BI515 - Population Genetics

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My research:

- **Avian** behavior, systematics, population genetics, and molecular evolution
- Behavior, molecular ecology, and systematics of *brood parasitic birds* and *estrildid finches*
What is population genetics?

- the theoretical and empirical analysis of genetic variation in populations and the evolutionary processes responsible for generating and shaping that variation over time
  - *mutation, selection, genetic drift, gene flow
- the foundation for evolutionary biology!

Famous (and Less Famous) Quotes

- “Nothing in biology makes sense except in the light of evolution.”
  - Theodosius Dobzhansky, 1973 (1964)
- “Nothing in evolution makes sense except in light of population genetics.”
  - Michael Lynch, 2007
The Modern Synthesis...

- combined Darwin’s observations with Mendelian genetics to produce a coherent theory of evolutionary change
  - even though methods for directly assaying genetic variation were not yet available!
  - seminal papers from 1918 to 1932
- R.A. Fisher (1890-1962)
  - *The Genetical Theory of Natural Selection* 1930
- Sewall Wright (1889-1988)
  - *Evolution and the Genetics of Populations* (4 vol.) 1968-78
- J.B.S. Haldane (1892-1964)
  - *The Causes of Evolution* 1932

After the Modern Synthesis...

- theory developed during the modern synthesis has been extensively tested (and revised) based on molecular genetic data since the 1960’s
- 1973: the nearly neutral theory - Tomoko Ohta (1933- )
Three recent “revolutions”

- **Coalescent theory**
  - Kingman 1982; Wakeley 2008 *Coalescent Theory*
  - “turns population genetics on its head”

- **Genomics**
  - complete genome sequences
    - 1977: phage Φ-X174 (5,386 nucleotides)
    - 2001: human draft genome (~3 billion nucleotides)
    - 2007 - ?: “1000 genomes” project, “BGI”
  - SNPs (single nucleotide polymorphisms)
    - 1998: dbSNP; now with > 20,000,000 human SNPs
    - high throughput genotyping (rapidly developing…)

- **Computation**
  - Markov-chain Monte Carlo simulation & Bayesian stats

How many parents do you have?

- Not a trick question!
- Answer: 2
How many grandparents?

- Answer: 4

How many ancestors?

- Great-grandparents: 8 \( (2^3) \)
- Great-great-grandparents: 16 \( (2^4) \)
- Great-great-great-grandparents: 32 \( (2^5) \)
- .
- .
- Great\(^{10}\)-grandparents: ? \( 4,096 \)
- Great\(^{20}\)-grandparents: ? \( 4,194,304 \)
- Great\(^{30}\)-grandparents: ? \( 4,294,967,296 \)

Is there something wrong with the underlying logic?
How many years ago?

- Great-grandparents: 100
- Great-great-grandparents: 130
- Great-great-great-grandparents: 160
- Great^10-grandparents: 370
- Great^20-grandparents: 670
- Great^30-grandparents: 970