Acknowledgments:

Many thanks to R. Sutton and A. Barto for making their figures and slides available online. Also many thanks to P. Dayan and L. Abbott for making the figures of their book available online.
A Taxonomy of Learning Settings

- Unsupervised
- Self-supervised
- Reinforcement
- Imitation
- Instruction
- Supervised

Increasing amount of "help" from the environment
Resources

Dayan & Abbott

Sutton & Barto
Requirements

• class participation:
  • come to class
  • ask question
  • answer questions

• do the posted readings:
  • required and optional ones

• homeworks:
  • as posted on the course web page
  • some include programming in Matlab
  • programming exercises can be substituted for a project/paper
nervous systems span a range of spatial scales; at every scale there is interesting structure that we would like to understand

figure from Churchland and Sejnowski (1992)
Temporal Scales

- **1 day = 8.6 \times 10^4 \text{ s,}**
- **1 year = 3.2 \times 10^7 \text{ s}**

<table>
<thead>
<tr>
<th>Event</th>
<th>Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant habituation</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>Plan chess move</td>
<td>$10^2$</td>
</tr>
<tr>
<td>Action potential</td>
<td>$10^3$</td>
</tr>
<tr>
<td>Object recognition</td>
<td>$10^4$</td>
</tr>
<tr>
<td>LTP, LTD</td>
<td>$10^5$</td>
</tr>
<tr>
<td>Percept. learning</td>
<td>$10^6$</td>
</tr>
<tr>
<td>Infant walks</td>
<td>$10^7$</td>
</tr>
<tr>
<td>Human life</td>
<td>$10^8$</td>
</tr>
<tr>
<td>Neuroevolution</td>
<td>$10^9$</td>
</tr>
<tr>
<td>Growing up</td>
<td>$10^{10}$</td>
</tr>
<tr>
<td>Learn skill</td>
<td>$10^{11}$</td>
</tr>
<tr>
<td>Percept. learning</td>
<td>$10^{12}$</td>
</tr>
<tr>
<td>Neuroevolution</td>
<td>$10^{13}$</td>
</tr>
</tbody>
</table>

- Infant walks = $10^{11}$
- Human life = $10^{10}$
- Growing up = $10^8$
**Different “Perspectives” on the Brain**

**Perspective A:** The brain is a computation device. It finds solutions to certain computational problems. Sometimes these solutions are only approximate. ("top-down, computational (functional) view")

**Perspective B:** The brain is a complex dynamical system with many non-linearly interacting parts. The behavior emerging from these interactions is often difficult to predict ("bottom-up, physical view")
The need for theoretical neuroscience

David Marr (1982):

“Trying to understand perception [the brain’s operation] by studying only neurons is like trying to understand bird flight by studying only feathers: it just cannot be done. In order to understand bird flight, we have to understand aerodynamics; only then do the structure of the feathers and the different shapes of birds’ wings make sense.”