A (possibly corrected) copy of this document is available online at: https://euclid.cs.qc.cuny.edu/316

Spring 2021

CSCI 316: Principles of Programming Languages (M W 1:40, 3:10, and 8 pm Sections)

Class Meetings Will be Held Online

Instructor Dr. T. Yung Kong
E-mail: tkong@qc.cuny.edu or yung_kong@qc.edu
Voice-mail: 718-425-9934

Instructor's Office Hours M W 4:35 – 5:00 and 9:25 – 10:00 pm by appointment; office hour meetings will be held online via Blackboard Collaborate Ultra or Google Meet

About This Course

Students will complete an implementation of a small programming language ("TinyJ") that is a subset of Java. This major programming project will involve reading and understanding code that is already written as well as writing code. It is to be done in Java, which students are assumed to have learned in an earlier course.

The project will provide a basis for concrete discussions of many aspects of programming languages—e.g., expressions and their evaluation, structured statements and their execution, arrays and pointers, storage allocation (static, stack-dynamic, and heap-dynamic) for variables, function call and return, parameter passing, scope, virtual machines.

In addition, this course will acquaint students with the *functional* programming paradigm (as an alternative to the procedural and object-oriented imperative paradigms that students will be familiar with from earlier courses). Students will learn to program in a functional style in the language Lisp.

Other topics relating to programming languages (e.g., programming language syntax) will also be covered, in class and/or by reading assignments.

Learning Goals

- To understand a variety of fundamental concepts relating to the design, specification, and implementation of programming languages.
- To become acquainted with the functional programming paradigm and the use of the programming language Lisp to solve problems in a functional style with frequent use of recursion.

Required Course Reader and Required Textbook

1. Coursepack sold by the Queens College Online Bookstore (https://qc.textbookx.com); this is a course reader that contains selections from: R. Sethi, *Programming Languages*, 2nd ed., Addison-Wesley, 1996.[1] **IMPORTANT: Certain exam questions may assume you have a copy of this course reader that you can refer to during the exam.**
2. D. S. Touretzky, *Common Lisp: A Gentle Introduction to Symbolic Computation*, Dover, 2013. ISBN 978-0486498201.[1,2]

Some Recommended Textbooks

3. M. L. Scott, *Programming Language Pragmatics*, 4th ed., Morgan Kaufman, 2016.[3]
4. P. Seibel, *Practical Common Lisp*, Apress, 2012.[1,4] https://dl.acm.org/doi/book/10.5555/2339396
5. R. Wilensky, *Common LISPcraft*, Norton, 1986.[1]
6. P. H. Winston and B. K. P. Horn, *Lisp*, 3rd ed., Addison-Wesley, 1989 (reprinted with corrections, August 1997).[1]

[1] This book is on reserve in the Library—see https://qc-cuny.libguides.com/er.php?course_id=18376 .

[2] An electronic version of this book is available online (to Queens College students) through the Library—see https://ebookcentral.proquest.com/lib/qc-ebooks/detail.action?pq-origsite=primo&docID=1920062 . Almost all of the content of an older edition of the book is publicly available online—see https://www.cs.cmu.edu/~dst/LispBook/book.pdf .

[3] An older edition of this book is available online (to Queens College students) through the Library—see https://ebookcentral.proquest.com/lib/qc-ebooks/detail.action?pq-origsite=primo&docID=649018 .

[4] The text of this book is available online—see http://www.gigamonkeys.com/book/ .

Grading Policy

Grades will be a measure of attainment (not effort). Your grade will be based on your scores on the cumulative Final Exam, two other exams, and six for-credit programming assignments[5] (the last three of which will constitute the above-mentioned TinyJ implementation project). ***Some exam questions will relate to programming assignments.***

When taking the three exams you will be expected to remain in a Google Meet of the Google Class for your section of this course (see pp. 7 – 8) with your webcam on.[6]

The maximum possible scores will be as follows:

Exam 1:	25 points
Exam 2:	25 points
Cumulative Final Exam:	40 points
For-Credit Lisp Assignments:	0.5 + 2.0 + 2.0 = 4.5 points
TinyJ Implementation Assignments:	1.5 + 2.0 + 2.0 = 5.5 points

When I compute the sum of a student's scores for grading purposes, **I will first replace the *lower* of the scores on Exam 1 and Exam 2 with (Final Exam score × 25/40) if the latter is higher.** (If your scores on Exams 1 and 2 are equal then at most one of those two scores can be replaced in this way.) Now let:

a = (sum of your exam scores and scores on for-credit assignments)
b = (sum of your exam scores) × 100/90
$m = \max(a, b)$

Your grade will be computed using rules A and B below—if the rules give different grades, you will receive the higher of those two grades. (Note that ***no grades of*** C− ***will be given***.)

Rule A I will consider you to be an ***A-range student*** if the following are ***both*** true: 1. You have a higher Final Exam score than at least 70% of the students in the class, and 2. $m \geq 87$.

If $a \geq 97$ and, in addition, you are an A-range student who has a higher Final Exam score than at least two-thirds of the A-range students, then your grade for the course will be A+.

If you are an A-range student and the previous sentence does not apply to you, then your grade will be A− or A according to whether $a < 90$ or $a \geq 90$.

If you are not an A-range student, then your grade will be F if either of the following is true:

(i) You are a graduate student, or are an undergraduate who *has asked to be excluded* from consideration for D+ and D grades,[7] and a is less than the threshold score for C.

(ii) You are an undergraduate who *has not asked to be excluded* from consideration for D+ and D grades,[7] and a is less than the threshold score for D.

If you are not an A-range student and neither (i) nor (ii) applies to you, then you will receive the highest grade below A− for which a is greater than or equal to that grade's threshold score. Provisional threshold scores for grades below A− are as follows: B+ 83, B 80, B− 76, C+ 73, C 69, and, for undergraduates who are being considered[7] for D+ and D grades, D+ 63, D 60. The threshold score for C may be lowered by up to 1 point for some students, at the instructor's discretion.

Rule B No grades of A+ will be awarded on the basis of this rule. Otherwise, rule B is the same as rule A except that b is used in place of a, threshold scores for grades might be a little lower, and the definition of "A-range student" might be a little broader.

There will be no make-ups for Exams 1 and 2: Missing either exam will be equivalent to scoring 0 on that exam, but the 0 will be replaced by* (your Final Exam score × 25/40) *if you miss just one exam.

Students absent from Exam 2 and the Final Exam may possibly receive a WU.

[5] Although the for-credit programming assignments will not count more than 10% towards your grade, and other homework exercises will not carry any credit, you should not underestimate the importance of doing this work. When you are given any homework (e.g., a reading assignment), assume that the work is to be done before the next exam unless some other deadline is explicitly indicated. Exam questions that are similar or related to for-credit and not-for-credit assignments or other homework exercises will count ***at least 40%*** towards your grade.

[6] If you do not have your webcam on while taking one of these exams—e.g., because of webcam failure—then you may have to take a special additional exam (that carries the same number of points) at the end of the semester, after which your score on the original exam would be replaced with the average of your scores on the original and the special exams for grading purposes: In any such case I will decide whether or not you will be given a special additional exam after I see your work on the final exam.

[7] If the College does not offer the CR/NC grading option, then undergraduates in this course will be asked in May to say whether they wish to be considered for D+ and D grades in the event that they do not qualify for a course grade of C or better.

Assignments and Late Submission Policy[8]

You may work either on your own or with up to two other students on the for-credit assignments. ***However, when two or three students work together on an assignment each student must write up his/her own submission (which needs to clearly state the name(s) of his/her partner(s)) independently, and is expected to fully understand all parts of the submission. No two students may make submissions that are essentially the same.***

For-credit programming assignments are to be submitted by leaving your source file(s) in the appropriate directory on the machine `euclid.cs.qc.cuny.edu`. You will be given a `euclid` account for that purpose—see page 6 of today's handout. ***Attempted "submissions" that are not made on euclid—e.g., "submissions" by e-mail—will not be graded!*** As explained on p. 5 of today's handout, you also have an account on another machine, `venus` / `mars`. You can do assignments on `euclid` or on `venus` / `mars` or on your own PC, but assignment submissions must be left on `euclid` (***not*** `venus` / `mars`)!

You can do assignments on your PC if you can install GNU Clisp (see the "Lisp Assignment 1" handout for instructions) and have installed or can install the Java SE JDK. The latter is available at the following URL: `https://www.oracle.com/technetwork/java/javase/downloads` . After installing the JDK, update the PATH environment variable—see: `https://bitly.com/jdk15setpath` .[9] In these instructions, `jdk-15` should be replaced with the actual folder name (e.g., `jdk-15.0.2`). Students who cannot get Clisp or the JDK to work on their PCs may have to do assignments on `euclid` or `venus` / `mars`.

If you do assignments on `venus` or your own PC then, when you are ready to submit, you can use an scp or sftp client to put a copy of the `.lsp` or `.java` file(s) you are submitting in the right directory on `euclid`.[10] ***Keep a backup copy of each submitted file on*** `venus` / `mars`, ***and another elsewhere***.

Late / corrected submissions of any assignment may be made until a late-submission deadline that will be announced later. Assignments will not be graded before their late-submission deadlines. Different assignments may have different late-submission deadlines, but no late-submission deadline will be earlier than Exam 1.

If when I compute a student's course grade I see that the number of assignments submitted late (as defined in the next paragraph) is ≥ 4, the student is subject to a penalty of $N - 3$ points, where N is the number of assignments submitted late. There is no penalty if $N < 4$.

If you are unsure whether one of your assignment submissions is on-time or late, you can find out using the command `ls -lc` *name* (e.g., `ls -lc doe-3.lsp` or `ls -lc TJ1asn/Parser.java`): Entering this command on `euclid` will show the "last change time" of the file whose pathname is ***name***. For grading purposes, "number of assignments submitted late" means the number of different assignments for which the last change time of a submitted file (as shown by the command `ls -lc` *name* on `euclid`) is after the assignment's due date.

Academic Misconduct. Plagiarism

Students found to have provided their answers to others during an exam or to have submitted work of others as their own will receive a grade of F for the course.

Attendance

Students are expected to attend all classes. Students who are absent from part or all of a class are responsible for catching up and *must not assume that I will assist them in doing that.*

E-mail Forwarding

I will send important e-mail to your `euclid` account from time to time. ***So you need to set up your*** `euclid` ***account to automatically forward e-mail to your regular e-mail address.*** See page 6 of today's handout for instructions on how to do this. E-mail forwarding is not 100% reliable; some forwarded e-mail may be blocked or removed as spam. So you should check e-mail on `euclid` ***at least twice a week***: You can do this by entering `alpine -i` on `euclid` after you logon. Logging on to euclid at least twice a week will also reduce the risk of your forgetting your euclid password.

---

[8] ***Tentative approximate*** due dates of the for-credit assignments are as follows: Lisp Assignment 3: early March. Lisp Assignment 4: mid-March. Lisp Assignment 5: late March. TinyJ Assignment 1: mid- to late April. TinyJ Assignment 2: early to mid-May. TinyJ Assignment 3: after the last class. The ***actual*** due date of each assignment will be stated in another document that gives details of the assignment and that will be provided to you at least one week before the actual due date.

[9] In Windows 10, the effect of **step 1** of the instructions can be achieved as follows: Type Windows-`r` (i.e., hold down the Windows logo key, type `r`, and release the Windows key) and enter `sysdm.cpl` into the `Open:` textbox.

[10] For example, you can copy the file `myfile.lsp` from your current working directory on `venus` / `mars` or a PC into your home directory on `euclid` by entering `scp myfile.lsp xxxxx_yyyy316@euclid.cs.qc.cuny.edu:` on `venus` / `mars` or in a powershell window on your PC; here `xxxxx_yyyy316` means your username on `euclid`. (*Note that* `.edu` *is followed by a colon here.*) This command can also be used in a terminal window on a Mac to copy `myfile.lsp` from your working directory on the Mac to `euclid`.

C SCI 316 (M W 1:40, 3:10, and 8pm Secs.): Preliminary Schedule

1 2/01 M Grading policies and other course information.

2 2/03 W Functional programming.
LISP: Introduction.

3 2/08 M LISP: Introduction (contd.)

4 2/10 W LISP: Atoms & lists. Some primitives.

2/15 M No class: Presidents' Day.

5 2/17 W LISP: Primitives (continued). DEFUN.

6 2/22 M LISP: Predicates, COND/IF.

7 2/24 W LISP: AND/OR LET/LET*.

8 3/01 M LISP: Recursion.

9 3/03 W LISP: Recursion (continued).

10 3/08 M LISP: recursion (contd).

11 3/10 W LISP: Functions as arguments.
FUNCALL, APPLY, LAMBDA.

12 3/15 M LISP: Functions that return functions.
Tail recursion.

13-15 3/17 W - 3/24 W Syntax of programming languages.

3/27 – 4/04 Spring Recess at CUNY: No classes.

16 4/05 M ***Tentative*** **date of Exam 1**.

17-18 4/07 W & 4/12 M Syntax (continued).

19-20 4/14 W & 4/19 M TinyJ project: lexical analysis and parsing.

21-24 4/21 W - 5/03 M TinyJ project: static, stack- & heap-dynamic storage allocation. hand-translation of TinyJ source code into TinyJ virtual machine code; compilation of TinyJ statements, expressions, and methods into TinyJ virtual machine code.

25-27 5/05 W – 5/12 W TinyJ project: execution of TinyJ virtual machine code. Parameter passing modes.

28 5/17 M **Probable date of Exam 2.**

CUMULATIVE FINAL EXAM:
1:40 – 2:55 pm section: Wednesday, 5/19, 1:45 – 3:45
3:10 – 4:25 pm section: Monday, 5/24, 1:45 – 3:45
8:00 – 9:15 pm section: Monday, 5/24, 8:30 – 10:30 p.m.

Last day to drop this course with a grade of W: Monday, 5/17

This schedule is preliminary and subject to change. However, any change in the date of an exam will be announced at least one week before the new date.

Accounts on `venus` / `mars` (`mars.cs.qc.cuny.edu` or `149.4.211.180`)

You have a Linux account on the machine **`venus`** (which is also called **`mars`**). In many if not all cases your **`venus`** / **`mars`** username is as follows:

first 2 letters of your *last* name (in lowercase) followed by
first 2 letters of your *first* name (in lowercase) followed by
last 4 digits of your 8-digit CUNYfirst ID.*

Example: Washington, George CUNYfirst ID: 12345678
Username: `wage5678`

If you have used this account before (in another course), then your password is probably the same as it was when you last used the account. If not, then your initial password is probably your 8-digit CUNYfirst ID#.

Note: Don't confuse your **`venus`** / **`mars`** account with your **`euclid`** account; **`euclid`** and **`venus`** / **`mars`** are different machines. Your **`euclid`** account has a ***different username*** and a ***different password*** from your **`venus`** / **`mars`** account! All assignments must be submitted on **`euclid`**.

The page **https://venus.cs.qc.cuny.edu/~xiuyi/** explains how you can logon to **`venus`** / **`mars`** from your PC or Mac, and how you can transfer files between **`venus`** / **`mars`** and your PC or Mac. (The ***simplest*** way to logon from a PC is described in the section Logging onto your linux account using Windows PowerShell.)

It is important that you be able to logon to `venus` / `mars`. Make sure you can do that *before* our second class meeting: If you cannot logon to your venus / mars account, then email the CS Department's Assistant Systems and Network Manager Xiuyi Huang at `xiuyi.huang@qc.cuny.edu` to ask for help.* **Note**: This applies ***only*** to **`venus`** / **`mars`**—if you can logon to **`venus`** / **`mars`** but need help with your **`euclid`** account, then make an appointment to see me during one of my office hour periods.

***If you are outside the United States**, you might not be able to connect to venus / mars unless you use a VPN client. In that case you can follow steps 1 and 2 in the appropriate one of the following two documents to install the PaloAlto GlobalProtect VPN client on your PC or Mac and use it to connect to the QC network:
PC: `https://www.qc.cuny.edu/Computing/Documents/QC_VPN_At_Home_Guide_%20(Windows_to_Windows).pdf`
Mac: `https://www.qc.cuny.edu/Computing/Documents/QC_VPN_At_Home_Guide_(Apple_to_Windows).pdf`
(Step 3 in these documents does not apply to students.) Once you are connected to the QC network, you should be able to logon to venus / mars using the instructions at **https://venus.cs.qc.cuny.edu/~xiuyi/**. The section "Logout / Sign out VPN connection" (which appears after step 3 in the two documents) explains how to disconnect the VPN connection.

CSCI 316 (M W 1:40, 3:10, and 8 pm Sections): Accounts on euclid and E-mail Forwarding

In addition to your **venus** account, you have an account on **euclid**; **venus** and **euclid** are different machines. Your **euclid** account has a ***different username*** and a ***different initial password*** from your **venus** account. You will need your **euclid** account to submit assignments. I will e-mail important course-related information to everyone's **euclid** account; by default, such email will be forwarded to your qmail.cuny.edu address. **IMPORTANT:** E-mail forwarding is ***not*** 100% reliable; some forwarded e-mail may be blocked or removed as spam. For this reason, and to reduce the risk of forgetting your euclid password, be sure to **check e-mail on euclid at least twice a week---you can do this by entering alpine -i on euclid after you logon.**

If you registered for the class ***before*** 1/31, your username is **xxxxx_yyyy316**, where:

xxxxx = **your last name in lowercase if it has ≤ 5 letters (omit any space or hyphen in the name)**
xxxxx = **first 5 letters of your last name in lowercase if it has > 5 letters**
yyyy = **your first name (as shown on the attendance sheet) in lowercase if it has ≤ 4 letters**
yyyy = **first 4 letters of your first name in lowercase if it has > 4 letters**

Examples: David Touretzky -> toure_davi316 Ada Lovelace -> lovel_ada316 Ravi Sethi -> sethi_ravi316

Your initial password is **q followed by the last 7 digits of your CUNYfirst ID.**
Example: If your CUNYfirst ID is 12345678, then q2345678 is your initial password.

The first time you logon, you will be asked to choose a new password, **so think of a good password in advance**--see, e.g., https://computing.cs.cmu.edu/security/security-password.html.

Assuming you are already logged on to venus, you can logon to euclid by entering
ssh ?????_????316@euclid
at venus's shell prompt; here ?????_????316 means your euclid username.*
If you get a "Host key verification failed." error, retry *after entering this*: /home/faculty/ykong/316setup

The ***first*** time you use ssh on **venus** to connect to **euclid** you will be asked if you trust **euclid**'s "key fingerprint": Answer **yes**. You will then be prompted for your euclid password: Enter **q followed by the last 7 digits of your CUNYfirst ID**. **NOTE:** ***No characters should appear on the screen when you type the password at a "... password:" prompt--the cursor should not move--but the system will know what keys you pressed! Remember to press ENTER at the end.***

You will have to change your password, but must first ***re-enter*** your q ... password:

Changing password for ?????_????316.
(current) UNIX password:

At this prompt, enter **q followed by the last 7 digits of your CUNYfirst ID** again and then you will be prompted for a new password:

New password:

Enter a new password. You will be asked to re-enter it for verification:

Retype new password:

If you re-enter your new password correctly, your password will be changed and you will be logged off. Immediately logon to **euclid** again (using your ***new*** password!) and then:

1. Enter the command **finger ?????_????316** (where **?????_????316** means your **euclid** username) and check that the **"Mail forwarded to"** line shows your email is being forwarded to your qmail.cuny.edu address: If you do not see a **"Mail forwarded to"** line, or it shows an incorrect email address, let me know!
2. Enter the command **alpine -i** and check that the Google Class Code email I sent you on **January 31** is listed in your alpine message index. A copy of that email should have been forwarded to your qmail.cuny.edu address, but you need to check that you can now read the same email within alpine as well. **After reading that email, type q and then type y to quit alpine.**
3. Enter the command **xc** on **euclid** to claim 0.25 pt. extra credit for doing 1 and 2.

If you do 1 - 3 no later than **Thursday, Feb. 11****, then you will receive 0.25 pt. extra credit: I will substitute $m+0.25$, $a+0.25$, and $b+0.25$ for m, a, and b in grading rules **A** and **B** when I compute your grade for the course. (You should receive an automatically generated reply at your qmail.cuny.edu address after step 3. Make sure this and other messages relating to this course are not lost as a result of spam filtering!)

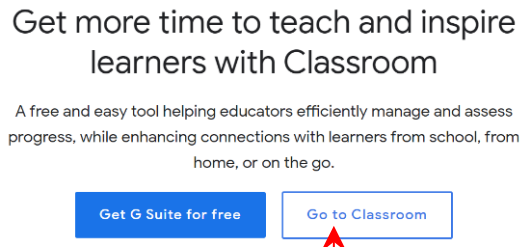
*The first time you login to your **euclid** account, I recommend you do so by ssh from **venus**. After you have verified that you can login to euclid via venus, you may prefer to connect to **euclid** using an ssh client on your PC or Mac--e.g., follow the Logging onto your linux account using Windows PowerShell or the Logging onto your linux account using Mac instructions at **https://venus.cs.qc.cuny.edu/~xiuyi/** but replace **mars** with **euclid** in those instructions.

****If you don't do 1 - 3 by Feb. 11, your account may be deactivated** (for security reasons). **To reactivate a deactivated account, or to reset a forgotten password, you must see me after class or during an office hour meeting. [Note that I will *not* reactivate accounts or reset passwords in response to e-mail messages.]**

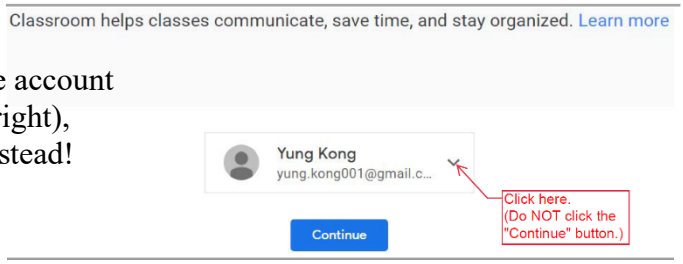
How to Join the Google Class for this Course

To join the Google Class for this course or to attend a Google Meet of that Google Class, you need to be signed into ***your Queens College G Suite for Education account***; that is the Google account associated with your `qmail.cuny.edu` email address. At step 4 below you will also need to use your *CAMS username* and *CAMS password*—i.e., the username and password you use to sign in at **https://cams.qc.cuny.edu/login4.aspx**. If you don't know your CAMS username and CAMS password, visit **https://cams.qc.cuny.edu/login2.aspx**.

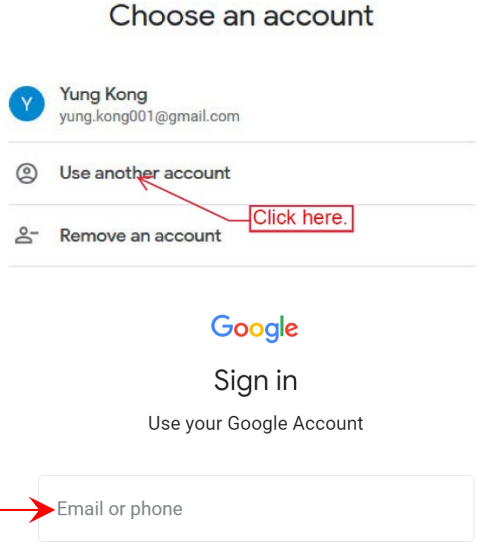
If you have never joined a QC Google Class before, you can do so by following the instructions below. These instructions assume you have ***already*** activated your QC G Suite for Education account. If you have ***not*** yet activated that account, do so now; instructions are given at: **http://ctl.qc.cuny.edu/claim-qc-google-apps-account**



1. Point your browser to https://classroom.google.com. If you then see the page shown on the right, click "Go to Classroom".



2. If you see a page with the address of a personal Google account you are currently signed into (like the example on the right), do **NOT** click "Continue", but click the down arrow instead!



3. If you see a "Choose an account" page such as the one on the right, then click on "Use another account".

4. When you see a Google "Sign in" page, type your `qmail.cuny.edu` email address into the "Email or phone" text box and press ENTER to be taken to a Queens College page where you must sign in with your *CAMS username* and your *CAMS password*.

5. If you are signing into Google Classroom for the first time and are asked to identify as a student or a teacher, then choose *student* (unless you are also teaching at Queens College).

6. When you see a page with a line like the following at the top

click the + in the upper right corner, and then click "Join class".

7. On the "Join class" page, check that you are signed in to your `qmail.cuny.edu` account; if you are not, then click the "Switch account" button.

8. You should have received a Google Class code in a Blackboard announcement that was emailed to you (and posted) on **January 31**. Type that code into the "Class code" textbox of the "Join class" page and then click on the Join button in the top right corner.

Note that you only need to join the Google Class ***once*** this semester!

In the event that the above instructions do not work for you (which may happen if you have Google Classes that are ***not*** associated with Queens College), here is another way to join the Google Class for this course:

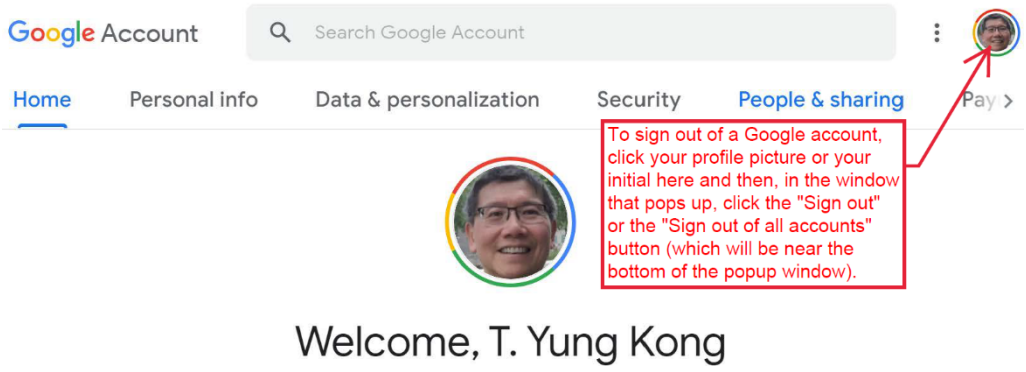
1. Point your browser to https://accounts.google.com, and then sign into your QC G Suite for Education account by doing 2(a) or 2(b).

2.(a) If you are ***not*** already signed into a Google account, then you should see a Google "Sign in" page or a "Choose an account" page. In these cases, sign into your QC G Suite for Education account by following the instructions in items 3 and/or 4 on the previous page.

(b) If you are already signed into a Google account, then the URL https://accounts.google.com takes you to a "Welcome" page such as the one shown below.

In this case you could simply reopen https://accounts.google.com in a new "incognito" or "private" browser window, and then sign into your QC G Suite for Education account by following the instructions in item 4 on the previous page.

Alternatively, you can first ***sign out*** of any Google account(s) you are signed into, and then sign into your QC G Suite for Education account by following the instructions in items 3 and 4 on the previous page: To sign out, click on your profile photo or your initial in the top-right corner of the page (see the example below), and then click the "Sign out" or "Sign out of all accounts" button near the bottom of the window that pops up; that button might not be visible until you scroll down the popup window. (After signing out you might see a "Signed out – syncing is paused" page, in which case you should click "Continue".)



3. Point your browser to https://classroom.google.com.

4. Follow the instructions in items 5 – 8 on the previous page to join the Google Class.

How to Attend Google Meets of the Class

After you have joined the Class, you can attend any Google Meet of the Class as follows:

1. Sign into Google Classroom (e.g., by following steps 1 – 3 on this page).
2. Click on the link for the CSCI-316 class.
3. Click on the Meet link near the top of the Stream page for the class.