San Jose State University

Department of Computer Science

CS 265, Cryptography and Computer Security, Section 1, Spring 2018

Course and Contact Information

Instructor: Kwang-Pill Sung

Office Location: MH 211

Telephone: 408-460-1059

Email: kwang-pill.sung@sjsu.edu

Office Hours: Tuesday 9:15-10:15 am

Class Days/Time: Tuesday and Thursday 10:30-11:45 am

Classroom: MH 225

Prerequisites: CS 149 or instructor consent.

Course Description: Security mechanisms for protecting information in computer systems and networks. Includes cryptography and its applications to security services in distributed systems, mathematics of cryptography, access control, protection models, security policies, design of secure systems, firewalls, and intrusion detection. Prerequisite: CS 149 or instructor consent.

Course Learning Outcomes (CLO) (Required) After completing this course you should be knowledgeable of the major technical security challenges in each of the following four areas: cryptography, access control, protocols, and software.

Required Texts/Readings

(1) Textbook: We will use a manuscript that will eventually become **the 3rd edition** of the textbook **Information Security: Principles and Practice**, Mark Stamp

I will announce about how to get the textbook at the first class.

(2) ALL of your Class Information will be uploaded to your Canvas

(3) Other Readings

● A Bug Hunter's Diary: A Guided Tour Through the Wilds of Software Security, Tobias Klein, No Starch Press, 2011. Lots of interesting real-world examples of vulnerable code.

● Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, Michael Sikorski and Andrew Honig, No Starch Press, 2012. An excellent book for information on reverse engineering (whether for malware analysis or other purposes). Includes many hands-on exercises.

● Software Reverse Engineering (SRE) (Links to an external site.) at http://reversingproject.info/. This website, which was created by a former masters student, includes lots of good information and detailed exercises with solutions.

● Network Security: Private Communication in a Public World, second edition, Charlie Kaufman, Radia Perlman, and Mike Speciner, Prentice Hall, 2002, ISBN: 0-13-046019-2. This book provides good coverage of cryptography and excellent coverage of several security protocols.

● Security Engineering: A Guide to Building Dependable Distributed Systems, Ross Anderson, John Wiley & Sons, Inc., 2001, ISBN: 0-471-38922-6; see Ross Anderson's Security Engineering (Links to an external site.) at http://www.cl.cam.ac.uk/~rja14/book.html, where you can obtain a free (and legal) copy of the 1st edition of the book. This is an excellent book for an overview of security in general, but it is not too focused or technically detailed.

● Security in Computing, third edition, Charles P. Pfleeger and Shari Lawrence Pfleeger, Prentice Hall, 2003, ISBN: 0-13-035548-8. The strength of this book is its coverage of the security issues related to software. In particular, operating systems and some aspects of secure software engineering are covered well. This book also has some good, basic information on viruses.

● Applied Cryptography: Protocols, Algorithms and Source Code in C, second edition, Bruce Schneier, John Wiley & Sons, Inc., 1995, ISBN: 0-471-11709-9. For better or for worse, in industry, this is the standard reference for all things cryptographic.

● Counter Hack Reloaded: A Step-by-Step Guide to Computer Attacks and Effective Defenses, Ed Skoudis with Tom Liston, Prentice Hall, 2006, ISBN: 0-13-148104-5. There are many books that claim to provide information on how to foil hackers, but this is by far the best that I have seen. This is an updated version of the original Counter Hack, published in 2001.

● Computer Viruses and Malware, John Aycock, Springer, 2006, ISBN: 0387302360. This book gives a good introduction to research topics related to malware. The book is well-written and surprisingly easy reading, given the technical nature of the material.

● Additional relevant material:

● Previous semester lecture videos are available on You Tube (Links to an external site.) at
http://www.youtube.com/playlist?list=PLQEAKfSI2JLOzrgaQOgF6S3PqXs2zR614

● Class-related discussion will be posted on Piazza. You are strongly encouraged to participate by asking questions, as well as by responding to questions that other students ask. At the start of the semester, you should receive an email asking you to join this discussion group—if not, contact your instructor via email.

● Quantum Computer/Post-Quantum Cryptography

https://www.youtube.com/watch?v=UiJiXNEm-Go

https://www.youtube.com/watch?v=g_IaVepNDT4

https://www.youtube.com/watch?v=S52rxZG-zi0

https://www.research.ibm.com/ibm-q/

https://www.youtube.com/watch?v=0dXNmbiGPS4

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/

Course Requirements and Assignments

Assignments (145 points including EXTRA 5 points)

No make-up tests will be given and *no* late homework (or other work) will be accepted.

- **Assignment 0: (10 points) DUE BY Jan 30, Related to IPSec (Very Easy)**
  Will be your handout in the class.

- **Assignment 1: (10 points) DUE BY Feb 1**

  Chapter 1, problems 1, 11, 13, 15, 17. The problems are available at http://www.cs.sjsu.edu/~stamp/other/chap1/probs1.pdf.

  Read the first 10 pages of PoS RAM Scraper Malware at http://www.trendmicro.com/cloud-content/us/pdfs/security-intelligence/white-papers/wp-pos-ram-scraper-malware.pdf.
  Then read a section on one of the "PoS RAM Scraper Families"
  Finally, do the same for one of the "Next-Generation PoS RAM Scrapers".

- **Assignment 2: (10 points) DUE BY Feb 8**
  (3rd Edition: Chapter 2, problems 1, 2, 5, 6, 8, 10, 16, 18) Use your program from problem 11 when you solve the simple substitution in problem 8.

- **Assignment 3: (10 points) DUE BY Feb 15**
  (3rd Edition: Chapter 3, problems 2, 7, 9, 10, 17, 18, 20, 23, 24)

- **Assignment 4: (10 points) DUE BY Feb 22**
  (3rd Edition: Chapter 4, problems 1, 2, 4, 6, 7, 9, 13, 14, 18)

- **Assignment 5: (10 points) DUE BY Mar 1**
  (3rd Edition: Chapter 5, problems 3, 8, 12, 13, 17, 18, 20, 21, 30, 33)

- **MIDTERM, 100 points (Date: Thursday, March 8)**

- **Assignment 6: (10 points) DUE BY Mar 15**
  (3rd Edition: Chapter 6, problems 3, 7, 10, 16, 17)

- **Assignment 7: (10 points) DUE BY Mar 22**
  (3rd Edition: Chapter 7, problems 1, 2, 3, 4, 6, 7, 12, 14, 17)

- **Assignment 8: (10 points) DUE BY Mar 29**
  (3rd Edition: Chapter 8, Solve all 25 problems)

- **Assignment 9: (10 points) DUE BY Apr 5**
  (3rd Edition: Chapter 9, problems 3, 6, 7, 9, 12, 13, 21, 22, 28)

- **Assignment 10: (10 points) DUE BY Apr 12**

(3rd Edition: Chapter 10, problems 1, 7, 8, 9, 12, 18, 20, 21, 25, 29, 30, 33)

- **Assignment 11: (10 points) DUE BY Apr 19**
  (3rd Edition: Chapter 11, problems 4, 7, 9, 10, 15, 25, 26)

- **Assignment 12: (10 points) DUE BY Apr 26**
  (3rd Edition: Chapter 12, problems 1, 2, 3, 7)

- **Assignment 13: (10 points) DUE BY May 3**
  (3rd Edition: Chapter 13, Solve all problems)

- **Assignment 14: (EXTRA 5 points CREDIT)**
  Attend one (or more) of the master's defenses listed at
  http://www.cs.sjsu.edu/~stamp/defenses/spring18.html
  Please provide me the snapshot of your attendance list to prove !!

CS 265 Cryptography and Computer Security, Section 1, Spring 2018 (Subject to Change thru Announcements On CANVAS)

Week 1 (on 1/25/2018) --- Syllabus, IPSec with Cisco Packet Tracer

Week 2 (on 1/30, 2/1/2018) --- Introduction and overview (Chapter 1)

Week 3 (on 2/6, 2/8/2018) --- Crypto basics (Chapter 2), Your project topic (Cryptanalysis Project) is due Tuesday, February 6 (Please email me about your project topic)

Week 4 (on 2/13, 2/15/2018) --- Symmetric key cryptography (Chapter 3)

Week 5 (on 2/20, 2/22/2018) --- Public key cryptography (Chapter 4)

Week 6 (on 2/27,3/1/2018) --- Cryptographic hash function and related topics (Chapter 5)

Week 7 (on 3/6, 3/8/2018) --- 1st MIDTERM, 100 points (Date: Thursday, March 8)

Week 8 (on 3/13, 3/15/2018) --- Authentication (Chapter 6)

Week 9 (on 3/20, 3/22/2018) --- Authorization (Chapter 7), The completed project (Cryptanalysis Project) is due Thursday, March 22

Week 10 (on 3/27, 3/29/2018) --- Network security basics (Chapter 8)

Week 11 (on 4/3, 4/5/2018) --- Simple authentication protocols (Chapter 9), Your project topic (SRE Project) is due Thursday, April 5

Week 12(on 4/10, 4/12/2018) --- Real-world security protocols (Chapter 10)

Week 13 (on 4/17, 4/192018) --- Software flaws and malware (Chapter 11)

Week 14 (on 4/24, 4/26/2018) --- Additional software security topics (Chapter 12)

Week 15 (on 5/1, 5/3/2018) --- Additional software security topics (Chapter 13)

Week 16 (on 5/8, 5/10/2018) --- Special Topics / Student Presentation, The completed project (SRE Project) is due Tuesday, May 8.

Week 17 (on 5/15, 5/17/2018) --- **Special Topics / Student Presentation**

Week 18 (on 5/22/2018) --- Final, 200 points (Tuesday, May 22, 09:45-noon, Classroom: MH 225)

http://info.sjsu.edu/static/catalog/final-exam-schedule-spring.html

Project Paper (less than 10 pages) (50 points) / Presentation Slides (50 points) will be due by MIDNIGHT, on Tuesday, May 22 (FINAL), 100 points

Zip your Project Paper (less than 10 pages) / Presentation Slides into a file named **project.zip.**

PLEASE START EARLIER and email me at kwang-pill.sung@sjsu.edu

The subject line of your email must be of the form:

CS265 yourlastname last4digitofyourstudentnumber

That is, the subject line must consist of 3 identifiers.

There is no space within an identifier and each identifier is separated by a space.
I will confirm your message. (If you don't get my confirmation, you need to resend)

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

Grading Information

- **Please Read University Syllabus Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf) and University policy F15-12 (http://www.sjsu.edu/senate/docs/F15-12.pdf)**

- **Grading Policy (TOTAL 745 points including EXTRA 5 points CREDIT)**
  - **Assignments (145 points including EXTRA 5 points) (Date: Starting from Jan 30)**
  - **MIDTERM (CLOSED BOOK), 100 points (Date: Thursday, March 8)**
  - **Cryptanalysis Project 100 points (Please see the below in details, 100 points. Your project topic is due Tuesday, February 6 (Please email me about your project topic), and the completed project is due Thursday, March 22. Note that a written report is required, but no oral report.**
  - **SRE Project, 100 points (Please see the below in details, 100 points. Your project topic is due Thursday, April 5 and the completed project is due Tuesday, May 8. Presentations will be given beginning on the due date. Note that an oral report (50 points) and written slides (50 points) are required**
  - **Final (CLOSED BOOK), 200 points (Tuesday, May 22, 09:45-noon)**
    - http://info.sjsu.edu/static/policies/final-exam-schedule-fall.html
  - **Final Project Paper (less than 10 pages) (50 points) / Final Presentation Slides (50 points) will be due by MIDNIGHT, on Tuesday, May 22 (FINAL), 100 points - PLEASE START EARLIER and Email me at kwang-pill.sung@sjsu.edu (ORAL REPORT is not required)**
  - ***No* make-up tests will be given and *no* late homework (or other work) will be accepted.**

- **Grading Scale: The grades will be curved.**

- The last day to drop is **Monday, February 5**, and the last day to add is **Monday, February 12**

[I] Cryptanalysis Project Requirements

- **Cryptanalysis Project 100 points (Please see the below in details, 100 points. Your project topic is due Tuesday, February 6 (Please email me about your project topic), and the completed project is due Thursday, March 22. Note that a written report is required, but no oral report.**

- You must attempt to solve one of the challenge problems posted here http://www.mysterytwisterc3.org/
  (level II or higher) or obtain instructor approval for a cryptanalysis project not on this site. The precise details of your project will vary somewhat depending on the challenge you select, but, in general, you will be expected to do all of the following:
  - Study your selected cryptosystem
  - Write software to implement the system
  - Write software to implement the attack on the system
  - Estimate the work factor for your attack
  - Conduct computational experiments to verify your analysis
  - Ideally, you will provide a complete solution for your selected challenge problem

  In summary, you must become an expert on the system that you choose to attack, and your work must demonstrate your newfound expertise.

- You are expected to work with a partner. All projects will be ranked against all other projects.
- You must select your project topic by the date given on the green sheet. Instructor approval of your topic is required. This must be done via email. The topics are first come, first served. For your email, use subject line "CS265-01 Cryptanalysis Topic" or "CS265-02 Cryptanalysis Topic" as appropriate. Send your email to kwang-pill.sung@sjsu.edu. If I have any concerns regarding your selected topic, I will let you know promptly. It is to your advantage to spend some effort to initially select a good topic.
- All software must be written in C or C++ or Java or Python. In most cases, the number of lines of code will be relatively small, but the coding may be technical and challenging.
- You must write a report that includes a detailed description and analysis of your work and results. There is no minimum or maximum length for this paper, but quality is far more important than quantity. Your paper should be concise and to the point. Your grade for the project will be largely determined by the content and substance of your paper. While this is not a writing class, poor grammar, usage, organization, etc., will definitely

not help your cause and may detract significantly from your grade. Every page of your report must include the authors' names and email addresses.

- Papers may be submitted to www.turnitin.com, an online plagiarism detection tool. If the instructor determines that you have committed plagiarism, you will fail the course and an academic dishonesty report will be submitted. The official SJSU policy on academic dishonesty (including plagiarism) can be found at http://www2.sjsu.edu/senate/s98-1.htm.
- On or before the due date, submit all material (including source code) via email to the instructor at kwang-pill.sung@sjsu.edu. Put all info in a single zip file named Lastname1_Lastname2.zip, where Lastname1 and Lastname2 are the last names of you and your partner. The subject line of the email must read "CS265-01 Cryptanalysis Project" or "CS265-02 Cryptanalysis Project", as appropriate.
- Finally, it is imperative that you begin working on this project immediately and that you work on it consistently. This is not the type of project that can be completed in a few days, no matter how many hours you work each day. It is also not the kind of project that you can drop and easily pick up where you left off. These are highly technical and challenging problems that require constant and ongoing effort to make any real progress.

[II] Reverse Engineering Project (SRE Project) Requirements

- **SRE Project, 100 points (Please see the below in details, 50 points. Your project topic is due Thursday, April 5 and the completed project is due Tuesday, May 8. Presentations will be given beginning on the due date. Note that an oral report (50 points) and written slides (50 points) are required**

- You are required to reverse engineer a piece of real-world software.
- Your reverse engineering work must not violate the End User License Agreement (EULA) for your selected program, or, if your work would violate the EULA, you must obtain permission from the developer in advance.
- Your objective is to:
    1. Fully understand the security aspects of your selected program.
    2. Bypass some aspect of the security by "patching" the code.
    3. Describe in detail how the software could be made more resistant to a reverse-engineering attack.
- It is your responsibility to find a suitable program for this project---I will not provide a list of potential project topics.
- At a minimum, you will need a disassembler, a debugger, and a hex editor. Additional tools may be needed, depending on the topic you select. The following specific tools could prove useful for your work:
    - OllyDbg --- disassembler and debugger. According to the OllyDbg website, "OllyDbg is a shareware, but you can download and use it for free".
    - IDAPro --- disassembler and debugger. There is a free evaluation version.
    - PEBrowse --- free debugger (and disassembler).
    - Process Monitor. Free.
    - VMware --- "desktop virtualization software". Free version is (or was at one time) available.

- Virtual PC --- "powerful software virtualization solution". There is a 45-day free trial edition.
- If you want more info on the Windows Portable Executable (PE) file format file, see this article.
- Good resources on reverse engineering include is this website and the book *Practical Malware Analysis: The Hands-on Guide to Dissecting Malicious Software*, by M. Sikorski and A. Honig.
- To see examples of some types of security techniques you are likely to encounter in software, see the book *Crackproof Your Software*, by P. Cerven.
- You will probably need a source of information on assembly code. Many good resources are available online.
- See this website for additional information on tools, many useful SRE-related links, etc.

All projects will be graded on the same basis, and all projects will be ranked against all other projects. Outstanding projects may get a 10 point bonus.

Instructor approval of your selected topic, via email, is required. The topics are first come, first served. For your email, use subject line "CS265-01 SRE Topic" or "CS265-02 SRE Topic", as appropriate. You must email your project topic to me at kwang-pill.sung@sjsu.edu by the date given on the green sheet. If I have any issues or concerns regarding your selected topic, I will inform you promptly. If you select a topic and find that it is too difficult, it is possible to change to a different project. However, this will cost you a significant amount of time, so it is to your advantage to spend some effort to initially select a feasible topic.

No written report is required, but you must be prepared to give an oral presentation at any time on or after the due date. During the oral presentation *you must demonstrate at least one of your attacks, by reverse engineering the executable in real time*.

The due date for the project is given on the green sheet.

It is essential that you start on this project **as soon as possible** after completing project 1.

[III] About your project paper and presentation slides and How To Write A Project Description: Key Criteria And Steps

- **Final Project Paper (less than 10 pages) (50 points) / Final Presentation Slides (50 points) will be due by MIDNIGHT, on Tuesday, May 22 (FINAL), 100 points -**
  PLEASE START EARLIER and Email me at kwang-pill.sung@sjsu.edu
  (ORAL REPORT is not required, but it will help your grades)

About your project paper and presentation slides

You may choose any "Cryptography and Computer Security" related topic for your project paper and your presentation slides such as

IPSec or ZFW with Cisco Packet Tracer, Crypto basics, Symmetric key cryptography, Public key cryptography, Cryptographic hash function and related topics, Authentication, Authorization, Network Security basics, Simple authentication protocols, Real-world security protocols, Software flaws and malware, Additional Software Security Topics, Post-Quantum Cryptography, DDos, VPN, PKI, Wireless Security, SSL, Smart Card, Cloud Computing Security, IoT Security, IPSec, ZFW, Security Tools, Server Side Attacks, Trojan Horses, IDS, IPS, Hacking Techniques, Web Security Vulnerabilities, Python Penetration Testing Essentials, Gray Hat Python, Black Hat Python, Violent Python, Java Security, VOIP Security, Steganography, Military Security, Bitcoin, Routers and Switches Security, Common Criteria, Mobility Security, Malware/Phishing/Dark Web,3rd Party Risk, Brand/Reputation Protection, Executive Protection, Threat Intelligence Feeds, Cyber Awareness Safety, Threat Intelligence Management, Deep Packet Inspection, Deep Packet Processing, iOS Security, Android Security, Dark Web, iPhone Jailbreaking,

Credit Card Skimming, KRACK Attack, iOS Security, Stuxnet, WannaCry Attack, Metamorphic Code and Metric-Based Detection, etc.

Project Paper (less than 10 pages) (50 points) / Presentation Slides (50 points) will be due by MIDNIGHT, on December 18 (FINAL), 100 points

> Zip your Project Paper (less than 10 pages) / Presentation Slides into a file named **project.zip.**

PLEASE START EARLIER and email me at kwang-pill.sung@sjsu.edu

The subject line of your email must be of the form:

CS265 yourlastname last4digitofyourstudentnumber

That is, the subject line must consist of 3 identifiers.

There is no space within an identifier and each identifier is separated by a space.
I will confirm your message. (If you don't get my confirmation, you need to resend)

How To Write A Project Description: Key Criteria And Steps

A Simple Guide To Creating A Description Document For A Project

A well written description of any project makes it possible for the indented audience (e.g. the sponsor, the executive) to understand the concept and context of the proposed project and to realize whether to approve and finance the project or not.

Writing a project description document is a general task of the project manager or his/her deputy who is supposed to identify the idea, goals, background, approach, outcomes and other data in a correct and comprehensive manner. The document should define the project as a worthwhile and economically effective and reasonable endeavor to convince the sponsor of the need to make the necessary investments. In this publication I'm going to talk about:

- Project Description definition
- Criteria to use to write this document efficiently

- Structure and sections of the document
- Steps to take to develop the document content

Definition

Project Description is a formally written declaration of the project and its idea and context to explain the goals and objectives to be reached, the business need and problem to be addressed, potentials pitfalls and challenges, approaches and execution methods, resource estimates, people and organizations involved, and other relevant information that explains the need for project startup and aims to describe the amount of work planned for implementation.

The focus of the project description is put on creating a clear and correct understanding of the project in minds of the people and organizations involved in the planning and development process. The project team (which is supposed to do the project) uses the document to get a general idea of what amount of work and under what requirements is planned for completion. The senior management team regards the project description as the key source of preliminary information necessary for strategic planning and development.

I need to note that some people are confused with the terms “project description” and “project background“. They might regard both terms as equivalent. But the terms are not same and they have different meaning.

Criteria: The 4C Rule

When writing a project description for requesting funding, it is always important to keep the structure and content of the document clear and understandable for the target audience. The rule says that the project description is written well and efficiently if it is Clear, Concise,

Complete and Credible. The 4C rule serves as the key criteria for document writing and development.

I suggest you keep this rule up when you describe the content and idea of your project. Here's what I mean:

· **Clear** means your document uses simple, generally accepted and unambiguous words and sentences to describe the key point. You should never try to make the document more complicated by using some confusing words and ambiguous instructions in the text. You can only use special terms and definitions if the project really requires that (e.g. in an engineering project it may be required to write about some technical terms and math calculations). However, it is best to avoid using special terms and definitions in project descriptions.

· **Concise** means the project description actually "describes the project", with no reference to other projects or not related information. You should never mention about something that is directly linked to your project and its context. Otherwise you're likely to will confuse the reader or keep the reader unfocused on the key points of your project.

· **Complete** means that your description includes everything that concerns and deals with the project. Although you must keep the document concise (as I said above) there is the need to make sure the text is 100% complete for the intended audience. You must be sure that the document covers every critical aspect that is required for the reader to understand and comprehend the project and its context.

· **Credible** means in your project description document you refer to up-to-date and relevant information only. You should never use data that is not related to the matter or does not support the idea of your project.

We regard this rule as a foreseeing method (4C = Foresee) that lets us minimize the risk of failure, predict future events and ensure success of our effort, through developing Clear, Concise, Complete and Credible documentation. We use the method as the key criteria for writing any kind of project documents, no matter whether it the project description, the scope statement, a kind of report, the funding request, the feasibility study report, or anything else.

Structure

Below I list the key steps you can take to develop the structure and content of your sample project description. Please use the given checklist as an additional guide for developing the document.

A sample project description paper includes the following structure:

- Section 1. Project Title and Overview
- Section 2. Purpose and Need
- Section 3. Business Divers and Significance
- Section 4. Benefits and Costs
- Section 5. Implementation Method
- Section 6. Timeline
- Section 7. Requirements
- Section 8. Expected Outcomes

Key Steps

Taking into account the typical elements of the document structure, you must complete the following steps to write a project description template:

1. Summarize. Summarizing the project means explaining the aims, outcomes, significance and benefits. You must use 3-5 sentences (or less) for writing the summary. The title of your project is to be placed at the beginning of the paper. Avoid using unnecessary and parenthetic words and expressions.

2. Define. Defining the project means explaining what purpose to reach and what need to address. Under the purpose you write about the main intent for project startup. Under the need you must define the business problem to be solved or the opportunity to be exploited,

3. Justify. Justifying the project means proving that the project underpins some business goals and is significant to success of the performing organization. You must identify business drivers that lead change to the project and determine how the project impacts the performance of the organization.

4. Evaluate. Evaluating means identifying the benefits to be gained upon successful completion of the project. You need to use the results of cost-benefit analysis to explain the ratio between the benefits to be gained and the cost to be covered.

5. Approach. Approaching the project means selecting, approving and describing a method that is efficient for implementing the goals and objectives of the project within the current operational environment. You must have an approach along with a methodology that explains how to phase the project and what lifecycle to be followed.

6. Scheduling means performing a preliminary estimation of time needed for the project. You'll need to develop a timeline that shows the total estimated amount of working hours required. Note that the timeline will be used later during the planning phase to develop the project schedule and estimate activity durations.

7. Wrapping the project is a slangy word I use here to explain the need for stating the requirements for your project. Wrapping means identifying all those limits, demands, needs, and other parameters that define the user expectations and interests as to the product and the implementation process. The requirements wrap the project making it limited and bounded in terms of the user expectations.

8. Compensate. Compensating the project means identifying the results to be gained as a compensation of all those resources and effort invested in the implementation process. You need to create a description of the desired outcomes that are anticipated upon successful completion of the project. This data will be used later in developing the deliverables list.

When all the steps of the process for writing the project description are taken and completed, you must review the document for errors and mistakes to make sure it is correct. I recommend you to follow the 4C rule to check and manage every piece of data included in the paper.