PACE UNIVERSITY
Seidenberg School of Computer Science and Information Systems

CS631G Software Verification

COURSE OVERVIEW (W1)

Class instructor: Yuri Chernak, PhD

Class Instructor's Bio

Chernak Bio

Yuri Chernak, Ph.D. has been teaching computer science courses at Pace University since Spring 2016. He is the president and principal consultant at Valley Forge Consulting, Inc. Yuri has worked for a number of major financial firms in New York leading IT and Business Transformation initiatives and helping clients improve software requirements, software testing, and production management practices.

Yuri has pioneered for financial applications on Wall Street a new discipline - Aspect-Oriented Requirements Engineering, which is also a part of this course. He has been a speaker at several international conferences in the US, Canada, and Israel and has published research papers in the IEEE publications and other professional journals. Yuri has a doctorate in computer science.

Contact him by email: ychernak@pace.edu

CS631G: Course Description

- Testing is a critical phase of the Software Development Life Cycle. When taking this course, students work in teams to analyze the application under test (an accounting cloud-based application), plan testing, produce test designs and test cases, execute testing and report software defects.
- Students complete a major Testing Project, present the project deliverables in class, and upload the project deliverables to the CS631G GitHub site for public evaluation and comments for improvement.
- Students will learn the importance of a systematic approach to software testing, and other related technical and professional skills of software testers. A working knowledge of an object-oriented analysis and design is recommended. A prior experience with software development in the role of a business analyst, developer, tester, or project manager is a plus.
- The course design includes two parts – a) lectures and b) testing seminars. Prior to testing seminars, students will have an exam to demonstrate that they have sufficient knowledge to start a testing project.
- Students will work on their projects in teams and produce scheduled deliverables.

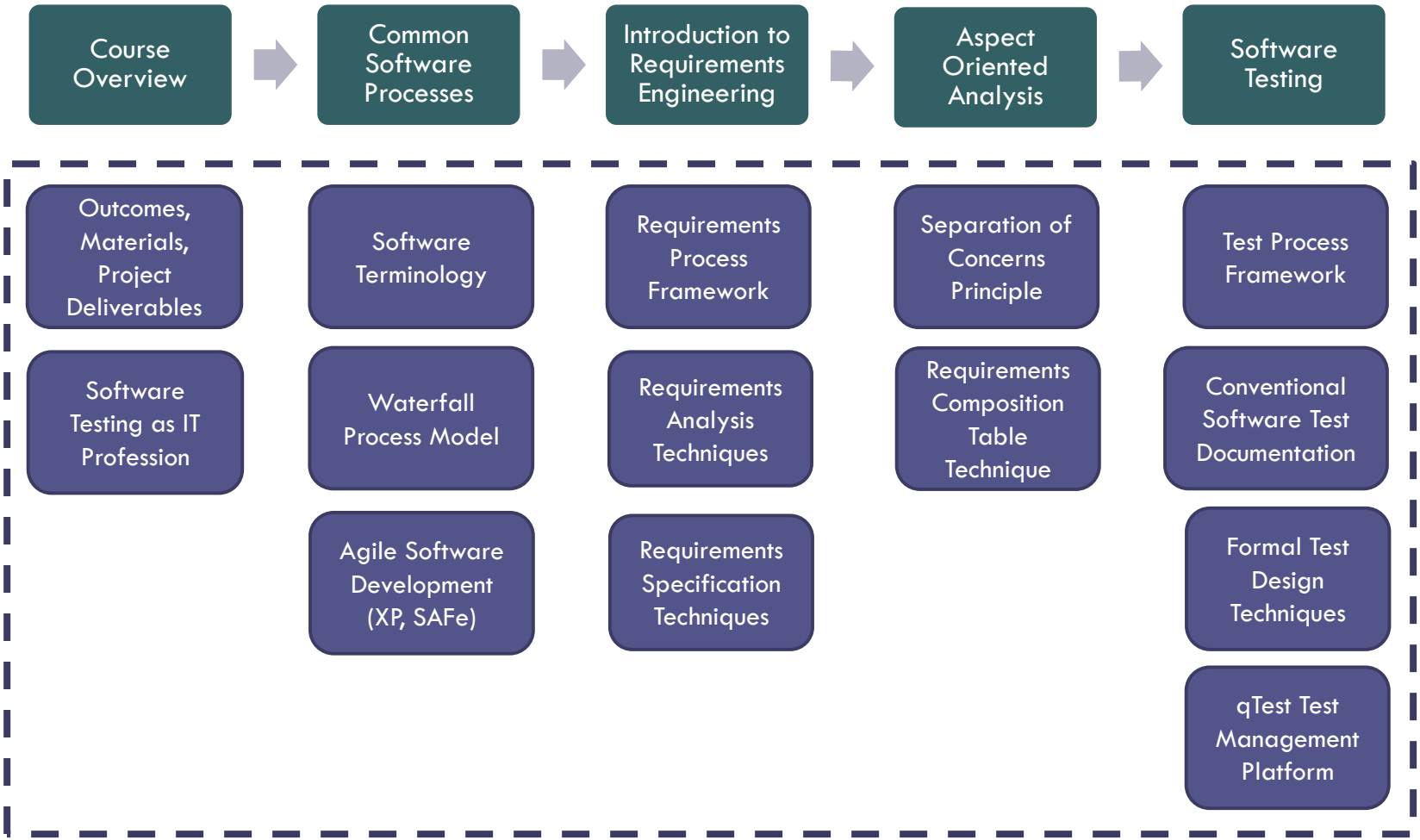
CS631G: Course Objectives

Course Objectives

- Students will learn about software processes, Agile development, requirements engineering, Aspect-oriented analysis, and formal software testing methodology.
- Students will develop hands-on experience with tools, common in the IT Industry – GitHub, Jira, qTest, and ChatGPT.
- Please note, this course does not teach coding, software testing documentation will be your main deliverables on the project this semester.

What This Course Is Teaching

Course Conceptual Structure



CS631G: Course Learning Outcomes

Learning Outcomes

Following the completion of this course, students will be able to:

- Understand the importance of a systematic approach to software testing.
- Understand the systems/software development life cycle (SDLC), especially the simplified Agile version of design, build, and test.
- Experience the systems' test planning, test design and execution as a team member on an actual project that will test an accounting cloud-based application.
- Within a project team, students will be assigned various roles common in the IT Industry.
- Understand the conventional software testing methodology, testing-related IEEE standards, common levels of testing, and formal test design techniques.
- Develop expertise in functionality reverse engineering based on the Aspect-Oriented Requirements methodology; performing requirements analysis, writing user stories, documenting story acceptance criteria, and producing conventional test documentation (Test Plans, Test Designs, Test Cases, Test Summary Report).
- Develop experience with ChatGPT to perform AI-assisted software test design.
- Develop skills and practice executing manual software testing, reporting testing metrics and software defects.
- Develop and use the skills with a test management platform qTest and Jira software.
- Understand and be able to explain the skills that are essential for successful testing professionals, and understand the significance of honesty, trust, and loyalty in teams.

Common Misconception about Software Testing

Misconception – testing does not require special expertise or knowledge, anyone can perform software testing.

There is a growing need for skilled professional testers in the IT industry that is driven by the following factors and needs:

- Rapid Growth in the Software Industry
- Complexity of Modern Software
- Regulatory Compliance
- Globalization and Outsourcing
- Validation of Functionality
- Identifying and Correcting Defects
- Reporting on Test Coverage and Test Completion
- Preventing Security Vulnerabilities by Identifying Security Weaknesses
- Ensuring Data Privacy

On-Campus Class Modality

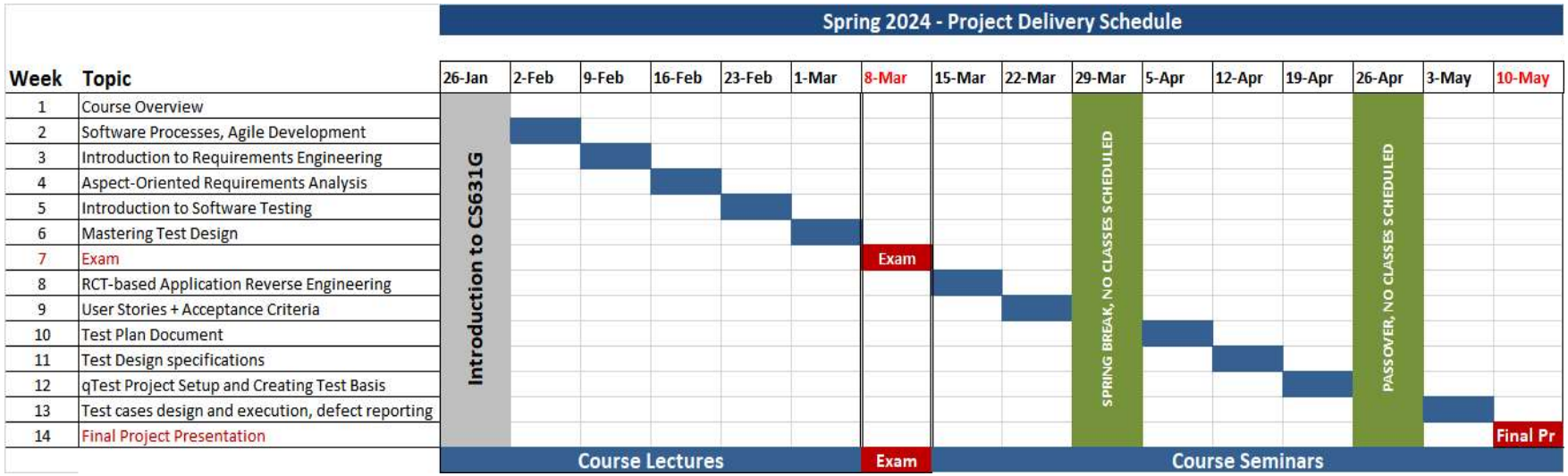
- During this semester this course offers an instructional method On-campus (ONCMP): Course is taught fully on campus following the traditional in-person format.
- In case of emergencies, students will have an option to request a class session online, via Zoom.

CS631G: Course Topics

Week	Class Dates	Course Structure	CS631G Course Topics
W1	26-Jan	Part I. Introduction	Course Overview
			Software Testing as a Professional Field
W2	2-Feb	Part II. Software Processes	Software Processes, Agile Development
W3	9-Feb		Introduction to Requirements Engineering
			Xero Application Overview
W4	16-Feb	Part III. Aspect-Oriented Analysis	Aspect-Oriented Requirements Analysis
			Requirements Composition Table Technique
W5	23-Feb	Part IV. Software Testing	Introduction to Software Testing
W6	1-Mar		Mastering Test Design
W7	8-Mar	Exam	Students will demonstrate that they have sufficient knowledge to start testing the application.
W8	15-Mar	Part IV. Testing Seminars	RCT-based Application Reverse Engineering
W9	22-Mar		Configuration and Release Management
			User Stories + Acceptance Criteria
	29-Mar	SPRING BREAK, NO CLASSES SCHEDULED	
W10	5-Apr	Part IV. Testing Seminars	Test Plan Document
			Jira Project training
W11	12-Apr		Test Design specifications
			qTest Platform training
W12	19-Apr		qTest Project Setup and creating Test Basis
			Test cases design and execution, defect reporting
	26-Apr	PASSOVER, NO CLASSES SCHEDULED	
W13	3-May	Part IV. Testing Seminars	Test cases design and execution, defect reporting
			Test cases design and execution, defect reporting
			Test Summary Report
W14	10-May		Final Test Project Presentation

CS631G: Weekly Project Delivery Schedule

- During CS631G Software Verification course, project teams will follow the Agile development and Formal Testing methodology.
- The course is comprised of two parts a) Lectures and b) Testing Seminars.
- After the first part, Students will take an exam to demonstrate that they have sufficient knowledge to start testing the application.



Project Teams and Roles

- Four project teams will be formed where students will work on their project assignments.
- Each project team includes the following roles:
  - QA Manager / GitHub Admin / Jira Admin
  - QA Analyst / qTest Admin
  - Business Analyst
  - Software Tester
- A team's QA Manager is a primary point of contact for the Class Instructor and team members.

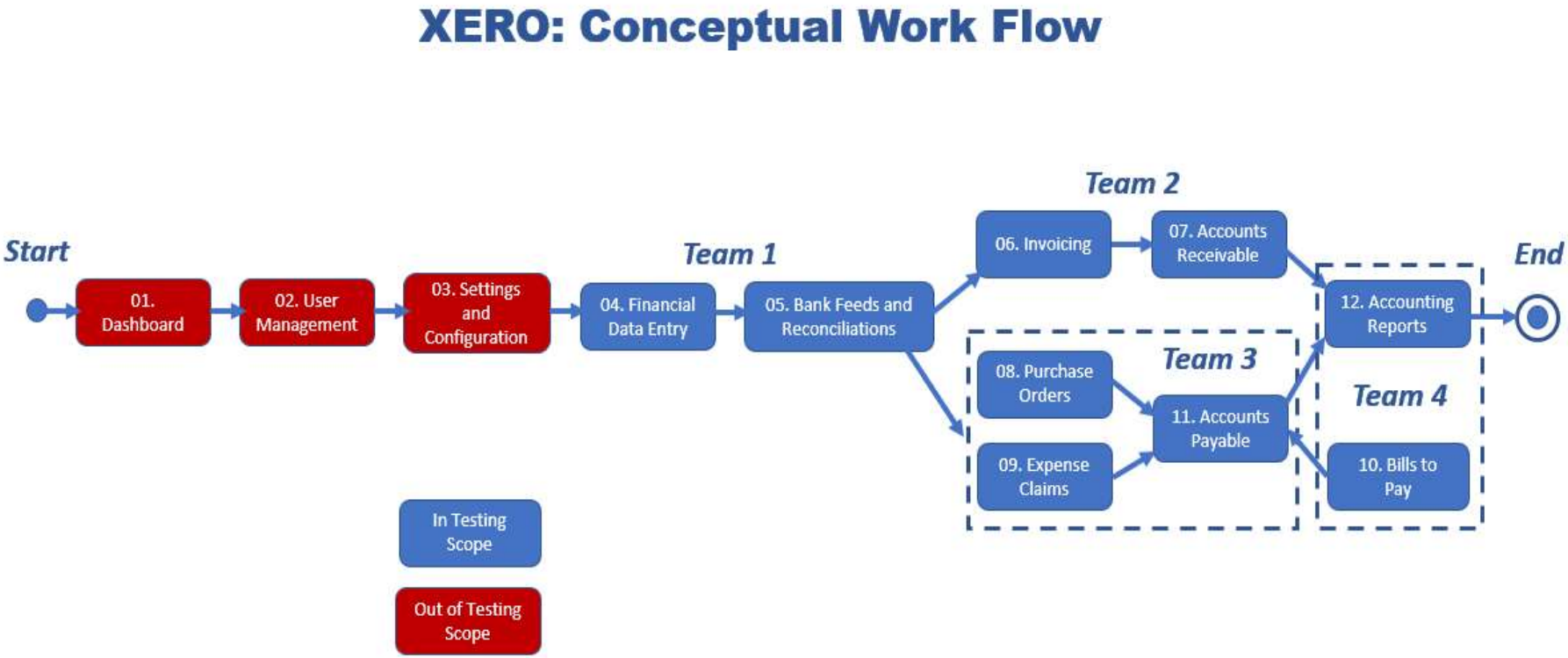
Project Teams and Roles (continued)

- The table below shows the project team composition and assigned project roles.
- Each team will be responsible for testing different application modules, as shown in the next slide.

	CS631G: Project Teams - Spring 2024			
Project Roles	**TEAM 1**	**TEAM 2**	**TEAM 3**	**TEAM 4**
QA Manager	**Noel Sam Routhu**	**Zhuowen Yan**	**Tarjanee Sandeep Desai**	**Mani Chandana Kilaru**
QA Analyst	Matt Borkowski	Daulet Kapezov	Rahul Anand Nayanegali	Manoj Challapalli
QA Analyst	Naga Bavana Kolasani	Jill Pathak	Pranit Kumbhar	Chandana Seelam
Business Analyst	Harsh Moradiya	Rahul Mendes	Shloka Gupta	Saikar Reddypally
Business Analyst	Meghana Gudipati	Shubham Mishra	Brunai Kunchala	Tejaswi Talluru
Software Tester	Yash Vora	Zaid Akhtar Mohammad	Tanzil Bilal Mohammed	Vinod Kumar Aluru
Software Tester	Jingsi Hu	Sushanth Nandeti	Sakshi Singh	Srija Vanka
Software Tester	Hanith Atluri	Damin Milan Shah	Madhu Kiran Thalluri	Praharsha Reddy Beemidi
Software Tester	Manish Thotakura	Rishitha Mandali	Sai Sandeep Mandava	Sree Vishnu Dommaraju
Software Tester	Sashank Allugunti	Laxman Madipadige	Kalpana Komatineni	Vaishnavi Dasari

Xero: Scope of Application Testing by Teams

Each project team will perform Xero's functionality reverse-engineering to identify application features of the assigned modules and create a test basis.



Xero: Application Under Test

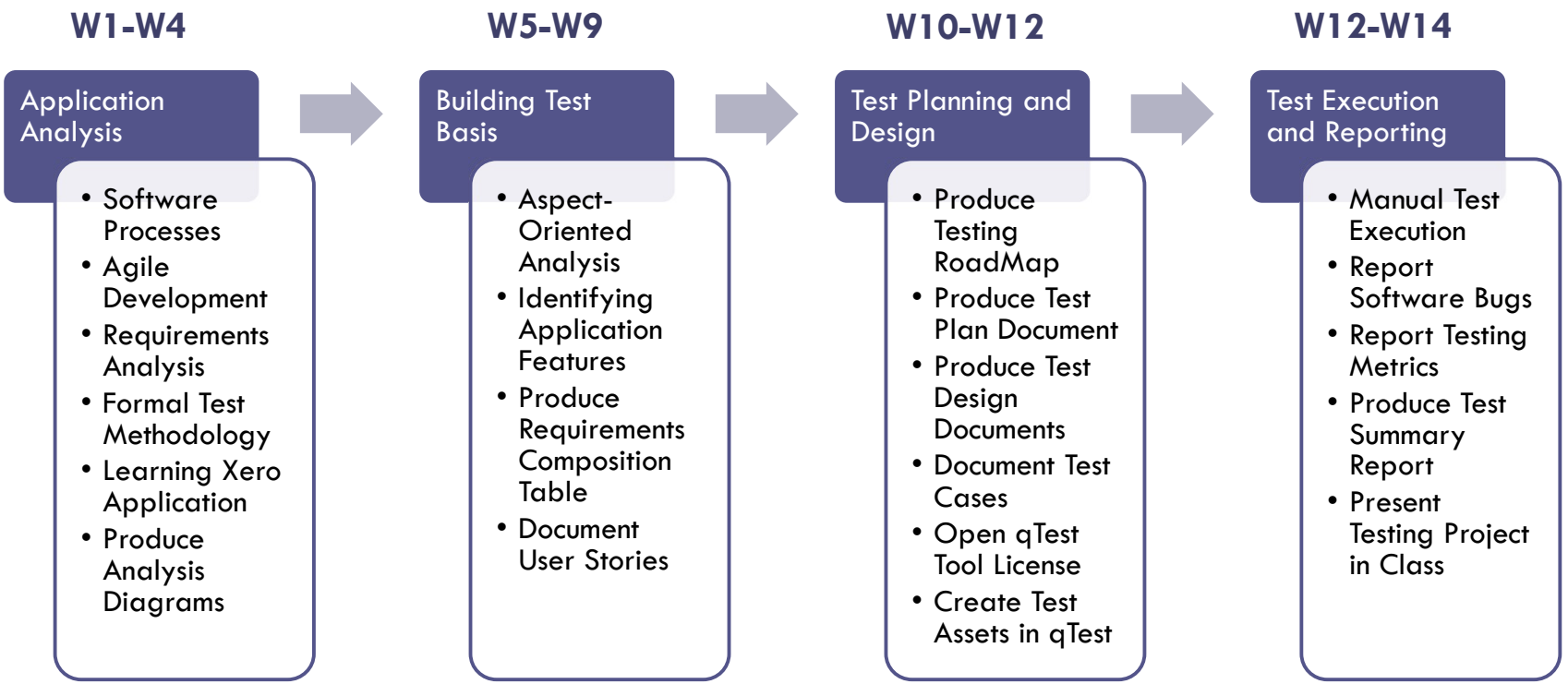
- **Xero** is a New Zealand–based technology company that provides cloud-based accounting software for small businesses.
- The company has offices in New Zealand, Australia, the United Kingdom and the United States.
- Xero's products are based on the software-as-a-service model and sold by subscription, based on the type and number of entities managed by the subscriber.
- The Xero accounting software uses a single unified ledger, which allows users to work in the same set of books regardless of location or operating system. It provides automatic bank feeds, invoicing, accounts payable, expense claims, fixed asset depreciation, purchase orders, bank reconciliations, and standard business and management reporting.

Xero: Application Main Features

Xero Feature	Feature Descriptoion
Cloud-Based Accounting	Xero operates on a cloud-based platform, allowing users to access their financial data from anywhere with an internet connection.
Unified Ledger	Xero utilizes a single unified ledger system, ensuring that all users are working with the same set of financial data regardless of their location or operating system.
Subscription Model	Xero follows a subscription-based pricing model. Users pay a recurring fee based on the type and number of entities (e.g., businesses, organizations) they manage using the software.
Automatic Bank Feeds	Xero facilitates automatic bank feeds, enabling users to seamlessly import and reconcile their bank transactions within the software.
Invoicing	Users can create and send professional-looking invoices through Xero. It streamlines the invoicing process and helps businesses get paid faster.
Accounts Payable	Xero assists in managing accounts payable, allowing users to track and pay their bills efficiently.
Expense Claims	The software includes features for handling expense claims, making it easier for businesses to manage and reimburse employee expenses.
Purchase Orders	Users can create and manage purchase orders within Xero, streamlining the procurement process.
Bank Reconciliations	Xero simplifies the bank reconciliation process, allowing users to match their financial transactions with bank statements easily.
Reporting	Xero offers a range of standard business and management reports, providing valuable insights into the financial health of the business.

Conceptual Project Delivery Framework

Conceptually, the project is comprised of four phases, where each phase has distinct learning goals as shown below:



CS631G: Project Deliverables and Ownership

Students are provided with a detailed weekly schedule of deliverables in the Excel document - CS631G_Project Delivery Schedule_Spring 2024.

CS631G_Project Delivery Schedule_Spring 2024 (partial example):

Week	Class Dates	Course Structure	Topics	Deliverables	Task Owner
W1	26-Jan	Part I. Introduction	Course Overview	N/A	N/A
			Software Testing as a Professional Field	Forming Project Teams **Project Roles:** QA Manager/qTest Admin QA Analyst Business Analyst Software Tester	Instructor
W2	2-Feb	Part II. Software Processes	Software Processes, Agile Development	N/A	N/A
			Xero Application Overview	Xero: Invite Users Quiz1: Software Processes Quiz2: Agile Development	Instructor Teams
W3	9-Feb		Introduction to Requirements Engineering	Learning Xero application	All
W4	16-Feb	Part III. Aspect-Oriented Analysis	Requirements Composition Table Technique	Learning Xero application Quiz: Requirements Engineering Context Diagram, Functional Decomposition Diagram	All Business Analyst
W5	23-Feb	Part IV. Software Testing	Introduction to Software Testing	Requirements Composition Table (draft) Quiz: Requirements Composition Table	Business Analyst All
W6	1-Mar		Exam Preparation Mastering Test Design	List of Crosscuts (Supplementary Requirements) Quiz: Software Testing	Business Analyst All
W7	8-Mar	Exam	Exam	Quiz: Test Design	All

CS631G: Project Deliverables Checklist and Grading

- Below is a list of all project deliverables with their respective assessment points.
- Grading is based on the assessment of each item consistency with the related guidelines (see next slide).

Project Checklist and Grading Policy		
No	**Deliverables**	**MAX Points**
1	Functional Decomposition Diagram	3
2	Context Diagram	3
3	Dataflow Diagrams	3
4	Requirements Composition Table (inventory of features)	10
5	Entitlements Specification (RCT tab)	2
6	User Stories with Acceptance Criteria	7
7	Testing RoadMap	3
8	Test Plan Document	7
9	Test Design Specifications	10
10	Test Case Specifications	10
11	Test Execution Logs (export from qTest)	5
12	Defect Reports (export from Jira)	5
13	Test Summary Report	5
14	Final Presentation (PowerPoint)	7
15	Final Project Presentation in Class	20
	Project Delivery TOT:	**100**

	Course Grading Policy
Exam	25%
Project Delivery	75%
TOT:	100%

Grading Policy

- All students in a project team will get the same grade for the project.
- Students' effective collaboration delivering their project is expected.
- **Final grade determination:**

A	ABOVE 92%
A-	90%-92%
B+	87%-89%
B	83%-86%
B-	80%-82%
C	70%-79%
D	65%-69%
F	BELOW 65%

Attendance: attending all scheduled class sessions is mandatory and is critically important for successful completion of the course. Students who will miss three (3) and more classes will get a 10% reduction of the total score that will impact the final grade for the course. In case you cannot attend a class, you must send a note to the Class Instructor.

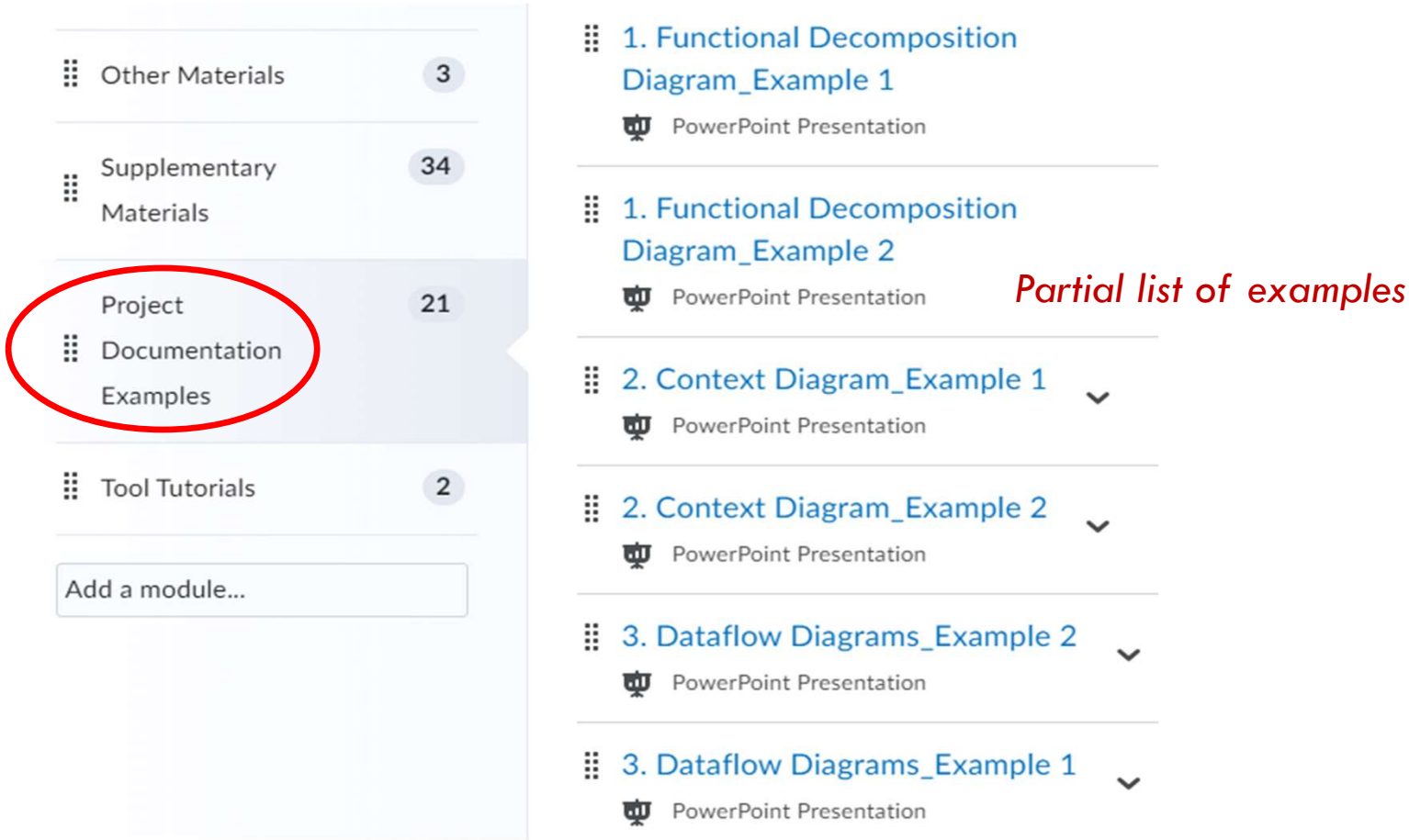
CS631G: Guidelines for the Project Deliverables

- For every deliverable, project teams can find guidelines in the Excel document in LMS/Other Materials - CS631G_Project Delivery Schedule_Spring 2024 (see example below).
- Instructor will be explaining guidelines for the weekly deliverables at each class session.

NO	Deliverables	Role	Comments
1	Functional Decompostion Diagram	Business Analyst	1. Identify functional areas of your application; note a functional area is a sizable part of the application functionality that will include multiple features. A common number of functional areas is between 4 and 6. 2. FDD - Enumerate the identified functional areas (modules); assign a team member to each functional area to lead the RCT development.
N/A	Weekly Quiz	All Team Members	1. A project team creates a quiz on the topic of the last lecture. 2. Each team member creates ONE quiz question and sends it to the Project Manager. 3. The QA Manager collects the quiz questions from all team members; the completed quiz is presented in template (a table with two columns - Student Name, Quiz Question). The document includes a header indicating the Quiz Topic. 4. The QA Manager sends the completed quiz to the Instructor and the team members.
2	Context Diagram	Business Analyst	1. The diagram includes your system and external parties, i.e., external systems and main user roles. Note, database is NOT an external system, it is part of your application architecture. 2. For all external systems, the diagram shows data flows with labels indicating the type of data being exchanged. All external interfaces are enumerated to be referenced in the second slide. 3. When showing a user/customer in the diagram, use a UML symbol "Actor" to differentiate it from a system. 4. The diagram should be delivered in a Power Point document with a title on the slide.

LMS – "Documentation Examples" Module

All project deliverables are provided with examples that can be found in the module "Project Documentation Examples":



Partial list of examples

CS631G: Tools Supporting Student Projects

Students on their projects learn and use tools, common in the IT industry, to support their testing project.

An open source distributed version control system.

Test Management Platform (Tricentis vendor)

Agile Project Management Tool (RoadMap, Kanban Board)

Students use **ChatGPT** to produce Test Plans for the assigned Xero modules, also as a learning resource throughout the course.

Using and Benefiting from ChatGPT

- ChatGPT can be an excellent personal tutor!
- **Concept Clarification:** Students can use ChatGPT to get explanations and clarifications on complex concepts covered in the course. If they're struggling to understand a particular topic, they can ask questions in natural language and receive detailed explanations.
- **Quick References:** ChatGPT can serve as a quick reference for key terms, concepts, and syntax in programming languages. Students can ask for definitions or examples on-demand.
- Remember that while ChatGPT can provide valuable assistance, it's important for students to balance its use with their own critical thinking and problem-solving skills.
- ChatGPT is a supplementary tool that can help enhance learning, but it shouldn't replace the process of actively engaging with the course material and collaborating with peers and instructors.

ChatGPT: Prompt Engineering Guidelines

What is AI Prompt?

- AI prompts play a critical role in the utilization of language models.
- Prompting is how a user communicates with AI tools.
- With prompts, you can "tell" the AI tool what you want and how you want it to be done.
- Through a prompt, you're basically describing what you want to see as a result.

Effective prompt design includes the following requirements:

- **Contextual Clarity:** ChatGPT is context-dependent. The model generates responses based on the conversation history provided in the prompt.
- **Explicit Instruction:** provide instructions about the format, tone, and style of the desired response.
- **Constraints:** specifying constraints is an essential aspect of crafting a prompt. This could refer to the length of the output, style, specific format, etc.

Managing and Archiving Project Deliverables

Students will produce many project deliverables that should be managed using two tools:

- Google Drive
- Git (project code repository)

Tool	Purpose	Links to Tutorials
Google Drive	Used for managing intermediate versions of project documentation.	https://www.youtube.com/watch?v=YPbWTG6LM84
Git	Used for managing and archiving project documentation.	https://www.youtube.com/watch?v=N_bMCff8q6A&feature=youtu.be

Class Communications Using Slack Tool

Slack (https://slack.com/) is a cloud-based set of team collaboration tools and services.

Teams

- Slack teams allow communities, groups, or teams to join through a specific URL or invitation sent by a team admin or owner.
- Although Slack was meant for organizational communication, it has been slowly turning into a community platform, a function for which users had previously used message boards or social media such as Facebook or LinkedIn groups.
- Many of these communities are categorized by topics, for example by project teams, which a group of people may be interested in discussing.

Messaging

- Public channels allow team members to communicate without the use of email or group SMS (texting). They are open to everyone in the chat provided they have first been invited to join the client.
- Private channels allow for private conversation between smaller sets of the overall group. These can be used to break up an entire class of students into their own respective project teams.
- Direct messages allow users to send private messages to a specific user rather than a group of people.
- Direct messages can include up to nine people (the originator plus eight people). Once started this direct message group can be converted to a private channel.

Class Communications Using Slack Tool

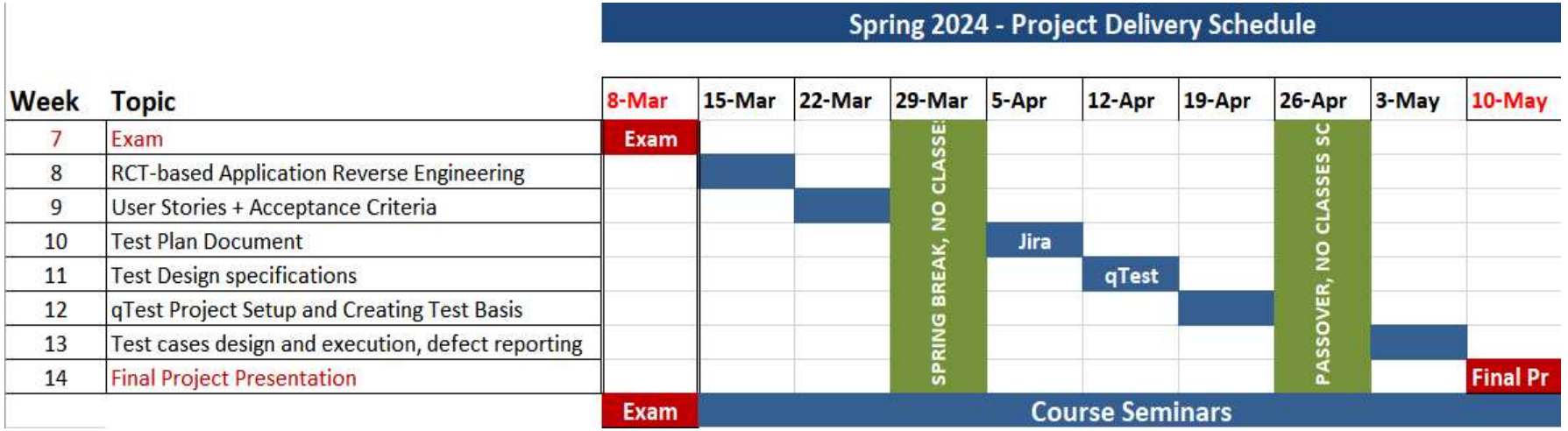
Slack Login Screen:

Channels

- General – used primarily by the Course Instructor to communicate to the entire class of students. Also, it can be used by students to post questions for a class discussion.
- Team1 (2,3,4) – used by any team member for communicating within a given project team. Also, for sending questions to the Class Instructor.

CS631G: Course Seminars

- After the mid-term exam on March 8, students will participate in seminars where they will acquire hands-on skills in software testing.
- The schedule of the seminars is shown below.
- On May 10 all testing teams will present their project deliverables that will be graded.



Engaging Students in Active Learning

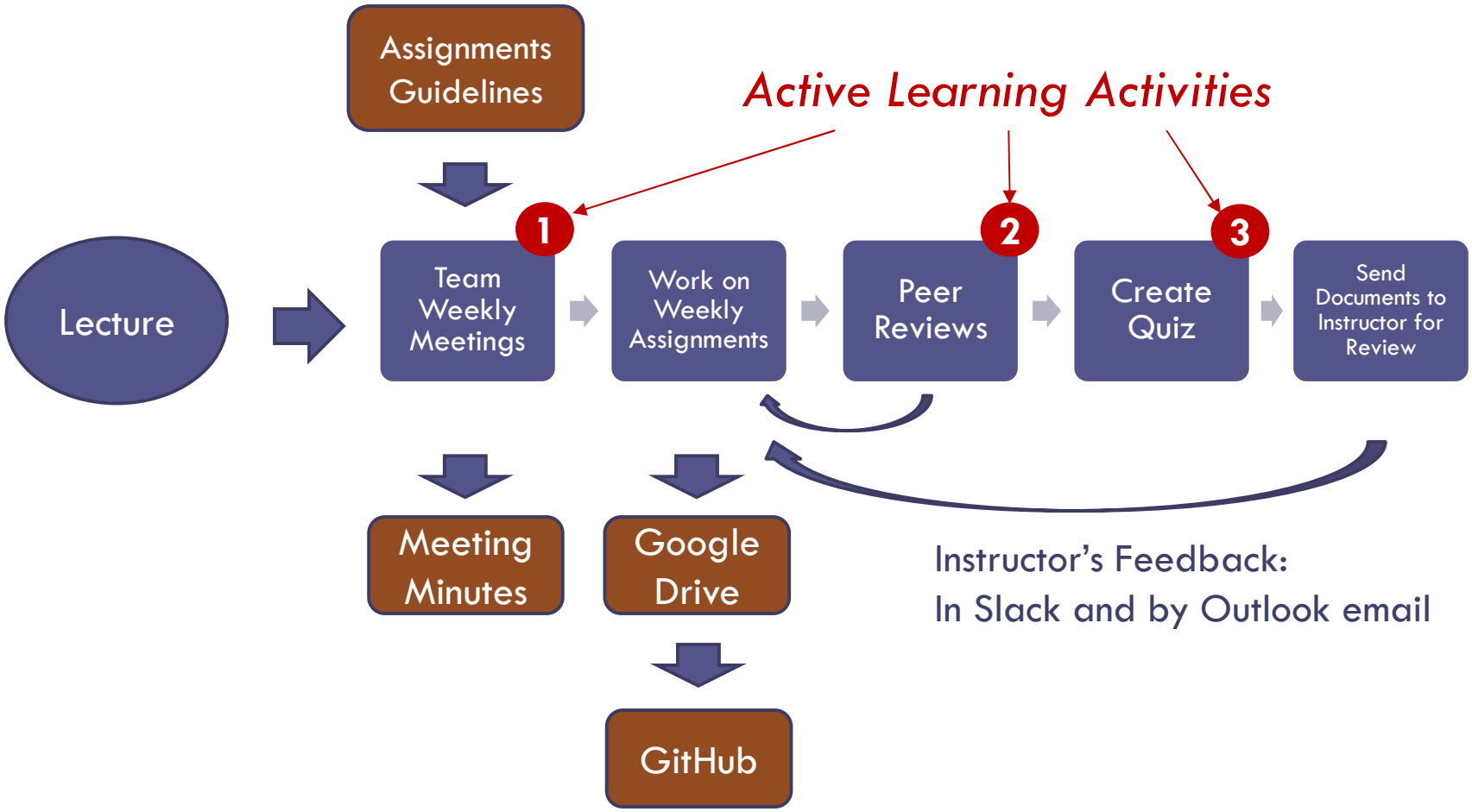
What is Active Learning?

- Active learning is a method of learning in which students are actively or experientially involved in the learning process.
- There are different activities in this course encouraging active learning and students' involvement.

Student Activities Supporting Active Learning in this Course

1. Team Weekly Meetings (Planning + Progress Tracking)
2. Peer-reviews of the team's weekly project deliverables
3. Creating a Quiz by students for the last lecture
4. Hands-on seminars where students present and discuss their project deliverables

Project Team's Weekly Working Cycle



Weekly Team Meetings and Deliverables

- Students will be working on their projects in teams.
- Each team should schedule regular weekly meetings, the first [planning] meeting should be conducted no later than next day after the lecture.
- A team's QA Manager is responsible for planning a meeting's agenda, creating Meeting Minutes (using a template in the Supplementary Materials module), and sending the minutes to the Class Instructor and team members after each team meeting.
- At the **first weekly meeting** the team reviews assignments, guidelines and agrees on who will work on draft deliverables and who will be a Peer Reviewer of each deliverable. This agreement is captured and communicated to the Class Instructor in the *Meeting Minutes* (see Slide 33).
- The Peer Reviewer checks a given deliverable for consistency with the related guidelines and provides feedback in Slack before the deliverable is sent to the Class Instructor for review.
- A second weekly meeting can be scheduled where the project team reviews and agrees to the deliverables due this week.
- A team's QA Manager is accountable that weekly deliverables are provided to the Class Instructor for review, strictly following the project delivery schedule.
- At the beginning of each class, the Class Instructor will discuss his feedback on the weekly project deliverables.

Team Meeting After the Frist Lecture

- All Project Teams should conduct a team meeting after the first lecture on January 26, 2024.
- The meeting agenda includes:
  - In-person introductions of team members;
  - Confirm the project roles;
  - Agree on the schedule of recurring weekly team meetings – Week Planning and Progress Check-point meetings.

Meeting Minutes – Partial Example

MEETING AGENDA

Team/Application Name:			
Date of Meeting: (MM/DD/YYYY)		**Time:**	
Meeting Facilitator:		**Location:**	

1. Meeting Objective & Agenda

2. Attendees	
Present at the Meeting	**Absent**

3. Documents and Owners			
Delievrables	**Progress %**	**Primary Owner(s)**	**Peer Reviewer(s)**

A Peer-Reviewer checks a given deliverable for consistency with the guidelines and provides feedback in Slack.

Recommended Textbooks

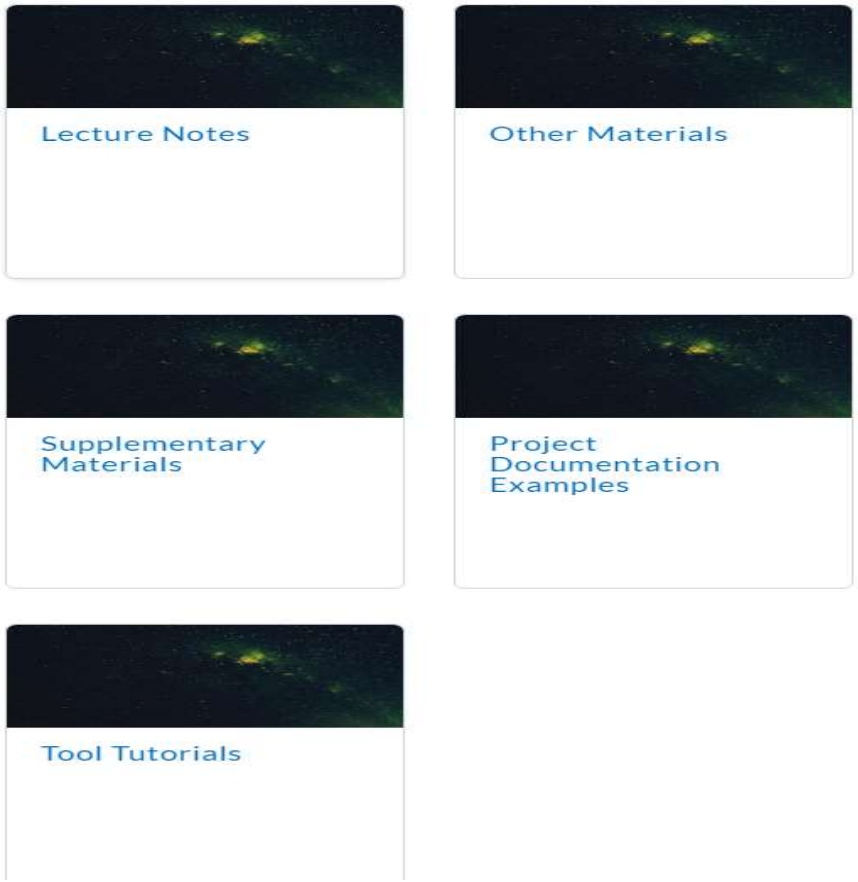
- *Systematic Software Testing*, R.Craig and S. Jackiel, Artech House Publishers
- *A Practitioner's Guide to Software Test Design*, Lee Copeland, Artech House Publishers
- *Lessons Learned in Software Testing*, Cem Cancer, James Bach, Bret Pettichord
- *Software Testing in the Real World*, Edward Kit, Addison-Wesley
- *Software Engineering*, 10th Edition, Ian Sommerville, Addison-Wesley
- *Requirements Engineering*, Gerald Kotonya, Ian Sommerville, John Wiley & Sons
- *User Stories Applied, For Agile Software Development*, Mike Cohn, Addison-Wesley
- *SAFe Distilled*, Richard Knaster, Dean Leffingwell, Addison-Wesley

The above books can be found on the following used-books portals:

- Alibris - http://www.alibris.com/
- AbeBooks - https://www.abebooks.com

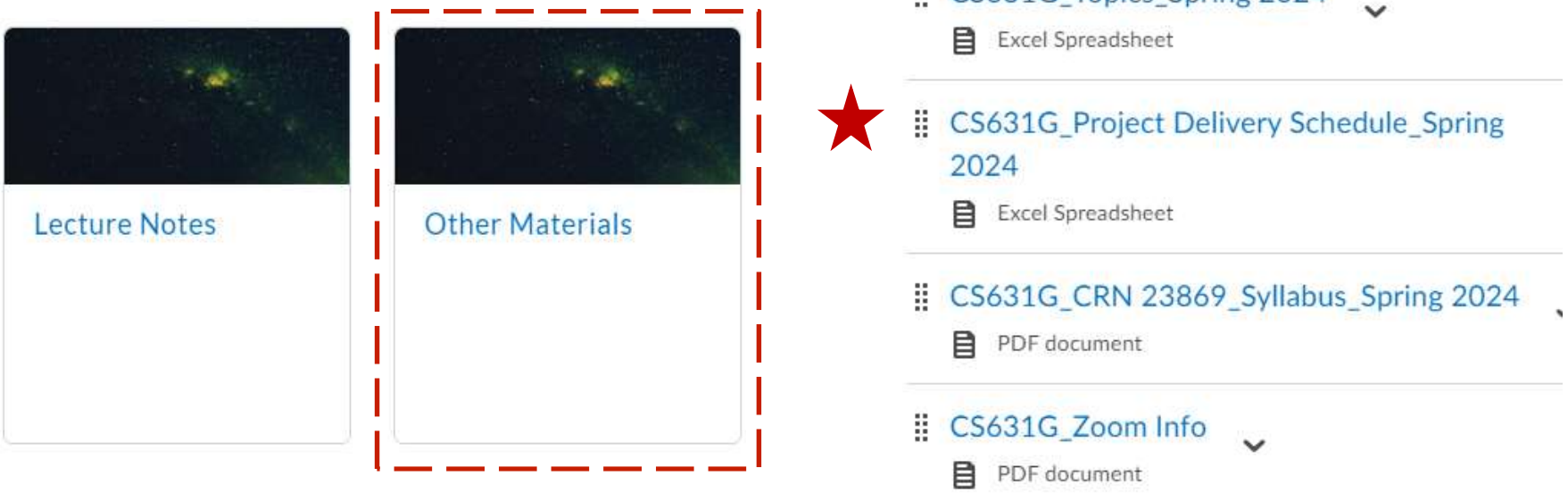
Course Materials

The course materials can be found in LMS/Classes as shown below:
https://classes.pace.edu/d2l/home/398109



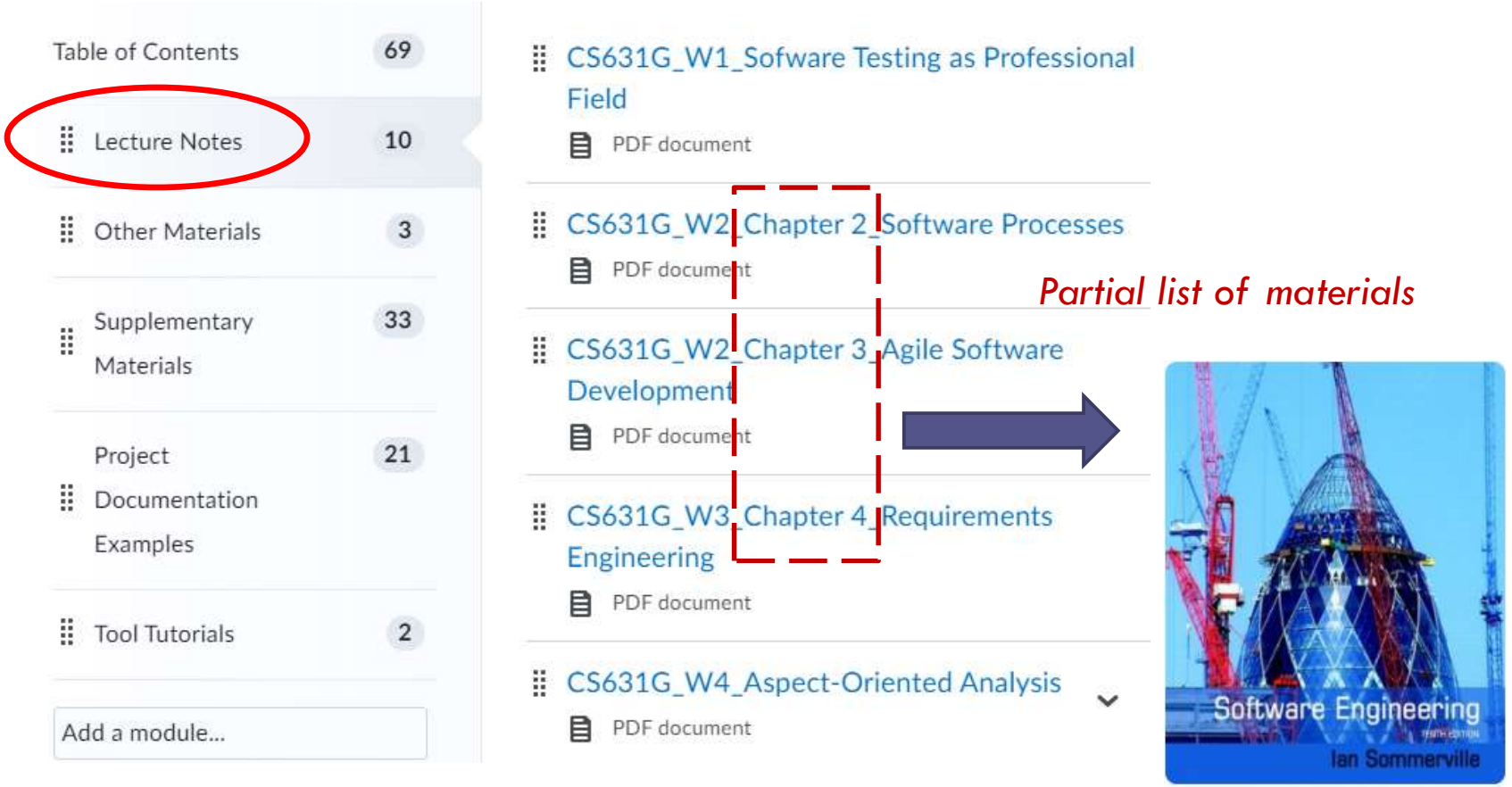
LMS – "Other Materials" Module

The Topics and Project Delivery Schedule can be found in the module "Other Materials":



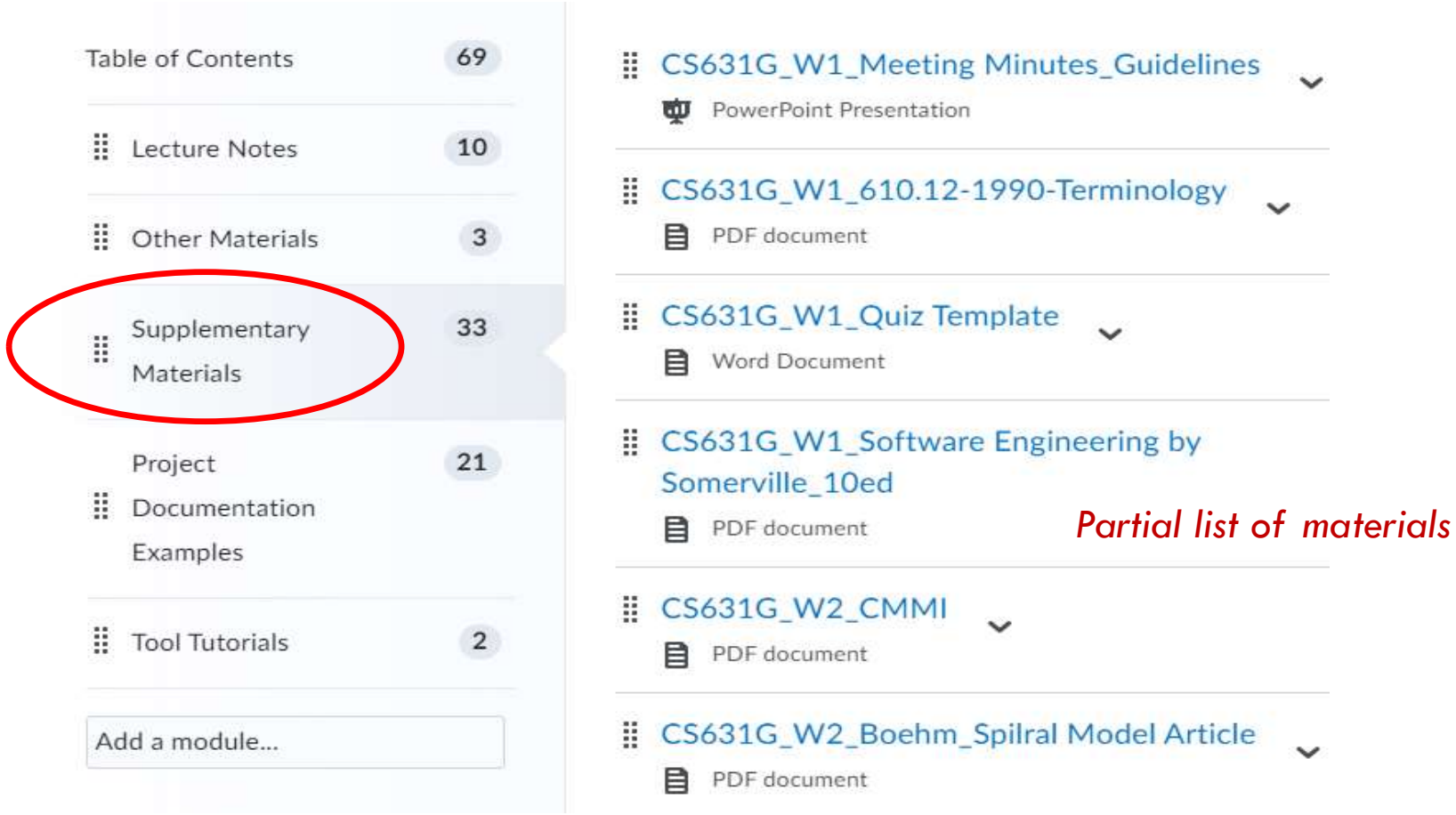
LMS – "Lecture Notes" Module

All lecture notes can be found in the module "Lecture Notes":



LMS – "Supplementary Materials" Module

Materials (34 items), supplementing the lecture notes, can be found in the module "Supplementary Materials":



Partial list of materials