Report on the Third NVO Summer School

Building the Framework for the National Virtual Observatory

NSF Cooperative Agreement
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NATIONAL VIRTUAL OBSERVATORY

IVOA

INTERNATIONAL VIRTUAL OBSERVATORY ALLIANCE

Report on the Third NVO Summer School (2006)

Introduction

This document describes the program and activities of the third National Virtual Observatory Summer School, which was held at the Aspen Institute in Aspen, Colorado from September 5 through September 14, 2006. This program introduced a broad range of scientists and developers to the opportunities for astronomical research opened by the development of the Virtual Observatory. This report summarizes the goals, program, and outcomes of the school. Appendix 1 includes the full program, Appendix 2 includes the results from a survey of the participants, and Appendix 3 gives a full financial report. This year a decision has been made to use the presentations given at the summer school as the basis for a book describing the NVO to be published in early 2007.

Overall the summer school was very successful. Approximately two thirds of students filled out an extensive Web survey summarized in Appendix 2. Feedback from the students was very positive. As with previous summer schools the primary concerns students had were with the amount of material that is covered in the limited time of the school. There were also issues with the summer school's coverage of both scientific use of the Virtual Observatory (VO) and the technical protocols that underlie it. Scientists were uncomfortable with some of the technical elements and programmers were not able to follow all of the science examples. Balancing these two audiences has always been the most difficult part of the school.

Objectives of the Summer School

The primary goal of the NVO Summer School is to communicate that the Virtual Observatory is open for astronomical research. The NVO itself is a program in the development of information technologies, but its goal is to enable new ways to do research in astrophysics. While there is still much development ongoing and planned in the US National Virtual Observatory program and other VO efforts worldwide, the VO now provides a rich suite of software and data resources.

The goal of this year's school was the same as the previous year although there were some changes in emphasis. Noting the student reaction to the first summer school's emphasis on Java, we had been very explicit in making visible multi-language support for the VO the second year. Comments then suggested that we focus on a smaller number of languages. In response we focused on the languages that had the most complete and robust support for the VO (Java, Python, IDL, and IRAF). Student comments this year suggest that we may have gotten the right breadth of language coverage, but it is less clear if the explicit language introductions we provided as part of the first two days of the school are needed.

Building on the success of the student projects in previous summer schools, we continued to make the student projects the focal point of the school. Scientists learn by doing, and just as in previous summer schools the entire program was geared towards ensuring that participants were involved in a major student project during the last few days of the school. This year students seemed to have a greater awareness of the upcoming projects and discussion and team building began very early in the school.

Another goal of this year's school was to validate the growing maturity of the virtual observatory by being able to reuse substantial amounts of the presentations from the previous year. To the extent that the VO protocols have become stable we should be able to reuse existing presentations.

All of our goals were met. The astronomers who attended this summer school clearly indicated in oral and written comments that they anticipated the VO playing a significant role in their future research and that they would be using what they had learned here. A number of the student projects gave access to major new data resources. Student projects made extensive use of the VO software tools including the summer school library. There was substantial re-use of the presentations from the second summer school.

Program Review

We discuss the summer school program chronologically and compare with the previous year, to emphasize the changes we have made and how these worked out.

The first two days of the summer school were devoted primarily to the discussion of underlying technologies used in the VO (SQL, XML and Web services), and an introduction to some of the languages used in the summer school. Unlike last year we also began the discussion of VO technologies themselves (with VOTables) and included a discussion of science goals for the Virtual Observatory. This was possible due to a substantial decrease in the time we spent on discussing programming languages. Generally these changes seemed to go in the right direction. Whether any time should be spent on our language introductions is raised by the student comments on the program.

For the pure scientists in the student body the technical discussions could be difficult to follow. We are just reaching the point of maturity of VO applications where users can deal with VO tools and resources without needing to understand their sometimes esoteric foundations. We did not segregate the first two days as an explicit Preschool and we strongly encouraged students to attend the full session (which led in part to one applicant deciding not to attend). This seemed to work out. Though some students complained that the earlier talks were too technical they set up the vocabulary and frameworks that would be used later.

The next three days comprised the bulk of the presentations of the VO protocols and applications. There were four kinds of presentations: VO protocols, VO applications, exer-

cises, and use of the VO in astronomy. Of these the protocols and astronomical use of the VO were very similar to last year. The new VO applications sessions, one each day, were intended to give students a tour of the major VO applications. There was a feeling that last year's program spent inadequate time showing students these applications so these new presentations were added into the program. While these went some way towards filling the gap, they were not as successful as they might have been. Student comments suggest that we need to do more in this area.

Last year we had had three long (90 minute) student exercises. These had not been very successful and also seemed too few for the diversity of topics. This year we had 12 much shorter exercises on a much wider variety of topics. While there is some feedback that the exercises were a bit rushed, overall they received a higher average rating than the non-exercise presentations and seemed successful during the program. Students did not like exercises where they were advised to complete the exercises on their own time. If we are going to continue to use lots of short exercises we need to limit their scope to what the students can accomplish in the time available. We could still have additional homework exercises that the student could work at later, but we should not have exercises where only the presenter can do them during the talk.

The science presentations were the highest rated presentations in the summer school, just as they were last year. This year they were not explicitly called out and that may have been a mistake since that made it less clear what they were. Students also enjoyed the two discussion sessions on science goals and the future of the VO. It may be slightly prejudicial to the results of the survey to have had the discussion of what more the VO can do as the last thing the students talked about in the school just before they were given the feedback from. This may tend to highlight the weaknesses and concerns they have. However it engendered precisely the kind of vigorous discussion we want to have.

Many of the presentations on VO protocols were able to re-use material from last year, but others were substantially rewritten or on topics not covered last year. The feedback on these is comparable to what we had last year.

The last three days focused on the student projects. The selection process was the same as last year, with the student teams entirely self-selected and student led. The projects are listed in the program in Appendix 1. The selection process worked efficiently with the teams fully formed in only 40 minutes. This year the students seemed very aware of the need to set up projects and had many good ideas and seemed very eager to start.

Four projects were deemed especially meritorious and were offered financial support to present the project at the January 2007 AAS meeting. These included a group looking for Fossil Groups (Santos/Tamura), a project looking at the correlations of the shapes of rotation curves with other parameters (Catinella), a tool for the automatic creation of SEDs (Muench), and the development of a SkyNode for the ingest and distribution of numerical data (Wagner).

There seemed to be fewer significant software glitches than the previous year. Issues with the MySQL database and SkyNodes that had caused problems in several presentations last year were substantially mitigated through changes in how they were presented. We had seriously considered going to a simpler database system at the beginning of this year's preparations, but decided to stay with MySQL to give a full featured database to the users. This decision worked out. Some of the newer software areas, e.g., VOSpace, had problems but it was made clear that these were very much at the leading edge of VO software development. We may wish to consider how such experimental software should be presented at future summer schools.

There were still a few cases where a problem should have been caught before the presentation. We need to test the software as independent packages and also in the context of how we use it in talks. There were a number of cases where Web software failed due to the high demand of 40 simultaneous uses. While we may not be able to make our software scalable to 40 simultaneous users (or it may not be appropriate to expend the resources to do so) we should be able to test software to understand which pieces are likely to fail and warn students when there may be problems.

Overall there was a very significant increase in the fraction of material that was re-used from the previous summer school. While at best 20% of material from SS1 was used again in SS2, we estimate that somewhat more than 50% of the material in SS2 was re-used in SS3.

There were several student comments which indicated that they felt they needed a better sense of how each talk fit into the larger picture of the VO. In future summer schools we will want to see how we can address this in both the overall organization of the talks and the material within them.

The overall student impression seems very similar to last year. We did very well with the overall rating for the school at 4.38 on a scale of 1-5, not significantly different from last year's 4.46. This is a very good result though we are a little disappointed that given the feedback we have had over the past two years we could not improve a bit. One reason is discussed below in the student section.

Faculty and Staff

The faculty for the summer school included

- Thomas McGlynn, NASA GSFC
- Dave De Young, NOAO
- Michael Fitzpatrick, NOAO
- Matthew Graham, Caltech
- Gretchen Greene, STScI
- Robert Hanisch, STScI
- Simon Krughoff, University of Pittsburgh

- Shui Kwok, Keck Observatory
- Brian Kent, Cornell University
- Chris Miller, NOAO
- Ray Plante, University of Illinois
- Doug Tody, NRAO
- Roy Williams, Caltech

Brian Kent was added to the faculty this year after having been a student last year. Bob Hanisch and Dave De Young represented the senior elements of the NVO team and each led one session consisting of roughly half lecture and half discussion. We were able to convince Simon Krughoff to repeat two of his highly rated talks just a few weeks after his marriage. A few faculty were unable to remain the entire school and came a few days late or left a few days early, but most remained the entire session. The size of the faculty (10 full time, 2 adjunct, and 1 half-time) seemed adequate.

Staff support before, during and after the summer school was ably provided by Sarah Emery Bunn (Caltech) who developed the student survey, and collated and analyzed the results as shown in appendix B. Sadie Lingham (JHU) provided billing and financial support.

Students

A total of 56 students applied for the summer school. Applicants ranged from graduate students to senior tenured faculty and included both astronomers and software developers. A sub-committee of three faculty members reviewed the applications and ranked the applicants. The full faculty reviewed these rankings and 41 applicants were invited to the school and 3 placed on the waiting list. One late application was accepted but the applicant was placed at the end of the waiting list. Due to a variety of conflicts and job changes several accepted students were unable to attend and were replaced from the waiting list. 39 students attended the school. There were 13 students from foreign institutions. The students included 30 men and 9 women. Four students had attended previous summer schools.

When we asked in the feedback form for the students to classify themselves as scientists, software developers or both, the results showed a significant shift towards NVO users from developers. Last year the number of pure users was 35% with user/developers a plurality at 46%. This year those numbers reversed with 45% users and only 38% user/developers. The number of pure developers stayed essentially constant (17% this year versus 19% last year). This shift is exactly what we hope for, but as it continues it will require careful revision of the curriculum.

A look at the breakdown of the overall evaluation by type of student shows this clearly. The average for developers, developer/users and users are 4.8, 4.5 and 4.2 respectively.

There is a clear trend. The results for users are still pretty good, but they clearly do not find the current program as satisfying as developers.

Attendees:

Jacob Albretsen	Brigham Young University
Colin Aspin	Gemini Obssevatory
Brian Brondel	Indiana University
Douglas Burke	Smithsonian Astrophysical Observatory
Barbara Catinella	Arecibo Observatory
Luca Cortese	Cardiff University
Joseph DePasquale	Harvard-Smithsonian Center for Astrophysics
Walter dos Santos Jr.	Instituto de Astronomia Geofisica e Ciencias Atmosfericas - Unversidade de Sao Paulo (IAG-USP)
Iranderly Fernandes	Laboratorio Nacional de Astrofisica
David Floyd	Space Telescope Science Institute
Oliver Fraser	University of Washington
Steven Gibson	Arecibo Observatory
Norman Hill	Canadian Astronomy Data Centre
Lilit Hovhannisyan	Byurakan Observatory
Amy Kimball	University of Washington
Michael Koss	University of Maryland/Goddard Space Flight Center
Howard Lanning	National Optical Astronomy Observatory
Don Lindler	Sigma Space Corporation
Kevin Lindsay	Space Telescope Science Institute
Omar Lopez-Cruz	INAOE - Instituto Nacional de Astrofisica, Optica y Electronica, Tonantzintla
Kelly McCusker	Harvard-Smithsonian Center for Astrophysics
Melinda Mello	National Radio Astronomy Observatory
August Muench,	Smithsonian Astrophysical Observatory
Tara Murphy	University of Sydney
Nathaniel Paust	Space Telecope Science Institute
Paresh Prema	Institute of Astronomy University of Cambridge
Ivanio Puerari	INAOE - Instituto Nacional de Astrofisica, Optica y Electronica
Jordan Raddick	Johns Hopkins University
Anthony Rogers	Space Telescope Science Institute
David Rosario	University of Virginia/University of California-Santa Cruz/UCO-Lick Observatory
Rafael Santos	Associate Laboratory for Computing and Applied

	Mathematics The National Institute for Space Research (INPE) Brazil
Rita Sinha	Inter-University Centre for Astronomy and Astrophysics (IUCAA) INDIA
Petr Skoda	Astronomical Institute Academy of Sciences of the Czech Republic
Brad Spitzbart	Smithsonian Astrophysical Observatory
Christopher Springob	Naval Research Lab
Takayuki Tamura	ISAS/JAXA
Katherine Vieira Rosa	Yale University
Richard Wagner	Laboratory for Computational Physics - University of California, San Diego
Phillip Warner	National Optical Astronomy Observatories

Preparations

Preparations for the academic program began in January 2006. Faculty selection was completed in February (one member of the faculty later dropped out) and regular bi-weekly (later weekly) telecons were initiated. Preparations included development of the course outlines, course assignments to faculty, software requirements, and the development of a rigorous software testing schedule. During the summer all software to be used at the summer school was tested by faculty members other than the developers and a complete software distribution system was brought up and tested. Software was substantially more mature this year. Notably, VOClient introduced a whole new class of potential VO users. While software preparations nominally used the same guidelines as last year, there seemed to be somewhat less urgency this time around. The release of software to the students was delayed slightly from the nominal timetable. For several services not all of the nominally supported architectures were properly supported. Windows compatibility was missing in three or four areas.

This year the decision was made to use Java 1.5 as the baseline version of Java to accommodate tools that require it. Incompatibilities with AXIS implementations were rather difficult to expunge from the software and required a lot of work by several of the faculty.

Unlike last year there was relatively little review of the courses by faculty other than the presenter, though given the repetition of material there was probably more familiarity with what other talks included. It would probably be desirable to have had more review of new material in future schools.

To ensure against network outages a small local network was brought along by Matthew Graham consisting of two machines. These had example services that could have been used in case of a network outage. It also included a local Open SkyQuery portal that en-

abled users to publish SkyNode sites running on their local machines – which would not have been visible to the normal test SkyPortal. This local network was very helpful though we did not need to use it as a backup as we had the previous year. Once it was properly set up, the configuration seemed perfectly adequate to the load of the ~40 users.

Mike Fitzpatrick also set up student accounts at NOAO for use if students needed to bring up services that were visible to the outside world. This turned out to be very helpful in tracking down some problems at the last minute and was used by at least one student project.

We recognized the issues that we needed to resolve for student developed services to interact with the rest of the NVO rather late in the game, but Matthew's and Mike's work addressed it adequately. In previous summer schools we had never been so ambitious as to expect users to be able to connect to complex student services from the registry and NVO portals. Being able to do so successfully this year was a major advance.

Parallel to the programmatic preparations, were a series of communication and logistics issues, largely handled by Sarah Emery Bunn (Caltech). Early on these included publicizing the school, developing and mailing out a school poster, and setting up and testing the application Web site. Once the selection process began, records on the status of all students needed to be maintained.

She coordinated with the Aspen Meadows to set up and finalize the reception, rooms, meeting rooms and the services to be provided. One glitch that arose here was that the combination of students and faculty slightly exceeded our room block. Since the hotel was completely booked for a wedding, two faculty had to stay at a secondary hotel – though this turned out to be no hardship. Arrangements were also made with a couple of tourist providers for activities during the off day, for the summer school banquet which went very well, and for the myriad of small details crucial to people feeling comfortable during the program. The social atmosphere this year worked well.

Sarah also handled the pre-school communications with the students. Some of the foreign students required significant help with visas and other travel arrangements. She also did the initial setup of the TWiki site that was used very successfully through the school, though the slow response of the TWiki web server was sometimes a concern.

Products

The largest change in the Summer School this year is the decision to use the summer school materials as the basis for a book on the National Virtual Observatory. This was extensively discussed in faculty telecons and team meetings during the year. Matthew Graham has taken the lead in editing the book with Mike Fitzpatrick and Tom McGlynn as the co-editors. Several publishers were contacted and the current plan is that we will publish through the Astronomical Society of the Pacific's Conference Series. Should something go awry in our agreement with the ASP, we can also self-publish the volume,

(using lulu.com or similar publisher), and have the book and updates available on-line. Currently the first draft of material in the book is due the beginning of December and we hope for publication in early 2007.

The summer school software distribution is also a major product. A standard distribution was made and the summer school course materials were collated, and both are available through the NVO web site. CDROM copies will be available for the AAS meeting in 2007. The software library includes end-user applications like Aladin, Topcat, SkyView, and Mirage as well as libraries for accessing VO resources in IDL, Perl, IRAF, Java, PHP, and Python. The VOClient code and associated libraries enable C, C++, and Fortran programs to use VO resources. The summer school library is an invaluable resource for any programmer or scientist wishing to access the VO through the command line or to integrate VO capabilities into their tools. The NVO summer school software library will be available on the NVO web site.

The material for all the courses presented at the summer school will also be available on the Web site, but this should soon be superseded by the NVO book.

Facilities

The summer school was hosted at the Aspen Meadows Resort of the Aspen Institute. The facilities were excellent and the staff was friendly and responsive. Rooms and meals were excellent.

Internet connectivity from the meeting room was generally adequate especially after the T1 link was established on Friday. Connectivity had been rather marginal previously. Limitations to connectivity afterwards were more often off-site than on. Connectivity from the rooms was not as impressive but was generally adequate. We had no major Internet service interruptions.

One student did not have a laptop of their own. A machine was provided by Roy Williams. This worked but was clearly awkward and less than desirable.

Appendix 1. Program

Wednesday: September 6	
9:00 Welcome and Introduction	McGlynn
9:45 Software library installation and overview	Graham
10:45 *Break*	
11:15 Introduction to SQL	McGlynn
12:00 *Lunch*	
1:30 Introduction to SQL--Cont'd	
2:00 Introduction to XML	Greene
3:00 *Break*	
3:30 Scripting languages: Python, IRAF, IDL	Kwok, Fitzpatrick, Miller
Thursday, September 7	
8:30 Advanced XML: Schema, Xpath, XQuery, XSL	Plante
9:30 VOTables	Fitzpatrick
10:15 *Break*	
10:45 Accessing Web Services	Graham
11:30 Building Web Services	Graham
12:15 *Lunch*	
1:45 Grid Computing	Williams
2:30 Development languages: Java, C, C#	Plante/Greene
4:00 *Break*	
4:30 VO Science Goals and Discussion De Young	
Friday, September 8	
8:30 Protocols Overview	McGlynn
9:15 Science Applications 1: Discovery and Exploration Tools and Libraries	Kwok
10:15 Exercise 1: Finding resources in the VO	Greene
10:30 *Break*	
11:00 Publishing data in the VO	Plante
11:45 Exercise 2: Publish a service in the VO	Plante
12:00 *Lunch*	
1:30 Data Access Layer Clients (VOClient) (Python)	Tody, Kwok
2:30 Data Access Layer Servers	Tody
3:20 Exercise 3:Build a cone search client	Tody
3:40 *Break*	
4:00 Exercise 4: Build a cone search service using local database	Kent
4:20 Understanding VO metadata: Registry and UCDs	Kent
5:00 VO science with cross-correlations	Krughoff

Saturday, September 9

8:30 Science Applications 2: Using VO Web and Grid Services (WCSFixer)(WESIX)	Krughoff, Fitzpatrick
9:30 Exercise 5: Using WESIX	Krughoff
9:50 Exercise 6: Using the Grid/NESSSI	Williams
10:15 *Break*	
10:45 Exercise 6: Using the Grid/NESSSI (continued)	
11:10 Introduction to OpenSkyQuery	Nieto-Santisteban &Williams
11:30 Exercise 7: Correlating Catalogs on the Web	Miller
12:00 *Lunch*	
1:30 Using the VO to Study Clusters of Galaxies	Miller
2:30 ADQL	Plante
3:15 Registry clients	Plante
4:00 *Break*	
4:30 Building SkyNode Servers	McGlynn
5:15 Exercise 8: Setting up a SkyNode	Greene

Sunday, September 10

No Summer School Activities

Monday, September 11

8:30 VOEvent	Williams
9:00 Science Applications 3: VO Analysis using local utilities	Kent
10:00 Exercise 9: Down and dirty with VO applications	McGlynn
10:20 *Break*	
10:50 Using an existing environment in the VO: IRAF/IDL	Fitzpatrick/Miller
12:15 *Lunch*	
1:45 Exercise 10: Making a VO-aware Tool	Fitzpatrick
2:15 Combining VO elements to build integrated services	Kent
3:00 Exercise 11: Show how to use a series of tools together	Kwok
3:30 *Break*	
4:00 Managing data in the VO	Graham
4:45 Exercise 12: Adding persistent storage	Graham
5:15 Project team selection	McGlynn/All

Tuesday, September 12

Project development

Wednesday, September 13

8:30 AM- 4 PM Project development

Project Presentations

4:00 AEGIServer	Rosario
4:12 Astronomy Workflow Editor	Rogers
4:24 Theory Skynode	Wagner

4:36 Fossil Groups	Santos/Tamura
5:48 Image Comparer	Aspin
5:00 ANCHORS	Spitzbart

Thursday, September 14

8:30 The future of the VO	Hanisch

Project presentations

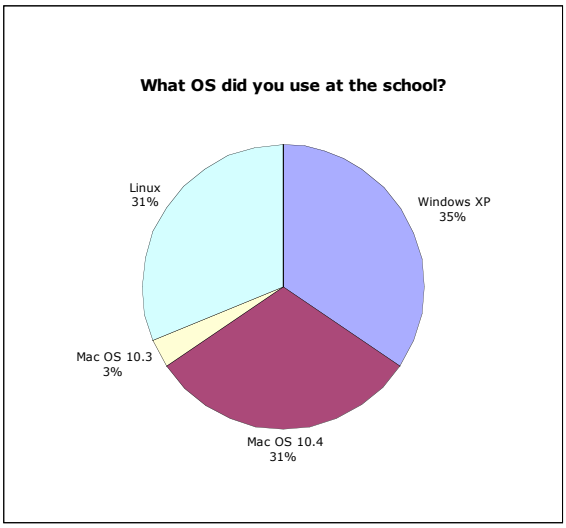
9:30 Deep QSO Survey/SEDBuilder	Floyd/Muench
9:46 Shape of Galaxy Rotation Curves	Catinella
9:58 Spectra Build SSA/SDSS QSO Spectra	Kimball/McCusker
10:10 Datascope for the People	Raddick
10:22 SIAP Server/Client Platform	Skoda
10:34 SPM3 Catalog/Magellanic Clouds Exploration	Viera

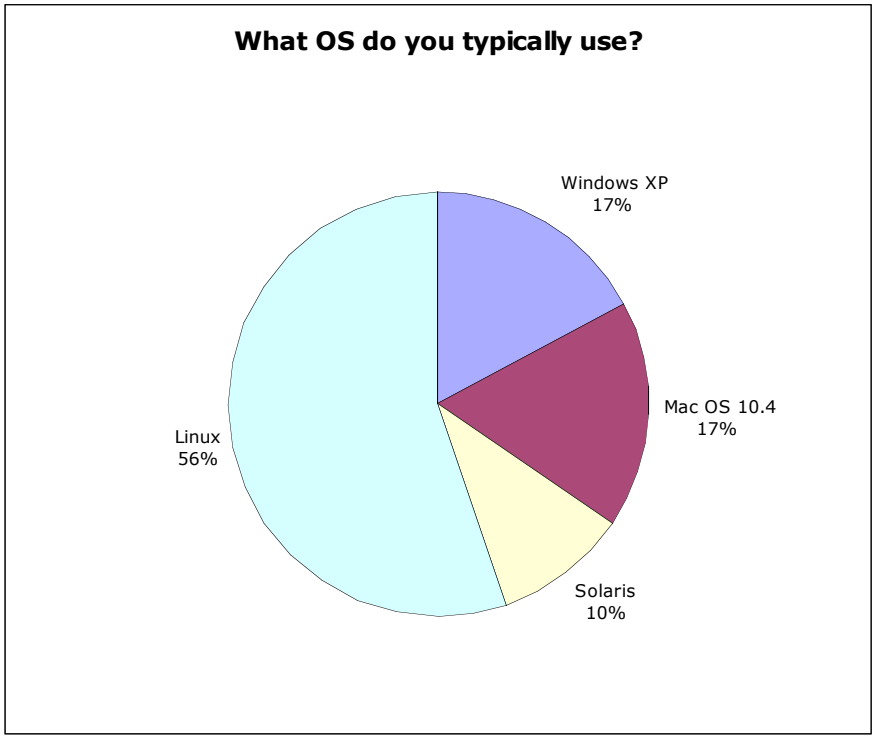
10:46 *Break*	
11:30 Prizes	De Young
11:40 Closing and feedback	Hanisch

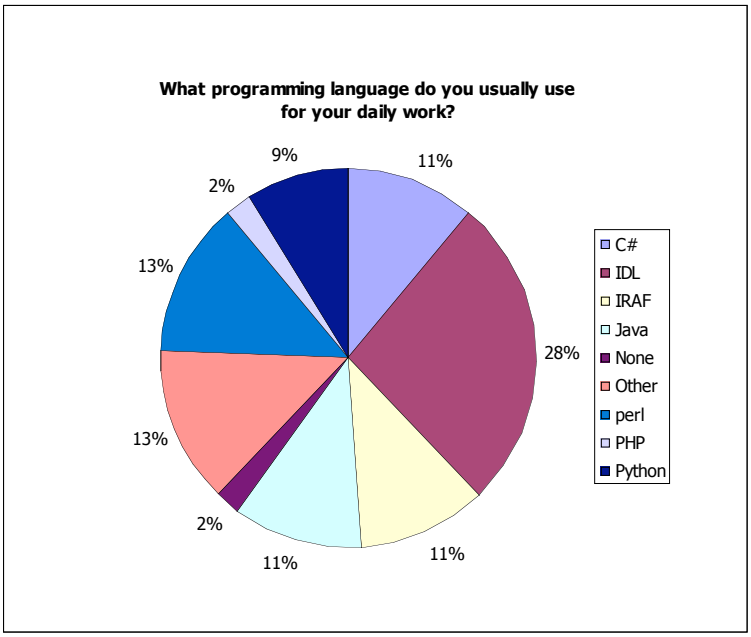
Appendix 2. Survey

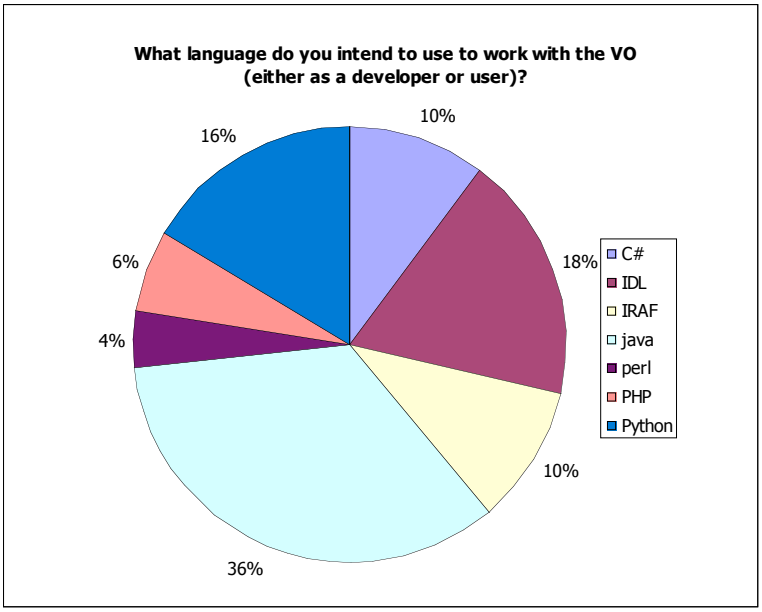
There were 29 responses to the survey out of 39 students attending the school.

1. Technical Statistics



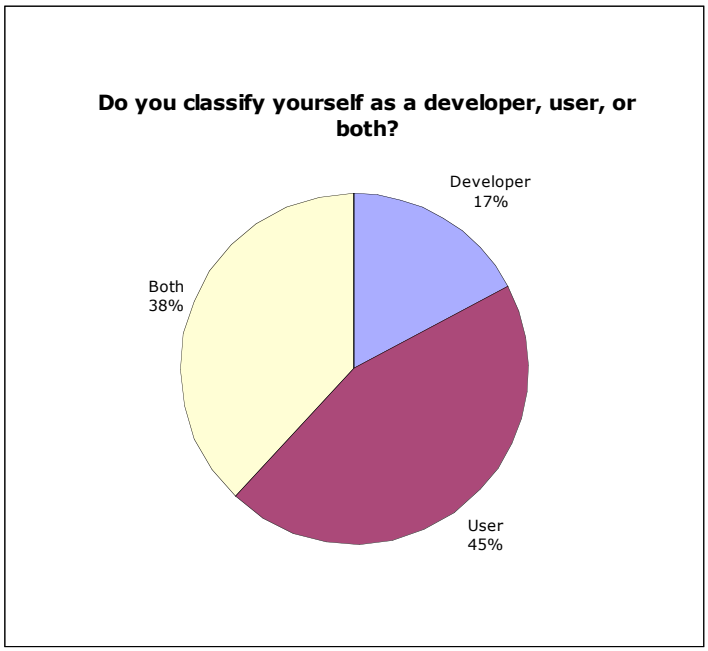



What programming language do you usually use for your daily work?
9%
11%
2%
13%
28%
13%
2%
11%
11%
C#
IDL
IRAF
Java
None
Other
perl
PHP
Python


What language do you intend to use to work with the VO (either as a developer or user)?
10%
16%
6%
18%
4%
10%
36%
C#
IDL
IRAF
java
perl
PHP
Python

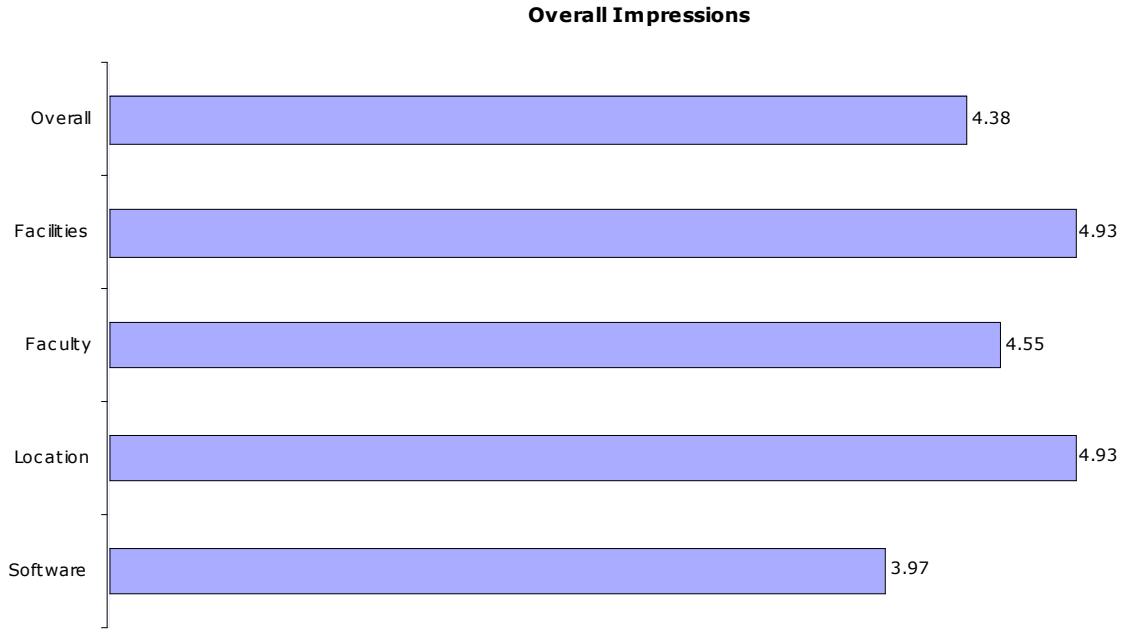
The respondents who chose "Other" listed the following answers:

- Fortran
- C
- Tcl/Tk
- SQL



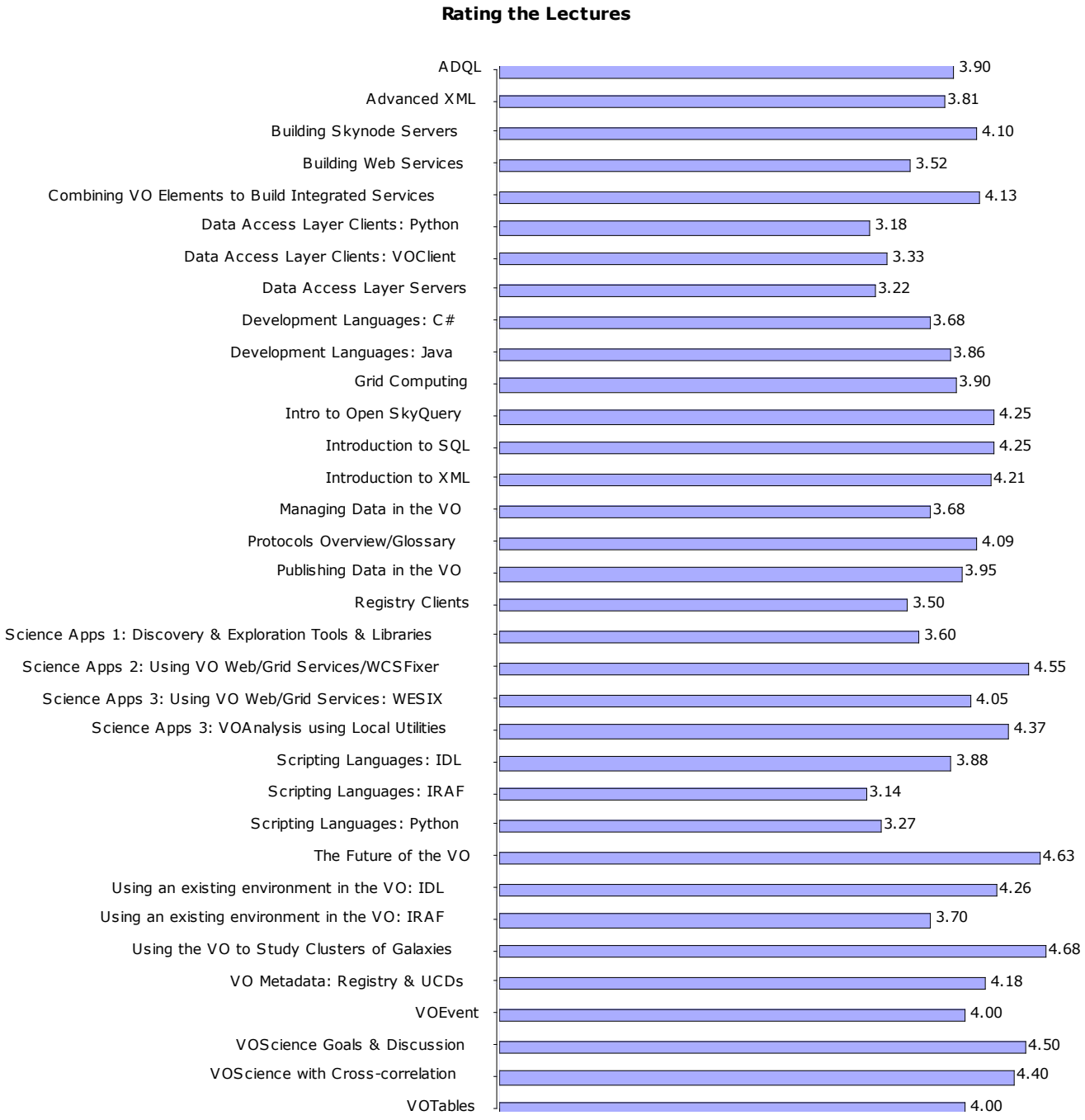
2. Overall Impressions

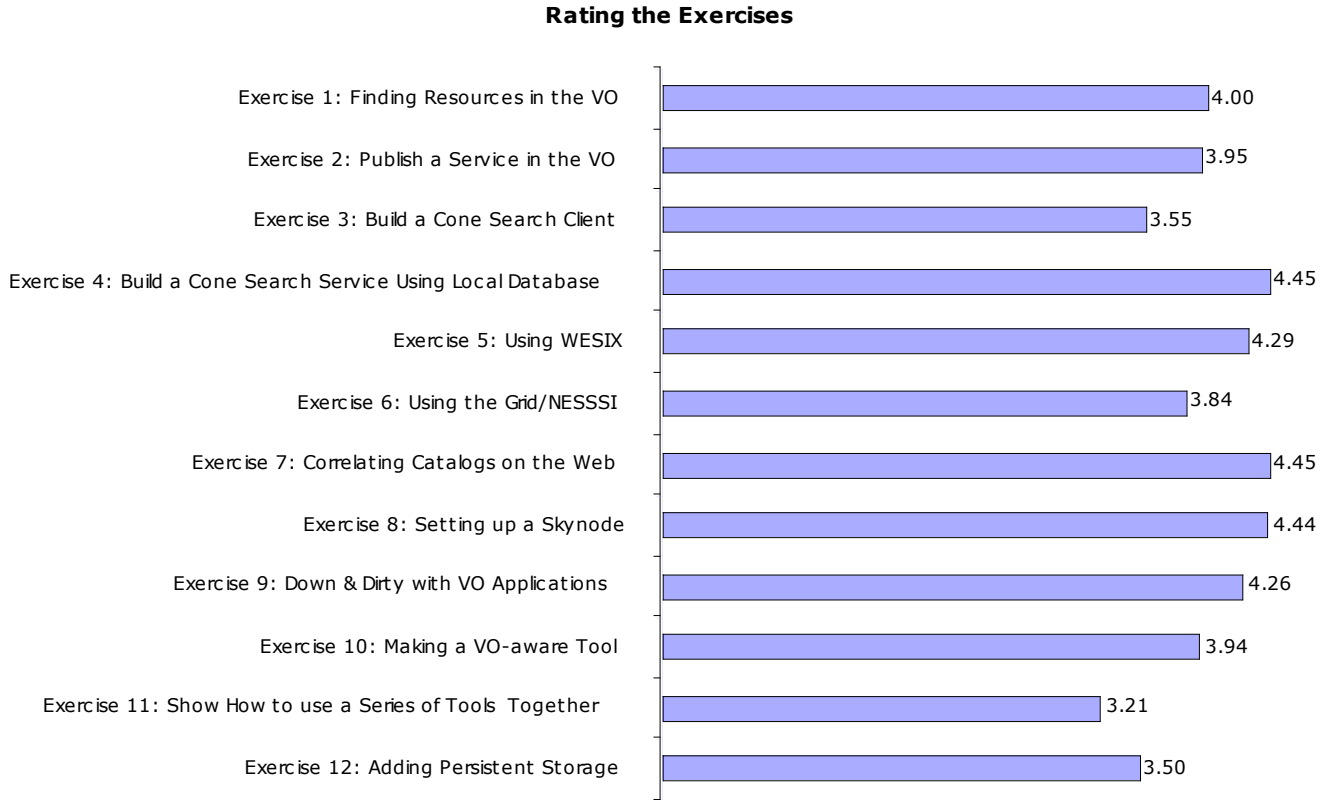
The survey asked students assess the following general areas on a scale of 1-5. The results show the average rating of each on a scale of 1-5, 1 being the lowest score and 5 the highest.



3. Rating the Lectures and Exercises

The survey asked students to rate each session on a scale of 1-5. The results show the average rating of each session on a scale of 1-5, 1 being the lowest score and 5 the highest.





3. Rating the Scope of the Program

Was the length of the summer school too long, too short, or just right?

Too Long	10%
Too Short	10%
Just Right	80%

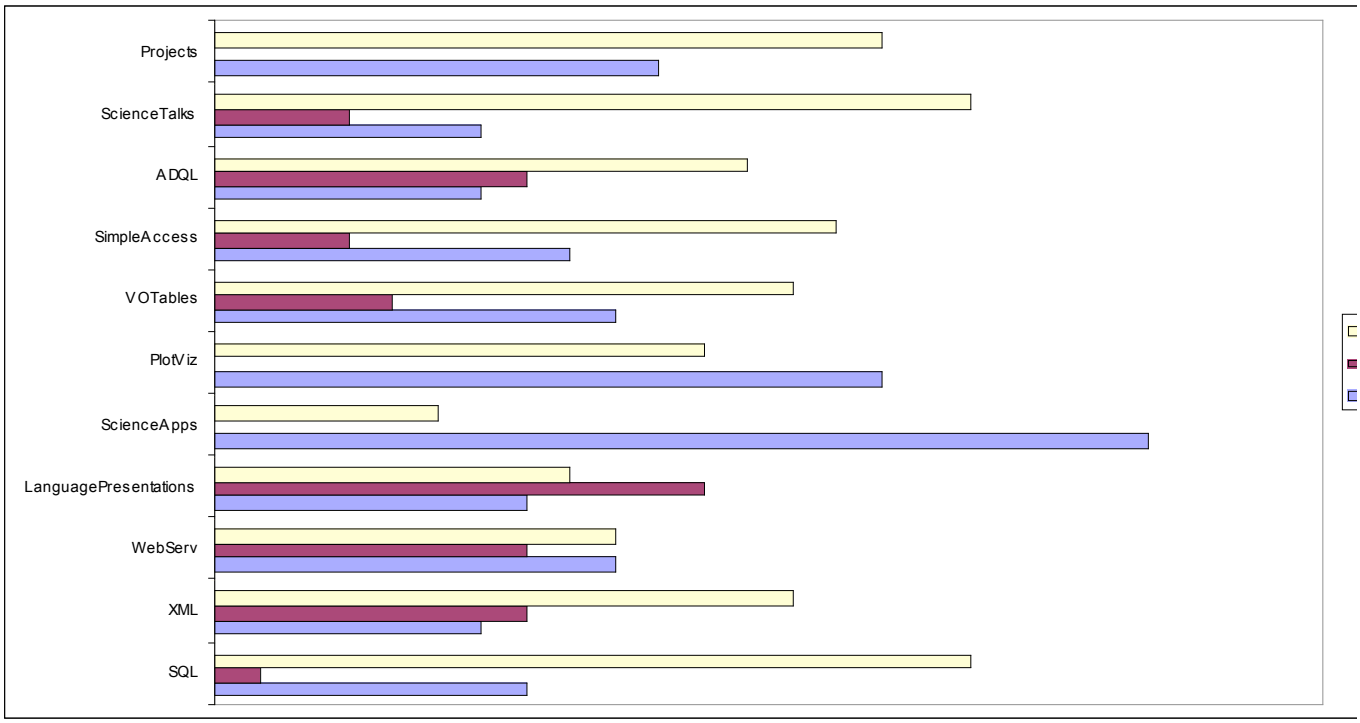
Was the pace of the summer school too fast, too slow, or just right?

Too Fast	62%
Too Slow	0%
Just Right	38%

Was the intensity of the summer school too intense, too dilute, or just right?

Too Dense	55%
Too Dilute	0%
Just Right	45%

Should we have spent more, less, or about the same amount of time on the following topics?



4. On the Future of the Summer School

Should we continue to hold NVO Summer Schools?

All respondents answered yes to this question.

If so, How often?

Of the respondents who answered this question (23), 19 of them answered "annually". Two people answered "twice a year" and two people answered "as needed".

Should we continue to hold NVO Summer Schools in Aspen?

All but one respondent answered "Yes" to this question.

Suggestions for alternate locations included the following:

- "Seattle or Baltimore"
- "Puerto Vallarta Mexico"
- "More affordable places :-)"
- "Santa Fe, NM"
- "latin america, though I do not know if it is possible"

Would it be useful if future summer schools ran parallel sessions (e.g. server side vs. end science user applications)?

Yes	83%
No	7%
Don't know	10%

Would you come again to an NVO Summer School?

Yes	62%
No	10%
Not sure	28%

Would you recommend the NVO Summer School to colleagues?

27 out of 29 students would recommend the Summer School to colleagues.

5. Comments & Future Plans

Many students wrote about their experiences at the summer school in some detail. This section contains the complete quotations from the student surveys.

Great experience, lots of information, great place, really nice people. I realize that this is my own fault, but sometimes I got lost with all the astronomical jargon and tasks/problems descriptions. Since I am a developer/CS guy I should had a crash course in astronomy science before the school, and will probably do it before the next summer school.

Future Plans: We're going to start developing small, VO-based solutions for astronomers in Brasil (LNA, INPE, USP). We will also start planning the development of the infrastructure of the Brazilian VO and plan a Brazilian VO School (will surely need lots of help for it!)

MISSION ACCOMPLISHED! Overall, a very broad and deep coverage of the VO, its services, tools and uses in the astronomy world. Hats off to the organizers and instructors. This is obviously a tremendous effort that these people must make in addition to their full time requirements back at the office.

Recommendations For Improvement

Follow the "Learning Tree" training model:

Short topics (no longer than 1/2 lecture) with a provided Reference Guide for more detailed information.

Lots of small easy excercies that are trivial to complete with "Extra Credit" ones that are more difficult.

Create separate classes for each specialty track: - OPO - Developer - Tester - Astronomer - Manager

As each class is created in this format, add them to the online web page.

Get course feedback at the end of each day rather then the end of the week. (Learning Tree does this when you attend one of their Beta Courses). That way it is fresh in the mind of the student. At this point, my brain is a bit mushy from it all and I can't recall the specifics. I realize my points listed above require a significant additional effort of (wo)man power and $$$. A training consultant could probably help polish the details.

Future Plans: Build Web services for Galex and MAST back at StSci.

Very good!!!!!!!!!!!!!!

Future Plans: I will try to develop some services for astronomer of my country. I will try to do simpler and reduce the impact for my community the necessity to know many different services, tools and languages. The impact in my research is clear, speed.

It was a tough but learning experience, at this moment the school is very much computer-oriented, which makes hard for astronomers to follow. I agree we astronomers, final users of the VO, must be aware of the technical details, but the school must be redesigned to make those details more easy to learn for astronomers. my personal feeling the first two days of classes, was that i was lost in a jungle of computer terms, i was unable to make a logical self-consistent general picture of all those programming languages and what their place or role is within the VO frame. it was like solving a puzzle without knowing how it should like at the end. if you have the picture of the solved puzzle next to you, you can start putting pieces together and solve it quickly, but if you don't know where you are going, you can be lost for ever. so i think you can do a far better job in the NVOSS by redesigning it, thinking a bit more on the astronomers. despite of all the numerous difficulties i faced, i am pretty much excited about using VO actively in my work. i might no be the ideal attendee for the school, some of the faculty may think that they should have preferred a more computer experienced student. on the other hand, keeping the school only for computer experts, can be really bad for the VO, if you truly want to publicize VO between plain astronomers. so people, it is really up to you, if you really want to make this school astronomer-friendly, then work on it too. otherwise, just accept computer-highly skilled astronomers, because they will really enjoy and take advantage of the NVOSS. many many many thanks for accepting my application to the school, i'll do my best to use VO tools and talk about it to other people, despite of all the restrictions and problems i went thru. the place for the school was great, food as well. i also have some specific suggestions i'll send to feedback@us-vo.org again, thanks a lot.

Future Plans: get a computer scientist willing to work with me some time to: i) go thru all the NVOSS material, and try to make more sense of it ii) make SPM3 a SkyNode, the astrometry group at yale is already aware of this, as well as the system manager of the astronomy dept., we have a server to do so. it should be a matter of several weeks of making this a reality. - future installments of SPM will be published in the VO web page - as i did with USNO-B in my project, i plan to do the same, with further improvements obviously, with the SPM catalog for the magellanic clouds, that should be available by 2008.

The Summer School was an excellent experience overall - I'm really glad I came. I came hoping to learn just enough about coding NVO tools to modify existing tools written by others to meet my needs. I'm not sure if I learned that, but I got comfortable with NVO terminology and technologies. The most useful part was the project. I'd suggest cutting one day from the lectures and adding it on to the projects.

Future Plans: I plan to continue developing the tool I started at the summer school, and to devote some time to learning C#.

I had a little bit of difficulty installing the summer school software. It might be a good idea to have a central machine with the software loaded, in addition to the downloadable package. I enjoyed visiting Aspen. Aspen is a little bit inaccessible and expensive, but is a great location overall. Aspen Meadows Resort was a wonderful host. In retrospect, I wish I had planned to stay an extra day to enjoy Aspen. The language talks weren't very helpful because I either knew the language already or didn't pick up anything I wouldn't have figured out by reading code. These might be consolidated into a few broader talks on programming in general. Talks on VO protocols and services were great. These were the most valuable part of the meeting. I now have a much deeper understanding of the internals of portions of the VO I haven't worked with. I also enjoyed the talks about end user tools. I had been unfamiliar with or had never heard of many of these. It's a shame that these tools aren't more widely known among astronomers. It might be worthwhile to have a small VO workshop at a AAS meeting. Jordan Raddick did a similar thing for SDSS at the Calgary meeting. I got a lot out of the exercises, and I'm happy to have the software distribution. The exercises at the school will make it easier to refer to the software later. The exercises were often difficult to follow because they went too quickly through specific parts. This was a particular problem when the HTML material wasn't fully written or was missing an essential step. Please nag the faculty more about having the supporting material done in time. Do the exercises more slowly. In the project portion of the school, I learned about using NVO tools with more depth than would be possible in a canned demo. This was very good. I would have preferred to work independently, but I felt pressure from the faculty to join a group. I would also have liked to exercise the "rule of the feet" after my partner lost interest in the project, but I'm too nice to do that. I don't have a solution to that problem. Overall, the summer school was informative and enjoyable. I'm looking forward to using what I learned to add to our site and make use of the VO for myself. I would certainly recommend the summer school for anyone who might be interested in astronomy data mining, and for anyone working on an NVO node. I hope you'll continue offering the program.

*Future Plans: Things I intend to do: * minor changes to our conesearch implementation * addition of a skynode based on the new implementation * use the SkyNode portal in my own research * teach others at IU about VO tools * ask our sysadmin for installation of Topcat, VOPlot, etc., on departmental machines. At the summer school I learned about several VO tools I hadn't been aware of previously. I expect these to be very useful to me. In the past, I have been almost entirely a developer of VO applications, but I anticipate being an end user much more in the future.*

The NVOSS was a great experience, I am really glad that I was able to make it over to the US. Thank you very much for the registration fee waiver. Overall I thought the summer school was excellent. The atmosphere was great, the staff were great (very knowledgeable and helpful) and the chance to exchange ideas with all the other attendees was excellent. The highlight was the student project. It was really fun working on something that I otherwise wouldn't have had any time to do. I think we did a nice prototype that will be really useful once its improved. You did a great job of packaging the necessary software, I had no problem setting it all up. I thought the one weakness of the summer school was the level that many of the lectures were pitched at. Generally most people seemed to find them too hard, but for those of us with any experience they did not cover any new material. In particular the programming lectures could be much better. If you can improve one thing it should be the programming lectures. Many people did not have a good basis in programming in any language. Python is an ideal language for beginners to learn, but for them to learn it quickly it has to be pitched at the right level. I have had a lot of experience teaching Python to teachers, school students and uni students so if you want more detailed feedback and/or suggestions please let me know. Several lecturers were really good (although the content was still sometimes pitched at the wrong level): - Gretchen Greene - Ray Plante - Matthew Graham - Brian Kent - Simon Krugoff - Chris Miller I don't want this to sound too negative - I had a great time at the summer school!

Future Plans: As you know I plan to run a small program in Australia next year and the summer school has given me loads of ideas to add to my current plan.

My overall experience at the NVO Summer School 2006 has been without any doubt extremely positive. All the main goals I had at the beginning of the school have been reached and I left Aspen with a strongly improved knowledge about the VO, its structure, its tools and how to publish data to it. Therefore I'm very happy to have participated at the Summer School and would like to thank all the school's staff (teachers+organizers) for the great work. However I think that in some parts the school could be better organized. As a researcher (thus mainly VO user, not developer) my main concerns regard the enormous amount of time (in particular during the first 3 days) dedicated to technical lessons describing protocols, registries, ecc... These lessons required a deeper "technical" knowledge than the one I have, resulting in some cases totally incomprehensible and not only unrelated to my interests. Going back to the first three days, I must admit that very few lessons were useful and that I was starting to ask myself whether I was wasting my time or not. In fact in the current organization I think that ~7 days are too much compared to the real utility of the school for a "VO user". I'm aware that the "technical" lessons are extremely useful and/or mandatory for developers but since they cover a large fraction of the school I'm wondering whether or not it would be possible to organize two different (parallel?) sessions dedicated to VO developers and users respectively. This solution would probably require a more complicated organization and logistic but will allow to have time for going into much more details regarding the technical and/or scientific side of the VO. In fact, from a scientific point of view, great part of the useful lessons give you a very general and superficial view of the tools and of the use you can do of the VO. This is great, since at the moment it is almost impossible to independently "discover" the VO tools through the VO web site. However when (and if) the VO web site would became more "astronomer-friendly", researchers will be independently able to

discover the different VO tools and learn how to use them. In this case the school, in its present form, will loose great part of its utility for a participant interested in using the VO to make science. The most useful parts of the school are without any doubt the exercises done "on-line" during the lessons. I think that they represent a crucial part of the school and that much more time should be dedicated to this stuff. In particular it will be a great improvement if all the exercises would be part of a single great project to develop during the school, and not independent tasks apparently not related with previous lessons and exercises. An idea could be to start from some astronomical data (tables, images and spectra) and proceed step by step building a MySQL database, a web interface, a cone search, register it to the VO and make i t available through OpenSkyQuery, build up SIAP servers and visualitation tools for image and spectra ... and finally use the VO tools to make science with them. In this case the utility of each exercise would be much more clear and also the "technical" exercises would be interesting and useful even for an "astronomer": in some cases in fact I found myself typing commands into a terminal without knowing what exactly I was doing! These are my general suggestions to improve the school and I hope they will be useful for the futures years in order to make these 7 days even more productive than they are now.

Future Plans: The knowledge acquired at the NVO summer school will be use for both technical and research activities. I will use the skills recently acquired to build up a web database for the Arecibo Galaxy Environment Survey and make it available through the Vo. It is difficult to predict what will be the impact of these summer school on my research activity. what I can say is that during the next year I will certainly use and test a lot all the VO tools and software learned in the school during my research activity and if I will definitly "convert" to the VO the impact on my reseach activity will be uge!

Overall, the summer school was a great way to meet new people with similar interests and forge new contacts. I also learned enough to prepare a SkyNode even though I am not a programming whiz. So, I think the summer school was a very worthwile endeavor. However, I do feel more time needs to be spent on exercises and projects...more quality time. Many exercises and talks were simply too fast paced or frought with problems with the networks and/or installations and being able to get things to work, or by the time items were downloaded and portions of exercises did work, the prof had gone on and left us in the dust. Not all speak up when problems are encountered, or profs don't wait to see if things are ok. There seemed to be a fair amount of duplication in some talks, some of which could have been omitted and time devoted to exercises and/or projects. This really needs to be a practical training school pimarily.

Future Plans: I plan to complete work begun in the projects to perpare a SkyNode for my survey data. I will also be providing information and training with our group on the creation of SkyNodes. The summer school has spurred me to complete the project and search the nodes for xmatching info and hopefully provide more useful information regarding the survey candidates.

A bit overwhelming at first, before it became clear what we were aiming to do! In the end it panned out well, but about halfway through I was quite irritated with the

blas attitude of some teachers. While the SQL and XML intro's were both very useful, I felt that the programming language lessons were fairly pointless - too shallow for anyone who has used them, too fast for anyone who had not. I felt that a better use of time would be to go straight to using VO services after SQL and XML, and to break them down more carefully and consistently. One could then split the group up according to who wanted to programme in what (you can't teach a person Java from scratch in a couple of hours!!!). The different groups might then focus on using their chosen language to do VO things for a couple of days. Finally, while the "concensual" concentric desk outlay is good for modern parliaments, it does not make sense for lectures! It is strenuous on the neck for those at the edges, and results in people paying attention to their laptops rather than the speaker.

Future Plans: Publish 3C modelling to VO. Use VO to obtain fluxes for ongoing and new science. Develop SED building tool.

It was great. The resort was great and the food was great. Things like that are important because pleasant food and surroundings make it easy to concentrate on the tasks at hand (learning, programming, etc.). As for the program itself (lectures, exercises, etc.): Some of the lectures were great, some were not. The good lectures were ones that didn't contain too much jargon, and were set at a low level. It would be better for us to do language tutorials before the summer school, so we wouldn't have to spend time on this there.

Future Plans: I plan to publish a dataset to the NVO. I will look into using VOPlot, VOMegaPlot, and TopHat to create contour plots. I don't know about the future.

It was a nice experience in terms of getting acquainted with the various VO tools, the languages which can be used for the development of such tools and the VO applications to science. Though I feel that we can have more mini tutorial on the languages if we want the students to really benefit from the School's (language) curriculum. As an alternative one may ask the students beforehand what is their language of choice and hold parallel sessions accordingly or ask them to do some homework on the basic languages(java,idl,python,iraf etc.) before coming to the School. Although the latter one seems more idealistic than practical. Since the language tutorials are very short and basic these are insufficient to help us write a code(for our project) during the School. Everyone used the languages they already knew or were familiar with for their project work. The science application talks were good and we can have few more tutorials on science applications possibly after lecture hours. I think extending the NVO summer School by a few more days (~ 2 weeks) would greatly benefit students and the VO development as well. It was at times difficult to cope up with the exercises e.g. if you miss a step or make a mistake there was no way you could complete the exrecise. May be couple of tutors(grad students/postdocs trained prior to the School) can assist faculty in helping out the Summer School students especially during the exercises(in case someone gets stuck). I can say that overall I have come back with an overview of what all can be done.

Future Plans: I plan to learn few languages such as java, idl or python, atleast acquire some working knowledge. I have already been using few VO tools such as voplot, topcat, VO3D, vomegaplot, voconvert for my AGN projects. I plan to extend my

VO regime to other tools taught in the School and to familiarize my colleagues with these, for instance, many would find the cross correlations in open skyquery very useful i.e. in general create more VO awareness. I plan to use more of the votools and give suggestions for improvement/add to the wishlist.

I enjoyed the Summer School very much, and thought it was very useful in becoming familiar with the current services and tools available.

Future Plans: I would like to find the time (whether at work or on the side) to develop, or assist in the development, of high-level tools for astronomers. Once current projects at work stabilize, I'd like to begin implementing tools associated with future VO services we plan to provide.

I had a great time and learned alot. The level of difficulty of the class material was very good. It was sometimes very difficult to keep up during the sample sessions when the instructions allowed cut/paste for UNIX and I was using a Windows computer. The scope of the class was very good except I would have prefered that the order of the classes been such that we began using some of the tools on the first day so that we had a context for the details (XML, VOtables, SIAP, etc.). I also think it would be better to split into separate groups for the langauge presentations so that more detailed information can be supplied for each language and users do not have to hear about the basic syntax of a language that they do not use.

Future Plans: Provide research support for the Astrophysics Science Division at NASA/GSFC. In particular support planning of Dark Energy/Planet Finder missions.

The NVOSS06 summer school immersed me in the protocols, science applications and opportunities of the NVO. I felt encouraged to develop tools, to use the tools to visualize and acquire data and to tell others to use these tools. The primary difficulty during the experience of the VO school was that many excercises which may be useful were skipped or suggested to work on later. These exercises need to be either done during the lectures or packaged in a way that encourages the user to try them each night even though the student is exhausted from the pace. I would not lengthen or shorten the meeting. At first thought I felt like more project time would be warrented. But in conclusion I think we had just enough time; the evidence was I think in that almost everyone got their projects done!

Future Plans: 1. Continue to develop VO Tools, especially federating data clients. 2. Use NVO resources to make the datasets I develop av to the community. 3. I hope to have NVO development and NVO science become more and more of my work effort in the future.

The summer school is a great way to get the most out learning new software and picking up on astronomy knowledge that does not cover your area of research. The relaxed atmosphere helps greatly and much knowledge can be attained. Great stuff!

Future Plans: I will use the summer school knowledge in the rest of my PhD research impacting greatly on my thesis and on my future plans especially if i decide to move on from astronomy. In this respect the software side of things picked up during the summer school will help me greatly.

Overall, I found the NVO summer school to be a very valuable and fun learning experience. I felt I was on the edge of being completely overwhelmed most of the time which can be both good and bad. I felt that some of the excercises/talks were not entirely relevant to me...though I'm not sure what I would've done if the school were split into science and development talks as I was interested in both aspects of the VO. I did feel that more time should have been spent on the student excercises so we could "get our hands dirty" using the VO tools. Most of the excercises felt very rushed and I was often not even aware of why I was typing certain commands. In general though, I do feel that I've had a valuable cursory exposure to some new programming languages, and I have a much deeper understanding of the purpose, usage and goals of the VO. I fully intend to spread the word...THANKS!

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*I found the summer school staff to be very friendly and enthousiastic and it was a great location. However, I was surprised and frustrated by the program emphasis on development over scientific use. I did not expect the primary audience to be developers, but this became clear fairly rapidly from the material of the lectures (many many such on languages and protocols, and only a couple general talks on scientific use). I am an astronomer and I found it difficult to follow all the developer language, nor did I feel it necessary to try to learn about 6 different ways of doing the same thing. I came to this school in order to learn basic things about the NVO -- how it works, how to use it, and how to put data on the web for others to access. But in the end I had to spend my project time (which was far too short) trying to figure out how to make a simple web SIAP service, since this was not covered in the lectures. 1.5 days was far too short a time for projects, especially since we were rarely given adequate time to do the exercises given during lectures. I would strongly recommend that future summer schools allow significantly more time for exercises and projects and less time and depth of material in lectures. It felt to me as though the lecturers were under pressure to cover too much material and thus the exercise time was often far too brief. Unless you know what you're doing already (which should not be assumed for summer school students!) it's easy to make a couple simple mistakes, or have some trivial system problem that derails an entire chain of exercises because you can't keep up with the rest of the group if anything goes wrong. This happened to me several times and was very frustrating. I think a far friendlier format would be to allow *equal* time for lectures and exercises, and to give at least 2-3 days at the end for projects! I know that this can only be done if there is a lot less lecture material, but really it was too much to absorb anyway. Either that or break the school up into separate tracks for astronomers and developers as suggested elsewhere on this review form. I discussed these issues with many other attendees, and a lot of the scientists had the same difficulties that I did with the program. The developers were more comfortable, I think because, consciously or otherwise, they were the primary audience.*

Future Plans: My reason for attending the summer school was to learn how to serve

images from a database. I would like to apply this to serve survey images from my institution to the public. I hadn't thought about using the NVO for my own science beyond what I already knew about SkyView and DataScope, but having seen some examples of what can be done I will think about ways to apply it to my research. I was particularly impressed with the idea of generating catalogs on the fly using available tools and scripting. I still would prefer to have most data local for my own work, but I will rethink this as new research issues arise.

Good points: . A reasonable intro to the uses and current state of the art of the VO. . Even astronomers with no development experience leave with a sense of importance of the VO and confidence is using it for their research. . Very nice location and strong bonding/collaborative spirit between faculty and students. Bad points: . Targetted mostly towards developers. Needs more planning for non-expert, general astronomers. Perhaps more initial overview talks, which describe how the various technologies and techniques to be presented fit together. Early access to glossaries of terms and perhaps some initial exercises that people can go over before starting the school.

Future Plans: The integration of VO applications with the large scale multiwavelength project of which I am currently a member, is the first, immediate use of my Summer School knowledge. My task for the next year will be quite VO intensive, so I found the Summer School to be very useful.

It seems to me that NVOSS should be catering more to the end-user considering that these are the people who are currently reluctant to use it. I believe that more of a 50-50 lecture-exercise curriculum would increase the level of comprehension, retention, and interest during and after the summer school. This could be accomplished one of several ways, including the development of a workbook in which a set of tutorials are used to explain all necessary topics, allowing the student to gain hands-on experience with each concept, tool, or application. I believe that the majority of people learn and retain best through visualization, i.e. pictures and hands-on activities. What I experienced was more of a line-by-line, one slide after another of detailed information on topics that most participants, based on conversation, have had no (or little) prior exposure to. It seems to me that the current goal of the NVO Summer School should be for the students to gain an overview of the NVO via practical experience to see how one might apply the available tools to a variety of astronomy-based research topics and tasks. It seemed that there was a fairly high level of inconsitency from one talk to the next. This was evident in the talks that included exercises, but did not facilitate, or take into consideration multiple platforms. As well, there were talks that had great exercises and/or diagrams and pictures for reference, and there were others that expressed complex ideas that contained none or few. It was these situations that could have really benefitted from some more attention. Even though we were able to cover all of the material, at what cost was this achieved? I spoke to several other students toward the end of the summer school who said that they were only able to make it through one or two of the exercises as a result of the speed at which the speaker was presenting them. This was very frustrating because even if we did get through all of the material, how much of an opportunity do we have to understand it as we were blazing through. For the more complex/detailed presentations, it might be a good idea to explain how one concept ties

into another a little better with graphical representation. As well, it would be really nice if at the beginning of every session, it was explained how the material covered in that session was going to tie into the bigger picture. NOTE: Regarding the session ratings and such that I filled out below; the talks were good, but there was too much material in a given amount of time, and not enough exercises. In the section below regarding the amount of time spent on specific topics; when I say that more time should be spent, that doesn't mean that more material should be crammed into a longer session, as we tend to do with more time. On the contrary, I think there should be less lecturing, lecturing should be at a slightly higher level, and there should be more exercises.

Future Plans: I plan on using it to further expand the NVO project that I am currently working on with another student.

Sorry for the lateness of my reply. It was a lot at me all at once and I was very overwelled by it all. However, it was a good experience. Getting overwelled is a good way to humble yourself and realize you are not the astronomer / developer you think you are.

Future Plans: First off, I plan on sitting down with some books and learning several programming languages. Also, several faculty at BYU want to become very involved with the NVO. I've already been asked how much I need to make and SIA for a telescope we are getting in a few years. As for how this will effect my Brown Dwarf research, I'm not sure since I've only just barely jumped ship into the field. But my advisor was very pleased that I went to NVOSS, so I'm assuming the NVO can / will be used at some point.

It was outstanding opportunity to learn about the basic technology behind the VO in more details than could be seen from ADASS lectures and proceedings. Extremely valuable are the practical excercises (also it could be devoted more time to them - rather than display ppt slides too long use longer time for going through exercises slowly - this was too fast and if the setup as not correct we could not follow the next exercise ....) and the unique project development time to practise all on real problem. More time should be devoted to learning practical work with VOPlot, Alladin.. and include something about spectra too - VOspec, Specview..

Future Plans: 1) propagate the VO ideas by teaching students (I have scheduled 2 lectures about VO at both main Czech universities (Charles and Masaryk) during October 2) I want to create archives of 2m telescope observations with VO access 3) I hope I will participate on development and testing of VO-enabled tools for stellar spectroscopy an participate in defining standards for mainly SSAP (emphasizing e.g. echelle spectra)

It was amazing to learn many of the possibilities that the NVO offers to astronomers. I believe that we, astronomers, have not fully exploited the resources of the NVO. This was a great experience for me.

Future Plans: I am using right now. I will teach my students to use the resources of the NVO. I already started many collaborations that will use NVO technologies.

The NVO school offered a great way to develop my existing computer skills, obtain a better understanding of possible ways to use VO tools to leverage my science research, and some time to think about developing possible tools for my science group. I was very impressed with the setup and presentations. Every lecturer was extremely well prepared and there was a cohesiveness to the whole experience that suggested much thought was put into the organization of the school. An exellent experience overall.

Future Plans: I hope to be able to use my knowledge acquired to in my work on the SWIFT program at NASA GSFC. The NVO school gave me several ideas about how to better offer SWIFT data for the public and programs and applications that would be useful for the SWIFT team.

The Summer School is an excellent idea and I believe necessary to get the VO in the astronomer's toolkit. Common among most students was the thought that it was too much in too little time. (Ie. perhaps a bit too detailed/technical in many lectures). Overall a great great experience though. I would recommend it to others.

Future Plans: For me, it was more learning about how the various technologies of the VO fit together, and how the end applications utilize them all. I wanted to know what kind of research astronomers planned/wanted to do with the VO tools. I came away with a decent sense of this and can use this basis to do further investigation on my own. As well, the picture of the VO project as a whole is a bit more clear.

I had a great time at the summer school and I certainly learned a lot about NVO, especially on how to use VO Tools and VO Services in scientific projects. The location and the facilities were great (perhaps a bit too fancy for me, hehe) and the faculty was very helpful. I do not have much knowledge on computer science but I was able to complete most of the exercises in the lessons. I found it difficult to follow all the instructions in the lessons, at the same time as the lecturers, but since we got the presentation files, I could complete the lessons afterwards. So, in general, the summer school was very helpful to me and I intend to use a lot the knowledge I got (see question 3 below).

Future Plans: I plan to use VO Tools and VO Services in scientific projects, similar to the one presented at the summer school (fossils groups). In particular, I think VO excels in multi-wavelength studies and in any works that involve cross-matches and large databases (Sloan, for example). Later on, I might also develop VO services. I also intend to pass along the knowledge I acquired at the summer school to the Brazilian astronomical community, helping develop the incipient VO in Brazil. In order to do this, I already have scheduled seminars and lessons about it. Since most of the astronomers here in Brazil are not developers, my focus in those seminars will be on how to use NVO tools and services.

I enojoyed the summer school. It was nice to understand the latest VO status. I think that it would be nice to have more scientific topics related to the VO.

Future Plans: I will use the knowledge to prepare our data archives.

Actually, pretty good. Same, at greater length: Clearly the NVO is just becoming something that is publicly consumable -- and it's impressive that there's so much that works so well. Amy and I are planning on giving a talk in our home department to show them all the neat stuff that we learned. Having said that, there are three specific (and hopefully constructive) criticisms of the summer school. Firstly, the curriculumn seemed to have a very strange order. It seemed like in the first few days there were presentations on, for example, building web services -- when we didn't know what a cone search or a registry was, much less a web service! I think imposing a curriculumn would help with about half the frustration the students felt. Secondly, for the most parts the exercises were very difficult to keep up with. There are probably good reasons why we were led through these instead of left to our own devices during the class times. However, if we're to follow along so quickly, it would be great to have a clearer presentation. Perhaps enforcing that every exercise describes the goal, the technology used, and the form of the result. Listing the computer commands given on a seperate web page, or at least clearly differentiating the input we're supposed to give from the output the computer is supposed to print out. Presenters who didn't provide files for the intermediate results often lost students when the student ran into trouble. The only other thing has to do with the "scripting languages portion". It was very clear that none of us were going to learn how to write in that language from these talks, and if we already knew the language we also didn't find out much that was interesting. Instead of preparing us in this way, I think it would be more effective to tell people to become familier with one of the languages beforehand, and then have short presentations geared towards just knowing how to read each of the important languages. Again, it was good, and it was fun, but it could be presented more clearly.

Future Plans: The most important thing for me was realizing that we didn't have to have the data close at hand in order to use it. I won't feel that I need to create large local copies of datasets in order to use them -- which should significantly reduce the barrier to do that kind of science.

Appendix 3. Budget

The budget for the Summer School was $136,650:

NSF support	$93,650
NASA support	$33,000
Registration fees	$10,000
	$136,650

As of 31 October 2006, actual expenses stand at $140,222. Registration fees fell short of the plan by $2,000, although travel support for participants was about $3,000 less than expected. Accommodation costs for faculty members were higher than planned (we had assumed 10 faculty members, but ended up with 14), and the dedicated network (which was essential for the tutorials and student projects) cost more than twice what it did the previous year. The conference hotel later told us that they had underbilled us last year. Overall we overspent by about $5,600; we have sufficient contingency in the main project budget to cover this amount.

Expenses	**Plan**	**Actual**
Accommodations		
Participants	$88,920	$87,292
Faculty	$22,230	$27,424
Travel		
Participants	$8,000	$9,088
Faculty	$2,000	$0
Per diem	$4,000	(included with Travel)
Internet (DSL)	$2,000	$4,650
Parallel meeting room	$500	$0
Supplies	$3,000	$3,045
Banquet	$5,000	$6,372
Misc	$1,000	$2,351
Total	**$136,650**	**$140,222**
Income		
NSF support	$93,650	$93,650
NASA support	$33,000	$33,000
Registration fees	$10,000	$8,000
Total	**$136,650**	**$134,650**
Net		**-$5,572**