Technical Report 1:
Internship Skills Inventory: Review of Akamai Internship Projects on Maui

Lisa Hunter,[1,3] Mark Hoffman,[2] J.D. Armstrong,[3] Elisabeth Reader,[2] Scott Seagroves,[1] Lynne Raschke,[1] Jeff Kuhn,[3]

1. Center for Adaptive Optics, University of California, Santa Cruz; 2. Maui Community College; 3. Institute for Astronomy, University of Hawaii

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Akamai Workforce Initiative
University of Hawaii Institute for Astronomy, Maui Division
34 Ohia Ku Street
Pukalani, Hawaii 96768 USA
http://www.ifa.hawaii.edu/haleakalanew/akamai/akamai.shtml

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1. Overview of the Akamai Workforce Initiative

The Akamai Workforce Initiative (AWI) partners high-tech industry, astronomical observatories, cutting-edge research, and inventive education to meet needs in astronomy, remote sensing, and other technology industries in Hawaiʻi. AWI provides training in electro-optics for a diverse student population through an innovative, culturally-relevant curriculum, designed to meet workforce needs. At the heart of the AWI are two internship programs that use a model developed by the Center for Adaptive Optics to retain and advance students into science and technology careers. The Maui Internship Program places students at Maui sites, primarily high tech companies, for a seven-week research experience. On Hawaiʻi Island, the Akamai Internship uses the same model, but places students at astronomical observatories. Through a carefully designed set of programs and activities, the AWI advances *akamai* – smart, clever, expert – students into the technology workforce on Maui, and more broadly in Hawaiʻi.

The AWI is headquartered at the University of Hawaiʻi Institute for Astronomy (IfA) on Maui, and partners the IfA with the Center for Adaptive Optics (CfAO) at UC Santa Cruz, the University of Hawaiʻi – Maui Community College (MCC), and the Air Force Maui Optical and Supercomputing Site (AMOS). In addition to the Akamai Internship Programs, AWI also includes the development of a new electro-optics curriculum at MCC, the development of science/engineering education expertise through the Teaching and Curriculum Collaborative, and recruitment activities in Hawaiʻi's high schools. These components are interwoven and all serve the goals of: preparing local students for high-tech careers; increasing the capacity of and building partnerships among the local technical and educational communities; and increasing the participation of diverse populations in technology and technology education.

The AWI was launched in September 2007 and builds on years of partnership activities on Maui, including the Akamai Internship Program, curriculum development, and extensive partnering with industry. Past work was funded by the CfAO in partnership with MCC, the IfA, Maui Economic Development Board (MEDB), AMOS, and many industry partners. On Hawaiʻi Island, the AWI is built on a long-term partnership of the CfAO, W.M. Keck Observatory, Hawaiʻi Community College, University of Hawaiʻi – Hilo, and many Mauna Kea observatories.

2. Introduction to Technical Report

The Internship Skills Inventory was undertaken by the Akamai Workforce Initiative as part of a study to gain a better understanding of the workforce skills needed for the technical workforce on Maui and Hawaii Island. In this phase of the project, we reviewed five years of internship projects completed by Akamai interns in order to create an inventory of skills, understandings, and attitudes needed to be successful in a summer internship experience at an observatory or industry position. The inventory will be used to inform our longer-term project to define workforce needs, and ultimately the development of a new engineering technology program that will create a locally trained technical workforce in Hawaii.

The Akamai Internship Program places Hawaii college and university students (and *kama'aina* who attend school on the mainland) at observatory and industry positions for summer research experiences. Internships are available on Maui and Hawaii Island. Each island runs an internship program based on the model developed by the CfAO, but shaped to meet the unique needs and opportunities of the island. After acceptance into the program, a student is matched with an organization and a mentor, attends a one-week "short course" with fellow interns focusing on technology skills and content, and then completes a seven-week project under the guidance of the mentor and others at the organization. The Akamai program asks mentors to provide a project, or in some cases several smaller projects, that will be the student's own. Mentors are specifically asked to avoid projects which are primarily "shadowing" experiences, or skills-training that does not provide the intern with a project that they have ownership of, and can present in a technical symposium.

Student internships are often representative of the types of projects and work that will be assigned to entry-level technicians, and thus are a valuable source of information about workforce needs. The Akamai Internship Program has been in operation since 2004, and due to the extensive program records, has a wealth of information about student internship projects. Each student prepares an abstract, and oral presentation, and a poster presentation (see: http://cfao.ucolick.org/EO/internships/presentations.php). In this phase of our project, we reviewed program records, and conducted interviews with our 2008 project mentors to inventory the types of projects and skills Akamai interns engaged in from 2004-2008 in the Maui Akamai Internship Program. A report on inventory skills for the Hawaii Island Akamai Internship Program is in progress.

3. Skills Inventory:

In order to create an inventory of Akamai internship skills we utilized two sources of information from the Akamai program:

- Interviews with 2008 Akamai internship project hosts
- Past Akamai intern projects (2004-2007)

3.1. Interviews with 2008 Akamai project hosts

Each year the Akamai program meets with prospective mentors to outline intern projects for the coming summer. The Akamai program staff meets with each mentor who will be working closely with an intern to learn about their ideas for projects, the skills and background needed to complete the project, as well as any additional information related to how to successfully match the intern and project. In January and February 2008 these meetings were conducted, and additionally, mentors were asked if they had new positions coming up and for information on skills that are important for their entry-level positions.

Internship hosts on Maui included:
Oceanit
HNU-Photonics
Textron
Trex
Maui High Performance Computing Center
Northrop-Grumman
Pacific Disaster Center
Akimeka
Institute for Astronomy, Maui

The authors wish to thank the technology companies, academic institutions, and observatories that contributed to this work. They have hosted Akamai interns in the past, participated in interviews, and given informal feedback in a range of ways. It should be stated that our interviews were performed in a casual manner, with groups of engineers, with no effort to find the consensus or "official" opinion of a workplace or organization.

This report reflects significant interpretation of the community's primary-source data by the authors. While we hope we have fairly represented the thoughts of those we've worked with, this report is the work of the AWI and should not be construed as the official position of any of the below-mentioned institutions.

3.2. Past Akamai Intern Projects

Past intern projects from 2004-07 were reviewed through project abstracts and Powerpoint presentations, and the tasks required to complete the project were identified. These projects took place at the same hosts as listed above.

3.3. Inventory of Intern Tasks

Skills and tasks identified from interviews and past intern projects were divided into four categories: hardware, software, engineering technology process skills, and attitudes for success in the workplace. Tasks included in the hardware and software category were further subdivided into more detailed task areas. Engineering technology process skills, such as "troubleshooting," came up in interviews as important skills in and of themselves and formed a separate category. The inventory is shown below. The order does not indicate any priority nor frequency in the tasks.

3.4. Engineering Process Skills:

Engineering process skills encompass the everyday practices and processes that engineers and technicians use to solve problems, design solutions, and keep things working. These are the types of skills that are transferable to new problems and technology, thus are tremendously important skills to develop if technicians are to continue to be productive as new technology and systems emerge. Engineering process skills came up frequently, and were phrased in a wide variety of ways, such as "problem solving," or "critical thinking," or in connection with more specific tasks, such as "characterize a deformable mirror." We have listed the process skills that came up independent of specific tasks, but observed from the "hardware" and "software" categories that process skills are repeatedly brought up and merited additional study. AWI is currently studying engineering process skills and will publish a technical report in summer 2009 to report findings.

INTERNSHIP SKILLS INVENTORY

HARDWARE

Telescopes:
operate and align
test ability of 8" telescope to track satellites
assemble a telescope system for tracking objects in the sky
verify that a telescope meets specifications

Optical devices and stages:
align, coat, and change optical devices
perform maintenance on optical stages (cleaning and oiling)
measure figure distortion of a primary mirror
measure mirror distortion

Lasers:
calibrate performance of laser receiver in the lab using a calibrated source
calibrate performance of laser receiver using standard stars

Diodes:
use of Schottky diodes
use of Schottky diodes for current limiting
Position Sensing Diodes
characterize Position Sensing Diode's temporal, spatial and power level sensitivity
compare Position Sensing Diodes to CMOS
create mount for photodiodes
create mount for photodiodes to be inserted into cooling unit
create and set up device made of laser and photodiode to detect water level

CCDs:
install, understand
measure plate scale of CCD using two stars
mount CCD control hardware

Interferometers:
set up and test FT interferometer
characterize DM using an interferometer

Solar cells:
solar cell module
measure voltage output from a solar cell under varying conditions
test the effect of tracking on solar cell efficiency
design cooling system for solar cell
test solar cooling device's effect on solar cell performance
build portable solar cell module and test kit

Sensory devices:
receiver-transmitter system
use remote sensing
create sensory substitution devices
create prototype sensory substitution device
convert from physical knob to remotely operated computer control

HVA cards

Pupil and blind deconvolution:
investigate how different pupil assumptions affect blind deconvolution results
study the effect of incorrect pupil information on blind deconvolution

Computers:
bring up, repair
integrate components with a computer
build resistive load box
interface
configure new hardware system
assess hardware system
design and build an inventory control database
set up wireless network on a bus and map the region where the bus can be found
upgrade power supplies for DM
proper configuration for new "hardware sustem"hardware
assess what components of a "hardware system" do
write a list of requirements for a "hardware system"
compare network hardware and configurations to documented specs

Other:
compare cost and performance of piezoelectric devices and voice coil FSM
select camera appropriate to project
position, track and measure errors in pointing satellites
investigate errors in pointing determinations of modeled satellites

SOFTWARE

Create:
email form for webmaster feedback that is hidden from spambots
programs for stars
an application to visualize the positions of satellite
database and real time geospatial model of Avain Influenza outbreaks
programs to run Matlab in paralell
models of atmospheric distortion in Mathematica
visualizing code for weather model
3D topographic map of Hawai'I from a 2D array of elevations
software for tracking satellites with remote telescope
Web pages
data pipeline from weather model to 3D visualization software
program to calculate Ro based on images of stars
image scaling algorithm
create database of equipment
database of mile markers and images

Understand and Perform:
autocad
solidworks
GIS to investigate the effect of El Nino on coral bleaching
GIS to evaluate correlaton of outbreaks of Avian Influenza and migratory patterns
asp.net

ArcGIS
matlab
jTrack
power point
ArcMap
mapping tools
microsoft vivio
CPLD Xilinx
ZeMax
CAD modeling for mount design
oracle database
designed database

Identify:
global web services gateway
website security
web development
XML web security, and document validation

Implement:
Web programming
java programming
C++
XML document validation
port public domain software from Linux(written in C) to Windows (also C)
CPLD Xilinx programmable logic device

Analyze:
images in blind deconvolution
images
inventory analysis
cost analysis
eliminate image flicker caused by GUI
randomly access any frame in a video file
transfer video/produce video of electronic installation for training purposes
examine South Pole data set with helioseismic analysis
compile data from learning studies
reasearch how to store previously developed Java programs
convert blind deconvolution code from Matlab to Python
convert any video type to MP4
modify software to disregard errors in CCD camara
compare output of computer program to master file
compare network software to documented specifications
test satellite tracking software with remotely operated commercial telescope
compute residual error in tracking from images
run security scripts to verify security compliance
map mile markers into GIS system
test accuracy of GPS measurements using redundant measurements
update web pages make them more usable for portable devices

ENGINEERING TECHNOLOGY PROCESS SKILLS

Project planning
Analytical skills
Troubleshooting
Problem solving
Systems thinking
Ability to follow instructions
Ability to work independently
Good communication skills
Mechanically inclined
Designing within requirements
Presentation/communication skills
Ability to clarify a problem
Use reference material and background reading
Critical thinking
Apply theory

ATTITUDES FOR SUCCESS IN THE WORKPLACE

motivation
teachable
Interest in project/work
proactive
willingness to learn (new program, new software)
enthusiasm