• Presentation look and feel adapted from the “Brain” Microsoft Office Online template.
• Presentation complements the thesis.
- Slide is a caricature to some extent, but...
- Main point is that the resultant decomposition is different and that a new approach is warranted
- Moreover, functional decomposition is multi-realizable. Do we have the right compositions today?
Two parallel & interactive functions:

1. **Maintain Information Coherence**
   - When old information in a recurrent flow meets new information, compensate for motion so that they “refer” to the same “thing”

2. **Handle Missing Data**
   - If bottom-up information is missing, fill it in using lateral or top-down flows
   - (This is not an isomorphic “filling-in” process)

- Parallel, interactive and *non-hierarchical* at this level of analysis
- Not traditional functional formulations
- Descriptive “filling-in” vs. explanative filling-in.
• Functions isomorphic to phenomena, e.g., filling-in function, have trouble when behaviour should not occur
  • They are the wrong functional decompositions
  • Filling-in should remain descriptive and not explanatory
• Our explanatory functions are finer grained and not explicitly about filling-in
  • Filling-in behaviour emerges when required
- Each of these lines of inquiry are ordinarily researched independently
  - Each has its own rich phenomenology
- Thesis is organized in a *phenomena first* manner so this presentation will not go into those details
  - This presentation is in a *model first* manner, how it differs from classical approaches, and its strengths
• The building blocks forming ECM
• Each Receptive Field (RF) within ECM is an Emergic Unit
• These are the structural elements forming a prototypical EN
  • Network, Units, Ports, Links
  • Structure of Values
  • Software
  • Ecological situation
• The only dynamics is the flow of values through the network
  • Includes ecological engagement through sensors and effectors
• Blue-free region
• Receptive field sizes that increase with eccentricity
• Random cone sensitivities
• “Random” cone positions
- Explain colour homogeneity and linearity
• Non-representational interaction with the environment
• Biological sensory system
- Lateral is “Memory” that can be split/joined by shifting
- Data could be missing due to: heterogeneity; damage; eye blinks; occlusions; beyond the retina; etc.
Maintain Information Coherence Function

- This cognitive function is complex:
  - Distribute motor plans in advance
  - Shift coordinates to maintain infocentric reference frame
  - Broadcast information locally (~Local Area Network)
  - Tag information (~Internet protocol)
  - Interpolative summation
Distribute Motor Plans (Shifts)

- Compensate for eye motion
- Allow the shifting of sensory information
• Lateral is “Memory” that can be split/joined by shifting
### Tag Spatial Information in Structured Values

- **ValueXY**({x, y, v, w}...)
  - **x**: the spatiotopic x-coordinate of this sample value
  - **y**: the spatiotopic y-coordinate of this sample value
  - **v**: the L, M or S colour value of this sample from 0 to 255
  - **w**: the weight assigned to this sample value
  - **...**: repeatable, in which case this emergic value represents the descriptive statistics for all the samples weighted accordingly

- **Internal Representation (for L, M & S)**
  - **n**: the number of samples = \(\sum 1\)
  - **sw**: sum of sample weights = \(\sum w_i\)
  - **swx**: weighted sum of X coordinates = \(\sum w_i x_i\)
  - **swy**: weighted sum of Y coordinates = \(\sum w_i y_i\)
  - **swv**: weighted sum of colour values = \(\sum w_i v_i\)
  - **swxx**: weighted sum of X coordinate squared = \(\sum w_i x_i^2\)
  - **swxy**: weighted sum of X coordinate multiplied by Y's = \(\sum w_i x_i y_i\)
  - **swyy**: weighted sum of Y coordinate squared = \(\sum w_i y_i^2\)
  - **swvv**: weighted sum of colour value squared = \(\sum w_i v_i^2\)

### Mean(x) = swx/sw; variance(x) = (swxx - swx^2/sw)/sw; sd(x)=\(\sqrt{\text{variance(x)}}\)

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- Note: the spiking output of neurons alone or in a group does have statistical properties
- The SD is used for calculating spatial overlap between shifting values and static RFs
Gives border/edge processing without specialized neural circuitry
• Each emergic unit has two independent yet interacting parts that lead to emergence
  • Four ports (2 in, 2 out) on the left hand side of each RF for shifting purposes
  • Four ports (3 in, 1 out) on the right hand side of each RF for surface LMS colours (*3)
Possible mechanisms and conceptualizations ought to influence how one measures for image stability.

Flowcentric suggests an alternative measurement regime and coordinate system
  - Compatible with RF remapping phenomenology

As all our flows interact coherently, images remain stable within the flow
  - Suggests the flow as a locus of consciousness
Handling motion → emergic filling-in (for free)

- Temporal vs. spatial mechanisms
  - Appears spatial under neurocentric analysis, but
  - Actually temporal under flowcentric analysis (cut & paste, e.g., "mpeg vs. jpeg")

Masking for free Instantaneous Filling-In

CHANG IS THE ONLY CONSTANT HERACHTUS

06-Jan-2013 David Pierre Leibowitz (Carleton University) Thesis Overview: UCM of Vision via EN 20
• The entire Emergic Network is synchronous and runs on small time increments called ticks, nominally 10ms each.
  • These are made small enough to simulate an asynchronous dynamic system
• Eyes in third column remain open for 50ms every 80ms.
- Borders are “respected” but not explicitly completed

- Most systems have dedicated neural circuitry for border and edge detection and completion
  - Comes for free

- Physical arrangement of RFs less important

- Temporal vs. spatial edge detection
Future Work

- Connecting model to dendritic processing
- Handling object motion
- Attention
Backup
• For top-most RF, ½ Red + ¼ blue overlap \( \rightarrow \) lilac
Modelling Contributions

- Emergic Networks (EN)
  - 1) Model of process metaphysics (EM)
  - Also primary epistemic contribution
  - http://emergic.upwize.com/?page_id=6

- Emergic Cognitive Model (ECM)
  - 2) Detailed model of human retina under motion, blinks, scotomas, etc.
  - 3) Unified model of visual “filling-in” phenomenology
    - Primary ontological contribution

- Emergic Simulation System (ESS)
  - 4) Model agent/environment interactions
• Top-down is often considered as “merely” modulatory
  • Surprisingly, there are typically more top-down (efferent/feedback) connections than bottom-up
• Memory is normally considered within a neuron, or via interlayer resonance
• All flows are equally important functionally