Data Driven Product and Service Design (com5961)

With the continuous development of the Internet to meet the growth of smart cities and the upcoming 4th industrial revolution, Internet of Things, Cloud Computing, Artificial Intelligence, Blockchain, and Big Data are increasingly being integrated into the fabric of our works and lives alongside mobile and social media. These technologies pose challenges to industries and organisations to adapt and to transform. The purpose of this class is to provide a framework for students to understand the context of this development, so they can equip themselves with required skills to prepare for a career in the field.

As smart, connected, and data driven products and services become more prevalent in this coming decade, knowing the sources of data and how to acquire them programmatically for further cleaning, filtering, aggregation, modelling, evaluation, visualisation, and on-demand interaction will become increasingly important. The class places heavy emphasis on mastering the basic user research, design and data skills for developing new media products and services that are both user and data centric.

Expected Learning Outcome

After taking the course, students will be able to:

1. Use **Design Thinking and Computational Thinking** constructs to frame and solve problems related to user experience embedded in new media products and services.
2. Tell story with infographics and data visualisation to enrich user experience.
3. Understand basic visual communication, encoding and **HCI** principles and how that affect human-computer interactions throughout the user journey.
4. Master the fundamentals of web development with basic knowledge about **HTML**, **CSS**, **JavaScript**, **and SQL**
5. Use digital tools to acquire, filter, clean, transform, and visualise data in the context of web application development.
6. Leverage **API**, **IoT, Open Data**, **web scraping, and SQL database** to develop web applications.
7. Integrate front-end web development with back-end database using **JSON** as the data transfer vehicle.
8. Use dashboard design to present **Key Performance Index** for building decision making intensive applications.
9. Apply **Google Analytics**, **Google Tag Manager**, **Google Optimize** and **UTM** coding to conduct **A/B test** and **conversion analysis** to validate web design and user engagement.
10. Consolidate learning through building a **data driven web app projec**t **with analytics tracking and dashboard display**.

Contact Information

Teacher 's Name	Prof. Bernard Suen
Email:	bernard@cuhk.edu.hk
Teaching Time & Venue:	Monday 6:30 to 9:30pm

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One Day Pre-Class Workshop on HTML, CSS, and JavaScript

1. Introduction to **HTML** and **CSS** (6 hrs)
   a. A grammar analogy on **HTML** (noun), **CSS** (adjective), and **JavaScript** (verb)
   b. Deconstruct the **DOM** (Document Object Model) architecture and the **Box Model** of a **HTML** element and its attributes using the browser console.
   c. **HTML5** Layout (header, nav, aside, section, article, and footer)
   d. Positioning of the element box (static, relative, and absolute) and the use of float and clear properties for positioning elements within the layout.
   e. Understanding style specification (inline, internal, or external)
2. Introduction to **Git** (2 hrs)
   a. Signup with **Git** and installation of **GitHub** Desktop
   b. Git repository initialisation and updates

Module 1 - Perspectives for Developing Connected Products and Services

1. Overview of the "**Smart City**" and "**Industry 4.0**" landscape and growing proliferation of smart connected products and services.
2. Familiarise students with design thinking and computational thinking concepts for effective problem discovery and resolution
3. Learn to perform journey mapping and data mapping
4. Jesse James Garrett's "Elements of User Experience" as the guideline for **UX/ UI** design.
5. Product development with minimum viable product (**MVP**)
6. Demonstration of previous student projects to prepare existing students for what should be expected from them as learning outcome.

Module 2 - Database Management as a Cloud Service

1. Introduction to the **MVC** (model, view, controller) model of web development in a **3-tier architecture** (front-end client tier, app server tier, and database server tier)
2. Introduction to **Airtable** as a cloud database for managing data tables and views.
3. Setting up a free **AirTable** account.
4. Creating **Airtable** tables, views, teams, and forms.
5. Embedding **Airtable** views and forms inside web pages.

Module 3 - Information Architecture, SEO/SEM, and Content Management System

1. Information Architecture (**IA**) for data classification, labelling, navigation, and search design
2. What are **SEO** (Search Engine Optimisation) and **SEM** (Search Engine Marketing)?
3. **IA** and **SEO**
4. What is a **CMS** (Content Management System)? What does **IA** (information architecture) have to do with **CMS**?
5. Introduction to **Airtable** as a **CMS**

Module 4 - Tools Used in the Data Visualisation Cycle

1. The CRISP-DM (Cross-Industry Standard Process for Data Mining) cycle
2. Sources of Data in a Big Data world: **Open Data**, **IoT**, social media/web **API** and Scraping
   a. What is **XML/JSON**?
   b. **Open Data** and **IoT**
   c. Web scrapping with **ParseHub**
   d. **CSV**, **XML** and **JSON** converters
3. Data cleanup with **OpenRefine**
4. Storing pre-processed data into **Airtable**
5. Data aggregation through **Airtable**
6. Data visualization demonstration in **Datawrapper**

Module 5 - DOM Manipulation in JavaScript and JQuery

1. Apply **Computational Thinking** concepts in computer programming.
2. Learn JavaScript commands (e.g. **XMLHttpRequest**, **getElementById**, **getElementByClassName**, **addEventListener**, i**nnerHTML**) for **HTML DOM and CSS** manipulation.
3. Effective **HTML/CSS/JavaScript** for form processing and validation.
4. Develop **JQuery** and JavaScript event triggers and handlers for building engaging user interface.
5. Class demonstration of JavaScript/JQuery visual effects for improving UX/ UI.

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Module 6 - Essentials of Data Visualisation Design

1. Basic Chart types, UI components and their use
2. Psychology principles for visualisation (e.g. Affordance, selective attention, memory load, contextual cues, visual hierarchy, and mental models)
3. Low-fidelity wire-frame prototype using paper prototype.
4. High-fidelity interactive prototype using **Figma**
5. Demonstration of a **JQuery** Data Table presentation based on a **Airtable** API/JSON data set.

Module 7 - Decision Making Approach to Dashboard Design

1. Understand the concept of KPI (key performance indicator) and the decision support context of content and data.
2. Choosing the right visualization object for the tasks.
3. Dashboard layout principles.
4. **Airtable** data rollup into a consolidated table for **API/JSON** data export and **jQuery** getJSON data import
5. **C3.js** integration with **Airtable** roll-up demonstration and assignment.

Module 8 - Responsive Web Design

1. Responsive web design through media queries, proportional layouts, and adaptive images.
2. Introduction to the **Bootstrap** library for responsive web app development.
3. High/low fidelity prototypes for responsive app development.
4. Revisit the MVC framework using **Airtable** and **Bootstrap** as integrated solution for MVC implementation.
5. Brief students on conducting user research for the final project.

Module 9 - JavaScript Based Data Visualization Libraries

1. Overview of popular web development front-end and back-end languages, libraries, and frameworks.
2. Introduction to **LeafLetJS** with demonstration.
3. Demonstrate **TimelineJS**, **StorymapJS**, **JQuery DataTableJS**, **Leaflet**, and **C3JS** integration into a single **Bootstrap** application.
4. Geo-location data retrieved from **Airtable** through **JSON** as rendered in a **LeafLet** map object.
5. Add interaction to data visualisation for more in-depth exploration and analysis using JavaScript/jQuery codes.

Module	Topic

Week 11   Physical Data Acquisition and Interaction on the Cloud
- Physical Computing
- IoT and wearable
- Commercial applications: smart home, office, retail outlets, and public facilities

References:
1. [Michael Porter's Framework of Connected Products and Services](#)
2. [Introduction to Internet of Things](#)

Week 12   Architectural Challenges: Security, Robustness, and Scalability
- Private vs. Public Cloud
- Hybrid Model
- Short term vs. long term considerations

References:
1. [Protecting Information in the Cloud](#)
2. [From box to cloud: An approach for software development executives](#)

Week 13   Final presentation
1. Final presentation

Assessment

Class Works	Description	Weight
1) 10 problem sets that include both coding and multiple choice questions (open book without time limit).	Each problem set will be done in class during the workshop session and to be submitted at the beginning of the next class.	50%
2) Final project (individual)	A responsive web project demonstrating data driven UX/UI design principles.	50%

Learning Activities (Hours per Week)

Lecture	Interactive Tutorial	Discussion of Cases	Field Trip	Project	Web-based learning	Others
1.5 hr/week	1.5/week			1 Personal Project	5 hours/week	Field research on personal project