Research Project

Exploring Current Topics in Operating Systems

CS 441/541 – Fall 2018

Project Available		Nov. 6
Component	**Points**	**Due Date (at 11:59 pm)**
Group Selection & Topic Request		Nov. 8
Final Group & Topic Announcement		Nov. 9
Presentations	60	Dec. 17
Paper	100	Dec. 17
Self and Group Evaluation	10	Dec. 17
Project Total	170	

Deliverables

There are several pieces and due dates for this project. It is important to adhere to these deadlines and reference this portion of the assignment regularly to make sure you are meeting them.

Group and Topic Selection - 11/8 - email - you must work in groups for this project. I encourage you to form your own groups and you MUST do so by 3/27. When you email me your group information, you will also include a list of three (3) topics (ranked) that you are interested doing the project on. I consider those who request topics first as having a higher priority, but I also try my best to make sure everyone has a topic that they will enjoy. If you have only a partial group or no group, please send me your topic preferences and I will group you based on common interest, if possible.

Final Group and Topic Announcement - 11/9 - Announcement on Canvas - groups and topics will be announced in class and posted on Canvas on 11/9. Groups will be created on Canvas at that time too. The presentation schedule will be announced at least one week before the presentations.

Group Check-in - Week of 11/27 - schedule with instructor - In order to make sure you are making progress and are able to find adequate resources, each group will schedule a quick meeting to discuss progress on the project, and any issues that may be occurring.

Presentations - 12/17 - *Final Exam Time* - All groups will present their topics to the rest of the class during the final exam period. We will have the last exam on 12/6.

Paper - 12/17 - Canvas - All groups will submit a high quality paper on their research topic. There is a starter document with information about formatting posted with this project.

Self and Group Evaluation - 12/17 - Canvas Quiz - All group members will submit an evaluation of their project experience. This will allow the instructor to adjust the grades of the individuals in the group according to effort (as needed), and to address any issues with the structure of the assignment going forward.

Overview

The goal of this project is to deeply understand and communicate a current topic in operating systems. Through this project you will develop a deep understanding of a particular topic and gain a breadth of knowledge in several current topics in operating systems from your fellow students' presentations. Each of these topics will draw on and extend your knowledge of operating systems into current challenging areas of computer science.

It is often the case that instructors are unable to cover many exiting current topics in a subject due to time, developing the prerequisite knowledge to understand these topics, and the time it would take to develop the content. By leveraging the power of parallelism, we can do more if we divide this task among the students and efficiently communicate the knowledge back to the rest of the class. In order to make this task easier, you will further parallelize and coordinate the task by working in small groups. This parallelism allows more work to be done than by one individual, however there is a coordination and communication cost, just like in concurrent programming. Carefully consider how you break up the work, coordinate and check in with your group members, and plan for the paper and presentation. I highly recommend checking in early and often, setting several smaller deadlines, starting early, and practice your presentation. If you do these steps, you will also be able to take advantage of the speaking and writing centers offered by the Murphy Learning Center.

Topics

For each of these topics, I have provided some starter material. You will need to find additional resources for your project. I encourage you to use peer reviewed or other highly regarded technical materials as opposed to personal websites, blogs, or editorials. For each topic, you will need to (1) relate it to the topics and structures in an operating system as we have discussed in class, (2) describe the topic in detail being sure to mention pertinent motivation, design and implementation details, (3) discuss how a specific application or user would use this particular system.

You may also propose your own topic. In order to do so, provide a brief description of the topic and at least one reference. It is preferable that the topic fits in one of the topic categories below.

Topic Grouping: Other types of OSes

Mobile OS - Android - describe the design and implementation details of the whole operating system or certain aspects of the system, like security.
http://ieeexplore.ieee.org/abstract/document/4768655/
https://dl.acm.org/citation.cfm?id=2000018

Mobile OS - iOS - describe the design and implementation details of the whole operating system or certain aspects of the system, like security.
https://www.apple.com/business/docs/iOS_Security_Guide.pdf

Real Time Operating Systems - survey of the features and design elements of real time systems. Be sure to include some examples of systems.
https://link.springer.com/content/pdf/10.1023/B:TIME.0000045319.20260.73.pdf
https://dl.acm.org/citation.cfm?id=71024

Topic Grouping: Parallel and Distributed Systems

Cloud computing - describe the structure, design and features of cloud computing systems. A survey of different cloud computing approaches should be presented and the advantages and

disadvantages should be discussed.
http://ieeexplore.ieee.org/abstract/document/6165242/
https://link.springer.com/article/10.1007/s00354-008-0081-5
http://ieeexplore.ieee.org/abstract/document/5071863/

Distributed file systems - describe the general goals and design of parallel file systems and present one or more implementations. Be sure to mention how applications use the systems, scalability, and performance.
https://www.cse.buffalo.edu//faculty/tkosar/cse710_spring14/papers/gpfs.pdf
http://ieeexplore.ieee.org/abstract/document/5348819/

MPI - describe how multiple processes can share information using MPI. You will want to include an overview of the basic operations, with some detailed discussion of how the data is communicated. Also discuss applications that use MPI and why.
https://www.open-mpi.org/ http://mpi-forum.org/

Hadoop - describe Map/Reduce in general, how Apache Hadoop works as an overall infrastructure, and describe how Apache Hadoop works more specifically. Also discuss the eco system of related tools. Also describe how a particular application uses the system as a case study.
https://wiki.apache.org/hadoop/ProjectDescription
http://hadoop.apache.org/

Kubernetes - describe how kubernetes works as a cloud platform built on containers. You will need to introduce containers, and describe the motivation, design, and implementation of the kubernetes platform. Also describe how a particular application uses the system as a case study.
https://kubernetes.io/

Google File System - describe the motivation, design, implementation, and use cases of this distributed file system.
https://static.googleusercontent.com/media/research.google.com/en//archive/gfs-sosp2003.pdf
https://en.wikipedia.org/wiki/Google_File_System

Topic Grouping: Security

SELinux - explore the theoretical and practical aspects of SELinux. A demonstration (or video of a demo) would be great here.
https://dl.acm.org/citation.cfm?id=990059
https://selinuxproject.org/page/Main_Page

Access Control - explore interesting ways access control can be organized, especially with respect to newer computing paradigms: mobile computing, IoT, and cloud.
http://ieeexplore.ieee.org/abstract/document/6234415/

Containers and cgroups - describe how containers work to provide security and resource management features of virtual machines in a more lightweight manner.
https://dl.acm.org/citation.cfm?id=1273025

Paper

You will work with your group to write a high quality, professional report on your topic. You must use proper grammar, spelling, and appropriate technical and professional writing style. The

first step in writing a document of high quality is to start with an outline. The structure of the paper that you need to produce is already outlined for you below:

1. Introduction - describe the topic you are going to present in the paper. Be sure to identify the problem(s) that are being addressed.

2. Design - how does the design address the problem(s)?

3. Implementation - describe how the problem(s) are addressed in the specific implementation(s). You may have multiple sections here to discuss different approaches or problems.

4. Applications - how do applications use the system? how does the design/implementation impact the performance/security/usability/other goals of the application? What tradeoffs exist for the application to choose this system software?

5. Conclusions - General pros and cons of this approach to the problem. Be sure to also mention how aspects of operating systems that we talked about in class relate to this topic.

6. References - This is a research paper and requires at least five (5) references **in addition to** any of the references you used from those given to you on D2L. Full citations are required for all references. You must use ACM style references. See the link below for information about the style and examples:
`http://dal.ca.libguides.com/content.php?pid=860&sid=11818`

If your topic is a survey of multiple different implementations or approaches to the same problem, the Introduction should clearly define the problem, then for each of the different items, describe the design, implementation, and a short example. You may want a discussion section that compares the advantages and disadvantages of the approaches or you can do this all in the conclusions. In either case, the discussion should be substantial.

Your group will submit a single document (as a PDF). The total length of the document, including figures and references, should be at least eight (8) pages and no more than ten (10) pages. You must use sections to break up the paper into logical pieces. There must be a references section named "References" which lists the full citations in IEEE style.

https://pitt.libguides.com/citationhelp/ieee

The paper must follow the guidelines from the IEEE. You can find a slightly modified version of the Microsoft Word template on Canvas. It has some copyright placeholders, extra information about authors, and the abstract removed. You may use Latex, but you will need to remove these items from the template accordingly.

https://www.ieee.org/conferences/publishing/templates.html

This paper should be of high quality and not contain typos and grammatical mistakes. The prose should be technical in nature, yet also flow nicely from one sentence to the next. The scholarly articles, documentation and technical reports should give you a good idea of what type of writing is required. Visiting the writing center on campus to help you start writing, organize or polish your writing is an excellent idea. Note that this requires you to start early enough to have a decent draft for them to critique.

Presentation

The presentation should follow the same outline as the paper, but you will want to focus more on the new content and less on the relationship to class. You will have 10 minutes to present your topic. You may use powerpoint or other mechanisms for presenting your work. You may also use video, but no more than 2 minutes total of video content. Demonstrations of the software are allowed and encouraged, just be sure to practice and have a backup video of the demonstration to make sure we have time for all of the presentations. All members of the group should participate in the presentation.

It is a good idea to practice the presentation as a group at least once, preferably multiple times. It is common for time to go much slower or much faster when you first start presenting, practice will help you gauge how much time it actually takes you to present the material. You may want to use UWL's Public Speaking Center for assistance in developing or polishing your presentation.

Technical Writing and Speaking References

http://web.mit.edu/me-ugoffice/communication/technical-writing.pdf
http://homepages.inf.ed.ac.uk/jbednar/writingtips.html
http://www.cs.columbia.edu/ hgs/etc/writing-style.html
https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/bes2.1258
http://wittcom.com/how-to-plan-a-technical-presentation/
https://www.hanselman.com/blog/11TopTipsForASuccessfulTechnicalPresentation.aspx
https://homes.cs.washington.edu/ mernst/advice/giving-talk.html