



## Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en  
Inligtingtegnologie / Lefapha la Boetšenere,  
Tikologo ya Kago le Theknolotši ya Tshedimošo

# Study Guide

## Department of Computer Science

Concurrent Systems

**COS226**

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# 1 Introduction

## 1.1 Welcome

This is a module on concurrent programming. Most computer science programming paradigms deal with sequential programming, however in order to improve program functionality and efficiency it is important to sometimes identify non-dependent processes within a program and stipulate that they function in parallel. This course introduces that aspect.

## 1.2 Educational approach

The course is a practical course which requires a practical oriented approach. Requires dedication towards learning by doing. ClickUP will be used in the module for class preparation, post-class activities and assessment.

## 1.3 Responsibilities of the student

Students are reminded of the importance of class attendance and preparation for class. Student engagement and interaction with content, tutors, peers and the lecturer is highly encouraged.

Quality instruction requires students to come to classes prepared, as this enables teaching to build actively on common prior knowledge.

## 1.4 Statement of Anti-Discrimination

*The University of Pretoria is committed to building an inclusive, affirming and transformed institutional culture, curriculum and campus life. It rejects and condemns racism, sexism, homophobia, transphobia, xenophobia, ethnic chauvinism, religious intolerance, unfair discrimination, hate speech, sexual harassment, gender-based violence and retaliation, and all other forms of discrimination. The University has committed itself to the eradication of these practices, and in 2019 adopted an Anti-Discrimination Policy, in order to realise procedural and substantive equality in all respects.*

*As the lecturer and presenter of this module, I acknowledge the extreme harm that racism, sexism, xenophobia and other forms of discrimination have inflicted and continue to inflict on our society and communities. I commit to ensuring that there is an open dialogue between myself and all the students in the module on curriculum content and teaching method which may be interpreted as discriminatory or exclusive. I undertake to ensure that any such concerns are raised without fear of intimidation or recrimination. Moreover, I resolve to continuously improve the teaching of this course in a way that allows the inclusion of all the students enrolled for this course, building their self-confidence and self-efficacy, and supporting the ultimate goal of substantive equality for all persons.*

*The choices that we make about curriculum content and pedagogy (what and how we teach) are also choices about what kind of society we wish to build. In this declaration of intent, I resolve to be part of and give substance to the University's anti-discrimination and transformation endeavours.*

## 2 Administrative information

### 2.1 Contact details

	Name	Building and room number	Telephone number	Email address
Coordinator/Lecturer	Dr T. Nyathi	CS Offices	(012) 420-3111	t.nyathi@up.ac.za
Assistant Lecturer	Mr J. Lutz	CS Offices	(012) 420-3111	u15323413@tuks.co.za



Your Faculty Student Advisor can advise you on goal-setting, adjustment to university life, time management, study methods, stress management and career exploration. Book an individual consultation or attend a workshop. For other support services see Section 5.

### 2.2 Timetable

Contact session	Day	Time	Venue
Lecture 1	Monday	9:30-10:20	online
Lecture 2	Tuesday	14:30-15:20	online
Lecture 3	Wednesday	12:30-14:20	online
Practical	Thursday	10:30-19:30	online
Tutorial	Monday	13:30-16:30	online

### 2.3 Study material and purchases

*The Art of Multiprocessor Programming* by Maurice Herlihy & Nir Shavit is the recommended text book for this module. The accompanying Chapter PDF notes available on clickUP are a must to read and more detail may be obtained from the book. Please note the PowerPoint slides provide a guideline of the study material and students should not solely rely on PowerPoint slides only. Java is the programming language of choice for this module and students are free to choose any IDE to run applications.

### 2.4 Programme/Departmental/Module rules, requirements and guidelines

This module adheres to the General department-specific policies, rules, requirements and guidelines.

### 2.5 Grievance procedures

All issues should be reported in writing, providing details of the complaint or issue. First consult the lecturer concerned about the complaint or issue. If the matter is, however, not resolved, you should consult the class representative (the primary function of the class representative is to serve as a two-way communication channel between the class and the lecturer.) If the matter remains unresolved you should consult the module co-ordinator in the case of large module classes with multiple lecturers. Where the co-ordinator is unable to or fails to resolve the matter, you should consult the Head of Department. Should the matter remain unresolved, you may approach the Dean of the Faculty.

## 3 Module information

### 3.1 Purpose of the module

Computer science courses deal mostly with sequential programs. This module introduces the notion of concurrent program execution. Concurrency is defined and its usefulness illustrated, as its nature is investigated by means of well-known problems and examples.

### 3.2 Module outcomes

At the end of this course, students should be able to use basic concurrency constructs in Java such as threads, locks, critical sections, atomic variables, isolation, actors, optimistic concurrency and concurrent collections, as well as their theoretical foundations. In order to take advantage of available resources and use them efficiently.

### 3.3 Module structure

The module deals with concurrency control issues and efficient use of CPU resources. The following units are covered and detailed in 3.6.

Mutual Exclusion

Concurrency

Foundations of Shared Memory

Primitive Synchronization Operations

Spin Locks and Contention

Monitors and Blocking Synchronization

Linked Lists: The Role of Locking

Stacks

### 3.4 Learning presumed to be in place

Prerequisite COS122 and COS 212

### 3.5 Credit map and notional hours

The number of credits allocated to a module give an indication of the volume of learning required for the completion of that module and is based on the concept of notional hours. Given that this module carries a weighting of 16 credits, it follows that you should spend an average of 160 hours of study in total on the module (1 credit = 10 notional hours). This includes time for lectures, assignments, projects, tests and exams.

### 3.6 Units

The following templates could be used to communicate information on unit outcomes and activities:

<b>Unit 1 : Introduction to concurrent systems</b> Theme: Week(s) and Dates: 1 16/08/2021 - 18/08/21			
Unit outcomes	Teaching and learning strategies, methods and activities	Assessment opportunities	Materials and resources
<b>Interfaces, creation of threads, synchronization</b>	<b>Interactive online lecture</b>	Programming exercises	Slides, lecture notes
<b>Unit 2 : Mutual Exclusion</b> Theme:			

Week(s) and Dates: 23/08/2021 - 25/08/21			
Unit outcomes	Teaching and learning strategies, methods and activities	Assessment opportunities	Materials and resources
<b>Knowledge of critical sections, locks- lock 1, lock2, Peterson lock</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecture notes
Unit 3: <b>Shared Memory</b> Theme: Week(s) and Dates: 30/08/2021 - 1/09/21			
<b>Registers, construction of, Atomicity</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecturer notes
Unit 4: <b>Shared Memory</b> Theme: Week(s) and Dates: 6/09/2021 - 08/09/21(test)			
<b>Atomicity</b>	<b>Class discussion</b>	<b>tutorials</b>	Slides, lecture notes
Unit 5: <b>Synchronisation Operations</b> Theme: Week(s) and Dates: 13/09/2021 - 15/09/21			
<b>Primitive Synchronization Operations</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecture notes
Unit 6: <b>Synchronisation Operations</b> Theme: <b>Week(s) and Dates: 20/09/2021</b>			
<b>Primitive Synchronization Operations</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecture notes
Unit 7: <b>Monitors and Blocking Synchronization</b> Theme: <b>Week(s) and Dates: 27/09/2021- 29/09/2021</b>			
<b>Consumer producer algorithm</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecture notes
Unit 8: <b>Concurrent Data Structures</b> Theme: <b>Week(s) and Dates: 4/10/2021- 5/10/2021</b>			
<b>Linked list data structures</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecture notes
Unit 9: <b>Concurrent Data Structures</b> Theme: <b>Week(s) and Dates: 11/10/2021- 13/10/2021</b>			
<b>Linked list data structures</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecture notes
Unit 10: <b>Concurrent Ques</b> Theme: <b>Week(s) and Dates: 18/10/2021(test)- 20/10/2021</b>			
<b>Ques, data structures</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecturer notes
Unit 11: <b>Concurrent Ques</b> Theme: <b>Week(s) and Dates: 25/10/2021- 27/10/2021</b>			
<b>Ques, data structures</b>	<b>Interactive lecture and class discussion</b>	<b>Practical, test and tutorial</b>	Slides, lecturer notes

## 4. Assessment

### 3.7 Assessment plan

#### Practicals

Weekly practical sessions provide an opportunity for you to work on your assignments in

Practical sessions will be supervised by teaching assistants and you are welcome to ask them for help and advice. The practical session is your weekly self-check to ensure that you can apply the theory. The practical sessions will also be used for teaching assistants to assess your work done in previous practical assignments. An assignment will be issued for each week during which a practical session takes place, however some assignments may span over more than one week. Each weekly assignment will require you to write a short program to solve a problem. **All weekly practical assignments are compulsory** and will contribute towards the Semester Mark.

Day	Time	Venue
Thursday	10:30 – 16:20	online
Thursday	13:30 – 16:20	online
Thursday	16:30 – 19:20	online

#### Class Tests

10 short tests will be conducted during each tutorial session at the end of each topic. The **class tests are compulsory** and will contribute equally towards your Semester Mark.

Day	Time
Monday	13:30 – 16:20

#### Semester Assignments

Two assignments will be submitted during the semester. The assignments will be more complex than the weekly practical. Both assignments will contribute equally to the Semester Mark.

Assignment	Due Date	Time
Assignment 1	24/09/2021	23:59
Assignment 2	01/11/2021	23:59

#### Semester Tests

Two tests will be written during the semester. These tests will assess your knowledge of the subject, as presented prior to the test. Both tests will contribute equally to the Semester Mark.

Test	Date	Time
Test 1	08/09/2021	17:30 – 20:00
Test 2	18/10/2021	17:30 – 20:00

#### Semester Mark

Activity	Percentage contribution
Weekly Practical Assignments	15
Weekly Tests	15
Semester Assignment 1	5
Semester Assignment 2	5

Semester Test 1	30
Semester Test 2	30

### 3.8 Assessment policy

#### Final Mark

The final mark will be calculated as follows:

<b>Semester Mark</b>	<b>50%</b>
<b>Examination Mark</b>	<b>50%</b>

#### Examination Entrance and pass requirements

In order to obtain Examination Entrance, you must obtain a Semester Mark of at least 40%

In order to pass the course, you must achieve Examination Entrance as well as both of the following minimum results:

<b>Examination</b>	<b>40%</b>
<b>Final Mark</b>	<b>50%</b>

#### Reporting and Querying of Marks

Querying class and Semester Tests should be submitted to the Lecturer or Assistant Lecturer. A query must contain your motivation and reasoning for why you believe an answer was marked inaccurately. Any query that does not include a reason in terms of the module curriculum or that simply states a demand for a remark will be ignored.

**N.B.** No late queries will be processed. If you do not study the outcome of the test within the given time, it will be assumed that you are satisfied with said outcome.

#### Absence from an Assessment

Should you be unable to attend an assessment or you have difficulty in handing in an assignment due to special circumstances, suitable provisions may be arranged. However, not all assessments are provided for. The following table lists the only provisions that may be made and how you should apply:

Assessment	Provision	Application	Recipient
Class	None	N/A	N/A
Practical Assignment	Extensions	Medical Certificates	Coordinator
Semester Tests	Aegrotat Tests	Medical Certificates	Coordinator
Examination	Aegrotat Tests	Medical Certificates	EBIT Faculty

**N.B.** No backdated medical certificates or certificates that state that the student informed the doctor instead of undergoing an examination will be accepted. All medical certificates must be submitted within three working days of the assessment. Unless otherwise indicated, provisions are made at the discretion of the Coordinator or EBIT Faculty. The sick tests for both semester tests will take place at the end of the semester and will respectively cover the contents of the original test.



### 3.9 Plagiarism

Plagiarism is a serious form of academic misconduct. It involves both appropriating someone else's work and passing it off as one's own work afterwards. Thus, you commit plagiarism when you present someone else's written or creative work (words, images, ideas, opinions, discoveries, artwork, music, recordings, computer-generated work, etc.) as your own. Only hand in your own original work. Indicate precisely and accurately when you have used information provided by someone else. Referencing must be done in accordance with a recognised system. Indicate whether you have downloaded information from the Internet. For more details, visit the library's website: <http://www.library.up.ac.za/plagiarism/index.htm>.

## 4 Support services

Please download a QR code reader on your cellphone. To download a QR code reader open your mobile app store (App Store, Google Play or Windows Marketplace) and search for QR code readers.



### 4.1 Safety in the evening and emergencies

- For any safety or emergency related matters, eg if you need a security officer to accompany you from your residence to campus, phone the Operational Management Centre (details at the back of your student card).
- The 24-hour, multi-disciplinary UP Crisis Line offers professional and confidential support to victims of crime in times of trauma. For assistance and immediate action, phone the UP Crisis Line on: 0800 00 64 28.
- Hatfield residence students: From 18:00 till 06:00 security officers are available to escort you (on foot) to and from your residence or campus anywhere east of the Hatfield Campus through to the Hillcrest Campus.

### 4.2 E-learning support

- Report a problem you experience to the Student Help Desk on your campus.
- Visit the open labs in the Informatorium Building or IT labs on your campus to report problems at the offices of the Student Help Desk.
- Approach the assistants at the help desks—campus specific (for example: adjacent to the Student Computer Laboratories in IT Building, NW2, CBT or Aldoel Building IT labs, etc).
- Call 012 420 3837.
- Email [studenthelp@up.ac.za](mailto:studenthelp@up.ac.za)

### 4.3 Other support services:

FLY@UP: The Finish Line is Yours	• Think carefully before dropping modules (after the closing date for amendments or cancellation of modules).	<a href="http://www.up.ac.za/fly@up">www.up.ac.za/fly@up</a>	
	• Make responsible choices with your time and work consistently.	email: <a href="mailto:fly@up.ac.za">fly@up.ac.za</a>	
	• Aim for a good semester mark. Don't rely on the examination to pass.		
Disability Unit	Academic support for students with learning disabilities:	<a href="https://www.up.ac.za/disability-unit">https://www.up.ac.za/disability-unit</a>	
	• Assistive technological services	012 420 2064 email: <a href="mailto:du@up.ac.za">du@up.ac.za</a>	

- Facilitation of test and examination accommodations
- Test and exam concession applications
- Accessible study venues and a computer lab
- Referrals for recommended textbooks in electronic format

Student Counselling Unit	Provides counselling and therapeutic support to students	012 420 2333	
Student Health Services	Promotes and assists students with health and wellness	012 420 5233 012 420 3423	
The Careers Office	Provides support for UP students and graduates as they prepare for their careers	<a href="mailto:careerservices@up.ac.za">careerservices@up.ac.za</a> 012 420 2315	
Department of Security Services	24-hour Operational Management Centre  24-hour Operational Manager Crisis Line	012 420-2310 012 420-2760  083 654 0476 0800 006 428	
Department of Student Affairs	Enquiries concerning studies, accommodation, food, funds, social activities and personal problems	012 420 2371/4001 Roosmaryn Building, Hatfield campus	
Centre for Sexualities, AIDS and Gender	Identifies and provides training of student peer counsellors	012 420 4391	
Fees and funding	<a href="http://www.up.ac.za/enquiry">http://www.up.ac.za/enquiry</a> <a href="http://www.up.ac.za/fees-and-funding">www.up.ac.za/fees-and-funding</a>	012 420 3111	
IT Helpdesk	For student IT related queries	012 420 3051 <a href="mailto:studenthelp@up.ac.za">studenthelp@up.ac.za</a>	