Cogs102A * Lab 2: Ecological Invariants

GOAL: Discover the regularities –Gibson's "**perceptual invariants**" – that predictably emerge in the interaction between a perceiver and its world.

METHOD: You will go outside and move around in the world in systematic ways, making note of patterns of change at the interface between you and the visible world. (You can think of this as how shapes move around on your retina as you move.) These patterns of change are such an everyday part of our existence, that we tend not to even notice that they are happening – this exercise is designed to make them explicit. Some of these will be exceedingly obvious; others, not so much. The hope is that, through having to identify them, you will come to recognize how many of the everyday perceptual tasks we accomplish – such as determining the size and relative position of objects, as well as navigating through an environment – depend upon emergent properties.

For Section 1 on **Texture Gradients**, you will be positioning yourselves at various points along Library Walk.
For Section 2 on **Kinetic Occlusion**, **Optic Flow**, and **Motion Parallax**, you will be moving around in the Eucalyptus grove. You can do these sections in either order.

HINTS: The invariants of interest here tend to depend on factors like rate of change and cycles per degree of visual angle. While you will not be using any man-made artifacts to measure these factors, each individual's anatomy provides constants that can be exploited – e.g. stride length, rhythmic gait, lateral arm movement, the fact that your thumbnail subtends about 2° of visual angle at arm's length, etc. These can help you assess how the image of the environment that falls on your retina changes as you change your point of view. While such constants are perceiver-specific, you will still be working in teams, so be sure to discuss how and what you observe. Note that using just one eye can also sometimes be helpful. You will often be asked to report *"How did you discover this?".* These hints provide some of the practices you can use to discover the invariants of perception.

Given the extreme familiarity of these tasks, you may often be tempted to report things like "Well, I can just see that its farther" or "It's obviously bigger". This will not do. The point here is to determine just what cues – what "**invariants**" - lead you to want to make such a claim.

Section I: Texture Gradients and the Relative Size and Position of Objects

Texture Gradients can be highly regular (as in man-made structures like bricks or the sitting blocks along Library Walk) or more irregular (as in a lawn of grass or a grove of trees). In both cases, the frequency of the gradient – i.e. the # of changes per degree of visual angle – changes with distance in an invariant way, relative to the point of view of the perceiver. Do 1 first (a, b & c) then 2 then 3 - OR - do 2 then 3 first, then do 1.

1a) Stand near an end of the row of blocks along Library Walk, with your toes touching the middle of the edge of a block, such that you can look straight down the row.
How does the frequency of the gradient created by the blocks change with distance?
How did you discover this?

1b) Three poles have been positioned at various places along the row of blocks.
From your end of the row, which pole is closest, mid-distance, farthest from you?
Describe the invariant that allows you to perceive this.

1c) Move to a position exactly half way between two of the poles. Look in one direction at one pole, and then in the other direction at the other pole, to determine the following.
Are the two poles equal or unequal in height?
If unequal, which is longer?
Describe the invariant that allows you to perceive this.
Why did you need to be exactly half way between the poles for this to work?

2) Notice the strips of colored tape on the brick walkway. Stand near one such that you can also see another,
Are they equal or unequal in length?
If unequal, which is longer?
Describe the invariant that allows you to perceive this.
Repeat this assessment from a different position relative to the strips.
Does this change your assessment – why or why not?

3) How might the people standing, sitting, walking around the area, or other stationary or moving objects, contribute to the above assessments?

Section II: The *Moving* Perceiver: Kinetic Occlusion, Optic Flow & Motion Parallax

The relevant invariants here are detectable in your moving interaction with any of the trees in the Eucalyptus grove. Move around in the grove in systematic ways, noting the regularities in how you move, in order to answer the following questions. Kinetic Occlusion concerns when one object blocks (occludes) your view of another. Optic Flow occurs when a scene or object is seen to contract or expand. Motion Parallax involves the relative motion of objects (like the trees) that is based on your movement. Note that all of the above depend on a moving perceiver. Do 1 - 4 in order. Note that, for each exercise, re-trying w/various trees can help make the regularities across those attempts more apparent.

1) Standing still, pick two trees. Describe two invariants that allow you to perceive which is closer to you.
Now move around near those trees. Describe a *different* invariant that allows you to perceive which is closer.

2) Walk directly toward a tree. Describe at least two invariants that tell you that you are on course as you move.

3) Find two trees <10 feet apart. Stand ~ 10 feet from one, such that the two trees are aligned, so that one totally occludes (blocks your vision of) the other. Facing the tree, take one step (about 1 meter) to the left so that you can now see the full outline of both trees. Walk forward, looking forward (not at the 2 trees) on a straight line to ~ 1 meter to the left of the closest tree (i.e. walk toward, but not directly toward, the trees).
How did the way these two trees moved across your retina differ?
How did you determine this?
Summarize the invariant that tells you about their relative position.

4) Find four trees in a row, any distance apart, that you can align such that the closest occludes all the others. Move to a position several paces to the left, on a line perpendicular to the line of trees. From that position, you will observe how the trees move across your retina as you walk back along that line (again perpendicular to the line of trees) to a point an equal distance beyond (i.e. to the right) the line of trees.
The first time you do this, keep your focus on the second closest tree. Note the direction that the other trees move across your retina.
The second time you do this, keep your focus on the farthest tree. Note the direction that the other trees move across your retina.
Did the motion of the trees across your retina remain the same or did it change?
If there was a change, which trees changed and how did they change?
Describe the invariant that tells you about the relative position of the four trees.

In Conclusion . . .

The objects and substrates in this exercise do not change (e.g. no trees actually move); but the invariants involved are all about the types of change that emerge when humans interact with these objects and substrates. And, while we presume that the brain is certainly relevant in making use of these invariants, we were able to identify them without making any reference to neural processes. Write a short statement about how this exercise is an example – both methodologically and theoretically - of the "ecological" approach to studying cognitive science.

Make sure the name of each participating team member is listed on the last page.
Put your Team Name on every page.