



Intrusive and Unobtrusive Assessment of Entrepreneurial and Technical Skills through Simulation and Gaming



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Mind Wide Open™



It takes a village to think make assessment

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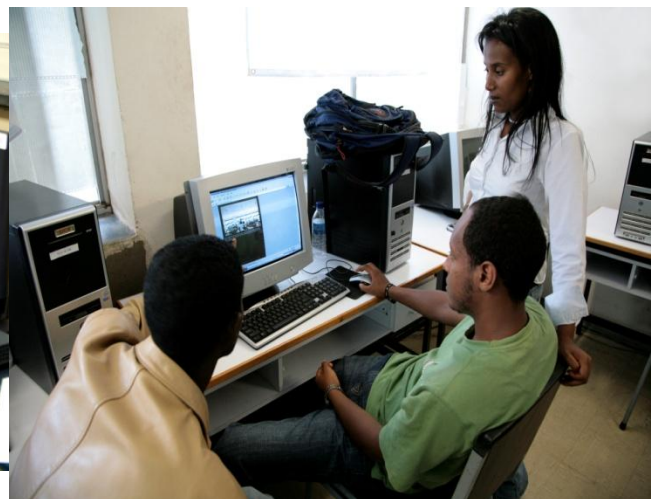
Patti West, Cisco

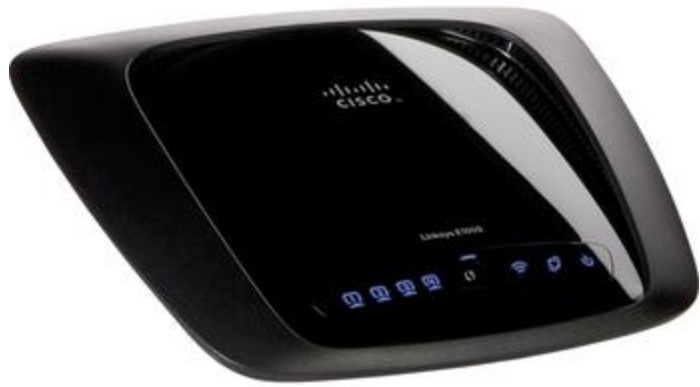
Telethia Willis, Cisco

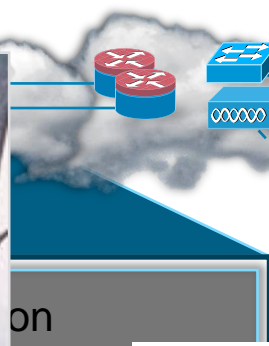


A play in 3 acts

- Who we are and where we come from
- Some intrusive assessment
- Some unobtrusive assessment (or is it something else?)







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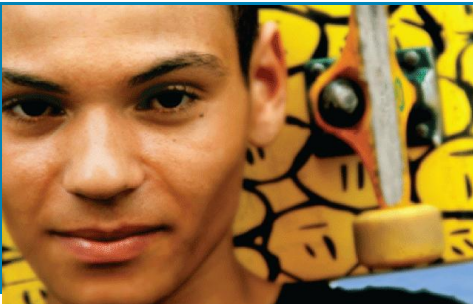
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Combined Student Log

Timestamp	Device	Prompt	Command
Mon 28. Sep 19:02:34 2009	SW_AC2	Switch>	enable
Mon 28. Sep 19:02:36 2009	SW_AC2	Switch#	conf t
Mon 28. Sep 19:03:55 2009	SW_AC2	Switch(config)#	enable secret class
Mon 28. Sep 19:04:08 2009	SW_AC2	Switch(config)#	no ip domain-lookup
Mon 28. Sep 19:05:55 2009	SW_AC2	Switch(config)#	line console 0
Mon 28. Sep 19:06:00 2009	SW_AC2	Switch(config-line)#	password cisco
Mon 28. Sep 19:06:04 2009	SW_AC2	Switch(config-line)#	login
Mon 28. Sep 19:06:10 2009	SW_AC2	Switch(config-line)#	line vty 0 15
Mon 28. Sep 19:06:16 2009	SW_AC2	Switch(config-line)#	password cisco
Mon 28. Sep 19:06:29 2009	SW_AC2	Switch(config-line)#	login
Mon 28. Sep 19:09:37 2009	SW_AC2	Switch(config-line)#	banner mode#
Mon 28. Sep 19:09:46 2009	SW_AC2	Switch(config-line)#	banner motd#
Mon 28. Sep 19:10:01 2009	SW_AC2	Switch(config-line)#	end
Mon 28. Sep 19:10:06 2009	SW_AC2	Switch#	conf t
Mon 28. Sep 19:10:15 2009	SW_AC2	Switch(config)#	banner motd #
Mon 28. Sep 19:14:23 2009	SW_AC2	Switch(config)#	hostname SW_AC2
Mon 28. Sep 19:15:02 2009	SW_AC2	SW_AC2(config)#	interface vlan 43
Mon 28. Sep 19:16:15 2009	SW_AC2	SW_AC2(config-if)#	ip address 172.16.43.12 255



Corporate Social Responsibility and Cisco Networking Academy



Large and Global

165
1 Million
3.75 Million

Countries
Students engaged this year
Students since inception



Diverse Students and Communities

Students: Diverse Age, Gender, and Circumstances
Communities: Mature and Developing

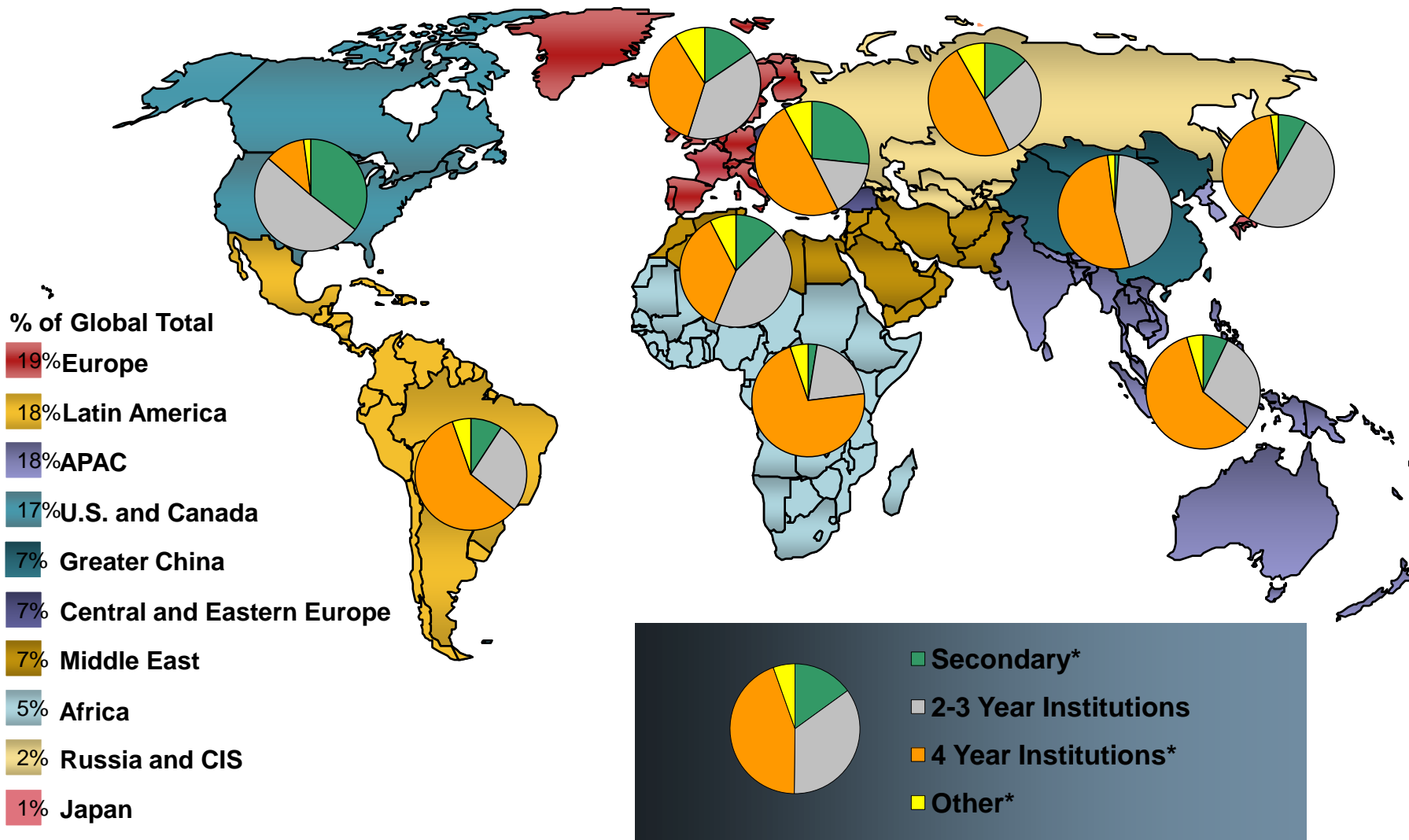


Diverse Educational Institutions

Universities, Community Colleges, Vocational Schools, Secondary Schools, Non-profit Organizations, Second Chance



Students by Education Level by Region (1,000,000 Students)



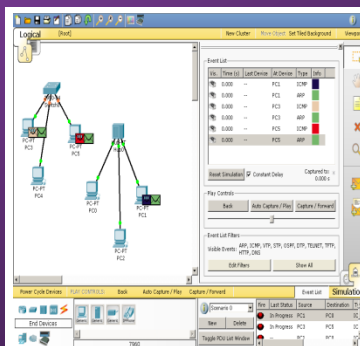
* See Notes Page for additional details on these definitions
Presentation_ID



A comprehensive educational partnership

Curricula

- 14 courses
- Entry-level tech skills
- Instructor-led
- Simulation and visualization software
- Hands-on experience
- Assessments

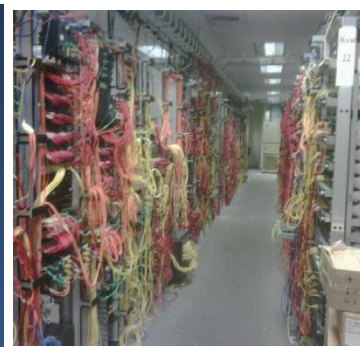


Relationships

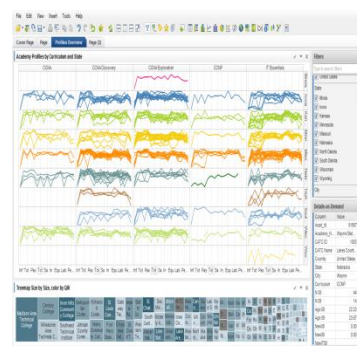
- Students
- Academies
- Instructors
- Governments
- Partners



- Educational process and learning systems
- Larger server base than cisco.com
- 2.5 terabytes of data
- 1M assessments/month



- Metrics
- Services
- Support



Infrastructure

Program Design





Behrens, J. T., Collison, T. A., & Demark, S. F. (2005) The Seven Cs of comprehensive assessment: Lessons learned from 40 million classroom exams in the Cisco Networking Academy Program. In S. Howell and M. Hricko (Eds.), *Online Assessment and Measurement: Case Studies in Higher Education, K-12 and Corporate*. (pp 229-245). Hershey, PA: Information Science Publishing.

Frezzo, D.C., Behrens, J.T., & Mislevy, R.J. (2009). Activity theory and assessment theory in the design and understanding of the Packet Tracer ecosystem. *The International Journal of Learning and Media*, 2. <http://ijlm.net/knowinganddoing/10.1162/ijlm.2009.0015>



Packet Tracer as a central tool for networking education

- Visualization
- Scaling
- Rapid revision
- Off-line delivery
- Complex scoring
- Built in gaming
- Micro-world authoring

The screenshot displays the Packet Tracer 4.1 interface. The main window shows a network topology with a central 2601XM Router1 connected to a 2950-24 Switch0. The switch is connected to several PC-PT devices (PC0, PC1, PC2, PC3, PC4, PC5). The interface includes a 'Logical' view, 'Physical Device View' windows for Router1 and Switch0, and an 'Event List' window showing network events.

Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
	0.000	--	PC1	ICMP	
	0.000	--	PC1	ARP	
	0.000	--	PC3	ICMP	
	0.000	--	PC3	ARP	
	0.000	--	PC5	ICMP	
	0.000	--	PC5	ARP	

Simulation Table

Fire	Last Status	Source	Destination	T...
	In Progress	PC1	PC0	IC
	In Progress	PC3	PC5	IC
	--	PC1	PC0	IC



Exploration, Explanation & Experimentation

Packet Tracer 4.0 by Cisco Systems, Inc. - C:/Documents and Settings/dfrezz

File Options Help

Logical Set Tiled Background

NAT dinámico de 199.99.9.4 a 199.99.9.14 para las red 2 = 192.168.2.x

PC-PT PCN_192.168.2.2

PC-PT PCN_192.168.2.3

PC-PT PC_192.168.1.2

PC-PT PC_192.168.1.3

PC-PT PC_192.168.1.4

AccessPoint-PT AccessPoint_1

Router-PT NAT_estatico_PAT

SW_LAN_INTERNA

NAT estático normal y extendido PC_S_Email = 192.168.1.101 a 199.99.9.10 PC_S_Web = 192.168.1.102:8080 a 199.99.9.10

Para la red = 192.168.1.x PAT interface serial 2/0 "overload" (dirección 199.99.9.2 de la Serial 2/0)

Scenario 1 Description:

Simulación con tráfico ping y al final solicitud S-WEB.102:8080_out_199.99.9.102:80 con y la verificación de un ping ICMP(0x8) y respuesta ICMP(0x0), a la misma maquina, desde Internet; produciendo un error por tiempo superado ICMP(0xb). Observe la tabla de traducción en estos casos.

Reset Net

Router

Simulation Panel

Event List

Vis.	Time (s)	Last Device	At Device	Type	Info
	0.006	PC_192.168.1.3	SW_LAN_INTERNA	ICMP	
	0.006	SW_LAN_INTERNA	NAT_estatico_PAT	ICMP	

Reset Simulation Constant Delay Captured to: * 0.006 s

PDU Information at Device: NAT_estatico_PAT

OSI Model Inbound PDU Details Outbound PDU Details

At Device: NAT_estatico_PAT
Source: PC_192.168.1.2
Destination:

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer 3: IP Header Src. IP: 192.168.1.2, Dest. IP: 200.21.100.2	Layer 3: IP Header Src. IP: 199.99.9.2, Dest. IP: 200.21.100.2
Layer 2: Ethernet II Header 000A.F3ED.D3EF >> 0002.1622.4372	Layer 2: HDLC Frame HDLC
Layer 1: Port FastEthernet0/0	Layer 1: Port(s): Serial2/0

- The routing table finds a routing entry to the destination IP address.
- The router decrements the TTL on the packet.
- The packet is going from an inside to an outside network. The router looks up its NAT table for necessary translations.
- The NAT table does not have existing translations with the inside local address and port. It goes through the inside source lists for necessary translations.
- An inside source entry is created from a list. The new entry is added to the NAT table.
- The NAT table has a matched entry for this packet. It replaces the inside local address and port with the global ones.
- The outgoing port has an outbound traffic access-list with an ID of 1. The router checks the packet against the access-list.

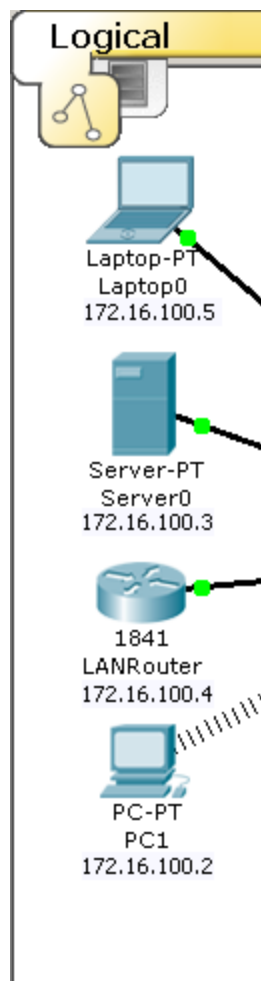
Challenge Me << Previous Layer Next Layer >>



Multiple layers of affordance

Layer	Attributes	Goal
Network Simulation	Interaction with Network Devices Programming Network Devices Behavior of Networks	Create a micro-world with verisimilitude to world of the domain
Interaction Interface	Visualization Interaction	Support understanding & manipulation
Authoring Interface	Edit and save Create stories and micro-worlds Local languages	Re-use and portability Conceptualization & use for explanation
Assessment Interface	Create and save answer networks and related activities	Support micro-worlds for assessment & feedback
Variable manager and macro language	Isomorphic and variant pattern creation. Low level access to data and combination	Support pattern based re-use, flexibility & extensibility

Frezzo, D.C., Behrens, J.T., & Mislevy, R.J. (2009). Design patterns for learning and assessment: facilitating the introduction of a complex simulation-based learning environment into a community of instructors. *The Journal of Science Education and Technology*. Springer Open Access <http://www.springerlink.com/content/566p6g4307405346/>



- Network
 - www.example.com
 - Wireless Router0
 - Power: 1
 - In Physical Shape:
 - Remote Management: 0
 - Password: cisco123
 - Internet Connection: 2
 - Authorization:
 - DNS Server IP: 0.0.0.0
 - Default Gateway: 172.16.67.2
 - Wireless
 - SSID: Default
 - Security Mode
 - Single Port Forwarding
 - Ports
 - Wireless
 - Vlan1
 - Internet

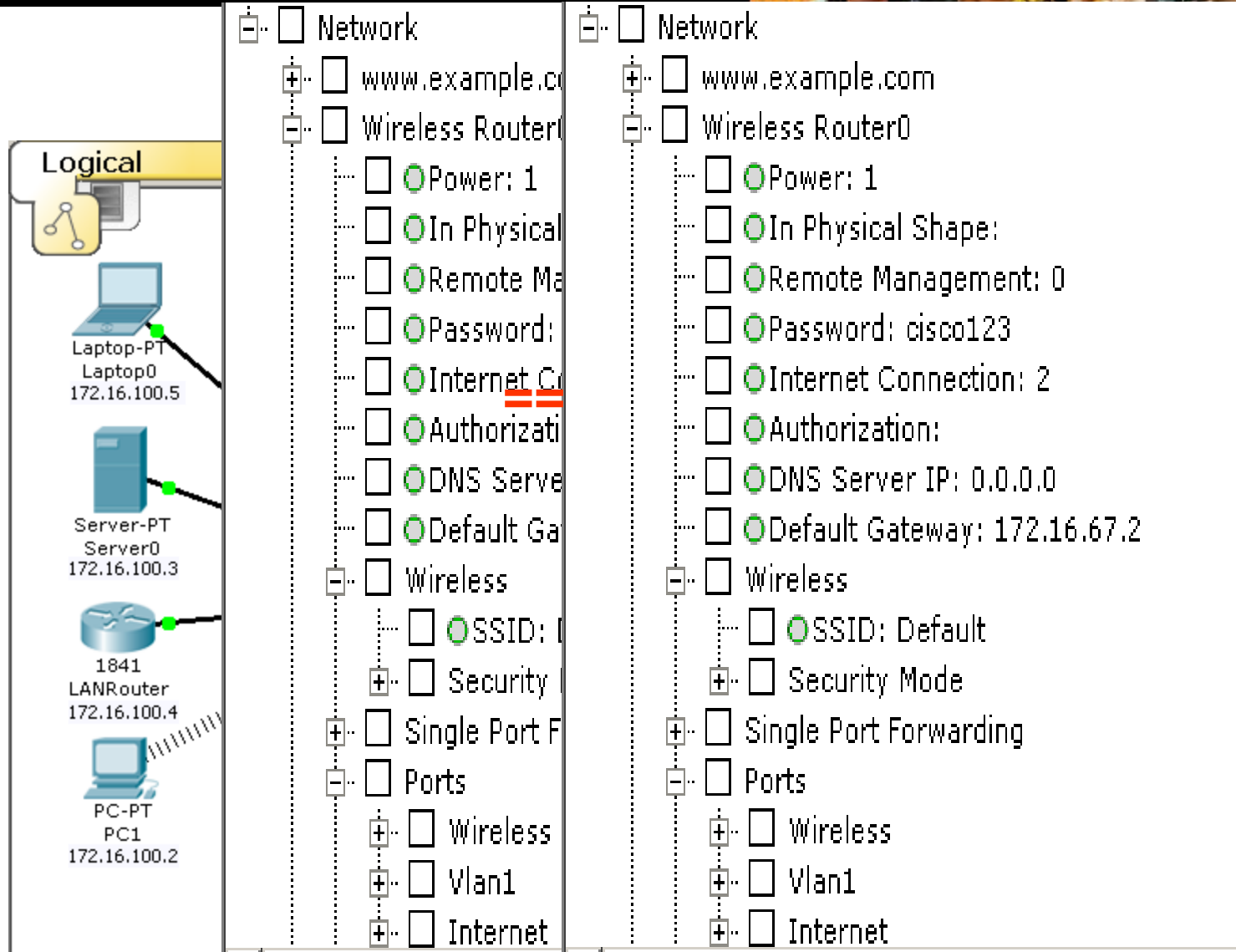
New Cluster Move C

top0 (172.16.100.5).

due to the policy,
I due to the policy,
it should fail due to the policy,
should succeed,
succeed.

Server-PT
www.example.com

PC-PT
PC0



Answer / Feature Network

Student Network

Activity Wizard

Welcome

Variable Manager

Instructions

Answer Network

Scripting

Initial Network

Password

Test Activity

Check Activity

Save

Exit

Building Answer Network

Show Answer Network

Import/Export

Import File to Answer Network

Export Answer Network to File

Assessment Tree

Connectivity Test

Scoring Model

Overall Feedback

Settings

The Scoring Model provides complete control over constructing activity tasks and providing feedback based on the evidence of the proficiencies.

Work Product Features

	Name	Expression	Description
1	ISPChoice	AssessmentModel.getAssessmentItemValue("user", "Network:Wireless Router0:Ports:Internet:Link to DSL ModemC	
2	PC0dhcpstate	AssessmentModel.getAssessmentItemValue("user", "Network:PC0:Ports:FastEthernet:DHCP client enable")	
3	PC1dhcpstate	AssessmentModel.getAssessmentItemValue("user", "Network:PC1:Ports:FastEthernet:DHCP client enable")	1 = dhcp 0 = sta
4	PC2dhcpstate	AssessmentModel.getAssessmentItemValue("user", "Network:PC2:Ports:FastEthernet:DHCP client enable")	
5	PC3dhcpstate	AssessmentModel.getAssessmentItemValue("user", "Network:PC3:Ports:FastEthernet:DHCP client enable")	
6	PC0cable	AssessmentModel.getAssessmentItemValue("user", "Network:PC0:Ports:FastEthernet:Link to Wireless Router0:Typ	right type of cab
7	PC3cable	AssessmentModel.getAssessmentItemValue("user", "Network:PC3:Ports:FastEthernet:Link to Wireless Router0:Typ	
8	PC1cable	AssessmentModel.getAssessmentItemValue("user", "Network:PC1:Ports:FastEthernet:Link to Wireless Router0:Typ	
9	PC2cable	AssessmentModel.getAssessmentItemValue("user", "Network:PC2:Ports:FastEthernet:Link to Wireless Router0:Typ	
10	wTimeElapsed	AssessmentModel.getTimeElapsed();	
11	wTimeElapsedInSeconds	wTimeElapsed/1000;	
12	wBonus		10000 bonus points
13	wMaxTime		60000 max time allowe
14	wR0Ip	AssessmentModel.getAssessmentItemValue("user", "Network:Router1:Ports:FastEthernet0/0:IP Address")	
15	wR0Power	AssessmentModel.getAssessmentItemValue("user", "Network:Router1:Power")	

Scoring Rules

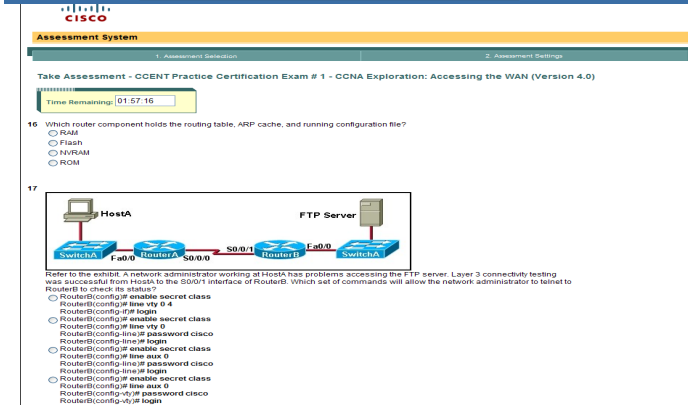
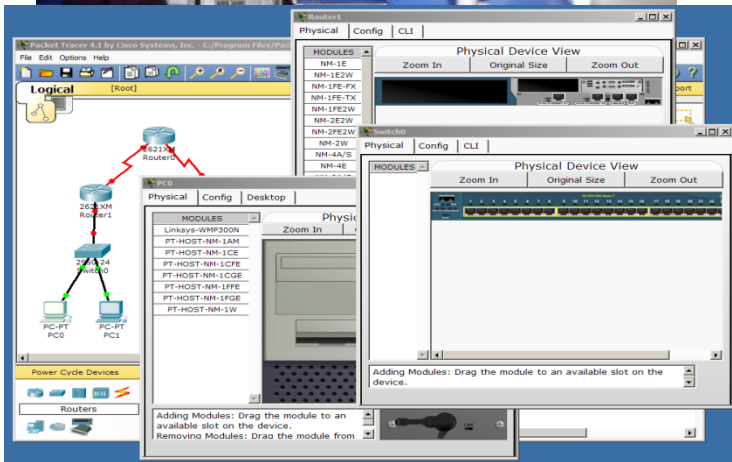
	Type	Name	Expression
1	Primary	ISPChoiceOverall	(ISPChoice == "Connects to Port 1") ? 10 : 2;
2	Primary	PC0movedfromstatic	(PC0dhcpstate == 1) ? 2 : 0;
3	Primary	PC1movedfromstatic	(PC1dhcpstate == 1) ? 2 : 0;
4	Primary	PC2movedfromstatic	(PC2dhcpstate == 1) ? 2 : 0;
5	Primary	PC3movedfromstatic	(PC3dhcpstate == 1) ? 2 : 0;
6	Primary	PC2cabletype	(PC2cable == "0 0") ? 2 : 0;
7	Primary	PC1cabletype	(PC1cable == "0 0") ? 2 : 0;
8	Primary	PC3cabletype	(PC3cable == "0 0") ? 2 : 0;
9	Primary	PC0cabletype	(PC0cable == "0 0") ? 2 : 0;
10	Report	CableTypeEval	((PC0cabletype + PC1cabletype + PC2cabletype + PC3cabletype) >= 8) ? "cables correct" : "check your cables"



Great for Authenticity; Bad for score consistency, scale and task variation, central analysis

Great for authenticity and local scale; Good for local communication, bad for central analysis

Great for scale, communication (if you want it) and central analysis but weak for authenticity





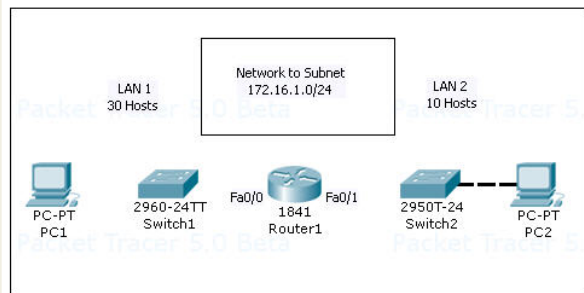
Detailed Environment Provides Detailed Feedback

View Activity

Activity Topology and Instructions

In this section, the initial topology and instructions are shown for review purposes.

Topology



Instructions

Basic Configuration PT Practice SBA

A few things to keep in mind while completing this activity:

1. Do not use the browser **Back** button or close or reload any Exam windows during the exam.
2. Do not close Packet Tracer when you are done. It will close automatically.
3. Click the **Submit Assessment** button to submit your work.

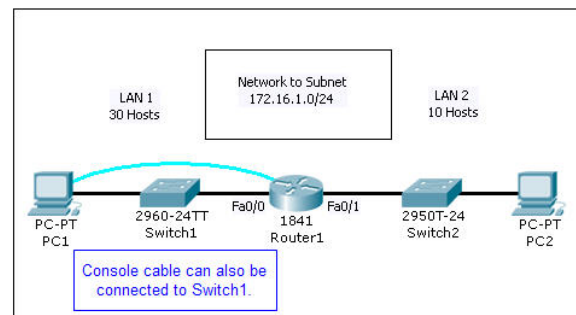
Introduction

In this practice Packet Tracer Skills Exam, you will

View Proposed Solution

Proposed Solution

Answer Topology



Answer Scripts

Router1

```
show run
```

```
Building configuration...
```

```
Current configuration : 838 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
```



What we are learning

Overall score related to experience/expertise

Tasks originally too highly constrained and not sufficiently taking account of technical affordances

Use of Packet Tracer throughout curriculum reduces construct-irrelevant variance from interface familiarity

Instructors like it (4.5/5; 94 satisfied or highly satisfied)

Students like it (cust sat = 3.9/5; 74% satisfied or highly satisfied)

Some students return to it like a game



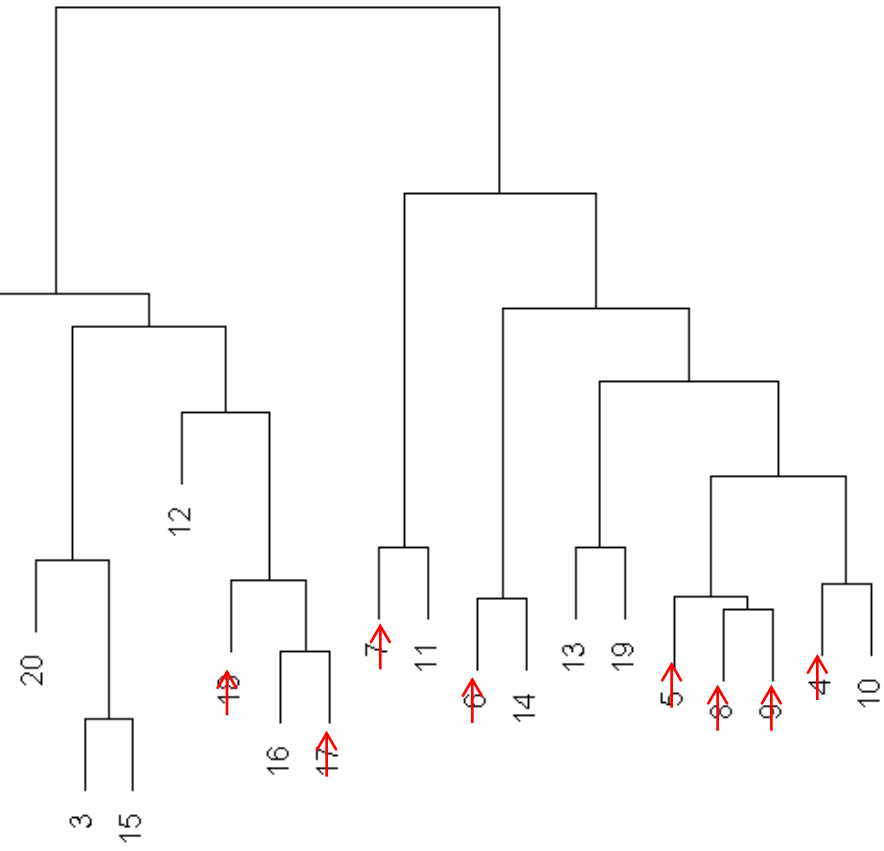
Application of SNLP & Document Retrieval Strategies for stream analysis

- We can see which “documents” are most like other “documents”

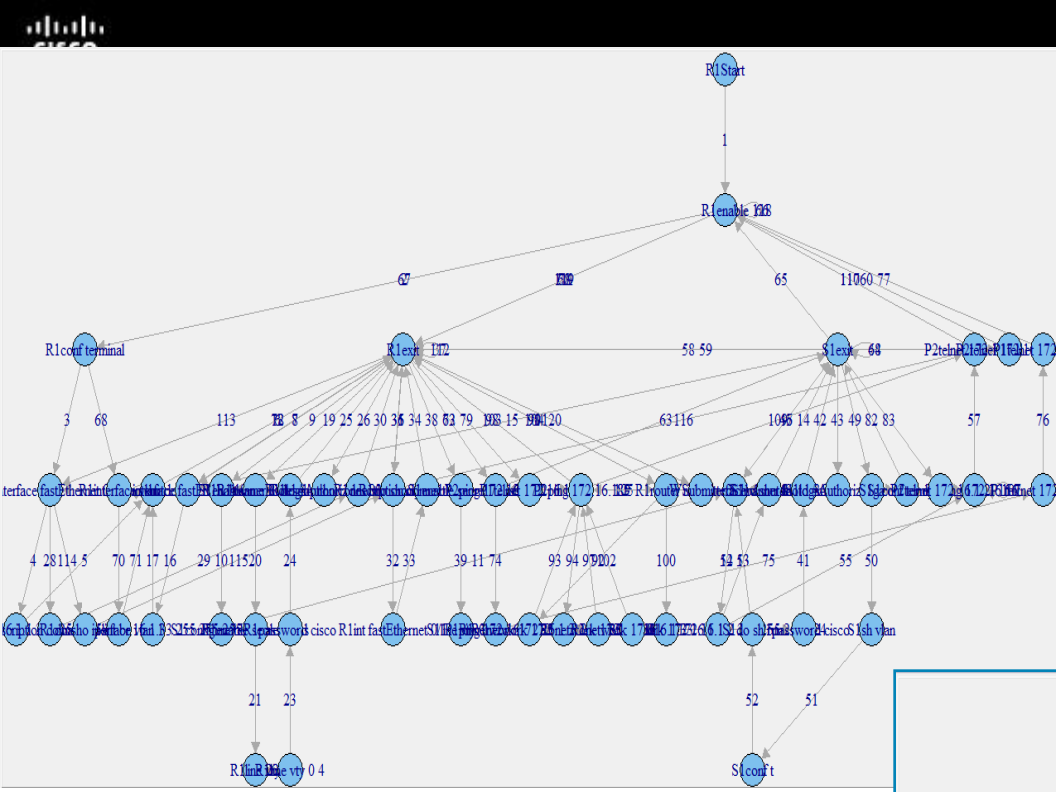
2.0

Combined Student Log

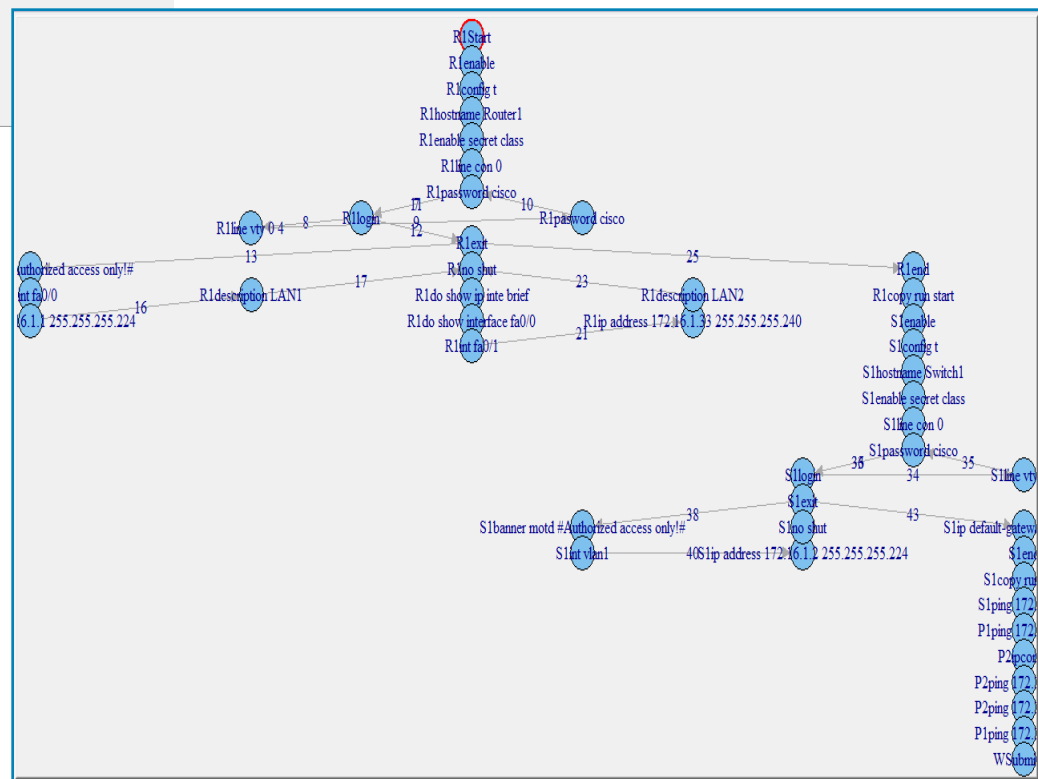
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Mon 28. Sep 19:10:06 2009	SW_AC2	Switch#	conf t
Mon 28. Sep 19:10:15 2009	SW_AC2	Switch(config)#	banner motd #
Mon 28. Sep 19:14:23 2009	SW_AC2	Switch(config)#	hostname SW_AC2
Mon 28. Sep 19:15:02 2009	SW_AC2	SW_AC2(config)#	interface vlan 43
Mon 28. Sep 19:16:15 2009	SW AC2	SW AC2(config-if)#	ip address 172.16.43.12 255



dissim.dist
hclust (*, "complete")



EDA and visualization



**Where to go
from here?**





PT + Assessment + Game Layer => Aspire

Passport21_Brochure[1].pdf - Adobe Reader

File Edit View Document Tools Window Help

96.9%

Find

ASPIRE

OPEN YOUR MIND

Welcome to the World of Cisco Aspire!

Success in the 21st century will depend on your ability to think like an entrepreneur and Aspire is the perfect opportunity to start practicing. As the key decision maker for every networking contract you accept, your primary objective is to complete as many projects as possible. You'll earn credits for every contract you complete and the game ends when you've completed all projects, or when you run out of credits and can no longer afford your expenses. Are you ready to open your mind to the challenges of our competitive global marketplace?

Log In and Select an Avatar

Your journey to entrepreneurship begins when you log in, create a user name and password and then choose an avatar from 16 options. You can start a new game, continue a current one, or use a different avatar you've created.

Utilize Your Mobile Phone

Stay connected to the characters you meet throughout the game with your mobile phone. Aspire teaches you how to make the most of your contacts as prospective clients call you with networking opportunities and new business referrals.

Purchase Your Equipment

Every networking project will require different hardware, software, connections and configurations. You'll find everything you need at the store, but choose wisely to stay within your budget and watch your business grow.

How Far Will You Go?

Aspire tracks your scores, calculates your credits and rates your financial management and business skills. It's a fun way to measure your progress as you complete more projects and develop your entrepreneurial ability.

Networking Opportunities are Everywhere

Aspire helps you identify potential networking contracts with a rotating "C" icon. After you complete a project, a new opportunity will appear at another location on the game board.

Ready for Your First Contract?

Your first project is a small-scale networking contract that gives you a sense of basic game play and interaction. Complete the contract, get paid for your work and check the game board for the next opportunity.

Manage Money Responsibly

The bank plays an important role in cultivating money management skills. You can visit the bank anytime you need to review your transaction history or take out a loan to purchase equipment and supplies.

Powerful Networking Simulation

Aspire utilizes a powerful networking simulation and visualization engine based on Cisco Packet Tracer that has been customized and optimized specifically for game play.

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Behrens, J. T., Frezzo, D. C., Mislevy, R. J., Kroopnick, M., & Wise, D. (2007). Structural, Functional and Semiotic Symmetries in Simulation-Based Games and Assessments. In E. L. Baker, J. Dickieson, W. Wulfeck, & H. F. O'Neil (Eds.) *Assessment of Problem Solving Using Simulations* (pp. 59-80). New York: Erlbaum.



Sara



3200

M B R C T P

Day 1

Mo Tu We Th Fr Sa Su Mo Tu We Th Fr Sa Su



Buy & Install PCs

- ! Go to the store and purchase 4 PCs. ✓
- ! We do not want laptops or wireless PCs, but see if they have any deals on refurbished PCs. ✓
- ! Please place the PCs on the counter in the cafe.



Thanks for picking up those PCs! Hey, you know, you should talk to my friend Mrs. Jones about doing this as a business.

ok

Realtime

Routers



Scenario 0

New Delete

Toggle PDU List Window

Fire	Last Status	Source	Destination	Type	Color

select a Device to Drag and Drop to the Workspace



Proficiency Dimension	Example evidence
Business Sense	appropriate choice of new vs. refurbished equipment
Network Configuration	home wireless settings, setting device IP addresses
Money Management	bill payment
Physical Labor	buy & place devices, connect cables
Troubleshooting	diagnose and repair network errors
Reputation	completeness of installation (going beyond minimum)



Demo Here



Pair Video – Coding, Qualitative Analysis

The screenshot displays the Transana-MU software interface, which is used for video analysis and coding. The interface is divided into several panels:

- Visualization:** Shows a red audio waveform over a video timeline. The timeline includes markers for 0:20:00.0, 0:40:00.0, 1:00:00.0, and 1:20:00.0. Below the waveform, it shows 'Time: 0:00:00.0', 'Current: 0:05:59.3', 'Selected: 0:00:00.0', and 'Total: 1:31:43.1'.
- Transcript "PairsTranscript" for Series "Pairs", Episode "Pair2":** Contains a list of dialogue lines with timecodes and speaker indicators. Some lines are highlighted in yellow.


```

then go back to it. ✖ Cut down on time. You'll be like knocking
your head by the time we're
47 (2) Yeah. ✖ The only IP address you can think of ... timed out.
Miserably ✖
48 (1) What do you claim?
49 (2) Nothing
50 (1) You are also claiming
51 (2) Oh, you actually got ... ✖ Try that connection. ✖ See if you
can see that configuraiton.
52 (1) They don't... at least the gateway looks different. ✖
53 (2) They are exactly the same. Alright, so why don't you check
other settings. ✖
54 (1) Savings? Does that mean I get money? ✖
55 (2) OK, so each one should have a gateway match. ✖ If they don't
we have a problem. OK, those two do in fact have ?? accurate. ✖
            
```
- ** Transcript "GameMoves" for Series "Pairs", Episode "Pair2" **:** Contains a list of network-related actions with timecodes.


```

22 ✖open PC1
23 ✖ping
24 ✖observe result
25 ✖ping again
26 ✖open PC2
27 ✖ping
28 ✖open PC3
29 ✖ping
30 ✖observe results ✖
31 reping
32 ✖look at config on PC3
33 ✖look at config on PC2
34 ✖look at other settings
35 ✖look at fast ethernet
36 ✖toggle PC2 and PC 3
            
```
- Video Media File:** Shows a video player with a 3D isometric view of a computer lab. A window titled "Fix PC Connectivity Problem" is open, displaying network configuration for PC3.

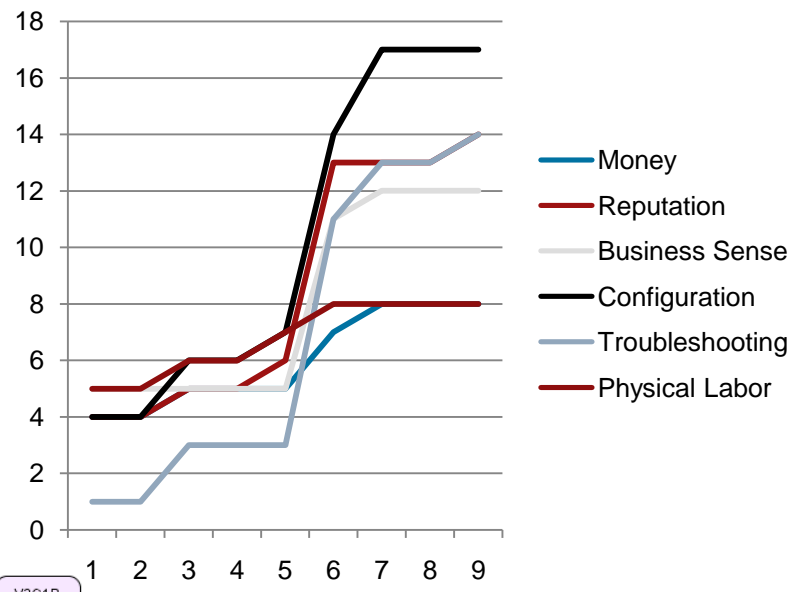
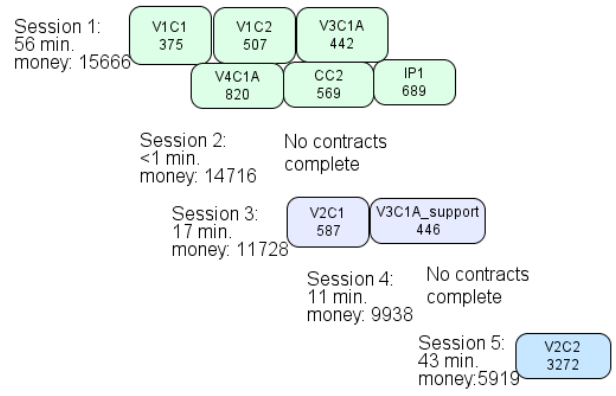
GLOBAL	Config	Desktop	Software/Services
Settings	Config	Desktop	Software/Services
Algorithm Settings	Config	Desktop	Software/Services
INTERFACE	Config	Desktop	Software/Services
FastEthernet	Config	Desktop	Software/Services

The configuration window shows "Global Settings" for PC3, including:

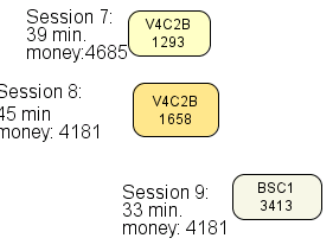
 - Display Name: PC3
 - Gateway/DNS: Static (selected), DHCP (unselected)
 - Gateway: 192.168.0.1
 - DNS Server: 192.0.2.254
 - Gateway/DNS IPv6: DHCP (unselected), Auto Config (unselected), Static (selected)
 - IPv6 Gateway: (empty)
 - IPv6 DNS Server: (empty)
- Data:** A tree view showing the project structure:
 - Database: transana
 - Series
 - Firsttry
 - Pairs
 - Pair2
 - GameMoves
 - PairsTranscript
 - Collections
 - Address



Individual Performance



V1C3 detail		
Work Product	Max Users	1
Features	Static IP Address on PC3	192.168.0.99
	PC3 is in Network	1
	Connectivity Tested	1
Proficiencies	Business Sense	1
	Configuration	1
	Troubleshooting	1
Presentation_ID	Score	300/300





What we are learning

- Students in more advanced classes complete more contracts faster than students in beginning classes
- Learning Process
 - Students can be observed trying and discarding potential solutions based on feedback from the game... resulting in new understandings
 - The game encourages students to engage in problem solving steps (problem identification, solution generation, solution testing, etc.)
 - Common incorrect strategies can be seen across recordings
- Game design
 - Additional feedback needed for students after given amount of struggling
 - Opportunities to increase information gathering



What does this tell us about assessment?



Curriculum

- Explanatory Text
- Interactive media
- Hands on Labs
- Embedded Assessment
- Rich Feedback
- Simulation supported

Feedback

Based on your performance on this assessment, this table reports your preparedness for taking and successfully perform these networking tasks on a repeatable basis.

Performance Components	Proficiency Estimates			
	None	Novice	Partial	Proficient
Device Connection				✓
Basic Device Configuration		✓		
Trunk Configuration			✓	
VTP and VLAN Configuration				✓
VLAN Access Configuration			✓	
Spanning Tree Configuration	✓			
Inter-VLAN Routing Configuration				✓
Port Security		✓		
VLAN Implementation	✓			

See [Terminology](#) section for an explanation of terms.

The following feedback summarizes why you received less than proficient on any of the estimates.

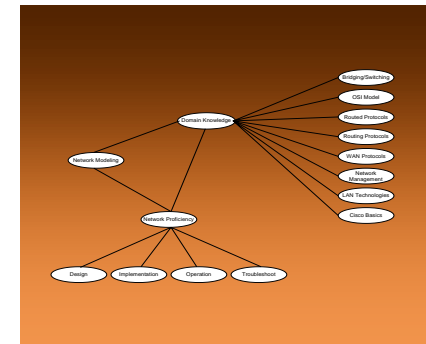
Assessment

- Knowledge focused questions
- Student or instructor initiated
- Integrated reporting
- Rich feedback
- Simulation supported



Gaming

- Promotes motivation and engagement
- Promotes learning and practice
- Provides larger context
- Rich feedback
- Simulation supported



Integration

- Comprehensive skill model provides coherence
- Common use of simulation supports cross-activity transfer
- Possibilities for future research



Conclusion

- Simulation based assessment can be constructed in flexible and scalable ways.
- Good infrastructure does not imply good task or assessment design
- Assessment implementation should be understood in the context of large social and technological ecosystems



And perhaps more important...

- The increasing ubiquity of natural tasks occurring with digital devices opens new worlds of possibility.

- Autopsy → Check up → Unobtrusive natural monitoring



Assessment in the digital ocean

Digital Desert	Digital Ocean
Disconnected intrusions	Ongoing ubiquitous data
Small samples of data	Dramatically large and ubiquitous
Special intrusive systems to get data	Data built into daily activity
Lack of data requires special focused inputs	“Items” no longer exist
Absence of data requires inferential stretch	Availability of data lessons need for inference
Data scarcity leads to small sample science (e.g models of expertise)	Data ocean leads to improved understanding of detailed mechanisms & rules (automated automated scoring)
“Exam” ignorant of your state	Activity starts with access to previous history
Data outside classroom not even considered	Data is data no matter where it is



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