EECS 1012: LAB 6 – Tracing Algorithms; using Sub-Algorithms (Oct 26–28, 2020)

A. REMINDERS

1) Note that the deadline of remaining labs is on Wednesday night.
2) Each lab including the pre-lab mini quiz is about 2.0 % of your overall grade.
3) You must attend your own lab session (the one you are enrolled in). If you need to change your lab enrollment, you should go to the department. Instructors or TAs cannot change your enrollment. TAs are available via Zoom to help you. The attendance is optional, but is highly recommended. You can also have your work verified and graded during the lab sessions. Feel free to signal a TA for help if you stuck on any of the steps below. Yet, note that TAs would need to help other students too. In case you run out of time, the submission you make over eClass will be marked by the TAs after the lab ends (possibly not by the same TAs who assisted you during the lab session).
4) You can submit your lab work anytime before the deadline. We do not accept late submissions.
5) You must complete the pre-lab quiz posted on eClass no later than the first 15 minutes of your lab time.

B. IMPORTANT PRE-LAB WORKS YOU NEED TO DO BEFORE GOING TO THE LAB

1) Download this lab's files and review them completely.
2) Practice tracing algorithms with different sample inputs. There are several examples in *Computational Thinking Part 3* lecture notes.
3) In Slides 23 and 24 of the same notes, there is an example of sub-algorithm. Review it and implement it in JavaScript once with and once without using sub-algorithms.

C. GOALS/OUTCOMES FOR LAB

- To practise computational thinking by first drawing flowcharts for basic computational problems, verify if they are correct (by tracing them), then implement them in JS.

D. TASKS

1) Your first task in this lab is to verify 5 algorithms, in Exercises 1 to 5, by tracing them for some sample inputs. You also provide pre- and post- conditions for each algorithm. In Exercise 6, you draw a flowchart that includes two sub-algorithms. This task should preferably be done in teams of two (not more). You may work solo in case you are unable to find a partner for this part. These drawings will need to be submitted as image files. Only **png** or **jpg** formats are acceptable.
2) In Part 2, you implement all 6 exercises in JavaScript. You should create one html, one css, and one js file for all your work, and you demo it to the TA. See the following pages for further instructions.

E. SUBMISSIONS

1) Manual verification by a TA (optional)

   You may have one of the TAs verify your lab before submission. The TA will look at your various files in their progression. The TA may also ask you to make minor modifications to the lab to demonstrate your knowledge of the materials. The TA can then record your grade in the system.

2) eClass submission

   You will see an assignment submission link on eClass. Create a **folder** named "**Lab06**" and copy all your lab materials inside (`img_{01,02,03,04,05,06.jpg`, `Lab06<yourName>.html`, `Lab06<yourName>.css` and `Lab06<yourName>.js`). This folder should be compressed (**zip** or **tar.gz**) and the compressed file submitted.

In case you work with a partner – who must be from the same lab section, **both** people should submit the files. However, an extra file, **group.txt**, should be included in the submission, containing the full names and the student numbers of the team members. Both students will then receive the same grade. Note that the pre-lab quizzes are still expected to be done by each student separately.

F. COMPUTATIONAL THINKIG

Part 1

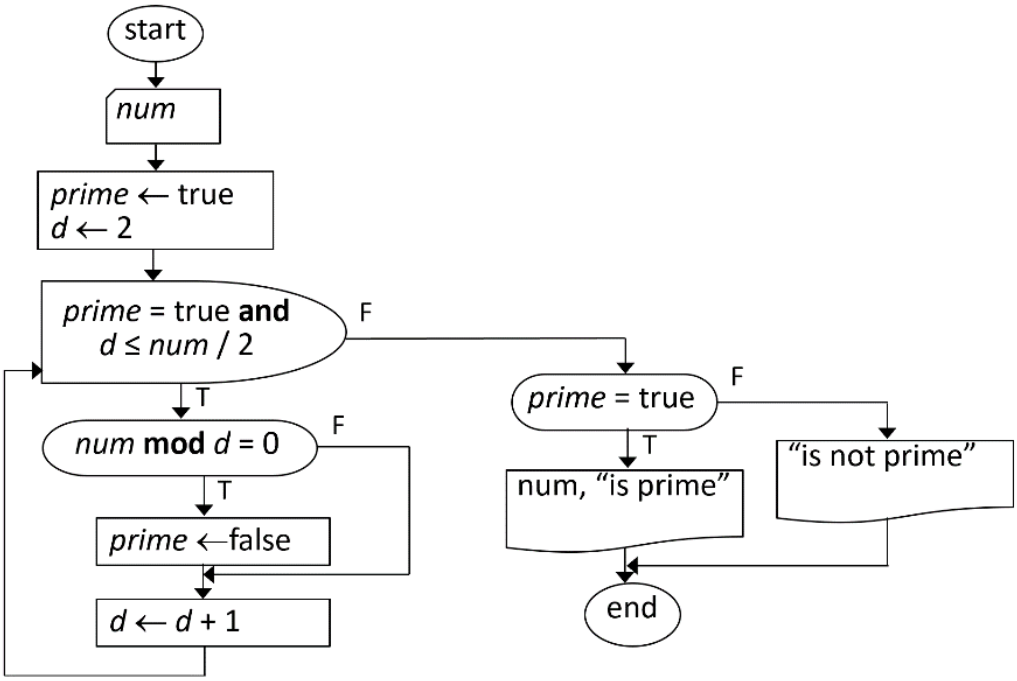
Preferably in teams of two. If you have already [mostly] completed it, you must discuss it with your peer before you show your final solution to your TA or submit it.

In Exercises 1 to 5, you verify the correctness of all algorithms by tracing them with some sample inputs. If an algorithm ends without using all inputs, re-run it for the remaining inputs. You also write pre- and post-conditions for each algorithm. In Exercise 6, you devise an algorithm that calls two sub-algorithms. In that Exercise you trace your new sub-algorithms for some sample inputs. Note that terms algorithm, sub-algorithm, function, method, programs are used interchangeably, yet they have subtle differences.

For each exercise, take one picture of all your trace tables and pre- post- conditions, including your name. By end of this lab, both you and your teammate should submit these pictures to eClass as **img_**{01, 02, 03, 04, 05, 06}**.jpg** files, where **img_x** is the picture for exercise **x** below. Try to keep the size of each image below 500 KB, e.g., by reducing the resolution of your camera.

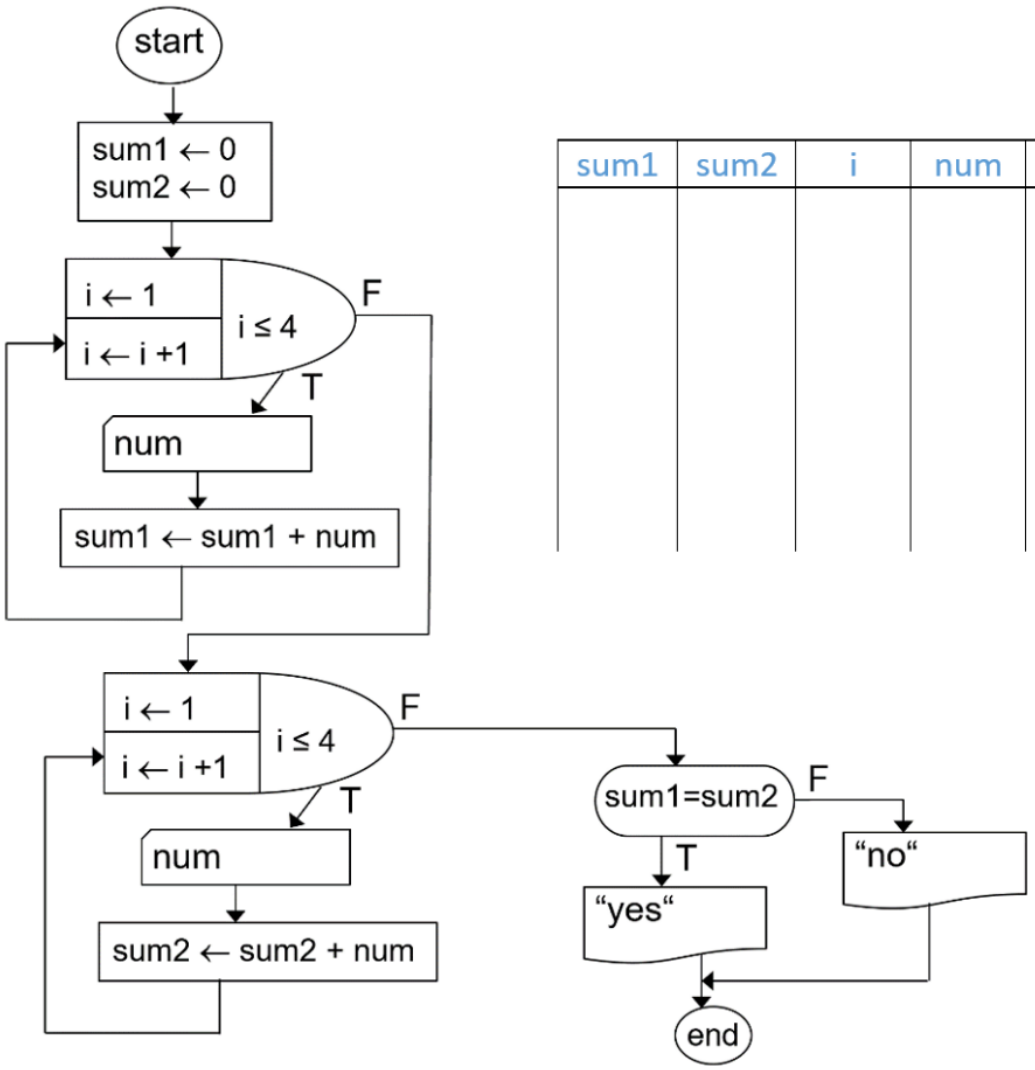
IMPORTANT: You are required to provide preconditions and postconditions for each solution you provide.

Ex 1) Trace the following flowchart for when input is 9 and complete the trace table. Also, write pre- post-conditions for this flowchart.



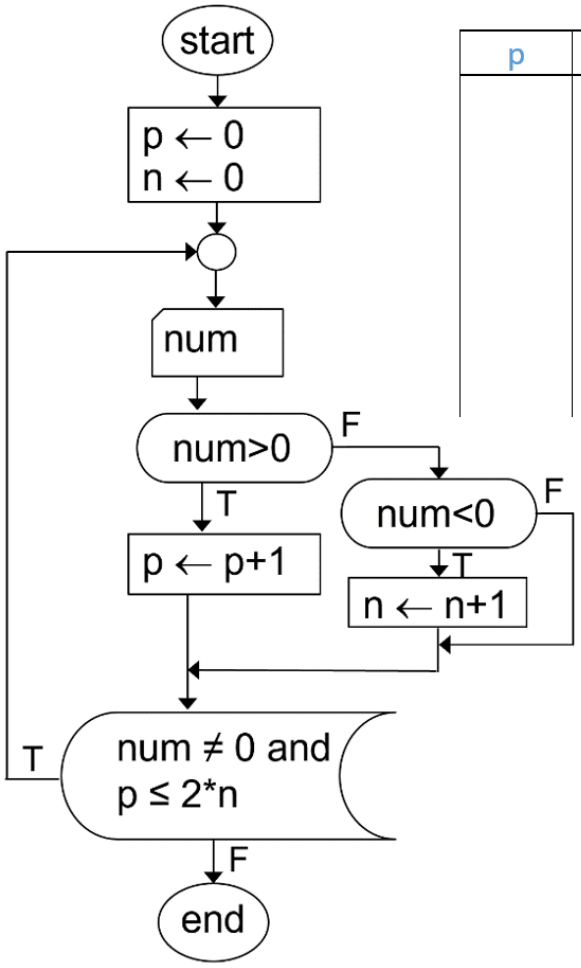
num	prime	d	output

Ex 2) Trace the following flowchart for when input values are 12, 3, 3, 6, 11, 14, 1, 1, and complete the trace table. Also, write pre- post-conditions for this flowchart.



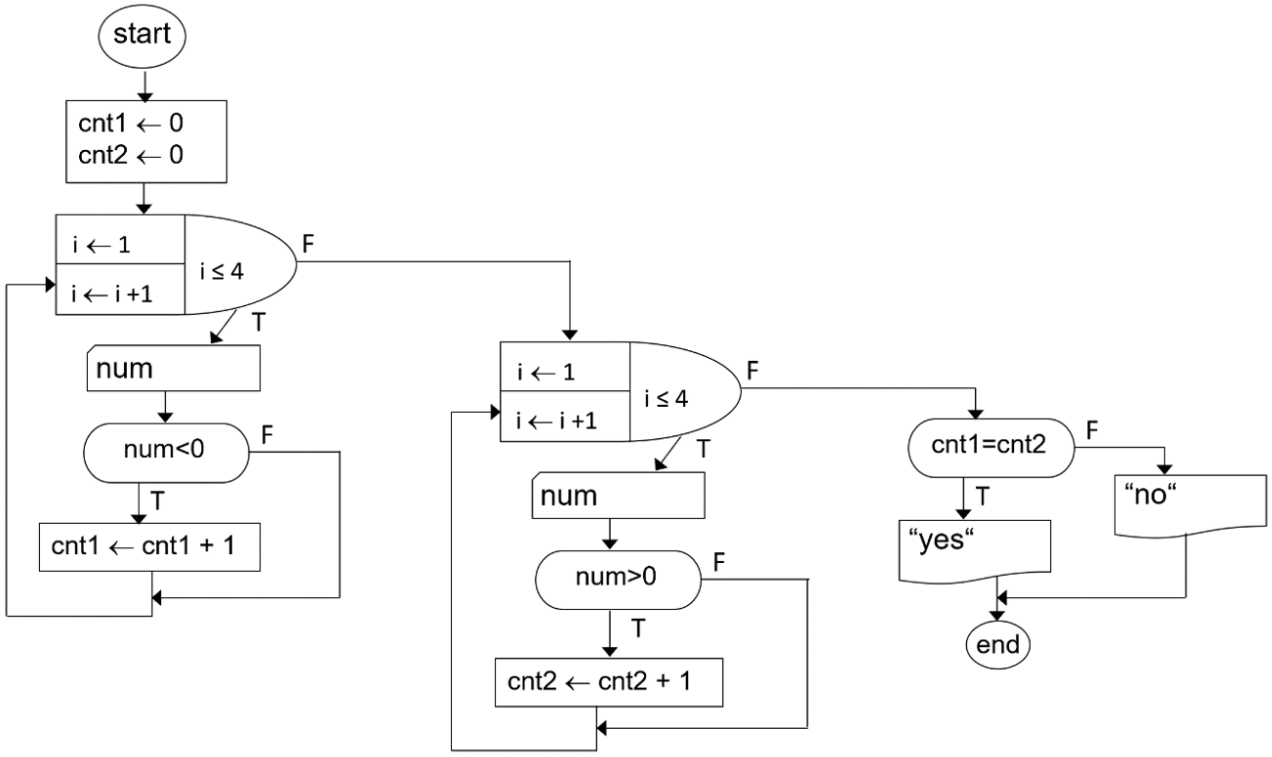
sum1	sum2	i	num	output

Ex 3) Trace the following flowchart for when input values are 12, 3, −3, 6, −11, −14, −1, −1, −3, 2, 0 and complete the trace table. Also, write pre- post-conditions for this flowchart.

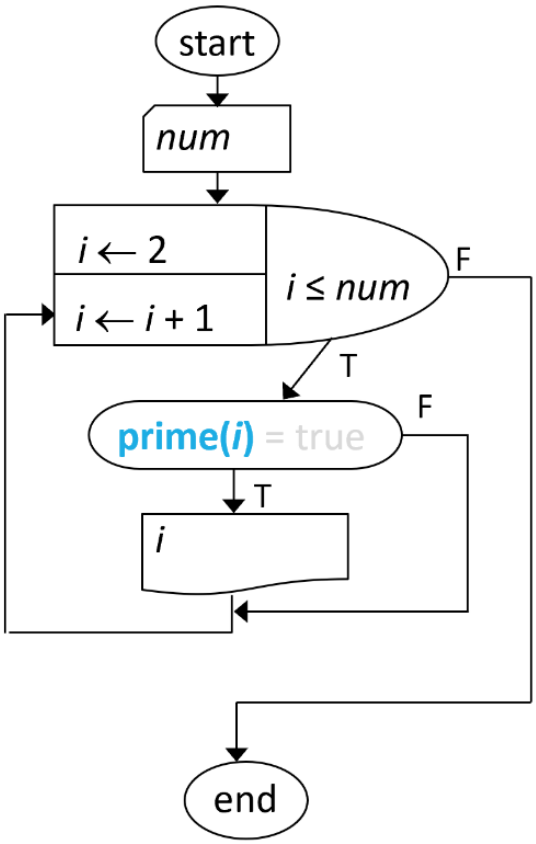


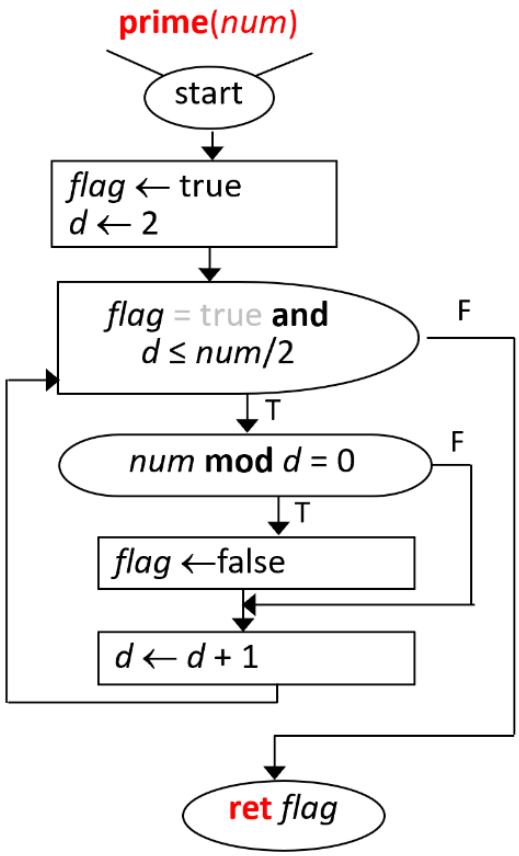
p	n	num	output

Ex 4) Trace the following flowchart for when input values are 12, 3, −3, 6, 11, 3, −1, −1 and complete the trace table. Also, write pre- post-conditions for this flowchart.



Ex 5) This exercise uses sub-algorithms. Trace it for when input value is 6 and complete the trace tables. Also note that there are two variables name num, one in the main algorithm and another in the sub-algorithm. Write pre- post-conditions for each of these algorithms (the main one and the sub-algorithm).





num	i	output

num	flag	d	returned value

Ex 6) Devise an algorithm to receive a positive number, n, and output all prime numbers that are smaller than n and have a digit 7. For example, if n is 100, the program should output 7, 17, 37, 47, 67, 71, 73, 79, and 97.

Your solution should have a main algorithm and two sub-algorithms, let's call them `prime(num)` and `has7(num)`. You may reuse the prime sub-algorithm of Ex 5. You do not need to verify (e.g. by tracing) it though because you did it in Ex 5. You need to trace your `has7` algorithm. You should provide pre- and post-conditions for all your 3 (sub)algorithms.

Part 2

Create a `lab06<yourname>.html` file supported by a `lab06<yourname>.css` and a `lab06<yourname>.js` files. In your html file, you should have 6 buttons with captions Problem 1, Problem 2, …, Problem 6. Then, you implement all 6 flowcharts in your `lab06<yourname>.js` . When each button is clicked, the event should execute the corresponding algorithm that you have in your `js` file.

G. AFTER-LAB TASKS (THIS PART WILL NOT BE GRADED)

In order to review what you have learned in this lab as well as expanding your skills further, we recommend the following questions and extra practices:

1) Revisit other flowcharts you have drawn/seen in the course and trace them for some sample inputs.
2) Devise an algorithm to receive a positive number, n, and output all prime numbers that are smaller than *n* and all their digits are prime too. For example, if n is 100, the program should output 2, 3, 5, 7, 23, 37, 53, and 73.
3) Add all algorithms and programs that you have drawn throughout the semester in your **Learning Kit** Project. You should be able to show that to your TA at the beginning of Lab 07 next week. Your Learning Kit project should include at least 30 problems by then.

Please feel free to discuss any of these questions in the course forum or contact the TAs and/or instructors for help.