GNG1103 – Engineering Design
GNG1503 – Génie de la conception

User Experience (UX) Design

Presented by: Emmanuel Bouendeu

www.claromentis.com/blog/wp-content/uploads/2015/06/user-centric.png

Agenda

- Reminders
- Comments on the Midterm Exam
- **Review Questions**
- **Designing for Task Efficiency**
- **Designing for Users**
- **User Experience (UX) Design**
  - **Usability:** Attention & Memory
  - **Understanding Users & User Personas**

Reminders

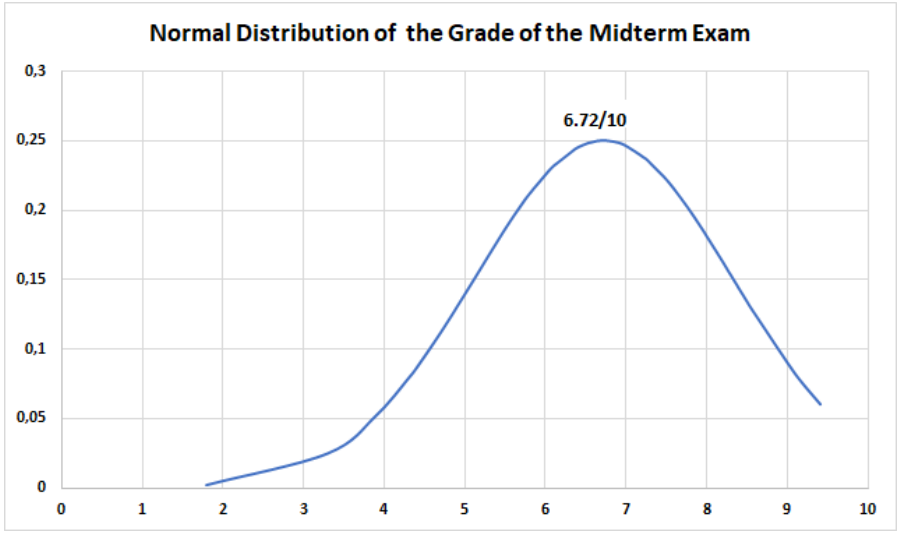
- **Lab 7**: MatLab (formula search): This week
- **Project Plan** (Week 4,6,8,10): Weekly review & update
- **Deliverable F** (Prototype I & Customer Feedback): March.01
- **Deliverable G** (Prototype 2 & Customer Feedback): March.08
- Assessment of **Teaching Staff** : Feb 28. before midnight
  https://survey.zohopublic.com/zs/huBU0g

What is your summary of **Lecture 11**?

- Purpose of personal feedback
- Attributes of a productive feedback
- Usefulness of Prototypes & Prototypes dimension
- Types of Prototypes & Fidelity Level
- Attributes of good prototypes
- Importance of testing & Test planning steps

Comments on the Midterm Exam

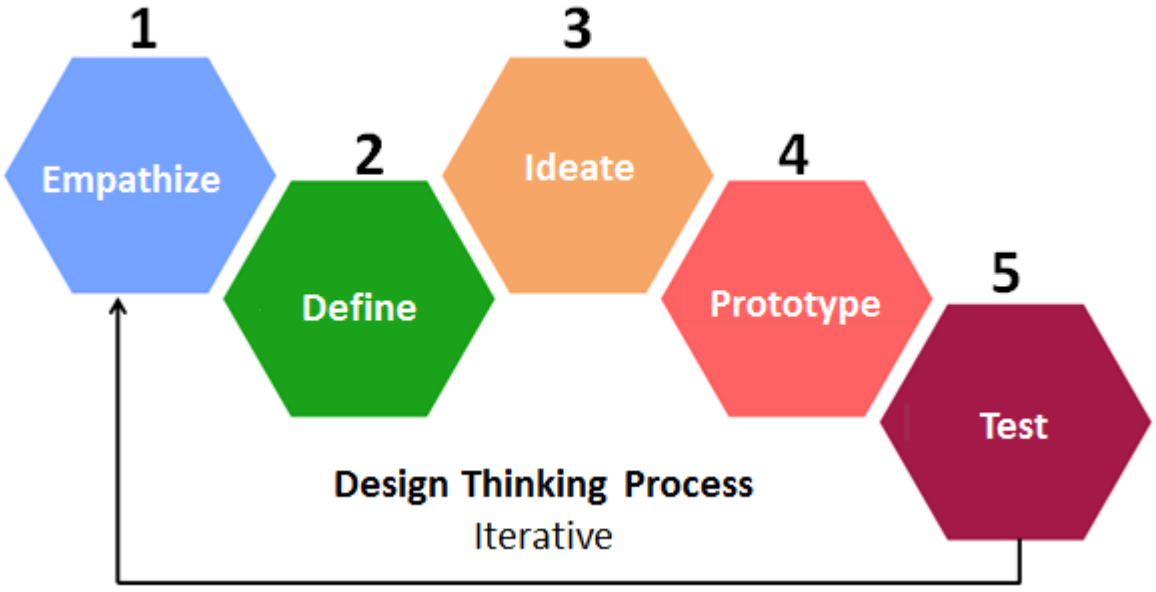
- 44 attendees, **84%** passed , **16%** failed
- Highest grade: **9.41/10**, Lowest grade: **1.8/10**



- **Point to improve**
  - Team energy & Use
  - Bill of material
  - Conflict management styles & Use
  - Considerations, assumptions, requirements, researches
  - Conversion of customer statements into interpreted needs
  - Choice of the best specifications
  - Gantt chart
  - Type of sketches
  - Engineering design process model
  - Steps of engineering analysis in Ski

Comments on the Midterm Exam

Bill of Materials				
Item #	**Item Description**	**Quantity**	**Unit Price**	**Amount**
1	LED-lamp 6V – 4W	2	$4.5	$9
2	DC-motor 6V – 10W	1	$15	$15
3	Battery 6V – 4A	1	free	$0
			Total	**$24**



Comments on the Midterm Exam

Special Considerations	Standards, VR environment,
Assumptions	Organic chemistry, have experience in VR
Requirements	Time, cost
Research	Create VR environment, organic chemistry principles

Customer Statement	Interpreted Need
I need a stretcher to transport injured people down the hill easily and safely	The **stretcher** can be **controlled**
When I get a rescue call, I need to take it up the hill	The **stretcher** is **Compact** in **size** when carried up the hill
I like when it is cheap	The **stretcher** is **low cost**
I don't like that it is hard to control	The **stretcher** can be **controlled**
I don't like that it is heavy	The **stretcher** is **light weight**
When there is a patient, I sometimes lose control and the stretcher becomes hard to stop	The **stretcher** is easy to **stop**
If I lose control, there is no way to stop it	The **stretcher** is capable of **stopping** when out of control
It is better if it is more compact to store	The **stretcher** is **Compact** in size when **stored**

Review Questions

1. What is **experience user** design?
2. What is a **user persona** and what is it used for?
3. What is Jakob Nielsen's **usability heuristics** used for in engineering design?
4. In the table below, indicate whether Nielsen's usability heuristic is true or false.

#	**Jakob Nielsen's usability heuristics**	**True/False**
1	The system status is visible.	
2	The system does not necessarily need to match the real world.	
3	The user should have the freedom to do and undo.	
4	Error preventions must be ensured.	
5	The user must remember stuff.	

Designing for Task Efficiency

- Factory-based Production (efficiency)
  - Frederick **Taylor (1856-1915)** ("Scientific Management"); Systematic studies of tasks to improve time efficiency; **Henry Gantt** worked with him too
  - Henry **Ford (1863-1947)** (task specialization; unskilled workers)
  - Frank and Lillian **Gilbreth (1868-1924)** (Motion) ⇨ "Time and Motion" Studies
- Organizational Behaviour (OB)
  - *Micro-level*: individual behaviour in organizations
  - *Meso-level* (Work groups) and *Macro-level* (org. behaviour)
  - Modern OB theories emphasize cultural effects and the effects of change as well as the role that social and psychological factors play in organizations

⇨ Designing for the **user** is important!

Designing for Users

- Importance of Psychology and Sociology now recognized for the design of objects and processes
  - Lillian Gilbreth was probably the first industrial psychologist and realized this (first working female engineer with a Ph.D.)
- Design ***starts*** with the user!
  - "*Empathizing*": First step in the "Design Thinking" process
- Ergonomics (or "Human Factors" design): design of products, systems, or processes to take proper account of the interaction between them and the people who use them*

* Definition from: https://en.wikipedia.org/wiki/Human_factors_and_ergonomics

"User Experience" – A System Design Concept

https://youtu.be/9BdtGjoIN4E

"User Experience"

- **User Experience**: "User experience" encompasses all aspects of the end-user's interaction with the company, its services, and its products*
  - People's emotions and attitudes about using a particular product, system or service are important
  - Design to create an *experience* for a person through a device**
  - Often used in the design of software, but the principles apply to the design of **anything** "**used**" by people
  - Practical, experiential, ***affective*** (i.e. elicits emotional responses), meaningful and valuable aspects of human–computer interaction and product ownership***
  - *Also* includes user **perceptions** about: efficiency, ease-of-use and utility (or the "usefulness") of a designed object

* https://www.nngroup.com/articles/definition-user-experience/
** Modified from: https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/user-experience-and-experience-design
*** Definition from: https://en.wikipedia.org/wiki/User_experience

Example: Elevator

- The user interface is simply the button panel that you use to call the elevator or to choose your destination floor once inside, plus things like the indicator that shows which floor the cabin is on.

- **UX** is not just these visible interactive objects, but everything that affects your elevator experience:
  - Where to find them?
  - How many they are?
  - How to know which ones go to your destination floor?
  - Is the cabin big or small?
  - Is it noisy, bumpy, smelly, hot, comfortable, uncomfortable?
  - Is it well lit or darkened?
  - Does it move slowly or quickly?
  - Can I keep my cell phone signal when I drive inside?
  - Does the door open too slowly, close too fast?

- What factors in the experience affect my choice of elevator versus stairs?

Website Example – Comparing User Experiences

- Old-style HTML website (maybe this is intended to be bad because money is being given away?... *):
  - http://paulgraham.com/index.html
- Not intended to be bad, but …
  - http://www.tagteamsigns.net/
  - https://iquim.org/
- Compare the above sites with these sites, in terms of *your* opinion of the "user experience":
  - www.apple.com
  - https://www.virginamerica.com **

Q: What are the differences between "good" and "bad" sites?

* Bad websites taken from:: http://www.webpagesthatsuck.com/
** Good website: http://webbyawards.com/winners/2016/websites/website-features-and-design/best-user-experience

Jakob Nielsen's Usability heuristics

1. Visibility of System Status (what's happening now?)
2. Match between system and the real world
3. User Control and Freedom ("Undo"; What's next?)
4. Error Prevention (confirmation options)
5. Error recognition, diagnosis and recovery
6. Consistency and standards (of words and images)
7. Recognition vs recall (users not forced to remember much/anything)
8. Flexibility and efficiency (tailoring, response time)
9. Aesthetic and minimalist design
10. Help and documentation (user-appropriate)

Taken from: http://www.uxness.in/2015/02/10-heuristic-principles-jakob-nielsens.html

Exercise – Flight Cost (New York to Beijing)

- Find the itinerary for the *best* trip (based on time in airports/planes ***and*** the total cost):
  - Run-trip from New York (USA) to Beijing (China)
  - Arrive in China early enough to get a good night's sleep before a May 2 (16:00) meeting in Beijing, returning back in time to make a May 8 (15:00) meeting in Times square
  - **Two** checked bags of 23kg (an extra cost for this?)
  - At least 2 hours is required between all connecting flights
- Note ***all*** of the "user experience" issues using: **www.aircanada.com**, **www.united.com**, **www.emirates.com**

Exercise: Applying Nielsen's Heuristics

	Air Canada	United	Emirates
Visibility of System Status (what's happening now?)			
Match between system and the real world			
User Control and Freedom (Undo; What's next?)			
Error Prevention (confirmation options)			
Error recognition, diagnosis and recovery			
Consistency and standards (words/images)			
Recognition vs recall (users not forced to remember stuff)			
Flexibility and efficiency (tailoring, response time)			
Aesthetic and minimalist design			
Help and documentation (user-appropriate)			
Total			

Basic Concepts of Usability

- "User Experience", has been studied for the software design of applications and websites
  - Also relevant for non-software designs!
- Can be understood in the context of human behavioural and cognitive processes:
  - **Attention**: Ability of a person to selectively concentrate on a discrete aspect of information, whether deemed subjective or objective, while ignoring other perceivable information (or also stated simply as the "allocation of limited processing resources")*
  - **Memory**: Process used to encode, store, and retrieve information. Information can be recorded for short periods of time in "short-term memory" (also called "immediate memory" or "working memory") or for longer periods of time in "long-term memory"**

* https://en.wikipedia.org/wiki/Attention

** https://en.wikipedia.org/wiki/Memory

Attention: Distractions

- People are easily distracted
  - ⇨ Provide cues about what to focus on
  - – People get "lost" in complexity (⇨ keep it simple!)
- Structure information so that it is easy to find and easy to browse
  - ⇨ Don't have too many items
  - ⇨ Don't have too few items
  - ⇨ Group items logically

Attention: How many passes?

https://youtu.be/IGQmdoK_ZfY

Attention: Complexity

- People multitask

  ⇨ Make the usage 'state' clear enough so that users can jump either backwards and forwards from '*where*' they are

- Some mental processes are automatic, or will *become* that way (when they are contrasted with controlled processes over time)

  – These processes are then very ***hard*** to "*unlearn*"

  ⇨ Avoid conflicting or changing aspects of the user interface (unnecessarily or even *at all*!)

Memory: Seven plus or minus two

7808526176

- Short term memory can contain **7±2** 'chunks' (i.e. 5 to 9 things)
  - ⇨ Avoid *requiring* users to remember more than this
  - ⇨ Logically **group** things so users can "chunk" them together

Memory: Recognition vs Remembering

- The more **meaningful**, the more easily **remembered** (familiarity, imagery and consistency all contribute to *meaningfulness*)
  - ⇨ Use effective names and icons (even animated ones!)
  - ⇨ Combine icons with words
  - ⇨ Icons can be analogies, examples or abstract, but should not arbitrary
  - ⇨ Watch out for cultural differences and "norms" (e.g. washroom symbols!)
- People can more easily recognize than recall
  - ⇨ Use menus, icons, quick lookup shortcuts

Course Attendance: Registration

- Use your smartphone or laptop to **register/notify** your attendance in this lecture
- Allow **geo location** in the attendance site
- Accept **cookies** from third parties applications
- Log in using only your **Uottawa** account at the link below

  https://attendance.azarm.ca/attendancerecord/gng1103f

- Your attendance must be registered only **during the lecture** and at the **time specified by the professor**
- You can also use the **QR code** below, to register quickly

Studying Usability: Experiments

- Experiment Requirements:
  - Establish a *hypothesis*
  - Compare 2 User Interfaces (ideally, one is a *control)*
  - *Measure* some aspect of usability
  - Perform *statistical* analysis of the results
- Conducting an experiment:
  1. Users perform the tasks
  2. Measure various factors and compare various conditions
  3. Record usability 'problems'

Process for Usability Analysis

1. Understand **users**
   - Think about each *class* of users (and the expected needs of each class, which could be based on experience, personality, attributes or interests)
2. Understand **tasks** the users will need to perform
3. Pick representative sets of tasks
   - Prioritize tasks that are more frequent and/or important
4. Pick a representative set of users
   - *Cover* a ***suitable*** set of the different classes
5. Determine exactly ***what*** questions need to be answered about usability

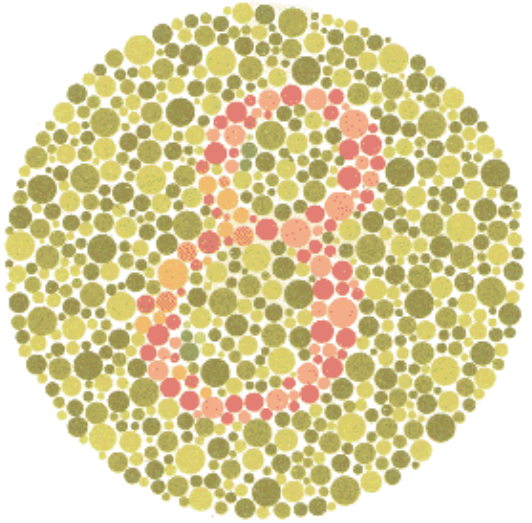
Understanding Users: Experience

- Job function
  - Different tasks, knowledge for different jobs (e.g. manager, salesperson, shipper, client all have different skillsets)
- Domain-specific experience:
  - Low experience (any difficulties with these kinds of users may not be directly related to the application)
  - High experience (problems with these kinds of users are probably the system designers' fault)
- Background experience level
  - Familiarity with different things (e.g. with computers or repairing automobiles or with social activities or with working with small children or ….)

Understanding Users: Personality

- Personality traits can be hard to know in advance, so some thought or research may be required
- Personality traits that might be important:
  - Shy, reticent, intimidated
  - Disinterested or defensive
  - Inarticulate (*hard to tell* if such a user is shy or disinterested!)
  - Absorbed, keen (e.g. "involved" designer!)
  - etc.

Understanding Users: Attributes



- Physical disability
  - Innovative I/O may be needed
- Colour blindness
  - Avoid colours as only means of conveying information
- Dyslexia or other cognitive glitches
  - Confusion between left and right
- Illiteracy / young children / foreign language speakers
  - Culturally-appropriate icons needed instead of words

Image: http://www.colour-blindness.com/colour-blindness-tests/ishihara-colour-test-plates/

Understanding Users: Interests

- Different kinds of users can have different ***interests*** in a product or service, and this may be determined by experience, personality or other attributes
- Different users can require trade-offs in the functional or non-functional criteria for the design

⇨ Create "User Personas" for each distinct type of user and give them simple names or handles (e.g. an e**x**pert computer user "**X**avier" or someone that won't read manuals "**No**r**man**" or time-pressed users that wants shortcuts "**Tim**", etc.

Creating User Personas I

1. Compile everything you know about your customers and group your findings into a spreadsheet or table
2. Use relevant headings for the particular design problem (e.g. based on specific industry, devices, time, or goals)
3. Organize your findings on Post-it™ notes or something that can be changed relatively easily (Wipebook?)
4. Look for patterns (e.g. industries in which your customers work, what devices they use, when/ where they use the devices, etc.)
5. Form questions about customers and determine what they have in common and how they differ (give them **names** as convenient handles when reviewing them)

https://uxmastery.com/create-ux-personas/

Creating User Personas II

6. Find people who form these clusters - either in your existing customer database or by actively going out and recruiting them
7. *Talk* to and interact with these people (ideally in person)
8. Tag and analyze your findings
   - If personas share many characteristics, combine them
   - If there's enough differences, split them up into multiple personas
9. Creating personas is an iterative process
   - What seems right at first glance may not hold up to close scrutiny
   - Review them with other people and keep them up to date as you learn new things about your customers or users

User Personas

https://youtu.be/B23iWg0koi8

Tips for Creating Personas

- Personas must be based on ***real*** people or ***real*** data and need to be defined so that they aren't just vague things with specific names (i.e. not "*elastic*"*):

1. **Keep simple and focused:** Focus the persona on design task at hand (1 page and at most 2 hours to create each)
2. **Make a user model, not a life story:** Just include the *specific* facts to help make good decisions (i.e. only if the user information affects design decisions that you're making)
3. **<u>Use</u> them when making decisions!** Actively use your personas when making design decisions. If missing stuff, don't just make assertions or guesses, but re-validate
4. **Use a simple process.** Give some simple training on how to use personas productively (we will practice in the lab too)

* http://www.uxdesignedge.com/2011/06/personas-dead-yet
https://www.slideshare.net/toddwarfel/data-driven-design-research-personas/28-I_think_we_didlunch

Ski Hill Case Study Exercise – Creating personas

- Create three or more *different* personas for the ski hill case study using the methods just described (repeated below FYI)
- You can do this for relevant users and customers, but we won't be able to do the customer interviewing/observation steps, unfortunately

1. Compile all you know about your customers, grouping findings in a spreadsheet/table
2. Use relevant headings for the study (e.g. industry, device, time, and goals)
3. Organize your findings on post-it™ notes or something that can be changed
4. Look for patterns (e.g. industries in which your customers work, what devices they use, when/ where they use the devices, etc.)
5. Form questions about customers; determining things they have in common and how they differ
6. Find people who form these clusters
7. Talk to and interact with these people (ideally in person)
8. Tag and analyze your findings
   - If personas share many characteristics, combine them
   - If there's enough differences, split them up into multiple personas
9. Creating personas is an iterative process
   - What seems right at first glance may not hold up to close scrutiny
   - Review them and keep them up to date as you learn new things about your customers

Example - Ski Hill User Personas

1. Strategic Ski Patroller
2. Tactical Ski Patroller
3. Experienced Ski Patroller
4. Safety-First Ski Hill Owner
5. Cost-First Ski Hill Owner

Example - Ski Hill User Personas

Strategic Ski Patroller

- Minnie ("Strategic" ski patroller)
  - Small (5' 2") and relatively light (120 lb) ski patroller
  - She is fit, keen and likes to prepare for all eventualities
  - She is not that adept mechanically, so is keen on "easy to use"
  - Gets cold easily, so dresses warmly, but "will do what is needed" in all cases of emergency "to get the job done"
  - Can lift up to 45 lbs
  - Has been ski-ing for 10 years, since she was 15, and is a very competent skier
  - Speaks English and Mandarin Chinese and is trying to learn French

Example - Ski Hill User Personas

Tactical Ski Patroller

- Brian ("Tactical" ski patroller)
  - Medium height (5' 9") and medium weight (180 lb) ski patroller
  - He is fit and keen and is happiest out on the slopes, rather than doing too much planning ahead of time
  - He is adept, mechanically, and likes 'extra' features
  - He is very keen and always likes to go "above and beyond" in all cases of emergency
  - Sometimes forgets necessary equipment, but is very good at improvising with available materials
  - Can lift up to 135 lbs (squat)
  - Has been ski-ing for 15 years, since he was 5, and is a very competent and could even be called an aggressive skier
  - Bilingual

Example - Ski Hill User Personas

Experienced Ski Patroller

- Madeleine ("Experienced" ski patrol supervisor)
  - Medium height (5' 5") and medium weight (155 lb) ski patroller
  - She is very fit, keen and has been in charge of a ski patrol team for the last five years
  - She is adept, mechanically, and a practical person
  - She has lots of experience on the slopes with sleds of different types
  - She is looking for specific improvements, in terms of controllability, but also for improvements in manageability in non-deployed mode
  - Understands the importance of a timely response and effective and responsive prioritized handling of emergency situations on the hill
  - Can lift up to 110 lbs (squat) and trains in the gym regularly, taking her ski patroller responsibilities very seriously
  - Has been skiing for 20 years, since she was 5, and is a very competent skier indeed, also instructing in her spare time
  - Bilingual

Example - Ski Hill User Personas

Safety-First Ski Hill Owner

- Michel ("Safety" first ski hill owner)
  - Ski-hill owner
  - Concerned about customer satisfaction and customer safety but is very proud of his ski hill's safety record and wants to both measure and improve it
  - Is an early advocate of the ski patrol on his hill and pays for the uniforms and for the ski passes for all ski patrollers there
  - Prepared to buy up to five sleds (to be kept at the base of all of his major ski lifts in dedicated ski rescue huts/ sheds) for the ski patrollers to use
  - Wants to encourage international skiers from Asia, who generally have less experience with skiing (meaning that more accidents can be expected) but wants to be able to boast that his ski hill is the "*safest in Quebec*"

Example - Ski Hill User Personas

Cost-First Ski Hill Owner

- Robert ("Cost" first ski hill owner)
  - Ski-hill owner
  - Is concerned about customer satisfaction and customer safety but is struggling to meet all of the costs associated with the ski hill, having had to invest recently in new ski lifts and new snowmaking equipment, as well as upgrades in the lodge for fire safety regulations, which were recently tightened
  - Realizes the value of the ski patrol, but wants them to be "cost-conscious" and do only the "necessary" work
  - Is prepared to buy one or two sleds for the ski patrollers to use, but is not prepared to store it for them at any time
  - Watches one-time costs, but is mostly concerned about ongoing (i.e. repetitive or "per-use") costs

Summary

- Task efficiency is affected by Usability (or User efficiency)
- Designing for users is important and "User Experience" is a system design concept, rooted in **user empathy** and **ergonomics**
- Human cognitive processes (e.g. Attention and Memory) place important constraints on designs which have users
- Users differ in terms of their: experience levels, personalities, aptitudes and interests
  - User "Personas" can be used as representative models of different types of user when designing

Design Skill: Website Wireframes

- A wireframe is a "bare bones" view of a design, usually for website or application software, allowing iterative design at increasing levels of detail, permitting prototyping at each stage with internal stakeholders and external users
  1. "**Low-fidelity**" stage: Shows the layout of the design at a very basic level (i.e. with just basic structural elements and a simple information hierarchy) but without specific content or branding
  2. "**Medium-fidelity**" stage: Initial wireframe is further developed to include content (i.e. specific images) or detailed branding
  3. "**High fidelity**" version: Includes user interactivity, motion and allows detailed user testing, with everything in its proper place and functionality implemented

https://www.lynda.com/UXPin-tutorials/Wireframing-overview/520235/577217-4.html