Application Specific and General Software Platforms: Open Source Distribution

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Outline

- Background
- Open Systems
- Case Study - Insight
- Summary

What is a Platform?

- Hardware
  - CPU
  - Peripherals
- Software
  - Operating System
  - Support libraries
- Services

Visualization Platform

- Hardware
  - Graphics accelerator
- Software
  - Graphics APIs
    - » OpenGL
    - » Direct3D
- Services
  - Algorithms
  - Architecture / Framework

Scanner Platform

- Hardware
  - CT/MRI scanner
- Services
  - Scan
  - Recon
  - Archive
  - Display
  - Film

Moving from Closed Software to Open Software

From www.opensource.org

"When programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, people fix bugs. And this can happen at a speed that, if one is used to the slow pace of conventional software development, seems astonishing."

Why Open?

- Protect software investment of funding organizations
- High quality software is possible
- Objective peer review
- Software outlives the developer
- Higher interoperability
- Access to a pool of developers that know the code
- Mix between custom and COTS code

Open Software

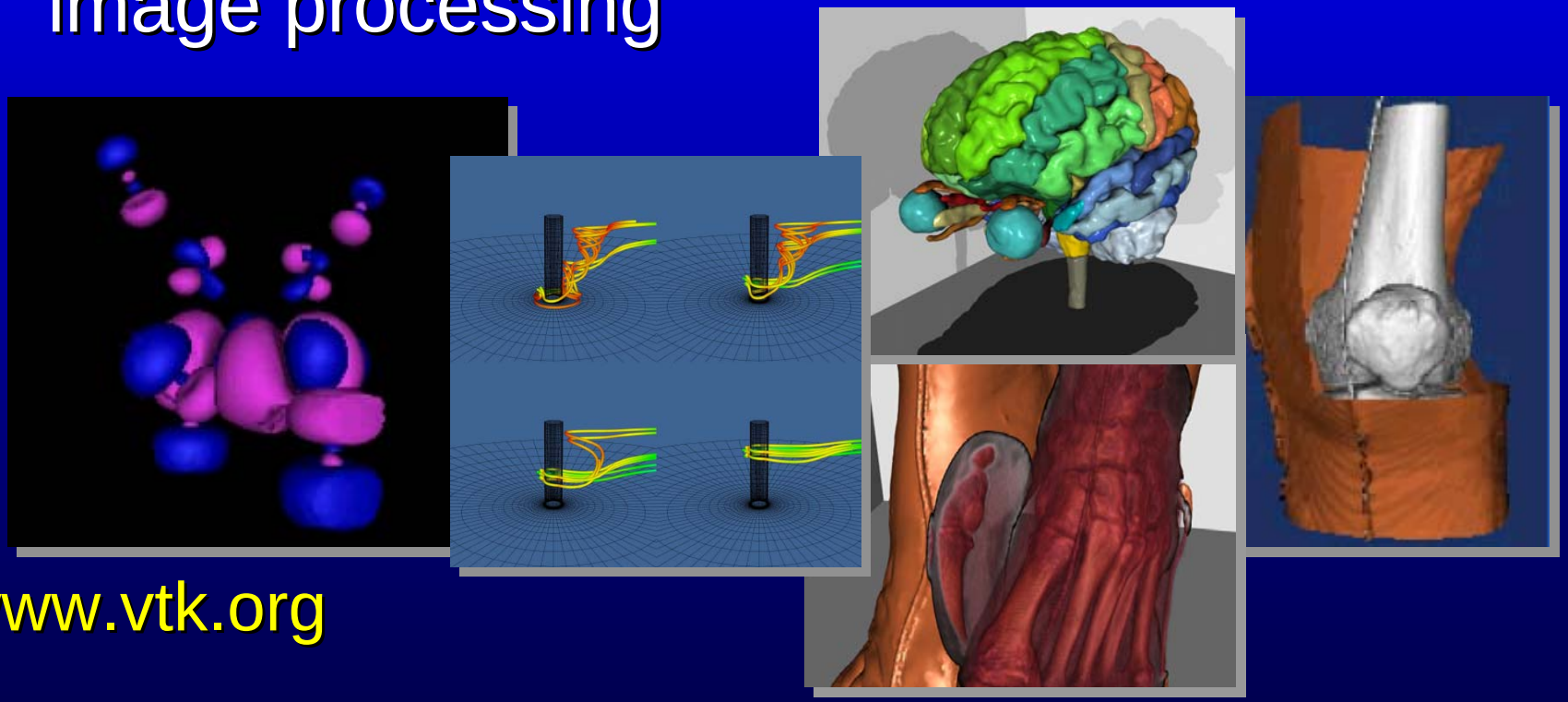
- Open API's
  - OpenGL
  - DICOM
  - Java
- Open Source
  - Emacs
  - Apache
  - Linux
  - OpenDX
  - vtk – Visualization Toolkit
  - itk – Insight Toolkit
  - vxl – Computer Vision Library
  - Cgal – Computational geometry
  - Slicer – surgical planning

Open Software Business Models

- Packaging, Service, Integration
  - Linux - Redhat
  - vtk - Kitware
- Hardware acceleration
  - VolumePro from TeraRecon
  - Mercury Computer's accelerated vtk
- Open plus Proprietary
  - GE Direct3D

Visualization Toolkit - vtk

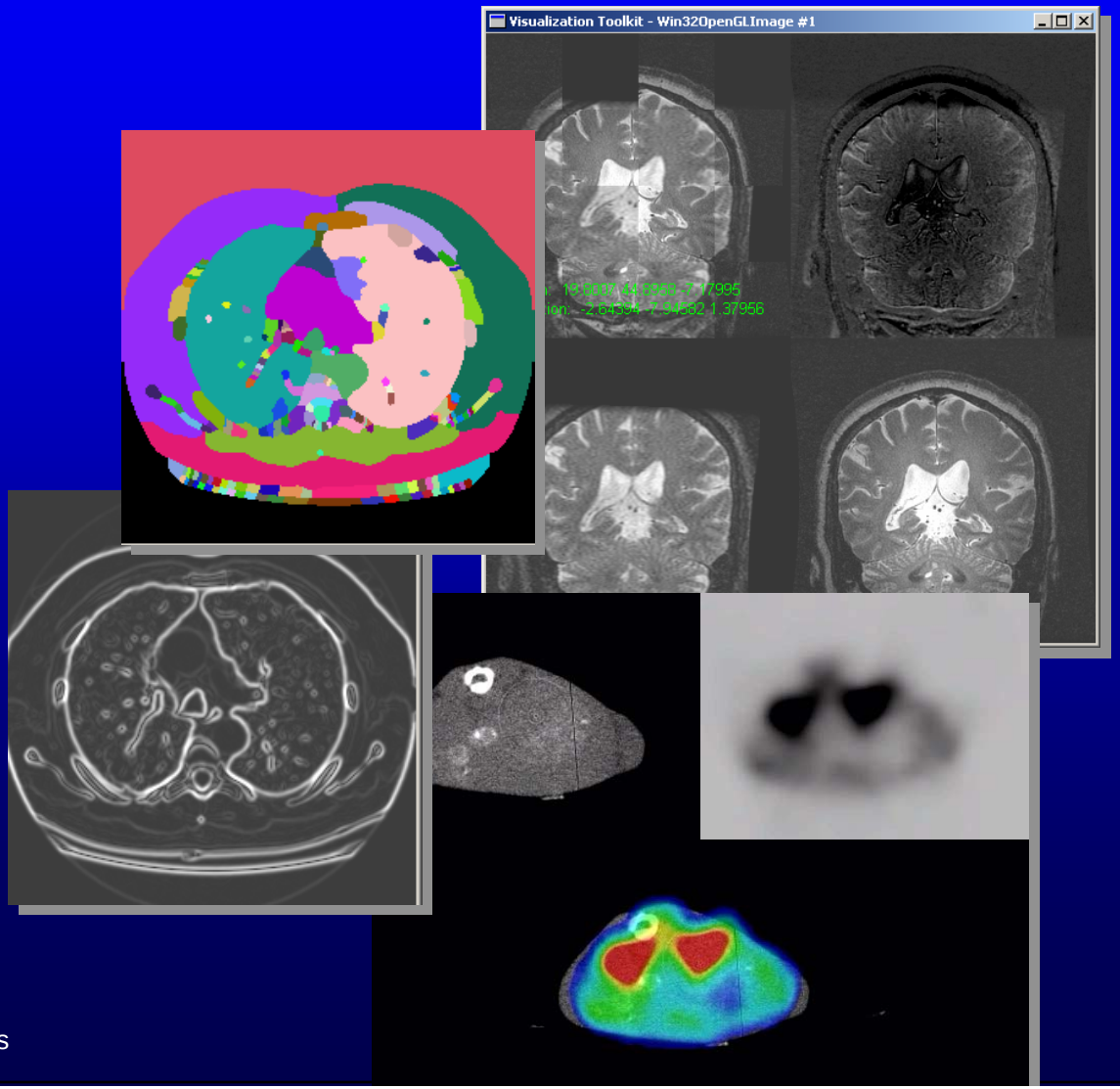
- Open source toolkit for scientific visualization, computer graphics, and image processing



www.vtk.org

Insight Toolkit - itk

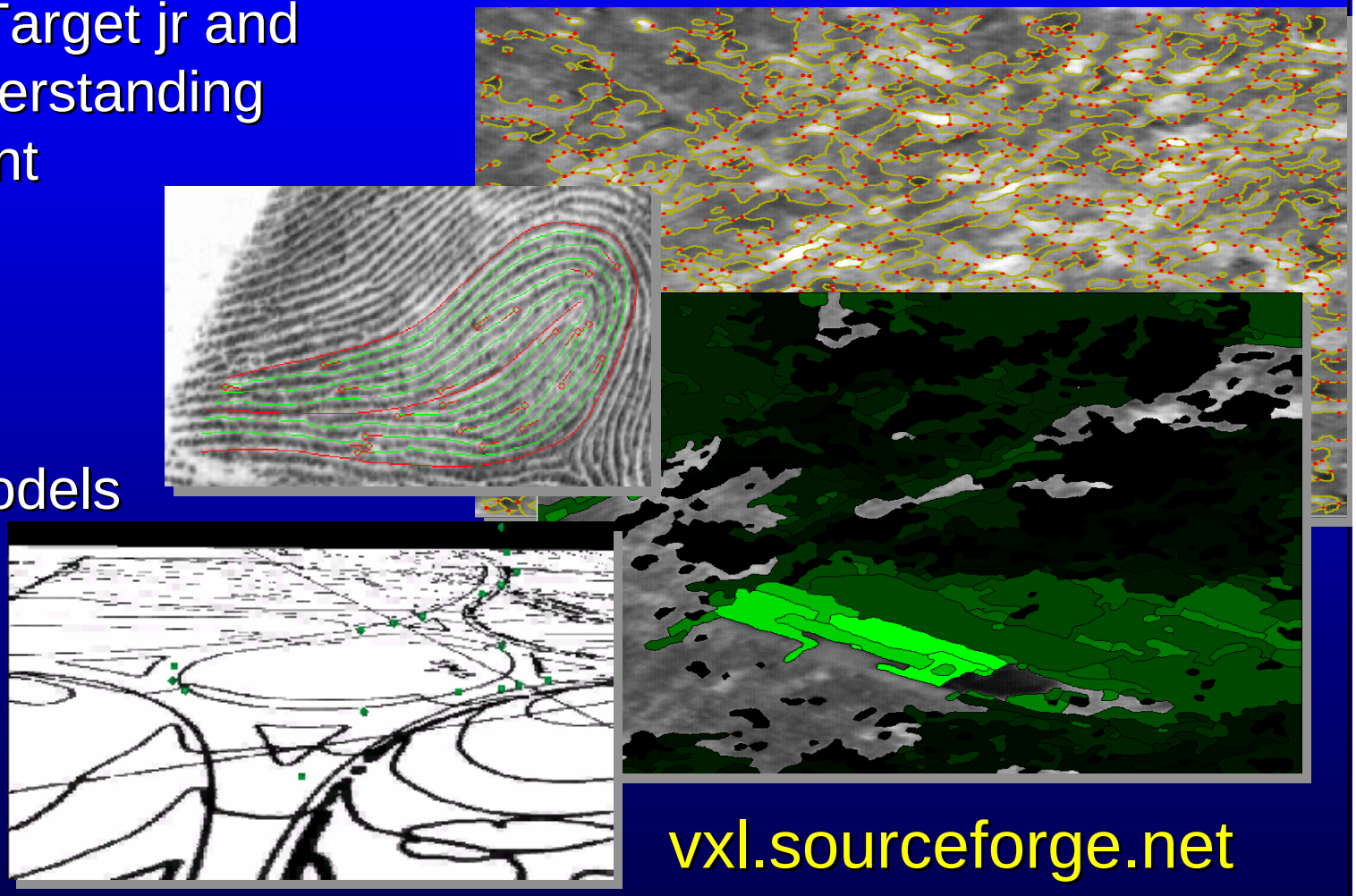
- Seeded by National Library of Medicine funding
- N-dimensional image processing
- Segmentation
- Registration



www.itk.org

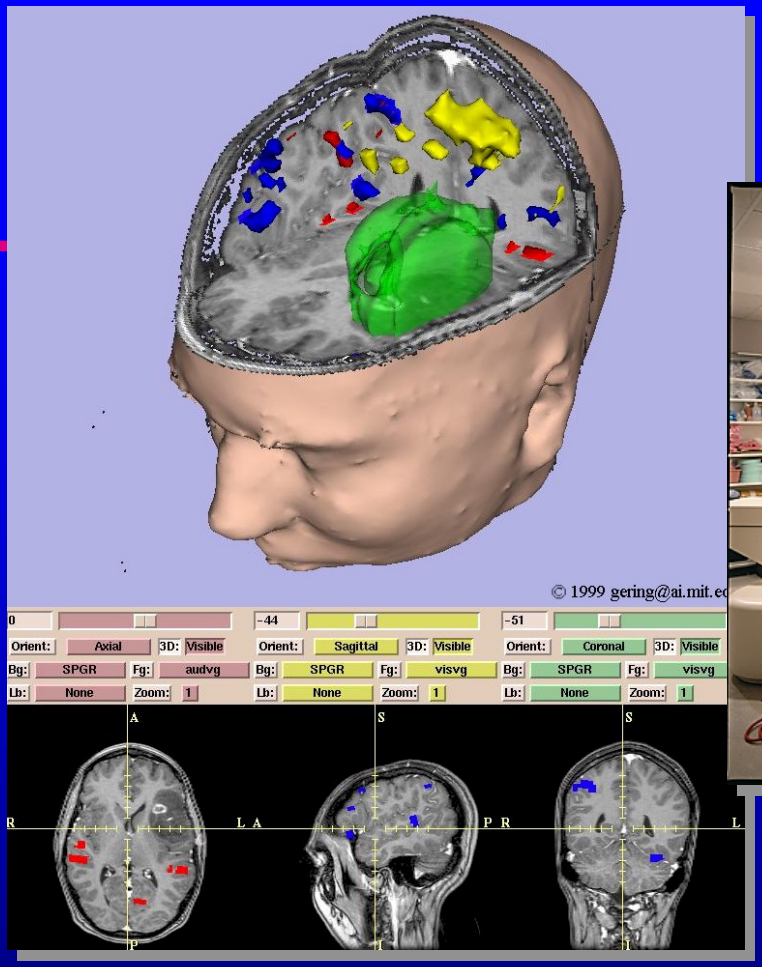
Computer Vision Library - vxl

- Based on Target jr and Image Understanding Environment
- Numerics
- Imaging
- Geometry
- Camera models



vxl.sourceforge.net

Slicer

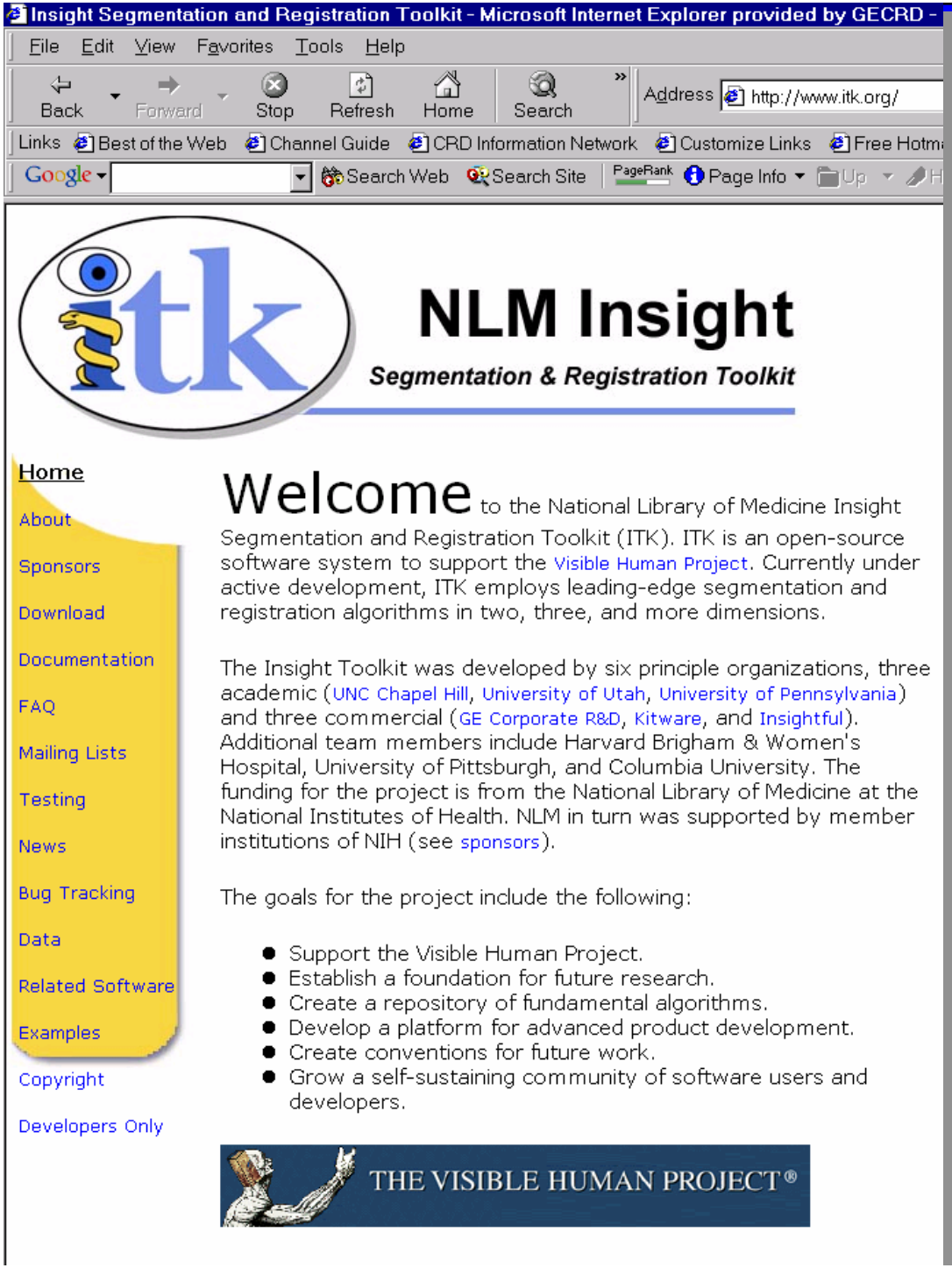


- Developed by Brigham and Womens Surgical Planning Lab
- User interface plus plug-ins for applications
  - Segmentation
  - Registration
  - Image Guidance

www.slicer.org

An Open Source Case Study

Insight



Insight Segmentation and Registration Toolkit

September 12, 2002

What is it?

- A common Application Programmers Interface (API).
  - A framework for software development
  - A toolkit for registration and segmentation
  - An Open Source resource for future research
- A validation model for segmentation and registration.
  - A framework for validation development
  - Assistance for algorithm designers
  - A seed repository for validated segmentations

Insight - Recipe for Success

- Vision
- Strong Core Team
- Openness
- Core Architecture
- Light Weight Software Engineering
- Community Support
- Funding

The NLM Vision

Create a *dynamic*, *self-sustaining*, *public domain* and *extensible* toolkit that will empower researchers throughout the world to develop new segmentation and registration algorithms and create new applications that leverage the NLM's investment in the Visible Human Male and Female data sets

The Insight Team

- GE Research/Brigham and Womens
  - Architecture, algorithms, testing, validation
- Kitware
  - Architecture, user community support
- Insightful/UPenn
  - Statistical segmentation, mutual information registration, deformable registration, level sets
  - Beta test management
- Utah
  - Level sets, low level image processing
- UNC/Pitt
  - Image processing, registration, high-dimensional segmentation
- UPenn/Columbia
  - Deformable surfaces, fuzzy connectedness, hybrid methods

Openness

- From the start, NLM recognized the value of Open Source software
- There are NO restrictions on the software
- The Team has embraced openness

In search of a new software development process

Extreme Programming

Cover Feature

Embracing Change with Extreme Programming

Extreme Programming turns the conventional software process sideways. Rather than planning, analyzing, and designing for the far-flung future, XP programmers do all of these activities—a little at a time—throughout development.

Kent Beck
First Class Software

In the beginning was the waterfall (Figure 1a). We would get the users to tell us once and for all exactly what they wanted. We would design the system that would deliver those features. We would code it. We would test to make sure the features were delivered. All would be well.

shows, the waterfall begat iterations.

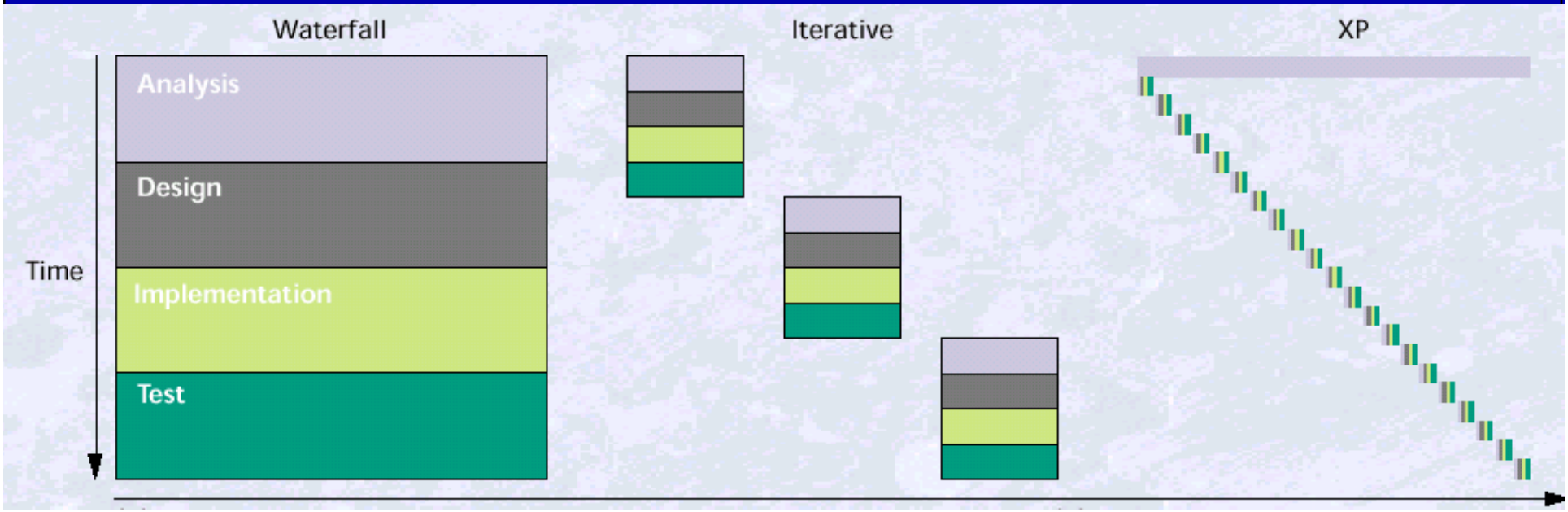
The waterfall model didn't just appear. It was a rational reaction to the shocking measurement that the cost of changing a piece of software rose dramatically over time. If that's true, then you want to make the biggest, most far-reaching decisions as early in the

A Light Weight Software Engineering Process

- Based on the new Extreme Programming process
  - High intensity design, test, implement cycle
  - Supported with web-enabled tools
  - Automated testing integrated with the software development

Extreme Programming

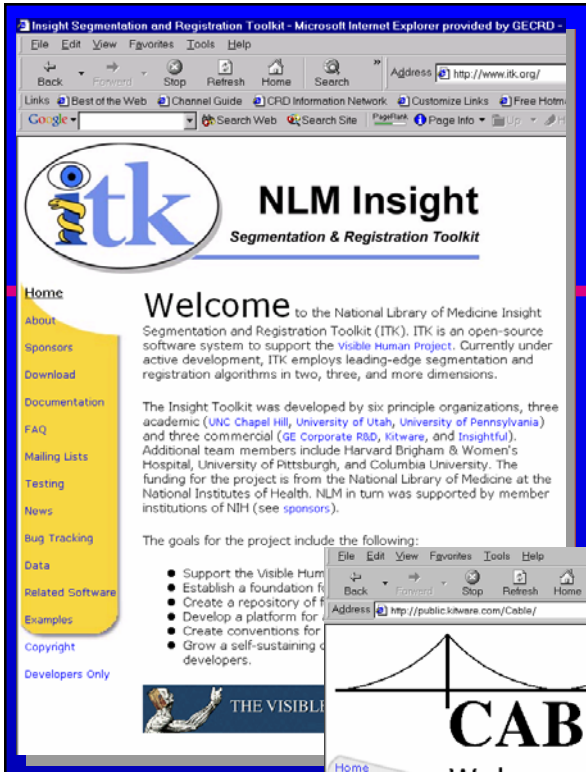
Compresses the standard analyze, design, implement, test cycle into a continuous process

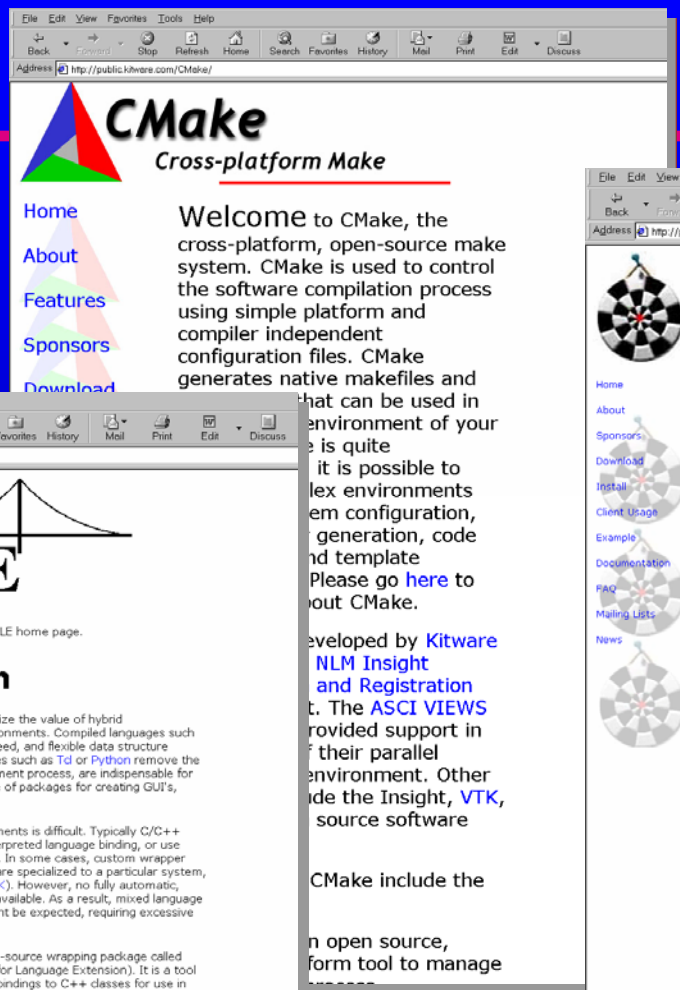


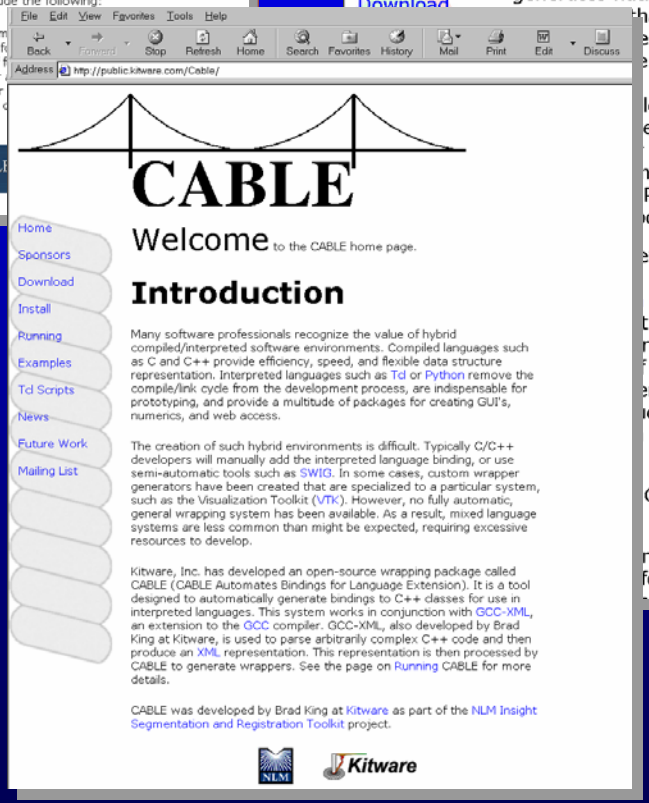
A process supported by a suite of portable, open source tools

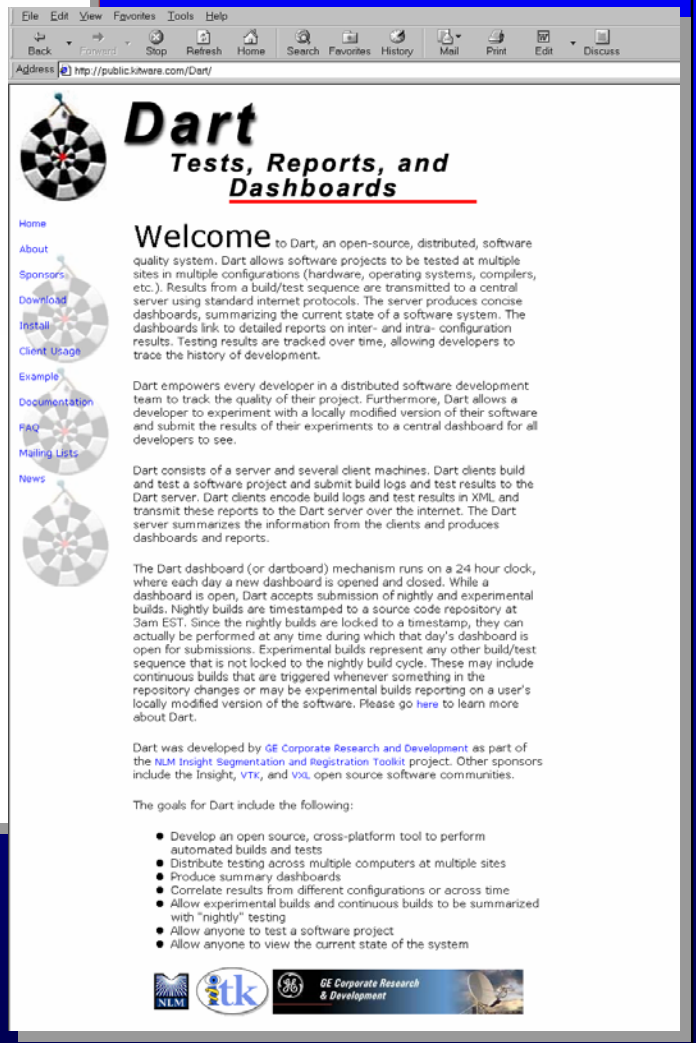
- Apache, perl, php
  - Web services
- cvs
  - Revision control
- Doxygen
  - Automated documentation
- CMake
  - Cross-platform program build
- Dart
  - Continuous and distributed test reporting

Insight - Open Source Products







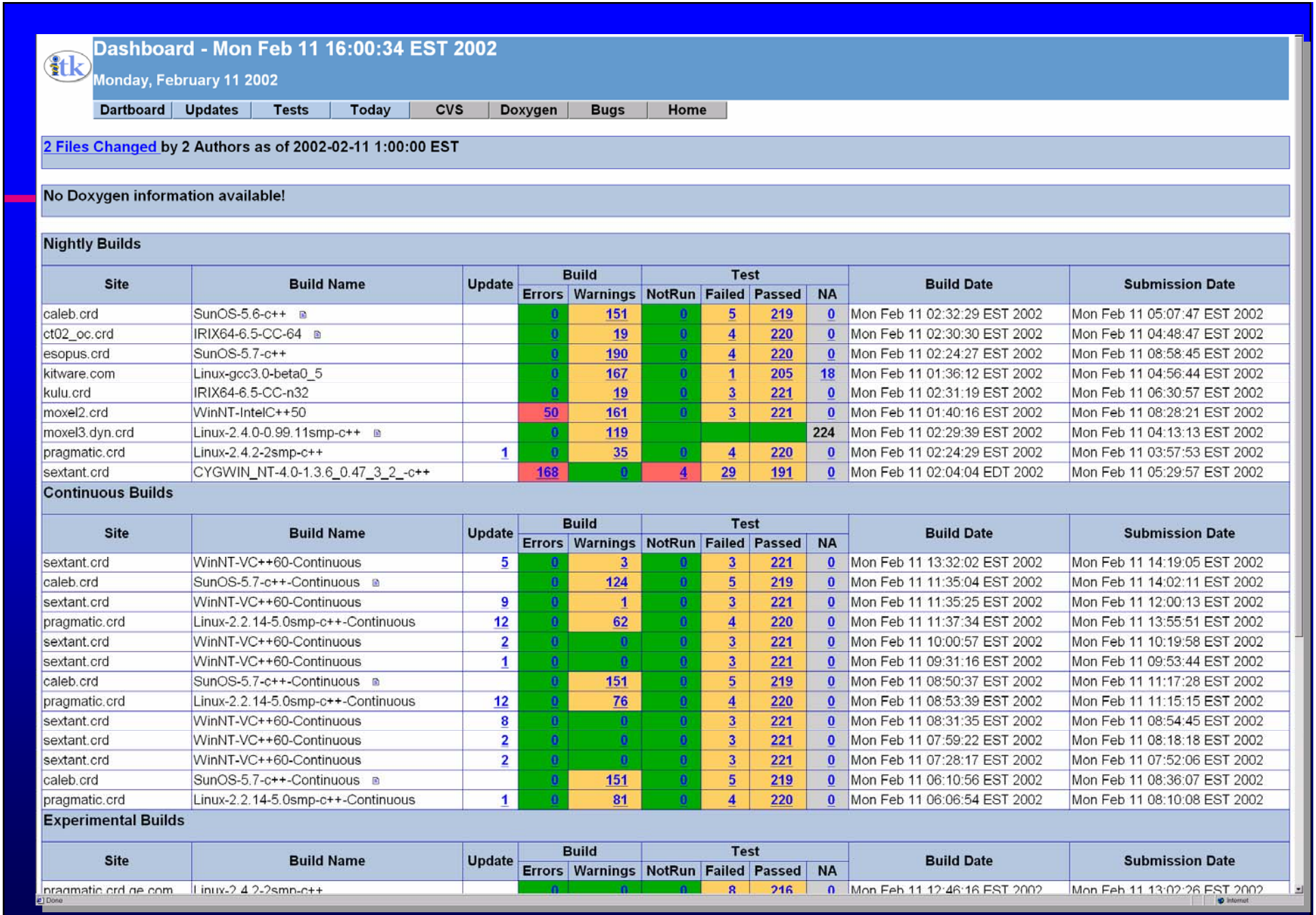


Insight - Development Cycles

- Daily – dashboard
- Weekly – telephone conferences
- Bi-weekly – architecture reviews
- Quarterly – developer meetings
- Yearly – work assignments

Extreme Programming Daily Testing Is The Key

- Testing anchors the development process (Dart)
- Developers monitor the testing dashboard constantly
- Problems are identified and fixed immediately
- Developers receive e-mail if they “Break the Build”



Dashboard - Mon Feb 11 16:00:34 EST 2002

Monday, February 11 2002

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2 Files Changed by 2 Authors as of 2002-02-11 1:00:00 EST

No Doxygen information available!

Nightly Builds

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			Errors	Warnings	NotRun	Failed	Passed	NA		
caleb.crd	SunOS-5.6-c++		0	151	0	5	219	0	Mon Feb 11 02:32:29 EST 2002	Mon Feb 11 05:07:47 EST 2002
ct02_oc.crd	IRIX64-6.5-CC-64		0	19	0	4	220	0	Mon Feb 11 02:30:30 EST 2002	Mon Feb 11 04:48:47 EST 2002
esopus.crd	SunOS-5.7-c++		0	190	0	4	220	0	Mon Feb 11 02:24:27 EST 2002	Mon Feb 11 08:58:45 EST 2002
kitware.com	Linux-gcc3.0-beta0_5		0	167	0	1	205	18	Mon Feb 11 01:36:12 EST 2002	Mon Feb 11 04:56:44 EST 2002
kulu.crd	IRIX64-6.5-CC-n32		0	19	0	3	221	0	Mon Feb 11 02:31:19 EST 2002	Mon Feb 11 06:30:57 EST 2002
moxel2.crd	WinNT-IntelC++50		50	161	0	3	221	0	Mon Feb 11 01:40:16 EST 2002	Mon Feb 11 08:28:21 EST 2002
moxel3.dyn.crd	Linux-2.4.0-0.99.11smp-c++		0	119				224	Mon Feb 11 02:29:39 EST 2002	Mon Feb 11 04:13:13 EST 2002
pragmatic.crd	Linux-2.4.2-2smp-c++	1	0	35	0	4	220	0	Mon Feb 11 02:24:29 EST 2002	Mon Feb 11 03:57:53 EST 2002
sextant.crd	CYGWIN_NT-4.0-1.3.6_0.47_3_2_-c++		168	0	4	29	191	0	Mon Feb 11 02:04:04 EDT 2002	Mon Feb 11 05:29:57 EST 2002

Continuous Builds

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caleb.crd	SunOS-5.7-c++-Continuous		0	124	0	5	219	0	Mon Feb 11 11:35:04 EST 2002	Mon Feb 11 14:02:11 EST 2002
sextant.crd	WinNT-VC++60-Continuous	9	0	1	0	3	221	0	Mon Feb 11 11:35:25 EST 2002	Mon Feb 11 12:00:13 EST 2002
pragmatic.crd	Linux-2.2.14-5.0smp-c++-Continuous	12	0	62	0	4	220	0	Mon Feb 11 11:37:34 EST 2002	Mon Feb 11 13:55:51 EST 2002
sextant.crd	WinNT-VC++60-Continuous	2	0	0	0	3	221	0	Mon Feb 11 10:00:57 EST 2002	Mon Feb 11 10:19:58 EST 2002
sextant.crd	WinNT-VC++60-Continuous	1	0	0	0	3	221	0	Mon Feb 11 09:31:16 EST 2002	Mon Feb 11 09:53:44 EST 2002
caleb.crd	SunOS-5.7-c++-Continuous		0	151	0	5	219	0	Mon Feb 11 08:50:37 EST 2002	Mon Feb 11 11:17:28 EST 2002
pragmatic.crd	Linux-2.2.14-5.0smp-c++-Continuous	12	0	76	0	4	220	0	Mon Feb 11 08:53:39 EST 2002	Mon Feb 11 11:15:15 EST 2002
sextant.crd	WinNT-VC++60-Continuous	8	0	0	0	3	221	0	Mon Feb 11 08:31:35 EST 2002	Mon Feb 11 08:54:45 EST 2002
sextant.crd	WinNT-VC++60-Continuous	2	0	0	0	3	221	0	Mon Feb 11 07:59:22 EST 2002	Mon Feb 11 08:18:18 EST 2002
sextant.crd	WinNT-VC++60-Continuous	2	0	0	0	3	221	0	Mon Feb 11 07:28:17 EST 2002	Mon Feb 11 07:52:06 EST 2002
caleb.crd	SunOS-5.7-c++-Continuous		0	151	0	5	219	0	Mon Feb 11 06:10:56 EST 2002	Mon Feb 11 08:36:07 EST 2002
pragmatic.crd	Linux-2.2.14-5.0smp-c++-Continuous	1	0	81	0	4	220	0	Mon Feb 11 06:06:54 EST 2002	Mon Feb 11 08:10:08 EST 2002

Experimental Builds

Site	Build Name	Update	Build		Test				Build Date	Submission Date
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pragmatic.crd.ge.com	Linux-2.4.2-2smp-c++		0	0	0	8	216	0	Mon Feb 11 12:46:16 EST 2002	Mon Feb 11 13:02:26 EST 2002

Dashboard - Mon Feb 11 16:00:34 EST 2002

Monday, February 11 2002

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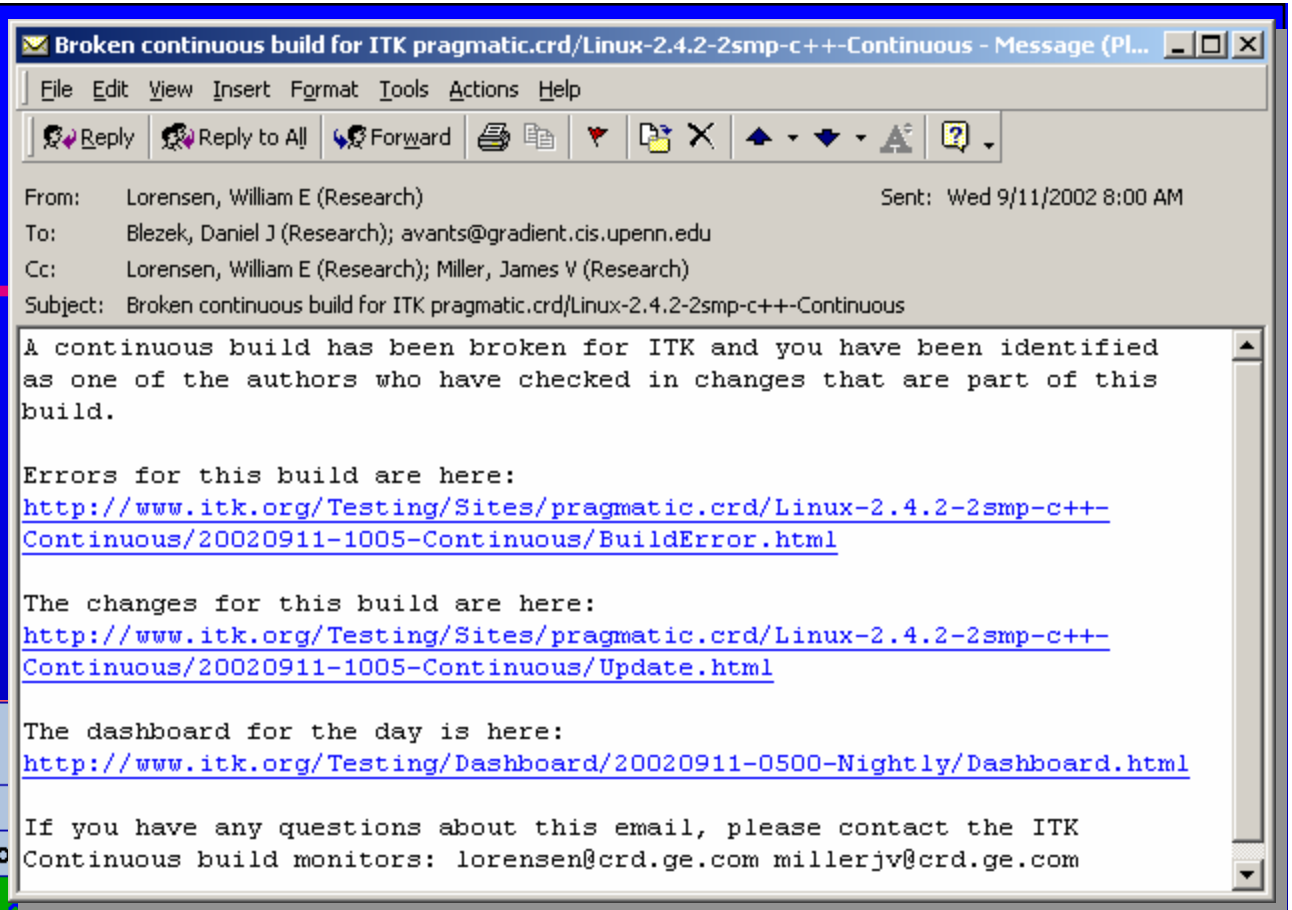
No Doxygen information available!

Nightly Builds

Site	Build Name	Update	Build		Test		
			Errors	Warnings	NotRun	Failed	Passed
caleb.crd	SunOS-5.6-c++		0	151	0	5	219
ct02_oc.crd	IRIX64-6.5-CC-64		0	19	0	4	220
esopus.crd	SunOS-5.7-c++		0	190	0	4	220
kitware.com	Linux-gcc3.0-beta0_5		0	167	0	1	205
kulu.crd	IRIX64-6.5-CC-n32		0	19	0	3	221
moxel2.crd	WinNT-IntelC++50		50	161	0	3	221
moxel3.dyn.crd	Linux-2.4.0-0.99.11smp-c++		0	119			
pragmatic.crd	Linux-2.4.2-2smp-c++	1	0	35	0	4	220
sextant.crd	CYGWIN_NT-4.0-1.3.6_0.47_3_2_-c++		168	0	4	29	191

Someone broke the build!



Continuous Builds

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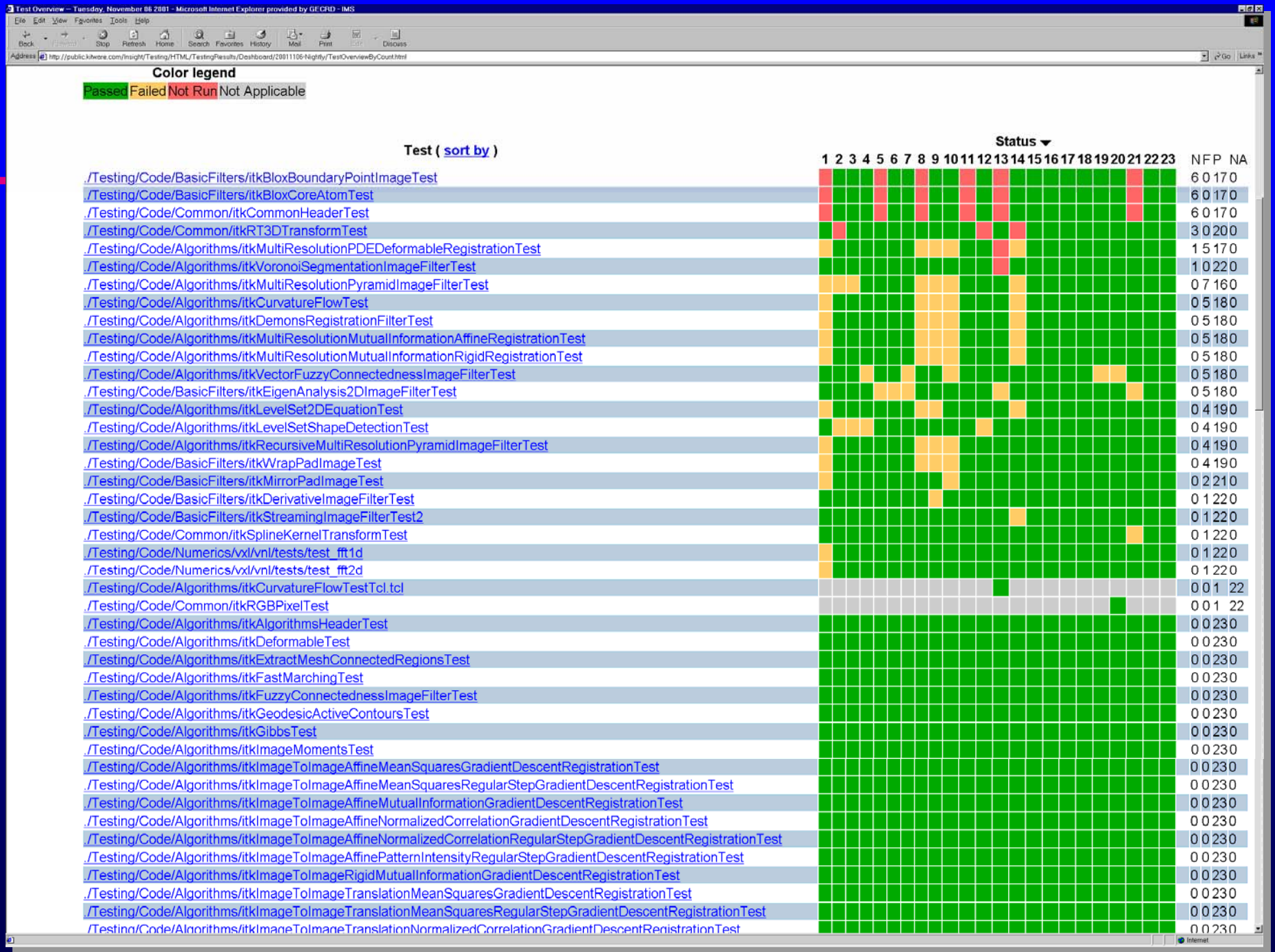
ct02_oc.crd	IRIX64-6.5-CC-n32-Continuous		0	5	0	0	301	3	Wed Sep 11 10:17:21 EDT 2002	Wed Sep 11 10:45:04 EDT 2002
pragmatic.-crd	Linux-2.4.2-2smp-c++-Continuous	2	0	3	0	0	301	3	Wed Sep 11 10:11:15 EDT 2002	Wed Sep 11 10:36:47 EDT 2002
caleb.crd	SunOS-5.7-c++-Continuous		1	13	0	0	301	3	Wed Sep 11 06:13:32 EDT 2002	Wed Sep 11 08:26:44 EDT 2002
ct02_oc.crd	IRIX64-6.5-CC-n32-Continuous		1	13	0	0	301	3	Wed Sep 11 06:13:09 EDT 2002	Wed Sep 11 07:03:31 EDT 2002
pragmatic.-crd	Linux-2.4.2-2smp-c++-Continuous	4	2	3	0	0	301	3	Wed Sep 11 06:07:59 EDT 2002	Wed Sep 11 07:45:46 EDT 2002


Test Overview – Tuesday, November 06 2001 - Microsoft Internet Explorer provided by GECRD - IMS
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address http://public.kitware.com/Insight/Testing/HTML/TestingResults/Dashboard/20011106-Nightly/TestOverviewByCount.html
Go Links
Color legend
Passed Failed Not Run Not Applicable
Test (sort by)
Status
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
N F P NA
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./Testing/Code/BasicFilters/itkBloxCoreAtomTest 6 0 17 0
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Internet

Insight - Building a Community

- Initial community of consortium members
- Outreach to other groups
  - Siggraph
  - Digital Human
  - DOE Genomes to Life
  - IEEE Visualization
  - NSF Shape Modeling Workshop
  - Supercomputer Conference
- Public Beta, February 2002
- Release 1.0, October 2002
- RFP for algorithms and data, July 2002

Insight - Funding

- Seed funding by NLM and its co-sponsors
  - Establish an architecture
  - Implement a representative set of algorithms
  - Produce frameworks to accommodate new algorithms
  - Define a development process
  - Establish a community support mechanism
- Continued support will be needed
  - Outreach to other communities
  - Create applications
  - More algorithms to fill gaps
  - Infrastructure support

Insight - Observations

- Good mix of commercial and academic
- Communication is critical
- The daily rhythm of Extreme Programming
- The Whole >>> Sum of the parts
- This process can (and should) be repeated

Menu for Success

- A Community with a common vision
- A pool of talented and motivated developers
- A mix of academic and commercial
- An organized, light weight approach to software development
- A leadership structure
- Communication
- A business model

Resources

- www.opensource.org
- sourceforge.net
- www.itk.org
- www.vtk.org
- www.slicer.org

Application Specific and General Software Platforms: Open Source Distribution

Bill Lorensen

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