Modulbezeichnung:	Selected Topics in ASC - Topics in Data Science: Some Old, Some New (STASC)	2.5 ECTS
	(Selected Topics in ASC - Topics in Data Science: Some Old, Some New)	
Modulverantwortliche/r:	Ralf Müller	
Lehrende:	Anthony Ephremides, Sebastian Lotter	

Startsemester: SS 2022	Dauer: 1 Semester	Turnus: jährlich (SS)
Präsenzzeit: 30 Std.	Eigenstudium: 45 Std.	Sprache: Englisch

Lehrveranstaltungen:

Selected Topics in ASC - Topics in Data Science: Some Old, Some New (SS 2022, Vorlesung, 2 SWS, Anthony Ephremides et al.)

Empfohlene Voraussetzungen:

The students who will take this course should have a working knowledge of Probability Theory and Stochastic Processes along with the underlying requisite Mathematics (like calculus and algebra). They should also have a basic background in Communication Systems. Finally, some acquaintance with notions of optimization will be useful.

Inhalt:

The motivation and intent of this course is to acquaint the participants with selected important aspects of the new emerging union of traditional and novel topics from a variety of fields under the umbrella rubrik of DATA SCIENCE. This term captures the ideas and heritage of Information and Communication Theory along with concepts from Computer Science, Networking, Signal Processing, and, even, Control Theory. It also leaves room for new ideas that have developed recently that expand the scope of these traditional fields.What is the most important common thread in all these fields is the focus on the central role played by Data.

The course will chart a journey through two selected, important, and interrelated aspects of Data Science, namely, Communication Networks and Information Freshness (known also as Age of Information).

Communication Networks is already a mature and vast field. Hence, the emphasis will be on those aspects of it that are necessary for the other field, that is, the Age of Information, which is new and rapidly expanding, and which captures the relationship between different traditional fields (like InformationTheory and Signal Processing). Thus, it will cover the following subjects:

- Introduction to the Fundamental Networking Paradigm
- Review of the Basic Models used from Queueing Theory
- Special Emphasis on Wireless Networks

Next, the course will introduce and develop the idea of Information Freshness, which is not only a new Concept, but also a Tool and, of course, a Performance Objective. It will review the following subjects:

- Description and Formal Definition of Age of Information
- Examples through the Use of Queueing Models
- Relationship of the notion of Age to Sampling (and, hence, to Signal Processing)
- Minimization of Age (i.e. Maximization of Freshness)
- Novel fields of Application of Age of Information (such as in Control Systems)

The course will strike a balance between theory and applications and will strive to meet the backgrounds, interests, and needs of the participants.

Lernziele und Kompetenzen:

The students:

- use queueing models to calculate the delay and congestion in networks.
- use methods resolve conflicts in wireless systems with multiple users sharing the same channel
- explain the new communication paradigm in data science that goes beyond the classical one of Shannon Theory
- exploit the notion of information freshness and use it to improve system performance

- apply the Age of Information concept in the Internet of Things
- use freshness of information in applications like vehicular networks and control systems
- use the material from this course in their subsequent studies and research by incorporating in them novel and important concepts and tools over a variety of subjects and areas of application.

Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:
Das Modul ist im Kontext der folgenden Studienfächer/Vertiefungsrichtungen verwendbar:

[1] **Advanced Signal Processing & Communications Engineering (Master of Science)**

(Po-Vers. 2021w | TechFak | Communications Engineering (Master of Science) | Gesamtkonto | Selected Topics in ASC)

Studien-/Prüfungsleistungen:
Selected Topics in ASC (Prüfungsnummer: 84511)
Prüfungsleistung, Klausur, Dauer (in Minuten): 90
Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Englisch

Erstablegung: SS 2022, 1. Wdh.: WS 2022/2023
1. Prüfer: Ralf Müller