Course Title	**Ubiquitous Computing**				
Course Code	**DLWSS503**				
Course Type	**Compulsory**				
Level	Master (2nd Cycle) – Distance Learning				
Year / Semester	1 / 1				
Teacher's Name	**Andreas Constantinides, PhD**				
ECTS	10	Lectures / week	3	Laboratories / week	0
Course Purpose	Ubiquitous Computing (*UbiComp*) touches on a wide range of topics including distributed computing, mobile computing, location computing, mobile networking, context-aware computing, sensor networks and many more, expands beyond the traditional challenges of those areas and more importantly demonstrates its value and importance through a device that lies on the backbone of UbiComp. That is, the cell phone, or more precisely the smarpthone where its advanced capabilites in terms of processing power and memory, its extended number of connection modalities and its unlimited number of sensors, made it one of the most widely adopted and ubiquitous computer ever existed. The purpose of this course is to provide students with advanced knowledge in emerging topics of ubiquitous computing in order to extend critical awareness of the issues and challenges associated with this area. Additionally, to allow students to identify and apply essential tools and techniques, as well as enhance their understanding on mobile systems. Furthermore, it covers a wide range of related topics such as context-awareness, privacy and personalization, mobile social networks and crowdsourcing via smartphones. Finally, it enables students to practice in various development platforms and toolkits to successfully design and develop smartphone applications. Emphasis is also given to extend students critical awareness regarding ubiquitous systems business aspect. The course aims to provide you with the knowledge of the essential tools and techniques to: • extend critical awareness of the issues and challenges associated with ubiquitous computing and several related topics • demonstrate specialized knowledge on cutting-edge technologies and methodologies on mobile systems • successfully design and develop smartphone application on the ubiquitous Android operating system.				
Learning Outcomes	By the end of the course the students are expected to: • Develop critical awareness on emerging topics of ubiquitous computing, next generation mobile systems (e.g., smartphones, tablets) and their application areas.				

	• Critically evaluate the main challenges, opportunities, complexity and trends of mobile and ubiquitous computing. • Develop highly specialized knowledge on methodologies and technologies related to distributed computing, peer to peer and client/server architectures, context-awareness and location-awareness. • Demonstrate cognitive and practical skills required to design and develop smartphone applications using various platforms, toolkits and third-party libraries on the ubiquitous Android operating system. • Assess the risks and opportunities of mobile social networks and personalization, and have critical understanding of privacy and security principles and methodologies. • Assess the risks and opportunities of crowdsourcing with smartphone and have critical understanding of its contribution in the evolution of big data.		
Prerequisites	None	Corequisites	None
Course Content	This course consists of the following eleven units: • This course consists of eleven units that will be taught within twelve (12) weeks: • Unit 1 (Week 1) is the introductory session for the whole course • Units 2,3 (Weeks 2 and 3) deals with topics related to computing areas that lie at the foundations of UbiComp, such as distributed and mobile computing. • Unit 4 (Week 4) deals with topics associated with challenges and applications of ubiquitous computing. • Unit 5 (Weeks 5 and 6) deals with software development on smartphone systems with major focus on smartphone application design and development on the ubiquitous Android operating systems. • Unit 6 (Week 7) covers topics on context-aware computing and systems with focus on how embedded and mobile systems can sense the environment and adapt according to the available resources on their surroundings. • Units 7-11 (Weeks 8-12) deal with several special topics related to Ubiquitous Computing and Smartphone Systems, including Location-Awareness and localization-based services for both outdoor and indoor environments, Internet of Things (IoT) Mobile Social Networks, Personalization and Recommendation Systems, Security and Privacy, Crowdsourcing with Smartphones, as well as Business and Monetization strategies for smartphone applications.		
Teaching Methodology	**Mode of Delivery: Distance Learning** The course is designed to introduce and explain the material students are expected to learn through an on-line learning environment. The on-line environment provides an opportunity for receiving on-line feedback from the Course Instructor during their study. In addition, students will be encouraged to interact both with other students and the instructor so as to feel part of an		

	on-line community of learners that belong to the University network. The course content will be delivered through online material/notes, recorded lectures and/or narrated presentations. Therefore, students may be asked to download and study notes, tutorials and numerical exercises as well as watch recorded lectures/demonstrations or narrated presentations posted on the web addressing the main concepts of a particular unit. Furthermore, the planned communication and the dynamic/online interaction activities between the course instructor and the students will include asynchronous communication tools (Discussion Forum) that students may be asked to participate, wherever appropriate, in an online forum posting their views on certain topics covered in a particular unit; and synchronous communication tools (instant messaging, such as Skype, chat rooms, video-conferencing, etc.), that students may discuss on-line with the Instructor (s) and/or other students specific issues covered in a given unit. Moreover, a number of case study readings are also considered, so as to demonstrate the relevance and practical applicability of mobile and ubiquitous computing methods and systems covered in the various units of this course. Case-studies can illustrate that what students have studied in each unit is not just of academic or theoretical value but also has value in terms of improving real-life challenges.
Bibliography	The following textbooks are associated with topics considered at various points throughout this course. • John Krumm (2016), Ubiquitous Computing Fundamentals, CRC Press • Dan Chalmers (2011) Sensing and Systems in Pervasive Computing: Engineering Context Aware Systems, Springer • Jia W. and Zhou W. (2005) Distributed Network Systems: From Concepts to Implementations (Network Theory and Applications) 2005th Edition, Springer The above textbooks are recommended as sources of additional reading for students so as to elaborate on the course's material. Students can also find additional examples that they can use for practice. Furthermore, students are also encouraged to explore other online / print sources that are related to topics covered in this course such as the following: • Mobile app monetization - Statistics & Facts, Published by J. Clement, Apr 21, 2020 • Rafael Alexandrou, Harris Papadopoulos, Andreas Konstantinidis, "Smartphone Indoor Localization using Bio-Inspired Modeling" , Nature-Inspired Computation in Navigation and Routing Problems, Springer, 2019 • F. Zafari, A. Gkelias and K. K. Leung, "A Survey of Indoor Localization Systems and Technologies," in IEEE Communications Surveys & Tutorials, vol. 21, no. 3, pp. 2568-2599, 2019 • Andreas Konstantinidis, Savvas Pericleous, Christoforos Charalambous, "Meta-Lamarckian Learning in Multi-Objective Optimization for Mobile Social Network Search" , Volume 67, Pages 70-93, Applied Soft Computing, Elsevier, 2018. • Ricardo Baeza-Yates, August 10, 2018 Re-examining user experience: Can personalization and privacy coexist?, August 10, 2018. • Demetrios Zeinalipour-Yazti, Christos Laoudias, Kyriakos Georgiou and Georgios

Chatzimiloudis, "Internet-based Indoor Navigation Services", IEEE Internet Computing (IC'16), IEEE Computer Society, 2016

- Andreas Konstantinidis, George Nicolaides, Georgios Chatzimilioudis, Giannis Evagorou, Demetrios Zeinalipour-Yazti and Panos Chrysanthis, "Radiomap Prefetching for Indoor Navigation in Intermittently Connected WiFi Networks", IEEE 16th International Conference on Mobile Data Management (MDM '15), IEEE Press, 2015.
- Andreas Konstantinidis, Georgios Chatzimilioudis, Demetrios Zeinalipour-Yazti, Paschalis Mpeis, Nikos Pelekis, Yannis Theodoridis, "Privacy-Preserving Indoor Localization on Smartphones." IEEE Transactions on Knowledge and Data Engineering (TKDE '15), IEEE Computer Society, USA, 2015.
- Wu, C., Yang, Z. and Liu, Y., 2015. Smartphones based crowdsourcing for indoor localization. Mobile Computing, IEEE Transactions on, 14(2), pp.444-457.
- "A P2P Search Framework for Intelligent Mobile Crowdsourcing", Andreas Konstantinidis and Demetrios Zeinalipour-Yazti "Opportunistic Mobile Social Networks" (Studies in Computational Intelligence), CRC Press, Pages: 377-405, ISBN: 978-1-4665-9494-4, 2014
- Lane, N.D., Chon, Y., Zhou, L., Zhang, Y., Li, F., Kim, D., Ding, G., Zhao, F. and Cha, H., November. Piggyback CrowdSensing (PCS): energy efficient crowdsourcing of mobile sensor data by exploiting smartphone app opportunities. In Proceedings of the 11th ACM Conference on Embedded Networked Sensor Systems (p. 7). ACM, 2013.
- Andreas Konstantinidis, Demetrios Zeinalipour-Yazti, Panayiotis Andreou, George Samaras, and Panos Chrysanthis, "Intelligent Search in Social Communities of Smartphone Users", Distributed and Parallel Databases, Springer Press, Vol: 31,
- US Patent: Akella et al. (2009) “Creation and maintenance of social relationship network graphs” United States patent, patent no.: US 7,539,697
  No: 2 Pages: 115-149, 2013.
- C. Laoudias, G. Constantinou, M. Constantinides, S. Nicolaou, D. Zeinalipour-Yazti, and C. Panayiotou, “The airplace indoor positioning platform for android smartphones,” in MDM, 2012
- Toch, E., Wang, Y. and Cranor, L.F., 2012. Personalization and privacy: a survey of privacy risks and remedies in personalization-based systems. User Modeling and User-Adapted Interaction, 22(1-2), pp.203-220.
- G. Chatzimilioudis, A. Konstantinidis, C. Laoudias and D. Zeinalipour-Yazti,, "Crowdsourcing with Smartphones", IEEE Internet Computing, SI: Crowdsourcing, 2012.
- Yuen, M.C., King, I. and Leung, K.S., A survey of crowdsourcing systems. In Privacy, Security, Risk and Trust (PASSAT) and 2011 IEEE Third Inernational Conference on Social Computing (SocialCom), pp. 766-773, 2011.
- Y. Gu, A. Lo, and I. Niemegeers, “A survey of indoor positioning systems for wireless personal networks,” Communications Surveys Tutorials, IEEE, vol. 11, no. 1, pp. 13–32, First 2009.
- H. Liu, H. Darabi, P. Banerjee, and J. Liu, “Survey of wireless indoor positioning techniques and systems,” Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on, vol. 37, no. 6, pp. 1067–1080, Nov 2007.
- Chellappa, R.K. and Sin, R.G., 2005. Personalization versus privacy: An empirical examination of the online consumer’s dilemma. Information Technology and Management, 6(2-3), pp.181-202
- M. Gruteser and D. Grunwald. Anonymous usage of location-based services through spatial and temporal cloaking. In Proceedings of the 1st Intl. Conference on Mobile Systems, Applications and Services, MobiSys ’03, pages 31–42, 2003

	• L. Sweeney. K-anonymity: A model for protecting privacy. Int. J. Uncertain. Fuzziness Knowl.-Based Syst., 10(5):557–570, Oct. 2002 • Textbook: Hanneman, Robert A. and Mark Riddle. 2005. Introduction to social network methods. Riverside, CA: University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/), • Brumitt, B., Meyers, B., Krumm, J., Kern, A., and Shafer, S., EasyLiving: Technologies for intelligent environments, Second International Symposium on Handheld and Ubiquitous Computing (HUC 2000), September 2000, pp. 12–27 • Abowd, G. D., Classroom 2000: An experiment with the instrumentation of a living educational environment, IBM Systems Journal, 38(4): 508–530. Special issue on Pervasive Computing, 1999. • Pitoura E. and Samaras G. (1998), Data Management for Mobile Computing Kluwer Academic Publishers • Mobile Design and Development, Brian Fling, O'Reilli, 2009 • Mark Weiser. The computer for the 21st century. Scientific American, 3:94–104, September 1991 • Android Studio. LINK: https://developer.android.com/studio • Android App Basics and Core topics. LINK: https://developer.android.com/guide/components/fundamentals
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 50% and 50%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as dynamic online activities, online quizzes, group project design, implementation and presentation. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • **An online quiz** (15% of total marks for module) • **One marked assignment/project** (15% of total marks for module) • **Presentation of project** (10% of total marks for module) • **Two dynamic interactive activities** (10% of total marks for module) • **One closed-book, 3-hour exam** (50% of total marks for module) Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in complex real-life problems. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the

	quality of the course.
Language	English