Benchmarks - March, 2015

Campus Computing News

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By Dr. Philip Baczewski, Senior Director of Academic Computing and User Services and Deputy Chief Information Officer for University Information Technology

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By the Numbers

Down the Corridor of Years

2011

Benchmarks Online publications from 2011 note:

- January 2011 marked the one-year anniversary of the operation of the Talon High-Performance Computing System (HPC).
- ACUS adds 24 additional processing nodes to the Talon HPC system for a total of 2080 cpu cores in the cluster. 4 compute nodes were added with Nvidia's Tesla M2050 GPU computing module that include 448 GPUs per node.
- The Information Science Building (ISB) is renamed Sycamore Hall.
- Micheal DiPaolo is hired as the UNT System Chief Information Officer (CIO).
- John Hooper is named Deputy CIO for the UNT System maintaining his role as acting CIO for UNT.
- Philip Baczewski is named UNT Deputy CIO with UIT divisions reporting directly to him.
- A number of computing infrastructure and shared services move to a newly created IT Shared Services organization under mangement of the UNT System.
- University Information Technology (UIT) is formed as the new central computing organization at UNT comprising Academic Computing and User

products for awhile, the era of getting a big package of DVDs of the company's software for a one-time really high price (even the educational discount was pretty steep)is long gone. Adobe's most popular products (Photoshop, Illustrator, Premiere, Acrobat Pro) are now bundled in the "creative cloud" and users download the products and then lease them on a monthly or yearly basis. The Creative Cloud Suite contains almost 20 useful and powerful Adobe apps.

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There's still time to register for these upcoming CLEAR Events

By Amber Bryant, Senior Marketing Specialist, CLEAR

Mark your calendars and make sure and register for these upcoming events! CLEAR has some great events planned for this spring.

Read more BOOKMARK

Today's Cartoon

Click on the link above for an information age laugh.

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- Students are able to have text messages sent to their cell phone of choice to alert them every time they get an important message in the Message Center located on the my.unt.edu portal .

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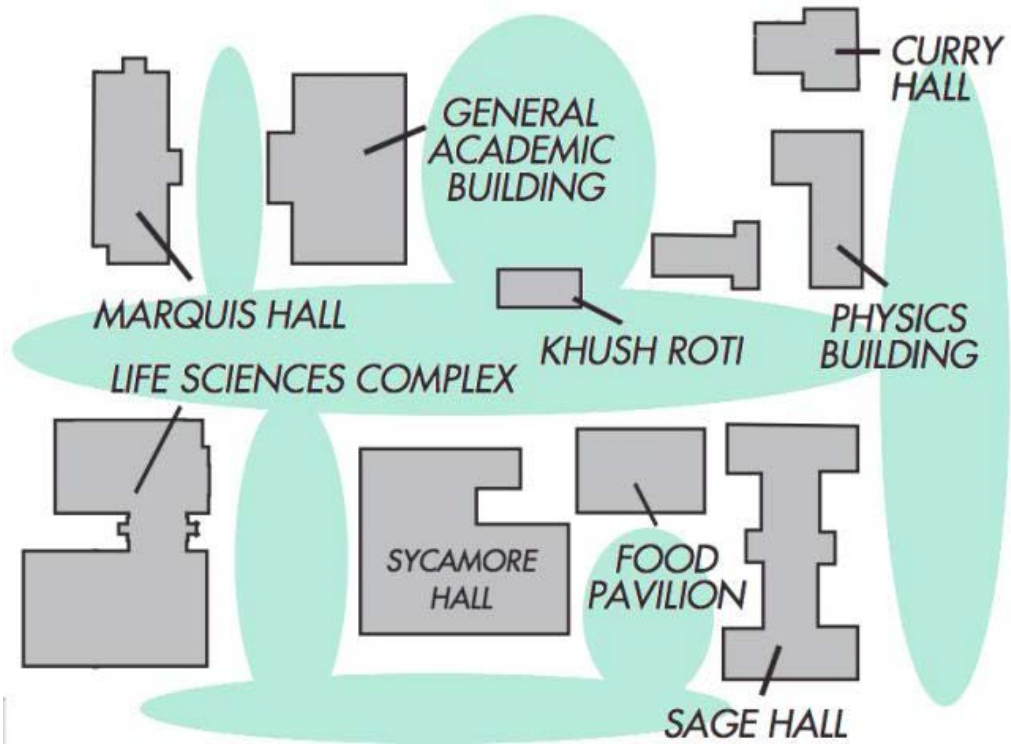
In the October article, we also noted that in addition to the building wireless installations, an evaluation installation of outdoor wireless service was being planned. The goal of this evaluation was to provide wireless access along the major promenades and within outdoor plazas where people gather on campus. Over the winter holiday break, work was completed to install 12 outdoor WiFi access points on campus buildings and the UNT WiFi network now officially extends to some of the exterior spaces on campus.

The area of campus that was chosen for this initial installation of outdoor WiFi access includes many core academic buildings. This is a part of campus that sees quite a bit of student walking traffic and also is includes the location of the temporary food pavilion and its associated outdoor seating. The coverage extends from Marquis Hall at the northwest part of this quadrant to Sage Hall at the southwest point. A building map showing a general depiction of the Wifi coverage is shown below. Areas shaded in green are where the strongest WiFi signals will be available.



The availability of outdoor seating and congregation areas in this part of campus made it an ideal first location for

outdoor WiFi. This project has provided a model for installation of this kind of service on existing UNT buildings and will allow for future expansion as funding allows. Completion of the new Union Building should see extension of the outdoor WiFi access farther south on campus and plans are to encompass the Onstead Plaza near the Willis Library.

Improvement of WiFi network access has been a frequently requested item that has come up on student IT surveys and focus groups. The work that has been done inside and outside of UNT buildings has greatly improved WiFi access on campus and will be of great benefit to UNT students, faculty, and staff. If you want to find out more about how to access the UNT wireless network, visit http://www.unt.edu/helpdesk/wireless/ or contact the UIT Helpdesk at 940-565-2324 or helpdesk@unt.edu.

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How do I learn more about it?

To get started, you may want to check out some of the resources Microsoft has online based on five main learning paths. You can learn how to:

- Get it done from anywhere with Office
- Use email and calendar on the go with Outlook
- Run more effective meetings with Lync
- Store, sync, and share files with OneDrive
- Work within your social network using Yammer.

Check out more training resources!

Try a Quick Start Guide, it can help you get more familiar with Office products by serving as a reference.

Download Office 2013 Quick Start Guides

A comprehensive list of training resources is available, by clicking on the icon below for Office 2013 and Office 365

If you want to know more about a specific application or service, then click on the video tutorial icons below to get you started

Remember we're here to help!

We realize that questions can arise as you get more comfortable with utilizing these applications and/or services to accomplish certain tasks. Feel free to visit our FAQ section on the ITSS website https://itss.untsystem.edu/faq

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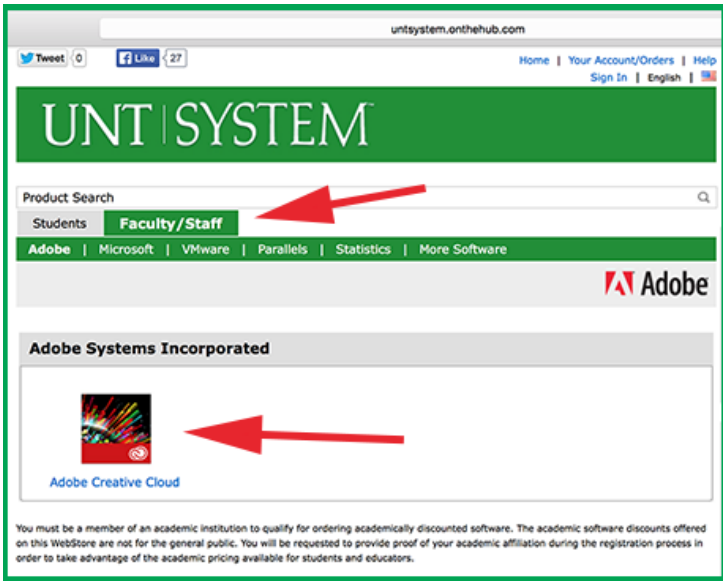
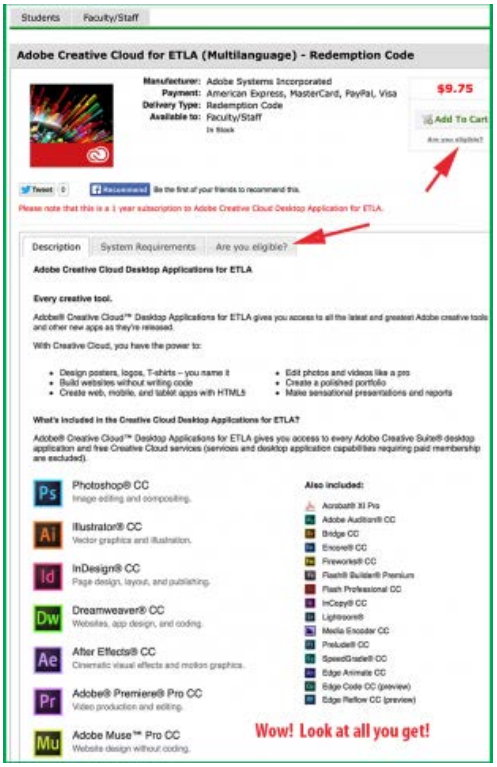
For UNT *students* (and actually any students), the monthly lease for the Creative Cloud Suite is $19.99. So they will pay approximately $240 per year for these products. This is a higher price than the discounted "boxed software" that used to be available but there are a few advantages. For one thing - you only need to pay "Adobe rent" during the month(s) that you use the products (though it can be a bit of a pain to re-activate all the time). For another - you always will have the latest upgrade of the products during your lease time. However - the deal that UNT has for *faculty and staff*is definitely more of a winner. Faculty and staff at UNT lease the Adobe Creative Suite for **$9.75 for a YEAR**! Now THAT is a real bargain! A nice little perk that I am now going to show you how to access and utilize. As always - remember that these are for HOME USE. If you need Adobe products on your UNT office computer to do UNT-related work with, please contact your network manager and he/she will install those items for you.

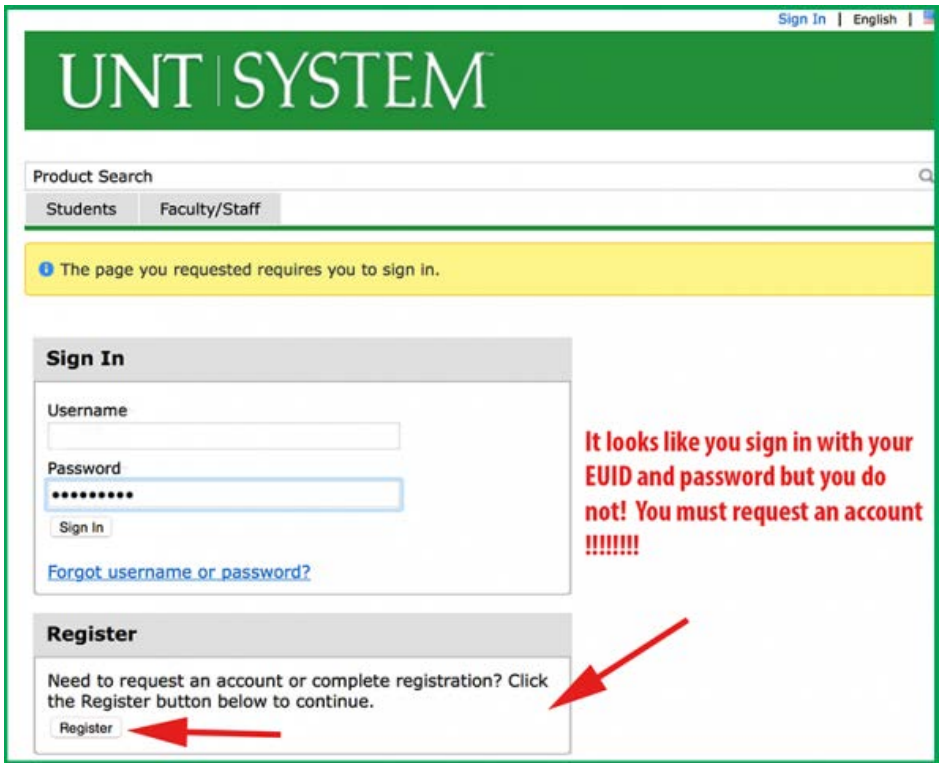
The Adobe Creative Cloud yearly subscription is available to UNT faculty and staff via https://untsystem.onthehub.com. Make sure you have clicked on the faculty/staff tab to get the proper price:

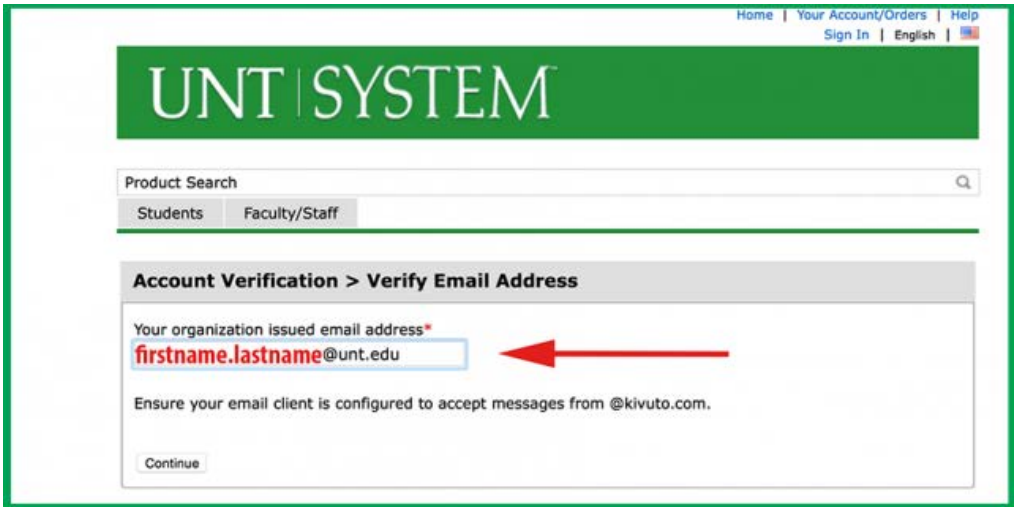


When you click on the Adobe icon you will get to a purchase page with variou tabs. You will not be able to purchase the product until your eligibility is confirmed, so click on the *Are you eligible?*tab or on the button underneath the price:

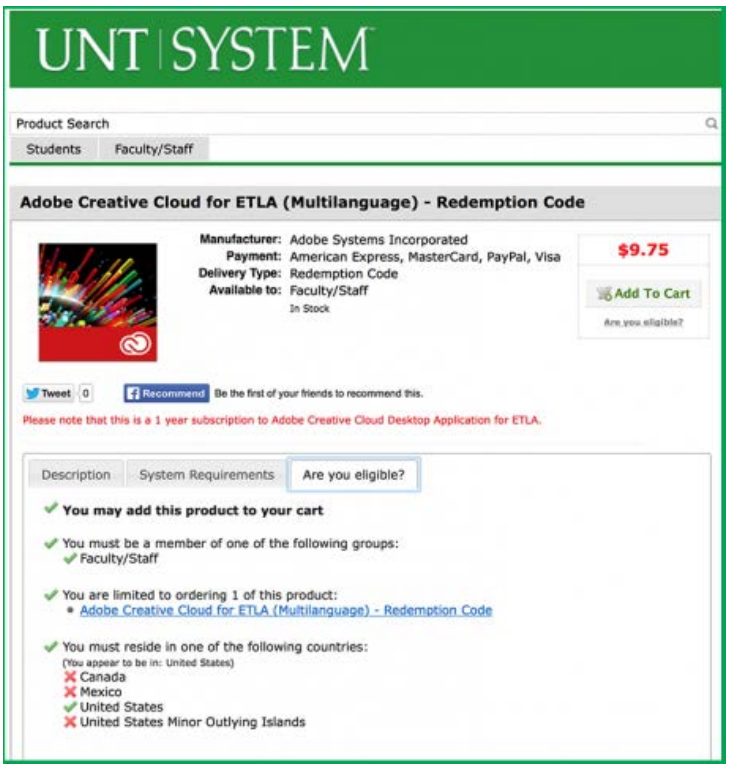


Once on that tab you will see a link to *Your Eligibility*. Now, here is where it gets a bit confusing (at least it was to me and also to some of the faculty members I have assisted with this). The page that comes up has UNT System on the top and a login which I naturally assumed was like all of our other login pages: put in your EUID and current password or your UNT email address and current password and away you go. Well - it does NOT work like that at all and now I am going to save you the 30 minutes it took ME to figure this out: Click on the Register button. You will be asked to put in your email address (use your UNT email address to qualify) and then to pick a password. It is VERY IMPORTANT that you remember that password because you will be using this email and password AGAIN to get your activation code:

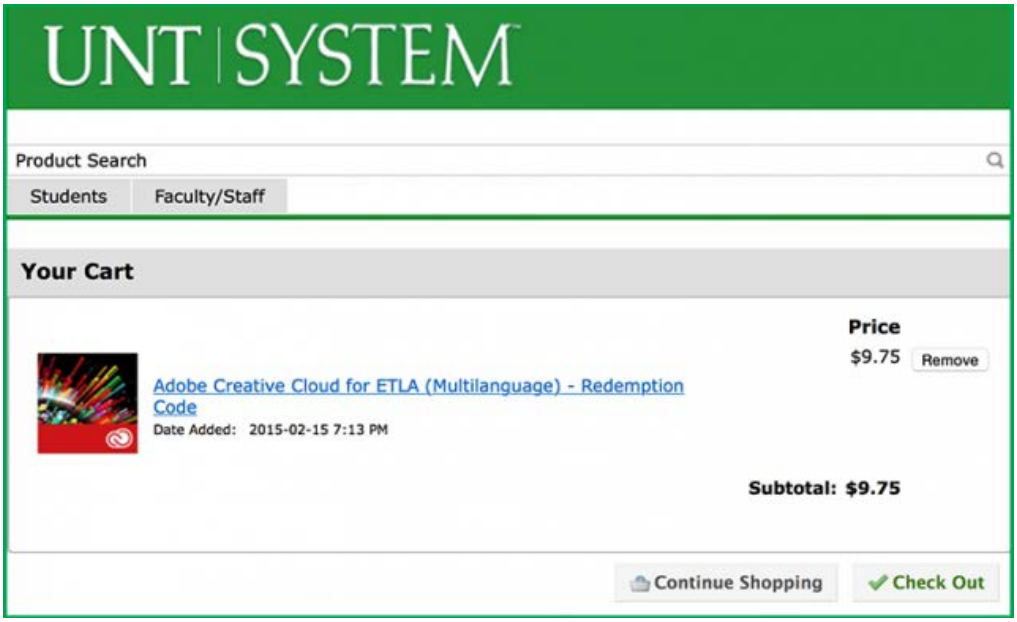


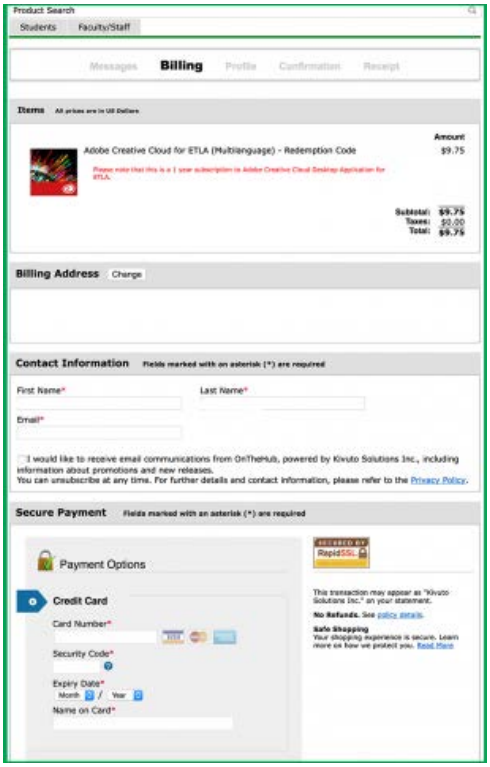


After you complete this task, when you return to the purchase page eligibility tab you will see that you are now fully qualified to purchase your product:

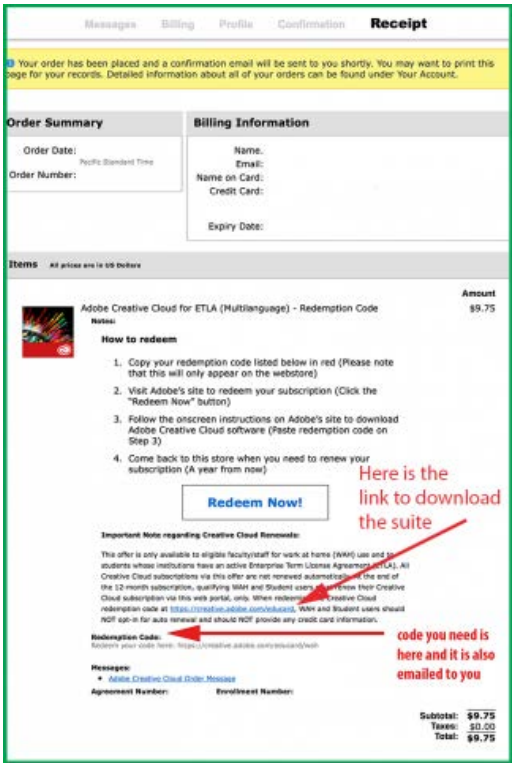


Add the product to your cart and now you will go through the standard online purchasing screens that you find at all your favorite online stores:

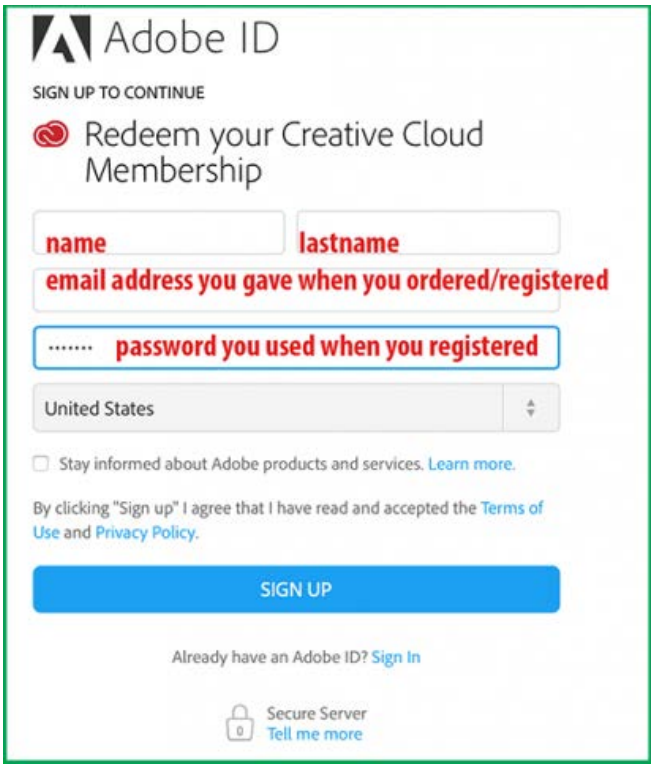




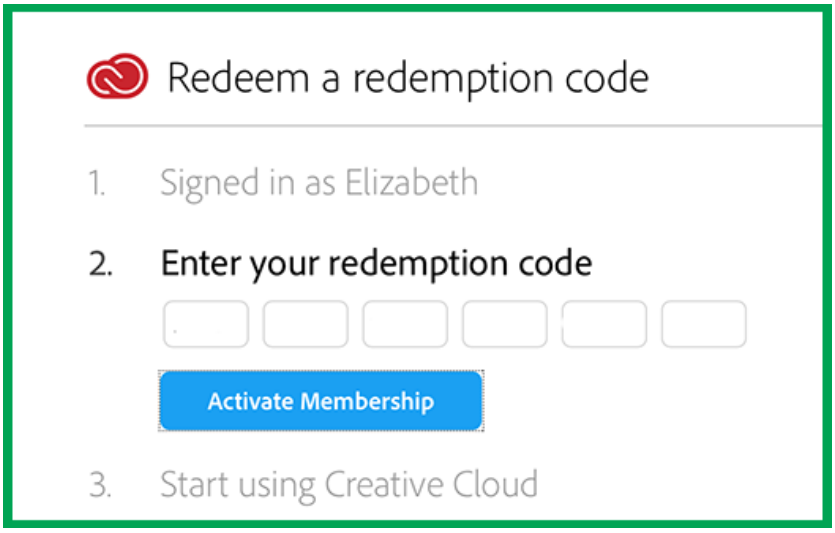
After successful purchase you will find your Adobe authorization code on the **Redeem Now!** page. You will also be emailed this code. Notice that on the VERY FINE PRINT of this page is the link where you download your purchase: https://creative.adobe.com/educard:



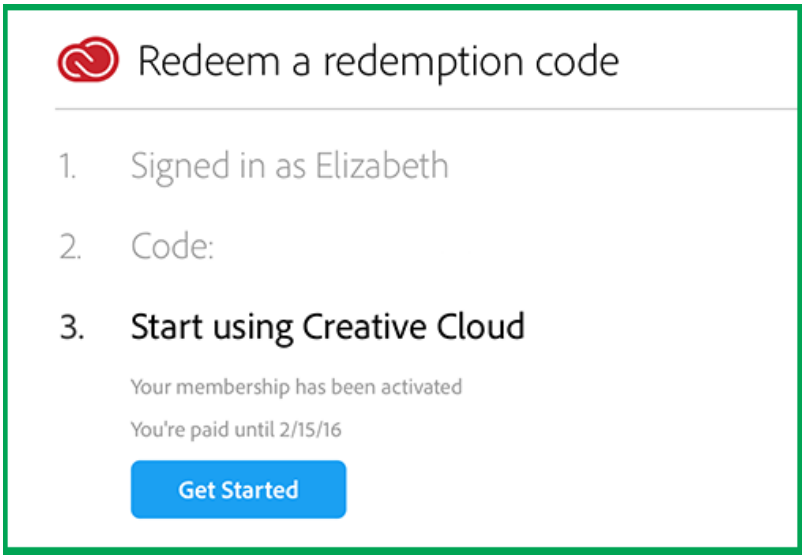
When you get to the Adobe site, put in your email address and password that you used to register for eligibility (see, I told you that you needed to remember it!):

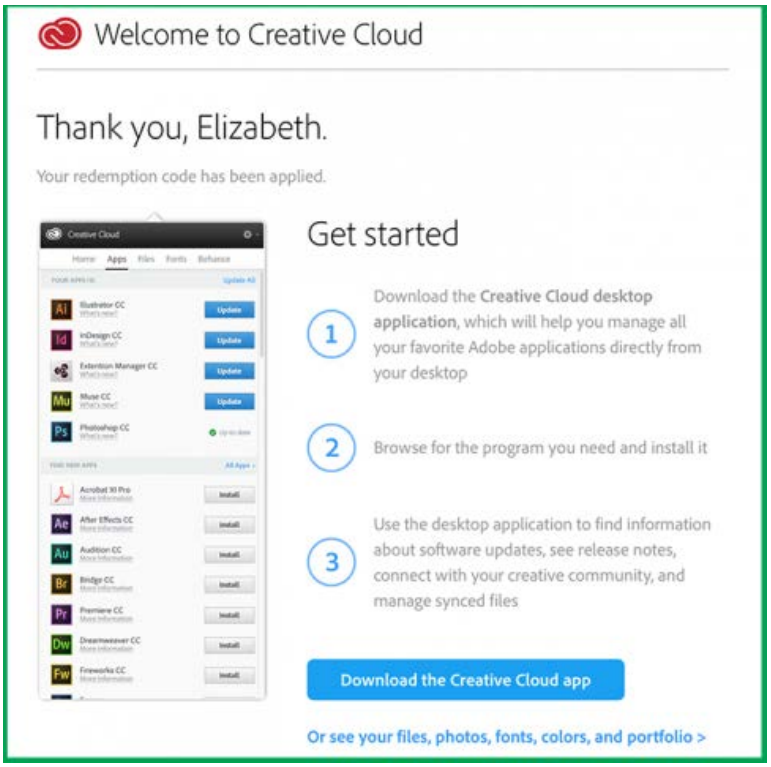


Enter your redemption code:

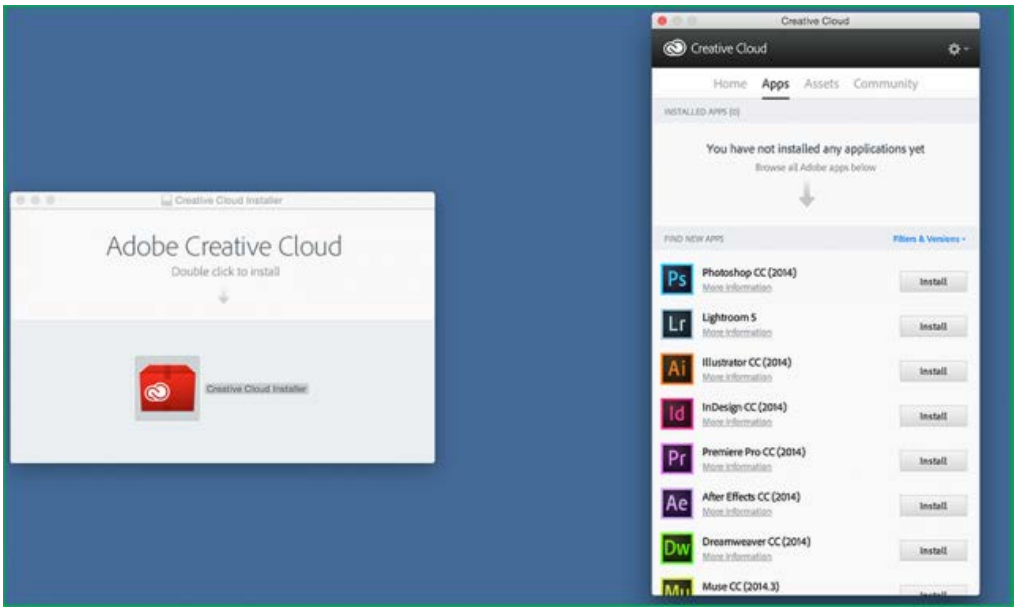


After success, click on the Get Started button and you will get access to all of the Creative Cloud Suite.





After downloading, you will get the Installer for the Suite (please note that I am using an iMac for this demonstration but it works the same way on a Windows machine) and you can choose which apps in the Suite you wish to install:



After installing the products, they are yours to use at home as long as you renew the yearly lease ($9.75 per year). This is a real bargain and I encourage everyone to try it out! A few things to note: not all of the Adobe products are included in the Creative Suite. Adobe Captivate (for making desktop demonstrations etc) is not included in this package. You have to buy this separately (it is not a lease, it is a standard onetime purchase) for the educational discount price of $299. Since you would probably be using Captivate, however, for UNT teaching or other work-related duties, you would probably not be using it at home. Your UNT network manager can install Captivate for you on your office machine if you need it. (I use Captivate at work often to create podcasts and tech 'how to's'). Also - if you are a multimedia professional or want to create Shockwave games and presentations and/or mobile apps, the product you would use is Adobe Director. Director does not have an educational discount price. It costs $1,000 or if you are upgrading, the price is $299. Those are the primary Adobe products that are not included in the Creative Suite.

So whether you are creating killer illustrations for an article or presentation or doing scrapbook pages and home movies of your latest vacation, the Adobe Creative Suite can be a useful home computing product for you. If you have any questions about this UNT discounted product feel free to direct them to me at ehinkle@unt.edu. In the meantime, Happy Creating!

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Network Connection

By Dr. Philip Baczewski, Senior Director of Academic Computing and User Services and Deputy Chief Information Officer for University Information Technology

Thank you for Sharing

If there's anything the Internet is good at, it's enabling the sharing of information and resources. You might say that sharing is in the Internet's DNA. The Internet and other wide area networks changed the way that information is communicated and was a revolutionary idea 30 years ago. Inventions such as the World Wide Web were intended to make information more quickly and readily accessible, and it seems to have fulfilled its original promise.

Sharing was also a part of the original culture of the Internet, springing from its roots in higher education and research. Since most Universities have the generation and dissemination of knowledge at the core of their missions, the Internet represented a mechanism to share information and knowledge more broadly than ever before and wide area networking was not only developed by, but also adopted as a tool for higher education. Ironically, as the Internet was adopted in the commercial world, the culture of sharing was in conflict with proprietary and economic concerns and those who attempted to share or share in collections of commercial resources (remember Napster?) were labeled as pirates and thieves (thank you for not sharing.)

The sharing economy

Now, sharing has made a comeback in the form of the sharing economy. Another strength of the Internet is the ability to connect individuals that would previously have never found each other in a slow-paced world of analog communication. Making these connections allows economic transactions between individuals who are geographically or otherwise remote from each other. A prime example is eBay, the online auction site that turns your previously garage-sale bargains into items for the discerning collector. eBay works because it expands the marketplace for goods, but more importantly, it supports direct transactions between individuals, without the need for a corporate me. As Forbes puts it, "The sharing concept has created markets out of things that wouldn't have been considered monetizable assets before."

Beyond selling your goods or services online, is the ability to "share" your capital assets as a method of income generation. The most prominent examples of this kind of sharing are the Uber and Lyft car services and the Airbnb room rental service. Uber and Lyft let you "share" your car with others in your community who will "donate" some funds to you for the trouble. Both of these services rely heavily on mobile apps to both match up a driver with a rider and to track the reputation of drivers and riders with ratings of each by the respective participants. Similarly, Airbnb lets you share a room or residence with travelers looking for a place to sleep while they are away from home.

These new services have met with their share of push-back. As we've seen before with the music industry, when you change the mode in which goods and services are provided, those with the control and financial stake in the status quo are likely to fight the adoption of the new paradigm. Taxi companies and others are suing to stop the operation of or more tightly regulate Uber and Lyft. Airbnb has faced an agressive negative campaign in New York City, and the imposition of the hotel tax in San Francisco. In spite of the dire predictions to the contrary, online delivery of music has not destroyed the "music business" nor are the alternate transportation and lodging available through Uber, Lyft, and Airbnb going to put taxis and hotels out of business. What it will do is provide more options and convenience and cause taxis and hotels to be better competitors in the marketplace, which should be a good thing for all of us. (Capitalism 101?)

The sharing economy doesn't end at goods and services. It applies to ideas and funding as well. Crowdsourcing is not a new idea, but it is one that is made particularly more accessible by the availability of the Internet. One kind of crowdsourcing is crowdfunding. Kickstarter is an example of a successful crowd funding service that supports creative projects in various genres. Often, "investments" in such projects come with preferred access to whatever the product is, such as an album of music or a technological device, but Kickstarter is more like the

National Endowment for the Arts than the New York Stock Exchange.

Another interesting kind of crowdsourcing is microwork. Microwork makes small tasks available for small amounts of compensation (Internet piecework, if you will.) One example is Amazon's Mechanical Turk site that presents a number of tasks, offered by various sources, and paying small amounts per task (usually pennies) assuming that you have the qualifications for completing the task. The combined workforce of the Internet population will magnify those microtasks and possibly provide a reasonable productivity return for the requestors.

Finally, there is the opportunity to share your computing capacity. Programs like SETI@home and Folding@home let you contribute to scientific research project by using your computer do some computation when it would otherwise be idle. SETI@home is the longest standing project, dating back to 1999 and seeks to detect intelligent life outside of Earth through detection of patterns in radio signals received from space. Folding@home seeks to understand the function of proteins by simulating how they structure (fold) themselves at the molecular level. Put together, all of the computers with Internet access could make the largest supercomputer imaginable.

A massive marketplace ...

In the early days of the Internet, hopes were that we would see it develop into a massive library, a sharing model that easily projected onto this new technology. In fact, library catalog systems were some of the first resources to become widely available on wide area networks. But, what we've also ended up with is a massive marketplace connecting people to goods and services in numbers that were previously not imagined and that also enables new paradigms for provision of goods and services. I have a feeling we are only seeing the tip of the sharing economy iceberg. The thing about icebergs is you never know when one will get in your way.

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Link of the Month

Security Awareness Training

Information Technology Shared Services (ITSS) reminds us that **all full-time employees** must participate annually in security training using the SANS Institute Securing the Human online tutorials to improve overall security practices. **Full-time employees** should have received an email from noreply@securingthehuman.org on March 4, 2015 with instructions on how to log in and participate in required online security training. The training is comprised of 11 different videos that are 2 to 5 minutes long, so employees can complete the training during their work days. There will be one assessment question at the end of each video.

Once all courses are complete employees will have the opportunity to print a completion certificate and earn one Continuing Professional Education (CPE) credit.

New employees will complete training during on-boarding and will not need to complete the training this academic year.

Part-time and Student Employees

Per licensing restrictions, part-time employees – including student employees – can continue to access their training by visiting:

itss.untsystem.edu/securitytraining

For more information about security standards visit:

itss.untsystem.edu/security

Questions can be directed to:

ITSS-securitytraining@untsystem.edu

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Helpdesk FYI

By Jacob Flores, UIT Support Services Manager

Chatting in EagleConnect

Last month, we covered where to get the Microsoft Lync client and how to install in on your machine. But, what if you need something more flexible that can be accessed from any other computer to quickly chat with your classmates? No problem Ð EagleConnect has you covered.

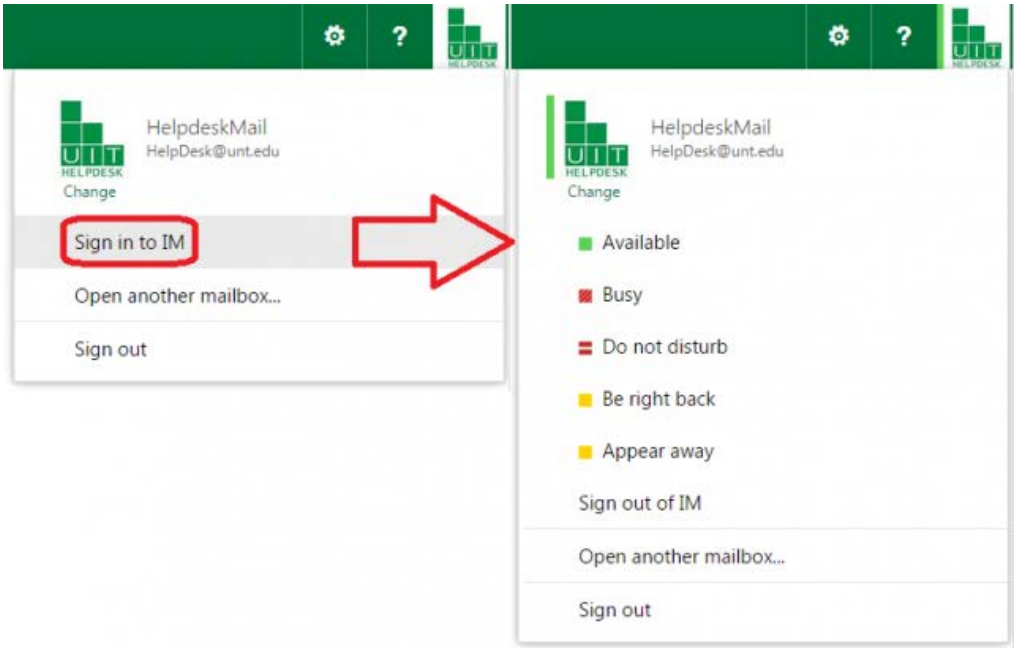
Note: The Chat function in EagleConnect is only available to current students; alumni and Retirees will not have the chat function at this time. Current students can find current employees in the public directory, and vice-versa.

Set your Availability

Set your availability to let others know if you are available to instant message. You can do this using the following steps:

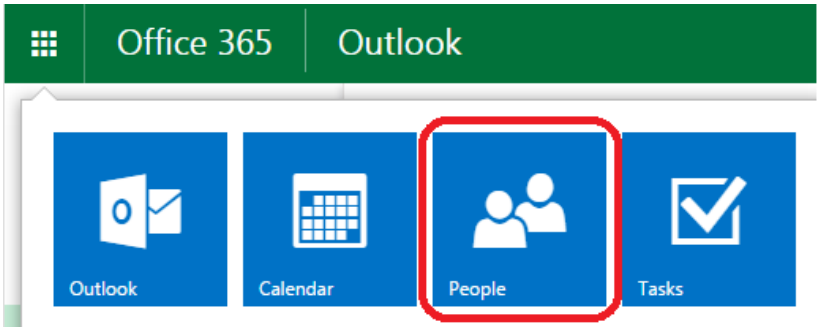
1. Click on your avatar in the top right-hand corner to display a drop-down menu.
2. If you are not automatically signed in to IM at the point of log-in, you will need to click "sign in to IM."

Once you are signed in, you will be presented with a list of availability options. You may choose the one that best suits your current availability. The color shown to the left of the availability option you choose is what will be seen by others when they try to send you an instant message and when you send an email.

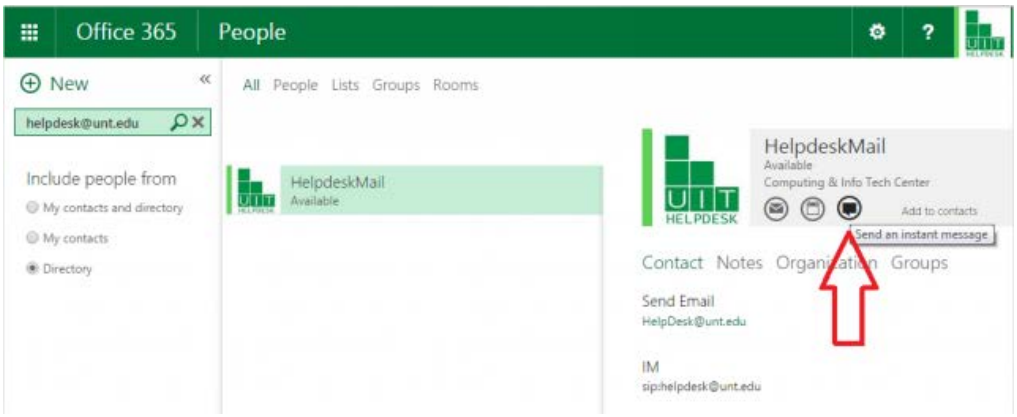


Start a new chat

1. In EagleConnect navigate to your **People** tab.



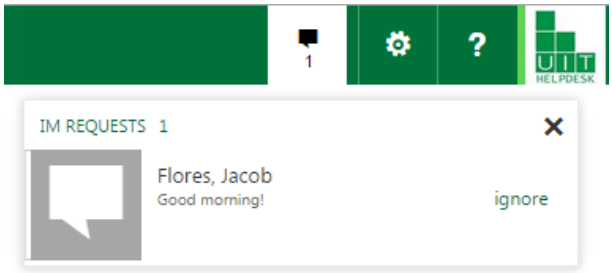
2. You can select one of your existing contacts or use the Directory to search.
3. After selecting a contact, click on the Instant Message icon under their name.
4. When a contact is online and available, a green bar will appear next to their image.
5. A new window will appear allowing you to chat with your contact.



Accept a Chat

When someone wants to chat with you a small chat icon should appear near the top right when logged into your EagleConnect account

1. Click on the chat windows to accept a chat session.
2. Press **ignore** if you would rather not chat.



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Confirmatory Factor Analysis and Structural Equation Modelin Group Differences: Measurement Invariance

Link to the last RSS article here: Data Reduction for making Comparisons: Principle Component Scores. -- Ed.

By Dr. Jon Starkweather, Research and Statistical Support Consultant Team

This month's article focuses on an explanation of measurement invariance. This article is specifically oriented toward the context of detecting group differences among latent variables for confirmatory factor analysis (CFA) models or in a structural equation models (SEM). Social scientists are often concerned with identifying group differences (e.g. differences between genders, ethnicities, locations, etc.). SEM is often applied in an effort to model the complex relationships of latent variables between groups for CFA-type models. Therefore, it is likely that many social scientists would find this article useful as a means to evaluate group differences among complex latent variable model structures. Attempting to evaluate or discover group differences among latent variables is necessarily complex due to the underlying factor models which support the latent models (i.e. SEM). So, it is necessary to recognize such complexity and evaluate the sequentially imposed constraints on the group differences – which implicitly leads to a discussion of *measurement invariance*. An excellent reference for this material is a *relatively* new book by Beaujean (2014), particularly chapter 4.

Measurement invariance is not a single unified concept; although generally we can define measurement invariance as stable measurement parameters across multiple groups, settings, and time periods. Commonly, the parameters referred to in the previous sentence refer to the factor structure (i.e. specific observed variables to latent variables, etc.), factor loadings, intercepts, and the latent variable means of a measurement model (i.e. factor model). Typically, there are a series of sequentially imposed measurement constraints, ranked as level 1 (configural invariance), level 2 (weak invariance), level 3 (strong invariance), and level 4 (strict invariance). Configural invariance refers to the *configuration* or structure of the factor model (i.e. which observed variables go with which latent factors). Weak invariance refers to factor loadings (and configuration) being the same between two groups, settings, or time periods. Strong invariance refers to the intercepts (configuration, and loadings) of the factor model and strict invariance refers to the latent variable means (configuration, loadings, and intercepts) being the same between two groups, settings, or time periods.

Testing for measurement invariance consists of a series of statistical hypotheses that assume population group factor parameters are equal between the groups. Fortunately, there is (of course) a function in R for testing measurement invariance in CFA and SEM models. The package 'semTools' (Pornprasertmanit, et al., 2015) contains the function 'measurementInvariance' which will be demonstrated below. The 'measurementInvariance' function takes a 'lavaan' package (Rosseel, et al., 2015) model object and raw data and tests the fit of the object while checking for chi-square (and fit indices) differences between two (or more) groups.

The examples

First, we import some (simulated) data. Keep in mind, the data is available for readers to duplicate what is done in this article by using the script shown in the article (script also available here; data available here). The data includes

two groups ($n_1 = 500$ & $n_2 = 502$) with ($N_i = 1002$) responses on ($j = 24$) variables (x1, x2, x3, … x24).

```
df.1 <- read.table("http://www.unt.edu/rss/class/Jon/ExampleData/measInvar_df.txt",
                   header = TRUE, sep = ",", na.strings = "NA", dec = ".",
                   strip.white = TRUE)
summary(df.1)
```

```
   group            x1                x2
 Min.   :1.000   Min.   :-3.703924   Min.   :-4.24310
 1st Qu.:1.000   1st Qu.:-0.843175   1st Qu.:-0.88901
 Median :2.000   Median : 0.076019   Median :-0.06182
 Mean   :1.501   Mean   : 0.001051   Mean   :-0.05534
 3rd Qu.:2.000   3rd Qu.: 0.853784   3rd Qu.: 0.80925
 Max.   :2.000   Max.   : 3.579749   Max.   : 3.77787
       x3                x4                x5
 Min.   :-4.015567   Min.   :-3.88353   Min.   :-3.86466
 1st Qu.:-0.886522   1st Qu.:-0.89705   1st Qu.:-0.85205
 Median : 0.046421   Median :-0.07672   Median :-0.02942
 Mean   : 0.004654   Mean   :-0.05154   Mean   :-0.02075
 3rd Qu.: 0.876326   3rd Qu.: 0.82199   3rd Qu.: 0.84022
 Max.   : 3.503825   Max.   : 3.60557   Max.   : 2.94853
       x6                x7                x8
 Min.   :-4.82883   Min.   :-3.415288   Min.   :-3.56686
 1st Qu.:-0.86454   1st Qu.:-0.847181   1st Qu.:-0.80358
 Median : 0.01619   Median : 0.042244   Median : 0.03872
 Mean   : 0.02247   Mean   : 0.005208   Mean   : 0.05161
 3rd Qu.: 0.90802   3rd Qu.: 0.853102   3rd Qu.: 0.89892
 Max.   : 4.06204   Max.   : 3.199517   Max.   : 4.16097
       x9              x10               x11               x12
 Min.   : 6.656   Min.   : 6.187   Min.   : 6.298   Min.   : 6.081
 1st Qu.: 9.251   1st Qu.: 9.261   1st Qu.: 9.213   1st Qu.: 9.257
 Median :10.085   Median :10.058   Median :10.041   Median :10.107
 Mean   :10.057   Mean   :10.038   Mean   :10.041   Mean   :10.059
 3rd Qu.:10.834   3rd Qu.:10.873   3rd Qu.:10.850   3rd Qu.:10.831
 Max.   :13.628   Max.   :13.615   Max.   :13.949   Max.   :13.481
       x13               x14               x15               x16
 Min.   : 6.077   Min.   : 6.471   Min.   : 6.450   Min.   : 6.463
 1st Qu.: 9.202   1st Qu.: 9.210   1st Qu.: 9.171   1st Qu.: 9.223
 Median :10.010   Median :10.049   Median :10.022   Median : 9.990
 Mean   :10.004   Mean   :10.008   Mean   : 9.979   Mean   : 9.991
 3rd Qu.:10.796   3rd Qu.:10.795   3rd Qu.:10.808   3rd Qu.:10.785
 Max.   :13.692   Max.   :13.386   Max.   :13.386   Max.   :14.251
       x17               x18               x19               x20
 Min.   : 6.154   Min.   : 6.854   Min.   : 6.687   Min.   : 5.959
 1st Qu.: 9.190   1st Qu.: 9.233   1st Qu.: 9.227   1st Qu.: 9.190
 Median :10.020   Median :10.033   Median : 9.988   Median : 9.945
```

```
 Mean   : 9.999   Mean   :10.019   Mean   :10.002  Mean   : 9.957
 3rd Qu.:10.729  3rd Qu.:10.795   3rd Qu.:10.784   3rd Qu.:10.741
 Max.   :13.122   Max.   :13.044   Max.   :13.510   Max.   :12.746
       x21             x22             x23             x24
 Min.   : 6.657    Min.   : 6.466    Min.   : 6.111    Min.   : 6.468
 1st Qu.: 9.309   1st Qu.: 9.250   1st Qu.: 9.281   1st Qu.: 9.318
 Median :10.036  Median :10.022  Median : 9.984   Median :10.040
 Mean   :10.025  Mean   :10.002   Mean   :10.003  Mean   :10.050
 3rd Qu.:10.742  3rd Qu.:10.735   3rd Qu.:10.760  3rd Qu.:10.787
 Max.   :13.497   Max.   :13.164   Max.   :12.962  Max.   :13.449
```

Upon initial inspection, the two groups appear to be virtually identical in terms of how the factor model fits each group's data.

```
factanal(df.1[1:500, 2:9], factors = 2)    # Group 1.

Call:

factanal(x = df.1[1:500, 2:9], factors = 2)

Uniquenesses:

   x1    x2    x3    x4    x5    x6    x7    x8

0.338 0.401 0.323 0.348 0.507 0.485 0.556 0.572

Loadings:

   Factor1 Factor2

x1  0.812

x2  0.774

x3  0.823

x4  0.807

x5         0.702

x6         0.716

x7         0.666

x8         0.654

            Factor1 Factor2

SS loadings      2.588   1.882

Proportion Var   0.323   0.235

Cumulative Var   0.323   0.559

Test of the hypothesis that 2 factors are sufficient.

The chi square statistic is 21.21 on 13 degrees of freedom.

The p-value is 0.0689

factanal(df.1[501:1002,2:9], factors = 2)  # Group 2.

Call:

factanal(x = df.1[501:1002, 2:9], factors = 2)

Uniquenesses:

   x1    x2    x3    x4    x5    x6    x7    x8

0.371 0.359 0.363 0.317 0.519 0.515 0.541 0.498

Loadings:

   Factor1 Factor2

x1  0.793

x2  0.801
```

```
x3  0.798

x4  0.826

x5        0.691

x6        0.696

x7        0.677

x8        0.708

                Factor1 Factor2

SS loadings      2.594   1.923

Proportion Var   0.324   0.240

Cumulative Var   0.324   0.565

Test of the hypothesis that 2 factors are sufficient.

The chi square statistic is 16.2 on 13 degrees of freedom.

The p-value is 0.238
```

Next, we load the 'lavaan' and 'semTools' packages in order to specify the CFA model and test for the levels of measurement invariance formally.

```
library(lavaan)

This is lavaan 0.5-17

lavaan is BETA software! Please report any bugs.

library(semTools)

###############################################################################

This is semTools 0.4-6

All users of R (or SEM) are invited to submit functions or ideas for functions.

###############################################################################

cfa.model <- '

 f1 =~ x1 + x2 + x3 + x4

 f2 =~ x5 + x6 + x7 + x8

 f1 ~~ 0*f2

 '

measurementInvariance(cfa.model, data = df.1, group = "group")

Measurement invariance tests:

Model 1: configural invariance:

   chisq      df    pvalue      cfi     rmsea      bic

  48.209    40.000     0.175     0.997     0.020 19980.029

Model 2: weak invariance (equal loadings):

   chisq      df    pvalue      cfi     rmsea      bic

  51.489    46.000     0.268     0.998     0.015 19941.851

[Model 1 versus model 2]

 delta.chisq     delta.df delta.p.value     delta.cfi

      3.280        6.000        0.773       -0.001

Model 3: strong invariance (equal loadings + intercepts):

   chisq      df    pvalue      cfi     rmsea      bic

  56.353    52.000     0.315     0.999     0.013 19905.257

[Model 1 versus model 3]

 delta.chisq     delta.df delta.p.value     delta.cfi

      8.145       12.000        0.774       -0.001
```

```
[Model 2 versus model 3]
  delta.chisq      delta.df delta.p.value     delta.cfi
        4.864         6.000         0.561         0.000
Model 4: equal loadings + intercepts + means:
    chisq       df    pvalue       cfi     rmsea       bic
 1222.336    54.000     0.000     0.622     0.208 21057.420
[Model 1 versus model 4]
  delta.chisq      delta.df delta.p.value     delta.cfi
     1174.127        14.000         0.000         0.375
[Model 3 versus model 4]
  delta.chisq      delta.df delta.p.value     delta.cfi
     1165.983         2.000         0.000         0.376
```

Evaluating the output of the 'measurementInvariance' function necessarily starts with configual invariance (model 1) which assumes the factor pattern is equal for both groups. Next, the second hypothesis is evaluated; weak invariance (model 2) which evaluates the chi-square change (or delta: Δ) and associated *p*-value; as well as the change in the Comparative Fit Index (CFI). The output for the comparison between model 1 and model 2 indicates no statistically significant change in the chi-square value, and the CFI does not change very much either – which indicates the loadings of the two groups are *close enough*. When the loadings are essentially the same, then weak measurement invariance is supported. The next hypothesis, strong invariance (model 3), is then evaluated. Model 3 involves testing the hypothesis that the loadings *and intercepts* are the same, or statistically equivalent, for both groups. The output shows that the first comparison, model 1 to model 3, is not statistically significant (p = 0.774); meaning the chi-square value is not significantly different between those two models. The second comparison, model 2 to model 3, also is not statistically significant (p = 0.561). In other words, when the loadings and intercepts are constrained to be equal, the model fit is not significantly different than the actual model fit across the two groups. Therefore, strong measurement invariance is supported. However, when we evaluate the final hypothesis of measurement invariance, strict invariance (model 4), we find that the latent variable *means* appear to be different – based on the chi-square change; indicating a significant difference between the groups' fit. There are several pieces of output which show this difference. First, numerically / visually compare the chi-square values for model 3 (χ^2 = 56.353, df =52, p = 0.315) and model 4 (χ^2 = 1222.336, df = 54, p < 0.000); which is a substantial change in chi-square. Also, notice how much the CFI changed from model 3 (*cfi* = 0.999) to model 4 (*cfi* = 0.622); while model 2 (*cfi* = 0.998) and model 1 (*cfi* = 0.997) are both very close to model 3. These differences (in chi-square & CFI) are also revealed in the two model comparisons. Comparing the change in fit between model 1 and model 4, we observe a significant chi-square change (χ^2_Δ = 1174.127, df_Δ=14, p_Δ< 0.000). Furthermore, comparing the change in fit between model 3 and model 4, we observe another significant chi-square change (χ^2_Δ = 1165.983, df_Δ=2, p_Δ< 0.000). The appropriate conclusion is; we do not have strict measurement invariance.

The utility of the 'measuremenInvariance' function extends beyond straightforward CFA and it can be applied to SEM settings as well. For instance, following the Anderson and Gerbing (1988) two stage approach to SEM, we can specify the measurement model of a SEM and use the 'measurementInvariance' function to check the levels (or models) of measurement invariance.

```
cfa.model <- '
  f1 =~ x1 + x2 + x3 + x4
  f2 =~ x5 + x6 + x7 + x8
  f3 =~ x9 + x10 + x11 + x12 + x13 + x14 + x15
  f4 =~ x16 + x17 + x18 + x19 + x20
  f5 =~ x21 + x22 + x23 + x24
  f1 ~~ 0*f2
  f1 ~~ f3
  f1 ~~ f4
  f1 ~~ f5
  f2 ~~ f3
  f2 ~~ f4
  f2 ~~ f5
  f3 ~~ f4
```

```
  f3 ~~ f5
  f4 ~~ f5
  '
measurementInvariance(cfa.model, data = df.1, group = "group")
Measurement invariance tests:
Model 1: configural invariance:
    chisq       df    pvalue      cfi    rmsea      bic
  492.800   486.000     0.406    0.999    0.005 61241.402
Model 2: weak invariance (equal loadings):
    chisq       df    pvalue      cfi    rmsea      bic
  508.302   505.000     0.450    1.000    0.004 61125.619
[Model 1 versus model 2]
  delta.chisq     delta.df delta.p.value    delta.cfi
     15.502       19.000        0.690        0.000
Model 3: strong invariance (equal loadings + intercepts):
    chisq       df    pvalue      cfi    rmsea      bic
  528.129   524.000     0.441    1.000    0.004 61014.161
[Model 1 versus model 3]
  delta.chisq     delta.df delta.p.value    delta.cfi
     35.329       38.000        0.594        0.000
[Model 2 versus model 3]
  delta.chisq     delta.df delta.p.value    delta.cfi
     19.827       19.000        0.405        0.000
Model 4: equal loadings + intercepts + means:
    chisq       df    pvalue      cfi    rmsea      bic
 1732.314   529.000     0.000    0.855    0.067 62183.796
[Model 1 versus model 4]
  delta.chisq     delta.df delta.p.value    delta.cfi
    1239.513       43.000        0.000        0.145
[Model 3 versus model 4]
  delta.chisq     delta.df delta.p.value    delta.cfi
    1204.184        5.000        0.000        0.145
```

It is also possible to specify a structural model of a SEM and check for measurement invariance; as show below.

```
str.model <- '
  f1 =~ x1 + x2 + x3 + x4
  f2 =~ x5 + x6 + x7 + x8
  f3 =~ x9 + x10 + x11 + x12 + x13 + x14 + x15
  f4 =~ x16 + x17 + x18 + x19 + x20
  f5 =~ x21 + x22 + x23 + x24
  f4 ~ f1
  f3 ~ f2
  f5 ~ f2 + f3
  f1 ~~ 0*f2
  f1 ~~ f3
  f1 ~~ f5
```

```
  f2 ~~ f4
  f3 ~~ f4
  f4 ~~ f5
  '
measurementInvariance(str.model, data = df.1, group = "group")
Measurement invariance tests:
Model 1: configural invariance:
    chisq      df    pvalue      cfi    rmsea      bic
  492.800   486.000    0.406    0.999    0.005 61241.402
Model 2: weak invariance (equal loadings):
    chisq      df    pvalue      cfi    rmsea      bic
  508.302   505.000    0.450    1.000    0.004 61125.619
[Model 1 versus model 2]
  delta.chisq     delta.df delta.p.value    delta.cfi
     15.502       19.000        0.690        0.000
Model 3: strong invariance (equal loadings + intercepts):
    chisq      df    pvalue      cfi    rmsea      bic
  528.129   524.000    0.441    1.000    0.004 61014.161
[Model 1 versus model 3]
  delta.chisq     delta.df delta.p.value    delta.cfi
     35.329       38.000        0.594        0.000
[Model 2 versus model 3]
  delta.chisq     delta.df delta.p.value    delta.cfi
     19.827       19.000        0.405        0.000
Model 4: equal loadings + intercepts + means:
    chisq      df    pvalue      cfi    rmsea      bic
 1732.314   529.000    0.000    0.855    0.067 62183.796
[Model 1 versus model 4]
  delta.chisq     delta.df delta.p.value    delta.cfi
    1239.513       43.000        0.000        0.145
[Model 3 versus model 4]
  delta.chisq     delta.df delta.p.value    delta.cfi
    1204.184        5.000        0.000        0.145
```

The output above for both the measurement model and the structural model of the SEM show very similar results to what was observed with the initial CFA measurement invariance results. This is because only the first two latent factors (f1 & f2) contain group differences; while the remaining elements in the SEM do not display group differences (i.e. f3, f4, & f5 measurement structures). For those interested in duplicating everything done in this article (and seeing the results of the SEM fit with groups specified); please see the RSS Do-it-yourself Introduction to R web site and specifically here in Module 9.

Lastly, it is very important to realize the example above used simulated data in order to demonstrate many aspects of measurement invariance. The examples above used a relatively small data set (n = 1002). Large sample sizes typically seen when conducting SEM are likely to provide statistically significant chi-square change statistics (chi-square is very sensitive to large sample sizes). Large sample sizes reduce the utility of the chi-square test. The implication being, that with large samples it would be very unlikely to establish measurement invariance using the chi-square change statistics. Therefore, Vandenber and Lance (2000) recommend using a CFI change of 0.2 as representative of a meaningful difference between models fit (p. 47).

Until next time, *have I told you about Sammy Jankis?*

References and Resources

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Training

By Claudia Lynch, *Benchmarks Online* Editor

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Statistical Analysis

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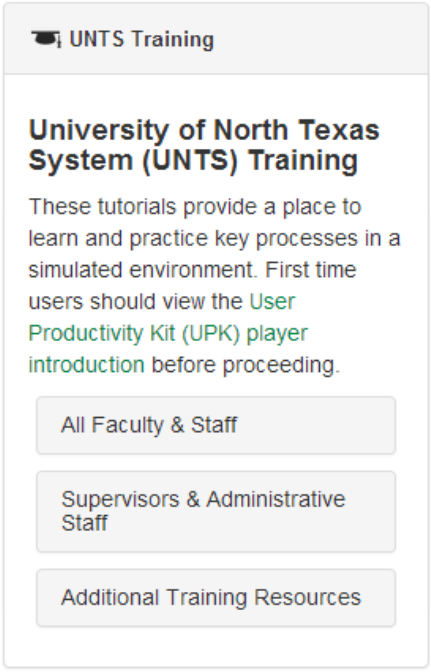

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Microsoft E-Learning

Updated instructions for accessing Microsoft E-Learning are below.

As part of an offering from Microsoft, you are eligible to access E-Learning courses online at Microsoft.com. These courses are meant to help you keep up-to-date with the latest major software releases.

Please note that some product and language versions may not be available at the time you activate your courses. For up-to-date information on the availability of E-Learning courses, please visit http://microsoft.com/licensing.

To gain initial access to the Microsoft® E-Learning courses, please follow the steps below:

1. Go to: https://onlinelearning.microsoft.com/subscriptionactivation/.

2. Input your multiuse access code: Contact Claudia Lynch or your Network Manager for the code *(The code is case-sensitive. Be sure to include the dashes and do not enter any spaces.)*

3. You are prompted to sign in using a valid Windows Live™ ID. (This is the user name and password you use to access the site each time you log on.) If you already have a profile on microsoft.com, use that Windows Live ID.

4. You will receive an e-mail confirming your registration.

5. From the confirmation e-mail, click the link to complete the e-mail confirmation and activate your courses.

6. You are prompted to sign in using a valid Windows Live ID, once again.

7. A confirmation page appears indicating that the access code has been accepted (or you may receive an error message if the code was not accepted).

8. Click the *My Learning* link to see list of available courses.

9. Click a course title to launch the offering. You have 12 months from the time of launch to finish that course.

Follow the instructions below to access E-learning until you arrive on the "UNT System authenticated service Page."

To access your course at any time, please follow these steps:

1. Go to: https://onlinelearning.microsoft.com/.

2. Click the "Sign In" button in the upper right corner of the page.

3. Sign in to Windows Live using your Windows Live ID and password.

4. Click the My Learning Catalog link on the left side of the page under Customer Login.

5. Begin your E-Learning course.

If you have any questions regarding your access code, you may e-mail or phone our support center. To view a list of support phone numbers, please visit https://www.microsoft.com/licensing/servicecenter/ and click the **Support / Feedback** link.

If you experience any problems with your E-Learning training, please contact the regional support center in your region at http://www.microsoft.com/learning/support/worldsites.mspx.

We trust you will enjoy this benefit and look forward to your participation. Please note that the access code we have received from Microsoft can accommodate a limited number of users from our organization. Do not share the code with unauthorized users. This is not permitted under our license agreement with Microsoft.

Microsoft E-books

Click on the link and access the largest collection of FREE Microsoft eBooks ever, including: Windows 8.1, Windows 8, Windows 7, Office 2013, Office 365, Office 2010, SharePoint 2013, Dynamics CRM, PowerShell, Exchange Server, Lync 2013, System Center, Azure, Cloud, SQL Server, and much more!
NOTE: How to enable 'Download All' for Free Microsoft eBooks and other tips

Central Web Support

Central Web Support provides "web hosting and support to appropriate campus entities free of charge."

CLEAR

CLEAR offers courses especially for Faculty Members. *CLEAR training includes:*

- Blackboard
- Turnitin
- Turning Point
- Assessment
- Teaching Effectiveness
- Respondus

Please check out CLEAR's training and event calendar at http://clear.unt.edu/calendar for the latest information regarding Blackboard, CLEAR's initiatives, and on campus instructional events.

Further information can be found here.

FREE Online Learning Consortium Workshops

The University of North Texas is a premium member of the Online Learning Consortium (formerly the Sloan Consortium) College Pass. To request FREE ENROLLMENT in an Online Learning Consortium workshop, please contact Amber Bryant with the name and date of the workshop selected. *Please click on the link below to see the available 2015 workshops.*

- Online Consortium 2015 Workshops

CLEAR also provides free access through group subscriptions for ALL Denton UNT faculty and staff to **Magna Commons, 20 Minute Mentor Commons, Distance Education Report, Online Classroom,** and **The Teaching Professor** from **Magna Publications.**

Ed2go

Ed2go are courses that are offered, for a fee, to UNT faculty, staff and students as well as the general public. The CALL website states:

> *Make UNT the first place you turn for career training and professional development. UNT's Online Minicourses, provided in conjunction with Ed2go, are downloadable 12-lesson modules that are designed to meet your needs for skill development. Lessons are instructor-led and course participants and instructor communicate through a course discussion board.*
>
> *Most courses are $89 and UNT faculty, staff and students may receive a $10 discount. Contact Tami Russell (940.565.3353) for more information.*

For additional information, visit the **Ed2go blog** here. You can subscribe to their newsletter also from a link at the bottom of the page.

Information Security Awareness

Information Security Awareness -- The ITSS Information Security team offers Information Security Awareness training to all UNT faculty and staff.

- It is a policy requirement that ALL staff take an information security course at least once a year.
- See the Virus Information Page and the Information Security Handbook -- for Faculty, Staff and Students for further information.

UNT HR Training and Development

As noted on their website:

> *Monthly emails are sent to all employees with a list of current classes, many available by webcast. (Note: Few, if any classes are offered during the winter break, spring break holiday periods for all UNT System campuses.) Learn more about classes here.*
>
> *If you have questions or specific needs, contact talentmanagement@untsystem.edu or call 855-878-7650 to be directed to a Talent Management staff member.*

Alternate Forms of Training

Many of the General Access Labs around campus have tutorials installed on their computers. See http://computerlabs.unt.edu/ for a list of labs and their locations. The 24 Commons in Willis Library, for example, has a list of Tutorials and Software Support. The Library Instructional Unit also offers workshops and training, including "tech skills" training. Visit their websites for more information: http://www.library.unt.edu/library-instruction.

Info~Tech, UNT's IT Research Partner

Info~Tech is UNT's IT research partner. UNT System, UNT, UNT Health Science Center and UNT Dallas employees have access to Info~Tech research at: www.infotech.unt.edu (click on the UNT System name to login). Your standard EUID and Password gains you access to the Info~Tech system. Please take a moment to read their terms and conditions by clicking through the agreement when you set up your profile the first time you log in.

State of Texas Department of Information Resources

Another possible source of training for staff and, perhaps, faculty members is the Texas Department of Information Resources. Search their website for the specific training you are interested in.

New Horizons Computer Learning Centers

New Horizons is a DIR vendor, which means that state agencies, like UNT, get special pricing for their services negotiated at the State level (click here for more information about DIR vendors). New Horizons offers courses at their own facilities in Dallas and Fort Worth, but will arrange for onsite training as well. They have a "Tips and Tricks" page that has helpful information. You can also join their mailing list to receive their monthly newsletter, event invitations and specials.

EDUCAUSE Live! Webinars

EDUCAUSE Live! is a series of **free**, hour-long interactive webinars on critical information technology topics in higher education. You can register for upcoming webinars and you can find recordings of **all past webinars** in the *EDUCAUSE Live!* archives.

Originally published March 2015 -- Please note that information published in *Benchmarks Online* is likely to degrade over time, especially links to various Websites. To make sure you have the most current information on a specific topic, it may be best to search www.unt.edu/ UNT. Website can also consult the UNT Helpdesk http://www.unt.edu/helpdesk/. Questions and comments should be directed to benchmarks@unt.edu.

BOOKMARK

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Sage Hall, Room 338
http://it.unt.edu/benchmarks/

Email us:

Have questions on content or technical issues? Please contact us.
unt.uit@unt.edu

UNT System:

- UNT Home
- UNT System
- UNT Dallas
- UNT Health Science Center

Site last updated on April 22, 2016

Staff Activities

Staff activities for UIT are reported in this column.

New Employees:

- **Sherma'n Wilson**, Classroom Testing and Desktop Services (part-time).
- **Bret Ferguson**, Classroom Support Services (part-time).

No longer working in UIT:

- **Michael Gallagher**, Classroom Testing and Desktop Services (part-time).
- **Brittaney Freiheit**, Classroom Support Services (part-time).
- **Ali SiavoshHaghighi**, IT Manager, Research Computing Support.

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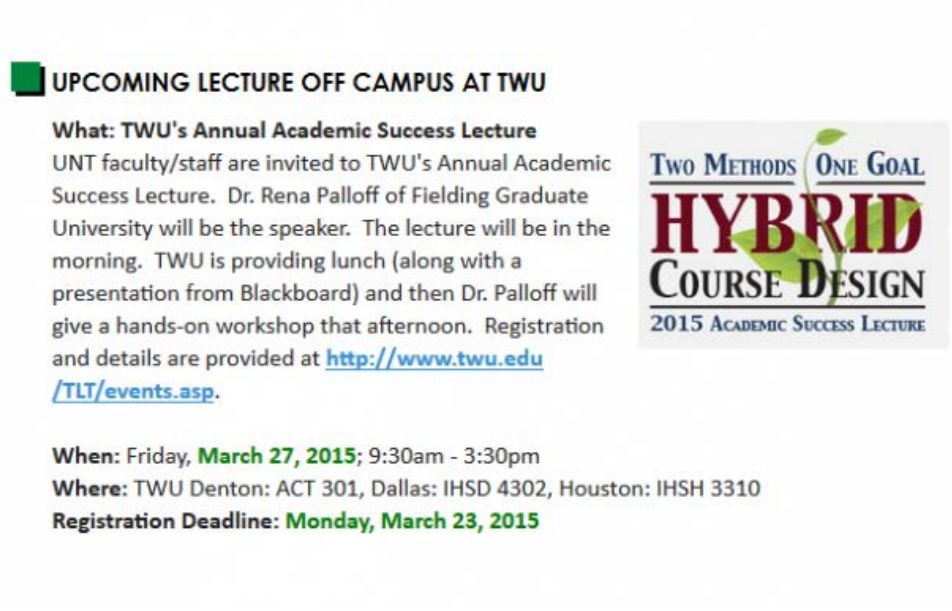
unt.uit@unt.edu

There's still time to register for these upcoming CLEAR Events

By Amber Bryant, Senior Marketing Specialist, CLEAR

Mark your calendars and make sure and register for these upcoming events! CLEAR has some great events planned for this spring.

Click on the images below to follow the links.



April 10, 2015 -- SAVE THE DATE!

University Forum on Teaching & Learning
8:30am to 12 Noon (*Breakfast will be provided.*)
Gateway Ballroom 035

UNT's University Forum on Teaching and Learning (UFTL) is a half-day event designed to enable faculty, graduate teaching fellows, and staff involved in support teaching and learning to engage in open dialogue about the challenges of teaching and to share ideas and practices that improve teaching effectiveness. The keynote speaker for the 2015 UFTL is George Siemens, Ph.D., an internationally known educator, theorist, and researcher on learning in the digital age. In addition to authoring numerous articles on open education, ePortfolios, and learning analytics, he has published two books: *Connectivism: A Learning Theory for the Digital Age* and *Knowing Knowledge*. Since 2013, Siemens has served as the Executive Director of the LINK Lab at the University of Texas at Arlington, where he and participants explore how traditional universities' role is affected by online learning and the growing influence of data and analytics on higher education practices. UFTL announcement page

INFORMATION ON CLEAR INITIATIVES

2015-16 Call for Proposals
NextGen Course Redesign Grants

The UNT Center for Learning Enhancement, Assessment, and Redesign (CLEAR) invites proposals from faculty or teams of faculty for the NextGen Course Redesign Grant 2015-16.

How do you know if your students are learning? How do you know what your students are learning? NextGen utilizes an innovative three-tier model of student learning outcomes, outcome-based instruction, and assessment that promotes deeper connection with course content, instructors, and peers.

Click here to see the different ways you can participate and apply.

Important Dates:

- April 30, 2015: Last Day to Apply
- June 15 - 18, 2015: **CLEAR Course Design Institute**, UNT Campus, Willis Library (**Note:** participants must complete approximately 15 hours of online work prior to attending.)

For additional questions or concerns, please contact the NextGen Program Manager Jenna Ledford at jenna.ledford@unt.edu or at 940.369.7243.
Requests for proposals will be sent out in February.

CLEAR Newsletter

Sign up to receive CLEAR's newsletter
View archived newsletters

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UNT System:

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- UNT Health Science Center

Site last updated on April 22, 2016

Today's Cartoon

From "Today's Cartoon by Randy Glasbergen", posted with special permission.
For many more cartoons, please visit www.glasbergen.com.

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