

# CIS 6930: Special Topics in CIS: Digital Health

Credits: 3

**Class Periods:** T | Period 4 (10:40 AM – 11:30 AM) & R | Period 4 - 5 (10:40 AM – 12:35 PM)

**Location:** ~~CSE-E220~~ Zoom

**Academic Term:** Fall 2020

**Instructor:** Professor [Abdelsalam \(Sumi\) Helal](mailto:helal@cise.ufl.edu), [helal@cise.ufl.edu](mailto:helal@cise.ufl.edu)

Office Hours: Thursdays 4:00-6:00PM, via Zoom.

## **Teaching Assistants:**

Please contact the TA through the Canvas website

- Kyuseo Park, [kyuseopark@ufl.edu](mailto:kyuseopark@ufl.edu)

## **About Digital Health**

Health and Wellness are undergoing digital transformations requiring skilled workforce catering to the emerging Health Tech industry as well as the top Computer Tech industry including Microsoft, Google, Amazon, Facebook, among many others. The code name for this new interdisciplinary area, emerging technology, skill set, and eventually own-industry is *Digital Health*. Digital Health entails the use and application of informatic and cybernetic technology in the pathways of disease diagnosis, treatment, healthcare delivery, health-related learning and discovery, and in general staying active and healthy throughout the entire lifespan.

## **Learning Objectives**

This is a special topics graduate-level class on the emerging and interdisciplinary area of Digital Health. Ideally, the class should include students from both the health and medicine domain as well as from computing and engineering domain. This semester, the majority of the students are computing and engineering major. This makes cohort-style learning of “the other” discipline challenging and sets the scope towards the areas of wellness and health, rather than wellness, health and medicine in which certain medical conditions or specific diseases may be considered.

You should expect to gain knowledge about today’s healthcare delivery systems and their associated payer models (nationalized, private insurance), basics of learning health systems, broad determinants of health, active and healthy living and health navigation, the envisioning of

future healthcare delivery systems and their associated payer model (democratized smart contract-based insurance), and of course the digital health technology itself and supportive sciences. You should also gain knowledge in a specific area or use case of digital health through a group research project that would involve a systematic literature review and a critical perspective on potential solutions. This means groups of you will become more deeply knowledgeable in important areas such as mental health, aging and frailty, aging with disabilities, living with dementia, and living with long term conditions such as diabetes, obesity, anxiety, COPD, drug addiction, among others. Some of you may gain such a deeper knowledge for specific demographics of age, race, gender identity, and served-underserved communities.

You will gain knowledge of health tech specifically Health IoT in the domain of wellness and health, Health Data, Health-Research Co-design, as well as basic overviews of relevant elements of data science and social sciences.

## Points of Assessment

- Quizzes
- Group research project
- Group hands-on project
- Two exams

## Modules Structure

The course is divided into three modules:

1. Introductions to Digital Health: providing different overviews addressing the different contexts of use and applicability of digital health
2. Digital Health Technologies: covering wearables and Health IoT, Mobile Health, Smart Homes
3. Personal Health & Health Navigation: which is the area of focus of digital health applicability this semester. This will involve two broad sub-areas:
  - 3.a Personal Health Informatics. This focuses on one direction of the digital health “traffic”, starting from using sensors and wearables to engaging patients, to making sense of the data to looking at the data from different angles and at different scales (e.g., aggregating data into population health data), and in general making sense of the data so it could be utilized easily in diagnosis or designing interventions, or driving AI algorithms to recommend more accurate diagnosis and “precise” interventions.
  - 3.b Personal Health Cybernetics. This focuses on the opposite direction of digital health “traffic”, starting from designing timely (or just-in-time) interventions through continuum-of-care models (as opposed to the traditional points-of-care), care-system interaction with the end user through technology channels, ensuring the user cooperation and “convergence”, engaging

the user and evidentially securing user actuation (ensuring the user is taking an action), and the more ambitious goal of behavioral change (ensure the user is changing behavior or lifestyle).

## Reading Material

You are not required to purchase any textbooks for this class. Reading materials, mostly published research papers, are specified along with the topics covered in the class schedule below. You should also be able to access other sources and reports from the IEEE Xplore Digital Library.

## Class Schedule & Planned Lectures

Date	Topics Covered
<b>PART I</b>	<b>Introductions to Digital Health</b>
Tuesday 1 Sept	<ul style="list-style-type: none"> <li>• Review of Syllabus</li> <li>• Digital Health in a Nutshell</li> <li>• Reading Materials:               <ul style="list-style-type: none"> <li>○ Sumi Helal and Ramesh Jain, "Introduction to the Special Issue of IEEE Computer on Digital Health: Active and Healthy Living," IEEE Computer, November 2019. (IEEE Xplore)</li> <li>○ B. Meskó, "Digital Health Technologies and Well-Being in the Future," in IT Professional, vol. 22, no. 1, pp. 20-23, 1 Jan.-Feb. 2020, doi: 10.1109/MITP.2019.2963121. (IEEE Xplore)</li> <li>○ M. K. Hudes, "Digital health: Hype to reality," 2016 Pan Pacific Microelectronics Symposium (Pan Pacific), Big Island, HI, 2016, pp. 1-5, doi: 10.1109/PanPacific.2016.7428386. (IEEE Xplore)</li> </ul> </li> </ul>
Thursday 3 Sept	<ul style="list-style-type: none"> <li>• The Key Determinants of Health &amp; Wellbeing</li> <li>• Quality of Life Assessment</li> <li>• The Digital Health Landscape</li> <li>• Reading Materials:               <ul style="list-style-type: none"> <li>○ WHO Social determinants of health - World Health Organization</li> <li>○ Social Determinants of Health 2020 (Chapter 39): Healthypeople.gov: <a href="https://www.healthypeople.gov/2020/about/foundation-health-measures/Determinants-of-Health">https://www.healthypeople.gov/2020/about/foundation-health-measures/Determinants-of-Health</a></li> <li>○ Social Determinants of Health 101 for Health Care. National Academy of Medicine.</li> <li>○ Barton, Hugh &amp; Grant, Marcus. (2006). A health map for the local human habitat. The journal of the Royal Society for the Promotion of Health. 126. 252-3. 10.1177/1466424006070466.</li> </ul> </li> </ul>
Tuesday 8 Sept	<ul style="list-style-type: none"> <li>• Today's Healthcare Systems, Relevant Base technology &amp; Payer Models</li> <li>• Reading Materials:               <ul style="list-style-type: none"> <li>○ Brief Comparison – UK Healthcare System vs. US Healthcare System. <a href="http://www.healthcareadministration.com/brief-comparison-uk-healthcare-system-vs-u-s-healthcare-system/">http://www.healthcareadministration.com/brief-comparison-uk-healthcare-system-vs-u-s-healthcare-system/</a></li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Chapter 2 of: Health Professions Education: A Bridge to Quality. Download from NIH's NCBI: <a href="https://www.ncbi.nlm.nih.gov/books/NBK221522/">https://www.ncbi.nlm.nih.gov/books/NBK221522/</a></li> <li>○ McIntyre A, Song Z. The US Affordable Care Act: Reflections and directions at the close of a decade. PLoS Med. 2019;16(2):e1002752. Published 2019 Feb 26. doi:10.1371/journal.pmed.1002752</li> </ul>
Thursday 10 Sept	<ul style="list-style-type: none"> <li>• The Future of Health: Digital Health Transformations.</li> <li>• Reading Materials: <ul style="list-style-type: none"> <li>○ Sumi Helal and Ramesh Jain, "Introduction to the Special Issue of IEEE Computer on Digital Health: Active and Healthy Living," IEEE Computer, November 2019.</li> <li>○ WHO Guideline: recommendations on digital interventions for health system strengthening. World Health Organization.</li> </ul> </li> </ul>
Tuesday 15 Sept	<ul style="list-style-type: none"> <li>• Case Studies: The Liverpool-Phillips COPD Connected Health Trial</li> <li>• The Stanford-Apple Smartwatch Atrial Fibrillation Trial</li> <li>• Reading Materials: <ul style="list-style-type: none"> <li>○ Chatwin M, Hawkins G, Panicchia L, et al. Randomised crossover trial of telemonitoring in chronic respiratory patients (TeleCRAFT trial). Thorax. 2016;71(4):305-311. doi:10.1136/thoraxjnl-2015-207045</li> <li>○ Large-Scale Assessment of a Smartwatch to Identify Atrial Fibrillation. New England Journal of Medicine, 2019;381:1909-17. DOI: 10.1056/NEJMoa1901183</li> </ul> </li> </ul>
Thursday 17 Sept	<ul style="list-style-type: none"> <li>• Group Research Projects Handout</li> <li>• Discussion, planning and getting organized with Slack</li> </ul>
<b>PART 2</b>	<b>Digital Health Technologies</b>
Tuesday 22 Sept	<ul style="list-style-type: none"> <li>• Health Wearables and IoT</li> <li>• Reading Materials: <ul style="list-style-type: none"> <li>○ W. Lindquist, A. Helal, A. Khaled and W. Hutchinson, "IoTility: Architectural Requirements for Enabling Health IoT Ecosystems," IEEE Transactions on Emerging Topics in Computing. Special issue on New Frontiers in Computing for Next-Generation Healthcare Systems. (IEEE Xplore).</li> <li>○ W. Lindquist and S. Helal, "Requirements and Evaluation of High IoTility Health Device Ecosystem," Under review in the ACM Transaction on Computing and Health. Will be provided in confidence by Professor Helal.</li> <li>○ A. Khaled, W. Lindquist, and A. Helal, "Demo Abstract: DIY Health IoT Apps," In Proceedings of the 18th ACM Sensor Systems Conference (SenSys), Shenzhen, China, November 4-7, 2018.</li> <li>○ IEEE P11073-10427/D2, January 2016. Health informatics—Personal health device communication. Part 10427: Device Specialization—Monitoring Power Status of Personal Health Devices</li> </ul> </li> </ul>
Thursday 24 Sept	<ul style="list-style-type: none"> <li>• Health Wearables and IoT (Cont'd)</li> </ul>
Tuesday 29 Sept	<ul style="list-style-type: none"> <li>• Health Wearables and IoT (Cont'd)</li> </ul>

Thursday 1 Oct	<ul style="list-style-type: none"> <li>• <b>Exam 1</b></li> </ul>
Tuesday 6 Oct	<ul style="list-style-type: none"> <li>• Smart Homes</li> <li>• Case Study: The Gator Tech Smart House - An Assistive Environment for Active and Healthy Aging</li> <li>• Next Generation Smart Homes: Smart-Ready Homes and Digital Plumbing</li> <li>• Co-designing Assistive Technology and Environments</li> <li>• Reading Materials: <ul style="list-style-type: none"> <li>○ A. Helal, W. Mann, H. Zabadani, J. King, Y. Kaddoura, and E. Jansen, "The Gator Tech Smart House: A Programmable Pervasive Space," cover feature, Computer, vol. 38, no. 3, Mar 2005, pp. 64–74</li> <li>○ A. Helal, C. Chen, R. Bose, E. Kim and C. Lee "<a href="#">Towards an Ecosystem for Developing and Programming Assistive Environments</a>," Proceedings of the IEEE, Vol. 100, No. 8, pp. 2489 – 2504, August 2012.</li> <li>○ A. Helal and C. Bull, "From Smart Homes to Smart-ready Homes and Communities," special issue on Technology and Dementia, in the Dementia and Geriatric Cognitive Disorders journal, Karger, Volume 47, pp157-163, DOI: 10.1159/000497803, June 2019.</li> <li>○ WHO Housing and Health Guidelines. World Health Organization. <a href="https://www.who.int/publications/i/item/who-housing-and-health-guidelines">https://www.who.int/publications/i/item/who-housing-and-health-guidelines</a></li> </ul> </li> </ul>
Thursday 8 Oct	<ul style="list-style-type: none"> <li>• Smart Homes (Cont'd)</li> </ul>
Tuesday 13 Oct	<ul style="list-style-type: none"> <li>• Mobile Health (mHealth)</li> <li>• The AWARE Framework</li> <li>• Reading Materials: <ul style="list-style-type: none"> <li>○ Steinhubl SR, Muse ED, Topol EJ. The emerging field of mobile health. Sci Transl Med. 2015;7(283):283rv3. doi:10.1126/scitranslmed.aaa3487</li> <li>○ The AWARE Framework Web site: <a href="https://awareframework.com/">https://awareframework.com/</a></li> </ul> </li> </ul>
Thursday 15 Oct	<ul style="list-style-type: none"> <li>• Mobile Health (mHealth) (Cont'd)</li> </ul>
<b>PART 3</b>	<b>Personal Health &amp; Health Navigation</b>
Tuesday 20 Oct	<ul style="list-style-type: none"> <li>• Group Research Project due (60 minutes before class starts).</li> <li>• Group Hands-on Project Handout (no discussion)</li> <li>• Group Research Project Brief Presentations</li> </ul>
Thursday 22 Oct	<ul style="list-style-type: none"> <li>• Group Research Project Brief Presentations (Cont'd)</li> <li>• Group Hands-on Project discussion</li> <li>• Getting organized with Slack</li> </ul>
Tuesday 27 Oct	<ul style="list-style-type: none"> <li>• Overview on Personal Health and Health Navigation</li> </ul>

	<ul style="list-style-type: none"> <li>• Reading Materials: <ul style="list-style-type: none"> <li>• N. Nag and R. Jain, "A Navigational Approach to Health: Actionable Guidance for Improved Quality of Life," in Computer, vol. 52, no. 4, pp. 12-20, April 2019, doi: 10.1109/MC.2018.2883280.</li> </ul> </li> </ul>
Thursday 29 Oct	<ul style="list-style-type: none"> <li>• Personal Health Informatics <ul style="list-style-type: none"> <li>○ Digital Health Biomarkers</li> <li>○ Digital Behavioral Biomarkers</li> <li>○ Sentience Abstractions: Events, Activities, Behavior, Phenomena, Episodes, among others.</li> <li>○ Managing Informatic uncertainty</li> </ul> </li> <li>• Reading Materials: <ul style="list-style-type: none"> <li>○ E. Kim, A. Helal and D. Cook, "Human Activity Recognition and Pattern Discovery," IEEE Pervasive Computing, Oct–Dec 2009.</li> <li>○ D. Cook, "Making Sense of Sensor Data" in IEEE Pervasive Computing, vol. 6, no. 02, pp. 105-108, 2007. doi: 10.1109/MPRV.2007.37 (IEEE Xplore)</li> <li>○ E. Kim, A. Helal, C. Nugent, and M. Beattie, "Analyzing Activity Recognition Uncertainties in Smart Home Environments," ACM Transactions on Intelligent Systems and Technology, vol. 6, no. 4, 2015.</li> <li>○ M. Thai, R. Bose, R. Tiwari, and A. Helal, "On Detection and Tracking of Variant Phenomena Clouds," ACM Transactions on Sensor Networks, vol. 10, no. 2, 2014.</li> <li>○ E. Kim and A. Helal, "Knowledge-Assisted Activity Modeling and Recognition," International Journal of E-Health and Medical Communications, vol. 3, no. 3, Nov. 2012, pp. 54-71; DOI 10.4018/jehmc.2012070105.</li> </ul> </li> </ul>
Tuesday 3 Nov	<ul style="list-style-type: none"> <li>• Personal Health Informatics (Cont'd)</li> </ul>
Thursday 5 Nov	<ul style="list-style-type: none"> <li>• Personal Health Cybernetics <ul style="list-style-type: none"> <li>○ Human in the loop digital health</li> <li>○ Human (soft) actuation</li> <li>○ Models for Engagement, empowerment and persuasion</li> <li>○ Behavior change and alteration</li> <li>○ Social (domestic) robots as last few feet technology channel</li> </ul> </li> <li>• Reading Materials: <ul style="list-style-type: none"> <li>○ E. Wilson, A. Helal, C. Bull and M. Honary, "Persuasive Health: Back to the Future," In Proceedings of 13 EAI International Conference on Pervasive Computing Technologies for Healthcare (Pervasive Health), Trento, Italy, 2019.</li> <li>○ D. Lee, A. Helal, and B. Johnson, "An Action-Based Behavior Model for Persuasive Telehealth," Proceedings of the 8th International Conference on Smart Homes and Health Telematics (ICOST), 2010.</li> <li>○ A. D'Aloia, M. Lelli, D. Lee, A. Helal, and P. Bellavista, "Cicero: Middleware for Developing Persuasive Mobile Applications," in Proceedings of the 11th International Conference on Persuasive Technologies, Salzburg, Austria, 2016.</li> <li>○ D. Lee, A. Helal, S. Anton, S. De Deugd, and A. Smith, "Participatory and Persuasive Tele-Health," The International Journal of Experimental, Clinical, Behavioral, Regenerative and Technological Gerontology, vol. 58, no. 3, 2012, pp. 269-281; DOI 10.1159/000329892.</li> <li>○ D. Lee, A. Helal, Y. Sung, and S. Anton, "Situation-Based Assess Tree for User Behavior Assessment in Persuasive Telehealth," IEEE Transactions on Human-Machine Systems, vol. 45, no. 5, 2015, pp. 624-634.</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Duckki Lee, Sumi Helal, Tatsuya Yamazaki, “Robotic Companions for Smart Space Interactions,” IEEE Pervasive Computing, Apr–June 2009.</li> </ul>
Tuesday 10 Nov	<ul style="list-style-type: none"> <li>• Personal Health Cybernetics (Cont’d)</li> </ul>
Thursday 12 Nov	<ul style="list-style-type: none"> <li>• Project Support Session (Zoom and Slack for individual groups)</li> </ul>
Tuesday 17 Nov	<ul style="list-style-type: none"> <li>• Project Support Session (Zoom and Slack for individual groups)</li> </ul>
Thursday 19 Nov	<ul style="list-style-type: none"> <li>• Projects due (60 minutes before class starts)</li> <li>• Final Project Presentations</li> </ul>
Tuesday 24 Nov	<ul style="list-style-type: none"> <li>• Final Project Presentations</li> </ul>
Tuesday 1 Dec	Review Session for Exam II
Thursday 3 Dec	<b>EXAM II</b>
Tuesday 8 Dec	Course assessment review & tips to developing your Digital Health CV

## Grading Policies

<b>Exams</b>	40% (20% each)
<b>Quizzes</b>	10%
<b>Group Research Project</b>	20%
<b>Group Hands-on Project</b>	30%

Please note:

- Absence from Exams or missing due dates of assignments will be accommodated only if they are due to sickness (a letter from the infirmary will be required). Job interviews or attending events will NOT be accepted excuses.
- Late submissions of assignments will get penalized 10% for the first 24 hours, additional 15% penalty for the second 24 hours, and will receive no credit if submitted any later.

## Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

## **University Honesty Policy**

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.