Data+Matter: Making Interactions

(formally known as "Interaction Engineering")

Goals

Our primary goal in the Data + Matter track in this masters is to provide students with the necessary tools to create, give form and function to interactive systems and prototypes that can be applied in their design process. This course focuses specifically in the interactive aspect of prototyping.

Furthermore we aim at stimulating a mentality of critical thinking about technology and develop a humane value system in the student's process that allows them to plan, create and build *consentful products* that are fun to experience and beautiful to behold.

Working methods

Each module is composed of a lecture on the central topic followed by an open discussion. Many of the topics will be rehearsed through hands-on workshops, followed by guided practice in the Codelab and tutorials supported by the teaching assistant.

Practice is the only way to get good at the more functional aspects of design, and Codelab is an opportunity to carry out guided practice with an experienced tutor and your fellow master candidates.

During lab ours those of you who would like to take the challenge we will carry a full product-cycle from beginning to end, from early sketches to a finished and functional tangible smart product. Learning happens on the go and is directly applied in this product.

It is impossible to cover even the basics of all the topics involved in the successful making of interactive products in a single year, this course offers a birds-eye view that focuses on fundamentals. We will not cover specific tools but rather the principles upon which these tools are built. It is up to you and to your self-study to get under the skin of topics and make work to push your skills further. Do not assume that just coming to class with automatically turn you into an expert. There is no substitute for actual experience.

Much of the learning that you will do during this academic year will come from your colleagues. The students of this masters are selected to form a diverse population with knowledge that spans different aspects of the product cycle, teams are assembled to be interdisciplinary. Do not expect to learn everything from your tutors, learn from those around you and be generous in teaching what you know.

Coaching

After the first Sprint, beginning on the 30th of September, I (Luis), will be available for coaching 4 hours per week. It is required that you book a coaching appointment with me. You can take this coaching individually or as a team, depending on what you are working on. Coaching sessions will be advertised in Brightspace and you have to book your slot through that same system.

Coaching will not take place during teaching Sprints (weeks of Sept 9th, Sept 16th, Sept 23rd and Oct 28th).

Guidelines to prepare for a coaching session: **be ready**, this means, bring the material you want to discuss prepared: sketches? photos or videos? please spare me the waste of time that it is to watch you fish for a lost image in your or another team member's hard-drive or a website whose URL you forgot and you have to Google for.

Interaction Lab

This course depends on a very tight feedback loop with the *Interaction Lab* run by **Marcus Graf**. This is where you will get to practice and exercise the chops you learn in class and practice with new tools. You have to think of the lab and this course as being two halves of the same package. The *Interaction Lab* functions as a first-stop expertise shop for your project. Any advice and materials you might need. The regular *Codelab* sessions where you can practice your code-fu will also take place in the lab.

The lab is a physical location in the building. **Marcus Graf** leads this lab and he should always be listened to in all matters pertaining to the lab, from schedule to materials, to ordering equipment for your projects, etc. The lab is there to support you in the development of physical and digital prototypes and can work as a testing ground for your ideas. As a shared space it requires shared responsibility and each week one or student is assigned to the lab as the responsible person. More on this during the first weeks.

At the end of the day the lab must always be:

- Clean and tidy
- All tools and equipment should be back where you found them
- All hot tools, unplugged and stowed away where they belong
- All projects that you do not intend to work on tomorrow, should be put in a box and stored away
- The only things allowed on the tables, walls and floors should be: clean empty space or projects that you will continue working on tomorrow morning. Everything else must be cleared.

The lab contains:

- Power tools like drills, saws, glue-guns, screwdrivers, hammers, etc.
- Traditional materials: wood, paper, cardboard, etc.
- Electronics workbench tools: soldering irons, multimeters.

- Electronic components: sensors, actuators, breadboards, microcontrollers, cables, etc.
- Digital media: Computers, VR-setups, etc.

The University has many more working spaces where to do specialized work, so if you need to do substantial wood-work, metal, electronics, robotics, plastics, laser-cutting, etc. You can use the other facilities that the University has available. From the Interaction Lab we can help you get in touch with these work spaces and book a working session there, you will also get an introduction to the Makerlab and the VR lab during the first semester.

Codelab

It is estimated that learning how to code takes a minimum of nine hours of practice per week. Less than that and your mind will not really have enough rehearsal time to integrate this skill. Learning takes practice, and practice is generally more productive and enjoyable when done together. Learning how others face challenges will also speed up your learning.

Codelab is a regular meeting where students, teachers and/or researchers explore a shared topic. Coming from the idea of a CoderDojo, these sessions function as a place and time to exercise your skills together with others. These sessions are initially hosted by Marcus and run in close collaboration with the Data and Matter sessions. Attendance to these sessions will greatly help improve your practical skills so it is strongly recommended that you attend.

At a later stage in the year, the topics to be explored will also depend on the input brought to the group by the students themselves, so if there's something you wish to explore a little deeper with others, bring your ideas to the Codelab. Codelab is also an essential part of the students' Self Directed Learning track.

It is expected that you participate in the *Codelab's* regularly.

Course Planning

See calendar on Brightspace for the specific scheduling of each session.

Sprint 1 - Screen-based interactions

Learning goals:
- Get familiar with code as a medium for sketching
- Understand and learn to design for the browser
- Understand the basics of time-based media using animation as a vehicle for learning
- Introduce students to the Javascript programming language
- Students will do a significant number of exercises to make sure that the basics are well exercised

Session 1 - Introduction & computational thinking

Syllabus hand-out, introduction to Data + Matter, material list, project box, learning resources and reading materials. Introduction to computational thinking.

Session 2 - The browser as a medium: understanding your canvas

Canvas, pixels, scanlines, colors, perception of color, etc.

Session 3 - From Zero to Javascript

Learn the ropes of Javascript, writing code in your browser, reading errors and getting a sense of this material.

Session 3 - Painting with code

Introduction to p5js as a canvas library, basic usage notions and some practical examples.

Codelab - Basic input methods

We will learn and exercise methods of input: keyboard, mouse, gestures.

Session 5 - Mastering animation

We will use p5js to animate a canvas scene. Tweening. Timelines. Keyframes. Penner curves and the math behind animating with code. Brief introduction to CSS animation. At the end of this session you will get a small challenge that you will have about 10 days to work on.

Codelab: Animation & DIWO work on the assignment

First guided session, where we will continue to apply animation techniques and work further on the assignment.

Session 6: Prototyping like a pro + Philips as study case

What is a prototype, steps for a successful prototype, fidelity, prototyping selectively. Prototyping interactions. Look at a Philips project study case from last year.

Session 7: Assignment review + Lecture: *Learnable Programming*

In *Learnable Programming* we will look at the history of interaction, the who is who of early work in interaction and why their work still matters.

Codelab: Oh my god it's full of stars!

In this session we will learn how to handle large amounts of data and turn them into large amounts of digital matter.

Codelab 3: Programming in human readable language

In this session we will explore on how to keep your code manageable through objects and functions. We will learn how to hide all that ugly code and how to work on the things we like the best.

Codelab 4: Let's make a game in a day

We will make a game in a day through playful exploration. We will let the digital material lead the way without starting with a specific concept. The goal is to bring together previous topics like drawing, animation, input, output to try to create an interactive system.

Sprint 2 - Interactive systems and designing devices

Learning goals:
- Introduce students to Arduino (and the C/C++ language used to program it)
- Create full interactive experiences from the screen to the physical world and back
- Understand and learn to design basic interactive systems with sensors and actuators
- Understand the basics of physical computing and apply this knowledge for the prototyping of physical interactive devices
- Experience physical prototyping and the manual labour required for digital physical products

Session 8 - Intro to interactive systems

Students will get familiar with the basics of microcontrollers and Serial communication, physical computing and writing basic programs.

Session 9 - Intro to sensors and actuators

Students will learn the basics of sensing through a capacitive sensing workshop. In a second session they will be introduced to different kinds of sensors and actuators and will have the chance to experiment with them in the dojo sessions.

Learn how to use and apply protocols like Serial, OSC and MQTT that help you stream data between different parts of an interactive system.

Learn how to read the sensors in your phone and use them as a tool for fast prototyping.

Other activities

After these two sprints you will have no more official Data + Matter sessions until next semester. But this doesn't mean that we are done. We just got started actually. Work will continue in the *Codelabs* and in the lab sessions.

You will get introductions to the Makerlab and the VR lab which are school facilities that are in other locations. You will have some tutorials in Unity as well, specifically oriented towards the creation of VR content. And you will have the opportunity to play around with some techniques such as photogrammetry and projection mapping.

Data + Matter project

In the first week of November we will start with the Data + Matter Project. You can think of this as an open-ended assignment where you will be asked to exercise various skills, including research, ethics and design methodologies and you will be asked to produce a work **starting in November**, **the deadline for this project will be in early May** and then we will work on a presentation for the first week of July. More details about this project will be revealed in the first week of November.

There will be a topic suggested but you will have substantial freedom to work on something you like.

Semester 2

In the second semester the Data + Matter track turns a little bit more reflective and will be composed mostly of lectures and workshops imparted by guest teachers. We will look at the technologies that we use everyday and their impact in our culture, the way we communicate and the way we learn and work. The idea behind these sessions is to break open a more reflective, critical and reflective attitude towards the media we adopt and create as digital designers, to give the student a survey of contemporary culture around digital media and a sense of having a "finger on the pulse". All sessions will be highly interactive with the teacher initiating the session with a seminar and opening to discussions and speculative exercises.

- ❏ Lecture 1 - VR and synthetic experience, past, present and future imaginaries
- ❏ Lecture 2 - Social Computing
- ❏ Lecture 3 - Neutrality and technopolitics

- ❏ Lecture 4 - Computing in the Anthropocene
- ❏ Lecture 5 - Data extractivism and sovereignty, origins and projections
- ❏ Lecture 6 - Machine Learning and Interaction: past, present and future

Grading & assessments

Within the *Data + Matter* track we will assess your progress based on a number of indicators. See Appendix B for a complete list of these indicators. **You must attain a level that is sufficient or higher in all indicators**. If you are deemed insufficient at one of the indicators, your entire assessment will be insufficient and you will have to go through a resit process.

Attendance to the classes in the MDD is mandatory. Continued unjustified absence will result in a fail.

You are entitled to receive formative feedback in writing at least once per semester. If your teacher does not provide you with formative feedback you may approach them asking for it. Formative feedback will provide you with written insights about how you are doing in the specific subject and what you can improve before the formal assessment comes.

Teaching Assistants

Dolinde van Beek and **Will Neeteson** will be our teaching assistants. They completed the Masters in Digital Design last year and they are the perfect support to lean on when you have questions about how to go about this program, where to get what you need and how to succeed in the courses.

They will also be supporting Marcus and Luis on specific tasks such as keeping the lab running smoothly, preparing materials for workshops and running follow-up tutorials on specific topics.

Self-learning

Self-learning is an important aspect of education today, the masters has an entire track devoted to the observation of self-learning. You are encouraged to pick on specific techniques, tools or topics from the *Data and Matter* paths to be part of your self-learning curriculum. Here are a few suggestions on learning materials to get you started:

> **Path 1: Creative coding using Processing.js**
> Books
> http://natureofcode.com/book/
>
> Daniel Shiffman's on of many great contributions to the Processing community. It is a great reference that teaches you programming while at the same time shows how to make cool things with code. Many of the principles laid out in this book are used across digital media of all breeds.

"Programming Interactivity: A Designer's Guide to Processing, Arduino, and openFrameworks", Joshua Noble

Online resources
http://learningprocessing.com/videos/
https://editor.p5js.org/
http://sketchpad.cc
https://www.openprocessing.org

Path 2: Basic electronics, Arduino and PhysComp
Online resources:
"ABC: Basic Connections - Reference Book for Makers", Alberto Piganti
http://www.pighixxx.com/test/

Practical schematics on how to connect anything to an Arduino.

Books (basic)
"Making Things Talk", Tom Igoe, ISBN: 978-0-596-51051-0
This book is about making things talk to each other, building more complex systems involving various interactive elements, it covers serial communication, basic networks, etc. It has a practical twist, guiding your learning process with practical exercises.

"Arduino cookbook", Michael Margolies
This book presents many practical exercises of the problem/solution kind, with step-by-step recipes.

Books (beyond basics)
"Physical Computing", Dan O'Sullivan and Tom Igoe, ISBN: 159200346X
https://www.hangar.org/docs/docs_lab/PhysicalColmputing.pdf

Though a bit dated by now, this continues to be an excellent reference book to get you started on physical interactions.

"Handmade Electronic Music", Nicholas Collins, ISBN: 9780415998734
A wonderful book full of great hacks to make machines that make sound, it's a wonderful introduction to analog electronics and circuit bending. This book encourages you to dismantle things, tinker with them in productive ways and learn to be creative with electronics.

Communications

Course materials, syllabus, schedules and appointment arrangements are all to be found in Brightspace.

I will mostly use Slack as a means of regular communication as well as LOLs and pigeon memes. **#interaction** is the Slack channel where we gather. Please check **#interaction** at least once a day to prevent missing out on something. Important announcements will also be made via Slack.

My email address is l.a.rodil@hva.nl you can contact me anytime you like, but please be sure to allow for a 48h response time. This means no email on the night before a deadline asking for help!!! For technical questions you may also include Marcus Graf (m.p.graf@hva.nl) in your inquiry.

As far as technical questions are concerned I will strictly follow the LMGTFY protocol (Let Me Google That For You) this means that: if I paste your question or error message on Google and the answer is on the first three pages of results, I will move on with my day and let you figure it out by yourself.

Appendix A: Course materials

You can always make use of the basic equipment available in the InteractionLab, but you will need to have a few things at hand in your own personal kit to follow the workshops and sketch on your own.

For project work, you can always check with Bambi and Marcus and use stocks at the IFAL when you need something, but you should always have your personal kit at the ready.

Where to buy electronics

For quick trips to the local Amsterdam shop you may choose:

Radio Rotor
Kinkerstraat 55, phone: 020 612 5759

Hecke Electronica
Ceintuurbaan 7, phone: 020 679 2459

These physical shops however are quite expensive, and their stock is limited. I only use them when I need something "today". You are probably better off getting what you need from online suppliers. Here's a list of my favorites.

Online suppliers

Dutch online shops are reasonably priced and most of them offer next-day shipping at little cost. You cannot always find everything, but most of the basics are well covered.

Always buy supplies as a group whenever you can, you can save on shipping costs. It's silly to order two LED strips separately when they could all be sent in a single shipment.

www.floris.cc
This is by far my favorite supplier, it has good prices, next day delivery and Pieter Floris is very responsive and knowledgeable.

www.kiwi-electronics.nl
Good for break-out boards and Raspberry Pi accessories and decent stepper motors. Good service, ships fast.

www.antratek.nl
They have some of the more obscure Sparkfun items that you cannot really find so easily in other Dutch suppliers. Always worth double-checking here before you go to a non-EU supplier with longer shipping times.

www.tinytronics.nl

An interesting mix between brand-name components and cheap chinese knock-offs. They have a good selection of audio gadgets and cheap generics like proto-wires, workbench tools, etc. Not great for sensors (you have been warned).

www.conrad.nl
Reliable, very large supply of all kinds of things to do with electricity. Not cheap for small components or microcontroller items.

www.distrelec.nl
Reliable, diverse, very large supply, you can find everything from a tiny electronic component to a fully equipped workbench. Great for tools.

Warning

China based sellers from DealExtreme, Alibaba, Elecrow and Banggood can have much cheaper prices but often take much longer to ship. Your experience might vary. I once ordered something from Elecrow from a Chinese supplier and was on my doorstep two days later, but that is more the exception than the rule. Always factor-in shipping times when you order stuff from China, it can easily delay your project if you cannot get hold of the parts.
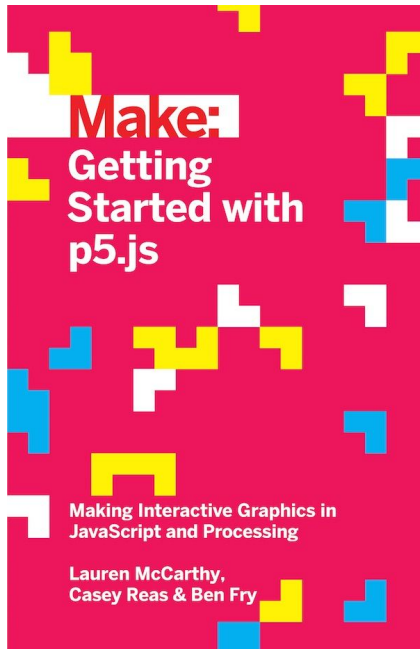
e-Waste

Never underestimate the power of electronic waste to supply your needs for material. Arduino was invented in the backyard of an old Olivetti factory near Milan by a group of researchers that wanted a quick way of prototyping with all that e-waste. Amsterdam is a rich city and its inhabitants throw away the most incredible stuff before it reaches its true end of life cycle, sometimes you can find stuff in perfectly usable condition.

I suggest you keep an eye open for speakers, we will use some during the course. You will only need the speaker cone, not the wooden-box enclosure that goes around it.

Book

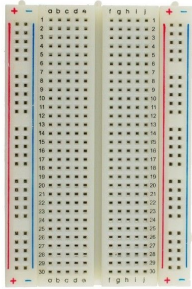To get started on P5.js we think you should get this book (paper of epub, whatever format you prefer).

Lauren McCarthy, Casey Reas, Ben Fry. **"Getting Started with P5.js: making interactive graphics in javascript and processing"**, Maker Media
ISBN 9781457186776

See it at bol.com.
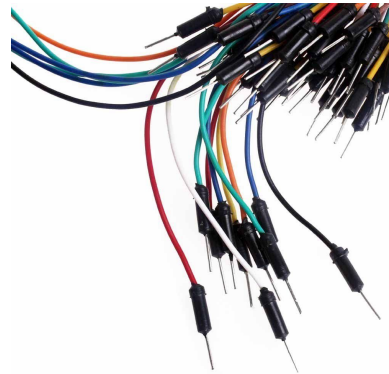
Things that you will need in your personal kit

Always have these at hand to sketch, keep a little box at hand with these components.

Solderless breadboard	
4x LDR sensors	

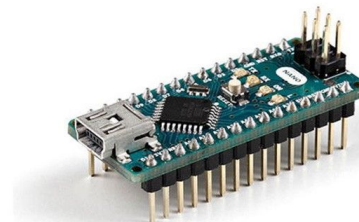|	
Assorted resistors get a package with many different values	
2x packs proto wires assorted, male to male, male to female, female to female	
10x alligator clip wires always handy	
Arduino Nano If you have to buy a new one I suggest a nano, but if you already have an UNO we can use it as well.	
USB cable(s) suitable for your Arduino(s) USB-A-B for the UNO mini-USB for the Nano micro-USB for the Featherboard	

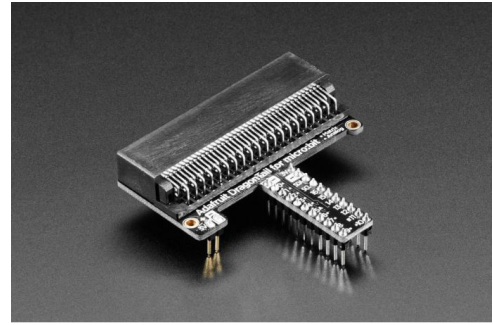|	
BBC micro:bit Go bundle https://www.kiwi-electronics.nl/micro-bit/bbc-micro-bit-go-bundel	
Adafruit dragon-tail for micro:bit https://www.kiwi-electronics.nl/micro-bit/adafruit-dragontail-for-micro-bit-fully-assembled	

Appendix B: Formal AUAS assessment system

The AUAS expects a formal evaluation in the form of individual marks on the competences pertinent to this track. Your mark on a particular competence will be derived from the averages of the marks obtained in each indicator. This appendix is a straight cut and paste from the official MDD assessment documentation. So when in doubt this is your canonical reference.

Indicators for this course

Indicator
Explains the technical choices involved in the execution of the work.
Examples
A web application for a customer uses a NodeJS-based backend and the Meteor framework for a multi-platform client. The student must be aware of alternatives and present evidence of why this choice is justified for this specific project. A prototype for an interactive installation in public space uses a computer-vision based interface that proves to have inaccurate results, making the interaction a bit hit and miss. It proves to be sufficient as a proof of concept. At the next stage the student must be able to provide an analysis of what went wrong, and what alternatives are available, and in which way these alternatives alter the interaction if they do. For an interactive installation for a museum, involving video playback, the student picks TouchDesigner, Adobe Premiere and some arcade buttons as triggers. The student is expected to provide insight into her toolchain and how this toolchain impacted her design process.

Insufficient (less than 5.5)	Sufficient (5.5 - 6.9)	Good (7 - 8.4)	Excellent (8.5 - 10)
The student explains his/her choices but provides superficial reasoning, resorts to unchallenging defaults or is unaware of alternatives. The student shows no process.	The student explains his/her choices and provides satisfactory reasoning, is somewhat aware of alternatives.	The student explains his/her choices and provides good reasoning, is well aware of alternatives and has a demonstrable process where she can suggest other possible executions of the work.	The student presents a well researched process with various trials in her process, and is capable of discerning the best execution. The student shows commitment to go beyond what is necessary.

Indicator

Demonstrates the influence of making in the design process.

Examples

To better understand this indicator, see concepts related to "Research Through Making".

For a mobile application that fuses data from multiple sources, the student develops a clickable prototype that later proves to be technically unviable or very expensive to develop. The student is expected to be able to iterate and make their design adaptable to the new circumstances.

For the design of a physical product the student chooses RFID tags, but in the process of making, discovers that material choices affect the range of reading. The student must prove a back and forth, researching possibilities and how the range affects usability.

To research the usability of a product, the student develops a series of prototypes. The student is expected to demonstrate an incremental understanding of the design space offered by the prototypes, and how usability is impacted as well as how to fine tune the prototype to better understand the design space.

For a commission involving a study on the future of travel, students set up a fake travel agency for a non existent hyperloop link between Paris and Amsterdam. Students are expected to use adequate methods of gathering data about their interaction as well as drawing conclusions from the experience that help profiling the design space for the commissioning client.

Insufficient (less than 5.5)	Sufficient (5.5 - 6.9)	Good (7 - 8.4)	Excellent (8.5 - 10)
Students present a haphazard approach to making, or shows no interest at all in prototyping her work, going no further than the concepting stage.	Students present executions of the work that are lacking in engagement with the material or technology used. They don't seem to derive any design insights from the execution of the work.	Students demonstrate good making skills, carries out designs with attention to detail in the craft involved. Discerns good from bad approaches to making something and derives insights from the making process that help	Students present a well researched process with various trials in her process, and is capable of discerning the best execution. The student shows commitment to go beyond what is necessary.

| | | fine-tuning their designs. | |

Indicator
Demonstrates an open process with multiple intermediary steps, each executed in a way that gives some degree of coherence to said process.
Examples
This concerns transparency of process as well as sketching methods.

For a home appliance involving a voice activated assistant, the student chooses an unconventional style of communication. The student must be able to present documentation of the various steps that lead to that decision and take teachers and clients through her reasoning in the process.

For a mobile application that implements a form of behavioural therapy, the student says to have done one focus group and three user tests, that resulted in two iterations on the prototype. The student will be expected to present documentation of these tests and show how this process impacted the different design decisions in said prototypes. The student also shows dead-end ideas, failures and mistakes that occurred during the process.

For a data visualization involving a wearable, the student must demonstrate ways of incorporating the garment design into her process, adapting her sketching methods to include this new unfamiliar field. Perhaps by doing prototypes of the garment on paper or plain textile, using mannequins or models, or whatever other approach suits their design needs. Their process must show adaptability to the design domain that is being addressed. |

Insufficient (less than 5.5)	**Sufficient** (5.5 - 6.9)	**Good** (7 - 8.4)	**Excellent** (8.5 - 10)
The student presents an opaque process, it is difficult for the assessor to determine how the student arrived at certain conclusions. The process is incongruous.	The student presents a semblance of a process with some documentation and some intermediary steps, but it is not clear to an external assessor or client to determine how conclusions were	Students demonstrate a healthy process involving various iterations, trials and errors, presenting abundant evidence. The process is well documented and communicates with clarity how the work	The student presents outstanding process documentation that transmits confidence in their process. It is clear to clients and assesors how the student operates as a designer.

	drawn from that evidence.	evolved.	

Indicator
Demonstrates awareness of aesthetic trends, technical and design conventions.
Examples
For a web application the student chooses to use a Single Page Application design. They must be able to reason through this choice and present how they adopted common conventions that already exist in these kinds of applications when they use them and where they break away from convention they must explain why. For a music festival, the student designs an interactive table where people can make their own mixes. The student demonstrates that she/he has done sufficient research into mixing interfaces and looks at how other designers have addressed this specific challenge. For a campaign for social engagement in a nature park the student develops a concept for a geolocated application, the student must reason through the design choices involved and investigate any possible conventions in this unfamiliar space.

Insufficient (less than 5.5)	Sufficient (5.5 - 6.9)	Good (7 - 8.4)	Excellent (8.5 - 10)
The student presents a subpar product. The decision making process is decoupled from the problem domain, doesn't seem to know what's out there and how other professionals have addressed similar challenges before.	The student presents awareness of what is out there, and how similar challenges have been addressed before. Talks about conventions, trends and current techniques but doesn't really apply them.	The student demonstrates solid understanding of the problem domain and uses the conventions of her trade and applies them where relevant.	The student demonstrates command of the techniques and conventions of her trade, can apply them where suitable and can break away from them and innovate when the existing conventions do not suit their style.