

GCB Prelim Syllabus

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Computational Topics

(At least at level of CIT 592, 594)

- dynamic programming
- basic data structures (lists, stacks, queues, trees, hash tables, graphs)
- sorting
- basic string matching
- phylogenies
- recursion
- basic complexity
- propositional logic (basic database queries)
- mathematical induction
- data structures, object representation

Statistical Topics

(In general at least at level of Bio 446 (some subjects at level of Bio 556))

- Random variables
- Basic concepts of statistical inference
- Estimation of parameters,
- hypothesis testing,
- the standard tests of hypothesis,
- non-parametric methods
- distributions
- expectation
- standard deviation
- conditional probability
- matrices and matrix operations at the level of Bio 556
- analysis of variance at the level of Bio 556

Genetics/Genomics

The structure and transmission of genetic information

- Classical Cytogenetics
- Chromatin organization
 - Euchromatin, Heterochromatin
 - Centromeres, Telomeres
- Meiosis, mitosis, non-disjunction, aneuploidy

Molecular basis of gene expression: transcription, translation

Proteins structure, domains, etc

Genetic Variation and Meiotic Mapping

- Polymorphic Markers
 - RFLPs and VNTRs
 - STRPs/microsatellites
 - SNPs
- Heterozygosity
- Meiosis and crossing over
- Recombination frequency, genetic distance, and DNA “distance”
- Linkage in human pedigrees, lod scores
- Variation in meiotic map distances:
 - Sex, Chromosome position

Human populations

- Linkage disequilibrium (LD)
- Haplotype blocks
- Mapping by LD

DNA Sequencing

- Sequence analysis and databases
- Genome Sequencing and assembly strategies
 - Whole-genome shotgun
 - Clone-by-clone

Genome Projects and Genome sequences

- Experimental organisms
- Human
- Comparative genomics (DNA, protein); sequence alignments

Functional genomics: gene expression and the transcriptome

- Analysis of gene expression by in situ hybridization, by microarrays
- SAGE and differential display
- Applications to development and disease

Mendelian and non-Mendelian inheritance

- Inherited diseases and syndromes
- Mitochondrial genetics
- Imprinting

Genetics in Model Organisms

- Animal models, “forward” genetics

“Reverse genetics”

- Creating models of human diseases
- Antisense experiments and RNAi
- Targeted gene knock-outs and knock-ins
- Transgenic mouse models

Pathways and epistasis

- Genetic pathway analysis/epistasis
- Ordering genes into genetic pathways
- Suppressor/enhancer mutagenesis screens
- Redundancy

(new suggestion) Molecular evolution of genomes

- Rates of sequence change
- Sequence comparisons for inferences about selection, etc.