Interaction with the Environment
Interaction with the Environment

• Review of Chemotaxis
• Eye: An Example of Sensing
• Applications of Biological Sensing
• Homework Prep
• Animal Rights Discussion
Chemotaxis: Sense and Respond

• Sense extracellular signal
  [Link](http://www.youtube.com/watch?v=EpC6G_DGqkl) (Neutrophil)

• Run and Tumble Motion
  [Link](http://www.youtube.com/watch?v=-_R9FwNA1CY) (Chilomonas to decompose algae)
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Sensing: Eye

• Bacteria light/dark
Sensing: Eye

- Bacteria light/dark
- Human integrate many signals
Integrate single

• Bacteria light/dark
• Human integrate many signals
Human Eye - Sensing

- **Light/dark**
  - High sensitivity
  - Rods (498 nm)

- **Color**
  - High resolution
  - Cones
    - Red (564 nm)
    - Green (533 nm)
    - Blue (437 nm)
Human Eye - Sensing

- Rods
- Cones
- Lens/Cornea
  - focus
- Retina

Receptors on Retina of Human Eye
Human Eye – Integration

- Rods
- Cones
- Lens/Corn – focus
- Retina

Receptors on Retina of Human Eye

BRAIN
Many Eyes

• Human/Vertebrate eye
  • Lens inverts image

• Octopus/Cephalopod eye
  • The lens doesn’t invert the image

• Insect/Compound eye
  • Each section contains lens and rods/cones
Light Sensing and Response

1. Opsin Outside the cell
2. Opsin Membrane
3. Opsin Inside the cell

Cell Membrane
Chromophore

Cellular Signal


http://www.photobiology.info/Terakita.html
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Tool: Optogenetics

Spatial and cell specificity

http://www.youtube.com/watch?v=l64X7vHSHOE&feature=related

Optogenetics
Parkinson’s and depression

Viviana Gradinaru
“Rules for Biologically Inspired Adaptive Network Design”

Atsushi Tero, et al.
Physarum polycephalum

http://www.youtube.com/watch?v=BZUQQmcR5-g

Tokyo Rail System

Challenges

• Geographical Constraints
• Fault Tolerance
• Cost-Effectiveness
• Transport Efficiency
Physarum Networks

Without Illumination

With Illumination

(Low-altitude regions shaded)

Comparisons/Discussion

Physarum Network
(with Illumination)

Minimal Spanning Tree (MST)

Tokyo Rail System

MST with Extra Links

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Parasite Life Cycle

2 stages of replication for protozoan:
- Asexual – incidental host
- Sexual – reservoir host

In parasitic virus no replication in incidental host

http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm
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Animal Rights

• Discussion

• Concerns?
  – Treatment protocols
    • http://www.its.caltech.edu/~olar/iacuc/policy-forms/A-1%20Maintaining%20Animals%20in%20Study%20Areas.pdf
  – Office of Research Compliance
    • http://www.researchcompliance.caltech.edu/IACUC