Theory of Computing:

Syllabus

Professor Imed Bouchrika
National Higher School of Artificial Intelligence
imed.bouchrika@ensia.edu.dz

Outline :

- Objectives & Outcomes
- Course Content
- Why it is important
- Teaching Staff
- Evaluation & Assignments
- Resources
- Ethics & Policies.

Objectives & Outcomes

- The aim of this module is to provide the basic concepts for the theory of computation and complexity.
- Students will learn
  - What can be computed and what cannot be computed at all
  - How efficiently can it be computed
  - How to formally reason about computation
  - The technology-independent foundations of computer science

Objectives & Outcomes

- The aim of this module is to provide the basic concepts for the theory of computation and complexity.
- Students will learn
  - What can be computed and what cannot be computed at all
  - How efficiently can it be computed
  - How to formally reason about computation
  - The technology-independent foundations of computer science

Course Content

- **Introduction**
  - Complexity theory, Computability theory, Mathematical notions, Types of Proofs
- **Automata theory**
  - Regular Languages : Finite Automata, Non-determinism, Regular Expressions, nonregular languages.
  - Context-free languages : Grammars, Pushdown automata
- **Computability theory**
  - Turing machines, recursively enumerable and recursive languages
  - Church-Turing thesis
  - Decidability
  - Reducibility
- **Complexity Theory**
  - Complexity of algorithms and of problems
  - Complexity classes P, NP, PSPACE
  - Polynomial-time reduction
  - NP-Completeness and Cook's theorem + PSPACE-Completeness

Why it is important ?

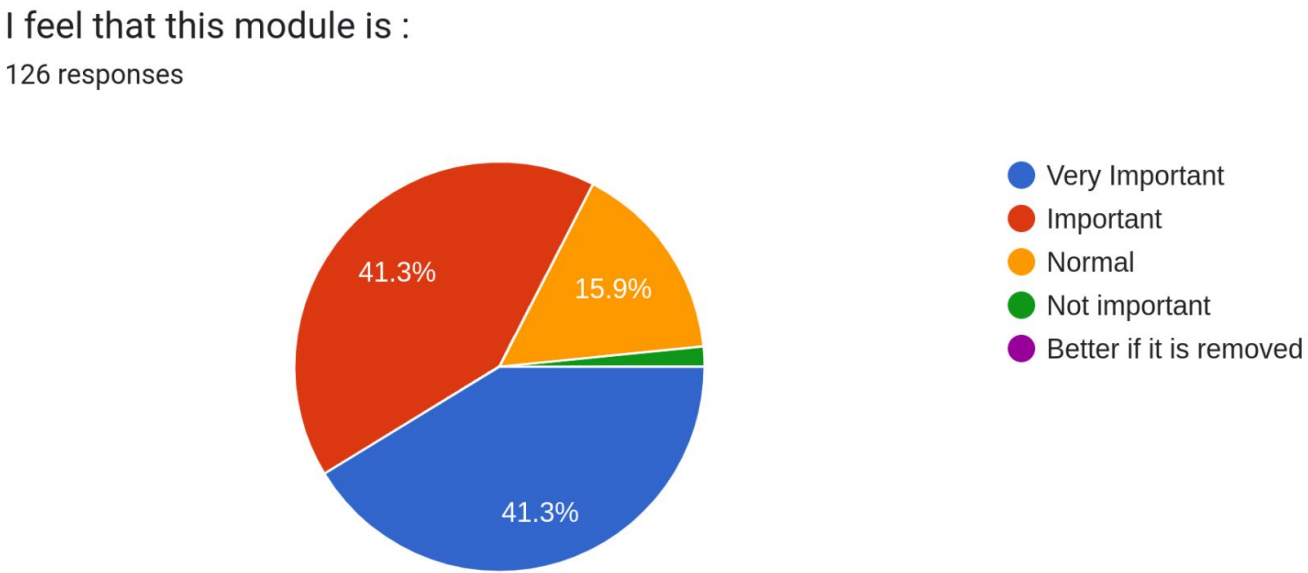
- Are we going to teach you programming ?
- Or how to create beautiful looking software systems ?
- Or how to create a computer ?
- Or how to create a smart AI solution ?

Why it is important ?

- Improve your skills for problem solving and algorithmic thinking
- Learn how to solve problems efficiently
- Master the formalism to creating solutions for a given problem using abstract models.
- Considered among the most fundamental courses for computer science. (Based on a survey for Stanford graduates)

Why it is important ?

- Feedback from prev students (2023/2025)



Teaching Staff

- ***Professor Imed Bouchrika***
  imed.bouchrika@ensia.edu.dz

- ***Dr. Farah Ibelaiden***
  farah.ibelaiden@ensia.edu.dz

- ***Dr. Fouzia Anguel***
  fouzia.anguel@ensia.edu.dz

Learning Process

Wednesday	Thursday AM	Thursday PM	Following Week
Lecture Slides are sent to students to have a glimpse about the materials	Attending lectures to understand the materials and listen to questions/answers	Quiz Form will be sent to students to try before the tutorial session Tutorial Sheet will be sent to students to look into the exercises before the session.	Students need to do a pre-tutorial exercise which is an easy exercise to get them into the materials. Tutorial Sessions for solving exercises related to the lecture

Evaluation & Assignments

- Exam : 60%
- Continuous Evaluation : 40%
  - Tutorial Online Quiz : **5 points** : (**from 10 quizzes**)
  - Mid-Term Exam : **10 points** *(8th Week)*
  - Assignment/Homework : **3 points**
  - Staff Appreciation : **2 points**
    - Challenge Exercises : **3 points** (Optional)
    - Penalty of Non-Justified Absence : **-5 points**
- Late Submission :
  - The system system will close automatically.
  - We will not accept email submissions.

Quizzes (5 points)

- Quizzes will be available either :
  - After the lecture and closed at the end of the week.
  - During the lecture only.
  - Only for the students who attended the lecture(s)
- Missing three **quizzes**, zero mark will be given directly and all other submissions will not be considered.
- There will be only 8 quizzes
- **Being absent in 5 lectures, ZERO mark will be given.**

Quizzes (3 points)

- Online Quizzes should preferably be done before attending the tutorial sessions.
- Quizzes include easy/medium M.C.Questions aimed to enforce your understanding for the concepts discussed during the lecture.
- PLEASE : Don't rush to answer the quiz, take your time, **search for the solutions on the web** and submit your answers when you are certain.
- The quiz will be open during the week of the lecture. (To ensure students will not procrastinate doing their revision and homework)

Assignments (5 points)

- There would be an exercise(s) given as an assignment from time to time
- Submission of your solution should be done through the Google Classroom platform OR Reviewed by the tutorial staff in the following week.
- Late submission subjected to the agreed penalties.
- Badly written, poorly phrased, unclear solution would be penalized. Typing your solution is recommended.
- The difficulty is medium for the exercises.

Challenge Questions

(3 points of extra credit)

- Meant for you to learn how to solve difficult problems that you may face in the future and you can not find their solutions on the web freely.
- Solutions for the challenge Exercises will be submitted via Google Classroom when the Assignments are created. (**It will be created without prior notice with only a one day deadline**)
- Solving the exercises is optional, but you are encouraged to do so.

Tutorial Sessions - TD

- Exercises of Prefix :
  - **C** : to be solved in class where you will be given some time to try to solve them.
  - **A** : **Assignments/homework** that you need to solve within a week deadline. You need to submit your solution via Google Classroom
  - **P** : Are optional exercises to be done at home after class. Discuss with your colleagues about the possible solutions. Feel free to bring your solutions to the tutorial staff to discuss in class when convenient.
- Note that all **P exercises** are potential exam questions that they **will** be included into the midterm/final exams.

Tutorial Sessions - TD

- Tutorial Series are given during the lectures for the following week to give students to have an insight on the exercises and potentially work on them
- Students must work on pre-tutorial exercises before attending the sessions.
- Students should not play with their phones during the TD/lecture sessions

Exams & Midterms

- There will be Questions in the Midterm or the Exam being :
  - Taken from the Optional Exercises
  - Asked inside the lecture
- For the marking procedure, to ensure fairness, each exercise/question is marked by the **same lecturer** for all students.
- If you are incorrect for a given answer, zero mark should be given straight away. However, we may subjectively give some points in appreciation to the effort made by the student. But, we are not required nor you have the right to claim points for incorrect or partially correct answers.

Attending Lectures

- There would be quizzes during lectures from time to time. They will be graded.
- Can the lectures be substituted by Youtube videos given by Top Scientists from MIT and Stanford ?
- Are lectures about telling you what's inside the book that you can read on your own ?
- Deliberate missing of lectures would contribute to create a lazy atmosphere among the students + Accumulation of pressure and stress before the exam.

Absence & Penalties

- LAB Sessions :
  - Students being absent more than allowed, law will be strictly applied and students will be excluded.
  - Students need to coordinate with the **administration** and LAB staff about their absences.
- Lecture Sessions
  - Students are **advised** to attend all lectures.
  - If you miss the lecture, don't expect LAB staff to repeat lecture materials.
  - Students who are were absent for a valid reason, should email only the lecturer (no need for the administration)
  - Attendance File :

Absence & Penalties

- Being late :
  - Students coming 10 minutes late, will be allowed in class but they will be considered **ABSENT**
- Absence Penalty Points :
  - **-0.25 Point per Non-Justified Absence** (LAB **Sessions OR Lectures)**
  - TD Session = one session of 90 minutes
  - A max of **5 points** can be deducted from the Continuous Mark.
  - Quiz marks will not be accepted.
- More than 5 absences :
  - All of their points in the bonuses are disregarded including challenge + quizzes..
  - .....

Attending Lectures

- Can the lectures be substituted by Youtube videos given by Top Scientists from MIT and Stanford ?
- Are lectures about telling you what's inside the book that you can read on your own ?
- Deliberate missing of lectures :
  - Would contribute to create a lazy atmosphere among the students
  - Accumulation of pressure and stress before the exam.
- Of course, You **may** learn a lot on your own without attending lectures, but for 7 modules within a semester, you are putting yourself at a risk.

Exceptional Cases

- Exceptional Progress : Mid-term vs. Exam Marks :
  - Students who scored below 10 in the midterm whilst their score above (>) 15 in the exam, their midterm mark will be the same as the exam.

- Exceptional Cases of Justified Absences:
  - Students who have missed considerable number of sessions, please always contact us for assistance when needed to catch up.

Policies

- The use of **Mobile Phones inside the classroom is prohibited for Chat and non-educational purposes**. Disciplinary measures would be taken as it is considered as a disrespect to the lecturers and to the school.
- **Chewing Gum + Coffees** are strictly prohibited inside the classrooms
- Penalty for Late Submissions will be applied strictly. Any submission that we cannot open or unzip, zero mark will be given directly. Submission by email email is never acceptable.
- If you need assistance or have any questions, always speak directly to the lecturer, lab staff and make use of the weekly office hours.

Policies : ChatGPT

- ChatGPT is totally for forbidden in the MobileDEV Course
  - Most exercises can be solved by ChatGPT, but the aim is teach you how to become a good problem solver, inventor and innovator by coming up with creating solutions.
  - Most questions can be answered by ChatGPT, students need to try and think to come up with answers themselves by trying, making mistakes.
  - We would be **very angry** seeing you opening ChatGPT in class asking computers to replace your humanly brain.

Resources

- Course Textbook :
  Michael Sipser. Introduction to the Theory of Computation. 3rd Edition. 2012

- Materials from other universities:
  - Stanford University : http://infolab.stanford.edu/~ullman/ialc/spr10/spr10.html
  - University of Boston : https://cs-people.bu.edu/mbun/courses/332_F21/
  - Washington State University : https://eecs.wsu.edu/~ananth/CptS317/Lectures/index.htm
  - University of California, San Diego : https://cseweb.ucsd.edu/classes/wi09/cse105/
  - University of Illinois : https://courses.engr.illinois.edu/cs373/sp2010/lectures/

Resources

- Youtube Video Lectures:
  - Stanford University : https://www.youtube.com/watch?v=U7LrP3s5tKU&list=PLoCMsyE1cvdV4CkdIZRKW8lk2BBOW-fbF&index=2
  - MIT (Sipser) : https://www.youtube.com/watch?v=9syvZr-9xwk&list=PLUl4u3cNGP60_JNv2MmK3wkOt9syvfQWY
  - Neso Academy : https://www.youtube.com/watch?v=58N2N7zJGrQ&list=PLBlnK6fEyqRgp46KUv4ZY69yXmpwKOIev

Policies

- All homework must be done individually
- Students caught cheating will be given a zero mark. Cheating includes the case of helping others, getting help, looking up websites for solutions with a direct copy & paste...(Exception is made for the quiz)
- The use of Mobile Phones inside the classroom is **prohibited**. Disciplinary measures would be taken as it is considered as a disrespect to the lecturers whilst they are teaching.
- ChatGPT is totally forbidden for learning. You will be penalized (Points deducted) if you are found to use ChatGPT.