Welcome!

COMP 546  Computational Perception

Prof:  Michael Langer

See public web page for this course:

My Background

- BSc at McGill in early 1980s (Math Major, CompSci Minor)
  (interest in AI, undergrad summer research in visual neuroscience lab)

- MSc in Computer Science at U of Toronto in late 1980s
  (topic: image coding and compression)

- PhD at McGill in early 1990s
  (topic: shading, shadows, and 3D shape perception)

- postdoc at NEC in NJ, USA in mid-1990s (3 years)
  (computer vision)

- postdoc at Max Planck Inst. in Germany in late1990s (2 years)
  (human visual perception)

- professor here since 2000
  (taught various versions of this course over 10x)
My Research Interests

- computational models of human vision
- human vision
- applications of perception in computer graphics
- computer vision
- computer graphics
What are your concepts of visual perception?

- optics (glasses)
- color (color blindness)
- binocular depth perception
- perspective (art)
- ....
What are your concepts of auditory perception?

- sound (waves)
- music (tone related to frequency)
- voice (automatic speech recognition is difficult)
- hearing aids (mechanism of cochlear implants)
Perception and Visual Illusions
Perception is...

... knowing *what* is *where*

(by seeing, hearing, touching, smelling ....)
"Sensation .... and Perception"

<table>
<thead>
<tr>
<th>physical</th>
<th>sensory</th>
<th>sense</th>
</tr>
</thead>
<tbody>
<tr>
<td>stimulus</td>
<td>organ</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>light (optics)</th>
<th>eye</th>
<th>vision (seeing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sound (acoustics)</td>
<td>ear</td>
<td>audition (hearing)</td>
</tr>
<tr>
<td>pressure</td>
<td>skin</td>
<td>haptics (touching)</td>
</tr>
<tr>
<td>chemistry</td>
<td>mouth, nose</td>
<td>olfaction (taste, smell)</td>
</tr>
</tbody>
</table>

... + proprioception, balance, pain, temperature, nausea,....
Perception is...

... knowing *what* is *where*

(by seeing, hearing, touching, smelling ....)

... an information processing task

(and some aspects of it can be modelled as computation)
Perception is .... a process.

physical world (state) → measurement → "computation"

model (perceived world)
Philosophical Challenge

physical world ≠ perceived world

Example: Vision

physical objects
- 3D shape
- 3D position
- material

perceived objects
- 3D shape
- 3D position
- material
- what and where?
Scientific Approaches to Perception

Neuroscience: Physiology, Anatomy, Biology
- neurons, nervous system, brain

Behavioral Psychology
- experiments that measure performance
  (detection and discrimination, recognition, attention, ... )

Computational Neuroscience
- information processing models
Levels of Analysis in Perception

- behavior / performance
- brain areas and pathways
- neural codes:
  'receptive and projective' fields
- neuron mechanisms:
  membranes, synapses, spikes
Levels of Analysis in Computer Science

- problem specification
- algorithms
- programs in a high level language
- machine and assembly language
- gates, circuits
- transistors

Here I went over the official Course Outline. See public web page.
Want to get involved in research?

See [www.cim.mcgill.ca/~langer/resources-gradschool.html](http://www.cim.mcgill.ca/~langer/resources-gradschool.html)

Undergraduates:

- COMP 400  Project in Computer Science  
  (Majors, with permission)

- COMP 396  Undergraduate Research Project

These can be done in any semester (F, W, S).

Graduate students (M.Sc.):

- Project or Thesis
COMP 546

Lecture 0

Course Introduction

origin of eyes and spatial vision

Thurs. Jan. 5, 2017
Primitive Eye (500 million years ago)

If you are interested in details, see Michael Land's paper
http://redwood.berkeley.edu/vs265/landfernal92.pdf
Origins of spatial vision
From spatial vision to behavior

Run away
Evolution of eyes

As pit becomes more concave, angular resolution improves (but amount of light decreases)
Origins of spatial vision

- Large aperture: poor angular resolution
- Small aperture: good angular resolution
Radians (review)

α radians * \( \frac{\text{arclength on circle}}{\text{radius of circle}} \)
Radians vs. degrees

\[ \alpha \text{ radians} \times \frac{180 \text{ degrees}}{\pi \text{ radians}} = \alpha \frac{180}{\pi} \text{ degrees} \]
Radians vs. degrees

1 radian = \( \frac{180}{\pi} \) degrees \( (~57) \)