Key points from Lecture 10 of ASTR 350

1. Stellar-mass black holes are the endpoint of the evolution of stars which begin their lives with at least $20 - 30$ times the mass of the Sun.
2. More massive stars are (a) hotter, (b) as a result, bluer, (c) much more luminous, and (d) as a result, much shorter-lived, then less massive stars.
3. On the *main sequence* (so named because this is the main track on the Hertzsprung-Russell diagram of temperature versus luminosity), stars are powered by the fusion of hydrogen into helium in their cores.
4. When the core hydrogen runs out, the core contracts and the envelope of the star expands: this is the *red giant* phase. Stars sufficiently massive can have additional, much shorter phases of fusion: helium to carbon, carbon to oxygen, and so on, but at iron, fusion can no longer generate energy.
5. Less massive stars end their lives as *white dwarfs*: roughly 0.2 to 1.3 times the mass of the Sun, but on the order of the size of the Earth. More massive white dwarfs are smaller than less massive white dwarfs; this is because they are supported against gravity by relativistic electron degeneracy.
6. There is a limit to the mass that can be supported by degeneracy. For the most massive stars, they build up a fusion-inert iron core, and when that exceeds $\sim 1.4\ M_\odot$ (remember that the $\odot$ subscript means the Sun, so this is 1.4 times the mass of the Sun), the core collapses. The collapse releases a huge amount of energy and produces a *supernova* which can outshine the entire host galaxy of billions of stars for a few weeks.
7. Can produce a *neutron star* (mass of a star, size of a city) or a black hole.
8. Computer simulations of supernovae are extraordinarily challenging.