Evolution, Part 1

Reading: Chapters 5-6
Evolution examples

• Netlogo evolution models:
  
  Bug hunt speed

  Bug hunt camouflage

• Picbreeder:
  http://picbreeder.org/user/editgenome.php?sid=-1&pid=-1

• Karl Sims’ evolved virtual creatures:
  http://www.youtube.com/watch?v=xiRhe8mL_08
“If I were to give an award for the single best idea anyone has ever had, I’d give it to Darwin, ahead of Newton and Einstein and everyone else. In a single stroke, the idea of evolution by natural selection unifies the realm of life, meaning, and purpose with the realm of space and time, cause and effect, mechanism, and physical law.”

—Daniel Dennett, *Darwin’s Dangerous Idea*
Charles Darwin, 1809–1882. Photograph taken in 1854, a few years before he published *Origin of Species*. (Reproduced with permission from John van Wyhe, ed., The Complete Work of Charles Darwin Online [http://darwin-online.org.uk/].)
Darwin: Major Influences

Thomas Malthus (1766-1844)
― "An Essay on the Principle of Population"

Adam Smith (1723-1790)
― "The Wealth of Nations"
Notion of "the invisible hand" in economics
Darwin: Major Influences

Charles Lyell (1797-1875)

“Principles of Geology”
Notion of “uniformitarianism” vs. “catastrophism”

Galapagos finches
To summarize the major ideas of Darwin’s theory:

- Evolution has occurred; that is, all species descend from a common ancestor. The history of life is a branching tree of species.
- Natural selection occurs when the number of births is greater than existing resources can support so that individuals undergo competition for resources.
- Traits of organisms are inherited with variation. The variation is in some sense *random*—that is, there is no force or bias leading to variations that increase fitness (though, as I mentioned previously, Darwin himself accepted Lamarck’s view that there are such forces). Variations that turn out to be *adaptive* in the current environment are likely to be selected, meaning that organisms with those variations are more likely to survive and thus pass on the new traits to their offspring, causing the number of organisms with those traits to increase over subsequent generations.
- Evolutionary change is constant and gradual via the accumulation of small, favorable variations.
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Gregor Mendel, 1822–1884
(From the National Library of Medicine)
Population Genetics and the Modern Synthesis

Ronald Fisher (1890-1962)
Sewell Wright (1899-1988)
J. B. S. Haldane (1892-1964)
Tenets of the Modern Synthesis

• Natural selection is the major mechanism of evolutionary change and adaptation.

• Evolution is a gradual process, occurring via natural selection on very small random variations in individuals. Variation of this sort is highly abundant in populations, and is not biased in any direction (e.g., it does not intrinsically lead to "improvement", as believed by Lamarck). The source of individual variation is random genetic mutations and recombinations.

• Macro-scale phenomena, such as the origin of new species, can be explained by the microscopic process of gene variation and natural selection.