NJIT
New Jersey's Science & Technology University

A. V. GERBESSIOTIS
CS332
Spring 2024   December 23, 2023
Course Syllabus: **General Information**
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1.1 CONTACT INFORMATION (HONORS SECTION)

Instructor:	Alex Gerbessiotis
E-mail:	alexg+cs332@njit.edu
Tel:	(973)-596-3244
Office:	GITC 4213, 4th floor
@NJIT "Office" Hours:	Mon/Wed 10:00-11:00, Mon 14:30-15:10
Assistant:	Check course web-page
Class Hours/Place:	See Registrar course schedule
LMS:	Learning Management System to be used is canvas.njit.edu
Web-Page:	http://www.cs.njit.edu/~alexg/courses/cs332/index.html
Web-Page:	http://web.njit.edu/~alexg/courses/cs332/index.html

1.2 COURSE ADMINISTRATION

CourseWork: 3 exams, 9 Homeworks (HW), Verification of Presence (VoP), MiniProjects (MP).

Points: 1020points= Ex1(235) + Ex2(235) + Ex3(350) + HW(180)+VoP(20)
(1pt would be subtracted from the VoP for each SelfAssessment not submitted.)

HW: Nine homeworks due **before 12 o'clock noon i.e. 12PM for Canvas** and submission through canvas.njit.edu; see Calendar Sec. 1.4. for dates and Appendix 1 for further information.

Exams: Exam1 and Exam2 in classroom, in canvas, 75min. Exam3 (final) cumulative where and when by the Registrar, in paper, and 120min. All exams closed everything; Dates in Calendar 1.4; more in Appendix D.2 and Canvas announcements Document P. A math calculator is allowed but is a waste of time! For Ex1 and Ex2 use your computer and have it charged to last the exam time. NJIT computer policies apply; see end of this section. A student who leaves early without permission gets a 0 in the exam. An OARS-requested accommodation results in a paper exam at an OARS location. *In case NJIT declares an emergency (e.g. Covid), an exam will become, time permitting, a canvas exam using ProctorU Record+ for proctoring. You are thus expected* **before 18:00 of the 3rd Friday of the semester** *to either acquire ProctorU credentials or check that your existing credentials still work with NJIT, and also test that your equipment still works with the ProctorU setup. Hopefully this option will not be exercised. But you and I should be prepared for the possibility of using it! Read DocumentP about canvas and ProctorU.*
NJIT computer policies: https://ist.njit.edu/student-computers.

MiniProject: Three mini-projects worth 50pt each. If you do not manage to get at least 75pts out of the combined total your final letter grade will be lowered one-level.

1.3 BASELINE COURSE SYLLABUS

Course: CS332. Principles of Operating Systems.

Credits: 3 credits.

Prerequisites: CS 114 or CS 116 or IT 114.

Description: Organization of operating systems covering structure, process management and scheduling; interaction of concurrent processes; interrupts; I/O, device handling; memory and virtual memory management and file management.

Textbook: [Required/Recommended, designated] Operating Systems: Internals and Design Principles, 9th edition, William Stallings, Pearson. ISBN-13: 978-0-13-467095-9, ISBN-10: 0134670957

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Learning Outcomes:

1. Be able to describe and discuss the basic components of a modern computer-based operating system and their interactions.

2. Be able to define and explain the operating systems concepts of process, thread, files, and file systems, synchronization etc.

3. Learn how different CPU and Disk scheduling algorithms work, compare and explain their relative merits.

4. Understand internal and external memory organization, physical and virtual memory, and be able to describe their usage and relative merits and trade offs in their usage.

Topics (with references to chapters of the designated textbook):

Every topic's slides are in a document known as Subject, and it is available in PDF. Every Subject has a SelfAssessment canvas-based quiz autograded by canvas that can be submitted as many times as desired. Not for credit but no submission generates a mild point penalty.

T01. Computer system overview (chap 1)

T02. Operating system overview (chap 2)

T03. Processes (chap 3)

T04. Threads (chap 4)

T05. Scheduling (chap 9)

T06. Multiprocessor scheduling (chap 10)

T07. Memory management (chap 7)

T08. Virtual memory (chap 8)

T09. I/O Management and disk scheduling (chap 11)

T10. File management (chap 12)

T11. Process Synchronization (chap 5)

T12. Concurrency and deadlocks (chap 6)

T13. OS security (chap 13)

Provost statement.

"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf. Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriate ly will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about th e code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu." Also, the following link is provided http://www5.njit.edu/provost/sites/provost/files/lcms/docs/Best_Practices_related_to_Academic_Integrity.pdf

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1.4 CALENDAR

Spring 2024					
Week	M	W	R	Out	In/Comments
W01	—-	01/17	01/18	HW0/MP1out 01/17	Class starts Wed.
W02	01/22	01/24	01/25	HW1 out on 01/22	HW0 in on 01/25 before noon
W03	01/29	01/31	02/01	HW2 out on 01/29	HW1 in on 02/01 before noon
W04	02/05	02/07	02/08	HW3 out on 02/05	HW2 in on 02/08 before noon
W05	02/12	02/14	02/15	MP2 out on 02/12	HW3 in on 02/15 before noon
W06	02/19	02/21	02/22	MP3 out on 02/19	**Exam 1 on Wed 02/21**
W07	02/26	02/28	02/29	HW4 out on 02/26	MP1 in on 02/29 before noon
W08	03/04	03/06	03/07	HW5 out on 03/04	HW4 in on 03/07 before noon
W–	——	——	——	SPRING BREAK	
W09	03/18	03/20	03/21	HW6 out on 03/18	HW5,MP2 in on 03/21 before noon
W10	03/25	03/27	04/28		**Exam 2 on Wed 03/27**
W11	04/01	04/03	04/04	HW7 out on 04/01	HW6 in on 04/04 before noon
W12	04/08	04/10	04/11	HW8 out on 04/08	HW7 in on 04/11 before noon
W13	04/15	04/17	04/18		HW8 in on 04/18 before noon
W14	04/22	04/24	04/25		MP3 in on 04/25 before noon
W15	04/29	RD01	RD02		Classes end Tue.
W16	——	—-	—-		For **Exam 3:Check Registrar**

Any modification/deviation from the calendar and its items will be done in consultation with the attending a class students and be posted on the course web-page. It is imperative that students check the course web-page regularly and frequently. Exceptions are as announced by the Provost's Office.

1.5 COURSE POLICIES

OARS: If you need special accommodations, contact the Office of Accessibility Resources and Services, KUPF 201, to discuss your specific needs. A Letter of Accommodation Eligibility from OARS authorizing your accommodations will be required and should be received by us at least two weeks plus two days before the first exam, if it also relates to a ProctorU exam, otherwise seven days before the first non ProctorU exam.

MISSING: If you miss a class, you make up for lost time. No HW extensions for any reason, medical or otherwise; submit early. If you miss an exam you MUST CONTACT the Dean of Students (DOS) within 2 working days from the day the reason for the absence is lifted with all necessary documentation and send an email of your intent and absence. Do not submit documentation to the instructor: it is a private matter between you and the Dean of Students. The maximum accommodation period will be the number of missing days to the exam date: it is imperative then that you contact DOS even before the 2 working day period has expired if the accommodation period would be shorter. For Exam1, a DOS approval will get you a scaled Exam2 plus Exam3 grade for Exam1. For Exam 2 a scaled Exam3 grade will be used. No makeup exam for a ProctorU exam.

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1.5 COURSE POLICIES (continued)

Grading: For paper exams if you use pencils to write down your answers do not complain about grading AFTER the EXAM. No Scratch paper. Work submitted will be graded for clarity, conciseness and correctness: be brief and to the point.

Grades: Check marks and report errors promptly. **Resolve any issues WITHIN 2 CALENDAR WEEKS and before the first Reading Day** starting from the day an exam or homework is released or returned. For the final, within 3 calendar days from the day grades are posted in canvas or Banner. Talk to the grader first, and then to the instructor. The final grade is decided on a 0 to 1000 point scale (VOP pts are additive). Assuming no violation of the Collaboration policy: around 850 points or more is an A, less than 500 points is F or D, and thus 500 points or more is C or better.

Incomplete: A grade of I(incomplete) is given in rare cases where work cannot be completed during the semester due to documented long-term illness or absence (e.g. unexpected national guard duty). A student needs to be in good standing (i.e. passing the course before the absence). An email (in lieu of a written letter) with a timeline of what is needed to be done will be sent to the student and the Department Chairperson. Not showing up in the final will probably get you an F rather than an I.

Collaboration: Collaboration of any kind (in HW, Exams, etc) is PROHIBITED. Students must turn in work that has fully been composed and written by them and no-one else. Finding an answer on the Internet, Web, on a piece of paper, or otherwise, or it is product of someone else's work, or it is (partly or fully) common with another student submission, in the same or other section/course risks punishment as outlined by the University. All parties of such interaction receive a 0 and letter grade is lowered by one or two levels. The work you submit must be the result of your own mental effort.

Devices: Power down (equivalent to removing battery) and switch off (not just silence) mobile and other devices including wearables (e.g. iwatch) and place them in a zippered bag or zippered backpack or on the floor screen facing down. (See article XI, student contact code.) **IF A STUDENT GETS CAUGHT TOUCHING SUCH A DEVICE (on or off) during an exam, the exam receives a 0. DEVICES MUST BE OFF and NOT ON YOU. For ProctorU exams "ON YOU" means anywhere viewable including at a distance of less than 6ft. A not completely powered down device of yours is assumed to be "ON YOU" independently of proximity.** Note that the use of a device without the express permission of the instructor is considered cheating (Article XI).

Email/SPAM: Use an NJIT e-address to send email to the course email address (Appendix G).

Canvas Note: Canvas assigns points to non CourseWork. Ignore canvas grade aggregations. Because of canvas synchronization issues, all point-assigned material released through canvas will be of limited availability and visibility. **Make backups if needed (e.g. take screenshots).**

The NJIT Academic Integrity Code will be upheld with violations reported to the Dean of Students. ∎

A   Course Delivery

Delivery in this course is through

(1) Lectures explaining TEXTBOOK content using slides known as **Subjects**.

(2) The canvas Learning Management System (LMS).

(3) A course web-page (CWP).

(4) Email (webmail, not canvas messaging).

(5) Other supplementary material.

A.1   Lectures on Subjects

The textbook is supplemented by textbook author slides plus additional slides prepared by this instructor and not covered in depth in the textbook. The resulting combination is referred to as **Subjects**. In classroom lectures the instructor uses the textbook in combination with the Subjects.

A.2   Canvas

The URL (Uniform Resource Locator) of the LMS is `canvas.njit.edu`. Access requires myUCID credentials (login, password). Renew credentials NOW if they are to expire in the semester.

A.3   Course web-page

`http://www.cs.njit.edu/~alexg/courses/cs332/index.html`
The course web-page (CWP from now) is split into three sections: A (Announcements, different from canvas Announcements), B (Public Information), and C (Other). Section C requires credentials that are common to all students. For login, use `cs332` and for password use `2024systems`

A.4   Course email: webmail

The course email address is `alexg+cs332@njit.edu`. Read the email protocol used in the course FAQ (Appendix G): we then respond within one working day to such an email or faster. Do not use canvas messaging or canvas email; it is rarely read and is not NJIT sanctioned: your email will be lost.

A.5   Supplementary material

In emergencies Webex Recordings would be made available in canvas Modules. Kaltura voiceovers might be made available for material not in the textbook and in the PrP, but NJIT plans to drop Kaltura during the summer of 2022 so this is speculative.

B   Course Structure

1. Textbook information is available on page 1.

2. Subjects are typewritten notes ritten primarily by the textbook author utilizing figures, tables and text from the designated textbook. They are supplemented by material prepared by the instructor. They provide detail not found in the textbook for some topics. The background style of the slides identifies the corresponding source (textbook author vs instructor). A cover slide maps a Subject to the corresponding Chapter of the textbook. Subjects are made available in PDF in canvas Modules, and in Section C of the CWP as a backup when canvas is unavailable. Corrections would become available only in Section C of the CWP because canvas has synchronization/concurrency issues.

3. Self-Assessment (SA) Quizzes in canvas. For every subject there is a self assessment quiz setup as a canvas Quiz. They are similar to short homeworks. The points collected are considered bonus points beyond the 1000pt total. They become available ordinarily ONLY for THREE WEEKs at a time: take screenshots if you need them for future review!

4. Homeworks (HW) in canvas. A HW is for credit and set-up as an untimed, limited availability canvas Quiz, with no more than three attempts to submit but only the LAST ATTEMPT graded. A HW is due before noon (12 o'clock noon which is canvas's 12PM; note that 12PM is not midnight but noon time) on a day specified in the Calendar. See Document P for canvas Quiz terms.

5. Verification of Presence (VoP).
It will be set up as a canvas Quiz. You first download and read the syllabus including the Appendix's first and last pages. After you read them taking the VoP quiz wont take more than a minute of your time. Doing the VoP can earn you 20pts that are bonus as they add to the 1000pts of HWs and Exams.
The VoP would become available 1 hour into the first class through noon time (12 o'clock noon i.e. 12PM) of the second Sunday of the semester. Submissions will be verified during morning hours on a Monday, Wednesday and Friday ONLY.

6. Programming Work.

At least 2 programming mini projects (MP) would be given. You must complete a minimal number of the combined total points to satisfy the programming work requirement. If you do not do so, your final letter grade will be lowered by one level. You may use C, C++, Java or Python; testing and grading will be done on an OSL machine (linux) using available command line tools there (gcc, g++, javac, java, python).

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C   Class structure

C.1   BEFORE A CLASS

- Anticipate what will be covered in that class. (We provide guidance before the first class.)
- Study the relevant sections of the designated textbook along with the relevant Subject.
- Prepare questions to ask. Keep notes.

C.2   DURING A CLASS

- Relate the material covered in class with the studied material. If the emphasis in class is on different topics than your prior study of the material, mark topics for a follow-up review.
- Ask questions. We learn from mistakes! Keep notes.

C.3   AFTER A CLASS

- Review the material covered in class using the textbook.
- Do the self-assessment quizzes in canvas. You are on the right track if you answer correctly almost all of the questions.

Repeat those steps above if your self-assessment is not consistent with your expectations. Consider contacting the instructor during office hours (or email) to ask further questions.

C.4   Before FIRST CLASS of the semester

These instructions will be sent in a Welcome email, and also posted in canvas Announcements in a message with title Welcome.

```
a. Download and read   from canvas announcements Document 1 (this document).
b. Do the canvas orientation for students (available in canvas)
    or
   Download and read from canvas announcements Document P.
c. Download and READ  Subject 0 from Module 0 in canvas modules.
   It is prerequisite material.
d. Document 2 is Fundamentals of Computer Science: it is up to you
   what to do with it as it is prerequisite material connected with
   Subject 0.
```

D Authentic assessment

D.1 Homeworks

There are Homeworks given for some credit. Your work is assessed by a grader or by canvas itself. The turnaround time for Homeworks is one week. Solutions are provided in the form of feedback you receive in canvas; a solution key is provided either in canvas Announcements or in Section C of the CWP. After grading, a canvas Homework becomes available for inspection for two weeks. After that two-week period it would be inaccessible. Take screenshots for your records.

D.2 Examinations

Bring a working pen with you and a backup. See also page 1 of this document and also Document P. There are three Examinations throughout the semester.

By default, Exam1 and Exam2 will be in canvas administered by the computer you will bring in the designated by the Registrar room (classroom) at the designated by the Registrar time (classtime). It is up to you to make sure that your device (laptop) has enough battery charge for the duration of the exam (75 minutes). Exam 1 is cumulative. Exam2 continues where Exam 1 stopped. See also page 1.

The final Exam, that is Exam 3, will be a paper exam. The final exam is an exam scheduled by the registrar (see its web-page for room, date and time) and duration is set to 120 minutes. Exam 3 is cumulative. See also page 1.

If NJIT declares an emergency, an exam will be setup us as acanvas Quiz with proctoring through ProctorU Record+. For this you need to obtain ProctorU credentials within the timeline described on page 1. If you do not do so, expect a zero in the resulting exam. Canvas orientation for students or Docuemnt P discuss canvas exam taking and also discuss ProctorU Record+ in conjunction with canvas Exam taking. It also provides a practice ProctorU Record+ exam.

An OARS request results in a paper exam for Exam 1 and Exam 2 as well, unless a covid-19 emergency overrides this.

Make sure, per College of Computing BYOD guidelines (see URL on page 1), that your computer has enough charge to last the duration of a canvas Exam.

D.3 Canvas LMS

Rule of thumb: If it is not in CWP (course web-page), then it will be in canvas.
The following areas of canvas will be utilized. Do not use other areas, even if canvas populates them with information.

- **canvas Announcements**. Contains mainly announcements generated prior to the first week of classes and attachments. Afterwards, check the Announcement Section of the CWP, or as directed.

- **canvas Modules**. One canvas module per Subject.

- **canvas Quizzes**. There you will find Homeworks, the Verification of Presence (VoP), self-assessments, and at least the first two Exams. The Quiz area is where you provide answers to them.

- **canvas Grades**. Be suspicious of canvas grade aggregates. We keep separate off canvas records.

- **canvas Assignments**. The Mini Project (MP) area.

E   Technicals

a. File size limitation. If there is a requirement to submit a file be considerate: 5,000,000B is the limit. Include your name info and last four digits of NJIT ID in every document you submit.

b. VPN. If you connect to an NJIT computer from outside NJIT (e.g. using ssh), you need to establish prior to this connection a VPN connection (eg your home-based PC will have an NJIT IP address). Our suggestion is for you to work inside NJIT and thus to avoid the use of VPN completely. But an NJIT supplied VPN client is available at `https://ist.njit.edu/vpn/` or type in Google `NJIT VPN client` and follow through the instructions/links or see the link in Section B3 of the course web-page cited below.

c. Linux and Highlander *Nix Sometimes we might ask you to work on a linux machine. They used to be called AFS machines, now they are called Higlander *nix machines. If you know nothing about the Linux operating system and its command line-based commands, go to the course web-page and Section B3 has links (URL) to tutorials that can help you. You may find there a document that describes how to use Mobaxterm on a windows machine to connect to an AFS computer. Such AFS machines (btw, AFS stands for Andrew File System, a network-based global file system) are located at GITC (2nd floor) and have names such as oslX.njit.edu or oslXY.njit.edu where X, Y are numeric digits. Machines osl1.njit.edu through osl31.njit.edu should be accessible most of the time.

d. File extensions: .tar and .zip . If you need to pack files as a tar or zip file do so using the command line on a *nix machine and command line directives. You may find some information in Section B3 of the CWP.

F   Miscellanea

F.1   NJIT ID

Login to `my.njit.edu` and navigate around. If you click on your name (with Javascript enabled) which is on the left of Sign out, which by itself is on the top right area of a window, you might see your full NJIT ID. Otherwise locate your personal information there.

F.2   Attendance

You are not required to attend a lecture (class). It is however strongly recommended that you attend class; students who drift away from the classroom, do not do as well as students who are in the classroom. If you are absent you need to study the material from the textbook and the associated notes (Subjects) and must definitely do the self-assessments prior to doing a Homework. Topics not covered in a Homework are covered in a Self-Assessment. Students who ignore the self assessments earn one or two lower letter grades than their peers.

F.3   List of Documents

```
Document  1 : COURSE SYLLABUS (4 pages)+Appendices (7 pages) ; THIS DOCUMENT
Document  2 : Math and CS for OS
Document  P : Canvas Exam taking and ProctorU
```

Document 2 is work in progress. Read carefully the sections needed; it might contain errors. Use it at your discretion.

The Course FAQ is on the next page

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Appendix G: **FAQ**
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G   Course FAQ

1. WHAT'S THE COMPLETE NAME OF THE COURSE?

CS332 : Principles of Operating systems

2. WHO TAKES THIS COURSE? (AKA PREREQUISITES)

A student who has the prerequisites: CS 114 or CS 116 or IT 114 or equivalent. This means you understand elementary data structures, their representation, and their properties (arrays, stacks, queues, linked lists) and also fundamental algorithms for searching. Moreover you know number representation of integers in binary, hexadecimal and denary (i.e. decimal) notation and their conversions from one radix (base) to another one. Prerequisite satisfaction is important: Homework 1 is already out to highlight this! *One more prerequisite: Memorize the last four digits of your NJIT ID.*

3. MYUCID CREDENTIALS: MYUCID.NJIT.EDU

Resolve login issues and password management now! Make sure your password does not expire any time soon, and preferably not before the end of the semester. Under regular circumstances passwords expire every 12 months. If it expires, renew it within the first week of classes.

4. COURSE WEB ACCESS? PROBLEMS? WHAT DO I DO?

The course Web-page is described in the syllabus or in page 1 of this document. All posted URL use `http`; let NJIT figure out the redirects. If the prefix `http://www.cs.njit.edu` does not work, replace it with `http://web.njit.edu`, or `http://cs.njit.edu`. Otherwise there is a serious NJIT IST problem if not resolved within half an hour.

5. COURSE EMAIL? The course email address is `alexg+cs332@njit.edu` per page 1. If you don't receive a response promptly, verify that you typed it as indicated above. There is a plus between the words `alexg` and `cs332` and no spaces. DO NOT USE your mailer's reply button but ALWAYS send a NEW email! Moreover, the Subject line of your email must contain three terms: **cs332**, the last four digits of your NJIT ID, and a term related to the reason you are sending the email (eg HW3 or Exam1). The instructor will respond to your email. The assistant's email address, if any, will be provided in due time at CWP(Course Information) and will be similarly structured.

6. PROTECTED AREA OF THE COURSE WEB-PAGE? PASSWORDS?

Learn how to navigate around the course web-page. In order to access the protected area, section C of the CWP, you must type in a login name and a password common to all. The pair is on appendix A (i.e. page 5). Logging on canvas requires the use of your OWN myUCID credentials (refer to question 3).

7. HOW DO I USE THE AVAILABLE COURSE NOTES?

The primary reference is the designated textbook as specified in the syllabus. Some supplementary slides are provided in the form of Subjects. THE LATTER DO NOT SUBSTITUTE FOR THE TEXTBOOK.

The black box on the extreme right indicates the end of this document. ■