

The values of mass, radius, luminosity and effective temperature do not vary independently over the ranges listed above. There are, in fact, two major relationships: luminosity with effective temperature and luminosity with mass. The first of these relations is known as the *Hertzsprung-Russell* diagram (HR diagram for short) or the *colour-magnitude* diagram. A schematic HR diagram for stars in the solar neighbourhood is shown in <u>figure 2</u>.



Figure 2: Schematic Hertzsprung-Russell diagram.

Most of the stars lie in four groups and there are large regions of the HR diagram which contain no stars. The narrow band which contains around 90% of the stars and runs diagonally across the HR diagram from hot, bright stars to faint, cool ones is known as the *main sequence*. The other groups are known as the *giants*, *supergiants* and *white dwarfs*. The giants and supergiants have higher luminosities than main-sequence stars of the same effective temperature. Given that luminosity is the energy radiated per second by the whole star, and each square centimetre of a giant star radiates the same energy per second as each square centimetre of a mainsequence star of the same effective temperature, it follows that the giants and supergiants must have larger radii than main-sequence stars. Similarly, the white dwarfs have lower luminosities than main-sequence stars of the same effective temperature, which means that they must have smaller radii.