Day 1 Recap

Joint MRC/INCF/SICSA Workshop on Atlas Informatics

Edinburgh, 15-16 May 2012

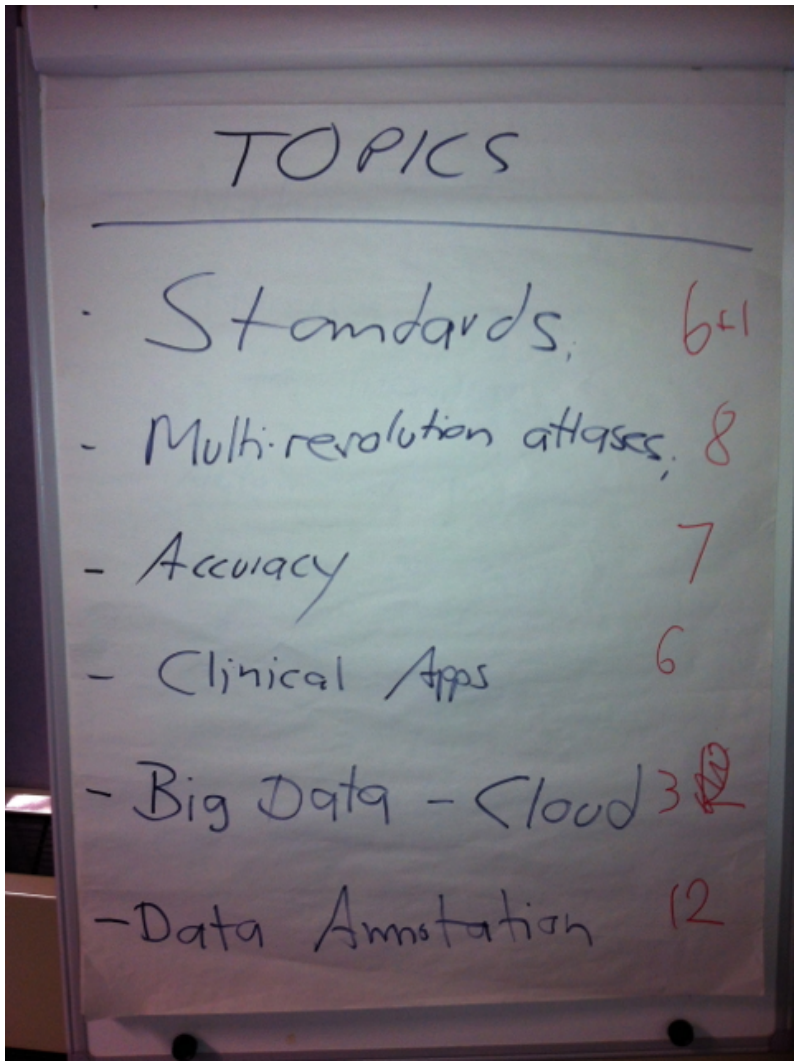
9.40 - 11.00: Atlas Systems:

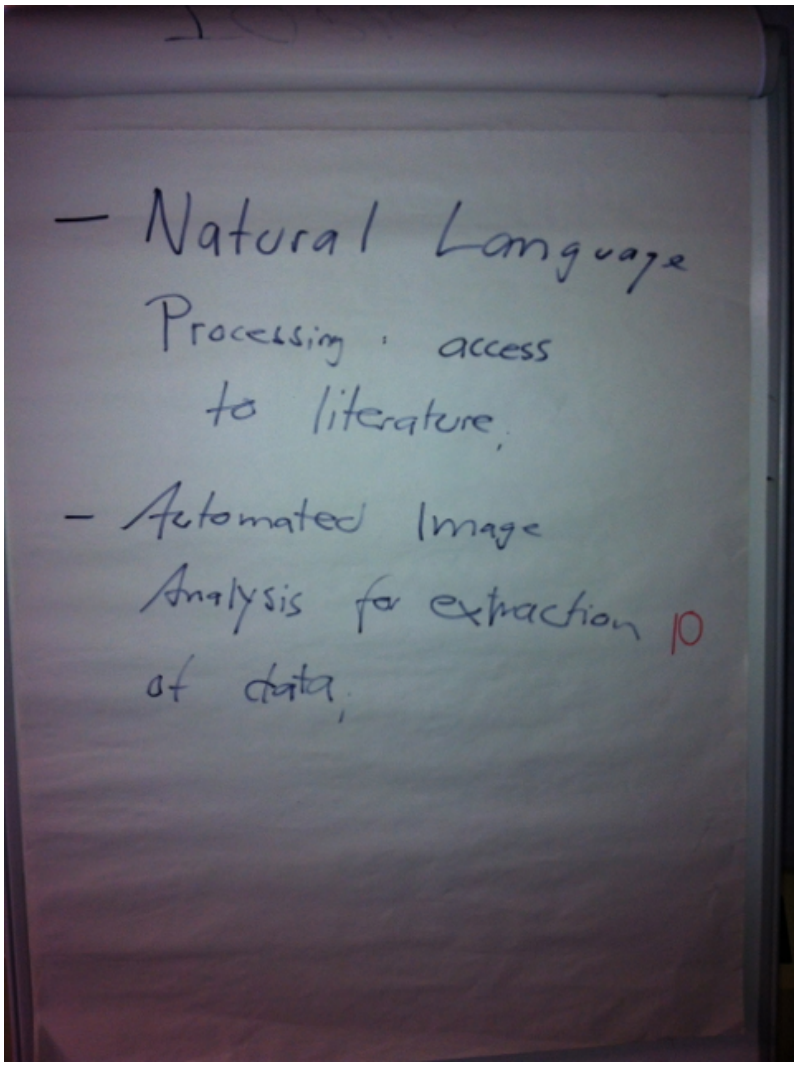
- 9.40 - 10.00: **The Virtual Fly Brain**; Prof Douglas Armstrong (Edinburgh University, UK); [abstract]
- 10.00 - 10.20: **New Dimensions to eMouseAtlas;** Dr Chris Armit (MRC Human Genetics Unit, IGMM, UK); [abstract]
- 10.20 - 10.40: **The Scalable Brain Atlas and the 3d Brain Atlas Reconstructor;** Dr Piotr Majka (Nencki Institute of Experimental Biology, Poland); [abstract]
- 10.40 - 11.00: **The INCF Digital Atlas Infrastructure;** Dr Ilya Zaslavsky (University of California, San Diego, USA); [abstract]

- 11.30 - 11.50: **Application of Atlases in the Segmentation of Medical Datasets;** Dr Ian Poole (Toshiba Medical Visualisation Systems, UK); [abstract]
- 11.50 - 12.10: **The use of anatomical atlases on neuroimaging and their importance in clinical research;** Dr. Maria del Carmen Valdés Hernández (Brain Research Imaging Centre, University of Edinburgh, UK); [abstract]
- 12.10 - 12.30: **Using Atlas Informatics to Improve Cancer Treatment;** Dr Bill Nailon (NHS Lothian: Department of Oncology Physics, and University of Edinburgh: Edinburgh Cancer Research Centre & School of Engineering, UK); [abstract]

- 14.00 - 14.20: **A Use Case of Transcriptome Analysis Frameworks in the Web-Accessible Anatomical Space of the Mouse Brain**; Yuko Okamura-Oho (RIKEN Advanced Science Institute, Japan); [abstract]
- 14.20 - 14.40: **Wnt pathway gene expression: toward comprehensive coverage using a test-case set of functionally related gene expression patterns;** Dr Paula Murphy (Trinity College, University of Dublin, Ireland); [abstract]
- 14.40 - 15.00: **Large-scale data production requiring new solutions for data integration**; Prof Jan G. Bjaalie (University of Oslo, Norway); [abstract]

Discussion Topics:





Three Topics Selected:

- Annotation and Standardization: [Ilya, Peter];
- Accuracy and Image Processing: [Jim];
- Multi-resolution Atlases: [Duncan];

Summary: Annotations + Standardization

- Annotations
  - How do we come up with agreed upon nomenclatures to annotate images
  - How we model annotations, given that many people describe them differently
    - Annotations specifically for atlases
    - Parts of annotations: geometric, semantic, provenance, relatedness to more than one object or another annotation, subtlety, user info
    - Some good tools exist for fly brain; need to connect with atlas services
  - What would make sense to standardize: nomenclatures themselves or models of annotations
  - Or would it be easier to standardize coordinate spaces (not always)

Summary: Annotations + Standardization

- General question is: what makes sense to standardize and how to come up with a community agreement
  - Not force everything into a single model – it is not possible and will only create tensions
  - Need a registry of potential reference models and good ways to select which of them to use
  - Try to agree on what is possible to agree on (how we define this?)
  - Try to come up with a standardization process which is open, transparent, based on consensus, and has time limits
    - Not 5 years to agree on a term!
    - Need a good **value proposition** for standardization

Summary: Automated Image Analysis & Accuracy

- Accuracy is in the eye of the beholder?
  - Lack of universal definition
    - Catalog of *many* evaluation measures - Dashboard
      - Recipes/best practices/recommended protocols
    - Accuracy when successful AND 'blunder' rate/information
  - Task specific/Task-based evaluation
    - Of general interest/relevance
    - Candidate studies?
      - Automated MRI mouse brain segmentation
        - » Acquisition protocol required to allow 'optimal' segmentation (>95% 'accuracy')
      - Automated histology brain segmentation
        - » Regardless of stains and sectioning orientation but feasible to be annotated by human expert
      - Dense reconstruction from sparsely sampled histological data
      - Distortions in histological sampling
      - Gene expression data-specific challenges

Summary: Automated Image Analysis & Accuracy

- How much can we 'standardize' with automated image analysis?
  - Best practices re: data acquisition that enable 'optimal' use of automated methods
    - Recommended 'contrast' image to support normalization/mapping
- Tools to assist customized assessment of 'accuracy'?
  - Processing 'statistics'

Summary: Automated Image Analysis

- Is full automation necessary or good?
- Analysis/tasks wish list
  - Mapping/transforming to standard spaces?
  - Volumetric reconstruction (from 2D sections)?
  - Standard methods *infeasible* given 'unstandard' ways in which data is collected in the community
  - Embryo-specific needs
  - Mouse brain-specific needs

Summary: Multi-resolution Atlases:

- many different contexts where data from atlases uses different levels of scale;
- each level of scale has a different kind of data, a different paradigm;

- time scales can be very different at different levels;
- at some point spatial mapping will break down: e.g. generally, tissue to tissue ok, but cell to cell not possible;

- at the point mapping breaks down, rely more on statistics and probabilities, e.g. x% of this cell type, y% of another cell type, or average of cell data, might be the definition of what makes up a tissue. (Ontologists might describe this as a mixture);

- an integrating framework has to accommodate all levels; there has to be some continuity;
- besides anatomy, other ways to tie a thread between levels is with models;
- ideally, any level could be described with a model or models;
- model at any given scale will be informed by data at that scale, and should inform other scales. Output at one level becomes input at next level up or down e.g. genes expressed in a cell and their relation to pattern effects of the tissue;

Summary: Multi-resolution Atlases:

- would be useful to have a specification of what levels are and what's needed (some candidates are molecules, synapses, gene expression, cells, connections, tissues, etc.);
- would be useful to have standards for data exchange between levels;

- example of these problems: radiotherapie and fly brain, e.g. individual neuron activity towards signalling at higher level of brain;
- example: question on section of brain, what do I have to know about the level below?
- example: different levels of anatomy and models and how they might inform other levels (learning and memory, changes in molecule to synapse to neuron to tissue to behavior);

Day 2 (focus on computational challenges)

Atlas Informatics is inter-disciplinary:

- Biomedical and Computational;
- Many Areas of Computer Science;

- 9.30 - 9.50: **Brain Atlas Systems and Ontologies;** Dr David Osumi-Sutherland (Cambridge University, UK); [abstract]
- 9.50 - 10.10: **Spatio-temporal Biological Process Modelling**; Dr Vashti Galpin (Edinburgh University, UK); [abstract]
- 10.10 - 10.30: **Large Deformation Atlas Registration**; Dr Bill Hill (MRC Human Genetics Unit, UK); [abstract]
- 10.30 - 10.50: **Atlas Interoperability Challenges;** Dr Ilya Zaslavsky (University of California, San Diego, USA); [abstract]
- 10.50 - 11.10: **Scalable Workflow**; Dr Adam Barker (University of St Andrews, UK); [abstract]