We will demonstrate two applications: other desktop applications.

ABSTRACT
At a minimum, university constituents want timely and accurate data. The focus now is the demand for user-friendly reporting. More specifically, in today’s fast-paced, technology-enhanced world, users want a friendly, web-reporting environment. As these demands increase, it presents challenges for the IR office. At the University of Central Florida (UCF), a major metropolitan university, we are meeting some of these challenges by converting legacy-based reports into dynamic and interactive Web applications using SAS tools, specifically SAS/IntrNet®, and other desktop applications.

We will demonstrate two applications:
- The Enrollment Profile uses SAS/IntrNet, Base SAS, SAS/GRAPH, SAS/Macro Language, HTML, JavaScript, and Microsoft Access to provide the university community with current and historical student enrollment headcount information.
- The Course Registration Profile uses the above tools and SAS/ACCESS to Oracle to provide the university administrative personnel, faculty, and staff with near-live course registration data during registration periods. Historical data are maintained for trend comparisons with previous year’s data.

WHO WE ARE

MISSION
The mission of the Office of Institutional Research (IR) is to support planning, decision-making, and assessment at the University of Central Florida by providing information that is timely and of the highest quality.

PURPOSE
The IR office is a service-oriented unit that provides information and proposes alternative solutions to support the decision-making process. The purposes of the Office of Institutional Research are to assist in the organization and maintenance of institutional data for decision-making, to analyze and interpret data, to provide information which is appropriate and useful in planning and decision-making, and to serve as a catalyst for institutional self analysis and improvement. The director and staff serve on numerous university-wide committees and workgroups and assist with the collection and interpretation of institutional data, assist in planning academic programs, and participate in the implementation of evaluative procedures. The functions of the office support the entire university enterprise.

BACKGROUND
The Office of Institutional Research (IR) has, as one of its primary responsibilities, the task of reporting all official data to internal and external constituents. Staff from the IR office routinely meet with end users and participate in workgroups and committees that deal with data needs and information access. This allows us the opportunity to interact directly with end users and determine, one-on-one, exactly what their data needs are and the format that would best meet their needs. This also has the added benefit of allowing IR staff to more immediately respond to needs and make changes to our new dynamic applications as they are requested.

INTRODUCTION
Throughout the year, numerous official data files and hard copy reports are produced. What we have found very recently is a trend that end-users want more and more data in varying formats. The legacy-based programs are cumbersome to change and the hard copy reports may not be as functional as the user needs. Having a more sophisticated and flexible reporting tool such as SAS/IntrNet has allowed the IR office to better respond to user’s data and information needs.

UCF has been using SAS in the classroom for many years. Thus, IR was able to utilize the SAS knowledge of a member of the Statistics & Actuarial Science Department—Dr. Morgan Wang, Director of the SAS Data Mining Certificate program at UCF. With the assistance of several of his graduate students we began to explore applications built on SAS technology because of the ability to dynamically create and display tables and graphs or charts on the web. As a result of senior level administrators wanting more timely and easily accessible data it was decided that the IR office would lead an effort to use SAS in an “administrative capacity.” Two applications were prototyped and will be discussed in this paper.

ENROLLMENT PROFILE
The Enrollment Profile site was originally conceived as a way for the IR office to be able to immediately respond to (daily) enrollment questions during key times of the year. The IR office was always the source for enrollment data and, before we had the capability to produce the data dynamically from a daily update process, we would have to wait until a hard copy printed out (often a day or two after the request was made). Since our census data file is not submitted until 6 weeks into the term, you can see where earlier data needed to be provided.

HARDCOPY REPORTING
Several hardcopy enrollment reports for each college and/or school at UCF are produced for each of an academic year’s semesters—summer, fall and spring. A page of one hard to read, multiple-page report is shown in Figure 1. These reports were written in COBOL and are difficult to program and redesign. Based on space limitations, adding columns or rows would pose some challenges. One department may have 30, 40, or 50 pages in one reporting term and there are more than 60 departments at UCF. Thus, physical storage room to house these catalogued reports is at a premium and, if a college wanted to collect historical information for each of its departments, it would take a tremendous amount of time and effort just to photocopy that many pages. This prompted us to look for a better way to provide this information.
MOVEMENT FROM HARDCOPY REPORTING
In an attempt to make enrollment information more easily accessible to the UCF community and the general public, the IR office began creating MS Excel files for display on the web. Thus, each semester when the reports are printed, IR's webmistress manually creates spreadsheets that could then be accessed from the IR website and downloaded to a local machine. Figure 2 shows the web display of the report shown in Figure 1. A PDF file is also created manually for ease of printing. This process is repeated twice for the fall and spring semesters, as first a preliminary report is created and then a final report, and once for the summer semester. Although the IR office is now able to provide enrollment information to the masses, it is an extremely labor-intensive process to maintain these types of data sets and static web reports. Also, the type of information provided is limited; therefore, not all of the university's data needs are being met. Thus, what we need is a true dynamic web-based reporting environment.

DYNAMIC WEB-BASED ENVIRONMENT
The decision was made to advance to a dynamic environment that provides information on student headcount enrollments in a myriad of different ways. For example, this application shows enrollments by college, undergraduate/graduate, full-time/part-time status, gender, ethnicity, classification and major in a drill-down fashion. For new students, headcount by student type is available at either the undergraduate or graduate level. This website was designed to replace and enhance numerous hard copy reports and be accessible via the web in a user-friendly, dynamic and interactive environment.

DATA ACQUISITION PROCESS
Using an Open DataBase Connectivity (ODBC) connection and a tool named Shadow Direct to access the student enrollment data on the mainframe, the data is brought into an MS Access database. Then SAS/ACCESS to PC File Formats is used to import the data into a permanent SAS data set. For the current term this process is repeated daily using "Windows Scheduled Tasks" to run two batch programs. The first program runs an MS Access macro to update the database, whereas, the second program runs a SAS program to import the data for use by the application. Historical data is captured in a similar fashion each time a new file is submitted to the state board of education.
Clicking on the “Summer 2003 Detailed Information” button brings you to the page shown in Figure 4. If you want to view information from a previous term and/or year, clicking on “Select Another Semester/Year” provides that option. On this page there are active links to drill-down deeper into the information. You can view trends as in Figure 5 by selecting a link under the “Trends” heading, or clicking a link under the “College” heading will display Figure 6, which breaks down the headcounts by classification, gender, undergraduate/graduate, and full-time/part-time status.

The following code makes the dynamic links by creating a format for the “Trends” and “College” variables that will be used later in the PROC TABULATE statements.

```sas
data acadfmt;
  length label $200;
  set temp(keep=aca acadgrp college);
  retain fmtname 'ACADFMT' type 'C';
  start=aca;
  label=trim('<A HREF="http://www.irweb2.ucf.edu/scripts/broker.exe?"'_service=beta&_debug=0&_program=enroll.coll_trends.sas"&new="&new"&term="&term"&hon="&hon"&year="trim(left(&year))"&college="trim(college)"">') || trim(acadgrp) || '</A>');
run;
```

```sas
proc format cntlin=ACADFMT;
run;
quit;
```

The following portion of code tells SAS to close the output window and send the procedure output to the web browser.

```sas
ods listing close;
ods html body=_webout (notop nobot) path=&_tmpcat (url=&_replay) rs=none;
```

The following is a portion of the PROC TABULATE code showing the format statement.

```sas
proc tabulate data=temp format=comma8.
  .. other SAS statements
  format col $collfmt. aca $acadfmt.;
  .. other SAS statements
run;
```

Then we need to stop the output to the browser and re-open the output window.

```sas
ods html close;
ods listing;
```

Figure 5 displays enrollment trends for summer semesters over the 5-yr period from 1998 to 2002. The Java device driver was used to create this grouped vertical bar chart.

```sas
proc format cntlin=COLLFMT;
run;
quit;
```

```sas
data collfmt;
  length label $200;
  set temp(keep=col college college_name);
  retain fmtname 'COLLFMT' type 'C';
  start=col;
  label=trim('<A HREF="http://www.irweb2.ucf.edu/scripts/broker.exe?"_service=beta&_debug=0&_program=enroll.class_lev_time.sas"&new="&new"&term="&term"&hon="&hon"&year="trim(left(&year))"&college="trim(college)"">') || trim(college_name) || '</A>');
run;
```
There are two sets of active links in Figure 6. The blue links take you to the output shown in Figure 7 and the black links go to the glossary where an explanation is given of how we define the fields for this site.

Figure 6. Headcount by Classification, Gender and Enrollment Status

Figure 7 has dynamically generated links that will display the most recent 5-yr trend for the chosen major when clicked (Figure 8).

Figure 7. Headcount by Major, Gender, and Enrollment Status

As shown in Figure 10, the same data displayed in Figure 1, which was manually entered into an MS Excel spreadsheet, is now dynamically generated and displayed by the click of a hyperlink.

Figure 8. Major 5-yr Headcount Trend

Figure 10. Dynamically Generated Version of Figure 1

The drop-down menu displayed in Figure 9 is created using JavaScript and gives the user immediate access to a particular view without having to drill-down from page to page. Thus, the functionality is interactive—the users have more control over the data they specifically want to see. Each page (except the home page) displays this drop-down menu; thus, a separate macro program containing the script was written rather than repeat the same lengthy code in multiple programs.

Figure 9. Interactive Drop-Down Menu

COURSE REGISTRATION PROFILE

Schedulers and course planners at UCF need a way to track daily course registration such as what courses are being offered, what the daily enrollments in courses are, who the instructor is, etc. in order to provide the university with the appropriate offering of classes. This information changes on a daily basis during the registration period but the previous day’s data was overwritten. Thus, there was not a way to track registrations over time, which would facilitate a decision to open up a new section if needed.

HARDCOPY REPORTING

Legacy reporting can be challenging to work with. Many of our legacy applications used Customer Information Control System (CICS) screens, as shown in Figure 11, that are difficult to change or redesign the views. A specific example is the field length for FIN ENR is limited to three digits and we now have web-based courses with enrollments over 1000, so the first digit is chopped off in the display. Another difficulty is that there is no search functionality and it can be cumbersome to find information on the screen.

The drop-down menu displayed in Figure 9 is created using JavaScript and gives the user immediate access to a particular view without having to drill-down from page to page. Thus, the functionality is interactive—the users have more control over the

As shown in Figure 10, the same data displayed in Figure 1, which was manually entered into an MS Excel spreadsheet, is now dynamically generated and displayed by the click of a hyperlink.
After the university went live with a PeopleSoft Student Administration system, course planners and other people in the colleges and departments were having an extremely difficult time getting any reports containing course schedule information. A web-based class schedule search application was created (Figure 12), but it didn’t provide all of the information that was available on the old CICS screens. At the same time, Dr. Taylor Ellis, Associate Dean of Undergraduate Programs in the College of Business, was developing a static HTML application using SAS for his own use to track course registrations. The programs were run manually and the pages stored on a local machine. Each semester, course information was manually entered to create the hyperlinks, which was labor-intensive for the programmer. What was needed was a tool that would allow anyone access to key registration data, give users control over what type and level of information they wanted to see, and not require extensive maintenance time.

The Course Registration Profile is a web-based application that provides information on course registration based on criteria selected by the user. Graphical and tabular reports show how quickly classes are filling up by campus, college, course modality, undergraduate/graduate, or specific courses. Users can drill-down from course prefix to course number to course section. At the course and section level, the user can access a plot that shows course enrollment over time. As time progresses, we would be able to create historical data files for future trend comparisons. Much of the same technology used in the Enrollment Profile, specifically SAS/IntrNet, is used to dynamically generate the pages and hyperlinks.

This application needs to display more up-to-date information so it was decided to access the PeopleSoft data directly, which is stored in Oracle tables, using SAS/ACCESS to Oracle technology. During peak registration times the data would be refreshed 4 times daily so a “Windows Scheduled Task” was created with multiple running times to run a SAS program. Throughout the day the data are replaced and the data from the last run are saved and stored.

```
RunSASPS.bat
"C:\Program Files\SAS Institute\SAS\8.1\sas.exe" -sysin C:\CourseReg\PSView\Database\getdata.sas
```

The data acquisition process

```
getdata.sas
%macro getdata(daily,all,tmid);
... other SAS statements
/*SAS/ACCESS to ORACLE*/
libname ps oracle user=userid password=password path='data source name'_;
proc sql;
create table psreq.&daily as
select * from ps.PS_CF_CLASS_IR_VW
where STRM=&tmid and CLASS_NBR ne . and
CLASS_STAT in ('A','T','S') and
COMPONENT in
('DIS','LAB','LEC','PER','SEM') and
substring(CATALOG_NBR from 2 for 3)
not in ('903','904','905','906','907','908','909','912','917','918','919','940','941','944','946','949','957','958','970','971','973','980');
quit;
libname ps clear;
... other SAS statements
```

Since it was not required to display graphs or provide calculations on the home page of the Course Registration Profile a standard HTML form is used to collect the name/value pairs needed to begin the application. Figure 13 shows the home page where you can select filters for the information desired. If information for a specific course is desired, ENC1101 for example, a text box is present to type in your request.

```
After clicking the submit button on the home page, the next page (Figure 14) has options to filter the data for a specific department based on the college selected, term and year selections, an option to exclude the display of Honors courses, and the ability to see information for courses where enrollment is at a certain percentage.
```
Figure 15 shows the course registration information by course prefix. SAS/GRAPH generates a pie chart using the GIF driver and the REPORT procedure generates the tabular display. Dynamic hyperlinks to drill-down to the next level are generated as detailed above in the Enrollment Profile. The ANNOTATE facility is used to generate custom displays for the pie chart. The ODS MARKUP destination (experimental in Version 8.2) is used to provide ALT information for the graph to comply with accessibility standards. There is a hyperlink available to display all the sections in a list format and another to go to the class schedule search shown in Figure 12.

```
proc template;
  define tagset tagsets.test;
  parent=tagsets.chtml;
  define event image;
  put "<img";
  put " border=2 alt="SAS Pie Chart"";
  putq " src=" URL "" NL;
end;
end;
run;
ods listing close;
ods markup tagset=test body=_webout (notop nobot) path=&_tmpcat (url=&_replay) style=styles.ucf rs=none;
/*Set Graphics Options*/
options reset=all
device=gif260
  gunit=CELLS
cback=white
  border
  ftext=swissxb
  ttrack=loose
  htext=1.5;
pattern1 value=psolid color=vlib;
pattern2 value=psolid color=CXFB3EB5;
data annotate;
  length function color style $ 8 text $ 25;
  retain function 'label' color 'black' when 'a'
  style 'swissxb' xsys ysys '2'
  position '5' hays '3' size 5.5;
  set temp3;
  if status='sumenr';
  midpoint=status;
  x=50;
  y=50;
  text=left(put(ratio,percent8.));
  output;
run;
data _null_; 
  set temp3;
  if status='sumenr' and ratio>1 then
    call symput('grp','annotate=annotest');
  else
    call symput('grp','percent=outside');
run;
proc gchart data=temp3;
  where number>0;
  format status $statfmt. number comma8.0;
  pie3d status /sumvar=NUMBER
    &grp
    value=outside
    slice=outside
    angle=60
    midpoints='Enrolled'
    'Available'
    nogroupheading
    noheading
    nolegend;
run;
quit;
ods listing;
The listing of all sections (Figure 16) is convenient for department heads who want to see all of a department's offered courses at once. However, printing an HTML table can sometimes be difficult. Sometimes, key information is chopped off at the bottom or top of the page. A hyperlink is available to dynamically generate a PDF file using the ODS PDF output destination available in SAS Version 8.2 (Figure 17). Another hyperlink is available to serve the temporary data set to the browser, first exported to an MS Excel file that can be saved on the user's local machine for data manipulation (Figure 18). A hyperlink is also available to display a data dictionary for some of the data fields in the table.

```
options orientation=landscape
  papersize=letter pageno=1
  leftmargin=.5 rightmargin=.5 topmargin=.5
  bottommargin=.5;
ods listing close;
ods pdf file=_webout style=styles2.ucf
  startpage=never;
```
ods proclabel "Expanded Course Listing";

%let rc=%sysfunc(appsrv_session(create));
PROC EXPORT DATA=WORK.TEMP
OUTFILE="C:\CourseReg\PSView\temp&_sessionid..xls"
DBMS=EXCEL2000 REPLACE;
RUN;

put '<a href="http://www.irweb2.ucf.edu/scripts/broker.exe?_service=beta&_program=sashelp.webprog.filesrv.scl_filetyp=e&_debug=0&_file=c:\course\psview\temp&_sessionid..xls" target="blank">';

Figure 16. Expanded Listing of All Sections

Clicking on one of the prefix hyperlinks in Figure 15 will display registration information by course number for each of the courses beginning with the prefix selected (Figure 19).

Figure 17. Dynamically Generated Acrobat PDF

The TEMPLATE procedure is used to modify the style for the tabular display of the REPORT procedure. The following macro is called prior to the code that produces the table and the style declaration is added to the ODS HTML statement.

%macro style1;
/*Create style sheet for browser output*/
ods path work.templat(update)
sashelp.tmplmst(read);
proc template;
define style Styles.UCF;
parent = styles.default;
replace fonts
"Fonts used in the default style" /
'FooterFont' = ("Verdana, Arial, Helvetica, Helv",2,Bold)
'TitleFont2' = ("Verdana, Arial, Helvetica, Helv",2,Bold Italic)
'TitleFont' = ("Verdana, Arial, Helvetica, Helv",3,Bold Italic)
'StrongFont' = ("Verdana, Arial, Helvetica, Helv",2,Bold)
'EmphasisFont' = ("Verdana, Arial, Helvetica, Helv",1,Bold)
'FixedEmphasisFont' = ("Courier",1,Italic)
'FixedStrongFont' = ("Courier",1,Bold)
"
To change the background color of a cell in the REPORT procedure if certain conditions are met we define a compute variable named “FYI” and then provide the if-then logic.

```sas
compute FYI /character length=40;
if (_C6_ < _C7_) and (_C7_ < _C8_) then do;
  FYI = "RmCap < ClsLim < RegLim";
  call define(_COL_, "STYLE",
    {background=CXD8D8D8 foreground=black});
  call define('_C6_','STYLE',
    {background=CXD8D8D8 foreground-black});
  call define('_C7_','STYLE',
    {background=CXD8D8D8 foreground-black});
  call define('_C8_','STYLE',
    {background=CXD8D8D8 foreground-black});
end;

ods html body=_webout (notop nobot)
  style=styles.ucf
  rs=none;
```

Selecting a course number hyperlink displays each section offered as shown in Figure 20. Clicking the “Course:” hyperlink will produce Figure 21.

**Figure 20. Course Registration by Course Section**

![Course Registration Profile](image)

To change the background color of a cell in the REPORT procedure if certain conditions are met we define a compute variable named “FYI” and then provide the if-then logic.
PROC GPLOT is used to produce the plot in Figure 21 and the ANNOTATE facility is used to put the date of registration below the horizontal axis and to display the numbers above each point.

```sas
data annotest;
  length function color style $8 text $10 position $1;
  retain function 'label' when 'a' xsys '2'
       ysys '3' position '6';
  set temp;
  if number>0 &shw;
    /*Put dates on axis*/
    style=’Arial’; color='black'; x=day;
    y=4; text=put(prev,mmddyyd8.);
    ysys=’3’; angle=90; size=&sz; output;
    /*Label data points with numbers*/
    style=’swissb’; color=’blue’; x=day;
    y=number; text=put(number,5.);
    ysys=’2’; angle=90; size=&dt; output;
run;
```

A hyperlink is provided to compare the course registration with the previous year (Figure 22). Two plots, one for the current year and one for the previous year, are shown using the OVERLAY option of the PLOT statement. Clicking on “Registration Calendar” will display Figure 23 and clicking on a course section hyperlink shown in Figure 20 will produce a plot of course registration over time for that section (not shown).

**CONCLUSION**

Constituents at UCF have a strong desire for dynamically accessible data. New applications were developed to meet user needs, prototyped to the University of Central Florida community, and extremely well received. SAS technology, specifically SAS/IntrNet, has provided the IR office with the tools needed to deliver timely and accurate data in a user-friendly dynamic web-based reporting environment. Once the initial programs are built, there is much less programmer time involved to maintain these types of applications. The IR office intends to continue the movement using SAS to develop administrative applications and serve as a leader in this area of database design and application.

**REFERENCES**

The following SAS publications were invaluable tools used extensively during the creation of these two applications.


ACKNOWLEDGMENTS
We would like to thank the technical support team at SAS for the assistance provided, especially when things were not working as expected.

TRADEMARK CITATION
SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.

Other brand and product names are trademarks of their respective companies.

CONTACT INFORMATION
Your comments and questions are valued and encouraged.
Contact the authors at:

Sabrina Andrews
Office of Institutional Research
University of Central Florida
P.O. Box 160021
Orlando, FL 32816-0021
Work Phone: (407) 823-5061
Fax: (407) 823-4769
Email: slandrew@mail.ucf.edu
Web: http://www.iroffice.ucf.edu

Evangeline Collado
Office of Institutional Research
University of Central Florida
P.O. Box 160021
Orlando, FL 32816-0021
Work Phone: (407) 823-5061
Fax: (407) 823-4769
Email: ecollado@mail.ucf.edu
Web: http://www.iroffice.ucf.edu

Patricia Ramsey
Office of Institutional Research
University of Central Florida
P.O. Box 160021
Orlando, FL 32816-0021
Work Phone: (407) 823-5061
Fax: (407) 823-4769
Email: ramsey@mail.ucf.edu
Web: http://www.iroffice.ucf.edu