Automated Cyber-Readiness Evaluation (ACE)

Rotem Guttman

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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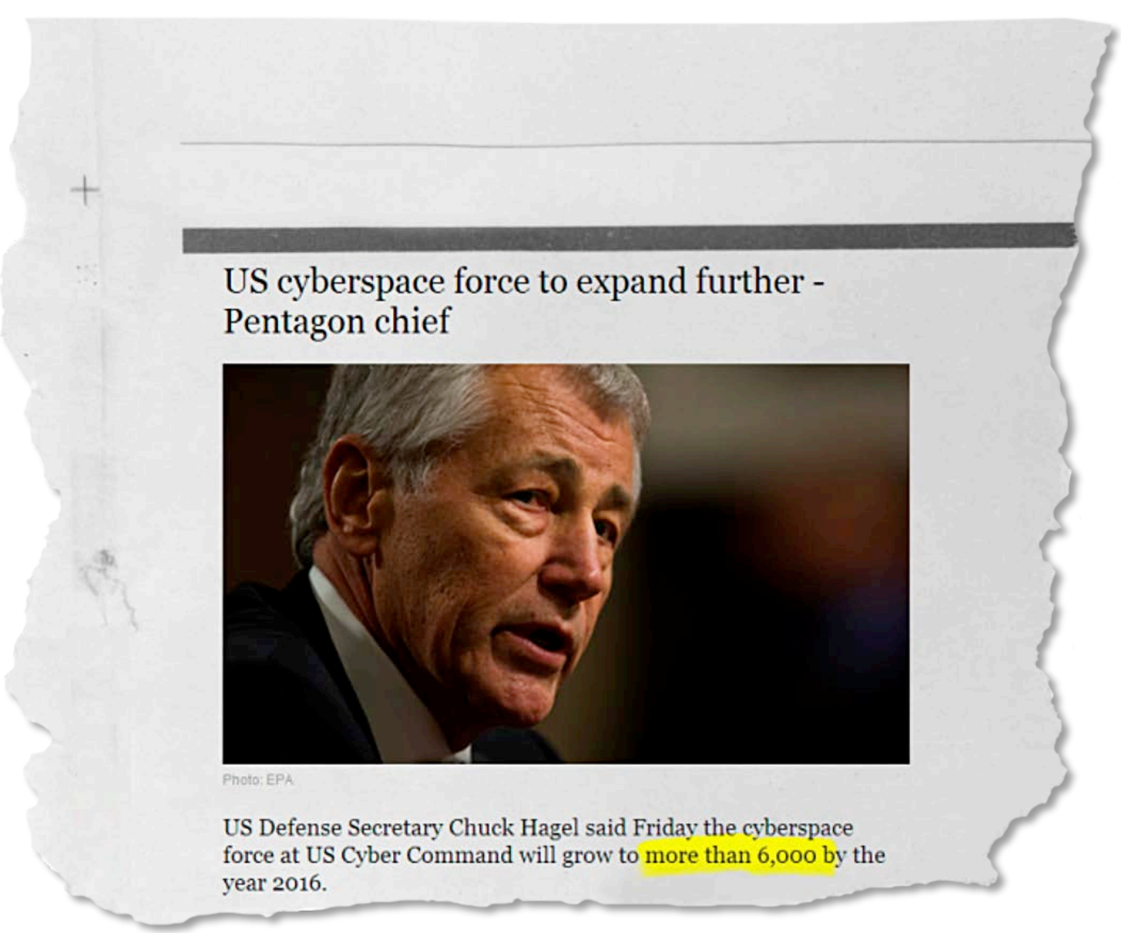
DM-0002758

Core DoD Challenge Problem



US cyberspace force to expand further - Pentagon chief

Photo: EPA

US Defense Secretary Chuck Hagel said Friday the cyberspace force at US Cyber Command will grow to more than 6,000 by the year 2016.

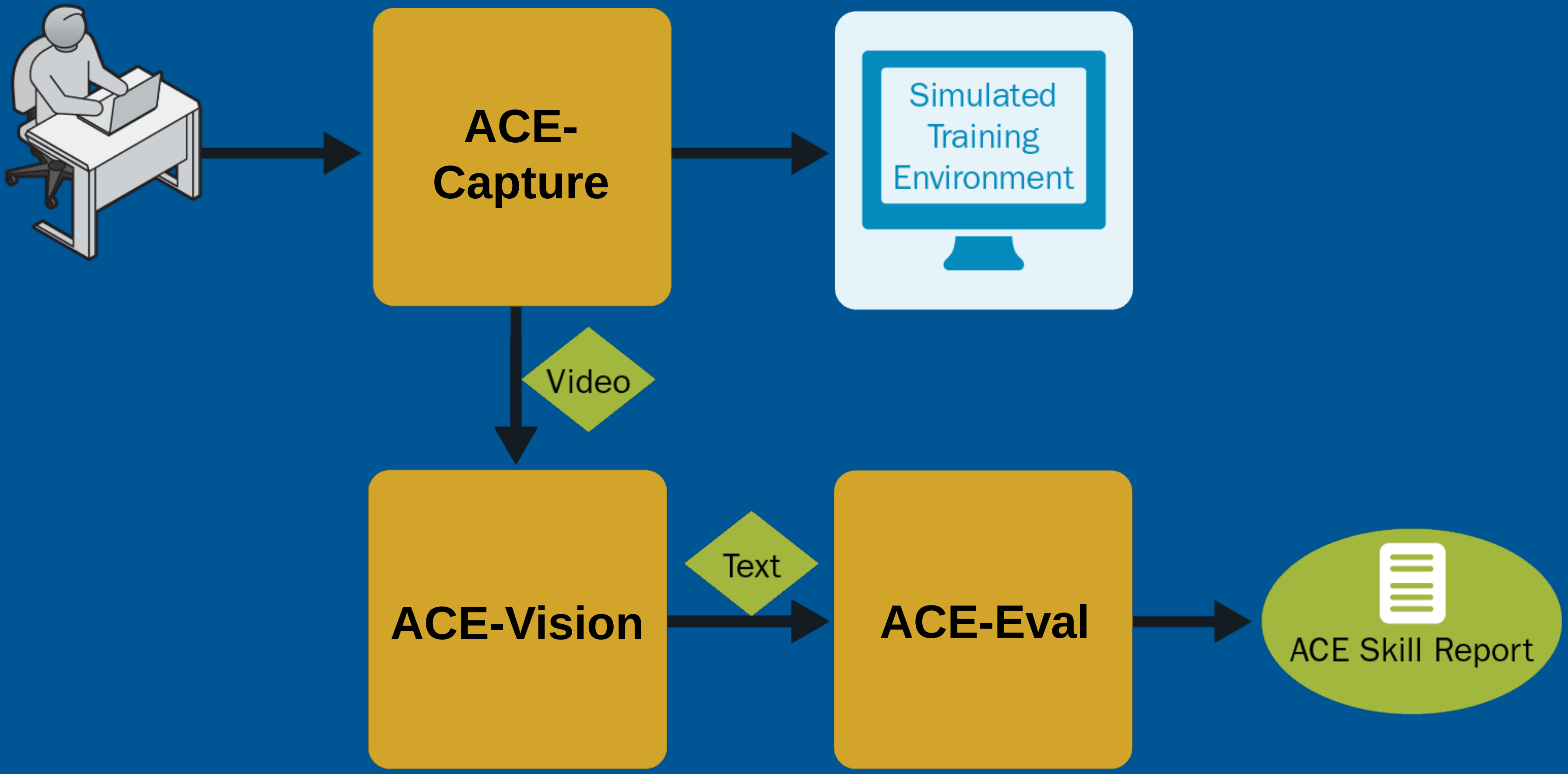
Evaluating Mission-Readiness for Cyber Operators

- **Scalable**
- **Objective**
- **Reliable**
- **Valid**

ACE Philosophy

- **Train as you fight?**
- **Evaluate as you fight!**
  - Place cyber operators in familiar environment
  - Task cyber operators with realistic mission
  - Understand actions taken within scenario
  - Verifiably asses mission-readiness based on actions taken
- **Benefits**
  - Automated Analysis
  - Specific deficiencies isolated
  - Automated remediation plans
  - Recording available for future review

ACE Architecture Overview



Role Choice

Joint Cyberspace Training &

Certification Standards (JCT&CS)

Forensic Analyst

- 2 Hours
- Existing DoD Standard
- Self-Contained

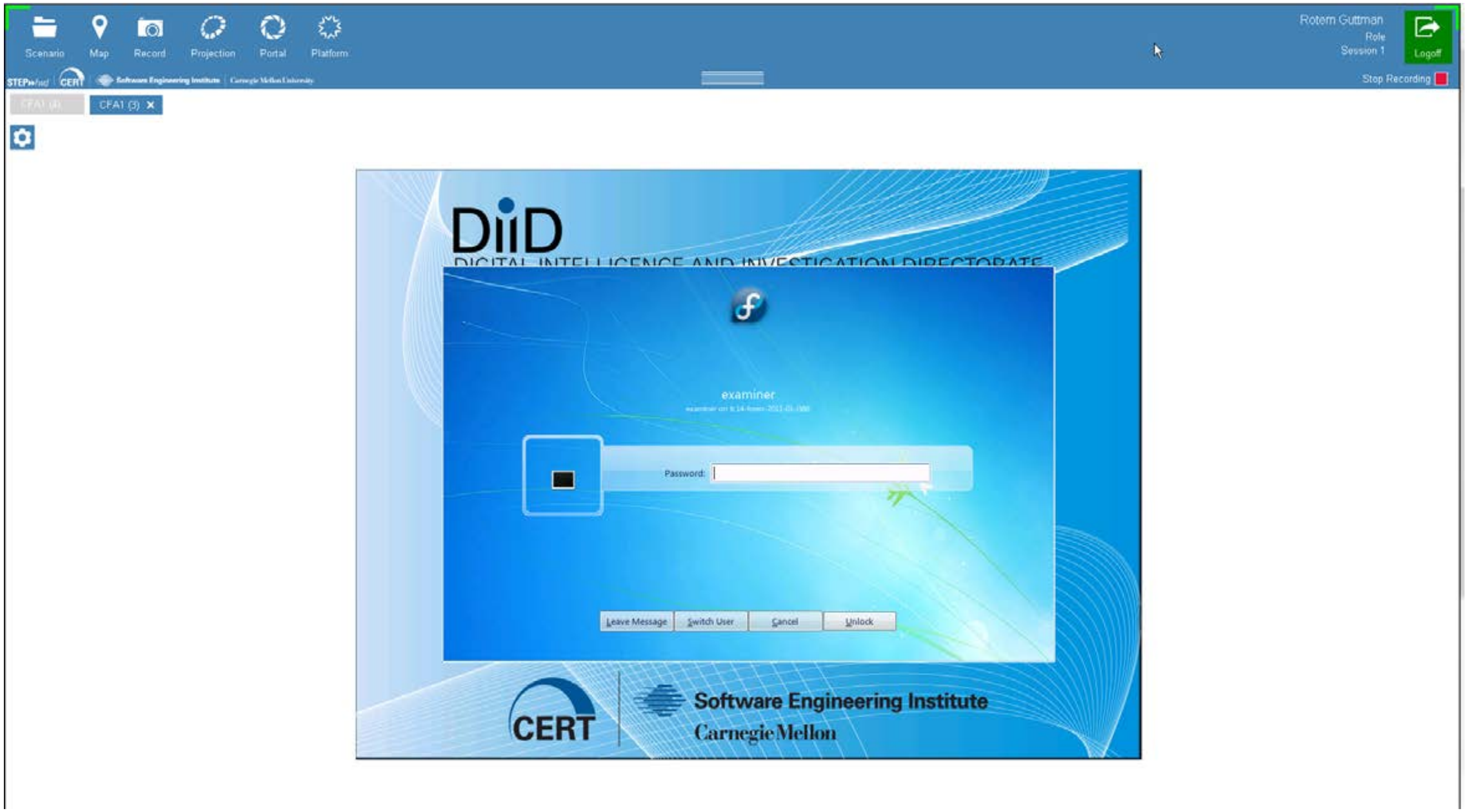
Scenario Development

Scenario I & II Details

- **Missing Person**
  - Foul Play Suspected
- **Classified* Documents Exfiltrated**
  - Computer Drive Image
  - Multiple Layers of Story
    - APT1
    - USB
    - Personal Email

***Fabricated Documents**
(Not actual classified data)

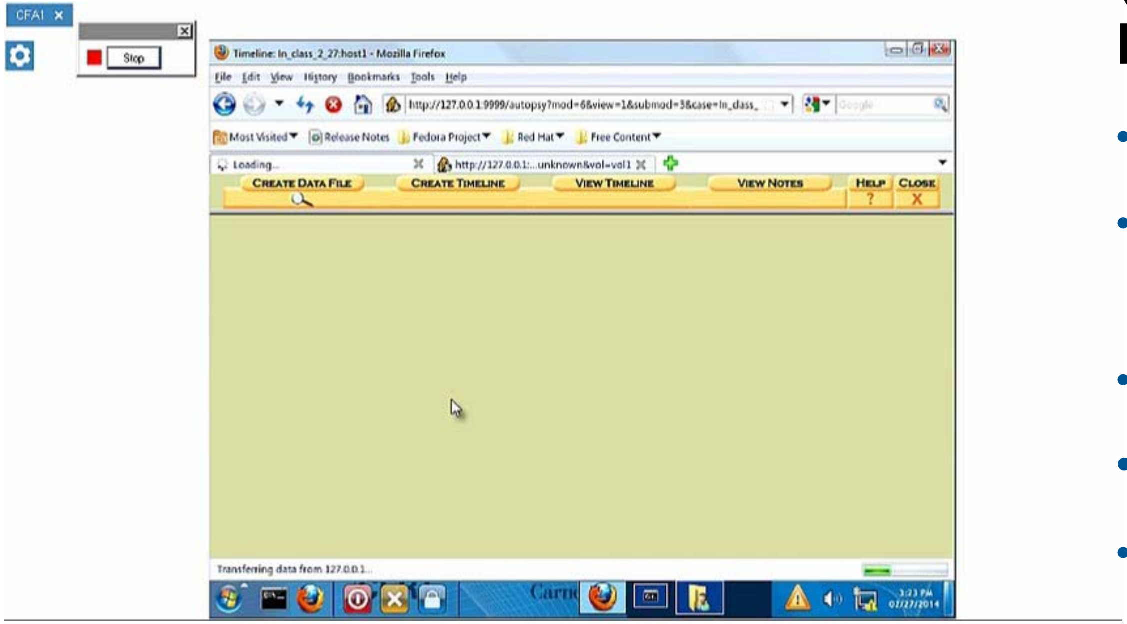
Data Collection Capability



Password:

- **Background Data Collection**
- **Restricted to Environment**
- **Scalable**

Data Collection


CFA1 ×
Stop
Timeline: In_class_2_27:host1 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:9999/autopsy?mod=6&view=1&submod=3&case=In_class_
Google
Most Visited Release Notes Fedora Project Red Hat Free Content
Loading...
http://127.0.0.1:...unknown&vol=vol1
CREATE DATA FILE
CREATE TIMELINE
VIEW TIMELINE
VIEW NOTES
HELP ?
CLOSE X
Transferring data from 127.0.0.1...
3:23 PM
02/27/2014

Multiple Sources (Increase Dataset Robustness)

- CERT Staff
- CMU Graduate Students
- DoD Personnel
- Multiple Collections
- NCFTA Personnel

ACE-Vision

Primary Collaborator:
Professor Yaser Sheik

CMU Robotics Institute, Graphics Lab

Custom Detection System

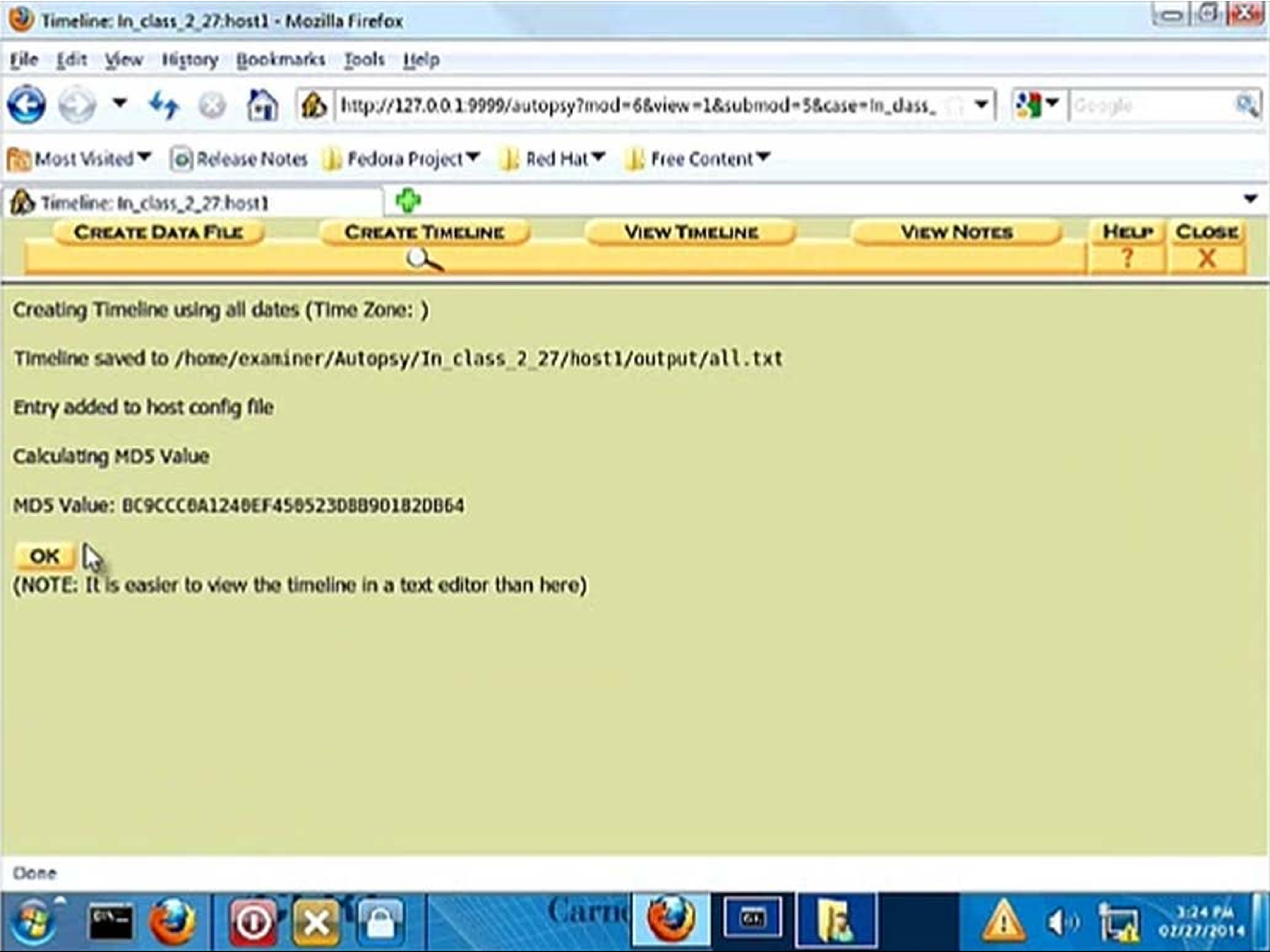
Designed for massive parallelization

Optimized for use case:

- Maximize pre-process capability
- Minimize duplicate calculations

- Original: O(nN)
  - Infeasable for our problem set.
- Optimized: O(NlogN) time.
  - Implemented on GPU array.

Note: Our data set uses high resolution images and so n >> logN


Timeline: In_class_2_27:host1 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:9999/autopsy?mod=6&view=1&submod=5&case=In_class_
Google
Most Visited
Release Notes
Fedora Project
Red Hat
Free Content
Timeline: In_class_2_27:host1
CREATE DATA FILE
CREATE TIMELINE
VIEW TIMELINE
VIEW NOTES
HELP
?
CLOSE
X
OK
Done
3:24 PM
02/27/2014

Creating Timeline using all dates (Time Zone:)

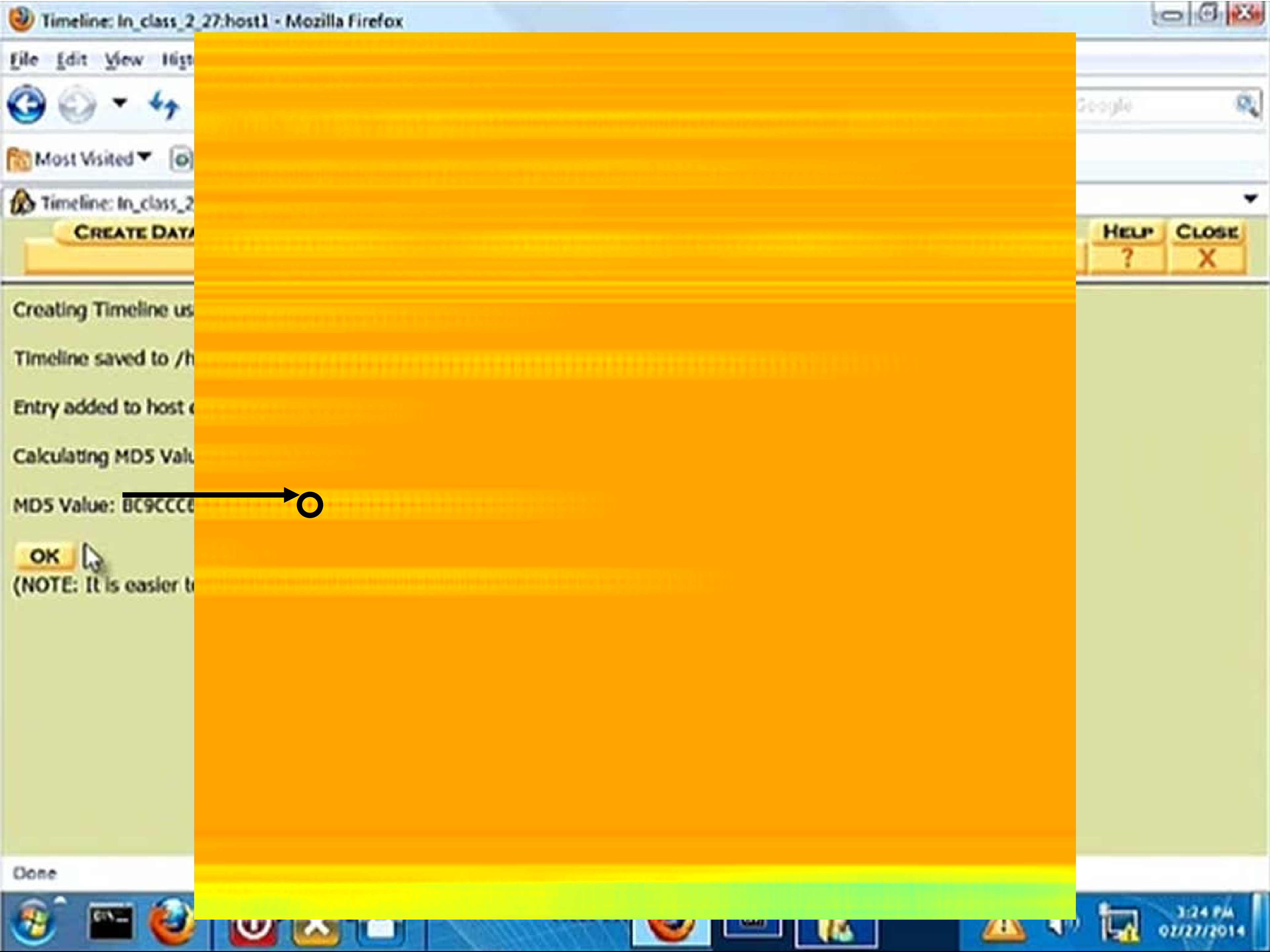
Timeline saved to /home/examiner/Autopsy/In_class_2_27/host1/output/all.txt

Entry added to host config file

Calculating MD5 Value

MD5 Value: 0C9CCC0A1240EF4585230B8901820B64

(NOTE: It is easier to view the timeline in a text editor than here)



Creating Timeline us

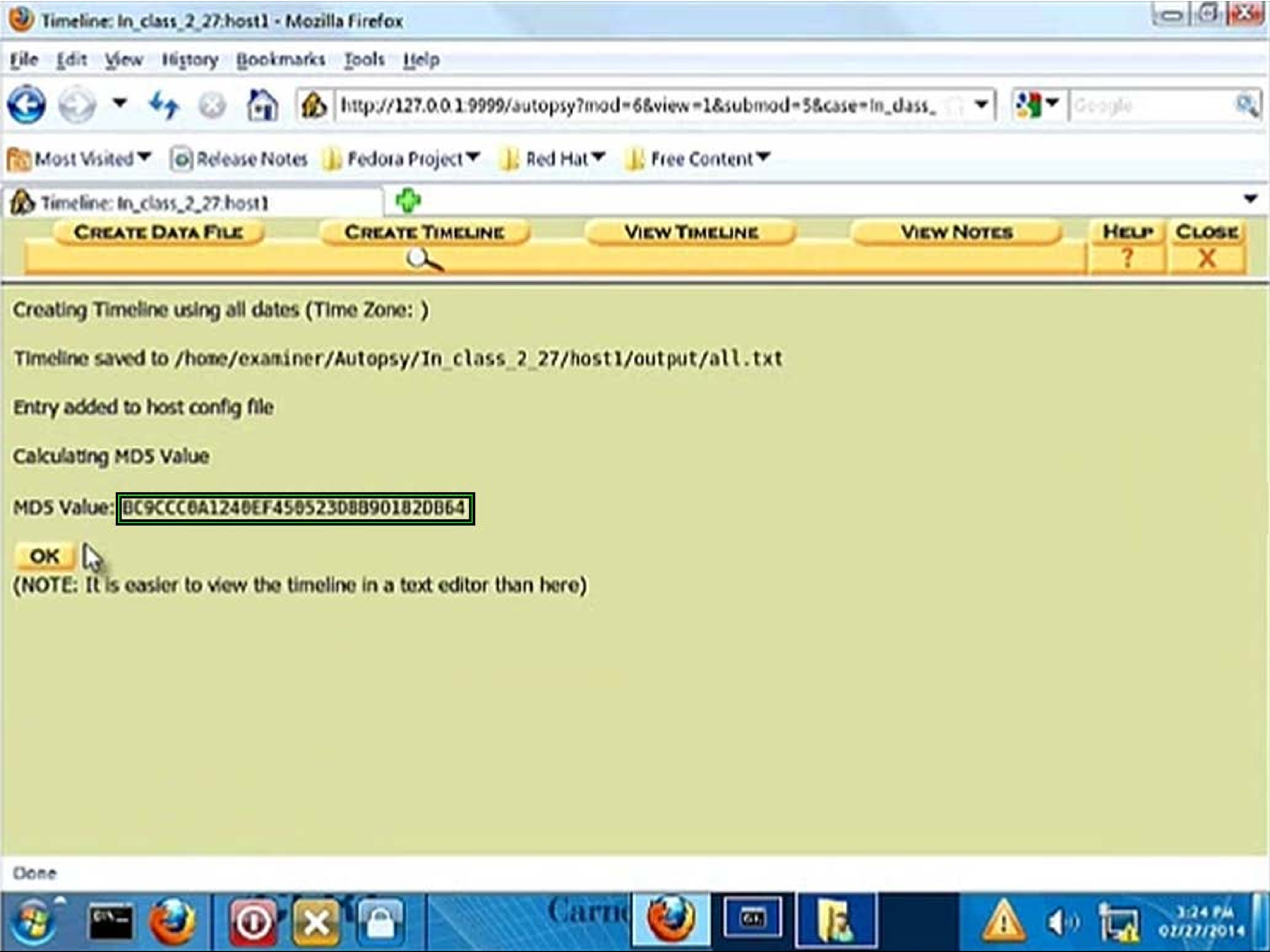
Timeline saved to /h

Entry added to host c

Calculating MD5 Valu

MD5 Value: BC9CCCE

(NOTE: It is easier t


Timeline: In_class_2_27:host1 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:9999/autopsy?mod=6&view=1&submod=5&case=In_class_
Google
Most Visited Release Notes Fedora Project Red Hat Free Content
Timeline: In_class_2_27:host1
CREATE DATA FILE
CREATE TIMELINE
VIEW TIMELINE
VIEW NOTES
HELP
?
CLOSE
X

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Entry added to host config file

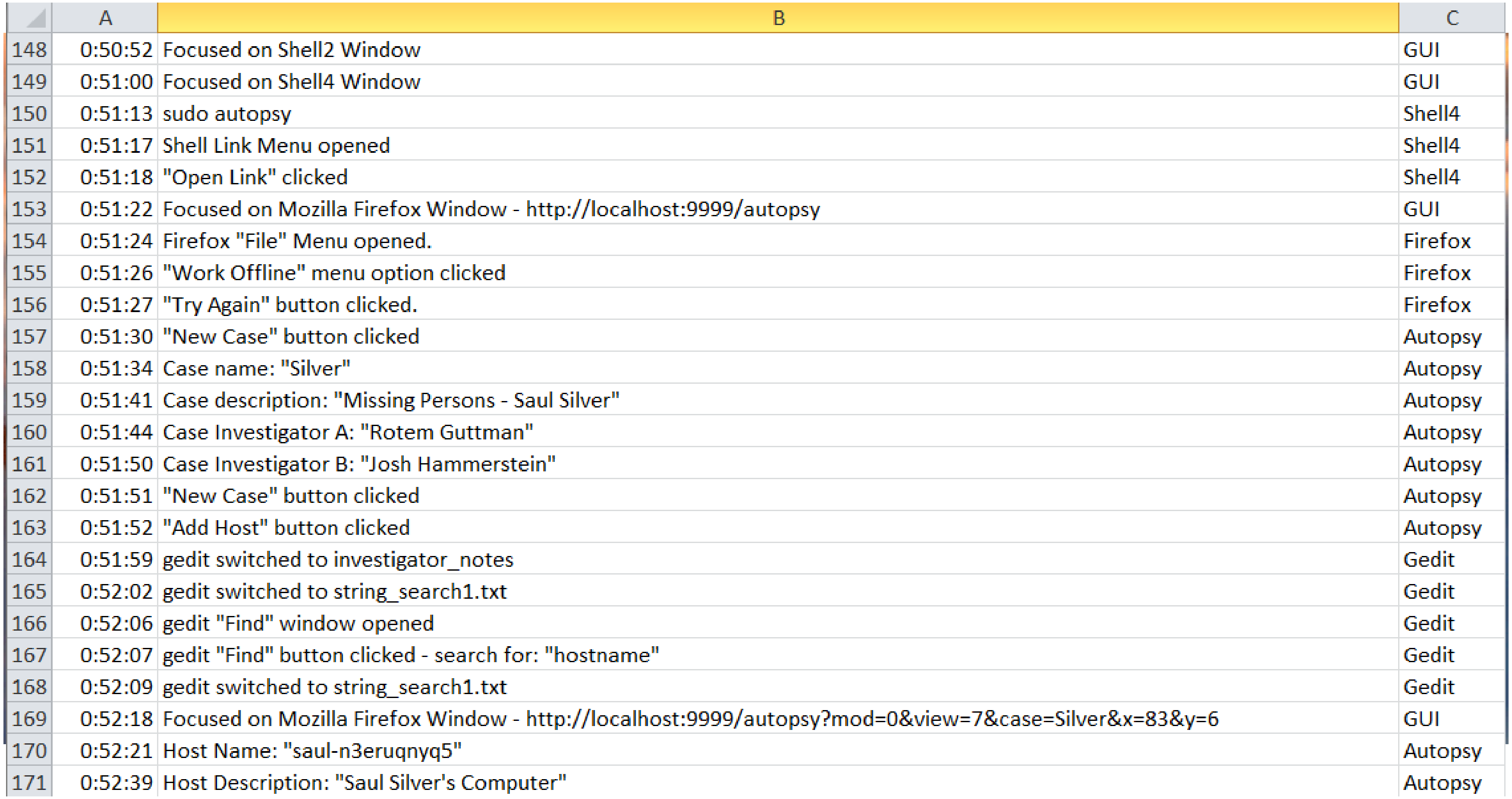
Calculating MD5 Value

MD5 Value: BC9CCC0A1240EF450523088901820B64

OK

(NOTE: It is easier to view the timeline in a text editor than here)

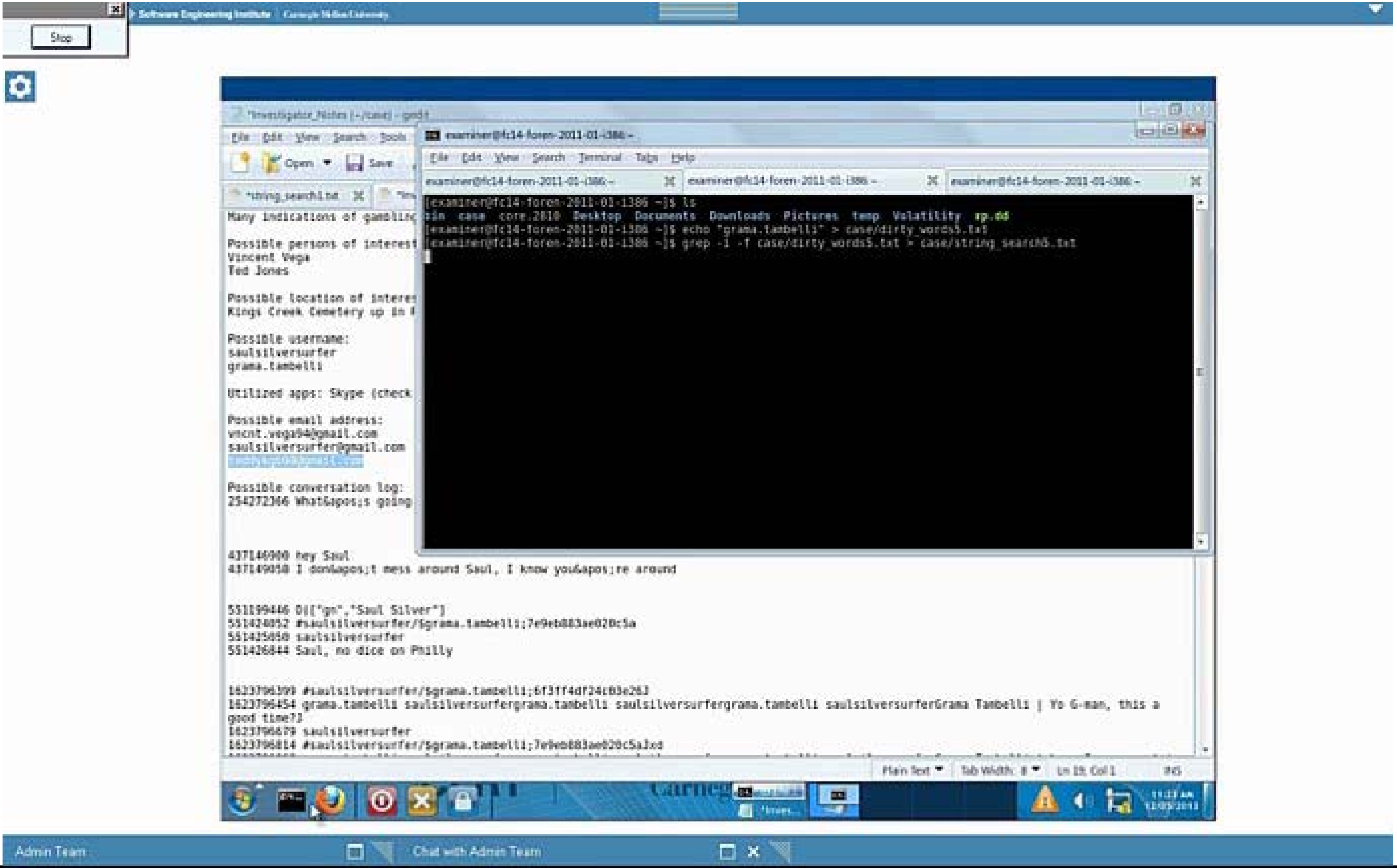
ACE Vision Output



	A	B	C
148	0:50:52	Focused on Shell2 Window	GUI
149	0:51:00	Focused on Shell4 Window	GUI
150	0:51:13	sudo autopsy	Shell4
151	0:51:17	Shell Link Menu opened	Shell4
152	0:51:18	"Open Link" clicked	Shell4
153	0:51:22	Focused on Mozilla Firefox Window - http://localhost:9999/autopsy	GUI
154	0:51:24	Firefox "File" Menu opened.	Firefox
155	0:51:26	"Work Offline" menu option clicked	Firefox
156	0:51:27	"Try Again" button clicked.	Firefox
157	0:51:30	"New Case" button clicked	Autopsy
158	0:51:34	Case name: "Silver"	Autopsy
159	0:51:41	Case description: "Missing Persons - Saul Silver"	Autopsy
160	0:51:44	Case Investigator A: "Rotem Guttman"	Autopsy
161	0:51:50	Case Investigator B: "Josh Hammerstein"	Autopsy
162	0:51:51	"New Case" button clicked	Autopsy
163	0:51:52	"Add Host" button clicked	Autopsy
164	0:51:59	gedit switched to investigator_notes	Gedit
165	0:52:02	gedit switched to string_search1.txt	Gedit
166	0:52:06	gedit "Find" window opened	Gedit
167	0:52:07	gedit "Find" button clicked - search for: "hostname"	Gedit
168	0:52:09	gedit switched to string_search1.txt	Gedit
169	0:52:18	Focused on Mozilla Firefox Window - http://localhost:9999/autopsy?mod=0&view=7&case=Silver&x=83&y=6	GUI
170	0:52:21	Host Name: "saul-n3eruqnyq5"	Autopsy
171	0:52:39	Host Description: "Saul Silver's Computer"	Autopsy

*Confidence measures associated with each row omitted.

Visualization: Synchronized Data



Stop
Software Engineering Institute | Carnegie Mellon University
*Investigator_Notes (~/case) - gedit
File Edit View Search Tools
Open Save
*string_search1.txt
examiner@fc14-foren-2011-01-i386:~
File Edit View Search Terminal Tabs Help
examiner@fc14-foren-2011-01-i386:~
examiner@fc14-foren-2011-01-i386:~
examiner@fc14-foren-2011-01-i386:~
Plain Text
Tab Width: 8
Ln 19, Col 1
INS
11:23 AM
12/05/2013
Admin Team
Chat with Admin Team

```
[examiner@fc14-foren-2011-01-1386 ~]$ ls
bin  case  core.2810  Desktop  Documents  Downloads  Pictures  temp  Volatility  xp.dd
[examiner@fc14-foren-2011-01-1386 ~]$ echo "grama.tambelli" > case/dirty_words5.txt
[examiner@fc14-foren-2011-01-1386 ~]$ grep -i -f case/dirty_words5.txt > case/string_search5.txt
```

```
Many indications of gambling

Possible persons of interest
Vincent Vega
Ted Jones

Possible location of interes
Kings Creek Cemetery up in 

Possible username:
saulsilversurfer
grama.tambelli

Utilized apps: Skype (check

Possible email address:
vncnt.vega94@gmail.com
saulsilversurfer@gmail.com
[illegible]

Possible conversation log:
254272366 What&apos;s going



437146900 hey Saul
437149058 I don&apos;t mess around Saul, I know you&apos;re around


551199446 D([“gn”,"Saul Silver"]
551424052 #saulsilversurfer/$grama.tambelli;7e9eb883ae020c5a
551425050 saulsilversurfer
551426844 Saul, no dice on Philly


1623796399 #saulsilversurfer/$grama.tambelli;6f3ff4df24c03e26J
1623796454 grama.tambelli saulsilversurfergrama.tambelli saulsilversurfergrama.tambelli saulsilversurferGrama Tambelli | Yo G-man, this a
good time?J
1623796679 saulsilversurfer
1623796814 #saulsilversurfer/$grama.tambelli;7e9eb883ae020c5aJxd
```

Focused on Shell2 Window
(GUI)

ACE-Eval

Primary Collaborator:
Professor Geoffrey Gordon

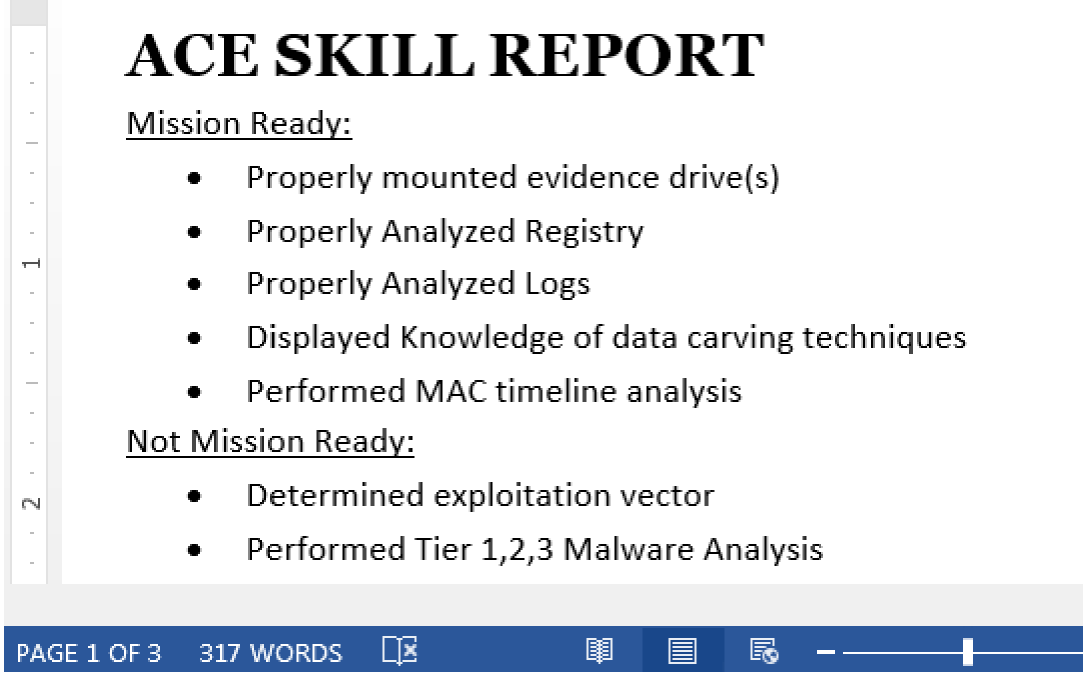
CMU Machine Learning Department

Development

Requires Categorized Data

- Evaluator driven categorization (Training data)
- Hybrid solution required
  - Differing KSA Complexity
    - Simple Binary Detection
    - Path Analysis
    - Hidden Markov Models
    - Frequency Analysis
  - Automated Anomaly Detection
    - Human Intervention

ACE Skill Report



ACE SKILL REPORT

Mission Ready:

- Properly mounted evidence drive(s)
- Properly Analyzed Registry
- Properly Analyzed Logs
- Displayed Knowledge of data carving techniques
- Performed MAC timeline analysis

Not Mission Ready:

- Determined exploitation vector
- Performed Tier 1,2,3 Malware Analysis

Output of Evaluation System

- Determines mission-readiness
- Isolates deficiencies
- Recommends additional training
- Automated remediation plans

Future Work

- **High Transition Potential**
  - Compatible with existing work
  - CPT integration
  - Additional job roles
- **FY16 Plans**
  - Evaluation of analyst to DoD partner’s satisfaction
  - Identification of additional roles
  - Integration of ACE capabilities with AC3 processes
- **Post FY16**
  - Integration with PWP work
  - Role expansion
  - Squad level evaluation