Creative Technology, University of Twente
Module 8: 201400436 Data: from the Source to the Senses

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--- April 2016 ---

Contents

A. General module description

A.1 Lecturers

Name	Topic	Mail	Acronym
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Angelika Mader	Hybrid Worlds	a.h.mader@utwente.nl	HW
Yuri Engelhardt	Data Visualisation	yuri.engelhardt@gmail.com	DV
Robin Aly	Data-Driven Applications	r.aly@utwente.nl	DDA
Boudewijn Haverkort Anna Sperotto	Internet Technology	b.r.h.m.haverkort@utwente.nl a.sperotto@utwente.nl	IT
Erik Faber Oresti Banos	Biosignals & Medical Electronics	e.j.faber@utwente.nl o.banoslegran@utwente.nl	BME
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A.2 General concepts & overall structure

Module 8 in the Creative Technology curriculum is the last joint component in the BSc program. It starts and finishes with a project ("Hybrid Worlds"; 5 EC) in which students work, in groups of 10 to 15, on an installation that brings together the physical world with the digital world. The idea is that in that project, data, in the broadest possible sense, is being used and processed, interactively or not, after having been brought together from various sources, finally is presented physically and interactively to a variety of senses (of an audience). In the project, students use all they have learned throughout the Create curriculum so far.

The project starts on the first day of the Quarter 2.4 (Monday, April 18), for one day per week, but is expanded to two full weeks later in the quarter (June 13—June 24).

To support the work in the project, the module also provides three other obligatory components, and one "2-out-of-1 component":

- *Data-Driven Applications* (DDA) on Tuesday;
- *Data Visualization* (DV) on Tuesday and on Wednesday;
- *Internet Technology* (IT) on Thursday;
- and the "1-out-of-2 choice":

- *Biosignals and Medical Electronics* (BME) (for Smart Technology),
- *Animated Narration* (AN) (for New Media), both on Friday.

These components, with different lecturers, all run in parallel and relatively independently, although they do have “cross assignments”. Each of these components has a volume of 2.5 EC. The Hybrid Worlds project has a volume of 5 EC, yielding a total of 15 EC.

In Section B, C and D below, we give more details of the individual components. For each component, the general topic, the learning goals, the (rough) quarter plan as well as the grading scheme is given. The overall module grade is obtained as weighted average of the component grades (with as relative weights the corresponding number of EC’s). At most one component grade may be a 5. Each of the components on Tuesday through Friday, that is, DV, DDA, IT, BME or IV, will have a final test (in week 8 in the quarter; week 24 in the year), with a retake 3 weeks later (week 27), on the same week-day as the lectures are normally scheduled.

On Blackboard, we use the same structuring in components for the course material, etc.

B. Details of components

B.1 Hybrid Worlds

In the Hybrid Worlds project, knowledge and experience form the tracks New Media and Smart Technology get integrated in the design, implementation and actual building of an installation for Physical Data Visualization. Practically, an installation has to be developed containing phenomena from the physical and the virtual domain, acting either simultaneously or in alternation, where possibilities of interaction or interplay of both domains are explored. Conceptually, the integration is based on an analysis of meaningful complementation of phenomena in the two domains. The usual design process of Creative Technology guides the project work planning and documentation of the project.

The learning goals of the project are:

Realization:

- The students can construct a working installation that features physical visualisation of data, where significant elements from the courses Networks, Data Driven Applications, Data Visualisation, Smart Technology and New Media are integrated.
- The installation provides a meaningful insight, experience and a convincing goal w.r.t. its topic.

Organization:

- The students understand the design process of Creative Technology and use this to plan and organize their project.
- Students can effectively organize and manage work distribution and communication in a larger group.

Documentation:

- Students can document and present the project goal, the design process, the planning, the installation and their individual contributions to the project in a complete and structured way. They are able to justify the project ideas and evaluate the product with respect to related work and addressing meaningfulness within the context chosen.

Feedback:

- Students can improve their installation and documentation by using feedback from supervisors, lecturers of the courses and other students.
- Students can give critical and constructive feedback to other project groups.

Details of the project planning and timing can be found in the project manual of Hybrid Worlds, as provided via Blackboard.

B.2 Data-Driven Applications

The data drive applications theme teaches students the management of data and to build data-driven applications. The main aim of this course is to provide knowledge on how to design, access and use data in a structured, effective and efficient way. The objective is to teach students the following basic topics: (1) **data modeling** using Entity Relationship models and their translation into database schemas. (2) **data retrieval** using the Structured Query Language (SQL). (3) **building data-driven applications** by displaying, sharing and accessing data via web applications and web services. Additional to the theoretical part, the theme also offers a workshop exposing the students to more practical aspects of data-driven applications: including loading data into a database and building web applications.

After completion of this thematic theme, the students:

- understand the fundamental concepts of data management,
- can create models for data with a low to medium complexity,
- can formulate SQL queries to retrieve and manipulate data,
- can use SQL in an web application programming language, and
- can create web services that store and retrieve data from databases.

Achieving these learning goals will enable the students to manage data within the module's Hybrid world project.

There will be **one homework assignment**, with deadline announced during the first lecture, and **one exam**:

Grades

- Let H be the (unrounded) grades for the homework assignment (1-10 scale).
- Let E be the unrounded exam grade (1-10 scale).
- The overall grade then equals $G_{DDA} = (H + 2E)/3$, that is the exam weighs 66% and the homework weighs 33%.

B.3 Data Visualization

In recent years there has been an explosion in the attention for “data visualization”, “information visualization” and “information graphics” (which are all related). To get an impression of the diversity of such visual representations of data, browse for example the large collection of examples that can be found at http://infosthetics.com/. In this course we will work on learning both **conceptual** and **practical skills** related to **(any kind of) useful visualization of (any kind of) data**. We will learn about principles of visual encoding, about the wide spectrum of different types of visualization, and about what makes a data visualization good or bad. We will learn skills for the critical analysis of data visualizations, for the generation of data visualization ideas, for the conceptual development of data visualizations, and for the actual making of data visualizations.

After successfully completing this track, students can:

- apply and discuss a broad range of concepts and principles related to representing data visually.
- critically analyze data visualizations regarding a range of aspects, and suggest improvements / design alternatives.
- develop creative and useful conceptual solutions for data visualization problems.
- successfully create good data visualizations with several different tools.

Information about the week-by-week planning, the assignments, and the grading will be added soon, both here and on Blackboard.

B.4 Internet Technology

Modern communication systems are centered around concepts developed over the last 50 years, primarily in the context of the Internet. The course addresses the basic principles of modern networks systems, thereby addressing both the general principles, and their concrete application in the Internet. The course follows a top-down approach, in that, starting from the overall **network architecture**, principles of the well-known (and widely used) **application protocols** are discussed, before diving deeper in the network technology. Subsequently, the notion of **end-to-end transport protocols**, **host-to-host network protocols** and **link-layer access protocols** (both for wired and wireless networks) are addressed. Finally, practical examples of Internet Technologies in practice are given (e.g. Internet of Things and Security). The course uses the textbook by Kurose & Ross.

After successfully completing this track, students:

- Understand the basic principles of layered network architectures, with application to the internet.
- Understand the principles of application-level protocols (such as DNS and HTTP) as well as multimedia (streaming) protocols.
- Understand the basic principles of transport protocols like TCP and UDP.
- Understand the basis of routing and addressing in the internet (IP).
- Understand the basic principles of media access control and addressing at the data-link layer, for both wired and wireless networks.
- Have basic knowledge of internet security issues and internet-of-things.

The track consists of 6 lectures + 6 tutorials (partly in an intermixed form) and a homework assignment using Wireshark (for which an online manual will be made available). We do envisage to have one or two invited lectures as well (next to those listed below) on important networking topics, such as security and (user-) mobility.

Date	Hour	Format	Topic	Lecturer
April 21	3+4 6+7	Lecture + Tutorial	Chapter 1 and 2	Boudewijn Haverkort T: Mitra Baratchi/Ricardo Schmidt
April 28	3+4 6+7	Lecture + Tutorial	Chapter 2 Chapter 7.1-2	Anna Sperotto T: Mitra Baratchi/Ricardo Schmidt
May 5	--	--	--	--

May 12	3+4 6+7	Lecture + Tutorial	Chapter 3	Boudewijn Haverkort T: Mitra Baratchi/Ricardo Schmidt
May 19	3+4 6+7	Lecture + Tutorial	Chapter 4	Anna Sperotto T: Mitra Baratchi/Ricardo Schmidt
May 26	3+4 6+7	Lecture + Tutorial	Chapter 5 and 6	Anna Sperotto T: Mitra Baratchi/Ricardo Schmidt
June 2	3+4 6	Lecture Guest lecture	Slides Security	Boudewijn Haverkort Roland van Rijswijk-Deij (SURFnet)
June 9	1+2	Written exam		
June 30	1+2	Retake exam		

There will be one **homework assignment**, which will be hand-out no later than in week 2, with hand-in deadline May 19, noon.

Grades

- Let *H* be the (unrounded) grade for the homework assignments H1 (on the usual 1-10 scale).
- Let *E* be the unrounded exam grade (on the usual 1-10 scale).
- The overall grade the equals $G_{IT} = (H + 4E)/5$, that is, the exam has weight 80%, the homework weight 20%.

B.5A Smart Technology: Biosignals and Medical Electronics

Electrophysiological measurements are nowadays at the reach of every layman at home. Heart rate, glucose, temperature, position (accelerometer), skin conductivity, muscular electrical activities (EMG) are examples of physiological quantities that can easily be determined since measurement techniques and tools have become cheaper, smaller, less invasive and can be embedded more than ever into commonplace electronic equipment and gadgets. The deepening part of Smart Technology will provide the students an introduction into this world of electrophysiological measurements and their analysis. It will treat:

- The origin of electrophysiological signals (action potentials)
- How to measure electrophysiological signals (e.g., EMG, ECG, EEG) and how to deal with noise in electrophysiological environments
- How to design, specify and implement amplifiers for a proper measurement and observation of electrophysiological signals.
- Preprocessing mechanisms for the conditioning of the electrophysiological signals and their analysis in both time and frequency domain
- Mining techniques for the generation of more meaningful and human-interpretable data from regular electrophysiological signals
- Ethical and safety issues concerning electrophysiological measurements
- Practical processing and analysis of signals from electrophysiological (EMG, ECG) measurements using MATLAB

After this course students

- understand the nature and properties of signals and noise (sources) in electrophysiological measurement environments;
- can determine the demands of and develop measurement amplifiers (using OpAmps), subsequent signal conditioning and data analysis needed to obtain proper electrophysiological measurements;
- get familiarized with common signal processing and data mining techniques to adequate and analyze electrophysiological measurements;
- gain practical experience in performing ECG and EMG measurements and know how to process and analyze the obtained data using MATLAB;
- acquire inspirational ideas for the elaboration of novel solutions and products based on electrophysiological monitoring.

This component of the module consists of 6 lectures + 5 tutorials + 2 lab sessions.

Deliverables:

B&ME students are expected to include the knowledge and experience gained in this course during the development of the Hybrid Worlds (HW) project. Therefore, a report will be required covering the engineering, design and practical aspects regarding the biosensing devices and methods used in the HW installation.

There are three main **tutorial sessions**:

T1: tutorial session (to be performed in groups of two) on Introduction to MATLAB on the 29th of April, 2016. Students write a tutorial report (digitally) and deadline for handing in is on 13th of May, 2016.

T2: tutorial session (to be performed in groups of two) on biosignal processing using MATLAB on the 13th of May, 2016. Students write a lab report (digitally) and deadline for handing in is on 20th of May, 2016.

T3: tutorial session (to be performed in groups of two) on biodata analysis using MATLAB on the 20th of May, 2016. Students write a lab report (digitally) and deadline for handing in is on 27th of May, 2016.

There are two **laboratory sessions**:

L1: laboratory session (to be performed in groups of two) on Electrocardiogram (ECG) measurements on the 13th of May, 2016. Students write a lab report (digitally) and deadline for handing in is on 20th of May, 2016.

L2: laboratory session (to be performed in groups of two) on Electromyogram (EMG) measurements on the 20th of May, 2016. Students write a lab report (digitally) and deadline for handing in is on 27th of May, 2016.

There will be one **written exam.**

Grades

- Let L_1 and L_2 be the (unrounded) grades for the laboratory reports L1 and L2 (on the usual 1-10 scale), and $L = (L_1 + L_2)/2$ be the mean lab grade.
- Let E be the unrounded exam grade (on the usual 1-10 scale).
- The overall grade equals $G_{BME} = (3.5L + 6.5E)/10$, that is, the lab sessions have weight 35% and the exam has weight 65%.
- The B&ME report subpart of the HW project will be evaluated with a pass/fail grade.
- There will be a total bonus of 0.5 points adding to the final grade. The bonus can be obtained for the tutorial reports (optional).

B.5B New Media: Animated Narration

For the new media course of 'Animated Narration', the student will present a topic which he/she will conduct a research from related sources for factual data. The visuals and narrative need to collaborate in an efficient way to convey the message clearly to be understood by the intended audience. The end product will be an animation of between one to five minutes. The acquired knowledge and trained skills from these eight weeks can be applied in other courses of this module.

This course 'Animated Narration' consist of…
1. you,
2. your topic,
3. your fellow students, and
4. your instructor [me].

The way you work consist of three phases…
1. deciding on the topic by comparing ten different proposals,
2. working on two different scripts for the topic you have decided on, and
3. making the animation.

The way you work in more detail...
1. ten different short scripts will be written down in one, two, or maximum, three sentences,
2. two different storyboards will be drawn with pen on paper, and
3. one animation executed in a technique or software of your preference.

The work that will be delivered...
1. ten short scripts on Friday April 29,
2. two storyboards on Friday May 20, and
3. final animation on Friday June 10.

The final animation will…
1. be between one to (maximum) five minutes,
2. use factual data from sources related to your topic,
3. inform, educate, entertain, enrich, and/or enlighten your audience,
4. make sense in its own way,
5. be understood by its audience,
6. delivered to the instructor –through a usb stick/WeTransfer–, and
7. hand over by the instructor to the vaults of the university.

The course will give the students…
1. an improved skill for generating various answers to a given problem
2. a better insight for constructing successful stories, and
3. a deeper understanding in the function of ingredients such as: imagery, language and sound.

The final animation will consist of…
1. imagery: made by the student,

2. language: spoken and/or written(optional), and
3. sound: such as voices, music, and foley

The course is conducted in the following manner…
1. you will either work independently or within a team that consist of maximum two students,
2. every week, you will report and discuss your process, and
3. every week, you will attend a short lecture on various aspects.

The weekly lecture consist of…
1. some short animations that are worth viewing,
2. various aspects of storytelling, communication and their theories, and
3. literature on the topics discussed.

The course's routine is as follows…
1. the instructor will be available from 8:45 till the last project is discussed,
2. the student has to report and discuss the weekly progress of his/her or their project,
3. the student is welcome at 8:45, but can choose for another moment of the day as well,
4. the student can leave the classroom when his/her or their project has been discussed,
5. the student is welcome to stay and work on, and
6. the student has to attend the lecture, which starts at 10:45.

The overall grade is build up by…
1. the research (R) conducted by the student or the team,
2. the arrangement (A) of the used ingredients such as imagery, language and sounds, and
3. the structure of the narration (N), resulting in
4. the effect of the animated narration (AN). Concluding in the overall grade of AN = (R+A+N)/3.

The course has a mandatory attendance…
1. for the weekly meeting to discuss the progress of his/her or their project, and
2. for the lecture.

Any absence is only permitted…
1. in case of sick and kept to bed,
2. in case of a funeral of a dear one, and
3. in case of your own marriage.

In case one of the above described situations occurs…
1. you have to contact me by email before the start of the to-be-missed lecture
2. you have to get information from fellow classmates on the topics discussed in the missed lecture, and
3. you have to try to catch up the delay for the next presentation.

Finally…
1. I look forward to assist you with the work you would like to make.
And...
2. in case something is not clear, please ask me, and
3. in case of a question or an emergency, please contact me at:

B.6: Portfolio Course

At the end of the Portfolio course of module 8 the student:

1. is able to reflect critically on his/her own developing process as a creative technologist,
2. takes responsibility for his/her own learning process by carrying out special activities that are related to personal ambitions as a creative technologist
3. has an updated professional portfolio website with information about his competences and about products developed inside and outside the CreaTe programme
4. has developed specific ideas about the coolness of his/her own products/designs

For Wednesday afternoon, June 3, the tutors will invite their tutor groups to discuss the coolness of product/designs in their portfolio.

Date	**Hour**	**Format**	**Topic**	
June 3rd	6-9	Tutor group meeting	Coolness	

B.7 Guest Speakers

During the module, we offer the students a set of guest lectures, summarized in the table below.

Thematic component	**Date**	**Speaker**	**Topic**
Hybrid Worlds	April 18, 2016	Yvonne Jansen (University of Kopenhagen)	Talk and Workshop Physical Data Visualization
Data Visualization	April 19, 2016	Nadieh Bremer	Visual Storytelling with Data https://www.utwente.nl/designlab/events/!/2016/4/502414/visual-storytelling-with-data
Biosignals and Medical Electronics	April 22, 2016	Matthijs Noordzij (UT)	Ethics in Electrophysiological Measurement
Hybrid Worlds	April 25, 2016	Christo Zonnev (InterOne)	Ways of Working in a Creative Technology Company
Animated Narration	May 17, 2016	Thomas Clever/Gert Franke https://www.cleverfranke.com	Data driven experiences
Biosignals and Medical Electronics	May 27, 2016	Peter Gloesekoetter (University of Applied Sciences Muenster)	Body-based Energy Harvesting
Internet Technology	June 2, 2016	Roland van Rijswijk-Deij (SURFnet and UT)	Network Security
Hybrid Worlds	June 6, 2016	Johnny Soraker (UT)	Reflection
Data Driven Applications	TBA	Maurice van Keulen (UT)	Data Integration

C. Evaluation plan

This module will be evaluated in the following ways:

- The CreaTe Evaluation Committee (CREEC) will organize twice times a panel discussion with a group of participating students and lecturers in this module. Two evaluations will be done *during* the module, and a final one after the module has finished. Topics to be investigated include:
    - The student experience of the module as a whole;
    - The workload experienced by the students, for the module as a whole, and for the components of the module;
    - The integration and coherence of the module;
    - The overall organization of the module;
    - The information supply;
    - The study material.
- There will be a formal UT questionnaire at the end of the module. The module team does not have any influence on the questions to be asked.
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D. Literature

Most of the study material will be made available online, in the form of readers, manuals or articles. However, two books will be used as well:

- For Internet Technology:
  J.F. Kurose, K.W. Ross. *Computer Networking: A Top-Down Approach*.
  6th Edition, Pearson International Edition.
  ISBN-13: 978-0-273-76896-8, ISBN-10: 0-273-76896-4.

- For Biosignals and Medical Applications (Smart Technology track):
  N. Storey. *Electronics, A Systems Approach*.
  5th Edition, Pearson Education, Inc, 2013.
  ISBN-13: 978-0-273-773276, ISBN-10: 0-273-77327-5.

E. Overall grading

Each component has specific requirements with respect to homework, lab assignments, etc., as described in detail above (Section D). We have carefully planned the whole module such that every component, including its homework, can be done on the day assigned to that component. No specific bottlenecks are foreseen.

Each of the components on Tuesday through Friday will have an exam (test) in week 4.8, with a retake in week 4.11, on the same week-day as the lectures for that component are normally scheduled.

The overall module grade is obtained as weighted average of the component grades, as computed above, with as relative weights the corresponding number of EC's. Note that either the grade for IV or the grade for BME goes into this computation, depending on the choice of the student.

At most one component grade may lie in the interval [4.5 , 5.5), where "[" does include the value 4.5, and ")" does not include the value 5.5; if rounded, such a grade would be "5". All other component grades have to be larger than 5.5, that is, if rounded, these would be "6" or higher.

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