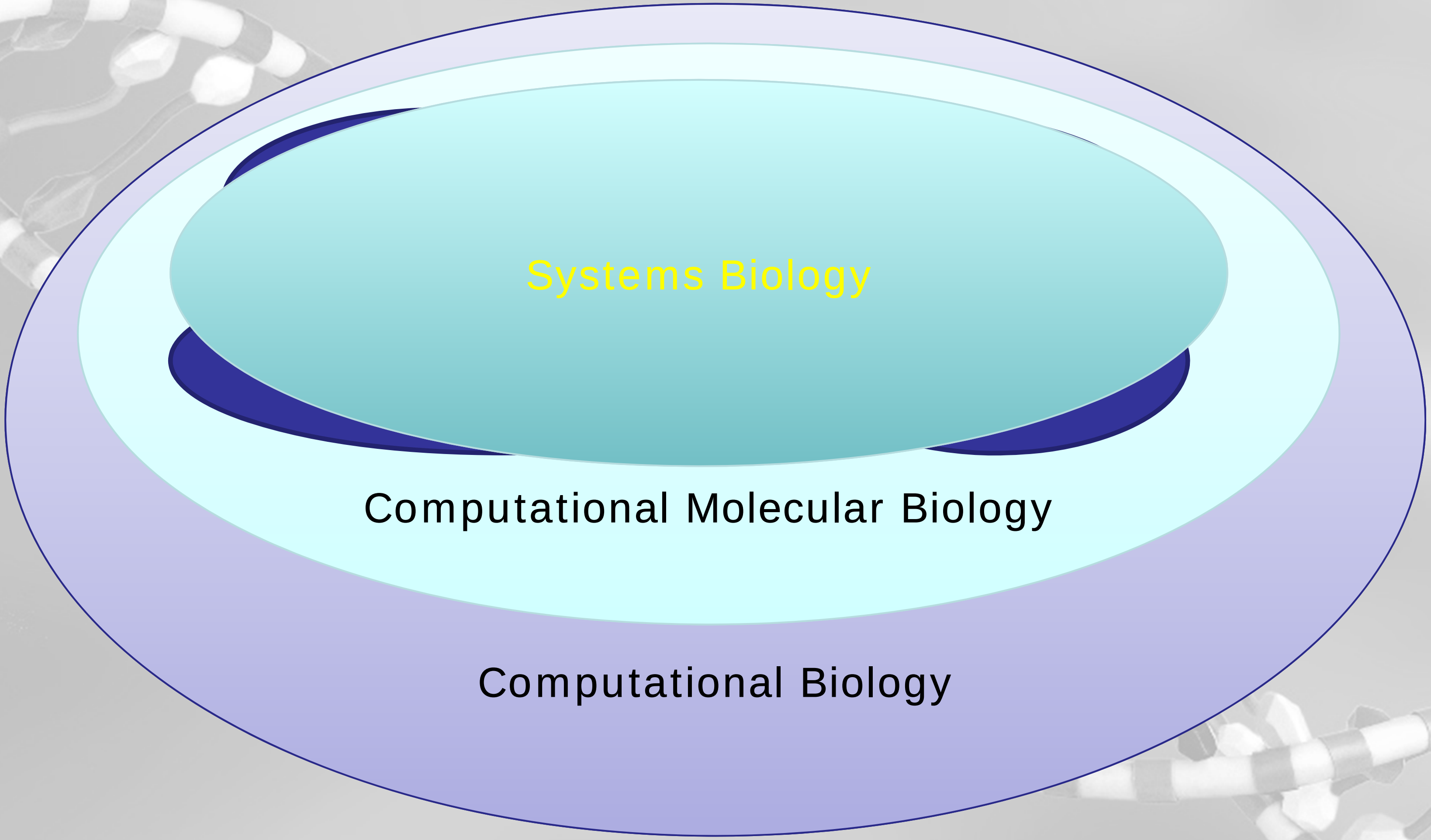
- Slides used during the lectures
- Moodle site
  - http://cmb.i-learn.unito.it/enrol/index.php?id=46

- Bioinformatics books

Program

- Introduction to Bioinformatics (today)
- Sequence Alignment
- Multiple Sequence Alignment and Profiles
- Clustering Algorithms and Philogenesis
- Classification and Prediction Algorithms
- (Introduction to Databases)
- Introduction to Graph Theory (Biological Networks)
- Microarray data analysis
- Representation and Identification Techniques of TFBS
- CpG Islands Identification
- ...

Genomics, Bioinformatics & Computational Biology

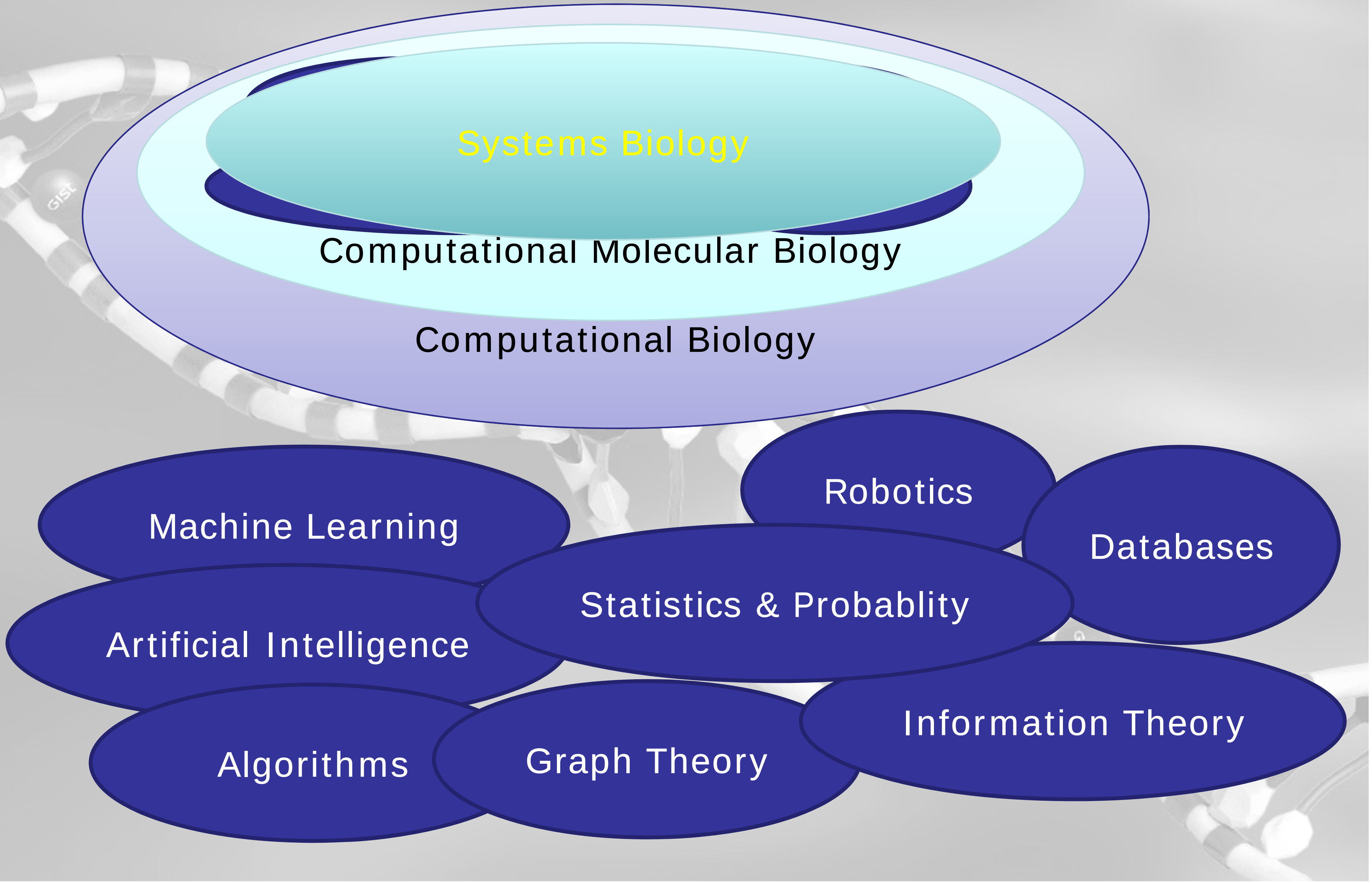


Systems Biology

Computational Molecular Biology

Computational Biology

Computational Biology & Computer Science



Systems Biology

Computational Molecular Biology

Computational Biology

Robotics

Machine Learning

Databases

Statistics & Probablity

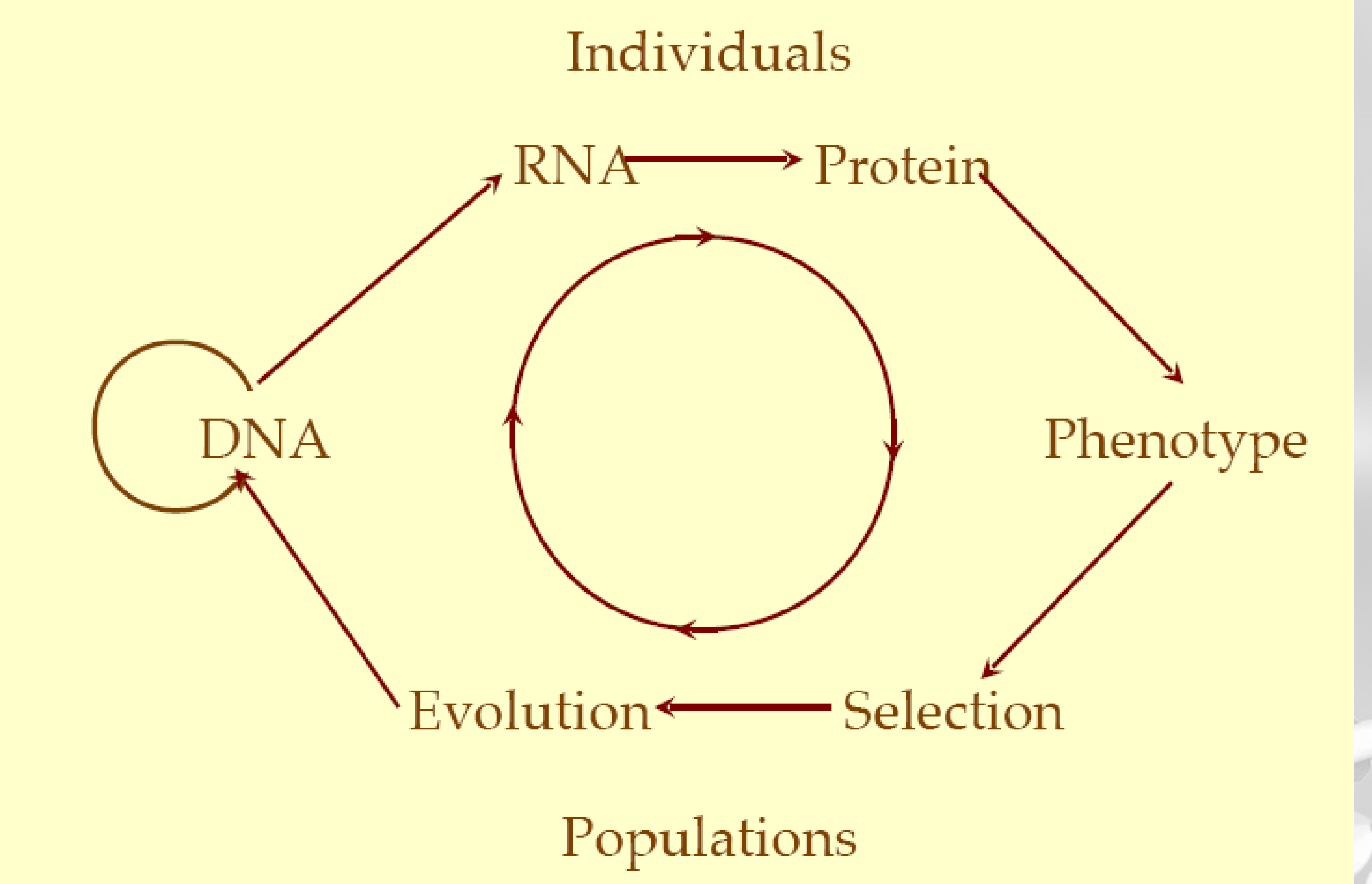
Artificial Intelligence

Information Theory

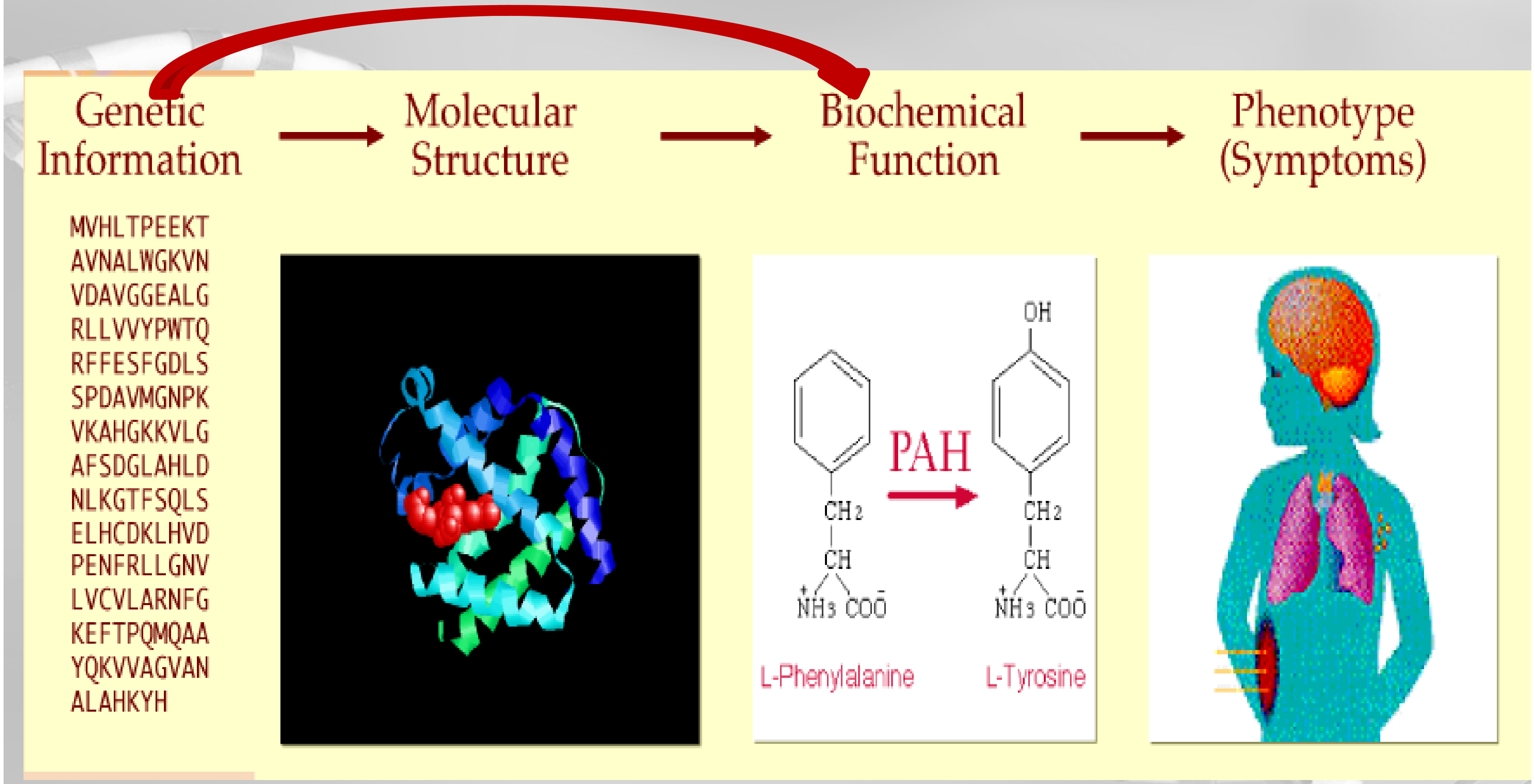
Algorithms

Graph Theory

Central Paradigm of Molecular Biology



Central Paradigm of Bioinformatics



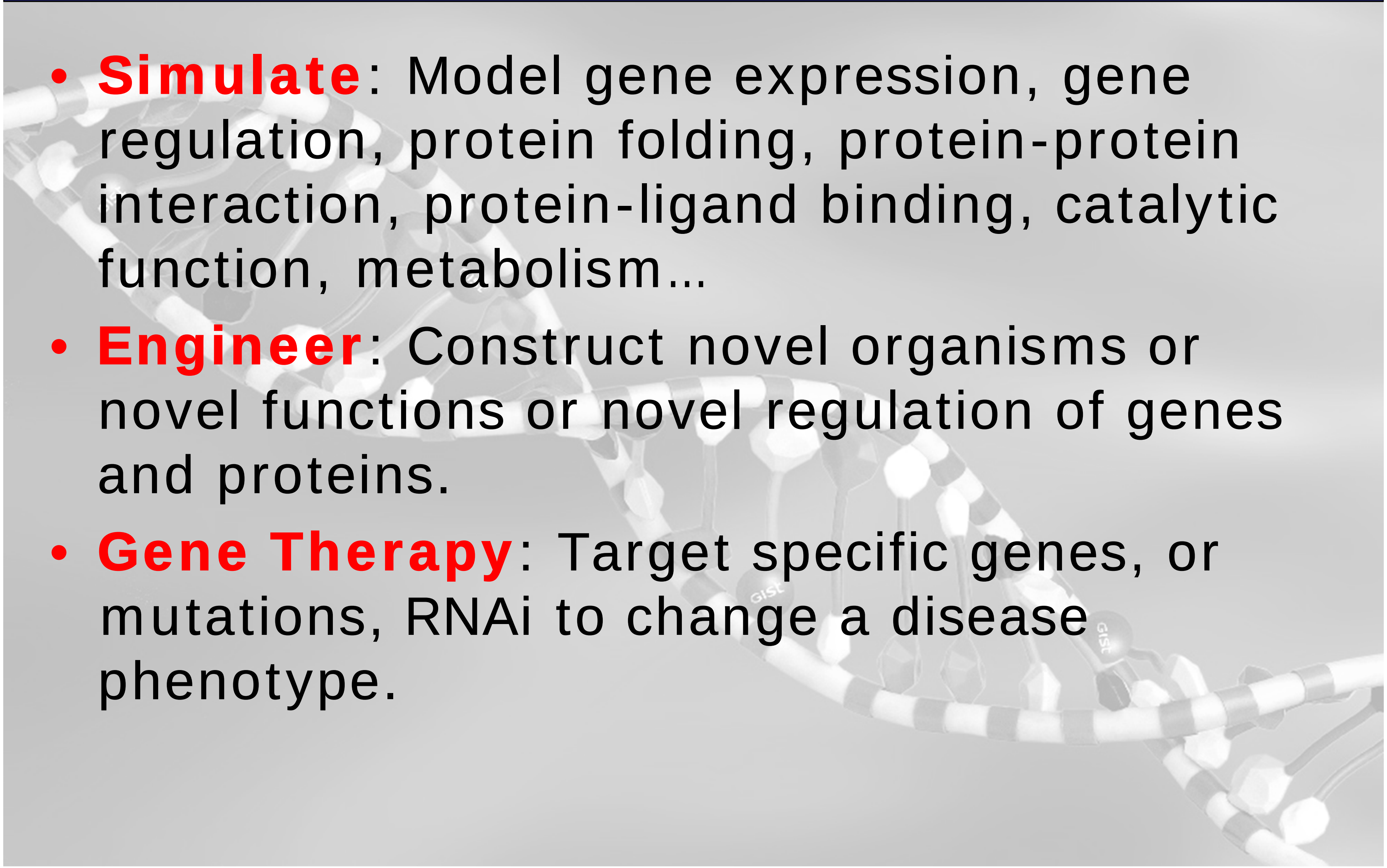
Genetic Information → Molecular Structure → Biochemical Function → Phenotype (Symptoms)

MVHLTPEEKT
AVNALWGKVN
VDAVGGEALG
RLLVVYPWTQ
RFFESFGDLS
SPDAVMGNPK
VKAHGKKVLG
AFSDGLAHLD
NLKGTFSQLS
ELHCDKLHVD
PENFRLLGNV
LVCVLARNFG
KEFTPQMQAA
YQKVVAGVAN
ALAHKYH

Computational Goals of Bioinformatics

- **Learn & Generalize**: Discover conserved patterns (models) of sequences, structures, interactions, metabolism & chemistries from well-studied examples.
- **Prediction**: Infer function or structure of newly sequenced genes, genomes, proteins or proteomes from these generalizations.
- **Organize & Integrate**: Develop a systematic and genomic approach to molecular interactions, metabolism, cell signaling, gene expression…

Computational Goals of Bioinformatics



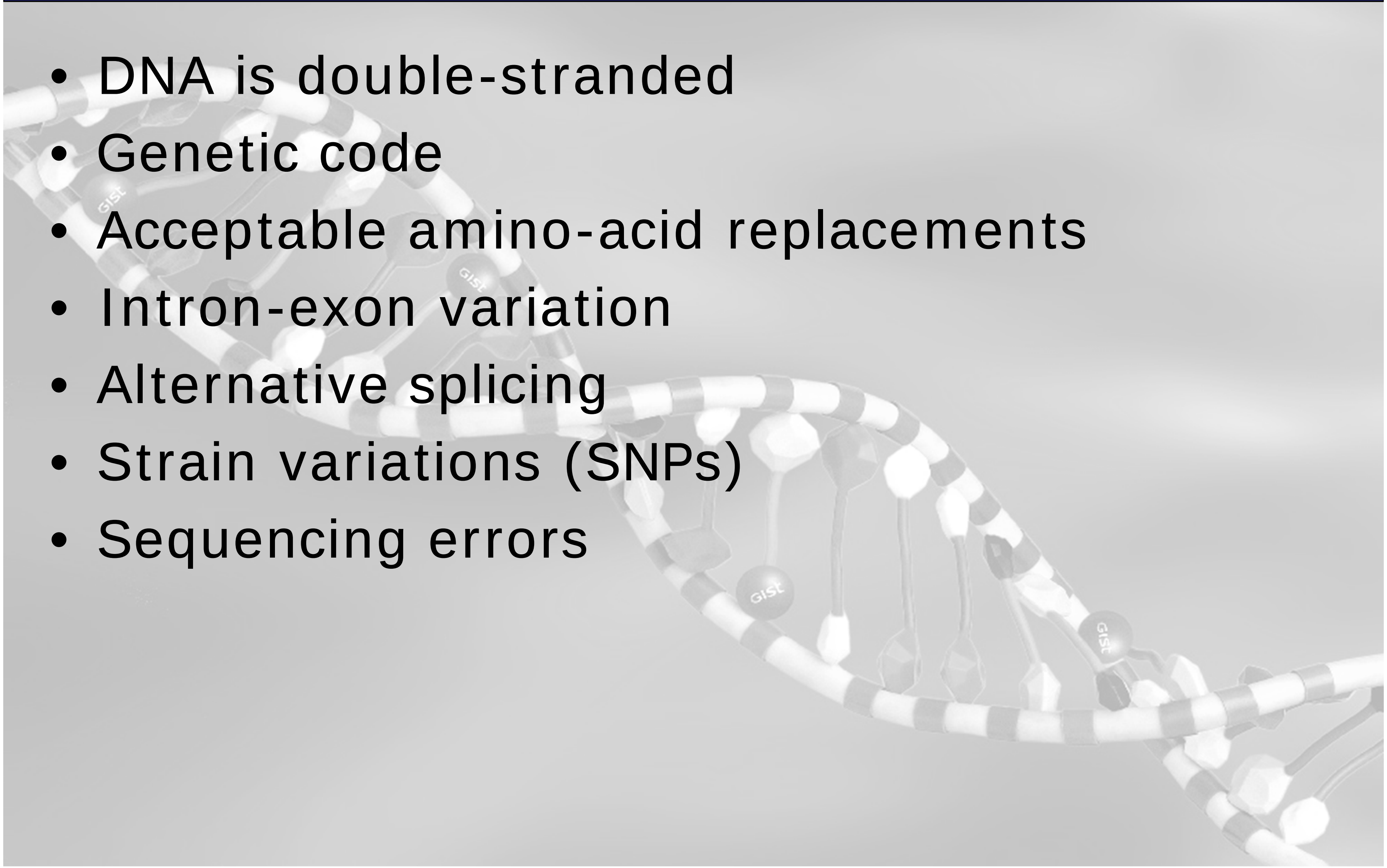
- **Simulate**: Model gene expression, gene regulation, protein folding, protein-protein interaction, protein-ligand binding, catalytic function, metabolism…
- **Engineer**: Construct novel organisms or novel functions or novel regulation of genes and proteins.
- **Gene Therapy**: Target specific genes, or mutations, RNAi to change a disease phenotype.

Challenges Understanding Genetic Information

Genetic Information → Molecular Structure → Biochemical Function → Phenotype

- Genetic information is redundant
- Structural information is redundant
- Genes and proteins are meta-stable
- Single genes have multiple functions
- Genes are one dimensional but function depends on three-dimensional structure

Redundancy in Genomic & Protein Sequences



- DNA is double-stranded
- Genetic code
- Acceptable amino-acid replacements
- Intron-exon variation
- Alternative splicing
- Strain variations (SNPs)
- Sequencing errors