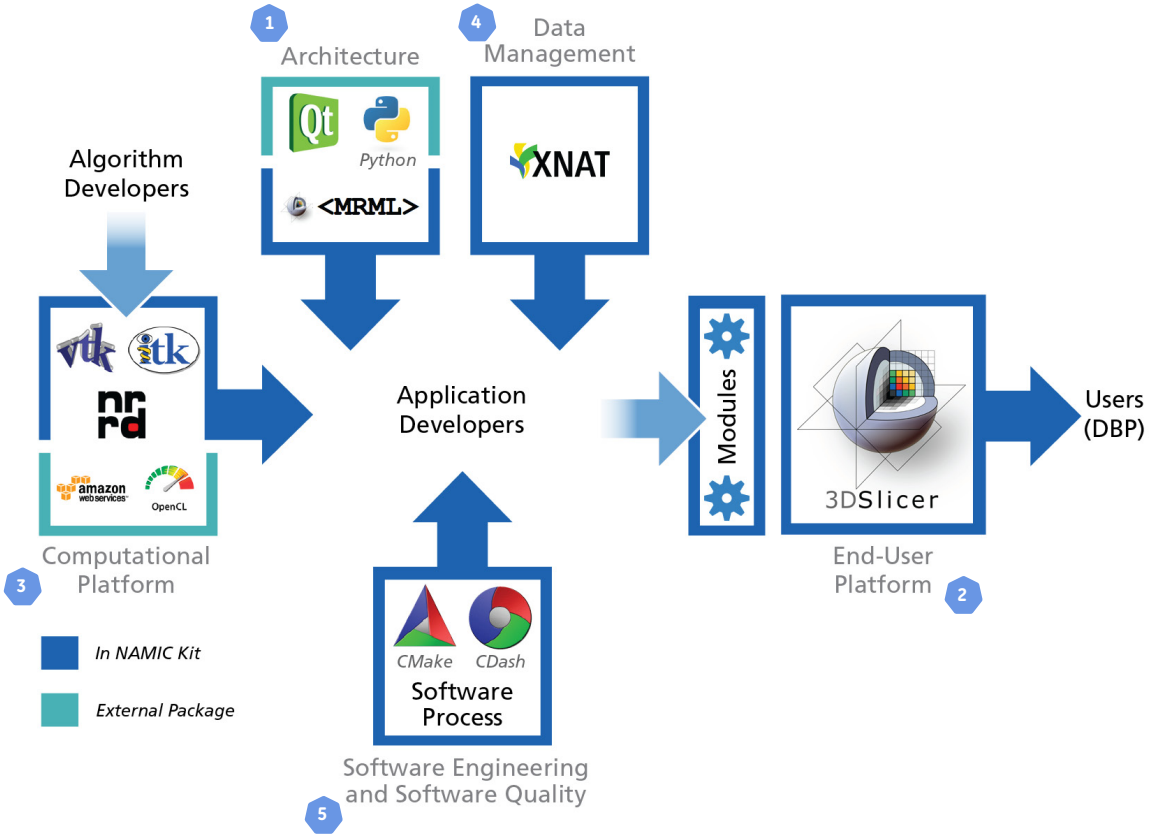
Core 1b – A glimpse at the renewal

imagination at work

Core 1b – Engineering
5 Aims / 5 Platforms



Architecture – tools, operating paradigms, reporting mechanisms, integration points

End-user platform – interactive methods and information visualization for longitudinal analysis, exploratory data analysis, and translational research

Computational platform – stream processing, cloud computing, statistical analysis, informatics, machine learning

Data management – non-imaging and derived data, DICOM and cloud services

Software engineering and software quality – navigable timeline for revision control, build, test, documentation and release

Core 1b – Engineering
Proposed schedule

Aim	Year 1	Year 2	Year 3
1	Data model to link longitudinal data; Framework for interactive segmentation	Interactive integration points; Workflows and parameter settings sharing	DICOM connectivity; Extension upgrade mechanisms
2	User interface for interactive segmentation; Plotting; Information visualization	Time series tools for tracking disease progression and response to therapy	Uniform application support for piecewise transformations
3	Resource management and cross-platform GPGPU infrastructure; Extensible feature measurement	IPython integration; Interfaces to statistical packages	Regression analysis; Multivariate clustering interfaces; Machine learning interfaces
4	DICOM formats; Non-DICOM formats; Non-imaging data	Data browser integration	DICOM networking
5	GIT conversion and training	GIT, CMake, CTest/CDash, MediaWiki, and Mantis links	Navigable timeline deployment

Core 1a - Algorithms

Statistical modeling of anatomy and pathology – statistical models to capture wider range of anatomy and pathology

Geometric correspondence – between images, coordinate systems, shapes, anatomies for robustness against variability

User interactive tools for segmentation – user guided tools to for segmenting tissues, organs, lesions

Longitudinal and time-series analysis – statistical and geometric analysis across time

Core 1a – Algorithms
Proposed schedule

Aim	Year 1	Year 2	Year 3	Year 4
1	(a) Manifold model for multi-modal images (HD) (a) Application of nonpara-metric priors to segmentation (AF) (b) Atlas initialization in the presence of pathology (c) Whole brain fiber-particle tractography	(a) Validation of the manifold model (b) Refinement of conditional priors(AF) (b) Optimization of nonpara-metric atlases (AF) (b,c) Segmentation of white matter injury and bleeding (TBI)	(a) Manifold priors in applica-tion to segmentation (HD) (a,b) Segmentation of the scar tissue (AF) (b) Characterization of fibrotic and ablated tissue (AF) (c) Validation of whole brain tractography (HD,TBI)	(a,b) System for integrating expert knowledge of pathol-ogy into algorithms (c) Application of whole brain tractography (HD, TBI)
2	(a) Transformation regulariza-tion with discontinuities (b) Correspondence soft-ware: user-defined landmarks and outliers (c) Correspondence-free mapping application and validation (AF) (d) Particle filtering for regis-tration	(a) Regularization with discontinuities for segmenta-tion (HNC) (c) Correspondence-free mapping in consecutive scans (AF, HNC, TBI) (d) B-spline particle-filter optimization with landmarks and exclusion regions (TBI, HD)	(a) Regularization with discontinuities for segmenta-tion (TBI) (b) User-guided correspon-dence model (AF) (d) Optimal registration for segmentation initialization (AF, HNC, TBI)	(d) Optimal registration for deformation mapping (AF, HNC, TBI) (c) Correspondence-free mapping for fully volumetric deformation (AF, HNC, TBI)
3	(a) Particle filtering for geometric active contours in NA-MIC Kit (b) Contour-based segmenta-tion methods in NA-MIC Kit	(b) Application of contour-based segmentation (HNC) (c) GPU-based methods for shortest path	(a) Particle-filter based segmentation (AF) (b) User-interactive segmen-tation (AF)	(a,b,c) User-interactive seg-mentation (HNC) (a) Particle filtering for trac-tography (TBI, HD) (b) Particle filtering module in Slicer for segmentation and registration
4	(a,c) A spatio-temporal model for multimodal contrast tra-jectories	(b,c) Validation of spatio-temporal models (b) Particle-based longitudi-nal correspondences (a,b) Longitudinal correspon-dences in clinical applications (AF, TBI)	(b,c) Hierarchical linear model for comparison of individual subjects to popula-tions (HD)	(b) Longitudinal correspon-dences in clinical applications (HD, TBI)

DBPs

Atrial fibrillation – precision guidance of interventional therapy based on integration of pre-procedural and intra-procedural image data

Huntington's disease – formulate and test hypotheses about the evolution of chronic disease in at-risk individuals

Head and neck cancer – quantification of change in body systems during disease progression and management

Traumatic brain injury – longitudinal imaging allow patients to serve as their own controls